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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'atterissage avant — Partie 1: Aéronefs de ligne

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

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

ISO 20683 consists of the following parts, under the general title *Aircraft ground equipment — Design, test and maintenance for towbarless towing vehicles (TLTV) interfaced with nose-landing gear*:

— *Part 1: Main-line aircraft*

— *Part 2: Regional aircraft*

Introduction

This part of ISO 20683 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 part of ISO 20683, 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 — Design, test and maintenance for towbarless towing vehicles (TLTV) interfaced with nose-landing gear —

Part 1: Main-line aircraft

1 Scope

This part of ISO 20683 is applicable to towbarless 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.

This part of ISO 20683 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 push-back and/or gate relocation or maintenance towing operations.

This part of ISO 20683 specifies requirements and procedures for 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). 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 part of ISO 20683 does not apply to TLTVs interfacing with aircraft main landing gear.

NOTE See also informative references in the Bibliography.

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.

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*

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

1) FAR Part 25 constitutes 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.

Joint Airworthiness Regulations (JAR) Part 25, *Airworthiness Standards: Transport category aeroplanes,* paragraphs 25.301, *Loads*, 25.509*, Towing loads,* 25X745(d*), Nose-wheel steering, and* ACJ (interpretative material) 25X745(d) [2)]

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

NOTE 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 towbar. 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 The aircraft is typically unloaded with minimal fuel load [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 The aircraft is typically unloaded with minimal fuel load (LGW), with speeds between push-back and maintenance towing.

2) JAR Part 25 constitutes the European Governments transport aircraft airworthiness Regulations, and can be obtained from: JAA Headquarters, Saturnusstraat 8-10, P.O. Box 3000, NL 2130 KA Hoofddorp, Netherlands.

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

NOTE 1 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 2 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 towbar 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
light gross weight
LGW

reference aircraft mass for combined 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 on landing (10 % to 20 % of total tanks capacity)

3.11
heavy gross weight
HGW
reference aircraft mass for combined 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 towbar 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 limit 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)

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 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 part of ISO 20683.

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 part of ISO 20683 and/or the applicable airframe manufacturer’s documentation. This certification shall allow use of the vehicle on specifically designated aircraft model types. The certificate should be established under an appropriate quality control program meeting the requirements of ISO 9001[2] or equivalent pertinent industry standard.

4.2 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.

4.3 Nose wheels retention

4.3.1 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 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 must allow for uneven tire displacement without imposing additional loads on the nose gear.

4.3.2 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).

4.4 Safety

4.4.1 General

TLTVs shall comply with the applicable safety requirements of ISO 6966-2.

4.4.2 Pick-up, release and associated loads

4.4.2.1 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.

4.4.2.2 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.

4.4.2.3 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.

4.4.2.4 If the pickup/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.

4.4.2.5 If aircraft type selection is necessary prior to the pickup or towing/push-back sequence, a safety system in the vehicle shall inhibit further operation if the incorrect aircraft type is selected.

4.4.3 Acceleration, deceleration and associated loads

4.4.3.1 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 4.4.3.2 a).

4.4.3.2 The vehicle’s maximum pulling and braking forces shall be limited to the maximum permissible nose-landing gear loads of the aircraft (see airframe manufacturer's documentation and FAR/JAR paragraph 25.509). One or two limiters may be used:

