Ministry of Defence

Defence Standard 81-41 Part 3

Issue 6 **Date: 12TH June 2014**

Packaging of Defence Materiel

Part 3: Environmental Testing

Contents

Figures

Tables

Foreword

AMENDMENT RECORD

Amd No	Date	Text Affected	Signature and Date

REVISION NOTE

This standard is raised to Issue 6 to update nominative standards and update format.

HISTORICAL RECORD

This standard supersedes the following:

Def Stan 81-41 (Part 3)/4 dated 01 October 2007

Def Stan 81-41 (Part 3)/4 dated December 1998

Def Stan 81-41 (Part 3)/3 dated June 1991

Def Stan 81-41 (Part 2)/2 dated July 1984

Def Stan 81-41 (Part 1)/1 dated August 1981

DG-11 Part V Issue 3 dated 1980

DG-11 Part V Issue 2 dated 1976

DG-11 Part V Issue 1 dated 1969

a) This part of the standard provides the environmental testing requirements for packaging designed to meet the needs of the MoD.

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) Inventory Management Operations Centre (IMOC), Support Chain Process (SCP), Packaging Policy (Pkg); (DES IMOC SCP-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.

d) 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.

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

f) 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.

0 Introduction

0.1 Environmental package testing is primarily intended to assess the overall ability of the package to provide the required level of protection for the enclosed materiel whilst in store or being transported. This usually involves subjecting a package design to a cumulative series of tests. The scope and degree (severity) of this testing is dependent upon the environments and hazards expected to be encountered during the package's life cycle.

0.2 Ideally the tests would accurately simulate the life cycle and successful completion would give confidence in the adequacy of a package design, and achieve a high level of confidence in the ability of the package to meet the expected hazards. In practice the package may not be subjected to all desired tests as the nature of the packaged item and the detail of the package design may determine that only certain tests are appropriate or possible.

0.3 However, sufficient evidence for adequate (or otherwise) performance may be gained by subjecting the package to climatic and physical tests alternately where the first test acts as a conditioning test for the next. Information may be usefully gained by simultaneously subjecting two or more packages to the same test sequence and withdrawing one at each stage for detailed examination.

Intentionally Left Blank

Packaging of Defence Materiel - Part 3: Environmental Testing

1 Scope

The tests depicted or referenced in this standard adequately simulate the environmental (climatic) and physical hazards normally expected in a package life cycle for military usage. On occasion other tests may be required to assess suitability against further specialist criteria, e.g., magnetic or electrostatic protection; these are dealt with by other standards.

1.1 This standard does not cover certification testing of packaging for the supply or carriage of dangerous goods.

1.2 Testing to NATO Levels (STANAG 4280) is covered by STANAG 4340 and related Allied Engineering Practice Publications (AEPP-3). It notes many of the differences to this standard in UK reservations, and is not covered by this standard.

2 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.

3 Normative References

3.1 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://www.dstan.dii.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 3.2, 3.3 & 3.4 below for further guidance), if you are having difficulty obtaining any referenced standard please contact the DStan Helpdesk in the first instance

BS 4826 - 6	Methods of Test for Complete, Filled Transport Packages – Part 6: Method for determination of resistance to a fixed low frequency vibration (Withdrawn)
BS 4826 - 10	Methods of Test for Complete, Filled Transport Packages – Part 10: Method for determination of the resistance to water spray (Withdrawn)
BS 4826 - 13	Methods of Test for Complete, Filled Transport Packages – Part 13: Method for determination of resistance to immersion in water (Withdrawn)
BS EN 22206	Complete, filled transport packages - Method for identifying parts when testing
BS EN 22248	Complete, filled transport packages - Method for determination of resistance to vertical impact by dropping
BS EN 22872	Complete, filled transport packages - Method for determination of resistance to compression
BS EN 22874	Complete, filled transport packages – Method of test for stacking using compression tester
BS EN 22876	Complete, filled transport packages - Method for determination of resistance to damage by rolling

BS EN 28474	Complete, filled transport packages - Method for determination of resistance to immersion in water
BS EN 28768	Complete, filled transport packages - Method for determination of resistance to damage by toppling
BS EN ISO 2233	Packaging - Complete, filled transport packages and unit loads - Conditioning for testing
BS EN ISO 2244	Packaging - Complete, filled transport packages and unit loads – Horizontal impact tests
BS EN ISO 2234	Packaging - Complete, filled transport packages and unit loads - Stacking tests using a static load
BS EN ISO 2873	Packaging - Complete, filled transport packages and unit loads – Low pressure test
BS EN ISO 8318	Packaging - Complete, filled transport packages and unit loads – Sinusoidal vibration tests using a variable frequency
BS EN 60068-2-17	Environmental Testing – Part 2-17 Test Q Sealing; Test Qf Immersion
BS EN 60068-2-27	Environmental Testing – Part 2-27 – Part 2-27: Tests — Test Ea and guidance: Shock
BS EN 600868-2-31	Environmental Testing – Part 2-31 Tests – Test Ec Rough handling shocks, primarily for equipment-type specimens
Def Stan 00-3	Design Guidance for the Transportability of Equipment (Interim)
Def Stan 00-35 - 3	Environmental Handbook for Defence Materiel - Part 3: Environmental Test Methods
Def Stan 00-35 - 4	Environmental Handbook for Defence Materiel - Part 4: Natural Environments
Def Stan 81-41 - 1	Packaging of Defence Materiel - Part 1: Introduction to Defence Packaging Requirements
Def Stan 81-41 - 2	Packaging of Defence Materiel - Part 2: Design
STANAG 4280	NATO Levels of Packaging
STANAG 4340	NATO Standard Packaging Test Procedures
AEPP-3	NATO Standard Packaging Test Procedures

3.2 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.

3.3 In consideration of clause 3.2 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 application of standards is as defined in the ITT or contract.

3.4 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

4 Definitions

4.1 Units.

All dimensions, (length, height, width etc), referenced are in millimetres (mm); all weights, or mass, referenced are in Kilograms (kg)

4.2 Standard Laboratory Conditions (SLC)

Unless otherwise stated, these shall comply with Def Stan 00-35 part 3 Clauses 2 and 3 and test tolerances with Clause 4.

5. Package Information and Detail

The minimum information to be provided and recorded on receipt of items for testing shall be;

a) Packaged items Service Identification particulars, e.g., Item name, NATO Stock Number (NSN), serial numbers, pack codes, drawing numbers, make, model and modification status and details.

b) Package Design Reference Number, e.g., SPIS number or similar identification, container specification or standard number etc.

c) Packaging Level

d) Gross Package mass

e) Package external dimensions

f) Primary Package Quantity (PPQ)

g) C of G (Centre of Gravity) (where relevant)

h) Visual description, recording any damage, deviations or anomalies from specification or standard

6 Identification of Faces / Sides, Edges & Corners

This shall conform to BS EN 22206; the following scheme shall be used to consistently identify the faces, edges, and corners for testing purposes.

6.1 Rectangular packages

Table 1 Face, Edge & Corner Identification

Face	Top	Right Side	Base	Left Side	Near End	Far End
Identity	1	2	3	4	5	6

6.1.1 Edges are identified by the numbers of the two adjacent faces, e.g., 1 / 2 are between the top and right side faces.

6.1.2 Corners are identified by the numbers of three adjacent faces, e.g., 1 / 2 / 5 is the top - right side – near end corner.

6.1.3 The manufacturers' joint shall be on the near end (Face 5) at edge 5/2.

6.2 Cylindrical packages

6.2.1 The container shall be marked as shown in Figure 1. The quarter points (90° angular spacing) around the top edge of the package shall be designated as points 1, 3, 5 and 7. Those around the bottom edge shall be designated as points 2, 4, 6 and 8.

6.2.2 Where a movable locking collar is present the lever housing shall be situated at a point on the circumference of the top midway between points 1 and 3.

6.2.3 Imaginary lines joining the top and bottom edge quarter points shall be parallel and shall be designated as 1/2, 3/4, 5/6 and 7/8 respectively.

6.2.4 If the package has one or more manufacturer's joints, one of the joints shall occupy the position 5/6.

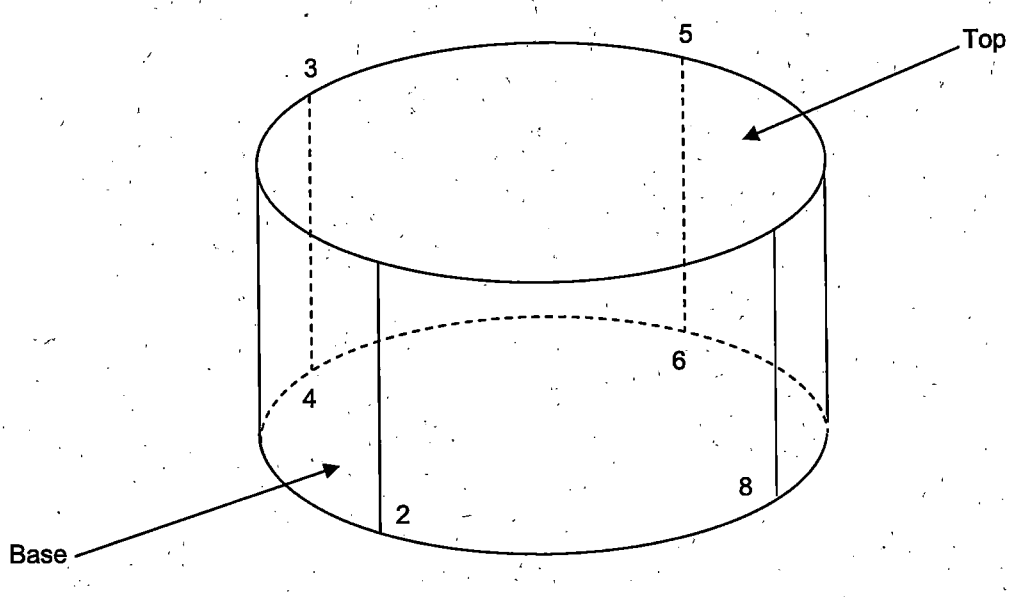

Figure 1 Identification of Cylindrical Packages Faces / Sides

7 Choice of Test Methods and Sequence

The individual test methods that may be chosen to assess the ability of the package to meet Military Levels of packaging are shown in Table 2 and detailed in the Test Methods.

Table 2 Applicability of Tests

Test Description	Military Level			Test	Def Stan 00-35 Method
	J	N	P		
Bounce (wheeled vehicle transportation)	Yes	Yes		A	M11
Damp Heat	Yes			B	CL6
Dry Heat	Yes			C	CL2
Impact (horizontal)	Yes	Yes		D	M5
Impact (vertical)	Yes	Yes	Yes	E	M5
Lifting	Yes	Yes		F	-
Low Temperature	Yes			G	CL5
Static Load	Yes	Yes		H	-
Temperate Storage †		Yes	Yes	-	-
Vibration	Yes	Yes		K	M1
Water Spray	Yes	Yes		L	CL27
Bending	Yes	Yes	Yes	M	-
Dry Heat Exposure (solar radiation)	Yes			N	CL2
Flexing (racking)	Yes	Yes	Yes	P	-

Table 2 (Continued)

Test Description	Military Level			Test	Test Method
	J	N	P		
Topple	Yes	Yes		Q	M4
Rolling	Yes			R	M4
Bump	Yes	Yes		S	M12
Water Immersion	Yes			T	CL29
Fragility Assessment *	Yes	Yes	Yes	U	-
Corner-wise Drop (rotational) +				V	AEPP-3
Edge-wise Drop (rotational) +				W	AEPP-3
Mechanical Handling +				X	AEPP-3
Leaks in Containers +				Y	AEPP-3
Heat-sealed Seam Test +				Z	AEPP-3

Note 1: * for packaging design information

Note 2: + Tests normally only for NATO assessments and comply with STANAG 4340 & AEPP-3. These are noted here only for information.

Note 3: † this test is no longer used in this issue of the standard, listed for information only

7.1 Consideration should be given to; the Military Packaging Level, the packaged materiel's nature, special requirements and package design features. If for example there is a special operational requirement additional testing, with suitably modified parameters, may be required.

7.2 Testing may not be required where; the package design is very simple, where experience of a technically similar items package is deemed to confirm suitability, where results of development tests are deemed to provide adequate evidence for package design acceptance.

7.3 Additional tests to those normally used, with suitably modified parameters, may be required when;

a) Packages are of abnormal dimensions or shape

b) There are Special Operational and / or Deployment requirements

c) A proposed test is not available or feasible (by agreement, with the Design Authority)

d) There is a particular hazard to be considered

e) The construction of the package or nature of the item requires performance validation

f) The materiel is required to be Air Portable (reference Def Stan 00-3)

7.4 By agreement dummy loads may be used in the test package instead of the item normally packaged. However, the dummy load shall be representative of the packaged item.

8 Conditioning

8.1 Prior to any form of testing the (test) package shall be conditioned. Conditioning shall comply with the following text and BS EN ISO 2233.

8.1.1 Unless otherwise specified the conditioning shall comply with SLC for a period of not less than 16 hours or until temperature stabilization is reached; see Def Stan 00-35 Part 3 Clause 5 (whichever is the shortest period).

8.1.2 The specified conditioning regime shall either;

a) Be one that conforms to one of the conditions shown in Table 3 or BS EN ISO 2233 Table 1 Atmospheric conditions, or

b) Is a regime of temperature and Relative Humidity (%RH) that has been agreed with the submitter, tester and Design Authority as appropriate

8.2 Temperature and relative humidity tolerances shall comply with BS EN ISO 2233. However, the temperature tolerances are not necessarily those required to maintain the required RH tolerances. In some cases closer temperature control may be required to comply with the required RH tolerances.

8.3 When conditioning has been carried out within an environmental chamber the subsequent tests shall be carried out within the chamber where possible. However, when this is not practicable, the test shall proceed immediately the package is withdrawn from the chamber.

Table 3 Conditioning

Condition		Temperature		Relative Humidity (RH) ± 5%
BS EN ISO 2233	Def Stan	Degrees Centigrade (°C)	Tolerance	
1	A	-55	±3	Not specified
2	B	-35	±3	Not specified
3	C	-18	±2	Not specified
4	D	5 ±1		85
5	E	20	±2	65
6	F	20	±2	90
7	G	23	±2	50
-	H	27	±2	65
8	-	30	See BS EN ISO 2233	85
9	-	30	" "	90
10	J	40	±2	Uncontrolled
11	L	40	±2	90
12	M	55	±3	30

Note: Care shall be taken to ensure that the dew point is not reached when using condition 4 or D.

9 General Test Evaluation

Where noted the test evaluation is normally as specified in Def Stan 00-35 Part 3 test methods, however the following shall always be included.

9.1 Failure

9.1.1 Test failure is normally considered to have occurred when;

a) There is any malfunction of the fittings and hardware (seals, closures, hinges, handles, etc.),

b) There is any damage to or spillage of the package contents

c) The packaged item is unserviceable or if the package is affected in any way, which would potentially, cause the item to be unserviceable.

9.1.2 Minor visible deterioration does not necessarily constitute failure of the package.

9.1.3 It should always be taken into account that failure is not always apparent until the test package is subjected to more than one test in a given sequence.

9.2 A test report shall be prepared certifying; compliance with or deviation from the methods used, the acceptability of the test package, all causes of any package failure, and any minor visible deterioration of the test package

10 Test A: Bounce (Wheeled Vehicle Transportation) Test

10.1 Scope

This test is intended to assess the capability of the package to withstand the hazards associated with transit by road, without degradation of the package, internal packaging components or damage to the packaged item.

10.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 2-11, Test M11.

10.2.1 Severity

A single package, or packages standing within a stack, shall be tested as per Table 4 while standing on its base or the face on which it is normally expected to be transported, unless otherwise specified. If a number of test attitudes are required the test period shall be divided equally between them.

Table 4 Bounce (Wheeled Vehicle) Test - Test period

Military Packaging Level	J	N	P
Test Period	15 minutes ± 45 seconds	5 minutes ± 15 seconds	Not Applicable*

Note: * unless otherwise specified

11 Test B: Damp Heat Test

11.1 Scope

The test is primarily intended to assess the effectiveness of the climatic protection provided by the package. The test may also be used to condition the package for assessment of the effects of tropical climate on the performance of its physical protective elements, e.g. the performance of the container, its furniture, load-bearing and cushioning materials may be reduced. When the damp heat test is sequentially applied with physical tests such as Bounce or Impact, it may reveal weaknesses in the climatic protection such as abrasion or rupture of barriers, which have occurred during these tests.

11.1.1 This test is applicable to Military Packaging Level J, approved materials as Test B and non-approved as B1.

11.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 3-06, Test CL6.

11.2.1 Test Regime

The package shall be placed in a suitable test chamber maintained at standard laboratory conditions. It shall stand on its base or the face upon which it is normally expected to be transported or stored. It shall be subject to a number of complete 24-hour cycles noted in Table 5 subject to the conditions shown in Table 6.

Table 5 Damp Heat Test (Number of Complete 24-Hour Cycles)

Test	**B**	**B1**	**B2***
Number of Complete Cycles	4	21	28

Note: *Test B2 is normally only used in NATO testing, included here for completeness and comparison

Table 6 Climatic Chamber Conditions for Damp Heat Test

Temperature (°C) (Tolerance ± 2)	**Humidity** (%RH) (Tolerance as stated)	**Duration** (Hours) (Tolerance ± 5%)
The package shall be exposed to standard laboratory conditions		
Adjusted to 25	Adjusted to 60 ± 15	Sufficient to allow package to stabilise
25	Raised to not less than 95	1
Followed by the following 24 hour cycle		
Raised to 40 at a uniform rate	not less than 90	3
40	91 ± 5	9
Reduced to 25	not less than 90	3
25	not less than 95	remainder of 24

12 Test C: Dry Heat Test

12.1 Scope

12.1.1 The test is primarily intended to assess the effects of drying on the protective properties of the package. That is, through shrinkage of timber and loosening of fastenings, (so the packaged item is permitted free movement); the drying out of paper-based materials and the degradation of some rubbers and plastics.

12.1.2 Subsequent physical tests, e.g. bounce and impact should be carried out with minimum delay.

12.1.3 The test is applicable to Military Packaging Level J

Note: If it is intended to carry out Test N 'Dry Heat Exposure Test', Test C is usually unnecessary

12.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 3-02, Test CL2 - Clause 2.2.2, Temperature Test Procedure –

12.2.1 The Test Severity shall be 'C' (+55 ± 2 °C)

12.2.2 Additional requirements

The test period shall be (48 ± 1) hour and throughout the test the humidity shall not exceed 75% RH or a water vapour pressure of 0.3 MPa (30 mbar), whichever is less.

13 Test D: Impact (Horizontal) Test

13.1 Scope

This test is performed to demonstrate the ability of a package of gross mass 225 kg and above to withstand horizontal impacts at a velocity of 2.5 ms^{-1} simulating impacts in crane lifting, rail shunting and other violent movements of the transporting vehicle.

13.1.1 This test is applicable to Military Packaging Levels J or N.

13.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 2-05, Test Method M5 – Horizontal Test (based on BS EN 60086-2-31), as amended in this standard.

13.2.1 Apparatus

13.2.1.1 Impact surface:

a) This shall have dimensions greater, i.e., be larger, than those of the impacting face, or specified area, of the package under test.

b) It shall be sufficiently rigid not to deflect more than 0.25 when an area of 100 mm^2 anywhere on the surface is loaded to 160 kg mass.

13.3 Procedure

13.3.1 All Tests

13.3.1.1 The test shall be carried out, if possible, at the same conditions used for conditioning, or if not the test shall commence within 5 minutes of removing the package from those conditions.

13.3.1.2 The impact velocity shall be (2.5 ms^{-1} ± 5% of the predetermined horizontal velocity).

13.3.1.3 When the impact is on a face or edge, the package shall strike the impact surface so that the angle between the face or edge and the plane of the impact surface is less than 2 degrees.

13.3.1.4 When the impact is on an edge of a parallelepiped package, the attitude of the package at impact shall be such that the angle between a prescribed surface of the package and the impact surface is within (± 5 degrees) or (± 10% of the permitted angle) whichever is the greater.

14 Test E: Impact (Vertical) Test

14.1 Scope

This test specifies a method of making a vertical impact test on a package by dropping. It may be performed either as a single test to investigate the effects of vertical impact or as part of a sequence of tests designed to measure the ability of a package to withstand a distribution system that includes a vertical impact hazard.

14.1.1 This test is applicable to Military Packaging Levels J, N and P.

14.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 2-05 Test Method M5 – Vertical Test, (based on BS EN 60086-2-31), severity as amended in this standard, for all packages up to and including 450 kg.

For packages above 450 kg, see **15.2.2**

14.2.1 Additional Tolerances

a) When a completely free fall is not possible the impact velocity shall be within (± 1%) achieved in free fall.

b) Drop height Tolerance shall be (± 2%) of the specified height.

c) Impact attitude tolerances shall be;

1) for face or edge drops: 2 degrees maximum between the impacting face, or edge, and the horizontal surface

2) for edge or corner drops: the angle between the specified surface of the package and the horizontal surface (± 1 degree)

d) For Levels J and N, packages not rectangular prisms in shape, nor having a designated base, shall be dropped on each face, corner or seam as deemed necessary by the requesting and approving authority. Depending on the mass of the package and Military Packaging Level, the drop height will be as indicated in **15.2.2** Table 7.

14.2.2 Test Severity for Packages

For all packages up to and including 450 kg, comply with the procedure stated in Chapter 2-05 of Defence Standard 00-35 Part 3, and summarised in Table 7. For all packages over 450 kg, this procedure is modified and stated in **Table 7**.

Table 7 Test E: Impact (Vertical) Test Severity

Military Packaging Level	Package Mass (kg)	Drop height (mm)	Procedure
J	≤ 30	(1 000 ± 5)	Dropped once onto its designated base and all perpendicular and parallel faces
	>30 ≤ 225	(500 ± 5)	Dropped once onto its designated base
	>225 ≥ 450	(300 ± 10)	
	< 450	(300 ± 10)	Dropped on its designated base by raising one end of the package and releasing. Each end shall be lifted and dropped in turn
N	≤ 450	(300 ± 10)	Dropped once onto its designated base
	> 450	(300 ± 10)	Dropped on its designated base by raising one end and releasing. Each end shall be lifted and dropped in turn.
P	≤40	(150 ± 5)	Dropped once onto its designated base
	> 40	(75 ± 5)	

15 Test F: Lifting Test

15.1 Scope

This test is performed to determine whether a container or package can be lifted either manually or with various mechanical handling methods without incurring damage.

15.1.1 This test is applicable to Military Packaging Levels J and N

15.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 2-15, 'Test M15 – Lifting Test', as modified here.

15.2.1 General

a) The test temperature and humidity test band shall be stated.

b) Test containers / packages shall be conditioned in accordance with Clause **8.**

c) The items shall be suspended from each test point for 5 minutes unless otherwise specified.

d) The test load / mass should be distributed to maintain the normal Centre of Gravity as far as possible.

15.2.2 Safety

15.2.2.1 The loaded container must be capable of being lifted safely.

15.2.2.2 Each lifting sling used for these tests shall have suitable safe working load carrying capacity. Particular attention should be paid to the lifting arrangements to ensure that no screws, rivets etc, are loosened and that there is no fraying of rope or tearing of webbing strap.

15.2.3 Apparatus

This includes suitable; pallet truck, forklift truck, dump truck, slip-sheet truck, overhead crane, lifting cables, slings and chains as applicable.

15.2.4 Procedure

15.2.4.1 Containers Fitted with Handles

a) These shall be subjected to a static load of three times the design gross packaging mass.

b) Lift and freely suspend the test item from each handle in turn.

15.2.4.2 Containers Fitted with Lifting Attachments

a) These shall be subjected to a static load of twice the design gross packaging mass.

b) Lift the test item using slings attached to the lifting points; the angles between the legs of a two-legged sling and the diagonally opposite legs of a four-legged sling shall be (75 ± 15) degrees.

15.2.4.3 Containers Fitted with Fork Lift Facilities

a) These shall be subjected to a static load of 1.25 times the design gross package mass.

b) The container shall be lifted clear of the ground by forklift truck. The forks shall extend to at least 66% of the underside dimensions of the base of the specimen across which the forks are carrying out the lift.

15.2.4.4 Containers Provided For Grabs

a) These shall be loaded to twice the gross package mass.

b) The specimen shall be lifted clear of the ground and suspended by grabs applied at the designed grab points.

15.2.4.5 Containers with No Lifting Devices

a) These shall be loaded to three times the gross package mass.

b) The specimen shall be lifted clear of the ground and suspended by two slings positioned at (15 ± 5) % of the length of the container from each end. The angle between the diagonally opposite legs of the slings shall be (75 ± 15) degrees.

16 Test G: Low Temperature Test

16.1 Scope

The test is primarily intended to condition the package and its contents to enable assessment to be made of the effect of low temperature on the protective properties of the package, e.g. the stiffening of cushioning materials, the contraction and stiffening of barriers, etc.

16.1.1 This test is normally applicable to Military Packaging Level J.

16.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 3-05, Test CL5 – 'Low Temperature Test' – Temperature Test Procedure

16.2.1 The test temperature shall be (-13 ± 2) °C or Test CL5 Severity 'C0' (-21 ± 2) °C or a severity as agreed.

16.2.2 Procedure

16.2.2.1 The package shall be placed in a suitable test chamber at standard laboratory conditions. It shall stand on its base or the face upon which it is normally expected to be transported or stored.

16.2.2.2 The chamber temperature shall be maintained at the test temperature for:

a) (16 ± 0.5) hours after the package has reached the test temperature, or

b) (168 ± 1) hours if the time required for the complete package to reach test temperature cannot be assessed.

17 Test H: Static Load Test

17.1 Scope

17.1.1 This test is applicable to packages, which may be subjected to the compressive loads applied to lower containers in a stack of identical containers. It is also applicable to packages that may be subjected to side compressive loads that are applied whilst being lifted by a net.

17.1.2 The test is intended to assess the effect on the protective qualities of the container in compression, where buckling, crushing or partial collapse of the container may mean unacceptable transfer of the load to the packaged item, and to check the stability of the packages when stacked.

17.1.3 Where the interface between test-items are of interest, a minimum of two identical test items are used

17.1.4 This test is applicable to Military Packaging Levels J and N.

17.2 Testing

The following standards are referenced;

a) DEF STAN 00-35 Part 3 Issue 4 Chapter 2-16 Method - M16, BS 2234 Packaging - Complete, filled transport packages and unit loads - Stacking tests using a static load,

b) BS EN ISO 2234 Packaging - Complete, filled transport packages and unit loads - Stacking tests using a static load

c) BS EN 22872 Complete, filled transport packages - Method for determination of resistance to compression

d) BS EN 22874 Complete, filled transport packages - Method of test for stacking using compression tester

17.2.1 Conditioning

a) Test packages shall be conditioned in accordance with Clause **8**.

b) The test shall be carried out if possible in the same environmental conditions used for conditioning, or by agreement it shall commence within 5 minutes of removing the package from those conditions.

17.2.2 Apparatus

The testing apparatus shall be capable of imposing a constant downward vertical force on the test specimen and includes:

a) A Horizontal mounting surface, which is flat and rigid.

Note: A concrete floor at least 150 mm thick is suitable.

b) A Loading platform, which is free to tilt when placed centrally on top of the package, shall be large enough to extend to at least 100 mm over all sides of the top surface of the package and rigid enough to support the load completely without deformation. The load and loading platform may be integrated.

c) A means of loading, such that the loading platform can be placed centrally over the test package.

Note: The load can be applied by means of; weights or a compression testing machine (hydraulically, pneumatically or mechanically activated) with suitable force and deflection recording devices and one fixed and one floating rigid platen.

17.2.3 Procedure

a) Place the package in the predetermined attitude on the flat horizontal surface

b) Place the loading platform centrally over the test package, so that it extends at least 100 mm over all sides of the top surface. The total applied load (e.g., mass of weights and loading platform) shall be within ±2% of the specified load.

c) The specified load shall be applied to the loading platform for (24 ± 1) hours, or 8 days for a non-approved materials / container.

Note: When using weights place them on the loading platform without impact, ensuring that they are in full contact with the loading platform before being released. Distribute the weights uniformly over the part of the loading platform surface in direct contact with the package, to ensure that the CG of the load is immediately above the centre of the package. The distance of the CG of the load above the loading platform shall not exceed 50% of the height of the package.

d) After testing remove the load and examine the package and contents.

17.3 Severity

The test force shall simulate the actual force on the bottom package of a stack of identical packages, including contents, as follows

Mass (kg)	Stack height (simulated) (mm)
≤15	2 000
>15	6 000

Note 1: When simulating net loads the package shall stand on its side or end, relative to the base, and the load shall be half of the load calculated in as appropriate.

Note 2: NATO Levels 1 to 3 as above except for packages over 15 kg, when the total height is 4 000 mm.

18 Test K: Vibration Test

18.1 Scope

This test is performed to demonstrate the ability of a package to withstand vibration over a frequency range encompassing general transportation.

18.2 Testing

18.2.1 The test method, apparatus, procedure and evaluation shall comply with; DEF STAN 00-35 Part 3, Chapter 2-01 Clause 3.2.2 and Annex B Clause B.2 'General Transportation', or Annex A Fig A1 Basic Spectrum (On-Road) Random Vibration. The random vibration method is preferred.

Note 1: If Transportation other than by Wheeled Vehicle is envisaged, guidance should be sought from Def Stan 00-35 Part 3, Chapter 2-01 Test M1 Annex A for the appropriate vehicle parameters.

Note 2: If, because of the geometry of the package, it is considered impracticable or unnecessary to vibrate the package in a particular plane, the package shall be vibrated for three hours in each of the two remaining test planes.

18.2.2 Procedure Additional Requirements

Immediately upon removal from the conditioning chamber, the test package should be firmly secured to the vibrating surface in its normal orientation for transport and test.

19 Test L: Water Spray – Driving Rain Test

19.1 Scope

This test is conducted to demonstrate the ability of a package to withstand exposure to continuous water spray that simulates natural rainfall.

19.1.1 This test is applicable to Military Packaging Levels J and N

19.2 Testing

The overall scope, test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3 Chapter 3-27, Test CL27 – 'Driving Rain'

19.2.1 After testing the package shall stand at standard laboratory conditions for at least 16 hours.

Note 1: Water Spray (not Driving rain) was covered by BS 4826 Part 10 (Withdrawn) used mostly as part of a conditioning process with other tests.

Note 2: Mist, Fog and Low cloud is covered by DEF STAN 00-35 Part 3 Chapter 3-26, Test CL26.

20 Test M: Bending Test

20.1 Scope

20.1.1 The test is to assess the resistance of the package to bending, (i.e., rigidity along its length), as well as its ability to withstand compressive loads across its section.

20.1.2 Application of this test is normally confined to packages of a length exceeding four times the smallest cross-sectional dimension of the package and with contents vulnerable to damage through bending, or to packages failure of which, through bending, could be a cause of later un-serviceability of the item.

20.1.3 This test is applicable to Military Packaging Levels J, N and P.

20.2 Testing

The test method, apparatus, procedure and evaluation shall comply with; "DEF STAN 00-35 Part 3, Chapter 2-17, Test M17 – Bending Test" as modified here.

20.2.1 Test packages shall be conditioned in accordance with Clause 8.

20.2.2 For testing purposes the "centre span area" is here defined as; a zone of width equal to the packages full width and of a length such that the area is equal to that of the cross-sectional area of the package.

20.2.1.1 Procedure

a) The package shall be supported at each end. The ends of the package shall each be supported completely over an area equal to (50 ± 5 % of the centre span area).

b) The package shall rest on the supports in the attitude normally expected in transit.

c) A static load of 3 times the gross package mass shall be applied over a centre span area for a period of not less than 5 minutes.

21 Test N: Dry Heat Exposure Test

21.1 Scope

This test is more of a simulation of exposure to hot dry climatic conditions than the Dry Heat Test (Test C) and enables assessment to be made of the effect of drying out on the protective properties of the package, i.e. shrinking, dehydration and the deterioration of constituent organic materials. It will also condition the package for assessment of its physical protective quality if subjected to subsequent movement and handling in the dry condition. The test may also have purpose if there is a requirement for thermal insulation of the packaged item.

21.1.1 This test is normally applicable to Military Packaging Level J

Note: If actinic effects of polymer materials are to be considered, reference to Def Stan 00-35 Test CL3 should be made. This test can be carried out on material samples rather than whole packages.

21.2 Testing

21.2.1 The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3 Chapter 3-02, Test CL2 – 'High Temperature, Low Humidity, Solar Heating'

Note: The Solar Radiation element of this test is for heating effects only. This may be achieved by the use of Infra-Red (IR) lamps.

21.2.2 The Test Procedure shall be to Paragraph 2.2.2 Climatic Test Procedure, severity to Def Stan 00-35 Part 4, Chapter 1-02, Table 7, A1 Meteorological

Note: One test cycle is a total of 24 hours.

21.2.3 The package shall stand on its base or the face upon which it normally will be transported or stored.

21.2.4 Duration

a) Approved materials, 10 cycles shall be used or by agreement 4 cycles.

b) Non-approved materials 56 cycles shall be used.

22 Test P: Flexing (Racking) Test

22.1 Scope

22.1.1 This test is primarily used to assess the rigidity of packages exceeding 225 kg mass; whose design is such that the packaging and contents are liable to become unserviceable when stored or lifted under conditions that would produce twisting.

22.1.2 Containers having skids or a sill base construction will vary in response to this test. The validity of its application is dependent on the permitted distortion of the container and its contents.

22.1.3 This test is applicable to Military Packaging Levels J, N and P.

22.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 2-18; Test M18 – Racking Test as modified here.

22.2.1 Temperature and Humidity

Unless a test band is specified, based on test-sequence and expected climatic environment, then Standard Laboratory Conditions shall be applied.

22.2.3 Procedure

a) With the package standing on its base on a hard, level surface, a base corner shall be lifted and supported at a height of (300 ± 10) mm for a period of not less than 5 minutes.

b) The package shall then be lowered and the operation repeated on the diagonally opposite corner.

c) The two remaining corners shall then be similarly treated.

23 Test Q: Topple Test

23.1 Scope

Application of this test is normally confined to packages containing items particularly vulnerable to damage through bending or to shock. The test may be of greater significance than the impact (vertical) test when the position of the centre of gravity of the package is markedly different from the geometric centre of the package.

23.1.1 This test is applicable to Military Packaging Levels J & N

23.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3 Chapter 2-04, Test M4 – 'Drop, Topple and Roll Test'

23.2.1 Procedure

This shall comply with Test M4 – 'Drop, Topple and Roll Test';

a) Clause 4.4 'Topple Test onto a Flat Surface' or

b) Clause 4.5 'Topple Test onto a Steel Girder

Note 1: The girder shall be cold rolled steel having a channel approximately 100 x 50 mm and a length exceeding the width or length of the package surface. The girder should be fixed to the impact surface with the web uppermost.

Note 2: Packages containing items more susceptible to damage by bending than by shock should be tested using the impact surface and steel girder.

Note 3: All other packages shall be tested using the hard flat-surfaced mass.

Note 4: Reference should also be made to BS EN 28768

24 Test R: Rolling Test

24.1 Scope

This test is intended to assess the capability of the container to withstand manual handling and toppling on a face or edge simulating packages that may be moved by rolling because of either lack of equipment or when lifting facilities are impractical.

24.1.1 This test is applicable to Military Packaging Level J.

24.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3 Chapter 2-04, Test M4 – 'Drop, Topple and Roll Test'

24.2.1 Procedure

This shall comply with Test M4 – 'Drop, Topple and Roll Test'; Clause 4.6 applying one impact for each face.

Note 1: For cylindrical packages refer to Figure 1 to identify impact faces.

Note 2: Reference should also be made to BS EN 22876

25 Test S: Bump Test

25.1 Scope

25.1.1 The test is primarily intended to assess the physical protection offered by the package when being bumped or jolted during distribution by road, rail or sea.

a) Container construction - loosening of nails, screws and fastenings;

b) Method of location - security of furniture and fittings; strength of locating load-spreading parts; fatigue/bedding down of cushioning, load-spreading and space-filling materials.

25.1.2 The test may also cause deterioration of the climatic protection through scuffing, abrasion or weakening of barriers or the displacement of, or damage to, protective coatings applied to the item.

25.1.3 This test is applicable to Military Packaging Levels J and N.

25.2 Testing

26.2.1 The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 2-12, Test M12 (refers to BS EN 60068-2-27 Environmental Testing – Part 2-27: Tests - Test Ea and guidance: Shock, that is Half-Sine)

25.2.2 Severity

The package shall be subjected to a total of up to (10,000 ± 5% bumps).

25.3 Procedure

25.3.1 The package shall be firmly secured to the table of the bump machine and tested in accordance with **26.2**.

Note: When the test is to be applied to a package containing a "live" load and/or a package incorporating resilient protection, the response of the system may affect the rate at which the specified bump can be applied. The bump repetition rate should be adjusted so that the response to one bump has died away before the next bump is applied. A rate of between 30 and 240 bumps per minute may be found suitable.

a) Packages up to and including 70 kg shall be capable of withstanding the test when standing on any one face.

b) Packages over 70 kg and up to and including 225 kg shall be capable of withstanding the test when standing on any one long face or, if cubic, on any face.

c) Packages over 225 kg mass shall be capable of withstanding the test when standing on the base or face upon which the package is normally expected to be transported.

25.3.2 Apparatus

The bump machine or vibration table shall be capable of accommodating the size and mass of the test package. An accelerometer and other instrumentation capable of recording the requirements of **26.2** and **26.3.3** shall monitor the impact.

25.3.3 Pulse Shape

At the monitoring point the height of drop of the table and the retarding medium of the machine shall produce a pulse approximating to one half cycle of a sine wave of 5 gn acceleration, amplitude (A) and (30 ± 5 ms) duration (D) represented by dotted lines in Figure 2. The true value of acceleration of the actual pulse shall be within the tolerance boundary shown in Figure 2 unless otherwise agreed.

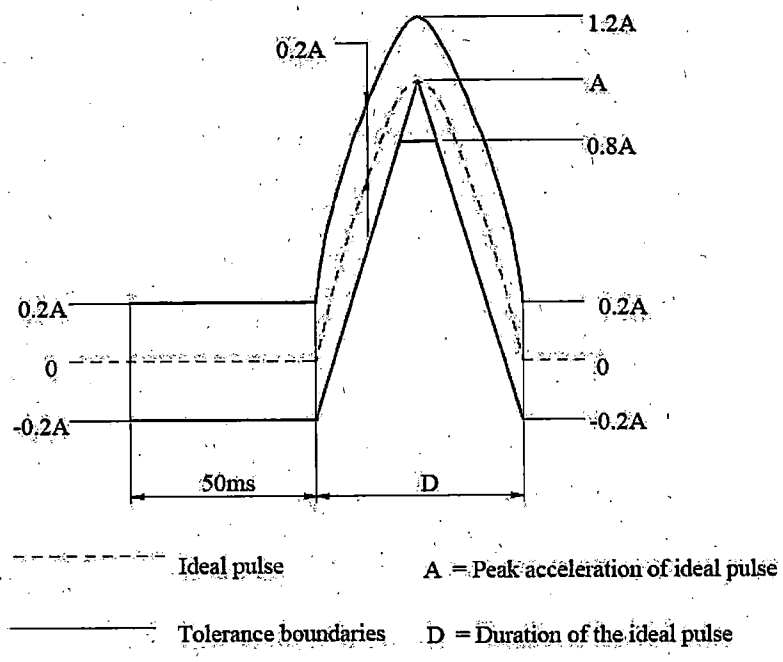

Figure 2 Pulse Shape (Half Sine)

26 Test T: Water Immersion Test

26.1 Scope

This test is performed to demonstrate the ability of a package to resist penetration of water from a static head of standing water simulating flooding or accumulation of rainwater.

Note: The immersion test is replaced by the water spray test for NATO packages when the exterior dimensions of the test package exceed 3 m. As calculated for rectangular prism exterior dimensions = length + width + height. As calculated for cylinder exterior dimensions = length plus twice the diameter.

26.1.1 This test is normally applicable to Military Packaging Level J.

26.2 Testing

The test method, apparatus, procedure and evaluation shall comply with DEF STAN 00-35 Part 3, Chapter 3-29, Test CL29 Immersion, Test Procedure B (Technically similar to BS EN 60068-2-17: Part 2 Test Q Sealing; Test Qf Immersion) as amended here.

26.2.1 Whether immersion is partial or total should be stated. If partial the degree of immersion should be stated and shall be recorded

26.2.2 Severity & Duration

The Severity shall be 'A' and face exposure duration shall be (20 ± 1) minutes.

26.2.3 Additional Procedure

26.2.3.1 The test apparatus shall consist of a water storage tank equipped with porous false floor permitting exposure of the package bottom face to standing water. Tie downs shall be incorporated in the tank to hold down packages that float or tend to float.

26.2.3.2 Test packages shall be conditioned at standard laboratory conditions

26.2.3.3 The temperature of the water in the holding tank shall not exceed 27 °C.

26.2.4 Evaluation

In addition to the normal evaluation; any penetration of moisture into the test package shall constitute failure of this test.

27 Test U: Fragility Assessment

27.1 Scope

This test is intended to establish an index of the durability (Fragility) of an item of equipment under mechanical shock.

27.1.1 This test is applicable to Military Packaging Levels J, N and P for design information.

27.2 Testing

27.2.1 The test shall be carried out using a free-fall machine unless otherwise agreed.

27.2.2 Test packages shall be conditioned at standard laboratory conditions.

Note: See also Test S and its references as this is essentially a shock test

27.2.3 Procedure

27.2.3.1 It is essential that the item is held during the test in exactly the same way as in the package, e.g. in an inner container or attached to a framework. The item (or container or framework shall be securely attached to the test table in the chosen orientation.

Note: If there is uncertainty as to the most vulnerable axis of the item, the test shall be carried out in each direction of three mutually perpendicular axes at each test level, before proceeding to the next test level.

27.2.3.2 Test pulse

a) The apparatus shall produce at the monitoring point on the test table a test pulse approximately to the ideal half-sine wave as shown in Figure 3. The true profile of the test pulse shall be within the tolerance boundary shown by the solid lines.

b) The following sequence of acceleration pulses shall be used unless otherwise agreed: 10, 12, 16, 20, 25, 32, 40, 50, 63, 80 and 100 gn.

27.2.3.3 Sample test

a) The item of materiel shall be subjected to a series of shocks of progressively increasing severity until either a failure occurs or the maximum test pulse level 100 gn is reached.

b) The duration of the ideal pulse, for each peak acceleration, in the series shall be determined from Figure 4 using the package drop height generated from Figure 5. The required pulse duration shall be obtained when the retarding medium has a rebound resilience of 36 %.

27.3 Evaluation

The point of failure shall be when the equipment becomes unserviceable, i.e. is unable to perform its function or fulfil its purpose satisfactorily; when some degree of permanent distortion is reached; or when fracture occurs.

27.3.1 Test Report

a) A test report shall be prepared which shall include the following:

1) Full description and particulars of the test sample;
2) Method of location of the sample on the test table;
3) Drop-test height of package;

4) Number of samples tested;

5) Any failure to meet the test pulse tolerance requirements.

b) If failure occurred the following detail shall be reported:

1) Description of failure;

2) Orientation of sample on test table at which failure occurred.

c) The fragility of an item shall be the acceleration test level before that at which failure occurred.

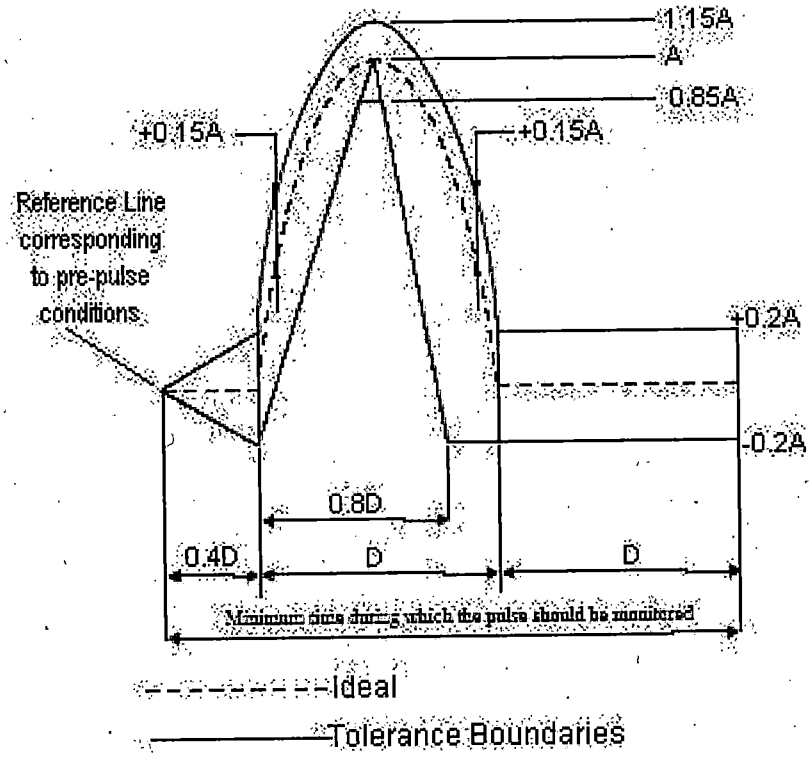

Figure 3 Half-Sine Pulse

$$D = \frac{\pi}{A}\sqrt{\frac{2h}{g_n}} \times 10^3 ms$$

Where;

D = Duration of Ideal Pulse,

A = Peak deceleration of ideal pulse in multiples of g_n

h = Package Drop height

The reference line shall not differ more than (± 0.05 A) or (± 1 g_n) whichever is greater from zero acceleration. D is not a mandatory requirement but is included merely for definition of pulse shape. The critical duration in any drop will depend on the; acceleration amplitude, height of fall and retarding medium rebound characteristics.

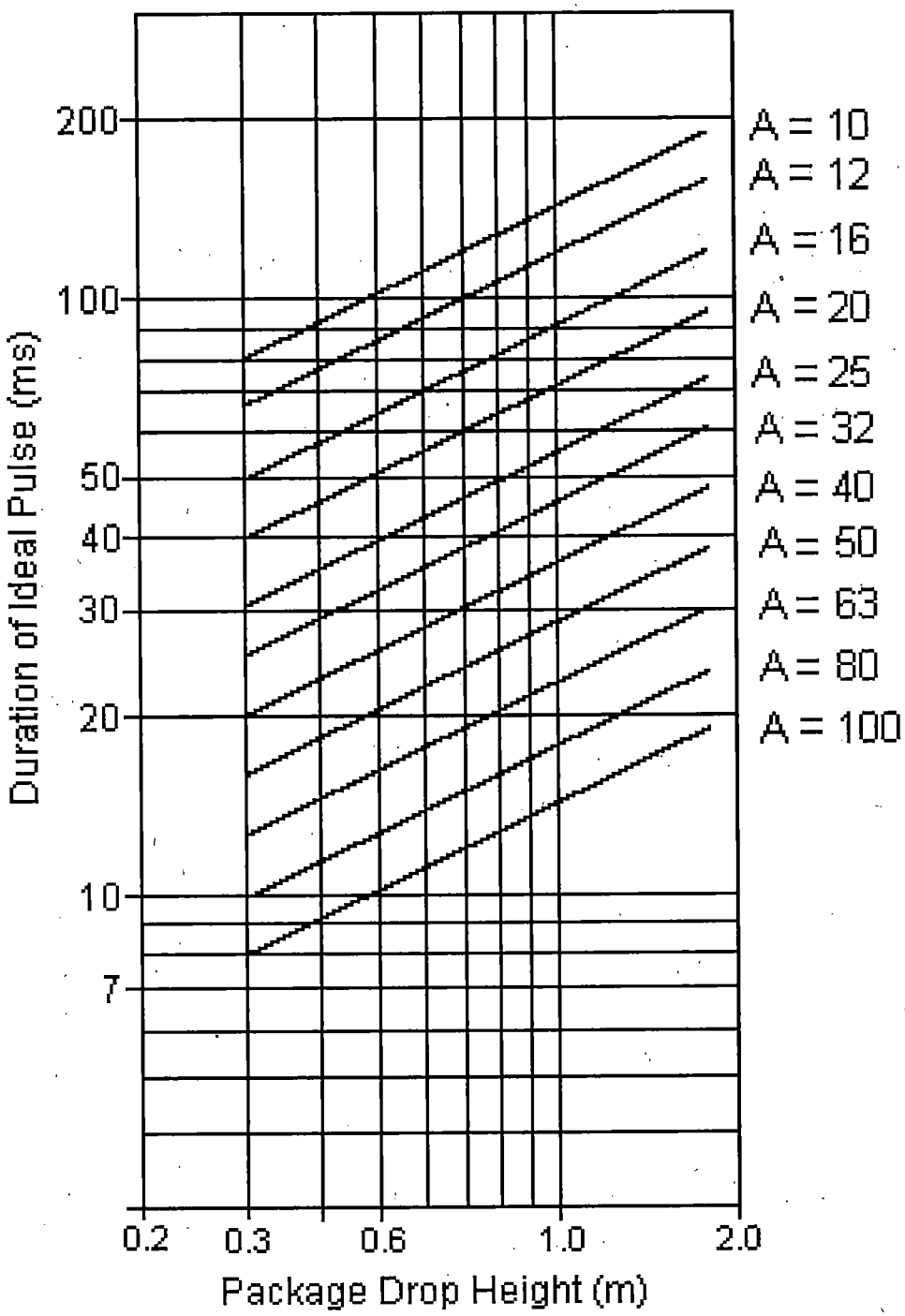

Figure 4 Duration of Ideal Pulse

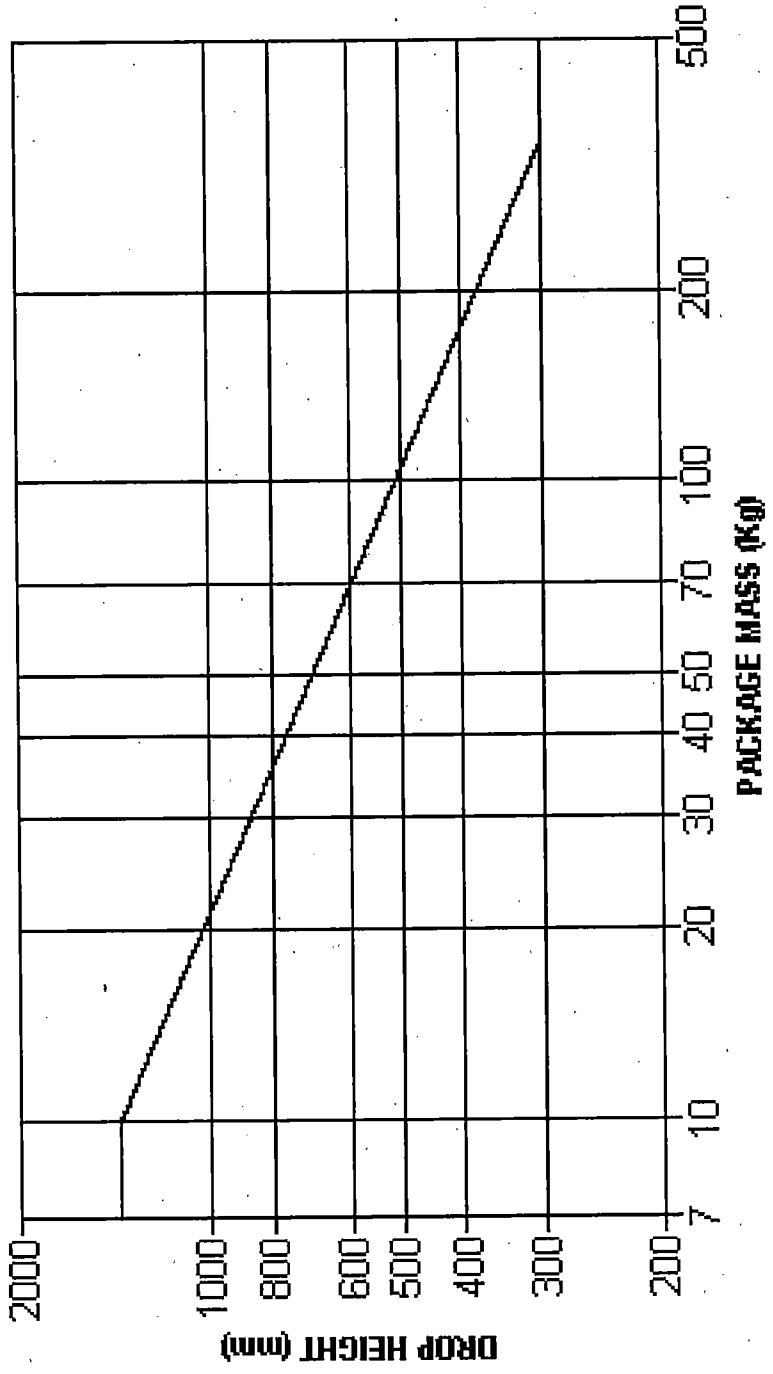

Figure 5 Calculation of Drop Height

28 Test V: Cornerwise Drop (Rotational) Test

28.1 Scope

29.1.1 This test is applicable for determining the ability of large shipping containers to resist the impacts of being dropped on their corners and for determining the ability of the packaging and packing methods to provide protection to the contents when the container is dropped on its corners.

28.2 Testing

The test method, apparatus, procedure and evaluation shall comply with STANAG 4340 and AEPP-3.

29 Test W: Edgewise Drop (Rotational) Test

29.1 Scope

29.1.1 This test is applicable for determining the ability of large shipping containers to resist the impacts of being dropped on their edges and for determining the ability of the packaging and packing methods to provide protection to the contents when the container is dropped on its edges.

29.2 Testing

The test method, apparatus, procedure and evaluation shall comply with STANAG 4340 and AEPP-3.

30 Test X: Mechanical Handling Test

30.1 Scope

30.1.1 This test determines the ability of a package or container to withstand handling by mechanical handling equipment.

30.2 Testing

The test method, apparatus, procedure and evaluation shall comply with STANAG 4340 and AEPP-3.

31 Test Y: Leaks in Containers

31.1 Scope

31.1.1 This test procedure provides eight common techniques for detecting leaks in containers.

31.2 Testing

The test method, apparatus, procedure and evaluation shall comply with STANAG 4340 and AEPP-3.

32 Test Z: Heat-sealed Seam Test

32.1 Scope

This test is applicable for determining whether or not the strength of a heat-sealed seam is adequate to resist a dead weight load applied in a manner tending to open the seam.

32.2 Testing

The test method, apparatus, procedure and evaluation shall comply with STANAG 4340 and AEPP-3.

Inside Rear Cover

Defence Standards are published by and obtainable from:

Defence Equipment and Support

UK Defence Standardization

Kentigern House

65 Brown Street

GLASGOW

G2 8EX

DStan Helpdesk

Tel: +44 (0) 141 224 2531/2

Fax: +44 (0) 141 224 2503

Internet e-mail: enquiries@dstan.mod.uk

File Reference

The DStan file reference relating to work on this standard is D/DStan/81/41/3.

Contract Requirements

When Defence Standards are incorporated into contracts users are responsible for their correct application and for complying with contractual and statutory requirements. Compliance with a Defence Standard does not in itself confer immunity from legal obligations.

Revision of Defence Standards

Defence Standards are revised as necessary by an up issue or amendment. It is important that users of Defence Standards should ascertain that they are in possession of the latest issue or amendment. Information on all Defence Standards can be found on the DStan Website www.dstan.mod.uk, updated weekly and supplemented regularly by Standards in Defence News (SID News). Any person who, when making use of a Defence Standard encounters an inaccuracy or ambiguity is encouraged to notify UK Defence Standardization (DStan) without delay in order that the matter may be investigated and appropriate action taken. Sponsors and authors shall refer to Def Stan 00-00 before proceeding with any standards work.

DSTAN®
UK Defence Standardization