INTERNATIONAL STANDARD

ISO 20683-1

Second edition
2016-08-15

Aircraft ground equipment — Nose gear towbarless towing vehicle (TLTV) — Design, testing and maintenance requirements —

Part 1: Main line aircraft

Matériels au sol pour aéronefs — Tracteur sans barre (TLTV) de train avant — Exigences de conception, essais et entretien —

Partie 1: Aéronefs de ligne

Reference number
ISO 20683-1:2016(E)

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

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

This second edition cancels and replaces the first edition (ISO 20683-1:2005), which has been technically revised.

A list of all parts in the ISO 20683 series can be found on the ISO website.

Introduction

This document 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 document, 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.

Aircraft ground equipment — Nose gear towbarless towing vehicle (TLTV) — Design, testing and maintenance requirements —

Part 1: Main line aircraft

1 Scope

This document 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. 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 document specifies requirements and procedures for towbarless tow vehicles (TLTVs) intended for aircraft pushback and gate relocation or maintenance towing only. It is not intended to allow for dispatch (operational) towing (see Clause 3). 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 document does not apply to towbarless towing vehicles interfacing with aircraft main landing gear.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 design requirements*

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
main line aircraft
civil passenger and/or freight transport aircraft with a *maximum ramp mass* (3.3) over 50 000 kg (110 000 lb)

3.2
regional aircraft
civil passenger and/or freight transport aircraft with a *maximum ramp mass* (3.3) between 10 000 kg (22 000 lb) and 50 000 kg (110 000 lb)

3.3
maximum ramp mass
maximum ramp weight
MRW
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
pushback
moving a fully loaded aircraft [up to *maximum ramp mass* (3.3) (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

Note 1 to entry: Engines may or may not be operating. Aircraft movement is similar to a conventional pushback 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

Note 1 to entry: 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

Note 1 to entry: The aircraft is typically unloaded with minimal fuel load (reference light gross weight, LGW), with speeds intermediate between pushback and maintenance towing.

3.7
dispatch towing
operational towing
towing a revenue aircraft [loaded with passengers, fuel, and cargo up to *maximum ramp mass* (3.3) (MRW)] from the terminal gate/remote parking area, to a location near the active runway, or conversely

Note 1 to entry: The movement may cover several kilometres 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 2 to entry: 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 pushback 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)

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* (3.9) or structure

Note 1 to entry: 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/EASA CS 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* (3.12) 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* (3.12) may be applied

Note 1 to entry: 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 manufacturer's 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* (3.13) setting is used

Note 1 to entry: 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)

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* (3.9) structure or steering system could take place

Note 1 to entry: 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 document.

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 document and/or the applicable airframe manufacturer's documentation.

This certificate 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 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 Clause 5 and/or Clause 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

4.3.1 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.

4.3.2 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.

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 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 shall be provided. If the nose gear is "canted", a turning maneuver will cause uneven loading on the nose gear (i.e. for an aft canted gear, the vertical load on the inboard nose wheel will tend to increase and conversely, the vertical load on the outboard nose wheel will tend to decrease). The retention feature shall allow for uneven tire displacement without imposing additional loads on the nose gear.

4.5.2 The geometry of the holding device shall be such that no interference with aircraft structure may occur (e.g. torque links, weight and balance sensors, tires, water spray deflector, etc.) at all wheel steering angles up to the limits defined by the airframe manufacturer's documentation, and the full range of shock strut extensions and tire deflections.

Surface contact area between pick-up device and tire surface should be sufficient to preclude unacceptable tire loading (refer to tire manufacturer for bearing pressure specifications).

4.6 Safety

4.6.1 General

Towbarless tow vehicles (TLTVs) shall comply with the applicable safety requirements of ISO 6966-2.

4.6.2 Pick-up, release and associated loads

4.6.2.1 During the loading sequence, safety equipment shall inhibit any movement of the loading device if the nose wheel is not properly positioned.

Positive clamping and correct positioning of the nose wheel shall be ensured.

4.6.2.2 When the positioning pick-up/release sequence involves a relative motion between the vehicle and the aircraft, only the vehicle shall be allowed to move (see 4.2).

The aircraft parking brake should be applied or wheels properly chocked during this phase. TLTV design shall ensure that no loads higher than authorized are applied to the aircraft.

4.6.2.3 In order to avoid damage to the aircraft, the net load from all points of contact between the vehicle and nose gear tires shall be limited (on "X" axis) at a value lower than or equal to the operational limit.

Any single failure of the tow vehicle's load limiting system shall not cause loads which exceed the maximum limits.

4.6.2.4 If the pick-up/release sequences are fully automatic, an emergency stop or deadman switch shall allow the operator to freeze the sequence at any time.

An automatic or manual system shall allow reversal of the sequence and restore the starting position.

4.6.2.5 If aircraft type selection is necessary prior to the pick-up or towing/pushback sequence, a safety system in the vehicle shall inhibit further operation if the incorrect aircraft type is selected.

4.6.3 Acceleration, deceleration and associated loads

4.6.3.1 If towing is attempted while aircraft brakes are applied or wheel chocks are in place, a safety device on the TLTV shall limit the maximum static force to the safety limit as defined in 4.6.3.2 a).

