

PACKAGING

BY

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Introduction

By definition, the term 'packaging' means the processes of preservation, identification and packing. An item is packaged to ensure that when required for use in any part of the world, it is in an 'as new' condition. The field of packaging in industry is vast, and it is probably true to say that every item produced commercially, whether it be a boiler or a cigarette, a tin of paint or an overcoat, is packaged to some degree. To produce a document to cover, in detail, all aspects of commercial packaging would be virtually impossible, but to meet the requirements of the Services a Defence Specification (DEF. 1234—General requirements for packaging supplies for the Services) has been issued. This specification does not say exactly how a particular item should be packaged but lays down standards to be adopted, methods to be used and approved materials available. The article which follows is in accordance with the Defence Specification and has been written to explain how modern packaging is applied to mechanical engineering spare parts and equipments. It is not intended to replace the Defence Specification but only to provide useful information for those persons concerned only occasionally with packaging. Packaging plants and authorities concerned with packaging problems as an every day occurrence should be in possession of a copy of DEF. 1234 and would probably also find it useful to have a copy of S.P.D.C. Packaging Specifications which provide detailed specifications for packaging particular items of machinery spare gear. Both these publications can be obtained on application to Admiralty, E.-in-C., Bath.

Standards of Protection

Although there are many hazards to which items may be subjected during transport and storage, it can be assumed that when dealing with metallic items, all hazards are adequately safeguarded if protection is provided against the two main hazards, mechanical injury and deterioration due to humidity.

The protection to be provided by any specific package depends upon the severity of risks to which it is expected to be subjected during transport and storage. Apart from exceptional instances, it can be specified by one or other of the following standards of protection.

Full Standard

The pack is designed to maintain the contents in an 'as new' condition throughout transport to any destination, and to maintain this condition for a designated period in storage in any part of the world.

Restricted Standard

The pack is designed to give full standard protection in all respects, except that the standard of the outer container is reduced to that appropriate to less drastic conditions of transport and storage.

Trade Package

The pack used by the manufacturer for normal commercial deliveries of his products within the country of origin is acceptable for the supply concerned, subject to the addition of specified identification particulars and the affixing of a 'trade package' warning label.

Trade Export Package

The pack used by the manufacturer for normal commercial deliveries of his products overseas is acceptable for the supply concerned, subject to the addition of specified identification particulars and the affixing of a 'trade export package' warning label.

The standard of protection to be selected for any individual item must of necessity depend on the anticipated future history of the item. It must be ensured that an adequate standard of protection is specified, although at the same time not providing an excessively protected and uneconomical pack. It is impossible to cover all circumstances, but the following rules are given for guidance in selecting the correct standard of protection.

<i>Full Standard</i>	All spare parts supplied to H.M. ships All items of machinery and spare parts intended for storage abroad.
<i>Restricted Standard</i>	Items of machinery and spare parts held in store for supply to refitting and overhaul authorities in the United Kingdom.
<i>Trade Package</i>	Items of machinery and spare parts supplied to refitting and overhaul authorities in the United Kingdom and intended for immediate use.
<i>Trade Export Package</i>	Items of machinery and spare parts supplied to refitting and overhaul authorities abroad and intended for immediate use.

Methods of Protection

It has already been stated that the two main hazards to be safeguarded against are mechanical injury and deterioration due to humidity. The mechanical risks of dropping, shaking and stacking packages require to be considered with regard to the nature of the contents because these depend on the ability of the contents to stand up to shock, vibration or deformation without damage, and on the possibility that, under these conditions, the delicate surfaces of the contents may become abraded or otherwise defaced.

Risks due to humidity also need careful consideration in terms of the particular needs of the contents and protection can be provided by contact-protective substances of various types, by waterproof or water-vapourproof coverings, by the container itself or by a lining to the container. These devices can be employed individually or in combination with one another, and their selection depends on the following considerations :—

- (i) The susceptibility of the item itself to corrosion, rot or decay. In considering this, there are two main points to bear in mind. The first is the nature of the protective finish provided as a permanent feature in the construction of the equipment or item to enable it to resist climatic exposure after unpacking and while in use. The second is the standard

of perfection which is necessary for serviceability. For example, an immaculate surface condition is unnecessary in a crowbar but vital to a ball-bearing; the protection required on a galvanized item or the painted surface of a casting is less than would be necessary on an unprotected ferrous surface.

- (ii) In choosing a scheme of protection, it is important that the items, when unpacked, should not need to be dismantled in order to remove the preservative. For example, certain preservatives—excellent in themselves for protecting the surfaces of metallic items—are unsuited to mechanical assemblies because, if the preservative is not completely removed, there is a risk that the equipment will fail to function satisfactorily.

In deciding how an item should be packaged, it is first necessary to decide whether it requires to be protected against atmospheric humidity. If it does, it is then necessary to decide whether a temporary protective can be applied to it and, if so, which. (Temporary protectives available for Service use are listed in the Appendix.) After the appropriate temporary protective has been applied and the primary wrap added, the item may then—but need not in all instances—be packed in a container. The container will in itself supply some added protection and will also give mechanical protection sufficient to deal with the risks of normal handling and indoor storage. The package resulting from these operations is called a ‘primary package’ and it is in this condition that items of machinery spare gear are intended to be stowed on board H.M. ships.

Classification of Primary Packages

The Non-Waterproof Package (Method O and Method I)

This package provides no protection against humidity, but only against mechanical damage. It is suitable for items which require no protection against humidity or for items already protected against humidity by a highly resistant temporary protective.

The Waterproof Package (Method I C)

This package is one whose construction includes a continuous barrier which is impervious to water when tested by immersion. It is suitable for items which are not rendered unserviceable by water-vapour but which might be spoilt by liquid water. It is also suitable for items subject to damage by water-vapour but which can be coated with a thick film-protective.

The Water-Vapourproof Package (Method I A)

This package is one in which a sealed barrier is incorporated, the barrier being of a material and construction which will not transmit more than one gramme of water-vapour per square meter in 24 hours when measured at 100 degrees F. and with a relative humidity difference of 90 per cent. It is suitable for items which require a high degree of protection against water-vapour, or for which coating with an oil or thin film is the only appropriate contact protective.

The Desiccated Package (Method II)

This package employs either a container which is hermetically sealed or a continuous barrier, within the container or applied to the container, formed from material having a water-vapour transmission rate below a specified limit. A desiccant is included within the hermetically sealed container or barrier to maintain a relative humidity inside the package below 50 per cent for a desig-

nated period of time. It is suitable for items which by the nature of their construction or material are unsuited to the use of contact-protectives but which require a high degree of protection against water-vapour.

Preservation of Metallic Items

It is essential that, before applying a protective coating, all metallic surfaces are thoroughly cleaned to free them from grease, dirt, dust, swarf and other workshop residues. As part of this process, it is equally essential that, at the last stage of cleaning, all moisture remaining on the surfaces is removed by thorough drying. If the coating is applied to a surface which is contaminated or damp, its value is greatly reduced, as surface deterioration will continue beneath the protective coating.

It is most desirable that the processes of cleaning, drying and applying the coating should follow immediately upon the final process of manufacture or repair of the item, and, once the preservation processes have started, the item should not be touched with bare hands at any stage in those processes. Handling with bare hands is liable to leave deposits upon metallic surfaces which will cause corrosion ; these deposits are not readily observed and are difficult to remove. To avoid this, it is desirable that suitable gloves should be worn, and these gloves should be frequently cleaned. These precautions are especially necessary when dealing with items having precision surfaces which it is essential to maintain in an immaculate condition.

The most commonly employed materials or methods of cleaning metallic items before preservation are :—

- (i) Trichlorethylene process
- (ii) White spirit
- (iii) Alkaline solution
- (iv) Shot and sand blasting, wire scrubbing, etc.

Details of the materials available are given in the Appendix. It is important to remember that when using an alkaline cleaner, the items after cleaning must be carefully rinsed in hot water at not less than 180 degrees F. On completion of any cleaning process items must be thoroughly dried.

The application of the temporary protective should follow immediately after completion of the processes of cleaning and drying. There is a clear distinction between temporary protectives and the more permanent surface protectives, such as paints and metallic coatings, which are intended to remain on the surfaces and protect them while the item is in use. The purpose of a temporary protective is to give protection during transport and storage and it may be removed (and frequently should be removed) before the item is put into use. Temporary protectives can be removed from metal surfaces by the commonly used petroleum solvents or by other simple methods such as wiping (for greases) or peeling off (for strippable coatings).

Temporary protectives are divided into six well-defined classes according to the nature of the coating which they provide :—

- (i) Hard films, solvent deposited.
(PX-2 PX-3).
- (ii) Soft films, hot dipping.
(PX-11).
- (iii) Soft films, grease.
(PX-7 LG-280).
- (iv) Soft films, solvent deposited.
(PX-1 PX-4).

- (v) Oil films.
(OX-52 OM-17).
- (vi) Hot-dip strippable coating.
(PX-15).

Wrapping

Wrappings are classified as primary wraps and container wraps. The purpose of the primary wrap is principally to prevent damage to the applied temporary protective and its contamination by dust, dirt, etc. The container wrap is one which is either a closely fitting covering to a paper-board type of container, rendering the container relatively proof against water and water-vapour, or a paper wrapping applied to prevent wax-dipped packages from sticking to one another. A full list of wrapping materials is given in the Appendix but the following list details the types of materials in common use :—

(i) Primary Wraps

Waxed paper. Applied to metallic items where surfaces have been treated with hard-setting temporary protective. It may also be used for other purposes where the exclusion of dirt and dust is the only requirement.

Grease-resisting paper. Applied to metallic items where surfaces have been treated with a soft-film grease or oil-type temporary protective.

Mouldable wrap. Applied to items where its mouldability to shapes and contours is an advantage. In this application the item in its wrapping is generally wax-coated.

(ii) Container Wraps

Mouldable waxed wrappings. Normally confined to the wrapping of paper-board containers to be subsequently wax-coated.

Kraft papers. Usually applied after containers have been wax-coated to prevent packages sticking together when stacked.

Barrier Materials

The purpose of a barrier in package construction is to control the entry of water or water-vapour into the package. Whether it is to control water only or water-vapour is dependent upon the class of package (Classification of Primary Packages—see above). A completely sealed metal container will clearly serve to give adequate control of ingress of water and water-vapour but, for a variety of reasons, the use of a metal container is not appropriate in all instances and alternative methods of protection are necessary for many packages.

Barrier materials vary in the degree of protection they give against water and water-vapour and the choice of the correct material is dependent upon the class of package. The selected barrier material may be incorporated by one of the following methods :—

- (i) In the form of a sealed bag or envelope in which the items themselves are enclosed
- (ii) In the form of a sealed covering applied to the primary container
- (iii) In the form of a wrapping.

Full details of materials available for Service use are given in the Appendix.

Use of Desiccants

It is not possible in all cases to provide protection against humidity by the application of temporary protectives, on account either of the intricacy of the

equipment or the susceptibility of the equipment to damage by the application of a temporary protective.

In these cases, protection against humidity can be achieved by the use of a water-vapourproof barrier and a desiccant material inside the package. This is designed to maintain the air inside at a relative humidity below 50 per cent for twelve months under the most adverse storage conditions of tropical heat and humidity experienced anywhere in the world.

Desiccants differ in their capacity for absorbing moisture. In order to avoid having several separate formulae for calculating the quantity needed for each desiccant, the formula given below has been developed in terms of a so-called 'basic desiccant' :—

$$W = \frac{AR}{5} + \frac{D}{2}$$

where W = weight in pounds of basic desiccant

A = area in square feet of barrier

R = the rate of transmission of water-vapour expressed in grammes per square metre per 24 hours

D = weight in pounds of hygroscopic material inside the barrier.

The relative volumes of units of desiccant corresponding to one ounce of basic desiccant are :—

Silica gel 2·5 cu. in.

Activated alumina 4·0 cu. in.

The life of a desiccated package is limited to that period during which the enclosed desiccant will continue to absorb moisture and maintain the relative humidity below 50 per cent. This period has already been stated to be one year under the most severe tropical conditions of climatic temperature and humidity. Clearly, under less drastic storage conditions, the life of the package is extended. The following figures are given for guidance in estimating the life of desiccated packages under storage conditions ashore in the main naval operating spheres of the world :—

United Kingdom and Europe	..	..	..	..	..	5 years
Malta	..	..	..	..	..	5 years
Canada	..	..	..	..	..	5 years
Simonstown	..	..	..	..	..	5 years
Australia and New Zealand (except Port Darwin)	..	..	..	..	..	5 years
Ceylon	..	..	..	..	..	3 years
Hong Kong	..	..	..	..	..	3 years
Durban	..	..	..	..	..	3 years
Bermuda	..	..	..	..	..	3 years
Karachi	..	..	..	..	..	3 years
Singapore	..	..	..	..	..	1 year
Aden	..	..	..	..	..	1 year
Bombay	..	..	..	..	..	1 year

When the estimated life of a desiccated package has expired the desiccant should be renewed. When a window and humidity indicator are fitted, the renewal of the desiccant should be governed by the humidity reading and should be renewed when the relative humidity rises above 50 per cent.

Protection against Physical Damage

In preceding paragraphs, it has been shown how protection can be arranged against atmospheric humidity. The second main hazard, that of physical damage, must also be provided against. In dealing with small engineering spare parts, the danger of damage due to physical causes is often adequately safeguarded by the packing that has already been applied to provide protection against humidity. Nevertheless, when packing small items, particularly when a number are packed together in one container, it must be ensured that no damage can be caused by abrasion. It is, however, in dealing with larger items and composite equipments that attention must be paid to the risk of damage during transport. It is not intended to give details for the protection of an equipment against physical damage, but it is important to realize that hazards such as dropping, vibration, shunting, crushing, etc., are frequently encountered under normal transport conditions. To safeguard against these hazards, the equipment must be securely fixed in a container and adequately blocked and cushioned. Arrangements must be made to ensure that the cushioning material used is kept dry because the efficiency of most cushioning materials falls rapidly when they become wet.

Identification

It is essential to ensure that, at all stages of packing, the item or equipment can be easily identified. This identification should detail :—

- (i) Maker's Part Number
Admiralty Catalogue Number
Admiralty Pattern Number } as appropriate
- (ii) Full description
- (iii) Quantity
- (iv) Items obtained through Admiralty Contract will also carry Admiralty Contract Number and method of packaging.

The quantity is normally detailed after the letters 'P.P.Q.' i.e. Primary Packaged Quantity. In cases where items are packaged in quantities in excess of the specified P.P.Q., the term 'Bulk Quantity' may be used. Issues of items packaged in bulk quantities are generally restricted to overhaul and refitting centres.

APPENDIX

<i>PACKAGING MATERIALS</i>		
<i>CLEANING MATERIALS</i>		
<i>Trichlorethylene</i>	E6/4981	Suitable for all metals, by liquid or vapour immersion. Will not remove soap or chemical residues. Is not suitable for part-painted items or for composite items containing rubber or leather.
<i>White Spirit</i>	E7/N.12311	Suitable for all metals, by immersion, spray or brushing. Will not remove soap or chemical residues. Must not be left in contact with rubber.

<i>TEMPORARY PROTECTIVES FOR METALLIC ITEMS</i>		
<i>Protective PX-2 (Composition, rust preventive)</i>	E7/1178	A hard setting black protective for metal items applied by dipping, spraying or brushing. The solvent in the protective is toxic and adequate ventilation is necessary. Can be removed by petroleum solvents.
<i>Protective PX-3 (Pigmented lanolin- resin solution)</i>	E7/1180	A hard setting protective for metal items with greater tenacity than PX-2. Applied by brushing or dipping. Can be removed by solvents but because of the difficulty of removal, is mainly used where removal before use is not essential. Pigmented yellow.
<i>Protective PX-11 (Preservative, mineral jelly, bees-wax)</i>	E8/1061	Suitable for application to metallic surfaces of single items, assemblies or sub-assemblies. Prevention from contact with rubber is essential and contact with leather or fabric should be avoided. Normally applied by dipping between 180°-195°F. to give a film approximately 0.050 in. thick. Should be completely removed by petroleum solvents.
<i>Protective PX-7 (Petrolatum, soft)</i>	E8/964	A soft film preservative suitable for battery terminals and interceptors.
<i>Grease, LG.280</i>	E8/861	A general purpose soft-film lime-based temporary protective which is applied at room temperatures by brushing or smearing. Complete removal is not necessary as any residual film will disperse harmlessly in lubricating oil.
<i>Protective, PX-1</i>	E7/1177	A thin, soft film which hardens slightly on ageing. Suitable for metallic items, assemblies, etc. The film will not stand abrasion and articles treated should be wrapped in grease-resistant wrapping with the minimum of handling. Where necessary, can be removed by petroleum solvents or boiling water. Pigmented green.
<i>Protective PX-4 (Composition, preservative, spraying)</i>	E7/1168	A thin, soft film preservative suitable for metallic internal surfaces applied by spraying, brushing or dipping. Normally used for internal surfaces of I.C. engines. Removal is not essential as it will dissolve in lubricating oil.
<i>Oil OX-52</i>	E9/4582	Used as a cleaning agent and preservative for small arms.
<i>Oil OM-17</i>	(Non-Patt.)	Used for the protection of bakery and canteen equipment.
<i>Protective PX-15 (Preservative, strippable, hot dipping)</i>	E12/5209	A tough impermeable coating which can be easily stripped from the protected item before use. It has the advantage of being able to provide mechanical protection in addition to atmospheric on precision surfaces, cutting edges, etc.
<i>Preservative PX-10 (Fluid, water displacing)</i>	E7/1179	This material has the property of displacing water from metal surfaces and, on evaporation of the solvent, it leaves a protective oily film which will prevent further rusting only for a limited period. Suitable for internal waterways, radiators, etc.

<i>WATER-VAPOURPROOF AND WATERPROOF BARRIER MATERIALS</i>		
<i>Metal foil laminated sheet (heat-sealable)</i>	E12/4641 4655	A water-vapourproof flexible barrier material coated with a compound to render it heat-sealable. The water-vapour transmission rate is not more than 1 gramme per sq. meter per 24 hours.
<i>Wrapping, grease resisting, mouldable, waxed</i>	E12/4637	A conforming waterproof wrap. When used in combination with wax, package dipping, the water-vapour transmission rate is not more than 1 gramme per sq. metre per 24 hours.
<i>Paper, kraft, creped, waxed</i>	E12/4638	A conforming wrap applied to cartons and boxes before wax coating. The water-vapour transmission rate of the combined materials is not more than 1 gramme per sq. metre per 24 hours.
<i>Polythene film, 'lay-flat' tubing, 0.005 in. thick</i>	E12/5980 to 5989	A waterproof, transparent, heat-sealable flexible barrier. The water-vapour transmission rate is 20 grammes per sq. metre per 24 hours for a thickness of 0.001 in. and is inversely proportional to the thickness.
<i>Paper, kraft, bitumen impregnated</i>	E12/4644	A waterproof lining material for packing cases and for lids or tops of large wooden containers.
<i>Paper, kraft union, waterproofed</i>	E12/4643	An alternative to paper, kraft, bitumen impregnated where the bitumen content might be harmful. Is not mould proofed and, therefore, suitable only for short-term temperate storage.
<i>Wax, package dipping</i>	E8/876	Employed in conjunction with wrapping, grease-resisting, mouldable, waxed; or paper, kraft, creped, waxed, to render packages waterproof and water-vapour-proof. Applied in a molten state by dipping at 170°-180°F.

<i>WRAPPING MATERIALS</i>		
<i>Paper, wrapping, waxed</i>	E12/4634	A primary wrapping material for items treated with hard film temporary protectives.
<i>Bags, paper, waxed</i>	E12/5252 to 5264	As a suitable alternative to paper, wrapping, waxed.
<i>Paper, wrapping grease resisting</i>	E12/4636	A primary wrapping material for items treated with soft film temporary protectives.
<i>Paper, kraft, wrapping</i>	E12/4645 4646	A kraft wrapping paper employed for wrapping packages.

<i>IDENTIFICATION MARKING MATERIALS</i>		
<i>Labels, tie-on, stringed</i>	E12/4620	For tie-on identification purposes.
<i>Labels, paper, ungummed</i>	E12/4621	For stick-on identification purposes.
<i>Labels, metal frame, card insert</i> Size 6 in. × 3½ in. frames Inserts for, 5 in. × 2½ in. frames Inserts for,	E12/4623 4624 4657 4658	These labels consist of a metal frame attached by nails with a reversible card insert.
<i>Covers, metal, packing note</i> Size 6 in. × 4 in.	B10/7599	The covers are provided for holding packing notes when these accompany the consignment.
<i>Tape, adhesive, waterproof, transparent</i>	E12/4625 to 4627	Used for the protection of paper labels.
<i>CLOSURE AND SEALING MATERIALS</i>		
<i>Tape, self-adhesive, fabric waterproof</i>	E12/4632 4633 5908	This tape is mainly used for reinforcing the the sealed joints of large flexible barriers or for sealing push-on lids of small metal boxes.
<i>Tape, kraft paper, gummed</i>	E12/4628 to 4630	A general purpose tape used for closing cartons and rigid boxes and for securing the 'ears' or 'flaps' of paper overwraps.
<i>Cement, rubber/resin</i>	E7/388	A general purpose adhesive and sealing compound.
<i>DESICCANTS</i>		
<i>Activated alumina</i>	E6/5378 to 5382	A general purpose desiccant supplied in bags.
<i>Silica gel</i>	E6/5370 to 5374	A general purpose desiccant supplied in bags.
<i>CUSHIONING MATERIALS AND SHOCKPROOFING DEVICES</i>		
<i>Paper, corrugated, single faced, coarse flute</i>	E12/4648	Suitable for employment as padding or as a shock-absorbing wrapping for light-weight items.
<i>Fibreboard, corrugated, double-faced, fine flute</i>	E12/4649	Suitable for employment for cushioning, chocking and bracing heavier items.
<i>Cellulose wadding</i>	E12/4650	Suitable for employment as a protective cushion for extremely light-weight items.
<i>Rubber, sponge</i>	E2/4824 4825	Suitable for employment as padding or a protective cushion for light-weight items.

<i>CUSHIONING MATERIALS AND SHOCKPROOFING DEVICES (Contd.)</i>		
<i>Rubber, expanded</i>	E2/2678-9 4820-3	As an alternative to sponge rubber.
<i>Granulated cork</i>	E2/2756	A filling material or liquid absorbent.
<i>Whiting</i>	E8/62	An absorbent material for packing bottles containing corrosive liquids.
<i>CONTAINERS</i>		
<i>Cartons, cardboard</i>	E12/4681 to 4768	A range of containers suitable for use as primary containers, or as outer-containers for consignments within the U.K. where a wooden transit container is unnecessary.