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Aircraft ground equipment — Design, test and maintenance for towbarless towing vehicles (TLTV) interfaced with nose-landing gear —

Part 1: Main-line aircraft

Matériels au sol pour aéronefs — Conception, essais et entretien des tracteurs sans barre (TLTV) s'accouplant au train d'atterrissage avant —

Partie 1: Aéronefs de ligne

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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ISO 20683-1 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

ISO 20683 consists of the following parts, under the general title *Aircraft ground equipment — Nose gear towbarless towing vehicle (TLTV) - Design, testing and maintenance requirements*:

- Part 1: *Main line aircraft*
- Part [n]:
- Part [n+1]:
- Part 1: *Main line aircraft*
- Part 2 : *Regional aircraft*

Introduction

This International Standard, constituting Part 1 of International Standard ISO 20683, *Aircraft ground equipment — Nose gear towbarless towing vehicles (TLTV) — Design, testing and maintenance requirements*, specifies design, testing, maintenance and associated requirements to be applied on towbarless aircraft towing vehicles to be used on main line civil transport aircraft in order to ensure their operation cannot result in damage to aircraft nose landing gears, their steering systems, or associated aircraft structure.

Throughout this International Standard, the minimum essential criteria are identified by the use of the key word “shall”. Other recommended criteria are identified by the use of the key word “should” and, while not mandatory, are considered to be of primary importance in providing safe and serviceable towbarless tractors. Alternative solutions may be adopted only after careful consideration, extensive testing and thorough service evaluation have shown them to be equivalent.

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Aircraft ground equipment — Nose gear towbarless towing vehicle (TLTV) - Design, testing and maintenance requirements — Part 1: Main line aircraft

1 Scope

This International Standard is applicable to towbarless aircraft towing vehicles (TLTVs) interfacing with the nose landing gear of main line civil transport aircraft with a maximum ramp mass over 50 000 kg (110 000 lb). The requirements for regional transport aircraft with a lower maximum ramp mass are specified in ISO 20683-2 (Part 2). It is not applicable to TLTVs which were manufactured before its date of publication.

It specifies general design requirements, testing and evaluation requirements, maintenance, calibration, documentation, records, tracing and accountability requirements in order to ensure that the loads induced by the tow vehicle will not exceed the design loads of the nose gear or its steering system, or reduce the certified safe life limit of the nose gear, or induce a stability problem during aircraft pushback and/or gate relocation or maintenance towing operations.

This International Standard specifies requirements and procedures for towbarless tow vehicles (TLTVs) intended for aircraft push-back and gate relocation or maintenance towing only. It is not intended to allow for dispatch (operational) towing (see clause 3, Terms and definitions). Dispatch towing imposes greater loads on nose gears and aircraft structure due to the combination of speed and additional passenger, cargo, and fuel loads.

This International Standard does not apply to towbarless towing vehicles interfacing with aircraft main landing gear.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Federal Aviation Regulations (FAR) 14 CFR Part 25, *Airworthiness Standards : Transport category airplanes*, paragraphs 25.301, *Loads*, and 25.509, *Towing loads* ¹⁾.

Certification Specifications and Acceptable Means of Compliance for Large Aeroplanes CS-25, paragraphs 25.301, *Loads*, 25.509, *Towing loads*, 25.745(d), *Nose-wheel steering*, and AMC 25.745(d). ²⁾.

ISO 6966-1, *Aircraft ground equipment — Basic requirements — Part 1 : General requirements*.

1) FAR Part 25 constitute the U.S.A. Government transport aircraft airworthiness Regulations, and can be obtained from :

US Government Printing Office, Mail Stop SSOP, Washington DC 20402-9328, U.S.A.

2) EASA CS25 constitute the European Governments transport aircraft airworthiness Regulations, and can be obtained from :

European Aviation Safety Agency: Ottoplatz 1, D-50679 Cologne, Germany - <http://easa.europa.eu/official-publication/>.

ISO 6966-2, *Aircraft ground equipment — Basic requirements — Part 2 : Safety requirements.*

NOTE Also see informative references in Bibliography.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

- 3.1 main line aircraft**
civil passenger and/or freight transport aircraft with a maximum ramp mass over 50 000 kg (110 000 lb)
- 3.2 regional aircraft**
civil passenger and/or freight transport aircraft with a maximum ramp mass between 10 000 kg (22 000 lb) and 50 000 kg (110 000 lb)
- 3.3 maximum ramp mass**
MRW
Maximum Ramp Weight
maximum mass allowable for an aircraft type when leaving its parking position either under its own power or towed, comprising maximum structural take-off mass (MTOW) and taxiing fuel allowance
- 3.4 push back**
moving a fully loaded aircraft (up to maximum ramp mass (MRW)) from the parking position to the taxiway. movement includes pick-up, push back with turn, a stop, a short push or tow to align aircraft and nose wheels, and release. Engines may or may not be operating. Aircraft movement is similar to a conventional push back operation with a tow bar. Typical speed does not exceed 10 km.h⁻¹ (6 mph)
- 3.5 maintenance towing**
movement of an aircraft for maintenance/remote parking purposes (e.g., from the parking position to a maintenance hangar). The aircraft is typically unloaded with minimal fuel load (reference light gross weight, LGW), with speeds up to 32 km.h⁻¹ (20 mph)
- 3.6 gate relocation towing**
movement of an aircraft from one parking position to an adjacent one or one in the same general area. The aircraft is typically unloaded with minimal fuel load (reference light gross weight, LGW), with speeds intermediate between push back and maintenance towing

3.7**dispatch towing**

operational towing

towing a revenue aircraft (loaded with passengers, fuel, and cargo up to maximum ramp mass (MRW)), from the terminal gate/remote parking area, to a location near the active runway, or conversely. The movement may cover several kilometers with speeds up to or over 32 km.h⁻¹ (20 mph), with several starts, stops and turns. Replaces typical taxiing operations prior to takeoff or after landing

NOTE In the definitions of the towing modes, the frequency of operation has not been included. This should not be interpreted to mean that no limitations are present. For limitations on the frequency of push-back and maintenance operations, refer to the appropriate airframe manufacturer's documentation or consult directly with the airframe manufacturer.

3.8**towbarless towing vehicle****TLTV**

towing vehicle acting without tow bar on an aircraft's nose landing gear

3.9**nose landing gear****NLG**

aircraft nose landing gear in a tricycle landing gear layout

3.10**Actual test gross weight****ATGW**

reference aircraft mass for testing of the vehicle and aircraft, defined as the manufacturer's operating empty mass of the aircraft type concerned, plus fuel remaining in the tanks but lower than STGW

3.11**Specified test gross weight****STGW**

reference aircraft mass for testing of the vehicle and aircraft, defined as the manufacturer's operating empty mass of the aircraft concerned, plus at least 50 % of the maximum total fuel tanks capacity on the type, or its equivalent in mass (payload may be accounted if present, providing aircraft balance condition remains within limits)

3.12**maximum limits**

limits (fore and aft tractive force, torsional, or angular) established by the airframe manufacturer as not-to-exceed values intended to preclude possible damage to nose landing gear or structure

NOTE Maximum limits are established by airframe manufacturer's documentation and may be different for towbarless or tow bar towing operations. All aircraft load limits are limit loads as defined in FAR/JAR paragraph 25.301 (a).

3.13**operational limits**

limits (fore and aft tractive force, torsional, or angular) which are set at a lesser value than the maximum limits established by the airframe manufacturer

3.14**aircraft family**

grouping of aircraft types or subtypes, defined by their manufacturer, for which the same maximum limits may be applied

NOTE A family usually encompasses all sub-types of a given type, but may also include other types. Testing for one (usually the lightest) model of the family results in towbarless towing approval for the whole family. See airframe manufacturers towbarless towing evaluation documentation.

3.15

TLTV setting

grouping of aircraft types or sub-types, defined by the TLTV manufacturer, for which a single operational limits setting is used

NOTE A single TLTV setting usually encompasses aircraft types or sub-types, which may be produced by different airframe manufacturers, in a same defined MRW range.

3.16

drag load

tow force

total force from the tow vehicle on the nose gear tires in the "X" axis

3.17

"X" axis

fore and aft axis of the tow vehicle, parallel to the ground

3.18

oversteer

exceedence of maximum torsional load or angular limits where potential damage to the nose landing gear structure or steering system could take place

NOTE These limits are defined in the appropriate airframe manufacturer's documentation. Torsional load limits typically occur after exceeding angular limits, but may occur before the angular limit is reached (e.g., nose gear hydraulic system bypass failure).

3.19

snubbing

sudden relief and reapplication of acceleration/deceleration loads while TLTV and aircraft are in motion

3.20

jerking

sudden application of push/pull forces from a complete stop

4 Design requirements

4.1 General

4.1.1 Towbarless tow vehicles (TLTVs) shall comply with the applicable general requirements of ISO 6966-1.

4.1.2 Airframe manufacturers should provide information for each aircraft type which allows TLTV manufacturers or airlines to self-test or evaluate the towbarless tow vehicles themselves. Refer to the airframe manufacturer's documentation for evaluation requirements and detailed testing procedures, that may be different from or additional to those contained in this International Standard.

4.1.3 TLTV manufacturers should prepare and provide customers or regulatory agencies, as required, with a certificate of compliance or equivalent documentation, as evidence that successful testing and evaluation of a specific tow vehicle/aircraft type combination has been completed in accordance with this International Standard and/or the applicable airframe manufacturer's documentation. This certification shall allow use of the vehicle on specifically designated aircraft models / types. The certificate should be established under an appropriate quality control program meeting the requirements of ISO 9001 (see Bibliography) or equivalent pertinent industry standard.

4.2 Towing loads

4.2.1 The push and pull towing forces induced by the TLTV onto the aircraft's nose landing gear as a result of either accelerating or braking shall be verified as per clauses 5 and/or 6 hereafter, and shall not at any time exceed the maximum values specified by the aircraft manufacturer.

4.2.2 Depending on the range of aircraft types the TLTV is compatible with, preset towing load values may be used for a number of aircraft types or sub-types in a given MRW range. In this case, each TLTV setting shall comply with the maximum limits specified by the manufacturer(s) of the designated aircraft types, sub-types, or family(s) thereof as defined by the aircraft manufacturers, and each TLTV setting shall be subjected to a separate verification.

4.3 Pick-up and holding system

4.2.1 The TLTV's nose landing gear pick-up/release device should operate in a smooth and continuous manner. Abrupt or oscillating loads during the pick-up/release sequence should not occur. It should be designed to minimize the loads during the pick-up/release sequence. The drag loads induced during pick-up/release should fall well below the "peak" loads experienced during a typical operation.

4.2.2 The maximum loads induced by pick-up and release sequences shall be measured either on an aircraft or on a fixture representative of the nose gear geometry. The vertical load on the nose gear or fixture shall be equal to the vertical load used for fatigue justification (refer to the appropriate airframe manufacturer's documentation). The maximum lift (height above the ground) of the nose gear shall not exceed the values given in the airframe manufacturer's documentation if such values are provided.

4.4 Oversteering protection

4.4.1 The maximum angular or torsional load limits stated by the aircraft's manufacturer in the event of oversteering shall not at any time be exceeded. See aircraft manufacturer's TLTV assessment criteria document.

4.4.2 This may be achieved either by oversteer protection built into the TLTV, or by an oversteer alerting system being provided.

4.4.3 Oversteer protection may be achieved either by intrinsic design precluding the possibility of either limit being reached or exceeded, or by a fail-safe oversteer protection system ensuring they shall not be exceeded. Oversteer alerting shall consist in an appropriate fail-safe warning system installed on the TLTV, providing the driver with unmistakable indication that one of the maximum limits was reached.

4.4.4 No testing of the TLTV oversteer protection or alerting systems shall be performed on an in-service aircraft, in order to preclude any possible damage to the NLG structure or steering system. Such testing should be accomplished with a suitable ground testing device representative of the specific aircraft model for which the TLTV is intended, or through appropriate numeric simulation demonstration.

NOTE EASA CS requirements:

For aircraft registered or operated under *EASA CS-25 paragraph 25.745(d) and associated AMC 25.745(d)*, requires the TLTV manufacturers to provide a Declaration of Compliance (see clause 4.1.3) of their unit's oversteer protection or oversteer alerting system(s) with the present International Standard and the criteria published by the manufacturer of each aircraft type for which it is intended, and the aircraft manufacturers to list in their appropriate documentation the TLTV models that were specifically accepted for each aircraft type based on this Declaration of Compliance.

4.5 Nose wheels retention

4.5.1 The nose wheels shall be held by the vehicle in such a way that pitch-up of the aircraft shall not cause the wheel to disengage from the pick-up device at any nose gear steering angle. A positive wheel retaining feature must be provided. If the nose gear is "canted", a turning maneuver will cause uneven loading on the