BRITISH STANDARD 4232 : 1967

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SPECIFICATION FOR

SURFACE FINISH OF BLAST-CLEANED STEEL FOR PAINTING

BRITISH STANDARDS INSTITUTION

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BS 4232 : 1967

BRITISH STANDARDS INSTITUTION
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THIS BRITISH STANDARD, having been approved by the Pigments, Paints and Varnishes Industry Standards Committee and endorsed by the Chairman of the Chemical Divisional Council, was published under the authority of the General Council on 29th December, 1967.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 9,000, fully indexed and with a note of the contents of each, will be found in the BSI Catalogue which may be purchased from BSI Sales Department. The Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards:

BS 15. Mild steel for general structural purposes.
BS 410. Test sieves.
BS 968. High yield stress (welding quality) structural steel.
BS 2451. Chilled iron shot and grit.
BS 2569. Sprayed metal coatings.
BS 2762. Notch ductile steel for general structural purposes.
CP 2008. Protection of iron and steel structures from corrosion.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following BSI references relate to the work on this standard:
Committee reference PVC/21 Draft for comment 66/3768

CO-OPERATING ORGANIZATIONS

The Pigments, Paints and Varnishes Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Board of Trade
British Colour Makers' Association
British Railways Board
Chemical Industries Association
Crown Agents for Oversea Governments and Administrations
*Greater London Council
Lead Oxide Convention
London Transport Board
Ministry of Defence, Army Department
Ministry of Defence, Navy Department
Ministry of Public Building and Works
Ministry of Public Building and Works—Building Research Station
Ministry of Technology
Ministry of Technology—Laboratory of the Government Chemist
National Federation of Builders' and Plumbers' Merchants
Oil and Colour Chemists' Association
Paintmakers' Association of Great Britain Ltd.
Paint Manufacturers' and Allied Trades Association
Post Office
Research Association of British Paint, Colour and Varnish Manufacturers
Royal Institute of British Architects
Royal Institute of Public Health & Hygiene
Titanium Pigment Manufacturers' Technical Committee
White Lead Convention
Zinc Development Association

The scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Association of Corrosion Engineers
Electricity Council, The Central Electricity Generating Board and the Area Boards in England and Wales

BS 4232 : 1967

BRITISH STANDARD SPECIFICATION FOR

SURFACE FINISH OF BLAST-CLEANED STEEL FOR PAINTING

FOREWORD

This British Standard was prepared under the authority of the Pigments, Paints and Varnishes Industry Standards Committee at the request of the British Association of Corrosion Engineers, now the Institute of Corrosion Technology. It is based on draft specifications for qualities of blast-cleaning proposed by an expert committee of the BACE, to whom due acknowledgement is made. It is not intended to cover wet methods of blast-cleaning.

The quality levels defined in this British Standard have been selected so as to be roughly equivalent to those defined in the internationally recognized standards of the Steel Structures Painting Council (USA) and the Swedish Standards Organization. This equivalence may be expressed as follows:

BS	SSPC	SIS 05 59 00
First quality	White metal	SA 3
Second quality	Near-white	SA 2·5 (see Note)
Third quality	Commercial	SA 2

NOTE. The intermediate quality described here as SA 2·5 was not included in the 1960 edition of the Swedish Standard SIS 05 59 00, but was added to the fifth edition published in 1967.

This British Standard is concerned primarily with the quality of surface finish resulting from blast-cleaning and only secondarily with the blast-cleaning equipment and procedure required to produce these results. It has been found difficult to base the standard on detailed measurement and assessment of surface finish, but since the finish achieved is closely related to the type and grade of abrasive used, it has been decided to list the abrasives that will normally give the surface finishes specified, provided suitable equipment is used by experienced operators.

Some notes are also included on the use of this British Standard, under three headings:

Selection of a suitable quality of surface finish for a given purpose (see Clause 4).

Methods of control and inspection of the quality of surface finish obtained (see Clause 5).

Blast-cleaning procedure (see Appendix A).

The blast-cleaning and protective painting of structural steelwork is considered in detail in CP 2008*.

This British Standard is concerned only with the preparation of steel surfaces for painting and not with the preparation requirements specified in BS 2569†, although the same surface finish may be suitable for metal spraying and for some types of paint.

Consideration was given to including a fourth quality equivalent to the so-called 'brush-off' finish that is sometimes used where the site or service conditions are not considered to justify (or do not permit) a better quality of finish. It was strongly felt, however, that this type of finish should not be encouraged or recommended as suitable for painting, and it was therefore decided to omit it from the standard.

SPECIFICATION

1. SCOPE

This British Standard specifies qualities of surface finish for all steels that are prepared by dry methods of blast-cleaning for the application of paints and non-metallic coatings. It applies both to uncoated steel, whether new or weathered, and to steel from which an old protective coating has to be removed.

First, second and third qualities of surface finish are defined. Recommendations are made regarding the selection of an appropriate quality of surface finish for a particular paint system or purpose; methods of inspection and control of the surface finish achieved; and blast-cleaning procedures.

2. QUALITIES OF SURFACE FINISH

2.1 General. The quality of blast-cleaned steel surface is defined in terms of (1) cleanliness and (2) roughness. There are no simple precise means of measuring these characteristics but the first can be estimated from the appearance of the surface and the second can generally be controlled within broad limits by the choice of blast-cleaning procedure, and notably of the type and grade of abrasive.

The surface finish attainable depends to a large extent upon the condition of the steel before blast-cleaning and a first quality finish is unlikely to be attained if the steel is deeply pitted or otherwise severely corroded before blast-cleaning, even though all contaminants appear to have been removed. Further, the degree of corrosion that has occurred before blast-cleaning (as indicated, for example, in the Swedish Standard SIS 05 59 00) may be reflected in the ultimate performance of the painted steel; the greater the degree of corrosion before cleaning, the more difficult it is to remove all surface contaminants and if this is not done the durability of the paint coating will be decreased.

* CP 2008, ' Protection of iron and steel structures from corrosion '.
† BS 2569, ' Sprayed metal coatings '.

2.2 Surface cleanliness. The following levels of cleanliness are covered by this British Standard (see also Table 1).

(1) *First quality.* The entire surface shall show blast-cleaning pattern and shall be clean bare steel completely free from any contamination or discoloration.

Areas that appear shadowed solely because of differences in the blast-cleaning pattern or the structure of the steel shall be classed as clean steel.

(2) *Second quality.* The entire surface shall show blast-cleaning pattern and shall be completely free from contamination by oil, grease, dirt or other matter, except that tightly-bonded residues of millscale or rust shall be permissible up to the following limits:

For the whole surface. An average of not more than 5%; i.e. at least 95% of the surface shall be clean bare steel.

For any single square of 25 mm (1 in) side. Not more than 10%; i.e. at least 90% of the square shall be clean bare steel.

Areas that appear shadowed solely because of differences in the blast-cleaning pattern or the structure of the steel shall be classed as clean steel.

(3) *Third quality.* The entire surface shall show blast-cleaning pattern and shall be completely free from contamination by oil, grease, dirt or other matter, except that tightly-bonded residues of millscale, rust, paint or other previous coating shall be permissible up to the following limits:

For the whole surface. An average of not more than 20%; i.e. at least 80% of the surface shall be clean bare steel.

For any single square of 25 mm (1 in) side. Not more than 40%; i.e. at least 60% of the square shall be clean bare steel.

NOTE. Figs. 1 and 2 are included as diagrammatic indications of the amounts of fine and coarse millscale residues that would satisfy the above definitions of second and third quality finishes, respectively. These diagrams are not intended to represent the actual appearance of the blast-cleaned steel surface, which may vary considerably (for the same quality of finish) according to the type of steel, the method of manufacture, the condition of the surface before cleaning, the type and grade of abrasive, and the blast-cleaning procedure adopted.

2.3 Surface roughness

2.3.1 *General.* The surface roughness achieved for each of the qualities of finish depends mainly upon the type of steel, its condition before blast-cleaning and the type and grade of abrasive used (see Clause 3).

2.3.2 *Use of metallic abrasives.* The grades of metallic abrasive recommended have been selected with the target of a surface roughness defined by a maximum amplitude* of 0·10 mm (0·004 in), which is usually acceptable for painting.

* The term ' maximum amplitude ' as used in this British Standard is defined as the greatest vertical distance between the summit of any peak on the blast-cleaned surface and the bottom of an immediately adjacent trough, but without taking into account any exceptionally high ' rogue peaks ', which are liable to occur on a blast-cleaned surface as a result of embedded particles of abrasive. Such peaks are very undesirable and their size and number may be the subject of special agreement between the parties to a contract.

TABLE 1. QUALITIES OF SURFACE FINISH OF BLAST-CLEANED STEEL FOR PAINTING

Quality of surface finish	First quality	Second quality	Third quality
Types of steel	All steels, including structural steels to BS 15, BS 968 and BS 2762*		
General appearance	Whole surface to show blast-cleaning pattern		
Description of finish:			
Clean bare steel	Whole surface	At least 95% of surface	At least 80% of surface
Extent of residue	Nil	Not more than 10% of any single square of 25 mm (1 in) side	Not more than 40% of any single square of 25 mm (1 in) side
Type of residue permitted:			
Millscale	Nil	Tightly-bonded residues	Tightly-bonded residues
Rust	Nil		
Paint or other coating	Nil	Nil	
Loose abrasive and dust	Nil	Nil	Nil
Surface roughness	The maximum amplitude should be related to the paint system and should preferably not exceed 0·10 mm (0·004 in) (see 2.3)		

* BS 15, ' Mild steel for general structural purposes '.
BS 968, ' High yield stress (welding quality) structural steel '.
BS 2762, ' Notch ductile steel for general structural purposes '.

2.3.3 *Use of non-metallic abrasives.* Similarly, the grades of non-metallic abrasive recommended have been selected with the target of a surface roughness defined by a maximum amplitude of 0·18 mm (0·007 in). If a maximum amplitude of 0·1 mm (0·004 in) is required, this can be obtained by using abrasive of maximum particle size 1 mm (0·04 in), i.e. No. 16 mesh.

2.3.4 *Rusty steel.* When rusty steel is cleaned, whether metallic or non-metallic abrasives are used, the surface roughness attainable will be influenced by the condition of the steel and this shall be taken into account when assessing the maximum amplitude of the cleaned surface.

2.3.5 *Methods of measurement.* No completely satisfactory method of measuring surface roughness is available for use in the field. It is advisable for the parties to a contract to agree beforehand on the method to be used, e.g. in case of dispute, and the following are examples of methods that may be suitable*.

(1) *Sectioning.* A metallurgical section is prepared and the surface profile measured under a suitable microscope using a micrometer eyepiece.

(2) *Grinding.* The thickness of the blast-cleaned specimen is measured with a flat-ended micrometer. The surface is then ground until the bottoms of only the deepest pits are just visible. A further thickness measurement is then taken.

(3) *Direct measurement by microscope.* The blast-cleaned specimen, or a replica, is viewed through a suitable microscope, first focussing on the peak and then focussing on the lowest adjacent trough, noting the necessary adjustment of focus.

(4) *Profile tracing.* A blast-cleaned specimen is traversed with a diamond or sapphire stylus and the displacement of the stylus as it passes over peaks and troughs is recorded.

3. ABRASIVES

It is desirable to specify by agreement between the parties, the types and grades of abrasive and method of use. The types and grades of abrasive listed in Table 2 are, in general, the coarsest for producing the qualities of surface finish covered by this British Standard (see also 2.3). Unless specifically agreed otherwise, these or finer grades should be used.

* A review of the present position is given in Chandler, K. A. and Shak, B. J., 'The assessment of surface profile after blast-cleaning', British Corrosion Journal, 1966, 1, No. 8 (Sept.). 307–316.

TABLE 2. TYPES AND GRADES OF ABRASIVE

Mesh	No.	Per cent by weight passing sieve									
		6	8	12	14	16	18	25	30	44	60
	mm	2·80	2·00	1·40	1·20	1·00	0·850	0·600	0·500	0·355	0·250
	in	0·1102	0·0787	0·0551	0·0472	0·0394	0·0335	0·0236	0·0197	0·0140	0·0098
S 240 chilled iron shot		—	—	—	—	100	90 min.	15 max.	—	Nil	—
S 340 steel and malleable iron shot		—	—	100	95 min.	—	15 max.	—	Nil	—	—
G 24 chilled iron grit		—	—	—	—	100	—	15 max.	—	Nil	—
G 39 steel and malleable iron grit		—	—	100	—	15 max.	—	Nil	—	—	—
Non-metallic abrasive		100	80 min.	—	—	—	—	—	—	—	5 max.

NOTE 1. If mixtures of shot and grit are used, both components should comply with these requirements.
NOTE 2. Size grades for blast-cleaning with sand are not included. If this abrasive is used, special precautions are necessary in view of the health hazard involved.
NOTE 3. The sieve sizes are those specified in BS 410, ' Test-sieves ', and the grading of the shot and grit is in accordance with BS 2451, Chilled iron shot and grit '. The same sieve sizes are assumed for steel and malleable iron as for chilled iron.

4. SELECTION OF A SUITABLE QUALITY OF SURFACE FINISH

The quality of surface finish to be selected for particular circumstances depends, among other things, on the blast-cleaning procedure and the paint system necessary to protect the steel in the environment in which it is going to be used. Some guiding principles are stated in Table 3.

TABLE 3

Quality	Typical application
First quality finish	For treating steelwork where extremely clean surfaces can be expected to prolong the life of chemical-resistant paint systems in exacting conditions
Second quality finish	The minimum requirement for chemically resistant paint systems such as epoxide and vinyl resin paints; also where the best attainable performance is required from conventional paint systems used under fairly corrosive conditions
Third quality finish	For steel that is to be painted with conventional paints for exposure to mildly corrosive atmospheric conditions

5. CONTROL AND INSPECTION

Methods of controlling the quality of surface finish, both with regard to cleanliness and roughness, are in course of development. For the time being, some measure of control can be exercised by comparison with agreed reference panels prepared beforehand to show the type of finish required. The following procedures have been found useful:

(1) In the case of large structures, it may be convenient to take coupon samples for inspection in the following manner:

A sample piece at least 150 mm × 100 mm made from the metal identical to the base structure being treated and in the same surface condition, is held temporarily in position on the base. An area containing the sample piece is then blast-cleaned to the desired finish. The sample piece is detached and placed in a clean, dry, airtight container containing sufficient moisture-absorbent material such as silica gel to dry the air in the container, for later examination in the laboratory or for reference purposes.

(2) Photographs, such as those issued by the Swedish Standards Committee (SIS 05 59 00, 'Rust grades for steel surfaces and preparation grades prior to protective coating'), are useful for assessing cleanliness.

(3) Sets of specially prepared reference plates* can be used to estimate roughness.

* For example, the ' Rugotest ' series.

APPENDIX A

BLAST-CLEANING PROCEDURE

A.1 The steel to be blast-cleaned should be dry and the operating conditions should be such that condensation does not occur on it during the work. When compressed air is used, this should be dry and free from oil.

Any oil or grease should be removed from the steel surface before blast-cleaning is begun.

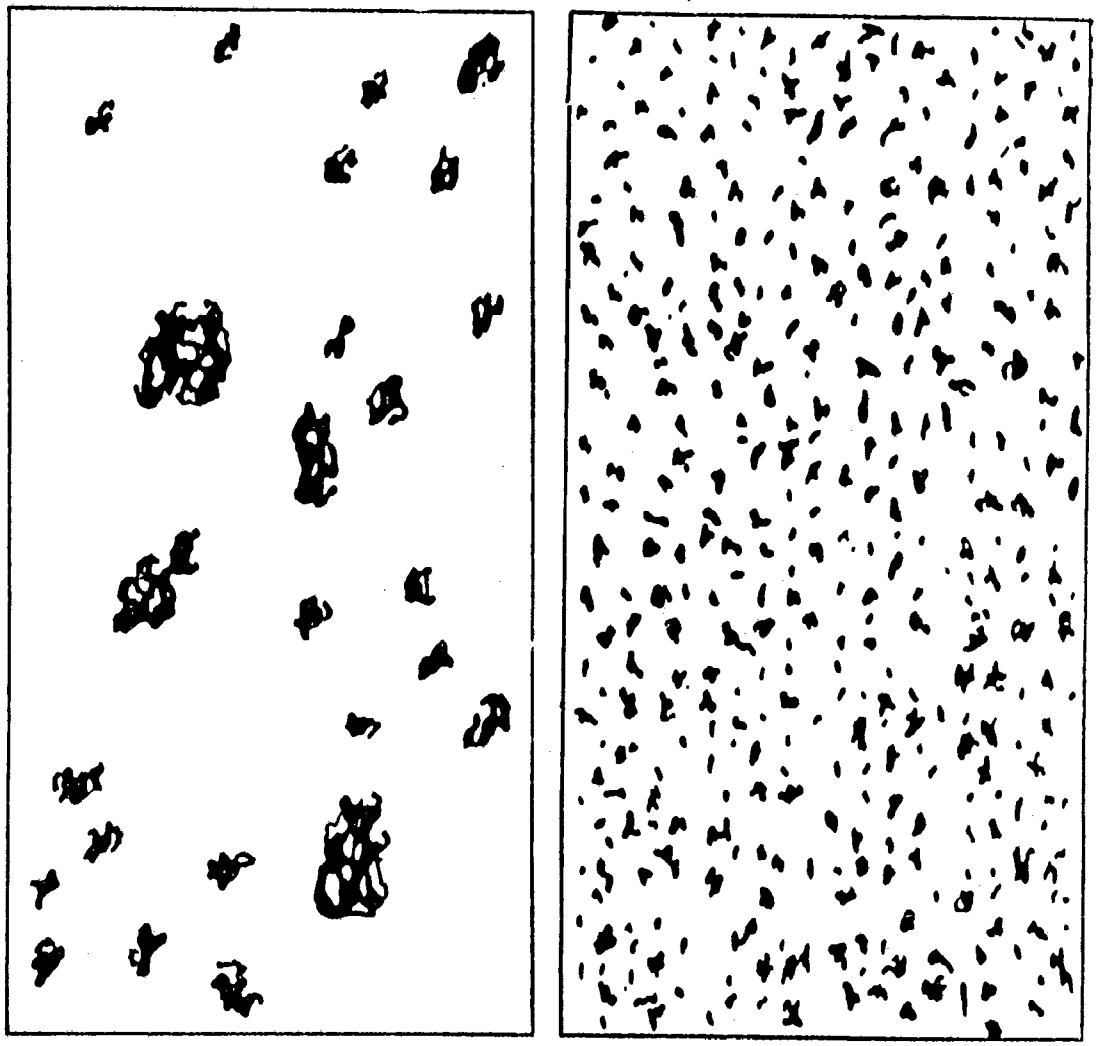
If the steel is heavily rusted, particularly if scaly rust is present, a preliminary cleaning with power-driven impact tools will generally prove economical.

Unless an instantaneous-recovery blasting machine is employed, the cleaned surface should be air-blasted, vacuum-cleaned, or otherwise freed from abrasive residues and dust immediately after the blast-cleaning.

Following the removal of abrasive material, the surface should preferably be rubbed over briefly with a nylon scraper or scourer to reduce the number of 'rogue peaks' (see footnote to 2.3.2).

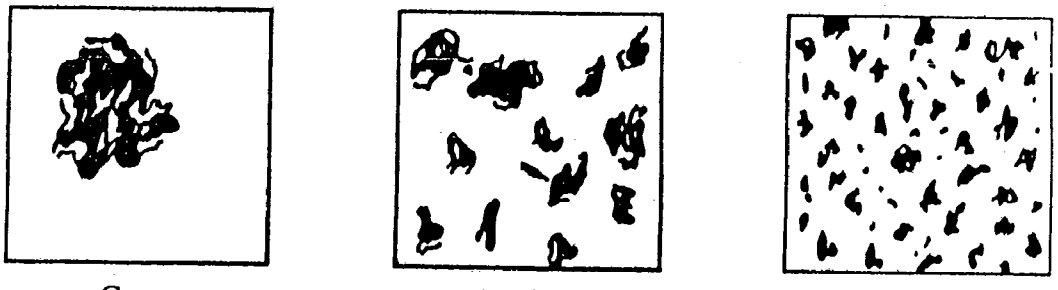
The application of at least the first coat of paint or non-metallic coating should follow with the least possible delay and in any case before visible deterioration has occurred as compared with a freshly blast-cleaned area.

WHOLE SURFACE
(5% Millscale residues)



Coarse Fine

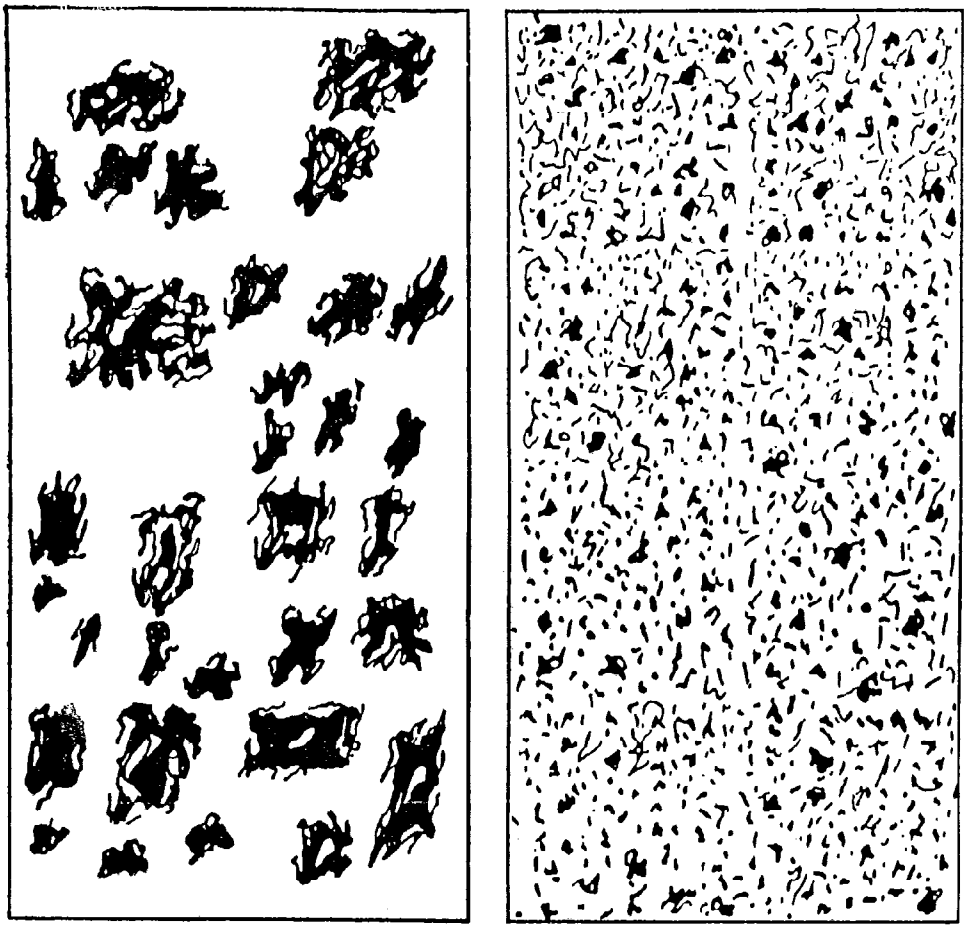
MAXIMUM PERMITTED IN ANY SINGLE 25 mm × 25 mm (1 in × 1 in)
(10% Millscale residues)



Coarse Medium Fine

Fig. 1. Diagrammatic indications of second quality

WHOLE SURFACE
(20% Millscale residues)



Coarse Fine

MAXIMUM PERMITTED IN ANY SINGLE 25 mm × 25 mm (1 in × 1 in)
(40% Millscale residues)

Coarse Medium Fine

Fig. 2. Diagrammatic indications of third quality

BRITISH STANDARDS INSTITUTION

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The principal objects of the Institution as set out in the charter are to co-ordinate the efforts of producers and users for the improvement, standardization and simplification of engineering and industrial materials; to simplify production and distribution; to eliminate the waste of time and material involved in the production of an unnecessary variety of patterns and sizes of articles for one and the same purpose; to set up standards of quality and dimensions, and to promote the general adoption of British Standards.

In carrying out its work the Institution endeavours to ensure adequate representation of all viewpoints. Before embarking on any project it must be satisfied that there is a strong body of opinion in favour of proceeding and that there is a recognized need to be met.

The Institution is a non-profit-making concern. It is financed by subscriptions from firms, trade associations, professional institutions and other bodies interested in its work, by a Government grant and by the sale of its publications. The demands on the services of the Institution are steadily increasing and can only be met if continuing and increased financial support is provided.

Membership of the Institution is open to British subjects, companies, technical and trade associations, and local and public authorities.