U.S. Department
of Transportation

Federal Aviation Administration

Advisory Circular

Subject: Transport Airplane Landing Gear Retracting Mechanism

Date: 12/28/2011 **AC No.** 25.729-1

Initiated by: ANM-110

This advisory circular (AC) describes an acceptable means for showing compliance with the requirements of Title 14 of the Code of Federal Regulations (14 CFR) 25.729 regarding the landing gear retracting mechanism requirements. It will be incorporated into AC 25-21, "Certification of Transport Airplane Structure" and 25-22, "Certification of Transport Airplane Mechanical Systems" at a later date.

K Uyanamura

for Ali Bahrami
Manager, Transport Airplane Directorate
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1. Purpose. This AC provides guidance concerning compliance with the landing gear retracting mechanism requirements for transport category airplanes.

2. Applicability.

a. The guidance provided in this document is directed to airplane manufacturers, modifiers, foreign regulatory authorities, and Federal Aviation Administration (FAA) transport airplane type certification engineers and their designees.

b. This material is neither mandatory nor regulatory in nature and does not constitute a regulation. It describes acceptable means, but not the only means, for demonstrating compliance with the applicable regulations. The FAA will consider other methods of demonstrating compliance that an applicant may elect to present. You may follow alternate FAA approved design recommendations. Mandatory words such as "must" apply only to those who seek to show compliance to a specific rule by use of a method prescribed in this AC without deviation. While these guidelines are not mandatory, they are derived from extensive FAA and industry experience in determining compliance with the relevant regulations. As of the issuance date, the guidance provided in this AC is harmonized with that of the European Aviation Safety Agency (EASA). It provides a method of compliance that both the FAA and EASA have found acceptable. On the other hand, if we become aware of circumstances that convince us that following this AC would not result in compliance with the applicable regulations, we will not be bound by the terms of this AC, and we may require additional substantiation or design changes as a basis for finding compliance.

c. This AC does not change, create any additional, authorize changes in, or permit deviations from, regulatory requirements.

3. Related Documents.

a. Related Federal Aviation Regulations. Section 25.729 of 14 CFR and other sections relating to landing gear retracting mechanism installations. Sections that prescribe requirements for the design, substantiation, and certification of landing gear retracting mechanisms include:

Section 25.111	Takeoff path.
Section 25.301	Loads.
Section 25.303	Factor of safety.
Section 25.305	Strength and deformation.
Section 25.307	Proof of structure.
Section 25.333	Flight maneuvering envelope.
Section 25.335	Design airspeeds.
Section 25.471	General [Ground loads].

Section 25.561	General [Emergency Landing Cond.].
Section 25.601	General [Design and Construction].
Section 25.603	Materials.
Section 25.605	Fabrication methods.
Section 25.607	Fasteners.
Section 25.609	Protection of structure.
Section 25.613	Material strength properties and material design values.
Section 25.619	Special factors.
Section 25.621	Casting factors.
Section 25.623	Bearing factors.
Section 25.625	Fitting factors.
Section 25.731	Wheels.
Section 25.733	Tires.
Section 25.735	Brakes and Braking Systems.
Section 25.777	Cockpit controls.
Section 25.863	Flammable fluid fire protection.
Section 25.869	Fire protection: systems.
Section 25.899	Electrical bonding and protection against static electricity.
Section 25.1301	Function and installation.
Section 25.1309	Equipment, systems and installations.
Section 25.1322	Warning, caution, and advisory lights.
Section 25.1435	Hydraulic systems.
Section 25.1515	Landing gear speeds.
Section 25.1555	Control markings.
Section 25.1583	Operating limitations.
Section 25.1585	Operating procedures.

b. FAA Advisory Circulars.

AC 20-34D	Prevention of Retractable Landing Gear Failures

AC 21-16F	RTCA Document DO-160 versions D, E, F, and G, "Environmental Conditions and Test Procedures for Airborne Equipment"
AC 23-17B	Systems and Equipment Guide for Certification of Part 23 Airplanes and Airships
AC 25-7B Chg. 1	Flight Test Guide for Certification of Transport Category Airplanes
AC 25-21	Certification of Transport Airplane Structure
AC 25-22	Certification of Transport Airplane Mechanical Systems
AC 25.1309-1A	System Design and Analysis
AC 25.1322-1	Flightcrew Alerting
AC 43.13-2B Chg. 1	Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair

c. FAA Orders.

Order 8110.4C Type Certification Process (Change 4 incorporated)

NOTE: FAA ACs and orders can be obtained electronically from; Federal eRulemaking Portal; http://rgl.faa.gov/, or from the FAA websites; http://www.faa.gov or http://www.faa.gov/regulations_policies/orders_notices/.

d. Society of Automotive Engineers (SAE) Documents.

SAE AIR-4566-A Crashworthiness Landing Gear Design

SAE ARP-1311C Landing Gear Structures and Mechanisms – Aircraft

ISO 7137 : 1995 Environmental Conditions and Test Procedures for Airborne Equipment (not an SAE document but is available from the SAE)

NOTE: These documents can be obtained by mail from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania, 15096; or electronically from the SAE International website, http://www.sae.org/.

e. RTCA Documents.

RTCA/DO-160G Environmental Conditions and Test Procedures for Airborne equipment, Issued December 6, 2007

RTCA/DO-178B Software Considerations in Airborne Systems and Equipment Certification, Issued December 1, 1992

NOTE: Copies of RTCA documents may be purchased by mail from the RTCA Inc., 1150 18th Street NW, Suite 910, Washington, DC 20036; by fax, after completing the Document Order Form and faxing to 202-833-9434; or electronically from the RTCA online store at: http://www.rtca.org/onlinecart/.

f. Military Documents.

MIL-STD-810F Environmental Test Methods and Engineering Guidelines

NOTE: This document can be obtained by mail from the Department of Defense, DODSSP, Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094; or electronically from the DODSSP website at: http://dodssp.daps.dla.mil/.

g. European Aviation Safety Agency Documents.

EASA Certification Specifications (CS) and Acceptable Means of Compliance (AMC) for CSs are available on the EASA website, http://easa.europa.eu/agency-measures/certification-specifications.php.

4. Definitions. For definitions of V_{SR}, V_{SR1}, and V_C, see 14 CFR part 1 §1.2, Abbreviations and symbols.

5. Background. Amendment 25-136 revised § 25.729(a) through (f) to harmonize part 25 with CS 25.729. The amendment adopted the more stringent of the two requirements.

6. Discussion and Demonstration of Compliance.

a. Intent of Rule. (Ref. § 25.729, Retracting mechanism). This rule provides minimum design and certification requirements for landing gear actuation systems to address:

(1) Structural integrity for the nose and main landing gear, retracting mechanism(s), doors, and gear supporting structure for loads imposed during flight, (Ref. § 25.729(a)(1)(ii)(iii)),

(2) Positive locking of the kinematic mechanisms, (Ref. § 25.729(b)),

(3) Redundant means of extending the landing gear**,** (Ref. § 25.729(c)),

(4) Demonstration of proper operation by test, (Ref § 25.729(d)),

(5) Gear up-and-locked and down-and-locked position indications and aural warning, (Ref. § 25.729(e)(2)(5)),

(6) Equipment damage from tire burst, loose tread, and wheel brake temperatures, (Ref. §§ 25.729(f)(1)(2), 25.731(d), and 25.735(j)).

b. Demonstration of Retracting Mechanism Proper Functioning (Ref. § 25.729(d), Operation test). Guidance addressing flight testing used to demonstrate compliance with this section may be found in AC 25-7B Change 1 "Flight Test Guide for Certification of Transport Category Airplanes," chapter 4, section 4, paragraph 52, issued December 7, 2011.

c. Retracting Mechanism Indication (Ref. § 25.729(e), Position indicator and warning device).

(1) When light indicators are used, they should be arranged so that:

(a) A green light for each unit is illuminated only when the unit is secured in the correct landing position.

(b) An alert consistent with § 25.1322 is illuminated at all times, except when the landing gear and its doors are secured in the landing or retracted position.

(2) The alert required by § 25.729(e)(2) should be consistent with § 25.1322 and operate regardless of the position of wing leading-or trailing-edge devices, or the number of engines operating.

(3) The design should be such that nuisance activation of the alert required by § 25.729(e)(2) is minimized, for example:

(a) When the landing gear is retracted after a take-off following an engine failure, or during a take-off when a common flap setting is used for take-off and landing;

(b) When the throttles are closed in a normal descent; or

(c) When flying at low altitude in clean or low speed configuration (special operation).

(4) Inhibition of the alert required by § 25.729(e)(2) above a safe altitude out of final approach phase either automatically or by some other means to prevent these situations is acceptable, but it should automatically reset for a further approach.

(5) Means to de-activate the alert required by § 25.729(e)(2) may be installed for use in abnormal or emergency conditions provided that it is not readily available to the flight crew, that is, the control device is protected against inadvertent actuation by the flight crew and its deactivated state is obvious to the flight crew.

d. Protection of Equipment on Landing Gear and in Wheel Wells (Acceptable Means of Compliance) (Ref. § 25.729(f), Protection of equipment in wheel wells).

(1) The use of fusible plugs in the wheels is not a complete safeguard against damage due to a bursting tire.

(2) Where brake overheating could be damaging to the equipment in the wheel wells, an indication of brake temperature should be provided to warn the pilot.