

**Air Cargo Pallet Extenders**

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### 1. SCOPE:

This SAE Aerospace Standard (AS) establishes the dimensional and operational requirements for pallet extension devices. It provides support for items of cargo beyond either the short or the long sides of a pallet, allowing increased volume to be achieved in conjunction with pallets meeting the requirements of AS1491 plus additional pallet sizes usable with extenders.

#### 1.1 Purpose:

This document defines the minimum requirements for pallet extensions for use in the lower deck of wide-bodied aircraft as well as of standard-bodied aircraft.

### 2. 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.

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### 2.1 SAE Publications:

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

AS1491	Interline Air Cargo Pallets
AS1677	General Requirements for Non-certified LD-2, LD-4 & LD-8 Cargo/Baggage Container) - for contour information only!
AS33601	Truck & Stud Fitting for Cargo Transport Aircraft, Standard Dimensions for

### 2.2 IATA Publications:

Available from International Air Transport Association, 800 Place Victoria, P.O. BOX 113, Montreal Quebec Canada H4Z1M1.

IATA ULD Technical Manual, Standard specification 50/0 appendix E, Maximum ULD contours, and standard specification 60/1, Pallet extensions

### 2.3 NAS Publications:

Available from Aerospace Industries Association of America Inc., 1250 Eye Street, N.W., Suite 1100, Washington, DC 20005, USA.

NAS 3610	Cargo Unit Load Devices - Specification for cargo unit load devices to be installed in certificated aircraft
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### 2.4 FAR Publications:

Available from the Federal Aviation Administration, 800 Independence Avenue, SW, Washington DC 20591.

Federal Aviation Regulation (FAR), Part 25, United States Department of Transportation

### 3. GENERAL:

Each extension consists of a panel or shelf extending upwards and outwards within a load envelope (see Figure 4).

The panel or shelf is secured in this position by means of chains, cables or structural members attached to the adjacent pallet edge rails.

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3.1 The extension shall be used in conjunction with pallets meeting the requirements of AS1491, or equivalent requirements, for the pallet sizes shown in Table 1:

TABLE 1

TABLE 1			PALLET DIMENSIONS		Extender Contour along Pallet Length/Width							
Size Code			mm	inch	1 side extender				2 sides extender			
1)	2)	3)	Length x Width	Length x Width	C	E	E <sub>3</sub> <sup>4)</sup>	G	U	F	F <sub>3</sub> <sup>5)</sup>	H
<b>A</b>			2235 x 3175	88 x 125	L	L	W	-	L	L	W	-
<b>L</b>			1534 x 3175	60.4 x 125	L	L	-	-	L	L	-	-
<b>M</b>			2438 x 3175	96 x 125	L	L	W	-	L	L	W	-
<b>K</b>			1534 x 1562	60.4 x 61.5	L	L	L	L	-	-	-	L
	<b>N</b>		2438 x 1562	96 x 61.5	L	L	W	-	-	-	W	-
		<b>Q</b>	1534 x 2438	60.4 x 96	-	-	L	-	-	-	L	-

- 1) In IATA, AS1491 and NAS3610
  - 2) In IATA Size N = AS1491 Size III
  - 3) In IATA Size Q = Basesize LD4/LD8
  - 4) E-3 LD-2 contour
  - 5) F-3 LD-8 contour
- } see AS1677

Note:  
Contour code according  
IATA UTM 50/0

Illustration 1: 1 side / 2 sides extender



Illustration 2: Length Loading / Width Loading

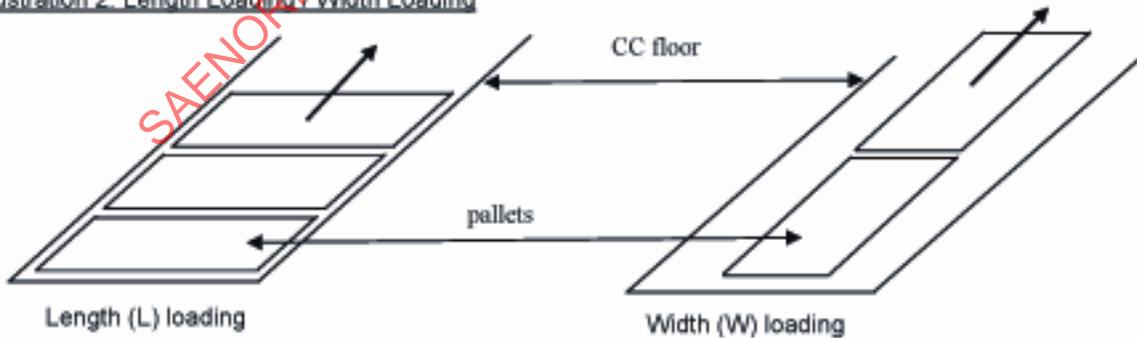


FIGURE 1

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3.2 There are two types of extenders actually in use:

3.2.1 The contour extender(s): a panel attached to the pallet at approximately 45°.

3.2.2 The horizontal extender(s): a shelf attached to the pallet with a horizontal load-platform.

An adequate pallet net encloses both extender types together with the pallet load. This net is attached as required either to the pallet edge rail (see 4.4.1) or to the extender itself (see 4.4.2).

Due to the different aircraft lower deck contours, the related IATA load contours, the different pallet sizes and thus extender dimensions and/or multi use combinations, several configurations are feasible/ advantageous.

NOTE: IATA load contours: C, E, G and U, F, H and the LD2-LD8 related contour herein called E-3 and F-3.

For reference see Tables 2A and 2B and Figures 5A and 5B.

3.3 It shall be possible to rotate contour extenders to come to a rest on top of the pallet, to facilitate handling and storage of empty units, or to use the units as pallets only.

3.4 For loading of nonstackable goods, without using the additional volume beyond the pallet, it should be possible to secure the extensions in the vertical position.

3.5 The extenders shall be designed to be operated with minimum effort by one person without requiring any tools.

#### 4. DESIGN AND CONSTRUCTION:

4.1 The extension shall be constructed to withstand normal cargo handling, to require only a minimum of maintenance and to provide a maximum service life.

4.2 Each extension shall be designed for quick attachment and rapid removal from the pallet by one person without the use of special tools.

4.3 The extensions shall be optimised for minimum weight and maximum durability.

4.4 The extensions shall be attached to the pallet edge rail by means of fittings in accordance with AS33601A. The number and the design of those fittings shall distribute the load to the pallet edge and base to avoid load concentration.

A vertical clearance of 108 mm (4.25 in) shall be provided to the extender structure, vertically to the pallet edge rail, to allow approximately 102 mm (4 in) of clearance for the net attachments (see Figure 4).

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- 4.4.1 Extender constructions requiring net attachments to the pallet edge rail must provide the space for net attachment points as per NAS3610/AS1491.
- 4.4.2 Extender constructions requiring net attachments to the extender itself shall meet the requirements of 4.4.

NOTE: In this case, the pallet extender becomes an integral part of the pallet and will require net attachment points on three sides of the extender and thus a specific net or net arrangement.

Such a unit will require certification to cover its configuration.

- 4.5 Chains, cables or structural members, which support the extension in the extended position shall be equipped with fittings according to AS33601A for attachment to the pallet edge rail.
- 4.6 All edges of the extensions shall be chamfered to avoid injuries to personnel and damages to aircraft or cargo.
- 4.7 All non-metallic parts which are liquid absorbent shall be sealed or treated to prevent liquid absorption.
- 4.8 All materials used shall comply with the applicable flammability requirements of the Part 25, Appendix F of the US Federal Aviation Regulations.

### 5. DESIGN LIMITATIONS:

- 5.1 Any downward deformation of the extensions (rotation of the extensions by lengthening of cables, chains or structural members or bending of the extensions themselves) shall not exceed the reference ULD contour, or lead to contact with the cargo compartment lining.

Maximum deflection limits correspond to the ultimate load, which is 5.1 times the payload in line with NAS3610 ultimate test loads.

For the applicable values refer to Tables 2A and 2B for the different configurations.

NOTE: This assumes that pallet extenders used exclusively in the lower deck are designed for the above ultimate load in line with NAS3610.

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### 6. DESIGN LOADS AND TEST REQUIREMENTS:

- 6.1 Each extender shall be designed and tested to support a share of the maximum total ULD download.

A volumetric share defines the load on a single extender. This share is a percentage of the total ULD load volume at MGW times the gross density variation required to cause a lateral CG shift of 10%.

- 6.2 Tables 2A and 2B list all data for which each extender shall be designed and tested.

When the pallet is designed and tested for a maximum gross weight which is not covered, the percentage of the maximum nominal download shall be used to establish the test loads.

Three load conditions are to be tested, two of them mandatory.

- 6.2.1 Load condition N°1 (required): The test load shall be the share of the ultimate download in line with NAS3610, which includes a safety factor of 1.5 according to FAR 25.303.

The load is thus the extender's payload times a factor of 5.1.

Deflections under this (static) test load shall not exceed the deflection limits for each case, corresponding to the different lower deck cargo compartment contours.

- 6.2.2 Load condition N°2 (recommended): The test load shall be the share of the limit load derived from NAS3610.

The load is the extender's payload times a factor of 3.4 (5.1g/1.5 (safety factor)).

Deflections under this (static) test load shall be less than the above deflection limits by at least 25.4 mm (1 in) [which covers the clearance for the pallet net], in order to prevent any lining damage or loading/unloading problems. No permanent deformation is allowed.

This load condition is not mandatory, provided the results of Load condition

N°1 assure that the requirements of Load condition N°2 are met.

- 6.2.3 Load condition N°3 (required): The test load shall be the share of the payload the ULD should be qualified for.

Deflections under this (static) test load shall not exceed the deflection limits for each case, corresponding to the reference ULD contour.

- 6.3 Concentrated loads at the pallet/extender interface when tested per Load condition N°1 must not exceed the structural allowable of the pallet, including a fitting factor of 1.33 and if applicable, an additional casting factor in accordance with FAR 25.621.

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6.4 For testing of above load conditions the extender shall be restrained as in operation per NAS3610. The pallet has to be vertically restrained to prevent upwards bowing.

The static load shall be applied at the load centreline, along a line approximately 13 mm (0.5 in) wide, extending symmetrically not more than 80% of the length of the extender. In order to represent a uniformly distributed load, a series of unconnected load segments not exceeding 305 mm (12 in) in length shall be used. Measurements shall be taken/recorded to ensure that deflection limits for each load condition are satisfied.

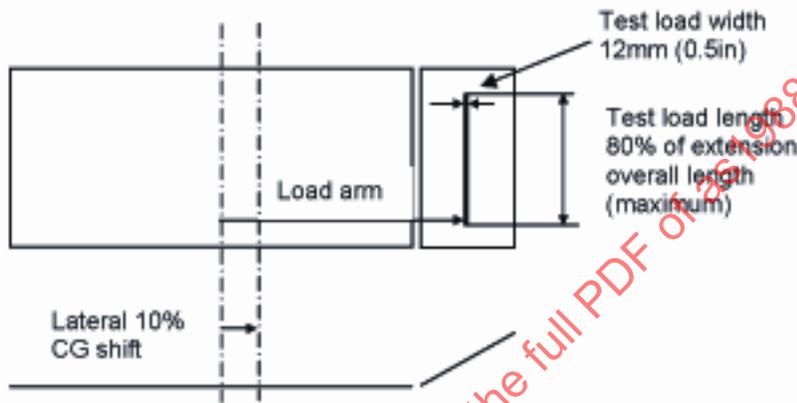


FIGURE 2

Example of load-arm calculation for an F contour

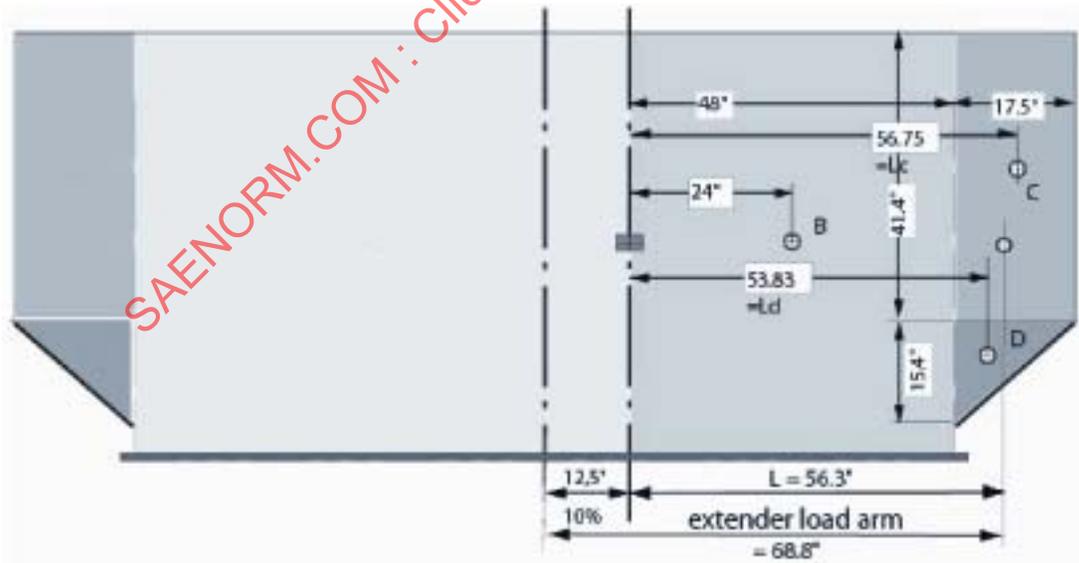


FIGURE 3

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6.4 (Continued):

Lc: distance from the shifted centre of gravity (CG) to the C area CG

Ld: distance from the shifted CG to the D area CG

L: distance from the shifted CG to the C+D area CG

Sc: surface C

$$Sc = 724.5 \text{ in}^2$$

Sd surface D

$$Sd = 134.75 \text{ in}^2$$

$$Lc \times Sc + Ld \times Sd = L \times (Sc + Sd)$$

$$\Rightarrow L = (Lc \times Sc + Ld \times Sd) / (Sc + Sd) = 56.3 \text{ in}$$

$\Rightarrow$  load arm of the load on the pallet extension

$$\Rightarrow = L + 12.5 = \boxed{68.8 \text{ in}}$$

- 6.5 In cases an extender is designed and tested for more than one configuration, i.e. more than one ULD contour or pallet size and and/or more than one maximum grossweight, the test conditions shall be the more severe case.

NOTE: Examples are:

- Extenders for A-size pallets also to be used for M-size pallets
- Extenders for E-3/F-3 contours also used for E/F contours
- Extenders for C/U contours also to be used for E/F contours

7. OPERATION:

- 7.1 It is recommended, when loading freight on pallets with extenders, to load heavier items on the pallet baseplate.

- 7.2 It is recommended to load the extenders such as to minimize a longitudinal CG eccentricity.

NOTE: Following these recommendations will minimize overloading the extenders.

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8. MARKINGS:

8.1 Each extension shall be marked with the following information:

1. The name and address of the manufacturer
2. The weight of the extension to the nearest half kilogram and pound
3. The serial number or date of manufacture or both
4. The manufacturer's part number
5. The flammability requirements determined for the extension under 4.8
6. Where applicable, the appropriate airworthiness authority or FAA Supplemental Type certificate
7. The NAS3610 size code(s) or pallet size(s) the extension is compatible with (only when the net attaches directly to the full periphery of the base pallet and not to the extension)
8. Pallet edge length the extension is compatible with
9. Maximum payload per extension assembly (multiple configurations addressed)

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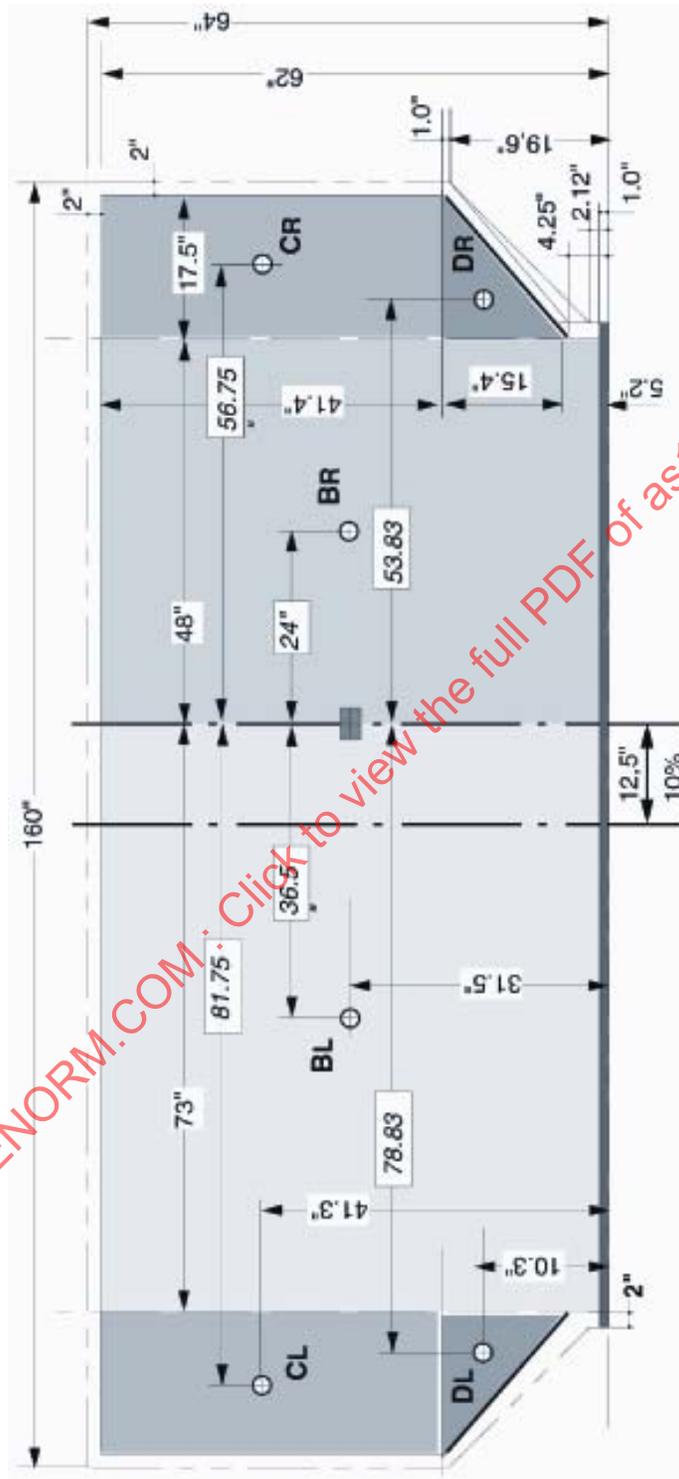


FIGURE 4 - Example F - Contour Dimensions for Volume/CG - Shift Calculations

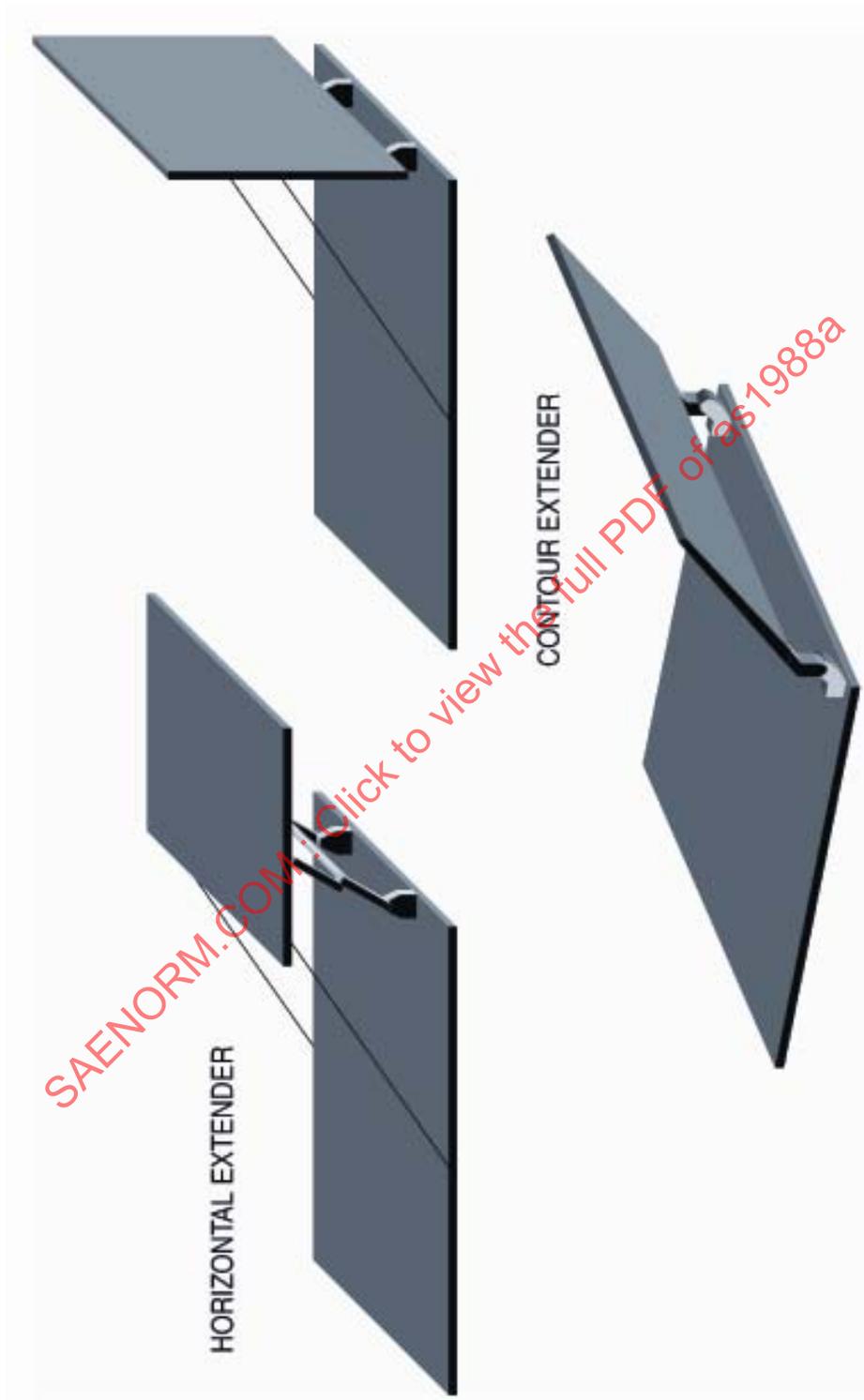


FIGURE 5A - Extender Types (Principles) - Contoured Extender (45°/90°) + Horizontal Extender