BRITISH STANDARD

BS 7664:2000

Specification for undercoat and finishing paints

ICS 87.040

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee STI/28, Paint systems for non-metallic substrates, upon which the following bodies were represented:

British Cement Association

British Coatings Federation Ltd

British Decorators Association

Department for Education

Department of the Environment, Transport and the Regions

European Resin Manufacturer's Association

Furniture Industry Research Association

Ministry of Defence

Oil & Colour Chemists Association

Society of Chemical Industry

Timber Research & Development Association

Union of Construction, Allied Trades & Technicians

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Contents

Foreword

This British Standard has been prepared by Technical Committee STI/28. This standard supersedes BS 7664:1993, which is withdrawn.

It is intended that this standard should encompass those materials that are widely available at the date of its publication, for example systems based on mineral spirit reducible alkyd resins which are suitable for both interior and exterior applications. The composition of these materials is, however, not specified and it is possible that advances in technology may produce water-borne coating systems that meet the requirements of this British Standard.

Paints conforming to this standard can be satisfactorily applied under all reasonable climatic conditions, i.e. when the ambient temperature is between 5 ºC and 30 °C and the relative humidity is not greater than 85 % .

In general, the test procedures have been aligned, wherever possible, with those specified in the BS 3900 series. This has, however, not been possible for the following tests.

a) *Opacity (contrast ratio)*. This test (see annex G) is broadly in line with BS 3900-D6:1982, except that sealed black and white card is used as the substrate and the opacity is determined and the minimum value specified for a two-coat system.

b) *Yellowing test.* This test (see annex I) determines the maximum instrumental colour difference that occurs after storage of painted panels in complete darkness for a specified time.

c) *Artificial weathering*. This test (see annex L) is based on ASTM G53:1988, using type UVA 351 fluorescent tubes. The test is carried out on a three-coat system using acid chromate pickled hard aluminium as a stable substrate. As the colour range of materials covered by this British Standard is potentially very large, it has not been possible to specify a maximum colour change for every finishing coat colour. A range of nine colours, together with white, has therefore been selected (see clause **4**). The maximum colour change, minimum gloss level and the freedom from chalking after 1 000 h artificial weathering are specified for this limited range of colours.

d) *Natural weathering.* This test (see annex M) is based on the European Standard EN 927-3[1)], and is carried out on a three-coat system. In the test, a primer conforming to BS 7956:2000 is used on a relatively unstable substrate for a period of 12 months. Limits for cracking, blistering, flaking, adhesion and mould growth are specified in EN 927-2[1)].

It has been assumed in the drafting of this specification that it will be used and applied by persons who are appropriately qualified and experienced.

WARNING This British Standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. This standard refers only to technical suitability and does not absolve either the designer, the producer, the supplier or the user from statutory obligations relating to health and safety at any stage of manufacture or use.

[1)] In preparation

Product certification. Users of this British Standard are advised to consider the desirability of third party certification or product conformity with this British Standard, based on testing and continuing product surveillance. This may be coupled with the assessment of a supplier's quality systems against the appropriate standard in the BS EN ISO 9000 series.

Enquiries on the availability of third party certification schemes are forwarded by BSI to the Association of British Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching a body from the list of Association Members.

Attention is drawn to statutory health, safety and environmental legislation.

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

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1 Scope

This British Standard specifies requirements for finishing and undercoating paints suitable for both interior and exterior use. It covers paints of liquid or gel type suitable, when used with an appropriate primer, for use on metal, wood and other substrates. It covers paints suitable for application by brush or roller, and the spray application of liquid paints when thinned as recommended by the manufacturer.

2 Normative references

The following normative documents contain provisions which, through reference to this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 245, *Specification for mineral solvents (white spirit and related hydrocarbon solvents) for paints and other purposes.*

BS 2015:1992, *Glossary of paint and related terms.*

BS 3887:1991, *Specification for pressure sensitive adhesive closing and sealing tapes.*

BS 3900-A13, *Methods of test for paints — Part A13: Test for flash/no flash (rapid equilibrium method).*

BS 3900-C1, *Methods of test for paints — Part C1: Wet edge time.*

BS 3900-D1, *Methods of test for paints — Part D1: Visual comparison of the colour of paints.*

BS 3900-D5:1997*, Methods of test for paints — Part D5: Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°.*

BS 3900-D8, *Methods of test for paints — Part D8: Determination of colour and colour difference: principles.*

BS 3900-D9, *Methods of test for paints — Part D9: Determination of colour and colour difference: measurement.*

BS 3900-D10, *Methods of test for paints — Part D10: Determination of colour and colour difference: calculation.*

BS 3900-H6*, Methods of test for paints — Part H6: Rating of degree of chalking by tape method.*

BS 4800:1989, *Schedule of paint colours for building purposes.*

BS 7956, *Specification for primers for woodwork.*

BS EN 971-1:1996, *Paints and varnishes — Terms and definitions for coating materials — Part 1: General terms.*

BS EN 21512, *Methods of test for paints — Sampling.*

BS EN 29117, *Paints and varnishes — Determination of through-dry state and through-dry time — Method of test.*

BS EN ISO 1513, *Paints and varnishes — Examination and preparation of samples for testing.*

BS EN ISO 1514, *Paints and varnishes — Standard panels for testing.*

BS EN ISO 1517, *Paints and varnishes — Surface-dry test — Ballotini method.*

BS EN ISO 1519, *Paints and varnishes — Bend test (cylindrical mandrel).*

BS EN ISO 2409:1995, *Paints and varnishes — Cross-cut test.*

EN 927-2[2)], *Coating materials and coating systems for exterior wood — Part 2: Performance specification.*

EN 927-3[2)], *Coating materials and coating systems for exterior wood — Part 3: Natural weathering test.*

ASTM G53:1988, *Standard practice for operating light and water exposure apparatus (fluorescent UV condensation type) for exposure of non-metallic materials*.

3 Definitions

For the purposes of this British Standard, the definitions given in BS 2015:1992 and BS EN 971-1:1996, together with the following, apply.

3.1
paint system
for liquid paints, one coat of undercoat and one coat of finish; for gel paints, two coats of finish or as defined by the manufacturer

4 Composition

It is not possible to specify colour change criteria for all the pigment compositions likely to be used in a product colour range. A limited number of colours has been selected for examination by this specification (see Table L.1). Other colours in the same product range as a colour which meets the requirements of this specification would be expected to also meet these requirements.

NOTE The product should conform to requirements concerning VOC content.

[2)] In preparation

5 Flash point

The paint, when tested in accordance with BS 3900-A13, shall have a flash point greater than 32 °C.

6 Performance

6.1 General

Unless otherwise specified in the appropriate test method, the test panels shall be prepared and coated as described in annex A.

Unless otherwise specified in the appropriate test method, all tests shall be carried out at (23 ± 2) °C and relative humidity (50 ± 5) %.

6.2 Sampling

For the tests specified in Table 1, a representative sample of not less than 500 ml of paint shall be taken in accordance with BS EN 21512. A container of non-corrodible material shall be used.

6.3 Condition

The paint shall be in a condition suitable for application by brushing, roller or, when thinned in accordance with the manufacturer's instructions, by spraying. The paint in the original containers or in laboratory sample containers, when examined in accordance with BS EN ISO 1513, shall be free from extraneous matter. The paint shall show no skinning, hard settlement or other defect that would prevent its application to produce a film conforming to **6.5** and **6.6**.

6.4 Storage stability

The paint, when stored in its original container at 40 °C for one month from the date of manufacture, shall conform to tests 1 to 7 of Table 1.

6.5 Application properties and finish

The paint system, when applied as described in annex A, to a burnished steel panel measuring not less than 300 mm × 100 mm and allowed to dry for 24 h, shall have an opaque, even finish, free from runs and sags.

6.6 Paint film and paint system properties

White paint film or paint systems shall conform to the requirements of tests 1 to 12 in Table 1.

The coloured paint film or paint systems listed in Table L.1 shall conform to the requirements of tests 1, 6 and 11 of Table 1 only.

7 Marking of containers

Each container shall be permanently and legibly marked with the following information:

a) the manufacturer's name, trademark and product designation;

b) the colour and, if appropriate, the colour code in accordance with BS 4800:1989;

c) the batch number and/or date of manufacture;

d) the method of application and the recommended application rate expressed in square metres per litre (m^2/l);

e) the thinners to be used, if required;

f) statutory health, safety and environmental information.

NOTE Reference to this British Standard is optional, but if reference is made, the following format is suggested:

"This product, when used in combination with an undercoat/finish*, forms part of a paint system which conforms to BS 7664:2000."[3)]

* delete as appropriate.

[3)] Marking BS 7664:2000 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Table 1 — Requirements for paint films and paint systems

Test	Paint coating; test panel	Test method	Requirement
1 Colour	Paint system; burnished tin plate	Annex B	Shall match the colour requested by the purchaser
2 Surface-dry time	Single coat; burnished tin plate	Annex C	Undercoat ≤ 2 h Finish ≤ 4 h
3 Through-dry time	Single coat; burnished tin plate	Annex D	Undercoat ≤ 4 h Finish ≤ 16 h
4 Drying under adverse conditions	Paint system; burnished tin plate	Annex E	Surface dry time ≤ 24 h Through-dry time ≤ three days
5 Specular gloss	Single coat; glass	Annex F	Finish only, high gloss ≥ 90 units[a]
6 Opacity (contrast ratio)	Paint system; sealed hiding power chart	Annex G	Contrast ratio ≥ 96 %
7 Wet edge time	Paint system; burnished steel 600 mm × 300 mm	Annex H	No evidence of the join
8 Yellowing test	Paint system; burnished tin plate	Annex I	Colour change ΔE ≤ two units
9 Flexibility	Paint system; acid chromate pickled soft aluminium	Annex J	No cracking or loss of adhesion
10 Adhesion	Paint system; burnished tin plate	Annex K	Classification 0
11 Resistance to artificial weathering	Paint system; acid chromate pickled hard aluminium	Annex L	No chalking. Gloss to be not less than 75 units. Colour change shall be as given in Table L.1
12 Resistance to natural weathering	Paint system; primed sapwood of European redwood or British-grown Scots pine, containing water trap	Annex M	To meet criteria for the "stable" end, use category and mould resistance according to EN 927-2[4)]

[a] Although the specular gloss has been defined for high gloss materials only, it is, however, recognized that other finishes, e.g. mid sheen and silk may be available. The specular gloss levels of these material finishes should be the subject of agreement between the manufacturer and the purchaser.

[4)] In preparation

Annex A (normative)
Preparation of the test panels

A.1 Preparation of the substrate

Use test panels conforming to, and prepared in accordance with, BS EN ISO 1514.

A.2 Paint application

A.2.1 Unless otherwise specified, apply the paint to the test panel as described in Table 1. Unless otherwise specified in the relevant test method, allow the test panel to dry in a vertical position with free access of air under the conditions given in **6.1**.

A.2.2 Apply the paint to the test panels at the spreading rate recommended by the manufacturer.

A.2.3 Unless otherwise specified, for liquid paints apply a system consisting of one coat of undercoat and one coat of finish to the test panels. For gel paints, apply a system consisting of two coats of finish to the test panels. Allow the first coat of the system to dry under the conditions given in **6.1** for 24 h before application of the second coat.

Annex B (normative)
Method for assessment of colour

B.1 Test panels

Use panels of burnished tin plate, nominal size 150 mm × 100 mm, prepared and coated with the paint system described in annex A.

B.2 Procedure

B.2.1 *General*

Assess the colour either visually or instrumentally.

B.2.2 *Visual comparison*

For visual comparison, test in accordance with BS 3900-D1 under diffuse daylight.

B.2.3 *Instrumental assessment*

For instrumental assessment, test spectrophotometrically with gloss excluded in accordance with BS 3900-D8, BS 3900-D9 and BS 3900-D10.

Annex C (normative)
Method for assessment of surface-dry time

C.1 Prepare and coat the panel with one coat of paint as described in annex A.

C.2 Allow the coat of paint to dry for the time period specified in Table 1 and then test in accordance with BS EN ISO 1517.

Annex D (normative)
Method for assessment of through-dry time

D.1 Prepare and coat the panel with one coat of paint as described in annex A.

D.2 Allow the panel to dry for the specified period given in Table 1 and then test in accordance with BS EN 29117.

Annex E (normative)
Method for assessment of drying under adverse conditions

E.1 Condition the paint and the test panels for at least 24 h at (5 ± 1) °C and relative humidity (85 ± 5) %.

E.2 Apply the paint to the test panel under the temperature and relative humidity conditions given in **E.1**.

E.3 Apply one coat of undercoat to the test panel and allow to stand in a vertical attitude with free access of air under the temperature and relative humidity conditions given in **E.1**.

E.4 Apply one coat of finish to the test panel and allow to stand in a vertical attitude with free access of air under the temperature and relative humidity conditions given in **E.1** for 24 h and then test in accordance with BS EN ISO 1517.

E.5 Allow the test panel to condition for a further two days under the temperature and relative humidity conditions given in **E.1** then test in accordance with BS EN 29117.

Annex F (normative)
Method for assessment of specular gloss

F.1 Prepare and coat the panel with one coat of paint in accordance with BS 3900-D5:1997 and allow to dry for seven days.

F.2 Determine the specular gloss in accordance with BS 3900-D5:1997 using the 60° geometry method and the glossmeter specified in clause **5.3**.

NOTE BS 3900-D5:1997 recommends the use of illuminant C, although it allows for the use of illuminant A for a transition period.

Annex G (normative)
Method for determination for opacity (contrast ratio)

G.1 Apparatus

G.1.1 *Bar, block or wire-wound film applicator*, capable of producing a wet film with a thickness of approximately, but not greater than, 50 μm.

G.1.2 *Hiding power chart,* sealed black and white.

G.1.3 *Automatic film applicator*

G.1.4 *Photoelectric reflectometer instrument*, accurate to within 0.3 %, giving an indicated reading proportional to the intensity of the light reflected from the surface under test, and having a spectral response approximating to the product of the relative spectral energy distribution of CIE illuminant C or D65 and the colour matching function y (λ) of the CIE standard observer.

G.2 Procedure

G.2.1 Adjust the temperature of the paint to (23 ± 2) °C and homogenize a 250 ml sample by mixing for 2 min using a high speed stirrer.

G.2.2 Apply the paint system to the sealed hiding power chart in accordance with annex A using the film applicator (see **G.1.1**). Allow the panel to dry for 24 h after application of the final coat.

G.2.3 Measure the reflectances at a minimum of four positions over both the black and white areas of the panel and calculate the average reflectance factors R_B and R_W respectively. Calculate the contrast ratio of the paint system, R_Y, using the following formula.

$$R_Y = \frac{R_B}{R_W} \times 100$$

where

R_B is the average reflectance factor over the black area of the panel;

R_W is the average reflectance factor over the white area of the panel.

Annex H (normative)
Method for assessment of wet edge time

Prepare and coat the panel with the paint system in accordance with BS 3900-C1, allowing a wet edge time of 10 min.

Annex I (normative)
Method for assessment of yellowing

I.1 Prepare and coat the panel with the paint system as described in annex A.

I.2 Determine the colour of the panel in accordance with BS 3900-D8 and BS 3900-D9 (using a spectrophotometer with specular gloss excluded). Cover the panel with aluminium foil to exclude all light.

I.3 Store the panel for a period of three months at (23 ± 5) °C.

I.4 Remove the aluminium foil and immediately determine instrumentally the colour difference in accordance with BS 3900-D8, BS 3900-D9 and BS 3900-D10 (using a spectrophotometer with gloss excluded) of the panel, using the data previously obtained from the freshly prepared panel as the standard.

Annex J (normative)
Method for determination of flexibility

J.1 Prepare and coat the panel with the paint system as described in annex A and allow to dry for seven days.

J.2 Test the painted panel in accordance with BS EN ISO 1519 at (0 ± 0.5) °C, using Type 1 apparatus fitted with a mandrel 6 mm in diameter.

Annex K (normative)
Cross-cut test

K.1 Prepare and coat the panel with the paint system as described in annex A and allow to dry for seven days.

K.2 Test the painted panel in accordance with BS EN ISO 2409:1995, using a manually applied multiple cutting tool with six 30° cutting edges to make six cuts 1 mm apart.

K.3 Examine the painted panel for loss of adhesion and classify in accordance with clause **8** of BS EN ISO 2409:1995.

K.4 Apply one end of a piece of 25 mm wide, clear adhesive tape conforming to BS 3887:1991 firmly across the cuts. Allow the tape to remain in position for 1 min and then remove it with a snatching motion approximately 90° to the panel surface.

K.5 Examine the panel and tape for further signs of loss of adhesion and classify in accordance with clause **8** of BS EN ISO 2409:1995.

Annex L (normative)
Method for determination of resistance to artificial weathering

L.1 Prepare and coat the panel with a paint system consisting of one coat of undercoat and two coats of finish. Allow drying for 24 h between coats and for seven days after the final coat at (23 ± 2) °C and relative humidity (50 ± 5) %.

Determine the colour of the panel in accordance with BS 3900-D8 and BS 3900-D9 using a spectrophotometer with specular gloss excluded. Determine the specular gloss in accordance with BS 3900-D5:1997, **5.3** using the 60° geometry method and the specified glossmeter (see **F.2**).

L.2 Use fluorescent UV-condensation artificial weathering equipment conforming to, and operated in accordance with, ASTM G53:1988.

L.3 Expose the panel for a period of 1 000 h to the following conditions:

— 4 h UV exposure using UVA 351 lamps at 60 °C;

— 4 h condensation at 40 °C.

L.4 Remove the panel, allow to stand for 24 h at (23 ± 2) °C and relative humidity (50 ± 5) % and then, without washing, determine the colour change in accordance with BS 3900-D8, BS 3900-D9 and BS 3900-D10 using a spectrophotometer with specular gloss excluded. The specular gloss should be in accordance with BS 3900-D5:1997, **5.3** using the 60° geometry method and the specified glossmeter (see **F.2**). Take an average of three measurements from different areas of the panel and then assess chalking in accordance with BS 3900-H6.

L.5 The colour change should as given in Table L.1 for colours specified in accordance with BS 4800:1989.

Table L.1 — Maximum colour change

Colour designation as specified in BS 4800:1989	Maximum colour change ΔE
24 C 39	5.0
24 C 33	2.0
06 E 51	6.0
14 E 51	7.0
08 E 51	12.0
10 E 51	3.0
04 E 53	10.0
04 D 45	10.0
04 C 33	2.0
00 E 55	2.0

Annex M (normative)
Method for determination of resistance to natural weathering

Resistance to natural weathering is determined using the procedure described in EN 927-3[5)], and using a pine panel without sealing of the back face. The panels contain a water trap as described in EN 927-3[5)].

Before application of the coating system, the test panels receive the following preservative pre-treatment.

Pre-treat the surface of the test panels by applying a liberal brush coat of a blue stain preventative solution consisting of a 1 % (m/m) solution of Dichlofluanid in white spirit which conforms to BS 245. Filter the solution before use. Allow the panels to dry for 24 h at (20 ± 2) °C and relative humidity (65 ± 5) %.

WARNING Dichlofluanid is potentially hazardous. Refer to the appropriate safety data sheet when handling this material.

Assess the panels for coating defects as specified in EN 927-3[5)] and derive an overall performance rating as described in EN 927-2[5)].

[5)] In preparation

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