الهيئة العامة للطيران المدني

Public Authority for Civil Aviation

FLIGHT INSPECTION MANUAL

For

Radio Navigation Aids

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Glossary of Terms or Abbreviations

The following terms or acronyms may be used in any manual or document published by PACA. Reproduction in part or whole is allowed without prior approval. The Document Control Office reserves the rights to include such a listing in any PACA manual or document prior to publishing.

ADF	**Automatic direction finder**
AFC	**Automatic frequency control**
AFIS	**Automatic Flight Inspection System**
AGC	**Automatic gain control**
AIP	**Aeronautical Information Publication**
AM	**Amplitude modulation**
ANSP	**Air navigation service provider**
ATC	**Air traffic control**
ATIS	**Automatic terminal information service**
CATV	**Cable television**
CVOR	**Conventional VOR**
CMN	**Control motion noise**
CW	**Continuous wave**
DDM	**Difference in depth of modulation**
DGNSS	**Differential global navigation satellite system**
DME	**Distance measuring equipment**
DVOR	**Doppler VOR**
EIRP	**Equivalent isotropic radiated power**
EMI/EMC	**Electromagnetic interference/compatibility**
FM	**Frequency modulation**
FMS	**Flight management system**
GNSS	**Global navigation satellite system**
GP	**Glide path**
IF	**Intermediate frequency**
IFR	**Instrument flight rules**
ILS	**Instrument landing system**
IM/MM/OM	**Inner/middle/outer marker**
INS	**Inertial navigation system**
ISM	**Industrial scientific medical**
ITE	**Information technology equipment**
ITU	**International Telecommunication Union**
LF/MF/HF	**Low/medium/high frequency**
LOC	**Localizer**
MDS	**Minimum discernible signal**
MHA	**Minimum holding altitude**
MSL	**Mean sea level**
MTBF	**Mean time between failures**
MTBO	**Mean time between outages**
NDB	**Non directional beacon**

NOTAM	**Notice to Airmen**
PAR	**Precision approach radar**
PBN	**Performance-based navigation**
PFE	**Path following error**
PFN	**Path following noise**
PLC	**Power line carrier**
PM	**Phase modulation**
POP	**Proof of performance**
pp/s	**Pulse pairs per second**
PRF	**Pulse repetition frequency**
RDH	**Reference datum height**
RF	**Radio frequency**
RMS	**Root mean square**
RNAV	**Area navigation**
SARPs	**Standards and recommended practices**
SDM	**Sum of depths of modulation**
VFR	**Visual flight rules**
VOR	**VHF omnidirectional radio range**
VSWR	**Voltage standing wave ratio**

FOREWORD

(1) This Document, Flight Inspection Manual for Radio Navigation Aids has been issued by the Public Authority for Civil Aviation of Oman (hereinafter referred as PACA) under the provisions of the Civil Aviation Regulation (CAR) 171, Aeronautical Telecommunication Service Provider.

(2) This Document sets out the procedures and criteria of the flight inspection, extension of flight inspection period and approval of Radio Navigation and Visual Aids services; and

(3) The following standards have been basis for this Document:
- (a) Oman Civil Aviation Law (CAL) Royal Decree 76/2019.
- (b) CAR 171 (Aeronautical Telecommunication Service Provider)
- (c) ICAO Annex 10 (Standards and Recommended Practices for Aeronautical Telecommunications).
- (d) ICAO Doc 8071 (Manual on Testing of Radio Navigation Aids)

(4) The editing practices used in this document are as follows:
- (a) ‘Shall’ is used to indicate a mandatory requirement and may appear in CARs.
- (b) ‘Should’ is used to indicate a recommendation
- (c) ‘May’ is used to indicate discretion by the AUTHORITY the industry or the applicant, as appropriate.
- (d) ‘Will’ indicates a mandatory requirement and is used to advise of action incumbent on the Authority

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1. GENERAL

1.1. INTRODUCTION

Each Radio Navigation and Visual Aids operated for Air Navigation Services shall be calibrated/tested/inspected in a manner periodically to ensure that Radio Navigation systems meet the regulatory requirements of CAR 171 and the SARPs in ANNEX 10.

Radio Navigation Aids and Visual Aids, includes:

a. Ground Based Radio Navigation System
   - VHF Omnidirectional Range (VOR)
   - Distance Measurement Equipment (DME)
   - Non-Directional Beacon (NDB)
   - Instrument Landing System (ILS)
   - VHF Marker Beacon (OM/MM/IM)

b. Surveillance Radar System

c. Visual Aids
   - Precision Approach Path Indicator (PAPI)
   - Visual approach Slope Indicator (VASI)

1.2. DEFINITION

The following term and meaning are applied in this document:

Flight Inspection Service Provider. Any organization that obtain certificates from Authority (PACA) to conduct flight inspection for Radio Navigation Aids.

Flight Inspector. A Competent personal that authorized to examine the signal of Radio Navigation Aids in space to ensure that it meet the standards in Annex 10, and state the operational status of equipment being tested.

1.3. FACILITIY INSPECTION

The facilities calibration/testing or inspection of Radio Navigation and Visual Aids is defined in the following categories:

a. Ground Inspection
b. Flight Inspection

1.3.1. Ground Inspection

Ground Inspection must be carried out by a trained CNS personnel using appropriate test equipment at the facility site or at a point on the ground remote from the site.

Ground Testing shall cover:

a. *Site proving*; Tests carried out at proposed sites for the ground element of radio navigation aids to prove suitability. Portable ground installations are used for this purpose.
b. *Initial proof of performance*: A complete inspection of the Facility after installation and prior to commissioning to determine whether the equipment meets the Standards and specifications.
c. *Periodic*: Regular or routine inspections carried out on a facility to determine whether the equipment continues to meet the Standards and specifications.
d. *Special*: Tests after a failure of the facility or other circumstances that indicate special testing is required or prior to Flight Inspection periodization. Special tests will often result in appropriate maintenance work to restore the facility and in a special flight inspection, if required.

1.3.2. Flight inspection

Flight Inspection shall be carried out by Flight Inspection Service Provider approved by PACA.

Flight inspection shall cover:

a. *Site proving*:
   A Flight Inspection conducted at the proposed site at the option of the responsible Authority to determine the effects of the environment on the performance of the planned radio navigation aid.

b. *Commissioning*:
   i) An extensive flight inspection following ground proof-of-performance inspection to establish the validity of the signals-in-space. The results of this inspection should be correlated with the results of the ground inspection. Together they form the basis for certification of the facility.
   ii) Commissioning Inspection for facilities installed on an unfinished runway.
   In case of commissioning being carried out prior to the completion of ground construction activities, including painting and lighting, Special Inspection Conditions will be implemented only if flight inspector states that the rest of runway work shall not affect the navigational aids performance and another special inspection will not be needed prior the facility being put into operation.

c. Periodic:
   Flight inspections to confirm the validity of the signals-in-space on a regular basis or after major scheduled facility maintenance.

d. *Special*:
   i) Flight inspections required as a result of suspected malfunctions, aircraft accident, etc. Typically, it is necessary to test only those parameters which have or might have an effect on facility performance. However, it may be economically advantageous in many cases to complete the requirements for a periodic inspection.
   ii) Equipment replacement of the same type and configuration as well as placed on locations where the same physical condition, including the location of the antenna, is necessary to conduct a special inspection. Items required for antenna change shall be done to a minimum flight test performance required for the facility. Additional requirements of the inspection are determined jointly by the flight inspector and ground technician.
   iii) Equipment modification, reconfiguration and relocation on a facility that will affect the radiant pattern is subject to a special flight inspection. Changes in type of antenna is classified as reconfiguration. All commissioning inspections shall be carried out in accordance with the reconfiguration of facilities, unless not required by flight inspector and facility maintenance technician.
   iv) Replacement of spare parts or modules affecting the value of parameters need to be determined through flight inspection is subject to a special flight inspection

1.3.3. Post-Accident/Serious Incident Inspection.

This inspection is carried out at the request of the accident coordinator /investigator to verify that the performance of the system is still eligible to use and can support instrument flight procedures.

(a) Follow-up
    This inspection is a high priority and shall be implemented as soon as possible

(b) The flight inspector shall obtain the following information:
   i) Configuration of equipment at the time of the accident, i.e. receiver, transmitter or radar channel under operating conditions.
   ii) The use of instrument flight procedures.
   iii) Any additional information that helps in the inspection analysis.

c. Inspection Procedure.

i) Coordinate with the facility maintenance technician to configure system according to paragraph b (i).

ii) Complete periodic inspection checklist. Checking is done only on equipment and instrument flight procedures used by the accident/incident aircraft. VOR or orbit track adjustment TACAN (if any) is not necessary. It is strictly prohibited to perform facility adjustment after an accident. Adjustment of equipment shall be performed on separate special conditions inspection.

iii) If the system or procedure does not have periodic inspection requirements, evaluation shall be done on the area where the accident occurred.

iv) Complete any additional materials requested by maintenance technician's facilities, air traffic control personnel (ATC) or accident coordinator / investigator.

v) In cases where the cause of the accident may be related to natural or man-made obstacles on the earth's surface (mountains, buildings etc.), the evaluation shall be done by Aeronautical Study.

d. Confidentiality of accident/incident information.
Any findings on flight inspection or other information related to results of accident/incident investigation shall be restricted and shared only with the approval of the accident Investigator. Flight inspection results shall be submitted to PACA as soon as possible.

1.4. INSPECTION PERIODIZATION

a. Ground Check/Inspection.

(i) Periodic test, shall be conducted with the following periodization:

SR	Type OF FACILITY	FACILITY FUNCTION	PERIOD
1.	ILS	LANDING	2 weeks
2.	VOR	HOMING	2 weeks
		ENROUTE	4 weeks
3.	DME	HOMING	2 weeks
		ENROUTE	4 weeks
		CO-LOCATED GP-ILS	2 weeks
4.	NDB	LOCATOR	2 weeks
5.	NDB	HOMING/CHECK POINT	4 weeks
6.	RADAR	APPROACH	2 weeks
		ENROUTE	4 weeks
	COMMUNICATION (VHF)	TOWER, APP, ACC	4 weeks
7.	PAPI WITH ILS	APPROACH	2 weeks
8.	PAPI WITHOUT ILS	APPROACH	4 weeks
9.	VASI	APPROACH	4 weeks

Table 1. Periodic Ground Test

(ii) Special test, shall be conducted in accordance with Flight Inspection periodization.

(iii) Ground Check/inspection shall be conducted using Ground Check/Inspection Form as per attachment A of this document.

b. Flight Inspection.

The validity period or periodization of flight inspection is as follows:

SR	NAME OF FACILITY	FACILITY FUNCTION	FLIGHT INSPECTION PERIOD
1	ILS	LANDING	6 Months
2	VOR	HOMING/ENROUTE	12 Months
	DVOR	HOMING/ENROUTE	3 Years
3	DME	CO-LOCATED VOR	12 Months
		CO-LOCATED DVOR	3 Years
		CO-LOCATED ILS	6 Months
4	NDB	LOCATOR	6 Months
5			
6	NDB	HOMING/CHECK POINT	12 Months
7	RADAR	APPROACH	If Required
		ENROUTE	If Required
8	COMMUNICATION (VHF)	TOWER, APP, ACC	If Required
9	PAPI WITH ILS	APPROACH	6 Months
10	PAPI WITHOUT ILS	APPROACH	12 Months
11	VASI	APPROACH	12 Months

Table 2. Periodic Flight Inspection

1.5. PRIORITY OF FLIGHT INSPECTION

Table 3 lists the priority of flight inspection to determine which mission will be conducted first when two or more requirements are competing for limited flight inspection resources (flight crew/aircraft/ground engineer or technician).

Priority	Type of Service
1A	Accident/Serious Incident Investigation and any facility which has exceeded its inspection interval
1B	Restoration of a commissioned facility after an unscheduled outage and restoration of CAT II/ III ILS approach
1C	Flight inspection of reported malfunctions or corrupted of the signal - in-space
2A	Commissioning inspection of new facility or new instrument flight procedure
2B	Periodic Inspection
3A	Site Evaluation
3B	Other Investigation

Table 3. Flight Inspection Priority List

1.6. GRACE PERIOD for PERIODIC FLIGHT INSPECTION

Air Navigation Service Provider must ensure that flight inspection of a commissioned Ground NAVAID shall be completed within the grace period of 14 days calendar from the due date of Flight inspection.

1.7. EXTENTION OF FLIGHT INSPECTION PERIOD

In case flight inspection can't be conducted within the grace period due to unforeseen circumstances e.g. technical and/or operational issue, then ANSP shall submit a proposal to Authority requesting approval for the extension of the Flight Inspection period.

Periodic flight inspections for NAVAID equipment may be extended by the authority up to the following provisions:

a. For instrument of ILS (Instrument Landing System) a period of extension up to 3 months;

b. For VOR equipment (Very High Omnidirectional Range) as homing facility function a period of extension up to 3 months;

c. For DME equipment (Distance Measuring Equipment) as homing facility function a period of extension up to 3 months;

d. For VOR equipment (Very High Omnidirectional Range) as en-route facility function a period of extension up to 6 months;

e. For DME equipment (Distance Measuring Equipment) as en-route facility function a period of extension up to 6 months;

f. For NDB equipment (Non-Directional Beacon) as locator a period of extension up to 3 months;

g. For NDB equipment (Non-Directional Beacon) as homing/check point period of extension up to 6 months;

h. For PAPI equipment (Precision Approach Path Indicator) a period of extension up to 3 months;

i. For VASI equipment (Visual Approach Slope Indicator) a period of extension up to 6 months.

During the extension of Flight Inspection Period, ANSP shall:

(1) Conduct periodic Ground Check as mentioned in paragraph 1.3 (a) using Ground Check Form as shown in Attachment A of this Manual.

(2) submit the Ground Check result of related facility to the Authority as reference to review and evaluate the performance of facility during the proposed extension period;

(3) Continue in Conducting the maintenance activities according to the maintenance plan for the facility, as well, the record the test result and monitor readings of critical parameters to indicate that the equipment consistently meets performance requirements.

(4) Issue a NOTAM stating that the status of facility as:

"[Facility Name] Operating but ground checked only, awaiting flight Check"

When issuing the NOTAM, the ANSP shall indicate the validity period of the NOTAM according to the approval issued by the Authority.

As it cannot be guaranteed that an "Operational Status" is always received after flight inspection it is suggested that the ANSP publish the time frame as an estimated period and include the letters EST after the expiry date and time of the NOTAM. In such cases the ANSP is required to coordinate with the NOTAM Office (NOF) prior to the expiry time advising if the NOTAM requires extension, cancellation or replacement with new criteria (i.e. if the facility returns to operation or is turned off etc.).

If the ANSP does not include the EST letters in the NOTAM the NOTAM will automatically cancel at the expiry date and time and the status of the facility will not be correctly notified to users.

Note: It is the responsibility of the ANSP to ensure the status of the NAV-AID is correctly published and to ensure the correctness of all NOTAM.

1.7.1. FLIGHT INSPECTION AT NIGHT

Flight inspection may be conducted at night only in certain areas which have high densities of air traffic during daylight hours. The following additional factors must be considered for night-time flight inspection:

a) **Effect of the environment on the radiated signal.** The signals radiated by some types of radio navigation aids are affected by propagation which differs between day and night.

b) **Effect of environment on the navigation aid.** The ground facility maintenance technician/ engineer should inform the flight inspector of any equipment variations, such as field monitor performance which may change at night. The effects of the local environment, such as changes in the position of reflecting obstacles, shall be considered.

c) **Position reference.** Flight inspection at night may use an independent reference system including ground tracking equipment.

d) **Evaluation of results.** The flight inspector should indicate if there are differences from expected measurements and indicate if these differences are caused by night conditions, problems with the equipment or making the measurements at different positions.

e) **Flight inspection reports.** The flight inspection report should indicate whether the inspection was made at night.

f) **Types of flight.** The inspection flights should be made in accordance with the guidance given in this manual, with the exception of measurements that specifically need low-level flights. It is recommended that at specific intervals an inspection is made under the same conditions as prevailed at the time of commissioning.

g) **Safety of flight.** Flights should be conducted 300 m (1O00 ft.) above the level normally used for daytime flight inspection in areas with terrain or obstacles. It will be necessary to change some horizontal distances in order to retain the same vertical angle from the navigation aid, where this is important to the measurements. Low-level below path (safety approach) glide path inspection flights should not be made during the night or when the level of natural light is low. Flights should normally be carried out in accordance with VFR.

1.8. UNIT OF MEASUREMENT

The references used in this manual (unless otherwise specified) are as follows:

Term	Reference
Distance Airspeed and Groundspeed	Nautical Mile 1 NM = 1.850 m 1 NM = 1.151 M Knots
Bearing, Heading, Azimuth Radial, Direction Information and Instruction Altitudes	Magnetic North Absolute

2. FLIGHT INSPECTION CREW AUTHORITY AND OBLIGATIONS

2.1. The Authority of Flight Inspection Crew

The flight inspection crew has the authority to:

a. Carry out flight inspections of Radio Navigation Aids (NAVAIDS) to determine that the navigation service meets tolerance set out in this manual, and the facility may support flight procedures.

b. Report any hazard conditions during flight inspection.

c. Take action in accordance with the procedure.

d. Review, verify, and customize topography, patterns and data barriers (roads, railways, antennas, towers, power lines, rivers, urban areas, etc.) contained on the flight map to evaluate the accuracy and usability of navigation aids.

2.2. The Obligation of Flight Inspection Crew

The flight Inspector's responsibility are limited to:

a. Conducting flight inspections in accordance with the procedures established by this manual;

b. Determining the adequacy of the system to meet its required functions;

c. Analyzing and evaluating the flight inspection data to enable a status classification to be assigned;

d. Certifying the signal-in-space of a NAVAID in accordance with the tolerances prescribed in this manual;

e. Coordinating with engineering, maintenance, and/or Air Traffic Control;

f. Reporting the flight inspection results and status of the system to the ANSP;

g. providing the technical details for NOTAMs based on the flight inspection data;

h. Verifying the accuracy of NOTAMs and published information related to facility status;

i. Inspecting the flyability of instrument procedures prior to their publication;

j. Optimizing facility performance during flight inspections requiring adjustments by coordinating with the ground engineer or technician;

3. GENERAL FLIGHT INSPECTION PROCEDURES

The order of activities of the flight inspection implementation in general as follows:

1. Pre-Flight Inspection.
2. Preparation before Flying
3. Flight inspection.
4. Analysis and Evaluation.
5. Flight inspection review and Reporting
6. Post Flight Inspection

3.1. PRE-FLIGHT INSPECTION

3.1.1. Status of Facility

Flight inspection should not be carried out until all facilities are installed and/or properly set and/or ground calibrated, and operating normally.

3.1.2. Notification

a. The flight inspection service provider shall notify the Air Navigation Service Provider about the Flight Inspection plan and Estimate Time Arrival (ETA) of aircraft.

b. The flight Inspection Service Provider shall coordinate with ANSP for any other notifications that are required for the purpose of flight inspection i.e. field evaluation, commissioning, periodical with monitors or inspections that require the support of the ground technician or maintenance personnel.

c. Regular inspection of ILS without a monitor does not require initial coordination with the maintenance personnel. This inspection must be carried out on transmitters that are in operation. If there is nonconformity with tolerance, the flight inspector shall inform the maintenance personnel and conduct flight inspection for back up or standby equipment.

d. NOTAM must be published if nonconformities have not been corrected.

3.2. PREPARTION BEFORE FLYING

Understanding between maintenance personnel and Flight Inspection crew is crucial to support the smoothness of flight inspection. Coordination shall be established between Flight inspection crew and maintenance personnel at times before, during, and after flight inspection.

The flight inspection crew shall give directions to the maintenance personnel about important steps taken before implementation of flight inspection or commissioning and for special circumstances.

Efficiency and smoothness of Flight Inspection requires good preparation before flying and actions from maintenance personnel. These preparations include:

a. Prepare two-way radio communications equipment and resources at facility locations.
b. Ensure that the facility is in normal operation and all parameters are in tolerance according to technical specification requirement.
c. Ensure the presence of qualified technician to perform corrections and adjustments.
d. Prepare the means of transportation to transfer the calibration equipment and personnel.
e. Prepare accurate facility data for new facilities or relocated.

The following actions shall be conducted by Flight Inspection crew prior to flight inspection:

a. Ensure that all flight inspection equipment has been calibrated and can be operated.

b. Gives direction to the maintenance personnel and/or ground technician.

c. Gives direction to the crew of the calibration aircraft.

d. Set up maps, charts, tools, data sheets, etc.

e. Review the status, limitations, and characteristics of the facility. Ensure that the publication and recording of results from flight inspections which applicable previously, and all the restrictions applied were accurate.

f. Providing direction to Air Traffic Control (ATC) personnel about the areas and altitude used for flying maneuvers during flight inspections and possible changes.

3.3. FLIGHT INSPECTION

Flight inspection shall be carried out according to the procedures in this manual.

The following shall be considered during the flight inspection implementation

a. **Expert.** During the flight inspection, qualified personnel must be assigned to avoid errors of equipment performance.

b. **Standby Equipment.** This is required to identify which system or transmitter is operating so that the performance of each such equipment can be tested. If one unit of dual equipped facility is found not according to tolerance, then the out of tolerance unit must be identified and shall not be used in the service. The unit can be identified as transmitter number 1 or 2. Channel A or B, serial number, etc.

c. **Standby Power.** During the commissioning /flight inspection. flight inspector shall check the facility with the standby power (if it is installed with standby power), to ensure that performance of the facility does not decrease with the standby power system and ensure that all parameters are in tolerance. If the standby power is installed after flight commissioning / flight inspection, then flight inspector shall check the facilities with standby power on next flight periodic inspection.

   The examination of standby power is not required for facilities equipped with batteries which are constantly supplied by other resources.

   Standby power replacement doesn’t require re-inspection.

d. **Philosophy in the field.** If in the implementation of flight inspection it is found that parameters that do not meet the standards and tolerance, the flight inspector should provide assistance to the ground engineer to attempt to resolve the issue.

e. **Restrictions.** When the facility parameters do not meet the tolerance or existing standards, flight inspector shall carry out an inspection to determine the area that can be used by the facility. This data is used as a basis for restriction, NOTAM, or to re-create a procedure.

f. **Limitations of spectrum management.** Facilities set in the limitation of spectrum management is classified as "Restricted" and must be identified in the facility data sheet. This restriction still applies although there is no disruption to facility performance. It is not allowed to remove the limitation of spectrum management that based on the results of the flight inspection.

g. **Incomplete Inspection.** In case, the commissioning inspection of the facility must be terminated before completing all the flight inspection procedure due to aircraft damage, weather, etc., flight inspection crew must discuss the condition of the facility under inspection.

If the facility maintenance manual allows setting parameters without flight inspection, and there are insufficient references on previous flight inspection, the equipment can be used in the service. This inspection is classified as incomplete inspection until the procedure of flight inspection completed.

If there is an item on the flight inspection checklist that cannot be set according to the tolerance limit, the inspection must be stopped. The status of facilities is changed to "unusable", and Inspections are classified as incomplete inspection until the rest of the flight inspection procedure are completed.

3.4. ANALYSIS AND EVALUATION

Flight inspection data must be analyzed and evaluated during the implementation of flight inspection in accordance with the value of tolerance which are set forth in this manual. Recording which is done during the flight inspection shall be entered permanent into a facility performance record data.

Flight inspection recording data is created and provided to maintenance technicians for technical analysis purpose. Aeronautical telecommunication service provider shall maintain the flight inspection recording data.

Setting Omni-directional facility (VOR, TACAN, DF, NDB, etc.) shall be calculated through the addition of algebra. The azimuth reference (AFIS, Theodolite, map) should always be positive (+), and the azimuth reference of ground facilities must always be negative (-). So, if the VOR radial receiver is 090.5 and the AFIS / theodolite position 090.0, then error at facility -0.50. Setup errors can also be understood i. e clockwise (positive) and counterclockwise (negative).

3.5. POST-FLIGHT INSPECTION

After completing the flight inspection, flight inspection crew shall perform the following actions:

(1) Advise the maintenance technician/engineer about the result of flight inspection. Flight inspection of all facilities shall be reported to authorized personnel.

(2) Setting Facility status. Flight inspection shall set status facilities (see. 3.5.1.1). Flight inspection also shall notify all notes about the status of the facility to authorized personnel.

(3) Preparing flight inspection report. Flight inspection reports must be accurate and clear in describing performance and facilities characteristics. Report must be completed in accordance with this Manual (see 3.5.1.2).

3.5.1. Flight Inspection Result (Classification), Certificate and Report

3.5.1.1. Flight Inspection Result.

The result of facility flight inspection shall be an operational status of facility, and classified as follows:

a. ***Usable*;** Available for the operational use, defined as:

i) ***Unrestricted*:** Providing safe, accurate signals-in-space conforming to established standards within the coverage area of the facility.

ii) ***Restricted*:** Providing signals-in-space not conforming to established Standards in all respects or in all sectors of the coverage area, but safe for use within the restrictions defined. The facility that may be unsafe shall not be classified as limited or restricted under any circumstance.

b. ***Unusable;*** Not available for operational use as providing (potentially) unsafe or erroneous signals, or providing signals of an unknown quality

The operational status of the facility as mentioned in above paragraph shall be determined by the Authority.

The status determination by authority shall be referred to judgement (by the pilot) of the flyability of the signal-in-space, analysis of airborne measurements of the facility by flight inspector and the statement of readiness by authorized ground maintenance personnel of ANSP.

The flyability of the instrument procedures is assessed as part of the validation activity conducted in accordance with the *Quality Assurance Manual for Flight Procedure Design* (Doc 9906), *Volume 5 — Validation of Instrument Flight* The facility status classification and NOTAM indicate the boundaries that can be applied to the facility. The facility status classification shows facility performance in general based on flight inspection results. This classification only intended for maintenance and / or facility users. NOTAM is required to inform the user of any restrictions on the facility.

When the range of equipment cannot be checked according to the standard the volume of flight inspection services due to state borders or limited airspace, this facility shall be classified as Restricted, with notes on reports to fly a limited range due border of the country. NOTAM and publication actions shall indicate facilities as unusable in areas is not inspected.

3.5.1.2. Flight Inspection Report

Flight inspection reports shall contain the following minimum information:

a. General information with basic report, crew and facility items, such as:

(1) date(s) of inspection and next inspection due
(2) type of inspection, e.g. routine, annual, commissioning, site proofing and special;
(3) name and facility designation;
(4) facility identification, frequency assigned, nominal angle and nominal width (for ILS)
(5) manufacturer and type of system being inspected
(6) Type of antenna of system being inspected
(7) category of operation (facility);
(8) serial number of report/unique identifier;
(9) aircraft registration;
(10) wind conditions, to allow cross-wind to be established;
(11) names and functions of all personnel involved in the inspection;

b. Method of making each measurement (where alternatives are available); these may be referenced to the operating instructions;

c. Results and tolerances;

d. Details of associated attachments, e.g. recordings (chart or graph)

e. Details of extra flights made necessary by system adjustments;

f. Assessment by the flight crew of the navigation facility performance;

g. Comments by the flight inspector;

h. Details of any immediately notifiable deficiencies;

i. Status section indicating the operational status of the facility;

j. Statement of conformance/nonconformance; and

k. Signatures of appropriate personnel.

To reduce transcription errors, the report should be computer-generated by the flight inspection system and include explanation of events, remarks and status of the equipment.

From the inspection report it should be possible to trace back the utilized facility database settings, system calibration, antenna calibration diagrams, antenna lever arm corrections, cable loss and all relevant data involved in or related to the calculations used.

Flight Inspection Service Provider shall submit Flight Inspection Interim/preliminary Report to the Air Navigation Service Provider or Aerodrome Service Provider after completion the flight inspection, before leaving the site.

Air Navigation Service Provider or Aerodrome Service Provider shall submit the interim report to NOTAM Office with using a NOTAM format in accordance with the applicable regulation.

3.5.1.3. Flight Inspection Certificate

Flight Inspection Certificate shall be provided by Flight Inspection Service Provider as summary of the implementation of flight inspection including performance and operational status for each flight navigation facility.

Flight Inspection certificate shall content minimum the following information:

a. basic identification items such as the aircraft tail number, facility name, facility identifier, frequency, category and type of inspection, date and time of inspection, names of the pilot and engineer or technician;
b. an assessment reference conducted by the flight crew of the navigation facility performance;
c. comments by the flight inspector/equipment operator;
d. details of any immediately notifiable deficiencies;
e. statement of conformance/nonconformance; and
f. signatures of appropriate personnel.

The Final Report as well as Flight Inspection Certificate for the facility shall be submitted by Flight Inspection Service Provider to Air Navigation Service Provider and Authority within 14 working days after completion of the Flight Inspection.

3.5.1.4. NOTAM of Facility

a. The NOTAM of Facility Status.
   (1) Air Navigation Service Provider must immediately draft NOTAM action whenever there is cause of the facility classification to be restricted (Restricted) or revised from previous status.
   (2) NOTAM of facility shall include name, type, component, and area/height that cannot be used. The absence of elevation information or special distances will refer to all the altitude and distance available, it is important to enter the information certain to avoid confusion.
   (3) A NOTAM must be issued if the restriction will affect instrument flight procedures, minimum approach, or ILS category authorization (CAT) II or III.
   (4) Air Navigation Service provider must verify that the NOTAM issued is appropriate and correct and published in the publication.
b. Notification of Change of Status
   (1) Notification of a permanent change of the facility status is to be done through the appropriate Aeronautical Information Publication (AIP); differences from Standards are to be notified to ICAO and in the AIP.

(2) Notification of temporary changes in the status of facilities are to be promptly and efficiently declared. A change in the status of a commissioned facility as a direct result of ground or flight inspection procedures, and resulting in a change of operational status ("unrestricted/restricted/unusable") or "unusable" designation, shall be advertised immediately by air traffic control (ATC) personnel, and promptly by a Notice to Airmen (NOTAM).

(3) A facility having an "unusable" status shall be removed from service and can operate only for test or troubleshooting purposes. In such cases the facility identification shall be transmitted as TST

(4) Particular attention shall be given to periodic or corrective maintenance procedures that involve false guidance signals being temporarily radiated. These conditions shall be coordinated with ATC and promulgated to users by NOTAM, before the procedures commence.

c. Out-of-Tolerance backup equipment.

If one of the transmitters (of dual system equipment) has out of tolerance parameters, the normal operation transmitter can be operated without NOTAM. However, the NOTAM data describing the restriction must be reserved for maintenance technicians/engineer. In case of limited transmitter Is used, the operation may issue a NOTAM.

d. Restricted Facilities.

The following rules shall be used in preparing NOTAM of facility Restrictions:

(1) Describe Radials or unusable bearing.
(2) Describes height and distance that cannot be used.
(3) VOR / DME / DF / NDB
Draw a radial / bearing from station in a clockwise direction (CW) direction, altitude in terms of at above and below an MSL altitude, and distance in terms of outside or inside in units of nautical miles (nm).
(4) Localizer / LDA / SDF / TLS azimuth.
Draw laterally in terms of degree of left or right inbound only and within nm of the threshold if effect of signal limitation limits can be used closest to the threshold limit. Use the distance (in nm) of the antenna to illustrate the restriction which affects the distance the facility uses. Describe the height in the above or below the height (MSL). Additional reference of DME distance can be used if DME is part of SIAP.
(5) Glide Slope / TLS Elevation.
Draw in degrees left or right only and inbound nm from threshold. Limitations related to altitude must be in above or below of the MSL height. Make sure it is correct reflecting restrictions on the volume of the original service. Additional reference to DME

3.5.2. INSTRUMENT FLIGHT PROCEDURE

The flyability of the instrument procedure of Ground NAV-AID is assessed as part of the flight validation activity conducted in accordance with Quality Assurance Manual for Flight Procedure Design (Doc 9906), Volume V – Validation of Instrument Flight Procedure.

The flight inspection crew must coordinate with the ANSP if the restrictions on NAVAIDs may have an effect on the published instrument's flight procedures. The Specialist procedures shall:

a. Determine the impact of published instrument flight procedures.
b. Initiatives to propose NOTAMs for amendment or change delay the procedure.
c. Evaluating the NAVAID restrictions to determine whether such limits will have an effect on the instrument flight procedure.

4. VERY HIGH FREQUENCY OMNIDIRECTIONAL RADIO RANGE (VOR)

This part provides guidance on the flight inspection requirement applicable to both CVOR and DVOR type VHF Omnidirectional Range (VOR). Since the means by which VOR signals are produced vary from one manufacturer to the other, broad guidelines are provided and adaptation to specific equipment will be required.

4.1. General

VORs should meet all requirements to be classified as unrestricted. The Air Navigation Service Provider shall, after proper coordination, prescribe the use of the facility on a restricted basis and issue Notice to Airmen (NOTAM) accordingly when a specific area of a facility does not meet these operating tolerances.

4.2. Flight Inspection performance parameter.

Summary of VOR Flight Inspection Requirement are listed in Table 4.

Parameter	*Annex 10, Volume I, reference*	*Doc 8071, Volume I, reference*	*Measured*	*Tolerance*	*Uncertainty*	*Inspection type*
Rotation	3.3.1.1	2.3.4	Clockwise	Correct		C, P, S
Sensing	3.3.1.3	2.3.3	Correctness	Correct		C, P, S
Polarization	3.3.3.1	2.3.5	Deviation	±2.0°	0.3°	C, P, S
Pattern accuracy Alignme nt Bends (PFE/PFN) Roughness and scalloping (CMN) Flyability	3.3.3	2.3.9 to 2.3.11 2.3.12 (2.3.47) 2.3.13 (2.3.47) 2.3.14	Deviation	±2.0° ±3.5° ±3.0° Flyable	0.6° 0.6° 0.3° Subjective	C, P, S
Coverage Power density or field strength	3.3.4	2.3.15 2.3.16	Power density	-107 dBW/m² (90 µV/m)* At limits or operational requirements *(recommendation)	3 dB	C
Modulation 9 960 Hz modulation (VOR without voice modulation) 9 960 Hz modulation (VOR with voice modulation) 30 Hz modulation	3.3.5	2.3.17	Modulation depth up to 5º elevation	See Note. 20 to 55% 20 to 35% 25 to 35%	1%	C, P, S
Modulation 30 Hz FM deviation ratio CVOR DVOR (below 5º elevation) DVOR (5º to 40 º elevation)	3.3.5	2.3.17	Deviation ratio	16 ±1° 16 ±1° >11°		C, P
Voice channel	3.3.6.2	2.3.18	Clarity	Clear		C, P
Identification	3.3.6.5	2.3.20 2.3.21	Clarity	Clear		C, P

Parameter	*Annex 10, Volume I, reference*	*Doc 8071, Volume I, reference*	*Measured*	*Tolerance*	*Uncertainty*	*Inspection type*
Speech effect on navigation Bearing Modulation	3.3.6.7	2.3.19	 Deviation Modulation	No effect	 0.3° 1%	C, P
Bearing monitor	3.3.7.1	2.3.22 to 2.3.25	Deviation	±1.0°	0.3°	C

Table 4. Summary of VOR Flight Inspection Requirement

Note. — When modulation is measured during Flight inspection under strong dynamic multipath conditions, variations in the received modulation percentage are to be expected. Short-term variations beyond these values may be acceptable.

Legend: ***C = Commissioning***
P = Periodic as per flight inspection periodization 1.3 (b)
S = Site proving

4.3. Flight Inspection Procedure

4.3.1. Sensing

This check is required at the beginning of the flight inspection and need not be repeated. The bearing of the aircraft from the station must be known. Select an appropriate radial and when the cross-pointer is centered, the indicator should indicate "FROM".

4.3.2. Rotation

Begin an orbit. The radial bearing as indicated should continually decrease for a counterclockwise orbit, or increase for a clockwise orbit. Sensing should be checked before rotation. Incorrect sensing might cause the station rotation to appear reversed.

4.3.3. Polarization effect

The polarization effect results from vertically polarized RF energy being radiated from the antenna system. The presence of undesired "vertical polarization" should be checked by the "attitude effect" and may be further investigated by either the "360" turn method" or the "heading effect" method.

4.3.4. Attitude effect method

The vertical polarization effect should be checked when flying directly to, or from, the facility, at a distance of 10 to 20 NM. The aircraft should be rolled to a 30" bank, first to one side, then to the other, and returned to a straight level flight. Track and heading deviations should be kept to a minimum. Course deviation, as measured on the recording, is the indication of vertical polarization effect.

4.3.5. 30° bank, 360° turn method

a. Vertical polarization maybe checked by executing a 30° bank, 360° turn, 18.5 to 37 km (10 to 20 NM) from the antenna. The turn should begin from an "on-course" (toward the station) position over a measured ground checkpoint.

b. The recording should be marked at the start of the turn and at each *90*° of heading change until the turn is completed. The turn should be completed over the starting point and the recording marked. The recording should show a smooth departure from and return to the "on-course'' position, deviating only by the amount that the aircraft is displaced from the original starting point when the vertical polarization effect is not present. Other excursions of the cross-pointer may be attributed to the vertical polarization effect. The effect of the wing shadowing the aircraft antenna should be considered in evaluating the recording

4.3.6. Pattern accuracy

4.3.6.1. Alignment

a. Alignment can be determined by flying an orbit or by flying a series of radials. The altitude selected for the flight should place the aircraft in the main lobe of the VOR.

b. The orbit should be flown at a height and range that allows the position reference system to accurately determine the position of the aircraft. This will require low, close-in orbits for theodolite-based position systems. Other automated systems will require the orbits to be conducted at a greater range to achieve the required accuracy. The orbit should have sufficient overlap to ensure that the measurement covers the complete 360°. The alignment of the VOR is determined by averaging the error throughout the orbit. Judgement may be exercised where the tracking of the orbit is interrupted to determine the effect of the lost information on the average alignment.

c. Alignment can also be determined by flying a series of radial approaches. These approaches should be conducted at equal angular displacements around the facility. A minimum of eight radials is considered necessary to determine the alignment of the VOR.

4.3.6.2. Bends

A bend is determined by flying a radial pattern and comparing the indicated course against a position reference system. The error is measured against the correct magnetic azimuth of the radial. Deviations of the course due to bends shall not exceed 3.5° from the computed average course alignment and shall remain within 3.5 ° of the correct magnetic azimuths.

4.3.6.3. Roughness and scalloping error

Scalloping is a cyclic deviation of the course line. The frequency is high enough so that the deviation is averaged out and will not cause aircraft displacement. Roughness is a ragged irregular series of deviations. Momentary deviations of the course due to roughness, scalloping or combinations thereof should not exceed 3.0" from the average course.

4.3.6.4. Flyability

Flyability is a subjective assessment by the pilot flying the inspection. Assessment of flyability shall be performed on operational radials and during procedures based on the VOR.

4.3.7. Coverage

a. Coverage of the VOR is the usable area within the operational service volume and is determined during the various checks of the VOR Additional flight checks are required to determine the distance from the facility at which satisfactory coverage is obtained at the specified altitudes.

b. The coverage of a VOR can be affected by factors other than signal strength. Where out-of-tolerance roughness, scalloping, bends, alignment, and/or interference render the facility unusable in certain areas, a restriction should result which should be handled in the same manner as restricted coverage due to lack of signal.

4.3.8. Modulation

The modulation of the 30 Hz reference, 30 Hz variable and 9 960 Hz subcarrier shall be measured during the flight inspection. Note that the roles of the FM and AM signals are reversed between the CVOR and the DVOR.

4.3.9. Identification

a. The identification signal shall be inspected for correctness, clarity, and possible detrimental effect on the course structure. This check should be performed while flying on-course and within radio line-of-sight of the station. Observe the course recording to determine if either code or voice identification affects the course structure. If course roughness is suspected, the identical track shall be flown again with the identification turned off. Maintenance personnel shall be advised immediately if it is determined that the course characteristics are affected by the identification signal.

b. The audible transmission of simultaneous voice/code identification signals shall appear to be equal in volume to the user. The voice identification is not utilized during ground-to-air broadcasts on the VOR frequency, but the coded identification must be audible in the background.

4.3.10. Bearing monitor

The requirements for checking the monitor are as follows:

a. during commissioning inspections; and

b. during subsequent inspections, if the alignment at the reference checkpoint has changed more than one degree from the alignment last established and the monitor has not alarmed

The check is made over the reference checkpoint at the same altitude as that used to establish the reference checkpoint. Position the aircraft inbound or outbound and activate the event mark exactly over the checkpoint while the following course condition exist:

a. with the course in the normal operating condition;
b. with the course shifted to the alarm point;
c. with the course shifted to the alarm point to the opposite direction from b) above; or
d. with the course returned to the normal operating condition.

The course alignment shall be compared, in each of these conditions, by reference to the recordings to determine the amplitude of shift to the alarm point and to verify the return to normal.
Check both transmitters in the same manner when dual monitors are installed. Both should be checked on a systematic basis. Follow the procedure for single monitor check above, except in steps b) and c) the course should be shifted in each direction until both monitors alarm. Determine the amplitude of course-shift required to alarm both monitors

4.3.11. Reference checkpoint

A checkpoint shall be selected during the commissioning inspection on or close to the monitor radial (usually 090 or 270 degrees) and located within 18.5 to 37 km (10 to 20 NM) of the antenna. This checkpoint shall be used in establishing course alignment and shall serve as reference point for subsequent inspections of alignment, monitors, course sensitivity and modulation measurements. Course alignment and sensitivity shall normally be adjusted with reference to this checkpoint. Adjustments made elsewhere will require a re-check of these parameters at this reference checkpoint.

The flight inspector shall record a description of the reference checkpoint that includes the azimuth to the nearest tenth of a degree, the distance from the facility, and the mean sea level (MSL) altitude, which is usually 460 m (1 500 ft) above the antenna. This data shall be revised any time the reference check point is re-established.

The final course alignment error, measured at the reference checkpoint, shall be recorded on the facility data sheet for subsequent reference in order to determine the necessity for a complete monitor check.

4.3.12. Standby Power.

Stand by power, when installed, shall be checked during the commissioning inspection.

The following items shall be evaluated while operating on standby power:

a. course alignment (one radial);
b. course structure; and
c. modulations.

The inspections are to be performed when flying a portion of a radial with the station operating on normal power, and then repeating the check at the same altitude and over the same ground track with the station operating on standby power.

4.3.13. Standby Equipment

Both transmitters shall be checked against each required item of Table 4. These checks may be performed using radial flights and a single alignment orbit.

4.3.14. Complementary Facility.

Facilities associated with the VOR that complement operational use (such as marker beacons, DME, lighting aids that support the visibility minima of an approach procedure, communications, etc.) shall be inspected concurrently with the VOR and in accordance with applicable procedures.

4.3.15. Evaluation of Operational Procedures.

4.3.15.1. Radials

Radials used, or proposed for use, for IFR shall be inspected to determine their capability to support the procedure. On commissioning inspections, a selection of radials proposed for IFR use shall be inspected. The selection shall be based on the following criteria:

a. All radials supporting instrument approach procedures should be selected.
b. Radials should be selected from areas of poor performance indicated by the orbit inspection.
c. Any radials where the coverage may be affected by terrain should be selected.
d. At least one radial should be selected from each quadrant, if appropriate. In general, this should include the longest and lowest radials.
e. Routine inspection requirements are contained in the following paragraphs.

4.3.15.2. En-route radials (airways, off-airway routes, substitute routes)

En-route radials shall be flown either inbound or outbound, along their entire length from the facility to the extremity of their intended use, at the minimum altitude for the associated airway or route as published. The minimum altitude for flying en-route radials, predicated on terminal facilities, is 300 m (1 000 ft) above the highest terrain or obstruction along the radial to a distance of 46.3 km (25 NM). The aircraft shall be flown on the electronic radial and the position of the aircraft shall be recorded using a position reference system.

Reference, variable and 9 960 Hz modulations and the vertical polarization effect shall be checked at least once on each airway and direct-route radial. Signal strength, course deviation and aircraft position should be recorded throughout the radial flight.

Course structure and alignment shall be determined by analysis of the recordings. The recordings should also be analyzed for possible undesirable close-in or over-station characteristics to determine that use of the facility for approach, holding, etc., is not adversely affected.

4.3.15.3. Terminal radials (approach, missed approach, standard instrument departure (SID)

Approach radials shall be evaluated at a distance that includes the procedure turn, holding pattern and missed approach on commissioning inspections. The approach radial shall be flown 30 m (100) ft below specified altitudes. Site and commissioning inspections require two additional radials 5° either side of the approach radial to be flown and analyzed with the same criteria as the approach radial. This needs to be performed only if the approach radial shows performance near the set accuracy requirement. Radials used to support SID procedures shall be evaluated to the extent to which they are used.

4.3.15.4. Intersections

Adjacent facilities that provide intersections should be inspected to determine their capability to support the intersection. Reliable facility performance and course guidance at the approved minimum holding altitude (MHA) shall exist. Minimum signal strength shall exist for the radial(s) 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.

Identification from each facility forming the intersection should be clear and distinct. The signal from each facility should be free from interference at all altitudes below the maximum authorized altitude for holding. A minimum reception altitude should be established for the intersection, which is normally determined by the facility providing the weakest signal.

Note: All minimum en-route altitudes are to be corrected to and reported as true altitudes above mean sea level. All intersections prior to being published and authorized for use are to be flight inspected against the requirements stated above. Routine inspections of intersections can be accomplished adequately by recording an airway radial of one facility and the transition from other facilities forming the fix. Routine inspections can therefore be conducted concurrently with airway radials. Departure from the airway radial that is being inspected to evaluate another radial which is part of the fix is not required, unless detailed investigations become necessary.

4.3.15.5. Cross-check radials

Commissioning and routine flight inspections of cross-check radials are not required provided there is sufficient flight inspection data to support the publication of these radials. The radial(s) shall be inspected prior to being authorized for use if cross-check radials are requested for use in areas outside of the operational service volume of the facility(ies) for which supporting flight inspection data is not available. Thereafter, flight inspections are not required.

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5. DISTANCE MEASURING EQUIPMENT (DME)

This chapter provides guidance on Flight Inspection requirements applicable to the standard distance measuring equipment (DME), as specified in Annex 10, Volume I, 3.5.

5.1. GENERAL

The flight inspection aircraft shall be equipped with a precision three-dimensional reference system, a high quality DME interrogator, an oscilloscope with good timing capability, and a signal processing capability. The flight inspection of DME can be performed separately or in parallel with the more detailed check of the associated ILS, MLS, or VOR facility

In many cases, a DME is installed at the site of a VOR or ILS facility that is already operational. The DME shall not be brought into unrestricted operational use until a commissioning flight inspection has been performed.

5.2. FLIGHT INSPECTION PERFORMANCE PARAMETERS

When conducting a flight inspection of DME, independent of an associated facility, check the following:

1. Accuracy
2. Identification
3. Coverage

Summary of DME Flight Inspection requirement are listed in Table5.

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type (See Notes 1-3)
Coverage Power density or field strength	3.5.3.1.2 3.5.4.1.5.2	3.3.5 to 3.3.8	Power density	Signal strength such that field density ≥–89 dBW/m^2 (690 µV/m) at limits or operational requirements	5 dB	S ,C
Accuracy	3.5.4.5	3.3.9	Distance	≤150 m ≤75 m for DME associated with landing aids	50 m	S, C, P
Pulse shape	3.5.4.1.3	3.3.10	Time, Amplitude	Rise time ≤3 µs Duration 3.5 µs, ±0.5 µs Decay time ≤3.5 µs Amplitude, between 95% rise/fall amplitudes, ≥95% of maximum amplitude	0.1 µs 1%	S, C, P
Pulse spacing	3.5.4.1.4	3.3.11	Time, Amplitude	X channel: 12 ±0.25 µsY channel: 30 ±0.25 µs	0.05 µs	S, C, P
Identification	3.5.3.6	3.3.13	Identification	Correct, clear, properly synchronized	N/A	S, C, P
Reply efficiency	3.5.4.6	3.3.14	Change in efficiency, position	Note areas where this changes significantly	N/A	S, C, P
Unlocks		3.3.15	Unlocking, position	Note where unlocking occurs	N/A	S, C, P
Standby equipment		3.3.16	Suitability	Same as primary transmitter	N/A	S, C, P
Standby power		3.3.17	Suitability	Should not affect transponder parameters	N/A	S, C, P

Table 5. Summary of DME Flight Inspection requirement

Notes:

1. ***Site proving tests (S) are usually carried out to confirm facility performance prior to final construction of the site.***
2. ***Commissioning checks (C) are to be carried out before the DME is initially placed in service. In addition, recommissioning may be required whenever changes that may affect its performance (e.g. variations or repairs to the antenna system) are made.***
3. ***Periodic checks (P) are typically made as per flight inspection periodization 1.3 (b).***

5.3. Flight Inspection Procedures

5.3.1. Coverage

DME coverage must be recorded or annotated and evaluated to the same coverage requirements as the service (ILS/ VOR/ NDB, etc.) it supports. Coverage is validated on one transponder only.

5.3.1.1. Horizontal coverage

The aircraft is flown in a circular track with a radius depending on the service volume of the associated facility around the ground station antenna at an altitude corresponding to an angle of elevation of approximately 0.5° above the antenna site, or 300 m (1000 ft) above intervening terrain, whichever is higher. If there is no associated facility, the orbit may be made at any radius greater than 18.5 km (10 NM). Since this flight is performed close to the radio horizon, it is possible to evaluate variations in field strength by recording the AGC voltage. Flight inspection of the coverage at maximum radius and minimum altitude, as prescribed by the operational requirements for the selected transponder, is usually necessary only on commissioning checks, when major modifications are made in the ground equipment, or if large structures are built in the vicinity of the antenna. The signal strength at the aircraft is generally adequate to maintain the interrogator in the tracking mode. Thus, the equipment itself can be used by the pilot for the desired orbit track guidance.

Note: Checking of the associated VOR can be performed on the same flight. For a terminal class VOR, an orbit of 25 N) can be flown.

5.3.1.2. Vertical Coverage

The following flight inspection may be made to evaluate the lobe pattern of a DME transponder. The Flight Inspection aircraft is used to perform a horizontal flight at approximately 1500 m (5000 ft) on a bearing found suitable. The flight inspector records the RF-level or the AGC from the airborne receiver. Airspace procedures based on the use of DME are evaluated at the minimum flight altitude. The flight inspector verifies that the distance information is properly available in the aircraft at ATC reporting points, along air routes.

5.3.1.3. Distance Accuracy

Check the accuracy of the DME distance information during inspection of radials, orbits, approach procedures, and DME fixes. The exact mileage indication displayed on the distance indicators must be noted on the recordings. Comparison of the scaled distance on the chart (converted to slant range) to the distance indicated by the DME distance indicator at the various points may be made for accuracy determination.

If the ground facility is emitting false reply pulses, erroneous distance information may be present. This condition usually occurs within 25 miles of the antenna. Whenever actual false lock-ons are experienced, the offending facility must be removed from service until this condition is remedied.

5.3.1.4. Identification

The identification must be checked for correctness and clarity, with the aircraft either in orbital or radial flight. A DME associated with an associated facility will be checked for correct synchronization of the two identification signals.

5.3.1.5. Standby Equipment

The standby DME transponder shall be spot- checked to ensure that it meets the same tolerances as the primary equipment. This shall be done at the most critical points during the facility check in order to obtain the comparison.

5.3.1.6. Standby Power

During commissioning and periodic inspections, standby power may be checked by observing operation and noting any appreciable differences in radiated signal characteristics that result from a changeover to standby power. The transponder characteristics (identification, energy radiated, etc.) shall not be degraded when switched to standby power.

5.3.1.7. Chart and Report

The parameters from a DME inspection shall be plotted on a graph relative to the distance or azimuth from the DME under test.

When the DME is associated with ILS, MLS, or VOR, the DME details can be added to the report of this facility. In other cases, a separate report can be issued.

6. INSTRUMENT LANDING SYSTEM

This chapter provides instructions and performance criteria for inspecting localizer and glidepath which operate in the VHF and UHF band as specified in Annex 10, Volume I, 2.7, 3.1 and Doc 8071

6.1. GENERAL

The ILS provides precision guidance to an aircraft during the final stages of the approach. The signals can either be interpreted by the pilot from the instruments or be input directly into the autopilot and flight management system.

Flight inspection of the associated facilities used as integral parts of the instrument landing system (ILS) must be accomplished in accordance with instructions and criteria contained in their respective chapters of this order or in other appropriate documents.

6.2. FLIGHT INSPECTION PERFORMANCE PARAMETERS

A summary of flight inspection requirements for ILS localizer, glide path and markers are given in Tables 6, 7 and 8.

Parameter	***Annex 10, Volume I, reference***	***Doc 8071, Volume I, reference***	***Measured***	***Tolerance***	***Uncertainty***	***Inspection type***		
						S	***C, C***	***P***
Identification	3.1.3.9	4.3.12	Morse code	Proper keying, clearly audible to the limit of the range.	Subjective assessment		x	x
Voice feature	3.1.3.8	4.3.13	Audibility, DDM	Clear audio level similar to identification, no effect on course line.	Subjective assessment		x	x
Modulation — Balance — Depth — Sum	N/A 3.1.3.5 3.1.3.5.3.6.1	 4.3.14 4.3.15 4.4.8	DDM, Modulation, Depth SDM	See Note 1. 0.002 DDM 18% to 22% <60% SDM within ±35° azimuth or actual coverage sector for systems installed post January 2000	 0.001 DDM ±0.5%	 x x	 (x) x x	 x x
Displacement sensitivity	3.1.3.7	4.3.16 to 4.3.20	DDM	Cat I: Within 17% of the nominal value Cat II: Within 17% of the nominal value Cat III: Within 10% of the nominal value See Note 2.	±3 μA ±3 μA ±2 μA For nominal 150 μA input	x	x	x
Off-course clearance	3.1.3.7.4	4.3.21, 4.3.22	DDM	On either side of course line, linear increase to 175 μA, then maintenance of 175 μA to 10°. Between 10° and 35°, minimum 150 μA. Where coverage required outside of ±35°, minimum of 150 μA except in back course sector.	±5 μA For nominal 150 μA input	x	x	x
High-angle clearance	N/A	4.3.23 to 4.3.25	DDM	Minimum of 150 μA.	±5 μA For nominal 150 μA input	x	x	
Course alignment accuracy	3.1.3.6	4.3.26 to 4.3.28	DDM, Distance, Angle	Equivalent to the following displacements at the ILS reference datum: Cat I: ±10.5 m (35 ft) Cat II: ±7.5 m (25 ft) [±4.5 m (15 ft) for those Cat II localizers which are adjusted and maintained within ±4.5 m] Cat III: ±3 m (10 ft)	 Cat I: ±2 m Cat II: ±1 m Cat III: ±0.7m	x	x	x

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C, C	P
Phasing		4.3.39, 4.3.40	DDM	10 µA of the modulation balance value. See Note 3.	±1 µA	x	x	x
DDM increase linear	3.1.3.7.4		DDM	>180 µA (Linear increase from 0 to >180 µA)			x	x
Voice no interference to basic function	3.1.3.8		DDM, Speech	No interference.			x	x
Phase to avoid voice null on dual frequency systems	3.1.3.8.3.1		Speech	No nulls.			x	x
Course structure	3.1.3.4 See Annex 10, Volume I, Attachment C, Note to 2.1.2.5	4.3.29 to 4.3.33	DDM	Outer limit of coverage to Point A: 30 µA all categories Point A to Point B: Cat I: Linear decrease to 15 µA Cat II: Linear decrease to 5 µA Cat III: Linear decrease to 5 µA Beyond Point B: Cat I: 15 µA to Point C Cat II: 5 µA to Reference datum Cat III: 5 µA to Point D, then linear increase to 10 µA at Point E. See Note 4 for application of tolerances.	See Annex 10, Volume I, Att. C, 2.1.5. From Point A to B, 3 µA decreasing to 1 µA From Point B to E, 1 µA	x	x	x

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C, C	P
Coverage (usable distance) — Power density	3.1.3.3 See Annex 10, Volume I, Attachment C, Figures C-7A and C-8A (C-7B and C-8B for the reduced coverage case)	4.3.34 to 4.3.36	Flag status, DDM Power density	-114 dBW/m^2 (40 µV/m) in all parts of operational coverage volume from 25 NM, when within the LOC course sector and on GP: Cat I: -107 dBW/m^2 (90 µV/m) on ILS from 10 NM to 30 m height Cat II: -106 dBW/m^2 (100 µV/m) on ILS from 10 NM, increasing to -100 dBW/ m^2 (200 µV/m) at 15 m height above THR Cat III: -106 dBW/m^2 (100 µV/m) on ILS from 10 NM, increasing to -100 dBW/ m^2 (200 µV/m) at 6 m height above THR, -106 dBW/m^2 (100 µV/m) along the length of the runway *Note.— The conversion is stated in Annex 10, Volume I, 3.1.3.3.2.*	±3 dB	x	x	x
Polarization	3.1.3.2.2	4.3.37	DDM	For a roll attitude of 20° from the horizontal: Cat I: 15 µA on the course line Cat II: 8 µA on the course line Cat III: 5 µA within a sector bounded by 20 µA either side of the course line.	± 1 µA	x	x	
Back course — Sector width	N/A	4.3.41 to 4.3.43	DDM, Angle	Not less than 3°.	0.1°		x	x
— Alignment	N/A		DDM, Distance	Within 60 m of the extended centre line at 1 NM.	±6 m		x	x

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C, C	P
— Structure	N/A	4.3.79	DDM	Limit of coverage to final approach fix: ±40 µA FAF to 1.85 km (1 NM) from threshold: ±40 µA Decreasing at a linear rate to: ±20 µA	Annex 10, Volume I, Attachment C, 2.1.4		x	x
— Modulation depth	N/A		Modulation depth	18% to 22% approximately 9 km (5 NM) from the localizer. See Note 1.	±0.5%		x	x
Monitor system	3.1.3.11	4.3.38		See Note 2.				
— Alignment			DDM, Distance	Monitor must alarm for a shift in the main course line from the runway centre line equivalent to or more than the following distances at the ILS reference datum. Cat I: 10.5 m (35 ft) Cat II: 7.5 m (25 ft) Cat III: 6.0 m (20 ft)	 2 m 1 m 0.7 m		x	x
— Displacement sensitivity			DDM, Distance	Monitor must alarm for a change in displacement sensitivity to a value differing from the nominal value by more than: Cat I: 17% Cat II: 17% Cat III: 17%	 ±4% ±4% ±2%		x	x
— Off-course clearance			DDM	Required only for certain types of localizer. Monitor must alarm when the off-course clearance cross- pointer deflection falls below 150 µA anywhere in the off-course coverage area.	±5 µA ±1 dB relative		x	x

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C, C	P
— Power			Power field strength	Monitor must alarm either for a power reduction of 3 dB, or when the coverage falls below the requirement for the facility, whichever is the smaller change. For two-frequency localizers, the monitor must alarm for a change of ±1 dB in either carrier, unless tests have proved that use of the wider limits above will not cause unacceptable signal degradation (>150 μA in clearance sector)	± 5 μA		x	

Table 5. Flight inspection requirements for localizer

Notes:

1. ***Recommended means by measurement is by ground check.***
2. ***Recommended means of measurement is by ground check, provided that correlation has been established between ground and air measurement.***
3. ***Optional, at the request of the ground technician, unless good correlation between airborne and ground phasing techniques has not been established.***
4. ***Course structure along the runway maybe measured by flight inspection or by ground vehicle.***

Legend: S = Site
C, C = Commissioning, Categorization
P = Periodic — as per flight Inspection periodization
N/A = Not applicable

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C,C	P
Angle — Alignment	3.1.5.1.2.1	4.3.45, 4.3.46	DDM, Angle	Cat I: Within 7.5% of nominal angle Cat II: Within 7.5% of nominal angle Cat III: Within 4% of nominal angle	Cat I: 0.75% Cat II: 0.75% Cat III: 0.3% of nominal angle	x	x	x
— Height of reference datum	3.1.5.1.5 3.1.5.1.6 3.1.5.1.4	4.3.81	DDM	Cat I: 15 m (50 ft) + 3 m (10 ft) (See Note 3) Cat II: 15 m (50 ft) + 3 m (10 ft) (See Note 3) Cat III: 15 m (50 ft) + 3 m (10 ft) (See Note 3)	0.6 m		x	
Displacement sensitivity — Value — Symmetry	3.1.5.6	4.3.47 to 4.3.49	DDM, Angle	Symmetry: Cat I: Between 0.07θ and 0.14θ above and below path Cat I*: 0.12θ above and below path, within ±0.02θ Cat II: 0.12θ above path, within +0.02θ and -0.05θ Cat II: 0.12θ below path, within ±0.02θ Cat III: 0.12θ above and below path, within ±0.02θ * Recommendation Value: Cat I: Within ±25% of nominal displacement sensitivity Cat II: Within ±20% of nominal displacement sensitivity Cat III: Within ±15% of nominal displacement sensitivity	Cat I: 2.5% Cat II: 2.0% Cat III: 1.5%	x	x	x
Clearance — Below path	3.1.5.6.5	4.3.50	DDM, Angle	Not less than 190 µA at an angle above the horizontal of not less than 0.3θ. If 190 µA is realized at an angle greater than 0.45θ, a minimum of 190 µA must be maintained at least down to 0.45θ.	±6 µA for a Nominal 190 µA input	x	x	x
— Above path	3.1.5.3.1			Must attain at least 150 µA and not fall below 150 µA until 1.75θ is reached.				

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C,C	P
Glide path structure	3.1.5.4	4.3.52 4.3.79	DDM	See Note 5. Cat I: From coverage limit to Point C: 30 µA. Cat II and III: From coverage limit to Point A: 30 µA From Point A to Point B: linear decrease from 30 µA to 20 µA. From Point B to reference datum: 20 µA.	Cat I: 6 µA Cat II: 4 µA Cat III: 4 µA	x	x	x
Modulation — Balance — Depth	 3.1.5.5.1	 4.3.53 4.3.54	Modulation depth	See Note 1. 0.002 DDM 37.5% to 42.5% for each tone.	 0.001 DDM 0.5%	 x	 (x) x	 x
Obstruction — Clearance	N/A	 4.3.55	DDM	Safe clearance at 180 µA (Normal), or at 150 µA (wide alarm).	Subjective assessment	x	x	x
Coverage — Usable distance	3.1.5.3.1 Attachment C, Figure 10	4.3.56	Flag status	Satisfactory receiver operation in sector 8° azimuth either side of the localizer centre line for at least 18.5 km (10 NM) up to 1.75θ and down to 0.45θ above the horizontal, or to a lower angle, down to 0.3θ as required to safeguard the glide path intercept procedure.		x	x	x
— Power density or field strength	3.1.5.3.2		Power density	-95 dBW/m² (400 µV/m)	±3 dB			
Monitor system — Angle	3.1.5.7	4.3.57, 4.3.58	DDM, Angle	See Note 2. Monitor must alarm for a change in angle of -7.5/+10% of the promulgated angle	±4 µA		x	x
— Displacement sensitivity			DDM, Angle	Cat I: Monitor must alarm for a change in the angle between the glide path and the line below the glide path at which 75 µA is obtained, by more than 0.037θ. Cat II: Monitor must alarm for a change in displacement sensitivity by more than 25%. Cat III: Monitor must alarm for a change in displacement sensitivity by more than 25%.	±4 µA ±1 dB		x	x

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C,C	P
— Power		4.3.58	Power	Monitor must alarm either for a power reduction of 3 dB, or when the coverage falls below the requirement for the facility, whichever is the smaller change. For two-frequency glide paths, the monitor must alarm for a change of ±1 dB in either carrier, unless tests have proved that use of the wider limits above will not cause unacceptable signal degradation.	±0.5 dB		x	
Phasing	N/A	4.3.59 to 4.3.65		No fixed tolerance. To be optimized for the site and equipment. See Note 4.	N/A		x	x

Table 7. Flight inspection requirements for Glide Path

Notes:

1. Recommended means of measurement is by ground check.
2. Recommended means of measurement is by ground check, provided that correlation has been established between ground and air measurements.
3. This requirement only arises during commissioning and categorization checks. The method of calculating the height of the extended glide path at the threshold is described in 4.3.81, Analysis — Reference datum height (RDH). For Category I approaches on Code 1 and 2 runways, refer to 3.1.5.1.6 of Annex 10, Volume I.
4. Optional, at the request of the ground technician.
5. Tolerances are referenced to the mean course path between Points A and B, and relative to the mean curved path below Point B.

Legend:
- S = Site
- C, C = Commissioning, Categorization
- P = Periodic — as per flight inspection periodization
- N/A = Not applicable

Parameter	Annex 10, Volume I, reference	Doc 8071, Volume I, reference	Measured	Tolerance	Uncertainty	Inspection type		
						S	C,C	P
Keying	3.1.7.4 3.1.7.5	4.3.66	Keying	Proper keying, clearly audible			x	x
Coverage — Indications — Field strength	3.1.7.3 3.1.7.3.2	4.3.67 to 4.3.71	Signal level distanc e Field strength	Proper indication over the beacon or other defined point. When checked while flying on localizer and glide path, coverage should be: OM: 600 m ±200 m (2 000 ft ±650 ft) MM: 300 m ±100 m (1 000 ft ±325 ft) IM: 150 m ±50 m (500 ft ±160 ft) On a normal approach, there should be a well-defined separation between the indications from the middle and inner markers. Measurement should use the Low sensitivity setting on receiver. (Refer to Annex 10 for specific field strength requirements)	±40 m ±20 m ±10 m ±3 dB	x	x	x
Monitor system	3.1.7.7	4.3.72, 4.3.73		An operationally usable indication should be obtained for a reduction in power output of 50%, or a higher power at which the equipment will be monitored. See Note.	±1 dB		x	x
Standby equipment		4.3.74		Same checks and tolerances as main equipment.			x	x

Table 8. Flight inspection requirements for Marker

Note. — Alternatively, this can be checked by analyzing the field strength recording.

Legend: S = Site

C, C = Commissioning, Categorization

P = Periodic — as per flight inspection periodization

N/A = Not applicable

6.3. Flight Inspection procedure

6.3.1. Localizer front course

6.3.1.1. Identification

The coded identification that is transmitted from the facility shall be monitored during the various checks over all of the coverage area. The identification is satisfactory if the coded characters are correct, clear and properly spaced. The transmission of the identification signal should not interfere in any way with the basic localizer function. Monitoring the identification also serves the purpose of detecting frequency interference, which is primarily manifested by heterodyne, or noise which affects the identification.

6.3.1.2. Modulation

a. ***Modulation balance.*** Although the modulation balance is most easily measured on the ground, it shall be measured as well from the air while radiating the carrier signal only. Position the aircraft close to the runway center line and note the cross-pointer indication.

b. ***Modulation depth.*** The percentage of modulation shall be determined only while flying inbound and on course at a point where the receiver signal strength corresponds to the value at which the receiver modulation depth calibration was made, or on the ground during taxiing, backtracking or lining-up operations when the aircraft is close to the runway center line. Therefore, this requirement shall be fulfilled concurrently with the alignment check. If the receiver modulation depth indications are influenced significantly by the RF level, measure the modulation depth near Point A. (An adequate preliminary check of modulation can be made while the aircraft is crossing the course during the displacement sensitivity check.) Modulation percentage is determined by the use of calibration data furnished with the individual receiver.

6.3.1.3. Displacement sensitivity

There are two basic methods of measuring the displacement sensitivity:

1. approaches on the edges of the course sector.
2. crossovers or orbits through the course sector, at right angles to the extended runway center line.

For special and commissioning flight inspections, the approach method is recommended. For all flight inspections the discrepancy between ground and air measurement shall not exceed 10 per cent of the nominal displacement sensitivity; where this degree of correlation is not achieved, the reason for the discrepancy shall be resolved. On initial categorization, the displacement sensitivity shall be set to the nominal value for that installation.

To determine the half-sector width in degrees using the approach method, fly the aircraft on either side of the course line so that the average cross-pointer deflection is 75 (or 150) microamperes in each instance. The average angular position of the aircraft, measured by the tracking device on each side of the course line, will define the angular value of the half-sector width. The following formula must be used to compute an equivalent angular change that corresponds to a displacement sensitivity percentage change:

$$\text{New sector width} = \frac{\text{current sector width}}{(1+ \text{change }\%)}$$

Example calculation:

Wide sector (-17% displacement sensitivity) = 6.0 /(1 + (-0.17)) = 6.0/(1 - 0.17) = 6.0/0.83 = 7.23;

Narrow sector (+17% displacement sensitivity) = 6.0 /(1 + (+0.17) = 6.0/(1 + 0.17) = 6.0/1.17 = 5.13;

Note. — Deviation of the aircraft toward the runway extended center line will reduce the accuracy of the measurements — normally the average cross-pointer deflection should be within 15 (or 30) microamperes of the intended value.

The crossover or orbital method of displacement sensitivity measurement is typically used during periodic inspections. In case of structure perturbation, the approaches on the edges of the course sector are to be used during periodic inspections to minimize measurement errors.

When the crossover or orbital method is used, the measurement is made at a convenient known distance from the localizer antenna, taking into account ground speed and the sampling rate and delay of the navigation receiver and position reference system. To best calculate the displacement sensitivity, it is necessary to use several samples from the linear DDM area and find the slope of the straight line that fits the data. In order to provide an accurate reference for subsequent use, and to correlate the results with the half-sector width measurement, this abbreviated procedure shall initially be carried out during the commissioning or major inspection.

The following is an example of measuring course displacement sensitivity by this method. Fly a track at right angles to the localizer course line so as to pass directly over the outer marker, or selected checkpoint, at a height of 460 m (1 500 ft) above the localizer antenna site elevation. The flight should begin sufficiently off course to assure stable airspeed prior to penetration of the course sector. Follow the aircraft position with the tracking device and measure the angles at which -150, -75, 0, 75 and 150 μA occur. The full sector from -150 to 150 μA should be flown so that linearity can be assessed by examining the recordings.

6.3.1.4. Off-course clearance

The localizer clearance is checked to determine that the transmitted signals will provide the user with the proper off-course indication and that there are no false courses. Conduct an orbital flight with a radius of 9 to 15 km (5 to 8 NM) from the facility and approximately 1 500 ft above the antenna. Where terrain is a factor, the height will be adjusted to provide line-of-sight between the aircraft and the antenna.

Clearance shall be checked within the promulgated angular limits of coverage provided on either side of the front course (typically 35 degrees), unless the back course is used for approaches. In such cases, clearances will also be checked to the angular coverage limits of the back course. Outside of the promulgated coverage, there may be false courses due to antenna pattern characteristics or environmental conditions.

6.3.1.5. High angle clearance

The combination of ground environment and antenna height can cause nulls, or false courses, which may not be apparent at all normal instrument approach altitudes. High altitude clearance shall therefore be investigated upon:

a. initial commissioning;

b. a change in the location of an antenna;
c. a change in the height of an antenna; or
d. installation of a different type antenna.

High-angle clearance is investigated within the angular limit of coverage provided, in the same manner as for off-course clearance, at a height corresponding to an angle of 7 degrees above the horizontal through the antenna. If the minimum clearance at this height, in an orbit of 5 to 8 NM, exceeds 150 microamperes, and the clearance is satisfactory at 1 000 ft, the localizer will be assumed as satisfactory at all intermediate altitudes. Where the clearance is not satisfactory, additional checks will be made at lower heights to determine the highest level at and below that which the facility may be used. In such a case, procedural use of the localizer shall be restricted.

If approach altitudes higher than the height of 6 000 ft above the antenna elevation are required locally, investigation shall also be made at higher heights to determine that adequate clearance is available and that no operationally significant false courses exist.

6.3.1.6. Course alignment accuracy

The measurement and analysis of localizer course alignment shall take into account the course line bends. The alignment of the mean course line needs to be established in the following critical region before the appropriate decision height:

Category I : for at least 0.5 NM containing of ILS Point B
Category II : ILS Point B to ILS reference datum
Category III : ILS Point C to ILS Point D

A normal ILS approach shall be flown, using the glide path, where available. The aircraft's position shall be recorded using the tracking or position-reference system. By relating the aircraft average position to the average measured DDM, the alignment of the localizer may be determined.

Where there are course line bends in the area being evaluated, they shall be analyzed so that the average localizer alignment may be calculated.

6.3.1.7. Course structure

This is an accurate measurement of course bends and may be accomplished concurrently with the alignment and displacement sensitivity checks. Recordings of approaches made during the course alignment check and during the course sensitivity checks can be used for the calculation of course bends.

The center, or mean, of the total amplitude of bends represents the course line for bend evaluation purposes, and the tolerance for bends is applied to that as a reference. If the evaluation is made on airborne data, low pass filtering of the position-corrected cross-pointer signal is necessary to eliminate high-frequency structure components of no practical consequence.

The total time - constant of the receiver and recorder DDM circuits for the measurements shall be referenced to an aircraft speed of 105 knots, for which the constant is approximately 0.5 second (refer to Attachment C to Annex 10, Volume I, 2.1.6, for specific filter guidance). From the recording of airborne measurements, the alignment for each zone for application of structure tolerances may be determined as the average course position between the runway threshold and Point D, and separately between Point D and Point E. To analyze the post-filtering low frequency spectral components, the guidance found in Attachment C to Annex 10, Volume I, 2.1.3 and 2.1.5, shall be used, with the structure tolerances referenced to the average course position in each zone.

For the evaluation of a course center line structure, a normal approach shall be flown, using the glide path, where available. For Category II and III localizers, the aircraft shall cross the threshold at approximately the normal design height of the glide path and continue downward to the normal touchdown point. Continue a touchdown roll until at least Point E. Optionally, the touchdown roll may be conducted from touchdown to Point D, at which point a take- off may be executed, with an altitude not exceeding 15 m (50 ft) until Point E is reached. These procedures shall be used to evaluate the localizer guidance in the user's environment. Accurate tracking or position reference shall be provided from ILS Point A to the following points:

for Category I : ILS reference datum
for Category II : ILS reference datum
for Category III : ILS Point E

For Category III bend evaluation between the ILS reference datum and ILS Point E, ground measurements using a suitably equipped vehicle may be substituted for flight inspection measurements. This is the only area where a direct comparison between the ground and flight measurement results is possible. Therefore, it is useful to perform this measurement with the flight inspection aircraft to allow a comparison between the two measurement results.

If the localizer's course is used for take-off guidance, bend measurements along the runway should be made for any category of ILS.

Guidance material concerning course structure is provided in 2.1.3 to 2.1.6 of Attachment C to Annex 10, Volume I.

Note. — Course structure shall be measured only while the course sector is in its normal operating width.

6.3.1.8. Coverage

This check is conducted to determine whether the facility provides the correct information to the user throughout the area of operational use. Coverage has been determined, to some extent, by various other checks; however, additional procedures are necessary to complete the check of the coverage at distances 18.5, 31.5 and 46.3 km (of 10, 17 and 25 NM) from the antenna.

Flights at appropriate heights are required for routine and commissioning inspections to ensure the following coverage requirements are satisfied.

The localizer coverage sector is specified as follows (Annex 10, Volume I, 3.1.3.3.1):

The localizer coverage sector shall extend from the center of the localizer antenna system to distances of:

46.3 km (25 NM) within plus or minus 10 degrees from the front course line;
31.5 km (17 NM) between 10 degrees and 35 degrees from the front course line;
18.5 km (10 NM) outside of plus or minus 35 degrees from the front course line if coverage is provided;

except that, where topographical features dictate or operational requirements permit, the limits may be reduced down to 33.3 km (18 NM) within the plus or minus 10-degree sector and 10 NM within the remainder of the coverage when alternative navigational means provide satisfactory coverage within the intermediate approach area.

The localizer signals shall be receivable at the distances specified at and above a height of 600 m (2 000 ft) above the elevation of the threshold, or 300 m (1 000 ft) above the elevation of the highest point within the intermediate and final approach areas, whichever is the higher; except that, where needed to protect ILS performance and if operational requirements permit, the lower limit of coverage at angles beyond 15 degrees from the front course line shall be raised linearly from its height at 15 degrees to as high as 1350 m (4 500 ft) above the elevation of the threshold at 35 degrees from the front course line. Such signals shall be receivable, to the distances specified, up to a surface extending outward from the localizer antenna and inclined at 7 degrees above the horizontal.

Note. — Where intervening obstacles penetrate the lower surface, it is intended that guidance need not be provided at less than the line-of-sight heights."

In the specification above, all the localizer coverage requirements are based on the assumption that the aircraft is heading directly towards the facility. When power density measurements are gain compensated based on the aircraft antenna pattern polar diagram(s), arc profiles can also be performed for coverage checks.

At periodic inspections, it is necessary to check coverage only at 31.5 km (17 NM) and 35 degrees either side of the course, unless use is made of the localizer outside of this area. Arc profiles may be flown at distances closer than this, provided an arc profile is flown at the same distance and altitude during the commissioning inspection to establish reference values.

6.3.1.9. Polarization

This check is conducted to determine the effects of undesired vertically polarized signal components. While maintaining the desired track (on the extended center line), bank the aircraft around its longitudinal axis 20 degrees each way from level flight. The aircraft's position shall be monitored using an accurate tracking or position-reference system. Analyze the cross-pointer recording to determine if there are any course deviations caused by the change in aircraft (antenna) orientation.

The effects of vertically polarized signal components are acceptable when they are within specified tolerances. If this check is accomplished in the area of the outer marker, the possibility of errors due to position changes will be lessened. The amount of polarization effect measured also depends on polarization characteristics of the aircraft antenna, hence the vertical polarization effect of the aircraft antenna should be as low as possible.

6.3.1.10. Localizer monitors

Localizer course alignment and displacement sensitivity monitors shall be checked by flight inspection. A suggested method of flight inspection is given below:

a. *Alignment monitor.* Request the ground technician to adjust the localizer equipment to cause an alarm of the alignment monitor. Fly the aircraft on the extended center line of the runway as indicated by the position reference system and note the precise displacement in microamperes from the recording in each condition of the alarm to the right and left of the center line. After the course has been readjusted to a normal operating condition, its alignment should be confirmed.

b. *Displacement sensitivity monitor.* Request the maintenance technician to adjust the displacement sensitivity to the broad and narrow alarm limits and check the displacement sensitivity in each condition. This check should follow the normal displacement sensitivity check described in 6.3.1.3.

c. The crossover or orbital flight method shall be used only if good correlation with a more accurate approach method has been established. After the alarm limits have been verified or adjusted, it is also necessary to confirm the displacement sensitivity value in the normal operating condition.

Note.— **During commissioning inspection or after major modifications, clearance shall be checked while the displacement sensitivity is adjusted to its broad alarm limit. The values of 175 microamperes and 150 microamperes specified for application during normal displacement sensitivity conditions will then be reduced to 160 microamperes and 135 microamperes, respectively.**

d. *Power monitor.* For single-frequency systems, the field strength of the localizer signal shall be measured on course at the greatest distance at which it is expected to be used, but not less than 33.3 km (18 NM), while operating at 50 per cent of normal power**.** For two-frequency carrier systems, the field strength of the localizer signal shall be measured on course at the greatest distance at which it is expected to be used, but not less than 33.3 km (18 NM), while operating at 80 per cent of normal power for the both carriers. Power monitor requirements for single-frequency and two-frequency systems are described in Annex 10, Volume I, 3.1.3.11.2 d) and e).

   In addition, if ground inspections do not allow control of the structure along the center line, the structure performances have to be met on course while operating at 80 per cent of normal power for the carrier providing a radiation field pattern in the front course sector and 120 per cent for the carrier providing a radiation field pattern outside that sector. If the alarm thresholds are lower than these 1 dB values but not less than 3 dB, the structure performances have to be met at these lower values (less than 100 per cent for the front course sector carrier and more than 100 per cent for the other carrier).

   The clearance areas have also to be checked, with the carrier providing a radiation field pattern in the front course sector at 120 per cent of the nominal value or at the upper alarm limit, while the carrier providing a radiation field pattern outside that sector at 80 per cent of the normal value or at the lower alarm limit.

6.3.1.11. Phasing

The following phasing procedure applies to typical localizer systems. Alternative phasing procedures in accordance with the manufacturer's recommendations should be followed for other types of localizers. To the extent possible, methods involving ground test procedures should be used, and airborne measurements made only upon request from ground maintenance personnel. If additional confirmation is desirable by means of a flight inspection, the following is a suitable example procedure:

Note.— Adjustments made during the phasing procedure may affect many of the radiated parameters. For this reason, it is advisable to confirm the localizer phasing as early as possible during the commissioning tests.

a. Measure the displacement sensitivity of the localizer if it is not already determined.

b. Feed the localizer antenna with the carrier equally modulated by 90 Hz and 150 Hz and load the sideband output with a dummy load. Note the cross-pointer deflection as X (90) or X (150) microamperes.

c. The aircraft should be flown at a suitable off-course angle (depending on the type of localizer antenna used) during the phasing adjustment and should not be closer than 5.6 km (3 NM) from the antenna.

d. Insert a 90-degree line in a series with the sideband input to the antenna and feed the antenna with sideband energy.

e. Adjust the phaser until the deviation indicator reading is the same as in b) above.

f. Remove the 90-degree line, used in step d) above.

This completes the process of phasing the carrier with the composite sidebands. As an additional check, displacement sensitivity should be rechecked, and compared with that obtained in step a) above. The value obtained after the phasing adjustment should never be greater than the value obtained before the phasing adjustment.

6.3.2. Localizer back course

Where the localizer back course is to be used for approaches to landing, it shall be evaluated for commissioning and at periodic intervals thereafter. Procedures used for checking the front course will normally be used for the back course, the principal difference being the application of certain different tolerances, which are given in Table 5. As a minimum, alignment, sector width, structure, and modulation depth shall be inspected as well.

Under no circumstances should localizer equipment be adjusted to enhance performance of the back course, if the adjustment would adversely affect the desired characteristics of the front course.

6.3.3. GLIDE PATH

Most glide path parameters can be tested with two basic flight procedures — an approach along the course line, and a level run or orbit through the localizer course sector. Variations include approaches above, below, or abeam the course line, and level runs left and right of the extended runway center line. By selecting suitable starting distances and angles, several measurements can be made during a single aircraft maneuver.

6.3.3.1. Glide path angle (site, commissioning, categorization and periodic)

The glide path angle may be measured concurrently with the glide path structure during these inspections. To adequately check the glide path angle, an accurate tracking or positioning device shall be employed. This is necessary in order to correct the recorded glide path for aircraft positioning errors in the vertical plane.

The location of the tracking or positioning equipment with respect to the facility being inspected is critical for accurate measurement. Incorrect siting can lead to unusual characteristics being shown in the glide path structure measurements. The tracking device shall initially be located using the results of an accurate ground survey. In certain cases, initial flight results may indicate a need to modify the location of the tracking device.

At commissioning, the glide path angle shall be adjusted to be as near as possible to the desired nominal angle. During periodic inspections, the glide path angle must be within the figures given in Table 6.

6.3.3.2. Displacement sensitivity (site, commissioning, categorization and periodic)

The mean displacement sensitivity is derived from measurements made between ILS Point A and Point B. Make approaches above and below the nominal glide path at angles where the nominal cross-pointer deflection is 75 µA and measure the aircraft's position using an accurate tracking device. During these measurements, the average cross- pointer deflection should be 75 ±15 µA. Note that any aircraft deviation toward the zero DDM course line will decrease the accuracy of the measurement. The displacement sensitivity can be calculated by relating the average cross-pointer deflection to the average measured angle.

6.3.3.3. Glide path angle and displacement sensitivity (routine periodic inspections)

The glide path angle and displacement sensitivity can be measured by using a level run or "slice" method. This is only possible where the glide path is relatively free from bends so that there is a smooth transition from fly-up to fly-down on the level run. This method shall not be used with systems that have asymmetrical displacement sensitivity above and below the glide path.

Level run method. Fly the aircraft towards the facility at a constant height (typically the intercept altitude), following the localizer center line, starting at a point where the cross-pointer deflection is more than 75 µA fly-up (more than 190 µA recommended). This flight is usually made at 460 m (1 500 ft) above the facility unless terrain prevents a safe flight. If a different height is used, it shall be noted on the flight inspection report and facility data sheet. During the flight, the aircraft's angular position shall be constantly tracked. By relating the recorded cross-pointer current to the measured angles, the glide path angle and displacement sensitivity may be calculated. The exact method of correlating the angle and cross-pointer measurements is dependent on the particular flight inspection system.

6.3.3.4. Clearance

The clearance of the glide path sector is determined from a level run, or slice, through the complete sector during which the glide path transition through the sector is recorded. This measurement may be combined with the level flight method of measuring the glide path angle and displacement sensitivity.

This flight is made using the level run method, except that the run shall commence at a distance corresponding to 0.3θ and shall continue until a point equivalent to twice the glide path angle has been passed. The aircraft's position shall be accurately measured throughout the approach. Cross-pointer current shall be continuously recorded and the recording marked with all the necessary distances and angles to allow the figures required in Table 6 to be evaluated. This recording shall also permit linearity of the cross-pointer transition to be evaluated.

6.3.3.5. Glide path structure

Glide path structure is an accurate measurement of the bends and perturbations on the glide path. It is most important to employ an accurate tracking or positioning device for this measurement. This measurement may be made concurrently with the glide path angle measurement. Guidance material concerning course structure evaluation is provided in 2.1.4 of Attachment C to Annex 10, Volume I.

6.3.3.6. Modulation

a. **Modulation balance.** The modulation balance is measured while radiating the carrier signal only. Position the aircraft close to the glide path angle and note the cross-pointer indication. Flight inspection of modulation balance should be conducted on specific engineering request only.

b. **Modulation depth.** This check can be best accomplished accurately while the aircraft is "on-path"; therefore, final measurements are best obtained during angle checks. The measurements should be made at a point where the receiver input corresponds to the value at which the receiver modulation depth calibration was made. If the receiver modulation depth indications are influenced significantly by the RF level, measure the modulation depth near Point A. For measurement systems that do not provide separate modulation level outputs, preliminary indications of modulation can be obtained during level runs at the time the aircraft crosses the glide path. The depth of modulation (in per cent) can be obtained by comparing the glide path receiver- flag-alarm-current to the receiver-flag-current-calibration data.

6.3.3.7. Obstruction clearance

Checks may be made beneath the glide path sector to assure a safe flight path area between the bottom edge of the glide path and any obstructions. To accomplish this check, it is necessary to bias the pilot's indicator or use an expanded scale instrument. Position the aircraft on the localizer front course inbound at approximately five miles from the glide path antenna at an elevation to obtain at least 180 µA "fly-up" indication. Proceed inbound maintaining at least 180 µA clearance until the runway threshold is reached or it is necessary to alter the flight path to clear obstructions. This check will be conducted during monitor checks when the path width is adjusted to the wide alarm limits during which a minimum of 150 µA fly-up is used in lieu of 180 µA. When this check has been made during broad path width monitor limit checks, it need not be accomplished after the path is returned to the normal width of the normal approach envelope, except during the commissioning inspection.

6.3.3.8. Glide path coverage

This check may be combined with the clearance check using the same flight profile. If a separate flight is made, it is not necessary to continue the approach beyond the intercept with the glide path lower width angle.

At site, commissioning, categorization and periodic checks this measurement shall be made along the edges of a sector 8 degrees either side of the localizer center line. Coverage will be checked to a distance of 18.5 km (10 NM) from the antenna. Coverage will be checked to a distance greater than 18.5 km (10 NM) to the extent required to safeguard the promulgated glide path intercept procedure.

Note. — Flight inspection alone is not sufficient to extend glide path coverage beyond 10 NM (e.g. Frequency coordination).

6.3.3.9. Monitors

Where required, monitor checks may be made using identical measurement methods to those described for glide path angle, displacement sensitivity and clearance. The level flight method for angle and displacement sensitivity shall not be used if there is non-linearity in the areas being evaluated.

Note. — If checks are required, see Note 2 of Table 7.

Power monitor (commissioning only). The field strength of the glide path signal shall be checked at the limits of its designated coverage volume, with the power reduced to the alarm level. Alternatively, if the monitor alarm limit has been accurately measured by ground inspection, the field strength may be measured under normal operating conditions and the field strength at the alarm limit may be calculated. This check may be made at the same time as clearance and coverage checks.

6.3.3.10. Phasing and associated engineering support tests

The glide path site test is made to determine whether the proposed site will provide satisfactory glide path performance at the required path angle. It is extremely important that the site tests be conducted accurately and completely to avoid re-siting costs and unnecessary installation delays. Because this is functionally a site-proving test rather than an inspection of equipment performance, only one transmitter is required.

A preliminary glide path inspection is performed upon completion of the permanent transmitter and antenna installation, but prior to permanent installation of the monitor system. This inspection is conducted on one transmitter as a preliminary confirmation of airborne characteristics of the permanent installation. Additionally, it provides the installation engineer with data that enables the engineer to complete the facility adjustment to the optimum for the commissioning inspection. This requires the establishment of transmitter settings for monitor alarm limits. These settings may be utilized by ground personnel to determine that the field monitor is installed at its optimum location and that integral monitors recombining units are correctly adjusted to achieve the most satisfactory overall monitor response.

The procedures for conducting various glide path engineering support tests are described below. These checks will be performed by ground methods prior to the flight inspection, and airborne checks will be conducted at the option of the ground technician. It is not intended that they will supplant ground measurements, but that they will confirm and support ground tests. The details of these tests will be included in the flight inspection report.

a. ***Modulation balance.*** Although the modulation balance is most easily measured on the ground, it may be measured from the air while radiating the carrier signal only. Fly a simulated "on-path" approach recording the glide path indications. The average deviation of the glide path indication from "on-path" should be noted for use in the phasing check. Ground personnel shall be advised of the result. The optimum condition is a perfect balance, i.e. zero on the precision microammeter. If the unbalance is 5 µA or more, corrective action shall be taken by ground personnel before continuing this test.

Note.— Level runs are not satisfactory for this test since shifting of centering may occur in low-signal or null areas.

b. ***Phasing — transmitting antennas****.* The purpose of the phasing test is to determine that optimum phase exists between the radiating antennas. There are several different methods of achieving airborne phasing and these tests shall normally be made using the manufacturer's recommended methods. Where difficulty is experienced in achieving airborne phasing to a definite reading by normal procedures, the flight inspector shall coordinate with the ground engineer to determine the most advantageous area for conducting the phasing test. When this area and track are determined, it shall be noted on the facility data record for use on future phasing tests of that facility.

c. ***Phasing — monitor system.*** Some types of glide path integral monitor need flight inspection checks to prove that they will accurately reproduce the far-field conditions when changes occur in transmitted signal phases. Procedures for making such checks shall be developed in conjunction with the manufacturer's recommendations.

d. ***Glide path antenna adjustment (null checks).*** These checks are conducted to determine the vertical angles at which the RF nulls of the various glide path antennas may occur. The information is used by ground engineer to assist them in determining the correct heights for the transmitting antennas. The test is made with carrier signals radiating only from each antenna in turn. The procedure for conducting this test is by level flight along the localizer course line. The angles of the nulls will be computed in the same manner as the glide path angle is computed. The nulls are characterized by a sharp fall in signal level.

6.3.4. MARKER BEACON

6.3.4.1. Keying.

The keying is checked during an ILS approach over the beacons. The keying is assessed from both the aural and visual indication and is satisfactory when the coded characters are correct, clear and properly spaced. The frequency of the modulating tone can be checked by observing that visual indication is obtained on the correct lamp of a three-lamp system, i.e. outer marker (OM) — blue, middle marker (MM) — orange and inner marker (IM) — white.

6.3.4.2. Coverage.

Coverage is determined by flying over the marker beacons during a normal ILS approach on the localizer and glide path and measuring the total distance during which a visual indication is obtained from a calibrated marker receiver and antenna or during which a predetermined RF carrier signal level is obtained.

At commissioning:

a. The coverage shall be determined by making a continuous recording of the RF signal strength from the calibrated aircraft antenna, since this allows a more detailed assessment of the ground beacon performance. The visual indication distance should be noted for comparison with subsequent routine checks.
   For routine checks, measuring the distance over which the visual indication is received will be sufficient, although the above procedure of recording signal strength is recommended.

The signal strength recording shall be examined to ensure that there are no side-lobes of sufficient signal strength to cause false indications, and that there are no areas of weak signal strength within the main lobe.

b. A check shall be made that the center of the coverage area is in the correct position. This will be over the marker beacon but in some cases, due to siting difficulties, the polar axis of the marker beacon radiation pattern may have to be other than vertical. Reference shall then be made to the operational procedures to determine the correct location of the center-of-coverage, with respect to some recognizable point on the ground. The center-of-coverage can be checked during the coverage flights described above, by marking the continuous recording when the aircraft is directly over the marker beacon (or other defined point). On a normal approach there shall be a well-defined separation (in the order of 4.5 seconds at 180 km/hr (95 kt)) between the indications obtained from each marker.

At commissioning, categorization and annual inspections, a check shall also be made to ensure that operationally acceptable marker beacon indications are obtained when an approach is made on the glide path but displaced ±75 µA from the localizer center. The time at which the indication is obtained will usually be shorter than when on the localizer center.

6.3.4.3. Monitor system

At commissioning, the coverage shall be measured with the marker beacon operating at 50 per cent of normal power and with the modulation depth reduced to 50 per cent. An operationally usable indication shall still be obtained; if not, the power shall be increased to provide an indication and the monitor adjusted to alarm at this level.

Alternatively, the coverage under monitor alarm conditions can be determined by analyzing the field strength recording as detailed in 6.3.4.2

6.3.4.4. Standby equipment

At commissioning, the standby equipment is checked in the same manner as the main equipment. It will not be necessary to check both the main and standby equipment at each routine check, if the equipment operation has been scheduled so that the routine checks are carried out on each equipment alternately.

6.4. CHARTS AND REPORTS

The ILS flight inspection report shall record the conformance of the facility performance to the Standards defined in Annex 10 as well as the equipment specific standards established by the authorized flight inspection organization and the responsible ground maintenance organization. Tables 6 and 7 list the parameters to be measured for localizer and glide path facilities, as well as localizer back course approaches. Table 8 summarizes the parameters to be measured for ILS Marker Beacons. It is recommended that the flight inspection report include an assessment of the parameters listed in Tables 5 through 7, which are appropriate for the type of inspection. Flight inspection reports shall allow for “As found” and “As left” results to be entered for routine documentation of the adjustments made to facilities.

6.4.1. Report contents

The ILS flight inspection report shall contain the minimum information as mentioned in Chapter 3 paragraph 3.5.1.2.

The following are additional requirement shall be established for ILS flight Inspection report:

a. Selected receivers, antennas, reference source and other selectable parameters must be traceable for each profile.

b. Glide path (GP) aiming point offset calculations are terrain dependent and are normally calculated and compensated for during commissioning.
c. Recordings and results should be configurable for ILS ground maintenance personnel in their requested format, e.g. with DDM instead of µA, if so required.
d. A full set of applicable calculated data are presented in the result section of the enclosed report.
e. The results should be automatically checked against the tolerances specified and applied by ICAO regulations (or otherwise towards stated regulations), and any out of tolerance situations should be highlighted (i.e. * or red color).
f. The course and glide path structure calculation shall be based on a 95 per cent probability according to Annex 10, Volume 1, Figure C-2.
g. As found and as left results, with adjustments and repeated profiles, shall be properly noted and explained.
h. If specific tests are requested by ILS ground maintenance personnel, the report shall include results accordingly.
i. If any unforeseen events occur, this shall be highlighted in the remarks section.
j. Current and any new restrictions applied shall be properly referenced in the remarks section

7. PRECISION APPROACH RADAR (PAR)

(RESERVED)

INTENTIONALLY LEFT BLANK

8. NON-DIRECTIONAL BEACON (NDB)

(RESERVED)

INTENTIONALLY LEFT BLANK

9. PERFORMANCE BASED NAVIGATION (PBN)

9.1. VOR for PBN

(RESERVED)

9.2. DME for PBN

(RESERVED)

INTENTIONALLY LEFT BLANK

10. SURVEILLANCE RADAR SYSTEM

(RESERVED)

ATTACHMENT A : GROUND CHECK FORM.

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ATTACHMENT A OF FLIGHT INSPECTION MANUAL

GROUND INSPECTION FORM
AERONAUTICAL TELECOMMUNICATION FACILITIES

MONTH : DATE :
AIRPORT :
EQUIPMENT : ILS LOCALIZER
SITE NAME :
EQUIPMENT FUNCTION :
TECHNICAL DATA : FREQ. : IDENTIFICATION :
LAST CALIBRATION : DATE :

SR	PARAMETERS	MEASUREMENT RESULT AFTER FLIGHT CALIBRATION	TOLERANCE	GROUND INSPECTION MEASUREMENT						REMARK
				TX1			TX2			
				MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	
A	**BUILD IN TEST PARAMETER**									
1	RF POWER LEVEL		P_{OUT} (Commissioning) - 3 db							
2	COURSE ALIGNMENT		0.0000 DDM ±0,0015 DDM Cat II: < 7.5 m							
3	DEPTH OF MODULATION		20% ±2%							
4	SUM OF MODULATION DEPTHS		40% ±4%							
5	IDENTIFICATION MODULATION DEPTH		10% $\pm$ 5%							
6	MONITORING :									
	- COURSE SHIFT		7.5 m							
	- CHANGE IN DISPLACEMENT		0.17							
	SENSITIVITY									
	- CLEARANCE SIGNAL		150 µA							
	- TOTAL TIME OF OUT OF TOLERANCE		5 s							
	RADIATION									
	- REDUCTION IN POWER		-3 dB dari Comm							
B	**ADDITIONAL TEST EQUIPMENT**									
1	RF POWER LEVEL		Field strength Comm - 3 db							
2	COURSE ALIGNMENT		<7,5 meter (25 ft)							
3	DISPLACEMENT SENSITIVITY		0,00145 DDM/m ±17%							
4	SPURIOUS MODULATION		<0,005 DDM peak to peak							
5	DEPTH OF MODULATION		20% ±2%							
6	SUM OF MODULATION DEPTHS		Modulation depth <60%							
7	ORIENTATION		Correct							
8	FREQUENCY		Single frequency : 0.005%							
			Dual frequency : 0.002%							

SR	PARAMETERS	MEASUREMENT RESULT AFTER FLIGHT CALIBRATION	TOLERANCE	GROUND INSPECTION MEASUREMENT						REMARK
				TX1			TX2			
				MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	
			5kHz < Diff. < 14 kHz							
9	CARRIER MODULATION FREQUENCY (90 Hz and 150 Hz)		±1.5% (Cat : II)							
10	IDENTIFICATION TONE FREQUENCY		1020 ±50Hz							
11	IDENTIFICATION MODULATION DEPTH		5 % - 15%							
C	**OTHERS**									
1	IDENTIFICATION SPEED		7 words / minutes							
2	IDENTIFICATION REPETITION RATE		> 6 times/minutes							
3	INTERCONECTION									
4	ANTENA									
5	CHANGE OVER (MAIN TO STANDBY)		5 s							
6	INDICATORS									
7	REMOTE CONTROL AND MONITORING SYSTEM									

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ATTACHMENT A OF FLIGHT INSPECTION MANUAL

GROUND INSPECTION FORM
AERONAUTICAL TELECOMMUNICATION FACILITIES

MONTH : DATE :
AIRPORT :
EQUIPMENT : ILS GLIDE PATH
SITE NAME :
EQUIPMENT FUNCTION :
TECHNICAL DATA : FREQ. :
LAST CALIBRATION : DATE :

SR	PARAMETER	MEASUREMENT RESULT AFTER FLIGHT CALIBRATION	TOLERANCE	GROUND INSPECTION MEASUREMENT						REMARK
				TX1			TX2			
				MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	
A.	**BUILT IN TEST PARAMETERS**									
1	RF POWER LEVEL		Pout Comisioning - 3 db							
2	PATH ANGLE		0.000 DDM ± 0.055 DDM Within 7.5% of nominal angle for Cat.II							
3	DEPTH OF MODULATION		40% ±2,5%							
4	SUM OF DEPTH OF MODULATION		80 % ± 5 %							
	(90 Hz + 150 Hz)									
5	MONITORING :									
	- TOTAL TIME OF OUT OF TOLERANCE RADIATION		2 s							
	- REDUCTION IN POWER		-3 dB dari Comm							
	- PATH ANGLE		Monitor must alarm for a change in angle of 7.5% of the promulgated angle.							
	- DISPLACEMENT SENSITIVITY		Monitor must alarm for a change in the angle between the glide path and the line below the glide path at which 75µA is obtained, by more than 25% of path angle (for Cat:II)							
	- CLEARANCE SIGNAL		Monitor must alarm for DDM<0.175 below path clearance area							
B.	**ADDITIONAL TEST EQUIPMENT**									
1	RF POWER LEVEL		Field strength Comm - 3 db							
2	PATH ANGLE		0.000 DDM ± 0.055 DDM							
3	PATH WIDTH		0.175 DDM ± 0.050 DDM							

SR	PARAMETER	MEASUREMENT RESULT AFTER FLIGHT CALIBRATION	TOLERANCE	GROUND INSPECTION MEASUREMENT						REMARK
				TX1			TX2			
				MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	
4	DEPTH OF MODULATION		40% ±2,5%							
5	SUM OF DEPTH OF MODULATION		80 % ± 5 %							
	(90 Hz + 150 Hz)									
6	ORIENTATION		Correct							
7	FREQUENCY		Single : 0.005%							
			Dual : 0.002%							
			4kHz < Diff.<32kHz							
8	CARRIER MODULATION FREQUENCY		±1.5% (for Cat:II)							
C.	**OTHERS**									
1	INTERCONECTION									
2	ANTENA									
3	CHANGE OVER (MAIN TO STANDBY)		5 s							
4	INDICATOR LAMP&METERING									
5	REMOTE CONTROL AND MONITORING									
	SYSTEM									

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GROUND INSPECTION FORM
AERONAUTICAL TELECOMMUNICATION FACILITIES

MONTH	:		DATE	:
AIRPORT	:			
EQUIPMENT	: VOR			
SITE NAME	:			
EQUIPMENT FUNCTION	:			
TECHNICAL DATA	: FREQ.	:	IDENTIFICATION	:
LAST CALIBRATION	: DATE	:		

SR	PARAMETER	MEASUREMENT RESULT AFTER FLIGHT CALIBRATION	TOLERANCE	GROUND INSPECTION MEASUREMENT						REMARK
				TX1			TX2			
				MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	
	BUILT IN TEST MONITOR									
1	CARRIER FORWARD POWER (COVERAGE)		3dB down							
2	CARRIER REVERSE POWER (VSWR)		≤ 5%							
3	IDENTIFICATION									
	a. speed		9 sec/words							
	b. repetition		2 kali/menit							
	c. clearness									
4	FORWARD UPPER SIDE BAND POWER		3dB down							
5	FORWARD LOWER SIDE BAND POWER		3dB down							
6	FIELD DETECTOR INPUT									
	- BEARING field detector		Az angle ± 1^{o}							
	- MODULATION 30 Hz Reff		30 ± 2 %							
	- MODULATION 9960 Hz		30 ± 2 %							
	MONITOR SISTEM ALARM									
	- BEARING		Az angle ± 1^{o}							
	- MODULATION 30 Hz Reff		30 ± 2 %							
	- MODULATION 9960 Hz		30 ± 2 %							
	- IDENTIFICATION									
8	BEARING CHEK (TO DVOR) :									
	Position 1									

SR	PARAMETER	MEASUREMENT RESULT AFTER FLIGHT CALIBRATION	TOLERANCE	GROUND INSPECTION MEASUREMENT						REMARK
				TX1			TX2			
				MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	
	Position 2									
	Position 3									
	Position 4									
	Position 5									
9	MANUAL CHANGE OVER SWITCH									
10	INTERCONNECTION									
11	CHANGE OVER TIME		10 Sec							
12	INDICATORS									
13	REMOTE MONITORING									

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GROUND INSPECTION FORM

AERONAUTICAL TELECOMMUNICATION FACILITIES

MONTH : DATE :
AIRPORT :
EQUIPMENT : DME
SITE NAME :
EQUIPMENT FUNCTION :
TECHNICAL DATA : FREQ. : IDENTIFICATION :
LAST CALIBRATION : DATE :

SR	PARAMETER	MEASUREMENT RESULT AFTER FLIGHT CALIBRATION	TOLERANCE	GROUND INSPECTION MEASUREMENT						REMARK
				TX1			TX2			
				MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	MEASUREMENT RESULT	IN TOLERANCE	OUT OF TOLERANCE	
1	Peak power output		± 1 dB from Nom.							
2	Pulse spacing									
	a. INTEROGATION (X chanel)		12 ± 0.25 µs							
	b. REPLAY (X chanel)		12 ± 0.25 µs							
3	Variation of peak power in any pair of pulse		± 20%							
4	Transponder Pulse repetition frequency (PRF)		≥ 700 pps							
5	Replay effisiensi		≥ 70 %							
6	Time delay (X chanel)		50 uS ± 1,0 uS							
7	Identification		CLEAR							
	Tone pulse pair		1350 pulse							
8	Monitor sistem alarm									
	a. Variation of replay Delay		DME VOR≤ 1µ s							
			DME ILS ≤ 0,5µ s							
	b. Spacing		± 0.25 µs							
9	Monitor action Delay		Delay ≤ 10 s							
10	MANUAL CHANGEOVER(MAINS/STANDBY)									
11	INTERCONECTION									
12	CHANGE OVER TIME		max 10 SECONDS							
13	INDICATORS									
14	REMOTE MONITORING									

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