



Advisory Circular

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1.0 INTRODUCTION

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 permit deviations from regulatory requirements, nor does it establish minimum standards.

1.1 Purpose

- (1) The purpose of this AC is to provide guidance for the determination of the standards applicable to the type certification of small aeroplanes and small helicopters that have been modified and/or are to be involved in special purpose operations under Visual Flight Rules (VFR) conditions only.
- (2) Compliance with the appropriate flight requirements of the original basis of certification must be demonstrated where it is intended to operate these aircraft in Instrument Meteorological Conditions (IMC).

1.2 Applicability

This document applies to all Transport Canada Civil Aviation (TCCA) employees, to individuals and organizations when they are exercising privileges granted to them under an External Ministerial Delegation of Authority. This information is also available to the aviation industry for information purposes.

1.3 Description of Changes

This document, formerly AC 500-011, Issue 01, has been reissued as AC 500-011, Issue 02. All references to the carriage of external loads have been removed and are now found in AC 500-004. With the exception of minor editorial changes and updated references, the content is unaltered.

2.0 REFERENCES AND REQUIREMENTS

2.1 Reference Documents

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

- (a) Part VI Subpart 2 of the Canadian Aviation Regulations (CARs)—*Operating and Flight Rules*;
- (b) Chapter 523 of the Airworthiness Manual (AWM)—*Normal, Utility, Aerobatic and Commuter Category Aeroplanes*;
- (c) Chapter 527 of the AWM—*Normal Category Rotorcraft*;
- (d) Advisory Circular (AC) 500-004, Issue 01, 2009-02-17—*Aircraft Carrying External Loads*.

2.2 Cancelled Documents

Not applicable.

3.0 BACKGROUND

- (1) When an aircraft is modified and/or designated to conduct a special purpose operation, a type certificate (TC), a supplemental type certificate (STC) or a limited supplemental type certificate (LSTC) may be issued in the restricted category for the special purpose operation. The applicant must demonstrate that no feature or characteristic of the aircraft makes it unsafe when it is operated within the limitations specified for its intended use.
- (2) An aircraft need not be reclassified in the restricted category if full compliance with the original basis of certification is shown and there are no unusual risks associated with the operation.
- (3) Restrictions will be imposed on special purpose operation aircraft to ensure that an adequate level of safety is maintained for the conduct of the operation; the extent and severity of the

restrictions will depend on the extent to which compliance with the original certification requirements was not demonstrated.

4.0 OCCUPANCY OF RESTRICTED CATEGORY AIRCRAFT

- (1) While a restricted category certification does not automatically impose a limit, an aircraft that has been modified for, or is involved in, special purpose operations will usually have an occupancy restriction.
- (2) Aircraft certificated and operated in the restricted category will usually have occupancy restricted to crew-only or crew and support personnel only. Generally, the carriage of other passengers will not be authorized.
 - (a) Crew-only limitation means that only those persons assigned an in-flight duty and persons being trained in the operational role may be carried in flight. This limitation will be placed on the aircraft when at least one of the following occurs:
 - (i) the mission being flown involves unusual risks (as described in (c) below); and
 - (ii) the flying qualities and performance of the modified aircraft have not been shown to comply with the original basis of certification.
 - (b) Support personnel occupants have no duties directly relating to the airborne operation of the aircraft or its equipment but need to be transported for reasons associated with the special purpose operation. This would include and not necessarily be limited to: aircraft mechanics, firefighters, forestry officers, police officers, medical personnel and spotters. These people may be carried provided the following conditions are met:
 - (i) there are no unusual risks involved (as described in (c) below);
 - (ii) the performance requirements of the original basis of certification are met;
 - (iii) there are limitations established to ensure that an acceptable level of safety is maintained;
 - (iv) there is a defined operating flight envelope within which there are no significant items of non-compliance;
 - (v) there are appropriate limitations that would ensure that an acceptable level of safety is maintained detailed in an approved Flight Manual Supplement (FMS);
 - (vi) the aircraft has an approved seating configuration;
 - (vii) there are appropriate provisions for emergency egress of the occupants; and
 - (viii) there is first aid and survival equipment, as required by Part VI Subpart 2 of the CARs, on board the aircraft.
 - (c) Unusual risks include but are not limited to the following:
 - (i) aircraft being used in aerial application operations, such as spraying and water bombing, or other operations involving low flying, such as surveying or patrolling;
 - (ii) aeroplanes operating at a weight greater than the certified maximum weight or otherwise operating outside the certificated flight envelope;
 - (iii) aircraft operating in extreme environmental conditions; and
 - (iv) helicopters required to operate for extended periods in the avoid area of the height-velocity envelope.
- (3) Parachutists directly involved with the special purpose operation (para-rescue specialists or firefighters) may be considered support personnel. There must be adequate restraint provided for these occupants during take-off and landing maneuvers.

- (4) Occupancy of a restricted category aircraft, subject to the requirements stated above, may be limited to crew-only when it is actively involved in a special purpose operation but may be approved to carry crew and support personnel when the aircraft is not so used.
- (5) Occupancy restrictions must be detailed in the STC data sheet and the approved FMS associated with the modification or operation.

5.0 AIRWORTHINESS REQUIREMENTS

- (1) The aircraft shall be shown to have adequate performance and to be safely controllable and maneuverable under all expected operating conditions without exceptional piloting skill, alertness, or strength being required.
- (2) The requirements contained in the original basis of certification will be used for issues not addressed in this AC. The Minister may grant additional exemptions.
- (3) Aircraft that are certificated using these reduced standards must be limited to VFR condition only.

5.1 Weights and Centre of Gravity Limits

- (1) Sections 523.25 and 527.25 of the Airworthiness Manual (AWM) apply.
- (2) Weight and centre of gravity limits must be established in accordance with the aircraft's basic certification standards.
- (3) Operations with loads exceeding certified maximum weight may be approved for small aeroplanes provided the following conditions are met:
 - (a) the flying qualities and performance standards of this AC are met;
 - (b) the load weight exceeding the certified maximum weight does not exceed 1.2 times the approved gross weight;
 - (c) the occupancy is limited to essential crew;
 - (d) taking-off and flying at a weight above the approved landing weight would normally require the disposal of that weight during flight prior to landing; and
 - (e) provisions are made for adequate structural inspection before the aeroplane is returned to standard category operations or is used to carry personnel other than essential crew.
- (4) An engineering substantiation is required for the approval of any increase to weight limitations for all helicopters.

5.2 Performance

- (1) Sections 523.45 and 527.45 of the AWM apply.
- (2) The original basis of certification is to be used to establish the performance criteria for a modified aircraft. Specific performance considerations detailed in this AC may be applied. Unless otherwise indicated, the performance is to be assessed at the maximum take-off weight with the centre of gravity in the most adverse location.

5.3 Stalling Speed(s)

- (1) Section 523.49 of the AWM applies.
- (2) The power-off (1g) stalling speeds for the aeroplanes must be determined in each configuration and maximum loading for which approval is sought.
- (3) For single-engine aeroplanes, V_{SO} must not exceed 70 mph (61 KCAS) at the maximum approved landing weight. All loads above the 70 mph stall speed weight must be readily jettisonable.

5.4 Take-Off Performance

- (1) Sections 523.51 and 527.51 of the AWM apply.
- (2) The take-off performance may be addressed in one of the following ways:
 - (a) by determining the effect of the modifications on the published take-off distance and speeds;
 - (b) for aeroplanes, by demonstrating that in calm air, at sea level, International Standard Atmosphere (ISA), 0 ft density altitude or higher, the take-off ground run is less than 1000 ft (305 m) or, when operating on water, the time from initiation of the take-off run to lift off is no more than 35 seconds; or
 - (c) for helicopters, by showing compliance with section 527.51 of the AWM.

5.5 Climb Performance

- (1) Sections 523.65, 523.67 and 527.51 of the AWM apply.
- (2) For aeroplanes, the climb performance may be addressed in one of the following ways:
 - (a) demonstrate compliance with the climb requirements of the basis of certification;
 - (b) demonstrate a rate of climb equal to or exceeding 300 fpm (91.4 m/min) at 5000 ft (1525 m) density altitude, at a speed and in a configuration selected by the applicant; and
 - (c) for multi-engine aeroplanes, with the critical engine inoperative (CEI) and operating engine(s) at maximum continuous power (MCP), demonstrate a positive rate of climb in the most favorable configuration at 5000 ft (1525 m) density altitude or provide a weight-altitude-temperature limitation (WAT) chart that would result in a rate of climb of 100 fpm (30.5 m/min) at 1000 ft (305 m) above the take-off surface in the most favourable configuration.
 - (d) in order to show compliance with these engine inoperative requirements, a readily jettisonable load may be dropped.
- (3) For helicopters, the change shall be determined in accordance with the published Category B climb performance in the flight manual.

5.6 Landing Performance

- (1) Sections 523.75 of the AWM applies.
- (2) Landing performance may be addressed, at the maximum approved landing weight, in one of the following ways:
 - (a) determine the effect of the modification on the published landing distance and approach speeds; or
 - (b) demonstrate that the landing ground roll is less than 800 ft (244 m) at a density altitude of 0 ft or higher for aeroplanes.

5.7 Height-Velocity Envelope

- (1) Section 527.49 of the AWM applies.
- (2) The effect of helicopter modifications on the published limiting height-velocity envelope must be estimated.

5.8 Level Flight Performance

For aeroplanes, it must be shown that an adequate margin exists between V_S and V_H to permit the operation to be safely conducted. In any case, V_H must be no less than $1.6 V_S$, or $V_S + 25$ mph (22 kt), whichever is greater, at 3000 ft (915 m) density altitude.

5.9 Flight Characteristics

- (1) Sections 523.141 and 527.141 of the AWM apply.
- (2) The flight characteristics of the aircraft must be demonstrated at the weight and centre of gravity limits to be approved. Where a restricted centre of gravity envelope is requested, it must be shown that the centre of gravity can be readily maintained within this range. A safe operating envelope must be established where it is proposed to jettison equipment or dispose of a load during flight. This must be addressed in an autorotative descent for helicopters.

5.10 Controllability and Maneuverability

- (1) Sections 523.143 and 527.143 of the AWM apply.
- (2) An aircraft must be safely controllable and maneuverable, both with the power on and off, throughout a defined flight envelope that is appropriate for the intended operation. It must be possible to make a smooth transition from one flight condition to another under any probable operating conditions, including the sudden failure of any engine, without the danger of exceeding any aircraft limitations. Refer to the aircraft's certification basis.

5.11 Longitudinal Control

- (1) Section 523.145 of the AWM applies.
- (2) With an aeroplane trimmed at appropriate speeds in take-off, climb, cruise, descent and landing configurations, it must be possible to pitch the aeroplane nose-down from speeds below the trim speed in order to affect a prompt acceleration and prevent stalling. Prior to initiating recovery action, the speed should be reduced for 1 second (at a deceleration rate of 3 kt/s) after the onset of a clear and distinctive stall warning.
- (3) From a steady, power-off descent in the landing configuration at $1.2 V_{SO}$, it must be possible to pitch the nose of an aeroplane up to achieve and maintain an attitude suitable for landing.
- (4) Where modifications reduce the distance between an aeroplane and the ground, the possibility of a ground strike during take-off and/or landing must be addressed. Safe operations using normal and abnormal flap positions must be demonstrated.

5.12 Lateral and Directional Control

- (1) Section 523.147 of the AWM applies.
- (2) It should be possible to make steady, coordinated turns in both directions using 45° banks in climb, cruise, descent, approach and landing configurations without encountering control limits or exceeding the control force requirements for prolonged applications. Turns using up to 60° banks should not present a hazard.
- (3) It must be possible to safely turn and maneuver the aircraft in either direction using a minimum bank of 30° for a multi-engine aeroplane with a CEI. Limits must be established if bank angles and speeds are limiting factors on safe maneuvers with a CEI.
- (4) There must be adequate lateral and directional control to contend with crosswind speeds of at least 17 kt or a crosswind speed between 10 and 17 kt that would be established and published as a limit.
- (5) If there are external changes to the aeroplane, the effect on the minimum control speed must be determined.
- (6) Rudder overbalance must not occur in an approach configuration/condition using up to full rudder deflection or otherwise during sideslips appropriate to the type of aeroplane. For greater sideslip angles, the pedal force required to recover from an overbalanced condition must not exceed 50 lb.

5.13 Trim

- (1) Sections 523.61 and 527.161 of the AWM apply.
- (2) Aeroplanes - Lateral and Directional
 - (a) for single-engine aeroplanes, the lateral and directional out-of-trim control forces in steady, level, coordinated flight in the cruise configuration at $0.9 V_H$, $0.9 V_{NE}$, or $0.9 V_{MO}$ (whichever is lower) must not exceed the control force limitations for prolonged applications as detailed in section 523.143 of the AWM; and
 - (b) for multi-engine aeroplanes, the requirements set out in (a) above must be met with the CEI and the propeller in the most favourable position at $0.9 V_H$ One Engine Inoperative (OEI) or $0.9 V_{NE}$ OEI, whichever is lower.
- (3) For aeroplanes – Longitudinal, it should be possible to trim longitudinal control forces to zero in climb, in cruise at $0.9 V_H$, $0.9 V_{NE}$ or $0.9 V_{MO}$, whichever is lower, in the approach configuration at $1.3 V_{S1}$, and in the descent configuration at 500 fpm (152.5 m/min).
- (4) For helicopters - The certification basis applies.

5.14 Stability

- (1) Sections 523.171 and 527.171 of the AWM apply.
- (2) Directional
 - (a) for aeroplanes, the directional static stability as shown by a tendency to recover from a skid with the rudder free (at the maximum rudder deflection appropriate to the type) should be positive in all conditions using symmetrical power settings up to MCP, at speeds above $1.2 V_{S1}$ in the take-off configuration, and $1.3 V_{S1}$ in all other configurations.
 - (b) a "residual" yaw rate following the directional (skid) tests may be acceptable provided there are no unstable characteristics noted and that if the rudder is returned to the trim position, the yaw rate decreases to zero.
 - (c) the control-fixed directional static stability must be positive for helicopters, using up to MCP, at speeds greater than the minimum power required speed.
- (3) Lateral and Longitudinal

An aeroplane should be longitudinally and laterally stable however, some slight instability is acceptable provided it is not considered hazardous and the following conditions are met:

 - (a) the flight regimes and/or configurations in which the aeroplane is unstable are established;
 - (b) the aeroplane is stable in a configuration appropriate for approach and landing; and
 - (c) the day VFR restriction is emphasized.

5.15 Trim and Stability

- (1) In the most critical case, with an aeroplane as much as possible in trim, no limitation should be exceeded nor should a hazardous attitude develop in normal atmospheric conditions if the flight controls are abandoned for 15 seconds in the climb or approach conditions or for 30 seconds in the cruise conditions.
- (2) For helicopters, the stability requirements of the certification basis apply; however, the stick position versus speed curve may have a negative slope provided the negative stick displacement does not exceed 10% of the total stick travel and the requirements set out in section 527.143 of the AWM are met.

5.16 Stall Warning

- (1) Section 523.207 of the AWM applies.
- (2) For aeroplanes, there must be a clear and distinctive stall warning with flap and undercarriage in any position, in both straight and turning flight with power off or on. This warning may be furnished through either inherent aerodynamic qualities or a device. A visual stall warning device requiring crew attention inside the cockpit is not by itself acceptable. An aural or tactile stall-warning device must be discernible at all engine power settings. The clear and distinctive criterion applies when noise-attenuating headsets are allowed. The stall warning should occur at a speed sufficiently above the stall speed so that a pilot could react, after a one-second delay, and prevent a stall. The stall warning must not activate during normal operations at normal flying speeds.
- (3) It may be necessary to feed the audible stall warning into the intercom system. In this case, it must not be possible to reduce the volume to zero.

5.17 Spinning

- (1) Section 523.221 of the AWM applies.
- (2) Spin demonstration is not required for restricted category certification. Instead, the following applies to aeroplanes:
 - (a) from a wings-level, no-skid stall (power-off and at 0.75 MCP) when the longitudinal control is moved to the aft limit at the point of stall and all controls are held fixed for 3 seconds thereafter, the aeroplane must be recoverable to straight and level flight using all controls in the normal sense, without exceeding any aeroplane limitations. This test should be conducted at the most critical loading condition. If a spin develops, recovery should be possible in less than one additional turn from the point of initiation of recovery action. Wheels, flaps, power and controls can be operated after the 3-second delay.
 - (b) Restricted category aeroplanes must be placarded to prohibit intentional spinning.

5.18 Ground and Water handling Characteristics

- (1) Section 523.233 of the AWM applies.
- (2) Aeroplanes should be safely controllable and maneuverable on the ground or water in 90° crosswind conditions up to 20 mph (17 kt) or as otherwise established as a limitation. In no case should this be less than 10 mph (8.5 kt). This also applies to a hovering helicopter with the wind from any direction.

5.19 Spray

- (1) Sections 523.239 and 527.239 of the AWM apply.
- (2) Spray should not cause a hazard during take-off, landing, or maneuvering on the water.

5.20 Vibration and Buffeting

- (1) Section 523.251 and 527.251 of the AWM apply.
- (2) Freedom from unusual vibration and buffeting must be demonstrated. The demonstrated speed must be at least 1.1 times the V_{ne} or 1.2 times the V_{mo} . No unsafe characteristics may be evident at this demonstrated speed, and recovery to a speed less than the maximum approved speed must be readily accomplished.
- (3) For aeroplanes, the new V_{ne} or V_{mo} may be less than that established for the basic aeroplane but in no case may it be less than the lower value of $1.8 V_{S1}$ or $1.15 V_H$.
- (4) For helicopters, the new V_{ne} must be adequate for the intended operation and must be greater than 1.2 times the minimum power required speed.

- (5) It must not be possible to easily and inadvertently exceed the limiting speed. An over speed warning system may be necessary.

5.21 Structural Considerations

- (1) Sections 523.301 and 527.301 of the AWM apply.
- (2) The impact of any modifications or changes in configuration on the structural integrity of the aircraft must be determined.

5.22 Cooling Tests

- (1) Sections 523.1043 and 527.1043 of the AWM apply.
- (2) The effect of aircraft modifications and/or the specific operation on the cooling characteristics must be addressed.
- (3) Full compliance with cooling requirements may not need to be demonstrated provided engine and oil temperature indicators are installed and marked with the limits. Ambient temperature limitations, operating procedures, cautions, and warnings may need to be established for engines, generators, and/or other installed equipment to ensure that temperature limits are not exceeded.

5.23 Function and Installation of Equipment for the Special Purpose Operation

Section 523.1301 of the AWM applies to any special purpose equipment installed in the aeroplane.

5.24 Flight and Navigation Instruments

- (1) Sections 523.1303 and 527.1303 of the AWM apply.
- (2) Instrument requirements as detailed in the basis of certification and the operating rules are applicable. In certain cases, some equipment may be removed because of the VFR restriction placed on restricted category aircraft for special purpose operations.
- (3) Where instruments are added to the aircraft for special purpose operations, the appropriate instrument requirements of the basis of certification will apply.

5.25 Operation of Special Purpose Equipment

- (1) Sections 523.1309 and 527.1309 of the AWM apply.
- (2) The carriage and operation of any special purpose equipment must not adversely affect the safe operation of the aircraft or any other installed systems essential to the safe operation of the aircraft.
- (3) The special purpose equipment must be designed and installed to minimize the hazard to the aircraft in the event of a probable malfunction or failure.
- (4) Procedures and limitations for the safe carriage and operation of the special purpose equipment must be determined and published.
- (5) Probable failures or malfunctions of special purpose equipment that could cause a hazard to the aircraft must be made apparent to the pilot or other crew member, and appropriate procedures to deal with such a malfunction or failure must be determined and published.

5.26 Pressure Errors

- (1) Sections 523.1323, 523.1325, 527.1323 and 527.1325 of the AWM apply.
- (2) Non-compliance with the specified pressure error limitations may be acceptable provided the following conditions are met:
 - (a) the errors do not create a hazard;

- (b) the errors are within the specified limits at the recommended approach speed(s); and
- (c) aircraft operation is restricted to day VFR conditions in the speed ranges and configurations where the errors exceed the requirements.

5.27 Altitude Limits

- (1) Sections 523.1527 and 527.1527 of the AWM apply.
- (2) It may be appropriate to establish altitude limits for aircraft in a special purpose configuration, particularly if a reduced V_{NE} is imposed or if altitude effects are significant.

5.28 Flight Manual Supplement Information

- (1) Sections 523.1581 and 527.1581 of the AWM apply.
- (2) Information necessary for safe operation of the aircraft must be furnished by means of suitable documents, markings and/or placards.
- (3) For aircraft with an approved flight manual, an FMS must be provided. For other aircraft, an addendum to an operating manual or other appropriate publication would be acceptable. The FMS must address those areas in the flight manual that have changed as a result of the installation or removal of equipment for the special purpose operation. The following must also be in the FMS:
 - (a) identification of any special equipment required (e.g. temp gauges, mirrors);
 - (b) the type of load(s) approved (i.e. approved size(s), maximum/minimum dimensions, maximum weight);
 - (c) areas of the flight envelope where minor instabilities have been identified; and
 - (d) a statement that declares that spin recovery in the configuration has not been demonstrated.
- (4) The following markings/placards must be provided, as appropriate:
 - (a) VFR operations only, or day VFR operations only;
 - (b) near the Airspeed Indicator (ASI), the speed and maneuver limitations and the stall speeds if these are different from the basic aircraft. The ASI must be newly marked if the modification is of a permanent nature;
 - (c) on the fuselage and/or floats, as appropriate, markings to limit the position of a load;
 - (d) on or near exits or emergency exits, instructions for emergency entry/egress if different from the basic aircraft;
 - (e) intentional spinning prohibited; and
 - (f) in clear view of each non-essential crew member, a placard indicating the following:

Attention

**This aircraft has not been shown to fully comply
with the airworthiness standards for its type.**

- (g) near the entrance(s) to the aircraft in clear and distinct view of anyone getting on board, a placard with the word: **Restricted Category**
- (h) a placard prohibiting abrupt maneuvers and one specifying essential crew only is required if operations with loads greater than the certified maximum weight are approved.

6.0 CONTACT OFFICE

For more information, please contact the:
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Suggestions for amendment to this document are invited, and should be submitted via the Transport Canada Civil Aviation Issues Reporting System (CAIRS) at the following Internet address:

www.tc.gc.ca/CAIRS

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