Advisory Circular (AC)

Operations From Unpaved Runway Surfaces

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1. Introduction

1.1. Purpose

The purpose of this Advisory Circular (AC) is to provide acceptable means, but not the only means, of demonstrating compliance with the requirements of Chapter 525 of the *Airworthiness Manual* (AWM) for the purpose of certifying transport category aeroplanes for operation from unpaved runway surfaces.

Like all advisory material, this AC is not mandatory and does not constitute a regulation. It is issued for guidance purposes and to outline a method of compliance with the rules. In lieu of following this method without deviations, the applicant may elect to follow an alternate method, provided the alternate method is also found by Transport Canada to be an acceptable means of complying with the requirements of Chapter 525 of the Airworthiness Manual. Because the method of compliance presented in this AC is not mandatory, the term "*shall*" used herein apply only to an applicant who chooses to follow this particular method without deviations.

Although this advisory material is primarily intended for the approval of operation from gravel runways, it may be also considered appropriate for other kinds of unpaved runway surfaces overlaying flexible pavement structures. Gravel surfaces coated with a binding agent, such as a seal coat are considered to be unpaved surfaces, unless shown to have stability and strength characteristics similar to a hard paved surface.

1.2. Guidance Applicability

This document is applicable to all Transport Canada personnel, delegates and industry.

1.3. Description of Changes

This document, formerly AMA No. 525/4A, is reissued as an AC. With the exception of minor editorial changes, the content is unaltered.

1.4. Termination

This document does not have a terminating action. It will however, be reviewed periodically for suitability of content.

2. References

2.1. Reference Document

It is intended that the following reference material be used in conjunction with this document:

Chapter 525 of the Airworthiness Manual (AWM) -*Transport Category Aeroplanes.*

2.2. Cancelled Document

As of the effective date of this document, AMA No. 525/4A dated 2 September 1999 is cancelled.

3. Background

Change 525-2 of 1 January 1989 introduced two regulatory changes addressing the determination of take-off and landing performances for operation from unpaved runways by adding paragraph 525.105(c)(1) and 525.125 (b). Following a review by a TC-industry working group, CARAC Technical Committee V recommended that those changes be revoked and the AC 525-006 rewritten. This revised advisory material reflects Transport Canada experience and policy developed during a number of transport category certification programs that led to the approval of those aircraft for operation on gravel runway surfaces.

4. Applicability

Although this advisory material is primarily intended for the approval of operation from gravel runways, it may be also considered appropriate for other kinds of unpaved runway surfaces overlaying flexible pavement structures. Gravel surfaces coated with a binding agent, such as a seal coat are considered to be unpaved surfaces, unless shown to have stability and strength characteristics similar to a hard paved surface.

5. Acceptable Means of Compliance

(a) Surface Definition - Each type of surface shall be defined so that it may be recognised in operations in service. The identification shall include specification of all characteristics of the surface necessary for safe operation. The identification should also include the allowable extent of degraded surface conditions.

(i) Surface strength, expressed as a *California Bearing Ratio* (CBR), or other accepted runway strength classification systems. The method and conditions used to measure the surface strength should be identified. Qualitative descriptions of surface strength such as "hard", "firm" or "soft" may be used, provided an acceptable method is established to correlate these to a quantitative surface strength measurement.

(ii) Pavement Bearing Strength where critical as expressed in the *ICAO-PCN* strength reporting system, *Transport Canada Pavement Load Rating* (PLR) charts or other accepted pavement strength classification system;

(iii) Maximum aggregate size;

(iv) Degree of grading and/or compaction of materials in surface;

(v) Allowable extent of rutting, undulations, or roughness;

(vi) Allowable extent of surface vegetation;

(vii) Allowable extent of damp areas, or standing water;

(viii) Allowable extent of soft areas, or accumulations of loose material;

(ix) Allowable extent of bare areas or lost material.

(b) Aircraft Performance

(i) General - If special equipment (such as shields and deflectors) or special procedures are required, the effect of such equipment or procedures on aircraft performance (including climb performance) shall be determined.

(ii) Take-off, Landing and Accelerate-Stop Performance - Take-off, landing and accelerate-stop performance shall be determined based on each type of runway surface for which approval is requested. Effects on scheduled speeds as determined from special handling procedures shall be accounted for.

The test runways should be chosen to be representative of the worst characteristics (i.e. high rolling friction, low braking friction) of each type of runway for which approval is sought. In this regard it is not sufficient to conduct tests from a runway with low surface strength. Previous work has shown that rolling friction is a function of (among other things) surface strength, but the braking friction is more a function of runway surface characteristics and largely independent of surface strength. Account should be taken of other variables such as aircraft weight and recommended tire pressure.

Testing for AFM performance should be conducted from at least three different runways of different surface characteristics. The AFM performance data should be based on the data from the runway that resulted in the longest distances.

(c) Aircraft Handling - The aircraft's handling characteristics shall meet the appropriate certification requirements at each weight and c.g. and in each configuration specified for operation. Any special procedures or techniques associated with unpaved operations such as the use of thrust reversers, different propeller settings, brakes, nosewheel steering, and bleed and system configurations, shall be identified.

(d) Systems - It should be demonstrated that systems whose functioning may be affected by operation from unpaved surfaces (e.g. anti-skid, nose-wheel steering) continue to perform their intended function under all conditions for which approval is requested. It should be determined that the aircraft can be operated on each defined surface without hazard from likely impingement or engine ingestion of gravel or other surface material. In demonstrating that there is no hazard, consideration should be given to immediate effects such as mechanical damage and to longer term effects such as accumulation of loose runway material in areas they could cause jamming of flight controls, prevent configuration changes or cause blockage of cooling ducts, filters, air data sources, sensor and drains.

(e) Structure - Aircraft ground loads appropriate to the surfaces to be approved shall be considered in meeting the appropriate certification requirements. Limitations to maximum weights and c.g. range may have to be established. Fatigue life limits for landing gear and other structural elements should be reviewed and revised as appropriate. The effects of likely impingement of gravel or other surface material should be assessed.

(f) Maintenance - The instructions for Continued Airworthiness, as required by Chapter 525, Appendix H, should provide for any maintenance procedures such as increased frequency of inspection, cleaning procedures or increased factors for calculating replacement life.

(g) MMEL - Dispatch with inoperative protective equipment or other systems such anti-skid, nosewheel steering, etc. affecting unpaved surface operations should not be permitted, unless specifically evaluated on unpaved surfaces and appropriate information established for the approved MMEL.

(h) Aircraft Flight Manual - All limitations, procedures and performance established shall be defined in a flight manual revision and/or supplement.

(i) The Limitation Section shall include:

1) runway surfaces specified under paragraph 5 (a) on which the aircraft may operate and for which suitable performance data has been determined. The method used to determine surface strength should be identified;

2) the requirement to inspect the runway at a frequency dictated by local conditions to assure that it is in a satisfactory condition;

3) appropriate weight and c.g. limitations;

4) tire pressure limitations;

5) approved aircraft configurations including any special equipment required, flap settings and applicable speed limitations;

6) thrust limits, powerplant control settings and use of reverse thrust during ground manoeuvring and prior to brake release.

(ii) The Procedures Section shall include any special procedures required (e.g. pre-flight inspection, thrust handling technique, use of nosewheel steering, rolling take-off). Actions to be taken by the flight crew in response to identify or foreseeable failures of the aircraft or gravel runway protective equipment should be included.

(iii) The Performance Section shall include performance determined under paragraph (b) in the form of guidance information and shall account for any procedures required. The information should be annotated that the performance data is based on tests of representative surfaces and is for guidance only. Specific runway conditions may result in improved or degraded performance. A statement should also be included that the performance information does not constitute an operational approval.

6. Headquarters Contact

For more information please contact:

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