SAE Aerospace
An SAE International Group

AEROSPACE INFORMATION REPORT

SAE AIR36107	REV. A
Issued 2006-02	
Stabilized 2011-11	
Superseding AIR36107	

AS36100 Background and Development

RATIONALE

This document constitutes a record of past research and discussions, to be kept available in order to be taken into account when elaborating any future revisions of AS36100. As a record, it is not open to change, therefore is classified as stabilized.

STABILIZED NOTICE

This document has been declared "Stabilized" by the AGE-2 Technical Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE

1.1 Purpose

1.1.1 This SAE Aerospace Information Report (AIR) provides a record of the development by SAE AGE-2A Air Cargo Sub-Committee of Aerospace Standard AS36100, Air Cargo Unit Load Devices - Performance Requirements and Test Parameters, published 2005-02, intended as a technical reference for airworthiness approval of air cargo unit load devices (pallets, nets and containers) to be loaded with either baggage or freight on board civil transport aircraft, and to partly supersede previously used NAS 3610, Cargo unit load devices - Specification for - [Revision 10, 1990, referenced in TSO C90c].

1.1.2 AS36100 was developed over a 5 year period (1999-2004) by a Panel of SAE AGE-2A designated as "NAS 3610 Oversight Panel" (OSP), based on a worldwide industry consensus that NAS 3610, used since 1969 as technical reference for TSO C90c, had become largely obsolescent, not properly understood by many of its users, and still contained errors while document sponsor AIA stated they were not going to update or revise this document. This consensus was initially reached at the International Standardization Organization (ISO) TC20/SC9, Air Cargo Sub-Committee meeting Nr 29 (1998, Memphis, TN), which hence agreed to prepare a corrigendum (published 2000) to ISO 8097 (based on NAS 3610), and to entrust SAE AGE-2A, on behalf of the industry, with identification of the needs for a replacement document. AGE-2A in 1999 created the OSP, which undertook a systematic review of the air cargo industry's actual requirements and the step by step development and discussion of AS36100.

1.1.3 The scope of the OSP work, thus the present AIR, also included other documents - some of which existed, some of which were subsequently developed - associated with AS36100 or supplementing it, covering such other areas as continued airworthiness requirements, design and testing methods, unit load devices design specifications and accessories, and rules for their proper operation/utilization and operating staff training. A list of the identified areas is provided under AS36100 para 1.1. See 2.1 hereafter for other associated documents concerned.

1.2 Field of Application

1.2.1 The present AIR is intended to provide future users of AS36100, including Airworthiness Authorities, unit load devices designers, purchasers and operators as well as civil transport aircraft and aircraft cargo systems designers within the industry, with the background and rationales of the requirements and parameters retained therein, in order to achieve full understanding of the technical justifications for these requirements.

1.2.2 In the same way, it is intended to provide AGE-2A members with means to re-examine provisions of AS36100 for future revisions resulting from operational experience or the evolutions of industry needs, while keeping track of the originally retained rationales.

1.2.3 It is intended such revisions will be evaluated by the AGE-2A permanent Airworthiness Panel established to continuously monitor AS36100 and the associated documents, and their rationales documented and recorded at that time.

2. REFERENCES

2.1 Reference Documents

2.1.1 The publications listed herein were duly taken into consideration when developing AS36100. When referring to them, the latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of publication of AS36100 (2005-02) or its latest revision. Nothing in these documents, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.2 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org

AS33601 Track and Stud Fitting for Cargo Transport Aircraft, Standard Dimensions For

AS36100 Air Cargo Unit Load Devices - Performance Requirements and Testing Parameters

AS36101 Air Cargo Unit Load Devices - Load Distribution Model

AS36102 Air Cargo Unit Load Devices - Test Methods

ARP36103 Air Cargo Unit Load Devices - Center of Gravity Control Methods

ARP36104 Air Cargo Pallets and Nets Compatibility

AIR36105 Air Cargo Unit Load Devices - Reference Standards [Bibliography]

AIR36106 Air Cargo Unit Load Devices - Use of Airworthiness Reference Standards

NOTE: No revision number is indicated. Check the latest published revision number on the SAE web site.
Numerous other unit load device related SAE documents may also be concerned: see AIR36105.

2.1.3 U.S. Government Publications

Available from U.S. Government Printing Office, Mail Stop SSOP, Washington DC 20402-9325, www.airweb.faa.gov/rgl

Title 14 CFR (FAR) Part 21 - Certification Procedures for Products and Parts, Subpart O - Technical Standard Order Authorizations

FAA Technical Standard Order (TSO) C90 - Cargo Pallets, Nets and Containers

Title 14 CFR (FAR) Part 25, Airworthiness Standards: Transport Category Airplanes

2.1.4 European Union Publications

Available from European Aviation Safety Agency, Otto Platz 1, Koln Deutz, Postfach 101253, D-50452 Cologne, Germany, www.easa.eu.int

EASA CS-ETSO, Certification Specifications for European Technical Standard Orders

European Technical Standard Order (ETSO) C90 - Cargo Pallets, Nets and Containers

EASA CS-25, Certification Specifications for Large Aeroplanes

2.1.5 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org

NAS 3610, Cargo unit load devices - Specification for - [Revision 10, 1990, referenced by TSO C90c]

2.1.6 International Standards

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org, or International Organization for Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org, or any of the national Standards Institutes worldwide, Members of ISO.

ISO 7166 Aircraft - Rail and stud configuration

ISO 8097 Aircraft - Minimum airworthiness requirements and test conditions for certified air cargo unit load devices [4th edition, 2001, referenced by ETSO C90c]

ISO 9788 Air cargo equipment - Cast component of double-stud fitting assembly with a load capacity of 22 250 N (5 000 lbf) for aircraft cargo restraint

ISO 11242 Aircraft - Pressure equalization requirements for cargo containers

ISO 21100 Air cargo unit load devices - Performance requirements and testing parameters [in preparation, ETSO pending]

2.1.7 IATA Publications

IATA standard specifications concerning air cargo unit load devices were taken into consideration, and are published in the IATA Unit Load Devices Technical Manual (UTM), available from International Air Transport Association, Publications Assistant, 800 Place Victoria, P.O. Box 113, Montreal, Quebec H4Z 1M1, Canada, Tel: 1-514-874-0202, www.iata.org

2.2 Terms and Definitions

For the purposes of the present AIR and listed documents, the following terms and definitions apply unless otherwise defined in the document:

CIVIL TRANSPORT AIRCRAFT: An aircraft, type certificated under 14CFR Part 25 or EASA CS-25, operated for civil commercial transport of passengers or freight, and capable of carrying air cargo unit load devices for baggage or freight.

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.

INSTALLATION: The fact of installing a unit load device for flight into an aircraft's cargo compartment and restraint system.

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

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 or straps 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): Device for grouping, transferring and restraining cargo for transit. It may consist of a pallet with a net or it may be a container.

UTILIZATION: All actions pertaining to operational use of a unit load device, including inspection, build-up, securing, ground transport, loading, and installation aboard aircraft.

3. AS36100 BACKGROUND INFORMATION

The information hereafter is provided in order to identify the background and rationale for each item concerned in AS36100. It is given in the sequence and numbering system of this document to indicate the source or decision process for each item.

An **[X-X]** index cross-refers for each item to the appropriate Minutes of the successive meetings, reproduced as Annexes to this AIR and where the same [X-X] index can be found. Annexes, one per meeting, are numbered from 1 through 11. The meetings Minutes are identified by codes M1, M2, M3, etc., and the attached work documents are designated as e.g., 1A, 1B, 1C, for meeting / Annex 1, etc.

3.1 General Requirements Part [AS36100 § 1 to 6]

Framed numbering refers to the relevant paragraphs of AS36100, in the document's sequence.

General It was agreed AS36100 was to retain, inasmuch as possible, NAS 3610 wording verbatim in order to facilitate TSO compatibility. AS36100 adds to NAS 3610 certain requirements where justified by experience **[M2-01]**.

Title See [M3-01].

1. No "9g" (type 1) ULD type was retained for AS36100, the ULD types of which are based on the established or foreseen 21st century air cargo market **[M1-01] [1A-01] [4B-01]**.

1.1 For all other aspects not included in AS36100, see bibliography (industry standards, not regulatory approved) in AIR36105 **[M4-04] [6G-01]**.

1.2 The 2nd sentence was agreed **[M5-02]** to clarify and avoid interpretation ambiguities in the former NAS 3610, which was often misconstrued by users for an aircraft systems design standard while it exclusively addresses ULD approval criteria. Also see **3.3** **[M10-01]** for more detailed clarification of ULD testing restraint conditions versus aircraft actual restraint cases.

The 3rd and 4th sentences were agreed to clarify the respective fields of application of AS36100 and maintained NAS 3610. ULD types not covered in AS36100, including all "9g" (type 1) ULDs, will still have to be approved in reference to NAS 3610.

NOTE: Cargo covers, except where a net is incorporated, are defined only from the fire protection perspective in 14CFR Part 25 Appendix F Part I (a)(2)(iv), and not deemed to be part of a unit load device except where they are permanently attached to a net. If a net is permanently attached, the performance and testing requirements applicable to the net as shown in the AS, plus 14CFR Part 25 Appendix F requirements, are applicable to the net/cover assembly. If no net is permanently attached, see applicable industry guidelines in ARP5486.

2.1.1 The Panel agreed that only U.S. Government (CFR) references would be included in AS36100. Foreign (European, Japanese) applicable references are listed in the equivalent International Standard ISO 21100.

2.1.2 For AS33601 (former MS 33601B) applicability and its equivalence with ISO 7166, see **[M6-02]** and **[6D-01]**. By convention, in order to reduce updating requirements, the current document revision letters are not provided and are to be checked on the SAE web site prior to reference.

3.1 Types 1 and 2 definitions wording is based on 14CFR 25.561: see **[M8-01]**, **[M9-01]**. For decision background on deleting type 1 "9g" units from AS36100, see **[M1-01]**, **[1A-01]**, **[4B-01]**, **[M6-01]**, **[6E-01]**, **[M9-01]**.

3.2 The selection of ULD sizes retained in AS36100 was based on established or foreseen air cargo market needs **[1A-01] [4B-01]**. Sizes not previously included in NAS 3610 are:

- sizes **N** and **S**: “half-size” units increasingly used by express cargo operators.

NOTE: Size S is 88x61.5” nominal. Where 88x62.5” units are used, it was agreed they could and should be approved as a TSO deviation under base size S parameters (see **UC S1** hereafter).

- sizes **P** and **Q**: widely used on B767 aircraft as non-certified containers only (see AS1677). Boeing perceives a potential need for certified (airworthiness approved) units of the same base size **[1A-01] [4B-01]**.

As to dimensions, it was agreed **[M3-02] [M4-01] [7B-01]** all dimensions and loads be given in metric units first with inch-pound units between brackets, as per SAE TSB-003 rules.

3.3 The last paragraph was added **[M10-01]** to clarify and avoid interpretation ambiguities in the former NAS 3610, which was often misconstrued by users for an aircraft systems design standard while it exclusively addresses ULD approval criteria. ULD restraint configurations shown in AS36100 Section 8 are for standardized ULD testing only. Aircraft cargo systems may be quite different, as dictated by aircraft design constraints and applicable aircraft local load factors. It is up to the airframer to determine (on the basis of the ULD's maximum capability determined in accordance with the AS) the criteria (maximum gross mass, maximum allowable C.G. deviation, others) to be met at any ULD position on the aircraft, and publish them in the airworthiness Authority approved Weight and Balance Manual, sole source for limitations to be applied by the operators. Also see general statement in **1.2** **[M5-02]**.

NOTE: "airframer", in the context of AS36100, designates the entity responsible for preparing and publishing the approved Weight and Balance Manual for the aircraft, which may be either:
- the Original Equipment Manufacturer holding the aircraft's Type Certificate (TC), or
- a Supplemental Type Certificate (STC) holder.

In either case, the Weight and Balance Manual defines the airworthiness Authority approved methods and parameters of installation of unit load devices on board the aircraft type or sub-type concerned.

3.5 The AS36100 ULD configuration codes were assigned in order to differentiate from former NAS 3610 ULD configurations where a difference exists. The same codes were used where ULD geometrical configuration, ultimate load criteria and test restraint conditions are identical. Thus configuration codes are non ambiguous and determine the maximum allowable capabilities for the so marked ULD, whether approved under AS36100 or former NAS 3610. See **7.2** **[4B-01] [M9-03]**.

4.4 For AS33601 (former MS 33601B) track and stud applicability and its equivalence with ISO 7166, see **[6D-01]**. ISO 9788 defines a modified geometry double stud fitting that is capable of higher 22,250 N (5,000 lb) omni-directional ultimate load when installed in an AS33601 (ISO 7166) aluminium alloy track. Though this ultimate load level is not normally required for double stud fittings used in ULD (nets) construction, using ISO 9788 double stud fittings remains allowable per excess as an alternate to AS33601 fittings **[M6-01]**.

4.5 The marking requirements were reproduced without change from TSO C90c wording **[M8-04]**.

4.7 The fire protection requirements applicable to ULD materials are specified in accordance with 14CFR Part 25 Appendix F, implying its latest published amendment, to be checked at the time of ULD approval. The applicable one currently is Amdt. 25-111, effective 2003-09-02.

4.8 The rapid decompression requirements are defined in NAS 3610 (TSO C90c) only as a general objective to be met. ISO 11242 provides detailed guidelines as to parameters to be met and the various allowable methods, particularly including:

- normal flight pressure balancing and emergency (rapid decompression) parameters,
- minimum venting area requirements in either case in relation with container internal volume,
- possibilities of using container door seal areas as part of the required minimum venting area.

4.9 Unspecified tolerances were determined in accordance with the metric usage for metric dimensions, and NAS 3610 for dimensions in inches. See **[M7-03]** and **[7E-01]** for conversion details. It is essential to note that, where tolerances are otherwise noted in the configuration or restraint drawings, these supersede the general unspecified ones in this paragraph. Particularly, all ULD bases dimensions have a (+ 0 / - x) tolerance, not a (± x) tolerance interval, in order to avoid the risk of jamming in aircraft restraint systems.

NOTE: Since AS36100 is intended as a ULD type approval reference document, the tolerances stated, whether unspecified or specified, are intended to apply to new units being tested. Tolerances for in-service units are not necessarily identical, where the approved Weight and Balance Manual for a given airplane type differently allows. However, the specified ULD bases dimensions tolerance intervals were determined taking into account industry experience to provide reasonable allowances for in-service wear, assuming the new unit was delivered at or close to the maximum allowable dimension.

4.10.1 Section 7 ULD configuration drawings all note where certain ultimate loads are to be considered as acting simultaneously (i.e., horizontal load in combination with a specified down load). These load combinations are identical to those in NAS 3610 for the same ULD sizes, based on the Oversight Panel agreed principle not to introduce a technical change from former approval criteria unless specifically required by available evidence or experience.

4.10.2 The general tolerances specified in **4.9** apply to all Section 8 restraint conditions figures where applicable tolerances are not otherwise explicitly defined.

4.10.3.2 See **4.4** **[6D-01]** for identity of AS33601 (former MS 33601B) and ISO 7166 track and stud and clarification of ISO 9788 double stud fitting's different geometry/capability.

4.10.3.3 Note that specified 8,900 N (2,000 lb) and 17,800 N (4,000 lb) omni-directional ratings are minimum ultimate strength requirements, supported by experience with aluminium alloy track and steel stud meeting AS33601/ISO 7166, respectively in the single stud and double stud cases. This does not preclude using higher performance items, e.g., ISO 9788 double stud fittings with a 22,250 N (5,000 lb) demonstrated ultimate capability **[6D-01]**.

4.10.3.4, **4.10.3.5** See **4.10.3.3**.

4.10.4 For background on minimum base area load capability (not required in NAS 3610), see **[M3-05]**, **[M5-01]**, **[6B-01]**. Note the minimum 10 kPa (209 lb/ft²) requirement applies to sizes A, B, K, L, M, N, P, Q and S. Sizes G and R have a minimum requirement of 20 kPa (418 lb/ft²).

For background on minimum ULD base edge vertical EI value (not required in NAS 3610), see **[7C-01]**, **[10E-01]**, **[M10-02]**.

For background on base edge profiles rounding or chamfer (not required in NAS 3610), see **[M7-01]**, **[M8-02]**, **[M9-02]**.

4.11 For discussion of references for environment and particularly U.V. degradation protection requirements, see **[M7-02]**. Currently available references are ISO TR 8647 and AIR1490C. However, they do need updating, and an ISO TC20/SC9 research project is underway to develop a standardized U.V. degradation testing method with calibrated and reproducible results. While this is not yet available, it was determined current documents, which provide only guidelines, should be left out of AS36100. Reference to a standardized testing method is intended to be added once available **[8B-01]**.

5.1 *"Tests and / or analysis"* as per NAS 3610 (TSO C90c). Numeric simulation added due to modern technologies development, with a definition including validation requirements added under **2.2**. See **[4C-01]**.

5.3 Dynamic testing was discussed but deemed both more realistic versus in-flight conditions and more difficult to achieve in a reproducible manner, thus static testing was kept as per NAS 3610 (TSO C90c). For background on ultimate load application duration, see **[M6-03]**: it was agreed to require the 3 seconds minimum duration defined in 14CFR 25.305 (b).

5.4 For an industry agreed definition of "discharging its contents", see AS36102, *ULD Test Methods*, which provides full details not included in AS36100. The agreed standard definition of "contents" for this purpose is a 600x400x250 mm (24x16x10 in) box **[M8-06]**. **[M8-08]**. **[M10-05]** **[10D-03]**.

The second sentence's "..*shall be based on yield stress values for the materials concerned*" was questioned **[11E-01]** at the end of the ballots, due to:

- yield strength being in principle more related to limit loads as defined in 14CFR 25.301, while the AS, same as NAS 3610, is based on ultimate loads (including factor of safety) more related to breaking strength **[M10-04]**,

- some aluminium alloys used do not yield like ductile steel, but go steadily to failure. Also, other materials (e.g., composites) increasingly used do not have a yield point at all.

It was thus decided **[M11-03]** to delete this wording at the first revision of AS36100.

6.1 For definition of type 2 aircraft cargo compartments the specified ULDs are exclusively intended for, see **1** and **3.1**.

6.2 Maximum gross weights (MGW) for the relevant unit load devices are not provided in AS36100, as they were not provided either in NAS 3610 since its Rev. 3 [referenced by TSO C90a]. The document specifies, and approval guarantees, only ultimate load capacities in defined restraint conditions, which airframers will use in order to determine the MGW allowable on any given aircraft position based on the certified local load factors applicable at that position (see aircraft Weight and Balance Manual) **[M8-05]**.

3.2 ULD Configurations (UC) Part [AS36100 § 7]

7.2 ULD configuration codes (see **3.5** and NOTE to Table 1) were assigned in order not to be ambiguous versus NAS 3610 configuration codes, i.e., the same code is used only where the same ultimate loads, C.G. eccentricities and testing restraint condition exist **[4B-01] [M9-03]**.

UCs layout In order to reduce the complexity of using previous NAS 3610, it was decided to combine into a single sheet (designated ULD configuration, UC) the minimum geometrical and dimensional requirements together with the ultimate loads and C.G. eccentricity requirements (former NAS 3610 load conditions, LC), and identification of the applicable testing restraint condition (RC) **[M4-02]**.

General The following additional details not previously in NAS 3610 are applicable to all AS36100 ULD configurations:

- minimum base area load requirement of 10 kPa (209 lb/ft^2), except for sizes G and R (high stiffness "heavy duty" base) 20 kPa (418 lb/ft^2), consistent with aircraft floors capabilities **[M3-03] [M5-01] [6B-01]**.

- C.G. height for containers and nets limited to 55% (+10% deviation) of ULD's maximum overall contour height, in order to avoid having e.g., to test at 48 in (+25% deviation) C.G. height a 63 in or less high lower deck dedicated container or net **[M9-08] [10B-04]**. Also see ULD C.G. control methods for C.G. height in ARP36103.

- base edge thickness (not specified in NAS 3610 except sizes K and L, or only indirectly as 32 mm (1.25 in) maximum through restraint Figures) specified as 19.6 mm (0.77 in) minimum / 25.4 mm (1.00 in) maximum, same as NAS 3610 UC 2K2 / 2L2. The 19.6 mm (0.77 in) minimum was retained versus the 12.7 mm (0.50 in) nominal in NAS 3610 UC 2G1 and 2R1, for consistency with sizes K / L and additional protection against in service wear.

- minimum container base periphery recess height (unspecified in NAS 3610 except sizes K and L) specified as 63.5 mm (2.50 in) for all sizes, not 53.8 mm (2.12 in) as in NAS 3610 UC 2K2 / 2L2, due to documented reports of interference of such containers when deformed with the top of aircraft side restraints. Increasing this dimension was deemed an airworthiness issue in the interest of enhanced flight safety **[M8-07] [M9-04]**.

NOTE: 63.5 mm (2.50 in) of course remains a minimum value defined for airworthiness purposes, and many industry design standards currently specify a higher recess on containers for operational reasons.

- continuous AS33601 track all around, which is common practice in the industry, optional on all pallets, except UC K4 and L6 where conditions of restraint without vertical restraint on the long sides of the base dictate precise net fittings locations in order to guarantee airworthiness. This results in some instances in the necessity to adjust net fitting locations to an integer number of inches **[M9-06]**. The minimum distance between base edge and track centreline, not specified in NAS 3610, was deemed a potential airworthiness issue due to reports of interference with aircraft restraints, hence specified at 41 mm (1.62 in) as per IATA SS 50/1 and industry practice.

UC A7 Initially based on NAS 3610 UC 2A6 (2A1 for nets, with 18 double stud fittings only), with ultimate load condition (LC) 18 under restraint condition (RC) 7 described by Figure 8.

NAS 3610 LC 18's C.G. eccentricities of ±14.4% / ±21.4% were found to be both excessive and impossible to reach in practice (loading simulations), hence never used by the airlines. It was, therefore, agreed to specify only ±10.0%, thus making the UC's loads in effect identical to NAS 3610 LC 32 (added at Revision 7 of NAS 3610 in 1983 [referenced in TSO C90b] but applicable to size M only, though in the same RC) **[3A-01] [M5-04]**.

It was then agreed **[M4-03]** to identify the worst testing case under those conditions in order to define the corresponding testing restraint condition (RC A), aiming at defining a single (hence bi-directional) worst testing case. This was found **[5B-01]** to be NAS 3610 RC 11-12 (Figure 13, with 635 mm / 25 in restraints spacing instead of 511 mm / 20.125 in in RC 7, Figure 8) but with NAS 3610 LC 32 ultimate loads instead of lower LC 14's .This resulted in RC A, intended as a single worst case restraint configuration, being defined with 3 restraints on the small sides (per NAS 3610 RC 7, Figure 8) and 5 equally spaced restraints on the long sides (per NAS 3610 RC 11-12, Figure 13). This RC was approved in AS36100's 9th draft, subsequently approved by AGE-2A ballot **[M5-04] [5B-01]**.

However, it was then found that another testing case, intended for lower deck, had been overlooked **[5B-01]**, i.e., NAS 3610 LC 8 (about 60% of the ultimate loads of LC18/32) under RC 9, Figure 9, with only 4 restraints on the long sides and a central 1270 mm (50 in) unrestrained span. Due to this gap, the upward bending moment in the central part of the ULD is in this case higher than with 5 restraints, even with the higher LC 18/32 ultimate load **[11G-01]**.

After considering various options, it was agreed **[M11-01] [11B-01] [11G-02]** that RC A would be changed to only 4 restraints on the long sides with a central 1270 mm (50 in) unrestrained gap, same as NAS 3610 RC9 / Figure 9, while keeping the ultimate loads of UC A7 unchanged (i.e., same as NAS 3610 LC 18/32): this combined the two separate worst testing cases into a desired single testing arrangement, thus was effectively a worst testing case.

A poll of participating ULD manufacturers **[11H-01]** indicated there was no evidence of a substantial ULD weight increase to result from such more stringent testing. Accordingly, the so revised RC A was approved **[M11-01]** in AS36100's 11th and last draft, then approved by AGE-2A and AGE-2 ballot. UC A7 as published is, therefore, based on this RC A testing arrangement.

UC B7 Based on NAS 3610 UC 2B5 (with 18 double stud fittings as in 2B6 instead of single stud in 2B5, due to increased durability at lesser cost), with ultimate load condition (LC) 16 under restraint condition (RC) 7 described by Figure 8 **[M9-05] [9B-01]**.

NAS 3610 LC 16's C.G. eccentricities of ±14.4% / ±21.4% were found to be both excessive and impossible to reach in practice (loading simulations), hence never used by the airlines. It was, therefore, agreed to specify only ±10.0% **[3A-01] [M5-04]**.

The retained corresponding testing restraint condition is RCA as ultimately decided (see detailed background in **UC A7** above) **[M11-01]**.

UC G1 Identical to NAS 3610 UC 2G1, with ultimate load condition (LC) 19 under restraint condition (RC) 24 described by Figure 31. UC designation code kept, since identical to NAS 3610.

Optional continuous track added as currently practiced on most pallets: NAS 3610 fittings spacing adjusted (9.32 in to 8.00 in, 15.43 in to 16.00 in, 17.02 in to 17.00 in) accordingly, since spacing has to be an integer number of inches **[M9-07] [10B-03]**. The minimum distance between base edge and track centreline was specified at 47 mm (1.85 in), higher than the 41 mm (1.62 in) retained for other UCs (see **General** above) in order to ensure compatibility with side restraints **[M9-06] [10B-02]**.

Edge details not affecting airworthiness or performance also adjusted to reflect current practice: edge thickness 12.7 mm (0.50 in) nominal changed to 12.7 mm (0.50 in) minimum / 25.4 mm (1.00 in) maximum, same as NAS 3610 UC 2R1, in order to minimize wear and ensure compatibility with aircraft vertical restraints **[M7-04] [M8-03]**.

Minimum pallet thickness, previously unspecified by NAS 3610, added as 50.8 mm (2.00 in) **[7B-02]**, consistent with industry practice and min. area load requirement of 20 kPa (418 lb/ft^2).

UC K4 Based on NAS 3610 UC 2K2 (containers) / 2K3 (pallets and nets), with the following changes (in addition to those applicable to all UCs):

Combination of 2K2 / 2K3 into a single UC applicable to containers, pallets, nets (reminder: container contours are not defined either in NAS 3610 or AS36100, since not directly pertaining to airworthiness requirements: see **6.3**).

Ultimate load condition in accordance with NAS 3610 LC 30 applicable to UC 2K2 / 2K3, but with increased side loads identical to fore and aft ones. This is due to more recent aircraft types presenting at certain locations higher side loads than had been assumed in former NAS 3610, thus possibly resulting in lower allowable MGW at such positions **[M7-05] [8B-02]**. It also meets the agreed target of a single, omni-directional, testing condition (see RC K). UC code hence changed to K4 in order to differentiate from 2K2 / 2K3 and reflect the different side loads condition.

C.G. height limitation to 55% of maximum contour height (see **General** above) maintained for containers, but not for nets, due to the possibility of a nominally 45 in high full contour net to IATA code NKH also being used in a 63 in high half-width contour to code NKE, where maximum C.G. height of 34 in applies **[M9-09] [10B-04]**.

Deletion of UC 2K2 local restraint slots, with previously optional, though universally used, continuous recess all around container base periphery becoming standard.

Minimum container base periphery recess height specified as 63.5 mm (2.50 in), not 53.8 mm (2.12 in) as in NAS 3610 UC 2K2, due to documented reports of interference of such containers when deformed with the top of aircraft side restraints (see **General** above). Increasing this dimension was deemed an airworthiness issue in the interest of enhanced flight safety **[M8-07] [M9-04] [10B-01]**.

UC L5 Based on NAS 3610 UC 2L2 (containers) / 2L3 (pallets and nets), with the following changes (in addition to those applicable to all UCs):

Combination of 2L2 / 2L3 into a single UC applicable to containers, pallets, nets (reminder: container contours are not defined either in NAS 3610 or AS36100, since not directly pertaining to airworthiness requirements: see **6.3**).

Ultimate load condition in accordance with NAS 3610 LC 31 applicable to UC 2L2 / 2L3, but with increased side loads identical to fore and aft ones. This is due to more recent aircraft types presenting at certain locations higher side loads than had been assumed in former NAS 3610, thus possibly resulting in lower allowable MGW at such positions **[M7-05] [8B-02]**. It also meets the agreed target of a single, omni-directional, testing condition (see RC L). UC code hence changed to L5 in order to differentiate from 2L2 / 2L3 and reflect the different side loads condition.

C.G. height limitation to 55% of maximum contour height (see **General** above) not kept for either containers or nets, all known ULDs of L size having a 63 to 64 in maximum contour height, where maximum C.G. height of 34 in applies.

Deletion of UC 2L2 local restraint slots, with previously optional, though universally used, continuous recess all around container base periphery becoming standard.

Minimum container base periphery recess height specified as 63.5 mm (2.50 in), not 53.8 mm (2.12 in) as in NAS 3610 UC 2L2, due to documented reports of interference of such containers when deformed with the top of aircraft side restraints (see **General** above). Increasing this dimension was deemed an airworthiness issue in the interest of enhanced flight safety **[M8-07] [M9-04]**.

UC L6 Based on NAS 3610 UC 2L4 (pallets and nets), with the following changes (in addition to those applicable to all UCs):

Ultimate load condition in accordance with NAS 3610 LC 31 applicable to UC 2L4, but with increased side loads identical to fore and aft ones. This is due to more recent aircraft types presenting at certain locations higher side loads than had been assumed in former NAS 3610, thus possibly resulting in lower allowable MGW at such positions **[M7-05] [8B-02]**. It also meets the agreed target of a single, omni-directional, testing condition (see RC L). UC code hence changed to L6 in order to differentiate from 2L4 and reflect the different side loads condition.

C.G. height limitation to 55% of maximum contour height (see **General** above) not kept for nets, since all known nets of L size have a 63 to 64 in maximum contour height, where maximum C.G. height of 34 in applies.

NOTE: NAS 3610 UC 2L4 (pallets and nets) was kept as a separate UC L6, due to its inherently different configuration and testing parameters. This was the sole case where it was found impossible to combine all NAS 3610 UCs into a single one, because actually different ULD types are in service. Reminder: in order to withstand tests without vertical restraints on the fore and aft sides, the 2L3/L5 pallet must be of a very stiff and thick construction, whereas the 2L4/L6 one remains thin and light while meeting the tests through specified load limited net attachments on the long (fore and aft) sides.

UC M2 Based on NAS 3610 UC 2M2 (pallets and nets) / 2M3 (containers and pallets), with the following changes (in addition to those applicable to all UCs):

Combination of 2M2 / 2M3 into a single UC applicable to containers, pallets, nets (reminder: container contours are not defined either in NAS 3610 or AS36100, since not directly pertaining to airworthiness requirements: see **6.3**).

Ultimate load condition in accordance with NAS 3610 LC 32 applicable to UC 2M2, with the same ±10% C.G. eccentricities. Since ULD configuration, ultimate loads and C.G. eccentricities are identical to NAS 3610 2M2, designation M2 was kept for this AS36100 UC.

NOTE: However, subsequent changes in AS36100 testing restraint configuration RC A made it substantially different from that of NAS 3610 (restraint condition (RC) 7 described by Figure 8). Therefore, performance criteria are not entirely identical, which would justify changing the UC designation to M4 in order to differentiate from NAS 3610 UC 2M2. To be addressed at the first revision of AS36100 if current RC A is kept.

The retained corresponding testing restraint condition is RCA as ultimately decided (see detailed background in **UC A7** above) **[M11-01]**.

UC N1 New ULD size and configuration, not previously in NAS 3610, agreed **[7B-03]** to be needed by the air cargo market, particularly express cargo airlines. A significant number of STC approved units were built, principally for use on B767, while the unit can physically be carried on the lower deck of most other wide-body aircraft and the main deck of some. TSO approval will allow unlimited carriage where appropriate aircraft restraint systems exist.

Since the unit is half an M size, the ultimate load condition and testing restraint condition (RC N) defined are half those of UC M2.

UC P1 New ULD size and configuration (containers only), previously in service only as a non-certified (LD2) container (AS1677, ISO 4118), principally on B767s. Boeing determined there would be identifiable advantages for certain airlines to order certified rather than non-certified units, which further seem likely to be required on future transport aircraft types.

The ULD configuration, ultimate load condition and testing restraint configuration (RC P) were proposed by Boeing, consistent with the B767 Weight and Balance Manual, and agreed but with increased side loads, identical to fore and aft ones **[M7-05] [8B-02]**, for the same reasons as other dedicated lower deck sizes (see UCs K, L, Q).

C.G. height limitation to 55% of maximum contour height (see **General** above) not kept, for it applies only to 64 in high lower deck containers where 34 in maximum C.G. height applies.

UC Q1 New ULD size and configuration (containers only), previously in service only as a non-certified (LD4-LD8) container (AS1677, ISO 4118), principally on B767s. Boeing determined there would be identifiable advantages for certain airlines to order certified rather than non-certified units, which further seem likely to be required on future transport aircraft types.

The ULD configuration, ultimate load condition and testing restraint configuration (RC P) were proposed by Boeing, consistent with the B767 Weight and Balance Manual, and agreed but with increased side loads, identical to fore and aft ones **[M7-05] [8B-02]**, same as size P.

C.G. height limitation to 55% of maximum contour height (see **General** above) not kept, for it applies only to 64 in high lower deck containers where 34 in maximum C.G. height applies.

UC R1 Identical to NAS 3610 UC 2R1, with ultimate load condition (LC) 19 under restraint conditions (RC) 24, 27 or 28 described by Figure 31 (lengthwise, side-locked), 36 and 37 (cross-wise, end-locked). UC designation code kept, since identical to NAS 3610.

NOTE: AS36100 RC G is identical to NAS 3610 RC 24 (Figure 31). NAS 3610 RC 27/28 (Figure 36/37) were combined into a single RC R, but it was agreed this does not significantly differ from either Figure 36 or Figure 37 in terms of testing performance, so that the testing restraint conditions remain in fact the same. With all other requirements identical, the same UC designator can thus be kept.

Optional continuous track added as currently practiced on most pallets: NAS 3610 fittings spacing adjusted (9.37 in to 8.00 in or 10.00 in, 15.43 in and 16.11 in to 16.00 in) accordingly, since spacing has to be an integer number of inches **[M9-07] [10B-03]**. The minimum distance between base edge and track centreline was specified at 47 mm (1.85 in), higher than the 41 mm (1.62 in) retained for other UCs (see **General** above) in order to ensure compatibility with side restraints **[M9-06] [10B-02]**.

Minimum pallet thickness, previously unspecified by NAS 3610, added as 50.8 mm (2.00 in) **[7B-02]**, consistent with industry practice and min. area load requirement of 20 kPa (418 lb/ft^2).

UC S1 New ULD size and configuration, not previously in NAS 3610, agreed **[7B-03]** to be needed by the air cargo market, particularly express cargo airlines. A significant number of STC approved units of this or very similar size were built, while the unit can physically be carried on the lower deck of all wide-body aircraft and the main deck of some. TSO approval will allow unlimited carriage where appropriate aircraft restraint systems exist.

Since the unit is half an A size, the ultimate load condition and testing restraint condition (RC N) defined are half those of UC A7.

NOTE: Discussion took place between the "half-size" S1 as defined (88x61.5 in nominal base size) and the "demi" size also used by certain airlines for containers (88x62.5 in nominal base size). S1 size was retained because it is readily compatible with standard existing aircraft restraint systems, while the "demi" size requires special, thinner, center restraint hardware which is not readily available on all aircraft, denying the free interchange of the unit size between aircraft of different types and different airlines which is the very purpose of TSO approval. It was agreed any "demi" (88x62.5 in nominal base size) containers could, as is common practice, be TSO approved under a UC S1 deviation, providing their identification code clearly identifies the difference in base size in order to avoid inappropriate loading on aircraft.

3.3 Testing Restraint Conditions (RC) Part [AS 36100 § 8]

8.2 Table 2: only 8 restraint configurations were found to be necessary for the 12 ULD sizes, due to RC A being common to UC A, B and M and RC N common to UC N and S.

It was agreed to specify lower, main and upper deck applicability (not specified in NAS 3610) in order to facilitate users understanding. This was based on known existing aircraft possibilities, except RC G (lengthwise, side-locked) was also agreed as a possible upper deck case based on Airbus A380F information **[M10-03]**.

RCs layout In order to reduce the complexity of using previous NAS 3610, it was decided to combine into a single sheet (designated restraint condition, RC) the general geometrical and dimensional requirements together with the restraint details (shown as separate Figures in NAS 3610) and identification of the applicable ultimate loads and C.G. eccentricity requirements (former NAS 3610 load conditions, LC). **[M4-02]**.

General A general decision, applicable to all RCs with the exception of RC G (side locks spacing), was to standardize the variety of restraint spacings in NAS 3610 to 635 mm (25.00 in), which was confirmed to be acceptable on existing ULDs based on test results, and compatible with new aircraft such as the A380 which do not anymore use a 20-21 fuselage frames spacing.

It was also agreed to consider all RCs, except for dedicated lower deck sizes and RC G, omni-directional instead of lengthwise only (already implicit in NAS 3610 with side loads identical to fore and aft in the cases concerned).

Variation of dimensions and shapes of restraint details in NAS 3610 restraint figures is considerable, seemingly modelled after actual aircraft systems many of which do not exist anymore. Since testing experience indicates no measurable difference as to test results and a single omni-directional test set-up was intended, it was also agreed to standardize all restraint details on a width of 25.4 mm (1.0 in), except for dedicated lower deck sizes and RC G side locks which are designed to take a major 90° horizontal load **[M7-12]**.

Applicable tolerances: see **4.9** where not explicitly specified in RC **[M7-03] [7E-01]**.

RC A Initially based on NAS 3610 RC 11-12 (Figure13) but under LC 18 for UC A and M, successively modified as follows (also see **UC A7** in 3.2 above):

- deletion of ±14.4% / ±21.4% C.G. eccentricities, i.e., referring to NAS 3610 LC 32 (same ultimate loads but ±10% C.G. eccentricity) rather than LC 18 **[3A-01] [M5-04]**.

- change based on conducted worst testing case analysis **[M4-03] [5B-01]**, retaining NAS 3610 RC 11-12 (Figure 13, with 635 mm / 25.00 in restraints spacing) on the long sides, while retaining RC7 / Figure 8's three restraints on the short sides **[M8-09] [8B-03]**. The restraint condition achieved was, therefore, a 16 restraints one, 3 on each short side, 5 equally spaced on each long side, effectively a worst case for the NAS 3610 RC 7 / LC 32 maximum load main deck case, approved by AGE-2A ballot in AS36100 9th draft **[M5-04] [5B-01]**.

- it was subsequently identified that another testing case, intended for lower deck, had been overlooked in **[5B-01]**, i.e., NAS 3610 LC 8 (with lower ultimate loads, about 60% of LC18/32's) under RC 9, Figure 9, with only 4 restraints on the long sides and a central 1270 mm (50 in) unrestrained span. Due to this gap, the upward bending moment in the central part of the ULD is in this case higher than with 5 restraints, even with the higher LC 18/32 ultimate load **[11G-01]**.

- after considering various possible options to resolve this difficulty, it was agreed **[M11-01] [11B-01] [11G-02]** that RC A would be changed to only 4 restraints on the long sides with a central 1270 mm (50 in) unrestrained span, same as NAS 3610 RC9 / Figure 9, while keeping the ultimate loads of UC A7 unchanged (i.e., same as NAS 3610 LC 18/32): this combined the two separate worst testing cases (one main deck, one lower deck) into a desired single testing condition, thus was effectively a worst testing case.

- a poll of participating ULD manufacturers **[11H-01]** indicated there was no evidence of a substantial ULD weight increase to be expected to result from such significantly more stringent testing. Accordingly, the so revised RC A was approved **[M11-01]** in AS36100's 11th and last draft, then approved by AGE-2A and AGE-2 ballot. RC A as published is, therefore, this condition with 14 restraints only.

Additional discussion had also considered the broad variety of restraint clearances shown in NAS 3610 restraint conditions, and agreed to retain an omni-directional 10.2 mm (0.40 in) clearance all around the testing configuration **[M7-07] [7F-01] [8B-04]**.

RC G Identical to NAS 3610 RC 24 (Figures 31-32) under LC 19 for UC G and R, without change.

Editorial clarification agreed **[M7-13]**: added legend (not shown in NAS 3610) to the figure in order to clarify 511.2 mm (20.125 in) spacing applies to vertical restraints, while side locks are spaced 1022.4 mm (40.250 in) from each other.

RC K Based on NAS 3610 RC 25 (Figures 33-35) under LC 30 modified with increased side loads as per AS36100 UC K4, with the following changes:

- side restraints spacing increased to 635 mm (25.00 in) as for all RCs **[7B-04]**. Note the word "*continuous*" means side restraints are assumed to be in a continuous 635 mm (25.00 in) layout all along aircraft system's side rails, resulting in the possibility of either 2 or 3 side restraints being located anywhere along the ULD's short side. The worst case retained for testing occurs as shown in RC K, i.e., when only 2 side restraints are available.

- discussion of restraint clearances (only lateral shown in NAS 36100) resulted in retaining an omni-directional 5.1 mm (0.20 in) clearance all around the testing configuration, identical to that shown for lateral clearances in NAS 3610 Figure 34 for size L. The 2.8 mm (0.10 in) shown in Figure 33 for size K were agreed to be too tight for realistic aircraft systems and conducive to jamming **[M11-02] [11C-01]**.

- in reference to NAS 3610 RC 25 (Figure 33) showing seven containers in line, the question arose whether this had effectively been used in any testing **[7B-05]**. Participating ULD manufacturers had no record or knowledge of such simultaneous testing of seven units ever taking place, implying all or most size K units in service were TSO approved without having been so tested. However, Boeing aircraft still restrain ULDs of size K by lines up to seven units. After discussion, it was agreed **[M7-08] [8B-05]** to add note ① requiring an evenly distributed horizontal force equal to 6 times the forward load to be applied alongside the pallet or container base edge to simulate a stack of 7 units. In accordance with **5.1** and **5.3**, this may be achieved either by physical means, or by analysis, or by numeric simulation.

Editorial clarification was agreed **[9B-02]** to add a note specifying the vertical rollers shown on the restraint details (as on NAS 3610 Figure 35) may be omitted for testing, providing the clearance remains identical to that specified.

RC L Based on NAS 3610 RC 26 (Figures 34-35) under LC 31 modified with increased side loads as per AS36100 UC L5/L6, with the following changes:

- side restraints spacing increased to 635 mm (25.00 in) as for all RCs. Note the word "*continuous*" means side restraints are assumed to be in a continuous 635 mm (25.00 in) layout all along aircraft system's side rails, resulting in the possibility of either 2 or 3 side restraints being located anywhere along the ULD's short side. The worst case retained for testing occurs as shown in RC L, i.e., when only 2 side restraints are available.

- discussion of restraint clearances (only lateral shown in NAS 36100) resulted in retaining the NAS 3610 Figure 34 5.1 mm (0.20 in) clearance, which was confirmed to be that existing on aircraft, but making it omni-directional all around the testing configuration **[M11-02] [11C-01]**.

- in reference to NAS 3610 RC 26 (Figure 34) showing seven containers in line, the question arose whether this had effectively been used in any testing **[7B-05]**. Participating ULD manufacturers had no record or knowledge of such simultaneous testing of seven units ever taking place, implying all or most size L units in service were TSO approved without having been so tested. However, Boeing aircraft still restrain ULDs of size L by lines up to seven units. After discussion, it was agreed **[M7-08] [8B-05]** to add note ① requiring an evenly distributed horizontal force equal to 6 times the forward load to be applied alongside the pallet or container base edge to simulate a stack of 7 units. In accordance with **5.1** and **5.3**, this may be achieved either by physical means, or by analysis, or by numeric simulation.

Editorial clarification was agreed **[9B-02]** to add a note specifying the vertical rollers shown on the restraint details (as on NAS 3610 Figure 35) may be omitted for testing, providing the clearance remains identical to that specified.

RC N New restraint configuration for sizes N and S, not shown in NAS 3610. The restraint configuration was proposed in the AS36100 4th draft **[6C-01]** and agreed **[M7-09]**, on the basis of NAS 3610 RC 16 (Figures 15-16-19) for 2E1 units (88x53in), closest to new sizes N and S.

It thus provides for 3 restraints on the long sides **[8B-03]** and 635 mm (25.00 in) restraints spacing, accordingly is in line with RC A as retained for double size units, respectively M and A.

Additional discussion also considered the broad variety of restraint clearances shown in NAS 3610 restraint conditions, and agreed to retain an omni-directional 10.2 mm (0.40 in) clearance all around the testing configuration, same as RC A **[M7-07] [7F-01] [8B-04]**.

RC P

RC Q New restraint configurations for formerly non-certified only sizes P and Q, not shown in NAS 3610. The restraint layouts were proposed by Boeing and agreed **[M7-10]**. All decisions taken as regard lower deck **RC K** and **RC L** (see above) were also applied to RC P and Q.

RC R Applies to size R units for carriage across aircraft, in addition to RC G applicable when they are to be carried lengthwise. Based on NAS 3610 RC 27 (Figure 36) under LC 32, agreed by the Panel **[M7-11]** with the following changes:

NOTE: NAS 3610 also contains RC 28 (Figure 37), equally applicable to 2R1 units restraint across aircraft. However, Figure 36 is essentially identical to Figure 37, with 4 restraints less (2 in the center part of each long side). Accordingly, it was agreed Figure 36 constitutes the worst testing case and could be retained as a single RC. In addition, this area is where NAS 3610 Rev. 10 contains a series of never corrected printed errors, which prohibit a comprehensive definition of the restraint arrangements. It was thus even more necessary to completely define a worst testing case restraint condition.

- fore and aft restraints spacing adjusted to 635 mm (25.00 in) instead of 629 mm (24.75 in), in order to standardize testing appliances on spacing retained for other sizes **[M9-10] [10B-05]**.

- side restraints spacing also adjusted to 635 mm (25.00 in) instead of 511 mm (20.125 in), also in order to standardize testing appliances on the spacing retained for other sizes **[M8-10]**.

Additional discussion also considered the broad variety of restraint clearances shown in NAS 3610 restraint conditions, and agreed to retain an omni-directional 10.2 mm (0.40 in) clearance all around the testing configuration, same as RC A **[M7-07] [7F-01] [8B-04]**.

APPENDIX A - OVERSIGHT PANEL SUMMARY

The “NAS 3610 Oversight Panel“ (OSP) was created on request of ISO/TC20/SC9's 29th meeting by SAE Sub-Committee AGE-2A, Cargo Handling, at its 81st, September 1998 meeting (see 1.1.2), under the Terms of Reference reproduced hereafter, in order to evaluate the needs for replacement of the NAS 3610 standard used for airworthiness approval of unit load devices under TSO C90c.

It held 11 successive meetings as follow (see relevant Annexes to the present AIR for meetings minutes and main approved work documents used as sources):

Meeting # 1, Fort Worth TX, April 12, 1999 (Chair: P. Emsters, Airbus): see Annex 1,
Meeting # 2, St. Petersburg FL, October 11, 1999 (Chair: P. Emsters, Airbus): see Annex 2,
Meeting # 3, San Diego CA, April 10, 2000 (Chair: P. Emsters, Airbus): see Annex 3,
Meeting # 4, Memphis TN, October 2, 2000 (Chair: K. Yata, Boeing): see Annex 4,
Meeting # 5, Salt Lake City UT, April 2, 2001 (Chair: K. Yata, Boeing): see Annex 5,
Meeting # 6, Monterey CA, April 15, 2002 (Chair: O. Atienza, Boeing): see Annex 6,
Meeting # 7, Arlington VA, September 23, 2002 (Chair: O. Atienza, Boeing): see Annex 7,
Meeting # 8, Scottsdale AZ, April 7, 2003 (Chair: O. Atienza, Boeing): see Annex 8,
Meeting # 9, Orlando FL, October 27, 2003 (Chair: O. Atienza, Boeing): see Annex 9,
Meeting # 10, San Antonio TX, April 26, 2004 (Chair: O. Atienza, Boeing): see Annex 10,
Meeting # 11, Montreal PQ, October 25, 2004 (Chair: O. Atienza, Boeing): see Annex 11.

As a result of these meetings and the additional work conducted, it prepared the Aerospace Standard AS36100, Air Cargo Unit Load Devices - Performance Requirements and Test Parameters, subsequently approved by AGE-2A, Committee AGE-2 and the SAE Aerospace Council, published February 2005 and proposed as a new technical reference for TSO approval.

See hereafter the list of individual experts who took part to various degrees to the Panel’s work, coded per categories as follow:

AIRL = Airlines,
OEM = Airframers,
SYS = Cargo systems manufacturers,
ULD = Unit load devices manufacturers,
REG = Regulatory authority (FAA).

Out of 45 participating experts, 18 were airlines, 7 airframers, 6 systems manufacturers, 9 ULD manufacturers and 5 regulatory. Thus, the Panel was deemed to represent a proper cross-section of the various points of view and expertise fields in the industry. All Panel decisions were taken unanimously, after any expressed differences had been resolved and consensus reached.

LIST OF OVERSIGHT PANEL MEETINGS PARTICIPANTS

Meetings # (C = Chair)

Name	Company	Categ.	1	2	3	4	5	6	7	8	9	10	11
M. Arcelle	FedEx	AIRL				X							
O. Atienza	Boeing	OEM		succeeding K. Yata				C	C	C	C	C	C
A. Brown †	Atlas Air	AIRL	X			X	X	succeeded by R. Hoffmann					
J. Burkett	UPS	AIRL	succeeding T. Tomeny						X	X	X	X	X
J. Chan	IATA	AIRL		X	X			succeeded by M. Terlecki					
S. Cole	Ancra	SYS	X										
B. Danczyk	Airbus	OEM					X	X			X	X	X
A. Davies	Bridport	ULD											X
D. Dubois	Cargolux	AIRL											X
J. Emslie	FedEx	AIRL	X	X	X	X							
P. Emsters	Airbus	OEM	C	C	C			succeeded by N. Lache					
F. Eriksen	Hydro	ULD		X				X	X	X	X	X	X
F. Eriksson	Envirotainer	ULD									X		X
R. Estes	FedEx	AIRL		X		X							
R. Fu	Telair	ULD							X				
M. Graf	Ancra	SYS			X								
F. Grahme	Northwest	AIRL		X									
K. Hacker	FAA	REG	X										
U. Hartmann	Alcan	ULD	X	X	X				X		X		
R. Hoffmann	Atlas Air	AIRL	succeeding A. Brown					X	X	X	X	X	X
D. Hyde	Envirotainer	ULD								X			
J. Jackson	[American]	AIRL	X	X			X	X	X	X	X	X	X
N. Lache	Airbus	OEM		X	X	X		X	X	X		X	X
G. Lane	Goodrich	SYS									X		
B. Lemon	SAE	--							X		X	X	
E. Moradians	Ancra	SYS										X	
J.J. Machon	[Air France]	AIRL	X	X	X	X	X		X	X	X	X	X
T. Martin	FAA	REG			X				X				
J. Neeld	Bridport	ULD	succeeding J. Startup					X	X	X	X	X	X
H. Offermann	FAA	REG								X			X
J. Risheim	FAA	REG								X			
H. van Rooijen	KLM (IATA)	AIRL			X	X	X	X	X	X	X	X	X
S. Savage	South African	AIRL											X
J. Searcy	FAA	REG	X	X	X								
W. Sehring	Lufthansa	AIRL	X										
S. Sondergaard	SAS	AIRL						X			X	X	X
M. Spry	Boeing	OEM										X	X
J. Startup	Bridport	ULD	X	X	X	X	X	succeeded by J. Neeld					
M. Sterk	FedEx	AIRL	X										
C. Stratford	[TRW]	SYS											X
D. Tanner	Telair	ULD							X				
M. Terlecki	IATA	AIRL		succeeding J. Chan							X	X	X
T. Tomeny	UPS	AIRL			X	X		succeeded by J. Burkett					
J. Traiser	TRW	SYS	X		X								
R. Wiecking	Boeing	OEM			X								
K. Yata †	Boeing	OEM		X		C	C	succeeded by O. Atienza					

Oversight Panel Terms of Reference

3.10.1 Subcommittee AGE-2A, Cargo Handling

3.10.1.1 A continuing “NAS 3610 oversight“ panel of the subcommittee is assigned two functions:

a. The panel is responsible for reviewing proposed revisions submitted by an air carrier, airframe manufacturer or equipment supplier to National Aerospace Standard (NAS) 3610, Cargo Unit Load Devices - Specification For. Following approval of the panel’s recommendation or revision by the subcommittee, in accord with the stipulations for subcommittee preparation, circulation and voting of the revision as outlined in paragraph 5, the revised NAS 3610 document is sent, by SAE Staff, directly to the Transport Aircraft Requirements Committee (TARC) for its approval and subsequent submittal to the FAA with a request for revision of Technical Standards Order TSO-C90, Cargo Pallets, Nets and Containers.

b. The panel is responsible for developing an Aerospace Standard (AS) to replace NAS 3610 with a user friendly, more comprehensive document (AS36100). The objectives are to establish clearer minimum performance requirements and test parameters and to simplify technical updating of the document, with an ultimate goal of direct submittal to the FAA, through SAE Headquarters, of requests for revision of Technical Standards Order TSO-C90, or its superseding alternative.

[Extract from SAE AGE-2 Organization and Operating Guide (1999)]

A N N E X E S

LIST OF ATTACHMENTS

ANNEX 1 - *OSP meeting N° 1 - Fort Worth TX, April 12, 1999*

MINUTES (abbreviated)

1. Chairman P. Emsters opened the meeting. The tentative agenda was adopted.

2. 12 Panel members were present : P. Emsters (Chmn)

W. Sehring, J. Emslie, M. Sterk, J.J. Machon
J. Traiser, U. Hartmann, J. Startup, J. Jackson
A. Brow

as well as 3 observers : J. Searcy (FAA), K. Hacker (FAA), S. Boehmer (Condat),

thus representing all concerned sectors of the industry : airframers, aircraft cargo systems manufacturers, ULD manufacturers, airlines, and regulatory agency, as required by the Terms of Reference assigned to the Panel.

Apologies had been received from R. Wiecking, T. Tomeny, M. Graf, H. Servais (AIA TARC) and T. Martin (FAA).

3. **Purpose :**

The task set on the new Panel, as had been identified and delegated to AGE-2A by ISO/TC20/SC9 at its June 1998 29th plenary meeting held in Memphis TN, was to analyze the industry's experience on using NAS 3610, and discuss the possible development of a more user friendly and up to date reference document better suiting the needs of the air cargo industry in the coming 21st century.

4. Work packages :

Work packages had been assigned to individual sponsors prior to the meeting in order to prepare it. As a result, a series of introductory presentations were given :

- projected long term growth of the worldwide fleet of ULDs (P. Emsters).

- dynamic numeric simulation of the behavior of a stack of ULDs loaded behind an aircraft's barrier net or partition under the "9g" emergency deceleration case defined by FAR 25 § 25.561 (b)(3)(ii). This presentation, made jointly by P. Emsters and S. Boehmer (Condat), was deemed highly instructive and received applause from all attendants.

- FedEx (J. Emslie) overview of the current FAA AD regarding ULD CG control on the main deck of B727PF STC aircraft : on going ATA Task Force, simulations, actual ULDs measurements with special equipment.

- ULD load models (P. Emsters) : theoretical analysis, practical ULD CG control and area load aspects.

- loads transfer between nets and pallets (S. Boehmer), on the basis of dynamic numeric simulation.

- ULD sizes and types to be covered into a new document (J.J. Machon), on the basis of worldwide current usage : see Attachment **1A** hereafter. **[M1-01]**

- NAS 3610 ULD configurations to be kept or deleted in a new document : (J.J. Machon) : see Attachment **1A**.

- average cargo densities and ULD maximum gross weights to be taken into account.

- ULD base thickness / stiffness requirements (shoring, area loads, "heavy duty" bases case).

5. NAS 3610 relationship :

H. Servais (Mc Donnell Douglas), Chairman of the AIA's TARC-218 Project Group in charge of updating NAS 3610, which seemingly has not met for many years, could not attend the meeting and did not report.

The last published issue of NAS 3610 (initially published in 1969) was revision 10, published 1989 i.e. 10 years ago, endorsed by TSO C90c, but which unfortunately contains printing errors that result in major technical inaccuracies. Both ISO/TC20/SC9 and AGE-2A have on several opportunities attempted to obtain from AIA a revision 11 to correct these errors. In addition, another revision 12 was also repeatedly requested to cover new ULD sizes. No AIA feedback whatsoever was obtained.

ISO/TC20/SC9 had accordingly launched a work item to prepare a new edition of International Standard ISO 8097 based on NAS 3610 (later note : published 2000)., intended to correct the errors, equivalent of planned revision 11. But no reaction could be obtained from sponsor organization AIA.

The Panel therefore unanimously concluded that there was no choice but developing an up to date reference document fully reflecting the industry's needs. This was at the moment considered to be a possible "revision A", reflecting its intent and scope might not be totally identical to those of NAS 3610's numerically designated revisions.

6. General orientations :

The Panel discussed in detail and unanimously agreed, as a general orientation framework for the new document, the presentation given by J.J. Machon (see Attachment **1A**). **[M1-001]**

This included the selection of the ULD sizes and configurations to be targeted by the new document, subject to the identified questionable cases being subject to further more in depth investigation prior to the next Panel meeting.

7. Program of work :

The Chairman defined individual task assignments to be completed prior to the next meeting.

In addition, an attempt will be made to obtain Airbus management financial support to launch further research on dynamic simulation cases to be submitted by the Panel in order to clarify pending ULD technical issues. This will require strong support being expressed with Airbus by customer airlines and / or Authorities.

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Attachment 1A page 1

JML

SAE AGE-2A Fort Worth April 1999
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PROPOSALS TO SAE AGE-2A NAS 3610 OVERSIGHT PANEL

"ALL NEW" REVISION A GENERAL OBJECTIVES :

- **Create a user friendly document :**
  (a) simpler to read and use (self-explanatory)
  (b) recognizable relationship to the purposes (to be detailed) of the different users :
  - airworthiness authorities (validation)
  - airframe and cargo systems designers
  - ULD manufacturers
  - ULD operators (actual air cargo practices)

  (c) provide typical, not mandatory, guidelines for application / equivalences

- **Maintain regulatory consistency :**
  (a) single TSO endorsement regardless of technical reference document (old or new)
  (b) keep unchanged main regulatorily meaningful general statements
  (c) do not increase regulatory burden unless proven necessary for safety

- **Adapt to modern air cargo needs :**
  (a) delete obsolete ULD sizes and restraint configurations
  (b) introduce needed sizes for baggage / general cargo / express and mail purposes
  (c) leave maximum design freedom for future aircraft types / cargo system variants

- **Complement by operating rules :** define a set of additional, non TSO, industry standards as to operating rules guidelines ensuring the TSO's requirements will be met in field practice

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Attachment 1A page 2 [1A-01]

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PROPOSALS TO SAE AGE-2A NAS 3610 OVERSIGHT PANEL

ULD BASE SIZES TO BE COVERED / DELETED IN "ALL NEW" REVISION A :

Code	Size	Being used	IATA code	9g type	Not for new designs ?	Comments
A	88 x 125	Yes	Yes	Yes		Delete 9g ? Evaluate variety of configurations.
B	88 x 108	Yes	Yes	Yes		Delete 9g (except 463L ?) ? Evaluate variety of configurations.
C	88 x 118	TBD	NO	Yes	X	L100 pallet ? Is it still in use ? Enquiry with operators required.
D	88 x 54	TBD	NO	Only	X	Delete ? DC9 : obsolete ? Bae146QT use ? Enquiry with operators required.
E	88 x 53	Yes	Yes	Yes	X	Delete 9g ? Remains necessary on DC9s ?
F	96 x 117 ¾	NO	Yes	No	X	Can be dropped altogether.
G	96 x 238 ½	Yes	Yes	No		
H	96 x 359 ¼	NO	Yes	No	X	Can be dropped except for specific (STC) applications ?
J	96 x 480	Indir.	Yes	No	X	Status of a dual 20ft unit ?
K	60.4 x 61.5	Yes	Yes	No		
L	60.4 x 125	Yes	Yes	No		Evaluate variety of configurations.
M	96 x 125	Yes	Yes	No		
R	96 x 196	Yes	Yes	No		

Sizes proposed to be added (subject to operators / IATA UTP concurrence) **:**

S?	88 x 61.5	Yes	TBD	No	Demi size used by express cargo / mail operators (main and lower decks).
T?	96 x 61.5	Yes	TBD	No	Demi size similarly used, plus B767 potential general cargo capability.

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Attachment 1A page 3 [1A-002]

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PROPOSALS TO SAE AGE-2A NAS 3610 OVERSIGHT PANEL

REVISION 10 ULD CONFIGURATIONS TO BE KEPT / DELETED IN "ALL NEW" REVISION A :

R.10 sheet	Conf. code	ULD type	Net attach	Proposal JJM	PE
13	1A1	NP	16D	delete	
14	1A2	NP	mix	delete	
15	1A3	P	mix	delete	KEEP
16	2A1	NP	18d	KEEP	delete
17	2A2	CNP	28s	delete	
18	2A3	NP	22d	delete	
19	2A4	P	cont	KEEP?	
20	2A5	CNP	mix	delete	
21	2A6	CNP	28s	delete	
22	1B1	NP	14D	delete	
23	1B2	NP	mix	delete	
24	1B3	P	mix	delete	KEEP
25	1B4	CNP	mix	delete	
26	1B5	NP	20st	delete	
27	1B6	NP	463L	KEEP?	
28	2B1	NP	32s	delete	
29	2B2	NP	18s	KEEP?	delete
30	2B3	C P	cont	KEEP?	
31	2B4	CNP	18D	delete	
32	2B5	NP	18s	delete	

R.10 sheet	Conf. code	ULD type	Net attach	Proposal JJM	PE
33	2B6	NP	18 d	delete	
34	1C1	CNP	mix	delete	
35	1C2	CNP	mix	delete	
36	2C1	CNP	18D	delete	
37	2C2	NP	18s	delete?	
38	1D1	NP	14st	delete	
39	1E1	NP	22d	delete	
40	1E2	NP	14D	delete	
41	1E3	NP	mix	delete	
42	2E1	NP	22d	delete?	
43	2E2	NP	18s	KEEP?	delete
44	2F1	CNP	26d	delete	
45	2G1	CNP	40d	KEEP	
46	2H1	CNP	54d	delete	
47	2J1	CNP	70d	delete?	
48	2K1	C		delete?	
48	2K2	C		KEEP	
49	2K3	NP	12s	KEEP	
50	2L1	C		delete?	
50	2L2	C		KEEP	

R.10 sheet	Conf. code	ULD type	Net attach	Proposal JJM	PE
51	2L3	CNP	14s	open	
52	2L4	NP	20s	KEEP	
53	2M1	CNP	28s	delete	
54	2M2	NP	18d	KEEP	delete
55	2M3	C P	cont	KEEP?	
56	2R1	CNP	36d	KEEP	

= 10/12 sheets instead of 43 ?

EXPLANATION OF CODES USED :

Apparent duplicates (loads) underlined
s,d,t = single, double, triple stud fittings
Cont = continuous ("seat") track
D = D rings

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Attachment 1A page 4

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PROPOSALS TO SAE AGE-2A NAS 3610 OVERSIGHT PANEL

AVERAGE DENSITIES AND MAXIMUM GROSS WEIGHTS :

- The former (original NAS3610) tables I through XIV showing ULD maximum gross weights were deleted, together with any mention of MGW, at Revision 5 dated 15 Nov.1975, endorsed by theTSO C90(a) revision dated 21 Dec 1978. Since, table II shows only ultimate load criteria, from which MGWs can be derived on any aircraft type or ULD position based on ultimate load factors certified for this type or position. See historical analysis.

- This major change was retained, in due concurrence with the FAA, because ULD MGW per se was becoming meaningless in view of an increasing variety of aircraft types where they could be loaded, and relevant ultimate load factors. This situation still exists, and has even expanded since with newer aircraft types as well as experience of certain ULDs certification and use at MGWs in excess of the originally rated value - at certain positions of certain aircraft.

- Reverting 25 years later to a published MGW value for each ULD configuration would create havoc in terms of regulatory consistency with ULD types already certified under NAS 3610 Revisions 5 through 10 - TS0 C90 (a) through (c), but also constitute a useless constraint on the design and potential of future aircraft, some of which could exhibit ultimate load factors lower than today's types.

- Airframe designers may need to know more than what is presently available in NAS 3610 as to the load footprint of a given ULD type. This could hopefully be derived from generally accepted figures of maximum area load and running load, applied to the unit MGW resulting from their aircraft's own (design or testing, as appropriate) ultimate load factors. A difficulty seems to be, there tends to be a broadening range of area loads and running loads, including some freighter aircraft (e.g. AN124) largely used today. Also, no assumptions can usually be made as regards ULD base stiffness (shoring effectiveness), except as specified by IATA (minimum level for purely practical reasons) or, implicitly, for those ULD restraint configurations not including vertical restraint all around.

☞ Recommend to maintain MGWs out of Revision A as per the current revision and TSO C90(c)

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Attachment 1A page 5

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PROPOSALS TO SAE AGE-2A NAS 3610 OVERSIGHT PANEL

BASE THICKNESS / STIFFNESS :

- Base thickness, or more accurately stiffness / load spreading capability, of the ULDs is not currently specified in NAS 3610. See previous view, average densities and maximum gross weights : except where implicitly specified by either restraint devices geometry (sizes F through J) or restraint configuration (e.g. 2L3), "heavy duty" (high inertia) bases are not covered, and remain an optional design feature not deemed to be part of airworthiness certification requirements.

- In practice, therefore, base thickness / stiffness appears as a customer requirement : it is of the same nature as load shoring requirements, handled by the operator. Note no minimum stiffness value that could be stated would, anyway, cover all possible concentrated loads shoring requirements ! In this context, operators may (and some do) elect, usually on a limited number of units, to specify a high inertia base in order to save on additional shoring time and materials. This essentially is the "heavy duty" base : a built-in supply of shoring capability (up to a limited extent anyway : it may itself need to be complemented).

- The actual certification question seems to be the download case : assuming the stated ultimate load (translated into MGW for a given aircraft and position) and CG offset limits are met, is it possible to significantly exceed aircraft maximum floor (area and running) loads ? The answer obviously depends on the, quite variable, value of these loads. It may also be pointed out that, on smaller base sizes (the larger ones, from G to J, are in fact bound to be high inertia), the size of the "most loaded quarter" resulting from maximum CG offset hardly ever spans more than 2 floor beams in the aircraft, so that the question of what is the intermediate load distribution onto the floor may look somewhat academic as to its influence on the aircraft's structure : it essentially affects potential damage to rollers and tracks, but airline experience demonstrates this is in any event to be catered for by adequate shoring, of which ULD base stiffness is only one component.

☞ Recommend to maintain base stiffness out of Revision A as per the current revision and TSO C90(c)

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Attachment 1A page 6

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PROPOSALS TO SAE AGE-2A NAS 3610 OVERSIGHT PANEL

ULD VARIANTS :

- ULD variants, currently not specified in NAS 3610, may include "heavy duty" bases (see previous view), but also a variety of items :
  - hanging loads (i.e. specific load pathes),
  - two-tier or slanted automobile transport devices,
  - dedicated aircraft engine transport units,
  - fluids tank containers,
  - etc . . .

- The rationale for analysing such specific circumstances seems the same as with base stiffness : a potential load distribution problem, principally in the download certification case, within the specified ultimate load and CG offset criteria. The same logic should prevail.

  ☞ Recommend to keep Revision A and any TSO C90 revision to general ULD certification requirements

  ☞ NAS 3610 and the TSO should include all that is necessary to guarantee safety within the aircraft's certified flight envelope, and solely that.

- In fact, apart from its layout complexity, NAS 3610, as endorsed by the TSO, was wisely written as deliberately limited to features pertaining to airworthiness certification, and only these. This scope should not be changed, as it defines the regulatory requirements.

- It is well understood, because of this NAS 3610 does not resolve all problems for everyone, e.g. in particular airframe or cargo system design parameters. But, where it may need to be complemented, this should be achieved by (may be more comprehensive than today's) industry specifications, without a regulatory character through a TSO status : such issues as shoring rules (including base stiffness), tie-down, and floor rules for designing and testing ULDs compliance should be handled in (a set of ?) such specifications.

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Attachment **1A** page 7

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PROPOSALS TO SAE AGE-2A NAS 3610 OVERSIGHT PANEL

ULD LOAD MODELS : THE PRACTICAL (CARRIER) SIDE :

- It is recognized NAS 3610 as it currently stands leaves an open interpretation problem as to how should the allowable CG deviation be translated into load distribution. The FAA B727 AD 98-26-18 essentially assesses it in the upload certification case, which appears correct. In the download case, see comments above as to ULD base stiffness.

- It is therefore reasonable to pursue the objective of a single, industry and Authority agreed, "ULD load model" method to allow consistency of interpretations. For the reasons outlined above, it might be more suitable to publish it once agreed in an industry agreed specification (in complement to NAS 3610) rather than NAS 3610 and the TSO themselves, but this is obviously up to the FAA. There is, however, a risk of a largely academic discussion in a theoretical approach, as illustrated by an airline's practical view :

- Most theoretical models need to assume load continuity : in practice, if load distribution is continuous; this is precisely when there is either a homogeneous commodity, or some random mix (baggage, small parcels, etc..) close to it, so there is no risk whatsoever of a major CG deviation ! ! Those cases where, in actual practice, airlines do meet a potential CG limits problem are :
  - either CG deviation (easy to compute) resulting from asymmetrical ULD contour with an homogeneous load,
  - or a single asymmetrical or overhanging large item (e.g., machinery, etc...) : its CG location is at least roughly determined, and care is taken to locate it in a reasonably appropriate manner vs the pallet's geometric center, or, if impossible, perform adequate additional tie-down directly onto the aircraft's structure in order to keep the restraint system within limits.
  - or when, because they came in at different times or they cannot be stacked together, two commodities of very different densities (e.g. flowers and mechanical parts) have to be loaded onto the same pallet. Standard airline procedures in this case require the load be located in a symmetrical arrangement in order to avoid a significant CG offset.

  None of these practical cases fits anywhere near the potential theoretical models under discussion ! Therefore, these models or algorithms largely have an arbitrary character, unrelated to reality - which does not imply they are meaningless, because choosing one will at least allow consistent designs, testing and comparisons.

  (See more detailed discussion in separate paper submitted)

ANNEX 2 - *OSP meeting N° 2 - St Petersburg FL, October 11, 1999*

MINUTES (abbreviated)

1. Chairman P. Emsters opened the meeting. The tentative agenda was adopted.

2. 12 Panel members were present : P. Emsters (Chmn)

K. Yata (V.Ch)	J. Emslie	N. Lache	J.J. Machon
U. Hartmann	J. Startup	J. Jackson	F. Grahme
R. Estes	F. Eriksen	S. Cole	

as well as 2 observers : J. Searcy (FAA) J. Chan (IATA)

Apologies had been received from R. Wiecking, T. Tomeny, J. Traiser, M. Graf, and T. Martin (FAA).

3. Liaisons :

J. Chan, Secretary of the IATA ULD Panel, reported that the ULDP meeting held in Geneva on June 8-9, 1999 had been briefed on the start of OSP activities. He expressed the airlines requirement to obviate the growing difficulties encountered with reference NAS 3610 and full support for the ISO TC20/SC9 and AGE-2A objective of developing a replacement document. IATA will send a formal liaison letter so requesting to SAE.

P. Emsters and J. Emslie reported on the joint ATA / FAA meetings held in Washington DC on Sep.15, 1999 and Seattle WA on Oct.6-7, 1999 regarding ULD CG location control in relation with the FAA AD on the main deck of B727PF STC aircraft. An alternate means of compliance (AMOC) letter will be prepared by the FAA.

4. Discussion :

All work assignments from the 1st meeting were reviewed, and the following subjects addressed and discussed :

- ULD sizes and types to be retained,
- corresponding ULD configurations,
- ultimate test loads and ULD loads distribution model (see Attachment **2A** for detailed discussions),
- numeric simulation allowances,
- operating rules and practices.

5. Program of work :

It was agreed a first draft "NAS 3610 Rev.A" document incorporating the results of the decisions taken would be prepared for the next meeting to consider, first concentrating on the text part. In order to maintain TSO compatibility, the aim would be to keep all NAS 3610 wording (already FAA agreed through TSO C90c) verbatim and determine which results of the discussions should be added to fill in the missing concerns. **[M2-01]**

ANNEX 2 - *OSP meeting N° 2 - St Petersburg FL, October 11, 1999*

Attachment 2A

ULD load distribution model - C.G. eccentricity " trade-off "

References : (a) Peter Emster's previous papers
(b) attachment to Vancouver fall 1998 AGE-2A meeting report
(c) FAA AD 98-26-18
(d) attachments 1 and 2 to Peter Emster's'e-mail of Jan.27, 1999

The purpose of the present is to express a few preliminary comments regarding the methodology, or principles / postulates implicit in it. If the panel wants to have any kind of "scientific" handling of the issue, we should first be quite sure the underlying assumptions are correct and the method appropriate.

1. Real life situation

What is basically missing in the approach till now is consideration of the practical situations encountered in commercial air cargo. This is where airframers are short of actual data, and only the experience gathered over the years by a large variety of multi-purpose (not only specialized, e.g. express cargo) operators can shed some light.

The basic attempt assumes some sort of continuity in the load distribution (hence investigates possible mathematical models to represent this supposedly continuous "density" variation over the base). This does not ever exist in real life cargo, and can be severely misleading. In real life situations, cargo can consist of :

1.1 - either a large quantity of boxes or crates of the same contents and weights : there is no load distribution variety, at least as long as their larger dimension is only a fraction of the pallet's, or the stack is centered on it,

1.2 - or a random mix of boxes, bags, etc.. of different contents and weights but still with relatively small dimensions. Typical cases are baggage (a good part of "cargo", at least for LD3s...), mail, parcel mail, express cargo, and many though not all cases of "general cargo". As long as their dimensions are small in relation with the pallet's, again, load distribution will be randomized and there is no practical possibility of any significant CG variation (noticeable exception : where the container contour itself creates a CG shift, e.g. LD3 and the like. But this is easy to compute and account for).
Both these cases could be assimilated to a more or less continuous load distribution, but they are precisely the cases when there will in practice never be any significant CG variation, or none at all. This tends to defeat the very concept of continuity, at least as a possible representation of reality (see 3 hereafter for other possible purpose).

1.3 - or large items (say, typically, more than half the pallet or base size), which may themselves have :

1.3.1 - either a centered CG : in this case, the worst one, what counts is where the piece is located on the pallet, and what else is loaded next to it,

1.3.2 - or an offset CG per their own contents (or a result of an unavoidable geometric overhang), e.g.with machinery. But in this case the logical thing to do, and it is usually done if staff is properly trained, is to locate the piece's CG towards the ULD base center. This results in alleviating the CG deviation, so that this case is in fact less critical. Noticeable exception : when overhangs out of the pallet's plan-view limit the possible offset. This occurs on main deck, not ever lower deck.

1.4 - or, a rather common case with the airlines, when for some reason two commodities with very different densities (e.g. flowers and mechanical parts) have to be loaded onto the same ULD. This is a case which can easily result in extreme CG locations. But it is so well known it is part of the most basis and systematic air cargo warehouse training : staff is made aware, and instructed to distribute such loads, when they cannot be stacked over each other with the lightest on the top - which would be ideal, in a symmetrical manner over the ULD base so as to keep an approximately centered overall CG. One can see how important is operator's staff training in coping with the situations encountered.

The point is, these latter cases can result in significant ULD CG deviation, but they cannot be assimilated to any kind of model using a continuous "density" variation, at least again as an attempt of representing reality. So, in any kind of real life situation, a continuous variation model cannot ever be useful in describing, even in a simplified approach, real load distribution on bases or pallets with a significantly offset CG.

The following general preliminary conclusions, based on experience, are therefore proposed :

1.5 - a typology of potential load cases, such as the above but more precise and thought out, should be part of the premises in any study, in order to define the real life environment expected,

1.6 - an assessment of actual load distributions on ULD bases cannot be made unless some prior hypotheses are laid down as to the training and procedures used by palletization (or baggage room) staff to fill up the ULD space in presence of different types of cargo, and the finished ULD load check by a supervisor to give it an OK for loading into the aircraft. Such defined assumptions are necessary for any realistic approach. Particularly see reference (c) page 2001, SeaTac FedEx facility evaluation,

1.7 - there is a major difference in practice between containers, used for baggage (practically homogeneous density) or even for cargo (they tend to be filled up with homogeneous commodities, or at least none of the last categories defined above, because of the physical difficulty in forklifting very large pieces into a closed volume) and pallets : pallets are, in practice, the overwhelming majority of ULDs presenting a significant load CG offset. Even farther, lower deck pallets in practice (except very special cases such as automobiles, split engine carriage, etc..) have very little CG problems. Main deck ones are much more exposed to it due to the nature and individual volume of cargo carried.

Note : as to whether this should or not be taken into account in the study, the following should be considered :
- a given pallet can be carried indifferently lower deck or main deck, and therefore ULD certification must be based on the most critical case i.e. main deck (while the aircraft lower deck system, itself, may not need to address major CG deviations not encountered in practice ?). The only ULDs that are specifically lower deck and never carried on a main deck are the contoured ones (LD3 and the like) : since they also are containers, it would be conceivable to limit their CG variation if this brought any value; but they must anyway meet the CG deviation their own contour systematically creates.
- even though the typology would clearly be of the kind above, there are no means to prevent some quite seldom exceptions to it (e.g. a very big and heavy steel cable drum into a container, etc..), and therefore ULD certification, based on safety and a very high probability objective (European Authorities tend to use 10^{-7} per flight, the FAA in reference (c) implies a "lifetime gust" at about 10^{-5} per flighthour), cannot refer to only what is considered "commonplace" or "typical" in the air cargo business. This implies that containers should probably be certified to the same criteria as pallets, contrary to factual evidence.

2. Statistics

The above contains the very reasons why the "statistical approach" suggested in reference (d) 2 is inappropriate :

2.1 - it can only be interpreted as an attempt to bring analysis closer to actual situations. But we just saw that, where a statistical evaluation (of package sizes and weights) would have some meaning, there would normally never be in practice any case of even being close to CG limits. And conversely, where CG limits might be reached, no random distribution of a large number of similar pieces could be taken into account, thus defeating the notion of statistical analysis.

2.2 - in fact, the major methodology bias is, statistical analysis can validly be applied exclusively to objects presenting some characteristic of a mass phenomenon, and some unknown but actual commonality resulting in a statistical distribution curve. In the air cargo case, this does not exist : there are several different types of cargo businesses (here again, a typology might be useful to clarify), e.g. baggage, mail, express cargo, general cargo, perishables, industrial shipments, oversize cargo, etc.. which have nothing in common and therefore cannot validly be subjected to a joint statistical analysis. This is true in general - at the industry's scale - but even truer if one considers any individual carrier (because many tend to specialize on certain markets) and more so if one considers an individual route (markets nature varies according to route and sometimes season), not to mention an individual flight (the one significant level in terms of safety, but deeply dependent on the day's type of cargo mix which may considerably differ from yesterday's).

2.3 - Taken at the industry's scale worldwide, there is no available data to support the notion that, from express cargo (in itself probably a reasonable candidate for statistical analysis if isolated) to oversize through a broad and unpredictable variety of intermediate sizes and natures of general cargo, there could be something as a valid common statistical distribution (Gauss or comparable, at least any kind of continuous distribution). Same as load distribution continuity over a pallet surface is a total illusion (see 1), a continuous statistical distribution of all kinds of cargo presented for shipment and subsequently palletized is likely another large illusion.

2.4 - last but not least, as already observed, if a statistical method was providing some closer relationship to reality, flight safety hence ULD certification could not be based exclusively on such parameters because there is no guarantee of how much and how often the "observed statistical distribution" taken into account will be deviated from, and the target is really a very high probability of never reaching the critical condition.

Note : agreedly, the probability could in principle, if accepted by the FAA/JAA, be defined as simultaneous occurrence of once-in-a-lifetime gusts and extreme CG deviation conditions on at least one ULD of the flight : by multiplying very low occurrence probabilities, we would obtain such extremely low simultaneous occurrence likeliness that discussions on the validity of sampling or statistical analysis could be many orders of magnitude afar. But this does not seem to be at least the FAA's thinking, as illustrated by reference (c) : they seem to consider the (very low) peak gust probability, and state the ULDs (as actually loaded on the flight, which is not only theory) shall withstand it (i.e. 100%, not statistically). This might be a subject for debate with them should an opportunity arise (out of the specific context of the B727 AD).

3. Algorithm

It would seem, from the above, hopeless to try establishing a set of methods or models to represent in a semi-realistic manner the actual load distribution situations which can be met in air cargo. It is only half so : yes, it is hopeless and futile if one tries to reproduce or approach "reality". But probably no, if the target is only establishing an industry agreed algorithm to handle definition, computation and ultimately testing of certified ULDs (as to testing, it should not be a systematic and mandatory requirement, but be left to the airworthiness authority's judgement).

The point is, the TSO, through NAS 3610, defines CG limits which the ULDs must be capable to safely handle in a given restraint configuration, but does not provide a defined method to analyse the consequences of these CG shifts onto the ULD itself (e.g. a net's straps) or onto the airplane's system and structure. Consequently, there are various ways to analyse this, which defeats standardization and may historically have allowed a manufacturer with a complacent local Authority representative to use his own favorable interpretation while his competitors could or would not (and his customers accepted it or not).

It is therefore believed it would be a service to both flight safety (through uniformization and elimination of adventurous ad hoc interpretations) and the industry (through more level competition rules) to define an industry agreed algorithm to link CG deviations with ULD design and airplane structural analysis (floor area loads, loads per latch, missing restraints, etc..). "Industry" means everyone i.e. airlines, airframers, ULD manufacturers, the FAA and the JAA. This is the consensus we need to achieve. It will be all the more difficult if the methodology and the target are not very clearly defined prior to discussion. And the conclusion is, such an algorithm is necessary but can only be arbitrary : it cannot bear any significant relationship (through modeling, statistics, etc...) with the actual situations met in air cargo. Compliance, in actual operation, will keep being ensured by airline training and supervision, including an "OK to fly" check by qualified independent personnel after ULD completion (this process itself could also very well be required and even controlled by the airworthiness authority, but within the operating rules, Part 121 or JAR-OPS, not Part 25 : SAE, ISO, NAS 3610 do not need to be involved).

The notion of an "arbitrary" algorithm may look shocking. However, many more basic parameters of airworthiness regulations, e.g. the 1,5 FAR 25.308 safety factor, or the ludicrous and much argued about "9g" crash case, etc.. are just as arbitrary - justified however by decades of experience and the advent of no recorded negative consequences. There is value in even arbitrary rules as long as they are the same for all and bear some reasonable - not identical - relevancy to the technical reality : obviously, It is not proposed to get a random set of rules out of a hat : we know enough of it, thanks to accumulated experience and theoretical research, to choose reasonably adequate ones.

4. FAA

The reference (c) B727 AD provides the first written and responsible statement on this subject known from the FAA in 25 years of activity. Therefore it is a precious move towards what should be done, and an indication of what may or may not be acceptable to the regulatory agencies.

According to the developments under "Fore and aft center of gravity shifts" and "FAA's methodology", pages 2000 through 2002 of reference (c) :

4.1 - the FAA used in this case a "trapezoidal" method (previously referred to as "linear" in working papers). It has the advantage of being relatively simple and impose a minimum number of arbitrary parameters : in fact, only one, the algorithm itself. For a given total weight and a given CG shift, there is only one load distribution possibility.

Note : it seems the FAA used this method in a linear mode, without integrating from "dx" to the whole width, which would result in a "saddle curve" (part of a paraboloid?). Can this be confirmed? It makes it so much easier, and also meets the principles developped above, i.e. arbitrary, but simple and reasonably relevant to the problem, while other more sophisticated calculation methods, such as integration, may provide only an illusion of accuracy because anyway they are not directly describing any actual situation...

4.2 - FedEx in their alternate studies used a "box" (fictitious boxes, not real ones) or "rectangular" or "step" model. The first major point is, the FAA concedes that this method is also acceptable, and even a bit more conservative by 14% (with side-locks. But this is the only case one wishes to consider : NAS 3610 provides for side vertical restraint, and many fail to understand why a freighter main deck could be certified without them at the onset !). This illustrates the fact that, for the FAA as well, a variety of methods (what are call algorithms above) may be acceptable, regardless of the fact that they unavoidably provide somewhat different results...

Note : one draw-back of the box method is, it is just as arbitrary as the trapezoidal one but necessitates more parameters, e.g. number and location of steps, which is more unnecessary arbitrary input.

4.3 - the second major point is, the FAA states in writing that the maximum 14% difference between both (arbitrary) methods "does not significantly affect analysis" (their words), one reason being that the sidelocks are distributed along the cabin in increments of 20" and not 89", hence their actual locations vary, and another being "the manner in which loads are actually distributed among all locks", which also varies (reasons : effect of container / pallet variable stiffness, different reaction of a net, effect of airplane floor deflection, etc... all which have nothing to do with CG shift). In other words, NAS 3610 provides only typical restraint configurations, the exact actual configurations will vary from an airplane type to another and even from one position to another on a given airplane type. The result is the actual load distribution on the locks and the airplane structure will vary, depending on exact detail configuration, by quite more than 14%, hence it is illusory to discuss the differences of such an order of magnitude between possible arbitrary algorithms while many other built-in factors have more influence.

The interim conclusion is, at this stage, we should better keep on the track the FAA is providing us, that is try to standardize one arbitrary but industry agreed algorithm to calculate the effects of ULD CG offset on the airplane in a gust situation, and choose the simplest (arithmetically but also necessitating least arbitrary parameters to be set) that would be acceptable to the regulatory authorities. From the above, this would point at the "trapezoidal" method more than any other one. Yet it would remain to be checked whether the JAA would concur with the FAA on it : there are past records of disagreement between agencies on similar issues.

5. Other issues

Rather than exclusively concentrating on the (agreedly important) CG offset isue, AGE-2A should identify other areas where similar industry agreed algorithms are also missing to calculate either ULD design or ULD operational rules. As examples :

- application of airplane running load : over the ULD length, or between two frames, or any distance, taking into account any unoccupied floor space or not, etc...

- application of maximum area load : the same questions more or less arise,

both being essential to determine any ULD stiffness and load shoring requirements, with the airframers presently providing surprisingly little material such as examples or interpretative statements for the user, and also undefined in NAS 3610 which does not at any point consider the roller system or the mode of transmission of the download to the structure.

- agreed rules as to computation / simulation of net stretching and the resulting load distribution on the pallet edge,

- probably quite a few others, not yet identified though we should.

Whether all such items should be introduced into NAS 3610 "all new" revision "A" itself is another story: It is strongly believed, for regulatory reasons, NAS 3610 as the reference document for the TSO, i.e. the official airworthiness regulation, should include everything that is deemed essential for safety, but solely this. Any additional interpretative material should be established in agreement with the FAA and JAA, but published somewhere else, e.g. an ad hoc industry agreed specification (see for instance the JAA system of regulations / Acceptable Means of Compliance / Interpretative Explanatory Material : though maybe a little too formal for the items we have in mind here, it illustrates the usefulness of a graded response at several levels). This is another discussion the Oversight Panel needs to have, but preferably once the list of items considered has been determined...

ANNEX 3 - *OSP meeting N° 3 - San Diego CA, April 10, 2000*

MINUTES (abbreviated)

1. Chairman P. Emsters opened the meeting. The tentative agenda was adopted.

2. 11 Panel members were present : P. Emsters (Chmn)

R. Wiecking (V.Ch)	J. Emslie	N. Lache	J.J. Machon
U. Hartmann	J. Startup	M. Graf	J. Traiser
T. Tomeny	H. van Rooijen		

as well as 3 observers : J. Searcy (FAA) T. Martin (FAA) J. Chan (IATA)

Apologies had been received from K. Yata and T. Wilmeth (FAA).

3. **Identification :**

Since "AS 3610" was not available, SAE had assigned number AS 36100 to the planned document, and further reserved numbers 36101 through 36109 for any additional documents that might appear necessary. It was agreed AS 36100 should be titled "Air cargo unit load devices - Performance requirements and test parameters". **[M3-01]**

4. Discussion :

A preliminary draft proposed under tentative designation "NAS 36101" by P. Emsters was discussed, but it was agreed that, though not objectionable, it was more of an intents statement / explanatory report than a technical standard. It was unanimously agreed the first draft of the technical standard (TSO intended), to be prepared for the next meeting, should :

- retain NAS 3610 language verbatim wherever possible (see meeting # 2), while complementing it if justified, in order to facilitate TSO endorsement and transition from one standard to the next

- state <u>all</u> the requirements pertaining to airworthiness but <u>only</u> those. Other considerations should be the subject of additional (potentially, not TSO targeted) documents, possibly using SAE reserved additional designation numbers.

- add Purpose and Field of application to fit the standard SAE Technical Reports style, resulting in slight clauses renumbering vs NAS 3610.

- provide under 1, Scope a first list of potential “satellite” or related documents. Whether or not they should be quoted in the References section is to be discussed with FAA representatives, since the goal is, contrary to AS 36100 itself, avoiding updates of these documents to be subject to regulatory approval (“Incorporation by reference”).

- refer to ISO 7166 and (for double stud fittings) ISO 9788 in replacement of MS 33601A (unless this was converted into an SAE standard, information not available, to be confirmed).

- introduce metric units (first, with imperial units between brackets) as per current SAE rule. **[M3-02]**

- keep the definitions of Type I ("9g") and Type II ULDs, in order to be able to cover the HCU-6E "463L system" military 88x108" pallet (CRAF and charter requirements), though probably eliminating all "civil" types of "9g" units.

- cover the list of ULD sizes as per previous Oversight Panel discussions (see meeting # 1), and include B767 sizes P and Q currently only non certified (Boeing request. Might prove useful for future aircraft types).

- add numeric simulation to the acceptable methods of demonstrating performance requirements.

The ULD base tolerances, ultimate load requirements (CG deviations simultaneity ?), and, preferably through a “satellite” document to be elaborated, test methods would still require further Panel discussion and orientations.

The wording and cross-referencing would clearly be affected by the final form of the tables and integrated ULD configuration sheets being developed under separate work packages. An agreed list of these sheets was required prior to finalizing a proposed draft.

The document might, as an alternate approach, include a non-normative “Bibliography” Annex that could potentially list all the “satellite” or complementary documents listed under 1, Scope, but also all generally agreed industry ULD design specifications. Subject to the “Incorporation by reference” being further discussed.

5. ULD loads distribution model :

The panel discussed the working papers presented by P. Emsters and J.J. Machon (see Attachment **3A**). It was decided to :

- introduce the notion, not shown either in NAS 3610 of minimum area load to be distributed to the aircraft floor, at around 200 lb/ft² for "thin" bases and 400 lb/ft² for "thick" ones (AS 1130, HCU-6E, etc..), as this was a key notion for airframe design hence airframe protection, **[M3-03]**

- further discuss at a subsequent meeting whether or not it was necessary to specify a minimum stiffness (EI value) for the ULD bases, not shown in NAS 3610,

- retain the "80%" load distribution model (already in use by both Airbus and Boeing stress engineering to design cargo floors) as the simplest common model. This might be covered in a separate document.

6. Other items :

Another joint ATA / FAA meeting was planned in Seattle WA on Apr.18, 2000 regarding ULD CG location control in relation with the FAA AD's alternate means of compliance (AMOC) on the main deck of B727PF STC aircraft. Peter Emsters and Jim Emslie would attend it in order to coordinate with the future contents of AS 36100.

7. Program of work :

The Chairman defined individual task assignments to be completed prior to the next meeting.

It was agreed a first draft of AS 36100, covering at least the text part, incorporating the results of the decisions taken would be prepared for the next meeting to consider. J.J. Machon was designated as sponsor, in coordination with Chairman P. Emsters.

ANNEX 3 - *OSP meeting N° 3 - San Diego CA, April 10, 2000*

Attachment 3A

ULD load distribution model- CG eccentricity " trade-off "

References : (a) “ULD load models preliminary general comments” paper (Spring 1999 AGE-2A), 5 p.
(b) “New document”<NAS 3610> Rev.A16.0,undated (Fall 1999 AGE-2A),ULD load models.
(c) Peter Emsters’ presentation to ATA ULD CG Control TF Seattle meeting, Jan.24, 1999 (50 p.)

In view of the reference (c) detailed computational approach and the recent discussions within the ATA (B727 P-F) ULD CG Control TF and with the FAA as to AMOC, the problem discussed seems to have now matured, or been sufficiently analyzed, to the extent tentative conclusions can be proposed. This is what is attempted hereafter, avoiding too theoretical / mathematical developments.

1. Load distribution model necessity / purposes :

It was generally agreed a standardized “load model” is one of the missing items in the present NAS 3610 puzzle, but not fully clarified why and for what practical/regulatory purpose(s) such a model is necessary.

The reference (a) comments, discussed in the Fort Worth meeting, propose the following conclusions :

■ an industry standard load model is required because essentially of two purposes within the scope :

1. standardizing the assumptions required for **ULD testing** (the sole primary purpose of NAS 3610 and TSO C90, to be remembered), and, as evidenced by ATA discussions and others :

2. providing standard means, acceptable to airworthiness Authorities, to develop **operating rules** on the use of ULDs, consistent with this testing. The readily available example is the need for CG eccentricity trade-off at ULD weights lower than certified MGW. There are potentially others (e.g. : determination of damage allowances for pallet nets ?).

NOTE : a standardized load model, once agreed and knowing it is the basis demonstrated by certified ULDs testing, can and probably will also be used for **other** purposes, most prominently as background for aircraft structure and cargo systems design. But this purpose should **not** be mixed with the others, since it does not properly belong to NAS 3610 and TSO C90’s scope.

■ no single load distribution model, however sophisticated, can realistically simulate the actual field situation, if only because this (nature and mix of cargo) considerably varies within the industry between different types of commercial operations while the ULDs used are often the same, and the airworthiness Authorities need a single set of rules applicable to all. Even in the relatively simpler case of express cargo operators where such notions as random distributions can be considered (untrue in the general cargo business), discussions have evidenced developing a model representative of reality is nearly hopeless.

■ the conclusion is, any model selected will necessarily have a somewhat **arbitrary** character (even though, obviously, it also has to be mathematically tested to make sure it does not produce results contradictory with reality). This may look shocking to some. Yet, many more important basic airworthiness assumptions or criteria already are arbitrary, because there was no other way, and they serve their purpose : e.g., the famous “9g” crash condition. In other words, the scheme (model, algorithm) selected would have value for the industry, including the Authorities that would have to approve it, by the sheer fact of being standard, not because of a supposed capability to simulate actual ULD loading.

■ since it will have to be arbitrary, the best for any purposes is that the selected model in the future document to supersede NAS 3610 be as **simple** as possible (i.e., consistent with testing requirements and field reality), and necessitates the **minimum number of parameters** (ideally, none) to be arbitrarily fixed (Occam’s razor).

2. Which model ?

Examining the various models discussed and the results of Peter's mathematical evaluations :

- the alleged "FAA model", a possible candidate if CG eccentricity's effects are separately analyzed in each direction, seems inappropriate if one wants to consider the worst case, i.e. simultaneous maximum CG offset in both directions : it is in this case non continuous, making it difficult to establish a test setup.

- the "multilinear" and "stair step" (with 1 ft^2 steps or similar) models appear somewhat uselessly complicated (e.g., introducing additional, non needed, arbitrary parameters),

- the "planar" model allows reaching at most only ± 6.6% deviation,

- the "6 steps" model appears the most realistic of all, because of the values reached and because it corresponds to a frequent real situation in the air cargo business (6 wooden pallets onto an aircraft pallet) that is easily repeatable for testing purposes and can also if needed be checked on the field.

Yet, all these models were demonstrated to suffer from one basic inconvenience : they address **only** the CG location issue, and they ignore other design constraints applicable to the ULD with effect onto the aircraft : particularly, in all of them it is impossible to reach ± 10% CG deviation without exceeding the maximum **area load** for the ULD and aircraft. This clearly points at their being not totally adequate.
NOTE : maximum area load is not currently stated in NAS 3610. It is in aircraft Weight and Balance Manuals. The implicit assumption here is that it should be one of the ULD design parameters to be stated in the new document to supersede NAS 3610 (consequence : unusual aircraft types with an extremely high maximum area load, e.g. the AN 124, would still be limited to common area load parameters when using NAS 3610 certified ULDs. This makes sense from an engineering standpoint).

On this basis, it is recommended the Panel retain (subject to acceptance from airframe manufacturers and the FAA) the simplest available model, which is the only one to also be consistent with maximum running load and maximum area load requirements : the **" 80% " model** (for a ± 10% CG deviation case). It easily lends itself to repeatable testing arrangements, can be readily understood by anyone, is visually verifiable in field situations, and requires the addition of no arbitrary parameters such as steps size, etc... **[3A-01]**

3. CG offset trade-off :

A good test of the practicality of the proposed " 80% " model is, how it can accommodate the requirement to provide a standard method to assess allowable CG deviation trade-off at ULD weights lower than MGW.

Reference (c), 5.2.1 page 39, provides the computation results for such CG deviation trade-off with the various models studied. The attached sheet reproduces them, together with the results of two conceivable simple methods to compute CG deviation trade-off in the " 80% " model :

A. Maintaining constant the moment from the ULD base's geometric center, or

B. Maintaining constant the area load on the most loaded part of the ULD base.

It is straightforward from either method to determine a maximum allowable CG deviation, as follows :

% of MGW	100	90	80	70	60	50	40	30	20	10	0
CG offset ±											
Method **A**	10%	11.1%	12.5%	14.3%	16.7%	20%	25%	33.3%	50%	>50	∞
Method **B**	10%	14%	18%	22%	26%	30%	34%	38%	42%	46%	50% (linear)

It can be seen method A provides seemingly acceptable values for the higher weights, but a maximum CG offset should be observed for the lower weights, e.g. something like 33%, since the figures become meaningless and unusable below approximately 30% of MGW.

Neglecting the ULD's stiffness (safe : any ULD base stiffness will contribute in more even load distribution), method B has the advantage of physically ensuring no part of the ULD base or the cargo systems will be more loaded than in the design case (MGW and ± 10% CG). It also is easy to compute or check for field applications where required, and offers no meaningless segment at low weights.

The comparison of both methods with computation results for the other models considered appears on the attached sheet. Method A, useless for the lower weights unless a straight limit is set, appears extremely conservative for the higher weights. Method B is less conservative at the higher weights, but its nature still guarantees the ULD base or aircraft cargo systems and structure will not be loaded over their design parameters. It also has the advantage of providing by the same token the reverse trade-off, i.e. the possibility (subject to airframe manufacturer allowance in the W&B Manual or otherwise) of increased MGW under reduced CG offset (or none) conditions.

Overall, linear method B appears both acceptable and optimum for all users.

4. Conclusions :

For the reasons outlined above, it is recommended that the Panel retains for inclusion into the future document to supersede NAS 3610 :

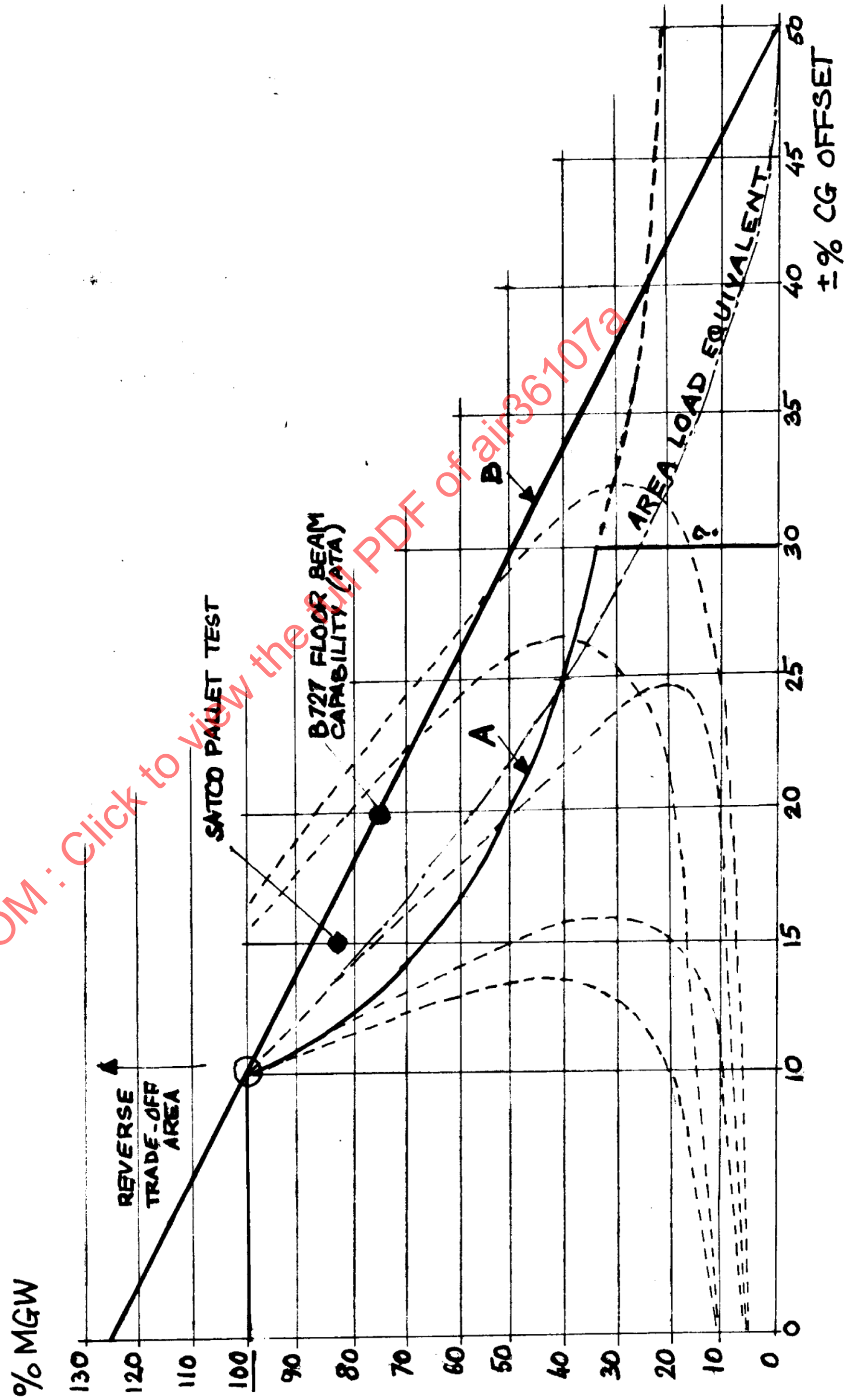
(a) mandatory maximum area load parameters (likely different for the "thin" type bases per AS 1491 and the "stiff" type ones, to be loaded on main deck only) per AS 1130,

(b) recognition of the simple " 80% " load model, the only one fully consistent with **(a)**, as standard means to determine ULD testing requirements and operational interpretations consistent therewith,

(c) the linear method for assessing allowable trade-off of ULD weight vs CG offset.

Computed CG offset vs GW trade-off curves

See reference (c) 5.2.1, page 39



ANNEX 4 - *OSP meeting N° 4 - Memphis TN, October 2, 2000*

MINUTES

1. The proposed agenda (see Attachment **4A**) was accepted. As a result of Peter Emsters' resignation for health reasons, it was necessary to elect a new Panel Chairman. After checking with previous co-chairman Russ Wiecking (Boeing) who declined, Ken Yata (Boeing) was unanimously elected.

2. 9 Panel members were present : K. Yata (Chmn)

A. Brown	J. Emslie	N. Lache	J.J. Machon
R. Estes	J. Startup	T. Tomeny	H. van Rooijen (V. Chmn)

3. The minutes of the 3d meeting in San Diego, April 10, 2000 were accepted as written and distributed.

4. AS 36100 draft work packages :

4.1 General part :

The Panel proceeded with a detailed review of the **AS 36100 first draft** proposal (see summary in Attachment **4C**) for the "general" package sent out by Jean-Jacques Machon on June 30. The principle was agreed, to retain as much as possible of the original NAS 3610 wording, insofar as this is expected to facilitate transition and FAA acceptance for TSO C90 continuity, and to add to it where and as required. It was also agreed the document be drafted in SI (metric) units, with inch-pound units between brackets, as per current SAE TSB-003 rules. **[M4-01]**

The various comments were discussed and noted down. An amended second draft will be accordingly prepared and sent to members. In the course of this review, the question was identified of whether the "seat-track" reference should be ISO 7166 or MS 33601B. The current status of the latter within the on-going process of converting military standards into SAE ones being unclear, it was agreed to request SAE to urgently research it and provide Panel members with a copy so that the differences, if any, with ISO 7166 can be analyzed and decided upon.

The test requirements section (clause 5) remained to be developed once a preliminary definition of the ULD and restraint configurations sections was available (see **4.2** hereafter).

4.2 ULD configurations / 4.3 Restraint configurations :

No new proposal was available due to Ulf Hartmann being unable to attend. The Panel proceeded with a detailed review of the preliminary draft he had handed over at the 3rd meeting. No detailed technical discussion was attempted, since this preliminary draft seemed established only to illustrate a possible proposed format, reproducing all the contents of the current NAS 3610 with a different layout. The following was agreed :

(a) Combining load condition, ULD configuration and restraint configuration in a single data sheet results in some complexity which can be detrimental to the user-friendliness looked for. Where the current NAS 3610 layout necessitates five different sources to be cross-checked (Table I, Table II, Table III, configuration drawing, restraint condition figure, the latter complemented by detail drawings), the optimum compromise would seem to be having only two : **[M4-02]**

- a **ULD** configuration sheet, showing the testing ultimate loads, the current configuration drawing, (the "seat-track" drawing (section BB) could be in a single place, or only by reference to ISO 7166 / MS 33601B, in order to save space), and the designation of the applicable restraint condition(s).
- a testing **restraint** configuration sheet, grouping each main figure with the corresponding details figures currently shown on separate sheets. **[M4-02]**

These would constitute the "ULD configurations" (UC) and "restraint configurations" (RC) work packages, but they could not be handled completely independently from each other, due to **(b)** hereafter.

(b) the agreed target is to reduce the number of potential testing cases, which necessitates both : **[M4-03]**
- retaining only those ULD sizes already agreed at the 1st (Fort Worth) meeting (see list in Attachment **4B**), and
- analyzing their NAS 3610 applicable restraint configurations to systematically determine which (ideally one only, but there may remain several) is/are the **testing worst case**, in order to be able to justify eliminating others.

Tim Tomeny will attempt this worst case analysis in the cases of sizes A and M, and report his findings to the Panel.

Ulf Hartmann and John Startup (previously assigned the "ULD manufacturers" work package) are, prior to the next meeting, requested to revise the configurations formatting proposal according to **(a)** and the input from Tim as regards sizes A and M.

5. (**5.1** through **5.6**) **"Satellite" documents** : **[M4-04]**

Those are the additional documents considered necessary to fully encompass the various factors of actual airworthiness of ULDs aboard aircraft, but not to be included in the mandatory requirements of the TSO, which would in principle apply only to the main AS 36100 document (including general part, ULD configurations and restraint configurations). They are envisaged to be cross-referred to in the main AS 36100, but maintain a status of (more easily updated) industry standards or recommended practices (subject to checking the FAA's understanding of "incorporation by reference" which might make them indirectly applicable with the same authority if explicitly referred to in a TSO enforced basic document?). They might be SAE ASs or ARPs, using the 36101 through 36109 numbering allocated by SAE. Some of them, subject to detailed review, might just be some of the standing SAE AGE-2A standards.

The tentatively agreed list of such potential satellite documents is as follows **(1)** :

Foreseen priority	Subject	Potential status	Existing SAE documents	Existing other industry documents
1	Load models	AS	None	
1	Test methods	AS	None	
2	ULD damage limits **(2)**	ARP?	Proj.97-01 **(3)**	
2	Restraint malfunction limits **(2)**	ARP?	ARP 5492 **(3)**	
	ULD general design specs	AS	AS 1130F	ISO 4117 / IATA 50/9
			AS 1131C	ISO 4115 / IATA 50/2
			AS 1491B	ISO 4171 / IATA 50/1
			AS 1492B	ISO 4170 / IATA 50/2
			etc... (see complete list)	
	ULD repair practices **(4)**	ARP?	None	
	Environmental degradation **(4)**	ARP?	AIR 1490B	ISO TR8647 **(5)**
	ULD maximum contours	AS?	AS 1825A	ISO 10046 / IATA 50/0
	ULD pressure equalization	AS?	None	ISO 11242 / IATA 80/2
	ULD utilization guidelines	ARP	ARP 5486	ISO 16412 (pallets & nets)
		ARP	None	None (containers)
		ARP	Proj.93-05	ISO 16049-2 (straps)
		ARP	Proj.93-06	None (shoring methods)

NOTES :

(1) Means of load CG location control were not retained as a potential satellite document, due to it being demonstrated they exclusively depend on operational control, hence ULD utilization guidelines (see **6** hereafter).

(2) The relevant cases should be introduced into the testing requirements. The ARP status would be justified by it primarily being industry standard guidance to the ULD or airframe manufacturers, responsible for stating applicable limits in their Authority approved ULD or Weight and Balance Manuals.

(3) The SAE AGE-2A drafts currently only refer to information availability and format, rather than the determination of applicable limits. Whether their scope should evolve or they should be complemented by other documents remains to be investigated.

(4) Added at the meeting.

(5) The reference documents currently provide only empirical evidence gathered as a result of tests. ISO/TC20/SC9 has retained the project of defining a standard test method to determine environmental degradation in ULD or accessories (primarily nets, also straps) textile materials, based on existing similar standards in other aerospace branches. This project is on-going and not yet completed.

6. ATA ULD CG Control Task Force liaison report :

Jim Emslie reported that FedEx has now completed a series of tests that demonstrate the following :

- using typical express cargo packages all under 150 lbs unit weight, random distribution over container base, flattening up the top of the load, evidenced no case of exceeding the certification ± 10% CG deviations.

- using cargo pieces most over 150 lbs unit weight, random distribution did result in cases of exceeding the limits, but reloading the same pieces using the industry's general palletization training rules eliminated those cases.

These results will be submitted to the FAA in Revision G of the Task Force Final Report by Nov. 8, 2000. Should the FAA accept this evidence, this would support the Panel's view that ULD CG control within certification limits can be achieved by proper palletization staff training and performance, hence does not require new industry rules other than stressing and enforcing existing CG control oriented training.

7. FAA / TSO relationship :

The Panel's objective remains to establish close liaison with (a) designated FAA representative(s) to ensure the future AS 36100 document and the set of "satellite" or related documents, when completed, effectively meet the certification Authority's requirements and allow recognition as the reference technical document in a revision of TSO C90.

Following the informal meeting with FAA representatives in Seattle on April 14, 2000 (Peter Emsters, Russ Wiecking, Ken Yata and MM. Todd Martin and Hank Hoffermann) and the subsequent message of June 27 from Todd Martin to Peter Emsters through Nils Lache, a letter must be sent by SAE to the responsible persons in the FAA to explain the scope and purpose of the Panel's activity and request support and, if possible, assignment of (a) designated liaison person(s).

It was agreed the draft letter being prepared by Peter Emsters will be sent to the Panel Chairman for his review and signature. It might also be useful to have it co-signed by SAE (Jay Myers) in order to confirm SAE's long term commitment to ensure active custody of the document over the years, regardless of the individuals presently active on the project.

8. Work assignments for next meeting :

J.J. Machon : update and circulate draft AS 36100 general part as decided at the meeting,

U. Hartmann / J. Startup : revise and circulate the tentative layout and list of pages of the future "configurations" sections as agreed at the meeting on the basis of attachment **4B**.

T. Tomeny : perform worst testing case analysis for sizes A and M retained restraint configurations, and circulate the results for evaluation.

J. Emslie : keep Panel members informed of FAA follow-up action on ATA ULD CG control TF work.

Other members : keep comments/inputs going on all the above.

ANNEX 4 - *OSP meeting N° 4 - Memphis TN, October 2, 2000*

Attachment 4A

AGENDA

1. Adoption of agenda
2. Membership review. Election of chairman
3. Review of minutes meeting N° 3 - San Diego, Apr. 10, 2000
4. AS 36100 draft work packages
   - **4.1** "reference document" (general) WP : AS 36100 first draft, J.J. Machon, June 30, 2000
   - **4.2** "ULD configurations" WP : U. Hartmann
   - **4.3** "restraint configurations" WP
5. Draft list and status of foreseen "satellite" documents (AS/ARPs 36101 - 36109 ?)
   - **5.1** explanatory report : "first draft AS 36101", P. Emsters, April 10, 2000
   - **5.2** ULD "load models"
   - **5.3** ULD test methods
   - **5.4** ULD CG control means
   - **5.5** ULD in service damage limits
   - **5.6** others (possibility of referring to existing or being developed AGE-2A standards ?)
6. ATA ULD CG control Task Force liaison report : J. Emslie
7. FAA / TSO relationship
8. Work assignments for next meeting

ANNEX 4 - *OSP meeting N° 4 - Memphis TN, October 2, 2000*

Attachment 4B [4B-01]

ULD CONFIGURATIONS RETAINED AT OSP 1 meeting (one horizontal box is **one** new configuration)

ULD size	ULD configuration	Load cond.	Restraint conditions	Figures (details) Across a/c	Figures (details) Lengthwise	Comments
A	net : 2A1 pal/cont : 2A4	14 or : 17	11-12-13-14 or : 2 - 7	13 (15,16,17) or: 1 (2,4)	14 (15,16,17) or: 8 (10,11)	**(1)**
B	pal/net : 1B6	25	3	5 (2,3)		HCU-6E ? **(2)**
B	pal/cont : 2B3 net : 2B6	6 or : 7	11-12-13-14 or : 5 - 7 - 9	13 (15,16,17) or: 9 (10,11) or : 5 (2,4)	14 (15,16,17) or: 8 (10,11 or 12)	**(1)**
G	pal/net/con: 2G1	19	24		31 (32)	
K	cont : 2K2 pal/net : 2K3	30	25	33 (35)		
L	cont : 2L2 pal/net : 2L3	31	26	34 (35)		
L	pal/net : 2L4	31	26	34 (35)		
M	net : 2M2 pal/cont : 2M3	9 or : 14 or : 18 - 32	9 or : 11 - 12 or : 7	9 (10,11) or : 13 (15,16,17)	8 (10,11)	**(1)**
N	pal/net/con: 2N1	parameters to be defined				new size prop.
R	pal/net/con: 2R1	19	24 - 27 - 28	36 or 37 (10,32)	31 (32)	**(1)**
S	pal/net/con: 2S1	parameters to be defined				new size prop.

(1) selection of load and restraint condition(s) is to be proposed, based on worst testing case analysis.
(2) Figure 3, side restraint without vertical lips, applicability to be reviewed (military transport aircraft?)

ULD CONFIGURATIONS TO BE INVESTIGATED (for potential certified **B767** unit sizes)

P	cont : 2P1 ?	discussion is required as to usefulness of certified LD2/LD4 size units and determination of the corresponding load and restraint conditions. Boeing only possible source ?	new size prop.
Q	cont : 2Q1 ?		new size prop.
Q	pal/net : 2Q2 ?		new size prop.

ANNEX 4 - *OSP meeting N° 4 - Memphis TN, October 2, 2000*

Attachment 4C

AS 36100 1st draft summary

Reference : Minutes of meeting N° 3, San Diego, April 10, 2000, § 2.1

The attached draft (5 pages) is a first proposal to meet the "reference documents" work package defined at the San Diego meeting. It consists in an attempt at producing the general cover pages for the future AS 36100, including scope, references, and general requirements. Explanatory comments are as follow :

- basically, it consists in a redraft, where and only where deemed necessary, of the present wording of NAS 3610 (the changes from it are underlined for clarity). The reasons are :

(a) this might facilitate FAA and (may be through ISO endorsement ?) JAA recognition as the new TSO reference,

(b) transition difficulties would increase should NAS 3610 and AS 36100 have significant differences in general requirements wording, that could affect the design of ULDs,

(c) when reviewing in detail the wording of the former NAS 3610, it appears carefully worded and in most cases quite pertinent to define ULD general requirements in a minimum number of words.

- Peter Emsters previously submitted general "NAS 36101" general document proposal could, as agreed, become the introductory and explanatory commentary. The main changes proposed on the basis of Oversight Panel discussions are :

- Purpose and Field of application added to fit the standard SAE Technical Reports style, resulting in slight clauses renumbering.

- First list of potential "satellite" or related documents in 1.1, Purpose. Whether or not they should be quoted in the References section is to be discussed with FAA representatives, since the goal is, contrary to AS 36100 itself, avoiding updates of these documents to be subject to regulatory approval ("Incorporation by reference" ?).

- Proposal to refer to ISO 7166 and (for double stud fittings) ISO 9788 in replacement of MS 33601B(where does this military standard currently stand ? It is not shown on the list of SAE conversions).

- Proposal to introduce metric units (first, with imperial units between brackets) as is current SAE rule (and U.S. legal rule ? to be confirmed).

- List of ULD sizes to be covered reflects Oversight Panel discussions, thus includes B767 sizes P and Q currently only non certified (is this necessary, particularly as they can hardly be applicable to pallets or nets ?).

- The ULD base tolerances, ultimate load requirements (CG deviations simultaneity ?), and, preferably through a "satellite" document to be elaborated, test methods may require further Panel discussion and orientations.

- Numeric simulation was added to the acceptable methods of demonstrating test requirements. **[4C-01]**

- The wording and cross-referencing will clearly be affected by the final form of the tables and integrated ULD configuration sheets being developed under separate work packages. We need an agreed list of these sheets prior to finalizing anything as a draft.

Alternate approaches could include :

- either an entirely new document rather than an update of the current NAS 3610 wording. This would have both merits and potential drawbacks.

- having a non-normative “bibliography” annex that could potentially list all the “satellite” or complementary documents listed under 1, Scope, but also all generally agreed industry ULD design specifications ?

Submitted for Panel Members discussion and comments.

ANNEX 5 - *OSP meeting N° 5 - Salt Lake City UT, April 02, 2001*

MINUTES

1. The proposed agenda (see Attachment **5A**) was accepted.

2. 7 Panel members were present : K. Yata (Chmn)

B. Danczyk	J. Jackson	J.J. Machon
J. Startup	H. van Rooijen	A. Brown

3. The minutes of the 4th meeting in Memphis, Oct. 2, 2000 were accepted with the following correction : Hans van Rooijen is to be considered a Panel member, but not vice-chairman.

4. AS 36100 draft work packages :

4.1 Review of 2nd draft :

The Panel proceeded with a detailed review of the **AS 36100 second draft** proposal for the "general" package, prepared by J.J. Machon according to the decisions of principle taken at the Memphis meeting. The various comments were discussed and noted down. A third draft will be accordingly prepared and sent to members, including what was agreed on the "ULD configurations" and "restraint conditions" work packages (see 4.2 and 4.3 hereafter). The following main changes were agreed :

- do not refer to the "satellite" documents as "requirements", but as "guidelines", and delete Bibliography, that will, if necessary, be published as a separate AGE-2A document, in order to avoid incorporation by reference into the regulatory (TSO) requirements,

- emphasize difference between ULD certification requirements and airplane operation requirements **[M5-05]**,

- refer to ISO 7166, 9788 and 11842 only as examples. The possible use of MS 33601B remains open : Jay Myers confirmed it is to be converted into an SAE standard, but, though a copy was requested for OSP evaluation, it was not yet provided,

- simplify 4.11, Environmental degradation, while referring for guidance to AIR 1490,

- draft 5.3, Test methods, in general terms, while the "satellite" document will provide more details,

- refer to AS 1825 for guidance as to container contours in 6.3.

4.2 ULD configurations :

The general layout proposed for the "ULD configurations" section was distributed with the drawings selected from NAS 3610, and approved. The main points of discussion included :

- minimum base area load for design of heavy duty bases to be 20 kPa (418 lb/sq.ft) - this is ULD minimum requirement, not aircraft - rather than 19.5 kPa (400 lb/sq.ft), **[M5-01]**

- configuration B2 (88x108") fits the military HCU-6E (463L system) pallet. It is defined by military specification MIL-P-27443E (USAF), which might have to be converted into an SAE standard (to be established with SAE), and a readable copy of which remains to be obtained. This, however, refers to **8g** dynamic testing for a duration of 0.1s, not to 9g static as per FAR 25 and NAS 3610. There may be various complexities involved. The proposal was tabled, not to include this type into AS 36100, and is to be reviewed at the next meeting (members consideration and comments required),

- sizes P and Q (B767) are to be retained, at Boeing's request. It is understood Boeing will thus provide the corresponding ULD configuration and restraint drawings as well as the ultimate load criteria to be taken into account for certification.

4.3 Restraint conditions :

Tim Tomeny could not be present to introduce the worst case analysis for size A pallets and containers. The Panel considered the presentation prepared by J.J. Machon in cooperation with Airbus (see attachment **5B**). The following was agreed in principle :

- remove the term "aircraft" throughout, in order to emphasize what is described is only ULD testing configurations, not conforming to any particular aircraft system, and avoid inasmuch as possible the risk of confusion with airplane, vs ULDs, design and operation requirements, **[M5-02]**

- consider inclusion of a base edge minimum stiffness (EI value) requirement, which may be useful for aircraft or cargo systems designers in order to assess the effect of the ULD onto the airplane structure with a different restraint geometry (to be reviewed with pallet and container manufacturers), **[M5-03]**

- target a single isotropic (lengthwise and crosswise tests) restraint configuration for sizes A, B and M,

- retain for the third draft, to be reviewed at the next meeting, the proposed restraint condition for these sizes, consisting in simultaneously using : **[M5-04]**
- restraint configuration plan view based on NAS 3610 Figure 13 (25" latch spacing all around), and
- in conjunction with NAS 3610 load condition 32 (maximum ultimate loads and CG height) for sizes A and M, TBD for size B.
It is estimated the conjunction of worst latches spacing with the maximum ultimate loads will effectively constitute a testing worst case. The potential difficulty is, this testing condition is more severe than those currently used for ULDs certification, hence the problem arises of which would be the status of earlier certified units. The ULD manufacturers would have to confirm ULDs of the present generation are capable of withstanding such an enhanced test case.

5. (**5.1** through **5.8**) **Satellite documents** :

No detailed discussion could take place, due to limited time available. See minutes of meeting N° 4 for tentative list of documents foreseen, and 4.1 above as regards documents status and Bibliography deletion.

A preliminary draft for the cargo shoring document (Project N° 2A-93-06), to be later assigned number ARP 5596, was presented to AGE-2A on Apr. 4, and will be circulated for AGE-2A comments.

6. ATA ULD CG control TF :

In the absence of Jim Emslie, it was reported that the FAA Transport Airplane Directorate Aircraft Certification Service has issued on Dec. 22, 2000 an AMOC approval for ULD CG control on STC modified B727s, allowing compliance with the respective ADs according to the means proposed by the ATA Task Force final report.

This document, distributed at the meeting, for the first time formally allows linear trade off of ULD weight vs CG location. Though limited in scope to STC B727s, it is believed this creates an opportunity to expand similar trade off to other aircraft types.

7. Cooperation with the FAA :

The draft letter from OSP Chairman Ken Yata to the FAA (Ms Angela Elgee, Continuous Airworthiness Maintenance Division in Washington and Ms Vi Lipsky, Transport Directorate in Seattle) was distributed, reviewed, and approved, under the proviso that the OSP's minutes and AS 36100 complete draft (except its scope) would not be attached to this first formal request.

Ken will take the necessary steps to have it sent shortly. It was recommended it should, if possible, be also signed by the Chairman of the SAE Aerospace Council, rather than the SAE staff.

8. Work assignments for next meeting :

The next Panel meeting will be held in Washington DC on Monday, Sep. 17 at 09:00 prior to the AGE-2 Committee meeting on Sep. 18 and 19.

Work assignments prior to this meeting are :

K. Yata : send letter to FAA and follow up on it. Investigate ULD configurations, restraint conditions and ultimate load criteria for sizes P and Q,

J.J. Machon / P. Emsters : update and circulate third draft AS 36100 as decided at the meeting,

U. Hartmann / J. Startup : review the questions of proposed single restraint configuration for sizes A, B and M (are current ULDs capable of withstanding such an enhanced test ?) and possible minimum EI value requirement for pallet and container base edges (see 4.3 above).

Other members : keep comments/inputs going on all the above (see e-mail addresses in attachment C).

SAE Secretariat : provide the Panel with current copies of :

- MS 33601B,
- MIL-P-27443E (USAF),

indifferently before or after conversion to SAE format, and ensure they are assigned to AGE-2A custody.

ANNEX 5 - *OSP meeting N° 5 - Salt Lake City UT, April 02, 2001*

Attachment 5A

AGENDA

1. Adoption of agenda

2. Membership review.

3. Review of minutes meeting N° 4 - Memphis, Oct. 02, 2000

4. AS 36100 draft work packages

- **4.1** review general part of AS 36100 2d draft, Dec. 15, 2000
- **4.2** review proposed outline of "ULD configurations" part
- **4.3** discuss proposals for "restraint configurations" part

5. Status and priorities of foreseen "satellite" documents (AS/ARPs 36101 - 36109 ?)

- **5.1** ULD "load models"
- **5.2** ULD test methods
- **5.3** ULD CG control means
- **5.4** ULD in service damage limits (AGE-2A Project N° 97-01)
- **5.5** ULD restraint malfunctions limits (ARP 5492)
- **5.6** ULD utilization guidelines (ARP 5486)
- **5.7** Heavy cargo shoring guidelines (AGE-2A Project N° 93-06)
- **5.8** Other documents (listing of existing or being developed AGE-2A standards)

6. ATA ULD CG control Task Force liaison report : J. Emslie

7. FAA / TSO relationship, OSP Chairman letter to FAA

8. Work assignments for next meeting

ANNEX 5 - *OSP meeting N° 5 - Salt Lake City UT, April 02, 2001*

Attachment 5B

AS 36100 Restraint Configurations

Proposed analysis of testing worst case for sizes A, B, and M - Sheet 1

Applicable NAS 3610 Rev.10 (TSO C90c) restraint conditions (RC)

Restraint condition (**RC**)	**1**	**2**	**5**	**7**	**9**	**11**	**12**	**13**	**14**	**19**	**20**
Applicable to ULD config. 2A1 to 2A6 2B1 to 2B6 2M1 to 2M3	 x (2A5 only)	 x	 x	 x x x	 x x x	 x x x	 x x x	 x x	 x x	 x (2B4 only)	 x (2B4 only)
Restraint Figure Fore and aft details Fig. Side restraint details Fig.	**1** 2 3	**1** 2 4	**5** 2 4	**8** 10 11	**9** 10 11	**13** 16 15	**13** 16 17	**14** 16 15	**14** 16 17	**22** 25 25	**23** 26 26
ULD across aircraft ULD lengthwise in aircraft	x	x	x	 x	x	x	x	 x	 x	x	x
Restraint spacing (sides)	20.00"	20.00"	20.00"	20.13"	20.00"	25.00"	25.00"	22.00" 25.00"	22.00" 25.00"	20.00"	20.00"
Restraint spacing (ends)	20.75" 24.75"	20.75" 24.75"	20.75" 24.75"	24.75"	20.75" 49.50"	25.00"	25.00"	25.00"	25.00"	20.00"	20.00" 26.25"
Vertical restraint all round No vertical restr. on sides	 x	x	x	x	x	x	x	x	x	 x	x
Total number of restraints with vertical restraint without vertical restraint	18 10 8	18 18	16 16	18 18	16 16	18 18	18 18	18 18	18 18	18 10 8	18 18

Objectives

■ Define worst testing case for the ULD, not the aircraft restraint system, which can - and generally will - be different :

⇨ Proposed section 8 title to avoid ambiguity : " Testing restraint conditions ", rather than "Aircraft ...".

■ Provide means for airframe design offices to extrapolate behavior of so tested ULD in a different restraint system :

⇨ Define / specify minimum base edge profile EI value ?

■ Ensure consistency - though not necessarily identity - with NAS 3610 restraint condition(s) for same load condition.

■ Minimize testing cost and complexity of testing, while still providing for worst ultimate load case :

⇨ Aim for isotropic restraint condition, consistent with isotropic horizontal ultimate loads stated in section 7 ?

Proposed criteria for selection of ULD testing worst case

■ Preferably, single testing restraint condition for all 3 sizes, or at least for sizes A and M (same ultimate loads)

■ Testing to be based on maximum ultimate loads and CG deviations stated in section 7, ULD configurations.

■ Eliminate cases without vertical restraint on the sides (not applicable : RC 1 - 2A5, and RC 19 - 2B4).

■ The critical testing cases are therefore assumed to be either of :

⇨ Upward testing under maximum horizontal CG offset,

⇨ Horizontal testing under maximum CG height.

■ Cater for worse possible pallet net fittings mislocation (continuous seat track standard).

Proposed definition of ULD testing worst case [5B-01]

■ The one worst testing case in existing NAS 3610 restraint conditions is RC **9** (Fig.9), due to 49.50" latches spacing on fore and aft sides. However, it can hardly be retained, because :

⇨ Not isotropic as per objectives, would require an altogether different lengthwise testing condition,

⇨ Highly irregular spacing would result in all ULDs requiring significantly (about 8 times) higher base edge EI,

⇨ It is applicable only for ultimate loads and CG height significantly lower than those required per section 7 :

2A1 - 2A6 : LC **8** = 12,500 lb fore and aft, 9,000 lb sides, 22,500 lb up, maximum CG height 36.0",

2M1 - 2M3 : LC **9** = 13,500 lb fore and aft, 9,720 lb sides, 25,200 lb up, maximum CG height 36.0",

corresponding only to a rather low MGW lower deck utilization.

■ The next testing worst case is RC **11** or **12** (Fig.13) : it encompasses all the other ones except RC 9. It is applicable according to NAS 3610 (TSO C90c) to the following load conditions (LC) :

2A1 - 2A6 : LC **14** = 18,750 lb fore and aft, 18,750 lb sides, 37,500 lb up, maximum CG height 36.0",

2M1 - 2M3 : LC **14** as well,

closer from target but still corresponding to a relatively low MGW and maximum CG height.

■ The ultimate load conditions and maximum CG height retained for sizes A and M in AS 36100 section 7 are :
NAS 3610 Load Condition **18** or **32** = 22,500 lb fore, aft and sides, 38,000 lb up, maximum CG height 48.0" (equivalent to 15,000 lb MGW under 1.5 g horizontal and 2.53 g upward),
which according to NAS 3610 (TSO C90c) corresponds to Restraint Condition **7** (Fig.8, lengthwise). But RC 7 is significantly less critical, restraint wise, than RC 11/12 (20.13" vertical restraint spacing, instead of 25.0", on sides).

■ Accordingly, the proposal to define a testing worst case condition is simultaneously using **Load Condition 32** (the ultimate loads specified in AS 36100 proposed ULD configurations A1 and M1) with **Restraint Condition 11/12** (Fig. 13), also using the worst possible pallet net fitting locations. This will effectively create a worst case condition, by either providing a more critical restraint condition for a given set of ultimate loads, or increasing the loads for the selected restraint condition. **[5B-01]**

NOTE : this would, in principle, create a more severe testing condition for a "new" (AS 36100 certified) 2A1 or 2M1 ULD than for previous (NAS 3610 certified) 2A6, 2M1, 2M2 or 2M3 ones. It is felt this should be no cause for inconsistency, inasmuch as ULDs of the present generation are assumed to be capable of withstanding such enhanced testing criteria (25.00" spacing between latches instead of 20.13" on the long sides and 24.75" on the short sides). This, however, is to be confirmed by ULD manufacturers.

■ One advantage of the proposed selection is isotropy, that is the possibility of using a single restraint configuration (i.e. test fixture) to test the ULD in all directions (see objectives).

ANNEX 6 - *OSP meeting N° 6 - Monterey CA, April 15, 2002*

MINUTES (abbreviated)

1. The proposed agenda (see Attachment **6A**) was accepted.

2. 9 Panel members were present : O. Atienza (Chmn)

B. Danczyk	J. Jackson	N. Lache	R. Hoffmann
F. Eriksen	H. van Rooijen	J. Neeld	S. Sondergaard

Due to Ken Yata being seriously ill, Oscar Atienza (Boeing) was elected Panel Chairman.

3.1. The minutes of the 5th meeting in Salt Lake City, Apr. 02, 2001 were accepted.

3.2. Review of outstanding questions and assignments :

a) EI value : Stig Sondergaard will draft a letter to be mailed to ULD manufacturers requesting the EI value they use in the design and fabrication of pallets. The draft will be circulated to the members of the OSP.
b) Agreed to 3 seconds duration for load application. **[M6-03]**
c) LC32 Fig. 13/15, letter to members, ULD manufacturers to confirm.
d) Agreed not to include the HCU-6E pallet (see Attachment **6E**). NAS 3610 will still cover it. Include pallet 88” x 108” with a 3g restraint configuration and call it B6 configuration. **[M6-01]**

4. AS 36100 4th Draft Discussion (see Attachments **6B** and **6C** plus written comments received in **6F**) :

a) Para 4.9: Tolerances: +0/-.03mm for two places decimals, +0/-.08 mm for two place decimals and +0/-.3 mm for one place decimal.
b) Stack loading of K/L sizes – will be kept for the time being but ULD manufacturers are requested to explain their justification how compliance has been shown.
c) K/L size 25 inch latch spacing has not been considered during the meeting. Nils Lache sent an Email dated 5/17/02 endorsing the 25 inch side restraint spacing for the K and L sizes. Agreed that the 25 inch spacing will be the maximum.
d) Stud/Track ISO 7166, agreed to be kept as reference (see Attachment **6D**). **[M6-02]**

5. Agreed the program of “satellite” documents has to be established by AGE 2A (see Attachment **6G**).

6. The Chairman mentioned that an SAE letter had been mailed to the FAA February 21,2002, requesting their support of the Panel in developing AS36100 as well as for future incorporation into TSO C90. A copy of the letter will be attached to the minutes.

ANNEX 6 - *OSP meeting N° 6 - Monterey CA, April 15, 2002*

Attachment 6A AGENDA

1. Adoption of agenda.

2. Membership review. Election of officers.

3. Review of minutes of meeting N° 5 - Salt Lake City, April 02, 2001 :

3.1 minutes approval.

3.2 review of outstanding questions and assignments :
3.2.1 minimum base edge EI value proposals.
3.2.2 minimum ultimate load duration proposals.
3.2.3 present ULDs compatibility with NAS 3610 LC 32 under Fig.13/15 restraint.
3.2.4 inclusion or not of HCU-6E 88x108" pallet, 9g testing requirements (Attachment **6C**).

4. AS 36100 4th draft discussion :

4.1 review comments to general part of AS 36100 4th draft, Mar. 15, 2002 (attached).

4.2 review proposed outline of "ULD configurations" part (unchanged from 3rd draft).

4.3 discuss proposals for "restraint configurations" part (4th draft. New).
4.2.1 RC **A** : clearance between pallet locks vs side restraints if omnidirectional.
4.2.2 RC **K** : change to 25" and continuity of side restraints spacing ;
& **L** 7 units stack vs individual testing.
4.2.3 RC **N** : discussion of proposed single restraint condition (see 4.2.1).
4.2.4 RC **R** : discussion of proposed single restraint condition.

4.4 follow-up action, tasks assignments in preparation of the Arlington 7th meeting.

5. Status and priorities of foreseen "satellite" documents (ARPs 36101 - 36109 ?).

5.1 review and discuss concept of "Bibliography AIR" (see Attachment **6E**).

5.2 ULD "load models" (TBD).

5.3 ULD test methods (TBD).

5.4 ULD CG control means (TBD).

5.5 ULD in service damage limits (AGE-2A Project N° 97-01). FAR 145 maintenance ?

5.6 ULD restraint malfunctions limits (ARP 5492).

5.7 ULD utilization guidelines (ARP 5486, Pallets, ARP 5595, Tie-down). Containers ?

5.8 Heavy cargo shoring guidelines (ARP 5596).

6. FAA / TSO relationship, OSP Chairman letter to FAA, feedback from FAA and JAA.

ANNEX 6 - *OSP meeting N° 6 - Monterey CA, April 15, 2002*

Attachment 6B

AS 36100 3rd draft summary

Reference : unconfirmed minutes of OSP meeting N° 5, Salt Lake City, April 02, 2001

The attached 3rd draft (23 pages) attempts incorporating into the previous 2nd draft, dated December 15, 2000, the results of the discussions at the Salt Lake City OSP/5 meeting as recorded in the minutes. The last date of issue for each draft page appears in List of current pages on page 2. On each page, the bold lines in the left hand margin indicate the parts changed since the previous issue of that page. The main items taken into consideration are :

- eliminate "requirements" for "guidelines" in references to "satellite" documents, and delete Bibliography.

- remove word "aircraft" (- restraint configuration), replaced by " testing " (- restraint condition), throughout.

- introduce new key sentences in 1.2, Field of Application, and 3.3, Configurations, to clarify the AS does not apply to aircraft.

- introduce SAE AIR 1490 and ARP 1825, and corresponding ISO documents, into 2.1, applicable documents.

- tentatively introduce in 4.10.4 a minimum base edge EI value. [1)]

- simplify 4.11 by eliminating the mention of possible expiry dates and referring to AIR 1490 (ISO TR 8647).

- draft a first proposed wording for 5.3, Test methods, and subsequently added 5.4, Test results.

- add to 6.3, Container contours, a reference to ARP 1825 (ISO 10046).

- change minimum area load for heavy duty bases in 7 from 19.5 kPa (400 lb/sq.ft) to 20 kPa (418 lb/sq.ft). **[6B-01]**

- develop as an example the beginning of Table 2 and the tentatively agreed omni-directional testing restraint condition (based on NAS 3610 Figures 13 and 15) for ULD sizes A, B and M, on new page 23. [2)]

Submitted for Panel Members review /e-mail discussion prior to the Washington, Sep. 2001, planned next meeting.

NOTES :

1) ULD manufacturers are requested to propose a minimum edge profile EI value (intended to be taken into account by airframe and cargo system designers for analysing any load distribution difference between the ULD test pattern and their own system's).

2) ULD manufacturers are requested to confirm present ULDs certified in accordance with NAS 3610 can withstand maximum ultimate loads of NAS 3610 load condition 32 while restrained in the configuration described in NAS 3610 Figures 13 and 15 (see OSP/5 minutes).

3) Page 23 shows the proposed Figures for restraint configuration, but the Figures from NAS 3610 in the ULD configuration pages are still not shown, in order to reduce the draft's electronic volume and avoid the transmission difficulties encountered with earlier drafts. Refer to the quoted NAS 3610 Rev.10 drawings if required.

ANNEX 6 - *OSP meeting N° 6 - Monterey CA, April 15, 2002*

Attachment 6C

AS 36100 4th draft summary

Reference : unconfirmed minutes of OSP meeting N° 5, Salt Lake City, April 02, 2001

The attached 4th draft (31 pages) of AS 36100 attempts completing the 3rd draft (23 pages), dated June 15, 2001, circulated as agreed immediately after the Salt Lake City 5th OSP meeting (for a record of the main changes introduced into the 3rd draft, see explanatory report dated June 15, 2001). Though still far from final, this is the first draft that is in principle complete and thus allows to have a look at the total document concept.

In order to save volume for electronic transmission, the ULD configuration drawings in section 7 are not shown in the attached draft : see indicated NAS 3610 drawings, or copy of the 2nd draft handed at the 5th meeting. The testing restraint figures, which were added, are shown in scanned bitmap form. The whole section 8 (pages 23 to 31) is a new proposal. Other revisions from the 3rd draft, mostly editorial, result from the comments received (essentially from J.Jackson, U.Hartmann, P.Emsters). The preliminary comments received from DGAC / JAA (separately circulated) were not taken into account at this stage because they address issues of principle which require prior discussion.

Technical questions to be resolved were identified while preparing this draft and particularly the proposed section 8, testing restraint conditions. The main ones, to be discussed and decided upon by the 6th OSP meeting in Monterey, are as follow :

1. Questions left over from 5th, Salt Lake City, meeting :

1) ULD manufacturers are requested to propose a minimum edge profile EI value (intended to be taken into account by airframe and cargo system designers for analysing any load distribution difference between the ULD test pattern and their own system's). See 4.10.4.

2) Open question : should a minimum duration under ultimate load be specified ? Recommendation would be something like 3s. Such a requirement could be introduced in 5.4.

3) ULD manufacturers are requested to confirm present ULDs certified in accordance with NAS 3610 can withstand maximum ultimate loads of NAS 3610 load condition 32 while restrained in the configuration described in NAS 3610 Figures 13 and 15 (see OSP/5 minutes) and in restraint condition A (page 24) of the draft.

4) As in NAS 3610, the defined tests are static in nature (subject to duration of exposure to ultimate loads, see question **2**). But a peculiar problem remains with configuration B2 - "9g" 88x108" military pallet - since applicable MIL-P-27443E specification refers to - not too well defined - dynamic testing. The OSP therefore still has to decide whether or not this pallet configuration is to be kept, or if AS 36100 should be limited to class 2 ULDs.

2. Questions arising from new section 8, testing restraint configurations :

RC **A** (UC sizes A, B, M) :
- based, as agreed at OSP/5, on NAS 3610 restraint condition 12 (Figures 13, 15, 16). The only change is making it omnidirectional, as are the ultimate loads. The difficulty is, NAS 3610 Figures define different clearances (.25 or .50") according to direction (maybe related to the ULD's longest dimension, due to consideration of upward bending moment, rather than relative orientation in aircraft ?). This results in an otherwise unnecessary difference between "pallet locks" and "side restraints". Should this be maintained ? Or should a single omni-directional

clearance of .50“ (.25 is a tight fit for ease of ULD loading) be used ? Note NAS 3610 Figure 8, to which it is believed most of today's ULDs are certified, already shows a .40“ clearance in the smallest dimension.
- terminology : NAS 3610, seemingly indifferently, uses the words (pallet -) “locks“ and “latches“. This may induce some confusion. Recommend standardizing throughout the document (e.g. “latches“, keeping “locks“ for the sole case of G size “side locks“, thus emphasizing the difference ?). This question might disappear depending on answer to previous question, if only “restraints“ are to be referred to.

RC **B** (UC B2, Class 1) :
- potential, not yet shown in the draft. If it is to be maintained (see question **4)** above), then the restraint condition may need to be shown for a dynamic type of “9g“ forward test.

RC **G** (UC sizes G, R when lengthwise) :
- based on current NAS 3610 sheets, taken verbatim. No specific technical issue identified.

RC **K** (UC size K) and **L** (UC size L) :
- based on current NAS 3610 Figures 33, 34, 35 taken verbatim. The following questions seem to arise :
- recommend changing the 20“ side restraints spacing to 25“ for consistency with RCs A and N. This would not significantly affect the restraint condition, since the same minimum of 2 restraints would remain on each 60.4“ side of a ULD, and the maximum unrestrained edge length would in fact be reduced from the current 19.00“ down to about 10“, under the proviso a continuous side restraints layout every 25“ is specified - this is not the case on current Figures 33 or 34, even though all aircraft systems provide it.
- the stack of 7 units as the certification case seems arguable : it may render testing uselessly more difficult, quite particularly with pallets (not considered at the time of developing NAS 3610) due to shingling, and it reflects only one aircraft type (B747). Should it be considered to replace it with a single unit restraint condition with only one fore and aft stop ? In the worst testing case philosophy adopted, if the ULD withstood the loads with only this one stop, then it would even better with the B747's two ? The necessity to keep the ULD acceptable on B747s might be taken care of by just adding a requirement that an additional load (equivalent to 6 forward ultimate loads) be applied on one 61.5“ base edge only, simultaneously to the ultimate load applied to the ULD itself ? Proposed for OSP discussion.

RC **N** (UC sizes N, S) :
- since these are new sizes, there are no existing NAS 3610 Figures. The proposal is based on NAS 3610 restraint condition 16 (Figures 19, 15, 16) applicable for 2E1 (88 x 53 “) pallets, closest to the new sizes. We thus benefit from the same latches layout (25“ spacing) in Figure 19 as in Figure 13, making RC N fully consistent with RC A.
- as a consequence, the same questions arise as for RC A (see above). **[6C-01]**
- there does not seem to be any question about a corresponding “9g“ class 1 “half-size pallet“, because, contrary to the HCU-6E 88 x 108“ one (NAS 3610 1B6), the military HCU-10E or HCU-12E 88 x 54“ pallets per MIL-P-27443E specification are not shown in the current NAS 3610 and therefore do not seem to have ever been TSO certified.

RC **P** (UC size P) and **Q** (UC size Q) :
- left open as agreed at OSP/5 for Boeing to fill in (based on B767, but possibly also on future aircraft concepts such as a B787 ?).

RC **R** (UC size R when crosswise) :
- NAS 3610 Rev.10 introduced two restraint configurations : Figures 36 and 37, similar except for two more latches along the long side in Figure 37. According to the adopted worst testing case philosophy, the proposal in RC R is based on Figure 36 (also the most commonly used on aircraft : B747 layout).
- no other specific technical issue identified.

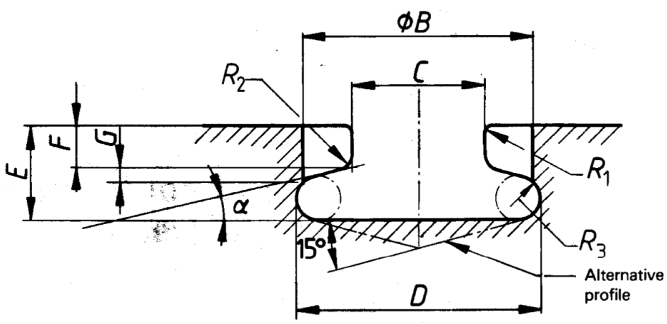
It is proposed the technical questions listed in **1.** and **2.** above be put on the agenda of, and if possible resolved at, the planned 6th OSP meeting in Monterey, as well as general comments on the overall document outline as provided by this 4th draft.

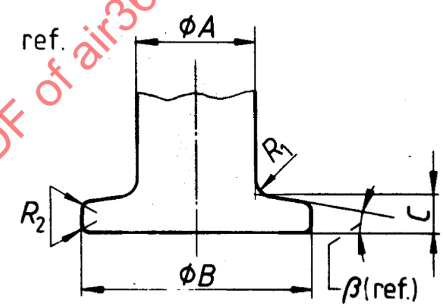
ANNEX 6 - *OSP meeting N° 6 - Monterey CA, April 15, 2002*

Attachment 6D

Track standards : equivalence of ISO 7166 and MS 33601B [6D-01]

A copy of MS 33601B of July 31, 1991, superseding MS 33601A of Dec.1, 1965, was obtained through the Chairman and Secretary. The following is a dimensional comparison with ISO 7166 of Aug. 15, 1985 (all dimensions in inches, radii left out for clarity).





TRACK

Dim.	MS 33601B	ISO 7166
C	.420 - .448	.421 - .449
D	.800 - .820	.799 - .819
E	.300 - .316	.299 - .310
F	.138 - .152	.133 - .154
G	.037 - .049	.039 - .051
α	10° 29' to 15° 33'	10° 30' to 15° 30'

STUD

Dim.	MS 33601B	ISO 7166 single stud	ISO 9788 5000 lb cast double stud
A	.382 - .385	.382 - .386	.386
B	.720 - .740	.721 - .740	.768
C	.124 - .130	.126 - .130	.145
β	8° 35' to 10° 29'	8° 30' to 10° 30'	23°

Proposed conclusions : **[6D-01]**

- MS 33601B and ISO 7166 are very closely equivalent for both track and stud dimensions, with ISO 7166 being slightly more stringent on some tolerances (believed to be non significant).

- the ISO 9788 double stud (no track standard. Designed to fit into ISO 7166 / MS 33601B track) has significantly thicker lips and an inverted angle difference which brings the upward load to bear first on the lips rather than the bottom of the track. It is not equivalent. Note this resulted from the R&D program led by VFW (now EADS / DASA) in 1984 / 86 for ISO TC20/SC9 to demonstrate the parameters required to guarantee a 5000 lb omnidirectional load rating in an ISO 7166 track, which is not necessarily guaranteed with the ISO 7166 / MS 33601B stud contour (for which only about 4000 lb can be surely guaranteed with a double stud regardless of the material used).

- for AS 36100 purposes, one addresses only the ULD, which means primarily the track. The stud normally is part of tie-down hardware, and there is no problem in using ISO 9788 double studs for such a purpose (higher rated load, demonstrated compatibility with all in service aircraft or ULDs). The proposal is therefore to remain with ISO 7166 (or equivalent MS 33601B) only in AS 36100.

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Attachment 6E

Extracts of MIL-P-27443E (USAF)specification (HCU-6E 88x108" pallet, NAS 3610 1B6)

A copy of MIL-P-27443E of Feb.24, 1967 was obtained through the Chairman and Secretary. It states :

3.5 Performance.

3.5.1 Ultimate load. When uniformly loaded to its rated capacity (see 6.3.1), the load being restrained to the pallet by nets (see 6.3.5), installed between rails as shown on figure 10, and resting on three rows of conveyors as specified in 3.5.4.1, the pallet shall withstand a dynamic load of eight times the force of gravity(g's) for a period of time not less than 0.1 second. The pallet need not be serviceable after undergoing such a load; however, the pallet shall remain in one piece.

3.5.2 Static load. When supported by conveyors as specified in 3.5.4.1, the pallet shall be capable of supporting a uniformly distributed static load (see 6.3.2) without permanent deformation.

4.5.8 Static test. While supported by three rows of conveyor located as specified in 3.5.4.1, parallel to the shortest side, the pallet shall be loaded with a static load (see 6.3.2). The load shall remain on the pallet for 1 hour. Permanent deformation as a result of this test shall be cause for rejection.

4.5.9 Ultimate load test. A uniformly distributed load (see 6.3.1) with a specified center of gravity (see 3.4.4) shall be placed on the pallet and tied down with nets (see 6.3.5). The rails shall be located approximately 108 inches apart for Type I and 88 inches apart for Type II and Type III. The pallet shall be restrained against forward movement by engagement of two slots on 40 inch centers on each side directly opposite each other. The entire assembly shall be subjected to a dynamic load of 8 g's for a period of time not less than 0.1 second in the forward direction. The pallet shall be restrained in place without any part of the pallet breaking or becoming delaminated; however, permanent deformation will be acceptable.

6.3 Definition. For the purpose of this specification, the following definition will apply:

6.3.1 Uniformly distributed load. A uniformly distributed load is defined as rectangular units. The total load weight for the Type I pallet shall be 10,000 pounds capacity. The total load weight for the Type II and Type III pallet shall be 5,000 pound capacity.

6.3.2 Static load. The static load for the Type I pallet shall be 45,000 pounds, for the Type II and Type III pallet the static load shall be 22,500 pounds.

6.3.3 Load test. The load for the Type I pallet shall be a uniformly distributed load of 13,000 pounds, for the Type II and Type III pallet the uniformly distributed load shall be 9,000 pounds.

Proposed conclusions :

- The testing ultimate load (for type I, HCU-6E model) is 80,000 lb forward (in a dynamic test, though 4.5.9 does not specify how the 8g for more than 0.1 s are to be achieved, and with a 48" C.G. height). No other ultimate load is specified, though of course the 45,000 lb downward static test may be considered ultimate. This is much in excess of the 54,000 lb forward (with 36" C.G. height) and 36,900 lb downward ultimate loads of NAS 3610 configuration 1B6, implicitly based on 6,000 lb MGW, not 10,000 lb.

- Therefore, apart from identical outline and dimensions, the "463L" HCU-6E pallet has limited commonality with its NAS 3610 1B6 variant, or proposed AS 36100 B2 configuration based on it. Should it be construed that this represents deliberately downgraded conditions of use of military pallets on civil aircraft ?

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Attachment 6F

Main written comments received on AS 36100 3rd draft (June 15, 2001)

Comment on third draft proposal AS36100, Jim Jackson, 24 June 2001

SCOPE, NOTE, Page 2; suggest—noting the definition shown in paragraph 2.2, Cover—that the statement "*the requirements for cargo covers are not defined in this Aerospace Standard*." should have leading comment added such as "*unless net restraint is incorporated*, " and thus read something along the line of: "**Unless net restraint is incorporated,** the requirements for cargo covers are not defined in this Aerospace Standard."

Para 1.1 Purpose, paragraph two, page 2; suggest, for clarity, the last clause be brought forward and the introductory statement would read:
"Other aspects that do not directly pertain to airworthiness certification and testing **are defined in other Aerospace Standards and Aerospace Recommended Practices**, e.g. :
- ULD design specifications,
- ULD in service damage limits,
- Etc. "

Para 2.2 Definitions, page 4; suggest addition of the term "**numeric simulation**" which may need to be defined—as it is not a commonly used term, and may not be recognized by the regulatory side without an understanding of what might be required; e.g. the definition might be something along the lines of, **"simulation of physical test condition and reaction of ULD employing numerical analysis, computational geometry, and computer graphics to obtain proof support and design verification."**

Para 2.2 Definitions, Cover, page 4; suggest the last sentence "*If it does, the performance and testing requirements of the present Aerospace Standard are applicable to the net.*" does not quite establish intent as dual parameters are suggested in the first sentence—i.e., "incorporate" or "permanently attach" net. Suggest change to something like: " If **net is incorporated or permanently attached to cover**, the performance and testing requirements **applicable to the net as shown in this Aerospace Standard are applicable to the net/cover assembly**."

3.3 Configurations, first sentence, page 4; suggest identification of the "7" in text, using either "**paragraph** 7" or "**clause** 7"; and the same in paragraph three, page 5, with respect to "8" —i.e., "**paragraph** 8" or "**clause** 8".

Para 3.5 Classification identifier, page 5; suggest semi-colon replace period at end of second sentence and adding "e.g." followed with a colon. Text would read: " . . . configuration drawings**; e.g.:** " (with example following as shown).

Para 4.4 Construction, last sentence, page 5; suggest "**ISO**" be appended to the "9788" spec number and equivalency be expanded/clarified—concerned that simple "equivalent" is too broad a term in the certification basis context of the document. The last portion of the paragraph might be more acceptable if it were to be stated " . . . configuration**,** or **recognized** equivalent (**e.g., MS33601B),** are . . .." —inclusion of examples of manufacturers stud/track may also be appropriate within the bracket. Para 4.10.1, Ultimate load criteria, first paragraph, second sentence, page 6; concerned that the underlined statement "*taken into account simultaneously*" may be confusing and suggest that appending "which shall be" to the statement may help focus on fact it applies only to the simultaneous application of the gravity centers; e.g.: " limits, **which shall be** taken . . .."

Para 5.2, Test parameters, page 7; suggest slight clarifications along the lines of: "Tests for any given ULD configuration ~~in this Aerospace Standard~~ shall be conducted using the maximum ultimate loads and center of gravity deviations shown in **this Aerospace Standard for that ULD** ~~that~~ configuration, with the ULD being restrained in accordance with the indicated testing restraint condition(s). Analysis or numeric simulation, if used, shall use the same assumptions."

Para 5.3, Test methods, page 7; suggest slight clarifications along the lines of: ". . . specified for that configuration in ~~the present~~ **this** Aerospace Standard. Analysis or numeric simulation, if used, shall provide an equivalent **assurance of conformity** ~~guarantee~~. A test and / or analysis report shall be established to record the details of the method(s) used and **shall** substantiate the results obtained.

Para 5.4, Test results, page 7; small problem with last clause, *"Analysis or numeric simulation, if used, shall be based on yield stress values for the materials concerned."* Shouldn't we ensure "analysis" result confirms that rupture will not occur? Suggest adding text along the lines of: " . . . material concerned**, and shall confirm that the analyzed ULD would not deform or rupture to the extent it's contents would be discharged under the test conditions.** "

Para 6.3, Container contours, page 8; note "container" used here; why not use "ULD"?

The document, I agree, will have to have electronic Figures drawn which can be stored in vectored, not bitmap, form, and include a few adjustments, e.g. to also show metric units. As this will be a significant work program, I agree we will need someone with the necessary resources to step forward soon—a formidable job only a large entity will able to tackle, such as Airbus or Boeing. I believe we will need the completed package available for the FAA's initial review—which, based on the FAA's Cargo Strategic Action Plan, may be as soon as Spring 2002.

Informal comments from DGAC / JAA, Jean-Yves Repussard & Jacques Houget, July 26, 2001

1 Scope
If no 9 g containers are taken into account in this standard, there is no more use to give a definition of class one and class two.

1.1 Purpose
In the list Other aspects that do not directly pertain to airworthinesss certification and testing , add

(repair manual; parts catalogue), after ULD in service damage limits
Add ULD maintenance (FAR 145)

Both are linked, since a FAR145 repair station is not allowed to perform unapproved repairs (ie not allowed in repair manual or not individually approved by the authority), and not to change parts without 8130-3 tags. These parts are the parts listed in the parts catalogue.

1.2 and 2.1.1
TSOs
We would be in favor of a new TSO linked with this new AS36100. All new ULD of appropriate size designs, the certification of which is applied for after this new TSO issuance would have to undergo AS36100.

Previous TSO C90b should be revised to issue d in order to be applicable to evolutions of ULDs the certification the design of which is older than new TSO issuance and to new ULD designs the size is not in AS 36100 but is in NAS 3610 e.g. 9 g containers.

4-5 Change wording “burning rate”, which is an old CAR 4B wording by “Pass test defined by FAR25-855-Appendix F”

4-8 and 5-1
Tests and/or numeric simulations: Choosing between tests, calculus or both must not be left to local authority appreciation without further indication As this standard is an international one, produces will be evaluated in very different more or less rigourous ways If kept guidances how to choose must at least be developed.
This is strongly linked with 5-3 “tests methods” where guidances must be developed.

Further comments
1 As for restraint conditions a wider pitch is under discussion, it would be wise to discuss if a maximum allowed mesh size is to be put for nets.

ANNEX 6 - *OSP meeting N° 6 - Monterey CA, April 15, 2002*

Attachment 6G [6G-01].

Concept of an AIR on "Bibliography of Air Cargo Unit Load Devices related Standards" :

In view of the number of present and future documents relating with either of the "other aspects" listed in 1.1 of the draft AS 36100, it might be helpful to list them in an informative (AIR?) document to be used as a quick reference or bibliography. The following is a first list of candidate documents (SAE or ISO only. "TBD", in this context, means "to be developed", and implies this should be one of the later tasks of AGE-2A or the Panel : 4 or 5 documents may be required).

For brevity, the titles of the documents are omitted : see attached AGE-2A "correspondence of standards" page 1 for identification of contents. The groupings are only first proposals.

1. Government airworthiness regulations :
FAR 25 (JAR 25, later EASA CS-25)
TSO C90
NAS 3610 (ISO 8097)

2. ULD design specifications :
MS 33601B (ISO 7166), later AS 33601
AS 832E (ISO 8323)
AS 1130F (ISO 4117)
AS 1131C (ISO 4115)
AS 1491B (ISO 4171)
AS 1492B (ISO 4170)
AS 4041B (ISO 4128)
AS 5896 (ISO 6517)
(ISO 10327)

3. ULD design criteria :

Test methods :	TBD (new)
Load models :	TBD (new)
Max. allowable contours :	AS 1825A (ISO 10046)
Pressure equalization :	(ISO 11842)

4. ULD continued airworthiness :

In service damage limits :	TBD (AGE-2A on going project)
Restraint malfunctions :	TBD (AGE-2A on going project)

ULD maintenance requirements ?? (ref. FAR 145 ? New ?)

5. ULD accessories specifications :
(ISO 9788 / ISO 12118)
AS 5385 (ISO 16049-1)
ARP1523A (ISO 8058)
ARP1554B (ISO 8268)
ARP1621B (ISO 9469)
ARP1840A (ISO 11241)
ARP1988A

6. ULD utilization :

Pallets utilization :	ARP 5486 (ISO 16412)	
Cargo tie-down :	ARP 5595 (ISO 16049-2)	
Cargo shoring :	ARP 5596	
C.G. location control :	TBD ? (ref. FAA B727F AMOC ruling)	After meeting note: assigned ARP 36103

i.e. a total of nearly 30 documents ... Submitted for AGE-2A OSP consideration.

CORRESPONDENCE TABLE BETWEEN ISO / SAE / IATA STANDARDS
Page 1 / 3 - ULD AND CARGO SYSTEMS (SAE AGE-2A) AREA - Dec. 2001

IATA	SAE	ISO	Subject (abbreviated)
UTM 40/0	-----	-----	Marking of ULDs
UTM 40/1	-----	-----	ULD ID code
UTM 40/2	-----	-----	Intermodal container marking
UTM 50/0	-----	-----	Requirements for interlining / ULD contours
UTM 50/1	AS 1491B	ISO 4171	Interline pallet (NAS 3610 Class II)
UTM 50/2	AS 1492B	ISO 4170	Pallet net (for interline pallet)
UTM 50/2	AS 1131C	ISO 4115	Pallet net (for air-surface pallet)
UTM 50/3	-----	-----	Non structural igloo
UTM 50/4	-----	ISO 6517	Certified container (lower deck)
UTM 50/4	-----	ISO 10327	Certified container (main deck)
-----	AS 4041A	ISO 4128	Certified container (intermodal sizes)
UTM 50/4	AIR 4359	-----	Hanging loads requirements
UTM 50/6	AS 832E	ISO 8323	Intermodal container (w/ corner fittings)
UTM 50/7	AS 1677B	ISO 4118	Non certified container (lower deck)
UTM 50/9	AS 1130F	ISO 4117	Air-surface pallet (16 / 20 ft sizes)
UTM 60/1	ARP1988A	-----	Pallet extension
UTM 60/2	AS 5385	ISO 16049-1	Air cargo tie-down straps (design & testing)
UTM 80/1	ARP1523A	ISO 8058	Thermal container requirements
UTM 80/2	-----	ISO 11242	Pressure equalization requirements
UTM 90/1	ARP1840A	ISO 11241	Aircraft engine transport device
UTM 90/2	ARP1621B	ISO 9469	Horses transport stall
UTM 90/3	ARP1554B	ISO 8268	Automobiles transport device
UTM Ch.11	-----	ISO 3676	Modular (non aircraft) load units
UTM App.	ARP 5595	DIS 16049-2	Air cargo tie-down straps (utilization guidelines)
AHM 911	ARP1334A	ISO 4116	GSE requirements for compatibility with ULDs
-----	NAS 3610	ISO 8097	Certified ULD minimum airworthiness requirements
-----	AS 33601	ISO 7166	Aircraft rail and stud configuration
-----	AIR 1490B	TR 8647	Environmental degradation of textiles
-----	-----	ISO 9788	Cast component of 5000 lbs double stud fittings
-----	-----	ISO 12118	Identification of 5000 lbs double stud fittings
-----	ARP 5486	ISO 16412	Air cargo pallets (utilization guidelines)
-----	ARP 5596	-----	Cargo shoring guidelines (draft)
-----	AS 36100	ISO 21100	ULD airworthiness requirements (draft)

NOTES :

- Classification per IATA, then SAE, then ISO numbers (does not imply precedence).
- Implies some correspondence, not identity : in many cases, documents scopes are different. Where practical, they have been entered on separate lines .
- Revision status indicated for SAE documents only. Requires being checked before use.

ANNEX 7 - *OSP meeting N° 7 - Arlington VA, September 23, 2002*

MINUTES

1. Chairman O. Atienza opened the meeting at 09:00 am. The proposed agenda (Attachment **7A**) was accepted.

2. 13 members and observers were present : O. Atienza (Chmn)

M. Arcelle	U. Hartmann	B. Lemon (SAE)	J. Neeld
J. Burkett	J. Jackson	J.J. Machon	D. Tanner
F. Eriksen	N. Lache	T. Martin (FAA)	H. van Rooijen

3.1 The minutes of the 6th meeting in Monterey, Apr. 15, 2002 were approved without change.

3.2 Review of outstanding questions and assignments :

3.2.1 minimum base edge EI value proposal (see attachment **7C**) :

The theoretical determination proposed in attachment 7B to the agenda was accepted. However, the pallet manufacturers present all confirmed their current edge profiles provide EI values around half the proposed figure (EI # = 5 x 10^7 N.cm^2 / 1.7 10^6 lb.in^2 instead of 10^8 N.cm^2 / 3.5 10^6 lb.in^2). This results from the profiles being designed to withstand the certification ultimate load test, under which permanent deformation is acceptable though not rupture : the peak stress incurred may therefore exceed the material's 0.2% yield normal stress taken as an absolute reference in attachment 7B. This reduces the necessary moment of inertia. Another factor is, modulus of elasticity E varies above or below the average value in attachment 7B, depending on the alloy used.

After discussion, the Panel agreed that the ultimate load test de facto ensures a sufficient minimum value for base edges stiffness. Where airframe or cargo system manufacturers may need a minimum edge EI value, e.g. to determine the effects of a different latches location (the original purpose for introducing this new parameter), it can be derived from the ultimate tests the ULD successfully withstood at certification. Therefore, the last sentence of AS 36100 clause 4.10.4 is to be deleted.

3.2.2 present ULDs compatibility (see Attachments **7D** and **7G**) :

Agenda attachment **7D** presented a tentative comparison between NAS 3610 Figure 13 (across) and AS 36100's proposed RC A. It was, however, modified by changing RC A to reflect, respectively, Figure 13 on the ULD long sides and Figure 8 on the small sides (see **4.3.6** hereafter). Agenda attachment **7G** proposed a revision of attachment **7D** in this context.

Attachment **7D** modified by attachment **7G** were discussed and approved, implying present ULDs certified to NAS 3610 requirements in the A, B and M sizes are deemed compatible with newly proposed AS 36100 RC A.

4. AS 36100 5th draft discussion (see 5th draft and explanatory report, dated Jul. 15, 2002) :

4.1 review changes to "general" part :

1. Scope : The editorial comments submitted by J. Jackson (see Attachment **7H**) were accepted in principle (delete class I and type 1 altogether). However, the proposed wording "...and which conform to all flight and ground

cargo restraint conditions required by FAR 25, excluding 9g forward emergency landing conditions" was not finally agreed because of some members feeling possible ambiguity might result. It was agreed the 6th draft should propose for OSP consideration appropriate wording in line with the actual wording of FAR 25.561 (b)(3) and (c).
The NOTE is to be moved to clause 1.2.

1.2 Field of application : 3rd paragraph, "...manufactured and put in service prior to..." is to be replaced by "...certificated prior to...".

3.1 Types : to be handled same as 1, Scope (see above).

4.9 Dimensions and tolerances : at the beginning of 2nd sentence, add "General tolerances..."

4.10.3.3 : add "... incorporating a single stud tie-down..."

4.10.4 Base performance : in accordance with agenda item 3.2.1 (see above), delete last sentence "All ULD base edge profiles ...".
In order to resolve N. Lache's comment (see Attachment **7H**) on size K (but in fact applicable to all configurations), add a sentence to specify that the underside of all bases edges shall be appropriately rounded or chamfered (wording to be proposed for OSP consideration in 6th draft). **[M7-01]**

4.11 Environmental degradation : delete last sentence "Information as to environmental degradation of textile ..." (will be reflected in future test methods additional document. Requires deleting AIR 1490 and ISO TR 8647 from clause 2, References). **[M7-02]**
NOTE : a reference might become appropriate in the future to the standard currently in the preliminary development stage within ISO/TC20/SC9 as to environmental degradation measurement methods, once published.

5.3 Test methods : the newly proposed NOTE was accepted, under the proviso it also reflects identity of restraint configurations, not only ULD sides.

6.1 Intended use : this clause (original NAS 3610 wording) is to be editorially amended to reflect the wording retained for 1.1, Scope and 3.1, Types.

4.2 review proposed outline of "ULD configurations" part :

4.2.1 rules for metric dimensions and tolerances (see Attachment **7E**) : **[M7-03]**

After discussion, the analysis and proposals in attachment **7E** to the agenda were agreed, with one change : the base size nominal dimensions and tolerances are to be shown with 1 decimal in mm, i.e. (+ 0 / - 1.5 mm) for K, L, P and Q, (+ 0 / - 2.5 mm) for sizes A, B, M, N and S, (+ 0 / - 4.8 mm) for sizes G and R width, and (+0 / - 6.3 mm) for sizes G and R length.

4.2.2 base track drawings :

The proposed introduction of base track drawings where required as per AS 36100 5th draft was agreed, with one change : these drawings are not to show fabrication dimensions, to be defined by a cross reference to AS 33601 (formerly MS 33601B).

4.2.3 sizes G and R edge dimensions proposed adjustment : **[M7-04]**

The drawing change from NAS 3610, shown on section A-A of UC G and R, was agreed.

4.2.4 sizes N and S 14 double stud net proposed configuration : **[M7-05]**

The proposals for new configurations were approved.

4.2.5 pallet and net compatibility. Multiple certification possibility :

The ULD manufacturers present confirmed it is common practice to seek and obtain dual certification for dual purpose pallet nets, e.g. A/M or G/R, based on a single ultimate load test at the most stringent conditions.

4.2.6 Other changes to ULD configurations (UCs) : **[M7-06]**

UC **K** : The comments expressed by N. Lache (see Attachment **7H**) were supported and agreed as follows :

- there is no logic except historical (only one aircraft type at the time) in NAS 3610 specifying an ultimate side load (equivalent to 1.08 g) less than the fore and aft loads (equivalent to 1.50 g). Many modern aircraft types, including large ones, exhibit in their cargo compartments loads in excess of 1.08 g, which may border on 1.5 g in certain instances - thus leading the airframer manufacturer to locally reduce the unit's maximum allowable gross weight. It was agreed to replace the side load by 23,350 N (5,250 lb).

- since this will result in stronger containers and pallets than NAS 3610 configurations 2K1, 2K2 or 2K3, it will be essential to be able to identify and differentiate them. Accordingly, the UC will be designated UC **K4**.

UC **L** : The same decisions thus apply to the two L size ULD configurations, with the ultimate side load to be 46,700 N (10,500 lb) instead of 33,600 N (7,560 lb), and to be designated UC **L5** and **L6** in order to differentiate from NAS 3610 ULD configurations 2L1, 2L2, 2L3 and 2L4.

UC **P** : The same decision applies as to ultimate side load, to be increased from 13,000 N (2,900 lb) to 18,000 N (4,050 lb). However, it is not necessary to change the designation P1 since this size is not covered in NAS 3610 and present containers are non certified only.

UC **Q** : The same decision applies as to ultimate side load, to be increased from 26,000 N (5,800 lb) to 36,000 N (8,100 lb). However, it is not necessary to change the designation Q1 since this size is not covered in NAS 3610 and present containers are non certified only.

4.3 discuss proposals for "restraint configurations" part :

4.3.1 RC A clearance between pallet locks vs side restraints if omnidirectional (see Attachment **7F**) :

After discussion, the analysis and proposals in attachment **7F** to the agenda were agreed. The clearances between restraints for sizes A, B, M, N and S omnidirectional testing are to be 10 mm (.40 inch). Also see **4.3.6**. **[M7-07]**

4.3.2 RC K & L : 7 units stack vs individual testing :

The comment from N. Lache (see Attachment **7H**) was supported and approved : the ULD manufacturers present confirmed they had never witnessed or heard of a container test using 7 containers together. After discussion, it was agreed to replace the testing restraint configurations for sizes K and L by a single ULD testing case, based on one (two for size L) fore and aft end stop (no vertical restraint on the long side), as the potential worst case.

An additional requirement (which may be satisfied by analysis) will be added to simulate the forward load of 6 other units on the base side, in order to verify restraint capability on those aircraft types where units are restrained in stacks. Also see **4.3.6**. **[M7-08]**

This may not apply to sizes P and Q (B767 sizes), where the units are normally restrained in stacks.

4.3.3 RC N : confirmation of proposed single restraint condition : [M7-09]

The new restraint configuration proposal was agreed (see agenda item 4.2.4) with the following changes :
- a single ULD to be shown,
- omnidirectional restraints clearance to be 10 mm (.40 inch) (see agenda item 4.3.1),
- only three restraints at 25 inch spacing along the ULD long side (see RC A, 4.3.6 hereafter).

4.3.4 RC P & Q : Boeing input for certified containers restraint : [M7-10]

Boeing input was received from O. Atienza as per UC P and Q drawings, and agreed (see 4.3.2 above).

4.3.5 RC R : confirmation of proposed single restraint condition : [M7-11]

The proposed RC drawing (based on NAS 3610 Figure 36 rather than 37) was agreed, side locks to be deleted.

4.3.6 Other changes to restraint configurations (RCs) :

Clause 8.2, Table **2** : delete the "Class" and "Upper/ Main/ Lower deck" columns, unnecessary. Amend RC P to read "1194 x 1534 mm" rather than "1198 x 1534". Define "lengthwise" and "crosswise" in terms of orientation.

All RCs : show restraint details with one (single head) side restraint only (no double ULD testing). One drawing required only since testing condition is omni-directional. Standardize width of restraints (variable in NAS 3610 according to configuration) to 25 mm (1.0 inch), except for RC K and L and side locks of RC G .

NOTE : NAS 3610 restraint width (in inches) is :

RC	1, 2	5	7, 8	9	11,12	13,14	16,17	18	19	20	22,23
Figure	1	5	8	9	13	14	19	21	22	23	27
Fore & aft restr.	2.13" or 2.34"	2.13" or 2.34"	1.80"	1.80"	2.25"	2.25"	2.25"	2.25"	3.12"	4.10"	1.00"
Side Restr.	4.00" or .36/1.16"	4.00" or .36/1.16"	1.25" 4.00"	1.25" 4.00"	2.25"	2.25"	2.25" 1.00"	2.25" 1.00"	3.00"	4.00"	2.20" 4.00"

It was agreed 1.0" restraint width therefore constitutes a testing worst case. **[M7-12]**

RC **A** (see Attachment **7G**) : the comment from N. Lache was supported and agreed. RC A is to be replaced by the alternate restraint configuration shown in attachment **7G**, with 3 restraints in the smallest ULD dimension (in accordance with NAS 3610 Figure 8) and 5 restraints in the longest ULD dimension (in accordance with NAS 3610 Figure 13). The total of 16 restraints instead of 18 is deemed acceptable as a testing worst case on the basis of the analysis provided in attachment **7G**.

RC **G** : the figure's legend is to be amended to reflect the 20.125" spacing applies to vertical restraints whereas side locks properly speaking are spaced 40.250" (NAS 3610 inaccuracy). **[M7-13]**

RC **K** and **L** : see agenda item 4.3.2 above. A note is to be added under "Other testing conditions" to reflect the additional requirement to simulate the forward load of 6 other units on the base side, in order to verify restraint capability on those aircraft types where units are restrained in stacks. **[M7-08]**

RC **N** : a single ULD is to be shown, with 10 mm (0.40 inch) clearance between restraints and only 3 restraints on the 88/96" sides (total 10 restraints instead of 12) in order to be consistent with already accepted alternate RC A (see above). **[M7-09]**

RC **R** : side locks are not to be shown (contrary to lengthwise RC G) : the configuration across the aircraft can be used with only vertical restraints (worst case).

5. Status and priorities of foreseen "satellite" documents :

It was agreed the various additional "satellite" documents deemed necessary will be discussed and developed by the main **AGE-2A** itself, through appropriate sponsors and working groups, rather than the OSP. The paragraphs hereafter do not constitute part of the present meeting minutes, and are a summarized report of the discussions held within the main AGE-2A committee on September 24 and 25 as to subject matters.

5.1 review and discuss concept of "Bibliography AIR":

Assigned to co-sponsors U. Hartmann and R. Fu. It might be structured in 3 tiers of airworthiness (FAR and TSO) reference documents, design and testing ARPs, operational and utilization ARPs (see hereafter).

5.2 ULD "load models" (ARP 36101 ?) :

Assigned to co-sponsors F. Eriksen and J. Neeld. J.J. Machon will provide as a starting point the summary of previous OSP agreements.

5.3 ULD test methods (ARP 36102 ?) :

Assigned to co-sponsors F. Eriksen and U. Hartmann. F. Eriksen presented AGE-2A with a first draft which met general agreement subject to later more detailed reviews, and the following principles were agreed : all used test methods should be covered ; container testing methods should be covered separately from pallet and net, possibly as two parts in the same document.

5.4 ULD C.G. control means (ARP 36103 ?) :

Assigned to co-sponsors J.J. Machon and M. Arcelle. J.J. Machon will provide as a starting point the operating procedure proposal that had been developed within the course of the ATA W/G study in response to the FAA's converted B727F NPRM.

5.5 ULD in service damage limits (AGE-2A Project N° 97-04), FAR 145 maintenance :

Assigned to sponsor U. Hartmann. Likely to be redesignated "ULD serviceability limits". ARP number to be assigned (within 3610X series ?). Draft expected to be circulated shortly.

5.6 ULD restraint malfunctions limits (ARP 5492) :

Assigned to sponsor B. Danczyk. AGE-2A ballot in July 2002 resulted in one disapproval. Expecting resolution of disapproval and ballot comments. Reballot seems likely.

5.7 ULD utilization guidelines (ARP 5486 Pallets, ARP 5595, Tie-down) :

Both now published. A separate ARP might be considered for operational utilization use rules for containers.

5.8 Heavy cargo shoring guidelines (ARP 5596) :

Now published.

6. FAA / TSO relationship, response to OSP Chairman letter to FAA :

The FAA had responded to the OSP Chairman's letter. T. Martin (present) and H. Hoffermann (apologies) from the Transport Aircraft Directorate in Seattle were assigned to liaise with the OSP.

On the European scene, Authorities part of the JAA were kept informally informed, concur with the project's intent, and keep indirectly monitoring. It is expected any new FAA TSO would be shortly adopted by the JAA as a European ETSO.

7. Follow-up action, tasks assignements :

It was agreed J.J. Machon will prepare and circulate prior to the 8th meeting in Scottsdale on April 07, 2003 a 6th draft of AS 36100 taking into account the Panel's decisions.

See minutes above for other task assignments (c/o AGE-2A for "satellite" documents).

More frequent meetings (i.e. between the regular SAE AGE-2 ones) might later become necessary to finalize the document. It was unanimously felt the TSO Authorization proposal process may be started only once AS 36100 is completed and final.

8. Meeting closure :

Chairman O. Atienza closed the meeting at 08:00 p.m.

ANNEX 7 - *OSP meeting N° 7 - Arlington VA, September 23, 2002*

Attachment 7A AGENDA

1. Adoption of agenda.

2. Membership review. Election of officers if required.

3. Review of minutes of meeting N° 6 - Monterey, April 15, 2002 :

3.1 minutes approval.

3.2 review of outstanding questions and assignments (see Attachments **7C**, **7D** and **7F**) :
3.2.1 minimum base edge EI value proposals (see Attachment **7C**).
3.2.2 present ULDs compatibility with NAS 3610 LC 32 under Fig.13/15 restraint (Attachments **7D** and **7F**).

4. AS 36100 5th draft discussion (see 5th draft and Attachment **7B** summary, dated Jul. 15, 2002) :

4.1 review changes to "general" part from AS 36100 4th draft, Mar. 15, 2002.

4.2 review proposed outline of "ULD configurations" part :
4.2.1 rules for metric dimensions and tolerances (see Attachment **7E**).
4.2.2 base track drawings.
4.2.3 sizes G and R edge dimensions proposed adjustment.
4.2.4 sizes N and S 14 double stud net proposed configuration.
4.2.5 pallet and net compatibility. Multiple certification possibility.

4.3 discuss proposals for "restraint configurations" part (5th draft) :
4.3.1 RC **A** : clearance between pallet locks vs side restraints if omnidirectional (see Attachment **7F**)
4.3.2 RC **K** & **L** : 7 units stack vs individual testing.
4.3.3 RC **N** : confirmation of proposed single restraint condition (see 4.3.1).
4.3.4 RC **P** & **Q** : expected Boeing input for certified containers restraint.
4.3.5 RC **R** : confirmation of proposed single restraint condition.

5. Status and priorities of foreseen "satellite" documents (ARPs 36101 - 36109 ?).

5.1 review and discuss concept of "Bibliography AIR" (see Attachment **6G**).
5.2 ULD "load models" (TBD).
5.3 ULD test methods (TBD).
5.4 ULD CG control means (TBD).
5.5 ULD in service damage limits (AGE-2A Project N° 97-01). FAR 145 maintenance ?
5.6 ULD restraint malfunctions limits (ARP 5492).
5.7 ULD utilization guidelines (ARP 5486, Pallets, ARP 5595, Tie-down). Containers ?
5.8 Heavy cargo shoring guidelines (ARP 5596).
5.9 Other subjects and documents.

6. FAA / TSO relationship, response to OSP Chairman letter to FAA, feedback from FAA and JAA.

7. Follow-up action summary, tasks assignments in preparation of the next Scottsdale 8th meeting.

ANNEX 7 - *OSP meeting N° 7 - Arlington VA, September 23, 2002*

Attachment 7B

AS 36100 5th draft summary

Reference : minutes of OSP meeting N° 6, Monterey, April 15, 2002

The attached 5th draft of AS 36100 attempts completing the 4th draft, dated March 15, 2002, circulated prior to the Monterey 6th OSP meeting (for a record of the main changes introduced into the 4th draft, see explanatory report dated March 15, 2002), based on the decisions reached at that meeting. Though still probably not yet final, this draft is in principle complete and thus allows to have a look at the total document concept and internal consistency. It can be seen that the main simplification **objectives** initially agreed by the OSP have been met, even though 4 new sizes N, P, Q, S were introduced to fit the market's needs :

- 31 pages instead of 93 in NAS 3610 Rev.10,
- 12 ULD configurations instead of 44 (configuration B2, "9g" 88x108" pallet, was deleted as agreed),
- 8 testing restraint conditions instead of 32,
- two steps utilization (UC, RC) instead of five steps (Tables I, II, III, ULD configuration, restraint figures).

In order to facilitate printing, the draft has been reformatted to fit "letter" 8.5 x 11 inch paper size, vs ISO A4 size used in the previous drafts. Changes from the 4th draft are underlined by a bold line in the left hand margin, and their words highlighted in red. Configuration drawings and testing restraint figures are shown in scanned bitmap form, and may still need to be developed in a vectorized form prior to publication, but configuration drawings show dimensions in both mm and inches as agreed (**tolerances** application to be reviewed).

The identified **technical questions** remaining to be resolved, and to be discussed at the Washington 7th meeting, still include those listed in the March 15, 2002 explanatory report, less those decided upon in Monterey :

1) ULD manufacturers are still requested to propose a minimum edge profile EI value (intended to be taken into account by airframe and cargo system designers for analyzing any load distribution difference between the ULD test pattern and their own system's). See 4.10.4.

2) ULD manufacturers are requested to confirm present ULDs certified in accordance with NAS 3610 can withstand maximum ultimate loads of NAS 3610 load condition 32 while restrained in the configuration described in NAS 3610 Figures 13 and 15 (see OSP/5 minutes) and in restraint condition A (page 24) of the draft.

3) RC **A** (UC sizes A, B, M) :
- based, as agreed at OSP/5, on NAS 3610 restraint condition 12 (Figures 13, 15, 16). The only change is making it omnidirectional, as are the ultimate loads. The difficulty is, NAS 3610 Figures define different clearances (**.**25 or **.**50") according to direction (maybe related to the ULD's longest dimension, due to consideration of upward bending moment, rather than relative orientation in aircraft ??). This results in an otherwise unnecessary difference between "pallet locks" and "side restraints". Should this be maintained ? Or should a single omnidirectional clearance of **.**50" (**.**25" is a tight fit for ease of ULD loading) be used ? Note NAS 3610 Figure 8, to which it is believed most of today's ULDs are certified, already shows a **.**40" clearance in the smallest dimension. This might be the right value for an omnidirectional application (confirmation by the Panel is requested).
- terminology : NAS 3610, seemingly indifferently, uses the words (pallet -) "locks" and "latches". This may induce some confusion. Recommend standardizing throughout the document (e.g. "latches", keeping "locks" for the sole case of G size "side locks", thus emphasizing the difference ?). This question might disappear depending on answer to previous question, if only "restraints" are to be referred to.

4) RC **K** (UC size K) and **L** (UC size L) :
- side restraint spacing was increased to 25" (but continuous, in order to guarantee presence of either 2 or 3 restraints on each unit), as agreed in Monterey and later confirmed by Airbus. See RC drawings. **[7B-04]**
- the stack of 7 units as the certification case remains arguable : it may render testing uselessly more difficult, quite particularly with pallets (not considered at the time of developing NAS 3610) due to shingling, and it reflects only one aircraft type (B747). Should it be considered to replace it with a single unit restraint condition with only one fore and aft stop ? In the worst testing case philosophy adopted, if the ULD withstood the loads with only this one stop, then it would even better with the B747's two ? The necessity to keep the ULD acceptable on B747s might be taken care of by just adding a requirement that an additional load (equivalent to 6 forward ultimate loads) be applied on one 61.5“ base edge only, simultaneously to the ultimate load applied to the ULD itself ? Proposed for Panel discussion. **[7B-05]**

NOTE : were containers ever effectively tested in a 7 units stack ? ULD manufacturers requested to confirm.

5) UC and RC **P** and **Q** :
- these 4 pages were left open as agreed at OSP/5 for **Boeing** to fill in (based on B767, but possibly also on future aircraft concepts such as a B787 ?).

In addition, other technical questions were identified throughout the ULD configuration drawings (proposed changes highlighted by a bold line in the margin) and their metric dimensions, with the main ones as follow :

6) Dimensional tolerances : **[7B-01]**
- **general** tolerances, <u>except where otherwise noted</u>, are per NAS 3610 (no change is advisable) in inches : ± 0.01 for three place decimals, ± 0.03 for two place decimals, ± 0.1 for one place decimals,.translated (see 4.9) as ± 0.01 mm for two places decimals, ± 0.1 mm for one place decimals, ± 1 mm without a decimal.
- **base** size dimensions tolerances, however, <u>are</u> otherwise noted in ULD configuration drawings, and three different sets can be found in NAS 3610 :
- for most sizes : XXX.0, i.e.(see above) ± 0.1 in. Since it had been agreed by AGE-2A no + tolerance is allowable, this was translated as + .0 / - .1 in, or + 0 / - 3 mm (or should it read - 2.5 mm, the correct conversion for 0.1 ?). Should these NAS 3610 tolerances be changed to two decimals in inches (one decimal in mm), for consistency with the two other cases hereafter ? To be confirmed by the Panel.
- for G and R sizes : + .0 / - .19 in, or + 0 / - 4.8 mm (correct conversion),
- for K and L sizes : + .0 / - .06 in, or + 0 / - 1.5 mm (correct conversion).

Tentatively, the first set was used for proposed new sizes N and S as derivatives of M and A. Logically, the last one should apply to Boeing's new sizes P and Q ? Confirmation of these values by the Panel is requested.

NOTE : in metric industrial practice, two place decimals (hundredths of a mm) are used only for high precision items such as machined bores, etc.. One place decimals (tenths of a mm) are considered maximum reasonable fabrication accuracy for a ULD at current costs.

7) Track drawings :
- tentatively, the distance of track centerline from base edge (not shown in NAS 3610) was added, from existing ULD design specifications. See UC A, B, K, L, M, N, S. The logic is, aside from operational standardization (not the purpose of AS36100), the load path is affected by this unshown dimension. Confirmation by the Panel is requested.
- where a single stud net fitting is mandatory and no continuous track option is allowable, the receptacle's drawing was adjusted accordingly. See UC K1 and L2. Confirmation by the Panel is requested.

8) Sizes **G** and **R** edges :
- tentatively, the edge dimensions in section A-A were modified to reflect different requirements for containers and pallets, bringing the minimum pallet thickness down to 2.00 in instead of 2.25 in, consistent with industry practice. Confirmation by the Panel is requested. **[7B-02]**

9) New sizes **N** and **S** (half-pallets) : **[7B-03]**
- the new proposed configurations are based on 14 double stud fittings, instead of 18 single stud ones in closest NAS 3610 configuration 2E2. This is for consistency with respective parent configurations M and A, as well as sturdiness and lower cost exhibited by double stud fitting nets. Fitting spacings were selected based on UC A and M for the 88/96 in sides and K and L for the 61.5 in side. Confirmation by the Panel is requested.

10) Pallet and net compatibility :
- tentatively, pallet and net compatibility (necessary in NAS 3610 due to numerous configurations for the same size) is not shown on UC drawings. The idea is, each net certified for a given size shall be used only together with a pallet of that size - not to preclude, e.g., double size certification such as A/M, or N/S, or G/R, if the net effectively was certified for both concerned sizes and marked accordingly (a common airline practice). Confirmation by the Panel is requested. An additional wording in the main text of the standard might be required for clarification.

Submitted for Panel evaluation and discussion at the N° 7, Arlington VA, September 23, 2002, next meeting.

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Attachment 7C

Minimum base edge EI value : **[7C-01]**

Since OSP meeting N° 5 in Salt Lake City, April 2001, it has been agreed to include a minimum base edge EI value for all ULDs in order to allow airframers and cargo systems designers to assess the effect of changes in aircraft restraint configurations. The ULD manufacturers were requested through the minutes to provide a proposed value. No feedback was yet obtained. Accordingly, the following is an attempt at theoretical computation of such a minimum EI value from the requirement approach :

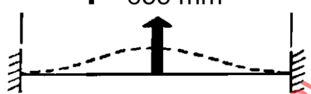
1. Worst case identification :

The worst case seems to be ultimate upward load, with 25" (635 mm) vertical restraints spacing as per AS 36100 RC A, where the upward load of a net fitting happens to be applied exactly at the center of the 25" (635 mm) spacing.

The maximum upward load **F** applied on one fitting is 169 000 N (UCs A & M upward ultimate load) divided per 18, multiplied by 1.25 to take into account simultaneous maximum 10% longitudinal and lateral CG eccentricities, i.e. 11736 N.

2. Computation (in metric units) : l = 635 mm

Based on the deflection schematic :



the maximum bending moment **M** at the center of length l is $\frac{F.l}{4}$ (vs $\frac{F.l}{24}$ if load was distributed).

The maximum normal stress in the edge at this location is $\sigma_{max} = \frac{M}{I/v}$, where **v** is the half height of the edge extrusion.

Therefore the minimum required moment of inertia is $I = \frac{F.l.v}{4.\sigma_{max}}$, where F = 11736 N, l = 635 mm.

Taking 20 mm (approx. ¾ in) for **v**, corresponding to a 40 mm (1 ½ in) thick extrusion, and assuming the minimum strength alloy used is 2024 which has a rated 0.2% yield normal stress of 32.10^7 Pa (N/m^2) or 32 000 N/cm^2, one obtains $\mathbf{I_{min} = 11.64\ cm^4}$.

With E, for 2024 alloy, being 7.3 10^6 N/cm^2, one obtains $\mathbf{EI_{min} = 85 . 10^6\ N.cm^2}$ (2.96 10^6 lb.in^2).

3. Proposal :

In order to provide some additional margin over the rated yield stress and cater for a simplified computation's accuracy, it is proposed to round up the result to enter into AS 36100 clause 4.10.4 :

$\mathbf{EI_{min} = 10^8\ N.cm^2\ (3.5\ 10^6\ lb.in^2\ )}$.

This 18% increased value would ensure the 2024 alloy yield stress is not exceeded under the specified testing ultimate load conditions.

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Attachment 7D

Present ULDs compatibility :

Since OSP meeting N° 5 in Salt Lake City, April 2001, it has been agreed to check that current ULDs (specially pallets, the lifetime of which is higher than a containers' and even more a nets') certified to NAS 3610 Rev.10 requirements could safely be accommodated into the restraint systems of future aircraft which might be designed taking into account only AS 36100 requirements. The ULD manufacturers were requested through the minutes to provide a confirmation. No feedback was yet obtained. Accordingly, the following comparison is proposed :

1. Restraint configurations comparison :

The restraint configurations applicable in the testing worst case for ULD sizes A and M are :

- according to **NAS 3610** Rev.10, Table II's load condition (LC) 18 or 32 (upward load 38 000 lb), in Table I's restraint condition 7 consisting (Table III) of Figures 8, 10 and 11, for the lengthwise case, **or** Table II's load condition 14 (upward load 37 500 lb) in Table I's restraint condition 11 consisting (Table III) of Figures 13, 16 and 15, for the crosswise case.

NOTE : LC 18 is in fact more critical than AS 36100's UC/RC A, due to the increased 14.4% and 21.4% CG eccentricity - which the OSP has found useless in practice. Hence comparison needs be only with LC 32, the less stringent.

- according to **AS 36100**, UC A1 or M1 (38 000 lb up load) in RC A (lengthwise or crosswise).

Since ultimate loads are the same, the significant differences in restraint amount to the following :

Direction	Document	Figures	Restr. number / spacing	Fore & aft restr.	Side restraint
length	**NAS 3610**	8, 10,11	18 20.13 or 24.75" spacing	1.10" overlap 0.20" clearance	1.00" overlap 0.40" clearance
across	**NAS 3610**	13,16,15	18 25.00" spacing	1.00" overlap 0.25" clearance	1.00" overlap 0.50" clearance
both	**AS 36100** **(1)**	RC A	18 25.00" spacing	1.00" overlap 0.40" clearance	1.00" overlap 0.40" clearance

(1) current clearance shown 0.25 / 0.50". Proposal for testing : 0.40" omni-directional, to be confirmed.

2. Comparison assessment :

AS 36100 testing restraint is equivalent to the NAS 3610 across configuration. Only the lengthwise configuration presents a difference.

In this case, the number of latches remains the same, only spacing varies. This might result in a problem when ULDs tested with 20.13" spacing are carried in a system with 25" spacing. However :

- latches distribution is more even in the AS 36100 case, i.e. unsupported lengths (where vertical loads may be applied) are higher in the NAS 3610 case (up to 47.68" for size M, vs 27.12").

- ULD base edge remains the same on both sides : hence, if it withstands ultimate load deflection at 25" spacing on one side, it should also withstand it on the other side.

It thus seems the restraints arrangements can be considered both ways equivalent, and RC A does not create a problem with former ULDs, should a new aircraft's system take into account only ULDs certified to AS 36100 requirements. An additional check would be to verify current ULDs base edge EI values meet the new AS 36100 requirement (see Attachment **7C**) based on 25" spacing.

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Attachment 7E

Metric dimensions and tolerances : **[7E-01]**

Conversion to SI (metric) units needs to be in accordance with SAE TSB-003 (1999 revision), *Rules for SAE use of SI (metric) units*, and requires precise rules to be agreed for, respectively, dimensions (number of decimals) and tolerances. See AS 36100 5th draft UC section for examples (to be adjusted after discussion).

1. Nominal dimensions :

The exact ("hard") SI (metric) conversions for NAS 3610 ULD base nominal outer dimensions are :

inches	**60.4**	**61.5**	**88.0**	**96.0**	**108.0**	**125.0**	**196.00**	**238.50**
mm	1534.16	1562.10	2235.20	2438.40	2743.20	3175.00	4978.40	6057.90

It is possible to use for ULD base outer dimensions either 1 decimal figures, i.e. an accuracy (see AS 36100 § 4.9) of ± 0.1 mm (0.004 in) (not to be mistaken for tolerance, see 2 hereafter) :

mm	1534.2	1562.1	2235.2	2438.4	2743.2	3175.0	4978.4	6057.9

or figures with no decimal, i.e. an accuracy (see AS 36100 § 4.9) of ± 1 mm (0.04 in) :

mm	1534	1562	2235	2438	2743	3175	4978	6058

NOTE : base dimensions in NAS 3610 are defined with 1 decimal (accuracy ± 0.1 in / 2.5 mm) for all sizes, except sizes G, K, L and R where 2 decimals (accuracy ± 0.03 in / 0.76 mm) are used. The second case above with no decimals is therefore more consistent, in accuracy terms, with the dimensions expression in inches.

2. Base size tolerances :

Noted on drawings, they are to be, per SAE AGE-2A decision, + 0.0 / - 0.1 in (+ 0.0 / - 2.54 mm). The resulting fabrication tolerance intervals (which cannot be lower than accuracy) therefore are :

inches	60.30	61.40	87.90	95.90	107.90	124.90	195.90	238.40
to :	60.40	61.50	88.00	96.00	108.00	125.00	196.00	238.50

NOTE : however, NAS 3610 specifies outer base dimensions with a (+ 0.00 / - 0.06 in) tolerance for K and L sizes : this is less than the above, and presumably should be kept. It also specifies (+ 0.00 / - 0.19 in) tolerance for G and R sizes, but, since this is larger than the agreed (+ 0.0 / - 0.1 in), it may safely be ignored. The resulting fabrication tolerance intervals for each size are as follows :

inches	60.34	61.44	87.90	95.90	107.90	124.90★	195.90	238.40
to :	60.40	61.50	88.00	96.00	108.00	125.00	196.00	238.50

★ (124.94 for size L)

and their exact ("hard") conversion in mm (including sizes G, K, L and R peculiarities) is :

mm	1532.64	1560.58	2232.66	2435.86	2740.66	3172.46★	4975.86	6055.36
(a) to :	1534.16	1562.10	2235.20	2438.40	2743.20	3175.00	4978.40	6057.90

★ (3173.48 for size L)

to be compared with, if 1 decimal figures (+ 0.0 / **- 2.5** mm tolerance) are used :

mm	1531.7	1559.6	2232.7	2435.9	2740.7	3172.5	4975.9	6055.4
(b) to :	1534.2	1562.1	2235.2	2438.4	2743.2	3175.0	4978.4	6057.9

or, if no decimal figures (+ 0 / **- 3** mm tolerance) are used :

mm	1531	1559	2232	2435	2740	3172	4975	6055
(c) to	1534	1562	2235	2438	2743	3175	4978	6058

This shows the fabrication tolerance intervals of line **(b)** are mostly within the intervals in inches, while the intervals of line **(c)** are somewhat (from 0.36 to 1.64 mm) larger on the low side. This may be acceptable : the only practical consequence to be expected is not safety related, but may slightly affect wear duration in airline service. Yet, if this was not desired, then an alternate solution could consist in using a (+ 0 / **- 2** mm) tolerance instead of (+ 0 / - 3 mm) :

mm	1532	1560	2233	2436	2741	3173	4976	6056
(d) to	1534	1562	2235	2438	2743	3175	4978	6058

Then, except, within ½ mm, for sizes K and L (which exhibit very little in service wear), the fabrication tolerance intervals of line **(d)** are contained within the intervals in inches. In addition, the tolerance interval (+ 0 / - 2) is equal to the accuracy (± 1), hence consistent internally as well as with the imperial units accuracy (± 0.1 in). A 2 mm overall fabrication tolerance seems achievable - including any diagonal measurements - with today's technology at no significantly increased cost.

3. General tolerances :

Pallet net fittings spacings are expressed in NAS 3610 with a **.**00 dimension in inches, implying (in accordance with NAS 3610 § 3.9 / AS 36100 § 4.9) a ± 0.03 in (± 0.76 mm) tolerance.

Pallet track geometry is specified with a **.**000 dimension in inches, implying (in accordance with the same) a 0.01 in (± 0.25 mm) tolerance : contradiction, since net fittings are installed on tracks ! A worse contradiction in NAS 3610 is, most net fittings spacings have a non integer dimension in inches, while continuous track can obviously be used only with an integer number of 1 inch spaced holes!

Sizes G and R side restraint slots spacing is specified as (N x 20.125 in), i.e. (see AS 36100 § 4.9) in principle with a ± 0.01 in (± 0.25 mm) tolerance, while the tolerance on the drawing is otherwise specified (hence no formal contradiction) as ± 0.03 in (± 0.76 mm).

4. Proposals :

Based on the above analysis, it is proposed to use the following set of rules to convert NAS 3610 figures into SI (metric) system units :

- nominal base size dimensions, whether expressed as **.**0 or **.**00 in inches, to be converted into mm figures with no decimal (see 1 above),

- base size tolerances shown on drawings to be :

	sizes K and L	all other sizes
inches :	+ 0.00 / - 0.06	+ 0.00 / - 0.10
mm :	+ 0 / - 2	+ 0 / - 2

NOTE : **alternate solution** to be considered : use (+ 0 / - 1.5 mm) for K and L, (+ 0 / - 2.5 mm) for other sizes ?

A note in the general part might be advisable to stress the tolerances shown apply for new units only : in service wear tolerances are to be defined for each cargo system in its manuals.

 general tolerances to conform with AS 36100 § 4.9, with the following applications :

- track (mechanical engineering) dimensions in **.**000 inch (± 0.01 in / 0.25 mm, or SI ± 0.1 mm),
- net fittings and restraint spacings in **.**0 inch (± 0.10 in / 2.5 mm), with net fittings spacings only as integers of 1.0 inch (nearest from current decimal figure),
- side restraint slots dimensions and spacings to be kept as in NAS 3610 (± 1 mm SI tolerance).

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Attachment 7F

Restraint configurations latch clearances :

NAS 3610 exhibits quite a variety of latch clearances throughout restraint configurations. The rationale is not always understood, but it is believed likely they originally reflected identified aircraft restraint systems, hence used these aircraft's existing clearances. A summary (clearances in inches) is as follows :

Figure	**1**	**5**	**8**	**9**	**13**	**14**	**18**	**19**	**21**	**22**	**23**	**24**	**27**	**31**	**32**	**33**	**34**	**36**	**37**
Fwd details	2	2	10	10	16	16	16	16	16	25	26	25	29	32	32	35	35	10	10
Side details	3,4	3,4 6,7	11, 12	11, 12	15, 17	15, 17	17	15, 17	17, 20	25	26	25	28, 30	32	32	35	35	32	32
NAS 3610 ULD size(s)	A	E	A,B C,M	A,B M	A,B M	A,B C	D	E	E	B,C	B,C	C	B,D	F,G H,J	R	K	L	R	R
across/length	acr	lng	lng	acr	acr	lng	lng	lng	lng	acr	acr	acr	acr	lng	lng	acr	acr	acr	acr
fore/aft clear.	.25	.25	.20	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	n.a.	n.a.	none	none	.20	.28
lateral clear.	.25	.25	.40	.20	.50	.50	.50	.50	.50	.50	.50	.50	.88	.40	.40	.10	.20	.40	.50
AS36100 RC					**A**									**G**		**K**	**L**	**R**	

In general, forward and lateral clearances are different, and the latter higher. It is not known whether this intended to relate with the ULD's longest dimension or the orientation in the aircraft. The first would be technically understandable : consideration of upward bending moment. But it does not seem to be supported by the numbers, which are clearly related to the orientation in the aircraft, regardless of the same ULD being across or lengthwise. No technical explanation comes to mind in this case, since testing ultimate loads per Table II are in most cases identical for forward and lateral directions. It must therefore be assumed, the forward clearances refer to movable latches and the lateral clearances to fixed latches, thus requiring more clearance for ULD movement (again, likely reflecting actual aircraft systems rather than minimum testing requirements).

This results in testing conditions never being omnidirectional, even though ultimate loads are the same. The Panel has agreed AS 36100 testing restraint configurations (RCs) to be omnidirectional, so that a ULD can be tested in both directions only once, irrespective (except of course sizes G, K, L, R) of orientation in the aircraft. Hence, what restraint clearances should be defined all around the base periphery ?

Consistency with NAS 3610 and previously granted TSO certifications would imply selecting the highest clearance in the above table for a given ULD size : if successfully tested in this condition, the ULD will perform even better with a lower clearance (worst case approach). This would result in **.**50 inch (all around) for sizes A, B, M, **.**40 inch for sizes G, R, **.**10 inch for size K and **.**20 inch for size L (since these two sizes do not have vertical restraint on the long side, they definitely cannot be tested omnidirectionally, and their clearances should not be changed, for performance consistency).

This might make the testing requirement more difficult for a given size A, B or M ULD (i.e., AS 36100 tougher to meet than NAS 3610). However, it should be noted that, according to NAS 3610 Load condition 16 or 18, Restraint condition 7, Figure 8, maximum ultimate load sizes A, B and M have to be tested with **.**40 inch lateral clearance and **.**20 inch fore and aft clearance. Making it **.**40 all around would still exceed this requirement, to which most of today's ULDs are certified.

Proposal : **[7F-01]**
The Panel to consider and approve, on the basis of the above analysis, an omnidirectional clearance of **.40 inch (10 mm)** in restraint configuration A for sizes A, B, M (RC N for sizes N, S to be investigated). Figure on page 24 to be modified accordingly.

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Attachment 7G

Restraint configuration (RC) A :

Current (5th draft) AS 36100 RC **A**, based on NAS 3610 Figure 13, is omnidirectional and contains 4 latches on the small sides and 5 on the long sides, for a total of 18 latches, spaced 25 in. Comments expressed by Airbus (see "NAS 3610 restraint and load conditions" presentation, ref. ECBL 27/8/02) point at this resulting in an inconsistency in the lengthwise case, where 4 forward latches are required for testing while most in service aircraft systems use 3 (NAS 3610 Figure 8). A ULD tested with 4 latches could hardly be acceptable on an aircraft with only 3. The alternate proposal therefore would be using Figure **13** for the **long** sides (5 latches) and Figure **8** for the **small** sides (3 latches).

The potential difficulty is, this would result in a total of **16** latches instead of 18 : this, again, would seem to make AS 36100 requirements apparently more stringent than NAS 3610's. However, in horizontal loads (respectively fore and aft or lateral), the effective restraint configurations would be identical to NAS 3610's. The case to be analyzed is the upward load.

Two approaches can be used to compare this upward load case with those already certified according to NAS 3610:

(a) actual maximum upload on most critical latches :

NAS 3610 Load condition 18 (38000 lb upload, CG eccentricity 14.4% / 21.4 %), Restraint condition 7, Figure 8, in the worst case (size M : 96x125"), has ¼ of the total upload acting on 2 vertical latches, hence maximum vertical load on a latch = 4750 lb.

Proposed alternate AS 36100 UC M (38000 lb upload, CG eccentricity 10 % / 10 %), RC A, in the same worst case, has ¼ of the total upload acting on 3 vertical latches, hence maximum vertical load on a latch = 3167 lb.

(b) maximum unrestrained edge length in the ULD's corner area :

In NAS 3610 Figure 8, the maximum unrestrained edge length in the worst case (size M : 96x125") is 28.55 inch on the small side and 19.13 inch on the long side, i.e. a total of 47.68 inch.

In the proposed alternate RC A configuration, the worst case is the same, and the maximum unrestrained edge length is 28.05 inch on the small side and 12.75 inch on the long side, i.e. a total of 40.80 inch.

On both accounts, the proposed alternate RC A configuration appears in fact less critical on the most loaded vertical restraints in the worst case than NAS 3610 load condition 18.

Proposal : **[7G-01]**

The Panel to consider and approve the alternate restraint configuration (RC) **A** for sizes A, B and M shown hereafter, based on NAS 3610 Figures 8 (lengthwise) and 13 (across), in order to allow unrestricted use of AS 36100 certified ULDs in existing (3 latches) main deck configurations.

RESTRAINT CONDITION (RC) A

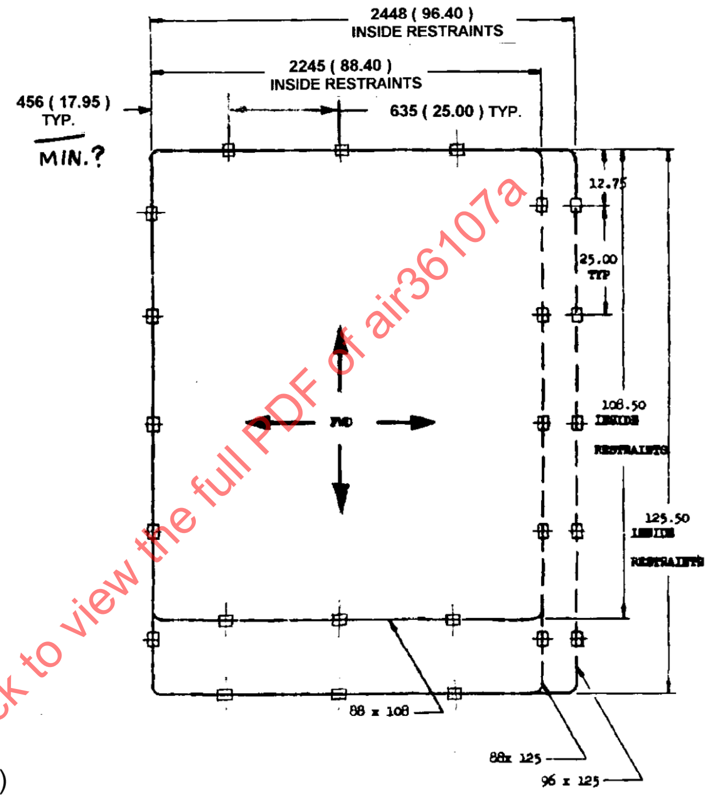
ALTERNATE PROPOSAL

Applicable to ULD configurations : A1, B1, M1 - Class II

Applicable to : Containers, Pallets, Nets

Orientation : omnidirectional

Restraint condition plan view



Dimensions in mm (inches)

ANNEX 7 - *OSP meeting N° 7 - Arlington VA, September 23, 2002*

Attachment 7H

Main written comments received on AS 36100 5th draft (July 15, 2002)

Comments on fifth draft proposal AS36100, Jim Jackson, August 2002

Several sticky points with the scope and classification clauses as a consequence of the Monterey meetings deletion of the military pallets, et al—i.e., no ***Class*** exists, per se, in this document; shouldn't the scope now read something along the line of :

This Aerospace Standard defines the minimum performance requirements and test parameters for air cargo unit load devices to be installed in certificated aircraft cargo compartment restraint systems and which conform to all flight and ground cargo restraint conditions required by Federal Aviation Regulations 14 CFR Part 25, excluding 9 g forward emergency landing conditions.

Further, the informational note might be more appropriately relocated to paragraph 1.2:

NOTE: The requirements for cargo covers are not defined in this Aerospace Standard, except insofar as net restraint is incorporated therein.

The same impact also appears to apply to paragraphs 3, 3.1 & 3.5; i.e., only one ***type*** is covered in the document—established in NAS3610 as type 2.

" *Unit load devices covered by this Aerospace Standard shall be of the following types, sizes, configurations and forms:*

3.1 Type :

Type 2: Unit load devices designed for use certificated aircraft cargo compartment restraint systems and which conform to all flight and ground cargo restraint conditions required by Federal Aviation Regulations 14 CFR Part 25, excluding 9 g forward emergency landing conditions

NOTE: Type 1 unit load devices are not shown in this Aerospace Standard. Refer to National Aerospace Standard NAS 3610 Revision 10.

3.5 Classification identifier :

The pallets, nets and containers described in this Aerospace Standard shall be identified by the numbers derived as shown. Types, sizes, configurations and forms shall be limited to those in configuration drawings; e.g. : ..."

Comments on fifth draft proposal AS36100, Nils Lache (in *Italics*), August 2002

" Configuration drawings show dimensions in both mm and inches as agreed (**tolerances** application to be reviewed) **"**:
Tolerances for testing should be + 0, - TBD to have the worst fit case underneath the latching (note : shown in UC and RC drawings for each size, as for all not otherwise specified general tolerances).

“ ULD manufacturers are requested to confirm present ULDs certified in accordance with NAS 3610 can withstand maximum ultimate loads of NAS 3610 load condition 32 while restrained in the configuration described in NAS 3610 Figures 13 and 15 (see OSP/5 minutes) and in **restraint condition A** (page 24) of the draft.**”**:
*If this is the case, we should be able to define 88”/96”x125” with **3 latches** at the short side and 5 latches at the long side (see 3 pages, 72 Ko pdf. file enclosed) for load condition 32 but a mix of figures 13 and 8.*

RC **A** (UC sizes A, B, M) :
“ based, as agreed at OSP/5, on NAS 3610 restraint condition 12 (Figures 13, 15, 16). The only change is making it omni-directional, as are the ultimate loads. The difficulty is, NAS 3610 Figures define different clearances (**.**25 or **.**50“) according to direction (maybe related to the ULD's longest dimension, due to consideration of upward bending moment, rather than relative orientation in aircraft ??). This results in an otherwise unnecessary difference between “pallet locks“ and “side restraints“. Should this be maintained ? Or should a single omni-directional clearance of **.**50“ (**.**25" is a tight fit for ease of ULD loading) be used ? Note NAS 3610 Figure 8, to which it is believed most of today's ULDs are certified, already shows a **.**40“ clearance in the smallest dimension. This might be the right value for an omni-directional application (confirmation by the Panel is requested).**”** :
I believe for testing a loose fit would probably the best to show restraint capability, in the aircraft the fit could be tighter to e.g. 0.25” up to 0.4”. I would suggest 0.4 inch should be used for testing an omni-directional application.

RC **K** (UC size K) and **L** (UC size L) :
“ - side restraint spacing was increased to 25" (but continuous, in order to guarantee presence of either 2 or 3 restraints on each unit), as agreed in Monterey and later confirmed by Airbus. See RC drawings.
- the stack of 7 units as the certification case remains arguable : it may render testing uselessly more difficult, quite particularly with pallets (not considered at the time of developing NAS 3610) due to shingling, and it reflects only one aircraft type (B747). Should it be considered to replace it with a single unit restraint condition with only one fore and aft stop ? In the worst testing case philosophy adopted, if the ULD withstood the loads with only this one stop, then it would even better with the B747's two ? The necessity to keep the ULD acceptable on B747s might be taken care of by just adding a requirement that an additional load (equivalent to 6 forward ultimate loads) be applied on one 61.5“ base edge only, simultaneously to the ultimate load applied to the ULD itself ? Proposed for Panel discussion.**”** :
Since stack loading is such a unique case (747s) application and the rest of the world is single positioning, the new AS 36100 should be a modern update and not a history copy. Those using the stack loading can still go back to the NAS 3610.

ANNEX 8 - *OSP meeting N° 8 - Scottsdale AZ, April 07, 2003*

MINUTES

1. Chairman O. Atienza opened the meeting at 08:30am. A special welcome was extended to FAA attendees : Hank Offermann (Transport Aircraft Directorate, Seattle) and Jan Risheim (TSOs administration office, Washington DC).

NOTE : at the subsequent plenary AGE-2 meeting, H. Offermann made a general presentation about the FAA's ACIP (Air Cargo systems safety Implementation Plan), that includes an objective to revise TSO C90(c). See AGE-2 minutes.

The proposed agenda (see Attachment **8A**) was accepted.

2. 13 members and observers were present : O. Atienza (Chmn)

J. Burkett	J. Jackson	N. Lache	H. Offermann (FAA)
B. Danczyk	R. Hoffmann	J.J. Machon	J. Risheim (FAA)
F. Eriksen	D Hyde	J. Neeld	H. van Rooijen

Apologies had been received from U. Hartmann and B. Lemon.

3.1 The **minutes of the 7th meeting** in Arlington, Sept. 23, 2002 were approved with one change : sponsorship of draft ARP/AS 36101 (load model) is N. Lache and J.J. Machon, not F. Eriksen and J. Neeld as shown.

3.2 Review of outstanding questions and assignments :

The task assignments of the 7th meeting were reviewed and found mostly met, as follows (numbers refer to 7th meeting minutes for ease of reference. Items late on schedule are underlined) :

4 : the AS 36100 6th draft was produced and circulated (see **4** hereafter),

5.1 : the bibliography AIR (co-sponsors : U. Hartmann and R. Fu) was not yet drafted,

5.2 : the first draft AS 36101 was produced and circulated (see **5** hereafter),

5.3 : the AGE-2A ARP 36102 (testing methods) working group has held a separate meeting in Geneva, Nov.2002 and prepared a new draft as well as a series of questions for OSP consideration (see **6** hereafter),

5.4 : the ARP 36103 (ULD CG control means) draft has been provisionally deferred after preliminary discussions between co-sponsors, pending general approval of draft AS 36101 which constitutes its background (see **7** hereafter),

5.5 : the ARP XXXX (AGE-2A project 97-04, ULD serviceability limits) first draft has been circulated to AGE-2A but disapproved by a significant number of members. It is to be rewritten and reballotted.

5.6 : the ARP 5492 (restraint system malfunctions) draft has met only one disapproval and also is to be shortly reballotted within AGE-2A.

5.7 : ARPs 5486 (pallets utilization), 5595 (tie-down) and 5596 (cargo shoring) have been approved by SAE Aerospace Council and are now published.

4. AS 36100 6th DRAFT DISCUSSION : (see Attachment **8B** summary)

4.1 Scope wording :

The proposed new wording in 1, Scope (also in 3.1 and 6.1) to identify "9g" ULDs are not part of the scope is to be reworded in the 7th draft based more verbatim on FAR 25.561. **[M8-01]**

4.2 Base underside :

The proposed new wording in 4.10.4 is to be modified in the 7th draft to refer in more general terms to edge profile's geometry as well as both conveyance and restraint systems. **[M8-02]**

4.3 Review of proposed new Figures :

The UC Figures will be redrawn for the 7th draft same as the RC ones in the 6th, by the same token correcting decimals in mm as agreed. Electronic formatting in a modifiable format (**.**TIF?) of the figures, presently shown in **.**BMP non modifiable format, may be necessary for later storage and processing : to be checked with SAE. An agreement has been reached with FedEx to provide figures reformatting as necessary.

UC **A1** (and others), view A : change "41 (1.62) TYP." to "41 (1.62) MIN."

UC **G1** : correct typo in section A-A to read "(1.75)" instead of "(51.75)".
View B, add minimum distance from edge to track centerline (TBD, somewhat larger than UC A).
Section A-A edge height, change from "12.7 (.50)" to "12.7 (.50) MIN., 25.4 (1.00) MAX." for consistency with other UCs and in order to allow minimizing edge wear, particularly severe on this unit size and which has resulted in incidents of in-flight disengagement from restraints. **[M8-03]**

UC **K4**, section A-A : change recess height (see 4.4 hereafter).

UC **P1** : drawing to be revised along the lines of UC K4, not showing container contour. Detail A to be replaced by UC K4 section A-A.

UC **R1** : view C, add minimum distance from edge to track centerline (same as G1).

RC **A** (also applies to RC N) : approved, not adding the 4th restraint on the 96" sides that would result from continuous 25" spacing. Rationale : in service aircraft have 3 latches, not 4 (worst case testing). **[M8-09]**
Height under restraint is to be shown from the conveyor plane, not the edge profile's top surface.

RC **K** : add note to restraint details to allow testing without vertical rollers and clarify clearance applies whether or not there are any (while on aircraft there usually are, because of tight clearance). Also applies to RCs L, P, Q.

RC **P** : to be replaced by single unit testing condition similar to RC K.

RC **Q** : to be replaced by single unit testing condition similar to RC L.

RC **R** : restraints spacing on 96" sides to be changed to 25", same as RC A, instead of 20.125" (no side locking). **[M8-10]**

4.3 Review of submitted written comments : (see Attachment **8C**)

Legal : if and when AS 36100 will be endorsed by a TSO revision, this authority will override any SAE general provision (confirmed by FAA attendees).

Continuous seat track : no change. Showing a continuous track on all ULDs would reduce the visibility of net fitting locations.

Tie-down straps : no change. Would require a definition of the tie-down arrangement, which cannot conform to a standard. Applicable requirements are stated in "satellite" ARP 5595.

Continued airworthiness : the requirement is agreed, but should not be mixed up with initial product certification into AS 36100. To be covered in future ARP XXXX (AGE-2A project 97-04), ULD inspection and serviceability limits.

Markings : 4.5 editorial sequence to be checked with TSO C90 wording. **[M8-04]**

NOTE : after meeting check : ULD P/N to be added in 4.5 (4). The other wording conforms.

Mandatory MGW marking was unanimously rejected, because : **[M8-05]**
- long standing industry agreement materialized from NAS 3610 Rev.3, and increased since, that MGW varies with aircraft type (flight envelope ultimate load factors defined in the Weight and Balance Manual),
- not required by TSO C90 wording.

6.2 : see MGW markings.

6.3 : ARP 1845 to be kept, as it only defines the criteria for establishing maximum contours. Publishing an SAE maximum contours document would duplicate the IATA ULD Technical Manual and be a source of discrepancies as well as useless in practice.

UC G1 : agreed. See 4.2 above (will require updating of AS 832, AS 1130 and AS 4041 by AGE-2A).

UC K1 : agreed.

UC L1 (L5) : not agreed, because the "thick and stiff" size L pallet still is in use in large numbers (ULD manufacturers multiple customers evidence + use by significant airlines, e.g. Cargolux, UPS).

UC L2 (L6) : to be reviewed by ULD manufacturers. Potential problem may not be that critical, since units have been successfully built and certified to this standard for 30 years.

Base wear allowances : see "Continued airworthiness" above.

4.4 Verbal comments and discussion :

See 4.1 through 4.3 above. In addition :

1.2, 3rd paragraph : replace "certificated" by "approved" (FAA recommendation : TSO articles are approved, not certificated).
Typically (see TSO C90(c) clause (e)), "*a ULD approved prior to the date of future TSO C90(d) may continue to be manufactured under the provisions of its original approval*" in reference to NAS 3610. The aircraft Weight and Balance manuals will call for TSO approval, not specifically a given reference document (unless there are effective technical differences resulting e.g. in different MGW allowable on a given aircraft position, reflected by a different configuration code). Accordingly, airframers, including on new aircraft types, will have to specify acceptability of TS0 C90(c) / NAS 3610 approved units.

4.4, revise last sentence in the 7th draft : no interface dimensions are shown anymore.

5.4, test results, was rediscussed in the light of question 5 of the AGE-2A Testing Methods working group (see Attachment **8D**). It was agreed the current wording "*shall not deform or rupture to the extent of discharging its contents*", though broad, already is much more precise than NAS 3610 (only "to show compliance with this specification"), and any more detailed definition of a "pass or fail" standard should, if needed, be addressed in ARP 36102, test methods. **[M8-06]**

UC **K4** (also applies to other UCs for containers), section A-A : the minimum container recess height was discussed. There was unanimous confirmation that AS 36100 minimum value should not be aligned on the design value recommended by any design industry standards, e.g. the 3.5 or 4.25" currently discussed within the IATA UTP : though there is no reason to object to such design objectives being stated, they may evolve and bear no direct relationship which airworthiness issues that should dictate the mandatory minimum values.
However, the Panel was presented with evidence (pictures of real situations provided by Airbus) that the current 2.12" minimum recess height as per NAS 3610 may in certain cases be insufficient to guarantee effective latching and restraint of the containers in the airplane. Accordingly, it agreed the 2.12" minimum value should be increased in AS 36100 7th draft to either 2.25" (consistent with sizes G and R recess, but possibly a bit low) or 2.50" (well enough to guarantee the absence of interferences). The rationale should be defined for the Panel. **[M8-07]**

8.2 : table 2 column "ULD base dimensions" should include "nominal", same as table 1.

5. AS 36101 1st DRAFT DISCUSSION :

The 1st draft AS 36101 (standard load distribution model) and its explanatory report, circulated to the Panel on March 20, 2003, were discussed and approved, including the proposed AS status rather than ARP as originally contemplated.

The word "certificated" in **1.2.1** is to be replaced with "approved" (see 4.4 above, decision on AS 36100 § 1.2).

The draft is to be circulated to AGE-2A for comments over a limited period, then, if no adverse comments are received, for ballot with the aim of reviewing any ballot comments at the next (Montreal, Sept.2003) meeting.

6. ARP 36102 2nd DRAFT DISCUSSION :

6.1 Working group report : (see Attachment **8D**)

See Geneva, Nov. 2002, working group meeting report. As a result of this meeting, the working group produced a 2nd draft, dated 2002-12-20, that was handed out at the meeting and further discussed during the subsequent AGE-2A meeting (see minutes thereof).

Though this is an AGE-2A project, OSP members are invited to attentively read it through and forward any comments or recommendations to the working group on receipt of the present minutes or, in any event, no later than prior to the next meeting.

6.1 Working group questions to the OSP : (see Attachment **8D**)

Panel responses are (numbers refer to agenda attachment **8D** for ease of reference) :

1. No, contours should not be referenced in AS 36100 (see 4.3 above on clause 6.3). It is recognized they do affect ultimate load testing, but this should be taken into account as needed by ARP 36102.

2. No, an overhanging panel's footprint should not be taken into account for determination of the ± 10% C.G. offset, which is to be determined in relation with the base (restraint system, aircraft interface). This is to be taken into account, according to container's geometry, in the test load setup, thus in ARP 36102.
The geometric contour area center is not to be a reference for this purpose. E.g., it was checked the area center of an homogeneous density filled up LD3 (UC K4) would, in relation to the base, correspond to approximately 11% (close to 10%) C.G. offset. In the worse but less frequent LD1 case, the same would correspond to approximately 14%, exceeding AS 36100 minimum performance and testing requirements. But this should then be taken into account under operators responsibility (remembering for instance that in accordance with draft AS 36101 C.G. eccentricity trade-off is allowable at weights lower than MGW, and MGW lower deck containers are in practice very seldom. An LD1 operator might elect, likely without commercial penalty, to post a reduced MGW to allow for homogeneous container filling).

3. No worse case scenario needs to be defined for differently built or located panels : AS 36100 § 5.3 NOTE states "*when two ULD sides and the corresponding restraint conditions are identical, testing may be performed on one side only*". Conversely, this implies that, wherever two sides are not identical (e.g. door and bottom, or sloped vs vertical panel), then both sides must be tested (recognizing one of them will likely be more severe).

4. Covered by application of AS 36101 standard load distribution model.

5. AS 36100 § 5.4, Test results, states the unit "*may exhibit damage or permanent deformation, but shall not deform or rupture to the extent of discharging its contents*". See 4.4 above for comments discussed on this clause.
The first 4 examples listed under question 5 clearly are damage allowable under ultimate load testing. The 5th item is already covered in AS 36100 § 5.3. The one question remaining open, which the working group is entirely justified in raising, is the last one : what is a standard (repeatable) definition of "discharging its contents"? The OSP judged, if a definition is required, it should be provided in ARP 36102. It is probably required (FAA attendees supported it). The working group is requested to consider it and report at the next meeting.

NOTE : Discussion, however, evidenced there is no unanimous support for a 12.6" (320mm) diameter sphere (seemingly put forth with essentially nets in mind : corresponds to a 10" square mesh with no elongation, or a 6" mesh should one strand be broken, which probably is allowable damage under ultimate load) being the standard "pass/fail" test within the Panel. It is mostly felt the "pass/fail" test, if needed, should be closer from commonly encountered cargo shapes, e.g. a small (maximum cabin size, which is precisely defined) piece of baggage or a small but common freight packaging such as a fruit box or tray. **[M8-08]**

6. Environment degradation is a problem worth addressing, but that should be handled elsewhere than AS 36100 (FAA attendees statement). The industry's accumulated knowledge is still reflected in fairly old documents based on general, not repeatable, evaluation methods that need being updated. ISO/TC20/SC9 has decided to start a project to develop a standard U.V. degradation testing method (led by the U.K., J. Neeld), but this will need extensive research and cannot be available in the present time frame. A "degradation factor" applied to test loads, such as IATA's, is a valid interim - though still now lasting - precaution, but pertains to ULD design specification, not to the performance requirements for ULD TSO approval.

7. Accordingly, the requirements of AS 36100 need not change : they consist in ultimate loads and maximum C.G. deviations in each direction. How these are to be added is a matter pertaining to testing methods, thus ARP 36102 (which should also take into account the method for applying a degradation factor on textile materials or components, where required by design specification or customer).

8. (Question not part of the working group memo in agenda attachment **8D**, added and discussed at the meeting): is a "C.G. factor" applied to the AS 36100 ultimate load allowable as a means to replace an offset test load? The Panel agreed this is an option allowable for nets, to be stated in ARP 36102, when offset loads are difficult to obtain in a repeatable manner.

9. (Question not part of the working group memo in agenda attachment **8D**, added and discussed at the meeting): the 45° type of test was tentatively eliminated by the working group, due to difficulty and repeatability problems. How in this case should the combined ultimate loads (additional downloads required) be tested? The panel agreed the combined load cases have to remain within AS 36100, as they represent the fact of gravity still acting on the load under horizontal accelerations. Since this will affect behavior of the ULD under test, means need to be found to apply this combined condition for testing. This is likely easier with certain methods than with others (e.g. air bags). The working group will discuss it and report at the next meeting.

7. ARP 36103 PROJECT DISCUSSION :

7.1 Document's intent :

First draft production had been deferred pending approval of draft AS 36101 (see 5 above). Co-sponsor J.J. Machon outlined the ARP contents foreseen contingent on this prior approval. The document would tentatively be based on the following sources :

(1) ATA "*Compliance Document for Unit Load device Center of Gravity Control on B727-PF aircraft*", published version dated Oct.31,2000 (taking into account SAE AGE-2A input),

(2) Subsequent FAA Dec.22, 2000 letter Ref. 00-113-1039, "*AMOC to paragraph (a) "Limitations" in ADs 98-26-18, 98-26-19, 98-26-20 and 98-26-21 for certain B727 Airplanes modified by STCs referenced in the ADs*". This formally rubber stamped the operational approach proposed in reference (1), including possible linear trade-off of CG offset in proportion of the % of allowable ULD MGW as verbatim reflected in draft AS 36101 (see attachment **8E**),

(3) SAE ARP 5486, *Air Cargo Pallets Utliization Guidelines*, clauses 3.4 and 3.5 of which, in an abridged form, address these operational procedures required to ensure CG location control.

The document would then :
- separately address the different kinds of cargo (already recognized in reference (2)) and recommend the different operational procedures necessary in each case,
- expand the basic contents of ARP 5486 clauses 3.4 and 3.5, much as ARP 5596, Cargo shoring, expands on the more abridged clauses 5.1 to 5.3 of this same ARP.

Such an approach was accepted in principle by the Panel. A first draft should be presented to be discussed at the 9th meeting in Montreal, Sep. 2003.

7.2 Relationship with FAA B727 AMOC letter : (see agenda attachment E)

The document is intended to be fully in line with reference (2). This should in principle ensure FAA approval. Though it is limited to B727s, its principle is clearly applicable to all airplanes. It was felt inappropriate, however, to directly refer to this document in the future ARP, because of this limited applicability and scope.

8. "Satellite" documents progress report :

See **3.2** above.

9. Follow up action :

9.1 Task assignments prior to the 9th meeting :

1. Bibliography AIR 1st draft to be prepared and circulated (U. Hartmann, R. Fu)

2. AS 36100 7th draft to be prepared and circulated (J.J. Machon) based on the meeting's decisions, both to the Panel and to AGE-2A ballot (H. van Rooijen). SAE (B. Lemon) to advise whether a specific electronic format is required for the figures.

3. AS 36101 1st draft to be circulated for comments then balloted to AGE-2A (J.J. Machon, N. Lache, H. van Rooijen)

4. ARP 36102 3rd draft to be prepared and circulated (F.Eriksen, U. Hartmann, J. Neeld) taking into account the meeting's decisions.

5. ARP 36103 1st draft to be prepared and circulated (M. Arcelle, J.J. Machon) based on AS 36101 1st draft.

6. ARP XXXX (AGE-2A Project 97-04, ULD inspection and serviceability limits) to be revised to resolve first AGE-2A ballot disapprovals, and reballotted through AGE-2A (U. Hartmann, H. van Rooijen).

7. Environmental degradation testing : the Panel to be kept informed of work advancement on a possible standard test method (J. Neeld).

8. The OSP agendas, working documents and minutes to be compiled into a single document (AIR status to allow SAE continued availability?) to constitute a record of decisions for future users of AS 36100 (J.J. Machon). Once the compilation is available, OSP will discuss whether it should follow a particular format (e.g. AS 36100 clauses sequence, for ease of reference, or other).

9.2 Work completion and planning :

It was felt the 7th draft AS 36100 as in principle now defined should be the last prior to successive ballotting processes (AGE-2A, AGE-2, SAE Aerospace Council).

This will be confirmed at the 9th, Montreal, OSP meeting planned on Sep. 08, 2003 where the final draft will be available.

The Chairman will liaise with Mr J. Risheim (FAA) as to the procedures for submitting the document, once approved, for TSO C90(d) reference. The FAA confirms formal approval will follow the FAA standard procedure, including Federal Register NPRM publication, comments, etc.., which will take an amount of time and may ultimately result in a need of further changes to the AS as initially approved within SAE.

AS 36100 publication by SAE by 2004 and TSO C90(d) publication in the course of 2005 seem to be reachable objectives at this stage if no major disapproval occurs.

10. Meeting closure :

Chairman O. Atienza thanked the attendees and particularly the FAA representatives for their valuable inputs, and closed the meeting at 06:00p.m.

ANNEX 8 - *OSP meeting N° 8 - Scottsdale AZ, April 07, 2003*

Attachment 8A

AGENDA

1. Adoption of agenda.

2. Membership review.

3. Review of minutes of meeting N° 7, Arlington VA, Sept.23, 2003 :

3.1 Minutes approval.

3.2 Review of outstanding questions and assignments.

4. **AS 36100** 6th draft discussion (see 6th draft and explanatory report, dated March 15, 2003).

4.1 Approval of new scope wording (ref. to 9g ULDs) in 1.1, 3.1 and 6.1.

4.2 Approval of new sentence on base underside in 4.10.4.

4.3 Review of proposed new Figures.

4.4 Review / answers of selected written comments submitted by P. Emsters (attached).

4.5 Verbal comments and open discussion.

5. **AS 36101**, Load models, 1st draft proposal discussion (N. Lache, J.J. Machon sponsors. See 1st draft and explanatory report, dated March 30, 2003).

6. **ARP 36102**, ULD test methods discussion (F. Eriksen, U. Hartmann, J. Neeld sponsors. See 1st draft proposal handed at the Sept. 24/25 AGE-2A meeting) :

6.1 Nov.2002 Geneva working group meeting report (attached).

6.2 Working group memo to OSP dated Feb.13, 2003 (Attachment **8D**).

7. **ARP 36103**, ULD CG control (M. Arcelle, J.J. Machon sponsors) : no draft proposed yet, subject to prior discussion of proposed AS 36101.

7.1 Discussion of intents.

7.2 Relationship with FAA B727 AD AMOC letter to ATA (Attachment **8E**).

8. Progress report of additional "satellite" documents in AGE-2A :

9. Follow-up action :

9.1 Task assignments for the 9th meeting.

9.2 Work completion objectives and planning. TSO revision procedures.

ANNEX 8 - *OSP meeting N° 8 - Scottsdale AZ, April 07, 2003*

Attachment 8B

AS 36100 6th draft summary

Reference : unconfirmed minutes of OSP meeting N° 7, Arlington VA, Sept. 23, 2002

The attached 6th draft of AS 36100 attempts revising the 5th draft, dated July 15, 2002, circulated prior to the Arlington 7th OSP meeting (for a record of the main changes introduced into the 5th draft, see explanatory report dated July 15, 2002), based on the decisions reached at that meeting. Though still probably not yet final, this draft is in principle complete and thus allows to have a look at the total document concept and internal consistency. It can be seen that the main simplification objectives initially agreed by the OSP remain met, even though 4 new sizes N, P, Q, S were introduced to fit the market's needs :

- 31 pages instead of 93 in NAS 3610 Rev.10,
- 12 ULD configurations instead of 44 (configuration B2, "9g" 88x108" pallet, was deleted as agreed),
- 8 testing restraint conditions instead of 32,
- two steps utilization (UC, RC) instead of five steps (Tables I, II, III, ULD configuration, restraint figures).

In order to facilitate printing in the U.S., the draft is formatted to fit "letter" 8.5 x 11 inch paper size, vs ISO A4 size used in the previous drafts. Changes from the 5th draft are highlighted in red overlined with yellow. Configuration drawings and testing restraint figures are shown in scanned bitmap form, and still need to be developed in a vectorized form prior to publication, but configuration drawings show dimensions in both mm and inches as agreed, with the rules for metric tolerances agreed in Arlington.

The main changes introduced from the 5th draft are as agreed by the 7th OSP meeting (see its minutes) :

- new proposed sentence in 1, Scope, in line with FAR 25.561 (b)(3) and (c), to identify "9g" case not considered,
- note on cargo covers moved from 1.1 to 1.2,
- word "certificated" introduced into 1.2,
- 3.1 amended same as 1,
- word "general" added to "tolerances",
- added "single" (stud tie-down fitting) in 4.10.3.3,
- 4.10.4 : deleted EI values sentence, and added proposed sentence along Nils Lache's comment,
- deleted reference to AIR 1490 (ISO TR 8647) from 4.11, environment degradation, and 2.1, References, **[8B-01]**
- 5.3 : added identity of testing restraint configurations,
- 6.1 amended same as 1 and 3.1,
- 8.1 Table 1 : changed designations of K and L configurations,
- metric dimensions decimals changed as agreed,
- base track drawings amended to delete fabrication dimensions and refer to AS 33601,
- ultimate side loads upgraded in UC K, L, P, Q (change in designation for UC K and L), **[8B-02]**
- 8.2 Table 2 : deleted "Class" column, added definitions for "lenghtwise" and "crosswise",
- all RC drawings amended to show single restraint, with 1.00 in width for RC A and R,
- RC A and N amended to reflect only 3 restraints on 88/96 in sides (16 total for RC A), **[8B-03]**
- 0.40 in restraint omnidirectional clearance introduced in RC A, N and R, **[8B-04]**
- new proposed single container testing RC K and L, with note to simulate load of up to 6 other units, **[8B-05]**
- RC N amended to show a single ULD,
- side locks deleted from RC R.

The comments received in between will be circulated together with the 8th meeting agenda in order to be considered and answered at the meeting, as well as the first drafts of "satellite" documents assigned at 7th meeting.

Submitted for Panel evaluation and discussion at the N° 8, Scottsdale AZ, April 07, 2003, next meeting.

ANNEX 8 - *OSP meeting N° 8 - Scottsdale AZ, April 07, 2003*

Attachment 8C

Main written comments received on AS 36100 5th draft (July 15, 2002)

Comments on fifth draft proposal AS36100, from P. Emsters :

These comments were extracted from Peter's 63 pages document, of which they constitute some of the main proposals or queries, excluding those queries that have already decided upon and included into the 6th draft.

- **legal** : how does the small script standard SAE sentence on cover pages "..use of this report is entirely voluntary..." fit with the intent of a TSO enforced document ?

- **technical** : continuous seat track should be the standard, except where otherwise specified, not the option.

- technical : request 0.25 in (6.35 mm) base dimensions wear allowances to be stated throughout.

- **2.2** : add "pallets with nets and/or tie-down straps" (strap standard might have to be referred to in 2.1).

- **4**, requirements : request referring to initial and continued (see e.g. wear allowances)airworthiness.

- **4.5**, markings : invert items (5) and (8) to keep in line with TSO wording.
Request MGW marking, for the same reason (see comment on 6.2).

- **6.2** : disagree, believe units MGW should be defined in the standard.

- **6.3** : disagree with referring to ARP 1845, which has a different scope and should be replaced / complemented by a new standard "ULD maximum allowable contours and clearances" (to be referred to in 2.1).

- **UC G1** : 45.2 mm (1.78 in) distance from edge to track C/L is too small. Recommend 45.2 mm (1.78 in).
12.7 mm (0.50 in) edge thickness is too small (part of reason for major wear). Restraint clearances would allow increasing it to at least 19 mm (0.75 in), or possibly up to 25.4 mm (1.00 in) as A/M. This would require updating AS 832, AS 1130, etc... Would also apply to UC R.

- **UC K1** : delete forward and aft pockets, obsolete. Keep recess continuous all around.

- **UC L1** : why not keep it for containers only, leaving L2 for pallets and nets? Pallets/nets to L1 practically do not exist anymore?

- **UC L2** : is the 59 mm (2.31 in) net fitting to corner distance not too close to be practical?

- all **RCs** : request defining whether base wear allowances are included in the restraint tolerances, or not.

ANNEX 8 - *OSP meeting N° 8 - Scottsdale AZ, April 07, 2003*

Attachment 8D

AGE-2A "ULD Test Methods" W/G – Memo to NAS 3610 Oversight Panel

At the last AGE-2A "ULD Test Methods" Working Group meeting which was held back-to-back with IATA ULD Technical Panel meeting in Geneva Nov. 5-7, 2002, it was agreed that the below items needed to be discussed and decided within the NAS 3610 Oversight Panel (OSP).

The reasoning behind this is that the "ULD Test Methods" ARP should only give a procedure for testing ULD, while definition of test parameters should be included in AS 36100 – although this would require a change from existing NAS 3610 specifications. Therefore, please include these items in the agenda for the upcoming OSP meeting.

1. Can/should ULD contours be referenced in AS 36100? The contour certainly matters when testing containers for ultimate conditions, see 2.-4.

2. Should panel footprint in container shell be included in the +/- 10% CG offset, as opposed to the +/- 10% based on base footprint only? This is relevant for all balcony containers, for example AKE when testing for ultimate up load. Should this information be specified in AS 36100?

3. Worst case CG offset scenario for non symmetrical load situations needs to be defined, an example would be 10% offset towards door and not towards aft side when testing AKE for ultimate up load, since aft side is stronger than door side. Another example would be 10% shift towards outboard side when testing AKE for ultimate up load, since a shift towards inboard side would be less critical. Should this definition be included in AS 36100 due to being a requirement?

4. Do we want to specify how to calculate and test CG offset in containers with domed roofs ("demi" containers)? The problem with these containers is that area of the roof and side/aft panel is larger in profile than in plan, thereby making it difficult to accurately calculate and implement CG offset. In which document do we want to include this if we specify it?

5. What should the minimum test requirements be for the test to be classed as a success, and should they not be located in AS 36100 due to being a requirement specification? Examples would be:

- No missing or broken fasteners
- No fracture of panel sheets or frame structure
- No damaged hardware
- No severed fabrics, braids, webbing or ropes
- ULD shall be freely suspended for a minimum of 3 seconds
- ULD shall contain the load under ultimate load test without damage that would allow a package of 12.6" spherical shape to escape

6. Should specification of degradation for both nets and containers be on top of ultimate load in AS36100? See 7.

7. Should the following definition be included in AS 36100: Certification test load = ultimate test load + degradation factor + CG factor?

ULD Test Methods Work Group

ANNEX 8 - *OSP meeting N° 8 - Scottsdale AZ, April 07, 2003*

Attachment 8E FAA A.M.O.C. letter (ULD C.G. control)

U.S. Department

of Transportation

Federal Aviation

Transport Airplane Directorate

Aircraft Certification Service

1601 Lind Avenue, S. W.
Renton, WA 98055-4056

In Reply Please Refer to 00-113- 1039 Dec. 22, 2000

Mr. Charlie Bautz
Director, Operational Engineering
Air Transport Association
1301 Pennsylvania Ave. Suite 1100
Washington, DC 20004-1707

References: (a) Air Transport Association (ATA) letter dated November 21, 2000 (ref. No. 2000-AE-091)
(b) Cargo Airline Association letter dated May 13, 1999

Approval of an Alternative Method of Compliance (AMOC) to Paragraph (a) «Limitations» in Airworthiness Directives (AD) 98-26-18, AD 98-26-19, AD98-26-20 and AD 98-26-21 for certain Boeing 727 Airplanes Modified by Supplemental Type Certificates (STC) Referenced in the ADs

This letter is in response to your letter dated November 21, 2000 reference (a), and the proposed Alternate Means of Compliance (AMOC) to the above Airworthiness Directives in which you requested Federal Aviation Administration (FAA) approval for an AMOC to the paragraph (a) «Limitations.»

The «Limitations» paragraph requires that «The location of the horizontal center of gravity for the total payload within each container or pallet shall not vary more than 10 percent (8.8 inches) from the geometric center of the base of the container or pallet for the forward and aft direction, and 10 percent of the width from the geometric center of the base of the container or pallet for the left and right direction.»

This limitation reiterated the design specification for unit load devices (ULD) provided by National Aerospace Standard (NAS) 3610 referenced in Technical Standard Order C90c. The amount of center of gravity (CG) offset specified in NAS 3610 has been used as one of the load conditions in the design of transport airplane cargo floor structures.

The Cargo Airline Association (CAA) letter, reference (b), requested a similar AMOC to the referenced ADs for a limited time period. The CAA recognized that it was difficult in practice to directly control the CG offset and committed to supporting the industry in developing an acceptable alternative. We understand that the information provided in the ATA request fulfills the CAA commitment.

We have reviewed your proposal and data attached to your letter, reference (a), and find the proposed process acceptable for the control of the CG offset of the payload in ULDs. This finding is based on the following data provided in reference a.:

a. ULD vs. CG weight tradeoff for the airplane and the cargo handling system – Attachment 1, Section 2.
b. Analysis of airplane local floor loading capability as a function of CG offset – Attachment 2 (Aircraft Technical Services Inc. report 2105, dated Jan. 26, 2000).
c. Analysis of cargo handling system restraint capability for 8000 lb. container – Attachment 2 (Ancara report 8000, dated February 16, 1981).
d. Methods for shoring compliance to CG offset limitations – Attachment 2, Section 6.
e. Training requirements for personnel who build up ULD payloads – Attachment 2, Sections 4 and 5.

The FAA finds that for the Boeing 727 airplanes, as modified by the STCs referenced in the subject ADs, can tolerate a CG offset greater than 10%, as shown in Figure 1. Also, the FAA finds the airplane cargo floor structure has the most limiting CG offset allowable in comparison with the strength capabilities of those applicable ULDs built in accordance with TSO C90c or that of the applicable ULD forward and aft and side vertical locks. Finally, the FAA finds that the application of the guidelines provided in the enclosure to this AMOC will control the CG of the payload in ULDs to within acceptable limits compatible with the effected airplanes capability.

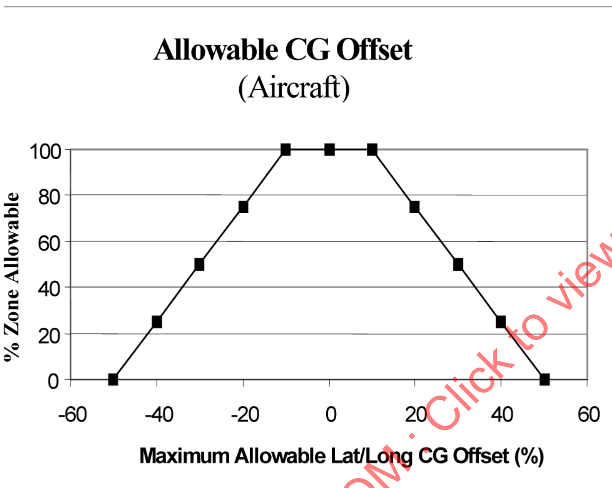


Figure 1

Each effected operator will apply the enclosed guidelines as appropriate to their particular or unique operation and obtain approval from cognizant Flight Standards District Office (FSDO) for implementation within 28 months after the effective date of the ADs (February 16, 1999). In addition, appropriate airline manuals associated with cargo loading (e.g., Weight & Balance, Loading, Flight Operation Manual etc.) should be revised to include ULD payload buildup procedures approved by the cognizant FSDO.

This AMOC should be maintained as a part of the airplanes permanent records. The cognizant Principal Maintenance Inspector (PMI) is to be informed of these requirements.

If there are any questions regarding this approval, please contact Mr. Mike Zielinski at (425) 227-2279.

Signed by Bob Brenemen for Lirio Liu Nelson, Manager, Standardization Branch, ANM-113

Guideline for Controlling ULD Payload CG

1. Air carriers which use ULDs for transport of air cargo on B727 airplanes converted by STC to freighters subject to Airworthiness Directives (AD) 98-26-18, AD 98-26-19, AD 98-26-20 and AD 98-26-21 must ensure that their cargo handling system manuals include the following information:

A. Definitions of ULD and ULD CG -

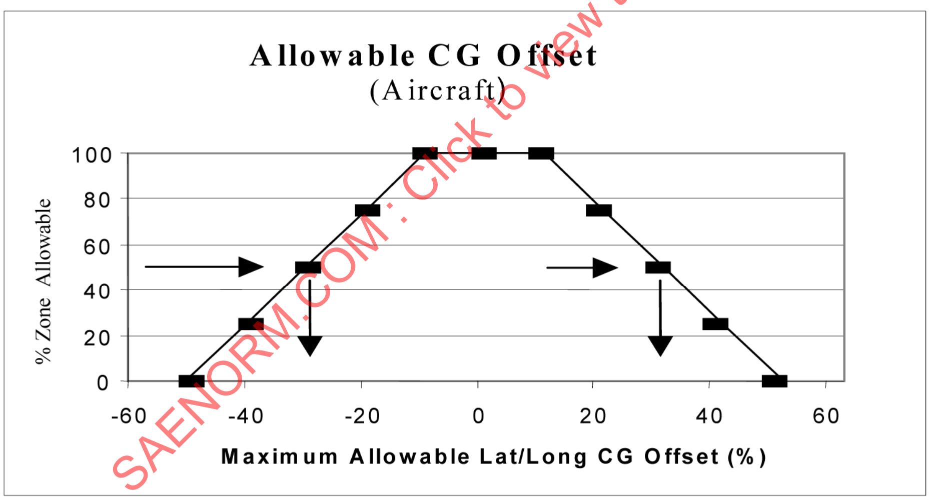
i. ULD is a device for grouping, transferring and restraining cargo for transit. It may consist of a pallet and a net or it may be a container.
ii. A container is a rigid structure that performs all the functions of a unit load device.
iii. ULD CG is the location in which all of the ULD content's weight, including the tare weight of the container, can be considered to be concentrated. Only the CG in the horizontal (fore-aft and left-right) direction is considered.

B. Concept of ULD CG versus Weight Trade-off -

Personnel involved in ULD buildup should be instructed that it is acceptable for the aircraft, the cargo handling system (CHS) and ULD to have ULD CG offsets that exceed 10% for ULD weights less than the maximum allowable in accordance with the zonal limitations as appropriate to the individual effected airplanes.

Figure 1 illustrates, for example, that for a payload that weighs only 50% of the aircraft zonal or position limit, the lateral and longitudinal CG offset can vary up to ± 30%.

Figure 1.



C. Description of Cargo Categories

Personnel involved in the buildup of ULDs should be instructed that, for the purpose of addressing ULD CG, the cargo carried on effected B727 airplanes is divided into three categories:

- Up to 150 lbs (Packages and Boxes)
- Over 150 lbs (Freight)
- Non-Standard Cargo and Animals.

ANNEX 9 - *OSP meeting N° 9 - Orlando FL, October 27, 2003*

MINUTES

1. Chairman O. Atienza opened the meeting at 08:30am. The proposed agenda (Attachment **9A**) was accepted, with the addition of 9.2, FAA ACIP program status and relationship of proposed AC with NAS 3610 / AS 36100.

2. 16 members and observers were present : O. Atienza (Chmn)

J. Burkett	R. Gauvin	G. Lane	H. van Rooijen
B. Danczyk	U. Hartmann	B. Lemon	S. Sondergaard
F. Eriksen	R. Hoffmann	J.J. Machon	M. Terlecki (IATA)
F. Eriksson	J. Jackson	J. Neeld	

Apologies had been received from N. Lache, represented by B. Danczyk, and H. Offermann and J. Risheim (FAA).

3.1 The **minutes of the 8th meeting** in Scottsdale, AZ, Apr. 07, 2003 were approved without change.

3.2 Review of outstanding questions and assignments :

The task assignments of the 8th meeting were reviewed and found mostly met, as follows (numbers refer to 8th meeting minutes for ease of reference. Items late on schedule are underlined) :

1 : the bibliography AIR (co-sponsors : U. Hartmann and R. Fu) was still not yet drafted. J.J. Machon will communicate the already agreed principles to U. Hartmann to prepare a first draft,

2 : the AS 36100 7th draft was produced and circulated for approval (see **4** hereafter),

3 : AS 36101 was approved at both AGE-2A and (after the resulting comments were incorporated) AGE-2 ballots, and now stands to be reviewed by Aerospace Council and published (see Attachment **9C**),

4 : the AGE-2A ARP 36102 (ULD testing methods) working group has held two other meetings in Frankfurt and Munich, and prepared a new draft dated Oct. 17, 2003, integrating the comments received and the OSP response to the questions asked from the 8th meeting (see **6.3** hereafter for change to AS 36102),

5 : the ARP 36103 (ULD CG control means) draft was circulated to the OSP by the co-sponsors for review and approval prior to intended AGE-2A ballot,

6 : the ARP 5597 (AGE-2A project 97-04, ULD inspection and serviceability limits) first draft had been circulated to AGE-2A but disapproved in its present form by a significant number of members. It will be rediscussed at the AGE-2A meeting,

7 : the environment degradation testing project was started by Bridport-Aviation, but it is a long term R & D project to be addressed when actual findings will be available,

8 : the "decision record" AIR (sponsor: J.J. Machon) was still not yet drafted, it being felt more appropriate to await ballots and comments incorporation,

9 : the ARP 5492 (missing restraints, sponsor : B. Danczyk) draft was balloted through AGE-2A without disapproval, but with extensive editorial comments that are being incorporated prior to AGE-2 ballot.

4. AS 36100 7th DRAFT DISCUSSION : (see attachment **9B** summary)

4.1 Scope wording :

The proposed revised new wording in § 1, Scope (also in § 3.1 and 6.1) to identify "9g" ULDs are not part of the scope was approved. **[M9-01]**

4.2 Base underside :

The proposed new wording in § 4.10.4 to refer in more general terms to edge profile's geometry as well as both conveyance and restraint systems was approved. **[M9-02]**

4.3 Revised UC codes A7, B7, M2 :

After again reviewing the relationship between AS 36100 and expected continued use of earlier ULDs approved under TSO C90(c) in accordance with NAS 3610, the proposed new codes were unanimously approved, consistent with K4, L5 and L6 approved at the 8th meeting, in order to avoid a risk of confusion with slightly less stringent NAS 3610 configurations. **[M9-03]**

4.4 Revised minimum container recess height :

As directed by item 4.4 (UC K4) of the 8th meeting minutes, N. Lache and J.J. Machon had researched the evidence available as to container recess height, currently minimum 2.12" as per NAS 3610. Based on in-flight incidents recorded and documented at Airbus, it was found container design at 2.12" still results in a number of cases of container jamming against aircraft vertical and side restraints. Geometric analysis of these occurrences leads to conclude a minimum of 2.25" is required, without margin, to avoid their reoccurring. This evidence justifies an increase. However, the Airbus files did not include any of the more sensitive LD1 containers, and no equivalent Boeing data that might have contained them was available, though Boeing had long (since 1994, J. Simmons) made known they were in favor of an increase of this minimum value. Accordingly, the proposal was to adopt 2.50" as a minimum height, thus leaving a little (¼ in) vertical clearance margin.

After discussion, this proposal was unanimously approved. It will apply not only to UC K4, but to all container configurations, with the exception of UCs G and R. **[M9-04]**

NOTES: (1) UCs G and R minimum recess height currently is at 2.25", while these units, inherently much more rigid, do not exhibit tendencies to insufficient vertical clearance. There is no identified need to change the existing industry specifications for these sizes.

(2) any maximum or recommended recess heights, vs minimum, do not impact safe restraint of containers in aircraft, hence remain to be defined by industry design specifications. The IATA ULD Panel, also meeting in Orlando on October 30, agreed the minimum recommended value will remain at 3.50".

4.5 Size B ultimate load condition :

It was agreed to change the ultimate load condition shown up to the 6th draft for UC B to load condition 16 of NAS 3610 in order to reflect main deck use. **[M9-05]**

4.6 Sizes G and R seat track location :

As agreed per 4.3 (UC G1) of the 8th meeting minutes, the 7th draft proposed to increase the minimum distance from base edge to track centerline to 48 mm (1.89 in), vs 41 mm (1.62 in) for sizes A, B and M.

Discussion evidenced this proposal, based on 30.2 mm (1.19 in) minimum latching clearance, resulted in a 7.4 mm (0.29 in) minimum extrusion thickness alongside the track's outer edge, significantly more than the equivalent 4.1 mm (0.16 in) provided for in sizes A, B and M with lower 26.5 mm (1.12 in) latching clearance. However, it was recognized the geometric situation was not identical in the vertical plane, where on "thin" pallets the track usually is integrated into the thickness of the edge rather than alongside it as on "thick" pallets. The Panel concluded the proposed minimum value should be slightly reduced, aiming at keeping typically ¼ in minimum extrusion thickness (corresponding to 47 mm (1.85 in) minimum distance from base edge to track centerline) in order to guarantee the required strength. **[M9-06]**

4.7 Fractional vs integer inches net fitting spacings : **[M9-07]**

For configurations G1, L6 (former L2) and R1 pallets, original NAS 3610 net attachment spacings are not an integer in inches, thus cannot be met with the optional continuous AS 33601 track at 1.0" increments defined in AS 36100. It was agreed these spacings will be changed to the nearest integer value in order to be consistent with optional continuous track.

4.8 Separate pallet / container drawings :

The question put to the floor was, configurations K4, L5 and L6 for the lower deck show separate drawings for containers and pallets (carried over from NAS 3610) while the others do not. It was agreed this was not needed, and one drawing only will be used as in the other configurations. A general note will be added in § 7.2 after Table 1 to underline the net attachment points shown may not apply to containers.

4.9 Sizes P and Q testing restraint configurations :

The 7th draft's proposed single container testing restraint conditions for sizes P and Q, as requested per 4.3 (RC P and Q) of 8th meeting minutes, consistent with other lower deck RC K and L, were approved.

4.10 Other comments and questions (in AS 36100 sequence) :

4.10.1 (§ **1.2**) : no aircraft certified under CAR-4B regulations still flying commercial service with ULDs could be identified in the U.S. It was accordingly agreed to delete the words "*or earlier CAR-4B Regulations*". It was further agreed to delete the sentence "*They may continue to be manufactured under the provisions of their original approval*" in the next paragraph, since it was felt this allowance pertained to the regulatory (TSO) rather than technical (performance requirements) scope.

4.10.2 (§ **2.1.1**) : it was agreed to delete "*[d ?]*", since there is not yet any TSO C90(d) revision, and to refer only to TSO C90 (latest published revision applies, per § 2.1 heading).

4.10.3 (UC A7 / B7 / M2 / N1 / S1) : **C.G. heights** **[M9-08]**

U. Hartmann pointed out that the 48" maximum C.G. height shown throughout the ULD configurations was intended to fit main deck operation, and was both unnecessary and unpractical for testing if applied to containers with a dedicated lower deck contour : e.g. a typically 64" high container tested for 48" C.G. height would leave only somewhat less than 16" height to arrange for the test load (see draft AS 36102).

After discussion, it was agreed this difficulty also arose with nets, when their maximum height was for lower deck only. The Panel unanimously approved adding in each of the concerned configurations ultimate load criteria Table a Note 2 to read : " **2** = *for containers and nets, 55% of maximum height, limited to the maximum shown* ". The figure of 55% was determined to maintain a 34" C.G. height for typical 64" high containers or nets. The 48" height shown will always be applicable to pallets, which may be used on main deck without a contour limitation.

4.10.4 (UC K4) : **C.G. height** : the same situation occurs with a 45" high LD3-45 A320 container, which when tested for 34" C.G. height would leave only less than 9" for the test load. It was thus also agreed to add a Note 2 to read : " **2** = *for containers, 55% of maximum height, limited to the maximum shown* ", resulting in a 25" maximum C.G. height for this container. This note will not be applicable to nets, since a LD3-45 symmetrical contour net can also be deployed to a full 64" high unsymmetrical LD3 contour. **[M9-09]**

4.10.5 (UC R1) : O. Atienza presented for consideration the alternate case of a "thin" 96x196" pallet without side blocks, planned to be restrained lengthwise on B767-300F main deck as a conventional 88 or 96x125" pallet but with 4 end locks instead of 3. Separate UC and RC sheets would be required if included. The Panel determined this new unit did not meet the originally agreed selection criteria, i.e. sufficiently large number of in-service units and interlining capability between at least two aircraft types. It will not be included, subject to possible reconsideration at the first 5 year review of AS 36100, should it then meet these agreed criteria. **[M9-10]**

4.10.6 (RC R1) : for consistency with the other testing restraint configurations, it was agreed to change the 24.75" restraints spacing on the long sides to 25.0".

4.10.7 Conclusion :

With the changes agreed at the meeting, it was unanimously agreed the draft had reached the near final stage where it should be submitted for AGE-2A ballot. The so amended 8th draft would be circulated to OSP members for a brief (one month) period of last comments, then submitted for AGE-2A ballot no later than Dec. 31, so that ballot results may be considered at the spring meeting

5. AS 36101, LOAD DISTRIBUTION MODEL :

The draft AS 36101 (standard load distribution model) was approved with a significant number of editorial comments at AGE-2A ballot, then, after incorporation of these comments, AGE-2 ballot. The Panel approved its continued processing for submittal to Aerospace Council and publication. See Attachment **9C** for summary report.

6. ARP 36102, TESTING METHODS :

6.1 / 6.2 Working group reports :

Subsequent to the Geneva, Nov. 2002, working group meeting and the Apr. 2003 8th OSP meeting, two other working group meetings were held in Frankfurt, July 9, 2003 and Munich, Oct. 6, 2003. As a result, the working group produced a 2nd draft, dated 2003-10-17, put together by F. Eriksen, that was circulated to Panel members shortly prior to the meeting. It will be further discussed during the AGE-2A meeting (see minutes thereof).

Though this is an AGE-2A project, OSP members were invited to attentively read it through and comment if needed for full consistency with the draft AS 36100.

6.3 Draft discussion :

In general, the Panel believed the 2nd draft now strikes the right balance between mandatory testing criteria and allowable methods flexibility, and thanked the working group for succeeding in this difficult development.

Discussions focused around the proposed "contents" definition to materialize the test results ("*The unit shall not rupture to the extent of discharging its contents*"), § 4.2.4.2 and 4.4.4.2 : the proposed reference 254 mm (10 in) cube was geometrically determined based on typical pallet net mesh size, but constitutes a quite light and small item. E.g., at average cargo density of 160 kg/m^3 (10 lb/cu.ft), this cube would weigh only 2.6 kg (5.8 lb), much less than any typical piece of cargo. Even at twice this density (the proposed though questionable definition for "non frangible cargo" in the draft FAA AC on Cargo Operations), it would weigh only about 5 kg (11 lb). Also, cubic packages are hardly ever met in air cargo, where packages usually have the shape of a parallelepiped (i.e., a 10x16x20" box, for instance, would seem a more representative shape).

The Panel recommended that research take place in order to determine a more realistic "pass or fail" criterion, closer to what small cargo packages usually look like. J.J. Machon will research the ISO standards relative to commodity **packaging sizes** in order to determine a smallest standard size, which might be a rational reference, and communicate the results to the working group for consideration.

In view of the document's quality and the requirement to strictly enforce the mandatory criteria, the Panel further recommended that a change to **AS**, rather than ARP, status be considered. This will imply some editorial updating to meet the SAE Technical Reports Style Manual requirements applicable to an AS, such as checking the respective uses of "shall" and "should", etc...

The unanimously agreed course of action, subject to endorsement by AGE-2A, was : leave one month, up to Nov. 30, for OSP members comments to the document sponsors, update the draft into AS form together with any changes that might result from either these comments, or those of AGE-2A members, or research on packaging sizes, then submit it for AGE-2A ballot no later than Dec. 31, so that ballot results may be considered at the Spring 2004 10th meeting.

7. ARP 36103, ULD C.G. CONTROL METHODS :

The proposed 1st draft was submitted to Panel members by sponsors M. Arcelle and J.J. Machon on July 15, 2003 and received no comments. Document review resulted in a number of editorial changes (deletion of ARP 5595 as a reference since not used in the text, replace the word "*stiff*" by "*rigid*", etc..), noted down.

The draft was unanimously approved for submittal to AGE-2A ballot by the end of Nov., 2003 with the identified editorial changes.

8. PROJECT AND "SATELLITE" DOCUMENTS PROGRESS REPORT :

The targeted progress stage of the main documents involved now stood as follows :

Document	Draft #	OSP approval	AGE-2A ballot	AGE-2 ballot	Aerosp. Council	Published	Contents
AS 36100	8	Nov. 03	Jan. 04			2004 ?	Airworthiness requirements
AS 36101	3	June 03	Aug. 03	Oct. 03	Nov. 03	Jan. 04 ?	Load distribution model
AS 36102	4	Nov. 03	Jan. 04			2004 ?	ULD testing methods
ARP 36103	2	Oct. 03	Nov. 03			2004 ?	C.G. control methods
AIR XXXX	1	open					ULD bibliography
AIR XXXX	1	open					AS 36100 decisions record
ISO 11242		N.A.	N.A.	N.A.	N.A.	1995	Pressure equalization
AS 1825 B		N.A.	N.A.	N.A.	N.A.	1999 ?	Allowable contours
ARP 5486		N.A.	N.A.	N.A.	N.A.	2002	Pallet utilization guidelines
ARP 5492		N.A.	Oct. 03	Dec. 03 ?		2004 ?	Missing restraint procedure
ARP 5595		N.A.	N.A.	N.A.	N.A.	2003	Straps tie-down guidelines
ARP 5596		N.A.	N.A.	N.A.	N.A.	2003	Cargo shoring guidelines
ARP 5597		under discussion					Inspection & serviceability
ARP XXXX		not yet assigned					Maintenance requirements

9. FAA MATTERS :

9.1 NPRM N° 2002-NM-91-AD and possible straps TSO :

The panel was briefed on contents and response of the NPRM regarding STC approved straps and the objective pursued by AGE-2A to obtain a TSO for straps based on both AS 5385 A (design and testing) and ARP 5595 (installation). It was discussed whether AS 36100 could / should contain provisions for straps tie-down on pallet edges, but unanimously agreed this was not feasible due to the variety of parameters to be taken into account. The performance parameters currently stated in AS 36100 for pallet edge track are appropriate to safely support the use of straps if the operational utilization rules in ARP 5595 are complied with.

9.2 ACIP program and relationship of proposed AC with NAS 3610 / AS 36100 :

The Panel was briefed on the current status of the ACIP program and the draft AC on Cargo Operations being prepared. It welcomed these developments in the interest of increased safety, but unanimously agreed there should be no direct relationship between NAS 3610 / AS 36100 and the proposed operational rules.

10. FOLLOW-UP ACTION :

10.1 Task assignments prior to the 10th meeting :

1. Bibliography AIR 1st draft to be prepared and circulated (U. Hartmann, R. Fu)

2. AS 36100 8th draft to be prepared and circulated (J.J. Machon) based on the meeting's decisions, first to the Panel and then to AGE-2A ballot (H. van Rooijen). B. Lemon advised the .bmp electronic format is acceptable.

3. AS 36101 to proceed to Aerospace Council and publication (J.J. Machon)

4. AS 36102 4th draft to be prepared and circulated (F.Eriksen, U. Hartmann, J. Neeld), first to the Panel and then to AGE-2A ballot (H. van Rooijen).

5. ARP 36103 edited 1st draft to be submitted for AGE-2A ballot (M. Arcelle, J.J. Machon).

6. ARP 5597 (AGE-2A Project 97-04, ULD inspection and serviceability limits) to be revised to resolve first AGE-2A ballot disapprovals, and reballotted through AGE-2A (U. Hartmann, H; van Rooijen).

7. Environmental degradation testing : the Panel to be kept informed of work advancement on a possible standard test method (J. Neeld. Long term project).

8. OSP agendas, working documents and minutes to be compiled into an AIR to constitute a record of decisions for future users of AS 36100 (J.J. Machon). The Panel recommends it be classified in document sequence.

10.2 Work completion objectives and planning :

It was felt the 8th draft AS 36100 as in principle now defined should be final, subject to any further comments possibly resulting from successive ballot processes (AGE-2A, AGE-2, SAE Aerospace Council). The results of the AGE-2A ballots of the various documents, including AS 36100, will be examined at the 10th OSP meeting planned on Mon. Apr. 26, 2004 in San Antonio, TX .

The general goal is all the main documents be published by SAE by Fall 2004, or earlier. The next step will be formally presenting the document to the FAA and requesting a TSO C90 amendment. It was not possible to discuss it further in the absence of the FAA representatives with the Panel, and it is hoped a detailed course of action can be agreed with them at the 10th meeting.

11. Meeting closure :

Chairman O. Atienza thanked the attendees for their valuable inputs, and closed the meeting at 06:00p.m.

ANNEX 9 - *OSP meeting N° 9 - Orlando FL, October 27, 2003*

Attachment 9A AGENDA

1. Adoption of agenda.

2. Membership review.

3. Review of minutes of meeting N° 8, Scottsdale AZ, April 07, 2003 :

3.1 Minutes approval.

3.2 Review of outstanding questions and assignments.

4. AS 36100 7th draft discussion (dated June 15, 2003).

4.1 Approval of revised scope wording in 1, 3.1 and 6.1.

4.2 Approval of revised sentence on base underside in 4.10.4.

4.3 Approval of revised UC codes A7, B7, M2, consistent with K4, L5, L6.

4.4 Approval of revised minimum container recess height 2.50" (sizes G and R 2.25").

4.5 Approval of size B ultimate load condition revised to NAS 3610 load condition 16 (main deck).

4.6 Approval of sizes G and R seat track centerline minimum inset 48 mm (1.89").

4.7 Discussion of fractional vs integer inches net spacings (UC G1, L6, R1).

4.8 Discussion of separate pallet / container drawings in UC K4, L5, L6.

4.9 Approval of proposed RC P and Q single unit testing restraint conditions.

4.10 Other comments or questions and open discussion.

5. AS 36101, Load distribution model (dated August 30, 2003):
Discuss AGE-2A ballot comments incorporated into 3rd draft and review results of AGE-2 ballot.

6. ARP 36102, ULD test methods discussion (dated August 14, 2003).

6.1 July 09, 2003 Frankfurt WG meeting report.

6.2 October 06, 2003 Münich WG meeting report.

6.3 Draft highlights, status and discussion (NOTE : AGE-2A project. OSP discussion for consistency check purposes).

7. ARP 36103, ULD CG control (M. Arcelle, J.J. Machon sponsors) : 1st draft review (dated July 15, 2003).

8. Progress report of additional "satellite" documents in AGE-2A, AGE-2, Aerospace Council.

9. Summary of FAA NPRM N°2002-NM-91-AD and possible straps TSO. Relationship with AS 36100.

10. Follow-up action :**10.1** Task assignments for the 10th meeting.
10.2 Work completion objectives and planning. TSO C90 revision procedure.

ANNEX 9 - *OSP meeting N° 9 - Orlando FL, October 27, 2003*

Attachment 9B

AS 36100 7th draft summary

Reference : minutes of OSP meeting N° 8, Scottsdale AZ, Apr. 07, 2003

The attached 7th draft of AS 36100 revises the 6th draft, dated March 15, 2003, circulated prior to the Scottsdale 8th OSP meeting (for a record of the main changes introduced into the 6th draft, see explanatory report dated March 15, 2003), based on the decisions reached at that meeting. This draft is expected to be final, or nearly so, before starting the balloting process, subject to OSP approval. It remains at 31 pages, all checked and updated.

The main changes introduced from the 6th draft are as agreed by the 8th OSP meeting (see its minutes) and highlighted in yellow (the wording not from original NAS 3610 is not anymore underlined as in previous drafts) :

- reworded sentence in 1, Scope, 3.1 and 6.1 in line with FAR 25.561 to identify "9g" ULDs are not covered, modified in accordance with FAA and OSP remarks (proposal, based on legal check by J. Jackson),

- word "certificated" systematically replaced by "approved" throughout, and sentence from TSO C90c clause (e) added at the end of 1.2, based on FAA input,

ULD configurations :

- all ULD configuration drawings were electronically redrawn (.bmp format), incorporating the agreed changes,

- configurations A, B, M : configuration codes changed (A7, B7, M2), consistent with already agreed K4, L5, L6, to avoid confusions with former NAS 3610 certifications still in service. Proposed to be discussed at 9th OSP meeting.

- configurations A, B, K, L5, M, N, P, Q, S : minimum recess height increased from 2.12" to 2.50" for containers (based on data submitted by N. Lache). This minimum height for sizes G and R remains at 2.25": it is felt thick and stiff bases do not present the same interference problems as thin ones,

- same configurations : added min. and max. base edge thickness, not always shown in NAS 3610 (rationale : why specify the underside clearance of vertical restraint in the RCs, if the base edge thickness is unspecified ?),

- size B : the ultimate loads and maximum CG height were tentatively changed from NAS 3610 load condition 7 to load condition 16, because the former did not allow for main deck use. Proposed to be discussed at 9th OSP meeting. **[9B-01]**

- sizes G and R pallets : introduced 48mm (1.89") min. distance from seat track to edge (proposal),

- sizes P and Q (containers only) redrawn in line with the other configurations.

NOTES : - for configurations G1, L6 (former L2) and R1 pallets, original NAS 3610 net attachment spacings are not an integer in inches, thus cannot be achieved with optional continuous AS 33601 track at 1.0" increments. Should it be changed ? Proposed to be discussed at 9th OSP meeting.

- configurations K4, L5 and L6 show separate drawings for containers and pallets (carried over from NAS 3610) while the others do not. Is it necessary to keep them ? Proposed to be discussed at 9th OSP meeting.

Restraint conditions :

- restraint conditions K, L, P, Q (lower deck only) : note on vertical rollers added, **[9B-02]**

- restraint conditions P and Q redrawn with single container, similar to K and L (B767 stacking covered by additional base force at testing).

Submitted for Panel evaluation and discussion at the 9th , Montreal Que, Sept. 8, 2003, OSP meeting. In order to save time at the meeting, however, all members are invited to send their comments by e-mail prior to it, so that prior discussion can take place if needed, and they can be consolidated and circulated for meeting preparation.

In view of the draft being close to final, all members are also strongly requested to cross-check all dimensions and tolerances shown, in order to spot any inadvertent error that might still have gone unnoticed though several were corrected while preparing this 7th draft.

ANNEX 9 - *OSP meeting N° 9 - Orlando FL, October 27, 2003*

Attachment 9C

AS 36101 explanatory report for AGE-2 ballot (Sep. 2003)

This draft AS was developed within AGE-2A and its NAS 3610 Oversight Panel in order to be one of the "satellite" documents of future AS 36100, intended to be the reference document for a TSO C90(d) revision. It had been determined by the Panel an industry standardized method was necessary to provide a single agreed way to compute the effects of load C.G. deviation onto the ULD and its restraint system and supporting structure, vs several different methods currently used.

The technical contents of the proposal are based on initial analysis approved by the OSP. The main difficulty arising is discrepancies in certain main deck cases between the area loads resulting from CG offset and the maximum area load defined in AS 36100 for ULD bases, as follow :

AS36100 UC	Maximum Area load lb/sq.ft	Usual MGW lb	Main / Lower Deck	Outer Area sq.ft	Area load (lb/sq.ft) resulting from CG offset on an area of X % of the base			
					100 %	80 %	72 %	64 %
A	209	10200 15000	LD MD	76.4 76.4	133 196	167 **245**		208 **306**
B	209	10000	MD	66	151	189		**237**
G	418	30000	MD	159	188	N.A.	262	N.A.
K	209	3500	LD	25.8	135	169		212
L5	209	7000	LD	52.4	133	167		209
L6	209	7000	LD	52.4	133	167		209
M	209	11250 15000	LD MD	83.3 83.3	135 180	169 **225**		211 **281**
N	209	5600 7500	LD MD	41 41	136 183	170 **228**		213 **285**
P	209	2700	LD	19.7	137	171		214
Q	209	5400	LD	40.3	134	167		209
R	418	25000	MD	131	191	N.A.	265	N.A.
S	209	5100 7500	LD MD	37.6 37.6	135 199	169 **249**		212 **311**

The solution for such discrepancies (underlined in the above table, mostly for sizes A and M and their half-size derivatives N and S on the main deck) is shown under § 3.1.4 (b) of draft AS 36101. It is to be noted, however, for most ULD cases computation rather exactly fits the agreed AS 36100 maximum base area load.

The CG eccentricity trade-off wording under § 4.1, including Figure 2, is taken verbatim from the FAA (Transport Airplane Directorate, Aircraft Certification Service) document 00-113-1039 of Dec.22, 2000, "*Approval of an Alternative Method of Compliance (AMOC) to ... Airworthiness Directives ... for certain Boeing 727 airplanes*", issued as a result of the ATA's ULD CG Task Force supported by the OSP. This ensures consistency with FAA requirements. Though this document is limited to B727s, its principle is clearly applicable to all airplanes. It was felt inappropriate, however, to directly refer to it in AS 36101 because of this limited applicability and scope.

The document was approved by AGE-2A and the OSP, including FAA representatives. The attached draft incorporates the comments received as part of the AGE-2A ballot (particular thanks to Jim Jackson for his extensive contribution).

ANNEX 10 - *OSP meeting N° 10 - San Antonio TX, April 26, 2004*

MINUTES

1. Chairman O. Atienza opened the meeting at 08:30am. The proposed agenda (Attachment **10A**) was accepted.

2. 16 members and observers were present : O. Atienza (Chmn)

J. Burkett	J. Jackson	E. Moradians	C. Stratford
B. Danczyk	N. Lache	J. Neeld	M. Terlecki
F. Eriksen	B. Lemon	S. Sondergaard	H. van Rooijen
R. Hoffmann	J.J. Machon	M. Spry	

Special welcome was expressed to new attendees E. Moradians (Ancra) and M. Spry (Boeing cargo systems).

Apologies had been received from H. Offermann and J. Risheim (FAA). However, J. Risheim would be attending the plenary AGE-2A meeting on next day, where TSO revision procedures could be discussed.

3. Review of minutes of the 9th meeting in Orlando, FL, Oct. 27, 2003 :

3.1 The minutes were approved with the following change : in § 4.4, NOTE (2), page 2, last line, replace "..agreed the maximum value recommended not to be exceeded.." by "..the minimum value..".

3.2 Review of outstanding questions and assignments :

The task assignments of the 9th meeting were reviewed and found mostly met, as follows (numbers refer to 9th meeting minutes § 10.1 for ease of reference. Items late on schedule are underlined) :

1 : the <u>bibliography AIR</u> (co-sponsors : U. Hartmann and R. Fu) was still not yet drafted. J.J. Machon will communicate the already agreed principles to U. Hartmann to prepare a first draft,

2 : the AS 36100 8th draft (AGE-2A ballot) and 9th draft (AGE-2 ballot) were produced and circulated for approval (see **4.1** hereafter),

3 : AS 36101 was approved at both AGE-2A and (after the resulting comments were incorporated) AGE-2 ballots, then by the Aerospace Council and was published in January, 2004.

4 : the AGE-2A AS 36102 (ULD testing methods) working group sent out the revised 3rd draft on Apr. 21, 2004 (see **4.3** hereafter),

5 : ARP 36103 (ULD CG control means) was ballotted through AGE-2A and AGE-2 and stands to be sent to the Aerospace Council (see **4.**4 hereafter),

6 : ARP 5597 (AGE-2A project 97-04, <u>ULD inspection and serviceability limits</u>), sponsor U. Hartmann, disapproved at its AGE-2A ballot, is still expecting a redraft to be circulated,

7 : the environment degradation standard testing methods project was started by Bridport-Aviation, but it is a long term R & D project to be addressed when actual findings will be available,

8 : the "<u>decisions record" AIR</u> (sponsor: J.J. Machon) was still not yet drafted, it being felt more appropriate to await ballots and comments incorporation. It will be attempted to present a first draft at meeting N° 11.

4. Review of documents ballot results and resolution of ballot comments :

4.1 AS 36100 (reference AS 36100 9th draft, dated Feb. 20, 2004, see attachments **10B** and **10C** summaries)

One disapproval (Fred Grahme's) at the 8th draft's AGE-2A ballot was successfully resolved, with the resulting change introduced into AGE-2 ballot's 9th draft. This change concerns § 4.11, *Environmental degradation*, where the text is now identical to FAR 25.603 (c). This completes full incorporation of FAR 25.603 wording, with 25.603 (a) already in § 4.1, *Materials*, and 25.603 (b) in § 5.3, *Test methods*, according to the subject concerned. This resolution was fully approved by the Panel.

Another disapproval (Chris Stratford's) was recorded at AGE-2 ballot. A number of items therein were due to insufficient familiarity with the OSP's previous work and the absence at this stage of the "decisions record AIR" intended to provide explanations and justifications, and were satisfactorily explained. Chris's concern remained, however, as to the lower deck restraint case for sizes A and M with 4 forward and aft latches (NAS 3610 load condition 8 or 9 respectively, restraint condition 9), where there is an unrestrained length of 50", rather than 25" as per AS 36100's applicable RC A, in the center of each long side. Panel discussion evidenced that :

(a) the OSP's assessment had been that for sizes A and M NAS 3610 load condition 18 (ultimate upward load 38 000 lbs) with 5 latches at 25" spacing effectively was the ULD testing worst case, vs NAS3610 load condition 8 (ultimate upward load 22 500 lbs) or 9 (ultimate upward load 25 200 lbs) with 4 latches at 50" maximum spacing. Therefore, a ULD tested and certified to AS 36100 UC A or M under RC A would be more than adequate to withstand the typical actual aircraft lower deck restraint condition with 4 latches (NAS 3610 restraint condition 9) at significantly lower ULD MGW. This assessment was checked and still stands. No additional RC is required for (lower deck) ULD testing.

(b) what is at stake here is an example of the separate assessment of the ULD itself and the actual aircraft restraint geometry, whatever it is. This is in principle covered by the last sentence in AS 36100 § 3.3. However, other ballot comments also evidenced that this condensed sentence is not always readily and fully understood. To ensure better understanding by future document users, the panel agreed to replace it by the equivalent but more detailed wording suggested by Gary Lane's comments, as follows :
"(The applicable restraint conditions) ~~*do not imply that other restraint configurations may not be used on aircraft*~~ " to be replaced by : **[M10-01]**
" *The ULD restraint conditions and ultimate loads included herein are intended to represent a worst case capability for the ULD. They are not intended to represent aircraft cargo handling system restraint designs. Actual aircraft implementations may vary from the ULD test parameters stated herein in such areas as number and spacing of restraints, among others, as long as they stay within the worst case ULD capabilities herein."*

(c) determination of the allowable ULD MGW in an aircraft's lower deck system meeting e.g. NAS 3610 restraint condition 9 will then pertain to the airframer or cargo system designer, same as, e.g., reduced allowances in the event of a missing restraint, etc... In this respect, the OSP had originally planned to introduce a minimum base edge EI value in order to make such assessment more standardized and straightforward. This had been later dropped, on the grounds that such an EI value already is implicit in the fact a ULD successfully passed its ultimate loads tests, and can be determined there from if needed. Though this remains true, consideration of the evidenced misunderstandings led the Panel to unanimously agree, for clarification, to reinstate this requirement as it had been previously agreed, but with a somewhat lower minimum requirement, as follows :
" 4.10.4 *Base performance* ", add :
" *All ULD base edges shall have a minimum vertical EI value of* 5×10^7 *N.cm*^{2} *(* 1.75×10^6 *lb.in*^{2} *)."* **[M10-02]**

NOTE : the actual figure above was subsequently determined and approved by the AGE-2A plenary meeting on Apr. 28. The detailed rationale and computation are shown in revised Attachment **10E** hereafter.

The other comments received at either AGE-2A or AGE-2 ballot were reviewed as follow :