

TECHNICAL GUIDANCE MATERIAL

Maintenance for Aerodrome Civil Infrastructure

ADVISORY CIRCULAR

SUBJECT: TGM FOR MAINTENANCE FOR AERODROME CIVIL INFRASTRUCTURE

DATE: 25 FEBRUARY 2019

REFERENCE:

- i. CARs Part 139
- ii. CATs Part 139
- iii. ICAO Annex 14 Volume 1. Aerodrome design and operations
- iv. ICAO Doc 9157 - AN/901 Aerodrome Design Manual Part 3 Pavements
- v. ICAO Doc 9137 - AN/898 Airport Services Manual Part 2 Pavement Surface Conditions
- vi. ICAO Doc 9137 - AN/898 Airport Services Manual Part 3 Wildlife Control and Reduction
- vii. ICAO Doc 9137 - AN/898 Airport Services Manual Part 8 Airport Operational Services
- viii. ICAO Doc 9137 - AN/898 Airport Services Manual Part 9 Airport Maintenance Practices
- ix. ICAO Doc 9683 - AN/950 Human Factor Training Manual
- x. ICAO Doc 9476 - AN/927 Manual of Surface Movement Guidance and Control Systems
- xi. ICAO Doc 9870 - Manual on the prevention of Runway Incursions

1. APPLICABILITY

- 1.1. This guidance material is applicable to all aerodromes that have submitted an Aerodrome Manual to the South African Civil Aviation Authority (SACAA) for acceptance and recommendation.
- 1.2. This guidance is recommended to all other licensed aerodromes to guide the development of a maintenance program.

2. PURPOSE

The purpose of this advisory circular is to:

- 2.1. Outline the procedures that should be used for undertaking civil infrastructure inspections;
- 2.2. Define the criteria by which maintenance and inspections should be assessed on movement areas and
- 2.3. Inform about standards, practices and procedures that has been found to be an acceptable means of compliance with the related regulations.

An acceptable means of compliance is not intended to be the only means of compliance with a regulation, and consideration will be given to other methods of compliance that may be presented to the SACAA. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate advisory circular.

3. OVERVIEW

While some hazardous aerodrome conditions develop virtually instantaneously, others are gradual. It is important therefore to have a comprehensive aerodrome inspection program to ensure:

- 3.1. All areas are systematically checked for compliance with established requirements;
- 3.2. Any deficiencies are identified and effective remedial measures are put in place before small defects develop into significant safety hazards.

4. PART A - AREAS TO BE INCLUDED IN THE MAINTENANCE PROCEDURE

4.1. Foreign Object debris (FOD)

- 4.1.1. It is important in the interests of safety to keep runways, taxiways and aprons clear of loose stones or other objects and debris that could cause damage to aircraft or engines, or impair the operation of aircraft systems. Certain aircraft engines are extremely susceptible to damage as a result of foreign object ingestion. Other damages may include that may arise from the presence of FOD on movement areas are damages to tires. Serious accidents have resulted from tires being punctured by a metal object on a runway.
- 4.1.2. Apart from the safety aspect, unscheduled replacement of parts or components damaged by debris will result in economic consequences for the aircraft operators. The cleanliness of the surface of the movement area is a matter of continuous concern and attention must be given to it by the aerodrome authority.
- 4.1.3. All personnel involved in operations on the aerodrome movement area, maintenance hangars and aircraft turnarounds have equal responsibility to ensure that their particular operation does not give rise to FOD. Likewise, every member of staff should act when they detect FOD, either by removing it, should that be safe to do so, or reporting it immediately to the appropriate authority. Above all, FOD should be prevented.
- 4.1.4. FOD prevention should be included in the induction and continuation training programmes, for all airside, maintenance and hangar staff. Specific procedures for the elimination of the risk of FOD should be implemented and working practices that pose a high risk of providing FOD should be reviewed.
- 4.1.5. Close co-operation between aerodrome license holders, aircraft operators and their service partners should also be adopted. The topic of FOD should be a standing agenda item for all committee meeting were all users of the aerodrome are present and also for internal safety meetings.
- 4.1.6. Aerodrome license holders should regularly review their FOD policy and assure themselves that it remains effective. They should also ensure that any third party operation on the aerodrome can demonstrate a satisfactory level of FOD awareness and that their working procedures do not increase the likelihood of FOD.
- 4.1.7. Particular care is needed in the maintenance of the surfaces of manoeuvring areas, especially where the pavement shows any signs of deterioration or damage.
- 4.1.8. Pavements should be adequately sealed and joints properly filled to allow for effective sweeping without forming a trap for debris. Where provided, runway and taxiway shoulders should also be adequately sealed and care exercised to minimize the risk of ingestion into turbine engines of vegetation, grass cuttings and debris that can result from erosion of the surface by overhanging turbine engines.
- 4.1.9. It is possible for stones to be thrown onto runways and taxiways during grass cutting or other work on areas adjacent to paved surfaces and the potential hazard to aircraft that this presents should be minimized by frequent inspections during such activities, sweeping as necessary.
- 4.1.10. Sand used to clean fuel and oil spillage from aprons is a potential cause of turbine engine and propeller damage and should be removed immediately after use.
- 4.1.11. Where construction work is in progress on aerodromes, the use of the movement area by construction vehicles should be prohibited as far as possible. On completion of the construction all debris, piles of dirt or rubble must be removed from the surrounding areas.
- 4.1.12. Polythene bags and paper on aprons is a potential source of damage to engines through ingestion. Suitably covered FOD bins should be provided, in sufficient numbers, by the aerodrome authority.

- 4.1.13. The origin of the debris on the movement area must be determined and remedial measures taken with those responsible.
- 4.1.14. Training of all personnel to include the identification and elimination of FOD must be considered by all concerned parties that is responsible for the maintenance of the aerodrome.

4.2. Paved Surfaces

- 4.2.1. The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas (strip areas) are critical and it is in the aerodrome operator's interest to minimize hazards to aircraft to ensure the safe operation of the aerodrome. As such the pavements must be preserved in a suitable condition for the particular demands of aircraft operations.
- 4.2.2. As with all aerodrome assets, the most effective means of preserving these pavements in a suitable condition is to implement appropriate inspection and maintenance programmes and procedures. The conditions of the surfaces must be monitored regularly as part of an aerodrome predictive, preventive and corrective maintenance programme with the objective of avoiding and eliminating any loose objects/debris that might cause damage to aircraft or impair the operation of aircraft systems.
- 4.2.3. Timely and disciplined core runway inspections should be carried out at regular intervals. Suitable procedures to ensure that such inspections are undertaken effectively must be established. Regular inspections should be executed to ensure that an appropriate level of compliance and safety is maintained at all times.

4.3. Unpaved Areas

- 4.3.1. The maintenance of unpaved areas will ultimately reduce the chances of damages from the following; Ponding and lessened compacted surface strength, erosion of the earth materials resulting in uneven surfaces and also the flush manner in which the paved and unpaved areas adjoin.
- 4.3.2. Vegetation on unpaved areas must be monitored with the maintenance of such areas. Any vegetation that will result in uneven surfaces or that will grow in a manner that poses as an object that may cause damage to aircraft must be carefully considered when maintenance is carried out on unpaved areas.
- 4.3.3. Any object that must be sited in the unpaved areas, for the purposes of navigational aids, must demonstrate frangibility from the manufacturer.
- 4.3.4. Ruts, depressions, humps or variations from the normal smooth surface that could present a hazard to aircraft must be avoided. Also there must be no objects in these areas, except those that must be located there because of their function (for example, runway lights, signs, or navigation aids) and the base for any equipment is at the same level as the surrounding safety area.
- 4.3.5. The ground in the strip areas must be maintained to ensure that it has not been eroded from around light bases, manhole covers, or other fittings that should be flush with the surface.

4.4. Airport Security

- 4.4.1. The movement area of the airport must be protected by a fence or other suitable barrier to prevent or deter the premeditated unauthorized access onto the airport. The barrier must also deter access of animals big enough to cause damage to aircrafts operating on the aerodrome.
- 4.4.2. All gates to the movement area of the airport must be kept locked. If not locked, there must be a security guard at all times at the unlocked gate.

- 4.4.3. Maintenance of the provided barrier must put measures in place to ensure the prevention or deterrence of all mentioned access to the airport.
- 4.4.4. The maintenance of the barrier must take into account the presence of wildlife and where relevant, the presence of residential areas in close proximity with the aerodrome.
- 4.4.5. If there are increased animal activities, the frequency of the inspections must be increased to ensure that access of such animals is deterred to access the aerodrome.

4.5. Safety Areas

- 4.5.1. The safety areas must be maintained in a manner similar to the unpaved areas with regards to the presence of objects and the flush manner the area adjoins other surfaces.
- 4.5.2. The surface of different safety areas must be completed and maintained in different conditions that will serve the purpose for which the area is intended.

4.6. Markings

- 4.6.1. The markings on runways must be visible and must be white.
- 4.6.2. The markings on taxiways, runway turn pads and aircraft stand markings must be maintained in a visible manner and must be yellow.
- 4.6.3. Apron safety lines must be maintained in a conspicuous colour which contrasts with the colour used for aircraft stand markings.
- 4.6.4. Care should be communicated and exercised when contractors are performing repainting of markings, to not change the position of markings.

4.7. Signs

- 4.7.1. Signs form part of navigational aids and SMCGS that are typically sited on safety areas. The frangibility must also be considered.
- 4.7.2. The signs must always portray a message that will be clear to all users of the airside including vehicle operators and pilots.
- 4.7.3. Care should be taken when the panels of the signs are removed for cleaning. When returned, the signs must still portray the message that is correct.

4.8. Drainage

- 4.8.1. The drainage system must be maintained to ensure that none of the drains are blocked.
- 4.8.2. The maintenance of the entire drainage system must be scheduled accordingly to ensure that drains in different parts of the airside are adequately inspected and maintained to perform the tasks they were designed for.

5. PART B: MAINTENANCE

5.1. Corrective Maintenance

Corrective maintenance includes activities that are required to slow down or prevent deterioration. These activities are prompted by findings/defects observed during regular inspections or at any given time. The correction of any defects must be carried out timeously based on the severity of the defect. The reported defects and their correction must be documented and records kept at the aerodrome. Keeping and observing such records will assist for the research of life cost cycles of infrastructure and thus helpful when trends of certain facilities are analyzed for future use or improvements.

5.2. Preventative maintenance

Preventative maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities. The work is pre-planned and may include regular painting of critical markings that fall in the area of touchdowns of aircrafts.

5.3. Predictive maintenance

Predictive maintenance is programmed maintenance where the inspections use tools/ machinery to predict any defects that may occur. This type of maintenance can be used to plan for large projects to prevent any defects from occurring.

6. PART C: INSPECTIONS

There are numerous systems that may be used to report defects observed during inspections. Any method that an aerodrome decides on must proof effectiveness in the manner which the defects are identified and the correction thereof.

6.1. Regular inspections will allow for maintenance activities to be completed on a more proactive basis. Inspections shall, inter alia, address the following items:

- 6.1.1. Inspection of the paved surfaces conditions, including water drainage characteristics on the runway as well as on the adjacent runway strip areas and runway end safety areas;
- 6.1.2. FOD detection and removal;
- 6.1.3. Aeronautical ground lighting fittings within or adjacent to the pavement, including the structural integrity of the fittings;
- 6.1.4. Signage, markings and other visual aids;
- 6.1.5. Cleared and graded areas, such as runway strip areas and runway end safety areas;
- 6.1.6. The perimeter fence.

6.2. Inspectors should fluctuate the patterns of the inspections. Although fixed inspection patterns, may be easy to learn and execute, they do not always provide for an adequate inspection. The use of such fixed inspection patterns can lead to complacency and to the possibility of missing items that are in need of correction. When conducting an inspection on a runway and when there is time to do only one pass on that runway, inspection personnel, whenever practical, should drive towards the direction of landing aircraft with high intensity flashing beacon and headlights on day and night. This practice will enable the inspection personnel to see approaching aircraft and improve visibility of the vehicle to pilots. However, runway inspections must be done in both directions.

6.3. Each person or agency involved in runway inspections must have a clear understanding of what is involved and how to carry out the task safely.

6.4. The aerodrome license holder shall ensure that runway inspection procedures are addressed in the Aerodrome Manual.

6.5. Daily Inspections

- 6.5.1. A minimum of three (3) inspections per day must be conducted on the movement area.
- 6.5.2. Inspections may be undertaken from a moving vehicle traveling at a speed suitable to the task.

6.6. Weekly Inspections

- 6.6.1. All aerodrome pavements within the movement area should be inspected in more detail at least once a week.
- 6.6.2. These inspections of the pavements should give particular attention to areas subject to high loads such as departure taxiways, apron parking stands, take-off taxiways and runway intersections and runway touchdown areas. Inspections should preferably be conducted on foot, but may be done from a slow moving vehicle.
- 6.6.3. The plan to implement maintenance should concentrate on problematic areas observed and on the status of the pavement areas, strip areas and their deterioration in relation to the design, maintenance and minimum levels of compliance.

6.7. Annual Inspections

All pavements within the movement area should be inspected at least once a year by a professional qualified engineer. These inspections should preferably be done on foot and should cover the whole of the movement area.

6.8. Special inspections

- 6.8.1. Special inspections of activities and facilities should be conducted after receipt of a complaint or when an unusual condition or unusual event occurs on the aerodrome, such as a significant meteorological event or an accident or incident.
- 6.8.2. Special inspections should also be conducted at the end of construction activity to ensure that there are no unsafe conditions present related to the construction activity. A special inspection should be conducted prior to construction personnel leaving the aerodrome in the event that corrective actions are necessary.
- 6.8.3. Since grass should be removed immediately after mowing as a protection against birds and for other safety reasons, the strip areas must be inspected following grass being cut to ensure that all grass is removed.
- 6.8.4. Whenever a unique type aircraft for which the infrastructure is not licensed operates on the aerodrome, an inspection should be scheduled prior to the aircraft landing, taking off, taxiing and parking. Another inspection should be schedule after the operations take place to ensure that the infrastructure has not sustained any damage from the landing, taxiing, parking or taking off of the said aircraft. Any affected area must be inspected to ensure no contamination to the surface and subsurface did not occur and that other aircrafts will not sustain damage from operating on the affected area.
- 6.8.5. Special inspections must also be documented on the appropriate portions of the regularly scheduled inspection checklist.

6.9. Detailed Pavement Inspection and Evaluation

- 6.9.1. The inspection procedures described previously addresses the functional condition of the surface of the aerodrome pavement, but does not consider the structural condition of the pavement as a whole. In order to monitor the change in the condition of the aerodrome pavements over time, it is recommended that the aerodrome operator establishes a formal index to define pavement condition.
- 6.9.2. The aerodrome operator should review declared PCN values in the light of the functional condition of the pavement structure, as the strength of the pavement can deteriorate over its lifespan.
- 6.9.3. A visual pavement inspection of the functional condition thereof is recommended to be undertaken every 3 years and a detail pavement structural investigation when relatively large cracks and/or rutting in the runway surfacing appear.

6.9.4. Information gathered from these inspections can be used to create a system such as a pavement management system, which will aid in the ability to predict, plan and budget for future maintenance work.

6.10. Runway friction and the presence of water

6.10.1. The surface of all the runways must be monitored regularly to ensure that the friction levels meet the minimum level of compliance. Friction must be tested as follows and as per ICAO Doc 9137 part 2 A2-1;

DAILY TURBO-JET AEROPLANE ARRIVALS FOR RUNWAY END	ANNUAL AEROPLANE WEIGHT FOR RUNWAY END (MILLION KG)	FRICITION TESTING
Less than 15	Less than 447	Once per year
16 to 30	448 to 838	Once every six months
31 to 90	839 to 2404	Once every three months
91 to 150	2405 to 3969	Once every month
151 to 210	970 to 5 535	Every two weeks
Greater than 210	Greater than 5535	Once every week

Table 1: Frequency of runway visual inspection surveys

6.10.2. The friction levels must be compliant with the table below depending on the method used to test friction characteristics;

Test equipment	Test tire type	Test tire pressure (KPa)	Test Speed (km/h)	Test water depth (mm)	Design objective new surface	Maintenance planning level	Minimum friction level
Mu-meter trailer	A	70	65	1.0	0,72	0,52	0,42
	A	70	95	1.0	0,66	0,38	0,26
Skiddometer Trailer	B	210	65	1.0	0,82	0,60	0,50
	B	210	95	1.0	0,74	0,47	0,34
Surface Friction Tester Vehicle	B	210	65	1.0	0,82	0,60	0,50
	B	210	95	1.0	0,74	0,47	0,34
Runway Friction Tester Vehicle	B	210	65	1.0	0,82	0,60	0,50
	B	210	95	1.0	0,74	0,54	0,41
TATRA Friction Tester Vehicle	B	210	65	1.0	0,76	0,57	0,48
	B	210	95	1.0	0,67	0,52	0,42
Grip Tester Trailer	C	140	65	1.0	0,74	0,53	0,43
	C	140	95	1.0	0,64	0,36	0,24

Table 2: Friction levels for new and existing runway surfaces

- 6.10.3. Whenever water is present on a runway, a description of the runway surface conditions should be made available using the following terms:

a.	DAMP	The surface shows a change of colour due to moisture.
b.	WET	The surface is soaked but there is no standing water.
c.	STANDING WATER	For aircraft performance purposes, a runway where more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by water more than 3 mm deep.

Table 3: Measuring Standing Water on the runway surfaces

- 6.10.4. The reporting of the presence of water on the surface must also include the slipperiness of the runway. This condition is not only determined by the friction characteristic, but may also be as a result of rain falling on a surface that has presence of contaminants such as dust following long periods of no rain. When the initial rainfall on a runway, following a prolonged dry spell, it results in a very slippery condition that is unrepresentative of the overall wet friction characteristics of the runway. This situation is a temporary one which remedies itself as further rainfall washes the runway's surface. It is believed to be caused by the emulsification of dirt and other deposits which are precipitated onto the runway and which may originate from adjacent industrial complexes. A similar phenomenon has, however, been observed on runways located in desert or sandy areas, and also in humid tropical climates where microscopic fungoid growths are believed to be responsible. When such conditions are known to exist, then friction measurements should be made as soon as it is suspected that the runway may have become slippery and should be continued until the situation has corrected itself.

6.11. Personnel conducting the inspections

- 6.11.1. The holder of an aerodrome license must have procedures to ensure that personnel performing aerodrome inspections are appropriately trained. The procedures need to assess and maintain the competence of these personnel.
- 6.11.2. The personnel need to be familiar with, and follow the established procedures for carrying out inspection on an operational aerodrome including correct radio communication procedures and techniques for those facilities and equipment that they are inspecting.
- 6.11.3. The personnel must be familiar with any identified deficiencies found during previous inspections and which are not yet rectified and if construction is in process, be familiar with the method of work plan (MOWP) and safety plan for the project.

7. PART D: DOCUMENTATION

- 7.1. The procedure of inspections must include, but not limited to, the details of the inspections for each area that is inspected, a reporting system and remedial actions necessary to address the defects by the responsible department or person for each task and for further action. The timeframe in which a defect is allowed to stand not corrected as per a severity rating given to each defect.
- 7.2. All aerodrome inspections, maintenance activities and matters arising from such must be formally documented by the aerodrome license holder and records maintained for future reference.
- 7.3. Each inspection must include a reporting mechanism to ensure that appropriate action is taken.

7.4. Competency and qualification

- 7.4.1. Each team of inspection must include at least one personnel qualified in civil engineering and built environment.
- 7.4.2. The aerodrome must also satisfy itself that such personnel is familiar with the layout and culture of the aerodrome.




8. PART E: CHECKLISTS

- 8.1. While the format of checklists may vary, it is important to develop a checklist that is relevant to the aerodrome and its operation. The checklist format needs to clearly record the status or condition of every inspected item.
- 8.2. When preparing a checklist, the relevant requirements of Part 139, including all appendices, should be reviewed to ensure all applicable requirements have been identified.
- 8.3. For consistent interpretation of requirements, a checklist can include the standard, or a reference to the standard.
- 8.4. A checklist should identify the type of inspection, who carried it out, the date and the result for every item checked (whether compliant or not compliant) with comments if needed. Following completion of the inspection the checklist should be signed to confirm it has been carried out in accordance with procedures. The use of electronic checklists with the results and deficiencies stored on an electronic database is acceptable.
- 8.5. If certain inspectors will be responsible for only certain items, separate checklists pertinent to those areas may be developed. If necessary a sketch of the aerodrome should accompany the checklist to record the location of any problem.
- 8.6. Deficiencies found during an inspection should be recorded, with sufficient detail to ensure appropriate remedial action can be taken. It is suggested that photographs are used to support and clarify the nature of the deficiency.

9. PART F: INDEX

- 9.1. Grass height in the strip area = 10cm and dependent on the bird species.
- 9.2. The height of the grass in the strip area must be kept at a height that will not obscure navigational aids that are sited in the unpaved safety areas.
- 9.3. Landing runway friction= Dependent on the method used for testing find different levels as per the friction test result levels. Table 2 given under Part C, of the advisory circular. These levels depend on the method of testing.
- 9.4. PCN = must not be less that the highest ACN operating at the aerodrome. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested for pavements, occasional movements by aircraft with ACN not exceeding 10 per cent above the reported PCN should not adversely affect the pavement.

-- END --

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