

Packaging code —

Section 22: Packaging in plastics containers

UDC 621.798.1:678.5/.8.004.12

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Committees responsible for this British Standard

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 30 November 1989

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First published May 1967
First revision November 1989

The following BSI references relate to the work on this standard:
Committee reference PKM/503
Draft for comment 87/40805 DC

ISBN 0 580 17820 X

Amendments issued since publication

Amd. No.	Date of issue	Comments

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Foreword

This Section of BS 1133 has been prepared under the direction of the Packaging and Freight Containers Standards Policy Committee. It is a revision of BS 1133-22:1967, which is withdrawn.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.

This revision of Section 22 updates the guidance material to reflect changes in use of the different types of plastics materials and methods of container manufacture.

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 transportation 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 drums;*
- *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 18.1: 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.*

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.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 22, 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.

1 Scope

This Section of BS 1133 provides general guidance on the use in packaging of containers made of plastics materials.

Typical properties for a range of plastics materials are listed in Appendix A.

2 General

It is technically possible, although not necessarily economically practicable, to find suitable plastics materials for the manufacture of containers for a great variety of products. Plastics containers are already in wide use in the food and drink, chemical, dairying, pharmaceutical, cosmetic and other industries.

In this Section of BS 1133, plastics materials in current use are described and an indication given of their properties and their suitability for various packaging applications (see clause 5). However, consultation with manufacturers is essential before a decision is taken on the use of a particular material for a specific product.

3 Choice of package

A number of factors affect the choice of the most suitable package for a given product. They are dealt with fully in Sections 1 to 3 of BS 1133, but for convenience may be summarized under the following headings:

- a) size and density of contents;
- b) storage, transport and handling conditions;
- c) physical and chemical nature of the contents;
- d) construction and shape;
- e) presentation;
- f) filling and dispensing requirements;
- g) processing requirements;
- h) possible re-use;
- i) quantity requirements;
- j) shelf-life requirements;
- k) sterilization requirements;
- l) migration of low molecular weight materials into and out of the container;
- m) legislative requirements concerning toxicity, contamination of product, labelling, and in the case of hazardous products, transport regulations which must be complied with.

It will be appreciated that the relative importance of the different factors will vary with the product to be packed.

Apart from these general considerations, the special considerations applicable to the use of plastics containers are discussed in clauses 4 and 5.

4 General properties of plastics materials

4.1 Colour

The majority of plastics are available in a full range of colours. Some groups have limitations, e.g. the base colour of phenol formaldehyde restricts it to dark colours.

Transparent tints are available only in plastics which are transparent in their natural form, e.g. acrylics, cellulose, polycarbonates, unmodified polystyrenes, styrene acrylonitrile and polyvinyl chloride.

Toxicity considerations will influence the choice of pigments which can be used.

4.2 Density

Density is defined as mass per unit volume, the SI unit of density being the kilogram per cubic metre (kg/m^3). Plastic materials have a low density.

Variations of density occur not only between different types of plastics, but often between grades of the same type. A notable example occurs in the polyethylene family where a change in density from 910 kg/m^3 to 960 kg/m^3 , i.e. a change of only 50 kg/m^3 , is associated with significant changes in rigidity, permeability and other properties. Density may be increased if pigments are added or reduced if the plastics material has a cellular structure.

4.3 Mechanical properties

In selecting a plastics material for a container, due regard should be paid to the mechanical properties relevant to the conditions of use. The following are the most important.

- a) *Impact resistance.* A measure of the ability of a material to withstand mechanical shock. Temperature and container design may have a considerable influence on impact resistance. At low temperature some materials will become brittle. When some containers are kept at an elevated temperature for an extended period, brittleness may also result from loss of plasticizer or from oxidation. When degradation is caused by oxidation, the incorporation of antioxidants minimizes this effect.
- b) *Rigidity.* A measure of the stiffness of a material determined by measuring the stress required either to produce a given degree of deformation or to result in a specified maximum degree of strain. With thermoplastic materials, rigidity decreases with rise in temperature and when plasticized by solvents or moisture.

c) *Creep*. A measure of deformation with time when a plastics material is subjected to a sustained load. In extreme cases creep can cause problems such as instability of stacked containers.

4.4 Chemical resistance

4.4.1 *Acids and alkalis*. Most plastics materials used in the manufacture of containers are resistant to a wide range of acids and alkalis. Advice regarding the suitability of a material should be obtained from the manufacturer.

4.4.2 *Solvents and oils*. It is difficult to generalize on the action of organic solvents on plastics materials. It is therefore desirable to obtain advice as to suitability from the supplier, and where necessary to carry out compatibility tests.

Solvents may permeate through containers and cause stickiness of the package and affect the print. Oils are generally classified into animal, vegetable and mineral, each type having a different effect. In general vegetable oils cause more difficulty in packaging. Essential oils used in perfumery and cosmetics may soften the plastic and cause dimensional changes.

4.4.3 *Surface active agents*. Some substances, for instance detergents, can cause cracking of certain plastics when stressed either internally, or externally. This environmental stress cracking can usually be avoided in practice by selecting grades of material that are more resistant to the phenomenon and by careful design of the container. Before general use, trials should be made with the complete container under the conditions to be encountered in storage and distribution.

4.5 Dimensional stability

4.5.1 *General*. Poor dimensional stability may cause considerable difficulties in printing due to inaccurate registration, and in stacking and handling. In severe cases, container capacity and shape may change significantly.

4.5.2 *Effect of moisture*. With some plastics, absorption of moisture can plasticize the polymer and cause dimensional changes and a reduction in physical properties, e.g. rigidity. The moisture can be absorbed from the atmosphere or from the product packed in a container.

4.5.3 *Effect of temperature*. All thermoplastics are affected by change in temperature. Some containers become limp and may deform as the ambient or product temperature increases. Such deformation may increase over a period of time when the containers are subjected to load, as in a stack. Containers with built-in strain, e.g. oriented bottles, will attempt to revert to their unoriented condition when a certain temperature is exceeded. Any chemical attack is accelerated at elevated temperatures.

4.6 Effect of light

Exposure to light is not normally a problem but prolonged exposure may cause degradation of certain plastics due to oxidation and result in loss of clarity, change in colour, brittleness or a surface deposit. These effects can be reduced by the addition of suitable stabilizers or pigments to the plastics, or by applying suitable coatings to the container.

4.7 Optical properties

The optical quality of a plastics container is determined by a number of factors of which the most important are the following:

a) *Gloss*. The ability of the plastic to reflect light in the same way as a mirror; it gives a quantitative measure of the “sparkle” of the container.

b) *Light transmission*. Indicates the proportion of incident light that passes through the container. There is no direct relationship between light transmission and clarity.

When protection of the contents from light is required, suitable pigments and/or other additives may be added to the material.

c) *Haze*. Haze is defined as that percentage of transmitted light which, in passing through a specimen, deviates from an incident beam normal to the specimen by forward scattering. Its measurement is designed to correlate with the clarity with which one can see detail of an object on the far side of, though not in contact with, the material.

d) *“See through” clarity*. An expression used to indicate the degree of distortion of a distant object when viewed through the container. Because the container is generally close to the contents of the pack “see through” clarity is of less importance than haze.

4.8 Toxicity, odour and taste

Plastics materials used for food packaging are required to comply with the Materials and Articles in Contact with Food Regulations SI 1987 No. 1927 and the Amendments thereto¹⁾. These requirements state:

“Materials and articles to which this regulation applies shall be manufactured in accordance with good manufacturing practice, that is to say in such a way that under normal or foreseeable conditions of use they do not transfer their constituents to foods with which they are, or are likely to be, in contact, in quantities which could —

- a) endanger human health or
- b) bring about a deterioration in the organoleptic characteristics of such food or an unacceptable change in its nature, substance or quality”.

In addition to the above requirement, which is applicable to all plastics, the Regulations contain sections dealing specifically with vinyl chloride monomer and polyvinyl chloride (PVC) plastics, and regenerated cellulose films.

To assist manufacturers and users of plastics in the selection of suitable compositions for food packaging, with respect to ensuring there is no transfer of harmful contamination, the British Plastics Federation in cooperation with the British Industrial Biological Research Association publish a code of practice “Plastics for Food Contact Applications”²⁾.

Food packaged in plastics containers can become tainted or contaminated with unacceptable odours from components of the plastic itself (residual monomers such as styrene and degradation products from processing) or volatiles from printing inks and adhesives. These problems can also arise from external vapours passing through the walls of the container. For all new plastics container types, taint and odour tests together with shelf-life experiments should be undertaken.

4.9 Sterilization

A plastics package to hold a sterilized product has to be capable of excluding micro-organisms throughout its service life and reliable seals or closures are essential. Sterility may be achieved by dry heat, steam, chemical agents or radiation and the effectiveness of the package is dependent on the method used. The packaging itself may also need to be sterilized by one of the above-named methods.

4.10 Radiation

Exposure to radiation, especially gamma and ultraviolet (UV), can cause some plastics materials to degrade, and consequently to embrittle and/or discolour and/or liberate gases. Special grades of some plastics are available to resist these changes.

4.11 Decoration

Decoration and information may be formed into a plastics article. Surface design if required may be applied in the following ways.

- a) *Printing*. Plastics can be printed successfully provided suitable inks are used, although some require pre-treatment of the surface for good results.
- b) *Hot stamped*. A method used where high quality metallic or coloured decoration is required.
- c) *Transfers*. Transfers suitable for plastics are available.
- d) *Labelling*. Labels of paper or film may be applied with an appropriate adhesive, alternatively stretch or shrink sleeve labels may be used. In some cases “in-mould” labels may be applied during the moulding process.

4.12 Permeability

4.12.1 Gas permeability. Gas permeability is a measure of the transmission rate of a gas through a specified thickness of the plastics material under controlled humidity, pressure and temperature conditions.

The rate of transmission of a gas through a plastics material decreases as the thickness increases.

4.12.2 Water vapour permeability. Water vapour permeability is a measure of the transmission rate of water vapour through a specified thickness of a plastics material under controlled conditions of humidity, pressure and temperature.

As with gas permeability, the transmission rate decreases with increase in thickness of the plastics material.

4.12.3 Solvent permeability. Solvents and solvent vapours can permeate the walls of a plastic container, and the partial vacuum thus created inside the container can cause the phenomenon of “panelling”. Absorption of solvent by the walls of the container can cause the latter to soften, resulting in deformation.

¹⁾ Obtainable from HMSO.

²⁾ Obtainable from the British Plastics Federation, 5 Belgrave Square, London SW1X 8PH.