Transport Canada Transports Canada

Advisory Circular

Subject: **Maintenance of Runway and Taxiway Lighting Systems**

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1.0 INTRODUCTION

(1) This Advisory Circular (AC) is provided for information and guidance purposes. It may describe an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or allow deviations from regulatory requirements, nor does it set up standards.

1.2 1.1 Purpose

(1) The purpose of this document is to provide guidance to common procedures used at aerodromes, when planning for and conducting routine inspections and preventative maintenance on airfield lighting systems.

1.3 Applicability

(1) This document applies to all aerodrome operators supporting night and reduced/low visibility aircraft operations, air navigation service providers, and electrical contractors. This information is also available to the aviation industry for information purposes.

1.4 Description of Changes

(1) This AC refers to the latest edition (5th) of the TP 312 - Aerodrome Standards and Recommended Practices. This AC also introduces an increased awareness of the potential impact that frost may have on elevated light fixtures, primarily runway edge and taxiway lights.

2.0 REFERENCES AND REQUIREMENTS

2.1 Reference Documents

(1) It is intended that the following reference materials be used in conjunction with this document:

(a) Transport Canada publication, TP 312 – Aerodrome Standards and Recommended Practices – 4th ed.; and

(b) Transport Canada publication, TP 312 – *Aerodrome Standards and Recommended Practices – 5th ed.* (effective 09/2015).

2.2 Cancelled Documents

(1) Not applicable.

(2) By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void

2.3 Definitions and Abbreviations

(1) The following definitions and abbreviations are used in this document:

(a) **TCCA**: Transport Canada, Civil Aviation Directorate

(b) **FOD**: Foreign Object Debris

(c) **HIRL**: High Intensity Runway Lighting

3.0 BACKGROUND

(1) Operating an aerodrome at night and reduced/low visibility conditions requires installation, operation, inspection and maintenance of runway and taxiway lighting systems. A comprehensive preventative maintenance and inspection program for determining the functionality of lighting systems will enhance flight safety and proper acquisition of these visual aid cues for pilots by not permitting any distortion or confusion, due to lighting system failures.

(2) By conducting proactive preventative maintenance activities in accordance with a well-developed and comprehensive plan, you should be able to meet the safety needs of the aviation industry, conform to regulatory obligations, and ensure the continued viability and operational safety of the aerodrome facility.

4.0 GENERAL

(1) The basic purpose of aeronautical visual aid systems is to aid in the safe operation of aircraft, therefore the highest standards of maintenance are required. Once a system has been installed, its usefulness is dependent on its serviceability, which in turn is dependent on the effectiveness of the maintenance work carried out by the aerodrome operator.

(2) The operator can successfully manage malfunctions or unserviceability of lighting systems by developing an inspection and preventative maintenance plan to deal with system failures and deficiencies.

(3) While planning an aerodrome's maintenance program, the inclusion of the following general guidelines, equipment manufacturers' recommendations, and other pertinent safety and health information should be considered. A preventative maintenance program should include procedures to deal with:

(a) personnel qualification and training;

(b) availability of spare parts;

(c) readily available as-built drawings;

(d) light system component inspection and maintenance schedule;

(e) light system component maintenance procedures;

(f) signs; and

(g) markings.

5.0 ROUTINE INSPECTION AND PREVENTATIVE MAINTENANCE ACTIVITIES

5.1 Lighting Fixtures

(1) Lighting fixtures for runway and taxiway use are divided into two broad categories of either elevated or in-pavement. The maintenance needs for each of these types are quite different. Where in-pavement lights generally need more maintenance than elevated lights to give consistent performance and uniformity of light output, elevated runway edge lights need more care in alignment (all axis) so that the light output is aimed properly to meet photometric requirements.

(2) Several factors are common to both types of fixtures such as:

(a) Dirt and other contaminants reduce light output requiring periodic cleaning of the glassware or lens to assure optimum performance; and

(b) Fixture bases need regular maintenance attention to ensure the integrity of the fixture and base assembly.

(3) Elevated lights, particularly taxiway lights, generally need less maintenance attention than the in-pavement lights such as runway centreline and touchdown zone lights. Taxiway edge lights normally only need periodic re-lamping, but they are probably the most likely candidates for other types of damage on the airfield such as that from ground vehicles, snowploughs and mowers.

(4) Elevated runway edge and taxiway light fixtures are also affected by frost, which causes the fixtures to move primarily upwards but also away from its optimal azimuth or vertical zenith. Some fixtures have moved significantly as to raise the frangible break point above safety minima and to expose the counterpoise connection (see Figure 1).

Figure 1

5.2 Repair hazards

(1) The primary hazards associated with the repair of elevated lights, when they have been run over or damaged, is from the glass and bare electrical conductors that may be exposed. Be sure to take proper safety precautions when handling these items (i.e. proper gloves and other safety equipment).

(2) Glass from broken taxiway globes is extremely sharp and poses a hazard to the maintenance personnel and may also pose as a significant Foreign Object Debris (FOD) hazard for aircraft.

(3) Removal of the existing frangible coupling is probably the single biggest problem with repairing damaged elevated taxiway or runway lights. Applying a coating of anti-seize compound or aluminum anti-oxidant to the threads before installing a new coupling may reduce this problem.

(4) Runway edge lights and threshold lights need more maintenance than taxiway lights. Runway edge lights may need periodic cleaning to remove dirt, mud, bird droppings, etc. The lenses of elevated runway edge lights can also become pitted and sandblasted from jet blast and need replacement.

(5) Elevated light fixtures may also need to be re-positioned if frost has caused the fixtures to move out of the standard position. When re-positioning the fixtures to within standard minima, care should be taken to make sure the counterpoise connection is not damaged.

(6) When re-lamping or repairing runway edge lights, care should be taken to make sure that all lenses and filters are properly oriented and that the fixture itself is in the proper orientation relative to the runway centreline. Some elevated runway edge light globes have an arrow on top that is to be aimed perpendicular to the runway centreline. Once the globe is properly orientated, the output beams are directed inwards ["toe-in"] toward the runway centreline. Proper orientation of the fixture is necessary for this toe-in and required output to be maintained.

(7) When re-lamping any fixture:

(a) check the lamp before installing to make sure that it is the correct type and wattage because many lamps look alike;

(b) **SEE CAUTIONARY NOTE UNDER SECTION 7.2(1)**;

(c) use only the lamp approved by the original equipment manufacturer of the fixture. Failure to do so may affect photometric output of the fixture and cause the fixture assembly to no longer meet requirements; and

(d) make sure the counterpoise connection is verified.

6.0 PREVENTIVE MAINTENANCE CHECKS

(1) Where an aerodrome is used at night, there exists the requirement to provide appropriate runway and taxiway lighting. It is also expected that this lighting is designed, installed, and maintained in an operational status.

6.1 Daily Checks

(1) These physical checks are the most common daily inspection of the aerodrome's lighting systems. They are conducted by the operator and should address all airside-manoeuvring areas. If a checklist is used, it should include the following:

(a) Do a visual check (driving patrol) of the system at twilight or night, each day. This allows the operator to visually detect any:

(i) dimly burning bulbs;

(ii) burned-out lamps; and

(iii) fixtures out of alignment.

(b) Record the locations of deficient fixtures and take corrective action, as soon as possible;

(c) Replace dimly burning and burned-out lamps when the system is deactivated, as soon as possible; and

(d) Check all lenses for cleanliness and clean as needed.

6.2 Monthly Checks

(1) Check the orientation of all lenses. Make this check by viewing the lights at night or by doing the testing as outlined below. Misaligned light units will appear dimmer or brighter than those that are properly aligned. The lenses may get out of adjustment when replacing lamps or when mowers and other vehicles strike the elevated lights:

(a) Conduct light intensity checks through Photometric Testing. Mobile photometric measurement units are now available to allow for the rapid and correct testing of the output of both in-pavement and elevated runway lighting fixtures.

(b) Photometric testing should be done before cleaning, re-lamping, or realignment to set up whether maintenance is necessary; and after cleaning, realignment or repair, to check the effectiveness of the maintenance action.

(c) High intensity elevated runway edge lights that show light output below 50% of the value specified in the appropriate TP 312, Appendix B – Figure B-10 or B-11 as applicable, (or 50% of the design value where the design value is in excess of the standard) should be targeted for maintenance.

(i) Straighten, level, and align all lighting units that have been knocked out of alignment;

(ii) Check lamp sockets for cleanliness and good electrical connections. If moisture is present, replace the fixture gasket; and

(iii) Inspect and clean the weep hole in the frangible coupling of stake-mounted lights.

6.3 Semi-annual Checks

(1) Check the ground elevation around lighting fixtures, especially following the winter season for frost damage. The frangible point should be less than 50mm above the ground elevation for stake-mounted fixtures and 25mm for base mounted fixtures.

(a) Grade around the fixture where necessary to support this fixture/grade relationship;

(b) Keep the elevation of all lights the same height above the runway/taxiway pavement edge; and

(c) Re-position the fixture to within standard height if frost has caused upwards movement.

(2) Check the elevation more often during times of frequent freeze/thaw cycles.

(a) Height of the lights should not exceed 350mm when located within 1.5m of the runway or taxiway edge; and

(b) In snow regions where the lights are located beyond 1.5m from the runway or taxiway edge, the lights may be raised in accordance with TP312.

(3) Check light bases and housings for evidence of moisture penetration.

(4) Check gaskets, seals, and clamps for deterioration and damage.

(5) Check the torque of light base cover bolts.

(6) Check fixtures, bases, and housing for corrosion, rust and peeling paint.

6.4 Annual Checks

(1) Check each light fixture carefully for cracking, corrosion, or shorts;

(2) Clean the contacts and ensure that lamp fits firmly into receptacle;

(3) Check condition of all connections;

(4) Check all gaskets on a leaky light unit and replace with new rubber gaskets; and

(5) Check each light fixture carefully to make sure they are sealed against ants or other insects to prevent nesting.

7.0 ELEVATED FIXTURES

7.1 Unscheduled Maintenance

(1) Remove snow from around the lighting fixtures as soon as possible after a snowfall so the light fixtures are not obscured. If heavy snowfalls are predicted, plant red flags or reflective sticks of enough length next to the edge lights to mark their location. The flags will help snow removal and will lessen the damage to fixtures by snow removal equipment.

(2) When flags or sticks are used, care is taken to ensure that the installation is secure and the devices will not be released so as to become FOD on the runway or taxiway.

7.2 Lamp Replacement

(1) With the lights operating, make a visual check to positively show the lighting unit or units that are not working. Turn off the lights and lock out circuits. Install safety-warning signs at the right locations.

CAUTION: De-energize the circuit and lock out the circuit or regulator so that the circuit cannot be energized from the remote lighting panel or other means before starting work on the lights. Remove switch cutouts if present.

(2) With the replacement lamp at hand, open up the fixture and remove the old lamp:

(a) Examine the old lamp to confirm the source of failure;

(b) Compare the identification markings on the old and replacement lamps to verify that the replacement lamp is the correct type;

(c) Inspect the lamp socket, connections, and wire insulation;

(d) Check the light unit and base for evidence of leakage or condensation and remove any water present;

(e) Replace fused film disc cut out, if used; and

(f) Install new lamps, ensuring that the lamp face is clean and free of oils, fingerprints, etc. Use a clean, dry, soft cloth and never touch the lamp with unprotected fingers.

(3) Check filters, when used, for cracking or misalignment and replace or adjust as needed.

(4) Clean all reflectors, filters and covers as needed. When hood or shield is used, check adjustment.

(5) When closing the light, confirm that the gaskets are positioned for proper sealing. Tighten all screws, clamps, and fasteners.

(6) Check frangible couplings for cracks.

(7) Check the horizontal and vertical alignment of the lights for proper adjustment.

(8) When all outages have been corrected, energize the circuit and make a visual check of the repaired units for proper operation.

(9) Record the repairs.

7.3 Spare Unit Replacement

(1) In some instances, it may be more convenient to fix defective edge lights by replacing the entire light with a spare unit. This will reduce the runway downtime and allow troubleshooting and refurbishment of the defective light at a more convenient location. Spare unit replacement is very convenient for repairing lights struck by lightning or vehicles.

7.4 Inspection

(1) When replacing the lamp, inspect the light thoroughly for other damage. Check for water in bases or lights, cracked and chipped glassware, defective or incorrectly positioned gaskets, loose connections, cracked or deteriorated insulation, and misalignment of lights or shields.

7.5 Cleaning

(1) When changing lamps, clean the light fixture inside and outside, as needed. Light surfaces should be kept clean to transmit light satisfactorily. In setting up a cleaning program, first consider the sources of the dirt problem. Many airfield lights are located at or near ground level and are subject to blowing dirt or dust, rain spattering, jet exhaust residue, bird droppings, corrosion, and heat and static attraction of dirt. In some cases, submersion or exposure to water may be a problem. Cleaning procedures will vary depending on the cause of the problem and its effect on the system. Cleaning problems may often be reduced by preventive measures.

7.6 Cleaning Schedule

(1) The cleaning schedule will vary at each location depending on such factors as environment, geographical location, the types of lighting units and the level of activities at the aerodrome. Clean each light thoroughly at least once a year. Regular photometric measurements may show a need for a more frequent cleaning schedule.

7.7 Cleaning Procedures

(1) Wash all glassware, reflectors, lenses, filters, lamps, and all optical surfaces. Washing may increase the light output by as much as 15 percent more than wiping with a dry cloth.

(a) Strong alkaline or acidic agents for cleaning should be avoided;

(b) Solutions that leave a film on the surface should not be used;

(c) When possible, remove the unit and do cleaning in the shop; and

(d) Alcohol or other cleaning agents that do not need rinsing or leave a residue should be used for reflectors or other optical surfaces that cannot be removed for cleaning.

7.8 Moisture

(1) **Water and Condensation.** Water is the most common cause of problems in airfield lighting fixtures. In bases, water may cause grounding of the lamp or circuit; in the optical assembly it may submerge optical parts, cause corrosion and deterioration, form condensation on optical surfaces, and accelerate the accumulation of dirt on optical surfaces. Preventing water from entering bases is very difficult. The alternate heating and cooling of the lights can create a strong "breathing" effect, especially when the base is located in saturated ground. The water may also enter through conduits, along the conductor or the cable, through gaskets and seals, through damaged glassware, or through fine holes in the walls of the bases.

(2) **Protection From and Removal of Water.** The immediate problem of water in lights and bases is removal and prevention of re-entry. In the light bases, the accumulated water can usually be drained or pumped out. Should you encounter a problem with water entering the light fixtures, the following corrective actions may be used to successfully remedy the situation as follows:

(a) Drain holes should be drilled or cleaned out if already present;

(b) Gaskets, seals, and clamps that may admit water should be checked;

(c) Chipped, cracked, or broken glassware should be replaced;

(d) If water cannot be removed from the light bases, ensure all electrical connections and insulation are watertight and above the waterline;

(e) New conduit and base installations should be designed to drain and have a separate drainage system installed at low elevation points in the system;

(f) Before installing the cover plate, blow out cover boltholes to make certain that fastening bolts are not anchored in sand or debris that prevents the cover from being torqued sufficiently on the gasket;

(g) Make sure the boltholes have serviceable threads and that the gasket is in good condition and properly placed to lessen the possibility of moisture entry around their threads; and

(h) Base flange bolts should be drawn down in opposite pairs until all are tightened to the recommended torque. Avoid excessive torque.

(3) **Strikes and Blast Damage.** Light units damaged by strikes from aircraft or vehicles, or by propeller or jet blasts, should be repaired or replaced at once. Areas where this damage recurs should be checked more often. A careful check should be made following damage of this type because the attaching cable may also be damaged. At locations where damage is frequent due to vehicular traffic, consider alternative safety solutions, such as replacing elevated lights with approved in-pavement types.

(4) **Repair and Replacement.** When possible, replace the entire damaged unit. Simple repairs usually consist of the following:

(a) Remove the broken frangible coupling from the base cover;

(b) Connect the new light to the secondary connector;

(c) Install a new light on a new frangible coupling; and

(d) Check for correct alignment; align as needed.

(5) **Frangible Coupling Replacement.** Frangible couplings are used primarily to reduce damage to aircraft in case of a strike. They give an intentional weak point and aid in preventing damage to other parts. An open-end wrench, pipe wrench, cold chisel, and punch and hammer are usually enough to remove and install frangible couplings.

Table 1. Checklist for Runway and Taxiway Elevated Edge Lights

MAINTENANCE REQUIREMENT	D	W	M	BM	SA	A	U
1. Inspect for outages; repair as necessary	X						
2. Check cleanliness of lenses	X						
3. Perform photometric testing (HIRL)			X				X
4. Check light alignment and orientation			X				X
5. Clean fixtures and sockets							X
6. Check light elevation					X		
7. Check for moisture in lights					X		
8. Inspect fixture for rust, deterioration						X	
9. Check lamp fitting and clean contacts						X	
10. Check gaskets						X	
11. Remove snow and/or vegetation from around lights							X

D = Daily, W = Weekly, M = Monthly, BM = Bi-monthly, SA = Semi-Annual, A = Annual, U = Unscheduled

8.0 IN-PAVEMENT (INSET) LIGHTING FIXTURES

(1) In-pavement or inset lights need more maintenance than elevated lights. Rubber deposits on the lens are the main cause of poor performance for fixtures installed in the runway. Jet fuel, de-icing fluid, and other contaminants can also collect on the lens and deteriorate the light output, even on lights installed in taxiways.

8.1 General Maintenance Practices

(1) When maintenance other than simple cleaning is needed, a way to ensure that in-pavement fixtures are properly kept is to remove them from the runway or taxiway and replace with a refurbished unit. A quantity of spare fixtures equal to 10% of the installed quantity should be kept for each type of fixture for this purpose.

(2) Many aerodromes that have a large number of in-pavement lights have either built or modified trailers or vehicles to allow for fast, efficient removal and replacement of in-pavement fixtures. These dedicated lighting maintenance vehicles or trailers can be equipped with generators, air compressors, and proper tools to do almost any task. Then the fixture may be removed and brought to the maintenance shop where it is disassembled and properly refurbished.

(3) Equipment is also now available to do photometric testing in the maintenance shop to verify that a refurbished fixture is performing to specifications before being reinstalled in the runway or taxiway.

(4) The main enemy of inset lights is water intrusion. More recently designed lighting fixtures have a much-improved ability to keep water out of the optical assembly. Improved gasket materials and designs have drastically reduced the amount of maintenance needed. When dealing with fixtures where water intrusion has become a problem, the first step is to assess where the water is entering the fixture. This can be in one of several places:

(a) the O-ring gasket sealing the fixture assembly;

(b) the gasket or sealing material around the lens; or

(c) the seal around the entrance point for the electrical conductors feeding the fixture.

(5) The best way to assess where the problem lies is to construct a testing jig by using a spare fixture. The method will vary depending on the type of fixture and the manufacturer. Aim to construct a method of pressurizing the fixture with air while submersing it in water. Five to ten pounds of air pressure is usually enough. The area with the bad seal will show up by the trail of air bubbles exiting the fixture.

(6) Care should be taken to regulate the pressure used to test the fixture because if too much pressure is applied, the lens can be blown out. Air pressure should not be applied to the fixture before submersing it in water, as this could present a hazard if one of the lenses is blown out of the fixture.

(7) Some newer fixture designs come from the factory with an air valve stem attached to the bottom of the fixture. This fitting is used at the factory to pressure test the fixture during final assembly and can be used for maintenance also. Consult the manufacturer of fixture for recommended air pressure settings. Once the area of the leak is decided, the cause can be found and corrected.

(8) On older fixture designs, the lens may be sealed into the fixture using RTV sealant. If replacing this type of lens, be sure to use the right sealant and primer as recommended by the fixture manufacturer. Usually a Dow Corning RTV 106, high temperature silicone sealant is used.

(9) Most new fixture designs use a lens with a replaceable gasket. This greatly improves the time and effort needed to replace the lens.

(10) Inset light lenses should be replaced when they have become scratched or pitted.

(11) When re-lamping either elevated or inset fixtures, *do not to touch the glass of the lamp with the bare hands*. Oils found in the skin will cause hot spots on the lamp and lead to premature failure.

(12) When installing a new lamp, be sure that the correct orientation is kept. Some lamps have arrows to show positioning in the holder. Improper lamp positioning can result in improper or reduced photometric output of the fixture.

(13) When reassembling an inset fixture, follow all manufacturers' instructions.

(14) Remove rust and other deposits from the inside surfaces of the fixture by using an abrasive blasting cabinet with the proper abrasive. Glass beads or material such as ground walnut shells work well and, as long as proper care is taken, they will not harm the lens or wiring of the fixture. Do not use abrasive materials on reflector assemblies in the fixture.

(15) Reassemble the fixture after checking or replacing the gaskets or O-rings. A light coating of silicone grease is sometimes recommended for the O-rings.

(16) When reinstalling the fixture:

(a) Check the condition of O-ring gaskets installed on the flange ring (if supplied) and replace if necessary;

(b) Lubricate O-rings with a small amount of silicone grease;

(c) Ensure that new screws or bolts and lock washers are used to reinstall the fixture and tighten to the specified torque with a calibrated torque wrench;

(d) Remove and replace any broken bolts. Failure to do so can result in all the bolts breaking under the impact of a landing aircraft; and

(e) Develop a systematic plan for checking the torque of inset fixtures on a regular basis, particularly on the runway.

9.0 PREVENTIVE MAINTENANCE INSPECTION CHECK PROCEDURES

(1) Because in-pavement lights are installed in the aircraft traffic area and are run over by aircraft, they tend to be higher maintenance items that need frequent attention to support specified performance. Additionally, their location below ground level makes them prone to water infiltration; this also needs frequent attention. These problems should be remembered when performing the PMIs contained in Table 2 and described in section 9.8.

9.1 Daily Inspections

(1) A driving patrol should be made daily at twilight. The operator should:

(a) Find burned-out lamps;

(b) Find dimly burning lamps; and

(c) Record their location.

9.2 Weekly Inspections

(1) A field electrician should inspect and service any lights reported as defective in the daily inspections. The preferred service method is to replace the in-pavement light unit with a spare and take the defective unit back to the shop for repair. The lighting *circuit should be deactivated*, *locked-out and tagged-out* before any maintenance is tried on the lights.

(2) The following defects may be the cause of the lighting malfunction:

(a) No light

(i) Fixture should be removed and replaced with a refurbished unit; and

(ii) Brought to the maintenance shop for re-lamping and refurbishing.

(b) Electrical failure

(i) A series circuit problem exists, if the replacement lamp also fails; or

(ii) A series circuit problem exists, if a string of lights fails.

(c) Dim light

(i) Exposed optical surface of the in-pavement light gets dirty from exposure to aircraft traffic and weather;

(ii) Can also be a sign of a weak lamp; and

(iii) May be cause for fixture replacement.

(d) Light aiming

(i) Shallow-base in-pavement light fixtures are often twisted out of alignment by aircraft landing or turning; and

(ii) Check any dimly burning lights to see if they are merely misaligned.

(e) Water in the Fixture

(i) Examine the lens for standing water or condensation behind the lens;

(ii) If water is present, remove and service the fixture.

9.3 Monthly Inspections

(1) Until a regular maintenance schedule is set up, it may be necessary to do the checks below on a monthly or even weekly basis at busy facilities. After some experience has been gained, the interval may be adjusted to meet operational needs.

(2) The frequency of measurement of lights for a precision approach runway should be based on:

(a) Traffic density;

(b) Local pollution level;

(c) Reliability of the installed equipment; and

(d) Continuous assessment of the results of the in-field measurements, but in any case should not be less than twice a year.

9.4 Cleaning

(1) Due to their position at ground level, in-pavement lights need frequent cleaning to support their specified performance. The frequency with which the lights are cleaned depends on:

(a) location;

(b) weather conditions; and

(c) traffic density.

(2) Both rubber deposits and runway de-icing fluids have been shown to have an extremely detrimental effect on light output.

(3) Clean the lights when the light output of the fixture is less than 50 percent of the standard [or of the design value when this value is in excess of the standard]. A fixture degraded below this is ineffective for high background brightness, low visibility conditions.

9.5 Intensity Checks and Photometric Testing

(1) Test equipment is now available to allow for the rapid and accurate testing of the light output of both in-pavement and elevated runway lighting fixtures. Regular photometric measurements are the only practical way of determining if the lights are emitting the specified amount of light and for determining misalignment errors.

(2) By using regular photometric measurements, maintenance of runway lighting fixtures may be targeted only where needed thereby saving resources and time while allowing the aerodrome to be assured of meeting light output specifications, especially in low-visibility conditions. This aids in providing a consistent lighting pattern to give the pilot with the best possible, non-ambiguous visual cues when landing.

(3) Necessary frequency of photometric measurements will vary from facility to facility and from runway to runway depending on amount of traffic and age of fixtures. After experience has been gained with the measurement equipment, inspection schedules may be decided on or modified.

(4) Due to the susceptibility of runway centreline lights to accumulate rubber deposits on the lens, weekly checks may be necessary. This is especially true for CAT II and CAT III runways where low-visibility operations are conducted. Any in-pavement runway light showing a light output of less than 50% of standard [or 50% of the design value] is ineffective for high background brightness or low visibility conditions and should be targeted for cleaning or maintenance.

(5) Photometric testing should be done:

(a) Before cleaning or re-lamping, to prove what maintenance is necessary; and

(b) After cleaning, or other maintenance actions, to track the effectiveness of the maintenance and decide the extent of degradation of the optical assembly.

9.6 Bi-Monthly Checks – Bolt Torque

The torque of the bolts attaching the light to its base should be checked. The impact of aircraft wheels can loosen mounting bolts and cause misalignment or fixture damage; this is particularly troublesome in the touchdown zone.

9.7 Semi-annual Checks – Shallow Base Installations

(1) Check the shallow base installations for the presence of water. Any water should be removed and the base should be sealed to prevent its re-entry.

(2) This check should be conducted more often in winter months since freezing may cause damage to the fixture by shearing the fixture hold-down bolts or rupturing the base. Having a dry light base is the exception rather than the rule. Water in light bases is very common, resulting from the miles of conduit that leak and slowly fill the system with water.

(3) To avoid water freezing in bases, place ETHA-foam (also known as closed cell foam) disks that are 2 inches thick by 8 inches diameter in the bases to displace the water. This prevents ice damage to the base, fixture, and transformer by allowing any remaining water to crush the ETHA-foam disks.

9.8 Unscheduled Maintenance

(1) Remove snow from around the lighting fixtures as soon as possible after a snowfall to prevent obscuring the light fixtures. Exercise extra care to prevent striking the lighting fixtures with snowplow blades.

(2) After snow removal operations, inspect all lighting fixtures and replace any damaged light assemblies.

(3) Whenever snowplows pass over in-pavement light fixtures, they should be traveling at less than 10km per hour or should lift the blades clear of the fixture.

(4) Rubber and plastic snowplow blades that are especially suited to ploughing wet or slushy snow are available; rotary brooms are also recommended.

(5) If snow removal is a frequent winter job, high-strength steel light fixtures may be specified to better withstand the impact of snow ploughing.

(6) Check wireways in saw kerfs. If wires are floating out, reinstall using wedges for anchoring wires. Space wedges 600mm on centre. Seal wireways using an appropriate sealer for the type of pavement.

Table 2. Checklist In-pavement Runway and Taxiway Lighting

MAINTENANCE REQUIREMENT	D	W	M	BM	SA	A	U
1. Check for burned-out lamps or dimly burning lights	X						
2. Replace defective lights with refurbished units		X					
3. Clean lights with dirty lenses			X				X
4. Perform photometric testing of runway taxiway light systems			X				X
5. Check torque of mounting bolts				X			
6. Check for water in shallow light bases					X		
7. Remove snow from around fixtures							X
8. Check wires in saw kerfs							X

D = Daily, W = Weekly, M = Monthly, BM = Bi-monthly, SA = Semi-Annual, A = Annual, U = Unscheduled

9.9 General procedures

(1) Servicing in-pavement lighting should be scheduled to cause the least disruption to normal aerodrome operations. For this reason, it is recommended that some spare fixtures be kept for installation in place of defective fixtures. The number of spare fixtures should be about 10 percent of the total number of each type of in pavement lights in use.

(2) By replacing the defective light with a spare unit, least time is spent on the runway; the defective light may be repaired in the shop.

9.10 Routine maintenance procedures

Note: The following procedures give a generalized approach to repair; for more specific information about a particular light, consult the manufacturer's instruction book.

(1) **Light Removal.** The light fixture should be removed for re-lamping or base inspection. When removing the fixture for base inspection, be careful not to damage the connections to the isolation transformers. In cold weather, ice or snow may obstruct the bolt heads and make fixture removal difficult. Some facilities have constructed a wooden box, slightly larger than the fixture and a few inches tall. The box has an electric heating element inside and an open bottom. When it is necessary to remove a frozen fixture, place the box over it and connect the heating element to a power source (usually a generator on the back of a truck). When the box heats the fixture enough to melt the ice, removal may be easily carried out.

(2) **General Cleaning.** Several different techniques are available for cleaning the exterior glassware of inset lights. Some techniques need special equipment and are suited to large-scale operations and need runway access with the light installed, while other techniques are more suited to bench cleaning of a light. The maintenance supervisor should select the method best adapted to the facility. Remember that not all techniques may be used with all lights; the manufacturer's recommendations contained in the instruction book are the final authority.

(3) **Manual Cleaning.** Commercially available cleaning detergents and pads can be used for removal of deposits from the lighting fixture lens unless prohibited by the manufacturer. Do not use abrasive materials such as sandpaper or emery cloth because they will scratch the glass. Solvents are available that will clean the lens, but the solvent should be left on for time to dissolve the deposit. The solvent used should be compatible with the lens sealing material. Commercial automotive paint rubbing or polishing compounds have been used successfully but care should be taken to not damage the lens when using abrasive cleaners. While manual techniques are well suited for bench cleaning of lights, they are very time consuming for cleaning lights when installed in pavement.

(4) **Blasting with Ground Shells.** Unless not recommended by the light fixture manual the cleaning can be done by using 20/30 grade, clean, ground walnut or pecan shells and clean, dry compressed air or nitrogen (nozzle pressure 85 psi). The following figure shows a typical example of how to clean the lighting fixture with shells:

(a) average time of 10 seconds is needed for cleaning the external surface of the lens;

(b) average usage of ground walnut shells is 0.27kg per fixture; and

(c) after removal of the deposit from the lens, the fixture's light channel should be cleaned of shells with a blast of air, and the remaining dust wiped off with a clean cloth.

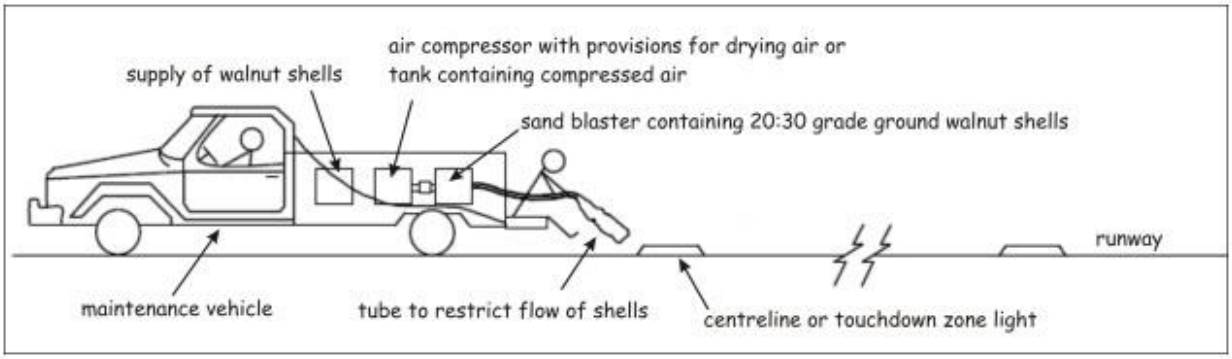

Figure 1. Cleaning Runway Centreline and Touchdown Zone Lights

(5) **Light Aiming.** The in-pavement lights are aimed as part of the installation procedure as follows:

(a) Lights installed on the tops of transformer housings, the aiming is fixed and nonadjustable;

(b) Lights installed on glue-in bases, the aiming may come out of alignment due to twisting of the light bases;

(c) Runway centreline lights, should be aligned to within 2 degrees of a line parallel to the runway centreline; and

(d) When reinstalling the base, use an adhesive compatible with the type of pavement.

(6) **Inside Light Cleaning and Sealing.** In-pavement lights gradually get dirty internally. Unless otherwise directed the following procedures are provided as follows:

(a) Clean the internal optical surfaces when the light is disassembled for re-lamping or maintenance;

(b) Clean rubber deposits off the casting, after all removable parts have been taken off, sandblasting equipment that use glass beads may be used;

(c) Use a cleaning solution that does not leave a residue after drying;

(d) When re-lamping a light, be careful to handle the lamp only by the leads, fingerprints on the glass assembly will shorten lamp life;

(e) Mount lamps in brackets according to manufacturer's recommendations. Using the wrong lamp or mounting it improperly can drastically reduce the light output of the fixture;

(f) When reassembling the light, replace all gaskets and O-rings exposed during the re-lamping process;

(g) Examine the optical prism to make sure that the sealer around the edges is in good shape; and

(h) Replace the optical prism if it is cracked, scratched, or badly pitted.

(7) **Reinstallation.** Unless otherwise directed, general procedures are provided as follows:

(a) If reinstalling a light fixture in a "dry system" (a conduit system without drains which depends on gaskets under the fixtures to keep out water), and when mounting an in-pavement unit on its base, care should be used to be sure that a watertight seal is obtained;

(b) Be sure the gasket and its mating surface are free of sand or grit; this is a common fault in servicing that allows moisture to enter;

(c) Graphite compound or gasket cement may be used on the gasket surfaces to ensure a watertight seal;

(d) When installing an in-pavement light in a "wet system" (a conduit system that uses drains at low points) the fixture is typically mounted directly on the base without a gasket;

(e) With either system, a supply of compressed air should be used to blow any sand or dirt out of boltholes and mating surfaces to assure proper fit and bolt torque; and

(f) Securely tighten all fixtures to the manufacturer's specified torque.

(8) **Photometric Measurements.** Photometric measurement of in-pavement lights is the most direct way of determining if they are emitting the specified amount of light.

10.0 SUMMARY

(1) Aerodrome operators should have a preventive maintenance program including a plan for inspection to ensure the continued viability and operational safety of the aerodrome facility.

11.0 INFORMATION MANAGEMENT

(1) Not applicable.

12.0 DOCUMENT HISTORY

(1) Advisory Circular (AC) 302-008 **Issue 01**, RDMIS 5204821 (E), 5764292(F), dated 2010-10-19 – *Maintenance of Runway and Taxiway Lighting Systems*.

13.0 CONTACT OFFICE

For more information, please contact the applicable Transport Canada, Civil Aviation (TCCA) Regional Office: http://www.tc.gc.ca/eng/regions.htm

Suggestions for amendment to this document are invited, and should be submitted by e-mail at: TC.Flights.Standards-Normesdevol.TC@tc.gc.ca.

[original signed by]

David White
Acting Director, Standards
Civil Aviation