BS 7371-1:2009

BSI British Standards

Coatings on metal fasteners –

Part 1: Specification for general requirements and selection guidelines

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Contents

Summary of pages
This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 16, an inside back cover and a back cover.

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Foreword

Publishing information

This part of BS 7371 is published by BSI and came into effect on 31 August 2009. It was prepared by Subcommittee FME/9/1, *Mechanical properties of fasteners*, under the authority of Technical Committee FME/9, *Fasteners*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 7371 supersedes BS 7371-1:1991, which is withdrawn.

Relationship with other publications

Other published Parts of BS 7371 are as follows:

- BS 7371-2, *Coatings on metal fasteners – Part 2: Specification for torque/clamping force relationship*;
- BS 7371-3, *Coatings on metal fasteners – Part 3: Specifications for electroplated zinc*; [1)]
- BS 7371-4, *Coating on metal fasteners – Part 4: Specification for electroplated nickel, nickel/chromium and copper/nickel/ chromium coatings*;
- BS 7371-6, *Coatings on metal fasteners – Part 6: Specification for hot dipped galvanized coatings*;
- BS 7371-7, *Coatings on metal fasteners – Part 7: Specification for mechanically applied zinc and zinc based coatings*;
- BS 7371-8, *Coatings on metal fasteners – Part 8: Specification for sherardized coatings*;
- BS 7371-9, *Coatings on metal fasteners – Part 9: Specification for phosphate or phosphate and oil coatings*;
- BS 7371-10, *Coatings on metal fastenings – Part 10: Specification for organic coatings*;
- BS 7371-11, *Coatings on metal fasteners – Part 11: Specification for zinc flake non-electrolytically applied cured coatings*; [2)]
- BS 7371-12, *Coatings on metal fasteners – Part 12: Requirements for imperial fasteners*.

The Parts of BS 7371 listed describe coatings for:

a) corrosion protection;

b) appearance;

c) electrical conductivity;

d) controlled lubricity;

e) identification; and

f) avoidance of hydrogen embrittlement.

Attention is drawn to Clause **4** and Annex A which provides advice on the suitability and limitations of the coatings for these purposes.

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1) Being reviewed, replaced by BS EN ISO 4042 but remains current.

2) Obsolescent, replaced by BS EN ISO 10683 but remains current.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- Change to Figure C.1.
- Exclusion of cadmium.
- General revision.

Product certification/inspection/testing. Users of this British Standard are advised to consider the desirability of third-party certification/ inspection/testing of product conformity with this British Standard. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

The attention of the user of this Part of BS 7371 is drawn to the restrictions placed on the use and supply of hexavalent chromium-containing substances by ECC Directive 2000/53/EC on End of Life Vehicles [1] and amendment of Annex II by Commission Decision June 2002 [Document No. C(2002) 2238] [2], and Non-Use on Motor Vehicles marketed after July 2007.

Attention is drawn to The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) [3], which came into force on 31 December 2006.

Attention is drawn to the restrictions placed on the marketing and use of cadmium and its compounds by in the Environmental Protection (Controls on Injurious Substances) (No. 4) Regulations 1992 [4]. Cadmium has thus been excluded from this Specification.

1 Scope

This Part of BS 7371 specifies general requirements that apply to coatings covered by all other Parts of BS 7371, including:

a) preparations before coating;

b) hydrogen embrittlement avoidance;

c) sampling for inspection;

d) thickness testing;

e) area tables for metric parallel threaded fasteners (area tables for imperial fasteners can be found in BS 7371-12); and

f) selection of coatings (including the opportunity to select non-hexavalent chromium-containing coatings).

Specific requirements are given in each Part of BS 7371.

2 Normative references

The following references are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 6041:1981+A1:1981, *Method of sampling of electrodeposited metallic coatings and related finishes: procedures for inspection by attributes*

3 Terms and definitions

3.1 significant surfaces
areas visible on a part when assembled

3.2 batch average thickness
average thickness of the coating on all components of a batch

3.3 production run
batches of parts processed continuously without any changes in coating techniques or constituents within a single working day

4 Selection of coatings

The coating shall be selected with regard to:

a) corrosion resistance;

b) appearance;

c) shape and size;

d) embrittlement;

e) conductivity;

f) lubricity;

g) application limitations;

h) colour (if applicable); and

i) whether hexavalent chromium can be tolerated.

NOTE Annex A provides guidance on suitable coatings for specific components.

5 Preparation before coating

Prior to coating, fastener parts shall be free of oil, grease, scale, oxides and other foreign matter.

*NOTE 1 The cleaning process should not induce hydrogen embrittlement (see Clause **6**).*

NOTE 2 It is essential that the cleaning process is not detrimental to the substrate.

6 Hydrogen embrittlement

6.1 Cleaning processes

Fastener parts heat-treated or cold-worked to a surface hardness of 320 HV to 390 HV, and also property classes[3)] 9.8, 10.9, and 10.9, shall be cleaned with an inhibited acid, alkaline or mechanical process.

NOTE 1 The time during which parts are immersed in inhibited acid cleaning agents increases the risk of the introduction of potential hydrogen embrittlement. Immersion time in the inhibited acid should therefore be of minimum duration. Cathodic cleaning processes should be avoided.

Special cleaning processes using non-acidic methods such as dry honing, abrasive blasting or alkali derusting shall be used to clean parts which have been heat-treated or cold-worked to a surface hardness greater than 390 HV or property class 12.9 and above.

NOTE 2 Hydrogen embrittlement might cause premature failure of parts which are heat-treated or cold-worked to a surface hardness of 320 HV and above when subjected to stress. The property classes affected include 9.8 and above. Although baking after coating will minimize the risk of failure, the process can never be guaranteed to be completely effective. Annex B includes a more detailed explanation.

6.2 Coating processes

Fastener parts shall be coated in accordance with the appropriate Parts of BS 7371.

NOTE The risk of hydrogen-embrittlement failure of parts with a surface hardness greater than 390 HV, and also property class 12.9 and above, cannot be precluded unless coating processes are used which do not involve electrolysis from aqueous solutions. Only high-efficiency, non-cyanide type electroplating solutions or alternative non-embrittling coatings should be used (see Annex B).

6.3 De-embrittlement processes

NOTE 1 Although property class 8.8 might marginally exceed 320 HV surface hardness, it is not neccessary to take these precautions provided that the surface hardness of this particular property class does not exceed 350 HV.

Except for those parts described in Note 1, parts heat-treated or cold-worked to a surface hardness greater than 320 HV (and also property classes 9.8 and above which have been electroplated) shall be de-embrittled by baking. Parts shall not be heated to a temperature above that at which they were originally tempered.

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3) Property classes are designated in BS EN ISO 898-1.

The baking process specified shall apply to the parts within the scope of this standard with the exception of:

a) parts tempered below 180 °C;

b) parts susceptible to hydrogen embrittlement;

c) parts with coatings adversely affected by a temperature of 180 °C to 210 °C; and

d) parts adversely affected by a temperature of 180 °C to 210 °C.

The heating process shall commence within 1 h after the completion of electroplating.

Except for those parts listed in a) to d), parts shall be heated to achieve a temperature of 180 °C to 210 °C within 4 h (maximum) after the completion of electroplating and shall be maintained at this temperature for the appropriate time as given in 1) to 6) below. These times shall be treated as minimum times at temperature.

1) Bolts and screws of property classes 9.8, 10.9 and 10.9 — 4 h.

2) Bolts and screws of property class 12.9 (see **6.1**) — 6 h.

3) Spring steel parts hardness range 400 HV to 500 HV — 8 h.

4) Spring steel parts hardness range 500 HV to 600 HV — 12 h.

5) Case-hardened tapping screws — 2 h.

6) Case-hardened thread rolling screws — 6 h.

NOTE 2 It should not be assumed that the specified baking process will completely remove hydrogen embrittlement in all cases. Other conditions of duration and temperature can be used if they have been shown to be effective for the parts listed in a) to d). Parts which have been tempered at temperatures below 180 °C need baking at a lower temperature. Generally, parts baked at lower temperatures require longer times at that temperature. Some types of steel are more susceptible to hydrogen embrittlement than others and the baking times given might be inadequate in some circumstances. Certain coatings, e.g. tin, and the physical properties of some parts might be adversely affected by a temperature of 180 °C to 210 °C. In such cases, lower temperatures and longer times will be required.

7 Thickness and coating weight

Thickness and coating weight shall be evaluated using the appropriate methods specified in each Part of BS 7371, which include:

a) local thickness;

b) batch average thickness; and

c) mass per unit area.

NOTE To assist in calculations, areas of standard metric bolts, screws and nuts are defined in Annex C.

8 Sampling for inspection

Sampling for thickness measurement shall be in accordance with BS 6041:1981+A1.

Sampling for corrosion testing or torque/clamping force measurement shall be in accordance with BS 6041:1981+A1, Table 3.

9 Delivery conditions

All requirements of the coating specifications shall be conformed to at the time of delivery of the fasteners or accessories to the location specified by the purchaser (see Annex D).

NOTE The purchaser should state the location in the enquiry or order.

10 Information to be supplied to the coater and designation

The following information shall be supplied to the coater.

a) The number of this British Standard, i.e. BS 7371-1:2009.

b) The Part of BS 7371 appropriate to the coating required.

c) The coating grade or thickness as applicable.

d) The requirement for lubrication, if applicable.

e) The requirement, if any, for stress relieving before coating, and the stress relieving conditions.

f) Special requirements, e.g. additional protection for storage (see Clause **9** and Annex D).

g) The requirements of subsequent operations such as the application of adhesives.

The coating shall be specified using at least the following designation (see footnote [A)] to Table A.2):

"Coating in accordance with BS 7371-X:20XX: Grade ".

The lubricated condition shall be designated by the letter "L" after the grade identification (see Annex A).

EXAMPLE
An electroplated zinc coating of grade Zn8C with added lubrication is designated thus:

BS 7371-3:2009: Grade Zn8CL.

Annex A (informative) Selection guidelines

A.1 Guidelines on the selection of coatings

A.1.1 Protective value and service condition number

The protective value and service life of a coating will vary according to the type of coating, its thickness, the use of a chromate conversion treatment (or other coating where appropriate), and so on.

For the purpose of this standard, degrees of severity are defined in Table A.1 and equated to a service condition number.

A.1.2 Coating selection

Coatings should be selected using the data in Table A.2 and Table A.3 in accordance with the criteria defined in Clause **4** and in conjunction with the appropriate Part of BS 7371.

NOTE Increased thicknesses may be specified to extend resistance to rust provided that thread dimensions before plating are adjusted.

All coatings except phosphate and oil coatings will not substantially deteriorate when stored in a good storage environment for a period of 3 months.

Table A.1 **Protective value and service condition number**

Designation number and service condition	Description and application examples
0 Very mild	Exposure to indoor atmospheres and not subject to condensation, wear or abrasion Example: a product with temporary protective coating for storage
1 Mild	Exposure to indoor atmospheres with rare condensation and subject to minimum wear or abrasion Example: domestic furniture screws
2 Moderate	Exposure mostly to dry indoor atmospheres but subject to occasional condensation, wear or abrasion Examples: fasteners for motor vehicle interiors, industrial machinery
3 Severe	Exposure to condensation, perspiration, infrequent wetting by rain, and cleaners Examples: fasteners for window fittings, washing machines, bicycles
4 Very severe	Exposure to harsh conditions or subject to frequent exposure to moisture, cleaners and saline solutions, plus likely damage by denting, scratching or abrasive wear Examples: plumbing, motor vehicle underbody fasteners

NOTE For exceptionally severe service conditions for outdoor use (for example, electrical transmission towers, buildings and bridges, etc.) where very long service is required, consider hot dip galvanizing to BS 7371–6 or mechanical galvanizing to BS 7371-7 or sheradizing to BS 7371-8. For the extra thread tolerances required, see ISO 965-5:1998, thread tolerance 6AZ.

Table A.2 **Coating selection**

Coating	Grade [A)]	Embrittlement [B)]	Galvanic [C)]	Conductive [D)]	Lubricity [E)]	Appearance and chromium content [F)]	Service condition number
Electroplated zinc [G)]	Zn5A	✗	✗	✗	—	Silver^{6+}	1
	Zn5B	✗	✗	✗	—	Silver^{6+}	1
	Zn5C	✗	✗	✗	—	Yellow^{6+}	2
	Zn5D	✗	✗	✗	—	Olive drab^{6+}	3
	Zn5V	✗	✗	✗	—	Silver-blue^{3+}	1
	Zn5W	✗	✗	✗	—	Silver-irid.$^{3+}$	1
	ZN8A	✗	✗	✗	—	Silver^{6+}	1
	Zn8B	✗	✗	✗	—	Silver^{6+}	1
	Zn8C	✗	✗	✗	—	Yellow^{6+}	2
	Zn8D	✗	✗	✗	—	Olive drab^{6+}	3
	Zn8V	✗	✗	✗	—	Silver-blue^{3+}	1
	Zn8W	✗	✗	✗	—	Silver-irid.$^{3+}$	1
	Zn12A	✗	✗	✗	—	Silver^{6+}	1
	Zn12B	✗	✗	✗	—	Silver^{6+}	2
	Zn12C	✗	✗	✗	—	Yellow^{6+}	3
	Zn12D	✗	✗	✗	—	Olive drab^{6+}	4
	Zn12V	✗	✗	✗	—	Silver-blue^{3+}	1
	Zn12W	✗	✗	✗	—	Silver-irid.$^{3+}$	2
Mechanically plated zinc [G)]	Zn5AM	—	✗	✗	✗	Silver^{6+}	1
	Zn5BM	—	✗	✗	✗	Silver^{6+}	1
	Zn5CM	—	✗	✗	✗	Yellow^{6+}	2
	Zn5DM	—	✗	✗	✗	Olive drab^{6+}	3
	Zn5VM	—	✗	✗	✗	Silver-blue^{3+}	1
	Zn5WM	—	✗	✗	✗	Silver-irid.$^{3+}$	1
	Zn8AM	—	✗	✗	✗	Silver^{6+}	1
	Zn8BM	—	✗	✗	✗	Silver^{6+}	1
	Zn8CM	—	✗	✗	✗	Yellow^{6+}	2
	Zn8DM	—	✗	✗	✗	Olive drab^{6+}	3
	Zn8VM	—	✗	✗	✗	Silver-blue^{3+}	1
	Zn8WM	—	✗	✗	✗	Silver-irid.$^{3+}$	1

Table A.2 **Coating selection** *(continued)*

Coating	Grade [A]	Embrittlement [B]	Galvanic [C]	Conductive [D]	Lubricity [E]	Appearance and chromium content [F]	Service condition number
	Zn12AM	—	✗	✗	✗	Silver^{6+}	1
	Zn12BM	—	✗	✗	✗	Silver^{6+}	2
	Zn12CM	—	✗	✗	✗	Yellow^{6+}	3
	Zn12DM	—	✗	✗	✗	Olive drab^{6+}	4
	Zn12VM	—	✗	✗	✗	Silver-blue^{3+}	1
	Zn12WM	—	✗	✗	✗	Silver-irid.$^{3+}$	2
Organic	OA	—	—	—	✗	Coloured [H]	1
	OB	—	—	—	✗	Coloured	2
	OC	—	—	—	✗	Coloured	3
	OD	—	—	—	✗	Coloured	4
Zinc flake	A	—	✗	✗	✗	Silver grey^{c}	3
	B	—	✗	✗	✗	Silver grey^{c}	4
Hot dip galvanized	—	—	✗	✗	✗	Silver/grey	4

NOTE 1 The use of cadmium is severely restricted, cadmium has been removed from this table.

NOTE 2 For exceptionally severe service conditions for outdoor use (for example, electrical transmission towers, buildings and bridges, etc.) where very long service is required, consider hot dip galvanizing to BS 7371-6 or mechanical galvanizing to BS 7371-7 or sheradizing to BS 7371-8. For the extra thread tolerances required, see BS ISO 965-5:1998, thread tolerance 6AZ.

[A] The designation can be extended to include requirements such as lubricity, colour, etc., in accordance with the appropriate Part of BS 7371 applicable to the specific coating.

[B] ✗ indicates the potential for embrittlement of parts during the coating process, see Clause **6**.

[C] ✗ indicates that the method of protection is galvanic.

[D] ✗ indicates an ability to form part of an electrically conductive assembly at voltages of 12 V and greater with little resistance.

[E] ✗ indicates that lubricity is, or can be, incorporated in the coating without the application of an additional lubricant.

[F] $^{6+}$ represents hexavalent-chromium containing. $^{3+}$ represents tri-valent chromium-containing, ^{c} represents might contain hexavalent chromium, see BS 7371-11.

[G] A 3 µm thickness can be specified, which is only suitable for service condition 0.

[H] Grade OA is also available as a clear coating to enhance the corrosion resistance of other coatings without significant change in appearance.

Table A.3 **Coating recommendations for parallel threads**

Coating	Nominal thickness or grade		Thread pitch [A]		
	Nominal thickness µm	Grade	Coated male fastener [B]	Coated female fastener [C]	Male/female both coated
Electroplated zinc	3	—	0.2	0.2	0.8
	5	—	0.45	0.45	1.25
	8	—	1.5	1.5	3
	12	—	3	3	None
Electroplated cadmium	3	—	0.2	0.2	0.8
	5	—	0.45	0.45	1.25
	8	—	1.5	1.5	3
	12	—	3	3	None
Mechanically plated zinc	3	—	0.2	0.2	0.8
	5	—	0.45	0.45	1.25
	8	—	1.5	1.5	3
	12	—	3	3	None
Mechanically plated cadmium	3	—	0.2	0.2	0.8
	5	—	0.45	0.45	1.25
	8	—	1.5	1.5	3
	12	—	3	3	None
Organic	—	OA	1 (0.7) [D]	2 (1) [D]	3 [D]
	—	OB	1 (0.7) [D]	2 (1) [D]	3 [D]
	—	OC	1	2	None
	—	OD	2	2 [E]	None
Zinc flake	—	A	0.75	0.75	0.8
	—	B	2	2.5	3

[A] The thread pitch quoted in the table will accept the designated coating on male threads of tolerance class 6g and female threads of tolerance class 6H.

[B] Female thread not coated.

[C] Male thread not coated.

[D] If electrophoretically applied.

[E] If applied by spraying techniques.

Annex B (informative) Avoidance of hydrogen embrittlement

B.1 Introduction

Fasteners and accessories will absorb hydrogen if subjected to processes which produce nascent hydrogen in the cleaning, pretreatment or coating process. This condition might cause premature failure of parts heat-treated or cold-worked to a surface hardness of 320 HV and above when subjected to stress. Property classes affected include 9.8 and above. Generally, the higher the surface hardness, the greater is the risk of failure.

Most electrolytic and acidic processes are liable to produce hydrogen and, though baking after coating will minimize the risk of failure, the process can never be guaranteed to be completely effective.

There is no known test procedure which can satisfactorily guarantee that the heat treatment process has successfully eliminated all traces of hydrogen embrittlement from all parts in a processed batch. If the risk of failure is unacceptable, cleaning and coating specifications which do not involve electrolysis from aqueous solutions should be used.

B.2 Non-embrittling coatings

Coatings that do not give any risk of the liberation of hydrogen during the coating process are not embrittling. The use of heat for curing certain coatings also helps to remove any embrittlement that could have been induced by cleaning or pretreatment processes. Notwithstanding this, the information given in the notes of Clause **6** should be considered.

Non-embrittling coatings are covered by further Parts of this British Standard as follows:

- Part 7: *Specification for mechanically applied zinc coatings*
- Part 10: *Specification for organic coatings*
- Part 11: *Specification for zinc flake non-electrolytically applied cured coatings*

Annex C (informative) Surface areas of bolts, screws and nuts

C.1 Bolts and screws

Table C.1 gives values for the calculation of surface areas of commonly used bolts and screws in square centimetres.

To obtain the total surface area of a bolt or screw the following parameter values are necessary (see Figure C.1).

a) the surface area, *b*, of a length of 1 cm of the threaded shank of the bolt or screw;

b) the surface area, *a*, of a length of 1 cm of the unthreaded shank of the bolt or screw;

c) the surface area, *c*, of the head to which has been added the surface area of the end of the shank.

NOTE If the thread is cut, the unthreaded shank will be approximately equal to the basic major diameter (nominal diameter). If the thread is rolled, the unthreaded shank will be approximately equal to either the thread effective (pitch) diameter or the basic major diameter. Surface area values for both basic major diameter and rolling diameter are, where appropriate, given in Table C.1.

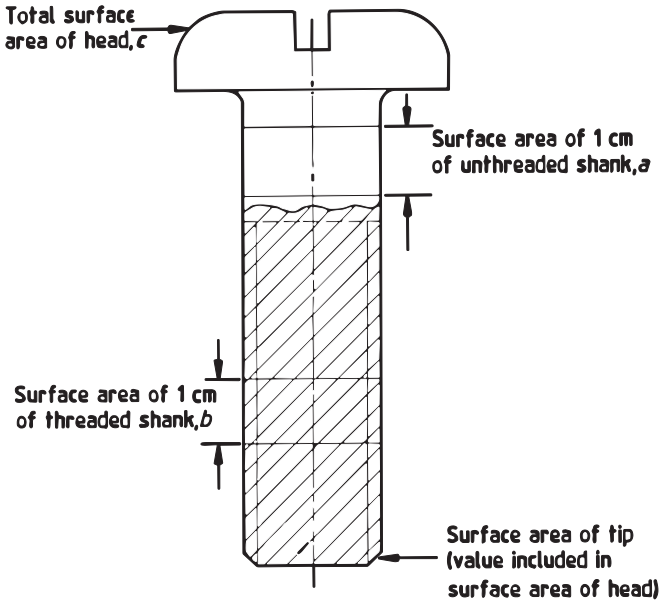
The total surface area of a bolt or screw in square centimetres may be calculated from the following formula:

Total area = (length of threaded shank in cm × *b*) +
(length of unthreaded shank in cm × *a*) + *c*

Table C.1 **Surface areas of screws and bolts**

Thread size	Area per centimetre length			Area of head, *c* cm^2				
	Unthreaded shank, *a*		Threaded shank, *b*	Flat countersunk head	Raised countersunk head	Pan head	Cheese head	Hexagon head
	Nominal diameter cm	Rolling shank diameter, coarse pitch threads cm	Coarse pitch threads cm					
M1.6	0.503	0.432	0.734	0.204	0.221	—	0.193	0.297
M2	0.627	0.544	0.931	0.326	0.355	—	0.320	0.471
M2.2	0.691	0.599	1.021	0.378	0.409	—	0.373	—
M2.5	0.785	0.691	1.181	0.499	0.541	0.564	0.470	0.722
M3	0.942	0.836	1.432	0.667	0.722	0.783	0.728	0.910
M3.5	1.100	0.975	1.665	0.858	0.930	1.104	0.914	—
M4	1.257	1.110	1.897	1.188	1.286	1.449	1.203	1.529
M4.5	1.415	1.255	2.149	1.281	1.386	1.822	1.621	—
M5	1.570	1.402	2.398	1.677	1.816	2.252	1.841	2.977
M6	1.885	1.671	2.862	2.418	2.612	3.196	2.583	3.122
M8	2.515	2.243	3.348	4.298	4.646	5.779	4.394	5.413
M10	3.142	2.817	4.831	6.715	7.258	9.018	6.660	9.058
M12	3.763	3.398	5.814	9.905	10.64	—	8.64	11.51
M14	4.399	3.945	6.797	12.57	13.57	—	11.58	15.23
M16	5.027	4.567	7.869	17.20	18.59	—	15.09	18.30
M18	5.654	5.088	8.763	20.75	22.40	—	19.13	23.85

Figure C.1 **Constituent surface areas of a bolt or screw**



C.2 Nuts

Table C.2 and Table C.3 give the surface areas of commonly used nuts.

Table C.2 **Surface areas of nuts for electroplated coatings**

Thread size	Area of nut cm^2		
	Ordinary hexagon	Pressed hexagon	Pressed square
M1.6	0.322	0.289	0.333
M2	0.497	0.442	0.512
M2.2	—	0.538	0.621
M2.5	0.774	0.713	0.820
M3	0.959	0.837	0.957
M3.5	—	1.035	1.200
M4	1.632	1.337	1.540
M4.5	—	—	—
M5	2.213	1.794	2.080
M6	3.458	2.760	3.200
M8	5.858	4.725	5.460
M10	9.710	7.938	9.180
M12	12.82	—	—
M14	16.76	—	—
M16	20.78	—	—
M18	26.78	—	—

Table C.3 **Surface areas of nuts for non-electroplated coatings**

Thread size	Area of nut cm^2		
	Ordinary hexagon	Pressed hexagon	Pressed square
M1.6	0.376	0.317	0.352
M2	0.589	0.472	0.542
M2.5	0.922	0.762	0.869
M3	1.221	0.911	0.987
M3.5	1.145	1.310	—
M4	1.998	1.465	1.668
M5	2.779	2.000	2.286
M6	4.266	3.054	3.494
M8	6.998	5.059	5.794
M10	11.972	8.783	10.025
M12	16.193	—	—
M14	21.294	—	—
M16	26.83	—	—
M18	34.308	—	—

The effective surface area of a nut for the purposes of electroplated coating application is normally less than its actual geometrical area because of the difficulty in attaining uniform distribution of the coating over the internal threads, the majority of the coating being on the first thread at each end.

For the purposes of this standard, therefore, the calculation of the surface area of a nut has been based on the following:

a) A solid of the shape of the nut but neither drilled nor tapped for electroplated coatings.

b) The full area for other coatings.

Annex D (informative)

Delivery conditions

After application, coatings will deteriorate with regard to corrosion resistance and mechanical performance according to time, handling, shipping and storage conditions. The rate of deterioration will vary according to the type of finish, exposure to corrosive atmospheres and packaging. A purchaser of coated fasteners or accessories will normally request the coating required from this British Standard and expect the specification requirements to be satisfied when the fasteners or accessories are delivered to the location agreed at the time of ordering. The coater has no control over the suitability of the selected coating or over many of the factors which will subsequently affect its ability to satisfy the specification requirements at the point of final delivery (see Clause **9**).

It is therefore the responsibility of the fastener or accessory supplier (manufacturer, distributor or stockist) to ensure that the instructions to the coater, and the packaging, allow for those factors which might generate failure of the coating to conform to the specification requirements at the point of final delivery.

Techniques for avoiding deterioration will vary and can include:

a) increasing the performance requirements or coating thickness;

b) special packaging; and

c) an additional coating.

If an additional coating is used, care should be taken to ensure that it does not interfere with any of the requirements of the basic coating, such as colour or torque/clamping force performance.

Information to be provided by the purchaser of the fasteners or accessories should include all of the requirements defined in Clause **10** of this Part of BS 7371, together with the delivery location.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 7371-6, *Coatings on metal fasteners – Part 6: Specification for hot dipped galvanized coatings*

BS 7371-7, *Coatings on metal fasteners – Part 7: Specification for mechanically applied zinc and zinc based coatings*

BS 7371-8, *Coatings on metal fasteners – Part 8: Specification for sherardized coatings*

BS 7371-11, *Coatings on metal fasteners – Part 11: Specification for zinc flake non-electrolytically applied cured coatings*

BS EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs*

BS EN ISO 4042, *Fasteners – Electroplated coatings*

BS EN ISO 10683, *Fasteners – Non-electrolytically applied zinc flake coatings*

BS ISO 965-5:1998, *ISO general purpose metric screw threads – Tolerances – Part 5: Limits of sizes for internal screw threads to mate with hot-dip galvanized external screw threads with maximum size of tolerance position h before galvanizing*

Other references

[1] EUROPEAN COMMUNITIES. 2000/53/EC. Directive on End of Life Vehicles Vehicles and amendment of Annex II by Commission Decision June 2002 (Document No. C(2002) 2238). Luxembourg: Office for Official Publications of the European Communities, 2000/2002. [4)]

[2] EUROPEAN COMMUNITIES. 2002/525/EC. Amendment of Annex II by Commission Decision June 2002 (Document No. EC(2002) 2238). Luxembourg: Office for Official Publications of the European Communities, 2002. [4)]

[3] EUROPEAN COMMUNITIES. 2002/96/EC. The Waste Electrical and Electronic Equipment (WEEE) Directive. Luxembourg: Office for Official Publications of the European Communities, 2002. [4)]

[4] GREAT BRITAIN. Environmental Protection (Controls on Injurious Substances) (No. 4) Regulations 1992. London: HMSO [4)]

[4)] Referred to in the Foreword only.

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