



Advisory Circular (AC)

Turbine Engine Propeller Reversing Systems (Commuter Category Aeroplanes)

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Advisory Circular (AC) is to provide guidance material for acceptable means, but not the only means, of demonstrating compliance with the requirements for commuter category aeroplanes that deal with the operation of turbine engine propeller reversing systems after a touchdown that is followed by a decision to take-off has been made. These requirements are set out in Chapter 523 of the *Airworthiness Manual*, which is entitled "Normal, Utility, Aerobatic and Commuter Category Aeroplanes."

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. 523/3A, 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.

2.0 REFERENCES

2.1 Reference Documents

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

Chapter 523 of the *Airworthiness Manual (AWM) - Normal, Utility, Aerobatic and Commuter Category Aeroplanes*, sections 523.143, 523.905, 523.933 and 523.1155.

2.2 Cancelled Document

As of the effective date of this document, AMA No. 523/3A dated August 28, 2001 is cancelled.

3.0 BACKGROUND

Following an accident involving a B-737 in Cranbrook, British Columbia, in February 1978, Transport Canada developed an Additional Airworthiness Requirement (AAR) dealing with a touchdown that is followed by a decision to take off after thrust reverser deployment on a landing roll. This requirement was used for several years in domestic type certifications and foreign familiarizations/validations of transport category aeroplane. Following changes to part 25 of the Federal Aviation Regulations (FAR), introduced at Amendment 42, it was considered that the AAR on thrust reverser could be replaced by an AC describing acceptable means of compliance with the revised requirements. The intent of the original AAR remained unchanged.

As a result of experience with an approval program on a turbine-engine propeller-driven aeroplane, the AC was amended to include criteria applicable to turbine engine propeller reversing systems.

Transport Canada has applied the latter criteria in recent approvals of aeroplanes in accordance with part 41 of the Special Federal Aviation Regulations (SFAR). As a result, the Aircraft Certification Branch has decided to apply these criteria to commuter category aeroplanes approved in accordance with Chapter 523 requirements. Although the applicable requirements of Chapter 523 are not identical to those applicable to transport category aeroplanes, the intent of the AC is clear.

4.0 APPLICABILITY

This advisory material is intended for turbine engine propeller reversing systems that enable propeller pitch settings below flight idle to be selected on the ground. This includes systems that have a ground idle or discing setting that produces negligible reverse thrust at zero forward speed.

5.0 ACCEPTABLE MEANS OF COMPLIANCE

Compliance may be shown by analysis or a combination of analysis and tests of the complete aircraft flight and propulsion control system.

5.1 Manoeuvre sequences

The following manoeuvre sequences should be considered:

- (a) Application of take-off power from full reverse thrust:
 - (i) Normal landing touchdown;
 - (ii) Selection of full reverse thrust; and
 - (iii) Rapid application of full forward thrust.

Note:

For most aeroplanes, it is not considered a normally encountered manoeuvre to continue this sequence to a takeoff because of the low speed obtained following selection of full reverse thrust. However, the engine and propeller control system should be capable of preventing the applicable limits from being exceeded. (Refer to paragraph 5.2(a)).

- (b) Application of take-off power from ground idle or discing:
 - (i) Normal landing touchdown;
 - (ii) Selection of ground idle or discing, as applicable;
 - (iii) Decision to take off;
 - (iv) Rapid application of forward thrust;
 - (v) Configuration changes as required; and
 - (vi) Takeoff.
- (c) Rapid cancellation of reverse thrust:
 - (i) Normal landing touchdown;
 - (ii) Selection of full reverse thrust;
 - (iii) Rapid cancellation of reverse thrust; and
 - (iv) Taxi.

5.2 Analysis

The applicant shall:

- (a) demonstrate by analysis or a combination of analysis and tests of the complete aeroplane flight and propulsion control system that the engine and propeller transient limits are not exceeded throughout the manoeuvre described in 5.1(a); and
- (b) demonstrate by analysis or a combination of analysis and tests of the complete aeroplane flight and propulsion control system that the manoeuvres described 5.1(b) and 5.1(c) do not produce hazards or unsatisfactory handling characteristics such as the following:

- (i) Any asymmetric control problems resulting from the propellers developing differential thrust; or
- (ii) propeller and/or engine control anomalies that could result in engine or propeller limits being exceeded.

Transport Canada would normally require flight test only if an assessment of the propeller reverser control operation is considered necessary or the analysis is inconclusive. The flight safety risk associated with such testing shall be evaluated and appropriate safety measures devised to minimize this risk.

Analysis used to show compliance should consider all the appropriate factors and operating conditions and should not be limited to verifying that no hazard is involved with any proposed flight test.

For electronic engine and propeller controls, including full authority digital engine control (FADEC) systems, the overall propulsion control system and associated electronic equipment must be substantiated to have an availability of the functions essential for the manoeuvres described in 5.1, in the installed configuration, at least equivalent to those of a conventional propulsion control system of a similar type encompassing a hydro mechanical engine control system that has already been certified in accordance with the Canadian Aviation Regulations.

6.0 AEROPLANE FLIGHT MANUAL

An aeroplane flight manual limitation prohibiting a touchdown followed by a decision to take off after a propeller reverse thrust operation may be required, but is not considered adequate to demonstrate compliance with the reference regulations.

7.0 HEADQUARTERS CONTACT

For more information please contact:

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