
**Aircraft ground equipment — Upper deck
loader — Functional requirements**

*Matériel au sol pour aéronefs — Chargeur de pont supérieur —
Exigences fonctionnelles*

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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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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 27471 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

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Aircraft ground equipment — Upper deck loader — Functional requirements

1 Scope

This International Standard specifies the functional and performance requirements for a self-propelled container/pallet loader capable of raising air cargo unit load devices (ULDs) to the upper deck of very large capacity freighter (VLCF) aircraft and also to the main deck of any main-line freighter aircraft.

This International Standard does not intend to provide all the design requirements applicable for aircraft upper-deck loaders. Other requirements can be found in separate standards which are also applicable:

- ISO 4116 specifies the additional requirements applicable for conveying surfaces of aircraft ground support equipment intended for handling and loading of baggage and cargo ULDs;
- ISO 6966-1 and ISO 6966-2 specify, respectively, the general and safety-related requirements applicable to all aircraft ground support equipment.

The requirements of this International Standard were determined based on generally recognized assumptions as to:

- a) the normally intended use of aircraft ground support equipment, when used on the ramp of international civil airports in order to handle, service or maintain civil transport aircraft;
- b) the environmental (surface, slope, weather, lighting, operating rules, traffic infrastructure, staff qualification, etc.) conditions prevailing on the ramp area of the majority of international civil airports.

It is assumed that the manufacturers of aircraft upper-deck loaders define in the relevant documentation the specifically intended conditions of use and environment for each model, and that the purchasers systematically review their own specific conditions of use and environment in order to determine whether those stated are adequate, or negotiate with the manufacturer appropriate modifications to ensure they are.

This International Standard does not specify requirements applicable to:

- any adapters or ancillary/supplemental equipment additions to in-service main-deck loaders in order to allow their occasional upper-deck use;
- any main-deck loaders fitted with optional access to upper-deck height of the front platform only (ISO 6967:2006, 4.8).

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 4116, *Air cargo equipment — Ground equipment requirements for compatibility with aircraft unit load devices*

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*

ISO 7000, *Graphical symbols for use on equipment — Registered symbols*

ISO 8097:2001, *Aircraft — Minimum airworthiness requirements and test conditions for certified air cargo unit load devices*

ISO 11532, *Aircraft ground equipment — Graphical symbols*

ISO 11995:1996, *Aircraft — Stability requirements for loading and servicing equipment*

ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

ISO 21100, *Air cargo unit load devices — Performance requirements and test parameters*

3 Terms and definitions

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

3.1

cycle time

<loader> time elapsed between the moment the loader reaches any reference position (e.g. ground level) and the next moment it reaches the same position, after transferring a full complement of unit load devices (ULDs) on the ground level, raising, transferring the ULDs to the aircraft, and coming down again

NOTE 1 Cycle time depends on loader performance.

NOTE 2 The addition of the necessary loader cycles constitutes the (offloading and loading) aircraft turnaround time.

3.2

cycle time

<unit load device (ULD)> loader cycle time divided by the number of ULDs carried in one cycle

NOTE 1 ULD cycle time represents the mean time to load or offload a ULD into or from the aircraft.

NOTE 2 ULD cycle time depends on both loader performance and size.

3.3

lower deck

lowest deck of either a two-deck or a three-deck very large capacity (VLCA) main-line aircraft

3.4

main deck

the highest deck of a two-deck main-line aircraft, or the intermediate deck of a three-deck very large capacity aircraft (VLCA)

3.5

main-line aircraft

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

3.6

turnaround time

<aircraft loading> total elapsed time between the moment a fully loaded aircraft starts being offloaded and the moment it is fully loaded again

NOTE Turnaround time constitutes the primary economic objective of the operating airline.

3.7

unit load device

ULD

device for grouping, transferring and restraining cargo for transit

NOTE A ULD may consist of a pallet with a net or it may be a container.

3.8

upper deck

highest deck of a three-deck very large capacity aircraft (VLCA)

3.9**very large capacity aircraft****VLCA**

main-line aircraft with three decks and a maximum ramp mass over 453 600 kg (1 000 000 lb)

3.10**very large capacity freighter****VLCF**

freighter version of a very large capacity aircraft, including an upper deck load of unit load devices (ULDs)

4 Requirements**4.1 General**

4.1.1 Upper deck loaders defined by this International Standard shall be capable of raising and transferring air cargo ULDs with base dimensions and maximum masses as follows:

ISO 8097/ISO 21100 Base size code	Length mm (in)	Width mm (in)	Max. gross mass	Max. gross mass
			kg (lb) Main deck	kg (lb) Upper deck
A	3 175 (125)	2 235 (88)	6 804 (15 000)	4 080 (9 000)
M	3 175 (125)	2 438 (96)	6 804 (15 000)	4 445 (9 800)
N ^a	2 438 (96)	1 562 (61,5)	3 402 (7 500)	2 220 (4 900)
R	4 978 (196)	2 438 (96)	11 340 (25 000)	8 980 (19 800)
S ^a	2 235 (88)	1 562 (61,5)	3 402 (7 500)	2 040 (4 500)
G	6 058 (238,5)	2 438 (96)	13 600 (30 000) ^b	Not allowable

^a Optional (see 5.11).
^b Or higher, on customer request (see 5.13 and 5.14).

4.1.2 On an adequate chassis, the loader shall provide at least two platforms, and may provide three:

- an aircraft interface platform capable of operating between 2 590 mm (102 in) to at most 2 900 mm (114 in) (see 4.1.4 and 4.1.9) and 8 380 mm (330 in) above the ground, which is positioned at the applicable aircraft door and shall remain at this position during the complete loading/unloading operation;
- optionally, an intermediate platform shuttling between the aircraft interface and main platforms;
- a main platform for up and down movement between 480 mm (19 in) and either 8 380 mm (330 in) or, if an intermediate shuttling platform is provided, 5 540 mm (218 in) above the ground.

4.1.3 The overall dimensions of the unit shall be kept to a minimum consistent with its intended use and performance. See 4.5.6 for turning-radius requirements.

4.1.4 The overall height of the entire unit when being driven should not exceed 4 000 mm (157 in), in order to be compatible with usually encountered airport infrastructure. See 4.1.9 for foldable guard-rails if needed.

It is recommended not to exceed this value. Loaders may however exceed it, subject to verification of available height clearances in the intended movement zone at the airport of use, but should not in any event exceed 5 000 mm (197 in), in order to prevent the risk of interference with the aircraft wing trailing edge while positioning at main-deck doors aft of it.

4.1.5 The loader shall simultaneously support, at their maximum gross mass, at least:

- one 2 438 mm × 3 175 mm (96 in × 125 in) ULD in either direction on the aircraft interface platform;

- two 2 438 mm × 3 175 mm (96 in × 125 in) ULDs in either direction on the main platform;
- where applicable, one 2 438 mm × 3 175 mm (96 in × 125 in) ULD in either direction on an intermediate platform.

Where the intermediate platform provides more than one ULD position, the aircraft interface platform may be smaller than one position. However, in such a case, an increased hazard may result from personnel working near to the aircraft door area being too close to the platform's edge: a retractable safety barrier (see 5.9) shall then be provided aft of the platform as a guard-rail across the whole width whenever the adjacent platform is not level with the aircraft interface platform.

4.1.6 The aircraft interface platform shall be adjustable to changes in aircraft attitude:

- a) pitch and roll: within a minimum range of $\pm 2^\circ$ (3,5 %);
- b) height: with an accuracy of ± 6 mm (0,25 in).

4.1.7 The aircraft interface platform shall be designed not to interfere with the opening and closing of the aircraft doors, either from a safe position on the loader or from inside the aircraft, up to a door width of 4 320 mm (170 in), with no less than 100 mm (4 in) clearance on each side. All component parts that may come into contact with the aircraft should be covered with protective padding, e.g. rubber tube or "D" section. See Reference [12] for information on protective materials.

4.1.8 The aircraft interface platform shall include adjustable side guides that can be aligned with those of the aircraft and locked into position. The platform should be:

- either overhanging by at least 305 mm (12 in) forward of the front vertical end of the chassis;
- or
- fitted on its forward edge with a telescoping element with rollers, in order to bridge the gap to the aircraft door sill where this is not achieved by an aircraft cargo door sill folding-out element.

The telescopic element extension, if applicable, shall have a minimum 3 300 mm (130 in) width, be powered and extend no less than 305 mm (12 in) forward of the fixed platform edge. It shall not be possible to lift or lower the platform, except for small adjustments to aircraft door sill height, prior to the telescopic element being fully retracted.

4.1.9 Fixed safety guard-rails (side panels) shall be fitted to both outer sides of the aircraft interface platform and shall have a minimum height of 1 100 mm (43 in), in accordance with ISO 14122-3, up to 1 400 mm (55 in). Guard-rails shall be adjustable to fully close any gap between the loader and the aircraft, including when the platform's telescopic element (see 4.1.8), if provided, is fully extended, and on the aircraft door opening.

Safety guard-rails/side panels shall be lockable in either deployed or stored position and provide a continuous kick plate at least 150 mm (6 in) high. They should preferably be filled with continuous material.

When the guard-rails are higher than 1 100 mm (43 in), a continuous hand rail should be provided along the inner sides at a 1 000 mm (40 in) height. Where necessary, to meet the overall driving height objective (see 4.1.4), the top part of the guard-rails may fold down in the driving mode. In such a case, the top part of the guard-rails shall fold down inward, fail-safe mechanical locking shall be provided for each guard-rail section in the deployed position, and the driver's position shall remain protected.

4.1.10 Where an intermediate platform is provided and is authorized for use in lifting personnel to the aircraft's upper or main deck, safety guard-rails shall also be fitted to its sides to constitute a full enclosure for this purpose and prevent personnel from walking near an unprotected platform edge.

4.1.11 The ground shall be accessible from the aircraft interface platform at all times (see emergency evacuation provision, 4.7.4). If a telescopic ladder is provided either for this purpose or for normal personnel access to the loader, it shall be fitted with a continuous back-brace protection above a height of 3,0 m (10 ft) from the ground, extending at least 1,0 m (40 in) over the top landing.

4.1.12 In addition, the loader's design shall meet all applicable requirements of:

- a) ISO 6966-1; and
- b) ISO 6966-2.

NOTE For intended operation in Europe, additional EU Machinery Directive requirements also apply. They can be met by complying with the requirements of the following European standards (see Bibliography):

- EN 1915-1;
- EN 1915-2;
- EN 1915-3;
- EN 1915-4;
- EN 12312-9.

4.2 Guide rails and stops

4.2.1 Longitudinal side guide rails shall be provided on each platform to accommodate the ULD widths it was designed for, with an additional 50 mm to 127 mm (2 in to 5 in) clearance.

- a) Aircraft interface platform: fixed height guide rails along the whole length of both sides of the platform to accurately guide ULDs into the aircraft. They shall be adjustable laterally to align with the appropriate in-aircraft guides, and lockable in this position (see 4.1.8 for telescopic elements, if applicable);
- b) Optional intermediate platform: fixed height guide rails along the whole length of both sides of the platform. They may be at fixed positions, based on the largest ULD dimension to be accommodated;
- c) Main platform: retractable guide rails along the full length of both sides of the platform. The guide rails shall consist of sections positioned adjacent to each powered conveyor section of the platform and able to operate independently. All sections shall automatically rise when the main platform starts moving upward over 559 mm (22 in) and remain in this position. When the main platform is being lowered and reaches the height of 559 mm (22 in) from the ground, it shall become possible for the operator to control the retraction of the guide rails.

For a unit with optional truck bed height transfer capability (see 5.12), it should be possible for the operator to control the retraction of the guide rails at any height below 1 520 mm (60 in) from the ground.

For a unit with optional ULD rotation capability (see 5.3), the side guide rails shall be able to be operated independently and/or simultaneously, and shall still automatically rise when the main platform starts moving upward and remain in this position.

4.2.2 Automatic ULD stops shall be provided as follows:

- a) Aircraft interface platform: at the end adjacent to the intermediate, if applicable, or main platform. These stops shall rise from the moment this platform starts moving down and shall fully retract when the upcoming platform is level with the aircraft interface platform. These stops shall remain raised at any position other than level with the adjacent platform. They shall effectively restrain all numbers and sizes (including sizes N and S if applicable) of ULDs possible on the platform;
- b) Optional intermediate platform: at the forward and aft ends. Each of these stops shall rise from the moment the adjacent platform starts moving either up or down relative to the intermediate platform. Each stop shall remain raised at any position other than level with the adjacent platform; They shall effectively restrain all numbers and sizes (including sizes N and S if applicable) of ULDs possible on the platform;

c) Main platform:

- 1) At the forward and aft ends. They shall effectively restrain all numbers and sizes (including sizes N and S if applicable) of ULDs possible on the platform; and
- 2) Retractable side guide rails that function as stops and guide rails [see 4.2.1 c)].

4.2.3 The main platform's stops adjacent to the intermediate, if applicable, or aircraft interface platform shall automatically retract as the main platform lines up with it. These stops shall start rising from the moment the main platform starts moving down and remain raised for as long as the two platforms are not level with each other.

4.2.4 The main platform's rear stops shall both automatically rise when the platform is raised above 559 mm (22 in) from the ground, and remain in this position as long as the platform is higher than this level.

For a unit with optional truck bed height transfer capability (see 5.12), it should be possible for the operator to control the retraction of the guide rails at any height below 1 520 mm (60 in) from the ground.

4.2.5 The main platform's rear stops and side guide rails operation shall be selected by the operator:

- a) If the operator selected the "end loading" mode and when the main platform comes down under 559 mm (22 in) from the ground, the rear stops shall automatically retract, but the retractable side guide rails shall remain in the raised position;
- b) If the operator selected the "side loading" mode and when the main platform comes down under 559 mm (22 in) from the ground, the selected side guide rails shall automatically retract, but the other guide rails and the rear stops shall remain in the raised position.

For a unit with optional truck bed height transfer capability (see 5.12), it shall be possible for the operator to control the retraction of the rear stops or selected side guide rails by continuous intentional action when the main platform is being lowered and reaches the height of 1 520 mm (60 in) from the ground.

4.2.6 All fixed or retractable guide rails and stops shall have a minimum height of 100 mm (4 in).

4.3 Conveyor surface

4.3.1 The loader shall be designed for powered end and side loading of ULDs:

- a) on the aircraft interface platform, the longitudinal and lateral movements shall be effected by means of a powered ULD transfer system;
- b) on the optional intermediate platform, longitudinal movement shall be effected by means of a powered ULD transfer system. Lateral movement, if provided, shall also be powered;
- c) on the main platform, the longitudinal and lateral movements shall be effected by means of a powered ULD transfer system. The main platform's powered system shall be divided into sections, each of which should accept one 3 175 mm × 2 438 mm (125 in × 96 in) ULD. It shall be possible to control these sections individually, or by pairs, or simultaneously.

4.3.2 The powered ULD transfer system shall be able to drive ULDs at a speed of approximately 0,3 m/s (60 ft/min). Consideration should be given to increased conveyance speed for high productivity units, but not exceeding 0,6 m/s (120 ft/min) and ensuring smooth, non jerking, starting and stopping proportionally controlled movements.

4.3.3 In order to ensure uninterrupted ULD movement, the driving elements of the powered ULD transfer system shall not be separated from each other, in either the longitudinal or lateral direction, by more than 1 220 mm (48 in), or 760 mm (30 in), where sizes N or S half-size ULDs are to be handled (see 5.11).

4.3.4 It shall not be possible to transfer ULDs from either platform when the stops are not properly operated.

4.3.5 All platform conveying surfaces shall meet the applicable requirements of ISO 4116. In particular, the required maximum spacing between rollers shall remain applied at all junctions between platforms.

4.4 Platform operation and loading

4.4.1 Platform elevating systems shall be able to hold all platforms at maximum height with full specified continuous lift capacity with no noticeable height decrease for 30 min, with and without the engine running.

4.4.2 The elevating mechanisms of all platforms shall incorporate fail-safe safety features to prevent sudden collapse in the event of a system failure.

4.4.3 The operator shall be able to safely:

- a) open and close the aircraft upper- or main-deck door from or near the aircraft interface platform;
- b) simultaneously operate the loader and in-aircraft systems, where provided by the aircraft's design.

4.4.4 In order to meet aircraft turnaround time requirements, the time taken for the main platform to reach maximum main-deck height from the lowered position and vice versa, i.e. one loader cycle, shall not exceed 50 s.

The time taken for the main platform, or, where applicable, the main platform and the intermediate platform, immediately after they level with each other, to reach maximum upper-deck height from the lowered position and vice versa, i.e. one loader cycle, shall not exceed 75 s.

4.4.5 It shall not be possible to alter the height of either platform while ULDs are bridging two platforms, nor to raise the main platform over the allowable level (see 4.2.4 and 4.2.5) while a side guide or rear stop is not raised. Fail-safe devices shall be provided to ensure no platform at any time rises higher than the adjacent platform.

4.5 Mobility and stability

4.5.1 The unit shall be capable of being driven at speeds up to 10 km/h (6 mph) for at least 3 km (2 miles). The unit does not require the capability of being driven when loaded.

4.5.2 For final safe positioning at the aircraft door and backing away from it, a slow non-jerking speed not exceeding 2,5 km/h (1,6 mph) is required. Under this condition, it should be possible to drive the loader for a short distance with the empty aircraft interface platform at maximum elevation, unless the aircraft interface platform is fitted with a telescopic element (see 4.1.8).

4.5.3 Except as provided in 4.5.2, it shall not be possible to drive the loader while any one of the platforms is not in its fully lowered position.

4.5.4 The unloaded unit shall be capable of starting from rest up a 3° (5 %) incline under its own power.

4.5.5 The unit should have positive clearance to the ground underneath any portion of it when negotiating two ramps that intersect at 3° (5 %) in either bridging or cresting.

4.5.6 Power steering shall be provided. The swept turning radius should be kept to a minimum consistent with the unit's size in order to allow the loader to be easily positioned at the aircraft and to be driven on airport service roads. Wherever possible, it is recommended that the swept turning radius not exceed 12,2 m (40 ft).

NOTE The typical layout of airside service roads in airport cargo areas requires a turning capability between two 12 m (40 ft) wide roads intersecting at 90° with 6 m (20 ft) inner radius.

4.5.7 The unit in operating condition shall meet the stability objectives of ISO 11995:1996, Clause 4.

4.5.8 Where stability is not provided by intrinsic design, power-operated adjustable stabilizers shall be installed in order to provide the stability required for loading/unloading operations.

4.5.9 If stabilizers are required, they should not protrude from the unit and it shall not be possible:

- a) to activate the ULD transfer system and to raise the main and, if applicable, intermediate platform(s) from the fully lowered position if the stabilizers are not extended; nor
- b) to drive the loader when the stabilizers are extended or not fully retracted; nor
- c) for stabilizers to collapse in the event of a system failure.

4.6 Controls

4.6.1 All controls necessary to move and position the loader, including stabilizer controls, shall be located at the driver's position. The driver's position, which may be in the same location as, or adjacent to, the operator's position, shall provide unlimited visibility forward and up for approach to the aircraft, and maximum visibility aft and on the sides of the loader in the driving mode. Mirrors or visibility aids, e.g. closed-circuit T.V., may be used to improve the visibility field where appropriate.

4.6.2 All controls necessary to allow vertical movement of the platforms and complete a loading/unloading process shall be located at the operator's position. For simultaneous operation of aircraft and loader controls, the operator's position should be located at the front right-hand side of the aircraft interface platform.

4.6.3 The operator's position shall provide uninhibited visibility toward the aircraft and as good as possible visibility of the main platform while at ground level, including at least the aft edge of the platform. Mirrors or visibility aids, e.g. closed-circuit T.V., may be used to improve the visibility field where appropriate.

4.6.4 An optional secondary operator's position (see 5.5) may be provided to improve ground transfer safety by ensuring uninhibited visibility of the main platform at the ground level. It may be located either in the most aft part of the aircraft interface platform, with a single operator moving from the main panel to the secondary one to control ground transfers, or at ground level alongside the main platform, preferably at its aft end, to be used by a second operator for ground transfer of ULDs.

The controls on such a secondary control panel shall be limited to those concerning ULD transfers on the main platform in the lowered position, including control of end stops and retractable guides, and ULD rotation if applicable (see 5.3).

If any controls are duplicated between the main and the secondary control panels, an interlock shall provide for only one of the panels to be active at any given time, with an indication light of activity or non-activity at each panel.

4.6.5 Any driver's or operator's elevated position on or adjacent to the aircraft interface platform shall be fully enclosed by guard-rails, that may be the guard-rails/side panels of the outer faces of the platform (see 4.1.9).

4.6.6 Ample lighting is required for night operations and to illuminate the platforms and close surroundings, including at ground level. A minimum illumination of 200 lx (18,5 fc) is required in the whole visibility area.

4.6.7 Normal system warning and indicator lights shall be provided at the driver's position.

4.6.8 All controls shall be identified, preferably by pictograms in accordance with ISO 7000 and ISO 11532.

It is also recommended that the layout of controls on the control panels be in accordance with IATA AHM 915 Section 2 (see Reference [6]).