INTERNATIONAL STANDARD

# ISO 6966

Second edition
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# Aircraft — Basic requirements for aircraft loading equipment

*Aéronefs — Caractéristiques de base du matériel de chargement*



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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.

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.



International Standard ISO 6966 was prepared by Technical Committee 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 6966:1982), of which it consitutes a technical revision.

Annexes A and B of this International Standard are for information only.



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# Aircraft — Basic requirements for aircraft loading equipment

## 1 Scope

This International Standard specifies the basic requirements applicable to aircraft loading equipment.

This International Standard applies to equipment for which functional specifications have been laid down. It shall be read in conjunction with ISO 4116 whenever the equipment involved is designed to handle unit load devices.



## 2 Normative references



The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6966. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6966 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2328:1993, *Fork-lift trucks — Hook-on type fork arms and fork arm carriages — Mounting dimensions.*

ISO 4116:1986, *Air cargo equipment — Ground equipment requirements for compatibility with aircraft unit load devices.*

ISO 7000:1989, *Graphical symbols for use on equipment — Index and synopsis.*

## 3 Materials

**3.1** Materials shall be selected from those which experience and/or tests have demonstrated to be suitable and dependable for use on aircraft ground handling equipment.

**3.2** Materials used shall be corrosion-resistant and protected by plating or other surface treatment (for example, to resist the action of de-icing and hydraulic fluids).

**3.3** Wherever possible, standard commercially available components shall be used.

## 4 Workmanship

Workmanship and methods of fabrication shall be of a high standard.

## 5 Codes of practice

The design, manufacturing processes and use of materials shall conform to national codes of practice.

## 6 Safety

### 6.1 General

**6.1.1** Considerable importance is attached to having equipment into which the essential safety aspects have been incorporated as part of the basic design. It is particularly necessary when designing aircraft handling equipment to take into account the adverse conditions which frequently prevail in ramp areas, e.g. congested vehicle movement, exposure to weather, night operation, noise from aircraft and other vehicles and difficult communications.

**6.1.2** All equipment or any component thereof, the failure of which could be hazardous, shall be designed to be fail-safe.

## 6.2 Personnel working surfaces

**6.2.1** Personnel work platforms and walkways shall have a high traction surface.

**6.2.2** Personnel work platforms and walkways shall have adequate handrail and/or guardrail protection.

**6.2.3** Stairs, ramps, ladder rungs, cleats or treads shall be of nonslip material.

**6.2.4** Ladders and stair treads shall be designed to support a minimum working load equivalent to a mass of 91 kg (200 lb).

**6.2.5** Landings and working surfaces shall be designed to support a minimum working load equivalent to a mass of 114 kg (250 lb) for each person occupying said landing and/or working surface at the same time.

**6.2.6** On open cab vehicles with passenger seat(s), a hip guard shall be provided on the outside edge of the outside seat(s) with a minimum height of 8 cm (3 in) above the seat surface.

## 6.3 Controls

**6.3.1** Controls and warning lights shall be grouped and located so as to be convenient to the operator from his normal operating station or stations. Where there is more than one station, interlocks should be provided at each station to render inoperative the controls of all other stations.

**6.3.2** Controls and warning lights shall be properly and permanently identified, preferably by pictograms (see ISO 7000).

**6.3.3** All operational controls shall move in the direction of travel for the function which they control and shall be of the deadman type, unless the control is set to achieve a function to permit the users to accomplish another task. In these cases, such set controls shall be detented or similarly locked into the operating position to prevent inadvertent deactivation or reversing. Such controls shall be readily available to the operator(s). Operating controls only used in emergencies need not meet this requirement.

**6.3.4** Hand and foot controls shall be sized and spaced to provide easy operation with a gloved hand and/or booted foot dependent on the control. Consideration shall be given to environmental weather conditions in which the unit will operate.

**6.3.5** Foot controls shall be a minimum of 5 cm × 8 cm (2 in × 3 in) and provided with a nonslip material.

**6.3.6** Controls and controlling circuits shall be designed in such a manner that failure within a control or its circuitry will not introduce an unsafe operating condition.

**6.3.7** Conventional automotive driving controls shall be used where possible.

## 6.4 Stability

**6.4.1** Selfpropelled type units equipped with power-actuated stabilizers shall have an operator warning device to indicate when the stabilizers are not in the stowed position.

**6.4.2** Lift type units exposed to blast, wind and/or irregular surfaces, shall be equipped with stabilizing devices, which preclude the unit overturning when exposed to wind or blast up to 120 km/h (65 kn) in the elevated position.



**6.4.3** The stability outlined in 6.4.2 shall determine at which point during elevation the stabilizing devices will be necessary. A safety device shall be provided to ensure this elevation is not exceeded unless stabilizing devices are extended and/or engaged.

**6.4.4** Retraction of the stabilizing device shall not be possible under normal or emergency conditions until the unit has been lowered to within the stability requirements outlined in 6.4.2.

**6.4.5** Stabilizer activating devices shall be located so as not to expose the operator to personal injury.

**6.4.6** An interlock shall be provided to prevent driving the vehicle when stabilizers are not fully retracted.

**6.4.7** Emergency-raising stabilizer controls shall be provided and shall be so located as not to expose the operator to injury.

**6.4.8** Stabilizers shall be marked with black and yellow reflective tape. Stabilizer pads shall be painted red.

**6.4.9** The stabilizers shall not collapse in the case of a system failure.

### 6.5 Doors

All doors shall be provided with securing devices to retain them in the open and/or closed position. These devices shall be capable of withstanding blast or ambient winds as specified in 6.4.2, and shall be installed so that the doors, when open, do not create a personnel injury hazard.

### 6.6 Components

All components that exceed 36 kg (80 lb) or that exceed 15 kg (33 lb) where only one person has access to the unit for handling, shall have provisions for attaching lifting or handling devices.

### 6.7 Machinery guards

Sprockets, gears, chains, belts, fans and pulleys, or other nip or pinch point hazards which are not protected by vehicle structures or covers shall be guarded.

### 6.8 Fuel and fluid replenishing

**6.8.1** Fuel lines shall be secured with a minimum of 5 cm (2 in) clearance to exhaust and electrical systems.

**6.8.2** Fuel tank(s) shall be located and installed so that any overflow during filling, or any leakage from the tank, lines or fittings, will not impinge on the engine, exhaust, electrical system or other ignition sources or enter the operator's compartment. Consideration should be given to avoiding spilled fuel making work or access surfaces slippery.

**6.8.3** Fuel tanks shall be located for maximum protection from collision damage.

### 6.9 Exhaust

**6.9.1** Internal combustion engines shall be fitted with a baffle-type muffler.

**6.9.2** The exhaust system, beyond the manifold, shall be supported at least 7,5 cm (3 in) clear of combustible materials, excluding flexible mountings, and at least 5 cm (2 in) clear of fuel, hydraulic and electrical system parts and shall not be subject to drippage of fuel, oil or grease.

**6.9.3** The surface and the discharge of exhaust systems shall be located so that they will not expose employees and/or materials to injury or damage.

### 6.10 Visibility

**6.10.1** Vehicle operators shall have clear and unimpaired visibility when operating the unit. Mirrors shall be provided where necessary.

**6.10.2** All glass shall be of a safety or tempered type and shall provide maximum visibility based upon the functional requirements of the unit.

**6.10.3** Any vehicle equipped with a windshield shall be provided with a powered windshield wiper giving a wipe area of not less than 60 % of the glazed area. A sun visor of suitable size shall be provided. Overhead view panels should also be fitted with wiping mechanisms.

**6.10.4** On enclosed cab-equipped vehicles, the windshield shall be provided with a defogger and/or defroster.

**6.10.5** Reflective material or, preferably, fluorescent paint shall be applied on all corners.



### 6.11 Towbars and couplings

**6.11.1** The tongues or towbars of units shall be designed to minimize exposure to pinch points during coupling.



**6.11.2** A stop shall be provided to prevent the towbar from coming into contact with the ground when dropped.

**6.11.3** The towing eye and the towbar shall be made clearly visible in poor lighting conditions in order to avoid accidents.

### 6.12 Emergency buttons

Emergency engine stop button(s) (red mushroom type) shall be provided. These should be installed at convenient positions on the unit to enable immediate shutdown in the event of an emergency. The location and number should be specified by the purchaser.

### 6.13 Vehicle slow speed

Positive, nonjerking slow speed is required for the final positioning of a unit/vehicle with respect to the aircraft.

### 6.14 Aircraft protection

Any part of a vehicle coming close to or liable to touch the aircraft shall have suitable padding.

### 6.15 Brakes

**6.15.1** A braking system shall be provided to stop vehicles safely under empty and full load conditions, and shall meet all local requirements and regulations.

**6.15.2** A parking/emergency brake shall be provided which will restrain the vehicle when fully loaded on an incline of 5 % (or more if specified by the user).

### 6.16 Fire prevention

A fire extinguisher of suitable type and capacity shall be provided either on the equipment or adjacent to the area of operation.

### 6.17 Engine operation

**6.17.1** For selfpropelled vehicles, it shall not be possible to start the engine unless the shifting lever is in the neutral or park position.

**6.17.2** For selfpropelled equipment with a hand throttle, it shall not be possible to engage the forward or reverse gear unless the hand throttle is in the idle position.



## 7 Environment

**7.1** The vehicles shall be designed and constructed so as to allow unrestricted use in all climates with the minimum of modifications. The unit shall have provisions to easily adapt to temperature variations ranging from – 40 °C to + 60 °C (– 40 °F to + 140 °F) and humidity of up to 100 %. Consideration shall be given to ambient temperature variations, rain and freezing precipitation, dust, salt/sea air and reasonable variations in atmospheric pressure.

**7.2** The unit shall be capable of being operated by day and night.

**7.3** The noise level shall be kept to a minimum but shall not exceed 85 dBA at a distance of 4,6 m (15 ft) from the perimeter of the vehicle and 1,5 m (5 ft) above the ground.

## 8 Mobility

**8.1** The vehicle shall be manoeuvrable in ice and snow and the driving wheels should have a sufficient clearance to permit installation and use of chains.

**8.2** Means shall be provided to tow a stalled vehicle clear of an aircraft.

**8.3** The fuel tank (gasoline, diesel or liquid propane gas) capacity shall be sufficient for a least eight hours continuous operation. Operational time requirements for electrically driven units are to be determined by the purchaser.

**8.4** Hydraulic valves and electrical circuits shall be provided with a bypass system for manual operation in case of failures.

## 9 Transport

**9.1** It shall be possible to transport the unit by road, or sea. It is possible that parts have to be removed to achieve the dimensions required by constraints of the selected transport mode(s) and/or rules/regulations governing such transportation. The design should also consider the possibilities for air transportation.

**9.2** Suitable lifting devices shall be provided to facilitate loading and unloading of the unit during transport and to reduce damage.

**9.3** When forklift pockets are used, they shall be installed in compliance with ISO 2328.



**9.4** When slings are used, the sling attachments shall be of adequate strength and clearly marked.

## 10 Mechanical

**10.1** Water traps and gulleys permitting dirt to collect shall be avoided. Where this is not practical, adequate drainage shall be provided.

**10.2** Vibration shall be kept to a minimum and shall have no adverse affect on the unit or the operator.

**10.3** The mechanical efficiency of powered or non-powered monodirectional conveyorized surfaces (such as roller beds) used to move unit load devices shall be in excess of 98 % when measured at maximum allowable load, on a horizontal surface and in a good equipment condition. (See annex A.)

**10.4** The mechanical efficiency of powered or non-powered multidirectional conveyorized surfaces (such as caster beds or ball mats) used to move unit load devices shall be in excess of 96 % when measured at maximum allowable load, on a horizontal surface and in a good equipment condition.

## 11 Electrical

**11.1** Wiring shall be grouped in cable or harness form and shall be routed to provide maximum protection from abrasion, road splash, grease, oil, fuel and excessive heat.

**11.2** All electrical fittings, wiring and components shall be easily accessible.

**11.3** All wiring shall be coded with markings for ease of repair and maintenance.

**11.4** Electrical buttons, switches, etc. shall be suitably waterproofed.

## 12 Hydraulic and pneumatic

**12.1** All pipe lines shall be coded with markings for ease of repair and maintenance.

**12.2** All fittings, lines and components shall be located to provide maximum accessibility, consistent with good design practice, to attain ease of maintenance.



**12.3** Relief valves shall be installed in all systems to protect against pressures in excess of the rated working pressure of each system component.

**12.4** System pressures shall be kept as low as possible, consistent with practical and economic design.

**12.5** All pipes/lines shall be routed so that they do not pass over or adjacent to any components which could cause a fire in the event of a pipe failure. If because of design considerations this is not possible, an adequate heat shield shall be provided between the pipe and the heat source.

## 13 Maintenance

**13.1** The equipment, components and systems shall be designed to cover a minimum of 200 operating hours between two consecutive maintenances. The period between consecutive maintenance may be shorter if no commercially available part can achieve the recommended maintenance performance. Servicing of fuel, oil, tire pressure, battery and water is not considered preventive maintenance.

**13.2** All parts of the equipment, components and systems requiring a routine or periodic inspection or preventive maintenance shall be easily accessible.

**13.3** The design criteria shall permit the assembly, disassembly and maintenance with general-purpose tools and commercially available equipment.

**13.4** The design shall be such as to eliminate loose parts as far as practicable. Where those loose parts are unavoidable, they shall be attached to the equipment wherever possible, and fixed stowages shall be provided for their storage.

**13.5** All components, assemblies and subassemblies incorporated into the equipment shall remain interchangeable within units of the same model. Where a new interchangeable component is introduced to the equipment and the data or parts within the new component are different, details of the changes will be advised through revisions to the appropriate manuals.

**13.6** All components used in new equipment, unless mutually agreed between manufacturer and purchaser, shall be new and carry the same warranty as the equipment.

**13.7** The covers or access doors to components or systems shall be easily opened or removed.

**13.8** The components and systems shall be capable of being removed from the equipment without disassembling other components.

## 14 Manuals

**14.1** Documents covering operation, maintenance, and spare parts, shall be provided, preferably to ATA 101 standard (see annex B).

**14.2** Modification, improvements, change in original spare parts shall be presented to users by means of service bulletins, spare parts information or manual revisions.

## 15 Vehicle marking

**15.1** Equipment limitations shall be clearly and permanently marked on the vehicle.

**15.2** The tank filler caps shall be of the following colour (in accordance with SAE ARP 1247C):

— red for gasoline;

— green for diesel fuel;

— white for water and coolants;

— yellow for oil and lubricants;

— yellow with a blue stripe for hydraulic fluid.

## 16 Optional features

NOTE 1 These options should be considered by the manufacturer in the design of the unit and may be requested by the purchaser. Further specific requirements of the purchaser may be added.

**16.1** Weather protection for driver and/or passenger, with a window for viewing vehicle approach to aircraft.

**16.2** Provide accomodation for a passenger.

**16.3** Seat belts.

**16.4** Automotive fresh air hot water heater and windshield defrosters.

**16.5** Sun visors.

**16.6** Instrumentation:

a) ammeter;

b) engine oil pressure gauge;

c) hydraulic pump pressure gauge;

d) engine coolant temperature gauge;

e) tachometer;

f) engine-hour meter (oil pressure type).

**16.7** Orchelon-type adjustable parking brake lever.

**16.8** A gasoline, diesel, LPG (liquid propane gas) or electric prime mover.

**16.9** Cold-starting aids and/or tropicalization.

**16.10** High output alternator capable of sustaining the maximum electrical load of vehicle + 10 % with engine set at a desired r.p.m. through the use of an adjustable "ON-OFF" hand throttle.

**16.11** Full flow engine oil filter.

**16.12** Fuel filter.

**16.13** Key or keyless type ignition.

**16.14** Manual or automatic transmission.

**16.15** Power steering.

**16.16** Nonslip differential.

**16.17** An installed backup battery. (This is to ensure the electrical supply should main battery become unserviceable.)

**16.18** Amber flasher type light.

**16.19** Wiring and plumbing schematic diagrams permanently affixed in convenient locations. All controls and instruments identified in like manner on the schematics as on the respective placards.

**16.20** Metal nameplate specifying the following data:

a) vendor's name and/or trademark;

b) vendor's part of model number;

c) vendor's serial number;

d) date of manufacture;

e) pertinent characteristics (such as ratings);

f) weight.

**16.21** Reflectors on all corners at a height of 61 cm (24 in) above ground level. (On the front they should be amber and on the sides and rear they should be red.)

**16.22** Automatic audible personnel warning for vehicle reversing and downward movement of lift platforms.

# Annex A
(informative)

# Efficiency of rollerized unit load device (ULD) handling equipment

## A.1 Definition of efficiency

The requirements in ISO 4116 for roller dimensions, characteristics and spacing are minimum values required to avoid damage to ULDs. Experience has demonstrated that such values can be insufficient to guarantee efficiency of rollerized pallet/container handling equipment. The term "efficiency" as used in 10.3 and 10.4 and as used hereafter is defined as the ratio

$$\frac{W - F}{W}$$

where

$W$ is the gross weight of the ULD being handled (usually, the maximum gross weight of any type of ULD acceptable on the equipment);

$F$ is the force which must be applied to start the ULD moving on its roller bed, when this bed is in good maintenance condition and levelled.

## A.2 Efficiency objectives

Efficiency, as defined above is an important design factor, since it will directly relate to savings in manpower (for nonpowered dollies or equipment) or overall power requirements (for powered ULD equipment), and therefore also operational costs.

The following objectives should be used for rollerized ULD equipment design in order to achieve adequate savings on handling costs:

a) efficiency or rollerized conveyor systems equal to or in excess of 98 % within the normal range of ULDs gross weight applicable;

b) efficiency of multidirectional (castors or balls) conveyor systems equal to or in excess of 96 %, within the normal range of ULD gross weight applicable; in the event of a castored conveyor system, castors should be oriented randomly or against the direction of movement before measuring the force necessary to start moving the ULD.

## A.3 Roller design experience

Extensive experiments have shown that such design objectives can be achieved and maintained throughout the life of the equipment by complying with the following basic criteria:

a) using continuous shaft (to avoid in-service deformations) rollers with good quality ball bearings, lubricated for life type, protected by adequate sealing, at both ends;

b) having a minimum 19 mm (3/4 in) shaft or inner ball bearing diameter;

c) having a strong enough roller skin [recommended minimum thickness 2 mm (5/64 in), minimum diameter 63 mm (2 1/2 in] to avoid in-service deformations.

The same experiments have demonstrated that:

1) increasing the number of rollers [i.e. to a spacing less than approximately 200 mm (8 in)] does not improve roller-bed efficiency when keeping the same type of rollers;

2) efficiency should be measured for the whole range of ULDs gross weight, rather than for its maximum value, since, for rollers in good maintenance condition, the actual efficiency ratio evolves slower than the gross weight of units (see figure A.1).