

*Statutory Instrument No. 91 of 2013*

**CIVIL AVIATION AUTHORITY ACT**  
(Act No. 11 of 2011)

**CIVIL AVIATION (AIR NAVIGATION SERVICES) REGULATIONS, 2013**  
(Published on 13th September, 2013)

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IN EXERCISE of the powers conferred on the Minister of Transport and Communications by section 89 of the Civil Aviation Act and with the recommendation of the Civil Aviation Authority, the following Regulations are hereby made —

### PART I – *Preliminary*

- |   |                |
|---|----------------|
| 1. These Regulations may be cited as the Civil Aviation (Air Navigation Services) Regulations, 2013.  | Citation       |
| 2. In these Regulations, unless the context otherwise requires —  | Interpretation |
| “aeronautical ground lighting (AGL)” means any light specifically provided as an aid to air navigation, other than a light displayed on an aircraft;  |                |
| “aeronautical mobile service” means mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival aircraft stations may participate; emergency position-indicating radio beacon stations may also participate in the service on designated distress and emergency frequencies;  |                |
| “aeronautical mobile station” means station in the Aeronautical Mobile Service, other than Aircraft Station, intended to be used while in motion or during halts at unspecified points. [Based on ITU-R SI. 32, SI. 67 & SI. 73 and ICAO Annex 10 Volume II Chapter 1];   |                |
| “air to ground communications” means one-way communication from aircraft to stations or locations on the surface of the earth;  |                |
| “air traffic service” means a generic term meaning air traffic control service, flight information service and air-ground communications;   |                |
| “base station” means a land station in the land mobile service. (ITU RR SI. 71);  |                |
| “data link system” means total set of component parts, equipment, software and protocols that is required to provide the data link service;   |                |
| “designated operational coverage” means volume of airspace needed operationally in order to provide a particular service and within which the facility is afforded frequency protection. [ITU RR S45.1.1].  |                |
| “ground to air communications” means one-way communications from stations or locations on the surface of the earth to aircraft (ICAO Annex 11, Chapter 1);  |                |
| “ground-ground communications” means two-way communications between or with ATS facilities located on the surface of the earth;   |                |
| “hazard” means a condition or an object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function;   |                |
| “land station” means a station in the mobile service not intended to be used while in motion. (ITU RR SI. 69);  |                |
| “licence” means a licence issued in accordance with regulation 6 of these Regulations; and  |                |
| “main and standby equipment” terms ‘Main’ and ‘Standby’ are generally used to describe identical or similar equipment, configured within a system to provide equipment redundancy, in order to improve the overall reliability and to ensure the continuity of service. The terms may also be applied to sub-equipment and modules as well as facilities, functions and services. |                |

Application

**3.** (1) These Regulations shall apply to a person who is or who wants to become an air navigation service provider.

(2) Notwithstanding the provisions of subregulation (1), these Regulations shall not apply to —

- (a) a person or entity which provides air navigation services for the military; or
- (b) any air navigation service provided by the military.

PART II – *Licensing*

Prohibition  
from operating  
without licence

**4.** (1) A person shall not provide air navigation services without a licence issued in accordance with these Regulations.

(2) A person who contravenes subregulation (1) commits an offence and is liable to a fine not exceeding P50 000, or to imprisonment for a term not exceeding 10 years, or to both.

Application for  
licence

**5.** (1) A person who wishes to provide air navigation service shall apply to the Authority for a licence in Form A set out in Schedule 1.

(2) An application for a licence under this regulation shall be accompanied by —

- (a) a non-refundable application fee of P5 000; and
- (b) a Manual of Air Navigation Services.

Issuance of  
licence

**6.** (1) The Authority shall, before issuing a licence referred to in regulation 5 (1), satisfy itself that —

- (a) the personnel of the applicant are adequate in number and have the necessary competency and experience to provide the service;
- (b) the applicant has in place facilities, services and equipment established in accordance with these Regulations;
- (c) the operating procedures make satisfactory provision for the safety of aircraft;
- (d) an approved safety management system is in place;
- (e) the applicant has approved procedures to meet the requirements of the Regulations on civil aviation security;
- (f) the applicant has financial capability to provide the air navigation service; and
- (g) the applicant has insurance policy in force in relation to the proposed air navigation service.

(2) Where the Authority is satisfied that an applicant meets the requirements under subregulation (1), the Authority shall issue a licence to the applicant in Form B set out in Schedule 1.

(3) Where the Authority declines application for the issuance of a licence, the Authority shall notify the applicant in writing, within 14 days of the decision having been made, of its decision and shall give the reasons for declining the application.

(4) A licence issued under this regulation shall contain —

- (a) a licence number specifically assigned to the air navigation service provider;
- (b) the list of air navigation services to be provided by a licensee;
- (c) the name and location of the principal place of business of the licensee; and
- (d) the date of issue and period of validity of the licence.

(5) A licence issued under this regulation shall be displayed in a conspicuous place at the licence holder's principal place of business.

**7.** A licence issued under regulation 6 shall be valid for 24 months unless it is earlier suspended or revoked.

Validity of  
licence

**8.** (1) A licensee may, as necessitated by a change of the circumstances and details on its licence, apply to the Authority to vary the details as they appear on the licence.

Variation of  
licence

(2) The Authority may upon a written application by a licensee under subregulation (1), and upon the Authority satisfying itself of compliance with these Regulations, vary a licence.

(3) An application under subregulation (1) shall be accompanied by —

- (a) two copies of proposed variation in the licensee's Manual; and
- (b) an application fee of P600.

**9.** (1) An application for the renewal of a licence shall be made in Form A set out in Schedule 1 and shall be accompanied by a non-refundable fee of P5 000.

Renewal of  
licence

(2) An application made under subregulation (1) shall be submitted to the Authority not less than 30 days before the expiry of the licence.

(3) The Authority may renew a licence where an application is made within the period specified in subregulation (2) and where it is satisfied that the applicant meets the requirements of these Regulations.

**10.** A licence issued under these Regulations shall not be transferable.

Licence not  
transferable

**11.** (1) A licensee whose licence is lost or destroyed may apply to the Authority in Form C set out in Schedule 1, for a duplicate licence.

Duplicate  
licence

(2) An application under subregulation (1) shall be accompanied by a fee of P600.

(3) The Authority shall, where it is satisfied that an application meets the requirements under this regulation, replace a licence.

**12.** (1) The Authority may suspend or revoke a licence where the Authority determines that the licensee has not met or no longer meets the requirements of these Regulations.

Suspension or  
revocation of  
licence

(2) The Authority shall, prior to acting in accordance with subregulation (1), give a 14 days written notice to the licensee to rectify the non-compliance.

**13.** A licensee who has been notified in accordance with subregulation (2) shall return the licence to the Authority within 14 days of the suspension or revocation of the licence.

Surrender of  
licence

**14.** (1) The Authority shall keep and maintain a register showing —

Register of  
licensees

- (a) name of the licensee;
- (b) date of issue or renewal of the licence;
- (c) type of air navigation service offered by the licensee;
- (d) expiry date of the licence;
- (e) date of suspension or revocation of the licence, if any;
- (f) physical and postal address of the licensee; and
- (g) any other particulars as may be necessary.

(2) Any changes in the particulars recorded under subregulation (1) shall be entered in the register by the Authority.

PART III – *Manual of Air Navigation Services*Requirements  
for manual

**15.** (1) A licensee shall not operate without Air Navigation Services Operations and Technical Manual compliant to the provisions of this Part and these Regulations.

(2) The manual referred to in subregulation (1) shall contain all information and instructions necessary to enable the personnel of the licensee to perform their duties and in particular shall include —

- (a) air navigation services to be provided;
- (b) personnel requirements and their responsibilities;
- (c) training and performance assessment of personnel and how that information shall be tracked;
- (d) safety and quality management systems;
- (e) contingency plans developed for part or total system failure;
- (f) evidence of compliance with the regulations on civil aviation security;
- (g) facilities and equipment and how they shall be installed and maintained;
- (h) fault and defect reporting;
- (i) maintenance of documents and records;
- (j) search and rescue responsibilities and co-ordination;
- (k) facility operations and maintenance plan and procedure;
- (l) schedule of the proposed hours of service for the first 12 months of operation;
- (m) a summary of safety factors considered before seeking certification;
- (n) the type and location of each facility;
- (o) the technical specification of each type of facility;
- (p) how each facility interconnects with any other facility or service;
- (q) the systems and procedures to ensure a separation between controlled flights and active special use airspace; and
- (r) any other information requested by the Authority.

(3) Procedures for the operation and maintenance of the recording equipment shall be produced and incorporated into the maintenance manual associated with an air traffic control (ATC) unit.

(4) The procedures referred to in subregulation (3) may refer to operating or technical manuals or other documentation relating to the recording equipment as long as they are readily accessible to the reader.

(5) Any preventative maintenance recommended by the manufacturer or supplier of the recording equipment and handling or storage precautions for the archival media may be incorporated into or referred to by the procedures.

Amendment  
of manual

**16.** (1) A licensee may, for the purpose of maintaining the accuracy of the information in the manual, amend the manual, with the prior approval of the Authority.

(2) Where a licensee wishes to amend the manual, the licensee shall make a written application to the Authority for approval of the amendment and the application shall be accompanied by details of the proposed amendments.

(3) Notwithstanding subregulations (1) and (2), the Authority may where it deems necessary for the proper carrying out of an air navigation service, direct a licensee to amend its manual.

(2) A licensee may during the inspection under subregulation (1), be required to demonstrate compliance with the terms and conditions of the applicable requirements for aeronautical radio licence.

Maintenance  
of aeronautical  
radio stations

**21.** (1) A licensee shall —

- (a) establish maintenance arrangements for equipment and systems at aeronautical radio stations associated with the provision of air traffic control services;
- (b) establish maintenance procedures for equipment and systems at aeronautical radio stations associated with the provision of flight information service and air-ground communications service;
- (c) undertake regular functional and performance checks, including measurements to verify transmitter frequency, modulation depth, output power and a determination of effective radiated power using calibrated measurement equipment; and
- (d) keep a record of any functional test, flight checks and participation of any maintenance, repair, overhaul, replacement or modification of the equipment and systems at aeronautical radio stations, and the records shall be preserved for a period of one year or longer as may be directed by the Authority.

(2) The maintenance arrangements shall comply with manufacturers technical and maintenance specifications and ICAO.

Equipment  
configuration

**22.** (1) A licensee shall ensure that the equipment configuration of a radio station has communications appropriate to the service being provided.

(2) A licensee shall provide the main or standby and emergency equipment redundancy together with systems and location dependent redundancy measures for air traffic control services.

(3) A licensee shall be considered compliant with this regulation where a transceiver or separate transmitter and receiver, with a hand held or portable transceiver being used as an emergency equipment for flight information services, is used as a main equipment.

Power supply  
for emergency  
equipment

**23.** (1). A licensee shall ensure that the power supply for the emergency equipment for air traffic control services is independent from that of the main equipment.

(2) A licensee shall notify users of the failure of the power supply to the emergency equipment and give instructions for actions to be taken by users in the event of a failure.

(3) A licensee shall provide a primary and alternative power supply, for air traffic control services, to increase the availability of power to equipment and systems in the event of an interruption to one of the power supplies and shall ensure that a change over between power supplies are on a 'no break' basis.

(4) The primary and alternative power supplies referred to in subregulation (3) shall be independent of each other and a licensee shall provide an indication of failure for each power supply to the user and corrective action taken in the event of failure.

Alarm of status  
indications

**24.** (1) In the case of an ATC service, a licensee's system shall provide an alarm or status indicator to monitor system failure that may have effect on the service being provided, in a timely manner, to ensure that actions are taken for the safe continued provision of an air control service or if necessary, the controlled withdrawal of the service.

(2) The alarm or status indicator referred to in subregulation (1) shall have both visual and audible elements and ability for the user to acknowledge that they are aware of the change of the status thereby removing the attention seeking elements.

**25.** (1) A licensee shall provide a system at an aeronautical radio station with all necessary signals and information to the recording equipment.

Interface to voice or data recording equipment

(2) Where an aeronautical radio station uses a separate transmitter and receiver, a licensee shall ensure that the receiver audio output is used as the signal source for the recording equipment.

(3) A licensee shall ensure that an aeronautical radio station using a transceiver provides a separate receiver on the same frequency.

(4) Where a separate receiver is used to record aircraft station transmissions, a licensee shall ensure that the antenna and receiver combination provides a signal comparable in strength and reception area to that of the main antenna and transceiver.

**26.** A licensee shall provide an emergency frequency 121.500 MHz at —

Provision of emergency frequency 121.500 MHz

- (a) area control centres and flight information centres;
- (b) aerodrome control towers and approach control offices serving international aerodromes; and
- (c) international alternative aerodromes.

**27.** A licensee shall ensure that the equipment and systems at an aeronautical radio station —

Unintentional or continuous transmissions

- (a) does not fail in a manner that will cause unintentional or continuous transmission; and
- (b) incorporate features to prevent unintentional or continuous transmissions, unless it is contrary to the intended purpose for which they have been designed.

#### *(b) Voice Communications Systems*

**28.** (1) A licensee shall ensure that —

Communication facilities

- (a) the operator (air traffic control officer or systems maintenance engineer) —
  - (i) has clear visual and audible indication of the status of all available lines of communication, and
  - (ii) has the ability to select or deselect independently lines of communication or facilities in any combination, without affecting the operation of other lines of communication or facilities available at that or any other position;
- (b) headsets are provided except at units with very low density operations where loudspeaker and free-standing microphone may be authorised;
- (c) loudspeaker and headset earphone volume are audible at the operating position when set to their minimum level;
- (d) operating positions have a loudspeaker which will allow selected lines of communications to be monitored; and
- (e) operating positions have provision for the connection of a number of headsets enabling instructor student, dual operator and supervisor monitoring facilities.

(2) A licensee shall ensure that —

- (a) an instructor or trainee facility, where provided enable —
  - (i) direct communication through headsets, and
  - (ii) the instructor to interrupt any trainee communications at any time;



- (b) the audio level of each audio outlet is independently adjustable and any communications still remain audible and intelligible to the operator when the minimum level is selected;
- (c) a separate control for the audio level of radio telephone facility communications and ground-ground communications are provided with a setting in use which is apparent to the operator;
- (d) a line of communication incorporates an automatic gain control function in order to maintain adequate speech signal levels;
- (e) where an automatic gain control function is used, only one device or function operates on any signal path; and
- (f) the design and implementation of the voice switch are such that any input can be connected to any output without the possibility of blocking occurring.

Radio Telephony  
Facility (RTF)  
communication

**29.** (1) A licensee shall provide a two-way radiotelephony communication facility for aerodrome surface movement control service for the purpose of controlling vehicles on the manouvering area.

(2) A licensee shall ensure that air-ground communications are cross-coupled to two-way radiotelephony communications channels for vehicles operating on the active runway.

(3) A licensee shall ensure that radio telephone facility communications which have been selected are always available irrespective of the state of other lines of communication.

(4) Where air-ground communication transmission to aircraft is in progress at the same time with ground-ground communication, the ground-ground communication shall not be transmitted to the aircraft, and a licensee shall give an indication to the other party that air-ground communications is in progress by relaying the operators' speech.

Ground-Ground  
communication

**30.** (1) A licensee shall ensure that the aeronautical fixed services equipment is adequate for the task for which it is to be used and in so doing shall consider —

- (a) reliability;
- (b) integrity;
- (c) levels of redundancy;
- (d) hours of service; and
- (e) classification of airspace and complexity of traffic.

(2) A licensee shall provide for direct and immediate break-in interposition communications between supervisors or operators at different positions which shall be possible irrespective of the state of other lines of communication.

(3) A licensee shall ensure that intercom communication is not transmitted on any radio telephone facility frequency or ground-ground communication.

Voice  
transmission  
quality for  
radio  
transmission

**31.** A licensee shall ensure that the voice transmission quality of a communication facility that utilises radio transmissions, the aeronautical mobile service and the surface movement control service, meet or exceed a quality defined by the following —

- (a) the frequency response which shall be a gain at any frequency between 300 Hz and 3.4 KHz and be within +/- 3dB of the gain at 1KHz;
- (b) the Total Harmonic Distortion (THD) which shall not exceed two per cent at any frequency between 300 Hz and 3.4 KHz with any gain controls adjusted to give the maximum permitted audio level at the headset or handset; and
- (c) residual noise and hum on any correctly terminated idle voice circuit which shall not exceed 60dBm.



**32.** A licensee shall ensure that —

- (a) the voice transmissions quality of non-radio transmissions meet or exceed those requirements defined in the standards for systems which are connected to the public switched telephone network;
- (b) the frequency response shall be such that the gain at any frequency between 300 Hz and 3.4 KHz shall be within +/- 3dB of the gain at 1 KHz;
- (c) the total harmonic distortion shall not exceed two per cent at any frequency between 300 Hz and 3.4 KHz with any gain controls adjusted to give the maximum permitted audio level at the headset or handset;
- (d) the crosstalk level on any voice circuit shall not exceed – 60dBm when a 1 KHz tone is injected into any other circuit at a level of 10 dB above nominal test tone level, with all voice circuits correctly terminated; and
- (e) residual noise and hum on any correctly terminated idle voice circuit shall not exceed 60dBm.

Voice  
transmission  
quality –  
non-radio  
transmission

**33.** (1) A licensee shall —

- (a) establish maintenance arrangements for voice communications equipment and systems associated with the provision of air traffic control services;
- (b) ensure that all maintenance specifications and standards comply with relevant ICAO and manufacturers' requirements;
- (c) establish maintenance procedures for voice communications equipment and systems associated with the provision of flight information service; and
- (d) undertake regular functional and performance checks, including measurements to verify voice, output power and a determination of effective dBm for incoming and outgoing voice channels using calibrated measurement equipment.

Maintenance  
of voice  
communications

(2) A licensee shall keep a record of any functional test, flight check and particulars of any maintenance, repair, overhaul, system failure, replacement or modification in respect of the voice communication equipment and systems and the record shall be preserved for a period of one year or longer as the Authority may direct.

### *(c) Information Alerting Systems*

**34.** A licensee shall provide flight data displays.

Flight data  
display

**35.** Where the equipment or facility has a direct effect on aircraft safety a licensee shall have a display showing its status, if not readily apparent or visible to the controller.

Status  
indicators

**36.** A licensee shall make available a clock which is easily visible from each control position and the co-ordinated universal time (UTC) of that clock shall be shown in hours, minutes and seconds and shall be accurate to within plus or minus 2 seconds per day.

Clocks

**37.** A licensee shall ensure that —

- (a) all systems on which information is displayed to air traffic control for operational use are designed, installed, configured and maintained in a manner which ensures the integrity of the information; and
- (b) the data processing system for operational use by controllers are easily visible from relevant control positions and the display is clear and free from reflections.

Data  
Processing  
systems

Aeronautical  
ground lighting  
(AGL) Control  
and Monitoring  
equipment

**38.** A licensee shall ensure that —

- (a) the aeronautical ground lighting system control and monitoring system enable the selection of the required display of lights and provide an indication of the lights displayed to the aerodrome control position;
- (b) an indication, easily visible from the aerodrome control position showing the actual serviceability status of an aeronautical ground lighting service, is given;
- (c) the equipment indicates when failure or abnormal operation of the aeronautical ground lighting service selected for use falls below levels required by the aerodrome licence;
- (d) the serviceability status information required to be passed to pilots is readily established from the indications visible from the aerodrome control position;
- (e) aeronautical ground lighting equipment complies with Annex 14 – Volume 1 of ICAO which describes the technical requirements for aeronautical ground lighting control and monitoring equipment; and
- (f) software related aspects of an aeronautical ground lighting control monitoring system at an air traffic control unit comply with international standards related to software safety assurance in air traffic services equipments.

Landing clear-  
ance indicator  
(LCI)

**39.** (1) A licensee shall provide a landing clearance indicator, when surveillance radar approaches terminating at a distance of less than 2 NM from touchdown are conducted.

(2) The landing clearance indicator system referred to in subregulation (1) shall incorporate a means by which the aerodrome controller can indicate to the radar controller that an aircraft is to be instructed to make an immediate go-around and an audio alert shall be associated with this indication.

(3) At units where a landing clearance indicator system is installed, instructions on its use shall be included in the operations and air traffic service manuals.

Surface  
movement  
radar (SMR)

**40.** At a unit where the air traffic controller has clearly defined and fairly narrow tasks to perform, a licensee shall ensure that the orientation of the picture is such that the runway on the surface movement radar is aligned with the view of the runway from the control position.

Visual signaling

**41.** (1) A licensee shall provide a signal lamp with interchangeable coloured lenses and spare bulb which shall be accessible to the controller.

(2) The signal lamp referred to in subregulation (1) shall enable control of aerodrome traffic and the light shall be visible from all points of the manouvering area.

(3) A licensee shall ensure that the choice of visual control room tinted glass does not affect the perceived colour of the signal from the signal lamp.

Emergency  
services  
alerting

**42.** A licensee shall provide —

- (a) an audible method of alerting airfield emergency services as a primary means of emergency call out;
- (b) a standby means of alerting airfield emergency services, independent of the primary method;
- (c) a means of communicating with other emergency services; and
- (d) check-list of actions to be carried out in the event of emergency shall be provided.

*(d) Automatic Terminal Information Service (ATIS)*

**43.** (1) A licensee shall provide Automatic Terminal Information Service equipment and systems that are complete, identified, accurate and uncorrupted voice or data communication of meteorological and other aeronautical information.

Safety  
objective

(2) The equipment, systems referred to in subregulation (1) shall comply with the applicable international standards and the recommended ICAO for air navigation services.

**44.** (1) A licensee shall ensure that the datalink-ATIS message applies to a single aerodrome.

Datalink-ATIS

(2) A licensee shall —

- (a) update the Automatic Terminal Information Service immediately whenever a significant change occurs; and
- (b) prepare and disseminate the Automatic Terminal Information Service message.

(3) A licensee shall ensure that individual Automatic Terminal Information Service messages referred to in subregulation (2) (b) are identified by a letter designator from the ICAO spelling alphabet assigned consecutively in alphabetical order.

**45.** (1) A licensee shall ensure that the Voice-ATIS is provided in association with an air traffic control service.

Voice-ATIS

(2) A licensee shall provide Voice-ATIS at aerodromes where there is an operational requirement to reduce air traffic control's very high frequency (VHF) air-ground communications workload.

(3) Voice-ATIS broadcasts shall comprise —

- (a) one broadcast for arriving aircraft;
- (b) one broadcast for departing aircraft;
- (c) one broadcast for arriving and departing aircraft; or
- (d) two separate broadcasts for arriving and departing aircraft where the combined broadcast would be excessively long.

(4) A licensee shall provide Voice-ATIS on a discrete very high frequency whenever practicable.

(5) Where a discrete very high frequency is not available, a licensee may provide Voice-ATIS on the most appropriate terminal navigation aid.

(6) Voice-ATIS broadcasts referred to in subregulation (3), when provided, shall be continuous and repetitive.

(7) In the event of Voice-ATIS failure, the air traffic controller may provide the Automatic Terminal Information Service information using the control very high frequency but where the workload prevents this, an additional air traffic controller or assistant shall open another alternative very high frequency.

(8) Where a licensee provide data-ATIS alongside the existing availability of Voice-ATIS, the content and format of the information shall be identical and shall be updated simultaneously.

(9) Where data-ATIS broadcast referred to in subregulation (8) includes real time meteorological information, which is within the parameters of the significant change criteria reference of ICAO, the content shall be considered identical for the purpose of maintaining the same designator.

(10) In the event of failure of the data-ATIS, a licensee shall obtain the Automatic Terminal Information Service information from the Voice-ATIS.

Collation of meteorological and aerodrome data

**46.** (1) A licensee shall use meteorological data in the preparation of Automatic Terminal Information Service messages compliant with ICAO.

(2) Where rapidly changing meteorological conditions preclude the inclusion of a weather report, the Automatic Terminal Information Service message shall contain information that the relevant weather information shall be given on initial contact with the air traffic control unit.

(3) A licensee shall ensure that the accuracy and integrity of the data used in the preparation of the Automatic Terminal Information Service message is maintained at a level appropriate to the operational requirements.

Preparation of messages

**47.** Where the Voice-ATIS broadcast messages are not prepared by the aerodrome air traffic control unit, a licensee shall ensure that —

- (a) the organisation responsible for this task shall immediately make known the information contained in the current broadcast to the air traffic control unit;
- (b) the Voice-ATIS broadcasts are prepared in the English language;
- (c) the Voice-ATIS broadcast are prepared to achieve optimum readability consistent with message length, speed of transmission and human factors performance and the message contents are kept as brief as possible; and
- (d) the message contains the elements of information as defined in ICAO.

Transmission of Voice-ATIS messages through CVOR/DVOR Transmitter

**48.** A licensee shall provide the Designated Operational Coverage and frequency assignment terms and conditions shall be consistent with both the CVOR/DVOR and Voice- ATIS operational requirements.

Broadcast of auto METAR

**49.** (1) A licensee shall provide a broadcast of auto aviation routine weather report utilising an Automatic Terminal Information Service frequency compliant with ICAO and shall be used only at an aerodrome where an Automatic Terminal Information Service facility has been approved and when the air traffic control watch is closed.

(2) The Designated Operational Coverage of the Automatic Terminal Information Service referred to in subregulation (1) shall have a frequency valid for the auto METAR broadcast.

(3) A licensee shall provide a METAR report prefixed with the word ‘AUTO’ and only the METAR information shall be included in the broadcast.

*(e) Ultra-High Frequency (UHF) Equipment and Systems*

General

**50.** The provisions of this Part shall —

- (a) apply to ultra-high frequency radio equipment and systems operating on frequency assigned in the ultra-high frequency land mobile service allocation 450 MHz to 470 MHz, using Frequency Modulation with 12.5 kHz channel spacing, for analogue voice communications; and
- (b) provide for the engineering requirements for ultra-high frequency radio equipment and systems at base stations and land mobile stations established or used within Botswana in support of air traffic services ground-ground communications at aerodromes.

**51.** (1) A licensee shall provide the equipment and systems designed and constructed to operate within the land mobile service allocation 450 MHz to 470 MHz with channel spacing of 12.5 kHz using Frequency Modulation with appropriate international communications union emission designator using semi-duplex operation.

Radio  
spectrum  
management

(2) The equipment and systems referred to in subregulation (1) shall be installed, operated and maintained in compliance with the terms of specific location dependent on general frequency assignment and the operational requirements of the air traffic services ground-ground communications being provided.

**52.** A licensee shall make available for inspection by the Authority equipment, systems and associated records for the purpose of demonstrating compliance with the provisions of this Part.

Inspection of  
UHF  
equipment  
and systems

**53.** A licensee shall —

Equipment  
configuration

- (a) ensure that the equipment is configured to ensure the availability of communications appropriate to the service being provided;
- (b) provide main, standby and emergency equipment for redundancy for Aerodrome Air Traffic Control Services; and
- (c) provide main and emergency equipment for redundancy for Aerodrome Air Traffic Services and flight information services.

**54.** (1) In the case of an air traffic control service, a licensee shall ensure that —

Power supply  
for UHF  
emergency  
equipment

- (a) the power supply for the emergency equipment is independent of that for the main equipment; and
- (b) standby power supply is able to sustain the equipment for at least eight hours of operation.

(2) A licensee shall —

- (a) notify users of failure of the power supply and transfer the users to the emergency equipment;
- (b) provide the instructions in the manual for user actions in the event of failure;
- (c) for an air traffic control service, provide a primary and alternative power supply to increase the availability of power to equipment and systems in the event of an interruption to one of the power supplies;
- (d) ensure that change-over between power supplies is on a 'no break' basis; and
- (e) give an indication of failure for each power supply to the user, and corrective action taken in the event of failure.

**55.** (1) For an air traffic control service, a licensee shall ensure that the ultra-high frequency system notifies users of system failure that has an effect on the service being provided, in a timely manner, so that actions can be taken to ensure the safe continued provision of an air traffic control service or if necessary the controlled withdrawal of the service.

Alarm or  
status  
indications

(2) The significance of the notification of system failure referred to in subregulation (1) shall be obvious to the user and shall remain obvious to the user whilst the condition causing the failure remains.

(3) A licensee shall ensure that changes in the ultra-high frequency system's state attracts the operator's attention without continuing to distract once they are aware of the change of state.

Interface to recording equipment	<p>(4) An air traffic controller shall raise alarm both when failures are detected and when they clear and shall ensure that subsequent status changes are notified to the users after the cause for alarm has been attended to.</p> <p>(5) The alarm referred to in subregulation (4) shall have both visual and audible elements and the ability for the user to acknowledge that they are aware of the change of state thereby removing alarm.</p> <p><b>56.</b> (1) A licensee shall ensure that the equipment and systems at the base station provide all the necessary signals and information to the recording equipment.</p> <p>(2) A licensee shall provide automatic recording facilities on communication channels used for the control of vehicles on the maneuvering area.</p>
Unintentional or continuous transmissions	<p><b>57.</b> A licensee shall ensure that the equipment and systems at aeronautical radio stations —</p> <p>(a) do not fail in a manner such as to cause unintentional or continuous transmissions;</p> <p>(b) where new, incorporate features to prevent unintentional or continuous transmissions, unless this is contrary to the intended purpose for which they have been designed; and</p> <p>(c) for existing equipment and systems, consideration is given to incorporating such devices by retrofit, modification or add-on circuitry, where appropriate.</p>
General	<p>(f) <i>Recording Equipment, Communications to be recorded, etc</i></p> <p><b>58.</b> (1) For purposes of this Part “digital recording equipment” means equipment that encodes and records analogue voice or data communications onto intermediate storage or memory and then regularly transfers the recorded data into archive storage.</p> <p>(2) A licensee’s recording equipment shall provide a complete, identified, intelligible and accurate record of the communications to be recorded which may be used, in the event of an incident, in any investigation by the Authority.</p> <p>(3) For purposes of subregulation (2), the following digital recording devices shall be recognised as recording equipment —</p> <p>(a) magnetic or optical media; and</p> <p>(b) storage drives utilizing electronic, electrical or mechanical devices.</p> <p>(4) The recording equipment referred to in subregulation (2) shall —</p> <p>(a) comply with the Minimum Performance Specification described in Schedule 2;</p> <p>(b) employ voice coding techniques which ensure the replay quality of previously archived radio communication messages will achieve a minimum Mean Opinion Score (MOS) of 4.0 (Good);</p> <p>(c) be such that the voice coding scheme —</p> <p>(i) can cope with different types of voice, multiple voices, background noise without any significant deterioration in quality, and</p> <p>(ii) complies with published international standards where available; and</p> <p>(d) be compatible with the replay facilities and working practices in use and evidence of this shall be presented in support of an application for a certificate under these Regulations.</p>

- 59.** A licensee shall ensure that —
- (a) air traffic services unit clocks and time-recording devices use coordinated universal time and can —
    - (i) express time in hours and minutes and seconds of the 24-hour day, and
    - (ii) midnight shall be designated as 2400 for the end of the day and 0000 for the beginning of the day;
  - (b) air traffic control unit clocks and time-recording are checked as necessary to ensure correct time to within plus or minus two seconds of coordinated universal time;
  - (c) the clock or time-recording device in the recording equipment is checked as necessary to ensure that the time-stamps are maintained within plus or minus two seconds of either the air traffic service unit master clock source where this exists and another common reference source, or global positioning system signals; and
  - (d) wherever data link communications are in operation, clocks and time-recording devices are accurate to within plus or minus one second of coordinated universal communications.
- 60.** A licensee shall ensure that —
- (a) direct pilot-controller communications between aircraft stations and aeronautical stations are recorded;
  - (a) the voice communications to be recorded are derived from a receiver in the aeronautical stations providing ‘off-air’ signal of the pilot and controller transmissions;
  - (a) where the voice communications to be recorded are routed through a voice communications system or other air traffic service equipment to the recording equipment, failure of the voice communications system or air traffic service equipment does not affect the continuity of recording; and
  - (a) voice communications derived from the controller’s operating position are recorded.
- 61.** (1) Where communication is within the Botswana flight information region a licensee shall record —
- (a) direct communication between air traffic service units; and
  - (b) direct communication between air traffic service units and military units.
- (2) Where communication is between adjacent air traffic service units a licensee shall record —
- (a) direct communications between area control centres serving contiguous control areas; and
  - (b) direct communications between air traffic units.
- (3) A licensee shall ensure that —
- (a) the surface movement control service communications used for the control of vehicles and personnel on the maneuvering area are recorded; and
  - (b) communications between operational positions at an air traffic control unit are recorded.

Time  
recording  
devices

Air-Ground  
communications  
(aeronautical  
mobile service)

Ground-  
Ground  
communications  
(aeronautical  
fixed service)



Recording  
equipment  
installations

**62.** A licensee shall ensure that the recording equipment is installed in accordance with the manufacturer's, supplier's or agent's instructions so as to ensure correct and reliable operation and reliable retention of data and realisation of expected media lifetimes.

Equipment and  
power supply  
configuration

**63.** (1) A licensee shall ensure that the equipment and power supply configuration enables the availability of recording without interruption when air traffic service is being provided.

(2) In order to comply with subregulation (1), the licensee shall —

- (a) provide separate main and standby recording equipment to ensure the uninterrupted availability of the recording equipment by increasing the reliability of the recording equipment configuration;
- (b) provide a back-up power supply from either a central battery system or individual uninterrupted power supply unit to ensure the availability of power to the recording equipment and other essential equipment in the event of a mains interruption;
- (c) ensure the equipment configuration takes into account such factors as —
  - (i) the hours of operation of the air traffic service unit,
  - (ii) provision of maintenance or repair,
  - (iii) ability to replay recorded archival media whilst continuing to record, and
  - (iv) replacement of media;
- (d) ensure suitable mains conditioning devices are part of the mains or backup power supply arrangements which will prevent equipment malfunction due to surges, spikes and noise on the power supply; and
- (e) where the equipment and power supply configuration is such that the availability of recording, without interruption, cannot be ensured whilst the air traffic service is being provided, then either the air traffic service shall cease within a time period defined in the local instructions for the air traffic unit or a written record shall be kept and the traffic shall be transferred to another air traffic service unit.

Alarm or status  
indications

**64.** (1) A licensee shall use the local and remote alarm or status indications of the recording equipment to alert air traffic controller and maintenance staff to take the necessary actions to ensure the continued operation of the equipment.

(2) The remote alarm or status indications referred to in subregulation (1) shall be 'latching' such that they require positive intervention to check that the recording equipment is operating correctly before any alarm can be cancelled.

(3) For purposes of this regulation "latching" means where a device keeps or remembers the alarm or status indication until it is manually cleared.

Working  
facilities

**65.** (1) A licensee shall have working facilities to enable authorised personnel to operate the equipment and undertake other duties such as replay and copying, maintenance, repair and inspection.

(2) The facilities referred to in subregulation (1) may include provision of —

- (a) lighting and mains electrical power in the vicinity of the recording equipment or control console;
- (b) suitable seating and writing surface; or
- (c) easily accessible connections to the recording equipment where copies of recordings are required to be made.



**66.** A licensee shall, before disposing of any recording equipment, consult the Authority in order to determine whether there is a need to retain the equipment as a replay facility for any impounded recordings.

Disposal of  
recording  
equipment

**67.** (1) A licensee shall keep a logbook and shall record in the logbook details of —

Recording  
equipment  
logbook

- (a) the operation and maintenance of the recording equipment;
- (b) the management of the archival media; and
- (c) visits by authorised persons.

(2) The record referred to in subregulation (1) shall be preserved for a period of one year.

**68.** (1) A licensee shall on a daily basis check the serviceability and recording function of the recording equipment without interrupting the recording of any active communications including intermediate and archival media storage devices.

Serviceability  
and recording  
functional  
check

(2) The results of the checks referred to subregulation (1) shall be recorded in a logbook.

(3) The recording function referred to in subregulation (1) may be checked manually by test transmissions on each of the communication channels confirming that the communications have been recorded and can be replayed.

(4) Notwithstanding subregulation (3), a licensee may use devices or facilities incorporated into the recording equipment which perform automatic checks of the recording function.

**69.** (1) A licensee shall take the following precautions during a test transmission —

Test  
transmission

- (a) inform the Aeronautical Information Services within a reasonable time before commencing the transmission to enable the Aeronautical Information Services to issue a NOTAM on the test transmission; and
- (b) at the commencement of the transmission, identify the transmission as a test transmission and the transmission shall contain information identifying it as a test transmission.

(2) A licensee shall test and maintain its facilities using equipment that is maintained and calibrated in accordance with applicable international standards.

(3) A licensee shall conduct regular checks of the time and date function of the recording equipment, at intervals appropriate to the accuracy of the air traffic service unit clock or time-recording device as used as the source and the results of these checks shall be recorded in the logbook.

(4) Where the checks referred to under subregulation (3) find the recording equipment time and date function to be outside limits, the licensee shall enter the discrepancy into the logbook and a correction made as soon as possible at an appropriate time which does not affect the recording of any active communication or the archiving process.

**70.** A licensee shall maintain archival media that have a unique identity, which shall be used in entries made in the logbook, and shall be shown by the use of an indelibly written or printed label firmly attached to the media.

Management  
of archival  
media  
identification

**71.** (1) A licensee shall use the maximum storage capacity available on the archival media, and where this equals or exceeds 60 days, the licensee shall only use it where the reliability of the recording equipment and archival media has been demonstrated and the risk of losing data due to the failure of the recording equipment archival drive or media itself has been minimised.

Storage  
capacity of  
archival  
media

Lifetime of archival media	<p>(2) A licensee shall, on a daily basis, change the magnetic tape archival media, at appropriate times related to the provision of the air traffic control services, or corresponding to air traffic control and maintenance staff duty changes.</p> <p><b>72.</b> (1) A licensee shall replace the archival media before any deterioration results in the loss of recorded data.</p> <p>(2) A licensee shall follow the precautions stated by the manufacturer or supplier of the recording equipment concerning the handling or storage of the archival media to ensure the integrity of the archived recorded data and the stated lifetime of the archiving media.</p>
Retention of recordings	<p><b>73.</b> A licensee shall retain recordings on archival media for a minimum period of 30 days from the date of the last recorded message.</p>
Impounding of recordings	<p><b>74.</b> (1) On receiving a detailed request concerning recorded transmissions from concerned investigating entity, normally within the 30 day retention period, the Authority shall impound archival media containing the specific recorded transmissions from the normal storage or taken out of use and placed in a separate and secure storage area pending further instructions.</p> <p>(2) In the case of an accident, the Authority shall impound the original recordings for the entire duration of the investigations.</p>
Access to recording equipment	<p><b>75.</b> A licensee shall permit access to the Authority, of the recording equipment, for purposes of replaying and making copies of original recordings.</p>
Prevention of accidental loss of recorded communications	<p><b>76.</b> A licensee shall have procedures which will prevent accidental loss of recorded communications, whilst operating the recording equipment.</p>

## PART V – Aeronautical Navigation Aids

### (a) Instrument Landing System (ILS)

General	<p><b>77.</b> (1) A licensee shall have an instrument landing system (hereinafter referred to as “ILS”) which provides precision guidance signals to aircraft in the last stages of approach and landing.</p> <p>(2) The ILS referred to in subregulation (1) shall be classified into —</p> <ul style="list-style-type: none"> <li>(a) Facility Performance Category I;</li> <li>(b) Facility Performance Category II; and</li> <li>(c) Facility Performance Category III</li> </ul> <p>in ascending order of accuracy, integrity and reliability.</p> <p>(3) Notwithstanding any other requirements under these Regulations, an ILS referred to in subregulation (1) shall comply with the ICAO.</p>
Serviceability indicators	<p><b>78.</b> (1) A licensee shall provide the air traffic control units directly responsible for ILS operations with —</p> <ul style="list-style-type: none"> <li>(a) visual indications showing the serviceability status of all elements of the ILS including power supplies; and</li> <li>(b) an audible alarm indicating when the visual alarms have changed state.</li> </ul>

(2) An air traffic controller shall not cause an immediate ILS close-down for Facility Performance Category II and III if there is a systems failure of the status communication:

Provided that for Facility Performance Category I systems it shall be acceptable to consider status communication failure as part of the Continuity of Service Assessment.

(3) A licensee shall, where there is failure of the status communications, only allow aircraft on final ILS approach to complete the approach and the ILS shall then be withdrawn from service.

(4) Where the ILS is configured to close-down the system after a delay following status communications failure, the delay must be long enough for the actions in subsection (5) to be completed.

(5) A licensee shall, in the event of a status communication failure, have an officer stationed at the ILS building with a suitable means of communication to the air traffic controller and the equipment shall then operate in local control guided by the system monitors.

(6) An officer referred to in subregulation (5) shall not override or inhibit the system monitors until the system is proven serviceable and the officer shall advise the air traffic controller of any change in ILS status without delay.

(7) A licensee shall not put into service a reciprocal ILS until the system with faulty status communications is positively disabled and cannot accidentally radiate.

**79.** (1) A licensee shall, in addition to the normal remote control, fit Performance Category III facilities with a unit that accepts signals from ILS equipment, its monitors and the runway direction switch, to automatically provide air traffic control with indications of the operational category of the ILS.

Failure of  
status  
communications

(2) A licensee shall ensure that the status unit has integrity of the order as that of the ILS.

(3) A licensee shall ensure that any change of calculated category causes an audible alarm and shall be done in accordance with Form A set out in Schedule 3.

(4) A licensee shall ensure that the status unit has provision to limit the maximum category out to the display and can automatically upgrade at initial ILS equipment switch- on or runway change.

**80.** (1) A licensee shall, when installing systems at possible ends of the same runway ensure that they are interlocked so that only one system may radiate at one time.

Category and  
status unit

(2) The interlocking system referred to in subregulation (1) shall be such that —

- (a) the non-operational system cannot be switched on using either the remote or local control switches;
- (b) the system shall fail-safe and if the communication link between the systems fails, it shall not be possible to make the non-operational system radiate using the local or remote front panel controls; and
- (c) the interlocking shall be considered as part of the Integrity and Continuity of Service Assessment.

**81.** A licensee shall ensure that the ILS has dual equipment so that the system is “fail operational”, regardless of proven Mean Time Between Outages (MTBO) and shall monitor its critical parameters and that the non-operational transmitter radiates into a dummy load.

Interlocking

Provision of  
standby

**82.** (1) A licensee shall provide the ILS including the remote control equipment, interlock and status displays with a standby battery power supply and in the event of a mains power failure, the standby battery power shall maintain the normal ILS operation for at least eight hours.

(2) A licensee shall have a procedure for managing the withdrawal of and return of the ILS to and from operational service when standby batteries are or have been in use.

Localizer back  
beam

**83.** (1) A licensee shall not use facilities designed to radiate back beams.

(2) A licensee shall provide the following localizer alignment —

- (a) for Facility Performance Category I, II and III, systems alignment measurements at threshold shall be taken as soon as possible after commissioning and flight inspections;
- (b) for Facility Performance Category I, II and III, systems alignment measurements at threshold shall be made at monthly intervals; and
- (c) for Facility Performance Category III, systems which provide roll out or take off guidance, measurements of bends along the runway to ILS —
  - (i) point E shall be made at commissioning and at six months intervals,
  - (ii) the commissioning and one check per year shall be conducted with an appropriate antenna height consistent with that of an aircraft antenna, and
  - (iii) the second check may be made at 15metres above runway.

(3) A licensee shall —

- (a) provide localizer displacement sensitivity measurements —
  - (i) no closer than half the runway length from the localizer, and
  - (ii) between the half end full sector width points, providing that a proportional relationship is established between that point and the full sector width;
- (b) make ground measurements approximately 300 meters in front of the local transmitting aerial for Facility Performance Category I localizers using 14 or less elements, field measurement; and
- (c) take displacement sensitivity measurements —
  - (i) as soon as possible after commissioning, and flight inspections, and
  - (ii) at monthly intervals.

(4) A licensee shall —

- (a) make ground measurements of displacement sensitivity instead of flight inspections;
- (b) measure, at commissioning, the displacement sensitivity by flight inspection and if the ground and air measurements differ by more than 17 per cent the disagreement shall be investigated by the Authority; or
- (c) where he or she wishes to use the ground measurements as a standard, consider the —
  - (i) position of the ground measurements points, and
  - (ii) details of the equipment to be used for this measurement.

(5) The localizer displacement sensitivity referred to in subregulation (2) shall be measured at a time as near as possible to that of the flight inspection.

(6) The ground measurements referred to in subregulation (3) may be made either in Difference in Depth Modulation (DDM) or micro Amperes deflection at the current measurement points.

(7) A licensee's ILS maintenance instructions shall show the method of calculating the width angle from ground measurements.

(8) A licensee's field test points at which field measurements are made shall be clearly and permanently marked.

(9) A licensee shall ensure that the marks referred to in subregulation (8) do not present a hazard to aircraft and shall be immune to disturbance by such operations as grass cutting.

**84.** (1) A licensee shall ensure that the localizer and glide path critical areas are clearly marked and identified. Critical areas

(2) The marking referred to in subregulation (1) shall be visible during the day and during the night and shall assist the air traffic control to ensure that no person or vehicle may enter the areas without permission.

(3) Where fencing is used to mark the critical areas referred to in subregulation (1), the operator shall ensure the ILS continues to operate in accordance with the requirements of ILS flight inspection requirements.

(4) The licensee shall ensure that details of the localizer and glide path critical areas are included in the air traffic services manual together with any appropriate procedures.

**85.** A licensee shall define the localizer and glide path sensitive areas based on ICAO. Sensitive areas

**86.** Where a licensee uses computer simulation, to define an ILS sensitive area, or to support a case for a system remaining operational during construction work, the licensee shall meet the following requirements — Computer simulation

(a) proof that the version of software being used is the latest issue, or recent confirmation from the software manufacturer that the version being used has no known safety related problems;

(b) proof that the person making the simulation has received formal training in the use of the simulation programs;

(c) proof that the model is suitable for intended simulation; and

(d) proof that there is correlation of the modelling tool with far field measurement.

**87.** (1) A licensee when installing a decommissioned equipment shall ensure that the installation is subject to examination by the manufacturer's quality representative or by an agent designated by the manufacturer. Use of decommissioned equipment

(2) A manufacturer referred to in subregulation (1) or his or her agent shall, after examining the equipment, make a written report which shall show that the equipment is in a satisfactory condition for further service and that there are no outstanding safety-related modifications.

(3) A licensee shall ensure that glide path aeralis are new or factory refurbished and re-tested to the original factory test specifications and that aerial feeder cables are renewed.

*(b) Instrument Landing System (ILS) Monitoring*

## Equipment

**88.** (1) A licensee shall ensure that references to signal voltages are measured at the aerial when terminated with 50 ohm.

(2) When calibrating the equipment, a licensee shall make due allowance for cable losses and for —

- (a) automatic scanning allowance for ability to bypass up to five channels;
- (b) frequency range for ILS calibration at 108 – 112.00 MHz;
- (c) frequency tolerance calibration of  $\pm 0.005$  per cent;
- (d) channel spacing of 50KHz;
- (e) IF bandwidth of 3dB bandwidth between  $\pm 10$  and  $\pm 15$  KHz and the exact figure shall be stated as it is required for analysis calculations;
- (f) receiver sensitivity, calibration shall be 2 micro volts for 10dB (signal + noise)/noise ratio at 50% Mod AM or FM deviation 30% of IF bandwidth;
- (g) modulation detector —
  - (i) the standard detector shall be for amplitude modulation and for normal monitoring this detector shall provide the output to the audio storage device, and
  - (ii) the receiver should also be able to detect frequency modulation;
- (h) audio bandwidth the minimum 3dB bandwidth of the receiver and recording equipment shall be 300 to 3400 Hz;
- (i) spurious responses: the receiver shall provide adequate immunity to interference from two-signal third order inter modulation products caused by signal outside the band being examined;
- (j) dynamic range —
  - (i) the receiver shall measure the signal strengths in the range of 2 micro volts to 100 micro volts, and
  - (ii) the receiver shall be capable of detecting modulation when the signal strength is in the range of 2 micro volts to 1 000 micro volts;
- (k) interval between successive scans shall be between one and two minutes when no modulation is being recorded;
- (l) scanning dwell time on each channel —
  - (i) for signals greater than Threshold 1 but less than Threshold 2: the receiver shall dwell on the channel long enough to allow time, channel number and signal strength to be logged, and for demodulated audio signals to be recorded, or
  - (ii) for signals greater than Threshold 2: the receiver shall dwell on the channel long enough to allow time, channel number and signal strength to be logged, and for demodulated audio signals to be recorded;
- (m) audio recording duration when a signal exceeds Threshold 2, the demodulated audio signal shall be recorded for a continuous period of approximately 20 seconds;
- (n) channels to be examined at each scan, initially, all except the operational localizer frequency or frequencies;

- (o) operational channel monitoring, if the equipment can also record interference events in the operational channel, details shall be provided of —
  - (i) the mask used to remove the ILS signal, and
  - (ii) the threshold levels used for the noise measurement;
- (p) threshold level —
  - (i) threshold 1 shall be adjustable over the range  $2\mu\text{V}$  to  $10\mu\text{V}$ , or
  - (ii) threshold 2 shall be adjustable over the range  $10\mu$  to  $20\mu\text{V}$ ;
- (q) aerial horizontal response the calibration shall be Omni directional;
- (r) aerial polarization calibration shall be horizontal; and
- (s) storage of results —
  - (i) channel occupancy data shall be sent either directly to a printer or stored on computer disk or both,
  - (ii) modulation information shall be stored on a suitable audio recording device, and
  - (iii) the results shall be stored in a format which will facilitate further analysis.

**89.** (1) A licensee shall follow the documented calibration procedures and apply the procedures to all equipment involved in the measurement of radio noise level.

Calibration

(2) All equipment referred to in subregulation (1) and standards used in the calibration process shall have traceability to national or international standards.

(3) Where the licensee uses any equipment that is claimed to be self-calibrating, the internal processes involved shall be clearly defined showing how the equipment's internal standard is applied to each of the parameters which it can measure or generate and the internal standard shall have traceability to national or international standards.

(4) A licensee shall state calibration intervals in the calibration records and provide all the evidence available to support the quoted calibration intervals.

**90.** (1) For horizontal position, where a licensee uses a single measurement point for the complete airport, the licensee shall ensure that the aerial is located near the midpoint of the runway and if an alternative location in the approach area is used, the measurements shall only apply to that particular approach.

Location of  
measuring  
equipment

(2) A licensee shall take measurements near the midpoint referred to in subregulation (1) only with equipment that is immune to blocking from the operational localizer.

(3) A licensee shall, for vertical positioning of the aerial, place it in a position higher than any obstructions in the immediate vicinity but shall make sure that it is not an obstruction to an aircraft.

**91.** (1) A licensee shall make measurements on Facility Performance Category II runway at intervals not exceeding one year.

Measurement  
interval and  
duration

(2) The total measurement period referred to in subregulation (1) shall be a minimum of 350 hours in any one year and the measurement need not be made in one continuous period.



*(c) Instrument Landing System (ILS) Monitors*

Safety objective	<b>92.</b> To achieve the safety objective a licensee shall ensure that, the ILS monitors do not radiate guidance signals which are outside the standard operational tolerances.
Near field monitor	<b>93.</b> A licensee shall — <ol style="list-style-type: none"> <li>(a) install localizers that have a minimum of one near-field monitor measuring the course centerline; and</li> <li>(b) ensure that glide paths have a minimum of one near-field monitor measuring either the glide path angle or the displacement sensitivity.</li> </ol>
Far field monitor	<b>94.</b> (1) A licensee shall ensure that Facility Performance Category II and III localizer systems are — <ol style="list-style-type: none"> <li>(a) fitted with a far field monitor which measures centre-line accuracy and displacement sensitivity; and</li> <li>(b) installed near the relevant runway threshold.</li> </ol> (2) The far field monitor referred to in subregulation (1) (a) shall provide alarms to a remote point, but shall not take executive action. (3) A licensee shall ensure that a delay shall be incorporated in the monitor to prevent false alarms due to aircraft movement. (4) A licensee shall ensure that the minimum parameters to be recorded shall be the centerline Difference in Depth Modulation (DDM) and displacement sensitivity. (5) A licensee shall ensure that the far field monitor output is recorded and time stamped at all times when the ILS is operational.
Monitor correlation	<b>95.</b> A licensee shall ensure that any monitors on which the integrity assessment is based shall correlate with changes in the far field and this correlation shall be demonstrated for each new design of ILS transmitter, antenna or monitor system installed.
Alarm and warning settings	<b>96.</b> (1) A licensee shall ensure that monitor alarm settings do not exceed the limits stated in Form B set out in Schedule 3. (2) In a system where several sets of monitors have been considered in the integrity assessment, a licensee shall have the system adjusted to a point where sufficient alarms on the monitors are generated to cause changeover or shutdown. (3) Where flight or ground tests show that the change measured in the field exceeds the limits stated in Form B set out in Schedule 3 with the transmitter set to the alarm condition, a licensee shall have the monitor system adjusted to tighter limits than those given in the form. (4) A licensee shall ensure that monitor limits referred to in subregulation (1) are not so tight that equipment instability can cause false shutdowns.
Changeover and shutdown times	<b>97.</b> (1) A licensee shall ensure that the maximum total time of false radiation does not exceed the number of seconds stated in Form C set out in Schedule 3. (2) A licensee shall, for Facility Performance Category I and II systems, where immediate changeover is not provided, provide for the delay from the time of shutdown of the main transmitter to the start of radiation from the standby transmitter at $20 \pm 2$ seconds. (3) For systems referred to in subregulation (2) having a delay, the figures given in Form C set out in Schedule 3 shall apply separately to each transmitter of the system.



**98.** (1) A licensee shall at commissioning, or whenever a flight inspection has shown the system to be non-compliant with the limits set in these Regulations and where no alarm has been shown by the monitors, ensure that the localizer alarms are checked by ground or flight inspection.

Localizer  
alarm testing

(2) A licensee shall ensure that the alarm points of all individual monitor units are measured at commissioning using independent test equipment and the figures measured shall be recorded as standard figures.

**99.** A licensee shall ensure that the —

- (a) alignment alarm is tested by adjusting modulation balance; and
- (b) displacement sensitivity alarm is tested by adjusting sideband power.

Method of  
simulating  
localizer  
alarms

**100.** (1) A licensee shall, at commissioning, or whenever a flight inspection has shown the system to be non-compliant with the limits specified in these Regulations, and no alarm has been shown by the monitors, check the glide path alarm by flight inspection.

Glide path  
alarm testing

(2) A licensee shall, following any engineering work involving the aerial distribution unit, feeder cables, aerials or monitor-combining unit, check the following glide path alarms by flight inspection —

- (a) angle low and width wide simultaneously;
- (b) phase advance alarm; and
- (c) phase retard alarm.

(3) A licensee shall ensure that the alarm points of all individual monitor units are measured at commissioning, using independent test equipment and the figures measured are recorded as standard figures.

**101.** (1) A licensee shall ensure that the alignment and displacement sensitivity alarms are checked in the following condition —

Method of  
simulating  
glide path  
alarms

- (a) width wide and angle low;
- (b) width normal and angle high;
- (c) width normal and angle low;
- (d) width narrow and angle normal; and
- (e) width wide and angle normal.

(2) A licensee shall ensure that the —

- (a) alignment is adjusted using modulation balance; and
- (b) displacement sensitivity is adjusted using sideband power.

(3) A licensee shall ensure that phase simulation for both advanced and retard alarms, the flight inspection shall measure the glide path angle, displacement sensitivity, Difference in Depth Modulation (DDM) and field strength at 0.32.

(4) A licensee shall ensure that for null reference, the simulation is by adjustment of sideband oscillator phase which is the same as the relative phase between upper and lower aerials.

(5) A licensee shall ensure that for sideband reference, the system aerial phasor shall be adjusted until the monitors show sufficient alarms of any type to cause a shut down.

(6) A licensee shall ensure that for Type M, simulation is by adjustment of the relative phase between middle, upper and lower aerials, by adjustment of the middle antenna phasor.

Routine  
monitor  
maintenance

**102.** (1) A licensee shall check alarms repeatedly at intervals not exceeding six months.

(2) The alarm checking interval referred to in subregulation (1) may be extended to 12 months if it can be demonstrated with a confidence of 95 per cent that the monitors have a reliability of 0.95 or better.

(3) A licensee shall ensure that all equipment monitor readings for all transmitters capable of operating into the aerial are taken at monthly intervals or as prescribed by the equipment manufacturer.

Localizer

**103.** A licensee shall, in Facility Performance Category III systems make all system monitor alarm checks using independent test equipment.

Glide path

**104.** A licensee shall ensure that alarm checks are made using independent test equipment and not by adjusting the transmitter.

*(d) Instrument Landing System (ILS) Flight Inspection Requirements*

Flight  
inspection  
interval

**105.** A licensee shall conduct successive flight inspections for ILS facilities, at six months intervals.

Tolerances

**106.** (1) A licensee may have a tolerance of +20 days to the six months flight inspection interval referred to in regulation 105 .

(2) If the previous inspection lasted more than one day, the flight inspection interval referred to in subregulation (1) shall be calculated from the date when the inspection was concluded.

(3) A licensee shall conduct a flight inspection —

(a) up to seven days earlier than the due date without affecting the due date for the next inspection; or

(b) more than seven days before the due date and if so, the date of subsequent inspections shall be set to the day the inspection was concluded.

Delays due to  
adverse weather

**107.** Where an inspection is prevented by bad weather, a licensee may continue to operate the system unserviced for a further 25 days provided that a reduced flight inspection has been made within the permitted tolerance interval.

Supplementary  
flight  
inspections

**108.** (1) A licensee shall make a supplementary flight inspection 90 days  $\pm$  20 days after a periodic flight inspection if at that inspection any parameter was found outside the flight inspection tolerances stated in Forms D, E or F set out in Schedule 3 and subsequently adjusted.

(2) The requirement under subregulation (1) may be relaxed if ground measurement and equipment monitors confirm the changes seen during the periodic flight inspection and in such a case it shall be acceptable to carry out more frequent ground monitoring and inspection of the equipment monitor records.

(3) A licensee shall, if there are parameters found out of tolerance, check them through a supplementary flight inspection.

(4) A supplementary flight inspection referred to in subregulation (3) may be requested by the Authority at any time if —

(a) a safety inspector considers that any aspect of maintenance is not being correctly carried out;

(b) an inspection of equipment monitor records, which may be requested at any time shows any evidence of instability;

(c) changes have been made within the safeguarded areas; and

(d) a periodic inspection has shown an unusual, though not necessarily out of tolerance, aberration in the course structure.

**109.** A licensee shall in commissioning flight inspections of localizers and glide paths make them with all field monitors that can have a significant effect on the signal in space installed in their final positions.

Field monitors

**110.** (1) A flight inspection under these Regulations shall be made by an organisation having an ICAO contracting state approval for the specific category of ILS which is being inspected.

Flight  
inspection  
organisations

(2) A licensee who conducts any flight inspection by any organisation that does not have the approval referred to in subregulation (1) commits an offence and is liable to a fine set under these Regulations.

(3) Any flight inspection carried out in contravention of subregulation (1) shall be invalid.

**111.** A licensee shall carry out a flight inspection as required where certain types of air navigation services engineering work involving the aerial distribution unit, feeder cables, aerals or monitor-combining unit requires that the system be flight checked before being returned to service.

Inspection  
after  
engineering  
work

**112.** (1) A licensee shall analyse the flight inspection records and inform the Authority of any deficiencies in the performance of the navigation aids.

Analysis  
of flight  
inspection  
records

(2) With the approval of the Authority, a licensee may delegate the task of examining the flight inspection records to a specialist organisation and this may be the same organisation that makes the flight inspection.

**113.** A person who carries flight inspection shall ensure that the results conform to the limits given in Forms D, E and F set out in Schedule 3.

Flight  
inspection  
limits

**114.** (1) An instrument rated pilot shall at commissioning and on an annual basis, check the final turn onto all Instrument Approach Procedures.

Promulgated  
procedure

(2) An instrument rated pilot referred to in subregulation (1) shall during the check, observe any other navigational aids that are used to support the procedure to ensure that any navigational signals used as part of the procedure, position the aircraft to allow the ILS to be correctly captured:

Provided that where several Instrument Approach Procedures follow the same path only one flight shall be checked.

(3) The instrument rated pilot shall provide confirmation of the performance of the navigational aids used for the Instrument Approach Procedures and the licensee shall formally record this confirmation.

#### *(e) Marker Beacons*

**115.** (1) A licensee shall provide for two marker beacons in each installation.

General

(2) An additional marker beacon maybe added whenever, in the opinion of a licensee, an additional marker beacon is required because of operational procedures at a particular site.

(3) The marker beacons referred to in this regulation shall conform to the requirements prescribed in ICAO.

(4) A licensee shall, when the installation comprises only two marker beacons, observe the requirements applicable to the middle marker and to the outer marker.

(5) The marker beacons shall produce radiation patterns to indicate pre-determined distance from the threshold along the ILS glide path.

Radio frequency	<b>116.</b> The marker beacons referred to in regulation 115 shall operate at 75 MHz with a frequency tolerance of plus or minus 0.005 per cent and shall utilise horizontal polarisation.
Coverage	<p><b>117.</b> (1) A licensee shall adjust the marker beacon system to provide coverage over the following distances, measured on the ILS glide path and localizer course line —</p> <ul style="list-style-type: none"> <li>(a) inner marker (where installed): 150 metres plus or minus 50 metres;</li> <li>(b) middle marker: 300 metres plus or minus 100 metres; and</li> <li>(c) outer marker: 600 metres plus or minus 200 metres.</li> </ul> <p>(2) The field strength of the marker beacons shall —</p> <ul style="list-style-type: none"> <li>(a) at the limits of coverage be 1.5 millivolts per metre (-82 dBW/m); and</li> <li>(b) within the coverage area rise to at least 3.0 milli-volts per meter (-76dBW/m).</li> </ul>
Modulation	<p><b>118.</b> (1) A licensee shall set the modulation frequencies of the marker beacons as follows —</p> <ul style="list-style-type: none"> <li>(a) inner marker 3000 Hz;</li> <li>(b) middle marker: 1300 Hz; and</li> <li>(c) outer marker: 400 Hz.</li> </ul> <p>(2) The frequency tolerance of the frequencies referred to in subregulation (1) shall be plus or minus two point five per cent, and the total harmonic content of each of the frequencies shall not exceed 15 per cent.</p> <p>(3) The depth of modulation of the marker beacons referred to in subregulation (1) shall be 95 per cent plus or minus 4 per cent.</p>
Identification	<p><b>119.</b> A licensee shall ensure that the carrier energy is not interrupted and the audio frequency modulation is keyed as follows —</p> <ul style="list-style-type: none"> <li>(a) inner marker: six dots per second continuously;</li> <li>(b) middle marker: a continuous series of alternate dots and dashes, the dashes keyed at the rate of two dashes per second, and the dots at the rate of six dots per second; and</li> <li>(c) outer marker: two dashes per second continuously and these keying rates shall be maintained to within plus or minus 15 per cent.</li> </ul>
Siting	<p><b>120.</b> (1) A licensee shall install the inner marker beacon in such a way that it indicates in low visibility conditions the imminence of arrival at the runway threshold.</p> <p>(2) A licensee shall, where the radiation pattern is vertical, place the inner marker between 75 metres and 450 metres from the threshold and at not more than 30 metres from the extended centre-line of the runway.</p> <p>(3) If the radiation pattern is other than vertical, a licensee shall place the equipment 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.</p> <p>(4) A licensee shall publish the positions of marker beacons, or where applicable, the equivalent distance indicated by the Distance Measuring Equipment when used as an alternative to part or all of the marker beacon component of the ILS in accordance with the provisions of ICAO.</p> <p>(5) When used in the manner referred to in subregulation (4), the Distance Measuring Equipment shall provide distance information operationally equivalent to that furnished by the marker beacon.</p> <p>(6) When used as an alternative for the middle marker, the licensee shall ensure that the Distance Measuring Equipment is frequency paired with the ILS localizer and sited so as to minimise the error in distance information.</p>

**121.** (1) A licensee shall provide suitable equipment which provides signals for the operation of an automatic monitor. Monitoring

(2) The monitor referred to in subregulation (1) 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.

*(f) Distance Measuring Equipment (DME) Transponders & Flight Inspection Requirements*

**122.** A licensee shall install Distance Measuring Equipment (DME) transponder equipment that does not radiate a signal which falls outside standard operating tolerances or provide false information over its Designated Operational Coverage area. Safety objective

**123.** (1) The DME transponder system referred to in regulation 122 shall comply with ICAO. System requirements

(2) A licensee shall ensure that the —

- (a) DME only transmits on the frequency assigned;
- (b) identification signal is suppressed when the DME is not available for operational service;
- (c) standby power supplies are provided, which are appropriate with the service being supported;
- (d) indication of change of status of equipment is given immediately by visual and audible means to the air traffic control personnel providing the approach control or aerodromes procedures; and
- (e) DME is sited to keep the triangulation error at the point at which the distance is required to a minimum.

**124.** (1) A licensee shall perform the DME flight inspection to ensure that the DME provides an accurate and uncorrupted source of range information within the Designated Operational Coverage. Distance Measuring Equipment (DME) Flight inspection

(2) A licensee shall assess the following parameters for the prescribed transponders whether they are within limits —

- (a) accuracy: the requirements shall be as provided in Form G set out in Schedule 3;
- (b) coverage: throughout the inspection whilst within the Designated Operational Coverage the DME receiver input shall not fall below -90dBm;
- (c) identification: the identification signal shall be clear throughout the flight inspection; additionally, where the indent is synchronised with other equipment, the correctness of the keying sequence shall be checked; and
- (d) performance: false unlocks and instances of interference shall be identified on the flight inspection report and investigated by the air navigation service provider and the appropriate rectification carried out.

**125.** (1) The intervals for flight inspection for the DME referred to in regulation 124 shall depend on the associated equipment. Flight inspection interval

(2) A licensee shall ensure that where there is no associated equipment, flight inspections are made on commissioning and in line with any flight inspection requirements of instrument flight procedures supported by the equipment.

Flight  
inspection  
organisation

**126.** (1) A flight inspection under these Regulations shall be made by an organisation having an ICAO contracting state approval for the specific category of DME which is being inspected.

(2) A licensee who conducts any flight inspection by any organisation that does not have the approval referred to in subregulation (1) commits an offence and is liable to a fine set under these Regulations.

(3) Any flight inspection carried out by an organisation that does not have approval shall be invalid.

Analysis of  
flight  
inspection  
records

**127.** (1) A licensee shall analyse the flight inspection records and inform the Authority of any deficiencies in the performance of the navigation aids.

(2) With the approval of the Authority, a licensee may delegate the task of examining the flight inspection records to a specialist organisation and this may be the same organisation that makes the flight inspection.

*(g) Requirements for Instrument Landing System (ILS)  
and Instrument Landing System Distance Measuring  
Equipment (ILS/DME) Identity Keying*

Key sequence

**128.** A licensee shall ensure that —

- (a) an associated ILS and DME radiate identity codes which positively identify their association;
- (b) when a DME is associated with an ILS in terms of subregulation (1), the identity keying of both systems shall be synchronized; and
- (c) complete keying sequence occupies approximately 40 seconds.

Master  
equipment

**129.** A licensee shall ensure that the DME or the ILS are used as the master identity keyer.

System  
operation

**130.** A licensee shall ensure that —

- (a) if at any time the master equipment fails, the slave equipment reverts to total independent keying;
- (b) if the master keyer is subsequently returned to service, the slave equipment shall automatically return to normal slave operation, with no requirement for manual resetting at the slave equipment;
- (c) when a localizer is acting as a slave to a DME, it shall key  $\frac{3}{4}$ ;
- (d) the DME keying shall be  $\frac{3}{4}$  synchronised to occur where there is an interval in the localizer keying;
- (e) if the DME fails, the air navigation service provider shall ensure that the localizer reverts to  $\frac{4}{4}$  keying with no gap where the DME identity would have been;
- (f) when a DME is slave to a localizer, it shall key  $\frac{1}{4}$  and if the localizer fails, the DME shall continue to key  $\frac{1}{4}$ ; and
- (g) regardless of which equipment is master or slave, a failure in one equipment does not leave the associated equipment without identity nor cause it to close down.

Independent  
operation

**131.** A licensee shall ensure that an ILS with no associated DME shall always key  $\frac{4}{4}$ .

**132.** A licensee shall ensure that if the DME identity code has an ‘I’ prefix, the DME continues to radiate this prefix if the associated localizer fails. Use of letter “I” prefix

**133.** A licensee shall suppress the identity keying whenever the equipment is not available for operational use. Equipment out of service

*(h) Requirements for Conventional and Doppler VHF OmniDirectionalRadio Range (CVOR/DVOR) Beacons*

**134.** (1) A licensee shall ensure the Very High Frequency OmniDirectional-Radio Range (VOR) beacon systems is installed in compliance with ICAO SARPs. System requirements

(2) A licensee shall ensure that —

- (a) the VOR beacons referred to in subregulation (1) only transmits on the frequency assigned;
- (b) the beacon accuracy is a measurement distance of four wavelengths from the centre of a CVOR beacon and the equivalent measurement position for a DVOR is 300 meters from the centre of the DVOR;
- (c) the Designated Operational Coverage is determined as part of a standard flight check during the commissioning of the VOR;
- (d) the identification is suppressed when the VOR is not available for operational purposes;
- (e) with the exception of Automated Terminal Information System (ATIS), no other voice communication channel shall be transmitted through the VOR system;
- (f) standby power supplies is provided commensurate with the service being supported;
- (g) the indication of change of status of equipment is given without delay by visual and audible means to the air traffic control personnel providing approach control or aerodrome control functions that use the VOR for published final approach procedures; and
- (h) flight inspection is carried out to ensure that the VOR provides an accurate and uncorrupted source of guidance information within the Designated Operational Coverage.

*(i) VHF OmniDirectionalRadio Range (VOR)  
Flight Inspection Requirements*

**135.** A licensee shall ensure that during commissioning and routine inspection the parameters in Form H set out in Schedule 3 are measured for all available transmitters and are within limits. Parameters to be measured

**136.** (1) A licensee shall have a reference checkpoint which is — Measurement method

- (a) selected during the commissioning inspection at a point in space where the signal is stable;
- (b) used in establishing course alignment, 30 Hz Modulation Depth, 9960Hz Modulation Depth and Field Strength to be recorded on the Flight Inspection report; and
- (c) recorded in terms of azimuth, distance from the facility, and the mean sea level (MSL) altitude.



(2) The mean alignment referred to in subregulation (1) shall be determined by flying a 360 degree orbit of the VOR and the altitude selected for the flight shall place the aircraft in the main lobe of the VOR.

(3) A licensee shall ensure that —

- (a) alignment is recorded at the reference check point;
- (b) bends are determined on all flown radials;
- (c) roughness and scalloping shall be determined on all flown radials;
- (d) coverage is measured as close to the edge of DOC as possible whilst flying either a radial or an orbit; and
- (e) field strength is recorded at the reference check point.

(4) A licensee shall ensure that —

- (a) at commissioning useable signals are established by two level flights, separated by approximately 90 degrees;
- (b) the modulation 30Hz and 9960Hz: the mean modulation depth is determined by flying a 360 degree orbit of the VOR and the altitude selected for the flight shall place the aircraft in the main lobe of the VOR;
- (c) that the modulation is recorded at the reference check point;
- (d) the voice is checked as close to the edge of Designated Operational Coverage whilst flying either a radial or an orbit;
- (e) the identification is checked as close to the Designated Operational Coverage as possible whilst flying either a radial or an orbit;
- (f) that the polarization: the vertical polarization effect is checked when flying a radial at a distance of 18.5 to 37 km (10 to 20 NM);
- (g) the aircraft is rolled to a 30 degree bank, first to one side, then to the other, and returned to a straight level flight;
- (h) track and heading deviations are kept to a minimum; and
- (i) the course deviation, as measured on the recording, is the indication of vertical polarization effect.

Profiles to  
be checked

**137.** (1) A licensee shall ensure that the profiles to be checked and the frequency of light inspection are in accordance with Form I set out in Schedule 3.

(2) A licensee shall ensure that a selection of radials, which support Instrument Flight Procedures other than Instrument Approach Procedures are inspected.

(3) The selection referred to in subregulation (2) shall be based on the —

- (a) areas of poor performance indicated by the orbit inspection;
- (b) any radials where the coverage may be affected by terrain;
- (c) one radial selected from each quadrant; and
- (d) the longest and lowest radials.

(4) A licensee shall —

- (a) evaluate the instrument approach procedures radials at a distance that includes the procedure turn, holding pattern and missed approach on commissioning inspections;
- (b) Ensure that the approach radials are flown 30m (100ft) below specified altitudes;
- (c) ensure that cross check radials are checked during radial inspection;
- (d) ensure that adjacent facilities that provide intersections are inspected to determine their capability to support the intersection; and
- (e) ensure that minimum signal strength exists for the radial forming the intersection within 7.4 km (4 NM) or 4.5°, whichever is greater, each side of the geographical location of the intersection fix.



**138.** A licensee shall conduct successive flight inspections for VOR facilities, at twelve months intervals.

Flight  
inspection  
interval

**139.** (1) A licensee shall analyse the flight inspection records and inform the Authority of any deficiencies in the performance of the navigation aids.

Analysis of  
Flight  
Inspection  
Records

(2) A licensee may, with the approval of the Authority, delegate the task of examining the flight inspection records to a specialist organisation and this may be the same organisation that makes the flight inspection.

**140.** (1) A licensee shall install and maintain in operation, a DME, as a complement to a VOR at a location where for operational reasons, or because of air traffic control reasons such as air-traffic density or proximity of routes, there is a need for a more precise navigation service than that provided by VOR.

Associated  
VOR and  
DME

(2) The associated VOR and DME facilities referred to in subregulation (1) shall be collocated in accordance with the following —

(a) coaxial collocation: the VOR and DME antennas are located on the same vertical axis; or

(b) offset collocation:

(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 30m (1000 ft) except that, at Doppler VOR facilities, where DME service is provided by a separate facility, the antennas may be separated by more than 30m (100 ft), but not in excess of 80m (260ft); and

(ii) for purposes other than those indicated in 11.9.2 the separation of the VOR and DME antennas does not exceed 600m (2000 ft).

**141.** A licensee shall ensure that when associated with a VOR, DME coverage shall be at least that of the VOR to the extent practicable.

Coverage

**142.** A licensee shall ensure that the characteristics of the associated signal are as follows —

Identification  
of VOR/DME

(a) 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; and

(b) 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 identification, where this is provided, transmitted during the remaining periods.

*(j) Requirements for Medium Frequency (MF)  
Non-Directional Beacons*

**143.** A licensee shall install Medium Frequency (MF) non-directional beacon system that radiates a signal which complies with the standard operating parameters and provides correct guidance to users within its rated coverage.

Safety  
objective

**144.** (1) The non-directional beacons system referred to in regulation 143 shall comply with ICAO.

System  
requirements

(2) A licensee shall ensure that the MF equipment referred to in regulation 143 only transmits on the frequency assigned and the assigned frequency shall be maintained within  $\pm 0.01$  per cent.

(3) A licensee shall adjust the power output of the system to give vertical field strength of 70 micro-volts/meter at the limit of the rated coverage, and be maintained within tolerances of +2 dB and -3 dB.

(4) A licensee shall ensure that the identification modulation of the system is by on/off keying of an amplitude modulating tone.

- (5) A licensee shall —
- (a) ensure that each non-directional beacon is individually identified by a two or three letter International Morse Code group as assigned and transmitted at a rate corresponding to approximately seven words per minute and the complete identification shall be transmitted at least three times in each 30 second period, equally spaced within that period;
  - (b) suppress the facility identification for operational purposes when the non-directional beacon is not available;
  - (c) ensure that the frequency of the modulating tone for identification shall be 400 Hz  $\pm$ 25 Hz;
  - (d) ensure that the carrier power of a non-beacon modulation during modulation shall not fall by more than 0.5 dB when the identification signal is being radiated;
  - (e) provide an executive site monitor to switch off the equipment in use and, if applicable, change over to the standby system in less than one minute if —
    - (i) there is a change in radiated carrier power of more than +2 dB or -3 dB to that required for the rated coverage, or
    - (ii) a malfunction or failure of the means of self-monitoring of executive parameters occurs;
  - (f) ensure that a non-executive alarm is generated within three minutes, if the non-directional beacon fails to transmit the correct identification code;
  - (g) give an indication of change of status of equipment by visual and audible means to the air traffic control personnel providing approach control or aerodrome control functions that use the non-directional beacon;
  - (h) ensure that a non-directional beacon is provided with suitable power supplies and means to ensure continuity of service appropriate to the needs of the service provided;
  - (i) regularly record the field strength of non-directional beacons, as measured at a remote location;
  - (j) ensure that remote measurement of field strength takes place at any point where the non-directional beacon ground wave is consistently established; and
  - (k) ensure that measurement of field strength at a non-rated range remote location is acceptable if correlation to measurement at rated range is traceable.

Flight  
inspection

**145.** (1) A licensee shall ensure that commissioning flight inspections are made by an approved organisation for flight inspection of non-directional beacons.

(2) A local pilot may conduct annual flight inspections and the pilot shall provide confirmation of the performance of the non-directional beacons as described in Form J set out in Schedule 3 and a licensee shall formally record this confirmation.

(3) The pilot referred to in subregulation (2) shall consider the yawing motion of the aircraft when inspecting the non-directional beacon.

Parameters to  
be measured

**146.** A licensee shall ensure that during commissioning an annual flight inspection referred to in regulation 145 (2), the appropriate parameters in Form J set out in Schedule 3 are measured and are within limits.

PART VI — *Surveillance**(a) Radar System Requirements*

**147.** A licensee shall identify the technical and operational responsibilities for radar equipment and systems and —

Identification  
of  
responsibilities

- (a) designate an entity in charge of the safety management system as an appropriate contact, through which the Authority shall channel request for data and information; and
- (b) produce figures (drawings and graphics) of how the function of the radar equipment is to fit within air traffic control environment and from such figures determine the following aspects —
  - (i) the required reliability and integrity of the system,
  - (ii) maintainability requirements of such mean time to repair (MTTR),
  - (iii) degree of design assurance required,
  - (iv) accuracy and resolution requirements of the system,
  - (v) coverage requirements,
  - (vi) data handling capacity, and
  - (vii) target level of safety (TLS) for the operational service.

**148.** (1) A licensee shall protect the radar system site with criteria which are derived from the following as a minimum —

Radar system  
site protection

- (a) operational range;
- (b) base of coverage;
- (c) operational usage; and
- (d) equipment manufacturer's recommended clearances to prevent degradation in the system's performance.

(2) The criteria for protection referred to in subregulation (1) shall include the following for all radar systems —

- (a) a Sterile Zone around the antenna to permit clean, uninterrupted beam formation;
- (b) a safeguarded slope shall be defined around the system which shall assure the system's performance such that it continues to support the operational requirement; and
- (c) consideration of the construction, shape, location, orientation and materials used in any application.

(3) For purposes of subregulation (2) (a) and (b), a licensee shall identify the Sterile Zone and protect the slope by diagram coverage with a detailed text description.

**149.** A licensee shall ensure that the protected radar system site covers the airport boundary from ground level.

Surface  
Movement  
Radar

**150.** A licensee shall not commence operations until the Authority has conducted a site inspection to check the level of compliance with the safety requirements.

Post  
installation

*(b) General Requirements for Flight Trials*

## Flight trials

**151.** (1) A licensee shall, before commencing operations conduct a flight trial to confirm that the radar achieves its operational requirements set out in its manual.

(2) A licensee shall —

(a) confirm the system performance as defined in the operational requirements set out in its manual using an aircraft ‘target’ and a general traffic study; and

(b) as the system provides a large coverage volume, conduct tests to prove the basic volume with detailed analysis in operationally significant areas.

(3) The significant area referred to in subregulation (2) (b) shall include, as appropriate —

(a) radar hand over areas;

(b) holding areas;

(c) typical airway routes;

(d) areas with clutter or reflection problems;

(e) upper and lower bounds of operational cover; and

(f) the approach.

(4) The flight trial referred to in subregulation (1) shall include —

(a) standard manoeuvres and manoeuvres that test the boundaries of allowable procedures;

(b) assessment of the radar sensor in all the configurations intended for operational use and such configurations may include main or standby transmitters, diversity or non diversity and polarization settings; and

(c) dedicated flying and a general traffic study and determine the accuracy and resolution of the system.

## Coverage check

**152.** (1) The flight trial referred to in regulation 171 shall contain an appropriate series of manoeuvres and transition levels to demonstrate the vertical lobe structure of the radar and these shall include manoeuvres at 1000, 2000, 4000, 6000, 10000, 20000 and 30000ft above the aerodrome reference point and as appropriate to the operational requirements.

(2) A licensee shall —

(a) when conducting flight trials carry out a 360-degree orbit at a suitable range at a level equivalent to the base of required coverage and any tangential fade shall be recorded; and

(b) record and analyse target returns registered in each block of airspace in order to identify areas of anomalous replies.

*(c) General Accuracy Requirements*Accuracy  
assessment

**153.** (1) A licensee shall conduct a flight trial to assess the accuracy of the system in the areas of operational significance and the errors in the collection and recording of data shall be calculated and justified and these may include —

(a) the resolution error in any recording devices; and

(b) the error in the equipment used to determine the aircraft position.

(2) The flight trial referred to in subregulation (1) shall produce at least five error profiles in each of the following areas —

- (a) the approach;
- (b) each holding area; and
- (c) each radar handover area.

(3) The flight trial referred to in subregulation (1), shall be conducted in areas requiring separation standards, and shall demonstrate that the appropriate Target Level of Safety (TLS) can be achieved for the required separation standards.

**154.** (1) For radar approach procedures, a licensee shall carry out the following accuracy assessment for any radar intended for use —

- (a) angular error shall be less than  $\pm 1$  degree; and
- (b) range error shall be less than  $\pm 55 + 0.05R$  meters where 'R' is the range of the respective range check point.

(2) A licensee shall —

- (a) for each surveillance radar approach procedure intended, carry out a minimum of 10 aircraft or helicopter tracked approaches;
- (b) where 3 NM surveillance radar approach is proposed, for each approach the target position record at threshold, 0.5 NM, 1 NM, 2 NM, 3 NM, 4 NM and 5 NM from touchdown and compared against the controller reported position; and
- (c) for surveillance radar approaches terminating at 5NM or greater, for each approach the target position record at 0.5 NM, 1 NM, 2 NM, 3 NM, 4 NM and 5NM from touchdown and compared against the controller reported position.

(3) A licensee shall, as part of the flight trial, carry out an assessment of maps and Permanent Echoes (PE), to confirm the accuracy of the video maps and Permanent Echoes (PE).

(4) The Permanent Echoes (PE) referred to in subregulation (3) shall be selected taking the following factors into account —

- (a) there shall be at least 3 Permanent Echoes (PE), each separated by more than 60 degrees; and
- (b) each Permanent Echo (PE) —
  - (i) shall not extend over more than 2 degrees of bearing,
  - (ii) shall be at least 5 degrees away from other fixed clutter, and
  - (iii) shall be at greater than one third the standard displayed range.

(5) A licensee shall use the flight trial to assess the resolution capability of the system in terms of the minimum separation standards as required in the operational requirements set out in its manual.

(6) A licensee shall evaluate the resolution capability of the system in both 'standard' areas and areas of clutter and reflections.

**155.** (1) A licensee shall establish a comprehensive training program for all technical staff involved in radar maintenance activities.

(2) A licensee shall ensure that —

- (a) each technician is competent and holds the qualifications appropriate to maintain the radar equipment and in particular, the air navigation service provider shall ensure that each technician has been appropriately trained and assessed as competent through a formal approved process; and
- (b) a periodic and comprehensive training plan is developed to ensure that each technician maintains the appropriate level of qualification not exceeding 12 months.

Accuracy  
assessment  
for radar  
approach

Technician  
qualifications

*(d) Radar Sensor Requirements*

Compliance with  
ICAO Annex 10

**156.** A licensee shall use a Secondary Surveillance Radar (SSR) system, including Mode S and surveillance system utilising Mode S Extended Squitter which comply with the ICAO.

Site  
requirements

**157.** (1) A licensee shall after installing equipment, assess possible side effects and their impact on coverage.

(2) For purposes of subregulation (1), a licensee shall —

- (a) show local site obstructions which acceptable for the required coverage and operational requirements;
- (b) shall provide by a 360 degree representation giving the elevation (in degrees) of any obstruction versus bearing and a 'line of sight' coverage chart for several target heights based on these radar obstructions and using the radar earth curvature;
- (c) restrict access to the radar and associated equipment such that the availability of the air traffic service is not compromised accidentally or intentionally;
- (d) justify the aerial stability limits allocated to the tower and analyse the tower structure to show that limits are met at the stated operating wind speed, ice loading, hail and sand storm;
- (e) construct the aerial support structure such that it can survive the excesses of once in 50 years wind speed;
- (f) ensure that the design and testing regime that the equipment operates as required in the chosen environment; and
- (g) ensure that all radar transmission equipment is located in a controlled environment with appropriate heat dissipation and dust control.

*(e) Primary Frequency Bands*

Transmitter  
requirements

**158.** (1) A licensee shall ensure that the following primary frequency bands are used for a primary frequency transmitter —

- (a) 590 MHz to 598 MHz (50 cm) medium/long range radar services;
- (b) 1215 MHz to 1365 MHz (23 cm) medium or long range radar services;
- (c) 2700 MHz to 3100 MHz (10 cm) short: medium range radar services;
- (d) 9000 MHz to 9200 MHz and 9300 MHz to 9500 MHz (3 cm) short range radar services;
- (e) 15.4 GHz to 15.7 GHz (GMR) very short range radar services; and
- (f) 34.5 GHz to 35.5 GHz (ASMI) very short range radar services.

(2) A licensee shall apply the following stability tolerances in a primary frequency bands —

- (a) Frequency Band Stability Tolerance;
- (b) 90 MHz–1365 MHz within 500 ppm;
- (c) 2700 MHz–9500 MHz within 1250 ppm; and
- (d) 15.4 GHz–35.5 GHz within 5000 ppm.

- (3) A licensee shall ensure that —
  - (a) a practical trial of ageing effects undertaken shows that the inspection intervals are consistent with the required stability;
  - (b) the frequency of the SSR transmitter is 1030 MHz;
  - (c) the output transmitter carrier frequency has a tolerance of  $\pm 0.2$  MHz;
  - (d) the carrier frequencies of the control transmissions and each of the interrogation transmissions do not differ from each other by more than 0.2 MHz and the polarization of the interrogation, control and reply transmissions are predominantly vertical;
  - (e) the transponder output carrier frequency tolerance (ground to air or from SSR site monitor) are  $\pm 3$  MHz;
  - (f) for primary radar, the level of any spurious component shall be either 50 dB down on the mean power in bandwidth or less than 100 mW, whichever results in the least spurious output;
  - (g) the bandwidth used is justified;
  - (h) for SSR, the spurious radiation of CW does not exceed -76 dBW;
  - (i) the existing electromagnetic environment in which the equipment is to operate is assessed to ensure that the proposed equipment will comply with all requirements;
  - (j) after installation, new service experiences interference from an existing service, modification of the new service take place normally; and
  - (k) all reasonable steps are taken to reduce the effect of interference.

**159.** A licensee shall ensure that —

- (a) all spurious return reduction techniques are defined and justified; and
- (b) for SSR the response of SSR ground equipment to signals not within the receiver pass band are at least 60dB below the normal sensitivity.

Spurious  
Return  
Reduction

*(f) Accuracy*

**160.** (1) A licensee shall ensure that when used for surveillance radar approach purpose, the accuracy of a radar system shall be better than 1 degree of bearing and 55 meters, +5 per cent of target range.

General

(2) A licensee shall ensure that when used for radar separation, the intended minimum separation standard of a radar system is justified.

(3) A licensee shall ensure —

- (a) that the radar systems that produce the radar data used for separation is assessed;
- (b) that for remote SSR used in conjunction with a local primary the following errors are assessed —
  - (i) error in slant range correction, if applied,
  - (ii) error in prediction of position due to differing scans rates,
  - (iii) error due to the curvature of the earth when transferring the centre of one volume to another centre,
  - (iv) stability and accuracy of original plots,
  - (v) tolerance error in detected position of site marker;
  - (vi) provision of secondary surveillance radar (SSR) or primary marker; and
  - (vii) allowable error in combination box.

- (c) that the error in range and bearing between the following are less than  $\pm 2$  degrees in azimuth and  $\pm 3$  per cent of target range —
  - (i) the aircraft position reported by SSR and primary radar,
  - (ii) the reported SSR monitor position and the video map, and
  - (iii) the reported SSR monitor position and the known monitor position.
- (d) that —
  - (i) the maximum time in store for the radar data does not exceed the time taken for 90 degrees of aerial rotation,
  - (ii) the algorithm chosen to determine the centre and run time of the target is defined and justified,
  - (iii) the effect of the plot extractor on resolution and the accuracy error budget together with theoretical justification shall be defined,
  - (iv) the processing precision is sufficient to meet the error budget for the system accuracy and resolution,
  - (v) if plot processing is used, any effect on detection is defined and justified,
  - (vi) the position of the radar relative to the coverage volume desired is justified,
  - (vii) the distribution of any misalignment errors between two sensors shall be justified,
  - (viii) where two sensors are not co-sited the analysis includes the position conversion error,
  - (ix) a system beam width plot  $\pm 10$  degrees off bore-sight or 40dB down on peak power, whichever the plot reaches first, is developed,
  - (x) in systems that rely on multiple beam patterns, the plot shows the interaction of the beam patterns,
  - (xi) in systems that have user adjustable beam width, methods recommended for the assessment of changes are stated,
  - (xii) demonstration of the beam patterns is carried out on a test range,
  - (xiii) the effect of beam width on accuracy, resolution, system loading and garbling shall be defined and justified, and
  - (xiv) the effect of rotation rate on system performance shall be defined and justified; and
- (e) that primary radar providing the positional data for the following services rotates at the following effective minimum turning rates —
  - (i) General TMA Zone and approach work, a rotation rate of 5 RPM,
  - (ii) surveillance radar approach (SRA) to 2 NM, a rotation rate of 10 RPM,
  - (iii) surveillance radar approach (SRA) to 1 NM, a rotation rate of 15 RPM, and
  - (iv) surveillance radar approach (SRA) to 0.5 NM, a rotation rate of 20 RPM.

## Resolution

**161.** A licensee shall ensure that for 3 NM separation the equipment resolves two targets at 1 NM separation and for 5 NM separation the equipment resolves two targets at 3 NM, both to a probability of 95 per cent or greater throughout the required azimuth and range as defined in the operational requirements of its manual.



*(g) Coverage*

**162.** A licensee shall ensure that —

General

- (a) the radars have a theoretical coverage, in the areas of the operational requirements, which corresponds to 80 per cent detection of the returns from a 1m target and this increases to 90 per cent for areas providing surveillance radar approach procedures;
- (b) for primary targets the theoretical cover assumes swirling case 1 targets;
- (c) the primary and secondary surveillance radar (SSR) sensors have their performance continuously monitored and a NOTAM is issued when coverage cannot be met, and
- (d) where the use of the primary radar system includes Surveillance Radar Approaches the coverage is suitable for the termination distance.

**163.** (1) A licensee shall ensure that —

SSR Coverage

- (a) for services that use SSR for separation purposes, a formal coverage specification whose output power of SSR or primary radar does not exceed the approved level is constructed;
- (b) for the secondary radar system, define details of the link power budget shall be defined and this link budget shall show that the system achieves coverage in both range and elevation;
- (c) where interrogation side lobe suppression (ISLS) is used, the amplitude of P2 shall be between 0dB and +3dB above the nominal greatest side-lobe level and the amplitude of P2 is greater than 9dB below the nominal level of P1 in the main beam;
- (d) where improved interrogation side-lobe suppression (IISLS) is used, in addition to the requirements, the level of P1 is within 3dB of P2;
- (e) the control channel response shall be greater than 3dB above the response of the interrogator channel outside the nominal bore-sight angle for receiver side-lobe suppression (RSLs);
- (f) the pulse spacing complies with ICAO;
- (g) that the Reply Transmission Characteristics (SIGNALS-IN-SPACE) complies, where appropriate, with ICAO; and
- (h) that the Interrogator and Control Transmission Characteristic complies with ICAO.

(2) A licensee shall —

- (a) where the equipment uses reflection suppression, the effects of reflection suppression on system performance are defined and justified; and
- (b) justify the de-garble capacity and performance of SSR extractors for the amount of traffic and the separation standard required.

*(h) Data Storage Capacity*

Data handling  
requirements

**164.** A licensee shall —

- (a) adhere to the operational requirements required for processing load in terms of —
  - (i) the number of aircraft targets expected based on overall load and sector peaks,
  - (ii) the worst case weather conditions,
  - (iii) any roads within the radar coverage, and
  - (iv) any fixed clutter patterns;
- (b) ensure that during operational trials the equipment monitors the processor and memory loading distribution of each sub-system;
- (c) ensure that the probability of 100 per cent processing load in any sub-system is less than 0.01;
- (d) ensure that the data precision used is consistent with the positioning performance required from the system;
- (e) ensure that the ASTERIX format is used for data interchange;
- (f) ensure that the system data achieves the required operational level of integrity;
- (g) ensure that the equipment contains error detection systems to ensure appropriate data integrity during operation;
- (h) ensure that any radar data processing equipment connected to the sensor can correctly identify the source of the data, the chosen data transmission standard supports source identification; and
- (i) ensure that the identification codes are unique.

Radar recording

**165.** A licensee shall ensure that any radar service used is fitted with radar recording equipment.

Default  
parameters

**166.** A licensee shall ensure that all default values of the recording equipment are stated.

Monitoring  
requirements

**167.** A licensee shall ensure that —

- (a) all radar systems have methods available to determine the alignment;
- (b) for analogue primary radar the system uses appropriate video outputs to check the range or bearing error based on Permanent Echoes (PE);
- (c) the system identifies at least three Permanent Echoes (PE), each separated by more than 60 degrees;
- (d) each Permanent Echo (PE) is at a range greater than one third of the standard display range and in addition the separation of each Permanent Echo (PE) from other permanent features at least 3 degrees in azimuth and  $\pm 0.5$  nautical miles in range;
- (e) where an analogue only channel is not provided and therefore Permanent Echoes (PE) cannot be displayed, an active test target (MTI runway marker) is used for alignment checking;
- (f) the position of any active test target (MTI runway marker) is as near to threshold as practical; and
- (g) the SSR site transponder and monitoring system monitors those radar parameters which affect detection, performance, accuracy or resolution.

**168.** (1) A licensee shall inform all air traffic service units of the operational status of the Remote Control and Monitoring System (RCMS) equipment used for controlling take-off, departure and approach to land.

Remote  
Control and  
Monitoring  
System  
(RCMS)

(2) The RCMS referred to in subregulation (1) shall report any failures that will put restrictions on the performance or abilities of the equipment.

(3) A licensee shall —

- (a) where a failure of a sub-system occurs, use the RCMS or the manual reporting system to record a hard copy of the event indicating, where possible, the cause of the event;
- (b) ensure that, the RCMS information, at a minimum, provides an indication of present operating configuration and of unavailable sub-systems;
- (c) ensure that the RCMS enables the operator to select the correct course of action; and
- (d) ensure that any configuration changes undertaken by remote control do not conflict with local control.

*(i) Reliability*

**169.** A licensee shall ensure that —

General

- (a) the reliability of the radar sensor as per the operational requirements shall be justifiable;
- (b) the expected reliability either from theoretical analysis or a practical trial is demonstrated and this reliability assessment extends to the power supplies and communication lines;
- (c) the reliability analysis is combined with a hazard analysis to produce a functional based reliability analysis; and
- (d) the reliability assessment states the method chosen and the chosen environment.

**170.** (1) A licensee shall specify and justify the mean time to repair (MTTR) system.

Mean Time  
to Repair  
(MTTR)

(2) When operating in reduced redundancy a licensee shall show that adequate safety mechanisms exist, including —

- (a) equipment identifies that no standby is available;
- (b) maintenance procedures identify the priority for repair that must occur; and
- (c) operating procedures identify the smooth transition to another service type in the case of loss of remaining equipment.

(3) A licensee shall —

- (a) ensure that the documentation and skills, training necessary to achieve repair times are defined; and
- (b) justify the maximum time taken to establish full operating conditions following a power supply interruption.

*(j) ATC Data Links*Data Links  
requirements

**171.** (1) A licensee shall perform a comprehensive safety assessment of the data link application or system and its interfaces with existing air traffic control (ATC) equipment, people and procedures.

(2) Where the safety assessment conducted in terms of subregulation (1) concludes that the data link system is at least tolerably safe, then the use of private data link networks shall be permitted for the following categories of communications messages —

- (a) meteorological communications;
- (b) flight regularity communications;
- (c) aeronautical information service messages; and
- (d) network or systems administration.

(3) Communications in categories assigned a higher priority than those in subregulation (2) may be permitted if the licensee proves to the Authority in addition to the safety assessment that —

- (a) the application is not time critical; and
- (b) procedures exist for ensuring that the failure of data link systems has no long term, short term, or immediate effect on the ability of the aircraft or air traffic service unit (ATSU) to complete the communication at an appropriate time.

Operational  
requirements

**172.** A licensee shall ensure that —

- (a) its data link system is compliant with its operational requirements;
- (b) the operational requirements form the basis for the collection of evidence that the stable implementation of the system is suitable for operational service;
- (c) the operational requirements include performance and safety requirements pertinent to the system concerned; and
- (d) the operational requirements specifically reference any security needs pertinent to the system concerned.

## Compatibility

**173.** A licensee shall ensure that —

- (a) any data link system which supports existing functionality is backwards compatible with any existing air traffic control methods, procedures and equipment which currently provide all or part of the service for which it is designed;
- (b) any incompatibilities are identified, and an impact assessment is performed on the ability of the revised systems and procedures to meet the operational requirements of all air traffic service units using the data link system; and
- (c) The data link system is compatible with all levels of aircraft equipment normally expected to be present in the air traffic service unit's operational area of interest.

*(k) Transponder and Communication Protocols*

- 174.** For purposes of this Part, “transponder” means a receiver and transmitter which generate a reply signal upon interrogation. Definition
- 175.** (1) A licensee shall ensure that a transponder responds to Mode A and Mode C interrogations in accordance with the provisions of ICAO. Requirements
- (2) A transponder referred to in subregulation (1) shall be capable of generating 4096 reply codes conforming to the characteristics given in ICAO.
- (3) A licensee shall —
- (a) establish procedures for the allotment of secondary surveillance radar (SSR) codes in conformity with regional air navigation agreements, taking into account other users of the system;
  - (b) reserve the following Mode A codes for special purposes —
    - (i) code 7700 to provide recognition of an aircraft in an emergency,
    - (ii) code 7600 to provide recognition of an aircraft with radio communication failure, and
    - (iii) code 7500 to provide recognition of an aircraft which is being subjected to unlawful interference;
  - (c) make appropriate provisions in ground decoding equipment to ensure immediate recognition of Mode A codes 7500, 7600 and 7700;
  - (d) reserve Mode A code 2000 to provide recognition of an aircraft which has not received any instructions from air traffic control units to operate the transponder;
  - (e) ensure that for systems having only Mode A and Mode C capabilities, the carrier frequency of the interrogation and control transmissions is 1030 MHz and the frequency tolerance is plus or minus 0.2 MHz;
  - (f) ensure that the carrier frequencies of the control transmission set under subparagraph (e) and of each of the interrogation pulse transmissions do not differ from each other by more than 0.2 MHz;
  - (g) set reply carrier frequency (air-to-ground) of the reply transmission at 1090 MHz and the frequency tolerance at plus or minus 3 MHz;
  - (h) ensure that polarization of the interrogation, control and reply transmissions are vertical;
  - (i) ensure that the interrogation modes and control transmission characteristics the interrogation modes, control transmission and technical characteristics of transponders comply with the provisions of ICAO;
  - (j) ensure that secondary surveillance radar (SSR) Mode S transponders are capable of recognising the following distinct types of interrogations —
    - (i) Modes A and C,
    - (ii) Inter-mode, and
    - (iii) Mode S.

*(l) Secondary Surveillance Radar (SSR) External Monitors Requirements*

- 176.** A licensee shall ensure that the external monitor provides accurate reference information to test the transmission, reception and decoding characteristics of the secondary surveillance radar (SSR) service in conjunction with the range and azimuth accuracy of the ground interrogator. Safety objective

Functional  
requirements

**177.** A licensee shall —

- (a) if the secondary surveillance radar (SSR) service is to be used without primary radar, provide an external site monitor; and
- (b) ensure that the external monitoring equipment continuously monitors those radar parameters which affect detection performance, accuracy or resolution and shall include the following parameters —
  - (i) target bearing,
  - (ii) target range,
  - (iii) peak power,
  - (iv) side lobe suppression, and
  - (v) pulse spacing.

Sitting  
requirements

**178.** A licensee shall ensure that —

- (a) where the controller uses the monitor to assess collimation errors the monitor shall be sited within the range that the air traffic service (ATS) operators can view;
- (b) the bearing chosen shall correspond to an area of airspace commensurate with operational situation and the position shall not conflict with operationally sensitive areas;
- (c) where an equipment sub-system, under the control of the user, uses the monitor to assess collimation errors, the monitor shall be within the nominal coverage of the radar;
- (d) where a sub-system, not under the control of the user, uses the monitor to assess collimation errors, the monitor shall be within the nominal coverage of the radar;
- (e) if the monitor position is outside the normal defined area displayed to the remote controller, a reporting procedure shall be in place and this procedure shall report alarms from the system provider to the service user;
- (f) the originator of the service, not the remote user, shall identify and notify the remote users of any collimation errors determined;
- (g) the secondary surveillance radar (SSR) monitor shall be located at a range greater than 4 km from the radar head, unless otherwise justified;
- (h) the monitor shall be set up to report its true position in range;
- (i) where operational considerations make this undesirable, the monitor shall not be visible from any other operational radar service; and
- (j) the Mode A code for the secondary surveillance radar (SSR) Site Monitor shall be 7777 unless specific approval is granted for a different code.

*(m) Primary Approach Radar Markers Requirements*

Marker  
requirements

**179.** A licensee shall ensure that any radar fitted with a processor to extract fixed clutter will not see passive targets, therefore, one of the following shall be provided —

- (a) a raw radar feed for calibration purposes independently aligned with the processed radar feed;
- (b) an active test marker; or
- (c) areas of radar coverage which are inhibited from processing.

**180.** A licensee shall —

- (a) provide non-permanent centreline markers —
  - (i) within 2 degrees of the applicable approach centerline, and
  - (ii) between 3 and 6 NM of the applicable touchdown point;
- (b) site the bracket marker as follows —
  - (i) two permanent markers available that enable the identification of the runway touchdown point,
  - (ii) the permanent markers shall be positioned equidistant from the runway centerline at the instrument touchdown point, and
  - (iii) the distance from the runway edge shall be the minimum commensurate with runway operations but not closer than 15 metres from the runway edge.

Additional  
marker  
requirements

**181.** (1) A licensee shall use sets of markers that allow the controller to confirm the correct position of the surveillance radar approach line.

Use of  
markers

- (2) The marker system referred to in subregulation (1) shall —
  - (a) contain an active monitor that checks the primary radar performance; and
  - (b) shall be used to evaluate —
    - (i) primary radar spectrum,
    - (ii) primary radar power level, and
    - (iii) primary radar beam width.

*(n) Radar Display Requirements*

**182.** A licensee shall assess the following in order to determine suitability for the operational requirement —

Display  
characteristics

- (a) screen area and corresponding display range;
- (b) the number of display lines: the number of lines shall be greater than 1000 \* 1000;
- (c) linearity and screen astigmatism;
- (d) frame refresh rate: frame refresh shall be 75 Hz (or greater), non-interlaced;
- (e) section of synthetic phosphor decay;
- (f) ability to display status information;
- (g) the chosen display brightness and luminance and the variation;
- (h) the ambient lighting; and
- (i) the colour set.

*(o) Symbolology*

**183.** A licensee shall select a suitable equipment that does not display any symbol indicating the position of particular filtered targets.

General

**184.** A licensee shall ensure that the equipment referred to in regulation 183 —

Display  
characteristics

- (a) draws the attention of the controller by flashing the associated label if it detects one of the following emergency codes—
  - (i) 7700 : Emergency,
  - (ii) 7600 : Radio Failure, or
  - (iii) 7500: Unlawful Interference;
- (b) displays both the emergency code and the previous call-sign or code if uncovered;
- (c) does not display a symbol that varies with displayed range; and
- (d) provides leader lines where the display automatically moves the labels to various positions;

*(p) Design*

## General

- 185.** A licensee shall ensure that —
- (a) the display specification is related to the operational requirement both infunctional and performance terms;
  - (b) allowable error budgets for the display system are calculated and justified; and
  - (c) the following parameters are specified and justified in relation to the operational requirements, technical specification and hazard analysis, as appropriate —
    - (i) resolution,
    - (ii) accuracy,
    - (iii) precision,
    - (iv) maximum and minimum,
    - (v) data load ('analogue' plus 'synthetic') and processing time,
    - (vi) MTBF,
    - (vii) MTTR,
    - (viii) Input type: Analogue, data formats, data transmission rates,
    - (ix) environmental performance,
    - (x) EMC performance,
    - (xi) quality standards applicable to equipment design, both hardware and software,
    - (xii) correct identification of radar source by validating radar source code, and
    - (xiii) identification of appropriate data input faults.

## Functional parameters

- 186.** A licensee shall —
- (a) ensure that the system is capable of showing the source of all data that the controller has selected for display on the radar display;
  - (b) if a remote SSR data source is used, ensure that the radar identification code decodes and displays on the screen; and
  - (c) indicate the region of the boundary where composite picture processing is being used.

## Display of QNH

- 187.** A licensee shall —
- (a) ensure that the display is capable of displaying the QNH values and any manual changes to these values shall be validated by double entry; and
  - (b) where it is possible to change the QNH remotely, ensure that necessary changes to the equipment are drawn to the controller's attention and confirmed on all displays.

## Target filtering

**188.** Where the radar equipment can filter out targets by area, type or height, a licensee shall ensure that the equipment is capable of displaying the parameters of such filters.

## Brightness

- 189.** A licensee shall —
- (a) restrict the brightness range, both overall and for individual screen elements, to the range determined in the colour assessment trial; and
  - (b) ensure that targets and map brightness are independently variable.



**190.** A licensee shall fit the equipment with facilities to record the data and display settings in accordance with these Regulations. Data recording facilities

(a) Aerodrome Traffic Monitors Safety Requirements

**191.** A licensee shall ensure that — Performance requirements

(a) the radar position displayed shall be within 0.5 NM of the true aircraft position;

(b) the radar used for display shall detect targets down to at least 200 feet below the minimum sector altitude; and

(c) in the runway approach zone, the radar shall detect targets down to 100 feet below the nominal glide angle to the terminating range.

**192.** A licensee shall ensure that — Functional requirements

(a) the system is capable of automatic adjustment of range and centre on runway change;

(b) the display shows the runway centreline;

(c) the system indicates ranges from the radar touchdown in 1 NM increments;

(d) the video map indicates the threshold position;

(e) handover procedure positively identifies all targets;

(f) the equipment shall resolve two targets at 1 NM separation;

(g) the labels shall not cross at 2 NM separations; and

(h) prediction vector or trail dots are used to indicate approach speed.

**193.** A licensee shall — Display

(a) install a screen size capable of displaying a circle of at least 6 inches (15cm) diameter;

(b) ensure that the display is readable in all ambient light conditions;

(c) ensure that the display is readable over a range of viewing angles, both vertically and horizontally;

(d) ensure that no colour is used for information coding; and

(e) ensure that where displays use colour for de-cluttering, the contrast control is not available in normal use (629).

(2) A licensee shall —

(a) position the aerodrome traffic monitor equipment so that the operational controller can easily note and act on the information shown; and

(b) where the operational controller has clearly defined and fairly narrow tasks to perform, the licensee shall ensure that the orientation is such that the runway on the aerodrome traffic monitors is aligned with the view of the runway from the control position.

#### *(r) Ergonomic Aspects of Radar Displays*

**194.** (1) A licensee shall carry out formal ergonomic evaluation to ensure that the safety of the air traffic services (ATS) is not compromised. Specification of the radar display

(2) In carrying out the evaluation referred to in subregulation (1), a licensee shall —

(a) in each case, assess the impact on air traffic control and justify it;

(b) define the activities that the system shall perform;

(c) define the events that can occur that require a cognitive or perceptive response;

(d) define the tasks that the system should accomplish in order to respond to the events and activities; and

(e) rank the tasks in order of priority according to the operational requirements.

## C.994

Functional  
and operational  
requirements

- 195.** A licensee shall ensure that —
- (a) the input device gives an immediate confirmation of selection;
  - (b) the selection time correlates with the priority level as follows —
    - (i) less than 1 second for high priority,
    - (ii) less than 5 second for medium priority, and
    - (iii) not defined for low priority;
  - (c) the system indicates its indeterminate state during the time between confirmation of activation and functional available.

### *(s) Input Devices Technical Requirements*

General

**196.** (1) A licensee shall ensure that input devices used are appropriate to the task, and confirm the consistent performance characteristics and facilities ease of use of these devices.

(2) In order to comply with subregulation (1), a licensee shall have regard of the following characteristics on all input devices on the workstation —

- (a) size of input device;
- (b) separation between input devices;
- (c) feedback method — aural, tactile or visual, as appropriate;
- (d) displacement;
- (e) labelling;
- (f) actuating force;
- (g) suitability of task; and
- (h) response time.

(3) A licensee shall ensure —

- (a) that the equipment does not use rotary selection switches to select more than 10 discrete positions;
- (b) the equipment does not use thumbwheels for high or medium priority controls;
- (c) non-tactile switches does not activate on the first activation;
- (d) equipment does not use lever switches to select more than 3 discrete positions;
- (e) all menus are appropriately positioned so as not to impede the primary task; and
- (f) all functions are by positive selection.

### *(t) Video Map General Equipment Requirements*

Tolerance  
on video  
map features

**197.** For a display used for surveillance radar approach (SRA), a licensee shall ensure that —

- (a) all features used in the surveillance radar approach (SRA) zone are accurate in within 5 per cent of range scale +55 metres (180 feet) in range and within 1 degree measured from the airfield reference point;
- (b) for raster scan display system, all features are accurate to within the resolution of the display; and
- (c) for all features accuracy is 450 meters (0.25NM).

New video  
maps

**198.** (1) Where new video maps are used, a licensee shall ensure that —

- (a) at least three features of new video maps have the accuracy assessed as part of the flight trial for the equipment;
- (b) the tolerance on the accuracy is better than 900 meters (0.5NM);
- (c) the three features shall, wherever possible, be three quadrants of the display; and
- (c) the accuracy assessment ensures that the features shown correspond identically to those displayed at adjacent air traffic control units.

- (2) A licensee shall ensure that the —
  - (a) new surveillance radar approach (SRA) maps are assessed for bearing and range errors at 6 NM, 5 NM, 3 NM, 2 NM, 1 NM and 0.5 NM as appropriate to the intended surveillance radar approach (SRA) termination range;
  - (b) assessment referred to in paragraph (a) are carried out by use of an aircraft with independent positioning equipment on board an aircraft or fixed ground mounted reflection sources; and
  - (c) methods independent of the original source are used for proof of changes which are independent of the original source.

**199.** A licensee shall ensure that the video maps used are in WGS84 format.

Consideration  
of mapping  
co-ordinate  
system

*(u) Radar Recording Equipment Requirements*

*(i) Surface Movement Radar System Requirements*

**200.** A licensee shall install the surface movement guidance and control system (SMGC) system and locate it at the surface movement radar (SMR) control position and such SMGC shall comprise the following elements —

- (a) visual and non-visual aids;
- (b) radio telephony communication;
- (c) operating procedures; and
- (d) control and information facilities.

Surface  
Movement  
Guidance  
and Control  
(SMGC)  
System

**201.** (1) A licensee shall ensure that the surface movement radar system performs as follows —

- (a) the display shall be usable in a daylight environment;
- (b) the system shall display the 'raw' radar return to show the traffic position;
- (c) the display system shall give historical trail information with the amount of 'trail' appropriate to the operational requirements;
- (d) the equipment shall display ranges between 1 NM and 6 NM and have range offset controls;
- (e) the equipment shall suppress information from non-operational areas;
- (f) the display size shall allow discrimination between targets spaced at one quarter of the minimum visual feature: size;
- (g) the coverage shall extend over a range and azimuth sufficient to cover the manoeuvring area;
- (h) the vertical coverage shall be suitable for monitoring all airport traffic on the ground;
- (i) the system shall be capable of detecting targets as necessary within the coverage as defined in the operational requirements;
- (j) any radar shadowing shall be mapped and verified;
- (k) operational use shall take account of both dynamic and static shadowing;
- (l) the system shall resolve two targets located at a distance equivalent to one quarter of the minimum visual feature size; and
- (m) the radar shall establish the position of a target to within one quarter of the minimum visual feature size.

Performance  
requirements  
for SMR

(2) The surveillance radar system referred to in subregulation (1) shall have calibrated maps that indicate the location of the following airport features —

- (a) stop bars;
- (b) block junctions used for holding airport traffic;
- (c) runway protected areas;
- (d) ILS critical areas (if relevant);
- (e) radio site restriction areas (irrelevant);
- (f) location of fixed obstructions;
- (g) alignment marks;
- (h) the manoeuvring area; and
- (i) areas next to the manoeuvring area.

(3) A licensee shall ensure that the —

- (a) information update rate is appropriate to the speed of airport traffic and the minimum visual feature size;
- (b) equipment presents the data to the controller within a period equivalent to one quarter of the resolution rate of the aerial;
- (c) radar achieves the required performance in the worst weather in which routine operations are likely to continue;
- (d) equipment is specified to survive the '1 in 50 years' extremes of weather;
- (e) system provides warning indications for line loss and system status; and
- (f) equipment sends to the remote user all data link fault reports and warnings that are sent to the local user.

*(ii) Airport Remote Radar Feeds Requirement*

Radar Data  
Links General  
Requirements

**202.** (1) A licensee shall assess the suitability of the data link and shall include the following aspects in the assessment —

- (a) link integrity and interference;
- (b) link data rate and capacity;
- (c) link distortion and effect on accuracy;
- (d) link delay;
- (e) link reliability; and
- (f) data resolution on link.

(2) A licensee shall define and justify the actual performance as regards bit rate, bit error rate, transmission delay and availability when compared with the required acceptable performance in the operational requirements in its manual.

Availability,  
Integrity and  
Interference

**203.** A licensee shall —

- (a) ensure that the availability of the equipment is defined and justified for the air traffic service being provided;
- (b) ensure that duplicate data paths are implemented to increase the availability;
- (c) carry out a Failure Modes, Effects and Criticality Analysis (FMECA) to ensure that the design meets the overall reliability requirement set out in the operational requirements in its manual;
- (d) safeguard the 'line of sight' path of the link where radio links are used;
- (e) ensure that the radiolinks referred to in paragraph (d) do not cross active runways, taxi-ways, railways or roadways;
- (f) determine the possibility of integrity errors arising during any reformatting by the encoder or conversion of the data at a data link interface;
- (g) determine the effects of pick-up of false signals including radio frequency interference, magnetic and electrostatic fields;
- (h) ensure that target the occurrence of false targets does not exceed once per revolution; and
- (i) ensure that error detection and correction algorithms are used to check for data corruption.

*(iii) Data Link, Format and Capacity*

**204.** A licensee shall —

- (a) test the correct operation of all data transformations under all data formats used;
- (b) ensure that the data link system is capable of detecting an overload situation on the link; and
- (c) ensure that the data link bandwidth is determined and shown that it has sufficient capability of transmitting the data required to satisfy the operational requirements in its manual.

General  
Requirements

**205.** A licensee shall ensure that the offset drift and dynamic range of the link is compatible with the data level and the worst case data delay through the system shall be defined and be justified as acceptable.

Link distortion  
and effect on  
accuracy

*(v) Automatic Dependent Surveillance – Broadcast Requirements*

**206.** A licensee shall ensure that —

- (a) the Automatic Dependent Surveillance Broadcast (ADS-B) shall be a means by which aircraft, vehicles on the aerodrome and other objects can automatically transmit or receive identification, position, velocity and additional data in a broadcast mode via a data link;
- (b) the Automatic Dependent Surveillance Broadcast (ADS-B) service shall collect position velocity and status information from systems and sensors on the aircraft and broadcast this information to other targets and ground stations;
- (c) the traffic information broadcast service, if any, shall collect aircraft position information from radar sources and broadcasts it to aircraft; and
- (d) the ADS-B referred to in paragraph (a) shall be automatic with no external stimulus being dependent and reliant on on-board navigation sources and on-board broadcast transmission system to provide surveillance information to other users.

Basic system  
requirements

**207.** A licensee shall ensure that the 1090 ES Ground Station —

- (a) provides at least the following functions —
  - (i) 1090 ES Reception and Decoding: Reception of 1090 MHz RF and extraction of Extended Squitter messages broadcast by ADS-B Out transponders,
  - (ii) Report Assembly: Compilation of ADS-B reports to be forwarded to third party client ground systems,
  - (iii) UTC Time Synchronization: UTC time synchronisation of the 1090 ES Ground Station for output report time stamping, and
  - (iv) Ground Station Management and Status Reporting: Station management. Monitoring and control functions, service status, including Built In Test Equipment (BITE);
- (b) ensures autonomous, reliable and accurate UTC time stamping of the generated ASTERIX reports;

Functional  
requirements

- (c) operates unattended and autonomously, except for maintenance and testing activities and is capable of providing a monitoring, maintenance and control function allowing a local or remote operator to —
  - (i) monitor the 1090 ES Ground Station status, and the status of each sub-system and service including BITE and end-to-end system checks, and
  - (ii) perform maintenance, configuration and control actions;
- (d) provides protection against unauthorised access to the system maintenance and control functions;
- (e) provides control facilities to allow the commanding changes of mode or state for the Ground Station or a service, as well as software configuration changes of sub systems and services; and
- (f) includes a status reporting function, which is able to report the status of the Ground Station and its services to client systems both periodically and on an event driven basis over a ground network.

Additional  
requirements

**208.** A licensee shall ensure that —

- (a) the receiver is protected from interference from out-of-band signals; and
- (b) an alternative out-of-band rejection characteristics is used to ensure that the performance requirements are met.

Equipment  
classes

**209.** A licensee shall classify the 1090 ES Ground Station equipment according to the unit's range capability and the set of parameters that it is capable of transmitting consistent with the following definition of general equipment classes and the specific equipment classes defined in ICAO —

- (a) Class A extended squitter airborne systems support an interactive capability incorporating both an extended squitter transmission capability (i.e. ADS-B OUT) with a complementary extended squitter reception capability; (i.e. ADS-B IN) in support of on-board ADS-B applications;
- (b) Class B extended squitter systems provide a transmission only (i.e. ADS-8 OUT without an extended squitter reception capability) for use on aircraft, surface vehicles, or fixed obstructions; and
- (c) Class C extended squitter systems have only a reception capability and thus have no transmission requirements.

Antenna

**210.** (1) A licensee shall ensure that the antenna pattern shall be nominally Omni-directional in the horizontal plane and has an antenna gain of 0 dB with respect to isotropic.

(2) The antenna referred to in subregulation (1) shall receive signals on the nominal operating frequency of 1090 MHz.

PART VII — *Air Traffic Services*

**211.** (1) A licensee shall use designated portions of the airspace or particular aerodromes for the provision of air traffic services.

Designation  
of airspace

(2) The Authority shall designate portions of the air space or particular aerodromes referred to in subregulation (1) into the following —

- (a) flight information region;
- (b) control area;
- (c) control zone; or
- (d) controlled aerodromes.

(3) In determining the need for the provision of air traffic services the Authority shall take into consideration —

- (a) the type of air traffic involved;
- (b) the density of air traffic;
- (c) the meteorological conditions; and
- (d) any other factors which may be relevant.

(4) Upon application in writing by the licensee for air traffic services, the Authority shall designate the air space or particular aerodrome.

(5) The Authority shall publish the designation of a particular portion of the airspace or aerodrome referred to in subregulation (4) in the relevant aeronautical publications.

**212.** A licensee shall, in providing air traffic services, establish procedures for the co-ordination with air operators, military authorities, meteorological service providers and aeronautical service providers by —

Co-ordination  
of Air Traffic  
Services

- (a) making available to the air operators information to enable them to meet their obligations;
- (b) establishing co-ordination with the military authorities responsible for activities that may affect civil flights;
- (c) providing the most up to date meteorological information for aircraft operations;
- (d) providing timely and up to date information to meet the need;
- (e) for in-flight information; and

exchanging and co-ordinating aeronautical information relating to the safety of air navigation between adjacent air traffic service units.

**213.** A licensee shall establish procedures to ensure responsibility for control of an aircraft and transfer of such responsibility between air traffic services units.

Responsibility  
for control

**214.** A licensee shall establish communication requirements in accordance with international standards and such other ICAO recommended practices.

Communication  
requirements

**215.** A licensee shall —

- (a) establish internal procedures for the notification, investigation and reporting of the air traffic incidents; and
- (b) ensure that air traffic incidents are reported to both the Authority and to the Directorate in accordance with the regulations for aircraft accident and incident investigations.

Air traffic  
incidents

**216.** A licensee shall —

- (a) make provision for assistance to aircraft in distress in the designated portion of airspace; and
- (b) collaborate in co-ordinated measures when undertaking search and rescue for aircraft in distress.

Aircraft in  
distress

## C.1000

Automatic recording of ATS data and communications

- 217.** (1) A licensee shall —
- (a) make provision for automatic recording of air traffic service data and communications; and
  - (b) retain the recorded data and communications for a period of at least 30 days.
- (2) Notwithstanding subregulation (1) (b), where the recorded data and communications is pertinent to accident and incident investigations, it shall be retained in such manner as prescribed under the regulations for accident and incident investigations.

### PART VIII — *Aeronautical Information Services and Aeronautical Charts*

Provision of aeronautical information services

- 218.** (1) A licensee shall —
- (a) receive, originate, collate, assemble, edit, format, publish, store and distribute aeronautical information concerning the designated airspace;
  - (b) publish the aeronautical information as an integrated aeronautical information package;
  - (c) ensure that the aeronautical information provided is adequate, of required quality and timely;
  - (d) make available to aeronautical information service of other states any information necessary for the safety, regularity or efficiency of air navigation; and
  - (e) designate the office to which all elements of integrated aeronautical information package originated by other states is addressed.
- (2) A licensee shall on request by other agencies, provide all information relating to the designated airspace.
- (3) The conditions, requirements, rules, procedures and standards for the publication of the aeronautical information in the —
- (a) Aeronautical Information Circular;
  - (b) Aeronautical Information Publication and its amendments;
  - (c) Aeronautical Information Publication Supplements;
  - (d) Notice to Airmen (NOTAM); and
  - (e) Aeronautical Information Regulation and Control (AIRAC) system,
- as the case may be, shall be in accordance with the requirements of these Regulations.

Production of aeronautical charts

- 219.** (1) A licensee shall ensure the availability of the required charts containing accurate, adequate information including information relevant to the phase of flight.
- (2) The units of measurement used shall be as the Authority shall provide in the Aeronautical Information Publication (AIP).

Telecommunications requirements

- 220.** (1) The international NOTAM office shall be connected, through the aeronautical fixed service (AFS), within the airspace for which it provides service, to —
- (a) area control centres and flight information centres; and
  - (b) aerodrome or heliport at which an information service is provided with pre-flight briefing and post-flight information.
- (2) The connections referred to in subregulation (1) shall provide for printed communications.
- (3) The aeronautical fixed service (AFS) referred to in subregulation (1) shall comprise the systems and applications that are used for ground-ground communications in the international telecommunication service in accordance with the requirements of these regulations.



- 221.** (1) A licensee shall —
- (a) establish and maintain a quality management system of procedures, processes and resources in its aeronautical information services to implement quality management at each function stage; and
  - (b) receive, originate, collate, assemble, edit, format, publish, store and distribute aeronautical information and data concerning the designated airspace responsible for air traffic services in accordance with its quality management system.
- (2) The quality management system established in accordance with subregulation (1) shall take into consideration that —
- (a) personnel are trained to acquire the skills, knowledge and competencies required to perform the relevant functions;
  - (b) procedures exist for traceability to its origin of data anomalies or errors, detected and corrected;
  - (c) procedures exist for assurance and confidence that distributed aeronautical information or data satisfy stated requirements for data quality, traceability and timeliness;
  - (d) publication resolution of aeronautical data are clearly discernible;
  - (e) the procedures for protection of electronic aeronautical data stored or in transit is monitored by the cyclic redundancy check (CRC) to assure integrity of data;
  - (f) material issued as part of the integrated aeronautical;
  - (g) information package is checked and coordinated with the relevant services before it is published;
  - (h) procedures exist for validation and verification to ensure quality requirements and traceability of aeronautical data; and
  - (i) procedures exist for the audit and remedial action for the compliance of the quality management system.
- (3) For the purpose of subregulation (1) (a) “function stage” means receiving, originating, collating, assembling, editing, formatting, publishing, storing and distribution of aeronautical information and data.

Quality  
management  
system

#### PART IX — *Construction of visual and instrument flight procedures*

- 222.** A licensee shall develop visual and instrument flight procedures to be used by aircraft operating in the designated airspace and aerodrome.

Construction  
of flight  
procedures  
Responsibilities  
of a licensee

- 223.** A licensee authorised under regulation 222 shall carry out —
- (a) design work; and
  - (b) review or amend visual and instrument flight procedures subject to any conditions specified in the licence.

#### PART X — *Exemptions*

- 224.** (1) A person may, in not less than 60 days before the proposed effective date, apply in writing to the Authority for an exemption from these Regulations.
- (2) A request for an exemption referred to in subregulation (1) shall contain the applicant's —
- (a) name;
  - (b) physical address and mailing address;
  - (c) telephone number;
  - (d) fax number;
  - (e) email address; and
  - (f) reasons for requesting exemption.
- (3) The application shall be accompanied by a non-refundable fee of P5 000.

Requirements  
for application

## C.1002

Substance  
of application  
for exemption

**225.** (1) An application for an exemption referred to in regulation 224 shall contain the following —

- (a) a citation of the specific requirement from which the applicant seeks exemption;
- (b) an explanation of why the exemption is needed;
- (c) a description of the type of operations to be conducted under the proposed exemption;
- (e) the proposed duration of the exemption;
- (f) an explanation of how the exemption would be in the public interest, that is, benefit the public as a whole;
- (g) a detailed description of the alternative means by which the applicant will ensure a level of safety equivalent to that established by the regulation in question; and
- (h) a review and discussion of any known safety concerns with the requirement, including information about any relevant accidents or incidents of which the applicant is aware.

(2) Where the applicant seeks emergency processing of the exemption application, the application shall contain supporting facts and reasons for the late filing of the application and reasons necessitating urgent processing of application.

(3) The Authority may deny an application if the Authority is not satisfied that the applicant has justifiable reasons for his or her application for exemption to be processed in the normal time.

Evaluation  
of  
application  
for  
exemption

**226.** (1) After reviewing the application for exemption, if the filing requirements have been satisfied, the Authority shall conduct an evaluation of the request to determine —

- (a) whether an exemption would be in the public interest;
- (b) whether the applicant's proposal would provide a level of safety equivalent to that established by these Regulations, although where the Authority decides that a technical evaluation of the request would impose a significant burden on the Authority's technical resources, the Authority may deny the exemption on that basis;
- (d) whether a grant of the exemption would contravene the applicable ICAO; and
- (e) whether the request should be granted or denied, and of any conditions or limitations that should be part of the exemption.

(2) The Authority shall notify the applicant by letter and publish in either the *Gazette* or at least one local daily newspaper with wide circulation, a detailed summary of its evaluation and decision to grant or deny the exemption request.

(3) The summary referred to in subregulation (2) shall specify the duration of the exemption and any conditions or limitations of the exemption.

(4) If the exemption affects a significant population of the aviation community of Botswana the Authority shall publish the summary in aeronautical information circular.

PART XI — *Miscellaneous*

**227.** A person who contravenes any provision of these Regulations may have his or her certificate, exemption or other document suspended or revoked. Contravention  
of Regulations

**228.** (1) If any regulation is contravened in relation to an aircraft, the operator of that aircraft and the pilot in command, if the operator or the pilot in command is not the person who contravened that provision he or she shall, without prejudice to the liability of any other person under these Regulations for that contravention, be deemed to have contravened that provision unless he or she proves that the contravention occurred without his or her consent or connivance and that he or she exercised all due diligence to prevent the contravention. Offences  
and penalties

(2) Subregulation (1) shall not apply if the person proves that the contravention occurred without his or her consent or connivance and that he or she exercised all due diligence to prevent the contravention.

(3) Any person who contravenes a provision of a regulation for which no penalty is provided, commits an offence and shall be liable to a fine not exceeding P50 000 or to imprisonment for a term not exceeding 10 years, or both.

**229.** (1) A valid licence, certificate, permit or authorisation issued or granted by the Director of Civil Aviation or the Authority or any authorised organisation before the commencement of these Regulations shall remain operational until it expires or is revoked, annulled or replaced. Transition and  
savings

(2) Notwithstanding any other provisions of these Regulations, a person who, at the commencement of these Regulations, is carrying out any acts, duties or operations, affected by these Regulations, shall within six months from the date of commencement, or within such longer period as the Minister may, by notice in the *Gazette* prescribe, comply with the requirements of these Regulations or cease to carry out such acts, duties or operations.

**SCHEDULE 1**

**FORM A**

*(regulations 5 and 9 (1))*

**APPLICATION/RENEWAL FOR AN AIR NAVIGATION SERVICE PROVIDER  
CERTIFICATE**

1. Name of applicant : .....

Address:.....

Telephone/Fax No:.....

Email Address:.....

2. Types of services for which the certificate is required.

(a) Communications, Navigational Aids, Surveillance

(i) Communications

VHF ☐

HF ☐

VCCS ☐

AFTN ☐

VOICE RECORDERS ☐

Others (Specify).....

(ii) Navigational Aids

VOR ☐

DME ☐

ILS ☐

NDB ☐

## (iii) Surveillance

Primary Radar ☐Secondary Radar ☐ADS-B/C ☐Multilateration ☐(b) Air Traffic Control services ☐(c) Aeronautical Information Services ☐(d) Meteorological Services ☐

3. Aerodromes at which the service is to be provided.....

4. Geographical regions/locations/coordinates at which the proposed service is to provided.

.....  
.....

5. State Operations and Training manuals available for submission to the Civil Aviation Authority of Botswana

.....  
.....

6. Qualifications and experience of operational personnel.

7. Qualifications and experience of managerial and senior executive staff and details of the positions for which each position is responsible.

8. Proposed date commencement of operations.

.....

I apply for the grant of an Air Navigation Service Provider's Certificate based on the information provided in this form.

Signature.....

Name (BLOCK LETTERS).....

Date:.....

Key:

**C.1006**

**Form B**

*(regulation 6 (2))*

*Air Navigation Service Provider Certificate*

<b>AIR NAVIGATION SERVICE PROVIDER CERTIFICATE</b>		
Issuing Authority: Civil Aviation of Authority of Botswana		
ANSP's Registered Name:		
Postal Address:		
Physical Address:		
Physical Location of Service:		
ANSP No.	Date of Issue:	Expiry date:
This certificate certifies that.....is authorized to perform commercial air operations, as defined in the attached operations specifications, in accordance with the operations manual and the .....		
<i>(For official use only)</i>		
Name of Issuing Officer: .....		<div>Official Stamp</div>
Title:.....		
Signature: .....		
Date:.....		

## Form C

*(regulation 11 (1))*

## Application for a Duplicate Certificate

## Application for a Duplicate Certificate

Name and address of the Authority issuing the Certificate
--

Application for a Duplicate Certificate
---

1. Registered Name of applicant: .....
2. Trading Name of Applicant (If different):.....  
 Address:.....  
 Telephone/Fax No.:.....  
 Email Address: .....
3. Original Certificate Number:.....  
 Date of First Issue..... Place of First Issue:.....  
 (DD/MM/YY)
4. Reasons for applying for a duplicate certificate  
 .....  
 .....  
 .....  
 .....  
 .....
5. Types of services for which the certificate is required.  
 (a) Communications, Navigational Aids, Surveillance  
 (i) Communications  
 VHF ☐  
 HF ☐  
 VCCS ☐  
 AFTN ☐  
 VOICE RECORDERS ☐  
 Others (Specify).....

**C.1008**

(ii) Navigational Aids

VOR ☐

DME ☐

ILS ☐

NDB ☐

Others (Specify).....

(iii) Surveillance

Primary Radar ☐

Secondary Radar ☐

ADS-B/C ☐

Multilateration ☐

Others (Specify).....

(b) Air Traffic Control services ☐

(c) Aeronautical Information Services ☐

(d) Meteorological Services ☐

6. Aerodromes at which the service is to be provided.....

I apply for the grant of a Duplicate Air Navigation Service Provider's Certificate based on the information provided in this form.

Signature.....

Name (BLOCK LETTERS).....

Date:.....Place.....



## SCHEDULE 2

*(regulation 58 (4) (a))***MINIMUM PERFORMANCE SPECIFICATION FOR RECORDING EQUIPMENT****1. Scope**

- 1.1 The appendix comprises the minimum performance specification for analogue and digital recording equipment used at Air Traffic Control Units for the recording of voice and data link communications.

**2. Equipment Configuration**

- 2.1 The equipment shall be designed with appropriate options to ensure the uninterrupted availability of communications recording. The appropriate options might include the duplication of critical internal units such as electronic modules; power supply units, intermediate and archival storage media drives and the ability to interconnect the main and standby recording equipments.
- 2.2 Where an option to interconnect main and standby equipment is available, an automatic changeover function shall be provided, which operates the main and standby equipment in parallel to ensure continuity of recordings.

**2.3 Alarm/Status Indications**

- 2.3.1 The equipment shall provide appropriate local and remote alarm/status indications including an output to indicate the overall operational status of the equipment.
- 2.3.2 The remote alarm/status indications shall not be affected by any loss and/or subsequent restoration of electrical power to the equipment. Urgent and non-urgent alarms shall be used to distinguish between problems which require immediate attention, such as failure of the recording equipment, and those which do not, such as an impending recording archival media change.

**2.4 Time and Date Information**

- 2.4.1 The equipment shall automatically record time (hours/minutes/seconds) and date (day/month/year) information.
- 2.4.2 Coordinated Universal Time (UTC) in hours, minutes and seconds of the 24 hour day beginning at midnight shall be used.
- 2.4.3 The time shall have an accuracy such that it can be maintained within plus and minus 15 seconds (UTC), except when data link communications are utilized, when the accuracy shall be plus and minus 1 seconds (UTC), within a reasonable period of time and at least for the duration of recording time on a single archival storage media.

## **C.1010**

2.4.4 The time shall have a resolution of 1 second.

2.4.5 Where an external source is used to derive time and date information the equipment shall incorporate an internal source to be used in the event of failure of the external source or temporary loss of signal from radio time code receivers.

### **2.5 Line Interface**

2.5.1 Line interface shall be provided which are compatible with telephone connections made via the Public Switched Telephone Network or private lines.

2.5.2 Line interface shall be provided which are compatible with radio connections made via the Public Switched Telephone Network or private lines to transmitter, receiver and associated control equipment at 2 Wire or 4 Wire level.

2.5.3 Optional modules to provide telephone connection Off-Hook and Ring Detect signals for the contact activation circuits may be incorporated into the line interface.

### **2.6 Recording Initiation**

#### **2.6.1 Voice Activation**

2.6.1.1 Voice Activation or Voice Operation Switch (VOX) can be used to initiate recording of telephone signals or other ground-ground communications.

2.6.1.2 The sensitivity of the voice activation circuit shall be adjustable.

2.6.1.3 An adjustable minimum time period shall be provided for the voice activation to prevent spurious responses to noise pulses.

***Note:** Due to the inherent delay with the voice activation circuit responding to initial syllables of speech and delays due to the mechanical inertia in the magnetic tape transport system of analogue equipment, it is possible that initial syllables of speech may not be recorded. The use of a circuit to buffer the signals to be recorded may be used to reduce this effect.*

*The setting of the voice activation sensitivity is more critical for varying input levels, such as radio signals, which may result in communication not being recorded.*

*Voice activation is not generally acceptable to radio signal due to these possible effects.*

## **2.6.2 Contact Activation**

- 2.6.2.1 Contact activation derived from on/off hook ring detects or other signalling conditions may be used to initiate recording of telephone signals or other ground-ground communications.
- 2.6.2.2 Contacts activation derived from transmitter push-to-talk (PTT) and receiver squelch or mute lift conditions shall be used to compensate for variations line interface levels.

## **2.7 Analogue Signal Conditioning**

- 2.7.1 Options for adjusting or disabling Automatic Gain Control (AGC) for individual inputs should be provided where it is used to compensate for various in line interface levels.
- 2.7.2 Compression and Expansion techniques may be used to match dynamic range of the line interface levels to that of the recording equipment.

## **2.8 Human Machine Interface**

### **2.8.1 Audio Output**

- 2.8.1.1 A front panel loudspeaker, volume control and on/off switch shall be provided on a remote control panel if this option is provided.
- 2.8.1.2 A front panel standard headphone jack(s) and volume control shall be provided on the equipment or on a separate remote control panel if this option is provided.

### **2.8.2 Copy Output**

- 2.8.2.1 A front panel or easily accessible output connector for making copy recording shall be provided, which may have a preset output adjustment.
- 2.8.2.2 The output shall comprise one audio channel, which shall be the selected recorded channel and another audio channel which shall have either a voice synthesized (spoken) time output or tone coded time markers from, or derived from, the time and date information of the original recording.

### **2.8.3 Security of Recordings**

- 2.8.3.1 Techniques shall be used to reduce the possibility of inadvertent erasure of recorded information. The use of software controlled password electronic or mechanical key switch access or other measures may be appropriate. Where the use of such devices is not feasible, for example with analogue reel to reel magnetic tape recording/erase mechanism may be necessary, which would then require the provision of a separate bulk erase machine. The use of action to record without verification or protection should be provided.

## **C.1012**

### **2.9 Archival Media**

- 2.9.1 The equipment shall utilize removable archival media for the recording of communications.
- 2.9.2 Guidance on the handling and storage of media shall be provided, as appropriate, with the equipment documentation.

### **2.10 Replay Function**

- 2.10.1 The equipment shall be capable of replaying the original recorded communications on archival media in a continuous 'real time' mode and presenting the time and date information separately from but synchronized with the recorded communication. The replay shall not interfere with the normal operation of the recording equipment.

## **3. Analogue Equipment**

Analogue recording equipment is classified as that which records analogue signal in real time directly onto archival media. Typical magnetic tapes reel to reel or cassette transport systems utilizing electronic, electrical and mechanical devices are used.

### **3.1 Recording Checks**

- 3.1.1 Devices and/or techniques shall be incorporated to provide a check for successful recording onto archival media.

*Note: Magnetic tape transport systems can employ off tape monitoring to establish that successful recording has taken place.*

### **3.2 Recording Quality**

- 3.2.1 When compared with a reference of -10 dBm at 1200Hz, the amplitude variation from 300Hz to 3400Hz shall not exceed  $\pm 3$  dB.
- 3.2.2 Signal to Noise ratio shall be better than 40 dBA (38 dB) when the reference signal is replayed at 0 dBm shall not exceed 2.5 %.
- 3.2.3 Crosstalk from adjacent channels shall not exceed 40 dB.
- 3.2.4 Wow and Flutter shall not exceed 1%.

## 4. Digital Equipment

Digital recording equipment is classified as that which records digital signal onto storage media and then regularly transfers the data onto the archival storage media. Magnetic/Optical media archival storage drives utilizing electronic, electrical and mechanical devices are used.

### 4.1 Analogue to Digital Conversion

#### 4.1.1 Voice Coding Scheme

4.1.1.1 The voice coding scheme shall use coding techniques which provide a Mean Opinion Score (MOS) of 2 (Unreadable), 3 (readable), 4 (Good) or 5 (Excellent) also known as 'High quality network speech' or 'tool quality speech'.

4.1.1.2 The voice coding scheme shall be able to cope with different types of voice, multiple voices, background noise without any significant deterioration in quality.

4.1.1.3 The noise coding scheme should comply with published international standards where available.

***Note:** Voice coding schemes using waveform coding techniques include CCITT G.711 – A/μ Law PCM, CCITT G.721 – ADPCM and CCITT G.728 – LD – CELP.*

#### 4.1.2 Data Compression

4.1.2.1 The amount of data compression applied at the analogue digital conversion either as part of the voice coding scheme or as a separate process, should not significantly degrade the recorded communication.

### 4.2 Intermediate Storage

4.2.1 Where an intermediate storage devices are used, the process by which the communications are transferred onto the archival media shall be secure from attempts to select, alter or interference in any way with the data.

***Note:** Digital recording equipment may utilize an intermediate storage device such as a hard disk drive (HDD), on which the communications are recorded in real time, before being transferred onto the archival media at regular intervals.*

4.2.2 The information on the intermediate storage media shall be transferred onto archival storage media via an appropriate drive mechanism at regular intervals.

4.2.3 The equipment shall use a safe shutdown mode, in the event of power failure or equipment malfunction, to ensure that intermediate storage data is not lost and that the communication can be replayed normally from the archival storage media.

## **C.1014**

### **4.3 Archival Media**

- 4.3.1 The equipment shall use a safe shutdown mode, in the event of power failure or equipment malfunction, to ensure that any necessary file management information can be written to the archival media, so that the communications can be replayed normally from the archival storage media.

#### **4.3.2 Recording Checks**

- 4.3.2.1 Devices and/or techniques shall be incorporated to provide a check for successful recording onto archival media.

***Note:** Read after write verification for the intermediate and archive storage media can be used.*

### **4.4 Recording Quality**

- 4.4.1 The recording quality shall meet the requirements as for analogue equipment as appropriate.

***Note:** It is anticipated that a suitable measure of recording quality will be defined for digital recording equipment but in the absence of this the quality shall be comparable with that of analogue equipment.*

## SCHEDULE 3

## Form A

*(regulation 79 (3))*

**GUIDANCE MATERIAL RELATING TO THE AUTOMATIC  
CALCULATION OF ILS CATEGORY**

<b>Condition</b>	<b>Display</b>
Failure of localizer standby transmitter	Cat II
Failure of glide path standby transmitter	Cat III
Changeover to localizer standby transmitter	Cat II
Changeover to glide path standby transmitter	Cat III
Far field monitor alarm	Cat I
Where single battery is used; Low battery voltage alarm	Cat I
Where each transmitter has its own battery and warning system:	
Low voltage alarm on one battery	Cat II
Low voltage alarm on both batteries	Cat I
Loss or corruption of data for calculation	ILS not available
Where multiple monitor sets are used; Disagreement between monitors Cat III	Cat III
Reciprocal on system	ILS not available
Status of reciprocal not known	ILS not available
Local control	ILS not available

## Form B

(regulation 96 (1) and (3))

**ALARM AND WARNING SETTINGS**

Parameter	Cat I	Cat II	Cat III
Localizer			
Alignment at threshold	$\pm 1.5\%$ DDM ( $15\mu\text{A}$ )	$\pm 1.1\%$ DDM ( $11\mu\text{A}$ )	$\pm 0.9\%$ DDM ( $8\mu\text{A}$ )
Displacement sensitivity	$\pm 17\%$ of nominal input. The ICAO Annex 10 standard that a localizer with angle must not exceed 60 degrees is interpreted as an “adjust and maintain” limit. The system alarm will still be set to $\pm 17\%$ of the nominal input. Field measurement is of nominal displacement sensitivity.		
	Localizer with no separate clearance system  $\pm 10\%$ of nominal input. If the clearance is in the region between $\pm 10$ degrees and $\pm 35$ degrees is at any point $< 170\mu\text{A}$		
Modulation Sum SDM	$\pm 4\%$		
	$\pm 20\%$ of nominal input		
Clearance	Localizer with a separate clearance transmitter		
	$\pm 10\%$ of nominal input. If the clearance is in the region between $\pm 10$ degrees and $\pm 35$ degrees is at any point less than $170\mu\text{A}$		
Identification Modulation	$\pm 5\%$		
Frequency Difference (Dual frequency)	$\pm 3\text{KHz}$		
RF Level Single Frequency	-3dB provided that coverage is satisfactory when the power is reduced to the alarm limit		
RF Level Dual Frequency	$\pm 1\text{dB}$ Unless tests have shown that a wider limit may be used		
	Glide path		
Alignment	$\pm 4\%$ DDM ( $35\mu\text{A}$ )		
	Field measurement $\pm 7.5\%$ of the nominal glide path angle		



Displacement Sensitivity	<p><math>\pm 25\%</math> of nominal input</p> <p>Field measurement is of nominal displacement sensitivity</p> <p>Glide path with no separate clearance transmitter:</p> <p><math>\pm 20\%</math> of the nominal displacement sensitivity. If the “fly up” signal at 0.32 is less than <math>200 \mu A</math></p>
Clearance	$\pm 20\%$ of nominal input
Parameter	<p>Cat I                      Cat II                      Cat III</p>
RF Level Single frequency	-3dB provided that coverage is satisfactory when the power is reduced to the alarm limit
RF level Dual Frequency	<p><math>\pm 1\text{dB}</math></p> <p>Unless tests have shown that a wider limit may be used</p>
Phase advance and retard	<p>Sideband reference</p> <p>Sufficient alarms to cause shutdown</p> <p>Glide path angle shall not be less than 0.9252 Displacement sensitivity within the limits above</p> <p>Fly-up signal at 0.32 must not be less than <math>150 \mu A</math></p> <p>Null reference and type M</p> <p>Sufficient alarms to cause shutdown</p> <p>Glide angle and displacement sensitivity within the limits above.</p> <p>DDM and field strength within flight inspection limits at 0.32</p>

**C.1018**

Form C

*(regulation 97 (1), (3))*

**CHANGEOVER AND SHUTDOWN TIMES**

	Cat I	Cat II	Cat III
Localizer	10	5	2
Glide path	6	2	2

## Form D

(regulations 108 (1) and 113)

**SUPPLEMENTARY FLIGHT INSPECTIONS**

<b>Parameter</b>	<b>Commissioning</b>	<b>Annual/routine</b>	<b>Transmitter to be checked</b>
Alignment of nominal total angular width	Cat I $\pm 1.5\%$ Cat II $\pm 1.0\%$ Cat III $\pm 0.5\%$	Cat I $\pm 5.0\%$ Cat II $\pm 2.1\%$ Cat III $\pm 1.4\%$	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Displacement sensitivity of the nominal displacement sensitivity	Cat I $\pm 5.0\%$ Cat II $\pm 3\%$ Cat III $\pm 3\%$	Cat I $\pm 17.0\%$ Cat II $\pm 10\%$ Cat III $\pm 10\%$	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Symmetry (either side of course line) of the measured displacement sensitivity	45% to 55%. In cases of disagreement with the ground figures, the ground measurements at threshold shall be used for assessment		Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Modulation Sum SDM  Sum of the modulation depths of the navigational tones	39% to 41%. Measured when approaching the facility, where the DDM is approximately zero	36% to 44%  Measured when approaching the facility. Where DDM is approximately zero	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Off course clearance	Substantially linear increase from the front course line angle where the deflection current is $175\mu A$ (0.18 DDM).  From this angle to 10 degrees on the same side, the deflection must not fall below $175\mu A$ (0.18 DDM).  From $\pm 10$ degrees to $\pm 35$ degrees the deflection current must not fall below $150\mu A$ (0.155DDM).		Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2

# C.1020

	<p>It is desirable that the deflection current in the region between 10 degrees and 35 degrees should not be below 175 <math>\mu</math>A (0.18 DDM). Where possible, systems should be adjusted to achieve this.</p>		
Coverage	<p>Usable signals at edge of DOC, <math>\pm 10</math> degrees to <math>\pm 35</math> degrees from the centerline</p> <p>Usable signals at 17NM, <math>\pm 10</math> degrees to <math>\pm 35</math> degrees from the localizer centerline</p>	<p>Annually only.</p> <p>Usable signals at edge of DOC on the localizer on centerline</p>	<p>Commissioning 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine 1 &amp; 2</p>
	<p>Using signals between <math>\pm 35</math> degrees from the localizer centerline at or beyond 6NM</p> <p>Usable signals shall be receivable to the distances specified, at and above a height of 2000 feet above the elevation of the threshold or 1000 feet above the elevation of highest point within intermediate and final approach areas, whichever is the higher.</p> <p>A usable signal is defined as a signal producing localizer flag current of not less than 275 <math>\mu</math>A and a DDM conforming to the off course clearance requirements</p>		<p>Commissioning 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine 1 &amp; 2</p>

Course structure	<p><b>Cat I</b> 30 <math>\mu</math>A (0.031 DDM) Edge of DOC to point A, then decreasing at a linear rate of 15 <math>\mu</math>A (0.015 DDM) at point B. 15 <math>\mu</math>A (0.015DDM) from point B to point C</p> <p><b>Cat II/III</b></p> <p>30 <math>\mu</math>A (0.031 DDM) Edge of DOC to point A, then decreasing at a linear rate to 5 <math>\mu</math>A (0.005 DDM) at point B. 5 <math>\mu</math>A from point B to the ILS reference datum.</p>	<p>Commissioning 1 or 2</p> <p>Annual 1 or 2</p> <p>Routine None</p>
	<p><b>Cat I</b> 30 <math>\mu</math>A (0.031 DDM) 8NM from the ILS reference datum to point A, then decreasing at a linear rate to 15 <math>\mu</math>A (0.015 DDM) at point B. 15 <math>\mu</math>A (0.015 DDM) from point B to point C</p> <p><b>Cat II/III</b></p> <p>30 <math>\mu</math>A (0.031 DDM) 8NM from the ILS reference datum to point A, then decreasing at a linear rate to 15 <math>\mu</math>A (0.015 DDM) at point B. 5 <math>\mu</math>A from point B to the ILS reference datum.</p> <p>Course structure shall have a probability of 95% or better not exceeding the limits given below, when assessed over a 40 second Interval.</p> <p><b>NOTE:</b> Guidance on structure assessment may be found in</p> <p>Attachment C to ICAO Annex 10 Volume I</p>	<p>Commissioning 1 or 2</p> <p>Annual 1 or 2</p> <p>Routine 1 or 2</p>
Identification	Clear and no perceptible interference to the basic localizer functions	<p>Commissioning 1 or 2</p> <p>Annual 1 or 2</p> <p>Routine 1 or 2</p>

**C.1022**

Power ratio  Two frequency systems only	On the localizer centerline, the course signal must exceed the clearance signal by a minimum of:  <b>Cat I /II</b> 10 dB.  <b>Cat III</b> 16 dB	NA	Commissioning 1 or 2  Annual None  Routine None
Polarization	Only required at the commissioning of an aerial system which is new.  Polarization error when the aircraft is in a roll attitude of 20° shall be no greater than:  Cat I 0.016 DDM.  Cat II 0.008 DDM.  Cat III 0.005 DDM.	As required	

## FORM E

(regulation 108 (1) and 113)

## SUPPLEMENTARY FLIGHT INSPECTIONS

Parameter	Commissioning	Annual/Routine	Transmitter to be checked
<b>Alignment</b>  Of the promulgated glide path angle	Cat I $\pm 1.5\%$  Cat II $\pm 1.0\%$  Cat III $\pm 1.0\%$	Cat I $\pm 7.5\%$  Cat II $\pm 7.5\%$  Cat III $\pm 4.0\%$	Commissioning 1 & 2   Annual 1 & 2   Routine 1 & 2
<b>Displacement Sensitivity</b>  Of the nominal displacement sensitivity	Cat I $\pm 8\%$  Cat II $\pm 6\%$  Cat III $\pm 5\%$	Cat I $\pm 25\%$  Cat II $\pm 20\%$  Cat III $\pm 15\%$	Commissioning 1 & 2  Annual 1 & 2  Routine 1 & 2
<b>Symmetry of upper/lower half sector.</b> Of the measured displacement sensitivity	Cat I 33% to 67%.  Cat II 42% to 58%.  Cat III 42% to 58%.		Commissioning 1 & 2  Annual 1 & 2  Routine 1 & 2
<b>Mod Sum SDM</b>  Sum of the depths of modulation of the navigational tones	78% - 82%  Measured when approaching the facility, where the DDM is approximately zero	78% - 82%  Measured when approaching the facility, where the DDM is approximately zero	Commissioning 1 & 2  Annual 1 & 2  Routine 1 & 2

**C.1024**

	<p>The clearance below path should be measured close to the edge of the Designated Operational Coverage (DOC). There shall be a smooth increase in DDM from the glide path angle to an angle where <math>190\ \mu\text{A}</math> fly-up (0.22 DDM) is reached. This shall occur at not less than 0.32 degrees.</p> <p>Where this is achieved at an angle above 0.452 degrees, the fly-up must not fall below <math>190\ \mu\text{A}</math> (0.22 DDM) between this angle and 0.452 degrees or to such lower angle, down to 0.32 degrees, as required to safeguard the promulgated glide path intercept procedure.</p> <p>Where coverage between 0.452 and 0.32 degrees is less than the specified datum, but sufficient current is present to remove the flag alarm, the fly-up shall not fall below <math>190\ \mu\text{A}</math> (0.22 DDM).</p>	<p>Commissioning 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine 1 &amp; 2</p>
--	--	---



<p><b>Below Path Clearance course only</b></p> <p><b>Note: This check is to ensure that 2 frequency M-Arrays have been set up and that the clearance transmitter is not hiding a problem</b></p>	<p><b>Cat I</b></p> <p>Between that glide path angle and 0.452 or to such lower angle, down to 0.32, as required to safeguard the promulgated glide path intercept procedure, the DDM must remain 150 Hz predominant wherever a useable signal is present.</p> <p><b>Cat II/III</b></p> <p>Smooth increase in the DDM from the glide path angle to an angle where 150 <math>\mu</math>A fly-up (0.0175 DDM) is reached. Between this angle and 0.452 or to such lower angle, down to 0.32, as required to safeguard the promulgated glide path intercept procedure, the DDM must remain 150Hz predominant wherever a usable signal present.</p> <p><i>Note:</i> With clearance signal removed, there is no requirement to meet any coverage (signal strength) specification. Only the value of DDM is being examined</p>	N/A	<p>Commission 1 or 2</p> <p>Annual None</p> <p>Routine None</p>
<p><b>Clearance Below Path (at <math>\pm 8</math> azimuth)</b></p>	<p>During the prescribed level flight, a minimum deflection current of 190 <math>\mu</math>A (0.22 DDM) must be achieved at 0.452 measured close to the edge of DOC. (1234)</p>		<p>Commission 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine 1 &amp; 2</p>
<p><b>Clearance Above Path</b></p>	<p>Smooth increase in fly-down from the glide path angle to an angle where the fly-down is 190 <math>\mu</math>A (0.22 DDM). Between this angle and 1.752, the fly-down must not fall below 150 <math>\mu</math>A (0.175 DDM)</p>		<p>Commission 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine 1 &amp; 2</p>

# C.1026

<b>Coverage Above Path</b>	<p>Adequate coverage must exist to the edge of the DOC and down to 0.452 or a lower angle down to 0.32, as required to safeguard the promulgated glide path intercept procedure.</p> <p>Adequate coverage is defined as a receiver input exceeding the equivalent of a 40 <math>\mu</math>A source of EMF and a total impedance of 50 ohms resistive, together with sufficient current to remove the flag alarm.</p>	<p>Commission 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine 1 &amp; 2</p>
<b>Course Structure</b>	<p>Course structure shall have a probability of 95% or better not exceeding the limits given below, when assessed over a 40 second interval.</p> <p><b>Cat I</b></p> <p>30 <math>\mu</math>A (0.035 DDM) Edge of DOC to the ILS reference datum to point C.</p> <p><b>Cat II</b></p> <p>30 <math>\mu</math>A (0.035 DDM) Edge of DOC to the ILS reference datum to point A, then decreasing at a linear rate to 20 <math>\mu</math>A (0.023 DDM) at point B. 20 <math>\mu</math>A from point B to the ILS reference datum.</p> <p><b>Cat III</b></p> <p>30 <math>\mu</math>A (0.035 DDM) Edge of DOC to the ILS reference datum to point A, then decreasing at a linear rate to 20 <math>\mu</math>A (0.023 DDM) at point B. 20 <math>\mu</math>A from point B to the ILS reference datum.</p> <p><b>NOTE:</b> Guidance on course structure assessment may be found in Attachment C to ICAO Annex 10 Volume 1.</p>	<p>Commission 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine 1&amp;2</p>
<b>Biased Structure</b>	<p>The structure of the edges used to calculate the displacement sensitivity should have good correlation with the course structure.</p>	<p>Commission 1 &amp; 2</p> <p>Annual 1 &amp; 2</p> <p>Routine none</p>

## FORM F

*(regulations 108 (1) and 113)***SUPPLEMENTARY FLIGHT INSPECTIONS**

<b>Parameter</b>	Commission/Annual	Transmitter
<b>Coverage</b>	The following distance shall be measured whilst on the ILS glide path and localizer course line:	Commission 1 & 2 Annual 1 & 2 Routine 1 & 2
	Inner Marker 150 m $\pm$ 50m Middle Marker 300 m $\pm$ 100 m Outer Marker 600 m $\pm$ 200 m	
<b>Field Strength</b>	No less than 1.5 millivolts per meter at the limits of coverage. Rising to at least 3 millivolts per meter	Commission 1 & 2 Annual 1 & 2 Routine 1 & 2

## FORM G

*(regulation 124 (2))***DISTANCE MEASURING EQUIPMENT (DME) FLIGHT INSPECTION**

<b>Procedure Supported by the DME</b>	<b>Where and how measurement is made</b>	<b>Interval/Tolerance</b>	<b>Transponder</b>
DME associated with precision approach	4NM-1NM on approach	Comm $\pm 0.03$ NM Routine $\pm 0.1$ NM	Both
DME associated with Instrument Approach Procedures (IAP) that are not precision approaches	4NM- 1NM on approach	Comm/ Routine $\pm 0.1$ NM	Both
IFP	On the procedure, spot check at ranges used	Comm $\pm 0.1$ NM	One TXP
Missed Approach Procedures	On the procedure, spot check at ranges used	Comm/ Routine $\pm 0.1$ NM	One TXP
Direct Arrivals	On the procedure, spot check at ranges used  The orbit as required for DME general below, may be carried out at the appropriate radius	Comm $\pm 0.1$ NM	One TXP
Hold	On the procedure, spot check at ranges used	Comm $\pm 0.1$ NM	One TXP
DME general	An orbit at a radius of the 5 NM or greater at an elevation of 2° from the DME site	Comm $\pm 0.1$ NM	A complete orbit on one transponder followed by a minimum 20° overlap on the second transponder.
En-Route	During radials flown on any associated facility	Comm/Routine $\pm 0.1$ NM	One TXP

## FORM H

*(regulation 135)***PARAMETERS TO BE MEASURED**

<b>Parameter</b>	<b>Limits</b>
Alignment	$\pm 2^{\circ}$
Bends	$\pm 3.5^{\circ}$
Roughness and Scalloping	$\pm 3^{\circ}$
Coverage	90 micro-volts per meter. At commissioning only, useable signals up to an elevation angle of 40 degrees
Modulation of 30Hz and 9960Hz	$\pm 2\%$
Voice	Clear
Identification	Clear
Polarization	$\pm 2^{\circ}$

**C.1030****FORM I***(regulation 137 (1))***PROFILES TO BE CHECKED**

<b>Profile</b>	<b>Commissioning</b>	<b>Routine</b>
	<b>Transmitter to be checked</b>	
Radials	1 or 2	1 or 2
Approach Procedures	1 & 2	1 & 2 **
Cross check radials	1 or 2*	None
Intersections	1 or 2 as required	None
Holds	1 & 2 as required	None
**For routine inspection of dual transmitter Doppler VOPRs, where it can be demonstrated that the alignment error between the transmitters is small i.e. $\leq 0.5$ degrees, then only one transmitter needs to be checked.		
*Flight inspection of cross-check radials is not required provided there is sufficient flight inspection data to support the use of those radials.		

## FORM J

(regulation 145 (2) and 146)

**FLIGHT INSPECTION PARAMETERS TO BE MEASURED**

<b>Parameter</b>	<b>Limits</b>	<b>Periodicity and Measurement Method</b>
Accuracy within the DOC	ADF needle oscillations $<\pm 10^\circ$ . See Note 1	<b>Commissioning</b>  Orbit at the DOC or 15NM, whichever is the smaller at Minimum Safe Altitude
Accuracy on Airways	ADF needle oscillations $<\pm 10^\circ$ . See Note 1	<b>Commissioning</b>  Following notified airways.  Where an NDB supports many airways the none airway in each quadrant should be flown.
Accuracy in Holding Patterns	ADF needle oscillations $<\pm 5^\circ$ . See Note 1	<b>Commissioning</b>  Following notified Holding patterns.
Accuracy on Instrument Approach Procedures	ADF needle oscillations $<\pm 5^\circ$ . See Note 1 below	<b>Commissioning and Annual</b>  Following Instrument Approach Procedure
Coverage	>70 microvolts per meter	<b>Commissioning</b>  Orbit at the DOC or 15NM, whichever is the smaller at Minimum Safe Altitude.
Identification	Correctness, clarity and proper tone	<b>Commissioning and Annual</b>  Throughout the flight inspection.

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Station passage	<p>Reversal without excessive ADF needle swing around station passage.</p> <p>ADF needle oscillations <math>&lt;\pm 10^\circ</math> throughout the remainder of the radial.</p> <p>See Note 1</p>	<p><b>Commissioning and Annual</b></p> <p>Two radials 90 degrees apart. From 5NM to 5NM past the station.</p>
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## FORM K

*(regulation 149 (a))***ELEMENTS SPECIFICATIONS**

	Global Average 95 % of the time	Worst case 95% of the time
Horizontal Position Error	13m (43ft)	36m (118ft)
Vertical Position Error	22m (72ft)	77m (253ft)

MADE this 2nd day August, 2013.

NONOFO E. MOLEFHI,  
*Minister of Transport  
and Communications.*