SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS36101

Issued 2004-01

Air Cargo Unit Load Devices - Load Distribution Model

TABLE OF CONTENTS

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

1. SCOPE:

This SAE Aerospace Standard (AS) defines an industry agreed reference model for load distribution on air cargo unit load device (ULD) bases, to reflect maximum allowable center of gravity (CG) eccentricity and ensure the maximum allowable area load is not exceeded.

1.1 Purpose:

The purpose of this document is to establish a common reference load distribution algorithm for:

a. comparable and repeatable ULD testing methods, or equivalent numeric simulations,

b. aircraft structure and cargo systems design assumptions, consistent with existing airframers practices,

c. definition of operators unit load devices utilization rules and pallet build-up training programs.

1.2 Field of Application:

1.2.1 This document applies to all types of unit load devices intended for use on board civil transport aircraft and airworthiness approved by TSO in accordance with the performance requirements and testing parameters of either AS36100 or, as applicable, its predecessor NAS 3610.

1.2.2 This document shall also apply to utilization of any non airworthiness approved unit load devices, such as "noncertified containers" as defined in AS1677B, of the same sizes, the utilization of which is controlled by the provisions of the aircraft type's Weight and Balance Manual and other airframe manufacturer's documents.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale PA 15096-0001.

AS1677B	Requirements for Noncertified LD2, LD4 and LD8 Cargo/Baggage Containers
ARP5486	Air Cargo Pallets - Utilization Guidelines
ARP5595	Air Cargo Restraint Straps - Utilization Guidelines
ARP5596	Cargo Shoring Guidelines
AS36100	Air Cargo Unit Load Devices - Performance Requirements and Test Parameters
AS36102	Air Cargo Unit Load Devices - Testing Methods
ARP36103	Air Cargo Unit Load Devices - C.G. Control Methods

2.1.2 U.S. Government Publications: Available from U.S. Government Printing Office, Mail Stop SSOP, Washington DC 20402-9325.

Federal Aviation Regulations 14 CFR Part 21 - Certification Procedures for Products and Parts, Subpart O - Technical Standard Order Authorizations

Technical Standard Order TSO C90c - Cargo Pallets, Nets and Containers

Federal Aviation Regulations 14 CFR Part 25 - Airworthiness Standards: Transport Category Airplanes

2.1.3 AIA Publications: Available from Aerospace Industries Association of America Inc., 1250 Eye Street NW, Washington DC 20006.

NAS 3610	Cargo Unit Load Devices - Specification for - (Revision 10)

2.2 Definitions:

CONTAINER (AIR CARGO -): A rigid structure which interfaces directly with the aircraft cargo handling and restraint system and alone performs all the functions of a unit load device.

NET (AIR CARGO PALLET -): A webbing or rope net for restraining load onto an air cargo pallet.

NONRIGID CARGO: For the purpose of the present document, cargo of such a nature that the whole weight of each piece is evenly distributed over the whole of that piece's footprint area.

NUMERIC SIMULATION: Simulation of physical test condition and reaction of ULD employing numerical analysis, computational geometry and computer graphics to obtain proof support and design verification, validated by demonstration that parameters, algorithms and analytical methods used provide results of at least equivalent reliability to the outcome of a specified actual test.

PALLET (AIR CARGO -): A unit load device consisting of a flat platform with flat undersurface of standard dimensions, on which goods are assembled and secured by a net before being loaded as a unit onto the aircraft, and which interfaces directly with the aircraft handling and restraint system.

RESTRAINT SYSTEM: Equipment for supporting and restraining unit load devices in an aircraft against the ground/flight loads. It usually consists of such items as rollers, side guides and locks for securing unit load devices to the aircraft structure. It does not include unit load devices, barrier nets and tie-down straps.

UNIT LOAD DEVICE (ULD): A device for grouping, transferring and restraining cargo for transit. It may consist of a pallet with a net or it may be a container.

3. REFERENCE MODEL:

3.1 Principle:

3.1.1 Airworthiness approval of each type and size of unit load device includes maximum load center of gravity (CG) eccentricity (offset) allowances at unit maximum gross weight, that are part of its testing and approval (see AS36100 or its predecessor NAS 3610, as applicable, ultimate load criteria).

3.1.2 CG eccentricity is expressed and measured in percentage (%) of the ULD's base length or width from the geometric center of the base.

3.1.3 The load distribution on a pallet's surface or a container base corresponding to the certified maximum CG eccentricity allowances shall be defined as nonrigid maximum gross weight cargo of an homogeneous density occupying a correspondingly reduced area of the base surface.

Example (applicable for 10% simultaneous longitudinal and lateral CG offset):

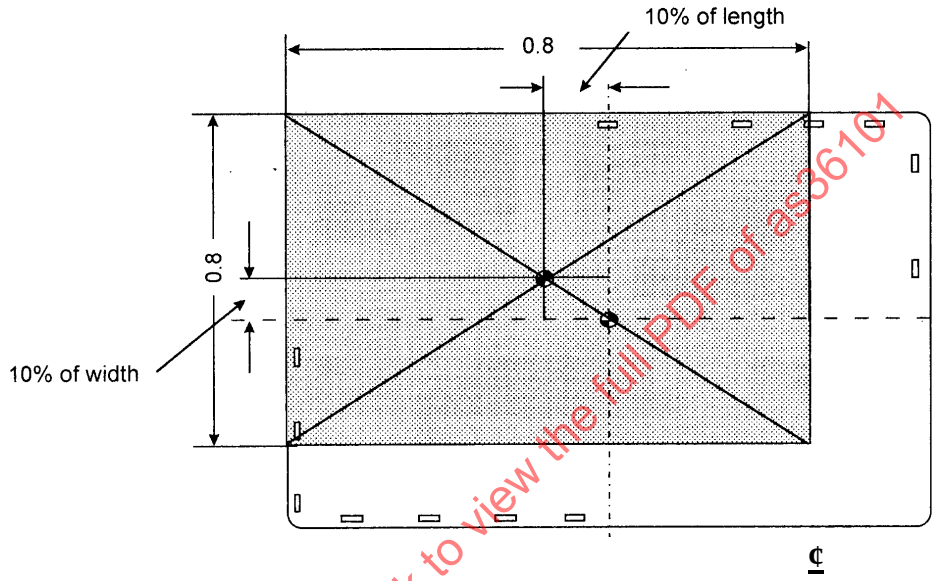

FIGURE 1

NOTE: For AS36100 or NAS 3610 sizes G and R, the maximum allowable CG offset is 5% longitudinal and 10% lateral.

3.1.4 A maximum allowable area load: $\frac{MGW}{S \times 0.64}$ (or: $\frac{MGW}{S \times 0.72}$ in the case of sizes G or R), where S is the ULD base plate area, can be derived from the reference load distribution model of 3.1.3. This maximum allowable distributed area load should not be confused with the maximum ULD base area load defined in the relevant AS36100 ULD configuration sheet, that is intended to specify the minimum load spreading requirements for the base, and protect aircraft conveyor systems and structure against excessive local loading. Accordingly, if the maximum allowable distributed area load, based on the applicable MGW for the intended aircraft position, is:

3.1.4 (Continued):

a. lower than or equal to the maximum ULD base area load: the ULD's maximum certified eccentricity limits are fully applicable,

b. higher than the maximum ULD base area load (which may be the case for, particularly, sizes A and M in certain aircraft main deck applications): the maximum ULD load CG eccentricity shall be operationally limited for the MGW concerned, so that the resulting maximum allowable distributed area load does not exceed the maximum ULD base area load.

3.2 Application:

3.2.1 When airworthiness testing unit load devices in accordance with the methods specified in AS36102, or conducting equivalent numeric simulation for this purpose, the test load shall be distributed (or simulated, as is the case) onto the pallet surface or the container base in accordance with the reference model defined in 3.1.3.

3.2.2 When designing aircraft cargo compartments structure and systems, it is recommended the load distribution assumptions defined in 3.1.3 be used to take into account maximum allowable ULD CG deviation limits. However, airframe manufacturers may use for this purpose alternate assumptions, providing aircraft structure and systems compatibility with the reference load distribution model is demonstrated.

3.2.3 When developing detailed unit load devices utilization rules, operators shall use the reference load distribution model as the assumption describing the most critical CG eccentricity case. They shall in addition apply any requirements set forth by the aircraft type's Weight and Balance Manual, and apply the requirements of Section 4 hereafter.

4. OPERATIONAL UTILIZATION:

4.1 The reference load distribution model in 3.1.3 is defined at the unit load device's maximum gross weight acceptable in the aircraft zone concerned. When the actual ULD gross weight is lower than this maximum, linear trade-off may be operationally used for increased CG eccentricity limits in proportion of the lower gross weight, as per Figure 2 hereafter: