BRITISH STANDARD

BS 4652 : 1995

Incorporating
Amendment No. 1

Specification for

Zinc-rich priming paint (organic media)

Confirmed
October 2008

ICS 87.040

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee STI/27, Paint systems for metallic substrates, upon which the following bodies were represented:

Aluminium Window Association
British Coatings Federation Ltd.
British Railways Board
British Steel Industry
British Telecommunications plc
Department of the Environment (Building Research Establishment)
European Resin Manufacturers' Association
Galvanizers' Association
Institute of Corrosion
METCOM
National Federation of Painting and Decorating Contractors
Oil and Colour Chemists' Association
Paint Research Association
Society of Chemical Industry
Steel Window Association
Union of Construction, Allied Trades and Technicians
Zinc Development Association

The following body was also represented in the drafting of the standard, through a subcommittee:

Zinc Pigment Development Association

This British Standard, having been prepared under the direction of the Materials and Chemicals Sector Board (I/-), was published under the authority of the Standards Board and comes into effect on 15 April 1995

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Amendments issued since publication

Amd. No.	Date	Text affected
10074	July 1998	Indicated by a line in the margin

The following BSI references relate to the work on this standard:
Committee reference STI/27
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Contents

Foreword

This British Standard has been prepared under the direction of the Materials and Chemicals Sector Board. It supersedes BS 4652 : 1971, which is withdrawn.

The first edition of BS 4652, and later published amendments, specified three types of zinc dust-containing coatings intended for use as anticorrosive primers for the protection of abrasive blast-cleaned steel surfaces.

Experience in the use of these materials, improvements in the preparation of steel surfaces, and formulation developments of zinc dust-based primers, have indicated that simplification of the existing standard can be made by a reduction in the number of types specified.

The method for determination of metallic zinc content (see annex A) is based upon a method used by Harcros Chemicals.

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.

Specification

1 Scope

This British Standard specifies requirements for rapid drying priming paints containing a high proportion of zinc, supplied as two components, which react chemically when mixed together prior to use.

The paints specified are formulated for direct application to steel immediately after blast-cleaning to grade Sa 2½ of BS 7079 : Part A1. These paints are generally supplied as welding and prefabrication primers for thin film application, up to 25 μm dry film thickness or, for higher build films, typically up to 75 μm dry film thickness.

2 Normative references

This British Standard incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on the inside back cover. Subsequent amendments to, or revisions of, any of these publications apply to this British Standard only when incorporated in it by updating or revision.

3 Sampling

Representative samples of each component of the paints shall be taken as described in BS 3900 : Part A1.

4 Containers and labelling

All containers shall have openings of sufficient size to allow adequate stirring and mixing and shall be clearly marked with the following information:

a) name of the supplier or manufacturer;

b) manufacturer's code or trade name;

c) batch number;

d) reference to this British Standard; i.e. BS 4652[1)];

e) statutory requirements and information as necessary;

f) ratio in which base and curing agent components need to be mixed and mixing instructions.

5 Requirements for the components of the paint

5.1 Zinc dust-based component

5.1.1 When the base component in its original container is first examined not more than 6 months after manufacture, any settlement shall be readily dispersed by mechanical stirring. The storage temperature shall be between 5 °C and 25 °C.

NOTE 1. After longer periods harder settlement may occur.

NOTE 2. See also annex D for gassing.

5.1.2 The zinc dust in the base component shall conform to BS 3982.

NOTE. The maximum allowable limit for lead and cadmium are subject to national health and safety legislation and therefore the maximum level will be dependent upon the current legislation, and not necessarily the figure quoted in BS 3982.

5.2 Curing agent

When the curing agent in its original container is first examined it shall be readily dispersed by stirring to give a homogeneous appearance. The storage temperature shall be between 5 °C and 25 °C.

5.3 Mixing ratio

The proportion in which the base component and the curing agent are to be mixed shall be a simple ratio by volume.

6 Composition

When tested in accordance with annex A, the composition of the mixed paint shall be such that the content of zinc metal in the dry film shall be not less than 85 % (*m/m*) of the cured paint film.

NOTE. Commercially available zinc dust contains small percentages of oxidized material and consequently total zinc metal (metallic zinc) content may be lower than total zinc (zinc dust) content.

7 Performance requirements of the paint after mixing

7.1 Application properties

The paint shall be suitable for application by the method(s) defined by the manufacturer or supplier in technical data sheets for the product.

7.2 Preparation of test panels

Test panels for **7.3** to **7.6** shall be prepared in accordance with annex B.

1) Marking BS 4652 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, which may also be desirable.

7.3 Appearance

The dried paint film, when applied by the manufacturer's recommended method at the recommended rate, shall be continuous and free from cratering, pinholing, sagging, bittiness and cissing. Examination shall be by normal or corrected vision.

7.4 Hard-drying time (weldable and prefabrication primers only)

When the paint film is applied at the recommended application rate (l/m^2) and tested by the method described in BS EN 29117 it shall be hard-dry in not more than 30 min.

7.5 Resistance to impact

When the paint film is applied at the recommended rate to a steel plate 200 mm $\times$ 200 mm $\times$ 5 mm and tested with the coating uppermost in accordance with BS 3900 : Part E7, it shall show no signs of cracking, flaking or detachment when examined using normal or corrected vision.

7.6 Resistance to continuous salt spray

When the paint film is tested in accordance with annex C, it shall show no signs of rusting, and blistering shall not exceed scale D3 (S2) of BS 3900 : Part H2 in density and size.

NOTE. A white deposit may be formed on the surface: this is not evidence of corrosion of the steel.

Annexes

Annex A (normative)
Determination of metallic zinc content

A.1 Principle

The uncured paint is diluted with a suitable solvent, followed by centrifugal separation of the pigment from the sample and reduction of an acidic iron/copper reagent solution by the metallic zinc with titration of the reduced reagent with standard potassium dichromate solution.

A.2 Reagents

A.2.1 *Water*, of at least grade 3 purity conforming to BS 3978.

A.2.2 *Methyl ethyl ketone*.

A.2.3 *Acetone*.

A.2.4 *Iron/copper reagent*. Dissolve (100 ± 5) g copper (II) sulfate heptahydrate in 1 l of water **(A.2.1)**. Add 1250 ml 60 % (*m/m*) iron (III) sulfate solution and dilute to 2.5 l.

A.2.5 *Potassium dichromate* 0.05 M. In an agate mortar, powder about 30 g potassium dichromate (analytical grade reagent). Place in a clean glass evaporating basin and heat in an oven at (105 ± 2) °C for 2 h. Allow to cool in a desiccator. Weigh out accurately 29.4 g of the dried salt, to the nearest 0.1 mg, dissolve in water and make up to 2 l in a volumetric flask. Shake well.

The reactor for this reagent:

$\frac{\text{mass taken}}{29.4190}$ is called the dichromate factor.

Record the factor.

A.2.6 *Sulfuric/phosphoric reagent*. Carefully add 250 ml concentrated sulfuric acid (ρ = 1.18 g/cm^3) to 1 l of water, cool and add 500 ml orthophosphoric acid (ρ = 1.65 g/cm^3). Dilute to 2.5 l.

A.2.7 *Indicator solution*. Dissolve 0.2 g sodium diphenylamine sulfonate in water and dilute to 100 ml.

A.2.8 *Ammonium hydrogen carbonate*.

A.3 Apparatus

A.3.1 *Centrifuge tubes*, 50 ml, of inert material.

A.3.2 *Laboratory centrifuge*, capable of imparting a relative centrifugal acceleration of about 100 km·s^{-2}.

A.3.3 *Mortar and pestle*, agate.

A.3.4 *Air-ventilated oven*, capable of being maintained at (105 ± 2) °C.

A.3.5 *Glass evaporating basins*.

A.3.6 *Volumetric flasks*, 100 ml, 2 l and 2.5 l.

A.3.7 *Conical flask*, quick-fit iodine type with stopper.

A.3.8 *Measuring cylinders*, 100 ml, 250 ml, 500 ml and 1 l.

A.3.9 *Burette*, 50 ml graduated to 0.1 ml.

A.3.10 *Precision balance*, accurate to 0.0001 g.

A.3.11 *Desiccator*.

A.3.12 *Magnetic stirrer bar*.

A.4 Procedure

A.4.1 Carry out the determination in duplicate.

A.4.2 Take a test portion of (1.2 ± 0.1) g of the mixed paint. Place in a weighed centrifuge tube, M_1 **(A.3.1)**. Immediately weigh the tube and the test portion to the nearest 1 mg, M_2.

A.4.3 Add about 20 ml of a suitable solvent and stir thoroughly with a glass rod. Withdraw the rod from the tube, washing the rod with a small quantity of the solvent, and centrifuge the tube until there is a clear supernatant liquor. Decant and discard the supernatant liquor from the tube.

A.4.4 Add further solvent to the tube and mix as described in **A.4.3**, taking care to disperse completely the solid matter. Repeat the centrifuging and decantation of the liquor.

With the addition of methyl ethyl ketone **(A.2.2)**, repeat the centrifuging and decantation for a third time. Finally add the acetone **(A.2.3)** in place of the initial solvent and mix as described in **A.4.3**. Centrifuge and decant the liquor as before.

A.4.5 After ensuring that excess acetone has evaporated, place the centrifuge tube in the oven **(A.3.4)** maintained at (105 ± 2) °C. After 24 h transfer the tube to a desiccator and allow to cool to ambient temperature. Weight the tube and contents to the nearest 1 mg, M_3.

A.4.6 Measure 50 ml of the iron/copper reagent **(A.2.4)** into a 500 ml flask. Add approximately 12 g (a heaped teaspoon) of ammonium hydrogen carbonate **(A.2.8)**. Wash down any reagent adhering to the side of the flask with water.

Using a precision balance **(A.3.10)** weigh accurately (0.4 ± 0.05) g of dried pigment into a suitable weighing boat. Record the weight, M_0, to four decimal places.

Drop the weighing boat carefully into the flask **(A.3.7)** (taking care to avoid touching the neck of the flask). Stopper and shake vigorously for about 1 min ensuring that the stopper is firmly positioned at all times.

Three-quarters fill the lip of the flask with water. With care, gently release the stopper. Wash down the flask and stopper with water.

Drop a magnetic stirrer bar **(A.3.12)** into the flask and stir for a minimum of 15 min.

Add 50 ml of sulfuric/phosphoric reagent **(A.2.6)**. Wash down the flask and stopper with deionized water. Add approximately 1 ml of indicator solution **(A.2.7)** and titrate with the potassium dichromate **(A.2.5)** using the burette **(A.3.9)** to a permanent purple end point.

A.4.7 Perform a blank determination, i.e. repeat the procedure in **A.4.6** without the pigment sample.

A.4.8 Determine the content of the non-volatile matter of the paint in accordance with BS 3900 : Part B18.

A.5 Calculation

The percentage of metallic zinc in the dry film shall be calculated as follows.

$$\frac{\text{Dichromate factor } (A - B)\ (M_3 - M_1)}{M_0\ (M_2 - M_1)\ NV} \times \times 100 \times 0.9806$$

where

M_0 is the mass (in g) of the test portion of the dried pigment **(A.4.6)**;

M_1 is the mass (in g) of the centrifuge tube **(A.4.2)**;

M_2 is the mass (in g) of the centrifuge tube together with the paint sample **(A.4.2)**;

M_3 is the mass (in g) of the centrifuge tube together with the extracted dried pigment **(A.4.5)**;

A is the volume (in ml) of 0.05 M potassium dichromate solution required for the sample **(A.4.6)**;

B is the volume (in ml) of 0.05 M potassium dichromate solution required for the blank **(A.4.7)**;

NV is the content of non-volatile matter (in %) of the paint **(A.4.8)**.

0.9806 is the factor to obtain free zinc content.

Calculate the mean of the two determinations and report the result to one decimal place. If the two determinations differ by more than 1 % from the mean, repeat the procedure **(A.4)** and disregard the original results.

Annex B (normative)
Preparation of test panels

B.1 General

Except where otherwise stated, the test panels shall be hot-rolled mild steel having the dimensions of 100 mm × 150 mm × 5 mm, free from distortion and abrasive blast-cleaned on the test surface to grade Sa 2½ of BS 7079 : Part A1.

Profile assessments of the blast-cleaned steel shall be carried out using a visual comparator in accordance with BS 7079 : Part C1 and BS 7079 : Part C2 and the profile shall be as given in table B.1.

Table B.1 Blast-cleaned steel with shot abrasives and grit abrasives

Shot abrasives	Grit abrasives
Grade coarse (S)	Grade medium (G)
Profiles equal to segment 3 and up to but excluding segment 4	Profiles equal to segment 2 and up to but excluding segment 3
60 μm to 80 μm	50 μm to 70 μm

B.2 Paint application and dry film thickness

The paint shall be applied in accordance with the manufacturer's instructions to give the following dry film thicknesses:

Weldable primer: up to 15 μm;

Prefabrication primer: (25 ± 5) μm;

Post fabrication/build-up primer: up to 75 μm.

The paint shall be allowed to dry for 7 days at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) % out of direct sunlight and with protection from dust. Because it is impracticable to measure the thicknesses of thin films on blast-cleaned surfaces, film thickness measurements shall be made on smooth cold-rolled steel panels (or coupons) of minimum thickness 2 mm, placed either side and in the same plane and painted at the same time as the test panels. The dry film thicknesses shall be measured by use of an electronic dry film thickness (DFT) gauge zeroed and calibrated on the same smooth uncoated panels.

B.3 Test conditions

Tests shall be carried out at a temperature of (23 ± 2) °C and relative humidity of (50 ± 5) % except where otherwise specified.

Annex C (normative)
Resistance to continuous salt spray

C.1 Attach a 50 mm × 1.5 mm strip of adhesive paper tape, incorporating water-soluble adhesives, across the test panel about 25 mm from and parallel to the bottom of the panel. Apply the paint to the whole of the test panel as described in **B.2**.

C.2 Expose the unpainted strip on the panel by removing the adhesive tape. Wash off any remaining adhesive with water of grade 3 purity conforming to BS 3978, before commencing the test as described in BS 3900 : Part F4 with the exposed strip along the lower edge.

For weldable primers (up to 15 μm), expose for 150 h.

For prefabrication primers (of (25 ± 5) μm), expose for 240 h.

For post fabrication/build-up primers (up to 75 μm), expose for 1000 h.

After these times, remove and examine the panel, with normal or corrected vision, particularly within 2 mm of the unpainted strip, for signs of rusting, blistering and rust undercutting (see **7.6**).

Annex D (informative)
Advice on handling and use of paint

D.1 Paints containing zinc dust are liable to generate hydrogen gas, particularly if contaminated by water. Care, therefore, should be taken when opening containers, particularly if the container shows signs of bulging.

D.2 Products conforming to this standard may have 'weld-through' capability. Users of this standard should ensure that at the specified film thickness any necessary requirements relating to weld integrity and production of fume should be certified by a competent authority.

D.3 Some of these paints have low flash points. In particular, attention is drawn to relevant regulations covering transport, storage, use, etc.

D.4 The shelf lives of these paints depend upon transport and storage conditions; reference should be made to guidance on these given in manufacturers' literature.

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List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 3900 :	*Methods of test for paints*
BS 3900 : Part A1 : 1992	*Sampling*
BS 3900 : Part B18 : 1994	*Determination of non-volatile matter of paints and varnishes and binders for paints and varnishes*
BS 3900 : Part E7 : 1974	*Resistance to impact (falling ball test)*
BS 3900 : Part F4 : 1968	*Resistance to continuous salt spray*
BS 3900 : Part H2 : 1983	*Designation of degree of blistering*
BS 3978 : 1987	*Specification for water for laboratory use*
BS 3982 : 1980	*Specification for zinc dust pigment*
BS 7079 :	*Preparation of steel substrates before application of paints and related products*
BS 7079 : Part A1 : 1989	*Specification for rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*
BS 7079 : Part C1 : 1989	*Specification for surface profile comparators for the assessment of abrasive blast-cleaned surfaces*
BS 7079 : Part C2 : 1989	*Method for the grading of surface profile of abrasively blast-cleaned steel using a comparator*
BS EN 29117 : 1992	*Paints and varnishes. Determination of through-dry state and through-dry time. Method of test*

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