

British Standard

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Metal scaffolding —

Part 1: Tubes —

Section 1.1 Specification for steel tube

Committees responsible for this British Standard

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Association of Consulting Engineers
 Association of Consulting Scientists
 British Constructional Steelwork Association Ltd.
 British Steel Industry
 Building Employers' Confederation
 Concrete Society
 Construction Health and Safety Group
 Construction Industry Training Board
 Department of the Environment (Property Services Agency)
 Electricity Supply Industry in England and Wales
 Engineering Equipment and Materials Users' Association
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 National Association of Formwork Contractors
 National Association of Scaffolding Contractors
 National Federation of Master Steeplejacks and Lightning Conductor Engineers
 Prefabricated Aluminium Scaffolding Manufacturers' Association
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Foreword

This Section of BS 1139 has been prepared under the direction of the Civil Engineering and Building Structures Standards Policy Committee. Together with BS 1139-1.2:1990, it supersedes BS 1139-1:1982, which is withdrawn.

This Section of BS 1139 is one of a series specifying requirements for the design, construction and testing of equipment for use in scaffolding and other temporary structures. It specifies requirements for steel tubing of the type traditionally used in tubular scaffolding and false-work. Recommendations for the design of tubular scaffolding structures are given in BS 5973 and BS 5974.

This standard was previously published as Part 1 of BS 1139:1982 which also contained specifications for aluminium scaffold tube. With the exception of specifying one wall thickness only (i.e. 4 mm), this standard technically aligns with European Harmonization Document HD 1039.

Tubing complying with this British Standard also complies with the requirements for type 4 only of HD 1039, and therefore can be classified and marked "EN 39" (see clauses 8 and 9).

BS 1139 is now published in separate Parts and Sections as follows.

- *Part 1: Tubes;*
- *Section 1.1: Specification for steel tube;*
- *Section 1.2: Specification for aluminium tube;*
- *Part 2: Couplers;*
- *Section 2.1: Specification for steel couplers, loose spigots and base plates for use in working scaffolds and falsework made of steel tubes (Identical with HD 74);*
- *Section 2.2¹⁾: Specification for steel and aluminium couplers, fittings and accessories for use in tubular scaffolding;*
- *Part 3: Specification for prefabricated access and working towers;*
- *Part 4: Specification for prefabricated steel splitheads and trestles;*
- *Part 5²⁾: Specification for materials, dimensions, design loads and safety requirements for service and working scaffolds made of prefabricated elements (Identical with HD 1000).*

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, 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⁾ In preparation: it will cover couplers, fittings and accessories not included in Section 2.1. Additional couplers have not yet been harmonized.

²⁾ In preparation.

0 Introduction

This Section of BS 1139 describes a tube intended for use in falsework and working scaffolds. Other very similar tubes are available, and to ensure that scaffolding tubes are able to be identified without doubt on the building site, there is a requirement for marking.

Scaffolds or falsework using these tubes should be erected in accordance with sound national practice; in some countries this could restrict the choice of tube.

Prefabricated steel scaffold components may be fabricated with these tubes, or others. The design of such scaffolds will relate to the steel sections actually used in them.

1 Object and field of application

This Section of BS 1139 specifies requirements for steel tube intended for use in falsework and in access and working scaffolds constructed with separate tubes and couplers. It has an outside diameter of 48,3 mm, and a wall thickness of 4,0 mm. It also specifies tests on protective coatings and gives values for the design of structures.

2 References

The titles of the publications referred to in this standard are listed on the inside back cover.

3 Terminology

The tube is referred to as “type 4” tube and represents a wall thickness of 4,0 mm.

4 Steel

4.1 Chemical composition

Tubes shall be manufactured from steel whose chemical composition shall be in accordance with Table 1.

Table 1 — Determination of chemical composition of steel by ladle analysis

Elements	%
Carbon	≤ 0,20
Silicon	≤ 0,30
Phosphorus	≤ 0,05
Sulphur	≤ 0,05
Nitrogen	≤ 0,009

For steel treated with aluminium, the nitrogen content may be increased to a maximum of 0,015 %.

For steel which is to be protected by hot dip galvanizing (see 6.1) the silicon content shall not exceed 0,05 %.

The use of rimming steel is not permitted.

4.2 Mechanical properties

The mechanical properties of the tube shall be in accordance with Table 2.

Table 2 — Mechanical properties

Tensile strength	R_m	N/mm ²	≥ 340 < 480
Yield stress	R_{eH}	N/mm ²	≥ 235
Elongation (on $L_0 = 5,65 \sqrt{S_0}$) ^a	A		≥ 24 %
^a In accordance with BS 18 L_0 = original gauge length of the tensile test piece. S_0 = original cross-sectional area of the gauge length.			

5 Manufacture

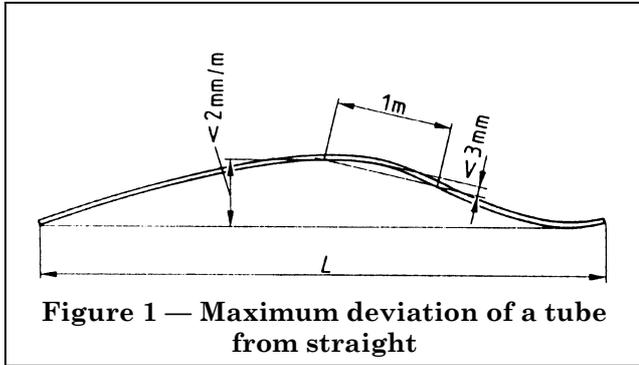
5.1 General

5.1.1 The tube shall be produced by a seamless or welded process. If the method of manufacture of the tube is not specified in the order, the choice of the method shall be at the option of the tube manufacturer.

5.1.2 The tubes shall have a smooth external surface consistent with the method of manufacture. Surface imperfections are permissible provided that the tube dimensions remain within the tolerance limit specified in Table 3.

5.1.3 The tubes shall have a circular profile and any ovality shall not exceed the tolerance limits on outside diameter specified in Table 3.

5.1.4 The deviation from straight shall not exceed 3 mm in any one metre and the maximum deviation over the full length L of the tube shall not exceed $0,002 L$ (see Figure 1).



5.1.5 The ends shall be cut square with the axis of the tube and shall be free from burrs.

5.2 Tube dimensions, mass and tolerances

Tube dimensions, mass and tolerances shall be in accordance with Table 3.

Table 3 — Nominal dimensions, mass and tolerances for tubes

Tube	Nominal values "Type 4,0"	Tolerances
Wall thickness	4,0 mm	- 10,0 % ^a
Outside diameter (including ovality)	48,3 mm	± 0,5 mm
Inside diameter ^b	40,3 mm	- 2,6 mm
Mass, single tube	4,37 kg/m	+ 12,0 % - 8,0 %
Mass, batches of tubes (10 tonnes or more)	4,37 kg/m	± 7,5 %

^a Upper tolerance: governed by the tolerance on the mass.
Lower tolerance: wall thickness shall be at least 3,6 mm on type 4,0 tube; a tolerance of - 15 % being allowed in isolated places over a length not exceeding 100 mm, but only if the decrease in thickness affects only the external surface.

^b The tolerances for the inside diameter shall also include the weld zone.

6 Delivery conditions

6.1 Tubes may be delivered from the tube manufacturer as rolled or with a protective coating. Corrosion protection may be applied either by the tube manufacturer, or separately later³⁾.

If tubes are to be delivered as rolled with a low silicon content (see 4.1), this shall be specified in the order.

Where tubes are to be supplied with a temporary corrosion protection, this shall be specified in the order.

6.2 Where tubes are protected by hot dip galvanizing, the coating shall be in accordance with A.2.

Where tubes are protected by a paint coating, the coating shall be in accordance with B.2.

7 Testing and certification

7.1 Testing and manufacturer's control

The tubes shall be subjected to tests and production control during manufacture in order to verify that they comply with the requirements of clauses 4, 5 and 6.

7.2 Where tubes are hot dip galvanized, the effectiveness of the coating shall be assessed by testing in accordance with annex A.

Where tubes are protected by a paint coating, the effectiveness of the coating shall be assessed in accordance with annex B.

7.3 These tests and manufacturer's control are the respective responsibilities of the tube manufacturer and applier of the corrosion protection.

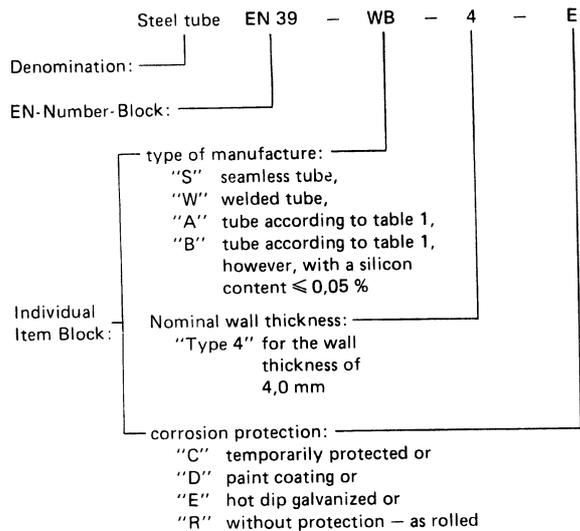
7.4 Certificate of compliance

At the purchaser's request in the order, the tube manufacturer, the protective coating applier or the supplier shall supply a certificate of compliance stating that the tubes comply with the requirements of this British Standard.

³⁾ Tubes should be provided with a permanent protection against corrosion before being put into use in falsework or scaffolds.

8 EN designation

The EN designation shall comprise the following items according to the denomination scheme: e.g. for a welded steel tube with a low silicon content, 4,0 mm wall thickness and hot dip galvanized:



9 Marking

The marking shall be legible after the protective coating has been applied⁴⁾.

Tubes shall be marked by impressing at intervals not exceeding 1,5 m. The height of the characters shall be at least 4 mm and the impression at least 0,2 mm deep.

When tubes are delivered from the tube manufacturer as rolled, the tubes shall be marked in the as rolled condition.

The marking shall show

- the name or trade mark of the tube manufacturer;
- the EN number "39",
- the letter "A" or "B" for silicon content as appropriate;
- the nominal wall thickness "4", which shall not be positioned immediately adjacent to the number "39".

After application of the protective coating an additional durable mark shall be applied to the tubes at intervals not exceeding 1,5 m showing the name or trade mark of the coating applier.

NOTE The marking in the as rolled condition gives no information about the application of any protective coating.

⁴⁾ Tubes should be marked before being put into use in falsework or scaffolds.

Annex A (Mandatory) Requirements and quality control of the zinc coating

A.1 Object and field of application

This annex specifies the quality of the zinc coating of hot-dip galvanized steel tubes complying with this British Standard, the tests for checking compliance with these requirements.

A.2 Characteristics of the coating

A.2.1 Appearance

The coating shall be uniform without gaps in the layer of zinc. It shall be free from spikes, which may be removed mechanically.

A.2.2 Thickness of the coating

When tested in accordance with A.3.2, the thickness of the coating shall be not less than 40 µm. The thickness test shall be carried out on the outside only.

A.2.3 Continuity of the coating

The continuity of the coating shall be considered satisfactory if tubes having any visually suspect spots meet the requirements of A.3.2.

A.3 Testing

A.3.1 Appearance of the coating

The coating shall be examined visually and manually to ensure that it complies with A.2.1.

A.3.2 Thickness of the coating

A.3.2.1 Choice of method

The coating thickness may be assessed by either the magnetic method or the gravimetric method. If a particular method is not specified in the order, the choice of method shall be at the option of the tube manufacturer or galvanizer.

A.3.2.2 Magnetic method

A.3.2.2.1 Principle

The thickness is assessed by measuring the influence of the zinc coating on a magnetic field. The test should be conducted in accordance with BS 5411-11, and only the main significant points are given here.

A.3.2.2.2 Equipment

The instrumentation chosen shall be appropriate for the size of tube and coating thickness specified.

A.3.2.2.3 Calibration

The instrument shall be calibrated on a piece of ungalvanized tube, and rechecked frequently during use.

A.3.2.2.4 Procedure

Using the same technique as was used in the calibration, take 10 readings spread over the surface of the tube under examination.

A.3.2.2.5 Accuracy

Calibration and operation of the instrument shall be such that the coating thickness can be determined within 10 % of its true thickness.

A.3.2.3 Gravimetric method

A.3.2.3.1 Principle

The thickness is assessed by measuring the mass of the zinc coating on a surface of known area and calculating the average thickness of zinc.

A.3.2.3.2 Procedure

The test shall be carried out in accordance with BS 729 using a sample tube cut from a hot dip galvanized tube.

Annex B (Mandatory) Requirements and quality control of the paint coating

B.1 Object and field of application

This annex specifies methods of test and criteria for quality control of the protective paint coating on the outside of steel tubes complying with this British Standard, and acceptable limits.

It is applicable to tubes immediately after painting and drying. Time and temperature should be recorded.

It gives a test for corrosion resistance and a cross-cut test to determine the adherence.

B.2 Characteristics of the coating

B.2.1 Corrosion resistance

When tested in accordance with B.3, the degree of corrosion shall not exceed $R_i 3^5$ at the end of the minimum exposure time.

B.2.2 Adhesion

When tested in accordance with B.4, the detached surface shall not exceed 15 % of the cross-cut area: class 0 or 1 or 2 of Table 4.

⁵⁾ This value is provisional; it may be changed after sufficient experience of testing has been obtained.

B.3 Test for corrosion resistance**B.3.1 Principle**

The test shall be conducted in accordance with BS 3900-F12.

B.3.2 Applier's information

The applier shall supply details of his protective treatment, including the following points:

- the preparation of the surface
- the method of application
- the method of drying or curing
- the thickness in micrometres
- details of the paint.

B.3.3 Test pieces**B.3.3.1 Nature and dimensions**

The test pieces shall be taken from freshly painted new tubes of current manufacture which have been coated externally with protective paint by the method normally used in the paint workshop. The length of the test piece shall be approximately 400 mm.

B.3.3.2 Number

Three test pieces shall be subjected to testing; only one determination shall be carried out (see clause 9 of BS 3900-F12:1985).

B.3.4 Panel size

The whole area of each piece shall be taken as the test panel.

B.3.5 Duration

The duration of the test shall be a minimum of 100 h. Continue the test until the degree of corrosion reaches the value of Ri 3 and record the time of this exposure. The time of exposure shall not exceed 500 h.

B.3.6 Inspection

Each test piece shall be examined visually and assessed with suitable accuracy against the states of corrosion in the scale of degrees of rusting for anti-corrosive paints given in BS 3900-H3.

B.4 Cross-cut test for adhesion**B.4.1 Principle**

The principle of this test is based upon BS 3900-E6, those of its requirements applicable to tubes are embodied in this annex.

An external surface on a painted tube section (test piece) shall be cross cut using either an appropriate single cutting tool (see Figure 2) in the longitudinal and transverse directions or a single cutting tool in the longitudinal direction and a multiple cutting tool (see Figure 3) in the transverse direction.

The adhesion of the coating to the tube is assessed according to the requirements of B.4.4.

B.4.2 Test pieces

For the nature, dimensions and number of test pieces see B.3.3.1 and B.3.3.2.

B.4.3 Procedure

Make 11 cuts spaced 1 mm apart using the cutting tool in the direction of the length of the tube and 11 cuts spaced 1 mm apart perpendicular to the first eleven cuts. An adequate device shall be used to guide the cutting tool in order to obtain the correct spacing of the cuts. All the cuts shall penetrate to the steel.

Brush the cross-cut area of the sample lightly with a soft brush in order to remove the detached particles of the paint coating.

B.4.4 Test results

Examine the cross-cut area of each test piece visually and evaluate the percentage of the surface of the detached coating using Table 4 (extracted from BS 3900-E6).

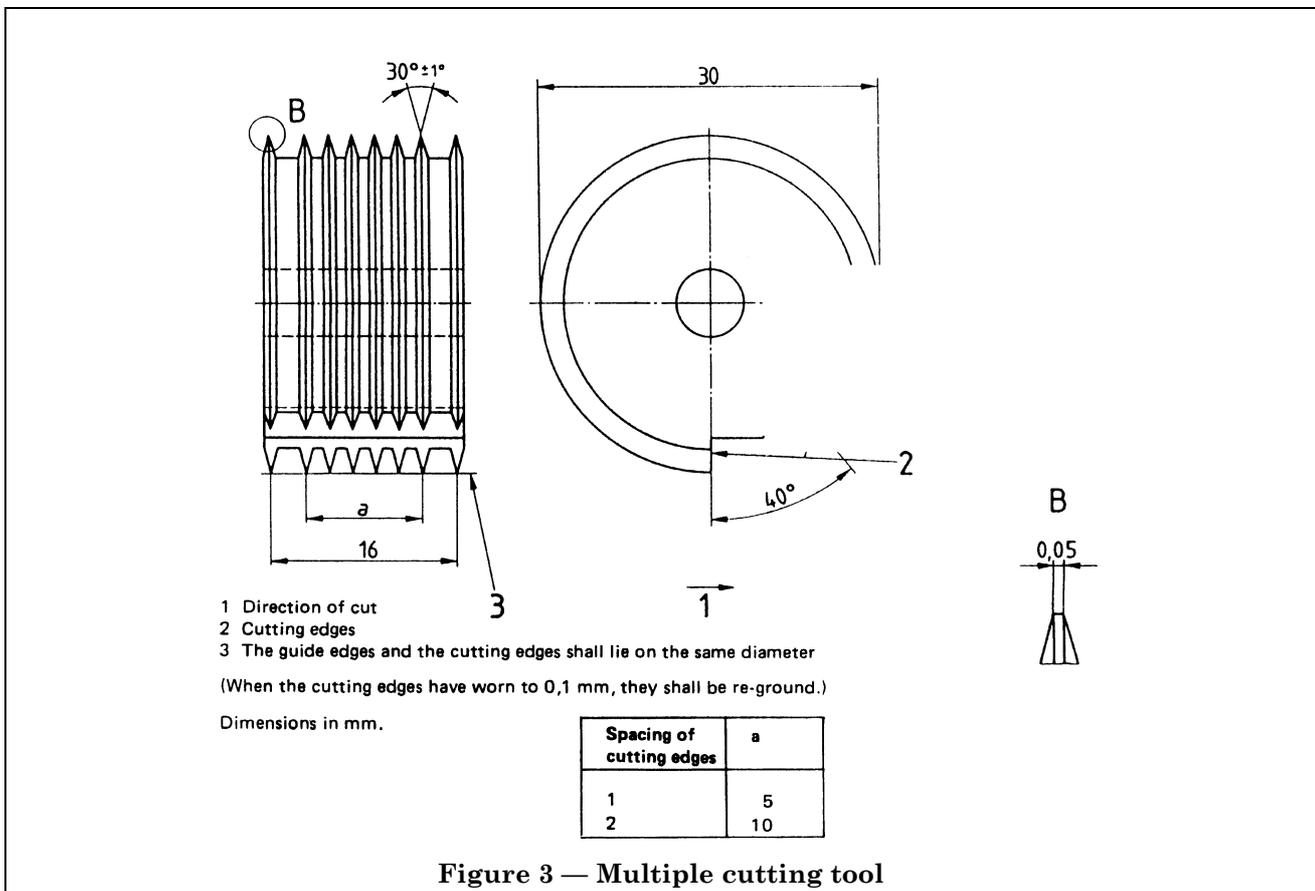
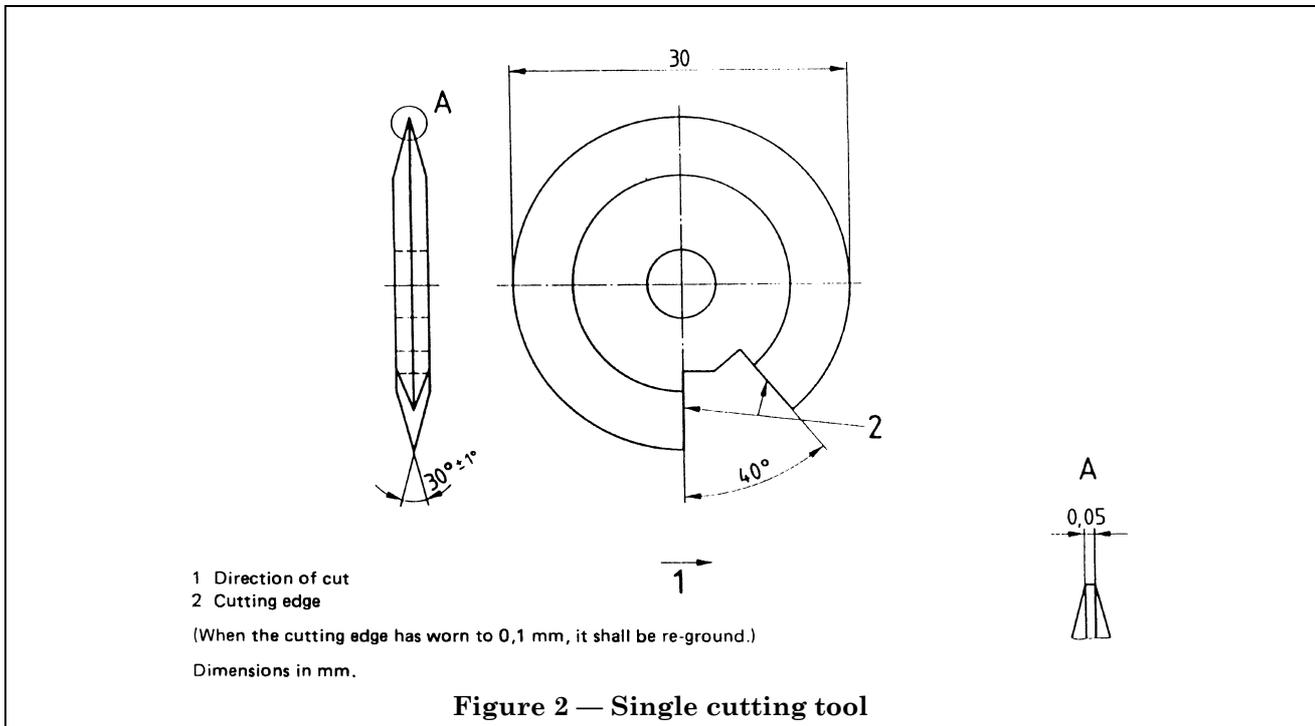
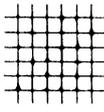
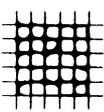
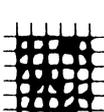
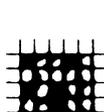


Table 4 — Classification of test results

Class	Description	Appearance of surface of cross cut area from which flaking has occurred (Example for six parallel cuts)
0	The edges of the cuts are completely smooth; none of the squares of the lattice is detached.	—
1	Detachment of small flakes of the coating at the intersections of the cuts. A cross-cut area not distinctly greater than 5 % is affected.	
2	The coating has flaked along the edges and/or at the intersections of the cuts. A cross-cut area distinctly greater than 5 %, but not distinctly greater than 15 % is affected.	
3	The coating has flaked along the edges of the cuts partly or wholly in large ribbons, and/or it has flaked partly or wholly on different parts of the squares. A cross-cut area distinctly greater than 15 %, but not distinctly greater than 35 % is affected.	
4	The coating has flaked along the edges of the cuts in large ribbons and/or some squares have detached partly or wholly. A cross-cut area distinctly greater than 35 %, but not distinctly greater than 65 % is affected.	
5	Any degree of flaking that cannot even be classified by classification 4.	

Annex C (Informative)

Values for the design of structures

Values for the design of structures		
		Type 4,0
Outside diameter	mm	48,3
Wall thickness	mm	4,0
Mass per metre	kg/m	4,37
Cross sectional area	cm ²	5,57
Second moment of area	cm ⁴	13,8
Section modulus	cm ³	5,70
Radius of gyration	cm	1,57
Plastic modulus	cm ³	7,87

Publications referred to

BS 18, *Method for tensile testing of metals (including aerospace materials)*.

BS 729, *Specification for hot dip galvanized coatings on iron and steel articles*.

BS 3900, *Methods of test for paints*.

BS 3900-E6, *Cross-cut test*.

BS 3900-F12, *Determination of resistance to neutral salt spray*.

BS 3900-H3, *Designation of degree of rusting*.

BS 5411, *Methods of test for metallic and related coatings*.

BS 5411-11, *Measurement of coating thickness of non-magnetic and vitreous or porcelain enamel coatings on magnetic basis metals: magnetic method*.

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