

Packaging code —

Sections 1 to 3: Introduction to packaging

UDC 621.798

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The preparation of this British Standard was entrusted by the Packaging and Freight Containers Standards Policy Committee (PKM/-) to Technical Committee PKM/503, upon which the following bodies were represented:

- Association of Drum Manufacturers
- British Glass Manufacturers Confederation
- British Paper and Board Industry Federation
- Department of Trade and Industry (Laboratory of the Government Chemist)
- Metal Packaging Manufacturers Association
- Ministry of Defence
- PIRA
- Pressed Felt Manufacturers' Association
- Process Plant Association
- Timber Packaging and Pallet Confederation

This British Standard, having been prepared under the direction of the Packaging and Freight Containers Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 29 September 1989

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First published (as Sections 1, 2, 4 and 6) December 1943
First revision September 1949
Second revision December 1967
Third revision September 1989

The following BSI references relate to the work on this standard:
Committee reference PKM/503
Draft for comment 86/40822 DC

ISBN 0 580 178706

Amendments issued since publication

Amd. No.	Date of issue	Comments

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Foreword

These Sections of BS 1133 have been prepared under the direction of the Packaging and Freight Containers Standards Policy Committee. They are revisions of BS 1133-1 to 3:1967 which are withdrawn.

BS 1133 was originally issued in December 1943, primarily to give guidance on the packaging of Service and other Government supplies. In practice, however, the code was used not only by Government departments and contractors but also by civilian packers and, accordingly, it was amended to suit peace-time requirements. The Parts were later issued separately and new Sections were added as new materials and methods were developed.

Various Sections of the code have been revised and the most recent revision of Sections 1 to 3 was in 1967.

This revision of Sections 1 to 3 updates the guidance material to take account of additional factors which currently influence the functions of packaging and to reflect changes in the use of different types of packaging.

The packaging code now consists of the following Sections all of which are published separately with the exception of Sections 1 to 3 which are published in one volume.

- *Sections 1 to 3: Introduction to packaging;*
- *Section 4: Mechanical aids in package handling;*
- *Section 5: Protection against spoilage of packages and their contents by micro-organisms, insects, mites and rodents;*
- *Section 6: Temporary protection of metal surfaces against corrosion (during transport and storage);*
- *Section 7: Paper and board wrappers, bags and containers;*
- *Subsection 7.1: Wrapping papers;*
- *Subsection 7.2: Bags and envelopes;*
- *Subsection 7.3: Cartons and boxes;*
- *Subsection 7.4: Fibreboard drums¹⁾;*
- *Chapter 7.5: Fibreboard cases;*
- *Subsection 7.6: Moulded pulp packaging;*
- *Section 8: Wooden containers;*
- *Section 9: Textile bags, sacks and wrappings;*
- *Section 10: Metal containers;*
- *Section 12: Methods of protection against shock (excluding cushioning devices);*
- *Section 13: Twines and cords for packaging;*
- *Section 14: Adhesive closing and sealing tapes;*
- *Section 15: Tensional strapping;*
- *Section 16: Adhesives for packaging;*
- *Section 17: Wicker and veneer baskets;*
- *Section 18: Glass containers and closures;*
- *Subsection 1: Terminology;*
- *Section 19: Use of desiccants in packaging;*
- *Section 21: Regenerated cellulose film, plastics films, aluminium foil and flexible laminates;*
- *Section 22: Packaging in plastics containers;*

¹⁾ In preparation.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 26, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. The functions of packaging

1 Scope

Sections 1 to 3 of BS 1133 provide general guidance on the basic functions of packaging, the factors influencing the selection of packaging and advice on packaging methods and management.

2 Definitions

For the purposes of these Sections of BS 1133 the definitions given in BS 3130 apply.

3 Packaging and its various functions

3.1 General

Packaging is defined in many different ways but some consensus exists that, in addition to the basic function of containment, it should provide protection and preservation, identification and information, market appeal and convenience. Implicit in any such definition is the assumption that the particular mix of requirements should also be met economically. It is possible to meet virtually any specification at a price, but modern production, distribution and retailing methods make economics of greater importance than ever.

In this Section the functions of packaging are outlined and many of the aspects associated with meeting them are discussed. However, packaging is such a complex interactive discipline that they cannot be exhaustively or definitively covered in a single guidance document.

3.2 Containment

Initially containment was merely a method of holding together loose products or restraining an unwieldy item. This function is still the basic requirement but a number of secondary requirements are now added, including:

- a) the appropriate quantity;
- b) compatibility with the product;
- c) containment under defined conditions (especially in the safety aspects).

3.3 Protection and preservation

3.3.1 General. Products may suffer from the effects of mechanical, chemical, environmental and biological hazards. The role of a pack is to eliminate (or at least moderate) any of these which lead to undesirable changes in the product.

3.3.2 Mechanical hazards.

3.3.2.1 General. Mechanical hazards include crushing, drop impacts and vibration, which may visibly damage the item or products but which can also produce less obvious effects such as vibration breaking an emulsion in a foodstuff.

3.3.2.2 Distribution hazards. Individual shock impacts in any of the possible attitudes (face, edge and corner) can occur in two ways. During travel a series of relatively small but frequent impacts will be experienced as a result of short, sharp movements of the transporting vehicle. This is especially the case with road vehicles, which will in effect have a pattern of random shocks superimposed on the general background vibration. The other source of impacts is during handling, either manual or mechanical. Cases or packs may tip onto a belt conveyor, impact against each other on a gravity roller conveyor, or be thrown onto a pallet during manual stacking. A complete sequence involving the transfer to a number of storage locations and multiple handlings will culminate in the product reaching the retailer's shelf. At this stage it is usually de-unitized and the final distribution hazards may involve being thrown into a bag, and transported to the consumer's residence. At this point it is particularly likely to suffer the possibility of localized pressure with puncturing as an extreme result.

Vibration is the transmitted repetitive motion defined by amplitude (maximum deviation from position of rest, usually measured in mm) and frequency (repeated movements per unit of time usually measured in hertz (Hz)²⁾) which is induced by some continuous mechanical vibration, frequently the engine of a vessel or vehicle; and in the case of road vehicles, the effect of the road surface irregularities. Patterns of vibration can build up to induce more dramatic levels which at their peak amplitude are termed resonance. Most of the vibration effects occur in a vertical plane, but some adopt a circular motion and others exhibit a horizontal component. The effects may be that stacks of containers lose their cohesion and become unstable.

²⁾ 1 hertz = 1 cycle per second.

3.3.2.3 Storage hazards. Storage hazards are mainly related to static stresses such as compression under stack load conditions. This is particularly important where unequal bearing surfaces are involved (the base bearers of a pallet for instance), or when uneven floors produce distortion effects. Also associated with storage are the probabilities of damage during movement of adjacent units, either single items or pallet loads, especially if stored too closely or handled by inexperienced staff.

Conditions of storage, including general housekeeping and hygienic standards, are very important during the storage of both unused and filled packs. Poor condition of floors from which damp may rise, the access of birds, insects or animals are all potential hazards; and the longer the storage period and the less frequently the stores are visited the greater these become.

Some storage hazards are associated with climatic effects, especially those relating to changes in temperature.

The thermal lag effect (the time taken for temperature equilibrium to be reached in a block stow of products) should also be taken into account and can be a matter of weeks in a tightly packed unit.

3.3.3 Chemical hazards

3.3.3.1 Oxidation. Oxygen is the most reactive of the gases making up the earth's atmosphere, of which it constitutes 20.6 %. It can produce many degradation reactions with a wide range of materials, examples being rusting of ferrous metals (in conjunction with water) and the breakdown of photographic chemicals. Some effects are catalysed by other factors; the rancidity of fats for instance is accelerated by exposure to light and also by minute traces of some metals, especially copper.

3.3.3.2 Loss of volatiles. Many products, especially foods and toiletries, have distinctive aroma and/or taste; the two are very closely linked. Those elements which are volatile can be comprehensively or selectively lost through the walls, closure or seal of a pack, resulting in major change to the nature of the product. These effects can be quite disproportionate to the quantities involved since the human palate is so very discriminating.

3.3.3.3 Taint pick-up. Taint can be defined as any change to the taste or smell of a product brought about by the pick-up of an odorous constituent from an outside agency, which results in detectable change from its original condition. The effect normally occurs under circumstances when a sensitive product, packed in a material which is a poor gas barrier, is adjacent to a product having a strong odour. More gross effects, such as by wetting with a chemical, are considered as contamination rather than taint. The combination of conditions resulting in transfer of such taint involves proximity, time, strength of odour, quality of barrier and temperature. In extreme cases its presence can be detected and even measured by analytical techniques, but it is mostly determined on the basis of organoleptic tests by a human taste panel using the techniques set out in BS 3755.

3.3.3.4 Product/pack interactions. Chemical hazards may also come from interactions between the product and components of the container. All materials are chemically reactive to some extent, it is just a matter of degree. For instance even glass is slightly soluble, especially in distilled water, and apparently inert materials such as paper contain varying traces of active chemicals. More common problems arise from the packaging of solvents in plastics containers — which can have the effect of leaching out certain constituents, or in extreme cases, destroying the pack completely. Reactions between product and lacquers, coatings, closure gaskets and liners are also possible sources of problems.

Under this heading should also be mentioned the phenomenon of environmental stress cracking which, although much less common now as a result of greater understanding of plastics, was once a serious problem. This results from the combined effects of chemical contact plus a tightly compressed or tensioned closure.

Product/pack interaction can operate in either direction. In all situations both the product and the pack are affected, but the significance may vary from, at one extreme, the product being rendered unusable, to the other where the pack itself is destroyed.

3.3.4 Environmental hazards. Environmental hazards are primarily temperature, humidity, water and solar radiation (visible and ultra-violet). Others which may be encountered in particular circumstances are sand and dust, salt spray and corrosive atmospheres. Atmospheric pressure changes are insignificant under normal circumstances but would be very significant in the case of air freight travelling in an unpressurized cargo hold.

Thermal effects can produce some unexpected results, for example a crystalline material such as sugar or salt may cake to a solid block inside a sealed container, even if it has a very low moisture content. This is due to the alternation of high and low temperatures resulting in moisture movement to selective cold areas.

Excessive drying out of paper based packaging materials leads to embrittlement and a major loss of strength. Dew point effects can cause rusting and blocking of moisture sensitive items.

3.3.5 Microbial/insect/animal contamination. Although microbes, insects and animals are all forms of "life" they are very different in their effects on packages, and in the preventative treatment required. The potential for contamination is wide, including bacteria, moulds, insects, rodents and other contamination. Deterioration of a product may occur through growth of a micro-organism on or in the product, the pack or the packaging material, or from subsequent contamination from the air or during handling. Foods, which either contain the elements of self-spoilage or offer a nutritional base for the development of micro-organisms, are a special and complex case. The shelf life can vary from a few days to years, and the main approaches to the prevention of microbiological spoilage of the short shelf life products are: tightly controlled distribution systems, including the use of a chill chain; deep frozen storage distribution and retailing, providing stability for a matter of months; and finally heat processing after filling into the pack, which can give years of life. New techniques are now being introduced including:

- a) modified atmosphere packaging (MAP)³⁾ in which the atmosphere surrounding a product in a sealed pack is modified to retard undesirable reactions;
- b) irradiation, i.e. the exposure of fresh or processed foods to irradiation from a cobalt 60 source or electron beam to kill organisms capable of causing dangerous deterioration of the food.

Pre-packaged medical products require absolute sterility. They are usually packed and then sterilized using ethylene oxide gas, steam or irradiation. If the first or second system is used the packaging material has to be gas permeable. Special grades of paper and synthetic materials are available having the required very small pore size, which has to be less than the dimensions of the bacteria to be excluded.

Insect contamination may occur after a product is packed or, more importantly, when the product or packaging material is in store. It is possible for eggs to be laid in a pack and the insects to hatch after packing. This problem and its prevention is dealt with extensively in BS 1133-5. No effective means of rendering packaging materials fully resistant to insect attack, using coatings or chemicals, are currently available which would be acceptable for food packaging.

Contamination by larger life-forms, e.g. rodents and birds, is, as stated earlier, a matter for good housekeeping. Stores and warehouses should be dry, fully proofed against ingress of animals, and subject to regular pest control routines.

3.4 Identification and information

Packaging should provide information on the manufacture of the product, the nature, strength and weight of the contents and any special instructions on usage, safety precautions etc. It should also meet all legal provisions or requirements for package marking.

For transit packages it may also be necessary to include handling instructions or symbols (see BS 2770).

³⁾ Sometimes erroneously referred to as controlled atmosphere packaging (CAP).

3.5 Market appeal

The role of packaging has expanded greatly as a consequence of changes in the pattern of retailing. Products such as ceramic tiles, lawn mowers, furniture, pottery, garden tools etc., all once sold through specialist outlets and largely unpacked, are now merchandized through superstores and have to be packed for both market appeal and take-home convenience. The standard of graphics and print quality associated with the packs for these products has also been raised as a consequence. In modern self-service stores the pack is in most instances all that the customer sees, and hence it has to sell its contents. To achieve this a pack has to explain the nature of the contents and the method of using them. It also has to accurately reflect the quality of the goods contained and enhance the reputation of the supplier. In recent years considerable research has been carried out into the science of brand recognition and shelf stand-out. This is used by designers in enhancing the sales appeal of products in self-service situations.

3.6 User convenience

The size, form and method of use of the product may all be dictated by the pack. Openability, reclosability, ease of carrying, dispensing facilities etc., and after-use potential are all aspects which may have to be provided as part of the functions of the pack. An additional aspect related to the user is security, with free access of customers to goods on sale; this has proved a problem which is by no means easy to resolve, but some effective measures can be taken with the packaging.

Section 2 Factors influencing the selection of packaging

4 Identifying the factors involved

4.1 Review of possible factors

Before a method of packaging can be selected, a review should be made of the factors relating to the particular contents to be packed. The weight to be given to any factor may differ greatly between products but the factors may be conveniently classified under the headings of 4.2, 4.3, 4.4, 4.5 and 4.6.

4.2 The nature of the product

4.2.1 General. The product under consideration may be liquid, solid, powder or gaseous; it may be one item or a number of discrete items. These in turn may be packed together (e.g. fabric items), located by fitments (e.g. engineering spares in a divided case) or they may be individual packs of product with either secondary or even tertiary levels of packaging (e.g. whisky in a bottle, packed in a carton, shrink-wrapped in sixes and placed in a case of twenty-four). At each level the pack would be specified to meet its functional requirements with the packaging elements already included being considered at that stage as part of the product.

4.2.2 Physical properties. Those physical properties of a product which influence the fundamental aspects of choosing a pack form include the following:

- a) size: measured at an acceptable level of deformation where appropriate;
- b) shape: subject to modification by folding, dismantling and packaging configuration;
- c) weight, density and mass distribution;
- d) state: solid, liquid, paste, powder or gas and the effects on this of temperature or other influences;
- e) pressure: including vapour pressure (volatility) and the effect on this of temperature, vibration, compression or other factors;
- f) moisture equilibrium level;
- g) thermal sensitivity.

4.2.3 Chemical properties. The chemical properties of a product will dictate the product's reactivity with itself and with any material or environment with which it comes into contact. They include the following:

- a) pH, i.e. the level of acidity or alkalinity;
- b) flammability;
- c) explosive potential, either spontaneous or in the presence of oxygen and an ignition source;
- d) hygroscopicity, i.e. sensitivity to water in the form of liquid or vapour, and the chemical effect of an uptake or loss of water on the product;

e) reactivity with other material used in the container, as a solvent or in specific chemical reactions;

f) sensitivity to atmospheric gases, especially oxygen, but also other trace gases such as hydrogen sulphide, carbon dioxide and sulphur dioxide;

g) sensitivity to contaminants likely to be present in the packaging materials, especially chloride, sulphate and sulphide traces in paper;

h) photochemical reactions or sensitivity to other forms of irradiation such as ultra-violet (UV) light or sterilizing procedures.

4.2.4 Microbiological properties. Microbiological properties are of extreme importance in the packaging of foodstuffs and medical products but can produce effects in other areas, for example, being involved in corrosion mechanisms, damage to some chemical products such as soap, and, at the very least, production of unsightly effects on the packaging.

Microbiological material may be present in a product or in, or on, any part of the packaging material, or it may be picked up during the packaging operations, or from any handling system. It can also come into contact with the product subsequently if the packaging is not adequate to prevent its ingress. Microbiological "loading" may be characterized as follows:

- a) The range and quantity (per unit area or volume) of micro-organisms present. These would be classified by their degree of potential danger to health or any other hazard which they represent.
- b) Any specific affinity between organisms present and the nature of the product involved, also the effects of any reactions of such affinity.
- c) The durability of the organism present, in respect of ranges of temperature and moisture levels which they can tolerate.
- d) Treatment levels necessary to achieve the required level of sterility for the product.
- e) The range of tolerance of any benign organisms, which may be integral to the product or indeed, may be the product itself.

4.3 Product vulnerability

4.3.1 General. To a large extent product vulnerability will be indicated by the characteristics of the products as listed in 4.2 and the next stage is to consider means of combatting any of the specific hazards associated with the storage and distribution sequence.