

NATO UNCLASSIFIED

NATO STANDARD

APP-22

MILITARY PALLETS, PACKAGES AND CONTAINERS

Edition B, version 1

SEPTEMBER 2021



NORTH ATLANTIC TREATY ORGANIZATION

ALLIED PROCEDURAL PUBLICATION

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)
NATO STANDARDIZATION OFFICE (NSO)
NATO LETTER OF PROMULGATION

22 September 2021

1. The enclosed Allied Procedural Publication APP-22, Edition B, version 1, MILITARY PALLETS, PACKAGES AND CONTAINERS, which has been approved by the nations in the MILITARY COMMITTEE LAND STANDARDIZATION BOARD, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 2828.
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Major General, GRC (A)
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
BGR	The standard will be implemented only by the declared to NATO units for full-spectrum operations.
CAN	<p>1) 2.2.3. ISO FOUR-WAY PALLET (EUR PALLET) - Canada does not use the EUR pallet (para 2.2.3) in the CAF as our general-purpose pallets.</p> <p>(2) 2.2.1. NATO STANDARD FOUR-WAY PALLET - Canada uses the NATO standard 4-way pallet (48X40") with minor variations between depots (i.e. fork-lift entry of 25CFSD pallet is different to accommodate high-bay pallet racking). Therefore, there could be a mix of depot pallets being shipped overseas. Canada does not use the 48X32" NATO standard pallet.</p> <p>(3) 2.2.2. BOX PALLET - Years ago, Canada used full & 1/2 size collapsible plywood sleeves & lids on our pallets.</p> <p>Depots were concerned about the metal hinges & personnel safety – we discontinued use when the black, collapsible, reusable plastic containers were introduced for round-trip depot to base shipments.</p> <p>(4) 2.4.3.2. DIMENSIONS AND SPECIFICATIONS (POL Pallet)</p> <p>b. NATO Stock Number (NSN): 3990-99-138-1783 – Canada has not adopted this NSN.</p>
DEU	<p>The approval occurs under following complement:</p> <p>add Para 1.5, Sub-Para 3, Page 1-1:</p> <p>3. If not already the case any pallet, package, container, handling equipment or other device should be added to and used in LOGFAS.</p>
FRA	<ul style="list-style-type: none"> - France still uses 1000x1200 mm² EUR pallets that, although they have the same dimensions as the 1000x1200 mm² NATO pallets described in APP-22, do not have wings for slinging operations. - France does not use the metal « petroleum, oil and lubricants » (POL) pallet described in APP-22, which corresponds to an Anglo-Saxon standard ; it uses the 1140x1140 mm² CP9 wooden pallet designed for the chemical industry. - For the transport of POL cargoes on pallet, France applies the following standard that should be mentioned in Table 4-1 of paragraph 4.5.1: <p>Nation : FRA Type of materials : POL Height : 1600 mm (63 in) Mass : 1000 kg (2205 lb).</p>

GBR	<p>1- Where are the Unit Load tests 1-7? It appears the series of Unit Load tests have been removed from the last Edition of the STANAG (Ed 7). Was this intentional? And why? Or if not intentional is this now in a second part of the STANAG? If so can we please review these tests...this is the most important part of the STANAG, and are key performance tests which must be passed by all UK MOD Unit Load designs entering service, and cannot be issued a Unit Load Specification (ULS) by the authority ie ourselves in WOC Pkg until all these tests are successfully completed.</p> <p>2- Strapping – the STANAG mentions “plain/galvanized steel strapping” in Annex A but can it be clarified when first mentioned, if plain OR galvanized...giving both the option of plain or galvanized for steel strapping?</p> <p>3- US Standards - There is a mention of MIL STD 147 for Palletized Unit Loads at Annex G in related publications, but no mention of MIL STD 1660, which MOD UK currently believe to be the US standard for palletized Unit Loads. What are the differences with these standards? Which is most up to date?</p> <p>4- There is a slight anomaly in what is permitted for the load capacity and stack load capacity of the NATO 4 way pallet, and then with nation’s exceptions for Ammunition Unit Loads.</p> <p>a. Para 2.4 Dimensions mentions max capacity at 1000kg , and a stack load capacity of 4000kg, suggesting 4 x the base pallet and therefore a maximum 4 high stacking load.</p> <p>b. It then further mentions at para 4.5 a max loading capacity as 1814Kg, for UK/GBR Ammunition Unit Loads. Does this mean when stacked to 4 high , the stacking load capacity of 4000kg as mentioning in para 2.4 may be exceeded? Provided the Stacking test (4 times the weight of base pallet) is complied with? Does this need to be clarified in para 4.5? The maximum stacking load capacity for each of the exceptions listed in the table?</p>
LVA	VAMOIC, will implement this standard in future,
<p>Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.</p>	

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CHAPTER 1 INTRODUCTION

1.1. REFERENCES

Publications that are referred to in this document are listed at Annex C.

1.2. AIM

The aim of this document is to establish the characteristics and test criteria necessary to ensure that pallets, packages, and containers or any other means of constituting unit loads used by nations are functionally interchangeable and can be handled, moved, and trans-shipped among nations at all logistics levels.

1.3. AGREEMENT

Participating nations agree to adopt the characteristics and test criteria for unit loads contained in this document.

1.4. TERMS AND DEFINITIONS

Terms and definitions that are used in this document can be found at Annex D.

1.5. GENERAL

1. It is intended that the provisions of this document will apply to future planning for and the introduction of new pallets, packages, or containers. This document is not intended to eliminate or modify existing pallets, packages, and containers or any other means of constituting unit loads. Also, it is not intended to replace existing criteria for proving the structural reliability of standard unit loads where this would entail considerable expenditure nor where different test equipment or methods are used to demonstrate equal or greater capabilities.

2. Throughout this document, dimensions are given in millimetres (mm) and inches (in), and masses are given in kilograms (kg) and pounds (lb). Dimensions and masses are considered to be corresponding values, although some may not be exactly equivalent. For ease of reference, 25.4 mm is equivalent to 1 in and 1 kg is equivalent to 2.205 lb.

3. All pallets, packages, containers, handling equipment, or other packaging material/device should be added and implemented in LOGFAS.

1.6. DETAILS OF THE DOCUMENT

1. Pallets. Chapter 2 details the required characteristics.

2. Packages. For the purposes of this document, packages are those loads which are not palletized and which are unsuitable for manual handling. They should be designed to:

- a. Provide devices to permit handling by forklift and pallet trucks from two opposite sides and preferably from four sides.
 - b. Provide devices to enable handling by overhead lifting equipment.
 - c. Conform where appropriate to the requirements for general-purpose pallets detailed at Chapter 2.
3. Freight Containers. Containers are used within military logistics systems. Chapter 3 details characteristics.
4. Unit Loads. Chapter 4 details characteristics.
5. Palletized Unit Loads. Annex A provides guidance on palletized unit loads for general supply.
6. Wood Packaging Material (WPM). Annex B provides details on phytosanitary requirements of regulated WPM used in export.
7. Evaluation Data Sheet. Annex F provides an example of a data sheet for field exercises.

CHAPTER 2 PALLETS**2.1. GENERAL**

1. This chapter covers general-purpose (GP) pallets including NATO standard four (4)-way pallets, ISO 4-way pallet (EUR pallet), and box pallets, as well as, special purpose pallets including pallets specific to type of transport, pallets for loads unsuited for GP pallets, metal POL pallet, etc.

2. Pallets are handling aids. The details of their construction are important only in the way in which they aid or impede handling efficiency and unit load integrity. Pallets consist of a top and bottom deck separated from each other and connected by blocks or of a single deck having supports, skids, and blocks or other devices on the lower side. The connecting pieces or devices attached to the lower side will permit handling vehicles to insert their lifting appliances under the top deck from any of the four sides.

3. The materials of the pallets will not be standardized within NATO. Typically pallets are manufactured from wood, but can also be made of alternative materials such as fibreboard, metal, plastic, etc.

2.2 GENERAL PURPOSE PALLETS**2.2.1 NATO STANDARD FOUR-WAY PALLET**

NATO standard 4-way entry pallets are in accordance with ISO 6780. Characteristics of the pallet are as follows:

- a. Dimensions as specified in Tables 2-1 through 2-3. Mass capacities provide for uniformly distributed loads.
- b. Openings shall be provided in the bottom deck of double-decked pallets to allow trail wheels of pallet trucks to pass through per ISO 6780. Dimensions are specified in Chapter 2.
- c. The total area of the base (i.e., bottom boards) shall not be less than 35 percent of the area of the top of the pallet. This allows for placement and stability of the pallet on soft soil conditions (e.g., sand, etc.).
- d. Wings on pallets allow for more options in handling unit loads especially when there is a shortage of materials handling equipment (MHE) (e.g., slinging operations¹ using the outside wings, etc.). There are situations when wings are not essential to the operations and may not be required at all.

¹ National slinging capabilities, which are readily available for pallet slinging operations in corps, division, and brigade areas are identified in STANAG 2827.

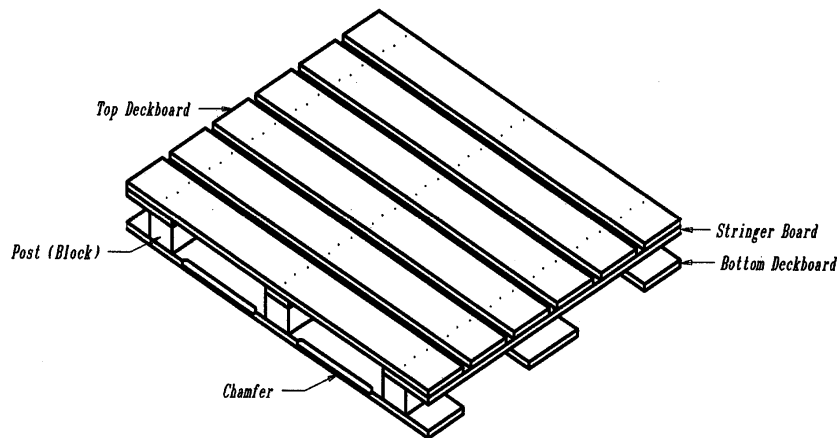


Figure 2-1: Typical View of Standard NATO 4-Way Entry, Winged Pallet

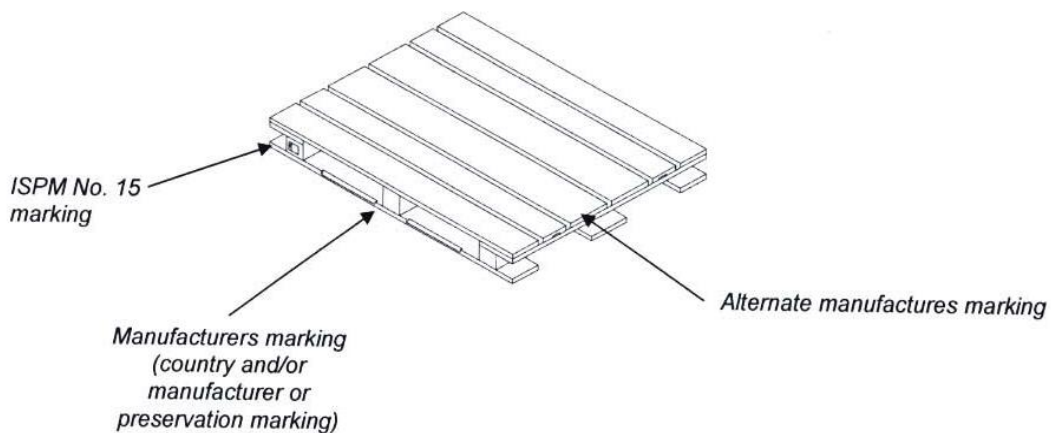


Figure 2-2: Typical Marking Locations (see Figure 2-4 for typical EUR pallet markings)

2.2.2. BOX PALLET

Box pallets can be designed with removable or collapsible sides and may be used with the pallet bases that conform to the characteristics of the NATO standard 4-way pallet or with special pallet bases. The outer dimensions, including reinforcements, are not to exceed the maximum overhang dimensions specified for unit loads. When the NATO standard 4-way pallet is used, the maximum permissible overhang dimensions are:

- a. Not more than 50 mm (2 in) on each side of the standard pallet width.
- b. Not more than 40 mm (1.5 in) on each side of the standard pallet length.

- c. The eyes and/or aperture into which the hooks of lifting devices are to fit should have:
- (1) An inside diameter of not less than 63 mm (2.5 in).
 - (2) An outside diameter of not more than 120 mm (4.75 in).
 - (3) A thickness not greater than 35 mm (1.375 in).
 - (4) Strength of eyes and/or aperture shall equal or exceed the rated capacity of the box pallet.

2.2.3. ISO FOUR-WAY PALLET (EUR PALLET)

The EUR pallet or EURO pallet is a generic term for an 800 mm (31.5 in) by 1200 mm (47.25 in) ISO pallet according to ISO 6780. The EUR pallet is similar in limiting exterior dimensions to the NATO standard pallet. The EUR pallet does not provide wings for ease of slinging operations. Further details on the EUR pallet are contained in paragraph 2.4.2.

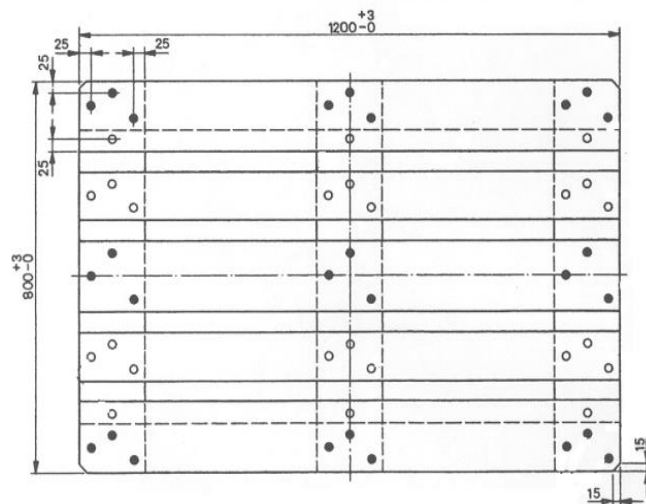


Figure 2-3: Typical Dimensional View

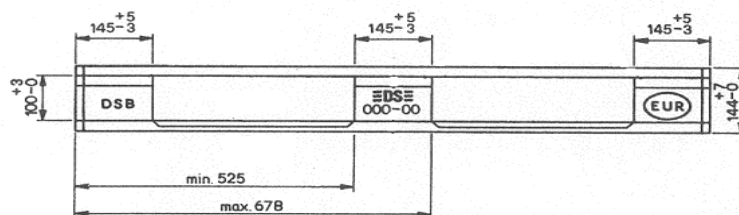


Figure 2-4: Typical Side View²

² Shows typical EUR pallet markings include EUR inside oval, manufacturer, quality mark (EPAL), etc.

2.3. SPECIAL PURPOSE PALLETS

Special purpose pallets are designed for special loads that may have outer dimensions of the pallet base not corresponding to the outer dimensions of NATO standard 4-way pallets. The design of such pallets should be such that the unit load meets the criteria of Chapter 4.

2.3.1. TRANSPORT-SPECIFIC PALLETS

The design of pallets specific to the type of transport will be the responsibility of the agency concerned but will take note of the specifications of this document. For example, pallets specific to air transport are provided in STANAG 7213.

2.3.2. PALLETS FOR LOADS UNSUITED FOR GENERAL PURPOSE PALLETS

1. The NATO standard 4-way pallet should be used unless:
 - a. They are unsuitable for use because of the characteristics of the load.
 - b. Their use would inhibit the creation of the most efficient unit loads in terms of operational and logistics factors, taking into account the whole of the supply chain with priority accorded to the needs of the end user.
2. Characteristics. Any pallet used should allow palletized loads to be handled, moved, and trans-shipped between nations at all logistics levels. As such, it should conform to the specification of the NATO standard 4-way pallet in those respects necessary to provide compatibility with STANAG 2829 equipment.
 - a. There should be 4-way entry.
 - b. Openings should be provided on at least two sides to allow forks of pallet trucks to pass through per ISO 6780.
 - c. Minimum fork entry width shall be 250 mm (10 in). Minimum fork entry height should be 98 mm (3.875 in)³.
 - d. Any lifting hook eyes should conform to paragraph 2.2.2.c.

2.3.3. METAL PETROLEUM, OIL, AND LUBRICANTS (POL) PALLET

The POL pallet is a stackable pallet designed to carry 21 jerricans (20 litres (5-gallon) per jerrican). Further details are contained in paragraph 2.4.3.

³ Certain North American pallets may have a fork entry height of not less than 75 mm (3 in).

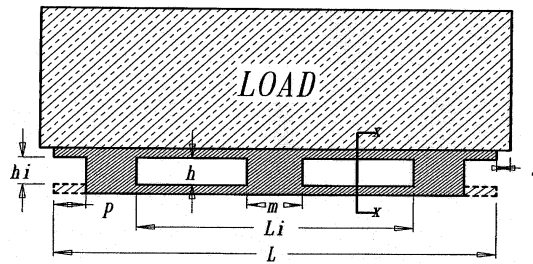
2.4. DIMENSIONS OF STANDARD FOUR-WAY PALLETS AND METAL POL PALLETS

Serial	Designation	Nominal Dimensions		Length		Width		Height		Pallet Capacity (Nominal)		Load Stack Capacity (Nominal)	
		mm	(in)	mm	(in)	mm	(in)	mm	(in)	kg	(lb)	kg	(lb)
A	B	C	D	E	F	G	H	J	K	L	M	N	O
1	NATO Standard 4-way Pallet	1200 x 800 (800 x 1200)	48 x 32 (32 x 48)	1200+20-0	47.25+0.75-0.0	800+15-0	31.5+0.5-0.0			1000	2205	4000	8820
2		1200 x 1000 (1000 x 1200)	48 x 40 (40 x 48)	1200+20-0	47.25+0.75-0.0	1000+16- 0	39.37+0.63-0.0			1000	2205	4000	8820
3	Metal POL Pallet	1325 x 1110	52.250 x 43.750	1325+16-16	52.25+0.63-0.63	1110+16 -16	43.75+0.63-0.63	754	29.750	500	1102.5	2000	4410

Table 2-1: Dimensions of Standard 4-Way and Metal POL Pallets⁴

⁴ The tolerances permitted in the above table are applied in the opposite sense for metric and customary (inch) dimensions to help bring the two measurements into line.

2.4.1. LIMITING DIMENSIONS

Figure 2-5: NATO Standard 4-Way Pallet - Limiting Dimensions⁵

The limiting dimensions applicable to the NATO standard 4-way pallet are as follows:

Side Pallet Dimension L (nominal)		Width of Centre Support m (maximum)		Entry Width Li (minimum)		Entry Height h (minimum)		Wing Height hi (minimum)		Width of Wing p (minimum)		Load Overhang s (maximum)	
mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)
800	32	150	6	590	23.25	98	3.875	-	-	0	0	40	1.5
1000	40	150	6	720	28.375	98	3.875	-	-	0	0	50	2
1200	48	150	6	770	30.375	98	3.875	70	2.75	65	2.5	50	2

Table 2-2: Dimensions

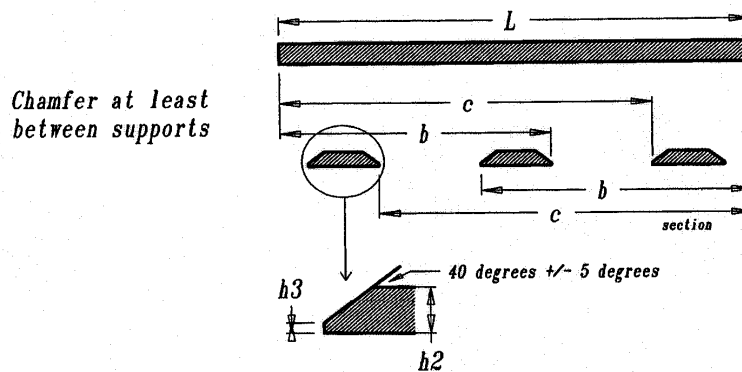


Figure 2.6: Limiting dimensions applicable to the NATO standard 4-way pallet to allow trail wheels of pallet trucks to pass through^{6 7}

⁵ The drawing does not show the method of construction of the pallet, but illustrates the dimensions that are limited in Table 2-2. Wings are not mandatory on bottom deck boards.

⁶ For ease of clarity, the vertical post is not shown.

⁷ When the thickness of the bottom boards exceeds 10 mm (0.375 in), the edges of the top surface of the bottom boards should be chamfered on each side of the top face, as shown in the drawing above. This requirement applies to a pallet of any material.

Openings shall be provided in the bottom deck of double-decked pallets to allow trail wheels of pallet trucks to pass through per ISO 6780. The limiting dimensions applicable to the standard 4-way pallet are as follows:

End Pallet Dimensions		b (maximum)		c (minimum)		Material Thickness h_2 (maximum)		Height of Vertical Face h_3 (maximum)	
mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)
800	32	482.5	19	695	27.5	28	1.125	15+0-3	0.625+0-0.125
1000	40	583	23	855	33.5	28	1.125	15+0-3	0.625+0-0.125
1200	48	685	27	980	38.5	28	1.125	15+0-3	0.625+0-0.125

Table 2-3: Limiting Dimensions

2.4.2. ISO FOUR-WAY PALLET (EUR PALLET)

2.4.2.1. GENERAL

This section describes the ISO 4-way pallet, also known as the EUR pallet or EURO pallet. The pallet is a wing-less, 4-way entry wood pallet. Nine wood blocks separate the top deck boards from the bottom deck boards to provide adequate fork entry space.

2.4.2.2. DIMENSIONS AND SPECIFICATIONS

1. Pallet capacity: 1000 kg (2205 lb); Load stack capacity: 4000 kg (8820 lb).
2. Length: Outer dimension 800 mm (32 in) (nominal); Width: Outer dimension 1200 mm (48 in) (nominal).
3. Specifications: The EUR pallet shall be manufactured in accordance with UIC Code 435-2.

2.4.3. METAL PETROLEUM, OIL, AND LUBRICANTS (POL) PALLET

2.4.3.1 GENERAL

This section describes the pallet required for the utilization of 20-litre (5-gallon) jerricans. The pallet is a skid-mounted, rectangular frame constructed of angle iron with a flat metal and round bar supporting structure. The floor is made from corrugated-sheet metal, drilled to allow spilled fluids to flow out. A spigot and locating hold system on the four corner posts provide a locking arrangement for pallets when stacked. Each pallet is capable of carrying 21 jerricans or 420 litres of fuel.

2.4.3.2. DIMENSIONS AND SPECIFICATIONS

1. Designation: Pallet POL stackable 1110 mm (43.75 in) by 1325 mm (52.25 in) by 754 mm (29.75 in) steel.
2. NATO Stock Number (NSN): 3990-99-138-1783.
3. Pallet capacity: 500 kg (1102.5 lb) (nominal); Load Stack Capacity: 2000 kg (4410 lb) (nominal).
4. Length: Outer dimension 1325 mm (52.25 in); Inner dimension 1270 mm (50 in).
5. Width: Outer dimension 1110 mm (43.75 in); Inner dimension 1060 mm (41.75 in).
6. Height: Outer dimension 754 mm (29.75 in); Inner dimension 604 mm (23.875 in).
7. Tare Mass: Approximately 50 kg (110 lb).

2.4.3.3. HANDLING

This can be achieved by Category A or B forklift trucks (reference STANAG 2829), 4-way entry. Hand or powered pallet trucks can only be used on a two-way entry basis. The pallets, when loaded with POL containers, should only be handled by equipment meeting national safety regulations.

2.4.3.4. ILLUSTRATIONS OF SINGLE AND STACKED PALLETS

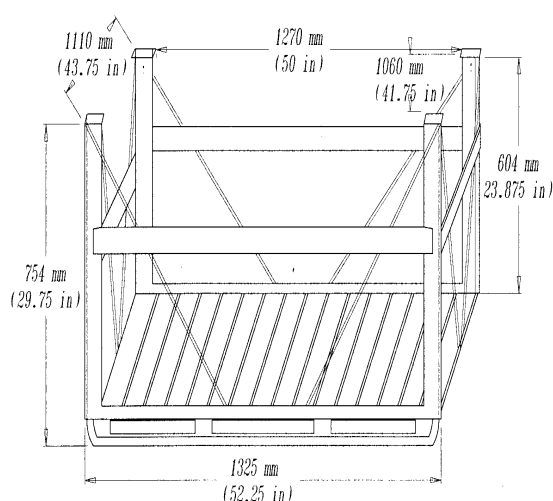


Figure 2-7: POL Pallet (Single)

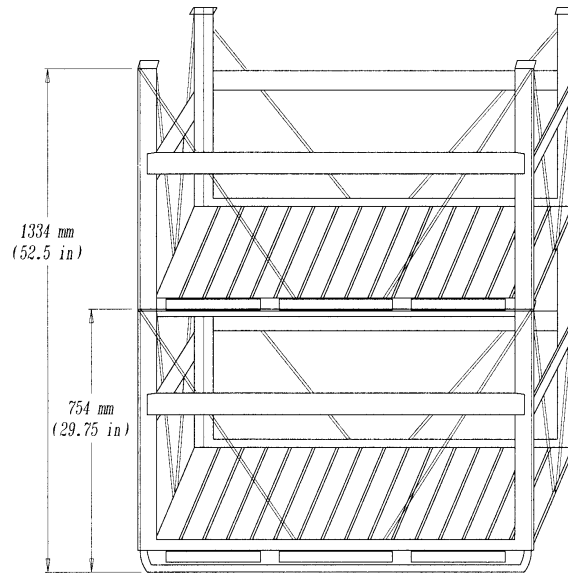


Figure 2.8: POL Pallet (Stacked)

2.4.4. AIR TRANSPORT (AIRLANDED) PALLET

1. Criteria for the air transport (airlanded) pallet that locks in aircraft restraint systems and is supported by aircraft conveyor systems, ground support equipment or MHE is described in STANAG 7213.
2. Guidelines for handling the air logistics pallet outside an airfield environment are:
 - a. Protect pallets from the elements.
 - b. Empty pallets should not be stacked upside down.
 - c. Dunnage is required to support each stack of 10 empty pallets along two equal length sides and through centre of stack.
 - d. Pallets should not be slid or pushed on any solid surface.
 - e. The proper method of handling a loaded pallet is with a forklift truck that has fork tines measuring a minimum of 1830 mm (72 in) in length and 203 mm (8 in) in width.
 - (1) Determine the center of gravity of the loaded pallet and place fork tines accordingly. Use maximum fork tine spread.
 - (2) Ensure the heavy side of the loaded pallet is toward the forklift mast.

- f. Recommended types of support for a loaded pallet in descending order are:
- (1) Wooden dunnage with a uniform thickness of at least 76 mm (3 in).
 - (2) Sand bags, minimum of 9 bags, with 15 bags providing the best support.
 - (3) Unserviceable military 20-litre (5-gallon) jerricans, minimum of 9 cans.

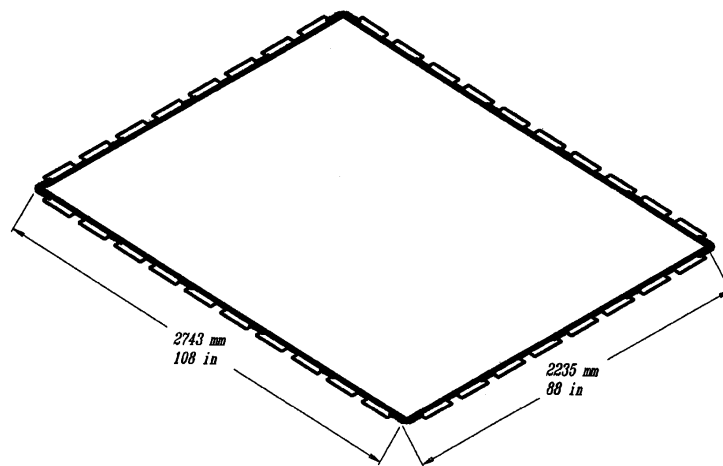


Figure 2-9: Typical Illustration of the Air Transport Pallet

CHAPTER 3 FREIGHT CONTAINERS

3.1. GENERAL

For the purposes of this document, a freight container is an article of equipment:

- a. Of a permanent character strong enough to be suitable for repeated use, and inherently suitable for storage of material.
- b. Specially designed to facilitate the carriage of material by one or more means of transport without intermediate reloading.
- c. Fitted with devices permitting ready handling, particularly its transfer from one mode of transport to another.
- d. So designed to be easy to fill and empty.
- e. Having an internal volume of 1 cubic metre (35.3 cubic feet) or more.

3.1.1. CHARACTERISTICS

In order to permit the trans-shipment of containers, the following requirements must be met:

- a. Freight containers comply with all relevant ISO container standards in existence at the time of manufacture.
- b. Containers, that do not meet the characteristics laid down in ISO 668 and ISO 1161 with regard to either their gross mass or their dimensions, must be able to be moved at least from two sides by forklift and, if possible, pallet trucks. For such containers, requirements for fork entry as detailed in Chapter 2 must also be considered.
- c. With regard to other types of containers, the requirements in ISO 668 and ISO 1161 and, in appropriate cases, relevant paragraphs of Chapter 2 will be taken into consideration.
- d. Logistics systems depending on the employment of these containers should take into account the need for appropriate handling equipment throughout the chain of supply, including minor ports or over beaches.
- e. Where applicable, the external markings of the military containers referred to in paragraph 3.1.1.a and, when necessary, those in paragraph 3.1.1.b above will be per STANAG 4281.

3.2. JOINT MODULAR INTERMODAL CONTAINER

3.2.1. GENERAL

1. This section covers the minimum requirements for a family of standardized, modular transportation unit loads, referred to as Joint Modular Intermodal Containers (JMICs), and establishes general design, interface requirements, and recommended associated tests for specialized shipping configurations.

2. The term JMIC refers to any container (closed or open), configuration, or platform meeting the requirements of the reference interface standard and is compatible with common transportation platforms. JMICs are used to effectively build and break down loads within 20-foot ISO containers, etc. or other commonly used platforms (e.g., flatracks, etc.) as well as trucks and railcars. JMICs can be transported as single units or as multiple units on platforms that can be rapidly transitioned between transport modes. JMICs can also be efficiently stowed aboard ships and air transport pallets and can be handled and hoisted with commonly available equipment.

3. The JMIC shipping configuration is used primarily by the USA Department of Defense (DoD). For interoperability purposes, nations that desire to acquire JMICs are to follow the interface requirements established in the DoD interface standard MIL-STD-3028⁸.

3.2.2. REQUIREMENTS

Details of the JMIC footprint, capacity and specific external features required for interface capability with another JMIC or handling equipment are described in MIL-STD-3028. Its nominal dimensions are 52 inches (1321 mm) long by 44 inches (1118 mm) wide by 43 inches (1093 mm) high. It is designed to fit sixteen (16) JMICs efficiently into a 20-foot ISO container.

3.2.3. ILLUSTRATIONS

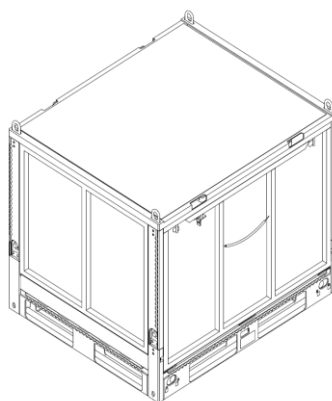


Figure 3-1: Typical Illustration of JMIC (Single)

⁸ Copies of MIL-STD-3028 are available at no charge to Nations and are online at: http://www.assistdocs.com/search/search_basic.cfm.

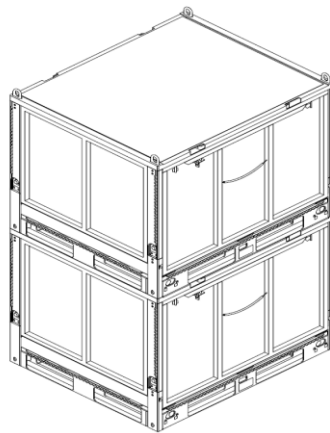


Figure 3-2: Typical Illustration of Double Stacked (Interlocked) JMIC

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CHAPTER 4 UNIT LOADS

4.1. GENERAL

1. A unit load is defined as a number of packages or loose items (in or out of containers) made up into one load, which because of its size and mass must be handled mechanically. It may be categorized as a palletized unit load, containerized unit load, or non-palletized unit load.

2. Unit loads should be designed, as far as practicable, to be moved without restriction, special racking, or special escort throughout the distribution systems used by ratifying nations and should be compatible with:

- a. Existing air, sea, rail, and road transport systems.
- b. Handling equipment used throughout the expected logistics flow patterns including forklift and pallet trucks and slings with particular regard to the Category B equipment requirements (see STANAG 2829).
- c. Being safely and efficiently loaded into military and commercial ISO containers.

4.2. CONSTRUCTION

Insofar as is practical, the complete unit load should be designed in the shape of a parallelepiped (see Annex A for further information), taking account of the following:

- a. item orientation: Items should be oriented in the unit load in a manner that will produce the most efficient unit load dimensions taking into account the needs to:
 - (1) Utilize space and mass capacity efficiently.
 - (2) Minimize any protrusions from the unit load that might cause or be subjected to damage.
 - (3) Ensure load stability on a motionless level surface without depending on strapping.
 - (4) Minimize the risk of damage to items by placing them in the least fragile position. Enable unit loads to withstand safe, stable, long-term stacking.
 - (5) Provide free drainage in the normal storage position by avoiding water retention.
 - (6) Comply with any specific instructions concerning the orientation, handling, and storage of items (e.g., THIS SIDE UP, etc.).

- b. Overhang: Unit loads should be assembled to ensure stability, to provide for efficient strapping application, and not to cause excessive bending force on those containers or items that may be structurally weak. Unit loads normally are to be within the overall dimensions provided in Table 4-2.
- c. Underhang: Under hang shall not be permitted for ammunition unit loads. Spacers, battens, or cap assemblies may be used to fill out the unit load so that the overall nominal plan view dimensions are at least flush with base dimensions. The strength and dimensions of the materials should be adequate to permit shipment by all means of transport (e.g., cap assemblies shall be of such size to withstand all loads imposed on it by adjacent unit loads under impact conditions, etc.).
- d. Pallets: Unit loads shall be designed to use pallets meeting the requirements of Chapter 2. Where the use of pallets is unsuitable, loads should be designed to permit mechanical handling from at least two opposite sides by forklift and pallet trucks together with handling by overhead lifting devices. Fork entry and lifting eye dimensions should be per Chapter 2.
- e. Material: Standard parts and materials should be used unless they are technically or economically impractical. Material used should not adversely affect items because of chemical incompatibility. In particular, all structural pallet material is to be free of decay, rot, insect or fungal infection, severe corrosion, deformation, and breaks. All wood members should be free of bark although wane is acceptable. See Annex B for additional WPM requirements.
- f. Fasteners: Fasteners such as nails and staples are to be of a size and strength sufficient to maintain load integrity without causing damage to the items, its containers and packaging.
- g. Strapping: All strapping and strapping seals shall be strong enough to retain the unit load and resist deterioration in storage and transport environments.
- h. Edge Protectors: Edge protectors of a size appropriate for the strapping may be used.
- i. Markings: Important markings including inspection data on items should not be concealed by the unit load members. In order not to prejudice the requirements for sound unit load construction, consideration should be given to marking unit loads after construction.

4.3. SIZE AND MASS

Size and mass classification of unit loads, including standard unit loads are contained in paragraph 4.5.

4.4. INSPECTION

Inspection procedures are concerned only with the unit load and with those materials that are used to make up the unit load (e.g., pallets, battens, strapping, etc.). Inspection should be capable of being implemented by visual observation and simple measurement.

4.5. UNIT LOADS SIZE AND MASS CLASSIFICATION

4.5.1. CATEGORY A: STANDARD UNIT LOAD

The NATO Standard Unit Load (reference STANAG 2827) has a height limit of 1 metre and a mass limit of 1 metric ton. Tolerances permitted are:

- a. Height: Up to 1050 mm (41 in).
- b. Mass: Up to 1130 kg (2500 lb).
- c. Plan dimensions (see Table 2-2).
- d. Unit load dimensions (see Table 4-2).

Exceptional Limits: At Table 4-1, the following standards are retained nationally.

Nation	Type of Materials	Height	Mass
CZE	Ammunition	1600 mm (63 in)	
	All other Defense materials	1600 mm (63 in)	
DEU	Ammunition	1465 mm (58 in)	2299 kg (5068)
FRA	Ammunition	1900 mm (75 in)	1300 kg (2867 lb)
GBR	Ammunition	1372 mm (54 in)	1814 kg (4000 lb)
	All other Defense materials	1575 mm (62 in)	1814 kg (4000 lb)
NLD	Ammunition	1260 mm (50 in)	
USA ⁹	Ammunition	1372 mm (54 in)	1814 kg (4000 lb)
	All other Defense materials	1372 mm (54 in)	1364 kg (3000 lb)

Table 4-1: Nations Exceptional Limits

⁹ Most USA unit loads have one horizontal dimension that is less than 1092 mm (43 in). The other horizontal dimension shall not exceed 1321 mm (52 in); however, some USA unit loads exceed 1321 mm (52 in) on the greater horizontal dimension. Some USA unit loads use special purpose pallets suitable for the size and mass of the unit load (see Chapter 2).

4.5.1.1. LIMITING UNIT LOAD DIMENSIONS

Pallet Dimension		Unit Load Dimension			
		Minimum		Maximum	
mm	(in)	mm	(in)	mm	(in)
800	32	800	32	880	35
1000	40	1000	40	1080	43
1200	48	1200	48	1300	52

Table 4-2: Limiting Unit Load Dimensions**4.5.2. CATEGORY B: CONTAINERS (INCLUDING DEMOUNTABLE LOAD CARRYING PLATFORMS/FLATRACKS)**

1. 1524 mm (60 in) (Standard 5 ft; also known as a QUADCON or quadruple container).
2. 2032 mm (80 in) (Standard 6 2/3 ft; also known as a TRICON or triple container).
3. 2991 mm (117.75 in) (ISO 668 Standard, nominal 10 ft).
4. 6058 mm (238.5 in)(ISO 668 Standard, nominal 20 ft).
5. 12192 mm (480 in) (ISO 668 Standard, 40 ft).

4.5.3. CATEGORY C: BULKY GOODS (LOOSE OR PACKED)¹⁰

Mass and dimensions:

Dimensions				
Group	Mass (Tons)	Length mm (in)	Width mm (in)	Height mm (in)
1	1-5	to 2500 (98)	2300 (91)	1600 (63)
2	6-9	2500 (98)	2300 (91)	1600 (63)
3	9-16	2500 (98)	2300 (91)	1600 (63)
4	over 16	2500 (98)	2300 (91)	1600 (63)
5	1-5	2000 (79)	2300 (91)	3500 (138)
6	6-9	4000 (157)	2300 (91)	3500 (138)
7	9-16	6000 (236)	2300 (91)	3500 (138)
8	over 16	over 6000 (236)	over 2300 (91)	over 3500 (138)

Table 4-3: Bulky Goods (Groups and Dimensions)

¹⁰ The use of bulky goods may hinder the effective and efficient handling and movement of supplies. Due to the difficulties in handling and movement, bulky goods are non-preferred supplies and wherever possible should be limited in use.

4.6. VALIDATION

The criteria within section 4 does not validate the ability of the unit load and any strapping or bonding methods to withstand the stresses, shocks, and impacts likely to incur during storage, handling, and surface transport. The ability of the unit load or container to withstand the distribution environment can be validated through testing in accordance with STANAG 4340/AEPP-3, NATO Standard Packaging Test Procedures, the International Safe Transit Association, Procedure 3E, Similar Packaged-Products in Unitized Loads for Truckload Shipment, or ASTM D4169, Standard Practice for Performance Testing of Shipping Containers and Systems, distribution cycle 18.

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ANNEX A	GUIDANCE ON PALLETIZED UNIT LOADS FOR GENERAL SUPPLY
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A.1. AIM

The aim of this annex is to provide general guidance on palletized unit loads for general supply. The guidance provides several methods, materials, and techniques to be employed in the formation of bonded palletized unit loads of military supplies, which are adaptable to unit loading. The guidance can be utilized with standard NATO or EUR pallets described in Chapter 2. However, the various methods of bonding and types of storage aids may be modified for use with other size pallets. This guidance is not to be used for the palletization of ammunition, explosives, or semi-perishable subsistence, except where otherwise stated.

A.2. GENERAL

1. Application. The contents of the annex are provided as guidance only for the preparation and shipment of bonded palletized unit loads.
2. Pallets. Lumber (wood) used in the construction of palletized loads should be well-seasoned, commercially dry lumber, which is also be free from decay, waness, loose knots, knots that would interfere with nailing, and from other defects that would materially lessen its strength. Wood shall meet requirements in Annex B.
3. Illustrations. As examples, the illustrated pallets shown in this annex are for 'example purposes only' and are based on the USA general-purpose 40- by 48-inch pallet (nominal 1000 mm by 1200 mm pallet).
4. Customary units-metric units conversion. Metric units are the official units of measurement in NATO. It is noted that illustrations and examples provided in this annex are depicted from the USA MIL-STD-147¹¹ and are given in customary (imperial) units versus metric units. For ease of conversion from customary units to metric units use 1 inch is equivalent to 25.4 mm.
5. Palletized unit load size and weight are described in Chapter 4.
 - a. Palletized unit load size and weight. Dimensional and weight limitations are to apply to the complete load including pallet, bonding, and storage aids, and not merely to the stacked units.
 - b. Size. Unit loads prepared for shipment should not exceed 40 inches (1000 mm) in length (end of load) and 48 inches (1200 mm) in width (side of load). Unit loads prepared for shipment in SEAVANs are not to exceed 43 inches (1092 mm) in height when 2-pallet high stacking is desirable.

¹¹ Copies of MIL-STD-147 are available at no charge to Nations and are online at:
http://www.assistdocs.com/search/search_basic.cfm.

The height of the pallets should be related directly to their stackability in the carrier.

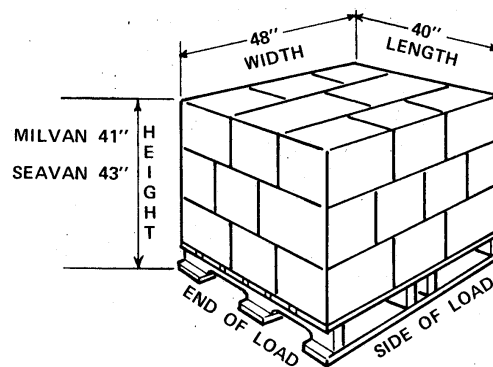


Figure A-1: Typical Size of Unit Load¹²

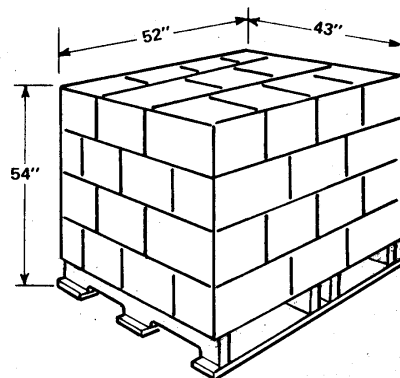


Figure A-2: Typical Size of Unit Load with Overhang

- c. Weight limits. Weight limits apply to the entire load including the pallet, bonding methods, storage aids, and units. The maximum weight of a load for domestic, inland waterways, or overseas shipments is not to exceed 2500 lb (1130 kg) unless otherwise specified.
 - (1) Decreasing weight of unit loads. When it is necessary to decrease the dimensions of a load in order to remain within the weight limitations, the height of the load is to be decreased rather than decreasing its length or width.

¹² As examples, the illustrated pallets shown throughout this annex are for 'example purposes only' and are based on the USA general-purpose 40- by 48-inch pallet (nominal 1000 mm by 1200 mm pallet).

A.2.1 LOAD PATTERNS

Information on load patterns, determination of load pattern selections, and examples of patterns for general supply are described in the USA MIL-STD-147.

A.2.2. STRAPPING

Metallic strapping is recommended and should be flat steel. Straps are to be held in tension on the load by double crimped steel seals of a size suited to the flat steel strapping used. Non-metallic strapping may also be used for general supply (not ammunition). All metallic and non-metallic straps applied to a load should be applied straight and are to be tensioned equally to a degree that precludes looseness on the side or top of the load and prevents excess strain on some straps that may cause looseness or breaking during handling and shipment. Straps are held in tension by appropriate seals.

- a. For general supplies either steel or non-steel strapping may be used. Non-steel/plastic strapping may be affected by heat, sunlight, stretching, etc.
- b. Additional strapping guidance:
 - (1) If smaller containers are being utilized and the weight of the container is relatively small, then follow the specification for that type of container and band accordingly. If it is not an ammunition/hazardous asset and it is going to be consumed on destination, then non-steel/plastic banding can be an option.
 - (2) Palletization of assets where there is very little weight (under 200 lb (90 kg)) can be strapped with 1/2- or 5/8-inch (12-15 mm) non-steel/plastic banding if the following applies:
 - (a) Assets are non-explosive or non-hazardous.
 - (b) Assets are not going overseas.
 - (c) Assets will not be in long-term storage. Items will be consumed at destination.
 - (3) Steel/galvanized strapping must be used for the following palletization:
 - (a) An explosive or hazardous item.
 - (b) Assets are going overseas.
 - (c) Determination of where or how long assets are to be stored is unknown.

- (d) All explosive/hazardous assets that are palletized must have a minimum of 3/4-inch (19 mm) steel/galvanized banding. No non-steel/plastic banding is to be used on palletized explosives/hazardous materials.
- c. Sequence of securing straps. When straps are used in combinations, they should be secured in proper sequence to acquire and maintain a stable load. Horizontal straps are always secured first, beginning with the lowest one of the load and working upward. Primary and secondary straps are next to be secured. When both are used, the strap which spans the greatest number of units should be secured first, followed by one strap positioned at right angles to the first. Next, the strap paralleling the second strap is to be secured. Auxiliary straps are secured last.

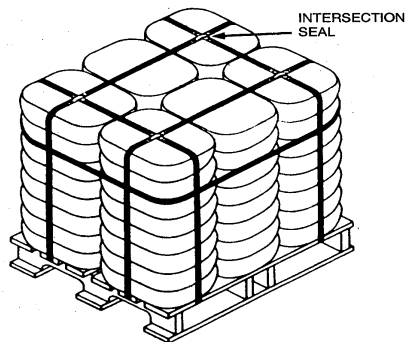


Figure A-3: Typical Strapping Method¹³

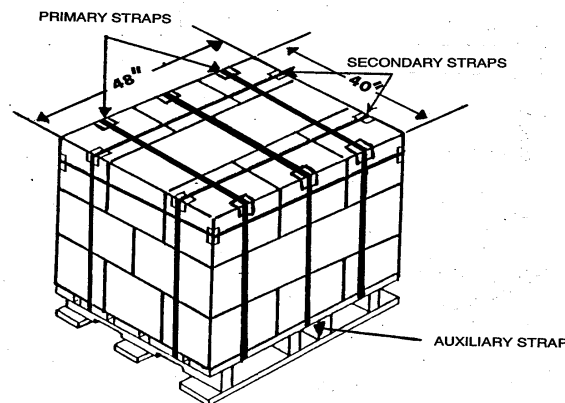


Figure A-4: Typical Strapping Method

¹³USA pallets used in the following illustrations have strap slots of 1 3/8 in (35 mm) underneath as to avoid strap damage when handled by forklift trucks.

A.2.3. TYPICAL ILLUSTRATION FOR WRAPPING UNIT LOADS

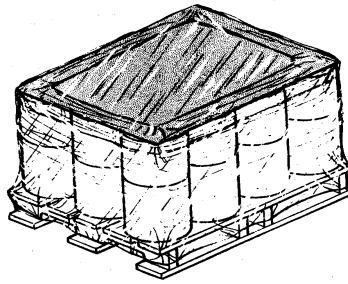


Figure A-5: Typical Wrapping Method

A.2.4. TYPICAL ILLUSTRATIONS FOR UNIT LOADS

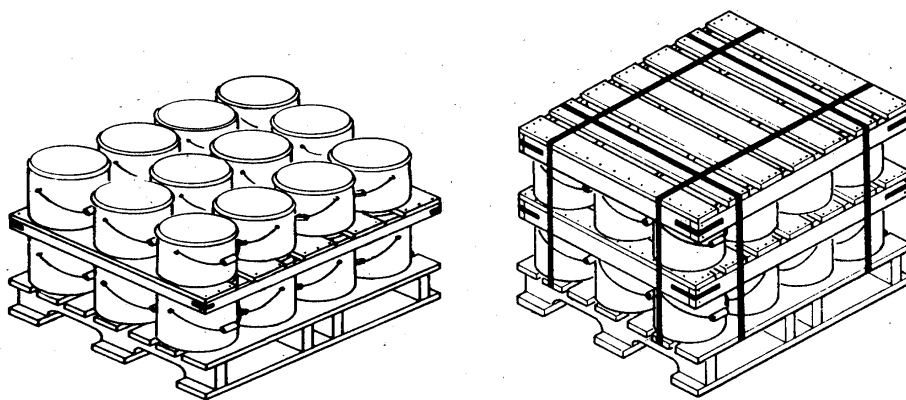


Figure A-6: Typical Method

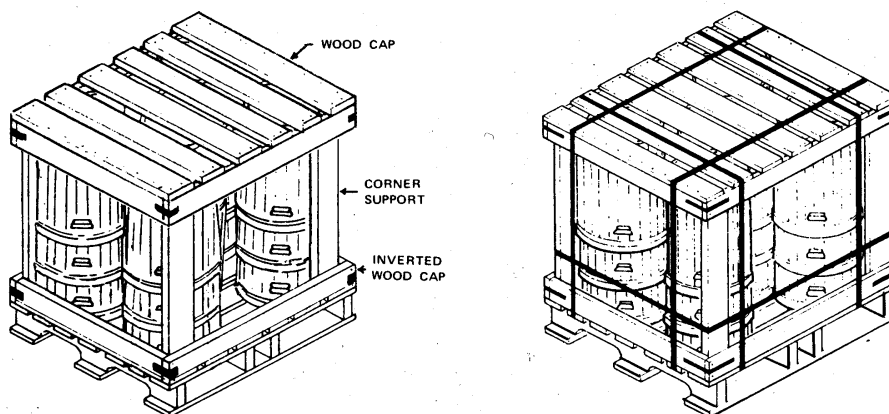


Figure A-7: Typical Method

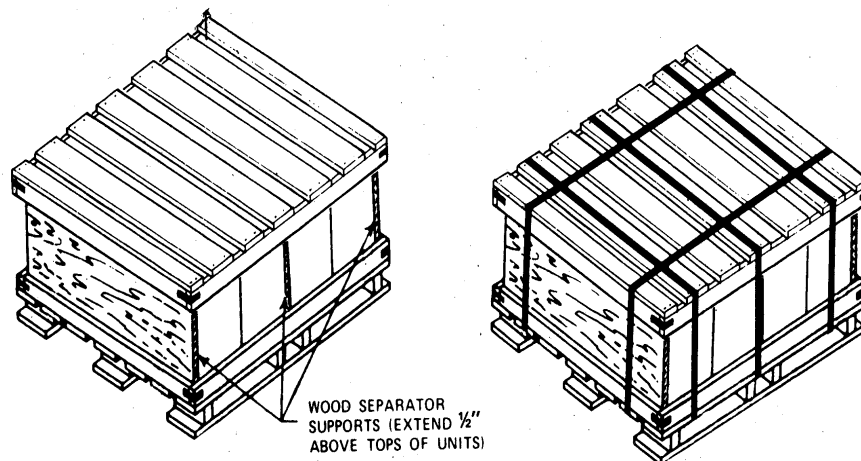


Figure A-8: Typical Method

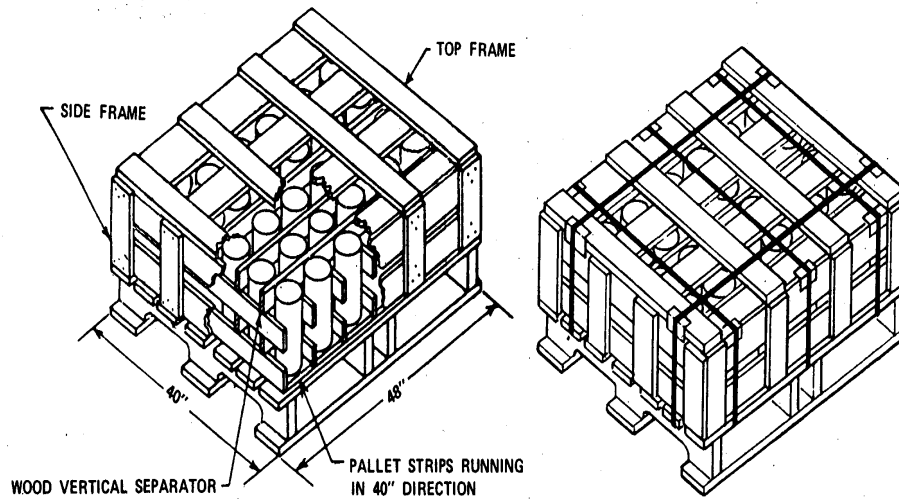


Figure A-9: Typical Method

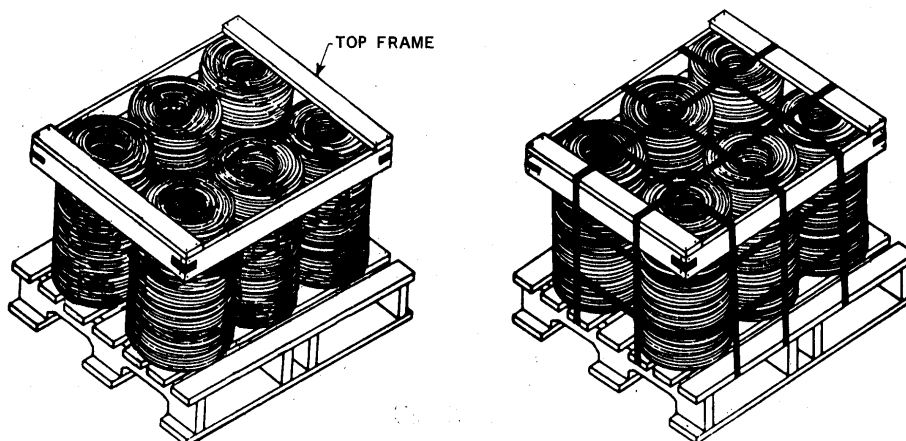


Figure A-10: Typical Method

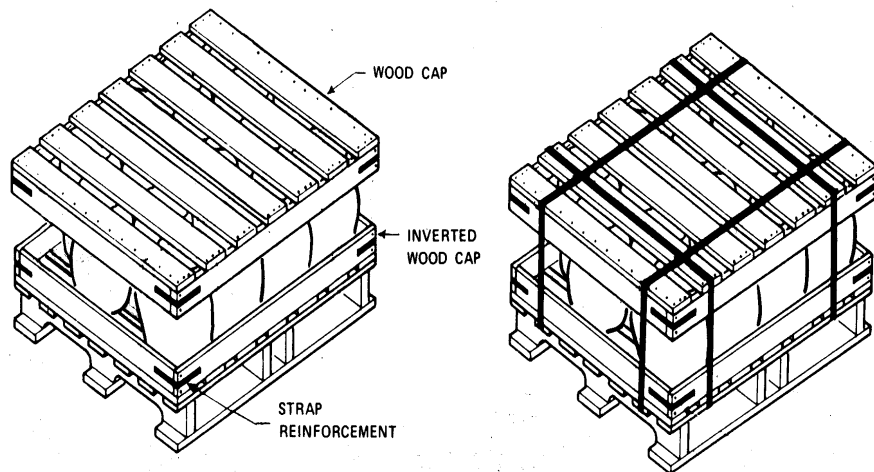


Figure A-11: Typical Method

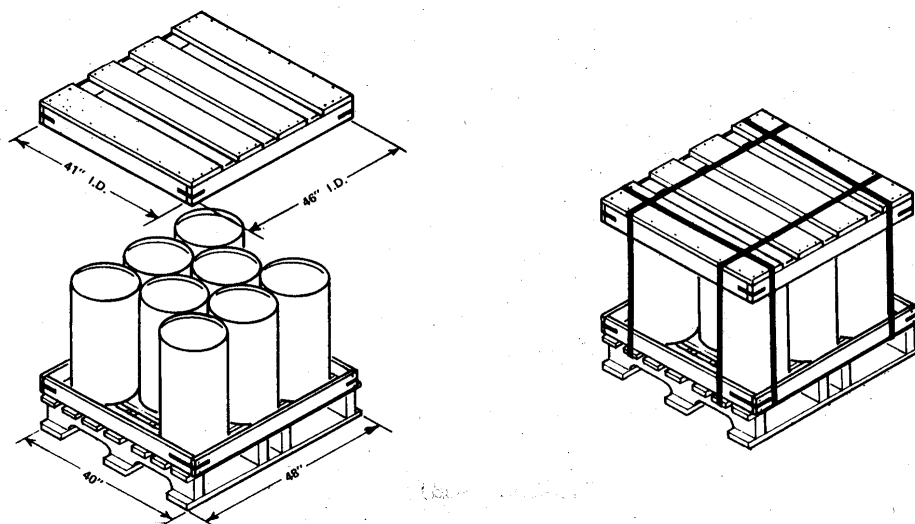


Figure A-12: Typical Method

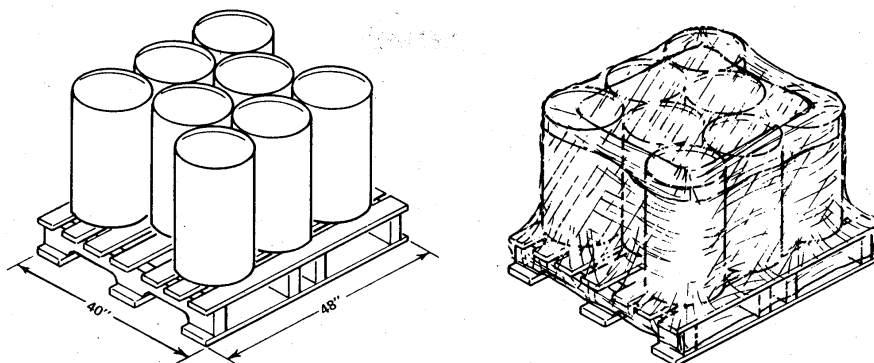


Figure A-13: Typical Method

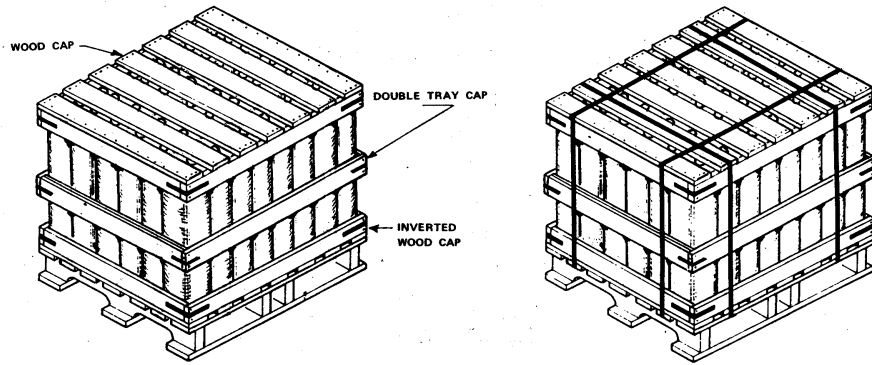


Figure A-14: Typical Method

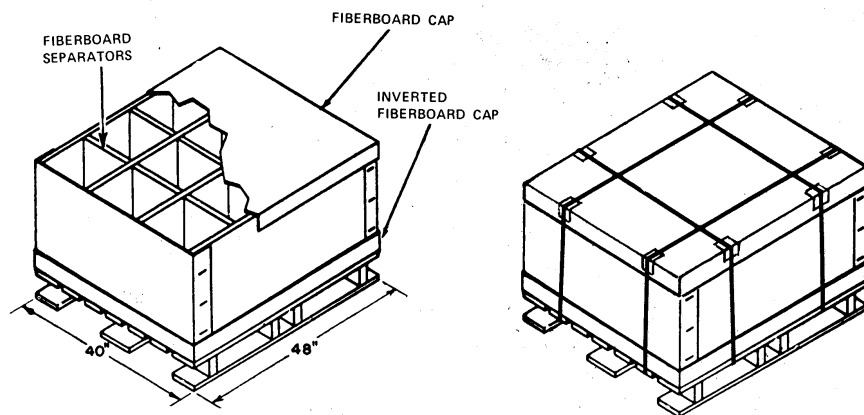


Figure A-15: Typical Method

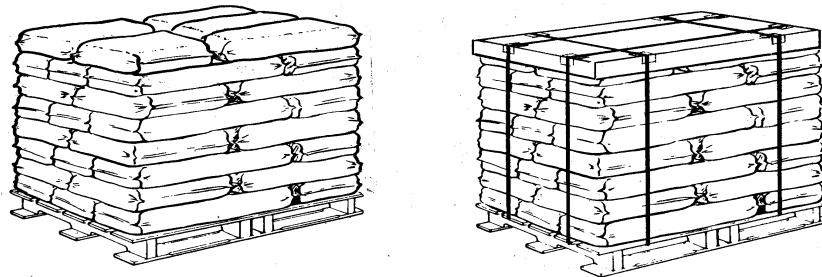


Figure A-16: Typical Method

ANNEX B	WOOD PACKAGING MATERIAL
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B.1. GENERAL

Wood packaging material (WPM) are non-coniferous (hardwood) and/or coniferous (softwood) lumber cut and/or assembled to support, protect, or carry a commodity (includes dunnage). Examples of WPM include but are not limited to pallets, skids, pallet collars, containers, crates, boxes, cases, bins, reels, drums, and dunnage. WPM shall conform to ISPM Number (No.) 15, Regulation of Wood Packaging Material in International Trade, Food and Agriculture Organization of the United Nations¹⁴.

B.2. REQUIREMENTS

Nations shall actively promote, implement, monitor, and measure procedures to reduce significantly the risk of introduction and spread of quarantine pests associated with the movement in international trade of WPM made from raw wood.

- a. Wood packaging made wholly of processed wood material, such as plywood, particle board, oriented strand board, or veneer, is exempt from the provisions of ISPM No. 15. Additionally, pieces of wood that are less than 6 mm (0.24 inches) in any dimension are exempt.
- b. The approved phytosanitary measures described in ISPM No. 15 consist of phytosanitary procedures including treatments and marking of WPM. WPM subjected to the approved measures shall be identified by application of an official mark in accordance with Annex 2 of ISPM No. 15. In cases where wood packaging is made of exempt materials and combined with solid wood components, the solid wood components must still be treated and marked.
- c. The certification mark consists of a dedicated International Plant Protection Convention (IPPC) symbol used in conjunction with codes identifying the specific country, the responsible producer or treatment provider, and the treatment applied. The internationally recognized, non-language-specific mark facilitates identification of treated WPM during inspection prior to export, at the point of entry, or elsewhere. National Plant Protection Organizations (NPPOs) should accept the mark as referred to in Annex 2 of ISPM No. 15, as the basis for authorizing the entry of wood packaging material without further specific requirements.

¹⁴ For international transport, WPM or wood pallets shall conform to ISPM-15 and wood pallets shall be stamped with the proper IPPC marking. Container shipments containing WPM or wood pallets, which do not conform to ISPM-15, can be frustrated during international transport.

B.3. ALTERNATE MATERIALS

Alternate materials such as metal, plastic, fiberboard, processed wood materials that have been created using glue, heat, and pressure or a combination thereof (e.g., plywood, particleboard, composite lumber, etc.), and non-wood based materials are not regulated according to ISPM No. 15.

ANNEX C	RELATED PUBLICATIONS
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This annex contains publications that are referred to in this document as well as others that are useful to logisticians. NATO Allied Publications (APs) and Standardization Agreements (STANAGs) are available on the NATO Standardization Office protected web site <http://nso.nato.int>.

<u>SHORT NAME</u>	<u>TITLE</u>
AAP-06	NATO Glossary of Terms and Definitions (English and French)
ASTM D4169 ¹⁵	Standard Practice for Performance Testing of Shipping Containers and Systems
STANAG 2827	Materials Handling in the Field (APP-25)
STANAG 2829	Materials Handling Equipment (APP-23)
STANAG 2830	Materials Handling Aids
STANAG 4281	NATO Standard Marking For Shipment and Storage (AAITP-05)
STANAG 4340	NATO Standard Packaging Test Procedures (AEPP-03)
STANAG 4370	Environmental Testing
STANAG 2634	Movement and Transport Planning and Procedures (AMTP-1)
ISO 445	Pallets for materials handling - Vocabulary
ISO 668	Series 1 freight containers – Classifications, dimensions and ratings
ISO 1161	Series 1 freight containers – Corner and intermediate fittings - Specifications
ISO 6780	Flat pallets for intercontinental materials handling – Principal dimensions and tolerances
ISO 8611	Pallets for materials handling - Flat pallets (Tests)
ISO 12777	Methods of test of pallet joints- Parts 1-3
ISO 18333	Pallets for materials handling – Quality of new wooden components for flat pallets
ISO 18613	Pallets for materials handling – Repair of flat wooden pallets
ISPM 15 ¹⁶	Regulation of Wood Packaging Material in International Trade
ISTA 3E ¹⁷	Similar Packaged-Products in Unitized Loads for Truckload Shipment
UIC Code 435-2	Standard of quality for a European flat wood pallet, with four entries and measuring 800 mm x 1 200 mm (International Union of Railways)
BS EN 60068-2-32	Environmental testing. Test methods. Test Ed. Free fall
BS EN 60068-2-55	Environmental Testing. Test methods. Test Ee and guidance. Loose cargo testing including bounce
USA MIL-STD-147 ¹⁸	Palletized Unit Loads
USA MIL-STD-3028 ¹⁸	Joint Modular Intermodal Container

¹⁵ Copies of ASTM D4169 are available at <http://www.astm.org/Standard/>

¹⁶ Copies of ISPM standards are available online at www.ippc.int.

¹⁷ Copies of ISTA Procedure 3E are available at <https://ista.org/>

¹⁸ Copies of MIL-STD-147, MIL-STD-3028, and MIL-STD-1660 are available at no charge to Nations and are found online at: <https://assist.dla.mil>

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ANNEX D

GLOSSARY OF TERMS AND DEFINITIONS

This annex contains terms and definitions that are used in this document for the purpose of this document:

Entry Height

Height of the opening that permits the passage of the trail wheels of a pallet truck and forklift trucks to insert their finger forks and fork tines between the top and bottom decks.

Palletized Unit Load

Quantity of any item, packaged or unpackaged, which is arranged on a pallet in a specified manner and securely strapped or fastened thereto so that the whole is handled as a unit. [AAP-06]

Pallet Length

Deck dimension in direction of stringers (bearers) or stringer boards. If these members are not present, the length is the longer dimension. The length dimension is quoted first when designating the pallet size. [ISO 445]

Pallet Width

Deck dimension at right angles to the length. [ISO 445]

Pallet Height

Dimension vertical to the horizontal plane of the length and width axes.

Under Hang

The distance the edges of the pallet extend beyond the vertical edges of the components of a unit load. Note. For ammunition unit loads under hang is not permitted.

Wing Height

Supplemental height between the floor boards (lower and upper) at the edges of the pallet to permit the insertion of cargo handling slings.

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ANNEX E	LIST OF ABBREVIATIONS
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This annex contains abbreviations used in this document.

<u>ABBREVIATION</u>	<u>FULL MEANING</u>
EUR	EURO
GP	General Purpose
ISPM	International Standards for Phytosanitary Measures
ISO	International Organization of Standardization
JMIC	Joint Modular Intermodal Container
NSN	NATO Stock Number
MHE	materials Handling Equipment
POL	Petroleum, Oil, and Lubricants
UIC	International Union of Railways
ULC	Unit Load Container
ULS	Unit Load Specification
WPM	Wood Packaging Materials

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ANNEX F	EVALUATION DATA SHEET
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F.1. GENERAL

The following is an outline that one could use in monitoring an exercise involving pallets, packages and containers.

F.1.1. OBJECTIVE

The objective of the test is to determine the interoperability of handling unit loads with various types of MHE and loading and unloading vehicles, flatracks and containers of participating nations.

F.1.2. TEST AREA

1. Large improved surface area.
2. Large unimproved area.

F.1.3. TEST EQUIPMENT

Participating nations need to provide the following:

1. Unit loads.
2. Vehicles for transport.
3. Flatracks and containers.
4. Various MHE.

F.1.4. TEST PROCEDURE

1. Starting with a stack of unit loads and a piece of MHE, unit loads shall be lifted and placed onto or into vehicles, flatracks or containers. The unit loads shall be restrained on a vehicle, flatrack or container as required. Record any problems.
2. Transport the unit loads around the test course established by the test coordinator. Record any problems encountered.
3. Unload vehicles and containers and re-stack unit loads. Record any problems encountered.
4. Observers shall analyse each problem to determine whether the operator or the equipment was the cause of the problem. If hardware induced, was the problem the result of the unit load, MHE, vehicle, or container.

F.1.5. DATA COLLECTION TABLE

Instructions: After completing each of the steps in the test procedure, place an “X” in the appropriate box if there was no problem. If there was a problem encountered, place the subsequent number of the “Note” in the appropriate box and explain the problem in the “Note” section below.

Nation Task							
Examine stacked loads							
Lift from all sides and load onto vehicle							
Restrained on vehicles							
Lift by crane							
Transport on road course							
Unload and re-stack							

NOTES:

Table F-1: Evaluation Data Sheet

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APP-22(B)(1)