



# Advisory Circular

**Subject: Decelerometer Performance Specifications**

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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 on technical performance requirements and correlation procedures for decelerometers to be used for Canadian Runway Friction Index (CRFI) measurements at airports.

### 1.2 Applicability

- (1) This document applies to airport operators and suppliers/manufacturers of decelerometers. The document is also available to the aviation industry for information purposes.

### 1.3 Description of Changes

- (1) Not applicable.

## 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) Part III, Subpart 02 of the *Canadian Aviation Regulations (CARs) — Airports*;
  - (b) Transport Canada Publication (TP) 312 5<sup>th</sup> Edition — *Aerodrome Standards and Recommended Practices*;
  - (c) Advisory Circular (AC) 302-013 — *Airport Winter Maintenance and Planning*;
  - (d) AC 300-005 — *Changes to Runway Surface Condition Reporting*; and
  - (e) TP 14371E — *Transport Canada Aeronautical Information Manual (TC AIM)*.

### 2.2 Cancelled Documents

- (1) As of the effective date of this document, the following document is cancelled:
  - (a) Aerodrome Safety Circular (ASC) 98-001A, Issue 01, 1998-04-13 — *Friction Measuring Devices for Winter Operations*.
- (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) **Canadian Runway Friction Index (CRFI)**: the average of friction measurements taken on runway surfaces with freezing or frozen contaminants present, using a mechanical or electronic decelerometer;

- (b) **Decelerometer:** a spot measuring device used to measure the rate of deceleration of a test vehicle during braking on an airport surface such as a runway or taxiway; and
  - (c) **g:** a unit of acceleration where 1 g is equal to the acceleration of gravity, which is 9.8 m/s<sup>2</sup> (32.2 ft/sec<sup>2</sup>).
- (2) The following **abbreviations** are used in this document:
- (a) **ABS:** Antilock Braking System
  - (b) **AC:** Advisory Circular
  - (c) **AIM:** Aeronautical Information Manual
  - (d) **AMSCR:** Aircraft Movement Surface Condition Report
  - (e) **ASC:** Aerodrome Safety Circular
  - (f) **CRFI:** Canadian Runway Friction Index
  - (g) **ERD:** Electronic Recording Decelerometer
  - (h) **TC:** Transport Canada
  - (i) **TP:** Transport Canada Publication

### 3.0 BACKGROUND

- (1) Requirements regarding winter runway surface condition reporting are given in Advisory Circular (AC) 302-013 – *Airport Winter Maintenance and Planning*.
- (2) The measurement and reporting of runway surface friction for winter contaminated surfaces such as ice, compacted snow, etc. is an essential component of the Aircraft Movement Surface Condition Report (AMSCR).
- (3) Although there are a variety of devices available for measuring runway surface friction, Transport Canada has standardized on decelerometers for use on winter contaminated surfaces. The friction coefficient developed between the runway surface and the test vehicle is directly related to the deceleration of the vehicle recorded by the decelerometer, when the deceleration is reported in g units.
- (4) Historically, when Transport Canada owned and operated a large number of airports, there was a product approval process in place to ensure that various decelerometers correlated with the decelerometer reference. Devices found to have acceptable correlations were approved for use on Canadian airports. The following devices were approved for use for friction measurement at airports in wintertime through this process:
  - (a) James Brake Decelerometer;
  - (b) Mechanical or Electronic Tapley meters;
  - (c) Mechanical or Electronic Bowmonk; and
  - (d) Electronic Recording Decelerometers produced by TES.This product approval process is no longer conducted by Transport Canada although the current models of the above decelerometers may still be in service.
- (5) The average of the runway friction as measured by a decelerometer on runways with freezing or frozen contaminants is defined as the Canadian Runway Friction Index (CRFI). The CRFI is also associated with the Landing Distance tables in the Transport Canada Aeronautical Information Manual (TC AIM). To ensure the reliability of the landing distance tables is maintained, the need exists for decelerometers to report as closely as possible, the same number under similar

conditions. The CRFIs associated with the landing distance tables are based primarily on friction measurements made with the Electronic Recording Decelerometer (ERD).

- (6) This AC gives performance specifications and correlation requirements for decelerometers to help ensure the consistency of the winter runway friction measuring and reporting process.
- (7) Transport Canada does not maintain a list of approved decelerometers. It is the responsibility of the airport operator to ensure that the device meets the performance specifications and correlation requirements given in this AC, as demonstrated by an attestation provided by the manufacturer or supplier of the decelerometer.

#### 4.0 PERFORMANCE SPECIFICATIONS

- (1) The following are performance specifications for spot-measuring decelerometers that any device not listed in section 3.0 (4) or new model of the devices listed in section 3.0 (4) should meet for it to be used at Canadian airports in wintertime to measure and report CRFI.
- (2) The decelerometer should be used on a trial basis at an airport to ensure that it meets all operational requirements.
- (3) The performance specifications do not address the testing that a device should undergo as part of a quality assurance process established by the manufacturer or local procedures, such as for example:
  - (a) calibrations required when the calibration of a particular unit has expired; or
  - (b) quality assurance checks that should be performed to ensure that a particular device is functioning properly and reliably.

#### 4.1 Operational Capabilities

- (1) The decelerometer should:
  - (a) be portable, rugged and reliable;
  - (b) be capable of being installed and operated inside a vehicle intended to be used for CRFI measurement, as specified in AC 302-013 *Airport Winter Maintenance and Planning*;
  - (c) be mounted and operated in accordance with the manufacturer's recommendations;
  - (d) be capable of measuring the deceleration rate of a vehicle during braking to an accuracy of  $\pm 0.02$  g;
  - (e) provide a means for low-pass filtering to attenuate disturbances resulting from, for example, the vehicle itself, or from accelerations resulting from high-frequency dynamics associated with the test process;
  - (f) have a means whereby zeroing can be performed when the vehicle is located on a horizontal surface, as selected by the vehicle operator;
  - (g) have a mounting system such that displacements of the device do not occur during testing. A system whereby the decelerometer is mounted on a soft seat or cushion in the vehicle is not acceptable;
  - (h) have a set up such that all displays and controls are readily visible and accessible to the operator;
  - (i) be capable of providing deceleration values upon request of the operator;
  - (j) be capable of temporarily suspending friction testing with no loss of recorded data;

- (k) if electronic, be capable of storing a minimum of 21 deceleration values, via the internal microprocessor memory; and
  - (l) be capable of consistently repeating friction averages throughout the friction range and of providing reliable results, on all surfaces for which CRFIs are to be reported, as specified in AC 302-013 *Airport Winter Maintenance and Planning*.
- (2) It is recommended that the decelerometer be capable of obtaining a reading without requiring the vehicle to come to a full stop, to reduce the time required to obtain readings.

#### **4.2 Reporting Capabilities**

- (1) The decelerometer should report the following information:
- (a) the test date and time;
  - (b) the test location including:
    - (i) the name or designator of the airport; and
    - (ii) runway designator;
  - (c) identification of the operator;
  - (d) friction measured for each test in recorded order; and
  - (e) the average friction over a section selected by the operator. The average friction should be calculated using all values measured within the section selected by the operator. For example, this could be used to obtain the average friction over thirds of a runway.
- (2) In addition, the decelerometer (or integrated software) may provide a means for recording the following additional information:
- (a) surface condition;
  - (b) ambient/pavement temperature;
  - (c) the decelerometer's calibration date and the expiry date for the calibration;
  - (d) vehicle parameters including the vehicle make, model, year and airport designator; and
  - (e) the make, model and serial number of the decelerometer.

#### **4.3 Calibration Requirements**

- (1) The decelerometer should be supplied with:
- (a) a calibration certificate that includes the test results of the calibration and the date when the calibration is no longer valid; and
  - (b) a recommendation from the manufacturer regarding the frequency at which the decelerometer should be recalibrated.

#### **4.4 Training**

- (1) The decelerometer should be supplied with training manuals and personnel should be properly trained in conducting friction measurements with the decelerometer.

## 5.0 CORRELATION TEST METHOD AND REQUIREMENTS

- (1) The following are correlation testing requirements that any decelerometer not listed in section 3.0 (4) or new model of the devices listed in section 3.0 (4) should meet for it to be used at Canadian airports in wintertime to measure and report CRFI. The airport operator should obtain an attestation from the manufacturer or supplier of the decelerometer that the device meets the correlation requirements based on test results obtained using the method described subsequently.

### 5.1 Reference Device

- (1) The reference decelerometer for any new device or model should be the ERD Mk II, or the ERD Mk III with an in-force calibration certificate.

### 5.2 Correlation Test Method

- (1) A side-by-side test program should be conducted in which the new device or model is placed in various vehicles in the field, along with a reference ERD Mk II or ERD Mk III and friction measurements carried out on a range of winter surfaces.
- (2) A side-by-side test program should include a range of representative test surfaces, including ice, compacted snow, sanded ice, and sanded compacted snow. None of the surfaces tested should be ones for which decelerometers are considered to give unreliable results, as specified in AC 302-13 — *Airport Winter Maintenance and Planning*.
- (3) The side-by-side test method should include surfaces with a range of friction reading magnitudes from about 0.1 to 0.4, as measured by the reference ERD used in the test program.
- (4) The test program should include at least three different vehicles, which are generally representative of those that would be used as platforms for friction measurements at airports using decelerometers. For vehicles with a 4-wheel Antilock Braking System (ABS), the ABS should be fully disabled for all vehicles used in the test program.
- (5) All tests should be done by applying the brakes to a vehicle that is travelling 50 km/h. For a test to be acceptable, all four wheels should lock up during the skid.
- (6) Each test case (e.g., vehicle type and surface type) should be repeated at least five times. The individual results from each run for the two decelerometers (i.e. the candidate device and the reference ERD) should be averaged and compared. The correlation requirements are specified in section 5.3 below.

### 5.3 Correlation Requirements

- (1) Correlation requirements should be based on the average reading computed from the candidate device and the reference ERD for each calibration case. These averages will be computed from a minimum of five individual measurements that are repetitions for each calibration case. A calibration case is considered to be each test matrix point (i.e. vehicle type and surface type) from the side-by-side field tests.
- (2) None of the average readings computed for each calibration case should be more than 0.03 g different than the corresponding average obtained from the reference device, which should be either the ERD Mk II, or the ERD Mk III.

## 6.0 INFORMATION MANAGEMENT

- (1) Not applicable.

**7.0 DOCUMENT HISTORY**

(1) Not applicable.

**8.0 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:

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