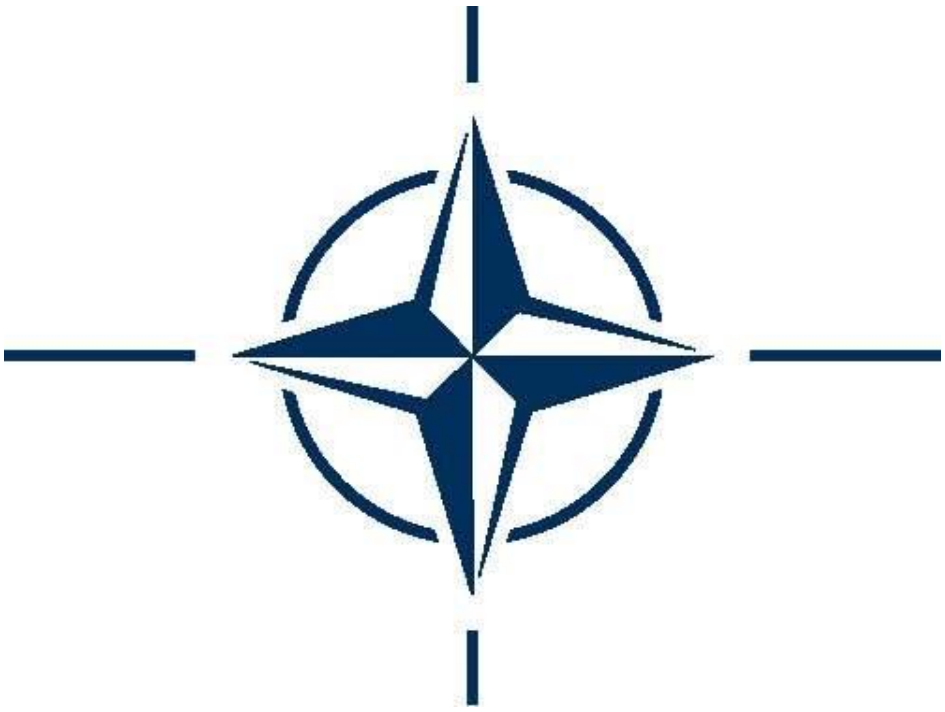
NATO STANDARD

APP-21

NATO PACKAGING AND PRESERVATION

Edition B, Version 1

JUNE 2021



NORTH ATLANTIC TREATY ORGANIZATION

ALLIED PROCEDURAL PUBLICATION

Published by the
NATO STANDARDIZATION OFFICE (NSO)

INTENTIONALLY BLANK

NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

16 June 2021

1. The enclosed Allied Procedural Publication APP-21, Edition B, Version 1, NATO PACKAGING AND PRESERVATION, which has been approved by the nations in the MILITARY COMMITTEE LAND STANDARDIZATION BOARD (MCLSB), is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 4280.

2. APP-21, Edition B, Version 1, is effective upon receipt and supersedes APP-21, Edition A, Version 1, which shall be destroyed in accordance with the local procedure for the destruction of documents.

3. This NATO standardization document is issued by NATO. In case of reproduction, NATO is to be acknowledged. NATO does not charge any fee for its standardization documents at any stage, which are not intended to be sold. They can be retrieved from the NATO Standardization Document Database ((https://nso.nato.int/nso/) or through your national standardization authorities.

4. This publication shall be handled in accordance with C-M(2002)60.

Zoltán GULYÁS
Brigadier General, HUNAF
Director, NATO Standardization Office

INTENTIONALLY BLANK

RESERVED FOR NATIONAL LETTER OF PROMULGATION

INTENTIONALLY BLANK

RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
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.	

INTENTIONALLY BLANK

RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
POL	Polish Armed Forces will not implement the storage of property outside buildings (level 1 and 2) according to procedure E-immersion in water or mud for 6 days.
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.	

INTENTIONALLY BLANK

TABLE OF CONTENTS

INTENTIONALLY BLANK

CHAPTER 1 INTRODUCTION

1.1. REFERENCES

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

1.2. AIM

The aim of this agreement is to establish NATO Levels of Packaging and Standard Methods of Preservation.

1.3. AGREEMENT

Participating nations agree to:

a. The NATO Levels of Packaging as the basis for negotiation for the procurement of packaged materiel.

b. The Procedural Principles indicating the basic requirements of protection on which the Standard Preservation Methods are founded.

1.4. TERMS AND DEFINITIONS

Terms used in this agreement are defined in the Lexicon (Annex C).

1.5. GENERAL

This agreement will apply to packaging, divided into four levels, and preservation, divided into six methods.

1.6. DETAILS OF THE AGREEMENT

The primary objective of packaging is to protect goods from deterioration, physical and mechanical damage, and to ensure that the goods remain in a serviceable condition from the time of purchase until use. This agreement covers packaging of materiel that must withstand unfavourable conditions such as extended periods of storage and/or multiple shipments. It does not cover the packaging of materiel that is delivered directly to the end-user or materiel that is regulated for transport (i.e. dangerous goods).

The NATO Standard Methods of Preservation are listed in Table 5 and the Comparison of Standard Preservation Methods (Annex B).

1.7. IMPLEMENTATION

This standard is considered implemented when a nation has issued the necessary orders and instructions putting the contents of this agreement into effect.

INTENTIONALLY BLANK

CHAPTER 2 NATO PACKAGING LEVELS

2.1. GENERAL

In establishing levels of packaging, the following shall be taken into account:

a. The comparison of NATO Levels 1, 2, 3 and 4 against the nearest national packaging levels (Table 1).

b. The differentiation between the NATO levels of packaging, climatic and transit shock and vibration categories as described and summarized in Tables 2, 3 and 4.

c. The need of a compendium of appropriate package tests to each level. These tests are the subject of STANAG 4340 (AEPP-3).

d. The characteristics of the environment (Annex A).

2.1.1. DETAIL

Packaging to each of the NATO levels shall provide adequate protection against the environmental conditions and mechanical constraints summarized in Table 2 within the geographical locations and the transit shock and vibration categories listed in Tables 3 and 4.

2.2. COMPARISON OF NATIONAL LEVELS OF PACKAGING

2.2.1. Table 1

NATO PACK-AGING LEVEL	SEVERITY	NATIONAL LEVELS				
		CANADA	GERMANY	ITALY	UNITED KINGDOM	UNITED STATES
1	SEVERE	A	Special	A	Special	A
2	HIGH	A	A	A	J	A
3	MEDIUM	B	B	B	N	B
4	LOW	C	C	C	P	Commercial

2.3. SUMMARY OF DIFFERENTIATION OF NATO PACKAGING LEVELS

2.3.1. The columns in Table 2 identify the possible limitations of each NATO packing level.

a. Storage

(1) Location (sheltered or exposed to the elements) within the ranges identified in the Environmental Conditions columns
(2) Duration
(3) Stacking height

b. Environmental Conditions

(1) Range of diurnal temperature
(2) Range of diurnal relative humidity
(3) Rainfall as defined by STANAG 4370 (AECTP-230)

c. Distribution

(1) Transit by mode of transportation and protection from the elements.
(2) Handling

d. Tests (Table 5 of AEPP-3)

(1) Vertical drop height, dependent on mass and size of package (Procedure K).
(2) Package tests not listed in Table 2 (Procedure T)
(a) Horizontal impact velocity of 2.5 meter/second (m/s) (Procedure L).
(b) Maximum vibration depending of all types of transit (Procedure G).
(c) Immersion in water or mud – up to 6 days – NATO Level 1 and 2 only (Procedure E).

2.3.2. Table 2

NATO PACKAGING LEVEL	STORAGE			ENVIRONMENTAL CONDITIONS [1]			DISTRIBUTION		TESTS*
	LOCATION	DURATION	STACKING HEIGHT	DIURNAL TEMP	DIURNAL RELATIVE HUMIDITY	RAINFALL	TRANSIT BY	HANDLING BY	VERTICAL DROP HEIGHT± (maximum)
1	Outdoors	1 year	2 – 4 metres depending on mass and shape of package	– 51°C to + 71°C	3% to 100% RH	Region Worldwide	Road, Rail, Sea, Air in open or enclosed conditions	Any method	1.0 m depending on mass and size of package
2	Outdoors	3 years	2 – 4 metres depending on mass and shape of package	– 46°C to + 63°C	14% to 100% RH	Region Europe	Road, Rail, Sea, Air in open or enclosed conditions	Any method	1.0 m depending on mass and size of package
3	In ventilated permanent buildings	5 years	2 – 4 metres depending on mass and shape of package	– 33°C to + 58°C	43% to 100% RH		Road, Rail, Sea, Air in enclosed conditions	Any method but use of mechanical handling equipment preferred	0.75 m depending on mass and size of package
4	In ventilated buildings	1 year	2 – 4 metres depending on mass and shape of package	– 33°C to + 58°C	43% to 100% RH		Road, Rail, Sea, in enclosed freight container conditions Air without transhipment	Minimal handling by mechanical handling equipment *only*	0.3 m always

* See paragraph 2.3.1.d

1) Data are described from STANAG 4370 (AECTP- 230)

2.4. CLIMATIC CATEGORY CODES (extracted from STANAG 4370 (AECTP–230))

2.4.1. Table 3

NATO Packaging Level 1	2	3	4		Extreme Storage Temperature (°C)	% Relative Humidity	NATO Areas
●				Extreme hot dry	+ 71	3 – 8	Southwest USA
●	●			Hot dry	+ 63	14 – 44	Mediterranean and South USA
●	●	●	●	Intermediate	+ 58	43 – 78	North America and Europe
●	●	●		Wet warm	+ 32	66 – 88	South USA
●				Wet hot	+ 63	74 – 100	Southeast Coast USA
●	●	●	●	Mild cold	- 21	Tends to saturate	GBR and South Europe
●	●	●	●	Intermediate cold	- 33	Tends to saturate	Mid USA and Mid Europe
●	●			Cold	- 46	Tends to saturate	Mid USA to North Canada
●				Severe cold	- 51	Tends to saturate	Alaska & Northwest Canada

2.5. TRANSIT SHOCK and VIBRATION CATEGORIES

2.5.1. Table 4

NATO Packaging Level 1	2	3	4	Mechanical Situation	
●	●	●	●	Wheeled vehicles	sea container, paved roads
●	●				pavé / gravel
●	●	●			cross-country
●	●	●		Tracked vehicles (sea container, paved roads, pavé / gravel, cross-country)	
●	●	●	●	Rail (sea container, at truck floor level)	
●	●	●	●	Sea (sea container, hull and deck, cargo hold)	
●	●	●	●	Air (sea container, turbo-prop aircraft, turbo-jet aircraft, helicopter)	

CHAPTER 3 NATO STANDARD METHODS OF PRESERVATION

3.1. GENERAL

The NATO Standard Methods of Preservation are listed in Table 5 and the Comparison of Standard Preservation Methods (Annex B).

3.2. PROCEDURAL PRINCIPLES AND NATO STANDARD METHODS OF PRESERVATION

3.2.1. Table 5

Procedural Principles	Code	NATO Standard Methods of Preservation
No climatic protection; mechanical protection only	1	No preservation; physical and mechanical protection only
Protection by preservative; if requisite, by supplementary wrapping	2	Preservative coating; with greaseproof wrap, if requisite
Protection by waterproof or waterproof, greaseproof enclosure; if requisite, by supplementary preservative	3	Waterproof or waterproof, greaseproof enclosure; with preservative coating, if requisite
Protection by strippable compound coating	4	Strippable compound coating (hot or cold dip)
Protection by water vapour- proof enclosure; if requisite, by supplementary preservative	5	Water vapour- proof enclosure; with preservative coating, if requisite
Protection by water vapour- proof enclosure and dehumidification	6	Water vapour- proof enclosure with static or dynamic dehumidification

INTENTIONALLY BLANK

ANNEX A CHARACTERISTIC OF THE ENVIRONMENT

A-1 GENERAL

FACTORS	POTENTIAL EFFECTS
temperature rain wind, sea, sand	corrosion micro-biological effect degradation of properties
solar radiation	thermal shock physical-chemical (UV & IR)*)
static electricity	electrostatic discharge (ESD)
handling	bending, dropping, puncturing, tipping
transport	vibration, shock, pressure change
storage	sagging, stacking

*) ultraviolet and infrared

INTENTIONALLY BLANK

ANNEX B COMPARISON OF STANDARD PRESERVATIVE METHODS

B.1. GENERAL

Code	NATO Standard Methods	Sub methods
1	No preservation; Physical and mechanical protection only, no climatic protection	Wrapped, Bag, Box, Case/crate, Reusable container, Strapped, bundled or bound, Attached to a pallet.
2	Physical and mechanical protection with preservative coating and greaseproof wrap, if requisite	Preservative coating with greaseproof wrap, if requisite. Preservative coating (dry film). Reusable container, preserved in box, in bag, in case/crate.
3	Protection by waterproof or waterproof-greaseproof enclosure; with preservative coating, if requisite	Wrap, mouldable, waterproof sealed. Waterproof bag. Waterproof-grease-proof bag Container, waterproof bag. Rigid container, other than all metal. Blister pack-single or multiple compartments, individually sealed Skin pack, vacuum formed, Skin pack, waterproof, vacuum formed Skin pack, greaseproof, waterproof, vacuum formed. vacuum formed.
4	Protection by strippable compound coating (hot or cold dip)	Direct application Application of strippable compound after wrapping the item in aluminium foil
5	Protection by water vapour - proof enclosure; if requisite, by supplementary preservative	Conforming wrap, Bag. Floating bag. Container, bag, Container, overwrap, dip coat sealed. Rigid metal container, Rigid container (items immersed in preservative, oil type). Rigid container, other than all metal. Reusable rigid container.
6	Water vapour- proof enclosure with static or dynamic dehumidification	Bag Floating bag. Container, bag, Rigid metal container Rigid container, other than all metal Reusable rigid container (metal or non-metal)

INTENTIONALLY BLANK

ANNEX C LEXICON

C-1 GENERAL

Term	Definition
absorbent packaging	A material included within a package to soak up liquids resulting from leakage or liquidation of contents.
barrier material	A material that retards transmission or passage of solids, liquids, gases, or radiated energy.
barrier, grease-resistant	A material that prevents or retards the transmission of grease or oils.
barrier, water vapour-resistant	A material that prevents or retards the transmission of water vapour.
blister pack	Package formed by a semi-rigid transparent, or opaque plastic bubble affixed to a flat backing
case liner	A lining, usually paper, or treated materials placed inside a shipping container for the purpose of preventing sifting, or entrance of moisture, dust, or dirt.
certification	The act of confirming that a completed package, marking inclusive, meets the requirements of performance oriented packaging. See also AAP-6.
commercial packaging	The methods and materials employed by the supplier to satisfy the requirements of that supplier´s distribution system.
conditioning	A measure to stabilize items, packaging materials, containers, and packages in a defined atmosphere.
consolidated package	Package containing a fixed number of standard packages of one and the same item packed together to facilitate handling operations.
container	Any box or receptacle which holds, restrains, or encloses any article(s)/or commodity(ies) to be stored or transported.
corrosion	The chemical reaction between a material, usually a metal(s), and its environment that produces a deterioration of the material and its properties.
corrugated fibreboard	The structure formed by adhering one or more flat-facing fibre linerboards to one or more corrugated fibre mediums. Normal designations are: a. Single face: The structure formed by adhering one medium to one linerboard. b. Single wall: The structure formed by sandwiching one medium between two linerboards. c. Double wall: The structure formed by sandwiching two intermediate mediums between three linerboards. d. Triple wall: The structure formed by sandwiching three intermediate mediums between four linerboards.

date packed	That date on which the product was packed in the unit pack, regardless of the date of exterior packing, shipping, or additional processing.
desiccant	A hygroscopic substance used to reduce and maintain a low relative humidity in a package or container.
edge protector	A right angled extrusion or pressing of varying lengths which protects the external edges of packages and/or containers from possible damage caused by applying tension to the banding material.
electrostatic discharge (ESD)	The transfer of electrostatic charge between bodies at different electrostatic potential.
expendable container	A container for shipping or storage, or both, intended primarily for a single trip.
expiration date	A date beyond which shelf-life items are to be suspended from issue or use.
export trade package	That used for the export of commercial commodities.
fire retardant	Material having or providing comparatively low flammability or flame-spread properties.
foam-in-place cushioning material	One formed by dispensing, usually into a box or mold, reactive chemical components that expand to envelop items packaged or to occupy void areas.
grease-proof	Capability of a material to be impervious to grease. A grease-proof packaging isolates grease from the interior surface of the exterior container and secures the integrity of contact protection given by grease.
heat seal	A method of bonding mating surfaces under controlled application of heat, pressure, and dwell time.
hermetic seal	When measured by appropriately sensitive means, impervious to the passage of unwanted gases or liquids.
humidity indicator	A device which displays data on moisture content within a package.
identification	The application of appropriate markings to ensure that the identity of an article or commodity is clearly indicated after preservation and at each stage of packing. See also AAP-6.
intermediate pack	A wrap, box, or bundle that contains two or more unit packs of identical items.
label	A piece of paper or other material to be affixed to a package, container, or article, and on which is printed either information concerning the product or addressees.
lifed item	An item of materiel, the use of which is curtailed by limitations imposed by its shelf life, in use life or a combination of both.
liner	1. Any linear material of equal size that fits against the inner wall of a container to minimize puncture and increase columnar strength. 2. Any fairly thin material fitting closely to the inside of a container to defer ingress of water or contaminates or to add puncture resistance or stacking strength to the container.

military packaging	Materials, methods, or procedures prescribed in NATO and nationally authorized documents such as standards, specifications, and drawings that are designed to provide the level of packaging necessary to prevent damage and deterioration during required distribution and storage.
obsolescent	A description applied to materiel expected to become obsolete and for which no further provision will therefore normally be made.
pack	To place materials into a container for handling, storage or transport.
package	1. One or more articles or pieces contained or secured into a single unit. 2. The product of a complete series of packaging operations.
packaging	The operations involved in the preparation of materiel for distribution, transportation, storage, and delivery to the user. The term includes preservation, packing, marking, and unitization.
packing	The selection or construction of the shipping container and assembling of items or packages therein.
preservation	The application of protective measures to prevent deterioration including cleaning, drying and the use of preservatives barrier materials, cushioning, and containers, when necessary.
preservative	A substance which when applied directly to an item provides initial environmental protection.
primary packaged quantity	The quantity of an item of material selected as being the most suitable for packaging for issue to the ultimate user. Also see unit pack quantity.
prototype pack	A pack designed and constructed to meet specified requirements and which is the model for production packaging.
puncture resistance	The resistance of a material or a product to penetration or tearing by a pointed or blunt object.
unit pack quantity	The number of items to be contained in a unit pack. See also primary packaged quantity.
reusable container	A shipping and storage container designed for reuse without impairment of its protective function and which may be repaired and/or refitted.
shrink film	Thermoplastic film which shrinks when subjected to heat.
skin pack	Product covered by a vacuum closely fitting thermoplastic film, heat bonded to a porous, rigid, backing material.
stretch wrap	A thermoplastic material having elastic properties to permit stretching and wrapping around small unit packs or pallet loads.
trade export package	A package produced for commercial deliveries overseas.

trade package	The package used by manufacturers for commercial deliveries of the materiel, subject to the addition of the identification particulars detailed in the contract. Normal designations are: a. Retail trade package: That used for packaging commercial retail commodities. b. Bulk rate package: That used for packaging bulk commercial commodities. c. Export trade package: That used for the export of commercial commodities. See also commercial packaging.
unit pack	The smallest marked package in which one supply item or several identical supply items packed together are supplied as a complete and identifiable pack.
vacuum packaging	The technique of packaging in containers from which substantially all air has been removed prior to sealing.
volatile corrosion inhibitor	1. A material which slowly releases vapour that inhibits corrosion within a package by neutralizing the effects of moisture-laden air. 2. A material which evaporates or sublimes and then forms a thin corrosion resisting film on the surface of a part.
waterproof	Impervious to penetration of water. See also watertight.
water-resistance	Measured ability to prevent both penetration and wetting by water in liquid form.
watertight	That quality of a container or package by which it prevents the passage of liquid water either into or out of the package. See also waterproof.
water vapour-proof	1. Not subject to damage by water vapour. 2. Resistant to passage of water vapour, though not necessarily a complete barrier. 3. Ability of packaging (or material) to retard the passage of water vapour.
water vapour-resistance	Measured ability to retard penetration and permeation by water vapours.
weather-resistance	Measured ability, using standard test methods, of a material to retain its original physical properties and appearance under prolonged exposure to weathering conditions.
wrap	Piece of flexible material either pre-cut or cut to length for manual or mechanical wrapping of the item to be packaged.

ANNEX D PRESERVATION OF MATERIEL

D-1. GENERAL

1. Preservation is defined as protection that is provided for the bare item to prevent deterioration from exposure due to atmospheric conditions during shipment and storage. The methods of preservation (item protection) are combinations of preservation steps taken for the prevention of deterioration of military supplies and equipment.

Methods of Preservation

2. The basic methods of preservation include:

a) Physical and mechanical protection. Cushioning, blocking, or bolting to prevent movement within containers and physical damage due to shock and vibration accomplishes physical protection. Mechanical protection is generally provided to an item to prevent damage from any force that will impair the proper functioning of the item. It does not provide protection from the entry of water, water-vapour, gases or fumes, or the growth of micro-organisms. No preservative is used on the items. Items usually packed by this method are of a noncritical nature made of corrosion resistant metals; non-metals such as ceramics, and glass; items that are painted, prime coated, anodized or have other similar corrosion resistant finishes or coatings; or items that are so rugged that they will not corrode to a degree that would affect their form, fit, or function.

b) Physical and mechanical protection with a preservative coating. Along with the protection described in paragraph a), the preservative coating provides all the corrosion protection given to the item. This method may be used to protect metal items of a non-critical nature where either the removal of the preservative is not required before the item is used, or removal of the preservative can be accomplished without further disassembly or damage to the item. This method may use a hard drying preservative on the item; a soft film preservative on the item, plus a greaseproof wrap; or may use volatile corrosion inhibitor (VCI) treated barrier materials.

c) Waterproof protection. This method consists of enclosing the item in a snug-fitting, greaseproof, waterproof container such as a heat-sealed bag, etc.

d) Water vapour-proof protection. This method consists of sealing the item in a water-vapour proof container such as a heat-sealed bag or solid metal or plastic box with a gasket.

e) Water vapour-proof enclosure with static or dynamic dehumidification, if requisite. This method provides the best possible protection in preservation. It is used for items of highly critical nature, mechanical, chemical, electrical, etc., which would normally not be coated with a preservative. This method is identical to the method described in paragraph d), and uses an absorbing material, known as desiccant, to absorb any moisture within the package. It must not be used on any item where the removal of moisture would cause damage to the item.

Cleaning

3. All contaminants and/or infestations must be removed before items that are being shipped internationally can be accepted for transport. Each item will need to be cleaned and inspected to the

requirements of the final destination and/or country. Any contaminant left on an item may cause deterioration. The cleaning process must not harm the item. When required, limit the disassembly of the materiel to a point where reassembly can be easily done without special tools or skills. Possible methods of cleaning include:

a) Wire brushing to remove loose scales and light rust from items.

b) Vacuum cleaning for radios and electronic items to remove dust, lint particles, etc.

c) Jet spray washing using a high-pressure stream of water is best used on items that will not be harmed by the pressure or water.

d) Abrasive blasting uses a high velocity stream of an abrasive material against the surface of the item and should be used on surfaces where the abrasive action will not affect the function of the item such as rough castings, pintle hooks, etc.

e) Steam cleaning uses a stream of steam with an added cleaning compound followed by steam alone to remove heavy greases from automotive equipment, such as trucks.

f) Ultrasonic cleaning is used on non-absorbent materials such as those found in electronic items.

Drying

4. Immediately after cleaning using fluids, items must be thoroughly dried to remove any cleaning solutions or residual moisture. There are several methods for drying materiel, which include compressed air, ovens, infrared lamps, wiping, and/or draining.

NOTE: Use caution to ensure the drying process does not harm the item.

Contact Preservatives

5. Contact preservatives are applied to items to protect them from deterioration due to exposure to adverse environmental conditions during shipment and storage. Most contact preservatives are physically oily or greasy and vary greatly in chemical composition and consistency; therefore, they cannot be used indiscriminately on all kinds of materials. Lubricating oils and greases can be used, but oils and greases designed for lubrication may be inadequate for the full protection desired. Selecting the right preservative should be as carefully considered as selecting the proper cleaning process. There are several preservative application methods including: dipping, flow coating, brushing, filling or flushing, fogging, spraying, etc.

NOTE: Petroleum based preservatives can cause skin and eye irritation. Personnel should avoid direct contact by wearing appropriate safety equipment. When spraying or fogging, personnel should always wear goggles and a respirator.

Desiccant

6. Desiccant is a moisture-absorbing material that is mandatory for certain requirements. Its purpose is to absorb any moisture that may seep through the water vapour-proof barrier material. The following information is provided for storing, handling, and applying desiccant.

a) Apply a greaseproof wrap to items treated with contact preservative to segregate desiccant from incompatible elements.

b) Secure bag enclosures evenly around the item.

c) Apply humidity indicators to desiccated packs.

d) Do not use damaged or frayed unit bags; allow unit bags to be packed or stored near incompatible elements such as lubes, and oils; or remove desiccant bags from storage container until ready for use.

e) Attach bags of desiccant to item by means of tape or tying.

f) Care should be taken to prevent desiccant bags from touching critical or bare metal surfaces of the item.

Barrier Materials

7. Barrier materials protect the item by providing an environmental enclosure around the item. Some of the features to consider in selecting an appropriate barrier material are:

a) Greaseproof for use when you are also using a contact preservative.

b) Waterproof for use when the item could be affected by standing water.

c) Water vapour-proof for use to protect items, which are susceptible to corrosion from atmospheric contaminants.

d) Heat sealable for use to close bags and provide a seal having the same waterproof or water-vapour proof properties as the barrier material itself. The factors affecting heat-sealing are: temperature, dwell time, and pressure.

e) Flame resistant material will not support combustion. Must be used for all supplies destined for shipboard use.

f) Transparent material allows for quick identification of the item or its condition.

g) Chemically neutral material will not affect or contaminate item. Generally used for critical surfaces or items highly susceptible to acid etching.

Cushioning

8. Cushioning is the means of providing physical and mechanical protection to an item by controlling the movement of the item within the container. Cushioning materials come in many forms and are usually reusable. Sometimes they may be found and recovered from the waste stream. Cushioning materials can be made of paper, bound fibre, and plastic. In order for plastics to work, air must be trapped inside. Bubble wrap, various hard and soft foams, expanded polystyrene, and polyurethane foam are plastic-based cushioning materials.

9. Cushion all sharp edges and corners of the item to protect barriers, as required. Units can successfully transport fragile items; they just need more cushioning to control the item’s movement inside the package. The amount of cushioning and cushioning type varies. If the packaging that the

item was delivered in is available and the cushioning is intact, that is the easiest method to cushion an item under field conditions.

Interior Containers

10. Interior containers can be any one of the following: fibreboard shipping boxes, paperboard folding boxes, setup boxes, wooden boxes, etc. Metal reusable drums can also be used as interior containers and are made of aluminium or steel and furnished in various sizes. The drums are made with a fully removable cover secured by an exterior locking ring. This locking ring is generally held in place by a removable nut and bolt. If the container is supplied with a rubber gasket it can provide a barrier against water-vapour. The reusable container is mainly used for the packing of delicate instruments, electrical/electronic components, relays, small electric motors, etc.

Container Selection

11. To help select the proper container you should first determine the item characteristics, or more simply put, determine whether the item should be protected from vibration, shock, or stacking forces during shipment, handling, and storage. Items are preserved to protect them from deterioration from the elements and physical and mechanical forces. The items are then packed in an intermediate and/or shipping container for added protection during handling and transport. Some interior containers may be used as shipping containers and do not require further packing.

Item Identification

12. The final operation of preservation is the labelling of the unit pack with the correct identification and markings. Items that are not properly identified are useless to the soldiers and are a waste of time, money, and effort. Markings on unit and intermediate interior packs and unpacked items must be located as to allow the markings to be easily read when stored on shelves or stacked, and to ensure that the markings will not be destroyed when the pack is opened for inspection or until contents have been used. The marking surface of a unit pack must be the outermost wrap, bag, or container of the unit pack. When clear plastic containers are used for unit protection, the labels may be inserted or affixed inside the container if the label will not affect or be affected by the method of preservation and will not generally obscure more than 50 percent of one surface of the container.

13. Information on package marking for shipment and storage can be found at STANAG 4281 (AAITP-05). The following information should appear on unit and intermediate packs and unpacked items in the order listed:

a) NATO stock number (NSN), to include spaces or dashes and any prefix or suffix shown in the contract or requisition, in the clear and bar coded. If no NSN is assigned, then this line may be omitted.

b) Part number (PN). The PN should be indicated. If the item has no PN assigned to it or if no PN is required, then nothing is shown.

c) Military method and date of unit preservation. Include information on unit preservation, if applicable.

Pictorial Symbols for Marking

14. Containers should be marked with pictorial symbols to indicate special handling and storage needs, such as "DO NOT STACK, DO NOT DROP, FRAGILE, HANDLE WITH CARE, KEEP AWAY

FROM HEAT, KEEP AWAY FROM COLD, ELECTROSTATIC DISCHARGE SENSITIVE, etc." They may appear on a label or be printed directly on the package. Affirmative and negative symbols need not be framed by borderlines, but all negative symbols with "DO NOT..." should have borders with a slash mark across. Pictorial marking symbols and their application are illustrated in ISO 780.

Shelf Life (SL)

15. SL is the total period of time beginning with the date of manufacture, cure, assembly, or pack (subsistence only). Typical SL items include food, medicines, batteries, paints, sealants, adhesives, film, tires, chemicals, packaged petroleum products, hoses and belts, mission-critical O-rings, and Chemical, Biological, Radiological and Nuclear (CBRN) equipment and clothing.
Packers should ensure there is adequate shelf life of the retrograde materiel before packaging and transporting. Information on shelf life codes are identified in STANAG 4281 (AAITP-05).

NOTE: Shelf life of extendable items may be reassessed and extend shelf life upon successfully passing inspection.

Electrostatic Discharge Sensitive (ESDS) Items

16. ESDS items include printed circuit cards, electronic parts, etc. Proper handling, special packaging materials, and labels for serviceable, repairable ESDS items are required to protect electronic equipment from electric shocks that may cause damage. Information on ESDS can be found at STANAG 4434 (AEPP-2).

INTENTIONALLY BLANK

ANNEX E PACKAGING OF MATERIEL

E-1. GENERAL

Packaging of Materiel

1. Packing is the assembly of items into unit packs and intermediate or exterior containers, with the necessary blocking, bracing, cushioning, weatherproofing, reinforcement, and marking.

Basic Steps of Packing

2. There are several basic steps of packing including:

a) Exterior shipping container. An exterior shipping containers needs to be selected based on the shipping destination, the item configuration, and the weight of contents to be shipped. The unit container may be sufficient.

b) Block, brace, or cushion. Containers are often subjected to rough handling during the shipment and transportation and must be protected against repeated shocks, jolts, and vibrations. Proper blocking, bracing, and cushioning will ensure stability of the cargo inside the shipping container or on the pallet.

c) Weatherproofing. Units can protect the contents of packs through the use of certain barrier materials. Depending upon the material and process used, weatherproofing can provide waterproof, water vapour-proof, or watershed protection. Waterproof will prevent the direct entry of water. If the barrier is completely sealed, it will provide waterproof protection. Water vapour-proof is resistant to passage of water vapour, and if the barrier is completely sealed, it will provide water vapour-proof protection. Watershed protection is a barrier material that is placed over or around the items and left unsealed. Watershed applications permit free circulation of air around the item.

d) Strapping. Strapping may be metal, plastic, or various tapes. Metal banding is the most common strapping material used. Plastic strapping can be used on fibreboard boxes. Tapes are most commonly used on fibreboard boxes.

e) Marking. Marking is used to speed up the movement of shipments without undue confusion and delay, and to permit ready identification of contents either at transhipping points or at destination. STANAG 4281 (AAITP-05) provides details on NATO markings.

Boxes and Containers

3. There are a number of boxes and containers designed to improve packing and unitizing of overseas shipments; compensate for shortage of terminal handling facilities, equipment, and personnel; protect against materiel pilferage, physical loss, and damage in transit; compensate for lack of covered storage and other severe environmental factors; and consolidate shipments of like and unlike stock numbered commodities.

a) Fibreboard boxes have widespread use and vary in sizes, shapes, styles, and weight limits. Boxes are either solid fibreboard or corrugated fibreboard. Fibreboard box class designates the amount of fire retardant, weather-resistant, and waterproof and water vapour-resistant.

(1) When packing a fibreboard box, you should place the regular shaped items next to the side and end panels so that they can provide support to the box. Irregular shaped items should be placed toward the center and cushioned or blocked in place. These procedures will make a good tight load, and help prevent damage to the items being shipped.

(2) After you have packed the box, the next step is to close and reinforce the box. The way you close the box will depend upon the style of the box. Each style of box has its own closure requirements. The materials used are nails, staples, steel and non-metallic strapping, filament reinforced tape, or a combination of them. There will be times when you will have to seal the box against the entry of water or dust. Sealing all seams and joints with water-resistant tape can do this. The tape should be at least 50 mm (2 inches) wide.

b) Wood Boxes - Wood is a common material used to make containers for shipping military supplies and equipment. Wood boxes are strong and rugged and hold up well under shocks and impacts during shipping and handling. Lumber may have certain defects that, if allowed to find their way into the construction of a box, may weaken the box when subjected to the stresses of handling. Several of the more common defects in wood are oversize knots, knotholes, and bark. Another defect in wood is too much moisture. In time, the wood will dry and this causes the box to shrink. As a result, nails and strapping begin to loosen.

NOTE: Information on International Standards for Phytosanitary Measures Number 15 (ISPM No. 15) requirements for wood packaging material (WPM) is described at Annex G.

c) Crates - There are two general types of crates, sheathed and open. They differ in the protection they provide. Sheathed crates are frame structures completely covered with lumber or plywood. Sheathed crates not only give protection against weather hazard but also are stronger and more rigid than open crates. Open crates are used largely to provide ease of transportation, handling, and storage. Open crates consist of frame members only or, at times, partial sheathing for added strength and rigidity.

d) Reusable Containers are described in STANAG 4398 (AEPP-1).

e) ISO Containers are large, demountable containers and are widely used for international transport (see ISO 668). They are available in many lengths ranging from 20 to 40 feet, are standardized to 8-foot widths and generally 8-foot heights, and are fabricated of different materials including steel, aluminium, wood, fibreglass, and combinations of these materials. They are compatible for global intermodal freight movement and are not part of packaging. They are used to consolidate shipments to one destination and are not meant to follow the materiel to point of consumption. Further information on containerization is described at paragraph 5, Annex F.

Marking and Labelling

7. Marking is the application of numbers, letters, labels, tags, symbols, or colours to provide identification and expedite handling during shipment and storage. Many packaged items are lost or become frustrated cargo because of illegible or inadequate markings. Marking of unit packs, unpacked items, and exterior packs may be accomplished by the use of labels, stamping, stencilling, printing, or tagging. No matter how well an item is made or packed, it has no value if it cannot be identified at its destination or throughout the end-to-end process. All shipments should be marked

and labelled in a manner suitable for the mode of shipment to be used. Unauthorized markings on shipping containers should be obliterated (blanked out, covered with paint, stencil ink, etc.). Each palletized unit and unpacked unit should bear the address of the intended receiving activity. Labels should be used in preference to tags, except when it is impracticable to apply a label. STANAG 4281 (AAITP-05) provides the minimum identification marking for storage and transport of items.

Rules for Marking and Labelling

8. Common rules for marking and labelling include:

a) Marking colours must be legible and contrasting.

b) Marking surface must be clean and dry.

c) Old markings must be obliterated.

d) Use approved marking materials.

e) Do not handwrite.

NOTE: When marking, closing, and reinforcing boxes make sure that the markings and labels are not covered by strapping or closure tape.

INTENTIONALLY BLANK

ANNEX F UNITIZATION, PALLETIZATION AND CONTAINERIZATION

F-1. GENERAL

1. This annex provides guidance on the unitization, palletization, and containerization of materiel.

Unitization

2. Unitization involves methods and means by which items of supply are shipped from origin to destination as a single unit. Unitized loads are the assembly into a single load of more than one package of one or more different line items of supply so that the load can be moved in an unbroken state from source to end destination. Unitization results in economies of scale through reduction in handling and documentation, whereas one unit taking the place of several units. Information on several methods, materials, and techniques to employ in the formation of palletized unit loads of general supplies are described in STANAG 2828 (APP-22). There are two basic forms of unitization including palletization and containerization.

Palletization

3. Palletization of equipment and supplies facilitates faster handling, ease of storage, and greater cargo protection. Pallets are horizontal platform devices used as a base for assembling, storing, and handling goods in a unit load. Details on pallets, packages, and containers are described in STANAG 2828 (APP-22).

NOTE: Wood pallets shall conform to ISPM No. 15 requirements (see Annex G).

4. Basic Steps. The following steps are helpful for units when palletizing cargo:

Step 1. Assemble the individual items on a pallet base or place wood, wire bound, or fibreboard consolidation containers on the pallet and fill with cargo.

Step 2. Load items flush with the pallet sides.

Step 3. Ensure cargo does not overhang the pallet.

Step 4. Secure all items tightly and firmly on the pallet using both horizontal and vertical strapping.

Step 5. Use adhesives or rough dunnage paper between fibreboard sections to unify the pallet load. Plastic stretch-wrap can also be used to secure the load to the pallet. When the pallet loads are to be stacked, provide protection on the top of the pallet load by using a lumber, plywood, or fibreboard “cap”. Water protection can be applied to the pallet load by using plastic stretch wrap or shrink wrap over the entire load or applying a waterproof paper over wrap.

Containerization

5. Containerization refers both to the placing of commodities in plywood and fibreboard containers, as well as to the stuffing of loads in ISO containers in such a manner as to assure their protection during shipping, handling, and storage. Information on the selection and inspection of ISO containers and the preparation, stuffing, blocking, bracing and securing of materiel in a container, and documentation is described in STANAG 2236 (AMovP-5).

a. Unit Stuffing Operations. Because every unit will load their equipment differently according to their mission requirements, units will need to have a load plan to follow when stuffing containers. Simply throwing items into the container on a first come, first in basis, as they are brought out from storage locations, results in poorly loaded containers and invites damage during transit. Information on stuffing operations is described in STANAG 2236 (AMovP-5).

b. General Planning Considerations. Some equipment may have to be processed for containerization. Due to size limitations, some equipment may have to be disassembled or reduced prior to stuffing and/or loading into a container. If the equipment is to be in usable condition upon arrival, it should not be dismantled beyond functional repair or assembly prior to loading in a container. Movement planners must plan each container load for ease of unloading or unstuffing at destination.

c. Packing, Blocking, and Bracing. Cargo placed in containers must be secured to withstand the most stringent transportation modes to which it will be subjected during multimode shipment. In addition, 20-foot containers picked-up with DROPS/PLS trucks will be tilted to approximately a 35-degree angle during the loading process. Dunnage materials are frequently by-products or scrap used in filling voids, blocking and bracing, or otherwise to protect and secure the contents. Information on blocking and bracing is described in STANAG 2236 (AMovP-5).

d. Dunnage Material. Whereas wood is the most common material used as dunnage, it is not all-inclusive. There are many additional devices and dunnage systems and material available to hold and secure cargo from movement while in transit. Some of these systems are designed for specific kinds of cargoes while others apply to cargo in general. Dunnage bags filled with polystyrene pieces can be used to absorb shock and secure products against impact and shifting. Used motor vehicle tires, metal frames, pallets, various plastic products, and nets have been successfully used as dunnage. Often, the material necessary to properly secure the cargo in the container is readily available as waste material or by products.

Wood Packaging Material (WPM)

6. WPM used for packing, blocking and bracing operations is regulated by ISPM No. 15 (see Annex G).

Lumber. Lumber should be selected specifically for the blocking and bracing of cargo in containers. It must be clean, dry, and free from dry rot, knotholes, infestation, and splits, which will affect its strength or interfere with proper nailing. The use of wet lumber should always be avoided. Such lumber quickly loses most of its strength and becomes decidedly inferior. Wet lumber may contain high contents of moisture depending upon the species and storage area. The movement of the container during transportation often causes nails to work out. This results in a reduction of cargo security in the container and eventual breakdown of the holding system. The load is then free to move in the container causing cargo and equipment damage, not to mention the loss of time and expense in securing the load. Wet lumber will emit a heavy concentration of moisture, which may cause water or sweat damage, molding, or cargo staining.

Consignment Tracking

7. For nations that implement consignment and /or asset tracking, procedures for passive and/or active radio frequency identification (RFID) are described in STANAG 2233.

INTENTIONALLY BLANK

ANNEX G REGULATED WOOD PACKAGING MATERIEL

G-1. GENERAL

1. Nations must 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 wood packaging material (WPM) made of raw wood.

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

3. Materials such as fibreboard and processed wood materials that have been created using glue, heat, and pressure or a combination thereof (e.g. plywood, particleboard, composite lumber, veneer, etc.), and non-wood based materials (e.g. metal, plastic, etc.) are not regulated according to ISPM No. 15. Additionally, pieces of wood that are less than 6 mm (0.24 inches) in any dimension are exempt. Wood packaging made of exempt materials, but combined with solid wood components, must still be treated and marked.

4. 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.

5. 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.

INTENTIONALLY BLANK

ANNEX H RELATED PUBLICATION

H.1. GENERAL

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 https://nso.nato.int.

SHORT NAME	TITLE
STANAG 4370 (AECTP-230)	Environmental Testing - Climatic Conditions
STANAG 4398 (AEPP-1)	NATO Requirements for Reusable Containers
STANAG 4434 (AEPP-2)	NATO Standard Packaging for Materiel Susceptible to Damage by Electrostatic Discharge
STANAG 2634 (AMP-1)	Movement and transport planning and procedures (Study)
STANAG 2830 (AEP-92)	Materials Handling Aids (Study)
STANAG 4281 (AAITP-05)	NATO Standard Marking for Shipment and Storage
STANAG 4340 (AEPP-3)	NATO Standard Packaging Test Procedures
STANAG 2233	NATO Consignment and Asset Tracking by Radio-Frequency Identification
STANAG 2828 (APP-22)	Military Pallets, Packages and Containers
ISO 668	Series 1 Freight Containers – Classification, Dimensions and Ratings
ISO 780	Packaging – Distribution Packaging – Graphical Symbols for Handling and Storage of Packages
ISPM No. 15	Regulation of Wood Packaging Material in International Trade

APP-21(B)(1)