Asia and Pacific Office

ASIA PACIFIC
FLIGHT INSPECTION GUIDANCE MATERIAL

Third Edition

AMENDMENTS

Amendments are announced in the supplements to the *Publications Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

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PREFACE

This publication was prepared in response to a recommendation from the "Seminar on Flight Inspection and Procedure Validation (FIPV)" held in the ICAO Asia and Pacific (APAC) Regional Office, Bangkok, Thailand from 24 to 27 September 2019 with content contribution from volunteer States / Administrations and industry partners. It is decided to complement existing Standards and Recommended Practices (SARPs) to provide guidance on flight inspection and to serve as a reference upon which States / Administrations can develop their own specific practices and procedures.

The guidance material is developed with the experiences and knowledge among APAC States / Administrations and industry partners and includes recommendations of key activities and milestones in planning, execution, and delivery of a flight inspection. Useful materials, including sample flight inspection reports are also included for reference. This guidance material can hopefully facilitate and be useful to States / Administrations, especially for those without a national Flight Inspection Service Provider (FISP) and with difficulties when conducting flight inspection.

This guidance material is not intended to and shall not replace the relevant flight inspection requirements stipulated in Annex 10 and Doc 8071. In the event of any inconsistency or conflict between this document and Annex 10 and Doc 8071, Annex 10 and Doc 8071 shall take precedence.

The support from ICAO APAC Office and contributions from the following volunteer State/Administration and industry partner (in alphabetical order) in preparing the guidance material are acknowledged and highly appreciated: -

- AeroPearl, Australia
- Airways, New Zealand
- Civil Aviation Authority of Singapore
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GLOSSARY

SYMBOLS AND UNITS

DDM	Difference in depth of modulation
Ft	Feet
Kg	Kilogram
Km/h	Kilometers per hour
Kw	Kilowatt
M	Meter
NM	Nautical mile
QNH	Atmospheric pressure adjusted to mean sea level

ABBREVIATIONS

ADS-B	Automatic Dependent Surveillance – Broadcast
AI	Artificial Intelligence
AIP	Aeronautical Information Publication
ANSP	Air Navigation Service Provider
AOC	Air Operator’s Certificate
APAC	Asia and Pacific
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
CCC	Crew Coordination Concept
CNS	Communication, Navigation and Surveillance
COVID-19	Coronavirus Disease 2019
CRM	Crew Resource Management
DF	Direction Finder
DGPS	Differential Global Positioning System
DME	Distance Measuring Equipment
DVOR	Doppler VHF Omni-Directional Range
EASA	European Union Aviation Safety Agency
EFB	Electronic Flight Bag
FAA	Federal Aviation Administration of the United States of America
FIPV	Flight Inspection and Procedure Validation
FISP	Flight Inspection Service Provider
FL	Flight Level
FTL	Flight Time Limitation
GBAS	Ground Based Augmentation System
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
GP	Glide Path
ICAO	The International Civil Aviation Organization
ICASC	The International Committee for Airspace Standards and Calibration
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LOC	Localizer
LSALT	Lowest Safe Altitude
MSA	Minimum Sector Altitude
MRVA	Minimum Radar Vectoring Altitude
NAVAID	Navigation Aid
NDB	Non Directional Beacon
NOTAM	Notice to Airmen
PANS-Ops	Procedures for Air Navigation Services – Aircraft Operations
PAPI	Precision Approach Path Indicator
PSR	Primary Surveillance Radar
RNAV	Area Navigation
RNP	Required Navigation Performance
RPAS	Remotely Piloted Aircraft Systems
SARPs	Standards And Recommended Practices
SMS	Safety Management System

SOPs	Standard Operating Procedures
SORA	Specific Operations Risk Assessment
SSR	Secondary Surveillance Radar
TAR	Test Accuracy Ratios
TERPs	Terminal Instrument Procedures
TRM	Team Resource Management
TSO	Technical Standard Orders
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
VASI	Visual Approach Slope Indicator
VHF	Very High Frequency
VMC	Visual Meteorological Conditions

Chapter 1

INTRODUCTION

This material was developed in response to the recommendation from the Seminar on Flight Inspection and Procedure Validation (FIPV) held in the ICAO APAC Regional Office, Bangkok, Thailand from 24 to 27 September 2019, considering the typical need of States / Administrations without a national FISP and some recommended measures necessary for conducting flight inspection at night.

1.1 OBJECTIVE

1.1.1 In accordance with the ICAO Annex 10 Volume I and Document 8071 requirements, flight inspection has to be conducted periodically to ensure accuracy, reliability and integrity of the signals-in-space from the air navigation facilities, and that the radio navigation systems meet the SARPs in Annex 10.

1.1.2 While flight inspection could also be conducted for surveillance facilities and/or other purposes such as flight procedure validation, VHF coverage checking, etc., this guidance material focuses on flight inspection for air navigation and surveillance facilities and is a sharing and representation of common practices existing in a number of States with considerable experiences in flight inspection.

1.1.3 This guidance material introduces and describes different stages in flight inspection for air navigation facilities, including planning, conducting and accepting the report that all tolerances are met. It is not intended to recommend specific FISP(s) or equipment to be used, but rather to provide general details and guidelines in the arrangement of flight inspection for States' own consideration.

1.2 SCOPE

1.2.1 This guidance material describes general reference in conducting flight inspection, including resources planning, roles and responsibilities of involving parties and identification of stakeholders. It also provides guideline in communication with stakeholders and criteria on planning and scheduling flight inspection.

1.2.2 This document introduces example flight inspection procedures for Instrument Landing System (ILS) including visual aids, Doppler Very High Frequency Omni-Directional Range (DVOR), Distance Measuring Equipment (DME), Primary Surveillance Radar and Secondary Surveillance Radar (PSR / SSR) and discusses about the arrangement for flight inspection at night and also emergency flight inspections.

1.2.3 Reference is also given on the example flight inspection system performance specifications and associated Test Accuracy Ratios (TAR) and the workflow on reporting of flight inspection results. Sample flight inspection records and reports are also shared in this document for States to make reference with.

Chapter 2

PLANNING FOR FLIGHT INSPECTION

2.1 GENERAL

2.1.1 General Setup and Resources Planning

2.1.1.1 General setup – there are 2 typical scenarios of flight inspection arrangements:

(a) State has its own flight inspection unit; or

(b) Engagement of external FISP.

2.1.1.2 State's own flight inspection unit will be:

(a) Able to activate within a short period of time during emergency (high flexibility);

(b) Particularly useful when State has large number of facilities / aerodromes to be flight inspected; and

(c) Likely regulated by State.

2.1.1.3 Engagement of external FISP will be:

(a) More cost effective when State has small number of facilities to be flight inspected;

(b) More feasible when the State may not have the necessary expertise;

(c) More flexible to change FISP to meet the required service performance; and

(d) Little or no control when an emergency flight inspection is required.

2.1.1.4 General planning before flight inspection typically includes the following:

(a) Determine types of flight inspection required (commissioning or routine) and periodicity for routine ones;

(b) Identify facilities to be flight inspected;

(c) Determine type of aircraft used for flight inspection, for example using jet aircraft for high level (i.e. FL350 and above) radar coverage check;

(d) Check with apron operations on where the inspection aircraft can park and identify any traffic/timing restrictions for its taking off and landing;

(e) Plan the time of flight inspection, after consulting operations;

(f) Develop draft flight inspection schedule and flight inspection profiles as well as proposed date for brief and debrief;

(g) Notify parties involved/affected by draft flight inspection schedule and flight inspection profiles. Parties involved/affected could be ATC, runway maintenance team, military, ground handlers, Navaids & Surveillance facilities managers, Navaids & Surveillance maintenance staff, airfield lighting / Precision Approach Path Indicator (PAPI) maintenance team;

(h) Conduct flight inspection briefing with involved / affected parties;

(i) Issue Notices to Airmen (NOTAMs) for any change / cancellation of runway maintenance works; and

(j) Develop list of contact details of parties involved in the flight inspection.

2.1.2 Roles and Responsibilities of the Flight Inspection Service Provider (FISP) Including Crew Resources Management

FISP is the main party to provide safe and reliable flight inspection services. Selection of an appropriate FISP is a key successful factor for flight inspection.

2.1.2.1 Roles

(a) Assist Air Navigation Service Provider (ANSP) in planning, scheduling and conducting the flight inspection;

(b) Be familiar with the airspace / airport to conduct safe and efficient flight inspection with minimum impact to normal traffic; and

(c) Provide routine, commissioning or ad-hoc (special or urgent) flight inspection services.

2.1.2.2 Responsibilities

(a) Assist ANSP to ensure no equipment (e.g. navigation aids) would expire the validity period as recommended by ICAO or State's regulatory requirement, or any validity period as confirmed by the ANSP, with proper planning and scheduling of flight inspection tasks;

(b) Survey or assist to survey the reference point(s) for Global Navigation Satellite System (GNSS) for precision flight inspection on ILS;

(c) Obtain all the necessary permits to fly over areas for its flight inspection;

(d) Closely coordinate with ATC and ground technical personnel to prepare and conduct flight inspection including the provision of flight profiles for ATC assessment;

(e) Implement Safety Management System (SMS) as appropriate to deliver safe flight inspection services;

(f) Keep good archived records of flight inspection results of the equipment / system being inspected and provide advice if there was any anomaly trend or result observed;

(g) Feedback to the ANSP on overall flight inspection arrangement, discuss and assist to resolve problems encountered; and

(h) Desirable to have Crew Resource Management (CRM) to clearly define the roles and responsibilities of each crew member and to establish close collaboration among the crew members.

2.1.2.3 Crew Resource Management (CRM) System

Crew Resource Management (CRM) and Crew Coordination Concept (CCC) define how crews are to work together and the roles and responsibilities of each crew member. It clearly describes the communications involved in executing tasks and should be reinforced by Standard Operating Procedures (SOPs) and checklists. The CRM system, however, does not only define the cooperation among cockpit members, but also should encompass procedures and communication between cockpit and cabin, and it should define the interface between the flight crew and the rest of the organisation, like tasking / scheduling, management, maintenance, etc. This holistic approach in CRM is of great importance to create a working environment that takes into account all requirements to accomplish the organization's mission profile safely and reliably. It effectively translates into a Team Resource Management (TRM).

2.1.3 Roles and Responsibilities of the Flight Inspector

A flight inspector is the person who performs checking on equipment / system status. He / she must be proficient and have a good understanding on the characteristics of various equipment / systems to be flight inspected as well as familiarise himself / herself with relevant procedures to perform flight inspection on that equipment / system.

2.1.3.1 Roles

(a) Contribute in early planning of the flight inspection;

(b) Coordinator between ANSP and the flight inspection service provider;

(c) Perform equipment checking in flight inspection and alert ANSP in real time of any out-of-tolerance conditions or anomaly observed during the flight inspection;

(d) Assist ANSP to identify and analyse any anomaly / adverse trends observed; and

(e) Prepare flight inspection records and reports.

2.1.3.2 Responsibilities

(a) Provide advice to ANSP in planning the flight inspection tasks;

(b) Assist in preparing flight inspection procedures for checking a specific equipment / system;

(c) Coordinate with the rest of flight inspection team (e.g. pilots) for ad-hoc and flexible arrangement of flight inspection procedures (e.g. re-check on a specific run);

(d) Observe the measured results of flight inspection and checks against the relevant tolerance limits;

(e) Keep records of the measurement results and notifies ANSP for any trend/anomaly observed;

(f) Assist ANSP from the flight inspection perspective for the rectification on any anomaly observed; and

(g) Coordinate any real time changes to the flight inspection schedule due to unforeseen circumstances such as inclement weather, aircraft or aircrew problem.

2.1.4 Roles and Responsibilities of ANSP

The ANSP is ultimately responsible for management of the flight inspection. It is therefore vital that ANSP takes an active role throughout the flight inspection.

2.1.4.1 Roles

(a) Types of ANSP Personnel

(i) Ground technical personnel maintaining navigational and landing aids, surveillance radars, airfield lighting and PAPIs, etc.; and

(ii) Air Traffic Controllers – En-route, Approach and Tower.

2.1.4.2 Responsibilities

(a) Ensure that all systems and facilities to be flight inspected are operational and in a condition suitable for flight inspection on the scheduled dates;

(b) Ensure all systems and facilities are regularly flight inspected, complying with the State's regulatory requirement on the periodicity of flight inspection;

(c) Provide an annual draft schedule of systems and facilities to be flight inspected to the flight inspection service provider to facilitate early planning;

(d) Assist in obtaining security clearance for flight inspection crew to access aircraft;

(e) Provide necessary geographical information of systems & facilities under flight inspection, for example latitude and longitude co-ordinates of all navigation facilities;

(f) Provide authorization for flight inspection aircraft to fly below established minimum altitudes, together with all other necessary air traffic authorizations to accomplish the flight inspection;

(g) Provide qualified staff to be present during flight inspection;

(h) Coordinate flight inspection briefing and debriefing;

(i) Review flight inspection profiles with ATC and arrange discussion with FISP for any clarification, if required;

(j) Ensure FISP obtain necessary permits to fly over areas for the planned flight inspection;

(k) Issue necessary NOTAMs for flight inspection;

(l) Review flight inspection reports;

(m) Publish addition or / and amendments to AIP regarding systems / facilities after flight inspection;

(n) Make arrangement for flight inspection crew to call ATC before the start of each sortie for co-ordination purposes;

(o) ATC to facilitate flight inspection and accord it some priority, whenever possible; and

(p) ATC to be conversant with flight inspection profiles.

2.2 FLIGHT INSPECTION COORDINATION AND PREPARATION

2.2.1 Identification of Stakeholders

The smooth conduct of flight inspection requires concerted efforts from all key stakeholders. Subject to the organization structure in the States, an example list of stakeholders related to flight inspection is provided below for reference:

2.2.1.1 Flight Inspection Service Provider (FISP)

(a) FISP plays a vital role in flight inspection and is expected to be conversant with the relevant ICAO and local standards and requirements for fight inspection of various CNS equipment. FISP is also expected to be familiar with the flight profiles to be conducted and local airport / airspace environment in order to perform flight inspection in an efficient and effective manner. FISP should also be familiar with details of permits / approvals required for flying in airspace to ensure a successful and effective flight inspection.

(b) The flight inspection team deployed by the FISP normally consists of three types of staff, namely pilots, flight inspectors and aircraft engineers.

(i) Pilots – mainly communicate with air traffic controllers to perform flight inspection profiles

(ii) Flight Inspector – mainly coordinate with ground maintenance personnel or systems supplier engineer to take, report and calibrate measurement reading to ensure the equipment under inspection performs within the relevant tolerance limits.

(iii) Aircraft Engineer – support staff to deal with daily maintenance and problems encountered on the flight inspection aircraft, which would normally have been deployed at a far distance from the FISP's main base.

2.2.1.2 ANSP - Air Traffic Controller

(a) States may consider, as far as practicable, to assign dedicated air traffic controller(s) in handling the flight inspection aircraft, in which the flight path might cross multiple sectors and affect normal traffic patterns. Experienced air traffic controllers could efficiently reduce the lead time to conduct flight inspection, while keeping the impact to normal traffic to a minimum.

(b) Subject to different airport and airspace, temporary holding of ground and / or air traffic might be required to allow the flight inspection aircraft to conduct dedicated profiles unaffected.

(c) Air traffic controller handling flight inspection aircraft has to work closely with the flight inspection pilot and keep a very close eye on the aircraft position to keep it clear from normal traffic.

2.2.1.3 Aerodrome Operator

(a) Local aerodrome operator plays an important role in providing necessary logistics support to the flight inspection team, for example in the facilitation of access to airport restricted area, facilitate the conduct of flight profiles on ground or assist in handling the shipment of spare parts to address technical faults encountered by the flight inspection aircraft.

2.2.1.4 ANSP - Ground Maintenance Personnel

(a) The ground maintenance personnel are responsible for equipment maintenance and adjustment during the flight inspection. They have to work closely with the flight inspector to ensure the measured reading is within tolerance limit and ensure the equipment is safe for operational use. Prior to the flight inspection, the ground maintenance personnel shall also ensure the equipment is operational and in a condition suitable for flight inspection.

2.2.1.5 Other Supporting Personnel

(a) To facilitate daily flight inspection mission, there might be logistics support required for the flight and ground crews of the flight inspection team to travel between airport and their accommodation place. Immigration, Customs and Exercise clearance support might also be required to facilitate smooth operation of flight inspection activities.

2.2.1.6 Military, if applicable

(a) The military shall be informed of the civilian flight inspection schedule to ensure military flights and civilian flight inspection aircraft routes are de-conflicted. The civilian flight inspection aircraft should take note of the military no fly zones.

2.2.2 Communication with Stakeholders

2.2.2.1 A thorough understanding of the details of flight inspection arrangements is crucial to the successful completion of a flight inspection. All stakeholders should know their roles and duties to render the best support to the flight inspection activities.

2.2.2.2 To facilitate clear communication among stakeholders, ANSP could consider preparing a comprehensive but concise daily programme for sharing among all stakeholders. The daily programme would typically include information on equipment / facility to be inspected, estimated start and end time, parties involved and their roles, useful contacts, etc. (see sample at Attachment A to this chapter).

2.2.2.3 In addition, the ANSP could also consider preparing a detailed flight inspection check sheet for each equipment / facility to document the planned flight inspection profiles to be conducted (preferably with diagrams for easy visualisation) and estimated duration for each run. This check sheet could greatly facilitate air traffic controllers and airport stakeholders to assess any potential impact to airport / airspace operations and to aid communication during the flight inspection (see sample at Attachment B to this chapter). Appropriate NOTAM should also be issued to ensure airlines and pilots are kept informed of the flight inspection schedule and time.

2.2.2.4 Before the commencement of each round of flight inspection, an in-briefing involving all key stakeholders is recommended to ensure all are familiar with their roles and responsibilities in supporting the daily flight inspection as well as any issues requiring special attention. This also allows all stakeholders to exchange comments about the daily arrangement, for instance the flight profiles sequence, and helps to spot early issues that would potentially hinder normal ATC operations and flight inspection.

2.2.2.5 Contingency plan, including backup flight inspection date(s) due to unexpected ad-hoc event such as inclement weather or technical fault, could also be discussed with key stakeholders during the in-briefing.

2.2.2.6 During the flight inspection, it is essential that the ground maintenance personnel maintains direct communication with the on-board flight inspector so that any required adjustment of ground facilities or any recheck can be done expeditiously.

2.2.2.7 During the flight inspection period, daily de-briefing among flight inspection crews, ANSP, ATC and ground maintenance personnel would allow quick feedback on any issues encountered during the flight inspection so as to make timely fine-tuning when necessary for the subsequent flight inspection. This allows individual stakeholder to make adjustment / enhancement arrangement promptly such as issuance / cancellation of NOTAM, co-ordination / cancellation of runway closures, etc.

2.2.2.8 After the completion of each round of flight inspection, a de-briefing involving all stakeholders would help all to strive for continuous improvements on overall flight inspection arrangement, with parties sharing their views and suggestions as well as to share results and resulting actions of the flight inspection.

2.2.3 Consideration in the Planning and Scheduling of Flight Inspection

Flight inspection, depending on the exact flight profiles to be conducted, often causes some degrees of disruption to normal airport and airspace operations, especially at busy international airports during peak traffic hours. When planning and scheduling flight inspections, a number of key factors have to be considered so as to minimise potential interruptions to normal operations, for example:

2.2.3.1 Traffic Volume

(a) During day time when normal traffic is usually at its peak, the coordination of flight inspection by air traffic controllers will be complex and with great challenges which often results in undesirable disruption to normal air traffic. Hence, for busy airports, there is a trend to advance the flight inspection time to dawn or even earlier so as to avoid the busy day time traffic.

(b) Some flight inspection profiles may require day-light conditions to perform. When scheduling the flight inspection, one possible way to take advantage of less busy early hours would be to perform those flight profiles that do not require day-light condition first, followed by those requiring day-light conditions. As the time of flight inspection is dependent on time of peak traffic volume, close co-ordination and early inputs from ATC and slot planner from the airport operator in the planning would be beneficial.

2.2.3.2 Holiday and Peak Travel Season

(a) Long holidays and travel peak seasons would significantly increase the air traffic volume. In some ANSPs, there may also be a period of time in which equipment configuration or change is not allowed as this supports the heavy traffic in long holiday and peak season. Therefore, when planning and scheduling flight inspection programs, such long holiday and travelling peak seasons should be avoided as far as practicable.

2.2.3.3 Seasonal Weather Condition

(a) In some States, there might be seasonal strong winds, typhoons or severe weather conditions in some parts of the year. Heavy rainfall, lightning and other severe weather conditions may impact or delay flight inspection activities. As such, the fight inspection program should be scheduled to avoid bad weather seasons as far as practicable.

2.2.3.4 Major Military Flying Exercises

(a) Planning of flight inspection should avoid disruption with a period of major military flying exercises. This is because during the latter, many forbidden flying areas / zones may be activated and such activations could affect the normal flight inspection.

2.2.3.5 Types of Flight Inspections

(a) Depending on type of flight inspections, some of them, such as some ILS commissioning checks, procedure validation, etc., may have to be carried out in the daytime with suitable visual conditions.

2.2.3.6 Contingency Arrangement

(a) Back-up/contingency dates should be planned to cater for any unplanned cancellation or effect on flight inspection activities.

(b) The back-up/contingency flight inspection date(s) could be inserted as buffer date(s) in between the planned flight inspection activities, or after all the planned flight inspection activities as an extended arrangement.

2.3 FLIGHT INSPECTION AT NIGHT

Flight inspection operations at night are becoming more popular and may inevitably be required at large and high traffic density airports so as to minimize potential impact to the normal air traffic flow. The possibility of reduced traffic flow densities at night may allow the necessary inspection profiles to be flown with minimal disruption to ATC. However, the potential risks for the FISP crew for performing such tasks at night need to be properly managed.

To reduce the risk in flight inspection at night, FISP crew should be familiar with the airspace and airport environment including the height of terrain and structures along and close to the flight inspection path. Air traffic controllers have to pay special attention to the altitude and flight path of the flight inspection aircraft to avoid any deviation from the planned safe flight path.

Night operations should be considered as any flight inspection being performed 30 minutes after sunset until 30 minutes before sunrise.

2.3.1 Flight Inspection Aircraft Type

2.3.1.1 The aircraft should be a multi-engine type capable of safe flight within the intended operational envelope with one engine inoperative, fully equipped and instrumented for night and instrument flight operations.

2.3.2 Crew Resource Management (CRM)

2.3.2.1 Flight inspection operations at night present additional risks that must be identified, assessed with necessary mitigations and documented. Night flying operations should only be conducted by experienced pilots that are current and proficient at night flying and who understand well the risks associated with night-time flight inspection.

2.3.2.2 A dual pilot operation should be considered for a normal night flight inspection operation to mitigate against the higher risks involved for night operations.

2.3.3 Night Duty Periods

2.3.3.1 FISPs operate under their own Air Operator’s Certificate (AOC) and Flight Time Limitation (FTL) which would normally include duty periods for their specific night operations. Consideration should be given to the preceding duty period prior to any planned night duty to ensure the crew, including the flight inspector, have enough rest periods before and after the night duties.

2.3.3.2 Limitations should be provided for night duties worked in immediate succession, for example two consecutive nights, with a maximum duty period of 11 hours each.

2.3.3.3 Upon the conduction of a single night duty, or two consecutive night duties, there should be a minimum interval of rest time for the FISP crew before the commencement of the next duty time.

2.3.4 Operational Requirements

2.3.4.1 Where a requirement exists for flight inspection of ILS or other NAVAID installations at night, the following operational requirements should be met.

2.3.4.2 Aircraft Related - In addition to the normal equipment required for a night operation, the following equipment should be functioning normally:

(a) Both aircraft altimeters;

(b) Radar altitude indicators;

(c) Auto-Pilot;

(d) All flight instrument displays;

(e) Up-to-date database for flight inspection equipment map display (If applicable);

(f) Electronic Flight Bag (EFB), if applicable; and

(g) Approach plate holders with adequate lighting.

2.3.4.3 ANSP Related – The following is recommended to be provided by the ANSP prior to any night flight inspection operation:

(a) ATC are able to provide an Instrument Flight Rules (IFR) service;

(b) ANSP should provide a full radar service within the area of operation;

(c) Runway edge, centreline, approach lighting and PAPI's shall be serviceable and operating normally;

(d) Any obstacle lighting shall be operational within the designated area of operation;

(e) The weather conditions for the night inspection must be Visual Meteorological Conditions (VMC) below the 25/10 NM Minimum Sector Altitude (MSA) or Minimum Radar Vectoring Altitude (MRVA) / radar Lowest Safe Altitude (LSALT); and

(f) ATC to provide any aerodrome QNH changes expeditiously.

2.3.4.4 Pilot Related - Prior to the commencement of any night inspection operation, a skyline plot of the obstructions in the approach path must be obtained from the aerodrome operating authority. The pilot should compare the intended inspection runs and adjustments made to the minimum operating altitude as necessary.

2.3.4.5 Where flight crew have not conducted a daylight operation into an aerodrome, then prior to conducting a night inspection task, the crew should first fly the approach in daylight conditions to assess the obstacle clearance within the approach area.

2.3.4.6 Areas surrounding the inspection runs shall be predominantly level, clear of terrain and obstacles.

2.3.4.7 For operations in certain States it may be compulsory for the crew to provide an alternate Aerodrome for recovery, these requirements must be determined prior to commencement of night operations. In addition, holding and alternate requirements always need to be borne in mind.

2.3.4.8 To raise the flight crew situational awareness and to reduce fatigue, the autopilot should be used whenever possible.

2.3.4.9 Flights should be conducted under the IFR.

2.3.4.10 Flight Inspection Profiles - Flight inspection at night should be conducted using the following minimum altitudes:

(a) Level runs, Orbits and Part Orbits should not be conducted below the sector 25NM/10NM MSA or radar LSALT.

(b) Not below SECTOR 25/10 NM MSA or radar LSALT until established on a flight inspection approach run, when established within full-scale deflection of the localiser descent may occur.

2.3.4.11 Localiser (LOC) offset approaches that involve flights more than half scale (5 Dots) indications should be flown during daylight.

2.3.4.12 Where a LOC part orbit altitude needs to be increased for a night operation, a range change may be required to ensure that the localiser coverage area correlates with the published Glide Path (GP) angle.

2.3.4.13 Cat III ILS approaches that include a fly through at 50ft along the runway to ILS Point 'E' should only be flown at night providing the following are met:

(a) Runway centreline lights are serviceable; and

(b) Pilots have conducted the relevant simulator training for such an operation.

An alternate method would be for the aircraft to perform a run along the runway centreline prior or post the inspection.

2.3.4.14 GP approach profiles that involve flight with more than half scale "FLY UP" indications should be flown during daylight e.g. GP lower edge (5 dots Fly Up) runs.

2.3.4.15 GP level runs need to encompass coverage and clearance at a minimum angle of 0.45Θ, however, increasing the height to be at MSA for this measurement will inevitably mean an increase in the start range to achieve this, with the possibility that the GP coverage tolerance may not be met beyond 10NM. As an alternate solution, the GP level run profile could be flown with the addition of the night profile run during daylight and the measurements used as a reference transfer standard between the two profiles.

2.4 EMERGENCY FLIGHT INSPECTION ARRANGEMENT

2.4.1 Types of Flight Inspection

2.4.1.1 The various types and priorities of flight inspection are published within ICAO DOC 8071, Chapter 1 (Para.1.5). The following paragraphs discuss the requirements surrounding special inspections.

2.4.2 Priorities of Flight Inspection

2.4.2.1 If there are multiple flight inspection requests, the use of inspection priorities will determine the tasks to be supported first and make the most effective use of the resources in FISP. The following is an order of priorities that should be considered:

Priority	Type	Description
1	Accident/Incident	Accident or incident investigation requiring immediate response.
2	Restoration	Restore a commissioned facility after an unscheduled outage.
3	Periodic	A regularly scheduled inspection of a commissioned facility.
4	Commissioning	A comprehensive inspection of a newly installed facility.
5	Site Evaluation	An inspection to determine the environmental effects on the performance of a planned navigational aid.

Table 2-1. Flight Inspection Priority

2.4.3 Post-Accident Investigation

2.4.3.1 A flight inspection may be requested following an accident or incident by the investigating authority to verify the NAVAID system performance is satisfactory and able to continue to support the published instrument approach procedures and ANSP operations.

2.4.3.2 For a FISP, this type of inspection should be accorded highest priority and an appropriate response time should be contractually agreed between the ANSP and the service provider.

2.4.3.3 Pre-Flight Requirements – The flight inspector will be required to obtain the following information:

(a) Equipment configuration at the time of the accident i.e. transmitter in operation;

(b) Instrument approach procedures used; and

(c) Any additional information required to support the investigation.

2.4.3.4 The flight inspector will need to coordinate the system configuration with the maintenance personnel and perform as a minimum, an inspection of the facility which may include the instrument procedure used if applicable. It is important to note that no equipment adjustments should be made during this inspection and if required, should be performed in a separate special inspection to facilitate investigation.

2.4.3.5 In the event of an accident or incident, ANSP should do all that is reasonably practicable to ascertain that a NAVAID is operating correctly. For this reason, ANSP should have equipment suitable for making field measurements available.

2.4.4 Post-Incident Investigation

2.4.4.1 Where a runway excursion by an aircraft has occurred and damage has been sustained to a NAVAID, the maintenance authority will determine the repairs required to the facility and whether a ground or flight inspection is required to return the facility back into service. However, the following considerations should be given when determining the need for a flight inspection:

(a) Antenna array replacements that will affect the radiated pattern;

(b) Cable replacements that affect transmission line lengths;

(c) Replacement or re-positioning of an ILS near field monitor if the system does not contain integral course monitoring;

(d) Major repair work to the LOC antenna distribution unit or when the center line phasor has been adjusted;

(e) Adjustment or corrective maintenance on phasing or width controls that results in figures outside the monitor site acceptance figures;

(f) Any work performed on the GP antenna distribution unit;

(g) Adjusts to GP integral monitor probes, cables or monitor combiner unit; or

(h) Damage to ILS critical areas ground in the beam forming areas that need re-grading.

2.4.4.2 In the event of an accident or incident, ANSP should do all that is reasonably practicable to ascertain that the facility is operating correctly. For this reason, all aerodromes should have equipment suitable for making field measurements available.

2.4.5 Flight Inspection Service Providers (FISP)

2.4.5.1 Information regarding FISP may be obtained from the appropriate ICAO Regional Office or online from the International Committee for Airspace Standards and Calibration (ICASC) at http://www.icasc.co [1]

[1] ICAO DOC 8071 Fifth Edition, 2018

2.4.6 Navigational Aid Performance Reports

2.4.6.1 The reporting of aviation safety occurrences is vital to the prevention of aircraft accidents and contributes to the understanding of where safety risks lie within the aviation system. This information provides an understanding of the safety related issues thus allowing these to be addressed and relevant measures adopted. Safety occurrence reporting by aviation professionals contributes to the prevention of accidents and fundamentally promotes the safety of aviation activities within the organisations that employs them or uses their services.

2.4.6.2 Persons involved in aviation activities should be encouraged to report any safety issue they encountered. State regulations should differentiate between the cases which would require mandatory reporting and those that may be reported after judging it relevant.

2.4.6.3 The obligation of these reporting occurrences would be included within the normal operation of an organisation's SMS. ANSP or airline operator should, through a mandatory reporting system, inform the relevant authority of a particular occurrence and with defined categories that represent a significant risk to aviation safety.

2.4.6.4 Safety management systems are reliant on the collection and analysis of safety related information. Therefore, anything that is perceived by the individuals as having the potential to impact safety should be reported within reasonable time, for example, 72 hours to raise awareness of the occurrence.

2.4.6.5 Organisations SMS may define the format of the occurrence reports to be used by relevant aviation professional. It should include areas to report NAVAID performance or RNAV procedure where relevant. In general, reporting forms need to be user friendly and will not discourage potential reporters to report the occurrences. The aim should be to facilitate the collection of occurrence information as much as practicable from the front-line individuals and allow the appropriate authorities to understand and address the issues from the information provided.

2.4.6.6 The following reporting information requirements should be considered as a minimum, but not limited to, in the determination of NAVAID's performance from both an ATC and Pilots perspective.

(a) Date/Time UTC

(b) Aircraft Call Sign

(c) Airline Operator

(d) Pilot Name

(e) SSR Code

(f) Aircraft Type

(g) Aircraft Flight Phase (Climb, Descent, Level, Approach), IFR/VFR, Radar Vectored, Navigational Aid in use (ILS/VOR/DME/NDB/RNAV)

(h) Description of Occurrence

2.4.6.7 ANSP's and Airline Operators are likely to have their own organisations occurrence report forms to cover the mandated reporting requirements within their SMS. These may not contain the aforementioned information relevant for a pilot reporting an unreliable NAVAID performance. Therefore, additional information may be required for investigation purposes depending on the seriousness of the occurrence. Consultation with the ground technicians will greatly assist an immediate investigation on a system status and possible actions required.

2.4.6.8 For precision approach landing aid systems such as an ILS/DME or GNSS Landing System (GLS), once an occurrence report related to the system is received from a pilot, an ANSP would have to follow up by investigation and discussion with ground technicians and may require the issue of a NOTAM on that facility once it is identified to be faulty and requires maintenance. The ANSP has to ensure a continued safe operation or provide alternative services and procedures resulting from the occurrence.

2.5 CONSIDERATIONS ON FLIGHT INSPECTION PERIODICITY DURING PANDEMIC

2.5.1 There might be occasion that the flight inspection could be affected by external factor with global impact, such as the COVID-19 pandemic. With such a huge global impact, cross-country deployment of flight inspection aircraft might become difficult, especially for those States who do not have their own FISP. As such, States should assess and consider the flight inspection periodicity on radio navigation aids to secure continuous service or keep minimum impact to service.

2.5.2 ICAO has published a reference note on the considerations of radio navigation aids flight inspection practices during the pandemic and restoration to service after temporary removal from service, details please refer to the following link:
https://www.icao.int/safety/OPS/OPS-Normal/Pages/Flight-inspection-for-radio-aids.aspx

2.5.3 During pandemic situation, every country may have different travel restriction policies in place to contain the spread of pandemic. Cross-country deployment of flight inspection may become difficult or infeasible due to border closure, especially for those States who do not have their own FISP. Therefore, States may have to consider to deploy flight inspection crew and aircraft to alternative base for timely completion of flight inspection. In this situation and to safeguard the health condition of flight inspection crew, the following considerations could be made when planning for the flight inspection:

(a) Negotiate with the FISP in advance for performing flight inspection from alternative base where is classified as low risk of the epidemic situation;

(b) Seek support from the government of the alternative base for the flight inspection activities;

(c) Work with local government to apply for exemption permits for the FISP to enter States If deployment from alternative base in another country is not possible, either due to border closure or not practical. The States should cater ample time when applying such permits so to ensure all the systems and facilities still comply with the State's regulatory requirement on the periodicity of flight inspection.

(d) Encourage FISP to develop a special management plan for performing flight inspection under pandemic as it may facilitate the exemption permits application in States. The pandemic management plan could include the following areas:

(i) Hazard & risk management

(ii) Fitness for duty evaluation for FISP crew – daily body temperature & symptoms check records

(iii) Self-isolation requirements for FISP crew

(iv) Mask wearing, social distancing and personal hygiene requirements for FISP crew

(v) Incident reporting mechanism

(vi) Contact tracing documents - names / telephone of physical contacts with FISP crew

(e) Develop special/additional arrangements during the flight inspection period, for example:

(i) Seek support from the relevant party to set up all essential ground equipment for flight inspection, e.g. DGPS equipment, locally and by local staff, instead of the flight inspection crew to be deployed;

(ii) Arrange point to point transportation between the airport and accommodation for the flight crew with close-loop arrangement as far as practicable;

(iii) Conduct virtual meeting with the FISP for coordination and discussion on the flight inspection reports to avoid face to face meetings;

(iv) Create controlled itinerary for the flight inspection crew, where the flight inspection crew is only allowed to leave their accommodation to carry out the flight inspection. This will minimize the physical interaction between the flight inspection crew and the public; and

(v) Keep up to date with the latest requirements of the exemption permits applied, e.g. the need for the flight inspection crew to take Polymerase Chain

Reaction (PCR) tests during the flight inspection period and the maximum number of days the flight inspection crew is allowed to stay.

(f) Such special/additional arrangements may incur extra cost for each deployment. The flight inspection crew might need to be quarantined upon return to the country where the FISP is based. States should consider these additional costs when planning for each deployment.

Attachment A

Example Flight Inspection Programme

Example Routine Flight Inspection Program

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Remarks
In-briefing at (time)						In-briefing with flight inspection team
	XX VOR OFF (time)	XX VOR F/I (start time)				XX VOR – periodic F/I after annual maintenance
			XX ILS maintenance (off time)	XX Tx 1 F/I (start time) XX Tx 2 F/I (start time)		XX ILS - periodic F/I after annual maintenance
					De-briefing	De-briefing with flight inspection team

<u>Notes for ATC and/or Aerodrome Operator:</u>

- Expected period and end time for VOR and ILS flight inspection
- Runway closure and maintenance requirements

Attachment B

Example Flight Inspection Profiles

VOR/DME Routine Inspection

EXAMPLE VOR/DME INSPECTION PROCEDURES LIST					Profile Version
Facility ID			[Facility ID]	Routine Inspection	
Target Completion Time (LT)	Run No.	Flight Procedure	Procedure Description	Facility Transmitter Number	Items To Be Inspected
xxxx-xxxx		Radial xxxº	xxNM-xxNM, QNH xxxxFT	VOR/DME No.1	e.g. Reference Radial/Alignment Check
		Radial xxxº	xxNM-xxNM, QNH xxxxFT	VOR/DME No.2	e.g. Reference Radial/Alignment Check
		Radial xxxº	xxNM-xxNM, QNH xxxxFT	VOR/DME No.1 Only	e.g. VOR Monitor Alarm Check
		Radial xxxº	xxNM-xxNM, QNH xxxxFT		
		Radial xxxº	xxNM-xxNM, QNH xxxxFT	VOR/DME No.1	e.g. VOR Monitor Alarm Normal
		Orbiting (C.C.W. / C.W.)	Radius: xxNM, QNH xxxxFT	VOR/DME No.1	Mean Alignment Error, Bends, Roughness, DME Range Error
		Orbiting (C.C.W. / C.W.)	Radius: xxNM, QNH xxxxFT	VOR/DME No.2	Mean Alignment Error, Bends, Roughness, DME Range Error

Routine Inspection (ILS Tx1)

EXAMPLE ILS INSPECTION PROCEDURES LIST					Profile Version
Runway		ILS Name	ID	ILS Identification	Routine Inspection
Target Completion Time (LT)	Run No.	Flight Procedure	Procedure Description	Facility Transmitter Number	Items To Be Inspected
xxxx-xxxx		e.g. Threshold Parking	Runway	LOC No.1&2	e.g. Monitor Alarm Check
xxxx-xxxx		e.g. Level Run	xxNM-xxNM QNH xxxxFT	GP No.1	e.g. Width (including alarm), Symmetry SBP, etc.
xxxx-xxxx		e.g. Level Arc	xxNM, +xx°/-xx °, QNH xxxxFT	LOC No.1	e.g. Width (including alarm), Symmetry, Clearance, etc.
xxxx-xxxx		e.g. Approach with low pass	Initial From xxNM and QNH xxxxFT	DME No.1; LOC/GP No.1	e.g. DME and Runway Lighting, Path Angle, Datum, Mod Sum, Structure, etc.

Routine Inspection (ILS Tx2)

EXAMPLE ILS INSPECTION PROCEDURES LIST					Profile Version
Runway		ILS Name	ID	ILS Identification	Routine Inspection
Target Completion Time (LT)	Run No.	Flight Procedure	Procedure Description	Facility Transmitter Number	Items To Be Inspected
xxxx-xxxx		e.g. Level Run	xxNM-xxNM QNH xxxxFT	GP No.2	e.g. Width (including alarm), Symmetry SBP, etc.
xxxx-xxxx		e.g. Level Arc	xxNM, +xx°/-xx °, QNH xxxxFT	LOC No.2	e.g. Width (including alarm), Symmetry, Clearance, etc.
xxxx-xxxx		e.g. Approach with low pass	Initial From xxNM and QNH xxxxFT	DME No.2; LOC/GP No.2	e.g. DME and Runway Lighting, Path Angle, Datum, Mod Sum, Structure, etc.

Remarks:

- Any protection to ILS sensitive area should be applied

Chapter 3

Conducting Flight Inspection

3.1 TYPICAL FLIGHT INSPECTION PROCEDURES

3.1.1 Flight Inspection Procedures Manual

3.1.1.1 Each FISP should provide evidence of operating to a Flight Inspection Procedure Manual. This manual provides assurance to the customer that the necessary compliance checks are being carried out as intended by Doc 8071 and can help with demonstrating compliance. These may vary State to State depending on the regulatory oversight. Some investigation into other areas of aviation within your State can aid with what could be acceptable criteria such as:

(a) Procedure Development (Procedures for Air Navigation Services – Aircraft Operations (PANS-Ops) or Terminal Instrument Procedures (TERPs)); and

(b) Aircraft Recognized Approval Documentation (FAA/EASA, etc.).

3.1.1.2 Doc 8071 provides guidance on typical check methods intended for both Ground and Air for each facility type. The operator should ensure that each listed item is applicable to the inspection type (Commissioning or Categorization, Site, Periodic). The operator or owner of the facility should verify the FISP is adequate to satisfy the required parameter check. For comparison, flight test procedures have been also included in Doc 8071 for guidance.

3.1.1.3 Some flight profiles have been included in this document to assist with comparisons. In some situations, flight validation of the procedure is considered a separate inspection, and therefore it is important to check if the intended procedure covers flying the approach procedure. This may be of benefit in satisfying the procedure revalidation criteria.

3.1.1.4 Clear procedures should be provided to cover any navigational, surveillance or communication equipment that is subject to flight inspections. Inspections should be undertaken with equipment that has calibration traceability and where the FISP can provide clear evidence of the suitability for individual parameter assessment. A Test Accuracy Ratio (TAR) of minimum three or better for each parameter measured can provide a good picture of uncertainties and if the system is fit for purpose.

3.1.1.5 As a provider of service such as DVOR, ILS or other navigational equipment, it is important that the ANSP can demonstrate the facilities are operating to the respective ICAO standard. For this reason, the closer the inspecting receivers represents the level of avionics needed in large aircraft, the less risk of finding inconsistencies between airline approaches and ground check measurements. Hence it is sometimes advantageous if the equipment has international accreditation such as TSO conformance and other relevant aircraft software development standards. This is more important for systems that are directly used for the purpose of Air Navigation verification. The degree of compliance is less for items used as a surveillance tool.

3.1.2 Instrument Landing System (ILS)

3.1.2.1 Key requirements:

(a) Antenna should be calibrated for field strength through the frequency range and different orientations. This should also include frequency response and polar patterns. This data should be available for verification.

(b) The antenna should have TSO compliance for IFR and comply with the local airworthy certification. Location and installation of the antenna should be in accordance with the following:

(i) Recordings should show minimum propeller modulation.

(ii) Aircraft should be fitted with airworthy ILS/DME/Markers equipment approved for IFR flight.

(iii) Kit should be capable of recording the required parameters against the reference system, typically at a rate greater than 5 samples per second.

(iv) The antenna should also have the appropriate TSO rating as required by IFR flight.

(v) The kit should be capable of recording the parameters as outlined in Doc 8071 within the accuracy specified.

3.1.2.2 Typical Flight Profiles for ILS flight checks:

(a) Alignment runs normally commencing as required by the published procedure or 10NM for periodic Inspections.

(b) 6-10NM arc profiles, forty degrees either side of the runway centre-line.

3.1.2.3 Typical parameters to be recorded as applicable for the items being checked:

(a) Receiver course deviation for all systems include Localizer/Glide Path/markers/DME

(b) Aircraft position fixing system deviation

(c) The difference (a) minus (b)

(d) Receiver input signal level

(e) Modulation levels

(f) Frequency spectrum (optional)

3.1.2.4 Careful consideration should be made with regard to the procedures used and the purpose of the check.

3.1.2.5 Depending on the methods employed to ensure monitor integrity, instead of inspecting both the transmitting and monitoring systems of the ILS in every check, some locations may choose to flight inspect the transmitting system once in every two inspections.

3.1.2.6 FISP should be able to provide a table of parameters to assist with comparisons against Doc 8071.

3.1.2.7 An example checklist of commissioning and periodic flight inspection items for ILS is tabulated below for reference.

Check Item	Commission	Periodic
Identification	X	X
Modulation Balance	X	R
Modulation Depth	X	X
Polarisation	X	R
Front Course Alignment	X	X
Course Structure	X	X
Course Sector Width and Symmetry	X	R
Off-course DDM Clearance	X	-
Coverage or Usable Distance	X	-
Monitor Alarm – Front Course Alignment (Position Alarm)	X	X
Monitor Alarm - Course Sector Width (Width Alarms)	X	X
Monitor Alarm - Off-Course DDM Clearance	X (1)	X
Monitor Alarm – Coverage	X	-
Dual Equipment	X	X (3)
Flyability	X	X
Associated Navigation Aids (Navaids)	X	X (2)

LEGEND: R = To action on request
X = To action

-	=	Not required
(1)	=	Capture/Clearance Wide Alarm applies only for a dual frequency localizer
(2)	=	Includes runway visual aids
(3)	=	Alignment, Modulation Depth and Identification Only

3.1.3 Doppler Very High Frequency Omni-Directional Range (DVOR)

3.1.3.1 Key requirements:

(a) Antenna should be calibrated for field strength, and data should be available for verification. The antenna should have TSO compliance for IFR and comply with the local airworthy certification.

(b) Recordings should show minimum propeller modulation.

(c) Aircraft should be fitted with airworthy DVOR equipment approved for IFR flight.

(d) Kit should be capable of recording the required parameters against the reference system, typically at a rate greater than 5 samples per second.

(e) The antenna should also have the appropriate TSO rating as required by IFR flight.

(f) The kit should be capable of recording the parameters as outlined in Doc 8071, within the accuracy specified.

3.1.3.2 Typical parameters to be recorded as applicable for the items being checked:

(a) Receiver course deviation

(b) Aircraft position fixing system deviation

(c) The difference (a) minus (b)

(d) Receiver input signal level

(e) Modulation levels

(f) Modulation index

3.1.3.3 An example checklist of commissioning and periodic flight inspection items for DVOR is tabulated below for reference.

Check	Commission	Periodic
Identification	X	X
Voice	X	X
9960 Hz/30 Hz Levels	X	X
Vertical Polarisation	X	-
Orbit	X	X
En-route Radials	X	R
Terminal Radials and Procedures	X	X (2)
Radial Plan	X	-
Intersections and Changeover Points	X	-
Off-track Coverage	X	-
VOR/DME Sector Altitude Coverage	X	R
High Angle Coverage	X	R
Receiver Checkpoint	X	X
VOR Monitor Checks	X	X
Dual Equipment	X	X
Transmitter Differential	X	-
Standby Power	X	-
Associated Navigation Aids (Navaids)	X	X (1)

LEGEND: R = To action on request
X = To action
\- = Not required
(1) = An appearance inspection of the VASI/PAPI is to be included if not otherwise subject to a routine inspection
(2) = Final approach radial(s) only, profile as published

3.1.3.4 Some typical Flight Profiles for DVOR flight inspections:

(a) Arcs at published minimum safe altitude.

(b) Published approach radials at advisory altitudes.

3.1.4 Distance Measuring Equipment (DME)

3.1.4.1 Key requirements:

(a) Antenna should be calibrated for field strength and data should be available for verification. This should consider cables and connectors.

3.1.4.2 A summary of flight test requirements is listed in ICAO Doc 8071. These form a comparison against the FISP's procedure manual. If there are missing parameters, further clarification should be made where in some cases, with acceptable technical and statistical validation, these parameters could be moved to a ground inspection. This is more common on DME facilities. However, this may not be acceptable by your State's regulatory authority and may need to be endorsed by them.

3.1.4.3 Often the DME equipment would be included as part of the ILS or DVOR flight inspections where it is considered an associated facility.

3.1.4.4 Typically, published DME arcs with the appropriate altitude restrictions would be flown, and in accordance with any associated procedures.

3.1.4.5 Doc 8071 provides a list of parameters for reference. It is important to consider both ground check requirements and flight inspection requirements for DME.

3.1.4.6 An example checklist of commissioning and periodic flight inspection items for DME is tabulated below for reference.

Check	**Commission**	**Periodic**
Identification	X	X
DME System Distance Accuracy	X	X
Coverage - Terminal Procedures	X	X
Coverage – Enroute Radials	X	-
Coverage - Off-track	X (1)	-
Coverage - Steps, Intersections and Changeover Points	X	-
Sector Coverage	X (1)	-
Dual Equipment	X	X (2)
Standby Power	X	-
Associated Navigation Aids (Navaids)	X	X

LEGEND: X = To action
\- = Not required
(1) = As specified by Navigation Services
(2) = Identification only for second transponder

3.1.5 Primary Surveillance Radar and Secondary Surveillance Radar (PSR/SSR)

3.1.5.1 The requirements are very dependent on the engineering assessment requirements and expected coverage volume.

3.1.5.2 Some typical considerations are:

(a) Altitude;

(b) Range;

(c) Delay to alert; and

(d) Minimum radar coverage elevation.

3.1.5.3 According to Doc 8071, Civil ATC PSR and SSR facilities, after being commissioned and set into operational service, do not require a periodic flight inspection.

3.1.5.4 Special flight inspections may be conducted as part of a measurement campaign after major equipment modifications, or for specific problem investigation.

3.2 OTHER TYPES OF FLIGHT INSPECTION

3.2.1 Procedure Validation

3.2.1.1 This is detailed in ICAO Doc 9906, Quality Assurance Manual for Flight Procedure Design. Volume 5 – Validation of Instrument Flight Procedures. The ANSP, FISP and Procedure Design Company need to work closely to ensure this aspect is covered off adequately.

3.2.2 Surveillance Flight Inspection

3.2.2.1 Surveillance flight inspection may be arranged for providing supplementary check and verification on the performance of the newly commissioned radio navigation aids, before its next required periodic flight inspection. Since the stability on operating environment and new system itself are yet to be demonstrated, the additional surveillance flight inspection could early detect any potential issues on system performance after commissioning and before the next routine check. Maintenance staff could then take prompt and appropriate actions to rectify the issues spotted to avoid safety hazards.

3.2.3 VHF equipment, ADS-B, GBAS

3.2.3.1 Flight inspection is typically carried out under request from an appropriately trained Communications/ADS-B or GBAS engineer. The specifics such as location, type of check and flight profiles are determined by a collaborative approach between all involved disciplines. In some cases, flight inspection is used to assist in the validation of models for determining coverage.

3.2.4 Performance-based Navigation – RNAV and RNP

3.2.4.1 At a minimum, the aircraft should have the capability to undertake the desired procedure validation. RNP procedures' validation requirements would normally be specified within the Procedure Design Company specifications. The Aeronautical Design and Development organization should analyse the results to determine containment within the specified criteria. Technical assessment perspective is as follows;

(a) Validation of obstacle survey data is recommended during the flight validation process.

(b) Verification of survey data can be performed by setting ground stations at certain survey points. The ground survey team can check and compare the DGPS signal to the TSO avionic aircraft receiver position.

(c) The survey data may be affected by waypoint, track and bearing error.

(d) The effect of terrain shielding should be taken into consideration.

(e) Verification is often done slightly lower than the published profile to remove altimeter error as often it is advantageous to verify in the worst-case position.

3.3 TYPICAL FLIGHT INSPECTION SYSTEM PERFORMANCE SPECIFICATIONS AND ASSOCIATED TEST ACCURACY RATIOS (TAR)

3.3.1 Test Accuracy Ratios (TAR)

3.3.1.1 As the results obtained by the flight inspection system could potentially be used to defend a service provider in the event of an incident or accident, the State should clearly specify the standards adopted in the maintenance and calibration of the systems used for flight inspection purposes. To effectively perform calibration of a system, the calibration equipment should be typically 5 times (minimum 3 times) more accurate than the system equipment. Some considerations should be as follows:

(a) Temperature stability and compensation.

(b) Electromagnetic interference.

(c) Polar Pattern considerations.

(d) Absolute measurements.

(e) Relative measurements.

(f) Aircraft receiver and calibration equipment duplication.

3.3.1.2 The calibration equipment should also undergo regular periodic checking as part of verification against traceable international standards that support the TAR required.

3.3.1.3 A dedicated calibration facility operated by the ANSP or ISO/IEC 17025 approved facility is the preferred means by which to achieve this to ensure a good consistency of standards.

3.3.2 Duplication

3.3.2.1 System duplication is important throughout the calibration process of both the flight inspection equipment and calibration laboratory used to calibrate the systems. Duplication of equipment can very quickly identify system drift and prevent unknowingly using a bad receiver to adjust an air critical system incorrectly.

Chapter 4

Reporting of Flight Inspection Results

4.1 TYPICAL FLIGHT INSPECTION REPORTS

4.1.1 After each daily flight inspection, the flight inspector should prepare the flight inspection report. The formal flight inspection report signed by the responsible captain and flight inspector should be provided after the flight inspection. The contents of flight inspection report typically include the following items:

(a) Location

(b) Identification

(c) Flight inspection date(s)

(d) Facility inspected

(e) Type of inspection

(f) Inspected items

(g) Results

(h) NOTAM

(i) Facility status

(j) Remarks

(k) Aircraft registration number

4.1.2 A sample flight inspection report is provided in Attachment A to this Chapter for reference.

4.2 TYPICAL FLIGHT INSPECTION RECORDS

4.2.1 Flight inspection records and flight inspection data sheet should be provided by flight inspector. The contents of flight inspection record typically comprise of the following items:

(a) Airport name

(b) Aircraft registration number

(c) Date of inspection

(d) Inspector's name

(e) Flight hours

(f) Facility type and identification

(g) Run numbers

(h) Transmitter number

(i) Flight inspection results of each run

4.2.2 A sample flight inspection record is provided in Attachment B to this Chapter for reference.

Attachment A

Sample Flight Inspection Reports

Sample Flight Inspection Report for ILS/DME

1.LOCATION:	2.RUNWAY NO:
3.DATE(S) OF INSPECTION:	4.IDENTIFICATION:

5.TYPE OF INSPECTION		SITE EVALUATION		PERIODIC		SPECIAL
		COMMISSIONING		SURVEILLANCE		INCOMPLETE
6.FACILITY INSPECTED		LOCALIZER		GLIDE SLOPE		DME
		LIGHTING SYSTEM		7. AIRCRAFT NO**:**		

8.CATELOGY:	9.FREQUENCY:
10.COMMISSIONED COURSE WIDTH:	11.COMMISSIONED PATH ANGLE:

12.LOCALIZER				
	TX1		TX2	
FLIGHT INSPECTION ITEMS	INITIAL	FINAL	INITIAL	FINAL
IDENTIFICATION				
MODULATION				
ALIGNMENT				
COURSE STRUCTURE—Z1/RNG				
COURSE STRUCTURE—Z2/RNG				
COURSE STRUCTURE—Z3/RNG				
COURSE STRUCTURE—Z4/RNG				
COURSE STRUCTURE—Z5/RNG				
VERTICAL POLARIZATION/RNG				
WIDTH/SYMMETRY				
MEAN WIDTH(HALF)/SYMMETRY				
CLEARANCE 90/DEG				
CLEARANCE 150/DEG				
MOD.BALANCE(COS/CLR)				
Z5 ROLL OUT RESULT:				

USABLE DISTANCE				
MONITOR				
WIDTH ALARM(NARROW)/SYM				
WIDTH ALARM(WIDE)/SYM				
CLEARANCE 90 (WIDE ALARM)				
CLEARANCE 150(WIDE ALARM)				
ALIGNMENT ALARM(+)				
ALIGNMENT ALARM(-)				

13.GLIDE SLOPE				
FLIGHT INSPECTION ITEMS	TX1		TX2	
	INITIAL	FINAL	INITIAL	FINAL
ANGLE /REFERENCE DATUM HEIGHT				
MODULATION				

PILOT IN CHARGE:	FLIGHT INSPECTOR:	AIRCRAFT NUMBER:

Sample Flight Inspection Report for Runway Approach Lights and PAPI

1.LOCATION:					2.RUNWAY NO:	
3.DATE/DATES OF INSPECTION:						
4.TYPE OF INSPECTION		SITE EVALUATION		PERIODIC		SPECIAL
		COMMISSIONING		SURVEILLANCE		INCOMPLETE
5.FACILITY INSPECTED		PAPI		RUNWAY LIGHTS		APPROACH LIGHTS
6.COMMISSIONED PAPI ANGLES		NO.1	NO.2	NO.3	NO.4	PATH ANGLE
	LEFT					
	RIGHT					
7.PAPI INSPECTION RESULTS						
ACTUAL PAPI ANGLES		NO.1	NO.2	NO.3	NO.4	PATH ANGLE
	LEFT					
	RIGHT					
ITEMS CHECKED	SAT	UNSAT	ITEMS CHECKED	SAT	UNSAT	
COVERAGE ANGLE			VISIBLE DISTANCE			
INTENSITY LEVEL			INTENSITY COINCIDENCE			
NO. OF INOPERATIVE LIGHTS			COINCIDENCE WITH ILS			
8.APPROACH LIGHTS RESULTS INSPECTION RESULTS						
ITEMS CHECKED	SAT	UNSAT	ITEMS CHECKED	SAT	UNSAT	
LAMP ALINMENT			VISIBLE DISTANCE			
INTENSITY LEVEL			INTENSITY COINCIDENCE			
NO. OF INOPERATIVE LIGHTS			LIGHTS CATEGORY			
9.RUNWAY LIGHTS INSPECTION RESULTS						
ITEMS CHECKED	SAT	UNSAT	ITEMS CHECKED	SAT	UNSAT	
LAMP ALINMENT			VISIBLE DISTANCE			
INTENSITY LEVEL			NO. OF INOPERATIVE LIGHTS			
RUNWAY END LIGHTS			LANDING ZONE LIGHTS			

<table>
<tr><td>10.FACILITY STATUS</td><td>PAPI</td><td>RUNWAY LIGHTS</td><td>APPROACH LIGHTS</td><td colspan="2" rowspan="4">11.NOTAM’s:</td></tr>
<tr><td>UNRESTRICTED</td><td></td><td></td><td></td></tr>
<tr><td>RESTRICTED</td><td></td><td></td><td></td></tr>
<tr><td>UNUSABLE</td><td></td><td></td><td></td></tr>
<tr><td colspan="6">12.REMARKS:</td></tr>
<tr><td colspan="3">PILOT IN CHARGE’S SIGNATURE:</td><td colspan="2">FLIGHT INSPECTOR’S SIGNATURE:</td><td>AIRCRAFT NO:</td></tr>
</table>

Sample Flight Inspection Report for DVOR/DME

1.LOCATION:	2.IDENTIFICATION:

3.FLIGHT INSPECTION DATE(S):	4.FACILITY INSPECTED		VOR		DME

5.TYPE OF INSPECTION		SITE EVALUATION		PERIODIC		SPECIAL
		COMMISSIONING		SURVEILLANCE		INCOMPLETE

6.ORBIT RESULTS

NO.	TX NO.	FLIGHT LEVEL(MSL)	ORBIT RADIUS(NM)	MEAN BEARING ERROR	MEAN RANGE ERROR
1	**1**				
2	**2**				

7.RADIAL RESULTS

RADIAL USE								
AZIMUTH								
TX NO.								
MSL ALTITUDE								
DISTANCE FROM								
DISTANCE TO								
ALIGNMENT ERROR								
MAX BEND/RANGE								
ROUGHNESS/RANGE								
POLARIZATION								
TRANSMITTER DIFF								
MOD30HZ AM								
MOD30HZ FM								
MOD9960HZ								
MINIMUM SS								

DME RANGE ERROR								
INTERFERENCE								

8.MONITORS						
TX NO.	REFERENCE RADIAL	MSL	RANGE	ALIGNMENT	ALARM+	ALARM-

9.ORBIT BEARING ERROR (TX NO.1)

9.ORBIT BEARING ERROR (TX NO.2)

10.GROUND RECEIVER CHECK POINT			
GROUND CHECK POINT	TX NO.	BEARING READING	RANGE READING

11.GENERAL	TX1		TX2	
	SAT	UNSAT	SAT	UNSAT
STANDBY POWER				
VOICE				
VOR IDENTIFICATION				
DME IDENTIFICATION				

DME ACCURACY				
DME COVERAGE				

12.FACILITY STATUS			13.NOTAM's:
STATUS	VOR	DME	
UNRESTRICTED			
RESTRICTED			
UNUSABLE			

14.REMARKS:

PILOT IN CHARGE'S SIGNATURE:	FLIGHT INSPECTOR'S SIGNATURE:	AIRCRAFT NO:

Attachment B
Sample Flight Inspection Records

Sample Flight Inspection Record

Flight Inspection Record / Log Sheet					
Airport Name:		Aircraft Registration Number:		Date of Inspection:	
Flight Hours:		Total Number of Run:		Inspector Name:	
Facility Type:		Identification:		Frequency:	
Temperature:		Air Pressure:			
Run Number	**Transmitter**	**Profile**	**Result Summary**		**Finding**

Appendix 1

1. USEFUL REFERENCE

- ICASC Website
  http://www.icasc.co

- ICASC - Document on Standards and Recommended Practices for Flight Inspection & Flight Validation Organisations
  http://www.icasc.co/sites/faa/uploads/documents/Library/ICASC/ICASC_SARPs_FI_FV_v14_11102018_final101.pdf

- ICASC Recommended Flight Inspection & Flight Validation Contract Annex
  http://www.icasc.co/sites/faa/uploads/documents/Library/ICASC/ICASC_FIS_Contract__Annex_v0_2_26_05_2016_final101.pdf

- Reference Note from ICAO on the Considerations of Radio Navigation Aids Flight Inspection Periodicity
  https://www.icao.int/safety/OPS/OPS-Normal/Pages/Flight-inspection-for-radio-aids.aspx

Appendix 2

1. Use of Emerging Technology to Supplement Flight Inspection

1.1. Flight navigation systems are essential in the world where global air traffic growths continuously. These systems enable Air Navigation Service Providers (ANSPs) to ensure that aircraft can reach their destination in due time safely, despite the continuous increase in air traffic density. Indeed, Air Traffic Management (ATM) companies strongly rely on advanced, unfailing and efficient navigation aid equipment in order to accomplish their mission in the best conditions.

1.2. Among the numerous requirements from the International Civil Aviation Organization (ICAO), flight navigation systems must be regularly calibrated, inspected and maintained to ensure that all essential navigation aids for pilots are always working properly. This means that these systems must be tuned and maintained to radiate the correct signals in the airspace, at any time. To achieve this, a combination of ground and air inspections is necessary, like the localizer measurements for CAT III ILS.

1.3. ILS is an essential navigation aid to help pilots land their aircraft in low visibility conditions during IFR flights. In order to maintain the ICAO ILS certification, dynamic measurements need to be performed by the airport operators / ANSPs, their subcontracted flight inspection organizations or government agencies. These companies are always looking to improve and streamline inspection processes to mitigate impacts on airport operations. The regular ILS signal inspection is made in flight, using a manned aircraft. It requires prior coordination and preparation with various stakeholders, together with ground measurements in order to optimize the manned flight inspection.

1.4. Both of the above flight and ground operations have their limitations: the manned aircraft is costly, noisy and environmental unfriendly with large fuel consumption by flight inspection aircraft, while the ground one is limited in terms of reachable distance and height for the measurement antenna. The ground ILS inspections are indeed restrained to the runway threshold, since they are performed using masts that generally don’t go higher than around 25 meters, from the ground. This is where the initiative for developing drones or Unmanned Aerial Vehicle (UAV) inspection solution. With improved lifting power, efficiency and reliability, the drone / UAV could perform inspections in the ILS far field as well as ILS elevation profiles and mini approaches with inspection to analyze the ILS signals (course alignment, slope angle, alarms, displacement sensitivity, etc.) and to supplement the ground and manned flight measurements in a more comprehensive mean.

1.5. With the technology of UAV being widely and rapidly developing, more and more flight inspection institutes came into the research on how to utilize UAVs for flight inspection and many practices have been made. The UAVs are normally classified in two groups, the drones, which are smaller, normally with multiple rotors; and Remotely Piloted Aircraft System (RPAS), which are heavier and with fixed wings. Some institutes concentrate on the development of RPAS flight inspection, which is quite similar to the performance of normal flight inspection aircrafts, but cheaper on cost.

1.6. It should be noted that the technology of UAV/RPAS is still emerging. Major issues that still need to be addressed including the integration of UAV/RPAS with other manned civil aviation traffic in unsegregated airspace, while maintaining a similar high level of integrity and reliability that have been developed and matured over the past decades. These integrity requirements, especially those apply to the operations beyond line of sight, would be even more significant when operating in Terminal Airspace, with a mixture of UAV/RPAS operations and regular traffic in densely used airspace. Major challenges in mastering UAV/RPAS autonomous operations (traffic sensing and avoidance), improving system integrity and reliability, as well as establishing a suitable certification framework and process, still need to be addressed. Nowadays, UAV/RPAS are already well positioned to assist Ground and Flight Inspection under a clearly defined and restrained operational environment.

2. Flight Inspection with Drones

2.1. Application of drone inspection allows improvements on ILS inspection operations by dramatically reducing the manned aircraft flight inspection frequency and thus decreasing the overall operational cost for airport operators. Highlights of advantages that could be brought by applying drone in ILS flight inspections are listed below:

(a) Supplement to ILS ground measurements

(b) Excellent repeatability

(c) Cost & time saving

(d) Flexible inspection time

(e) Reducing operational disturbances

(f) Reducing CO_2 and noise emissions

2.2. This major step in ILS maintenance domain for preventive and corrective maintenance is only a beginning. Thanks to the technology advancement, research institutes are going further in developing the next generation ATM systems. In addition to ILS flight inspections, new horizon also arise for drone / UAV inspection on other systems like VOR, DF, PAPI, radars, etc.

2.3. With user-friendly interface, preparing the drone operation could take less than 1 minute. The operator just has to select the airport and the runway from database and then choose the type of the required inspection. Once this is done, all the required data (missions, waypoints, distances, altitudes, etc.) is generated automatically. There is no need to read the procedures to figure out which measurements that are to be made and where to be made. The operation could be created in platform with simple access from the tablet to view and download the details. This database of airports, runways and navigation aids can be expanded and updated with an easy-to-use web interface.

2.4. Once the corresponding operation has been downloaded to the inspection program / application, the operator could launch the mission and monitor the automated procedures. The operator is guided throughout the mission. Each mission takes only a few minutes of flight and could be repeated as many times as needed. Measurements are available and could be viewed in real-time.

2.5. Reports are viewable on-site through the program / application. There is no need to download the measured data to compile the reports. Reports contain all the relevant measurements and parameters same as any report generated from generic flight inspection aircraft, in the form of tables and images. Reports, along with all the measurements, images or videos, are uploaded into a platform for centralized recording, future reference or additional processing.

3. Worldwide Development of Drones to Assist Flight Inspection / Testing

3.1. Flight inspection organizations or institutes in Belgium, China, Germany, Italy, Russia, Spain have used drones to assist and provide supplementary tests in flight inspection works. The drones are normally be used to assist testing of navigation equipment signals, since they are not competent for all flight inspection missions with limited performance in speed, service ceiling, endurance, crosswind resistance, payload, etc. Some latest developments on technology and standard shared by States/organizations are listed below for reference:

3.2. Belgium

(a) The development of the UAV / drone solution for ILS inspection was started in 2015 and in operation since January 2018 in Belgium and has extended the usage to Geneva (GVA – LSGG) and Zurich (ZRH – LSZH) airports.

3.3. Germany

(a) In early November 2018, a drone specially developed for carrying out ILS measurements was employed at Hannover International Airport in Germany during the commissioning of a new ILS. This entailed generating Difference of Depth of Modulation (DDM) measurement curves above and below the 3° approach path of the new 09R ILS at 1 km distance from the threshold. The measurement flights were monitored not only in the control tower of the Hannover airport, but also at the DFS headquarters in Langen via a drone tracking system. The flights were very successful and form an important impulse for the rapid operational introduction of measurement drones for ground measurements of the numerous Instrument Landing Systems installed at German airports.

3.4. China

(a) In CNS/SG/25 meeting, China has shared their trials and application of UAS as well as the progress of standards development. Some reference materials contributed by China are summarized below for reference:

(i) UAS-Based PAPI Inspection Technology in China
https://www.icao.int/APAC/Meetings/2021%20CNS%20SG%2025/WP24_CHN%20AI.12%20-%20UAS-based%20PAPI%20Inspection%20Technology%20in%20China.pdf

(ii) Standard Establishment of UAS-Based Flight Inspection System in China
https://www.icao.int/APAC/Meetings/2021%20CNS%20SG%2025/Flimsy%2003_CHN%20AI.12%20-%20Standard%20establishment%20of%20UAS-based%20flight%20inspection%20system%20in%20China.pdf

(iii) Standard Establishment of Data Link for UAS-Based Flight Inspection in China
https://www.icao.int/APAC/Meetings/2021%20CNS%20SG%2025/IP15_CHN%20AI.12%20-%20Standard%20Establishment%20of%20Data%20Link%20for%20UAS-based%20Flight%20Inspection.pdf

4. Flight Inspection with RPAS

4.1. Balancing the factors of performance, cost, operation, maintenance, management, safety, the fixed-wing RPAS with 8-11 meters wing span is better for flight inspection due to its stability in flying, with following example performance for reference.

4.2. Typical performance of RPAS for flight inspection

(a) Wingspan: 8-11 meters

(b) Cruising speed: 100-180km/h

(c) Max speed: 200-240km/h

(d) Ceiling: 6000m or higher

(e) Runway length for take-off and landing: 300m or longer

(f) Payload for inspection equipment: 50kg or more

(g) Electrical power supply: 2kw or more

(h) Endurance: 5 hours or more after inspection system installed

(i) Communication: C2 or 5G or Data link with bandwidth more than 2M

(j) Flight control: fully pre-programmable

4.3. Typical RPAS flight inspection system configuration

(a) RPAS aircraft

(b) Airborne inspection system including all the receivers, transceivers, camera, position-fixing, communication equipment and antennas, etc.

(c) Vehicle-borne system including control console, communication equipment, differential station, etc.

(d) Container and transportation truck

(e) Control car

(f) Auxiliary equipment and mobile

4.4. Operation considerations of RPAS flight inspection

(a) Fully pre-programmed flight for all inspection profiles including take-off and landing

(b) Signal collection in the air and processing on the ground

(c) Internet Big Data system and Artificial Intelligence (AI) analysis

(d) On-site co-operation with NAVAID maintenance and ATC

(e) Ground transportation from airport to airport

(f) Crew members:1 or 2 inspectors, 3 or 4 maintenances/operators

4.5. Safety management of RPAS flight inspection

(a) Organizations or institutes operating RPAS flight inspection should establish a safety management system (SMS) to ensure flight safety of RPAS. A good experience is to evaluate with the tool named SORA (Specific Operations Risk Assessment).

5. Profiles and Items for RPAS Flight Inspection

5.1. ILS

(a) All the ILS inspection profiles could be flown by RPAS.

(b) All the inspection items including LOC alignment, GP angles, modulations, structures, clearance, width, coverage and all the alarms could be checked by RPAS.

(c) Alignment alarm of LOC should be checked closer to the antenna on the runway or using the approach since it would be difficult to get a stable result on the ground of runway threshold.

5.2. VOR/DME and NDB

(a) RPAS could implement almost all the profiles required for VOR/DME and NDB flight inspection. The only insufficiency is the high flight level en-route signal check limited by RPAS performance.

5.3. PAPI

(a) Many institutes and organizations have attempted to check PAPI with camera-equipped drones. RPAS could do this work better since it could simulate a real approach and get more realistic results. However, camera stability and the ability to zoom during high speed approach would be a challenge to RPAS flight inspection researchers.

5.4. Flyability

(a) The lack of human sensing and judgment in actual cockpit and without assistance from on-board flight instruments, it is difficult to rate the fly-ability for a specific procedure / equipment by RPAS flight inspection. It is suggested that fly-ability should be assessed by manned aircrafts.

5.5. Flight inspection recordings and plotting

(a) Flight inspection recordings and plotting, together with the inspection reports could be done on ground and transferred to a central data repository, which could then be analysed by customers and facilitate set-up of a Big Data system for future management and reference.