Ministry of Defence

Defence Standard 81-041 Part 2

Issue 9 **Date: 14 January 2017**

Packaging of Defence Materiel

Part: 2 : Design

Section 1

Foreword

Defence Standard Structure

Section 1 (Generated by the StanMIS toolset)

- Revision Note
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REVISION NOTE

Normative Standard Changes, many editorial changes, text amendments

HISTORICAL RECORD

This standard supersedes the following:

WARNING

The Ministry of Defence (MOD), like its contractors, is subject to both United Kingdom and European laws regarding Health and Safety at Work. Many Defence Standards set out processes and procedures that could be injurious to health if adequate precautions are not taken. Adherence to those processes and procedures in no way absolves users from complying with legal requirements relating to Health and Safety at Work.

STANDARD CLAUSES

a) This standard has been published on behalf of the Ministry of Defence (MOD) by UK Defence Standardization (DStan).

b) This standard has been reached following broad consensus amongst the authorities concerned with its use and is intended to be used whenever relevant in all future designs, contracts, orders etc. and whenever practicable by amendment to those already in existence. If any difficulty arises which prevents application of the Defence Standard, DStan shall be informed so that a remedy may be sought.

c) Please address any enquiries regarding the use of this standard in relation to an invitation to tender or to a contract in which it is incorporated, to the responsible technical or supervising authority named in the invitation to tender or contract.

d) Compliance with this Defence Standard shall not in itself relieve any person from any legal obligations imposed upon them.

e) This standard has been devised solely for the use of the MOD and its contractors in the execution of contracts for the MOD. To the extent permitted by law, the MOD hereby excludes all liability whatsoever and howsoever arising (including, but without limitation, liability resulting from negligence) for any loss or damage however caused when the standard is used for any other purpose.

Section 2

Packaging of Defence Materiel Part 2: Design Introduction

Foreword

REVISION NOTE

This standard is raised to Issue 9 to update its; content, format, and normative standards changes

HISTORICAL RECORD

This standard supersedes the following:

Def Stan 81-41 (Part 2) Issue 8 dated 16th October 2015
Def Stan 81-41 (Part 2) Issue 7 dated 5th June 2014
Def Stan 81-41 (Part 2) Issue 6 dated 15th September 2005
Def Stan 81-41 (Part 2) Issue 5 dated 15 March 2002
Def Stan 81-41 (Part 2) Issue 4 dated 4 June 1999
Def Stan 81-41 (Part 2) Issue 3 dated 6 December 1991
Def Stan 81-41 (Part 2) Issue 2 dated 24 July 1984
Def Stan 81-41 (Part 2) Issue 1 dated 1 August 1981
DG-11, various Parts, Issue 3 dated 1980
DG-11, various Parts, Issue 2 dated 1976
DG-11, various Parts, Issue 1 dated 1969

a) This standard provides requirements and guidance for Military Level packaging for Ministry of Defence use.

b) This standard has been produced on behalf of the Ministry of Defence (MOD) by UK Defence Standardization (DStan) and by the Defence & Equipment Support (DES), Support Enablers Operations Centre (SEOC), Support Chain Process (SCP), Support Engineering (SptEng), Packaging Policy (Pkg)

c) This standard has been reached following broad consensus amongst the authorities concerned with its use and is intended to be used whenever relevant in all future designs, contracts, orders etc. and whenever practicable by amendment to those already in existence. If any difficulty arises which prevents application of the Defence Standard, DStan shall be informed so that a remedy may be sought.

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0 Introductions

Arrangement of Def Stan 81-041

Def Stan 81-041 is in six parts. More than one part may apply to any one packaging requirement. It is essential that all parts be considered and used where appropriate.

The arrangement of the complete series of Def Stan 81-041 is given below:

Part 1 – Introduction to Defence Packaging Requirements

Part 2 - Design

Part 3 - Environmental Testing

Part 4 – Service Packaging Instruction Sheet (SPIS)

Part 5 - Production Processes

Part 6 - Package Markings

1 Scope

1.1 This part of the Defence Standard specifies the Ministry of Defence (MOD) requirements for the design of packages to meet the Military Packaging Levels.

1.2 This Defence Standard does not cover the design of packaging for the transportation and storage of dangerous goods; that is covered by mandatory regulation elsewhere, and is dependent on the proposed modes of transport.

1.3 Following on from **1.2** this Defence Standard does not cover the design of munitions packaging, where Defence Standard 00-088 "Packaging for Ammunition and Explosives", should be referenced, except where stipulated in standards relevant to munitions packaging, e.g., principles of packaging.

Contents

Tables

2 Warning

Standard warning supplied in Section 1 of this document

3 Normative References

Normative References table supplied in section 3 of this document

4 Definitions

Definitions table supplied in section 3 of this document.

5 Basic Overview of the Packaging Process

Packaging is the preparation of materiel for; handling, storage and transportation to the user. In order to protect materiel against damage from possible adverse environmental effects it is necessary to prepare, protect and contain the materiel in a manner which will ensure that all reasonable risks are eliminated. The sequence of actions shown in **Table 1** provides the basis for MOD packaging. It may not be necessary to use all the actions detailed, depending on the item to be packaged and the level of packaging required, but each of the requirements shown in the "reasons" column must be considered in the package design process.

Table 1 - Basic Packaging Requirements

Step	Action	Reason
1	Clean	to remove contamination
2	Dry	to remove cleaning fluids
3	Protect	to prevent corrosion or deterioration
4	Pad	to protect barrier from abrasion or puncture
5	Wrap	to keep out contamination and protect preservation
6	Enclose	to provide barrier against effects of climate
7	Contain	to avoid physical damage
8	Locate	to secure firmly
9	Cushion	to protect against shocks
10	Close	to provide integrity
11	Label	to provide identification

Note: This Table is not exhaustive.

6 The Package Design Process

6.1 Def Stan 81-041 (Part 2) was prepared as a guide for the designers of packages used to contain MOD equipment and spares. The information is presented in a logical progression of packaging requirements starting with the various types of information that are required to be taken into account before a package design can be prepared. This is followed by the various processes that are used to prepare and contain the item together with sections on; dangerous goods, clean room items and electrostatic sensitive devices.

6.2 The main function of a package is to ensure that the item contained is fit for purpose when opened.

7 Factors to be considered

7.1 The main factors that influence the choice of packing are:

a) The Military Packaging Level

b) The Basic requirements

c) The Risks to materiel

d) The Vulnerability of materiel to shock

e) The Method of climatic protection chosen

f) The Hazard classification

g) Shelf Life

7.1.1 The relative importance of each factor will vary from one application to the next, some more significant in the choice of container, others in the choice of inner packing or location.

8 Military Packaging Levels

8.1 The military packaging level required shall be supplied by the relevant authority before any design process is initiated. Packages shall be designed to Military Levels P, N, J or H using the information contained in this part of the standard.

8.2 The handling, storage, and distribution requirements for each military level are given in Def Stan 81-041 (Part 1) which should be consulted before any design work is undertaken.

9 Basic Requirements

The following requirements shall be observed when designing a package.

a) The mass and size shall be the minimum practicable (having regard to economy).

b) The shape shall be rectangular whenever practicable.

c) No redundant features shall be incorporated.

d) The package shall not cause a safety problem or danger when handled and shall be as stable as practicable (the centre of gravity shall be central and low if possible).

e) The packaging shall protect the contents against hazards (e.g., climatic, physical and biological, see Table 20 required by the packaging level specified.)

10 Risks to Materiel

10.1 An item may be damaged or affected by environmental hazards (mechanical, climatic, chemical, or biological) unless protected (see **Table 2**).

Note 1: These effects are described in BS 1133 Sections 1-3 and more detailed information is given in the tables in Def Stan 00-035: (Part 1) Chapter 2 and (Part 2) Chapter 1 including (a) the principal effects of single environments and (b) environmental factors in relation to the Service life cycle.

Note 2: When considering the susceptibility of the item to damage or deterioration knowledge of; its constituent materials, its construction, and its use are essential.

10.2 The following should be consulted where applicable:

a) BS EN 61340-5-1 (provides information on protection from electrostatic hazards).

b) BS 7195 and Def Stan 03-030 (provide information on corrosion problems and prevention).

c) Def Stan 81-130 (provides information on transportation, handling, storage, and packaging of magnetically sensitive items).

d) DGS PS 5104 (provides information on packaging of Nuclear Grade 'A' (clean room items).

10.3 Material compatibility problems should be resolved.

10.4 As a general rule the risks to the materiel should be detailed and the most important identified. This should be considered first and then the other hazards should be addressed. Finally a possible combination of these should be considered.

Table 2 - Environmental Damaging Factors

Hazard	Property	Potential Hazards
Climatic	Temperature, Solar Radiation, Rain, Humidity, Wind, Sea, Sand	Degradation of properties, Corrosion, Thermal shock, Physio-chemical effects
Physical	Handling, Transport, Storage, Stacking, Static electricity, Magnetism	Tipping, Dropping, Puncturing, Vibration, Shock, Stress, Bouncing, Distortion, Abrasion Electrostatic effects, Magnetic fields
Biological	Mould growth, Fungi, Insects, Rodents	Decay, Contamination, Micro-organism destruction

11 Vulnerability of Materiel to Shock

11.1 The "fragility" of an item is the maximum shock under acceleration or deceleration that it can survive without damage (fragility is expressed in multiples of the acceleration due to the earth's gravity). The value obtained is known as the Fragility Factor or G Factor. The greater the fragility factor the more robust the item.

11.2 It is important to determine whether the materiel is robust or fragile as this will dictate the choice of both the container and the method of location.

Table 3 gives guidance of typical fragility factors commonly encountered by various items of equipment. Generally an item may be defined as 'robust' or 'fragile', see definitions.

11.3 The fragility factors given in **Table 3** are for general guidance. It is important that the package designer liaises with the materiel designer/manufacturer to establish a realistic fragility factor in relation to the physical protection required and economy.

Table 3 - Typical Fragility Factors

G Factor	Equipment Classification
20-40	Fragile Electronic/ Mechanical Equipment
40-60	Laboratory Equipment. Instrumentation generally
60-80	Laboratory Equipment. General Electronic Assemblies
80-100	Mass produced Electronic/Mechanical Equipment
Above 100	Robust Mechanical Equipment

12 Methods of Climatic Protection

12.1 Method List

The first step in deciding the best way to preserve an item is to determine which method of preservation is most appropriate to the constituent materials. The following five methods of preservation are used by MOD.

12.1.1 Method O: Employing no preservative

Method O is used for materiel which is unaffected by climatic hazards or which is not significantly susceptible to deterioration.

12.1.2 Method I: Employing a temporary protective or preservative

Method I is used for materiel having constituents which are susceptible to deterioration but which can be protected by the application of a temporary protective or preservative.

12.1.3 Method IC: Employing a waterproof barrier

Method IC is used for materiel having constituents which are susceptible to deterioration but which can be protected by enclosure in a waterproof barrier. The item may be pre-treated with a temporary protective

12.1.4 Method IA: Employing a water-vapour proof barrier

Method IA is used for materiel having constituents which are susceptible to deterioration but which can be protected by enclosure in a water-vapour-proof barrier.

12.1.5 Method II: Employing a desiccant within a water-vapour proof or water-vapour resistant barrier

Method II is used for materiel having constituents which are susceptible to deterioration and which cannot be protected using methods O, 1, 1C, or 1A but which can be protected by using a desiccant within a water-vapour proof or water-vapour resistant barrier.

12.2 Selection of the Method of Preservation

12.2.1 The methods of protection shall be considered in the following order of preference: Method O, Method I, Method IC, Method IA, and Method II.

12.2.2 The selection of the method of preservation shall be based upon the following factors:

a) The susceptibility of the materiel to deterioration (including individual components). Special attention should be paid to whether any protective finishes have been applied during manufacture e.g. paint.

b) The size, mass, shape and complexity of construction of the item.

c) The function of the materiel (including such considerations as the critical nature of its purpose and whether some measure of deterioration can be tolerated)

d) The type of physical protection or packaging adopted.

Note: Certain items of materiel, may not be suitable for enclosure in a container owing to their particular characteristics e.g. propellers and anchors. However such items may require some form of climatic protection.

12.2.2.1 The packaging production costs should be one of the determining factors when choosing a method. It should be borne in mind that labour costs are a high proportion of the total cost of many techniques. When the costs are similar for different methods the technique which entails the least effort to preserve the item should be chosen.

12.2.3 Materiel for which Method O is appropriate is easily characterised.

12.2.4 Materiel for which Method I is appropriate are items of simple construction which are wholly metallic or composite metallic/ non-metallic items. This Method shall not be used if (a) cleaning operations before use would be difficult and/or (b) the areas of the item subject to deterioration are not readily accessible.

12.2.5 Materiel for which Method IC or IA is appropriate. These Methods are best considered together initially. No hard and fast rule is used when choosing between a waterproof barrier (Method IC) and a water-vapour proof barrier (Method IA). A waterproof barrier will stop the ingress of liquid water but may not prevent condensation taking place inside the barrier during the diurnal cycle if storage conditions allow. Condensation is still possible but less likely to occur in quantity within a water-vapour proof barrier as less moisture can enter after sealing, over time. Therefore the choice may be made on the basis of whether or not the materiel would deteriorate if condensation were to remain for some time. In both cases if the entrapped atmosphere is dry / dried it is less likely (see Note below).

12.2.6 Materiel for which Method II is appropriate. Method II can be used for materiel that cannot be protected by any other method. It is useful for complex items and assemblies, especially those containing composite materials. It is applicable to all items that are sensitive to corrosive or fungal attack as the RH within the packaged environment does not exceed 50%.

12.3 Examples of the different methods of climatic protection are shown in **Table 4**.

Table 4 - Methods of Climatic Protection

Method O	Method I	Method IC	Method IA	Method II
No temporary protective	Temporary protective	Waterproof (WP) barrier	Water-vapour proof (WVP) barrier	Water-vapour resistant (WVR) or WVP barrier
	PX-32, PX-11 etc.	Polyethylene film (minimum thickness, 65 µm), or Mouldable waxed wrapping, or Paper Kraft union	Polyethylene film (total thickness, 500 µm), or Metal foil laminate	Polyethylene film or Metal foil laminate
		Either: with or without a temporary protective PX-1, PX-4, XG-250, XG-291 etc.,		With desiccant

12.4 A guide to choosing a method of preservation for various types of material is shown in **Table 5**.

Note: Where any barrier is used, flushing through with dried air before sealing will enhance protection. The use of a dried inert gas, e.g., Nitrogen, is likely to further improve performance; by reducing oxygen content the corrosion of metals and oxidation of rubber will be reduced.

Table 5 - Guide to the Methods of Preservation for Military Levels of Packaging

Type of Item of Materiel	Example	Preservation	Primary Wrapping	Barrier Material	Remarks	METHOD
ITEMS HIGHLY RESISTANT TO CLIMATIC DETERIORATION	Components for oxygen or breathing systems.	None	Def Stan 93-116 Type 1	Def Stan 93-116 Type 1 or 2	Dusting powder, oils or grease must not be used also see Def Stan 81-039 & 81-136	Method IC or IA
	China and glassware (not optical)	None	Tissue paper	None		Method O
	Plastics items	None None	Def Stan 81-030 Type 1 Def Stan 93-116 Type 1 or 2	None None	also see Def Stan 81-055	Method O Method O
	Wooden furniture	None	None	None	Metal components such as hinges should be treated with a grease	Method O
ITEMS FOR WHICH A MEASURE OF DETERIORATION IS ACCEPTABLE	Ingots, bars, rods, rough castings and forgings	None	None	None		Method O
METALLIC ITEMS With accessible surfaces and non-moving parts	High precision finish items, inspection gauges Precision finish items, bolts, nuts, pistons, connecting rods, gear wheels	PX-4, PX-7, PX-19, XG-291 or XG-279	Def Stan 81-093 Def Stan 81-129	Def Stan 93-116 Type 1 or Def Stan 81-129	Def Stan 81-129 is used as a primary wrap when extra strength is required.	Method IC
	Cutting tools, milling cutters, reamers, chisels, drills, taps and dies Tools and single components	PX-11 or PX-32	Def Stan 81-093	None	also see Def Stan 81-055 & 81-056	Method I
	Cutlery, mess tins, cooking utensils	PX-1 or PX-4	Def Stan 81-093 or 81-129	93-116 Type 1 or 81-129	see remarks concerning Def Stan 81-129 above	Method IC
	Hammer heads, crowbars	PX-32	Def Stan 81-030 Type 1	None		Method I

Table 5 - Guide to the Methods of Preservation for Military Levels of Packaging (continued)

TYPE OF ITEM OF MATERIEL	EXAMPLE	PRESERVATION	PRIMARY WRAPPING	BARRIER MATERIAL	REMARKS	METHOD
METALLIC ITEMS With inaccessible surfaces and non-moving parts	Castings	PX-7 PX-19 XG-291 XG-279 None	Def Stan 81-093, or Def Stan 81-129 Def Stan 81-030 Type 1	Def Stan 93-116 Type 1 or Def Stan 81-129 None	see remarks concerning Def Stan 81-129 above for wholly painted items only	Method IC Method O
	Components with internal passages	PX-4	Def Stan 81-093, or Def Stan 81-129	Def Stan 93-116 Type 1 or Def Stan 81-129	see also Def Stan 81-055 see remarks re Def Stan 81-129 above	Method IC Method IC
With inaccessible surfaces and moving parts	Adjustable spanners, vices, screw jacks, chucks, pliers	PX-4 None	Def Stan 81-093, Def Stan 81-129 None	Def Stan 93-116 Type 1 or Def Stan 81-129 Def Stan 93-116 Type 1	see remarks re Def Stan 81-129 above see also Def Stan 81-055	Method IC Method IC or IA
	Carburettors, fuel pumps, injectors, oil pumps, delicate mechanisms	PX-4 Desiccant	Def Stan 81-093 Def Stan 81-129 Def Stan 93-116 Type 1	Def Stan 81-129 or Def Stan 93-116 Type 1 Def Stan 93-116 Type 1 or 81-075	see remarks concerning Def Stan 81-129 above	Method IC Method II
	Small arms, machine guns	OX-24	Def Stan 81-093, Def Stan 81-129	Def Stan 93-116 Type 1 or Def Stan 81-129	see remarks re Def Stan 81-129 above	Method IC
METALLIC ITEMS With inaccessible surfaces and moving parts (continued)	Hydraulic jacks, shock absorbers	Operating fluid and PX-7 PX-19 XG-291 or XG-279	Def Stan 81-093 or Def Stan 81-129	Def Stan 93-116 Type 1 or Def Stan 81-129	Only the operating fluid should be used internally. see also Def Stan 81-077	Method IC

Table 5 - A Guide to the Methods of Preservation for Military Levels of Packaging (continued)

TYPE OF ITEM OF MATERIEL	EXAMPLE	PRESERVATION	PRIMARY WRAPPING	BARRIER MATERIAL	REMARKS	METHOD
NON-METALLIC ITEMS	Life-rafts, rubber sheeting Rubber items - aprons, gloves, O-rings, grommets, seals, gaskets, covers, hoses	None	Def Stan Type 1 Def Stan 93-116 Type 1 or 2	Def Stan 93-116 Type 1 or 2 Def Stan 81-075 or Def Stan 81-134	The treatment of vulcanized rubber items with dusting powder is not necessary if protected from the influence of; UV light, heat, ozone and contamination. Items should be left loosely wrapped and free from distortion. When extreme conditions are likely to be experienced high surface finish rubber sheeting may adhere to itself after a storage period, e.g. where items are packed in a small volume and held in upper deck stowage of ships. This can be prevented by the use of a dusting powder or by interleaving with a material, which is readily removed from the rubber surface. Also see Def Stan 81-039, 81-060	Method IC or IA
	Leather items (other than clothing)	None	Def Stan 81-030 (Type 1 or 3)	Def Stan 93-116 Type 1	see also Def Stan 81-055	Method IC
	Woollen items	BS 5962	Def Stan 81-030 (Type 1 or 3) or Def Stan 93-116 Type 2	Def Stan 93-116 Type 1		Method IC
	Linen, cotton and man-made fibres	None	Def Stan 81-030 (Type 1 or 3) or Def Stan 93-116 Type 2	Def Stan 93-116 Type 1		Method IC
	Paper, cork and felt items, gaskets	None	Def Stan 81-030 Type 1	Def Stan 93-116 Type 1		Method IC
	Optical glass and other high precision glass items	None	Def Stan 81-030 Type 2	Def Stan 81-75 or Def Stan 93-116 Type 1		Method IC or IA

Table 5 - A Guide to the Methods of Preservation for Military Levels of Packaging (concluded)

TYPE OF ITEM OF MATERIEL	EXAMPLE	PRESERVATION	PRIMARY WRAPPING	BARRIER MATERIAL	REMARKS	METHOD
COMPOSITE ITEMS With accessible surfaces	Anti-vibration mountings or oil seals (rubber metal)	XG-250	Def Stan 81-129	Def Stan 81-129 or Def Stan 93-116 Type 1	XG-250 must be applied only to unpainted ferrous metal surfaces see remarks concerning Def Stan 81-129 above	Method IC
With inaccessible surfaces	Electrical items - ammeters, voltmeters, switches, chokes, connectors, electronic sub-assemblies, tag board assemblies, headsets, pressure indicators, resistors, capacitors	None	Def Stan 93-116 Type 1	Def Stan 93-116 Type 1		Method IC or 1A
		Desiccant	Def Stan 93-116 Type 1	Def Stan 81-75 or Def Stan 93-116 Type 1	see also Def Stan 81-36, 81-58 & 81-77	Method II
	Electric motors, generators, voltage regulators, electronic assemblies, transmitters, receivers, amplifiers, gyroscopic instruments	None	Def Stan 81-122 or Def Stan 93-116 Type 1	Def Stan 93-116 Type 1	see also; Def Stan 81-065, 81-078 & 81-080	Method IC or 1A
		Desiccant	Def Stan 93-116 Type 1	Def Stan 81-075 or Def Stan 93-116 Type 1		Method II
	Cameras, binoculars and other optical instruments	None	Def Stan 81-122 or Def Stan 93-116 Type 1	Def Stan 93-116 Type 1		Method IC or 1A
		Desiccant	Def Stan 81-030 Type 2 or Def Stan 81-122	Def Stan 93-116 Type 1 Or 81-075		Method II

13 Dangerous Goods (Materiel)

For some items the determining feature may be the nature of the materiel itself, i.e. the danger/hazard to personnel, transport or other materiel

13.1 All dangerous goods must be packaged safely and to meet the requirements of the relevant MOD, UK and international regulations for the envisaged circumstances. Compliance with the regulations is a statutory obligation.

13.2 There may be further MOD (RAF) air movement requirements to be complied with.

Note: It is possible that some military level packaging designs may be suitable for the carriage of limited quantities, but this must be confirmed before use.

14 Preparation (cleaning and drying of materiel before preservation)

g) An important first step in the packaging process is the preparation of materiel. It is essential that an item is clean, uncontaminated, and dry before any form of climatic or physical protection is given. This is very important for metallic items that are susceptible to corrosion as the best surface protective may be rendered worthless if applied over a contaminated substrate.

14.1 The Cleaning Process

When selecting a cleaning process the following factors have to be considered:

a) Nature of contaminants to be removed;

b) Nature of the materials of which the materiel to be cleaned is constructed;

c) Complexity of construction of the materiel

14.1.1 Nature of Contaminants. The contaminants are usually workshop residues, i.e. dirt or swarf amalgamated with oil or grease, and these can be removed by any of the approved materials. Generally; soaps, sweat, and chemical residues can be removed only by the detergent cleaners.

14.1.2 Nature of the materials. Most metal surfaces can be cleaned with inhibited trichloroethylene, petroleum solvents, or detergents. Items which are partially painted or varnished should be cleaned with petroleum solvents. Assemblies made up of both metallic and non-metallic materials should not be cleaned by immersion techniques but should be wiped or cleaned with clean dry air.

14.1.3 Complexity of construction of the materiel. Metal assemblies of complex construction should be cleaned with inhibited trichloroethylene or petroleum solvents only, because if detergent solutions are used there is a risk of trapping the cleaning solution which may not be removed by subsequent rinsing and drying. This applies particularly to items which are porous or have capillary spaces, extended lap joints, riveted areas or spot welded parts, etc.

14.2 Drying

After cleaning and before the application of temporary protection, materiel must be thoroughly dried. There are four methods of drying normally used:

a) Hot-air oven

b) Infra-red radiation

c) Warm clean dry air from a blower

d) Wiping with a clean dry cloth

14.2.1 In the first two of these methods the temperature of the hot air oven or tunnel of infra-red lamps should be (65 ± 3) °C or (110 ± 10) °C depending on the type of materiel to be dried.

14.2.2 These methods should not be used if the materiel cannot withstand exposure to these temperatures. The appropriate range shall be specified in the packaging specification.

14.2.3 The time taken to ensure that the material is thoroughly dry will vary according to the size of the item, the cleaning agent used and the drying temperature. Items which are too large to be placed in an oven or passed through a tunnel of infra-red lamps should be dried with warm, clean, dry air.

14.2.4 Wiping with a cloth should be used only as a last resort. Cloths shall be; clean, dry, and free from laundering residues.

14.3 Guidance for the cleaning and drying of materiel

14.3.1 Detailed guidance is given in **Table 6,** which should be consulted by the designer. Further information may be found in Def Stan 003-2.

14.3.2 Table 6 gives a choice of procedures depending on the type of materiel involved (metallic, non-metallic or composite) and refers to individual procedures in Def Stan 81-041 (Part 5) which describe each cleaning and drying method or process in detail.

Table 6 – A Guide to the Cleaning and Drying of Materiel before Preservation

Materiel	Cleaning Agent	Cleaning Method	Process	Drying Method	Process	Remarks
WHOLLY METALLIC ITEMS (a) Simple construction e.g. hand tools with no movable parts, nuts, bolts or washers	Inhibited Trichloroethylene (Commercial)	Vapour degreasing or Immersion in boiling solvent or Jetting or Ultrasonic agitation	C2	None - after degreasing with trichloroethylene items are normally dry	-	(a) Not suitable for painted items, porous items and items with internal passages. (b) Vapour degreasing will remove deposits of dirt, oil, and grease. (c) Stubborn adherents may be removed by immersion aided by jetting or ultrasonic agitation. (d) Will not remove soaps, sweat, or chemical residues.
	White spirit (BS 245, Type A) or Hydrocarbon solvent (Commercial) or Kerosene (BS 2869, Class 2) or Turbine Fuel (Def Stan 91-91)	Immersion or Spraying/Jetting or Brushing	C3	Hot air oven (65 ± 3) °C or (110 ± 10) °C) or Infra-red radiation (65 ± 3) °C or (110 ± 10) °C or Clean dry air blow or Wiping	C11	(a) Will remove deposits of oil, grease, and dirt. (b) Will not remove sweat or chemical residues. (c) Immersion is suitable for removal of loose surface adherents. Spraying is suitable for the removal of more stubborn adherents. Brushing can be used when other methods are not practicable. (d) Drying methods employing heat are the most effective. Lower temperatures may be specified if required. (e) Methods employing heat should be avoided if they cause changes in the material condition or distortion. (f) Wiping should be used only as a last resort.
	Detergent cleaners (Commercial)	Immersion or Spraying or Jetting	C4	Hot air oven (65 ± 2 °C) or (110 ± 10 °C) or Infra-red radiation (65 ± 2 °C) or (110 ± 10 °C)	C11	(a) Will remove deposits of dirt, oil, and grease. (b) Will remove sweat and certain chemical residues. (c) Weak detergent solutions are suitable for certain types of painted surface and non-ferrous metals. (d) Drying methods employing heat are most effective. (e) Wiping should be used only as a last resort. (f) Stubborn adherents may be removed by brushing, spraying/ jetting or ultrasonic agitation

Table 6 – A Guide to the Cleaning and Drying of Materiel before Preservation (Continued)

Materiel	Cleaning Agent	Cleaning Method	Process	Drying Method	Process	Remarks
WHOLLY METALLIC ITEMS (b) Complex construction, e.g. hand tools with movable parts, pliers, castings with narrow internal passages, ball and roller bearings, carburettors, external surfaces of fuel pumps, injectors	White spirit (BS 245, Type A) or Hydrocarbon solvent (Commercial) or Turbine Fuel (Def Stan 91-91)	Immersion or Spraying or Brushing	C3	Hot air oven (65 ± 3 °C) or (110 ± 10 °C) or Infra-red radiation (65 ± 3 °C) or (110 ± 10 °C) or Clean dry air blast or Wiping	C11	(a) Will remove deposits of oil, grease, and dirt. (b) Will not remove sweat or chemical residues. (c) Immersion is suitable for removal of loose surface adherents. Spraying is suitable for the removal of more stubborn adherents. Brushing can be used when other methods are not practicable. (d) Drying methods employing heat are the most effective. Lower temperatures may be specified if required. (e) Methods employing heat should be avoided if they cause changes in the material condition or distortion. (f) Wiping should be used only as a last resort.
WHOLLY NON-METALLIC ITEMS (a) Hygroscopic materials, e.g. textiles, leather, cork, etc.		Clean dry air blow or vacuum cleaning	C10			(a) This type of material should be substantially clean and dry when received for packaging. (b) Cleaning and drying are carried out in one operation.
b) Non-hygroscopic materials e.g. glass, china etc.	Detergent cleaners (Commercial) or Cloth	Immersion or Wiping or Washing	C4 C10	Wiping with a cloth or Warm clean dry air blast	C11	(a) The materiel itself may be unaffected by dirt or moisture, but such contaminants might affect the packaging material being used. For this reason all items should be clean and dry when packaged. (b) Wiping with a clean cloth will normally be sufficient for this type of materiel. Washing may be used to remove stubborn adherents. Further cleaning may sometimes be necessary because of either the critical nature of the item or the particular contaminants present. Specialist advice should be sought in appropriate instances.

Table 6 - A Guide to the Cleaning and Drying of Materiel before Preservation (concluded)

Materiel	Cleaning Agent	Cleaning Method	Process	Drying Method	Process	Remarks
COMPOSITE ITEMS (a) Relatively simple construction e.g. combined metallic/non-metallic items, partially painted items	White spirit (BS 245, Type A) or Kerosene (BS 2869, Class 2) or Hydrocarbon solvent (Commercial)	Brushing	C3	Wiping with a cloth or Clean dry air blast	C11	a) Metallic surfaces only should be cleaned by brushing with solvent. b) Non-metallic surfaces should be prepared by wiping with a cloth or by using a clean dry air blast. c) Solvents should not be used if the non-metallic parts may be affected: for example, with plastics or waxes. In such instances both cleaning and drying should be by wiping with a cloth or by using a clean dry air blast. For process C10 the cleaning and drying are carried out in one operation
(b) Complex items e.g. electronic assemblies		Clean dry air	C10			(a) This may be supplemented if necessary by vacuum cleaning. (b) Cleaning and drying are carried out in one operation.

15 Preservation of Materiel

The following materials may be used either alone or in combination using the processes described in Def Stan 81-041 (Part 5):

a) Temporary protective

b) Preservatives

c) Sharp-edge protection materials

d) Primary wrappings

e) Barriers

f) Desiccants.

15.1 Temporary Protective

A Temporary Protective forms a film on the surface of the metal thus protecting the item against corrosion. The film may need to be removed before the item is used. There are seven basic types:

a) Hard film (solvent-deposited); a protective, such as plasticized resins, in a volatile solvent which evaporates to leave a thin hard film of protective.

b) Soft film (solvent-deposited); a protective, such as lanolin, in a volatile solvent which evaporates to leave a thin soft film of protective.

c) Soft film (hot dip); consists of a thick film of a protective petroleum substance (known as; petroleum jelly or mineral jelly).

d) Soft film (grease); consists of a thick soft film.

e) Oil film; consists of lubricating oils containing corrosion inhibitors.

f) Hot Dip (strippable coating) consists of ethyl cellulose and mineral oil with additives.

15.1.2 Guidance on temporary Protective materials and their use is given in **Table 7** and Def Stan 01-5, Fuels, Lubricants and Associated Products.

15.2 Preservatives

Only two preservatives are specified here; a moth repellent for textiles and an anti-sticking agent for certain rubbers. Guidance on the use of preservatives is given in **Table 8.**

15.3 Sharp-Edge Protection Materials

It may be necessary to pad sharp edges, projections, or corners of the item to prevent abrasion, tearing or puncturing of the primary wrapping or the barrier material. This protection may be achieved in various ways dependant on the construction of the item and the classification of the method(s) of climatic protection selected, see Process [C49].

15.4 Primary Wrappings

h) **15.4.1** Primary wrappings are grease resistant or non-grease resistant; sheets, bags, or envelopes used to wrap the item:

a) To prevent loss of the temporary protective or preservative (and contamination of the rest of the package)

b) To protect the item from contact corrosion problems

c) To prevent contamination of the item by dust, dirt etc.

15.4.2 Guidance on the use of primary wraps is given in **Table 9**

15.5 Barriers

15.5.1 Barriers are materials that are used to enclose an item in a sealed bag or envelope. Their function is to minimise the ingress of liquid water or water-vapour. Barrier materials are classified as waterproof (WP), water-vapour resistant (WVR), or water-vapour proof (WVP) (see **Definitions**).

15.5.2 Guidance on the use of barriers is given in **Table 10**. In addition to those listed there are materials which are impermeable to water vapour (glass or metal) which may be fabricated to form climatic barriers. Resin-bonded glass fibre and some semi-rigid plastics though not in general impermeable may also be used as WVR / WVP barriers if their measured WVTR is adequate.

15.6 Desiccant

15.6.1 Silica Gel and Activated Clay desiccants are materials that possess a high affinity for water-vapour. They are used in packages to reduce and maintain the % RH below a safe limit of 50% within a sealed WVR or WVP barrier. MOD desiccants for packaging are supplied in bags or sachets containing 5, 10, 15, 25, 50, 100, 250, 500, or 2500 grams of basic desiccant (see Def Stan 81-068). Information on various desiccants and associated materials is given in **Table 11**.

15.6.2 The quantity of desiccant required to protect the contents of the package is dependent upon a number of factors. These include the surface area of the barrier, the permeability of the barrier material to water-vapour, the amount of moisture enclosed within the barrier at the time of sealing and the duration for which protection is required. Information on barrier materials and formulae for calculating quantities required for Military Level packaging is shown in **ANNEX A**.

Note 1: Silica gel is capable of adsorbing up to 30% of its dry weight of water from the surrounding atmosphere at 25 °C and 50% RH. This depends on its surface and can be degraded and ultimately destroyed by overheating or contamination with; dirt, grease, petroleum products and particularly ammonia.

Note 2: Further information may be obtained by consulting BS 1133: Section 19.

15.6.3 The calculated amount is placed in a uniform manner as close to the wrapped item as possible preferably using a number of small size bags rather than a single large unit. The procedure is described in Process [C60]. It is important that the bags are secured in a position that ensures that the effective surface area is not impaired.

15.6.4 Only beaded Silica Gel bags shall be used in conjunction with special containers for clean room conditions.

15.6.5 The use of humidity indicators may be considered to determine whether a desiccant is nearing the end of its useful life; these are described in **ANNEX B**.

15.6.6 Reactivation / Regeneration of Desiccant

It is MOD policy not to reactivate silica gel or molecular sieve desiccants. This policy has been formulated as a result of experience which has shown that:

a) the reactivation process is often ill-controlled and the previous history of the desiccant is not always known;
b) degradation of the desiccant occurs leading to loss of efficiency and physical breakdown;
c) reactivation cannot remove oils and organic contaminants, again leading to loss of efficiency;
d) If they are not removed prior to reactivation, indicator papers deteriorate as a result of heating and become unreliable.

NOTE: In an emergency, saturated silica gel but not molecular sieves can be reactivated by heating at 115 °C in a current of dry air, but recharging should be carried out as soon as possible afterwards

15.6.7 Humidity Indication

It is essential to be able to monitor the humidity within desiccated packaging, and equipment, so that the desiccant can be changed before the safe humidity limit is reached. See **Annex B**.

Table 7 – Temporary Protective

Temporary Protective	Method Of Application		Process	Recommended Use	Brief Description And Remarks
	Preferred	Alternatives			
HARD FILMS, SOLVENT DEPOSITED PX-32 (Def Stan 80-083)	Dipping	Spraying or Brushing	C16	On non-precision, readily accessible, metal surfaces, tools and spares for motor transport, single components and small arms.	Resistant to handling or rubbing. Not for internal use in engines or for parts with inaccessible recesses. Removal before use is necessary. PX-32 may contain toxic and flammable solvents. Prolonged and/or major skin contact must be avoided.
SOFT FILMS, SOLVENT DEPOSITED PX-1 (Def Stan 80-217)	Dipping	Spraying or Brushing	C17	On high precision metal surfaces (should then be supplemented by the use of a waterproof or water-vapour resistant barrier) and single shaped canteen equipment (cutlery, mess tins, ovens etc.).	A lanolin composition that hardens slightly on ageing but is easily displaced by handling or rubbing.
	Spraying	Brushing or Dipping	C17	On internal metal surfaces of aircraft internal combustion engine cylinders.	A wax mineral oil composition that provides a non-drying protective film that will not drain from inclined surfaces. Neutralizes the corrosive effects of the combustion products of leaded fuels.
SOFT FILMS, GREASE PX-7 (Def Stan 91-038)	Brushing	Smearing	C18	On battery terminals.	A thick petrolatum that provides an easily displaced protective film.
XG-291 (Def Stan 91-105) XG-279 (Def Stan 91-027)	Brushing	Smearing	C18	On precision ferrous surfaces.	General purpose lubricant Protective. Easily displaced by handling or rubbing. Removal only essential if normal lubricant is synthetic based oil.
XG-250 (Def Stan 68-069, obsolete) Commercial Silicon Compound (see [C19])	Brushing	Smearing	C19	On metal surfaces of metal/rubber components. Should not remain in contact with rubber.	A silicone based grease. Should not be permitted to come into contact with high density polyethylene nor with components parts associated with electrical switching.

Table 7 - Temporary Protective (concluded)

Temporary Protective	Method of Application		Process	Recommended Use	Brief Description And Remarks
	Preferred	Alternatives			
SOFT FILM, HOT DIP PX-11 (Def Stan 80-085)	Dipping	Brushing	C20	On high precision metal surfaces.	A thick petrolatum and beeswax mixture that provides a fairly firm protective film. Is easily displaced by handling or rubbing. Will easily penetrate crevices or holes. Dipping temperature approx. 90°C. Removal is normally necessary.
OIL FILMS PX-4 (Def Stan 80-034) OMD-90 (Def Stan 91-113)	Dipping	Spraying or Brushing	C21	On internal surfaces of internal combustion engine cylinders (not aircraft), castings with internal passages, delicate mechanisms etc. If used externally should be supplemented by the use of a water resistant or water-vapour proof barrier.	Thin mineral oils with added oxidation and corrosion inhibitors. Removal not essential. Miscible with mineral lubricating oils. Note: PX-4 is not suitable for internal use with engines unless specified.
PX-27 (Def Stan 91-040)	Circulating through lubrication system		C21	On internal surfaces of aircraft internal combustion engine lubrication systems.	A thin mineral oil with added corrosion inhibitors. Neutralizes the corrosive effects of the combustion products of leaded fuels. Removal not essential

Table 6 – Preservatives

Preservative	Method Of Application	Process	Recommended Use	BRIEF DESCRIPTION AND REMARKS
Naphthalene, Grade 1 (BS 5962)	Distributing evenly throughout materiel	C33	With woollen supplies. Not to be used near pitch or bituminous compounds.	A moth repellent. Shall always be used in bags.
Powder, dusting, for rubber (Commercial)	Dusting surfaces	C35	To prevent adjacent surfaces of rubber items sticking together. In particular, rubber items that are stacked directly one upon another and which are required to be packed in small volume. Not to be used on oxygen or breathing apparatus.	Consists of French chalk or china clay in the form of a soft white dry powder.

Table 9 – Primary Wrapping

Material	Process	Recommended Use	Brief Description And Remarks
Primary Wrappings, Non Grease-Resisting Paper, wrapping, waxed (Def Stan 81-030 Type 1)	C41	For wrapping materiel treated with hard film temporary protective or as a barrier between untreated surfaces and hygroscopic material.	A paper coated on both sides with paraffin wax. Can be used as a bag made to Def Stan 81-93 drawings
Paper, Kraft, crepe, wet-strengthened (Def Stan 81-133)	C41	For wrapping materiel that has a surface treatment requiring protection during transport & handling, e.g. panels, tubes, pipes etc. Also suitable for wrapping rubber tyres to exclude light.	A creped pure Kraft paper treated with a synthetic resin.
Paper, Kraft, creped (anti-bleed) (Def Stan 81-133)	C41	For wrapping materiel liable to contamination by bitumen exuding from the barrier material e.g. textiles.	An unbleached Kraft paper free from imperfections and added colouring matter.
Paper, textile wrapping (Def Stan 81-030 Type 3)	C41	Used as a primary wrapping for textiles. Should not be used where it may come in contact with metal fittings or attachments.	A paper made mainly from sulphate pulp.
Paper, tissue, wrapping (Def Stan 81-030 Type 2)	C41	For wrapping optical glass or instruments or other delicate instruments requiring acid free wrappings.	A pure chemical wood pulp tissue paper of light substance. The chemical purity is controlled.
Paper, tissue (Commercial)	C41	For wrapping china and glassware, or when a light substance paper is required and Acid Free wrappings are not essential. Should not be used where it may come in contact with metal fittings or attachments. NOT TO BE USED IN DIRECT CONTACT WITH OPTICAL GLASS	Any light substance tissue paper (commercial grade). The chemical purity is not controlled.
Polyethylene film (low density) natural colour (Def Stan 93-116 Type 1)	C41	For wrapping untreated materiel when a strong primary wrap is required. Suitable for use with item protected with PX-1. Available in thicknesses of 65 µm, 125 µm and 250 µm (see Note below).	A flexible translucent material, available in the form of sheet or layflat tubing. Can be heat-sealed (non- desiccated pack) or secured with tape. There is a possibility of static electricity being produced by friction. **Must not** be allowed to come into contact with oils, greases, or hydrocarbons.
Polyethylene film (low density) black, opaque (Def Stan 93-116 Type 2)	C41	For wrapping of clothing and rubber components etc., where the exclusion of light is of prime importance. Available in thicknesses of 65 µm, 125 µm and 250 µm	A flexible opaque material available in sheet or layflat tubing. Can be heat-sealed (non- desiccated pack) or secured with tape. As it is non-conducting there is a possibility of static electricity being produced by friction.
Polyethylene film, black, Electrically conductive (Def Stan 93-097)	C41	For wrapping electrostatic discharge sensitive devices.	A flexible, electrically conductive, opaque material available in sheet or layflat tubing. Can be heat-sealed or secured with tape.

Note: When layflat tubing is used the preferred range of widths should be chosen from the following; 50, 65, 75, 100, 125, 150, 175, 200, 225, 250, 300, 375, 400, 450, 600, 800, 1000, 1200, 1500, or 1800 mm

Table 9 - Primary Wrappings (concluded)

Material	Process	Recommended Use	Brief Description And Remarks
Primary Wrappings, Non Grease-Resisting (Continued)			
Bags, Electrostatic Shielding (Def Stan 81-112)	C41	For wrapping electrostatic discharge sensitive devices	The material of the bags is of laminated construction comprising polyethylene and metalized film. The overall construction may be "buried metal" or "metal-out" construction. The bags provide protection by having an inner (intimate) contact layer that is both antistatic and electrostatic dissipative having both a "Faraday cage" shielding effect and being capable of dissipating electrostatic charges and provide a path to ground.
Polyethylene, bubble film, for packaging (Def Stan 81-122)	C41	For wrapping untreated materiel when a degree of sharp edge protection is required.	The material consists of two layers of polyethylene of different thicknesses; each layer may be coated on one side with a non-PVC coating. The thicker film layer is embossed with the cylindrical cell shape (e.g. Type A or Type B). The two layers of material are sealed to entrap air within the embossed areas and produce a uniformly distributed closed cell structure.
Primary Wrappings, Grease-Resisting			
Wrapping, mouldable, waxed, grease-resisting (Def Stan 81-129)	C41	A conforming wrap for items of irregular shape which have been treated with a soft film or oil temporary protective or preservative. Also provides good sharp edge protection. (see process [C49])	A water-resistant material of cellulose film laminated with textile reinforcement coated both sides with wax, treated with a fungicide. At room temperature it is self-adhesive under finger pressure (see **Table 10**). Can be moulded to conform to the shape of items.
Paper, Wrapping Grease-resisting and Bags, Paper, Grease-resistant (Def Stan 81-093)	C41	For wrapping materiel treated with soft film or oil film temporary protective or preservative. NOT TO BE USED IN DIRECT CONTACT WITH PAINTED OR RUBBER SURFACES	A paper rendered grease resisting by a coating or laminate on one face. Can be used as a bag.

Note: Where primary wrappings are available in various thicknesses, the thickness shall be chosen according to physical strength requirements.

Table 7 - Barrier Materials

Material	Process	Recommended Use	Brief Description And Remarks
Barrier Materials, Waterproof Paper, creped, Kraft union, Reinforced (PCKUR) (Def Stan 81-048)	C43	For wrapping of textiles and woollens. NOTE: a primary wrap of Def Stan 81-133 (Anti-bleed) should be employed. Must not come into contact with materiel because of the possible exudation of bitumen. To make water resistant, seams and joints should be sealed with an approved adhesive.	A material consisting of two plies of creped pure Kraft paper (at least one of which has high wet-strength properties) laminated with bitumen or pitch and reinforced by an interlayer of suitable fibre in the form of either fabric or separate strands.
Paper, Kraft union (PKU) (Def Stan 81-048)	C43	As above	A material consisting of two plies of pure Kraft laminated with bitumen or pitch.
Paper, Kraft, polyethylene coated (heat sealable) (Def Stan 81-134)	C44	For use as a barrier for Method IC packages. Must not come into contact with oils, greases, or hydrocarbon solvents.	A pure Kraft paper coated on one side with polyethylene. Can be heat-sealed. Available in a range of thicknesses.
Polyethylene film (low density) (Def Stan 93-116 Type 1 or 2)	C44 or C48	For use as a barrier for Method IC packages. A minimum thickness of 65 µm is sufficient for water resistance. See Note below for preferred range of layflat tubing widths.	A flexible material in the form of sheet or layflat tubing. Can be heat-sealed. As it is non-conducting there is a possibility of static electricity being produced by friction.
Wrapping, mouldable, waxed, grease-resisting (Def Stan 81-129)	C45	For use as a conforming barrier for Method IC packages. As it is grease resisting it may be used in direct contact with oils or greases.	A cellulose material laminated with textile reinforcement and coated on both sides with wax treated with a fungicide. At room temperature it is self-adhesive under finger pressure. Can be moulded to conform to the shape of items.
Barrier Materials, Water Vapour Resistant Polyethylene film (low density) (Def Stan 93-116 Type 1 or 2)	C44 or C48	For use as a barrier for Method II packages. A minimum total thickness of 250 µm is used for a water-vapour-resistant barrier. See Note below for preferred range of layflat tubing widths	A flexible material in the form of sheet or layflat tubing. Can be heat-sealed. As it is non-conducting there is a possibility of static electricity being produced by friction.

Note When layflat tubing is used the preferred range of widths should be chosen from the following; 50, 65, 75, 100, 125, 150, 175, 200, 225, 250, 300, 375, 400, 450, 600, 800, 1000, 1200, 1500 or 1800 mm

Table 10 - Barrier Materials (concluded)

Material	Process	Recommended Use	Brief Description And Remarks
Barrier Materials, Water-Vapour Resistant PVC Bags (Def Stan 81-101 Types 1 and 2 (grades A, B, C and D))		As a barrier for Method IA or Method II packages.	Flexible reusable WVR covers made from various grades of calendared PVC sheet, one of which is fabric reinforced. With extruded PVC closures. Provision is made for windows, pockets and relief valves and for reinforcement by fabric reinforced PVC material or metal bearer plates as required
Aluminium Foil Laminate Bags (Def Stan 81-101 Type 3 (grade E))		As a barrier for Method IA or Method II packages	Flexible reusable WVR bags made from aluminium foil laminate. Provision is made for windows, pockets, and relief valves. These bags are considered semi-robust.
Barrier, Materials, Water-Vapour Proof Barrier material aluminium foil laminate, flexible, heat sealable (Def Stan 81-075 Type 1: Plastics film based Type 2: Kraft paper based Type 3: Natural or Synthetic Fibre based)	C47 or C48	For use as a barrier for Method IA or Method II packages. The use of Type 2 material is not recommended when the application involves twisting or flexing the foil laminate (as distinct from creasing) during either the packaging make-up procedure or Service use.	One surface of the laminate is coated with a compound to render it heat-sealable by normal heat-sealing equipment.
Polyethylene film (low density) (Def Stan 93-116 Type 1 or 2)	C44 or C48	For use as a barrier for Method IA or Method II packages. A total thickness of 500 μm is necessary for a WVP barrier. See Note below for preferred range of layflat tubing widths	A flexible material in the form of sheet or layflat tubing. Can be heat-sealed

Note 1: When layflat tubing is used the preferred range of widths should be chosen from the following; 50, 65, 75, 100, 125, 150, 175, 200, 225, 250, 300, 375, 400, 450, 600, 800, 1000, 1200, 1500, or 1800 mm

Note 2: Where appropriate barrier properties can be achieved within a range of thicknesses, the thickness shall be chosen according to strength requirements.

Table 11 – Desiccants and Associated Materials

Material	Process	Recommended Use	Brief Description And Remarks
Silica gel for use as a desiccant in packages (BS 2540)	-	For use as a drying agent inside a WVP or WVR barrier.	A form of pure silica in a highly porous state, being a hard granular material which is chemically inert.
Bags, desiccant, silica gel (Def Stan 81-068)	C60	For use as a drying agent inside a WVP or WVR barrier.	Linen bags filled with silica gel to BS 2540. Available in sizes containing 5g to 2.5 kg.
Desiccant, activated clay (BS 7529)	-	For use as a drying agent inside a WVP or WVR resistant barrier	Activated mineral clay in granular form, free from extraneous matter. It is chemically inert.
Bags, desiccant, activated clay (Def Stan 81-068)	C60	For use as a drying agent inside a WVP or WVR barrier.	Linen bags filled with activated clay to BS 7529. Available in sizes 5g to 500g of 'basic desiccant'.
Paper, humidity indicator, cobalt chloride (Def Stan 81-132)	-	For use within desiccated packages having barriers that are transparent or that have observation windows fitted, to indicate changes in relative humidity within the barrier.	An absorbent paper, blue in colour when dry, gradually changing to pink when exposed to a relative humidity exceeding 50 per cent. Should not be used in close proximity to desiccant.

16 Bundling, Wrapping and Bailing

Bundling, wrapping and baling are used for robust items of materiel which will not suffer damage in transit but which may require collecting together to facilitate handling.

Note: Where aggregation of a quantity of items is required, bundling and/or wrapping may be sufficient but usually this entails the use of a rigid container.

16.1 Bundling

This is the simplest form of packing but is not directly protective. It consists of securing a number of items together using rope, cord, wire, metal or plastics strapping, webbing or adhesive tape. It is applicable to items such as metal tubes.

16.2 Bandage and bundle wrapping

This is used where tying is impractical. It may be applied to more vulnerable parts of the item to give protection or to adjacent equipment where relevant, e.g. the ends of metal tubes (see Process [C41] and [C42]).

16.2.1 Common wrapping materials are paper, water-resistant paper, plastics films, and fabrics, the choice is governed by the nature of the materiel to be wrapped, and the degree of protection required.

16.2.2 Aggregated small rugged items may be wrapped using bags or envelopes.

16.3 Baling

This is a special instance of wrapping and bundling in which items such as textiles are compressed, wrapped, and secured. Baling materials commonly used are Hessian or woven polypropylene films, secured by stitching, using either hemp twine, BS 6125, or polypropylene twine, BS 4881.

Note: The polypropylene twine must be ultra-violet (UV) inhibited (see Process [D17]).

17 Methods of Location

The purpose of the location arrangement is to support the materiel in a manner which provides as easy a load as practicable for the container. It also should give the necessary degree of physical protection for the materiel (and for any climatic protection already applied) and prevent uncontrolled movement. An easy load is obtained by using space-filling, wrapping, or load-spreading methods of location, but may result from the use of certain forms of cushioning.

The following methods of location should be considered and used with the materials listed in **Table 12**:

a) Space-filling, loose, granular or shredded

b) Wrapping, flexible sheets or wadding

c) Load-spreading

d) Blocking and bracing, fabricated or rigid fitments

e) Cushioning, resilient pads (bulk materials) or spring devices

17.1 Space-filling

This consists of filling all the free space between the item and the container surface, (see [D1]); in this way any external impact forces are distributed over both the surface of the container and the item being packaged. It also limits movement to a small extent.

17.1.1 It is suitable for items of robust construction and should not be used for materiel with vulnerable projections or with heavy loads note the following;

a) It is important that the space-filling material should show little or no compacting to either the static load of the item or the dynamic load resulting from impact shock or vibration.

b) Granular material is not suitable as a space-filler for an item of high density, which will tend to migrate towards the lowest part of the package and be unprotected.

c) Some space-filling materials have the property of absorbing liquids (useful for leakages).

17.2 Wrapping

Wrapping is suitable for materiel of regular shape and/or relatively robust construction (see Process [D3]).

17.2.1 It provides anti-abrasive protection and is used, for example, when an item in a barrier material is packed into a stapled fibreboard container and it is necessary to prevent contact between the barrier and staples.

Note: In some circumstances contact may be prevented by taping over the staples

17.2.2 Cellulose wadding or polyethylene bubble film is recommended for the most vulnerable items.

17.3 Load spreading

Load spreading involves supporting the item over the major portion of its surface(s) using expanded polystyrene mouldings or corrugated paper/fibreboard fitments (see process [D4] & [D5] and Figures 11-16 inclusive).

17.3.1 Load spreading will afford protection for relatively robust items or for brittle items that may be liable to fracture when subjected to shock or stress concentrations. It is suitable for both regular and irregular shaped materiel and for protecting vulnerable projections.

17.3.2 The choice of materials will depend upon the size and mass of the materiel and on the size and shape of the support areas. The material may be used as rolls, pads, blocks, strips, or cells which should be shaped to avoid any pressure on weak areas or projections. Interlocking partitions may be used in conjunction with a space-filling material. It should be noted that corrugated board will support considerably higher loads when used in the direction of the fluting. Die-cut or moulded fitments, requiring production and setting-up of special tooling, may be economical only if made in large quantities. Expanded polyethylene mouldings may be used on machined fittings.

17.4 Blocking and Bracing

Blocking and bracing is used to secure heavy or large items or where load spreading techniques are unsuitable because only a limited surface area can be used for support purposes. It consists of positioning fitments, made of timber, plywood, oriented strand board (OSB) or medium density fibreboard (MDF), between the strongest areas of the item and the container (see Process [D6] and figures 17(a-m) inclusive).

Note 1: None of the blocking and bracing materials should be allowed to come into contact with any metallic or painted item.

Note 2: The vapours given off by timber products and the bonding agents used in plywood, OSB or MDF may cause corrosion of the materiel (see BS 7195).

Note 3: Timber is dimensionally unstable when stored under different climatic conditions (drying out etc.). The maximum effect is across the width (i.e. at right angles to the grain). Therefore a timber member should be used with the grain in the length direction. When a large assembly of softwood is used, the addition of a plywood, OSB, or MDF facing should improve the structural stability and strength of the assembly.

Note 4: A facing material may be used to prevent contact between timber fitments and the item (thus reducing the risk of abrasion). The thickness should be sufficient to accommodate the slight variations in the fit of the item and normally a 5 mm synthetic felt or expanded polyethylene sheet is often adequate. This may be secured with an adhesive supplemented with wire staples or tacks positioned so they cannot contact the item (see **ANNEX C**). Hygroscopic facing materials may be covered with a waterproof material.

Note 5: The padding of sharp edges, corners and projections of an item with mouldable waxed wrap or strips of cellulose wadding (secured by self-adhesive tape - see **ANNEX C**) may be necessary to prevent abrasion or puncture of the primary wrapping or barrier material (see Process [C49]).

Note 6: The fitments used within the barrier of a Method II package shall be the minimum required (extra desiccant will be required with fitments inside the barrier). Plywood should be used in preference to softwood when practicable as it has lower equilibrium moisture content.

17.4.1 Metal fitments such as straps, brackets, and stays may be used as alternatives to timber for bracing where; they are required to be in shear or tension, or a higher degree of precision is required, or where space is limited, e.g. using tie-rods or J bolts (see Process [D6] figure 17(l)). Metal fitments are less liable to cause corrosion although care must be taken to avoid bimetallic contact. They should be suitably treated to resist corrosion and may be faced with an anti-abrasive material (see Def Stan 81-086).

17.4.2 It is advisable to use flexible attachments, e.g. rubber/ metal mountings, either; when a long or large item of low density is required to be secured to a framework at several points, or within a container when racking of the framework or container would cause unacceptable distortion of the item.

17.4.3 The indiscriminate use of attachment holes and brackets on an item for bracing purposes should be avoided since these are intended for static use and may not withstand dynamic loading. However when rigid fitments are bolted to an item using existing attachment holes a bush manufactured from a non-hygroscopic material such as high density polyethylene should be used for highly engineered items.

17.4.4 Where permissible, to minimise the package volume any heavy, unsupported or overhanging components should be removed where possible and secured to the base of the container and operating handles should be detached when possible. If removal is not permissible they should be braced to the base and/or other faces of the container as appropriate. The cross-sectional area of bracing members should be adequate to support possible dynamic loads. If timber members are half-jointed an allowance should be made for the consequent reduction in strength.

17.4.5 It is important that the method of locating and securing fitments does not include attachment to the lid of the container. This can be achieved as shown in Process [D6] Figures 17 (e), (f), (k), & (l). When items are secured as illustrated, the fasteners used to close the lid shall be clearly marked and opening instructions affixed to the exterior of the container together with a suitable warning. This is because the fasteners, securing the fitments adjacent to the lid, may be misidentified as lid fasteners when opening.

17.4.6 The method of blocking and bracing for large heavy items varies with the type of container e.g. it may bear upon the base for a skid base container or on all the surfaces for a sill base container (see Process [D6] figure 17(l)). In the case illustrated the transverse members on the top of the item may be utilised as compression bars when the container is being lifted by slings or grabs.

17.4.6.1 Bracing pieces should be attached to the container sides by cleats which may be reinforced by extra members to the corner frames of the container where necessary (see Process [D6] figures 17 (g), (h), & (j)).

17.4.7 All fitments may be assembled using nails, screws or bolts supplemented by gluing where appropriate (see **ANNEX C**). Nails should be clinched but where this is not possible they should be arranged so that direct pull is avoided. Nailing or screwing into end grain should be avoided.

17.4.8 When blocking and bracing an item protected by a WVP barrier to a base, any stress points on the barrier may be reduced with plywood strip load spreaders. In this case the item and the barrier shall be protected from the load-spreader using a water-resistant material and an anti-abrasive material respectively. Where attachment bolts pass through the barrier an effective seal shall be made (see Process [D6] figure 17(m)). A suitable method using gaskets in conjunction with a sealing compound is detailed in Process [C48].

17.4.9 When a sub-assembly is attached to an item by means of anti-vibration mountings it is recommended that a temporary rigid attachment be used (blocking) so that the mountings are packaged in an unstressed condition. Heavy sub-assemblies with mountings that are susceptible to shock loading should be supported by chocking where possible. The fragility index of the item will be considerably increased in this way. Advice should be sought from the equipment manufacturer.

18 Cushioning

This is the use of materials or devices to dissipate the energy of a shock. They are classified as elastic (resilient) or non-elastic. It is important that the physical characteristics of the cushioning material do not change when subjected to repeated impacts (elastic) and does not deteriorate whilst being stored. Therefore non-elastic or degradable materials are unsuitable as cushioning.

Note: It is necessary to regularise the shape of the item by locating it in a container or attaching it to a framework. The assembly so formed is termed the sprung mass (see DR4).

Cushions include the following:

a) Bulk materials - non-metallic pads, sheets and mouldings (see Process [D7])

b) Spring devices - extension and compression springs, rubber resilient mounts (see Process [D8]).

18.1 Bulk materials

18.1.1 The sprung mass is located centrally in an outer container by one of the following methods:

a) The space is filled completely with the cushioning material (see Process [D7] figures 18(e) & (f)).

b) Strips, pads or other forms of the cushioning material are secured at precise positions on each inner face of the outer container, except the lid (see Process [D7] figures 18(a), (b) & (g)) where a load-spreading batten is necessary (see Process [D7] figure 18(c)).

18.1.2 When exceptionally thick cushions of small contact area are required their stability may be improved using stabilising plates (see Process [D7] figure 18(d)). The plates should be secured to the cushions with a rubber/resin adhesive or double-sided tape (see **ANNEX C**).

18.1.3 In order to ensure that the bulk cushioning material will compress without bending or buckling the width of the cushion should be at least 33 % more than the thickness (height) of the pad.

18.1.4 The performance data of different cushioning materials is shown in **Table 13.** In order to provide the required protection with the minimum thickness of material the optimum loading conditions must be obtained.

Note 1: The dynamic performance of bulk cushioning materials may be affected by temperature but generally are suitable for use between – 13 °C and + 55 °C.

Note 2: Long term storage under static loads may cause creep leading to reduced cushioning properties.

Note 3: Certain physical, environmental, or biological properties which may affect bulk cushioning may have to be taken into account (see **Table 14**).

18.2 Spring Devices

In the simplest form either; metallic helical springs, rubber cords, straps are attached to the sprung mass and to the outer container (see Process [D8] Figure 19). Alternatively the support may be provided by resilient rubber mounts held in compression or shear (see Process [D8] Figures 20 & 21 or by torsion bars.

Note 1: Adequate provision for the damping of spring systems must be made where this property is not inherent in the mountings.

Note 2: Reference should be made to BS 1726 for the design or selection of helical springs.

18.2.1 A spring is a device, which can undergo considerable changes in form without losing elasticity or being permanently distorted. Unlike bulk cushioning materials, which are normally designed for use in compression, spring device designs may be designed to absorb energy when loaded in; tension, compression, or shear (e.g. metal bonded rubber, elastomeric mounts or spring wire mounts. Therefore an item may use the spring device only in one plane thus reducing the number of mounts required. As with bulk cushioning materials there will be an optimum loading condition for each device which will give the lowest peak deceleration obtainable for the given impact conditions.

18.2.2 Helical springs, used in compression or tension, exhibit a largely linear load-deflection characteristic and their energy absorption is dependent upon the material and dimensions of the spring. They are noted for their accuracy of rate and their wide range of deflection. These properties enhance their application over many other forms of spring, but for cushioning applications some damping is required. When helical springs are used in torsion about their longitudinal axis the material is in tension, and it is possible to work at a higher safe stress.

Note 1: The performance of metallic spring devices is relatively unaffected over the normal temperature range associated with packaging requirements. If required a suitable finish treatment should be used to prevent corrosion.

Note 2: At low loads helical springs can be strongly non-linear, a property which can be used to advantage in protecting against both shock and vibration inputs

18.3 The Design of Spring Devices

Many spring systems have complex characteristics and a complete guide to their design or selection is beyond the scope of this section however the following formulae are given as an aid to selection. The formulae provide a preliminary estimate of the deflection and spring rate required for a particular application and thus give an indication as to the most suitable type of device. The deflection required will provide an indication of the spatial requirements in the container. An allowance for dead space must be made.

18.3.1 The deflection required for a spring or system with linear load/deflection characteristics for a given height of drop and maximum deceleration is given by:

$$d = \frac{2h}{G}$$

Where; d = deflection (mm), h = height of drop (mm), G = G Factor (g_n)

18.3.2 The total stiffness required is given by:

$$S = 9.81\ m_S\ G^2 / 2h$$

Where S = stiffness (N/mm) and m_S = Sprung mass (kg)

18.3.3 The cost of cushioning an item is an important consideration when designing a package and a cost comparison of the requirement using different materials and devices should be made before choosing.

Note: The above calculation is useful but simplified and may lead to incorrect scoping of mount size and requirements.

18.4 Choice of cushioning system

This should be made against a requirement for packages to be of minimum size, mass and cost. The first choice is between the use of bulk materials or spring devices. As a general rule the choice will be for bulk materials whenever possible as they can be cut easily to exact sizes. However spring devices should be used for large or heavy items and for specialised applications (e.g. reusable packages).

18.4.1 The item must be squared up and the bulk material used in pad or strip form, but for simple shapes it may be advantageous to use mouldings. The use of corner block or bulk materials for light, very fragile items is limited, as the large deflections required would tend to create unstable cushions. In these circumstances the use of a suspension system may be an advantage.

18.4.2 When an item can be squared up it is possible to use spring devices placed at specific locations between the inner (sprung mass) and outer container. The main advantages of metallic wire spring devices used in this manner are the consistency of operation and stability under extremes of temperature and humidity.

18.4.3 Where it is not practicable to square up or where shock protection may be required only in two axis, e.g. for large heavy items, metal bonded elastomeric mountings or spring wire mounts may be suitable, thus reducing the number of mountings required and avoiding the need for additional supporting structures or frameworks. The compactness and versatility of metal bonded rubber shear mounts make them suitable for a variety of such applications through the multi-directional protection that they can provide either as single units or when mounted in combination.

Table 12 – Location and Cushioning Materials

Material	Specification Number	Process	Brief Description And Remarks	RECOMMENDED USE
Fibreboard, solid, Kraft-lined chipboard	Def Stan 81-001	D5	Consists of chipboard with a pure Kraft lining on one face. Possesses good scoring and bending properties.	As a load spreading or blocking material in the form of partitions, cells, pads or die-cut fitments.
Board, corrugated, Double-faced, Types A, B and C	Def Stan 81-046	D5	Consists of a corrugated fluting and a facing of Kraft on each side. The number of corrugations is Type A - 105-129 flutes per metre Type B - 150-185 flutes per metre Type C - 120-145 flutes per metre Produced in seven substances.	As a load spreading or blocking material in the form of pads cells, blocks or die-cut fitments.
Paper, corrugated, Single-faced, Coarse flute	Def Stan 81-099 Type 1	D3 D5	Consists of a paper fluting and facing with 105-125 flutes per metre (32-38 flutes per foot).	As a wrapping or blocking material in the form of rolls, tubes or pads.
Board, corrugated, (two flute, three liner)	Def Stan 81-106	D5	Consists of two sheets of corrugated fluting and three sheets of Kraft liner arranged alternately. The flutings of Type 1 shall be: outer fluting, either 120-145 flutes per metre or, 150-185 flutes per metre and inner fluting, either 105-125 flutes per metre or 120-145 flutes per metre. Both flutings of Types 2 shall be 105-125 flutes per metre.	As a load spreading or blocking material in the form of pads cells, blocks or die-cut fitments.
Board, corrugated, (three flute, four liner)	Def Stan 81-107	D5	Consists of three sheets of corrugated fluting and four sheets of Kraft liner arranged alternately. The number of corrugations of the outer fluting shall be either 120-145 or 150-185 flutes per metre and the other two flutings shall be 105-125 flutes per metre.	As a load spreading or blocking material in the form of pads cells, blocks or die-cut fitments.
Fibreboard, corrugated, Double-faced, 'E' flute	Def Stan 81-108	D5	Consists of a corrugated fluting and a facing of Kraft or jute on each side. The number of corrugations is 290-320 flutes per metre (84-96 flutes per foot).	As a load spreading or blocking material in the form of pads cells, blocks or die-cut fitments

Table 12 – Location and Cushioning Materials (Continued)

Material	Specification Number	Process	Brief Description And Remarks	RECOMMENDED USE
Board, corrugated, (three flute, four liner) Medium grade	Def Stan 81-115	D5	Consists of three sheets of fluted semi-chemical or Kraft fluting with four sheets of Kraft liner arranged alternately. The fluting shall be AAA, ACC, BAA, BCC, CAA, and CCC.	As a load spreading or blocking material in the form of pads cells, blocks or die-cut fitments
Paper Kraft, embossed, Four ply (for cushioning)	Def Stan 81-099 Type 2	D3	Consists of four plies embossed Kraft paper in the form of rolls or sheets perforated so as to be torn easily into pads.	As a resilient non-abrasive wrapping material
Synthetic-fibre Needlefelts	BS 7200	D6	Consists of two felts (soft or hard) each of 5 and 10 mm thickness made from specified synthetic fibres. It should be noted that these felts are temperature dependent.	As a non-abrasive or, in with metal or timber supports, a facing material.
Electrostatic conductive foam sheet	Def Stan 81-125	D7 Note 1	The material consists of carbon black filled or impregnated polyether urethane foam of inter-communicating cellular structure.	As a conductive material for protection against static electricity in accordance with BS EN 61340-5-1
Polyethylene, bubble film, for packaging	Def Stan 81-122	D3	The material consists of two layers of polyethylene of different thicknesses; each layer may be coated on one side with a non-PVC coating. The thicker film layer is embossed with the cylindrical cell shape (Type A or Type B). The two layers of material are sealed to entrap air within the embossed areas and produce a uniformly distributed closed cell structure.	As a resilient space-filling material.
Cross-linked expanded ethylene-vinyl acetate sheets and mouldings	Def Stan 81-119	D7	Consists essentially of ethylene-vinyl copolymer free from diluents and fillers. Supplied in the form of substantially non-intercommunicating thin walled cells filled with air or an incombustible gas. Available in sheets, cut parts, or mouldings. The standard colours are white and grey. It is non-silver staining.	As a resilient cushioning material in the form of sheets, cut parts or mouldings. Thicknesses over 30 mm may be prepared by laminating thinner sheets by heat welding or by means of a suitable adhesive.
Expanded polystyrene	BS 3837	D4	The material consists of polystyrene derived mainly from styrene monomer expanded to form a cellular structure consisting substantially of closed cells. Expanded polystyrene to BS 3837 is designated by specifying the appropriate grade, type, and structure. It is produced in several grades, two types, and various structures. SD (standard duty) and HD (high duty) grades of type N (normal) material and cut board structure are recommended for use in Services packaging. NOTE: The relative nominal apparent density of grade SD is 16 kg/m^3 and grade HD is 24 kg/m^3	As a load-spreading or blocking material in the form of fitments. **(See Notes 1 and 2)**

Note 1: In meeting its environmental responsibilities, the MOD in general discourages the use of polystyrene products in favour of other Eco friendly materials.

Note 2: Expanded polystyrene is not acceptable in Military Level Packages designed for the Navy Dept.

Table 12 – Location and Cushioning Materials (Continued)

Material	Specification Number	Process	Brief Description And Remarks	RECOMMENDED USE
Expanded polystyrene mouldings types GP and QX	Def Stan 93-035	D4	Mouldings manufactured from expanded polystyrene granules. Available in five grades having nominal densities of 16, 24, 32, 64 and 80 kg/m^3 and two types: type GP for general purpose packaging and type QX where a high degree of compatibility with explosives is required.	As a load-spreading or blocking material in the form of fitments. **(See Notes 1 and 2)**
Expanded polystyrene sheet and blocks, reconstituted	Commercial	D4	Contains a proportion of reconstituted expanded polystyrene from off cuts of virgin material. Available in block and sheet form of density up to approximately 24 kg/m^3.	As a load-spreading or blocking material in the form of fitments **(See Notes 1 and 2)**
Plywood for Military Packaging Applications	Def Stan 81-027	D6	Plywood boards manufactured from veneers of temperate hardwood or softwood. The plywood shall conform to the requirements of BS EN 636 depending on the severity of the Military Packaging Level required. (See Def Stan 81-27).	As a load-spreading or blocking material in the form of strips or sheets.
Medium Density Fibreboard for Packaging Applications	Def Stan 81-120	D6	A wood based sheet material manufactured from wood fibres bonded together with a synthetic resin adhesive.	As a load spreading or blocking material in the form of strips or blocks.
Oriented Strand Board (OSB)	BS EN 300	D6	A wood based sheet material manufactured from softwood flakes bonded together with a moisture resistant adhesive.	A load spreading material in the form of strips or blocks.
Rubber sheet, Cellular, Closed Cell, Non-Oil Resistant	Commercial	D7	Consists of a vulcanized natural rubber compound in the form of closed thin wall cells filled with air and/or nitrogen. Of 350 kg/m^3 maximum density (normally 176 and 288 kg/m^3) has low water absorption, but is not resistant to mineral oils, etc. It is not non silver-staining	As a resilient cushioning material in the form of pads.
Expanded polyethylene Sheet Types GP, QX and Grades A, B, C and D	Def Stan 81-116	D7	Consists of expanded low-density polyethylene in the form of substantially non-intercommunicating thin walled cells filled with air or an incombustible gas. Available in sheets and cut parts. The standard colours are white, black, and olive drab.	As a resilient cushioning material in the form of pads and cut parts. Thicknesses over 25 mm may be prepared by laminating thinner sheets by heat welding or by means of a suitable adhesive.

Note 1: In meeting its environmental responsibilities, the MOD in general discourages the use of polystyrene products in favour of other Eco friendly materials.

Note 2: Expanded polystyrene (EPS) is not acceptable in Military Level Packages designed for the Navy Dept.

Table 12 – Location and Cushioning Materials (Concluded)

Material	Specification Number	Process	Brief Description And Remarks	Recommended Use
Bonded polyurethane Chipfoam	Def Stan 81-083	D7	Consists of polyurethane foam of the polyether type, ground into flakes bonded with a coloured binder and cured. Available in the form of blocks, sheets, and mouldings in four densities, coded by colour. The densities are 65, 100, 150, and 200 kg/m^3 and colour coded; green, orange, red, and blue respectively.	As a resilient cushioning material in the form of pads and mouldings.
Sawdust	Commercial	D1	Usually a by-product of timber processing, small flakes and particles	As a lightweight, liquid absorbent, space-filling material.
Timber	Commercial	D6	Mostly Softwood	As a load-spreading or blocking material in the form of strips or blocks.
Vermiculite	Commercial	D1	Exfoliated mica.	As a lightweight, resilient, absorbent space-filling material.
Wadding, cellulose	Def Stan 81-128	D3	Consists of plies of creped paper. Is prone to linting.	As a resilient, non-abrasive wrapping material. If used with material subject to damage from linting, a suitable primary wrap should be applied
Wood wool	BS 2548	D1	A mass of tangled strands of well-seasoned, low resin content, softwood.	As a resilient, space-filling material.
Loose-fill expanded polystyrene	Commercial	D1	A loose-fill, free flowing material suitable for use with overhead hopper dispensing systems.	As a resilient space-filling material. **(See Notes 1 and 2).**

Note 1: In meeting its environmental responsibilities, the MOD in general discourages the use of polystyrene products in favour of other Eco friendly materials.

Note 2: Expanded Polystyrene (EPS) is not acceptable in Military Level Packages designed for the Navy Dept.

Table 8 - Typical Performance Data for Cushioning Materials

Material	Density (kg/m^3)	Optimum Cushion Factor C	Optimum Dynamic Stress		Dynamic Stress Range				CUSHION FACTOR C max	Maximum Static Stress	
			(kgf/cm^2)	(kPa)	(kgf/cm^2)		(kPa)			(kgf/cm^2)	(kPa)
					max	min	max	min			
Polyurethane foam Type B, Class S, Grade 170, BS 3379	32	2.2	0.117	11.47	0.178	0.086	17.45	8.43	2.5	0.015	1.47
Bonded polyurethane Chipfoam Def Stan 81-083	64	3.0	0.184	18.08	0.328	0.106	32.16	10.40	3.3	0.018	1.76
	96	3.0	0.349	34.23	0.571	0.222	55.99	21.77	3.4	0.025	2.45
	144	3.7	0.855	83.85	1.530	0.510	150.00	50.00	4.2	0.060	5.88
	192	4.0	1.740	170.64	3.200	0.998	313.81	97.87	4.4	0.100	9.80
Expanded polyethylene											
Def Stan 81-116 Grade A	28	2.8	1.960	193.00	3.840	1.500	376.00	147.00	3.3	0.071	7.00
Grade B	40	2.8	1.940	190.00	3.630	1.540	357.00	151.00	3.5	0.092	9.00
Grade C	50	2.6	2.350	231.00	4.150	1.640	408.00	161.00	2.7	0.124	12.10
Grade D	68	2.6	2.860	281.00	3.970	1.590	389.00	156.00	2.8	0.138	13.60
Expanded ethylene-vinyl acetate Def Stan 81-119	50	3.5	1.824	178.87	2.990	1.168	293.22	114.54	3.7	0.040	3.92
Rubber sheet, Cellular, Closed Cell Non-Oil Resistant – Commercial; (Note: was Def Stan 93-057)	176	4.1	1.230	120.62	2.070	0.800	202.99	78.45	4.5	0.050	4.90

Table 9 - The Relative Properties of Space Fillers, Cushioning Materials and Devices

Material Or Device	Specification	Water Retention	Corrosive Effect	Mould Growth Support	Dusting
Wood wool	BS 2548	High	High	High	High
Polyurethane foam (Type B, Class S, Grade 170)	BS 3379	High	Moderate	Moderate	Low
Expanded polystyrene boards. **(See Notes 1 and 2)**	BS 3837	Low	Low	Low	Moderate
Synthetic-fibre Needlefelts	BS 7200	Moderate	Nil	Nil	Moderate
Bonded polyurethane Chipfoam	Def Stan 81-083	High	Low	Moderate	Low
Paper, Wrapping, Location	Def Stan 81-099 Type 1	High	Low	High	Low
Paper, Wrapping, Location	Def Stan 81-099 Type 2	Moderate	Low	High	Moderate
Expanded polyethylene sheet, Types GP and QX and Grades A, B, C and D	Def Stan 81-116	Low	Nil	Low	Nil
Cross-linked expanded ethylene-vinyl acetate sheets and mouldings	Def Stan 81-119	Low	Nil	Low	Nil
Rubber sheet, Cellular, Closed Cell	Commercial	Low	Low	Moderate	Nil
Metallic springs		Nil	Nil	Nil	Nil*
Rubber springs		Low	Nil	Possible	Nil*

Note 1: In meeting its environmental responsibilities, the MOD in general discourages the use of polystyrene products in favour of other Eco friendly materials.

Note 2: Expanded polystyrene is not acceptable in Military Level Packages designed for the Navy Dept.

Note 3: Metallic & Rubber springs may be subject to dusting under severe vibration conditions

19 Choice of Container

19.1 Introduction

The following information is provided as a series of guidelines. The final criterion affecting choice is the ability of the package to provide the required level of protection for the appropriate time.

19.1.1 The choice of container may be made by considering; the military packaging level required the mass of the item, whether the load is classified as easy or difficult, if the container is required to be reusable, and if the item is classified as dangerous goods.

19.1.2 The container selected should be the minimum size and mass for the application.

19.1.3 The suppliers of a container that differs in construction (including materials, fasteners, lifting aids etc.) from the specification described in any of the container Defence Standards shall ensure that the container has been tested as fit for the purpose intended.

19.2 Military Packaging Level

19.2.1 Level P packages require little provision for physical protection other than to ensure they will withstand normal handling during storage.

19.2.2 Level N packages require (a) rigidity (high static forces involved in meeting the stacking requirement) and (b) robustness (dynamic forces of a high order may occur). Fibreboard containers should be adequate for all but heavy or difficult loads. The packaging is required to withstand climatic exposure, including rain, for approximately five minutes.

19.2.3 Level J packages make heavy demands on the container which have to be rigid, robust and constructed of more durable materials. In addition to a stacking requirement 'high side wall' crush strength is required. The container shall have adequate resistance to water and abrasion.

19.3 Mass of the Item

The shape of the item will often determine the shape of container. Rectangular packages are preferred for their convenience when handling, storing, and transporting. The closer the shape is to a cube the greater the overall strength of the container.

19.4 Easy and Difficult Loads

19.4.1 Since easy loads support the sides of the container the use of thin wall constructions may be adequate. When a heavy or large item is packaged, a strong frame may be required to give the necessary rigidity and stability.

19.4.2 Difficult loads may require containers of much greater wall strength and more rigid materials should be used in their construction e.g. timber, metal, reinforced plastics and heavy duty corrugated fibreboard, (e.g., triple wall fibreboard).

20 Container Preference

In order to select the most appropriate container suitable for the item being packaged the following list gives a recommended order of preference:

Paper or plastics bags and envelopes	Various
Containers, fibreboard	Def Stan 81-015
Composite fibreboard and wood cases	Def Stan 81-021
Cases, board, collapsible	Def Stan 81-023
Cases, wood (plywood, metal-edged construction)	Def Stan 81-008
Case, wood, collapsible, reusable	Def Stan 81-113
Cases, wood (panel and batten construction)	Def Stan 81-012
Crates, wood	Def Stan 81-005
Cases, wood (batten and board construction)	Def Stan 81-014
Cases, wood, packing, reusable	Def Stan 81-071
Cases, Wood, Packing (Board or Panel and Batten Construction)	Def Stan 81-135

21 Special to Contents (STC) Containers (STCC)

21.1 A special to contents container is a uniquely configured container designed for multiple journeys whilst supporting and protecting its prescribed contents during handling, storage, and transportation throughout the Supply Chain. The container shall protect personnel and equipment from any hazardous contents.

21.1.1 It is a requirement that STCC are codified by allocation of a NATO Stock Number (NSN) for accountability and identification purposes.

21.1.2 A full set of working drawings are required, prepared in accordance with BS 8888 together with a Services Packaging Instruction Sheet (SPIS) or Special Packaging Instructions (SPI).

21.1.3 Before manufacturing a STCC, designers must where appropriate, consider the following requirements, which list is not exhaustive:

Rubberised item use by date	Desiccant receptacle	Slinging and lifting facilities
Dissimilar materials reaction	Barrier requirements	Stacking location points
Standard use of parts	Desiccant	Handling wearing NBC clothing
Material stability	Humidity/Desiccant indicator	Breathing device (valve)
Shock absorption	ESDS compatible	Tie down point(s)
Fragility requirements	Magnetic shielding	No specialist removal / refit devices for openings
Fire resistance	Non-magnetic	Air handling
Reusable fasteners	UV shielding	Shipboard handling
Drainage	Skids	Internally material sealed e.g. varnish
Ventilation	Document holder	All round accessibility
Closure	Re-sealable opening	Observation window
Preservation requirement	Packaging instruction sheet	Orientation indicator

Note 1: Guidance on general requirements can be obtained from STANAG 4398 (AEPP-1)

22 Reusable Containers

Reusable Containers should be durable which may necessitate the use of stronger materials and a preservation treatment in their construction (see **Table 15** and Process [D31]). Any closure (and closure reinforcement) should be such that the container can be opened and re-closed without damage

23 Fibreboard Containers

Fibreboard containers include cartons, fixed joint and collapsible, and boxes, rigid and collapsible, which may be manufactured from solid or corrugated fibreboard; and cylindrical tubes. Also included are fibreboard containers with wooden ends.

23.1 In general terms a fibreboard container may be defined as follows:

a) **Fibreboard Carton**; a container which is delivered by the manufacturer to the user in a flat collapsed form, aka a 'Blank', for further setting up at the packaging point (stitching, gluing etc.)

b) **Fibreboard Box, Rigid;** a container set up ready for use without further fixing when received from the manufacturer. It may be creased to permit the container to be folded into a flat form for ease of storage.

c) **Fibreboard Case** is a container with a wooden end. The sides, bottom and top of the case are constructed from fibreboard (solid or corrugated); which may have a single top flap, or overlapping flaps, or may have a horizontal batten in one side on which the two ends of the fibreboard will butt. The ends of the case may be solid or may consist of framed fibreboard or plywood panels or softwood boards, either completely framed or with vertical battens only.

23.2 Fibreboard containers are light in relation to their capacity and load carrying ability. Low calibre solid fibreboard containers are suitable for use in the light to medium mass/capacity range in applications which do not involve exposure to rain although grades are available which give good weathering performance. They are relatively cheap even in small quantities.

23.3 Light duty cartons and boxes are suitable for small volume and/or mass loads and are used mainly for easy loads (see **Tables 16, 17 & 18**).

23.4 Fixed joint cartons of corrugated or solid fibreboard are used for medium loads. They are suitable as bulk containers for aggregation purposes. The corrugated board cartons provide some degree of shock absorption (flute material is the best). Solid board cartons show a small saving in volume and have rather better puncture and abrasion resistance

23.5 A fibreboard case with wooden ends may be preferred; when the cross-sectional area is small in relation to length, or when the ends are to be heavily loaded, or when increased stacking strength is required.

23.6 Double and triple wall corrugated boards have greatest strength, rigidity and durability and may be acceptable alternatives to wooden containers for Level J packages particularly for aggregation purposes or easy loads.

24 Wooden Containers

24.1 Wooden containers are the strongest of the general purpose containers and afford greatest protection against rough handling. They are; suitable for packaging of heavy or difficult loads, are relatively economical (even in small quantities), and interior furniture is usually easy to locate. Perhaps more than any other type of container they are repairable "in the field".

Note: That, **17.4 Note 3** also applies, and reference to BS EN 336 "Structural timber - Sizes, permitted deviations" may be necessary.

24.2 There is little to choose in strength between the main types of large wooden container with either a sill or skid base although the latter is simpler in construction and preferred. Choice will depend upon the physical characteristics of the item. The sill base is suitable for items that can be supported above their lowest point as it will reduce the overall height of the container, e.g. engines and vehicle chassis.

The skid base is better for items that can be supported on their lowest part or for items that rest flat on their bases, e.g. horizontal lathes.

24.2.1 When a wooden container is of 'Top Hat' construction and the lid is deemed to be difficult to remove by two or more personnel, a method to aid the removal of the container lid should be considered, e.g., handles to Def Stan 81-029 or lifting straps to Def Stan 81-086. When a lifting aid is fitted specifically for Top Hat removal only, the container shall be stencilled adjacent to each lifting attachment, to indicate that the top hat itself only shall be lifted by this method, with the text:

"Lid Lift Only"

Note: Lifting a container by 'Top Hat' lid lifting straps can be hazardous as they may not have sufficient lifting capability (design or strength) to safely lift the whole container; they are not container lifting straps.

24.3 It is acceptable for oriented strand board (OSB), BS EN 300 or medium density fibreboard (MDF), Def Stan 81-120, to be used as an alternative to plywood, Def Stan 81-027, for the construction of certain wooden containers (see the relevant container standard). It is pointed out that OSB and MDF should not be used either; in the construction of Def Stan 81-003, Def Stan 81-071 or Def Stan 81-135 cases, or for any wooden container designed for contents with a maximum mass above 400 kg.

24.4 Wood based products can be subject to infestation or attack from biological organisms. Consequently embargoes, national or international are periodically implemented to prevent the spread of various organisms. It is therefore important to ensure material is marked and/or certified as acceptable, e.g. undergone an approved treatment to permit free use and shipment, otherwise delays may result.

24.4.1 All wood timber based packaging material shall conform to the International Standard for Phytosanitary Measures 15 (ISPM15), "Guidelines for Regulating Wood Packaging Material in International Trade". Wood packaging made wholly of processed wood-based products such as plywood, particle board, oriented strand board or veneer that have been created using glue, heat and pressure or a combination thereof should be considered sufficiently processed to have eliminated the risk associated with untreated raw wood.

Note: ISPM-15 may not be applied when the timber is never to leave the UK mainland.

24.5 Wood Fasteners and their use.

24.5.1 A variety of closures are available and the containers may be made reusable with minimal additional cost. The latter should be closed by one of the special fasteners described in Def Stan 81-073. General information about closures and the structural use of timber can be obtained from BS EN 1995-1-1.

24.5.2 The most commonly specified closures / fasteners in military packaging are Steel; Nails, Staples and Wood Screws, as listed in the normative references and the individual container standards. These are, with dowels, cylindrical fasteners for wood can be alternatively specified using BS EN 14592 where they shall be at least equivalent in performance.

24.5.3 A change in the type, use of fastener or the pattern of its application should involve comparative testing, (e.g., vertical/horizontal impact testing as per Def Stan 81-041 (Part 3)), to confirm performance equivalence.

25 Metal Containers

Metal containers are usually very strong and have an advantage over timber or fibreboard in that size dimensions can be held to measured tolerances. Typical applications are for liquids, semi-solids, and granular substances. Where enhanced container performance is needed for valuable, critical, or hazardous material may justify the cost.

26 Moulded Pulp Containers

Moulded pulp containers are economical when produced in large quantities. Some low density materials may possess good shock absorption properties but may not be durable, e.g. the egg box.

27 Plastics Containers

Plastics containers are; relatively light, have high strength to mass ratio, are generally waterproof and a few types may have good water-vapour resistance. The range of applications is similar to a metal container but the saving in mass is offset by lower overall strength and durability. Although most materials used for containers are resistant to a wide range of acids and alkalis they may be affected by solvents or oils. Vapours given off by some plastics materials may cause corrosion of materiel (see BS 7195).

28 Glass Containers

Glass containers are used for liquids and powders. They are useful for the storage of corrosive liquids, e.g. acids, although some form of outer container is usually required for added physical protection, (e.g., see dangerous goods packaging).

Table 10 - Wood Preservatives and Methods of Application

Preservative	Method Of Application In Order Of Effectiveness					Remarks
	Pressure Impregnation			Dipping / Immersion	Brushing / Spraying	
	Full Cell Vacuum	Empty Cell Pressure	Double Vacuum			
BS 4072 Copper / Chrome / Arsenic compositions	1	2	-	-	-	Not to be used in contact with rubber or light alloys. Treated timber may be stained, painted varnished or glued. Suitable for protection against insect infestation.
BS 5707 wood preservative in organic solvent	-	-	1	2	3	For general packaging purposes, fungicidal types F1, F4, F5, or F6 shall be used. For protection against termite attack insecticide type N2 should be specified see also Part 5, process D31

29 Container Types Used for Military Packaging

The main types of container used for military packaging are described below. Further information may be obtained in BS 1133 Sections 7, 8, & 10.

Note 1: It may be necessary to line a container with a waterproof barrier that may be a loose liner or fitted as an integral part of the container. Fitted waterproof linings should be used only for large containers and/or where the method of location employed would constitute a hazard for a loose liner (see Def Stan 81-041 (Part 5) process [C43]).

Note 2: Where there two or more Container Types that may be appropriate for a given mass of item to be packaged the smaller should be selected where this does not cause problems with closure etc.

A range of fibreboard containers and their normal maximum mass is shown in **Table 16**.

Table 11 - Guide to Maximum of Contents for Fibreboard Containers

Container	Maximum Mass (kg)
Def Stan 81-015 Range A	10
Def Stan 81-015 Range B, Type 1 - Class AC, AF & AM	40
Def Stan 81-015 Range B Type 2	55
Def Stan 81-015, Range C, Type A	200
Def Stan 81-015, Range C, Type B	400
Def Stan 81-021, Class A, C, D & E	55
Def Stan 81-021, Class F & H	90
Def Stan 81-021, Class G	150

29.1 Fibreboard based containers

Note; Defence standard 81-015 from Issue 7 has absorbed two other related standards, 81-015 Issue 6 became 81-015 Range A, 81-009 is now 81-015 Range B and 81-028 is 81-015 Range C.

29.1.1 Def Stan 81-015; Range A

29.1.1.1 This standard covers seven styles of container; three rigid and one collapsible box, one fixed joint and two collapsible cartons, see **Figs 1 To 7**, for material see Def Stan 81-015 and for dimensional limitations see **Tables 17 & 18**.

29.1.1.2 The maximum volume and mass of contents of these containers is limited to 36 dm^3 and 10 kg respectively.

29.1.1.3 Cartons formed from die-cut blanks by folding and tucking in flaps, are not as strong as the supplied boxes.

29.1.1.4 Style D and H boxes are the most rigid and have the highest sidewall strength but need more material to construct (are more costly) and should be used only when greater wall strength is required to cater for difficult loads.

29.1.1.5 The Style G box is not as strong as the stitched boxes but has smooth interior surfaces which make it particularly suitable for applications where a barrier is in contact with the inner surface of the box.

Table 12 - Def Stan 81-015, A; Dimensional Limitations for Boxes

Style	Capacity (dm^3)	Thickness of fibreboard (min) (mm)	Maximum Height Of Box (mm)
"C" rigid	up to 0.25	0.70	300
"D" rigid	over 0.25 up to 1	0.85	300
	over 1 up to 3	1.20	300
	over 3 up to 36	1.45	300
"H" collapsible	up to 0.25	0.70	Half the width
	over 0.25 up to 1	0.85	Half the width
	over 1 up to 3	1.20	Half the width
	over 3 up to 36	1.45	Half the width
"G" rigid	up to 0.25	0.70	150
	over 0.25 up to 1	0.85	150
	over 1 up to 20	1.20	150

Table 13 - Def Stan 81-015, A; Dimensional Limitations for Cartons

Style	Capacity (dm^3)	Length (mm)	Thickness of fibreboard (min) (mm)	Dimensional Limitations (L x W x H) (mm)
"E" collapsible	up to 1	-	0.70 (	40 x 40 x 25 min
	over 1	-	0.85 (	Height 300 max
"F" collapsible	up to 1	up to 300	0.85 (	Height 45 max
	up to 1	over 300 up to 500	1.20 (	
	over 1 up to 3	up to 500	1.20 (	
	over 3	any length	1.45 (	
"J" fixed joint	up to 0.25	-	0.70 (	100 x 100 x 300 max
	over 0.25 up to 1	-	0.85 (	
	over 1	-	1.20 (	

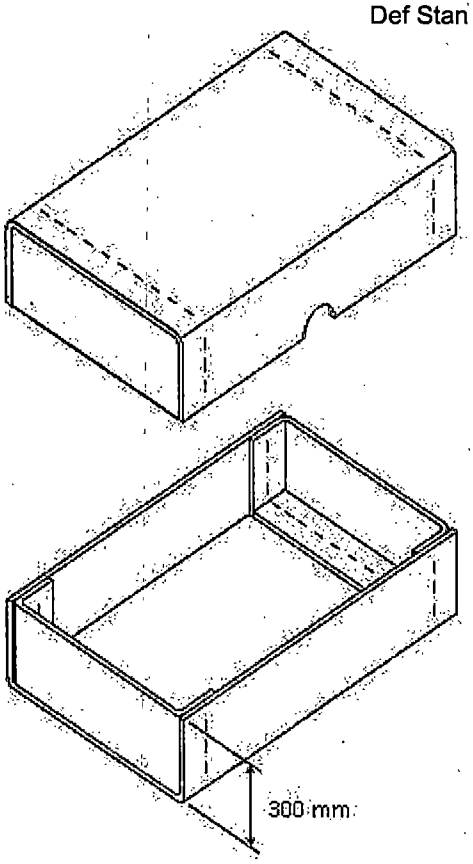


Figure 1 - Def Stan 81-015, A; Style "C" Box, Rigid

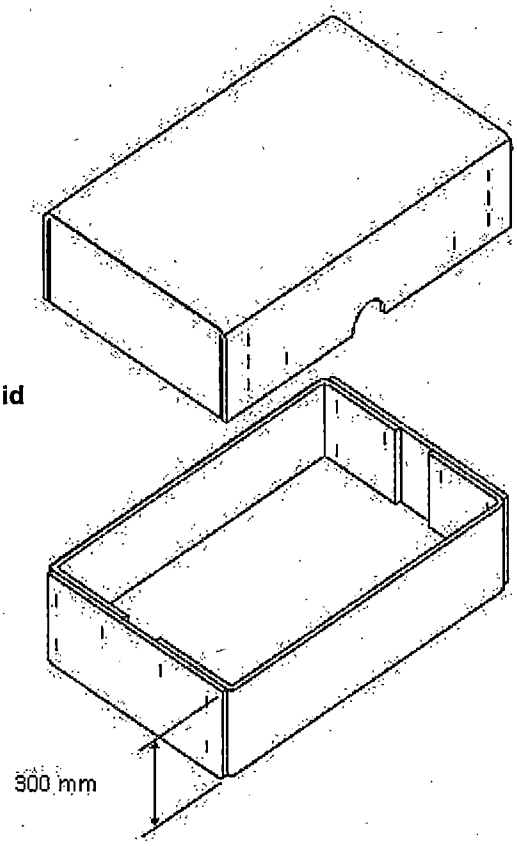


Figure 2 - Def Stan 81-015, A; Style "D" Box Rigid

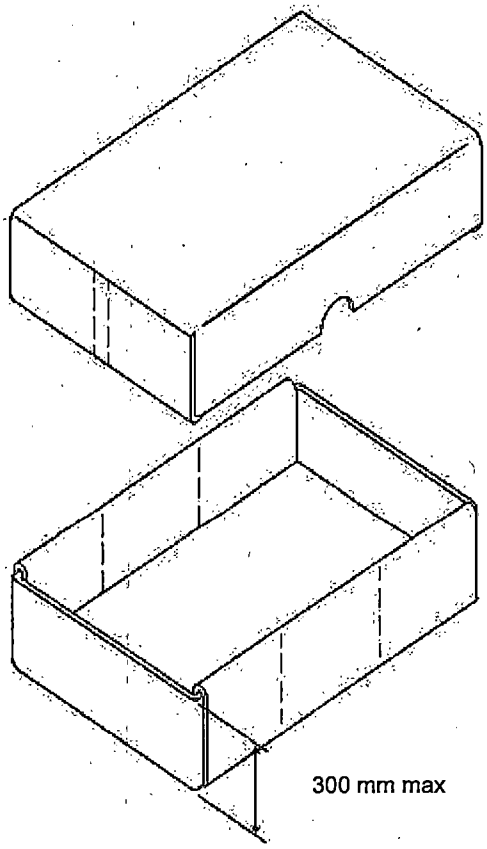


Figure 1 - Def Stan 81-015, A; Style "E" Carton, Collapsible

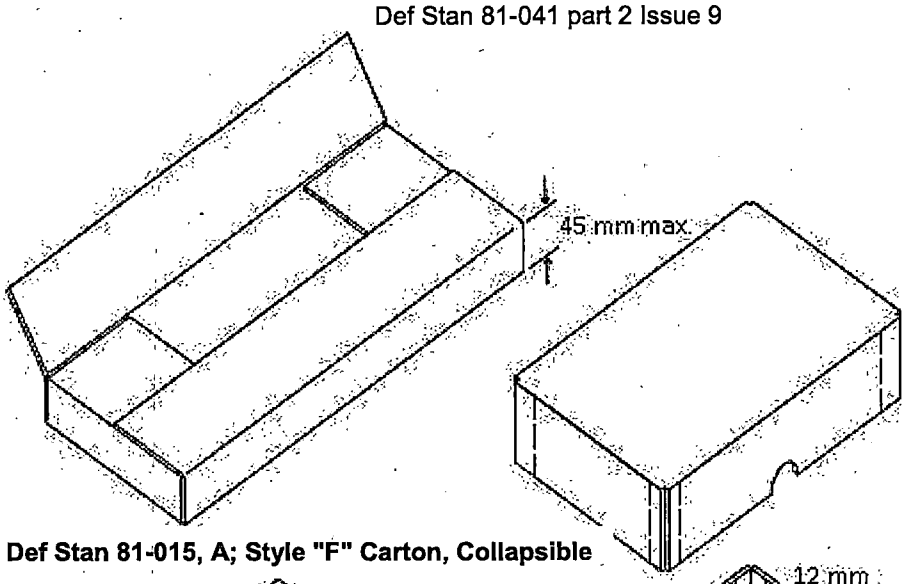


Figure 6 - Def Stan 81-015, A; Style "F" Carton, Collapsible

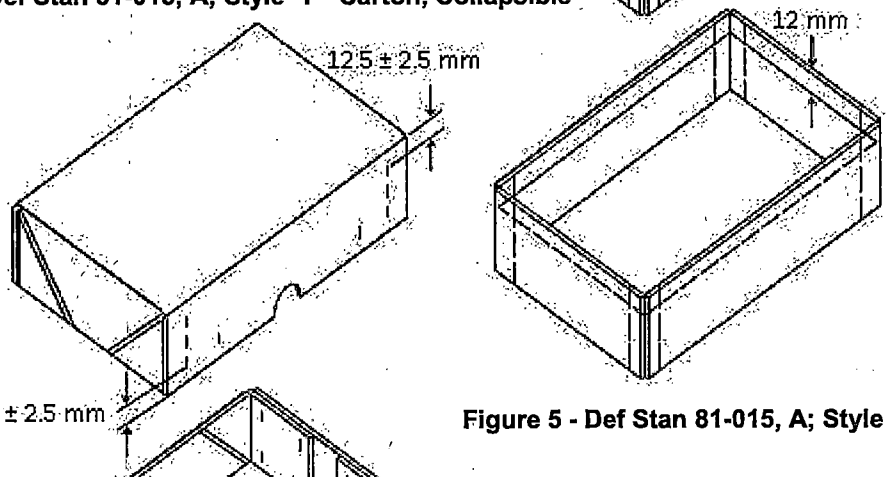


Figure 5 - Def Stan 81-015, A; Style "G" Box, Rigid

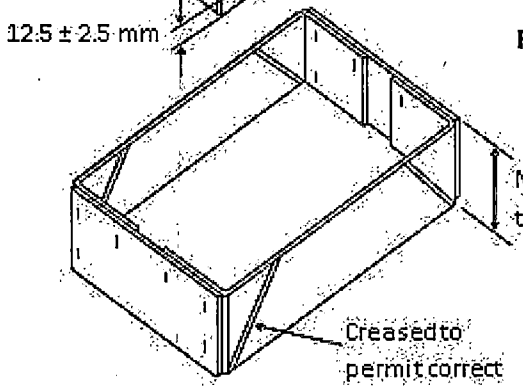


Figure 4 - Def Stan 81-015, A; Style "H" Box, Collapsible

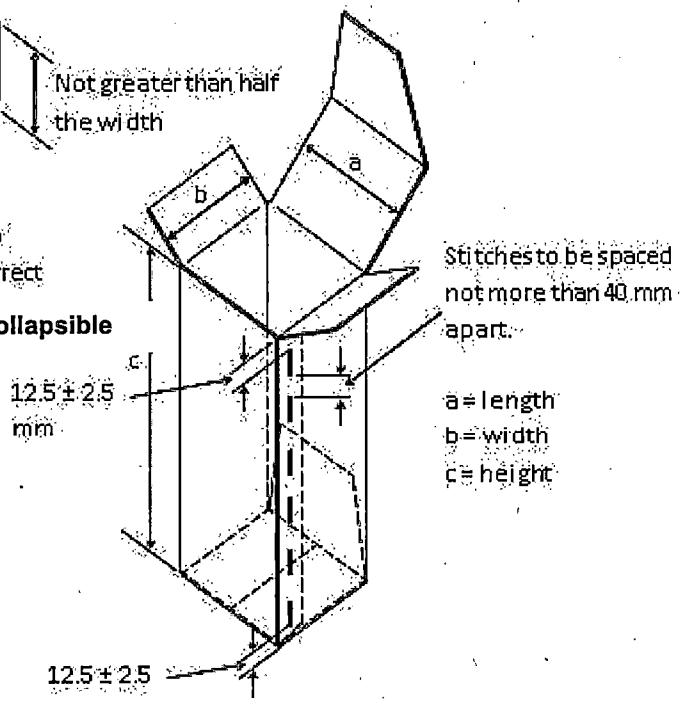


Figure 3 - Def Stan 81-015, A; Style "J" Carton, Fixed Joint

29.1.2 Def Stan 81-015 Range B; Type 1 - Cartons, Fibreboard, Fixed-Joint, Double-Faced, Corrugated

29.1.2.1 This Standard covers four Styles for contents up to 40 kg mass (see **Figs 8** to **10 & 12**). Each style may be produced in the three different classes (AC, AF and AM) of case made from Fibreboard, Def Stan 81-046 Types A, B and C respectively.

29.1.2.2 The size of the carton (length + width + height) is related to the maximum mass of contents packaged as shown in **Table 19**.

29.1.2.3 A guide to the choice of Class is shown in **Table 20** and a guide to the choice of style of carton is shown in **Table 21**.

Table 14 - Def Stan 81-015, B; Type 1: Dimensional Limitations

Mass of Contents (kg)	Dimensions Limit (L + W + H) (mm)
5	635
8	750
10	1025
15	1275
20	1525
30	1650
40	1775

Table 15 - Def Stan 81-015, B; Type 1: Choice of Class

Class	Use
AC	This board should be used where high top to bottom compressive strength is required. It preserves greater capacity to absorb shock due to wider spacing of the flutes.
AF	This board should be used when maximum crush resistance is required. It also has greater strength at the score line where metal items have a tendency to tear out.
AM	This board is a compromise between classes AC and AF. It has reasonably good stacking strength and a fair amount of stiffness and is suitable for easy loads.

Table 16 - Def Stan 81-015, B: Style Choice

Size of Item	Additional Requirements	Carton Style
Length approximately equal to width	-	1
Length much larger than width	-	2
Length much larger than width	extra strength	3
Length much larger than width	extra strength	3a
Length approximately equal to width	extra strength	4

Note 1: Style 3 container is stronger than a Style 3a.

Note 2: Style 3a cartons are available for Def Stan 81-015, B Type 2 containers only.

29.1.3 Def Stan 81-015, B; Type 2 - Cartons, Fibreboard, Fixed-Joint, Kraft Lined, Chipboard

29.1.3.1 This covers five Styles for contents up to 55 kg mass (see **Figs 8 to 12**), for material used see Def Stan 81-015.

29.1.3.2 The minimum thickness of the fibreboard used is related to either the maximum mass of packaged contents or the size of the carton (length + width + height). Whichever gives the greatest thickness shall be chosen using the information in **Table 22**.

29.1.3.3 A guide to the choice of style of carton is shown in **Table 21**.

Table 17 - Def Stan 81-015, B Type 2: Dimensional Limitations

Maximum Mass of Contents (kg)	Dimensions Limit (L + W + H) (mm)	Minimum Thickness of Fibreboard (mm)
8	750	0.85
10	1025	0.95
15	1275	1.20
20	1525	1.45
30	1650	1.75
40	1775	2.15
55	1900	2.50

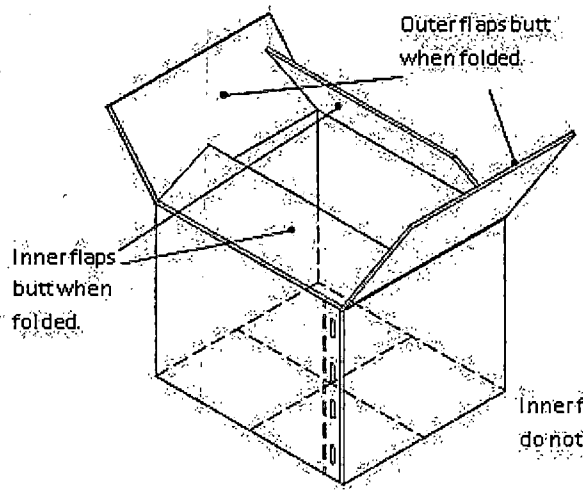


Figure 7 - Def Stan 81-015, B; Style 1

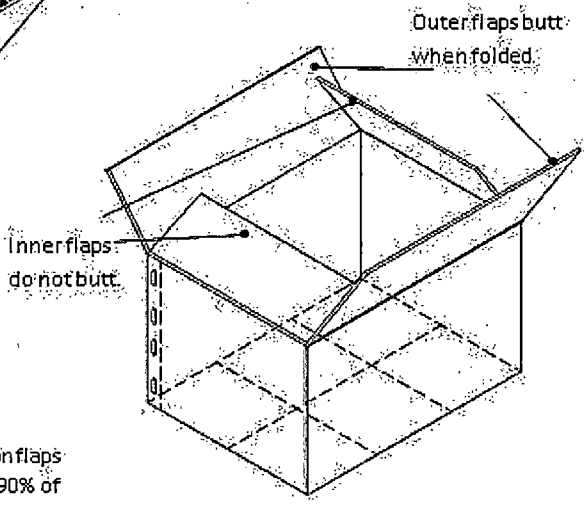


Figure 8 - Def Stan 81-015, B; Style 2

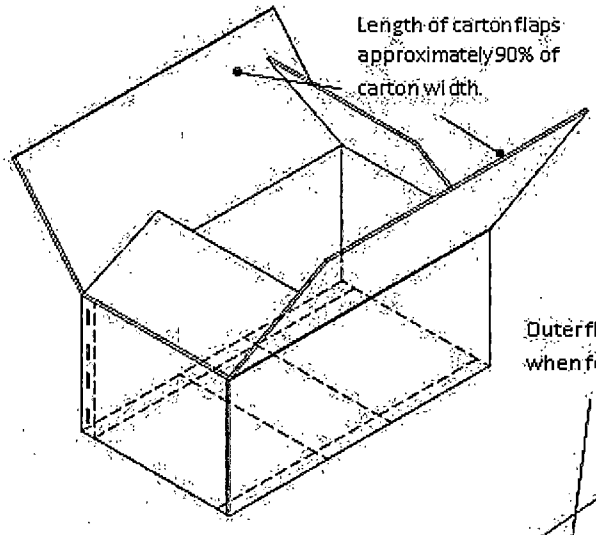


Figure 9 - Def Stan 81-015, B; Style 3

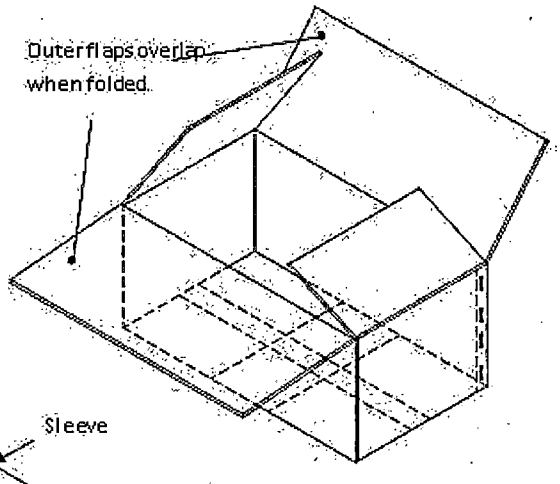


Figure 10 - Def Stan 81-015, B; Type 2 - Style 3a

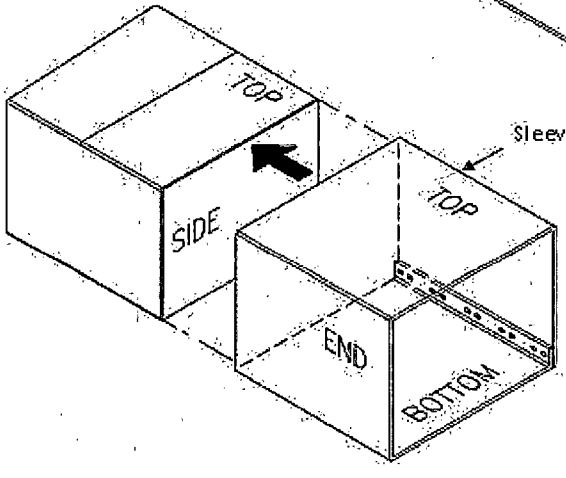


Figure 11 - Def Stan 81-015, B Style 4

Note: Bottom closure flaps shall be the same length as corresponding top closure flaps.

Note: Def Stan 81-015, B, has four similar styles in Type 1 and Type 2. Type 2 Style 3a is a fifth Type 2 Style, see Figure 11.

29.1.4 Def Stan 81-015, C; Cartons, Fibreboard, Fixed-Joint, Multi-Wall, Corrugated

a) This Standard covers a container (see **Fig 9**) available in two Types, A and B, for contents up to 200 and 400 kg mass respectively. Both grades are suitable for all levels of military packaging as defined in Def Stan 81-041 (Part 1).
b) Both grades can be made from either double or triple wall corrugated fibreboard capable of taking the load. However it is preferred that Type B is manufactured using triple wall corrugated fibreboard.
c) The size of the carton (length + width + height) is related to the maximum mass of contents and choice of grade of carton as shown in **Table 23**.

Table 18 - Def Stan 81-015, C: Choice of Type

Type	Fibreboard	Maximum Mass Of Contents (kg)	Maximum Dimensions (L + W + H) (mm)
A	Double or triple wall corrugated	200	3150
B	Triple wall corrugated	400	4000

29.1.5 Def Stan 81-021; Cases, Fibreboard and Wood

This Standard covers five styles of case for contents up to 150 kg mass (see **Figs 13** to **17**). The end panels on Styles 1, 4 and 5 are softwood, Style 2 is plywood, and Style 3 is fibreboard. The cases are available in eight classes that relate to the grade of fibreboard used.

Note: Styles 4 and 5 may be made reusable by fitting captive fasteners.

The size of case (length + width + height) is related to the maximum mass of contents and choice of class of case as shown in **Table 24**.

Table 19 - Def Stan 81-021: Choice of Class of Case

Class	Board Specification	Maximum Mass Of Contents (kg)	Maximum Dimensions (L + W + H) (mm)
A	Def Stan 81-001	20 30 40 55	1275 1525 1650 1775
C	Def Stan 81-046 Type B	as above	as above
D	Def Stan 81-046 Type A	as above	as above
E	Def Stan 81-046 Type C	as above	as above
F	Def Stan 81-106	90	2300
H	Def Stan 81-115	90	2300
G	Def Stan 81-107	150	2700

29.1.6 Tubes, Packaging, Open End

Also known as post tubes these are helically wound and lapped cylindrical tubes with open ends, made of unlined fibre/chipboard. They may have push in end-caps, usually plastic, if required. They are available commercially and are available codified in four inside diameters 25, 50, 75 and 100 mm, with a nominal length of 1500 mm. They are suitable for use both as containers for cylindrical items or documents, or as sleeves to protect delicate parts of other items.

29.2 The Closure and Reinforcement of Fibreboard Containers

29.2.1 Fibreboard containers are normally closed in accordance with Process [D16] using paper tape (gummed), waterproof film tape or water resistant fabric tape (Pressure sensitive adhesive) (see **ANNEX C**).

29.2.2 Def Stan 81-021 cases shall be closed in accordance with Process [D20] except those with horizontal battens on one side (reusable) which shall be closed using captive fasteners (see Def Stan 81-073).

29.2.3 Multi-wall corrugated fibreboard containers may be made reusable with captive fasteners (see Def Stan 81-073).

29.2.4 Certain styles of cartons may be strengthened by the application of an adhesive to the contact area of the covering flaps thereby stiffening the closed container (see Process [D32]).

29.2.5 The closure of fibreboard containers and cases may be reinforced by the application of non-metallic tensional strapping, BS EN 13394 (see Process [D19]).

29.2.6 Where containers are relatively small, if thicker multi-walled material is required due to the load mass it can become compressed on closing. This can have the effect of producing a 'spring-effect' with a tendency to open the container against the closure. The packaging may then be compromised and it could be a safety concern. This should be avoided by either using a slightly larger container or reinforcing as **29.2.5**.

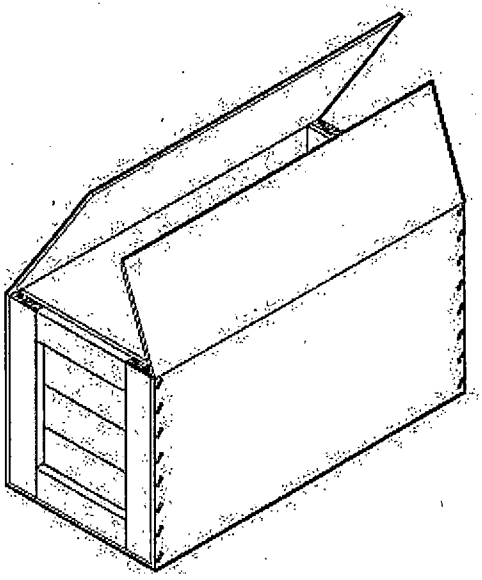


Figure 13 - Def Stan 81-021; Style 1

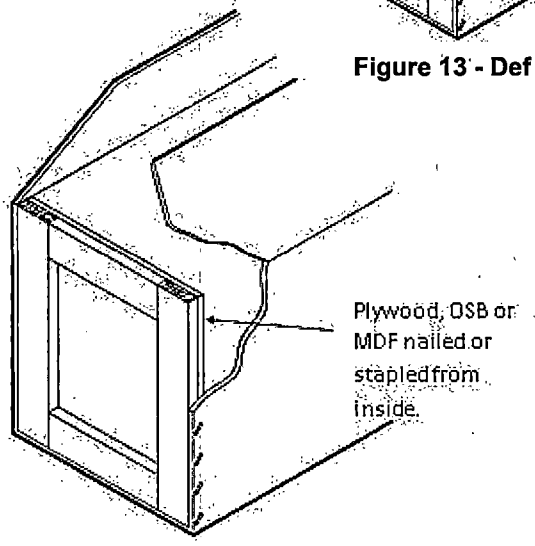


Figure 13 - Def Stan 81-021; Style 2

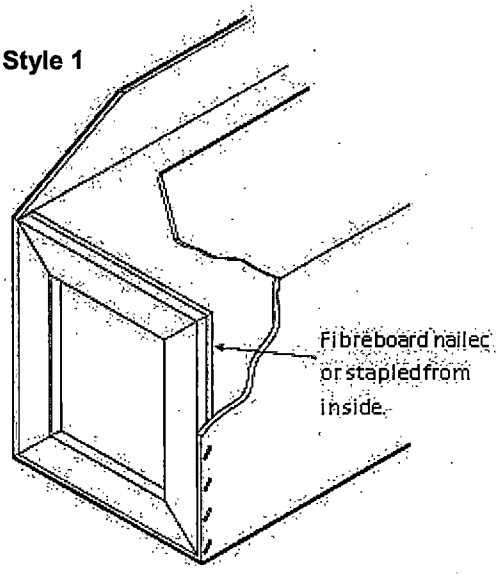


Figure 12 - Def Stan 81-021; Style 3

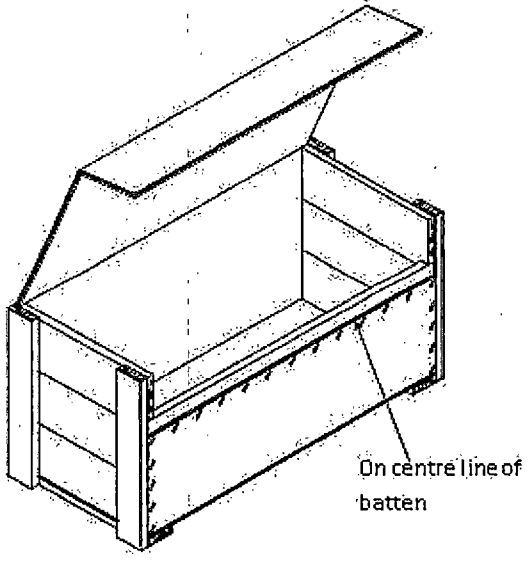


Figure 16 – Def Stan 81-021; Style 4

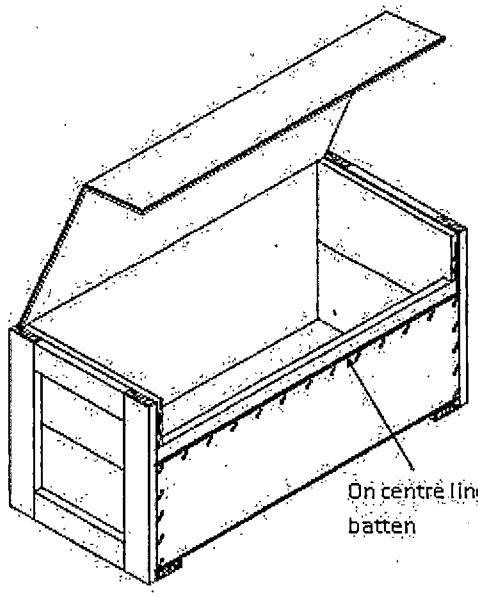


Figure 17 – Def Stan 81-021; Style 4

29.3 Wooden Containers

A range of wooden containers, which may be procured to defence standards and their normal maximum mass, is shown in **Table 25**, refer to actual standard for more detail.

a) It is acceptable for oriented strand board (OSB), to 'BS EN 300' or medium density fibreboard (MDF), to 'Def Stan 81-120' to be used as an alternative to plywood, Def Stan 81-027, for the construction of certain wooden containers (see the relevant container standard).
b) OSB and MDF shall not be used either; in the construction of Def Stan 81-003, Def Stan 81-071, or Def Stan 81-135 cases, or for any wooden container designed for contents with a maximum mass above 400 kg.
c) Suppliers of a wooden container that differs in construction (including materials, fasteners, lifting aids etc.) from the specification of any of the Defence Standards shown in **Table 25** must ensure that the container has been tested as fit for the purpose intended before use.

Table 20 - Guide to Maximum Mass of Contents for Wooden Containers

Container	Maximum Mass (kg)
Def Stan 81-023 class 2	70
Def Stan 81-023 class 1	100
Def Stan 81-008 grade II	75
Def Stan 81-008 grade I	150
Def Stan 81-113 Type 1	200
Def Stan 81-113 Type 2	200
Def Stan 81-113 Type 3	200
Def Stan 81-012 style 1	30
Def Stan 81-012 style 2	60
Def Stan 81-012 style 3	200
Def Stan 81-014 class X	100
Def Stan 81-014 class Y	200
Def Stan 81-014 class Z	400
Def Stan 81-005 class X	100
Def Stan 81-005 class Y	200
Def Stan 81-005 class Z	400
Def Stan 81-071 style 1 or 4	60
Def Stan 81-071 style 1F or 4F	200
Def Stan 81-071 style 2 *	500
Def Stan 81-071 style 3 or 5 *	1500
Def Stan 81-071 style 6	3000
Def Stan 81-135 style 1 class A	1000
Def Stan 81-135 style 1 class B	4500
Def Stan 81-135 style 2 class A	1000
Def Stan 81-135 style 2 class B	7000
Def Stan 81-135 style 3	4500
Def Stan 81-135 style 4	10000

* Including all modifications

29.3.1 Def Stan 81-003; Cases, Wood (Plywood), Comb-Jointed Construction

29.3.1.1 This container is constructed from plywood panels joined together by glued vertical comb-joints. The lids and bases may be framed and the bases secured to the sides by pinning and gluing. They are used primarily as inner containers to square up an item within an outer container. They are considerably stronger than fibreboard cases for this purpose and are useful for the positive location and support of heavier items.

29.3.1.2 Def Stan 81-003 covers two styles of construction (see **Figs 18 & 19**)

a) Style 1 - without top and bottom framing.

b) Style 2 - with top and bottom framing.

29.3.1.3 There are several classes of case viz: A, B, C, and D which are constructed from different thicknesses of plywood (see **Table 26**).

Table 21 - Def Stan 81-003 Cases: Plywood Thickness

Style	Class A	Class B	Class C	Class D
	(mm)			
1	-	9	12	15
2	6	9	12	15

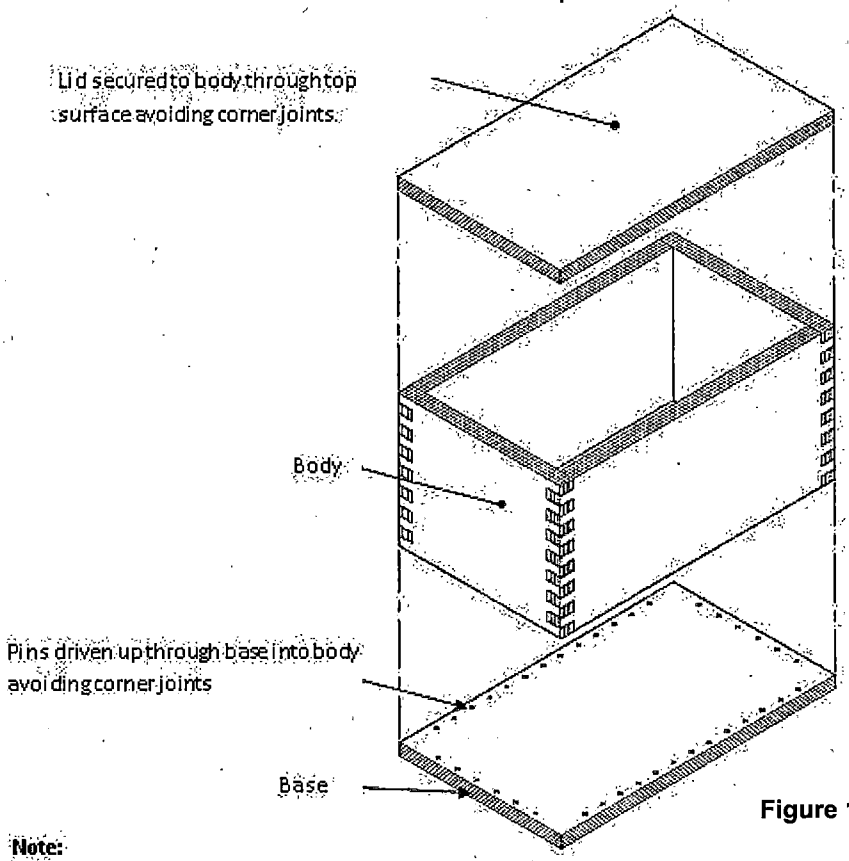


Figure 18 – Def Stan 81-003 Style 1

Note:
Construction of lid is identical to base.

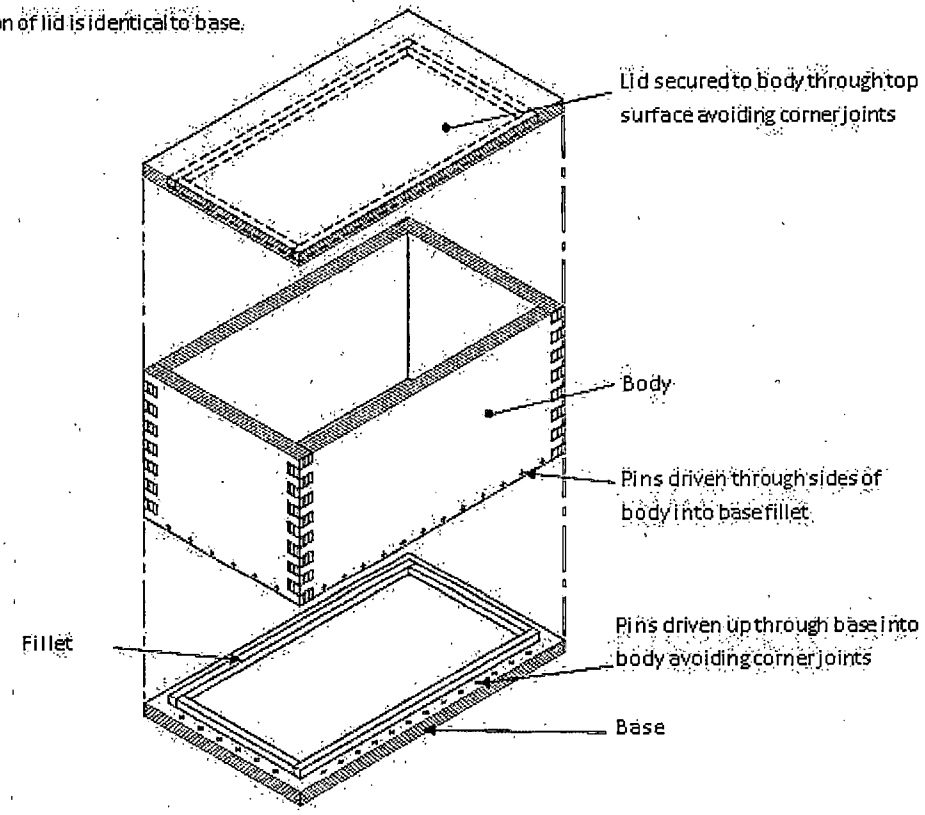


Figure 19 – Def Stan 81-003 Styles 2

29.3.2 Def Stan 81-023; Cases, Board, Collapsible

This Standard covers two styles of metal-edged case for contents up to 100 kg mass (see **Fig 20**). A metal-edged plywood case is strong, light, and suitable for general purpose packaging and easy loads. The base is flat (apart from shallow depth rubbing strips) which makes a good choice for air freight use. The loose base and lid are fitted with internal softwood battens so that they fit snugly into the body and can be secured by tensional steel strapping or by screws driven through the body into the base and lid battens.

Note: See also Def Stan 81-008.

a) Style 1 is available in two classes (see **Table 27**).

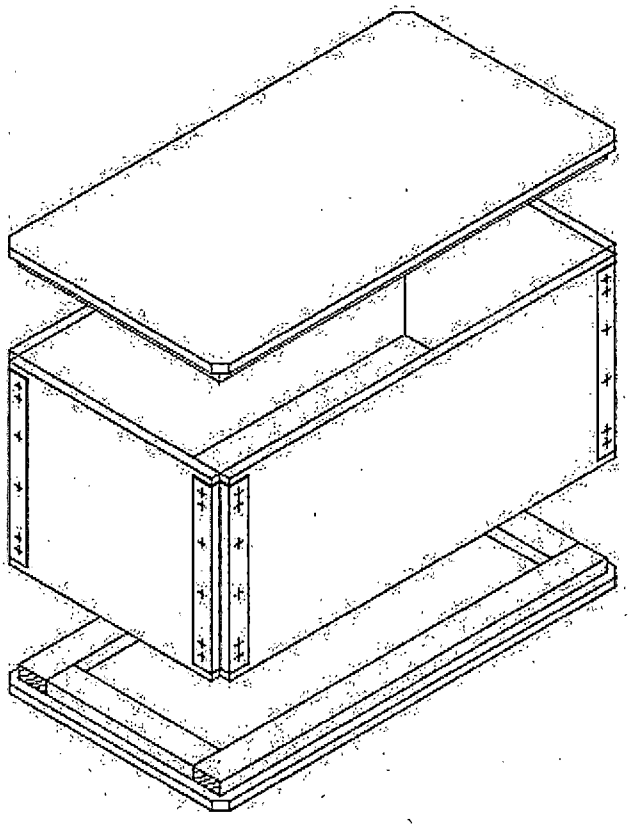
b) Style 2 is available in 6 mm plywood, OSB or MDF in three types, A, B, and C, each of which relates to the body internal height of the case (see **Table 28**). In addition style 2 is available with inter-space boards which can be used to provide individual drawers for the case.

Table 22 - Def Stan 81-023, Style 1: Choice of Class of Case

Class	Board Type	Board Thickness (mm)	Mass of Contents (kg)
2	Plywood	4 or 5	70 max
1	Plywood, OSB or MDF	6	70 to 100

Table 23 - Def Stan 81-023, Style 2: Choice of Type of Case

Case Type	Body Internal Height (mm)	Interspace Board Quantity	Special To Contents
A	315	4	4 x 51 mm deep drawers
B	334	2	2 x 127 mm deep drawers
C	264	1	1 x 203 mm deep drawers



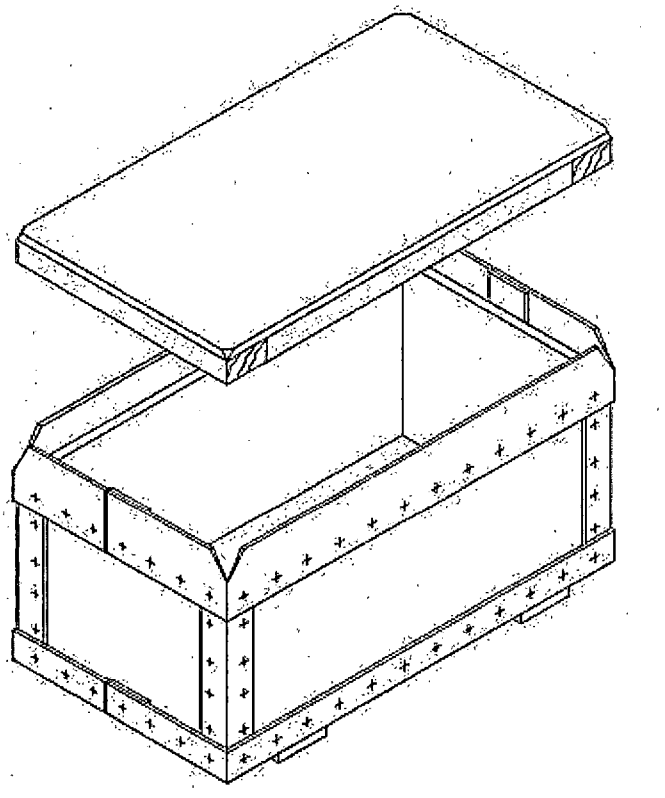


Figure 14 - Def Stan 81-008; Plywood Cases of Metal-edged Construction

29.3.3 Def Stan 81-008; Cases, Wood (Plywood, Metal-Edged Construction)

This Standard covers two grades of metal-edged case for contents up to 150 kg mass (see **Fig 21**). It is available in two grades which relate to the thickness of plywood used (see **Table 29**). OSB or MDF may be used as alternatives to plywood for grade I cases.

Table 24 - Def Stan 81-008: Choice of Grade of Case

Grade	Board Type	Board Thickness (mm)	Maximum Mass Of Contents (Kg)
II	Plywood	4	75
I	Plywood, OSB or MDF	6	150

29.3.4 Def Stan 81-113 Case, Wood, Collapsible, Reusable

This Standard covers three types of containers for contents up to 200 kg. They may be manufactured from plywood, OSB or MDF.

Type 1: Wire-bound case. An example of a wire bound case is illustrated in BS 1133, Section 8, subsection 5, Para 19, figure 27, Style 51.

Type 2: Metal edged case. Examples of metal edge cases are illustrated in BS 1133, Section 8, subsection 5, Para 18, figure 21, Styles 43, 44 and 45.

Type 3: Clip fastened case (see **Fig 22**)

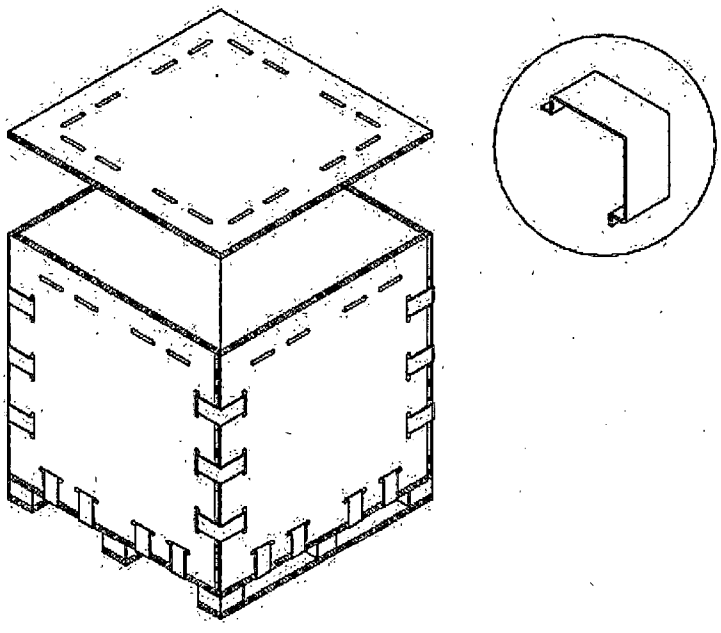


Figure 16 - Def Stan 81-113; Case, Wood, Collapsible, Reusable, Type 3: Clip Fastened Case

29.3.5 Def Stan 81-012; Cases, Wood (Panel and Batten Construction)

This Defence Standard covers three styles of case for contents up to 200 kg mass (see **Figs 23** to **25**). It is not suitable for difficult loads. The choice of style is related to the mass of contents (see **Table 30**). Each style is available in two grades.

a) Grade 1 uses 6 mm plywood, OSB or MDF and is suitable for moderately difficult loads.

b) Grade 2 uses 4 mm plywood and is suitable for easy loads only.

Def Stan 81-012 cases are similar in strength to Def Stan 81-014 cases but are not as heavy and the load carrying capacity is lower. However they have better weathering properties. Although the panels may be strengthened by the use of additional battens the main advantage of the construction is in the framework formed by the edge battens.

Table 25 - Def Stan 81-012: Choice of Style of Case

Style Of Case	Mass of Contents (Kg)
1	up to 30
2	30 to 60
3	60 to 200

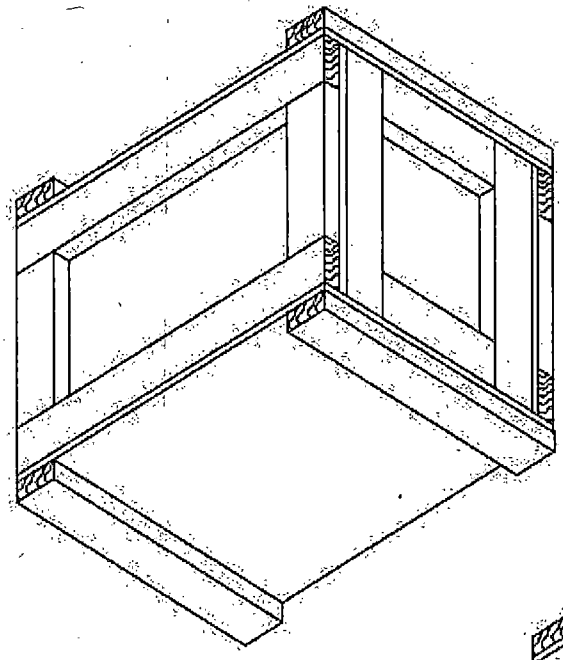


Figure 17 - Def Stan 81-012; Style

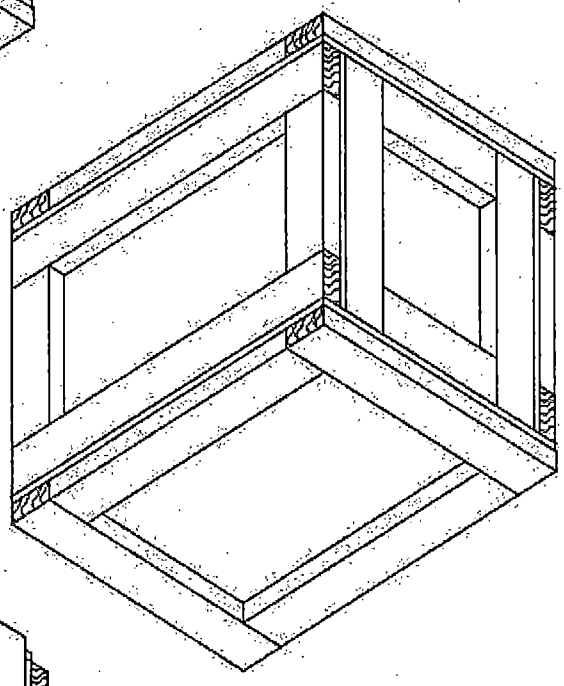


Figure 24 - Def Stan 81-012; Style 2

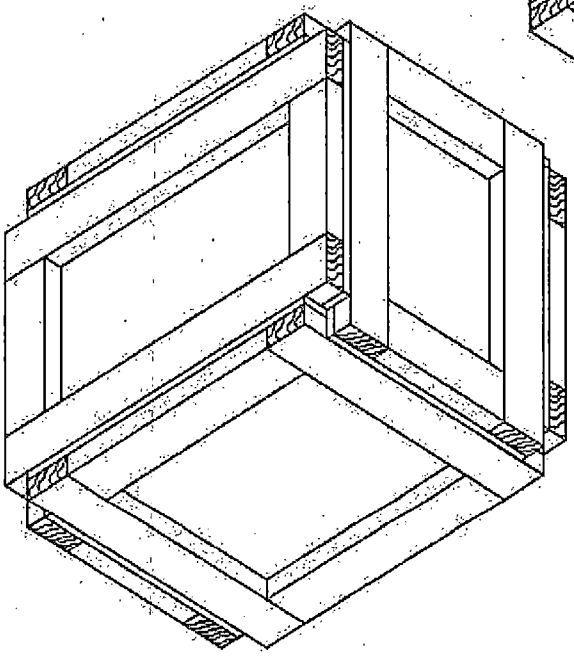


Figure 25 - Def Stan 81-012; Style 3

29.3.6 Def Stan 81-014; Cases, Wood (Batten and Board Construction)

This Standard covers eight styles of case for contents up to 400 kg mass (**see Figs 26** to **30**). The choice of style is related to the dimensions of the case (see **Table 31**). Each style may be supplied in three different classes related to the mass of contents (see **Table 32**). Any case may be supplied in two grades which relate to the type of joint between the boards as follows:

a) Grade I - planed or fine sawn tongue & groove construction.

b) Grade II - fine sawn butt-jointed construction.

Grade I is stronger, more weather resistant but more costly than Grade II and should be used only for the most severe distribution requirements.

Def Stan 81-014 cases have the greatest load carrying capability of all the wooden containers in their size range. They are the best choice for dense or difficult loads because of the wall strength inherent in the design.

Note: There is a tendency for containers of this construction to rack. This may be prevented by adding additional diagonal bracing struts.

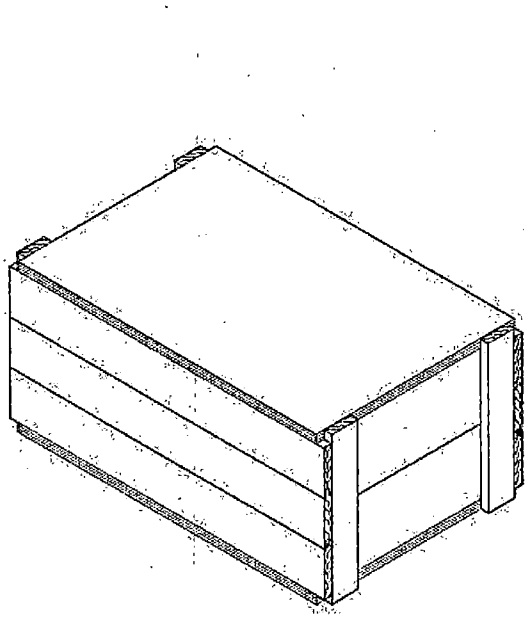
The case is constructed from softwood boards nailed together with reinforcing battens. Lids and bases of styles 1A and 1C may be of plywood, OSB or MDF secured by nailing. Several bands of girth battens may be employed for added strength. Styles 1A and 1B are supplied assembled and styles 1C and 1D unassembled. Styles 2 - 5 may be supplied assembled or unassembled.

Table 26 - Def Stan 81-014: Choice of Style of Case

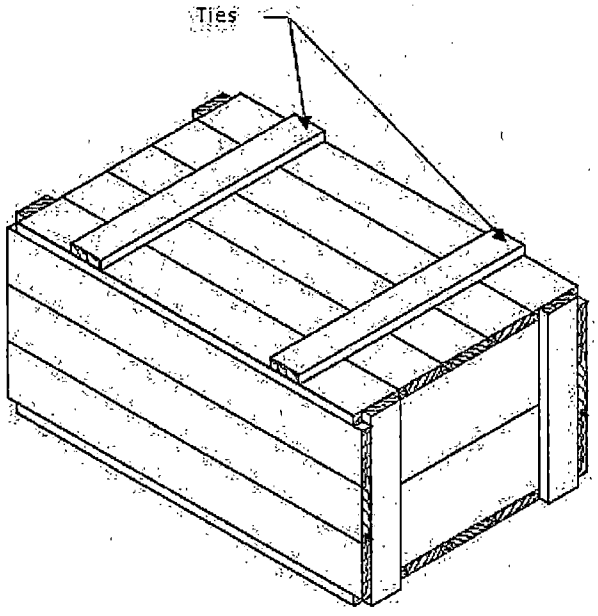
Style	Internal Dimensions (mm)		
	Length	Width	Height
1A, 1B, 1C or 1D	up to 600	230 min	125 min
2	600 to 900	230 min	125 min
3	900 to 1800	230 min	125 min
4	over 1800	230 min	125 min
5	all lengths	250 max	250 max

Table 27 - Def Stan 81-014: Choice of Class of Case

Mass of Contents (Easy Load) (kg)	Class Of Case	
	Volume up to 200 dm^3	Volume over 200 dm^3
up to 100	X	X
100 to 200	-	Y
200 to 400	-	Z



Style 1A Supplied Assembled



Style 1B Supplied Assembled

Style 1C (Supplied Unassembled)

Style 1D (Supplied Unassembled)

Figure 18 - Def Stan 81-014; Style 1A, 1B, 1C, & 1D

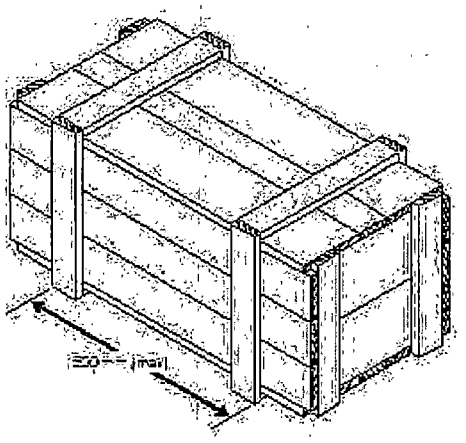


Figure 19 - Def Stan 81-014; Style 2

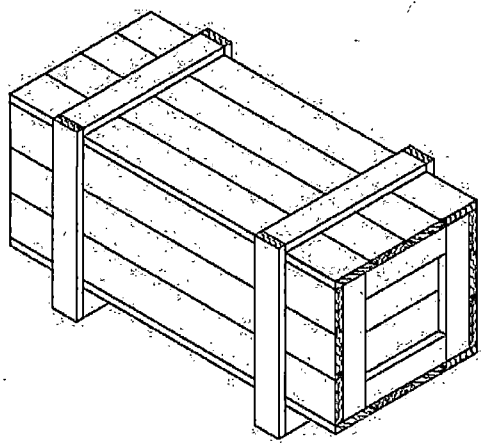


Figure 20 - Def Stan 81-014; Style 3

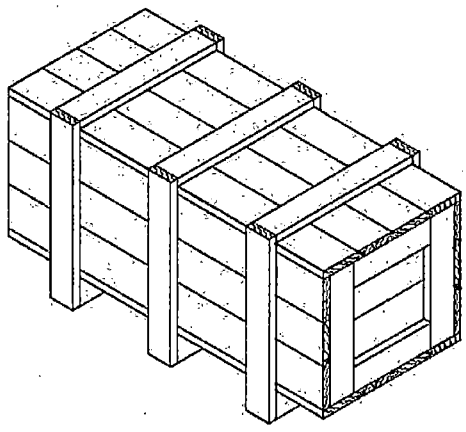


Figure 21 - Def Stan 81-014; Style 4

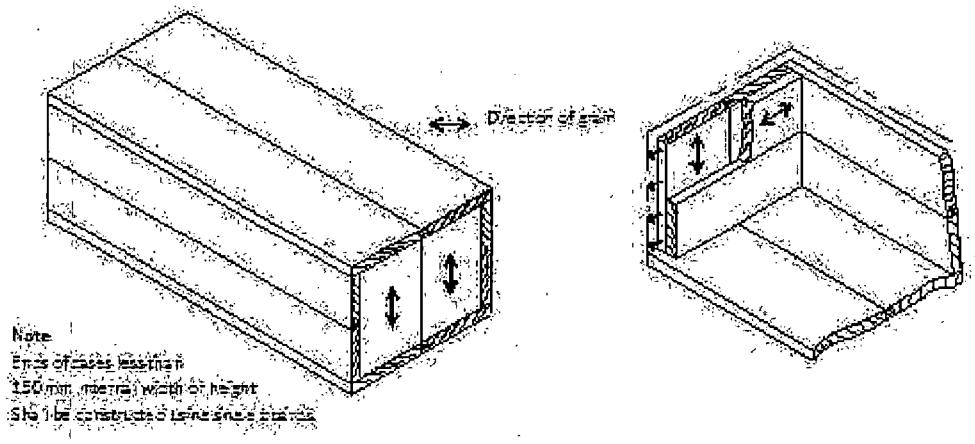


Figure 22 - Def Stan 81-014; Style 5

29.3.7 Def Stan 81-005; Crates, Wood

This Standard covers six Styles of crate for contents up to 400 kg mass (see **Figs 31** to **36**). Three styles are supplied with external battens and three with internal battens. The choice of Style is related to the dimensions of the crate (see **Table 33**). Each Style may be supplied in three different Classes related to the mass of contents (see **Table 34**).

The crate is constructed from softwood boards nailed together with reinforcing battens. It differs from a wooden case in that spaces are left between adjacent boards. The boards may be braced diagonally.

Wooden crates are comparable in strength and are lighter than batten and board cases. They are suitable for the same range of loads but should not be used for materiel vulnerable to surface damage or to direct exposure to the weather. Crates with external battens will normally be chosen but those with internal battens may be preferred when a smooth exterior is required (e.g. for movement by roller conveyor).

Table 28 - Def Stan 81-005: Choice of Style of Crate

Internal Length (mm)	Capacity (dm^3)	Style Of Crate
up to 600	100	1 or 1A
over 600	100 to 250	2 or 2A
	over 250	4 or 4A

Table 29 - Def Stan 81-005: Choice of Class of Crate

Mass of Contents (Easy Load) (kg)	Class of Crate		
	Volume up to 100 dm^3	Volume 100 to 250 dm^3	Volume over 250 dm^3
up to 100	X	X	X
100 to 200	-	-	Y
200 to 400	-	-	Z

Style 4, is similar to Style 13 in BS 1138-8 in that it should not be used with fork lift battens (FLB). The main exceptions are if the FLB are on the ends or unless the base brace is either omitted or fitted internally. If the top brace is also being considered to be omitted or fitted internally then another Style should be chosen. As with any modification it shall be established that the characteristics and properties are not degraded.

Note: Other modifications to enable the use of FLB, e.g. the addition of levelling timber on the top and/or bottom shall be noted in the relevant SPIS and it shall be noted as "Style 4 modified".

The Preference is that either another style is used or FLB are only used on the ends.

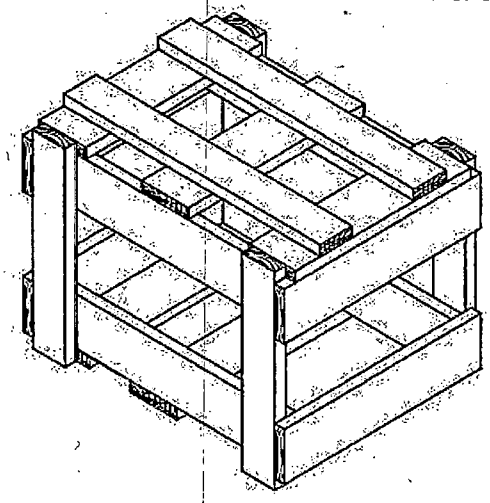


Figure 23 - Def Stan 81-005; Style 1 Crate

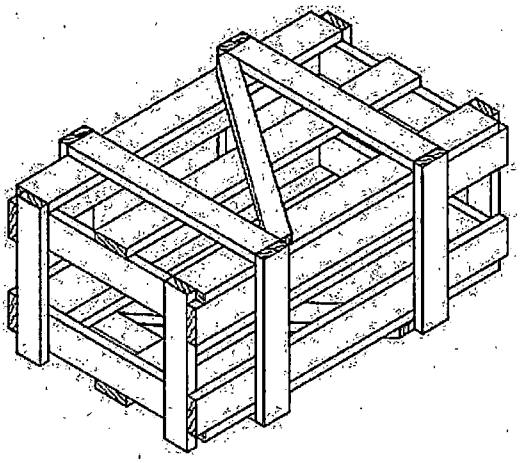


Figure 24 - Def Stan 81-005; Style 2 Crate

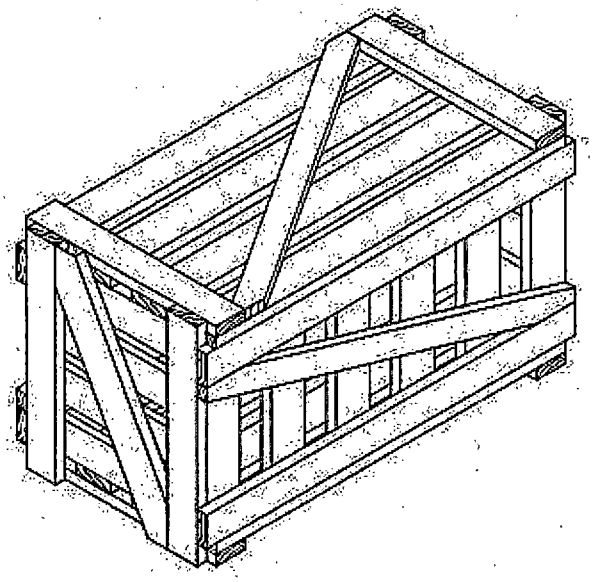


Figure 33 – Def Stan 81-005; Style 4 Crate

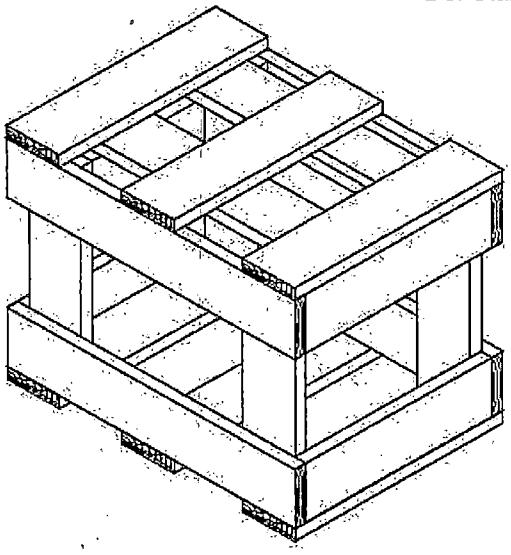


Figure 25 - Def Stan 81-005; Style 1A Crate

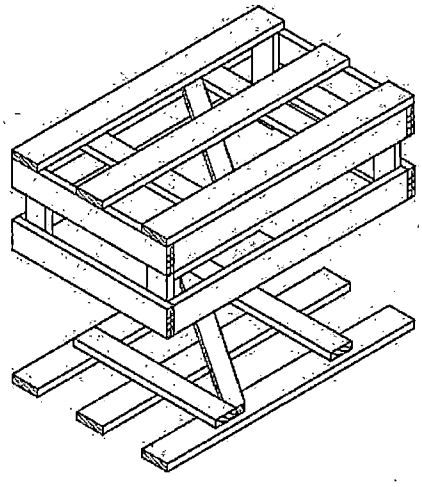


Figure 26 - Def Stan 81-005; Style 2A Crate

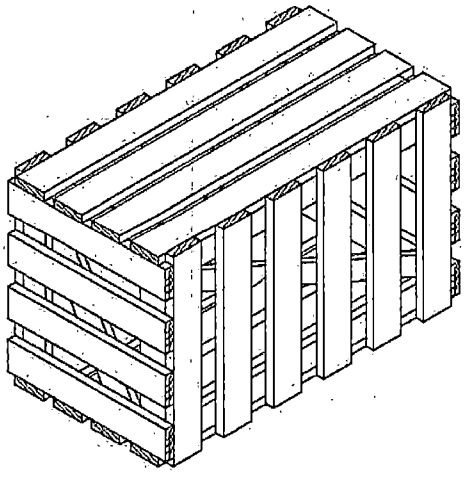


Figure 27 - Def Stan 81-005; Style 4A Crate

29.3.8 Def Stan 81-071 Cases, Wood, Packing, Reusable

This Standard covers six Styles of case for contents up to 3000 kg mass (see **Figs 37** to **41**). The choice of style is related to the dimensions of the case (see **Table 35**).

a) Styles 1, 2 and 3; Batten and board cases

b) Styles 4 and 5; Plywood battened cases

c) Style 6; Plywood battened, bolted construction cases.

Each style can be modified according to the features provided in the case design, i.e. Top hat (T), Fork lift (F) or Pallet base (P).

Table 30 - Def Stan 81-071: Choice of Style of Case

Mass Of Contents (kg)	Maximum Length Of Case (mm)	Case Style
up to 60	any	1 or 4
60 to 200	any	1F or 4F
200 to 500	up to 1700	2F or 2FT or 2P or 2PT
200 to 1500	over 1700	3F or 3FT or 3P or 3PT
200 to 1500	any	5F or 5FT or 5P or 5PT
1500 to 3000	any	6

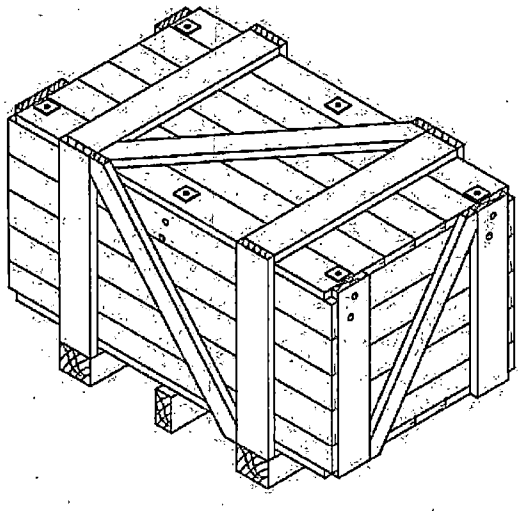


Figure 28 - Def Stan 81-071; Style 1 & 2 Case

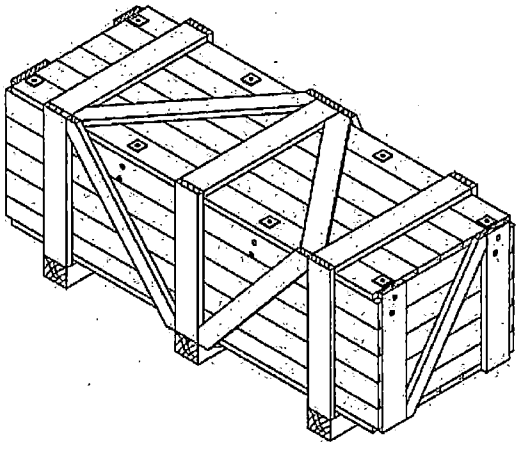


Figure 29 - Def Stan 81-071; Style 3 Case

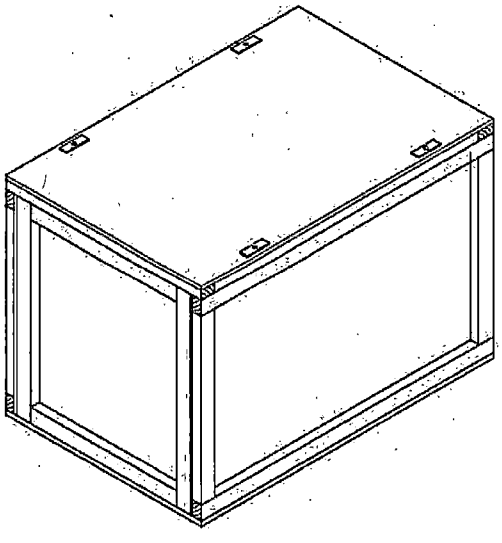


Figure 30 - Def Stan 81-071; Style 4 Case

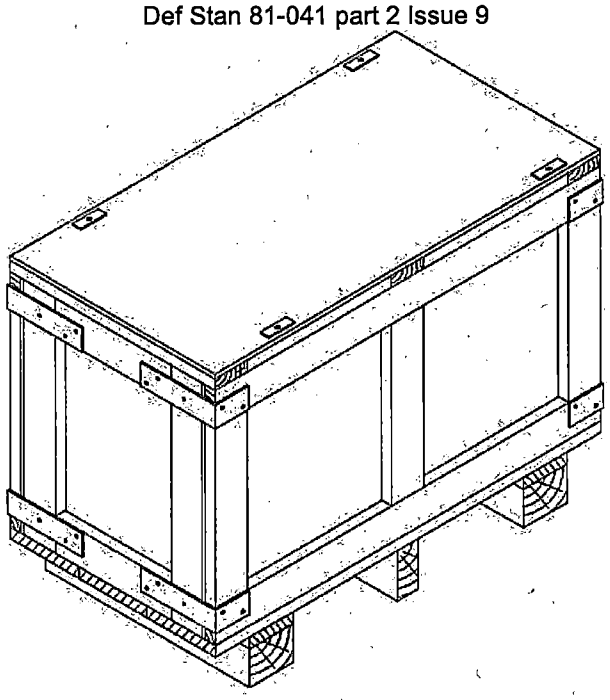


Figure 31 - Def Stan 81-071; Style 5 Case (with Reinforcement Bracket)

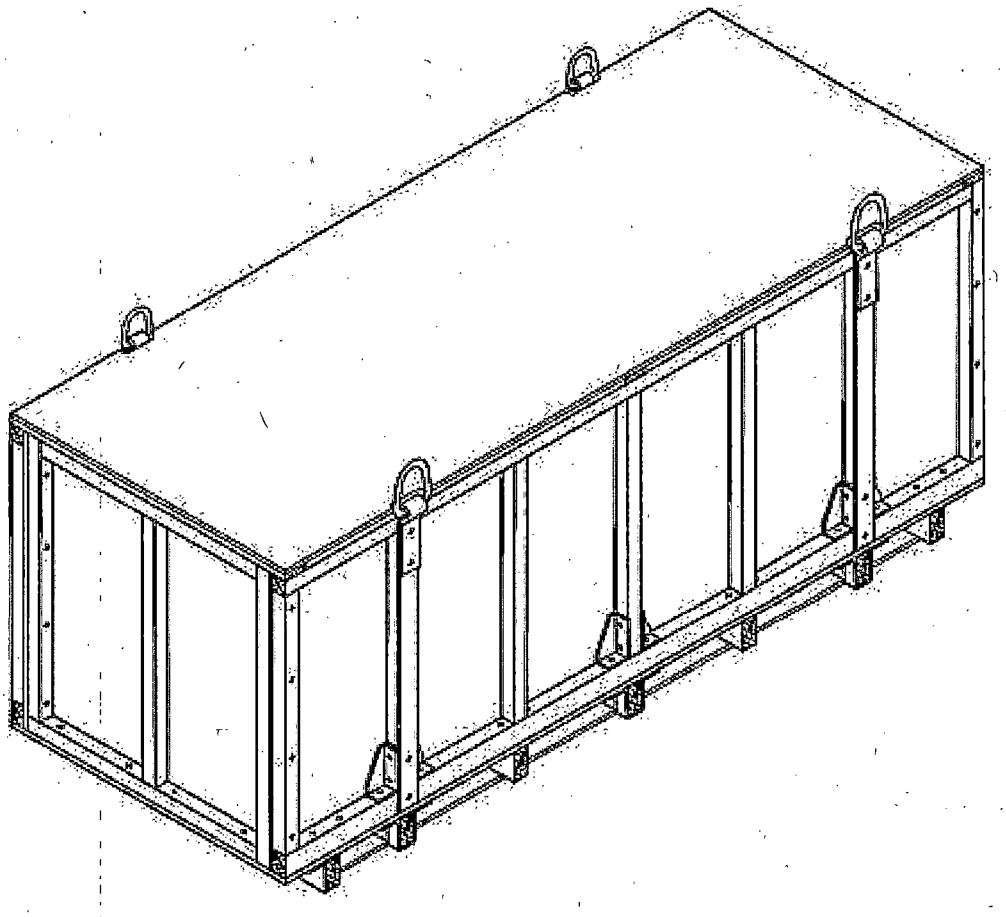


Figure 32 - Def Stan 81-071; Style 6 Case

29.3.9 Def Stan 81-135; Cases, Wood, Packing (Board or Panel and Batten Construction)

This Standard specifies requirements for four different styles and two classes (Styles 1 and 2 only) of case for the packaging of MOD materiel up to 10 000 kg gross mass of the package.

a) Styles 1 and 2 cases are of board and batten, nailed construction and assembly. (See **Fig 42**)

b) Styles 3 and 4 cases are of panel and batten, nailed and screwed construction and bolted assembly. (See **Fig 43**)

These cases are designed to be constructed around the item(s) to be packaged with additional internal location furniture as required.

The use of each style of case is determined by the gross package mass as shown in **Table 36**.

Table 31 - Def Stan 81-135: Choice of Style/Class of Case

Style / Class	Maximum Gross Package Mass (x1000 kg)
Style 1 Class A	1
Style 1 Class B	4.5
Style 2 Class A	1
Style 2 Class B	7
Style 3	4.5
Style 4	10

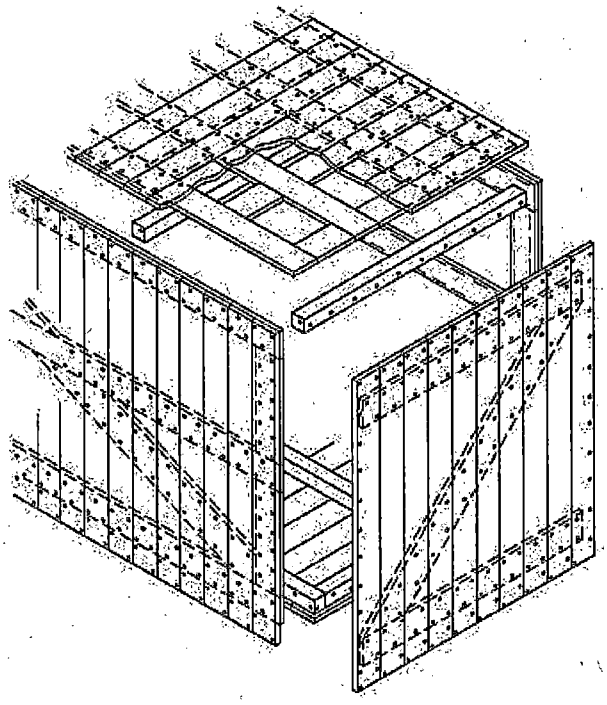


Figure 33 - Def Stan 81-135; Style 1, and 2 Case (exploded view

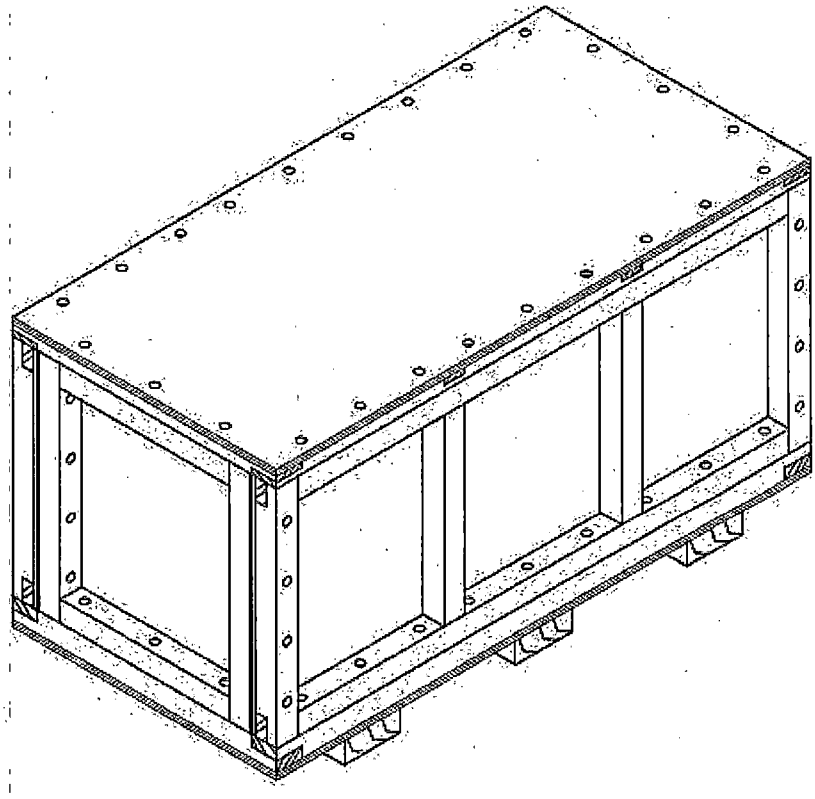


Figure 34 - Def Stan 81-135; Style 3 and 4 Case

29.3.10 Sheathed Framed Large Wooden Containers (Skid & Sill Base)

These are large wooden containers constructed of substantial frame members with sheathing applied to add strength and to cover the case. Wherever possible this sheathing shall be secured to the frame members before the case is assembled (using nails or staples for plywood and nails for timber).

There are two forms of construction used (see also BS 1133, Section 8)

a) Skid base (**Figure 44)**

b) Sill base (**Figure 45**).

Note: Information on pallets for material handling for through transit may be found in BS ISO 6780

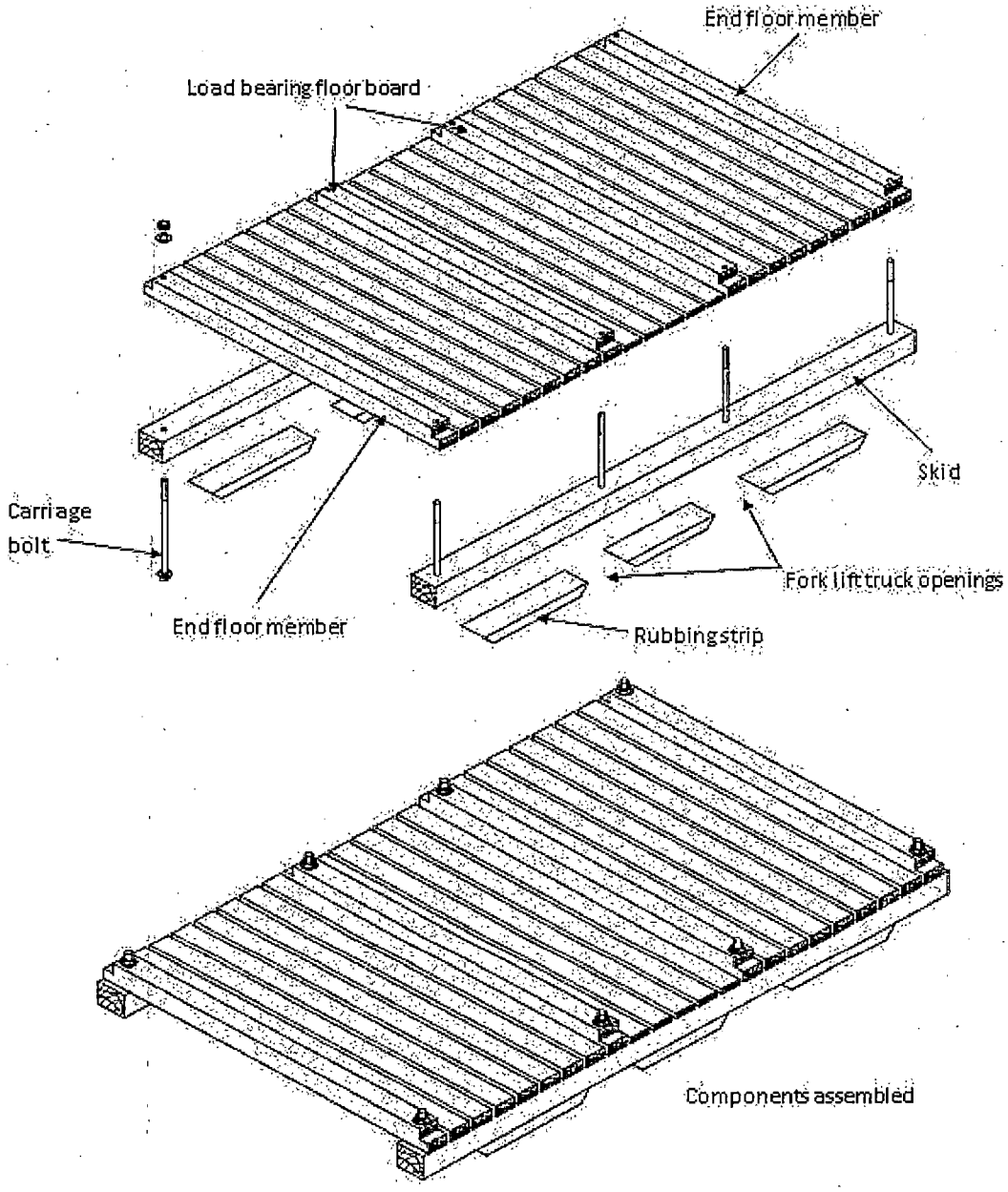


Figure 35 - Skid Base for Large Wooden Containers

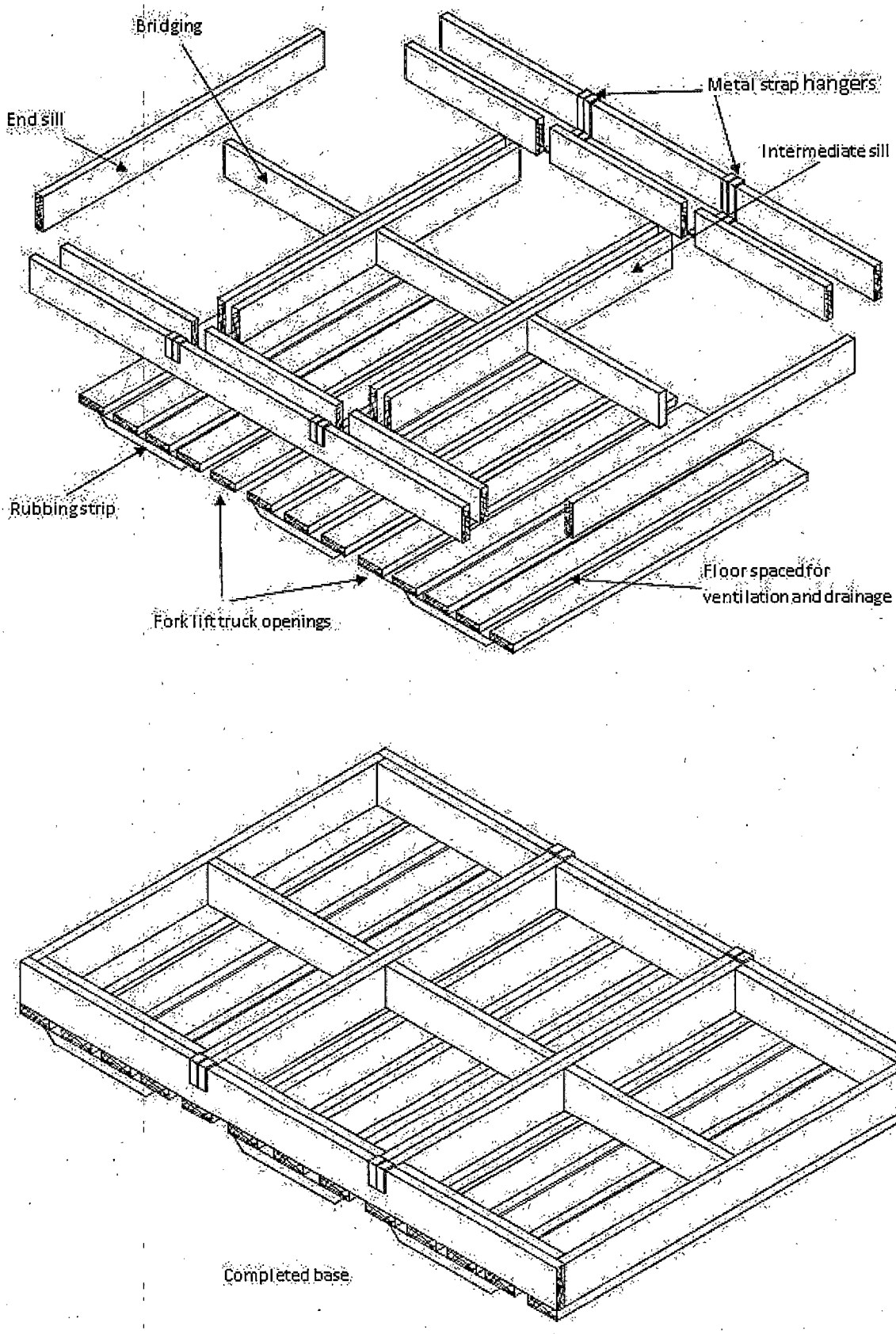


Figure 36 - Sill Base for Large Wooden Containers

29.4.1 Closure

a) The simplest (and cheapest) way of closing wooden containers is by nailing (see Process [D11]).

b) Reusable containers may be closed by screwing with or without screw cups (see Process [D12]). However if reusability is of prime importance then a special fastener may be used, e.g., toggle catches, spring loaded catches, catches with adjustable spring loading, case & strap bolts, rotary fasteners (see Def Stan 81-073). It should be noted that all metal parts of such closures should be provided with an anti-corrosion treatment.

c) Plywood cases with metal edging round the top may be closed with wire staples or tenterhooks (see Process [D14]).

29.4.4 Reinforcement of Closure

This may be done by one of the following methods;

a) Girth Straps; Straps of cold rolled flat tensional steel strapping, BS EN 13246, applied around the girth of the container;

b) Hoop-iron; applied in the form of short straps to corners;

c) Corner plates; of mild steel sheet

Girth straps should be positioned (a) in contact with the sheathing of the case and (b) to take advantage of the protection afforded by girth battens if fitted. No part of the length of the strap shall be unsupported. Extra battens shall be fitted to provide the necessary support when necessary.

Note: BS 1133, Section 15, and Process [D19] contain guidance on the use of tensional steel strapping for containers up to 2000 mm long. Larger containers should use cold rolled flat strapping. If practicable the number of straps should be such that the distance between straps does not exceed 1000 mm.

29.5 Metal Containers

Metal containers are made in a wide range of sizes. The most common shape is a drum or tin but rectangular shapes are available particularly in the smaller sizes (see **Table 37**).

BS 1133, Section 10 provides useful information. Closures are usually integral to the container.

A wide variety of surface coatings or treatments may be applied internally or externally to meet special requirements (e.g. to render the container resistant to corrosion or to prevent contamination of contents).

Table 32 - Metal Containers

Specification	Title	Remarks
BS EN 210	Steel Drums	Specifies Non-removable head (tight head) drums with a minimum total capacity of 216, 51 litres.
BS 1262	Round tins for liquid paints, varnishes and allied products	Three styles are available in capacities from 100 ml to 10 litres.
BS 1702	Mild steel drums (heavy-duty fixed ends)	22 to 410 litres capacity of welded construction.
BS 1764	Nominal diameters of round built up tins	
BS EN 209	Steel Drums	Specifies Removable head (open head) drums with a minimum total capacity of 210 litres.
UK/CIS/22	Containers, tin, rectangular, for packaging of paints and chemicals	Rectangular containers with screw closure, available in sizes from 285 ml to 4.5 litres).

29.6 Moulded Pulp Containers

Moulded pulp may provide a light (weight) form of packaging (see BS 1133, sub section 7.6). The containers are made using paper pulp, which is either forced under pressure into a mould, or vacuum formed on to a perforated former. It should be pointed out that the chemical purity of the pulp may be variable and the processed material may cause corrosion of the item of materiel if in direct contact.

The containers may be made water or water-vapour resistant.

29.7 Plastics & GRP Containers

Plastics containers may be constructed from a wide range of materials (see BS 1133 Section 22). Those used in packaging by the MOD are mostly constructed from thermoplastics such as; Polyethylene (PE), Polypropylene (PP) etc.

Glass reinforced plastics (GRP) containers may be more expensive but possess high mechanical strength, corrosion-resistant, good insulators, and require little maintenance. Handling, location members, and other container fitments may be provided in the mould design.

Note: Depending on the material these may not be WVP

29.8 Glass Containers

Glass containers are non-permeable to gases, odours, vapours (including water-vapour) and liquids and are often reusable (see BS 1133, Section 18).

30 Use of Handling and Lifting Aids

30.1 Lifting Aid Selection

Adequate handling facilities shall be provided for the package/ container which should be capable of being transported throughout the logistics chain without the use of specialised equipment if possible (see **Table 38**). It must be remembered that the container must be strong enough to cope with the forces developed when handling and may have to be strengthened. The sides and lid shall be strong enough to resist the crushing forces applied during lifting, and bracing struts may be built into the lid for reinforcement. The provision of bracing struts is important for large wooden containers that are lifted with grabs (see BS 1133, Section 8). The containers detailed in Section 8 are suitably constructed.

Table 33 - Lifting Aid Selection

Gross Mass of Package (Kg)	Handles	Fork-Lift or Pallet Based	Lifting Straps
up to 10	To be considered		
10 - 20	Desirable		
20 - 60 *	Required	To be considered	
60 - 225		Required	To be considered
225 - 500		Required	To be considered
500 – 10 000		Required	Required

Note: * - It is recommended that packages with a gross mass in excess of 28 kg should be designed where practicable for handling by mechanical handling equipment. Packages above 60 kg are not suitable for man-handling and sling points, lifting aids, tie down points, roller conveyor skids, fork lift truck or pallet transporter access shall be provided when applicable.

30.2 Handles

Information on different types of handles is given in Def Stan 81-029. The fitting of handles to fibreboard (all thicknesses) and OSB, MDF or plywood (6 mm or less) shall involve the use of a backing plate.

30.3 Fork-lift

The container shall be fitted with 100 mm high (nominal) base battens or blocks positioned transversely at distances allowing two-way entry to fork-lift equipment. When fixing fork-lift battens to battened plywood cases additional battens, (of the same cross-section as the frame battens), shall be secured to the base of the container as shown in Fig 46.

30.4 Pallet Bases

The container shall be fitted with a decked pallet base with the edges of the bottom deck boards chamfered to 45° to allow two-way entry to a pallet truck (see BS ISO 6780 and STANAG 2828).

30.5 Lifting Irons

Details of lifting attachments, methods of fitting and other metal fittings suitable for wooden containers are contained in Def Stan 81-086

30.5 Crane Lift

Provision for crane lift may be met by the container having bottom battens that permit slings to be located securely (it may be necessary to provide sling protection plates).

30.6 Air portability

The distribution of packaged material by air is described in Def Stan 00-3. When required the container may be converted into a pallet base by affixing a sheet of 9 mm thick plywood bridging the outermost fork-lift battens.

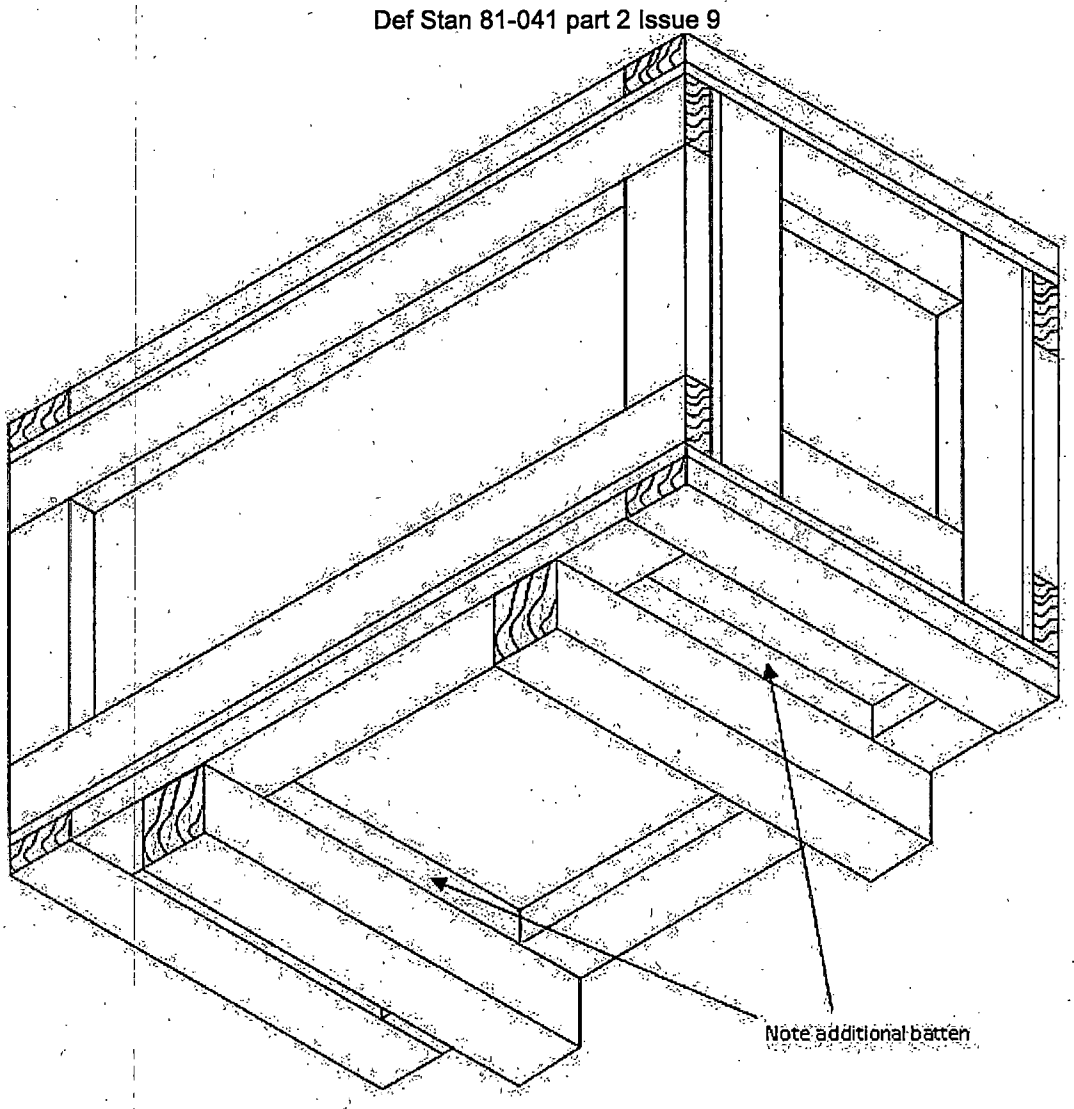


Figure 37 - Battened Plywood Case Fitted with Fork-lift Battens

31 Nuclear Grade A Clean Room Items

31.1 Clean room items ordered to DGS PS 5104 will be received from the contractor or supplier in a barrier which will be marked "GRADE A CLEAN" and "OPEN ONLY IN A CLEAN ROOM". Items received without the appropriate protection and/or identification shall be returned to the manufacturer.

31.2 When a military level of packaging is specified the barrier shall not be disturbed and any further packaging shall consist of providing physical protection to the barrier in accordance with Def Stan 81-041 (Part 5) by one of the following methods:

31.2.1 When packaging to Standard Family Specification (SFS) is specified all processes shall be applied except that cleaning, drying and preservation clauses in the SFS will not be required.

31.2.2 When packaging to Services Packaging Instruction Sheet (SPIS) all the cleaning, drying and protective boxes on the SPIS shall be bracketed together referring to a note in the "Remarks and Special Packaging Instructions" box stating "This item has been prepared in accordance with DGS PS 5104".

31.3 Additional markings as specified in DGS PS 5104 shall be applied to packages and containers.

32 Electrostatic Discharge Sensitive Devices

32.1 Electrostatic discharge sensitive devices ordered to BS EN 61340-5-1 will be received from the contractor or supplier in a shielded barrier (e.g. Def Stan 81-112). Items received without the appropriate protection and/or identification shall be returned to the manufacturer.

32.2 When a military level of packaging is specified the shielded barrier shall not be disturbed and any further packaging shall consist of providing physical protection to the barrier in accordance with Def Stan 81-041 (Part 5) by one of the following methods:

a) When packaging to Standard Family Specification (SFS); all processes shall be applied except that cleaning, drying, and preservation clauses in the SFS will not be required.

b) When packaging to a Services Packaging Instruction Sheet (SPIS); all the cleaning, drying, and protective boxes on the SPIS shall be bracketed together referring to a note in the "Remarks and Special Packaging Instructions" box stating "This item has been prepared in accordance with BS EN 61340-5-1.

32.3 Additional markings as specified in BS EN 61340-5-1 shall be applied to packages and containers.

Annex A
Calculation of Desiccant Quantity for Packages to Military Levels J, N & P

A.1 The following formulae are based on the use of silica gel, BS 2540 and activated clay, BS 7529, and have been developed in terms of so-called "basic desiccant". Each desiccant is related to this basic desiccant by the ratio of its individual capacity for absorbing moisture to that of the basic desiccant. The absorbing capacity of the basic desiccant is defined as 27 % of the dry mass of the desiccant when operating in an atmosphere maintained at 50 % relative humidity at 25 °C.

A.2 Formulae used for the Calculation of Desiccant Quantity

A.2.1 Military Level J

$$W = 24ARM + DF$$

A.2.2 Military Levels N & P

$$W = 4ARM + DF$$

A.2.3 Impermeable Barrier (completely impervious to water-vapour)

$$W = 70V + DF$$

A.2.4 Permeable Seal

$$W = 90R_sLM$$

A.2.5 Impermeable Barrier used with a Permeable Seal

$$W = 70V + DF + 90R_sLM$$

Note: When a bag/container is employed using Def Stan 81-101 material, the formula to calculate the desiccant quantity shall be either formula stated at **A.2.1** or **A.2.2** dependant on the military level, added to the formula stated in **A.2.4**, that is;

$$W = 24ARM + 90R_sLM + DF$$

A.2.6 Symbols used in the Formulae

A	=	area of barrier (square metres)
D	=	mass of hygroscopic material (including dunnage) inside the barrier (grams)
F	=	factor depending on type of dunnage
L	=	length of seal (metres)
M	=	the required package life (months)
R	=	water-vapour transmission rate of the barrier (grams per square metre per 24 hours)
R_S	=	water-vapour transmission rate of seal (grams per metre length per 24 hours)
V	=	volume of free space inside the barrier (cubic metres)

W = mass of basic desiccant (grams)

A.2.7 The following values shall be used as appropriate. When the material is not listed the value shall be obtained from manufacturer's information, reference information or determined by test.

F = 0 for non-hygroscopic materials such as expanded polyethylene and polystyrene

F = 0.1 for softwood, plywood, OSB and MDF with a moisture content up to 14%

F = 0.125 for corrugated fibreboard (and other materials not listed)

F = 0.2 for softwood and plywood with a moisture content over 14%

M = 24 for Military Level J

M = 60 for Military Levels N and P

R = 0.2 for Def Stan 81-075, "Barrier Material, Aluminium Foil Laminate" Types 1 and 2

R = 0.4 for Def Stan 81-075, "Barrier Material, Aluminium Foil Laminate" Type 3

R = 1 for Def Stan 93-116 Type 1, Polyethylene (low density) film, 500 µm thick

R = 2 for Def Stan 93-116 Type 1, Polyethylene (low density) film, 250 µm thick

R = 2 for Def Stan 81-101 Grade A, Reusable water-vapour resistant bags.

R = 8 for Def Stan 81-101 Grade B, Reusable water-vapour resistant bags.

R = 16 for Def Stan 81-101 Grade C & D, Reusable water-vapour resistant bags

R = 1 for Def Stan 81-101 Grade E, Reusable water-vapour resistant bags

R = as shown in BS 1133: Section 18, table 2 for various plastics materials

R = as shown in **Table A.1** for thick plastics sheet and materials

R_S = as shown in **Table A.2** for gaskets and "O" rings

Note: the data given in **Tables A.1** & **A.2** and BS 1133: Section 18, Table 1 are guidance and should be confirmed or determined for the material concerned.

Table A.1 - WVTR of Typical Container Materials

Material	Thickness (mm)	WVTR (gm^{-2}/24 hours)
Acrylonitrile Butadiene Styrene (ABS)	3	0.8
Glass reinforced plastic / rigid polyurethane foam / glass reinforced plastic sandwich	16	1.7
Glass reinforced plastic/expanded polystyrene / glass reinforced plastic sandwich	16	1.5
GRP epoxy and polyester resin	6	0.8 - 2.0
GRP (printed circuit board quality)	2	0.2
High density polyethylene	3	0.4
Polyethylene	3	0.1
Polyphenylene oxide (PPO)	4	0.1
Polypropylene	3	0.4

Table A.2 - WVTR of Gaskets and "O" Rings

Material	Size (mm)	WVTR (g/metre of seal length/24 hour)
Gaskets	Thickness	
Cork, processed	2	72×10^{-4}
Expanded natural rubber	3	15×10^{-4}
Expanded neoprene	3	13×10^{-4}
Expanded PVC	6	24×10^{-4}
Expanded silicone rubber	3	66×10^{-4}
Solid rubber (hard)	3	12×10^{-4}
Solid rubber (medium)	3	30×10^{-4}
'O' Rings	Diameter	
Fluorocarbon rubber	2.5	9.6×10^{-4}
Nitrile rubber	2.5	42×10^{-4}
Polyurethane rubber	2.5	138×10^{-4}
Silicone rubber	2.5	96×10^{-4}

A.3 Re-desiccation of Packages

A.3.1 **Military Level J**; Re-desiccation of the package is recommended after two years in non-temperate storage and after 12 years in temperate storage.

A.3.2 **Military Levels N & P;** Re-desiccation is recommended after five years.

A.3.3 When calculating the amount of desiccant required for re-desiccating a package the dunnage portion of charge may be excluded from the formulae shown in **A.2.**

A.3.4 Re-desiccation is not necessary if a barrier is impermeable.

A.4 Calculation of residual storage life of Military Level J packages transferred from one climatic area to another.

The following formula provides guidance when calculating the remaining shelf life for packages stored in one climatic area and later transferred to a second climatic area before the recommended re-desiccation date has been reached.

A.4.1 Transferred from non-temperate storage to a temperate storage

$$M_T = 6(24 - M_{NT})$$

M_T = months remaining for temperate storage, M_{NT} = months expended in non-temperate storage.

A.4.2 Transferred from temperate storage to a non-temperate storage

$$M_{NT} = \frac{(144 - M_T)}{6}$$

M_{NT} = months remaining for non-temperate storage, M_T = months expended in temperate storage.

Note: it may be uneconomic to transfer packages with a remaining shelf life of less than six months without re-desiccation

Annex B
Humidity Indicators

B.1 General

B.1.1 In order to determine when a given level of relative humidity (RH) has been reached or exceeded within a desiccated package a humidity indicator should be used. It shall be positioned as far away from the desiccant as is practical and not contact the packaged article.

B.1.2 The indication involves a change in; colour, electrical resistance or capacitance.

B.2 Humidity Indicator Paper (HIP) or Card (HIC)

B.2.1 The simplest is an absorbent paper usually impregnated with a cobalt salt, cobalt chloride, which changes from blue to pink when 50 %RH is reached. It can be calibrated as follows;

Test Reference Humidity % RH (produced by saturated salt solutions at 25°C)*	Compared to Reference Paper
33 & 43	A deeper blue
57 & 64	A deeper pink

The colour may be intensified by using additional chemicals. Alternative Cobalt free indicators like copper chloride may also be used. In all cases the expected colour change at what %RH should be indicated.

Note 1: There are split-level and multi-spot indicators; consisting of papers impregnated with chemicals which change colour at different RH, usually 15-20% apart. Multiple indication of the level enables a more accurate assessment to be made of the RH within equipment and the remaining life of the desiccant. They are preferred to single-level papers for use within Defence equipment.

Note 2: Standards that cover HIC include MIL-I-8835A (General use), & J-STD-033C (Electronic components)

Note 3: A colour reference paper may be produced by; immersing a piece of base paper material conforming to BS 6410 Type 2 (or Whatman Grade 1) in a 20% m/v aqueous solution of cobaltous chloride hexahydrate for not less than 1 minute. Allow surplus solution to drain off and then suspend the paper in an oven maintained at a temperature of 80 °C ± 0.5 °C for 30 minutes ± 2 minutes

Note 4: * In order; Magnesium chloride, Potassium carbonate, Sodium bromide, Sodium nitrite.

B.2.2 Humidity indicators may be used in the following ways:

a) In strips located within the barrier

b) In a paper envelope and located within the barrier

c) In plugs which are mounted in the wall of the barrier or container.

Note: In equipment, the paper may either be mounted behind a window on the exterior end of a breather desiccator, or form part of an indicator humidity plug. These plugs, which also act as a mounting for the smaller static desiccators, have been used in conjunction with sachet desiccators.

B.3 Humidity Indicating Desiccants

A grade of beaded silica gel desiccant impregnated with cobalt chloride is available in a sachet with a sight window. This shows a colour change from blue to pink. The sachet may be located within the barrier.

B.4 Humidity Indicating Sensors

Passive remote indicating humidity measuring systems are available. These respond quickly and may be used where visual access may be difficult. They consist of a sensor (positioned within the barrier and connected to an external meter) and a measuring instrument calibrated to read the relative humidity. Sensors consist of salts or metallic films deposited on a supporting substrate such that their resistance or capacitance varies with humidity.

Note: Dewpoint indicators, provide an alternative means of monitoring humidity. They are particularly suitable for large installations.

Annex C
Adhesive Systems and Tapes

C.1 General

For Definitions and Terms of adhesives see BS EN 923. For self-adhesive tape terminologies refer to BS EN 12481.

There are many adhesive systems available for bonding different combinations of material. Listed immediately below is a brief list of the most commonly MOD specified adhesives and tapes.

a) BS 1204 Parts 1 & 2 "Synthetic Resin Adhesive for Wood"

b) BS EN 12765 Classification of Thermosetting Wood Adhesive for Non-structural Applications

   a. Class C1

c) Def Stan 80-117 "Adhesive Rubber resin No 7"

d) BS 7116 "Tape, Pressure-sensitive Adhesive, Double-sided"

e) "Hot Melt Adhesive for Packaging Purposes" – Commercial

f) Defence Standard 81-145 "Tape, Adhesive for General Packaging"

C.1.1 A guide to the use of adhesive systems, including tapes, is given in **Table C.1**.

C.1.2 Other tapes and adhesive systems are used when marking packages (see Def Stan 81-041 Part 6). These are not described here.

C.1.3 Information on other adhesives and conditions for those combinations Def Stan 81 (Packaging) series standards specify and for those they do not; advice and guidance should be obtained from specialist (commercial) suppliers and trade associations.

Note 1: See Def Stan 81-041 (Part 6) with respect to shelf-life and its markings.

Note 2: The assured shelf-life from a supplier is not the life of an adhesive or tape in use / after application. Full compliance to the appropriate Defence Standard (if one is extant) indicates the tape / adhesive is known to meet the in-use life expected for the military levels they are recommended. Partial compliance to pH & Conductivity may mean that tape can still be suitable for short-term (1 year) or less than a Level J requirement.

Table C.1 - Use of Adhesive Systems and Tapes

Material	Specification Number	Process	Brief Description	Recommended Use And Remarks
Adhesive, Synthetic Resin for wood. Types WBP, BR, MR, and INT	BS 1204 Parts 1 and 2	D32	Two part adhesive which may be pre-mixed or applied separately.	Non-flammable. Part 1 relates to gap filling adhesives and Part 2 to close contact adhesives. Type WBP produces the durable joint whilst type INT is not suitable for joints exposed to moisture.
Classification of Thermosetting Wood Adhesive for Non-structural Applications Class C1	BS EN 12765 Class C1	D32	One part powder to which water is added.	Non-flammable. Gap filling. Joints less durable than BS 1204 type MR.
Synthetic rubber/resin Adhesive No 7	Def Stan 80-117	C43, C48, D4, D6 and D32	Aerosol pack or Sprayable / Brushable liquid. Organic solvent	Flammable. Aerosol foam is expensive. Rapid build-up of strength Not gap filling
Hot melt adhesive for packaging purposes	Commercial	D32	One part 100% solids	Applied as a bead, sets on cooling.
Tape, pressure-sensitive adhesive (waterproof transparent)	Def Stan 81-145 Type 3	C44, C48 and D3	A transparent film coated on one side with a pressure-sensitive adhesive.	Waterproof. Not suitable for closure of containers for Military Packaging. For protecting paper labels, fastening wrapping materials and securing ears of sealed barriers when folded to conform to the shape of the item. Low cost.
Tape, masking, pressure-sensitive adhesive	BS 4J11	D4	A crepe paper base coated on one surface with a pressure-sensitive adhesive.	Non-waterproof. Not suitable for closure of containers for Military Packaging. For securing expanded polystyrene fitments in a container.
Tape, Kraft Paper, Gummed	Def Stan 81-145 Type 5a	D16	Hard-sized Kraft paper uniformly coated on one side with gum.	Closure of fibreboard containers, where water resistance is not required
Tape, Kraft Paper, Gummed Reinforced	Def Stan 81-145 Type 5b	D16	Plies of Kraft paper & extensible or creped Kraft paper, laminated with synthetic resin, reinforced with an interlayer of fibre, and uniformly coated on the plain Kraft paper with gum	Closure of fibreboard containers, where water resistance is not required

Table C.1 - The Use of Adhesive Systems and Tapes (concluded)

Material	Specification Number	Process	Brief Description	Recommended Use And Remarks
Tape, pressure-sensitive adhesive, double-sided	BS 7116	D4, D6 and D7	A solid/foamed carrier or transfer tape (with or without reinforcement) having two pressure-sensitive adhesive surfaces.	Non-waterproof. Used outside the climatic barrier for fastening cushioning and bearing facing materials.
Tape, pressure-sensitive adhesive (fabric)	Def Stan 81-145 Type 2	C42 and C49	A woven fabric of cotton and/or viscose, coated on one side with a pressure-sensitive adhesive.	Non-waterproof. Used inside barriers to protect wrapping and barrier materials from sharp edges, corners, and projections. Also for fastening various wrapping materials. High cost.
Tape, pressure-sensitive adhesive (water-resistant film)	Def Stan 81-145 Type 4	C42, C44, C45, C47, D5, D16 and D20	A film-based pressure-sensitive adhesive tape coated on one side with a pressure-sensitive adhesive.	Waterproof. Used for masking or reinforcing the closure of packages or containers to Military Levels P & N. Often cheaper than Def Stan 81-145 Type 1 or Def Stan 81-25.
Tape, pressure-sensitive adhesive (water resistant, conformable)	Def Stan 81-145 Type 1	C42, C40, C47 and D16	A low density polyethylene coated on one side with a pressure-sensitive adhesive	Waterproof. For sealing joints of irregular contour and for resealing polyethylene barriers where water resistance is required. Also for fastening wrapping materials and closure of containers to Military Level J. High cost.
Tape, pressure-sensitive adhesive (water resistant fabric)	Def Stan 81-145 Type 2a	C42, D16 and D20	A woven fabric which is water resistant on one side and coated on the other side with a pressure-sensitive adhesive.	Waterproof. Used for masking or reinforcing the closures of packages or containers for Military Level J where a measure of water resistance is required. Expensive.

Note 1: Defence Standards 75-1, 75-2 and 75-3 were re-designated Def Stan 81-145 Types 1, 2 and 3 respectively.

Note 2: Def Stan 81-025 is now Def Stan 81-145 Type 2a

Note 3: Def Stan 81-047 is now Def Stan 81-145 Type 4

Note 4: Def Stan 81-126 is now Def Stan 81-145 Type 5a and Type 5b

Annex D
Innovation and New Materials

D.1 The materials and techniques listed in this document are the beneficiaries of decades of real-life experience within the military and commercial supply chains. Any new material or technique of packaging needs to prove some advantage in performance or financial improvement over the current ones, or be equivalent, before they can be considered for incorporated within Def Stan 81-041.

D.2 In order to establish equivalence in performance; proof satisfactory to the MOD must be provided. This normally entails a degree of testing using the Environmental Test Techniques indicated within Def Stan 81-041 Part 3 (or their equivalent) at a recognised test house / facility (accredited by UKAS etc.).

The actual testing required and its severity depends wholly on the proposed method or material and for what military level or purpose it is intended. This shall be determined by discussion between the MOD (DES SEOC SCP-SptEng-Pkg) the proposer and any internal MOD advocate. An advantage is acceptance by one or more MPAS Part 3 Registered contractors.

It should be understood that any proposed Trade Pack / Export Trade Pack materials / technique is the responsibility of the supplier to ensure suitability for the purpose indicated in a contract.

D.3 Any proposed new material shall consider the environment it is to be used. Maritime areas have a particular concern for smoke generation and fume toxicity of burning material and their flammability in general; Poly Vinyl Chloride (PVC), Nylon, and Polystyrene (PS) for example do not score well.

All three Services prefer new materials / techniques to further Environmental policies and not worsen them.

An innovative technique should provide some advantage for a Military Packaging Level. For example, military level packaging is designed to permit long term (multiyear) storage of items, so an effective preservation technique that is useful for one year or less is likely not to be acceptable.

Example: A biologically easily disposable flow-filler based on starch is often proposed and can be utilised for short term storage or transport in suitable environments. But, the limitations must be clearly noted, as biological attack and certain inimical environments can destroy it, making it unsuitable for Military Levels.

Most often the proposed materials easiest to accept are those which are developments of previous materials or direct replacements for materials that are no longer available, such as a method of converting fibre-board into filling material or a lighter-weight higher performance board.

Proprietary or one-source materials / techniques are harder to gain acceptance. It is preferred that any proposed material be describable for procurement in a generic fashion, preferably using National or International Standards. Modification of current Def Stans is possible if appropriate, but creation of new Def Stans is less desirable.

D.4 The method of obtaining inclusion within Def Stan 81-041 begins with an approach to DES SEOC SCP-SptEng-Pkg with a proposal taking the above into account. Discussions may result in a test requirement being set forth. If testing or the offered proof is acceptable the material / technique may be accepted where there is a benefit to the MOD.

On agreement with DES SEOC SCP-SptEng-Pkg any material that is accepted will be publicised within the Packaging Bulletin at least once, and in due course an amendment made to Part 2, Part 5 etc. of Def Stan 81-041 or other 81-nnn series Def Stan, as appropriate.

Section 3

Normative References

1 The publications shown below are referred to in the text of this standard. Publications are grouped and listed in alpha-numeric order.

Note: Def Stan's can be downloaded free of charge from the DStan web site by visiting <http://dstan.uwh.diif.r.mil.uk/> for those with RLI access or <https://www.dstan.mod.uk> for all other users. All referenced standards were correct at the time of publication of this standard (see A.2, A.3 & A.4 below for further guidance), if you are having difficulty obtaining any referenced standard please contact the DStan Helpdesk in the first instance.

Def Stans

Number	Title
80-117, Iss 3	Synthetic Rubber Resin Adhesive No.7
81-145, Iss 3	Tape, Pressure-Sensitive Adhesive for General Packaging
81-003, Iss 10	Cases, Wood (Comb-Jointed Construction)
81-005, Iss 08	Crates, Wood
81-008, Iss 7	Cases, Wood (Metal Edged Construction)
81-012, Iss 08	Cases, Wood (Panel and Batten Construction)
81-014, Iss 08	Cases, Wood (Batten and Board Construction)
81-015, Iss 06	Cartons and Boxes, Fibreboard
81-021, Iss 06	Cases, Fibreboard and Wood
81-023, Iss 06	Cases, Board, Collapsible
81-071, Iss 05	Cases, Wood, Packing, Reusable
81-101, Iss 3	Reusable Water Vapour Resistant Bags for Engine Change Units, Propulsion Units and Associated Equipment
81-113, Iss 3	Case, Wood, Collapsible, Reusable
81-135, Iss 2	Cases, Wood, Packing (Board or Panel and Batten Construction)
91-091, Iss 9	Turbine Fuel, Kerosine Type, Jet A-1; NATO Code: F-35; Joint Service Designation: AVTUR
01-005, Iss 18	Fuels, Lubricants and Associated Products
03-030, Pt 5	Treatments for the Protection of Metal parts of Service stores and Equipment

	against Corrosion - Index, Related Documents and Sources
81-068, Iss 5	Bags, Desiccant, Silica Gel and Bags, Desiccant, Activated Clay
91-027, Iss 3	Grease, Automotive and Artillery NATO Code No: G-403 Joint Service Designation: XG-279
91-038, Iss 02	Petrolatum, Technical Joint Service Designation: PX-6 Petrolatum, Technical NATO Code No: S-743 Joint Service Designation: PX-7
91-040, Iss 3	Corrosion Preventive Oil, Aircraft Engine: Piston, Metallic NATO Code: C-615 Joint Service Designation: PX-27
91-102, Iss 2	Lubricating Oil, Corrosion Preventive, Small Arms and Light Calibre Weapons NATO Code: 0-157 Joint Service Designation: OX-24
91-113, Iss 2	Lubricating Oil, Engine: Severe Duty Diesel, Extended Service - SAE 10W/30 NATO Code: O-1176 Joint Service Designation: OMD-90
81-122, Iss 3	Polyethylene, Closed Cell Film for Packaging
81-133, Iss 3	Paper, Kraft, Creped, Wet-Strengthened or Anti-Bleed
68-069, Iss 1	Silicone Compound Electrical Insulating - NATO Code S-736 - Joint Service Designation XG-250
80-034, Iss 3	Corrosion Preventive, Compound Oil, Thin Film Joint Service Designation: PX-4
80-085, Iss 1	Corrosion Preventive Compound: Soft Film, Hot Application NATO Code No: C-628 Joint Service Designation: PX-11
80-083, Iss 3	Corrosion Preventive, Hard Film, Transparent: Cold Application Joint Service Designation: PX-32
80-217, Iss 1	Corrosion Preventive Compound: Soft Film, Cold Application NATO Code: C-614 JSD: PX-1
91-105, Iss 2	Grease, Multi-Purpose, Heavy Duty NATO Code: G-421 Joint Service Designation: XG-291
81-030, Iss 5	Paper, Wrapping
81-048, Iss 04	Paper, Kraft Union (PKU) and Paper, Creped, Kraft Union Reinforced (PCKUR)
81-075, Iss 3	Barrier Material, Aluminium Foil Laminate, Flexible, Heat-Sealable, Water-Vapour Resistant
81-093, Iss 04	Paper, Wrapping Grease-Resisting and Bags, Paper, Grease-Resistant
81-112, Iss 3	Bags, Electrostatic Shielding

81-129, Iss 3	Wrapping, Mouldable, Waxed, Grease-resisting
81-134, Iss 3	Paper, Kraft, Polyethylene Coated (Heat Sealable)
93-097, Iss 2	Polyethylene Film, Black Electrically Conductive
93-116, Iss 3	Polyethylene (Low Density) Film for Packaging Types 1, 2 and 3
81-001, Iss 05	Fibreboard, Solid, Kraft-Lined Chipboard
81-027, Iss 7	Plywood for Military Packaging Applications
81-046, Iss 04	Board, Corrugated, Double-faced (Types A, B and C)
81-083, Iss 4	Bonded Polyurethane Chipfoam
81-099, Iss 4	Paper Wrapping or Location
81-116, Iss 3	Expanded Polyethylene Sheet, Types GP and QX, Grades A, B, C and D
81-119, Iss 3	Cross-Linked Expanded Ethylene-Vinyl Acetate Sheets and Mouldings
81-120, Iss 3	Medium Density Fibreboard for Packaging Applications
81-125, Iss 04	Electrostatic Conductive Foam Sheet
93-035, Iss 3	Expanded Polystyrene Mouldings Types GP and QX
81-029, Iss 05	Handles, Webbing or Rope, with Metal Brackets or Wood Blocks for Use on Containers
81-073, Iss 4	Guide on Use of Captive Fasteners
81-086, Iss 3	Metal Fittings for Wooden Containers
81-036, Iss 05	Packaging of Switches
81-039, Iss 6	Packaging of Rubber Hoses, Plastics Hoses; and Hose Assemblies
81-055, Iss 6	Packaging of Mechanical Components
81-056, Iss 05	Packaging of Pistons, Assembled or Unassembled and Piston Sets
81-058, Iss 04	Packaging of Connectors, Electrical
81-060, Iss 04	Packaging of Gaskets, Seals, "O" Rings, Grommets and Similar Materiel
81-065, Iss 05	Packaging of Electronic Panels and Equipment which may contain Electrostatic Discharge Sensitive Devices
81-077, Iss 06	Packaging of Small Robust Electrical, Electronic, Electro-Mechanical Assemblies and Sealed Electrical Indicating Instruments

00-035, Pt 4, Iss 4	Environmental Handbook for Defence Materiel - Natural Environments
00-035, Pt 5, Iss 4	Environmental Handbook for Defence Materiel - Induced Mechanical Environments
00-035, Pt 6, Iss 4	Environmental Handbook for Defence Materiel - Induced Climatic, Chemical and Biological Environments
00-035, Pt 1, Iss 4	Environmental Handbook for Defence Materiel - Control and Management
00-035, Pt 2, Iss 4	Environmental Handbook for Defence Materiel - Environmental Trials Programme Derivation and Assessment Methodologies
81-041, Pt 1, Iss 9	Packaging of Defence Materiel - Introduction to Defence Packaging Requirements
81-041, Pt 5, Iss 8	Packaging of Defence Materiel - Packaging Processes
81-041, Pt 6, Iss 09	Packaging of Defence Materiel - Package Marking
81-041, Pt 4, Iss 8	Packaging of Defence Materiel - Service Packaging Instruction Sheet (SPIS)
81-130, Iss 4	The Transportation, Handling, Storage and Packaging of Magnetically Sensitive Equipment
81-078, Iss 04	Packaging of Fractional Horsepower Motors, Electrical
81-080, Iss 04	Packaging of Transformers and Inductors
81-136, Iss 03	Packaging of Metal Pipes and Pipe Assemblies
00-003, Iss 5	Design Guidance for the Transportability of Equipment
00-035, Pt 3, Iss 4	Environmental Handbook for Defence Materiel - Environmental Test Methods
00-035, Iss 2	Environmental Handbook for Defence Materiel
00-088, Iss 3	Packaging for Ammunition and Explosives
81-041, Pt 2, Iss 8	Packaging of Defence Materiel - Design
81-041, Pt 3, Iss 06	Packaging of Defence Materiel - Environmental Testing

STANAGs

Number	Title
2828 Edition 7	MILITARY PALLETS, PACKAGES AND CONTAINERS - APP-22 EDITION A
4398 Edition 1	NATO REQUIREMENTS FOR RE-USABLE CONTAINERS - AEPP-1

Allied Publications

Number	Title
APP-22 Edition A Version 1	MILITARY PALLETS, PACKAGES AND CONTAINERS
AEPP-01 Edition 1	NATO REQUIREMENTS FOR REUSABLE CONTAINERS

Other References

Standard Type	Standard Name
CIVIL	BS 245 Specification for Mineral Solvents (White Spirit and Related Hydrocarbon Solvents) for Paints and Other Purposes
CIVIL	BS 2869 -2 Fuel Oils for Agricultural and Industrial Engines and Boilers, Specification for Fuel Oil for Agricultural and Industrial Engines and Burners (classes A2, C1, C2, D, E, F, G and H)
CIVIL	BS ISO 27831 - 1 Metallic and other inorganic coatings - Cleaning and preparation of metal surfaces Part 1: Ferrous metals and alloys
CIVIL	BS ISO 27831 - 2 Metallic and other inorganic coatings - Cleaning and preparation of metal surfaces Part 2: Non-Ferrous metals and coatings
CIVIL	BS 1133 - 19 Packaging Code: Section 19; Use of Desiccants in Packaging
CIVIL	BS 2540 Specification for Granular Desiccant, Silica Gel (Withdrawn)
CIVIL	BS 4072 Wood Preservation by Means of Copper/Chromium/Arsenic preparations for wood preservation (Withdrawn)
CIVIL	BS 5707 Specification for Preparations of Wood Preservatives in Organic Solvents
CIVIL	BS 7195 Guide for Prevention of Corrosion of Metals Caused by Vapours from Organic Materials
CIVIL	BS 7529 Specification for Desiccant Activated Clay (Obsolescent)

CIVIL	BS 4881 Specification for Polypropylene Film, Cords, Lines and Twines
CIVIL	BS 6125 Specification for Natural Fibre Cords, Lines and Twines (Withdrawn)
CIVIL	BS EN 300 Oriented Strand Board (OSB). Definitions, Classification and Specifications
CIVIL	BS EN 636 Plywood Specifications
CIVIL	BS 1726-2 Cylindrical helical springs made from round wire and bar - Guide to methods of specifying, tolerances and testing - Part 2: Extension springs
CIVIL	BS 2548 Specification for Wood Wool for General Packaging Purposes
CIVIL	BS 3379 Combustion modified Flexible Polyurethane Cellular Materials for Load Bearing Applications, Specification
CIVIL	BS 3837-1 Expanded Polystyrene Boards; Boards and blocks manufactured from expandable beads, Requirements and Test Methods
CIVIL	BS 7200 Specification for Synthetic-Fibre Needlefelts
Other	DR/4 Package Cushion Design Data
CIVIL	BS 4J 11 Specification for pressure-sensitive adhesive paper masking tape
CIVIL	BS 1204 Specification for type MR Phenolic and Amino plastic Synthetic Resin Adhesives for Wood (withdrawn)
CIVIL	BS 7116 Specification for double sided pressure sensitive adhesive tapes
CIVIL	BS EN 923 Adhesives - Terms and Definitions
CIVIL	BS EN 12481 Self-adhesive tapes, Terminology
CIVIL	BS EN 12765 Classification of Thermosetting Wood Adhesive for Non-structural Applications
CIVIL	BS EN 209 Steel Drums Removable head (Open Head) Drums with a Minimum Total Capacity of 210 l
CIVIL	BS EN 210 Steel Drums Non-removable head (Tight Head) Drums with a Minimum Total Capacity of 216, 5 l
CIVIL	BS 1133 - 7 Packaging Code: Section 7 Paper and board wrappers, bags and containers (Withdrawn)
CIVIL	BS 1133 - 7.6 Packaging Code: Section 7.6 Moulded Pulp Packaging

CIVIL	BS 1133 - 8 Packaging Code: Section 8 Wooden Boxes, Cases and Crates
CIVIL	BS 1133 - 10 Packaging Code: Section 10 Metal Containers
CIVIL	BS 1133 - 18 Packaging Code: Section 18 Packaging in Glass (Withdrawn)
CIVIL	BS 1133 - 22 Packaging Code: Section 22 Packaging in Plastics Containers
CIVIL	BS 1262 Metal packaging - Round lever-lid metal containers for surface coatings - Specification
CIVIL	BS 1702 Specification for Mild Steel Drums (Heavy Duty - Fixed Ends)
CIVIL	BS 1764 Specification for Nominal Diameters of Round Built-up Tins (Withdrawn)
Other	UK/CIS/22 Containers, Tin, Rectangular, for Packaging of Paints and Chemicals
CIVIL	BS ISO 6780 Flat pallets for intercontinental materials handling - Principal dimensions and tolerances
CIVIL	BS ISO 6780 Flat pallets for intercontinental materials handling - Principal dimensions and tolerances
CIVIL	BS EN 13246 Specification for Tensional Steel Strapping
CIVIL	BS EN 13394 Specification for Non-metallic Tensional Strapping
CIVIL	BS 1133 - 15 Packaging Code: Section 15 Tensional Strapping
CIVIL	BS 1133 1 to 3 Packaging Code Sections 1 to 3 Introduction to Packaging (Withdrawn)
CIVIL	BS 1202 -1 Specification for nails; Steel nails
CIVIL	BS 1210 Specification for wood screws (obsolescent)
CIVIL	BS 3964 Specification for flexible vulcanized fibre sheets (withdrawn)
CIVIL	BS 718 Specification for density hydrometers
CIVIL	BS 8888 Technical Product Documentation (TDP) Specification for Defining Specifying and Graphically Representing Products (Withdrawn)
CIVIL	BS EN 336 Structural timber - Sizes, permitted deviations
CIVIL	BS EN 10230 - 1 Steel Wire Nails; Loose nails for general applications
CIVIL	BS EN 13246 Packaging; Specification for tensional steel strapping

CIVIL	BS EN 13394 Packaging; Specification for non-metallic tensional strapping
CIVIL	BS EN 14592 Timber structures - Dowel-type fasteners - Requirements
CIVIL	BS EN 1995-1-1 Eurocode 5: Design of timber structures Part 1-1: General - Common rules and rules for buildings
CIVIL	BS EN 61340-5-1 Electrostatics. Protection of Electronic Devices from Electrostatic Phenomena. General Requirements
CIVIL	BS ISO 21067 Packaging - Vocabulary
Other	DGS PS 5104 Cleanliness and Packaging Requirements for Naval Nuclear Primary Plant
Other	ISPM 15 International Standards for Phytosanitary Measures, Publication No. 15 Guidelines for Regulating Wood Packaging Material in International Trade
Other	MIL-I-8835A Indicator, Humidity, Card, Chemically Impregnated

2 Reference in this Standard to any normative references means in any Invitation to Tender or contract the edition and all amendments current at the date of such tender or contract unless a specific edition is indicated. Care should be taken when referring out to specific portions of other standards to ensure that they remain easily identifiable where subsequent amendments and supersession's might be made. For some standards the most recent editions shall always apply due to safety and regulatory requirements.

3 In consideration of clause A.2 above, users shall be fully aware of the issue, amendment status and application of all normative references, particularly when forming part of an Invitation to Tender or contract. Correct identification of standards is as defined in the ITT or contract.

4 DStan can advise regarding where to obtain normative referenced documents. Requests for such information can be made to the DStan Helpdesk. Details of how to contact the helpdesk are shown on the outside rear cover of Defence Standards.