SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS4041 REV. A

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Superseding AS4041

AIR MODE GENERAL PURPOSE CONTAINERS

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1. SCOPE:

1.1 This SAE Aerospace Standard (AS) establishes the basic requirements for the design, construction and testing of air mode 2.44 m X 2.44 m (8 ft X 8 ft) cross-section containers.

These containers are to be used exclusively in conjunction with the air mode in freighter versions of wide-body commercial transport aircraft. Air mode containers will normally be on aircraft roller conveying systems and/or on similarly equipped ancillary ground handling devices. Similar requirements for air/surface (intermodal) containers are provided in AS832.

2. REFERENCES:

2.1 Applicable Documents:

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

AS832	Air/Surface (Intermodal) General Purpose Containers
ARP1334	Ground Equipment Requirements for Compatibility with Aircraft Unit Load Devices
ARP1372	Minimum Requirements for Air Cargo Unit Load Device, Ground Handling and Transport Systems

2.1.2 NAS Publications: Available from Aerospace Industries Association, 1250 Eye Street NW, Washington, DC 20005.

NAS 3610 Cargo Unit Load Devices, Specification for. Aerospace Industries Association of America, Inc., 1725 DeSales Street N.W., Washington, DC 20036

2.1.3 FAR Publications: Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

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

Technical Standard Order TSO-C90

2.1.4 ANSI Publications: Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

Federal Test Method Standard No. 406, Plastics - Methods of Testing - Method 1091: Abrasion wear (loss in weight)

ISO 6346 Freight Containers, Coding, Identification and Marking

ISO 11242 Aircraft-Pressure Equalization Requirements for Cargo Containers

2.1.5 IATA Publications: Available from International Air Transport Association, 2000 Peel Street, Montreal, Quebec, Canada H3A 2R4.

IATA Standard Specification Number 50/0, Condition Requirements for Interlining of ULDs

IATA Standard Specification Number 40/0, Marking of Unit Load Devices

IATA Standard Specification Number 40/1, IATA Identification Code for Unit Load Devices

IATA Standard Specification Number 50/6, Air/Surface (Intermodal) Container

IATA Standard Specification Number 80/2, Press Equilization Requirements for Aircraft and Shipping Containers

2.2 Definitions:

AIR MODE CONTAINER: An article of transport equipment having an internal volume of 14 m^3 (500 ft^3) or more, with restraint provisions compatible with an aircraft restraint system and an entirely flush base bottom to allow handling on rollerized cargo handling systems.

MAXIMUM GROSS WEIGHT, MGW: The maximum allowable combined weight of the container and its cargo.

TARE WEIGHT, T: The weight of the empty container, including its normal complement of loading restraint devices.

2.3 Terminology:

The term “Weight” is used throughout this aerospace standard instead of the correct technical term “Mass” in order to conform to current commercial usage.

The essential basic and detail criteria are identified by use of the key word “shall.” Recommended basic and detail criteria are identified by use of the key word “should,” and, while not mandatory, are considered to be of primary importance in providing serviceable, economical and practical air mode containers.

3. TECHNICAL REQUIREMENTS:

3.1 General:

It should be noted that Appendices A, B, C, D, and E also form part of the requirements of this section. In addition, IATA Standard Specification No. 50/0 should be referred to for general requirements beyond the scope of this document (e.g., serviceability limits).

3.1.1 Airworthiness: The airworthiness requirements laid down by the Federal Aviation Administration, FAR Part 25, and supplementary document TSO-C90 are the governing requirements for container design. Airworthiness design criteria provided in this document dealing with ultimate loads, center of gravity limits, pressure equalization and fire protection requirements are provided for reference purposes only and are based on the FARs in effect at the time of this revision. Specific design guidelines to meet the pressure equalization requirements of the FARs are based on ISO 11242.

3.1.2 Tare Weight: Taking into consideration the unique aircraft requirements, container design should utilize the combination of design and material which results in as low a tare weight as possible.

3.1.3 Customs Sealing: Since air mode containers are expected to travel on international routes under customs control, container design shall meet the appropriate requirements of the following international conventions:

a. UN/IMO (International Maritime Organization): Customs convention on containers, Geneva, 1972-12-02

b. UN/ECE (Economic Commission for Europe): Customs convention on the international transport of goods under cover of TIR carnets (TIR Convention), Geneva, 1975-11-14

The main items from the above international conventions to be taken into consideration for container design appear in A.5 of Appendix A. Also, in accordance with Annex 5 of the convention quoted in (a), and with Annex 3 of the convention quoted in (b), an approval certificate should be issued by competent national authority, and an approval plate as specified (minimum dimension 200 mm x 100 mm (8 in x 4 in) should be affixed accordingly in the vicinity of the lower edge of the container door.

3.1.4 Symbols and Marking: To denote the container as an air mode (8 ft x 8 ft) container, the symbol illustrated in Figure 1 shall be used and located at the top left-hand corner of the end walls and sidewalls and, as appropriate, on the roof. Overall indentification and marking of the containers shall be in accordance with IATA 4010 and 4011. These requirements are presented in Appendix C.

NOTE: If any other markings are used on the container, they shall in no way interfere with the location of the markings required by IATA 40/0 (Section 4) and IATA 40/1.

3.2 Dimensions and Tolerances:

3.2.1 External Dimensions: The overall external dimensions and tolerances of the containers covered by this aerospace standard are shown in Appendix B. No part of the container shall project beyond these specified overall external dimensions.

3.2.2 Minimum Internal Dimensions: The internal dimensions of the containers shall be as large as possible but at least equal to those values shown in Appendix B.

NOTES:

1. To denote that the container is an air mode container incapable of being stacked, the above shall be used.

2. The aircraft symbol shall be at least 130 mm (5 in) high and 360 mm (14 in) long. The no stacking symbol shall be at least 280 mm (11 in) high and 260 mm (10 in) wide. The recommened proportions should be used. The capital letters shall be at least 80 mm (3 in) high.

3. The color of the symbol should be red. If the color of the container is such that the symbol does not show clearly, a panel of a suitable color, preferably white, should be provided as background.

FIGURE 1 - Symbol to Denote Air Mode Container

3.2.3 Door Opening: The container shall be designed to make the maximum possible internal cross-section available for loading.

Each container shall be provided with a door opening at least at one end.

Door openings shall be as large as possible, but not less than:

a. Minimum door height: 2134 mm (84 in)
b. Minimum door width: 2286 mm (90 in)

3.3 Load Ratings:

For the ratings of containers suitable for air transport, the following definitions apply.

3.3.1 Maximum Gross Weight Rating, Ra and Load Distribution: The container shall not be used at gross weights in excess of those given in Table 1.

TABLE 1 - Maximum Gross Weight of Container, Ra

Container Designation	Maximum Gross Weight Ra kg	Maximum Gross Weight Ra lb
1A	20 412	45 000
1B	15 876	35 000
1C	11 340	25 000
1D	5 670	12 500

A uniformly distributed load up to 6759 kg (14 900 lb) may be used over a 3 m (10 ft) linear length for 1A, 1B and 1C containers.

3.3.2 Center of Gravity: Cargo placement shall limit the center of gravity to within the envelope indicated below:

a. ±10% of the external lateral width, measured from the geometric center

b. ±5% of the external longitudinal length, measured from the geometric center

c. Between a height of 356 mm (14 in) to 1 219 mm (48 in), measured from the bottom of the base

To obtain the asymmetric conditions, cargo density shall be assumed to vary linearly.

3.4 Structural Requirements:

NOTE: Also refer to Appendix A for supplementary structural requirements.

3.4.1 Ground Handling:

3.4.1.1 Bridging and Cresting: The container shall be capable of negotiating a crest or bridge when being moved along a rollerized conveyor system, without suffering permanent deformation or damage (see 4.7 - Test No. 6).

3.4.1.2 Roof Strength (Walking Loads): The container roof shall be capable of withstanding a uniformly distributed load of not less than 300 daN (660 lb), over an area of 600 mm x 300 mm (24 in x 12 in), applied vertically downwards (see 4.4.2 - Test No. 3.1).

3.4.1.3 Base Restraint On Roller Bed Vehicles: Slots to be used for ground transport restraint on roller bed vehicles shall be provided, as shown in Figure 2. The inner face of each outward slot (or block) shall be capable of restraining, laterally, 33% of the maximum gross weight (Ra).

The container lower edge member shall be capable of restraining an upward load of 20% of the maximum gross weight (Ra) in the slot area. These loads shall be applied simultaneously (see 4.8 - Test No. 7).

3.4.1.4 Ground Transport Equipment: The applicable portions of ARP1372 shall be considered for handling of the container.

3.4.2 Aircraft Restraint Loads: The container shall be designed to bear the ultimate loads given in NAS 3610 (see Appendix D) while on a minimum roller system per 3.5.2.6, with the base restrained in accordance with 3.4.2.1 and 3.4.2.2, and with the center of gravity of the cargo located at any point in the envelope specified in 3.3.2.

Under these loads, the container may exhibit permanent deformation, but it shall not break up to the extent of discharging cargo.

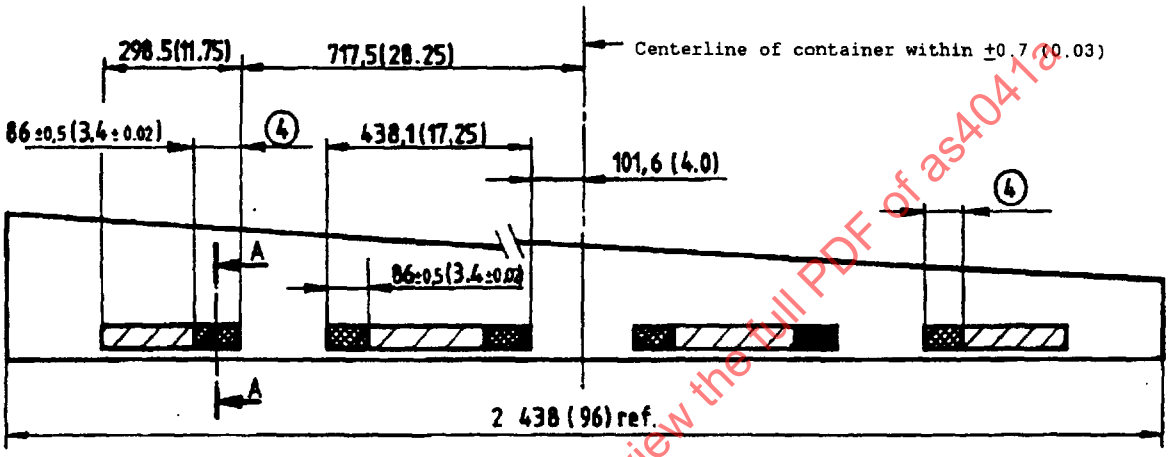
3.4.2.1 Base Restraint Loads: Side loads shall be exerted on the container base. Upward, forward, and aft loads shall be exerted by a fitting, as shown in Figure 3, inserted into the restraint slots, as shown in Figures 4 and 5. The design shall allow the forward and aft loads to be exerted on the following number of load-bearing slots:

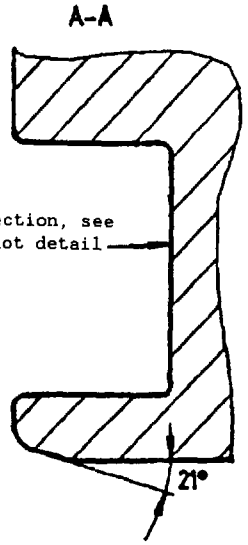
a. 1 A (40 ft) container: 11 slots
b. 1 B (30 ft) container: 8 slots
c. 1 C (20 ft) container: 5 slots
d. 1 D (10 ft) container: 2 slots

The ultimate forward and aft load capability of each slot shall be 8340 daN (18 750 lb), imparted by a restraint latch as shown in Figure 3, acting on the abutment face.

The container shall be designed to be restrained by vertical loads exerted by 50 to 60% of the total number of slots, equally distributed on each side. The upward load shall be exerted by a minimum fitting, as shown in Figure 3, inserted in the side restraint slots (see 4.2.2, 4.2.3, 4.3.2, 4.3.3, 4.4.3 and 4.4.4).

Dimensions in millimeters
(Dimensions in inches in parentheses)

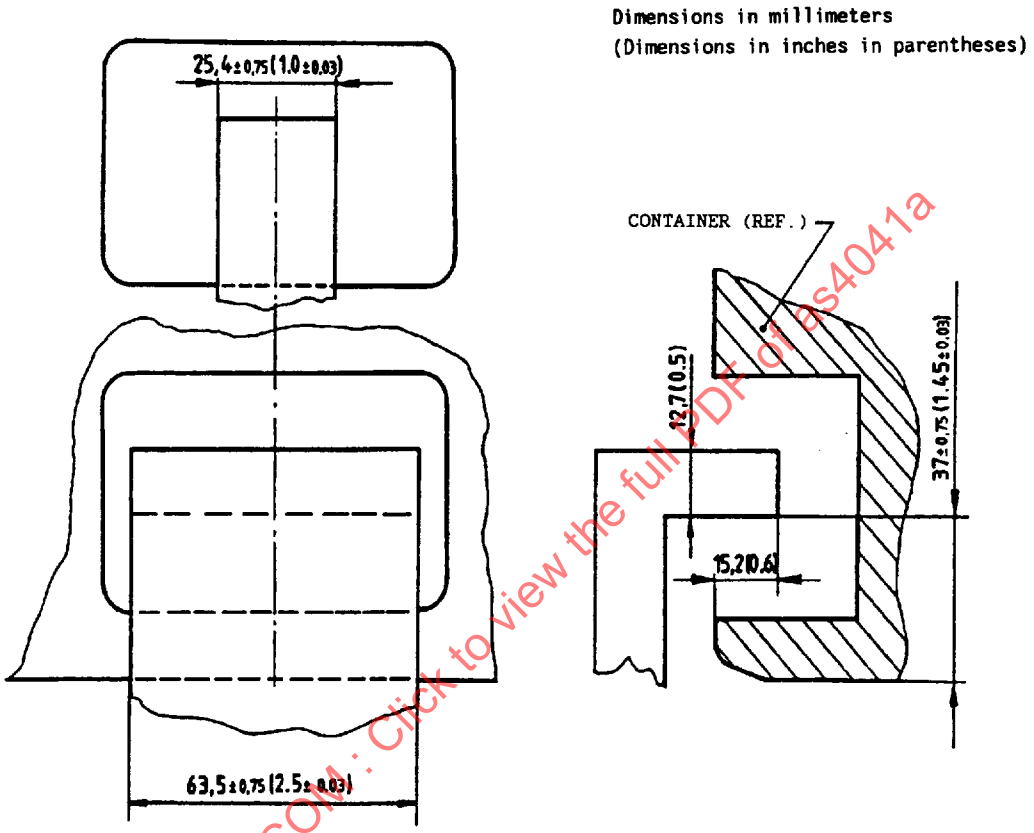




NOTES

1. Slots are indicated thus:
2. Optional slot sizes are indicated thus:
3. Tolerance: ±0.7 (±0.03), unless otherwise stated.
4. (Refer to the illustration) Slots to be used for ground transport restraint. The area shown shall be kept clear for aircraft and ground equipment latch interface.

FIGURE 2 - End Slots



NOTE: Latches with the dimension of 25.4 (1.0) are for vertical restraint only.

FIGURE 3 - Latch Dimensions

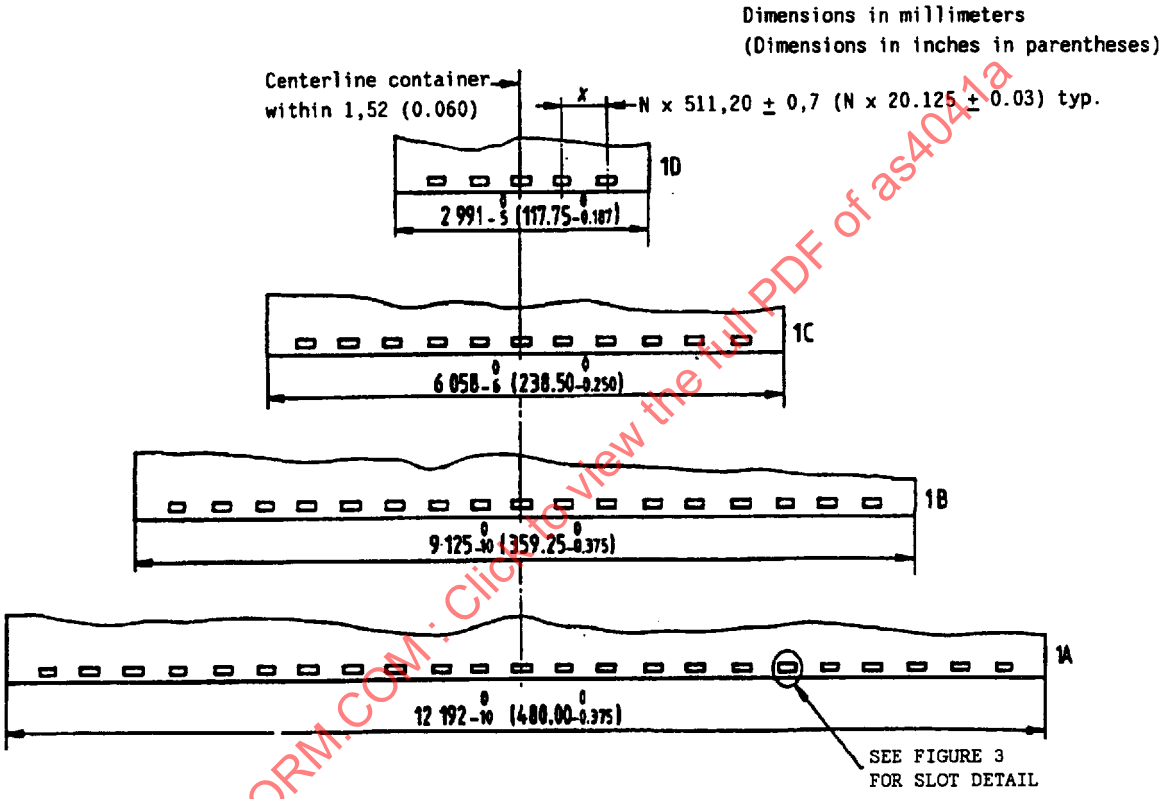


FIGURE 4 - Side Restraint Slots Location

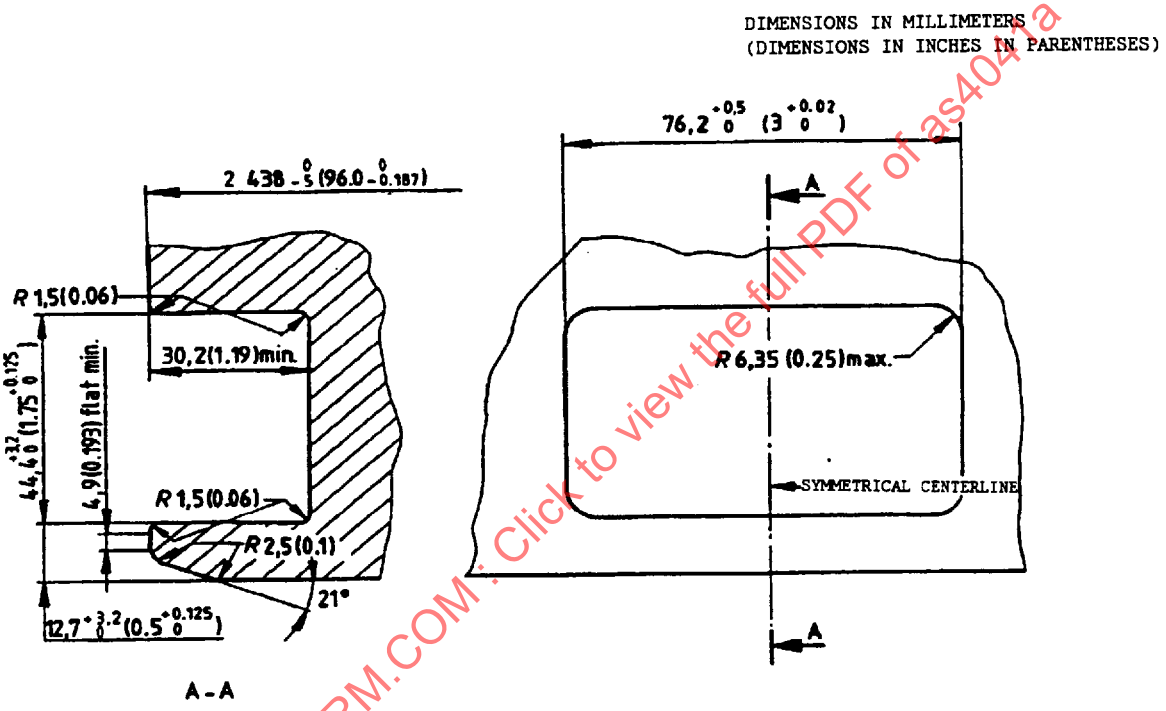


FIGURE 5 - Side Slot Detail

3.4.2.2 Base Restraint Loads - 1D Containers: In addition to the requirements of 3.4.2.1, end restraint slots shall be designed to restrain a 1D container against ultimate forward, aft and vertical upward loads, when used in conjunction with restraint fittings, located as shown in Figure 6 and in the configuration illustrated in Figure 7. The container end slot dimensions and location are shown in Figure 2.

3.4.3 Pressure Equalization Requirements:

3.4.3.1 Normal Flight Conditions: The container shall have a built-in vent area to allow normal (low airflow) pressure equalization. This vent area shall be a minimum of 5 cm^2/m^3 (.02 in^2/ft^3) of container internal volume and shall be located so that it cannot be blocked or partially blocked by cargo or cargo shift.

The container door seals may fulfill part or all of this vent requirement if they are sufficiently flexible to deflect in either direction (in and out) under a pressure differential of between 3.5 and 7.0 kPa (0.5 to 1.0 psi).

3.4.3.2 Emergency (Rapid Decompression) Conditions: The container shall be designed to ensure high flow pressure equalization in the event of a rapid decompression without creating a hazard to the cargo compartment or the aircraft structure. A minimum vent area of 100 cm2/m3 (0.45 in^2/ft^3) of container internal volume shall be provided unless the container door seals and door frames deform sufficiently under rapid decompression conditions to fulfill this requirement. If the container design incorporates a blow-out panel or equivalent device to meet this requirement, then such a device shall fully open in less than 0.2 s when subjected to a maximum pressure differential, from the inside, of 14 kPa (2.0 psi).

All vent areas shall be located and/or designed to avoid becoming blocked or partially blocked by cargo or cargo shift.

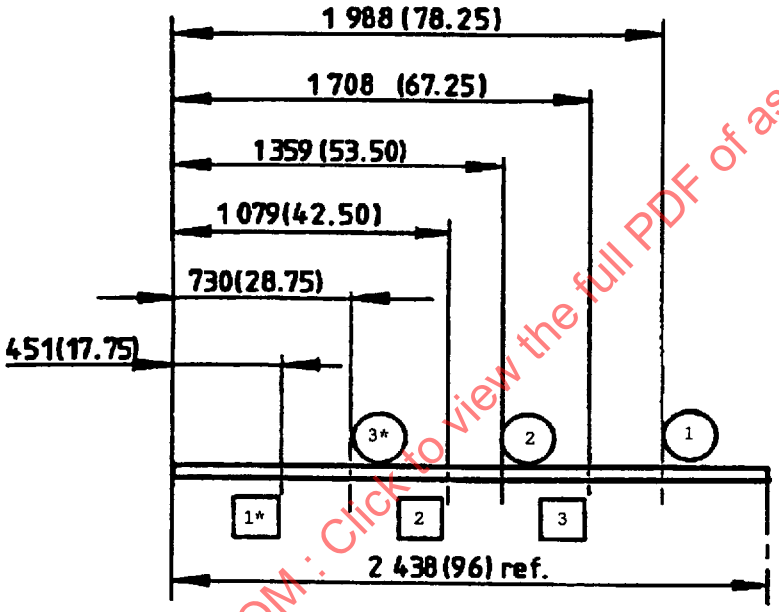
NOTE: Full scale tests have indicated that typical aircraft containers design and construction meet the above requirement since, when submitted to the rapid decompression condition, the panel joints and noticeably the door frames immediately deform to the extent of creating sufficient space for the high airflow required, without breaking or projecting parts which could become a hazard to the surrounding structure (see ISO 11242).

However, it remains necessary, in compliance with clause 3,8 of ISO 8097 (NAS 3610), to verify this requirement by analysis or testing when designing any new type of container, particularly if the new design is intended to be built in a stronger manner than is current industry practice.

3.5 Construction:

3.5.1 General: Container body construction shall be rugged and weatherproof.

DIMENSIONS IN MILLIMETERS
(DIMENSIONS IN INCHES IN PARENTHESES)



*SET OF THREE LATCH LOCATIONS USED DEPENDING ON THE ORIENTATION IN THE AIRCRAFT; EACH SET IS MARKED □ OR ○ .

FIGURE 6 - End Restraint Locations

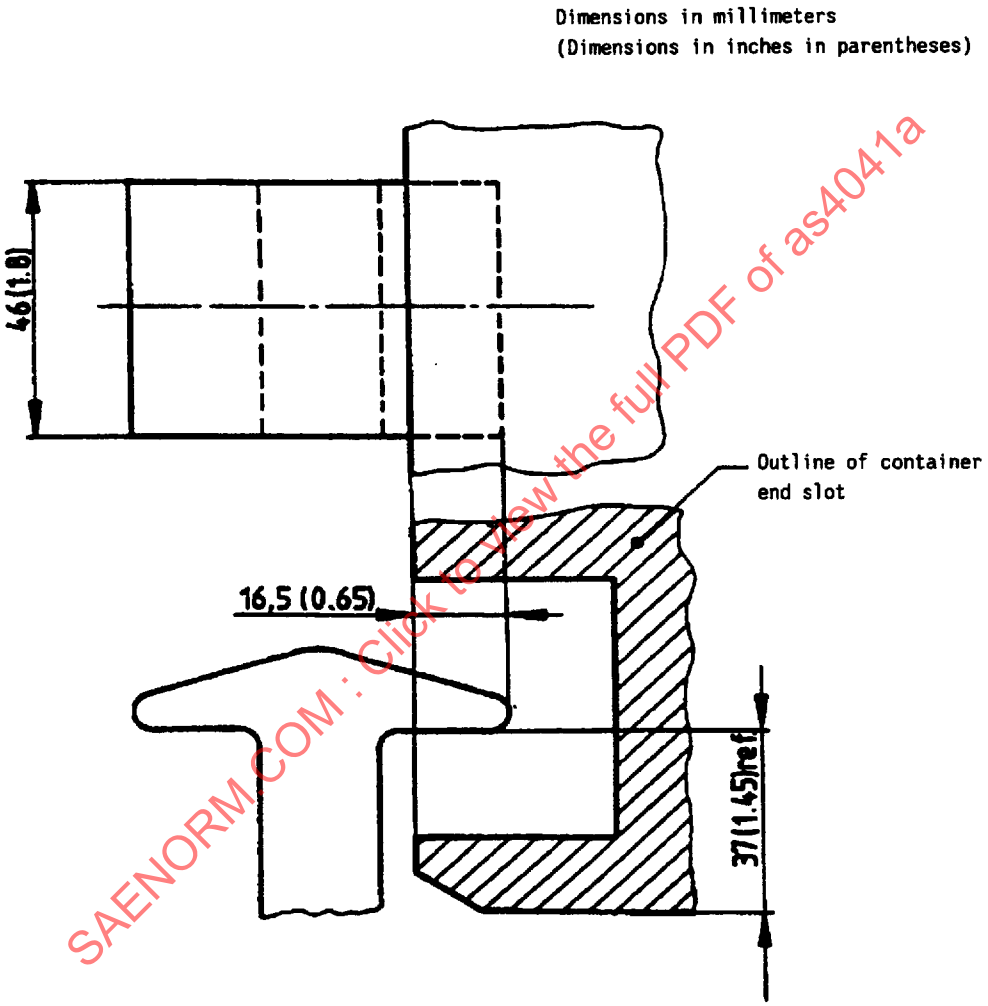


FIGURE 7 - End Latch Dimension

3.5.2 Container Base:

3.5.2.1 The container shall have a smooth bottom below which there shall be no protrusions. The lower surface of the edge members shall be flush with the bottom surface of the base.

3.5.2.2 Along the length of the container, the bottom surface shall be flat to within 3 mm (0.125 in). This shall allow for a waviness factor, crest to crest, at a minimum pitch of 915 mm (36 in).

3.5.2.3 The base edge shall have the restraint slots which conform to Figures 4 and 5. End slots shall be provided in accordance with Figure 2. The vertical surface of the base edge between the restraint slots shall be smooth and continuous in order to provide a suitable interface for the automatic aircraft restraint latches. The lower profile of the edges shall be as shown in Figures 2 and 5.

3.5.2.4 Securing points shall be provided internally for the attachment of devices for the lashing of cargo, and these points shall be located on 600 mm (24 in) centers around the periphery of the base, excluding the door sill area. These points shall be “D” rings, or equivalent, each capable of reacting a tiedown load of 1776 daN (4 000 lb) in any direction.

3.5.2.5 So that the container conforms to the aircraft system deflected shape, the 1A and 1B container base, loaded to the rated maximum gross weight (see Table 1), shall be free to deflect ±9.5 mm (±318 in), without rigid restraint by the sidewalls. Base stiffness in the forward and aft direction in the plane of the base shall have a maximum value of 339 075 $N.m^2/m$ (3×10^6 $lbf\ in^2/in$) or 824 000 Pa per 25.4 mm.

NOTE: These 1A and 1B container requirements relate to current aircraft and may be amended for future aircraft.

3.5.2.6 The base shall provide for support and ease of movement when loaded to the rated maximum gross weight on the following minimum conveyor systems:

a. Four rows of rollers, approximately equally spaced over a width of 1930 mm (76 in), measured between the centers of rows. Each row comprises 38 mm (1.5 in) diameter parallel rollers 76 mm (3 in) long, uncrowned, with an edge radius of 1.5 mm (0.06 in), spaced 254 mm (10 in) apart. The container travels perpendicular to the roller centerlines.

b. Swivel castors, with 25.4 mm (1 in) diameter wheels, having a contact length of 51 mm (2 in), located on a 305 mm x 305 mm (12 in x 12 in) grid pattern. The container travels in all directions across the grid.

c. Ball transfer units, with 25.4 mm (1 in) diameter balls, located on a 127 mm x 127 mm (5 in x 5 in) grid pattern. The container travels in all directions across the grid.

3.5.3 Closures and Doors:

3.5.3.1 Any closure in the container which, if unsecured, could be hazardous during handling, shall be provided with an adequate securing system.

3.5.3.2 Doors should be capable of being securely fastened in the open or the closed position, while the container is being supported on the minimum conveyor systems, as described in ARP1334.

3.5.3.3 The lower edge of the door and its attached hardware shall not encroach on the mandatory restraint slot areas as shown in Figure 2.

3.5.3.4 The door latches shall be designed to allow the opening and shutting of the door, when the container is on an uneven surface that varies up to 12.7 mm (0.5 in) over the width of the door opening.

3.5.3.5 Provision shall be made for a mechanical device to indicate that doors are positively locked.

3.5.3.6 Particular attention should be given to the prevention of water leaking through door-to-body interface areas (see 4.6 Test No. 5).

3.5.3.7 Handles, straps, or handholds shall be provided on the door of the 1D container to assist manual movement of the container. These devices shall withstand a 450 daN (1000 lb) pull in any direction, and should provide an area equivalent to 152 mm (6 in) wide by 76 mm (3 in) deep for gripping with a gloved hand.

4. TESTING:

4.1 General:

Unless otherwise stated, operational design loads are used in all tests. For substantiation of analytical data, when required, tests, in selected cases, may be repeated under ultimate load conditions. If this becomes necessary, the container tested in this way shall not be used in service, until structural and design parameters have been completely restored. Where a test is not stipulated, the design requirements specified in Section 3 may be verified either by calculation or testing.

4.1.1 The symbol Ra denotes the maximum gross weight of the air container (see Table 1) and the symbol P denotes the maximum payload of the container under test, that is the tare weight, T, subtracted from the maximum gross weight:

$$Ra = P + T \qquad \text{(Eq.1)}$$

4.1.2 The test load within the container shall be uniformly distributed, unless otherwise specified. The maximum variations in the center of gravity, as specified in 3.3.2, shall be considered for test Nos. 1.1, 1.2, 2.1, 2.2, 3.2, 3.3, 4.2, and 6.

4.1.3 Test equipment and methods of testing described are not intended to be restrictive; however, for uniformity of testing results the apparatus and methods described in Appendix E should be used.

4.1.4 When restraint or movement on an aircraft system is demonstrated, the test system shall be in accordance with 3.5.2.6. Suitable latches and guide-rails shall be provided to guide the container along the conveyor and secure it at its latch points. The test system shall be of sufficient length to permit cycling of the longest container to be tested.

4.1.5 The diagrams in Figures 8A to 8D (Tests Nos. 1 to 7) show the test loads and reaction forces applied to a 6 m (20 ft) container (drawn approximately to scale). Variations in the geometrical layout of restraint means and test methods are stated underneath the diagrams, where appropriate.

4.2 Test Series No. 1 - Strength of End Wall/Door: (Reference Figure 8A.)

4.2.1 General: These tests shall be carried out to prove the ability of the container end walls or door to withstand the maximum operational forward forces which may be experienced during air transportation, while secured by means of the appropriate aircraft restraint system.

4.2.2 Test No. 1.1:

4.2.2.1 Procedure: The container shall be secured to the aircraft restraint system, or its equivalent. The number of latches indicated in 3.4.2 shall be engaged on one side of the container and the latches adjusted, by a suitable means, to ensure contact with the end of the side latch receptacle slot. The container shall have a test load of Ra - T applied horizontally to one end wall. A similar test load of Ra - T may be applied downwards, simultaneously, to the top surface of the container base.

The test shall be repeated at the opposite end of the container unless the ends are identical.

4.2.2.2 Requirements: On completion of the tests, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

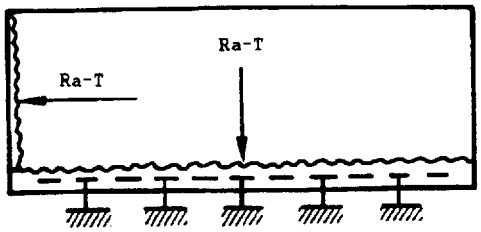
4.2.3 Test No. 1.2 - 1D Container Only:

4.2.3.1 Procedure: The container shall be secured to the aircraft restraint system or its equivalent, using only restraints in the fore and aft end slots, in accordance with Figures 6 and 7.

The container shall have a test load of Ra - T applied horizontally to one end wall. A similar test load of Ra - T may be applied downwards, simultaneously, to the top surface of the container base.

The test shall be repeated at the opposite end of the container unless the ends are identical.

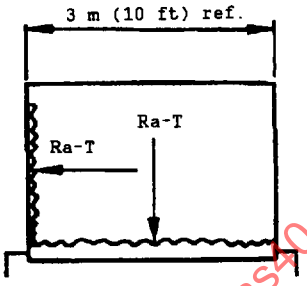
Test No. 1.1 - Strength of End Wall/Door - Forward Operational Load



NOTES

1. SEE 5.3.1 FOR MINIMUM RESTRAINT REQUIREMENTS.
2. HORIZONTAL LATERAL REACTION FORCES ARE NECESSARY AT THE BASE TO PREVENT HORIZONTAL ROTATION OF THE UNIT.
3. Ra-T DOWNWARDS IS OPTIONAL.
4. REPEAT TEST WITH THE HORIZONTAL FORCE, Ra-T APPLIED TO THE OPPOSITE END UNLESS THE ENDS ARE IDENTICAL.

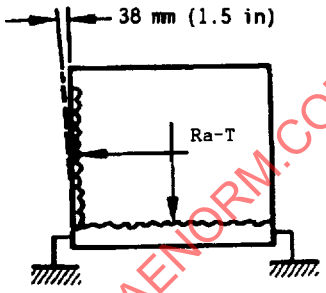
Test No. 1.2 - Strength of End Wall/Door - Forward Operational Load - 1D Container Only



NOTES

1. RESTRAINT AT END SLOTS ONLY.
2. Ra-T DOWNWARDS IS OPTIONAL.
3. REPEAT TEST WITH THE HORIZONTAL FORCE, Ra-T APPLIED TO THE OPPOSITE END UNLESS THE ENDS ARE IDENTICAL.

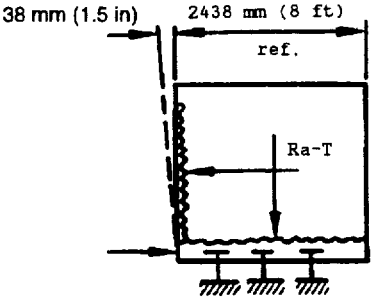
Test No. 2.1 - Strength of End Sidewalls - Side Operational Load



NOTES

1. SEE 5.3.1 FOR MINIMUM RESTRAINT REQUIREMENTS.
2. Ra-T DOWNWARDS IS OPTIONAL.
3. REPEAT TEST WITH THE HORIZONTAL FORCE, Ra-T APPLIED TO THE OPPOSITE END UNLESS THE ENDS ARE IDENTICAL.

Test No. 2.2 - Strength of End Sidewalls - Side Operational Load - 1D Container Only

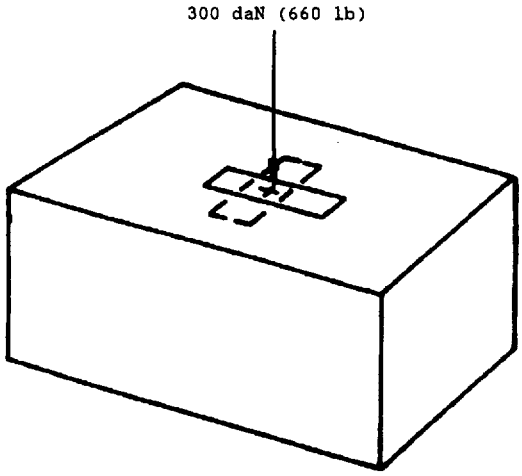


NOTES

1. REACTION FORCE, F, AT THE BASE INCREASES END SLOT RESTRAINT.
2. Ra-T DOWNWARDS IS OPTIONAL.
3. REPEAT TEST WITH THE HORIZONTAL FORCE, Ra-T APPLIED TO THE OPPOSITE END UNLESS THE ENDS ARE IDENTICAL.

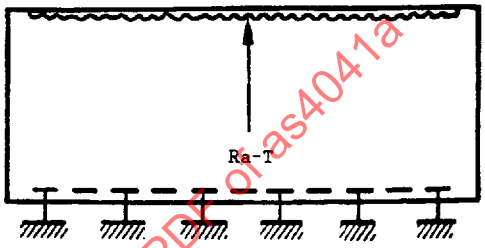
FIGURE 8A - Diagrammatic Representation of Tests Nos. 1.1, 1.2, 2.1, and 2.2

Test No. 3.1 - Roof Strength - Localized Walking Load - Surface Mode



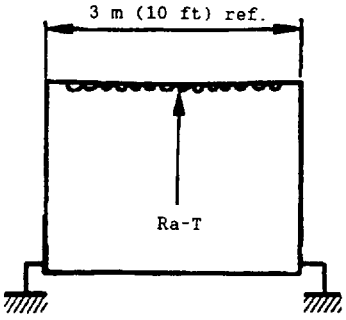
NOTE: THE TEST LOAD SHALL BE APPLIED OVER AN AREA OF 300 MM X 600 MM (12 IN X 24 IN) ON THE WEAKEST PART OF THE ROOF.

Test No. 3.2 - Roof Strength - Upward Operational Load



NOTE: SEE 5.3.1 FOR MINIMUM RESTRAINT REQUIREMENTS.

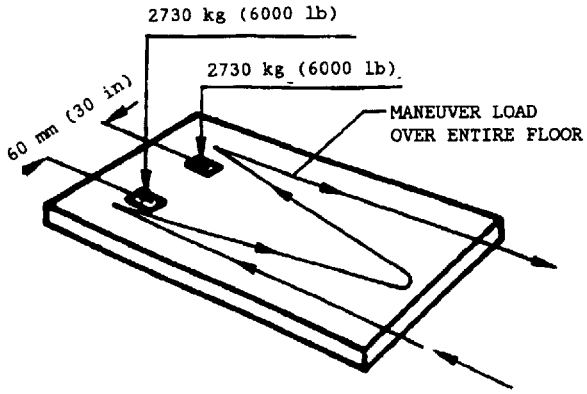
Test No. 3.3 - Roof Strength - Upward Operational Load - 1D Container Only



NOTE: RESTRAINT AT END SLOTS ONLY.

FIGURE 8B - Diagrammatic Representation of Test Nos. 3.1, 3.2, and 3.3

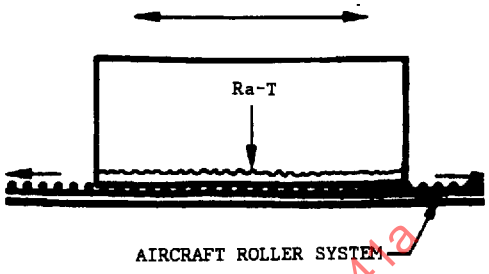
Test No. 4.1 - Floor Strength - Cyclic Loading



NOTES

1. THE LOAD SHALL BE APPLIED BY TWO WHEELS, EACH 185 MM (7.25 IN) WIDE, WITH 142 CM^2 (22 IN^2) MAXIMUM CONTACT AREA WITH THE CONTAINER SUPPORTED ON THE CONVEYOR SURFACE, IN ACCORDANCE WITH THE MINIMUM REQUIREMENTS OF ARP1334.
2. MANEUVER LOAD FOR 100 CYCLES.

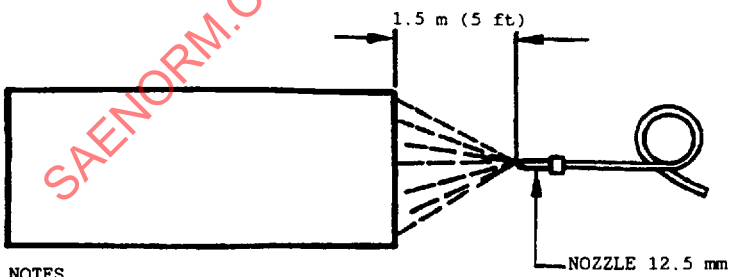
Test No. 4.2 - Floor Strength - Cyclic Loading
Travel at Least the Container Length



NOTES

1. SPEED OF TRAVEL 18.3 M/MIN (60 FT/MIN) FOR 100 CYCLES.
2. THE DRAWBAR PULL SHALL BE MEASURED PERIODICALLY AS SPECIFIED IN 6.5.2.2.

Test No. 5 - Weatherproofness

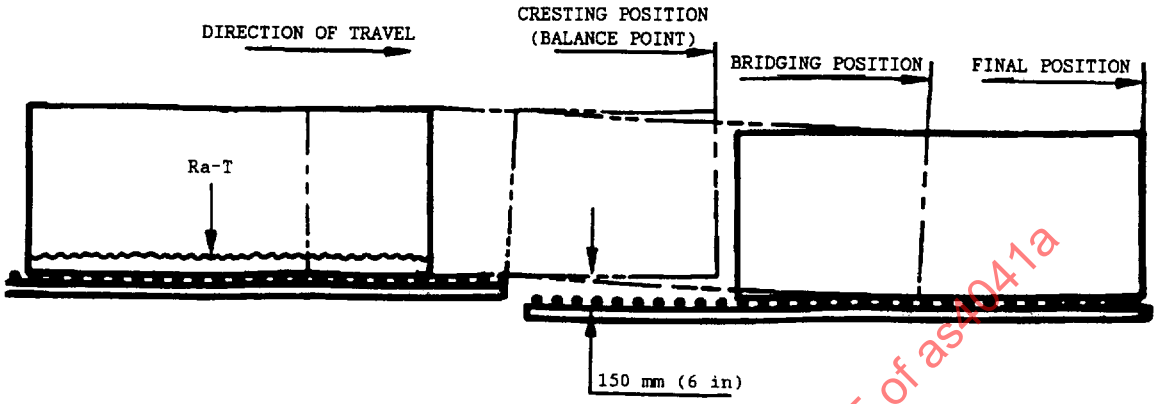


NOTES

1. WATER PRESSURE: 100 kPa
2. WATER VELOCITY: 100 mm/s (4 in/s)

FIGURE 8C - Diagrammatic Representation of Test Nos. 4.1, 4.2, and 5

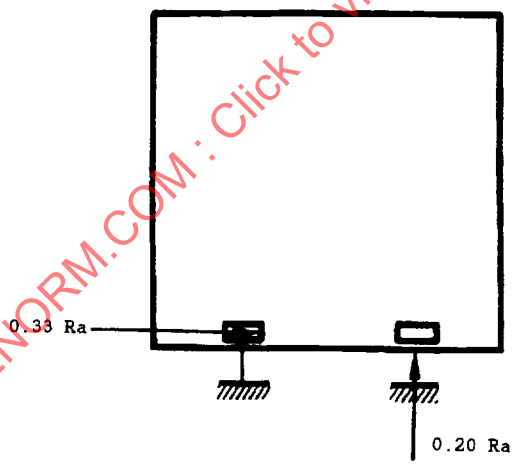
Test No. 6 - Bridging and Cresting



NOTES

1. CONTAINER SHALL BE HELD IN CRESTING POSITION FOR 5 S MINIMUM
2. CONTAINER SHALL BE ALLOWED TO DROP FROM THE BRIDGING POSITION ONTO THE LOWER PLATFORM

Test No. 7 - Base Restraint on Roller Bed Vehicles - Surface Mode



NOTES

1. RESTRAINT AT GROUND TRANSPORT END SLOTS ONLY (BOTH ENDS)
2. APPLY HORIZONTAL AND VERTICAL FORCES, Ra, AT BOTH ENDS OF THE BASE, SIMULTANEOUSLY
3. REPEAT TEST IN THE OPPOSITE SLOTS UNLESS THE SLOTS AND BASE SIDES ARE IDENTICAL

FIGURE 8D - Diagrammatic Representation of Test Nos. 6 and 7

4.2.3.2 Requirements: On completion of the test, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.3 Test Series No. 2 - Strength of Sidewalls:

4.3.1 General: These tests shall be carried out to prove the ability of the container sidewalls to withstand the maximum operational side forces that may be experienced during surface transportation or air transportation, while secured by means of the appropriate aircraft restraint system.

4.3.2 Test No. 2.1:

4.3.2.1 Procedure: The container shall be secured to the aircraft restraint system, or its equivalent. The number of latches indicated in 3.4.2 equally spaced on both container sides, shall be engaged in the side slots and the latches adjusted, by suitable means, to ensure vertical restraint.

The container shall have a test load of Ra - T applied horizontally to one sidewall. A similar test load of Ra - T may be applied downwards, simultaneously, to the top surface of the container base.

The test shall be repeated on the opposite sidewall unless the walls are identical.

4.3.2.2 Requirements: Throughout the tests, the maximum permitted lateral deflection of the container roof, with respect to the container base, shall not exceed 38 mm (1.5 in).

On completion of the test, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.3.3 Test No. 2.2 - 1D Container Only:

4.3.3.1 Procedure: The container shall be secured to the aircraft restraint system, or its equivalent, using only restraints in the fore and aft end slots, in accordance with Figures 6 and 7.

The container shall have a test load of Ra - T applied horizontally to one sidewall. A similar test load of Ra - T may be applied downwards, simultaneously, to the top surface of the container base.

The test shall be repeated on the opposite sidewall unless the walls are identical.

4.3.3.2 Requirements: Throughout the tests, the maximum permitted lateral deflection of the container roof, with respect to the container base, shall not exceed 38 mm (1.5 in).

4.3.3.2 (Continued):

On completion of the tests, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.4 Test Series No. 3 - Roof Strength: (Reference Figure 8B.)

4.4.1 General: These tests shall be carried out to prove the ability of the container roof to withstand the force imposed by persons working on it and to withstand the maximum operational load which may be experienced during air transportation.

4.4.2 Test No. 3.1:

4.4.2.1 Procedure: A load of 300 daN (660 lb) shall be uniformly distributed over an area of 600 mm x 300 mm (24 in x 12 in), located at the weakest area of the rigid container roof.

4.4.2.2 Requirements: On completion of the test, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.4.3 Test No. 3.2:

4.4.3.1 Procedure: The container shall be secured to the aircraft restraint system, or its equivalent. The container shall have a test load of Ra - T applied upwards to the underside of the roof.

The total number of restraint latches shall be as given in Table 2 and the latches shall be equally distributed between both sides and equally spaced along the full length of the container.

TABLE 2 - Total Number of Restraint Latches

Container Designation	Total Number of Restraint Latches
1 A	24
1 B	18
1 C	12
1 D	6

4.4.3.2 Requirements: On completion of the test, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing, and interchange shall be satisfied.

4.4.4 Test No. 3.3 - 1D Container Only:

4.4.4.1 Procedure: The container shall be secured to the aircraft restraint system, or its equivalent, using only restraints in the fore and aft end slots, in accordance with Figures 6 and 7. The container shall have a test load of Ra - T applied upwards to the underside of the roof.

4.4.4.2 Requirements: On completion of the test, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.5 Test Series No. 4 - Floor Strength: (Reference Figure 8C.)

4.5.1 Test No. 4.1 - Cyclic Loading:

4.5.1.1 General: This test shall be carried out to prove the ability of a container floor to withstand the concentrated dynamic loads imposed during cyclic loading operations by powered industrial trucks or similar devices.

4.5.1.2 Procedure: The test shall be carried out using a test vehicle equipped with tires, and loaded to an axle weight of 5460 kg (12 000 lb), that is 2730 kg (6000 lb) on each of the two wheels. The vehicle shall be positioned so that all points of contact between each wheel and the flat continuous surface lie within a rectangular envelope measuring 185 mm (7 1/4 in) (in a direction parallel to the axle of the wheel) by 100 mm (4 in), and so that each wheel makes physical contact over an area within this envelope of not more than 142 cm^2 (22 in^2). The wheel width shall be nominally 180 mm (7 in) and the wheel centers shall be nominally 760 mm (30 in).

The path of the test vehicle shall be patterned over the entire floor area of the container. One cycle is defined as the test vehicle entering the container, traveling its entire length along various paths and then leaving the container. This maneuver shall be repeated for 100 cycles. The test shall be made with the container supported on unidirectional and multidirectional conveyor systems, as described in ARP1334.

4.5.1.3 Requirements: On completion of the tests, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.5.2 Test No. 4.2 - Cyclic Endurance:

4.5.2.1 General: The test shall be carried out to prove the ability of the base structure to withstand the cyclic action of being moved along aircraft and ground mode conveyor systems.

4.5.2.2 Procedure: The container loaded to Ra - T, shall be placed on a system consisting of one half rollers and one half swivel castors (but not ball units), as described in 3.5.2.6. The maximum vertical displacement of system parts should be less than 0.76 mm (0.03 in).

4.5.2.2 (Continued):

The container shall be moved along the system over a distance not less than the container length and back to the starting position. This traverse cycle shall be repeated for 100 cycles at a mean velocity not less than 18.3 m/min (60 ft/min).

The drawbar pull shall be measured periodically at test speed or at breakaway.

4.5.2.3 Requirements: During the test, the maximum drawbar pull shall not exceed 3% of the maximum gross weight at test speed or 5% of the maximum gross weight at breakaway. The variation of drawbar pull from the first to the last cycle shall not exceed 0.5% of the maximum gross weight.

After the test, with the container still loaded to its maximum gross weight and resting on the conveyor system, the doors shall be fully opened and closed for three complete cycles. The doors shall open and close without jamming and the door-locks shall engage and disengage with ease.

On completion of these tests, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.5.3 Test No. 4.3 - Abrasion:

4.5.3.1 General: If the container base assembly is constructed from plastic coated or magnesium materials, prior to tests No. 4.1 and 4.2 an abrasion resistance test shall be conducted.

4.5.3.2 Procedure: Three samples of the container base assembly material shall be subjected to a test method equivalent to the United States Federal Test Method Standard No. 406, Method 1091, except that the abrasion wheel shall be dressed every 1000 cycles. A CS-10 wheel with a load of 500 g shall be used for all tests.

4.5.3.3 Requirements: The average weight loss shall not exceed the following values:

a. After 1000 revolutions: 0.015 g
b. After 2000 revolutions: an additional 0.005 g
c. After 5000 revolutions: an additional 0.030 g up to a total of 0.050 g

4.6 Test No. 5 - Weatherproofness: (Reference Figure 8C.)

4.6.1 Procedure: A stream of water shall be applied on all exterior joints and seams of the container from a nozzle of 12.5 mm (0.5 in) inside diameter, at a pressure of about 100 kPa (corresponding to head of about 10 m (33 ft) of water) on the upstream side of the nozzle. The nozzle shall be held at a distance of 1.5 m (5 ft) from the container, and the stream shall be directed at the container at a speed of 100 mm/s (4 in/s).

4.6.1 (Continued):

Procedures involving the use of several nozzles are acceptable, provided that each joint or seam is subjected to a water loading no less than that which would be imparted by a single nozzle.

4.6.2 Requirements: On completion of the test, no water shall have leaked into the container.

NOTE: It is recommended that this test be carried out last.

4.7 Test No. 6 - Bridging and Cresting: (Reference Figure 8D.)

4.7.1 General: This test shall be carried out to prove the ability of the container to move from one item of handling equipment to another, when the level of the conveyor surfaces are not in the same plane. At the point where the container balances on the end of the higher surface, the entire load is supported by one row of rollers.

4.7.2 Procedure: The container, loaded to its maximum gross weight Ra, with the center of gravity at the maximum limits shown in 3.3.2, shall be moved along a roller system compatible with the minimum requirements of ARP1334, and made to pass across a stepped junction with another similar roller system, with the height difference at the junction being not less than 150 mm (6 in).

The container shall be held at the balance point (cresting) on the edge of the higher platform for a minimum period of 5 s.

The rear end of the container shall then be allowed to drop from the higher platform onto the lower roller platform.

4.7.3 Requirements: On completion of the test, the container shall show neither permanent deformation nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

4.8 Test No. 7 - Base Restraint on Roller Bed Vehicles: (Reference Figure 8D.)

4.8.1 General: This test shall be carried out to prove the ability of the container to be transported on ground vehicles, incorporating roller beds, while being restrained by latches engaged in the container slots used for ground transport.

4.8.2 Procedure: The container shall be secured to a rigid base, using only latches, in accordance with Figure 7, engaged in the fore and aft ground transport end slots, as shown in Figure 2. The latches shall be adjusted, by suitable means, to ensure restraint and contact with the inner face of each outward slot.

4.8.2 (Continued):

The container shall have a test load of 0.33 Ra applied horizontally, in an inward direction, to each inner face on one of the outward slots. Simultaneously, a test load of 0.20 Ra shall be applied vertically, in an upward direction, to the container lower edge member in the opposite slot area. The test loads shall be applied to both ends of the container. The test shall be repeated in the opposite slots unless the slots and base sides are identical.

4.8.3 Requirements: On completion of the test, the container shall show neither permanent deformation, nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

PREPARED BY SAE SUBCOMMITTEE AGE-2A, CARGO HANDLING OF
COMMITTEE AGE-2, AIR CARGO AND AIRCRAFT GROUND EQUIPMENT AND SYSTEMS

APPENDIX A
SUPPLEMENTAL DESIGN REQUIREMENTS

A.1 INTRODUCTION:

The following is intended to supplement the basic design requirements laid down in Section 3. These requirements should be taken into consideration in order to provide serviceable, economical, and practical air mode containers.

A.2 CONTAINER ASSEMBLY:

A.2.1 The container shall be equipped with devices allowing the air to flow in or out for normal pressure equalization. These devices shall be constructed so as to prevent access to the contents.

A.2.2 The structural and operational integrity of the container shall be maintained in a temperature environment from -54 °C to +71 °C (-65 °F to +160 °F).

A.2.3 Material used in the manufacture of the container shall be capable of withstanding the environmental conditions experienced in air transport, airport ramp and terminals and ground transport on rollerized vehicles.

A.2.4 Container construction shall be free of any recesses or voids in which cargo (or other material) could be concealed.

A.2.5 In order to meet agricultural requirements, exterior and interior surfaces should be as free as possible of recesses, railings and protuberances, where pests could hide or where soil or other residues could accumulate.

A.3 CONTAINER BASE:

A.3.1 There shall be no sharp corners or edges on the base of the container.

A.3.2 The base bottom skin shall be enclosed by its edge rims.

A.3.3 The base should be structurally attached to the body by means of a minimum number of easily removable and interchangeable fittings.

A.3.4 The top of the base should be smooth to allow easy sliding of cargo and there shall be no voids or crevices where a considerable amount of dirt could accumulate. The construction shall allow for the efficient drainage of liquids used for cleaning the unit.

A.3.5 The base corners should be a 76.2 mm (3 in) radius in the plane of the panel. This requirement shall be carefully considered as a design objective while not compromising the door opening requirement of 3.2.3. Corners should be readily replaceable or shall be repairable.

A.4 DOORS:

A.4.1 It should be possible for one man to open and close the door in no more than 30 s. No tools should be required to open or close the doors or latches.

A.4.2 The door should have the minimum number of position latches and restraint attachments that will sustain the ultimate load (see 5.2.1) without unlatching or releasing the container contents.

A.4.3 Latches shall be located so that they cannot damage or be damaged by adjacent units should they inadvertently be left open or become open in flight.

A.4.4 It should be possible to lock (in order to discourage entry) and seal the door so that there shall be some visual indication of unauthorized entry.

A.4.5 Hinges shall be made and fitted so that doors cannot be lifted off the hinge pins, once shut. The screws, bolts, hinge pins and other fasteners shall be welded to the outer parts of the hinges, unless the closure system has locking devices, inaccessible from the outside which when applied, prevent the doors from being lifted off the hinge pins.

A.4.6 Handles, straps or handholds shall be provided on the door on the 1 D container to assist manual movement of the container. These devices should withstand a 445 daN (1000 lb) pull in any direction. They should provide an area equivalent to 152 mm wide by 76 mm deep (6 in x 3 in).

A.5 CUSTOMS SEALING:

According to the applicable international conventions, the container design shall provide the following characteristics and features for custom sealing approval:

A.5.1 The container shall be designed, constructed and equipped in such a manner that:

a. No goods can be removed from, or introduced into the sealed container without leaving obvious traces of tampering or without breaking the customs seal.

b. Customs seals can be simply and effectively affixed.

c. It shall contain no concealed space where goods may be hidden.

d. All space capable of holding goods are readily accessible for customs inspections.

A.5.2 In particular, the following design features shall be provided:

a. The constituent parts of the container (sides, floor, doors, roof, frames, etc.) shall be assembled either by means of devices which cannot be removed and replaced from the outside without leaving obvious traces, or by such methods as will produce a structure which cannot be modified without leaving obvious traces. When the sides, floors, doors, and roof are made up of various components, these shall meet the same requirements and be of sufficient strength.

b. Doors and all other closing systems shall be fitted with a device on which a customs seal can be fixed. This device shall be such that it cannot be removed and replaced from the outside without leaving obvious traces, nor can the door or fastening be opened without breaking the customs seal. The latter shall be adequately protected.

c. Apertures for venting and drainage, if provided, shall be provided with a device preventing access to the interior of the container. This device shall be such that it cannot be removed and replaced from the outside without leaving obvious traces.

APPENDIX B
OVERALL INTERNAL AND EXTERNAL DIMENSION AND TOLERANCES (See 3.2)

B.1 The nominal container lengths are given in Table B1.

TABLE B1 - Nominal Lengths

Freight Container Designation	Nominal Length m	Nominal Length ft
1A	12	40
1B	9	30
1C	6	20
1D	3	10

B.2 The minimum internal dimensions are given in Table B2.

TABLE B2 - Minimum Internal Dimensions

Freight Container Designation	Minimum Height	Minimum Width mm	Minimum Width in	Minimum Length mm	Minimum Length
1A				11 998	39 ft 4-3/8 in
1B	2197 mm			8 931	29 ft 3 -5/8 in
1C	(7 ft 2-1/2 in)	2330	91-3/4	5 867	19 ft 3 in
1D				2 802	9 ft 2-5/16 in

B.3 The external dimensions and tolerances are given in Tables 133 and B4.

TABLE B3 - External Dimensions and Permissible Tolerances (See Figure B1)

Freight Container Designation	mm	Tolerances mm	Length, L	Length, L Tolerances in	Width, W mm	Width, W Tolerances mm	Width, W ft	Width, W Tolerances in	Height, H mm	Height, H Tolerances mm	Height, H ft	Height, H Tolerances in
1A	12 192	0 -10	40 ft	0 -3/8	2438	0 -5	8	0 -3/16	2438	0 -5	8	0 -3/16
1B	9 125	0 -10	29 ft 11-1/8 in	0 .3/8	2438	0 -5	8	0 -3/16	2438	0 -5	8	0 -3/16
1C	6 058	0 -6	19 ft 10-1/2 in	0 -1/4	2438	0 -5	8	0 -3/16	2438	0 -5	8	0 -3/16
1D	2 991	0 -5	9 ft 9-3/4 in	0 .3/16	2438	0 -5	8	0 -3/16	2438	0 -5	8	0 -3/16