Transport Canada Transports Canada

Advisory Circular

Subject: **Runway Grooving**

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1.0 INTRODUCTION

(1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes 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 permit deviations from regulatory requirements, nor does it establish minimum standards.

1.1 Purpose

(1) The purpose of this document is to provide information and guidance regarding the grooving of runway pavements. In particular, the document outlines factors determining the need for grooving, as well as grooving technique, specifications, maintenance, and winter operations.

1.2 Applicability

(1) This document applies to Canadian airport operators and is also available to the aviation industry for information purposes.

1.3 Description of Changes

(1) Issue No. 3 of this AC includes the following principal revisions:

(a) Guidance related to runway surface texture measurement and restoration has been moved to AC 302-017 Runway Friction Measurement;

(b) Addition of new Section 4.0 Runway Surface Texturing and renumbering of subsequent sections;

(c) Revisions to Section 7.0 Grooving Technique. Item regarding grooving by methods other than saw cutting no longer included.

(d) Deletion of statement concerning friction characteristics of grooved pavements under winter conditions previously in Section 12.0 Winter Operations (1).

(e) Other minor changes of an editorial nature.

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) *Aeronautics Act* (R.S.., 1985, c. A-2);

(b) Part III, Subpart 2 of the *Canadian Aviation Regulations* (CARs) — *Airports*;

(c) Advisory Circular (AC) 302-017 — *Runway Friction Measurement*;

(d) Transport Canada Publication, TP 312 5th Edition — *Aerodrome Standards and Recommended Practices*;

(e) Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5320-12C, 1997-03-18 — *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*;

(f) FAA AC 150/5200-30D, 2016-07-29 — *Airport Field Condition Assessments and Winter Operations Safety*;

(g) FAA Report No. DOT-FAA-RD-82-77, 1983-01 — *Braking of an Aircraft Tire on Grooved and Porous Asphaltic Concrete*;

(h) FAA Report No. FAA-RD-80-78, 1981-01 — *The Braking Performance of an Aircraft Tire on Grooved Portland Cement Concrete Surfaces*;

(i) International Civil Aviation Organization (ICAO) Annex 14 to the *Convention on International Civil Aviation — International Standards and Recommended Practices: Aerodromes* (Seventh Edition, July 2016); and

(j) ICAO Doc 9157-AN/901 — *Aerodrome Design Manual, Part 3 Pavements* (Second Edition, 1983).

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** are used in this document:

(a) **Hydroplaning (dynamic)**: phenomenon in which an aircraft tire is lifted out of contact with the pavement surface by hydrodynamic forces generated by a water film on the pavement surface;

(b) **Macro-texture**: the coarse-scale roughness of the pavement surface as a whole, created by the hills and valleys formed by aggregate particles;

(c) **Micro-texture**: the fine-scale roughness of individual aggregate particles, which may not be readily discernible to the eye but should be apparent to the touch;

(d) **Saw kerf**: a saw cut made in the pavement surface, usually for the installation of lighting cables; and

(e) **Spalling**: breaking, chipping, or fraying of slab edges at pavement joints or cracks.

(2) The following **abbreviations** are used in this document:

(a) **AC**: Advisory Circular;

(b) **FAA**: Federal Aviation Administration;

(c) **FOD**: Foreign Object Damage;

(d) **HMAC**: Hot Mix Asphalt Concrete;

(e) **ICAO**: International Civil Aviation Organization; and

(f) **PCC**: Portland Cement Concrete

3.0 BACKGROUND

(1) Runway grooving consists of providing parallel transverse channels (grooves) in the pavement surface. Grooving improves the macro-texture of the pavement surface, reduces water film thicknesses during rainfall and provides an escape channel for water that may become trapped between the pavement surface and an aircraft tire. These effects reduce the potential for aircraft hydroplaning under wet conditions. Grooving may also improve aircraft braking performance on a wet runway as compared to a wet non-grooved runway.

(2) Hydroplaning is a complex phenomenon which depends on several variables such as water film thickness, aircraft speed, tire pressure, tire tread condition, and the micro-texture and macro-texture properties of the pavement surface. During hydroplaning, the aircraft tire rides on the water film and skid resistance is virtually eliminated.

(3) The presence of excessive water depths on the surface of a pavement during aircraft operations may under certain conditions create the potential for aircraft tires to hydroplane. When there is reason to believe that such conditions exist on a runway surface or portion thereof for extended periods of time, an Airport Operator may consider runway grooving as corrective measure to minimize surface water depths and reduce the potential for hydroplaning. However, runway grooving is not a requirement for new or existing runway pavements in Canada.

(4) Runway grooving will not prevent the accumulation of water due to ruts and ponding. Surface drainage is achieved by the provision of suitable runway transverse slopes and by minimizing surface depressions which may result in the accumulation of standing water. Runway grooving helps to reduce water film depths during rainfall but does have limits with respect to coping with deep standing water due to heavy rainfall.

(5) Runway grooving can be used on both Portland Cement Concrete (PCC) and Hot Mix Asphalt Concrete (HMAC) pavement surfaces.

4.0 RUNWAY SURFACE TEXTURING

(1) For asphalt surfaces, the provision of surface texture may be achieved by the selection of the appropriate aggregate in terms of size, gradation, resistance to polishing and wear, and shape.

(2) For concrete runways, surface texture is applied to the concrete while it is still in the plastic condition. Types of surface texturing include brush or broom finish and burlap drag finish.

(3) Another method for applying texture to concrete pavements is wire combing in which rigid steel wires are used to form a deep texture in plastic concrete pavement. A similar method is wire tining in which flexible steel wires are used to form a deep texture in plastic concrete pavement. However, if a runway is to be subsequently grooved, an alternate texturing technique should be used.

Note: Wire combing and wire tining are texturing techniques and cannot be considered as equivalent to runway grooving.

5.0 DETERMINING THE NEED FOR RUNWAY GROOVING

(1) The following factors should be considered in determining the need for runway grooving:

(a) Historical review of aircraft accidents/incidents related to hydroplaning at the airport;

(b) Wetness frequency (review of annual rainfall rates and intensity);

(c) Transverse and longitudinal slopes, flat areas, depressions, mounds, or any other surface abnormalities that may impede water runoff;

(d) Surface texture quality, which if not sufficient, may contribute to slipperiness under dry or wet conditions. Examples of conditions which may lead to a loss of available surface friction are polishing of aggregate, improper seal coating, inadequate micro-texture or macro-texture, and contaminant build-up that reduces surface texture; and

(e) Crosswind effects, particularly when low friction factors prevail at the airport.

6.0 SUITABILITY OF EXISTING PAVEMENT FOR GROOVING

(1) Existing pavement surfaces may not be suitable for grooving. A condition survey of the runway should be conducted to determine if an overlay or pavement rehabilitation is required prior to grooving.

(2) A thorough inspection to evaluate the structural condition and integrity of the pavement should be conducted. If areas exist with extensive cracking or spalling, or with bumps, depressions, or significant ruts, grooving is not recommended unless such areas are adequately repaired or replaced.

(3) For HMAC pavements, the stability of the asphalt mix should be considered in evaluating the suitability of the pavement for grooving. Other factors to be considered in determining how long grooves will remain effective in HMAC pavements are aggregate properties, maximum operational pavement temperature, effective tire pressures, and frequency of braking action in given areas.

7.0 GROOVING TECHNIQUE

(1) Pavement surface grooves are normally cut using diamond-tipped rotary saws.

(2) The grooving equipment should be capable of producing clean cut grooves to specified dimensions without damage to the pavement surface between the grooves.

(3) For new equipment, without proven field experimental records, performance should be demonstrated using a test section to the satisfaction of the engineer and prior to commencing work on the runway.

(4) The equipment should be capable of making the required width and depth of the grooves in one pass of the machine.

(5) For HMAC and PCC pavements, grooves should be saw-cut in the pavement.

(6) For new HMAC pavements, grooving should not commence until the asphalt pavement has sufficiently cured to prevent displacement of the aggregate (at least 30 days but a waiting period of one year may be necessary).

(7) For new PCC pavements that have hardened, the pavement should be sufficiently cured before grooving (a minimum of 28 days) and timing should be as directed by the engineer.

(8) Grooving operations should not take place when freezing conditions prevent the immediate removal of debris and/or drainage of water from the grooved area.

8.0 GROOVING SPECIFICATIONS

(1) The grooves should be perpendicular to the runway centreline (i.e. perpendicular to the direction of aircraft landing and takeoff operations).

(2) The recommended groove configuration is 6 mm ± 1.5 mm in depth by 6 mm ± 1.5 mm in width with 38 mm ± 3 mm centre to centre spacing. The depth of 60 percent or more of the grooves should not be less than 6 mm and the width of 60 percent or more of the grooves should not be less than 6 mm. The centre to centre spacing of 95 percent of the grooves should not exceed 38 mm.

(3) Grooving should normally be continuous for the entire length of the runway. However, some regional Canadian airports have used intermittent grooving i.e. a grooved strip with a nominal length of 620 mm followed by a non-grooved strip with a nominal length of 620 mm and so on. If this type of grooving is used, it is recommended that the centre to centre spacing of the grooves

be reduced to 32 mm ± 3 mm. No other lengths of intermittent grooving have been used or evaluated at Canadian airports.

(4) The alignment deviation of the grooves should not exceed 30 mm over 25 m in length.

(5) Grooves in PCC pavements should not be closer than 75 mm to transverse joints (i.e. joints running parallel to grooving alignment) so as to avoid the creation of small sections of pavement having the potential to break out and create a FOD hazard for aircraft.

(6) Grooves should be terminated 3 m short of the runway pavement edge to allow adequate space for the operation of the grooving equipment.

(7) Grooves should be cut continuously through the length of the run except where obstructions such as lighting fixtures exist. Grooving through diagonal or longitudinal saw kerfs containing lighting cables also has to be avoided. Grooves may be cut continuously through longitudinal construction joints (i.e. joints perpendicular to grooving alignment). Where neoprene compression seals have been installed and the compression seals are not recessed sufficiently to prevent damage from the grooving operation, grooves should not be closer than 75 mm to longitudinal joints.

(8) Extreme care should be exercised when grooving near in-pavement lighting fixtures and subsurface wiring. An easement of 150 mm or greater should be applied on each side of the light fixture, as necessary to avoid contact by the grooving machine**.**

9.0 CLEAN UP

(1) Cleanup is extremely important and should be continuous throughout the grooving operation. Failure to remove waste material from all paved and shoulder areas can create conditions hazardous to aircraft operations. It is important to ensure that the waste material produced during the grooving operation:

(a) be collected and disposed of by suitable methods such as flushing with water, sweeping or vacuuming;

(b) not be allowed to enter the airport storm or sanitary sewer system; and

(c) be disposed of in compliance with all municipal, provincial and federal environmental regulations and standards.

10.0 GROOVING RUNWAY INTERSECTIONS

(1) Runway intersections require a decision as to which runway continuous grooving is to be applied. Normally, the entire length of the primary runway should be grooved.

(2) The selection of the preferred runway may be dictated by other factors such as surface drainage aspects, aircraft speed at the intersection, location of the touchdown area, and risk assessments.

11.0 GROOVE MAINTENANCE

(1) Build up of rubber deposits in the pavement grooves will reduce the effectiveness of the grooves; rubber removal should be performed as necessary.

(2) Grooves in HMAC pavements may be susceptible to shoving or closure especially in touchdown areas.

(3) Periodic inspections should be conducted to measure the depth and width of a runway's grooves to check for wear and damage. When 40 percent of the grooves are equal to or less than 3 mm

in depth and/or width for a distance of 500 m, the effectiveness of the grooves has been considerably reduced.

(4) Corrective action should be taken as necessary to reinstate the 6 mm groove depth and/or width. Re-grooving of a worn HMAC pavement may not be feasible without causing a FOD risk; it may be necessary to resurface and groove full width.

12.0 WINTER OPERATIONS

(1) Grooves cut into pavement will trap anti-icing/de-icing chemicals, reducing loss of the chemicals, and prolonging their actions. Grooving may also assist in draining melt water and preventing refreezing.

(2) It is important to ensure that applied anti-icing/de-icing chemicals penetrate the grooves to prevent the formation of ice in the grooves.

13.0 INFORMATION MANAGEMENT

(1) Not applicable.

14.0 DOCUMENT HISTORY

(1) Advisory Circular (AC) 300-008 Issue 01, RDIMS 7622630 (E), 7636513 (F), dated 2012-11-20 – *Runway Grooving*.

(2) Advisory Circular (AC) 300-008 Issue 02, RDIMS 8254532 (E), 8255170 (F), dated 2013-04-08 – *Runway Grooving*.

15.0 CONTACT OFFICE

For more information, please contact:

http://www.tc.gc.ca/eng/regions.htm

Suggestions for amendment to this document are invited, and should be submitted via:

TC.FlightStandards-Normsvol.TC@tc.gc.ca

[original signed by]

Robert Sincennes
Director, Standards
Civil Aviation