

INTERNATIONAL STANDARD

ISO 10684

First edition
2004-07-15

Fasteners — Hot dip galvanized coatings

Éléments de fixation — Revêtements de galvanisation à chaud

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10684:2004](https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004)

<https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004>



Reference number
ISO 10684:2004(E)

© ISO 2004

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10684:2004](https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004)

<https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004>

© ISO 2004

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
1 Scope.....	1
2 Normative references	1
3 Terms and definitions	2
4 Materials.....	3
4.1 Raw material of parts.....	3
4.2 Zinc.....	3
5 Hot dip galvanizing procedures and precautions	3
5.1 Stress relief.....	3
5.2 Cleaning and pickling	3
5.3 Baking	3
5.4 Fluxing.....	3
5.5 Hot dip galvanizing	3
5.6 Spinning and quenching	4
5.7 Special requirements for nuts	4
5.8 Post-treatment.....	4
6 Requirements on thread tolerances and additional marking	4
6.1 General.....	4
6.2 Requirements and precautions in assembling hot dip galvanized threaded fasteners	4
6.3 Special requirements for marking when supplying fasteners in sealed containers.....	8
7 Mechanical properties of nuts tapped oversize and undersize threaded bolts, screws and studs.....	8
8 Coating requirements	8
8.1 Appearance of zinc coating	8
8.2 Considerations for hot dip galvanized washers	8
8.3 Zinc coating thickness	8
8.4 Adhesion of zinc coating.....	8
9 Lubrication.....	9
10 Ordering requirements	9
11 Designation.....	9
Annex A (normative) Special requirements for bolts, screws and nuts with thread sizes M8 and M10	11
Annex B (normative) Limits of sizes for hot dip galvanized internal and external screw thread M8	13
Annex C (informative) Calculation of minimum ultimate tensile loads and proof loads for bolts and screws M8 and M10 with threads undersized to tolerance class 6az	15
Annex D (informative) Surface areas of bolts, screws and nuts	16
Annex E (normative) Adherence of hot-dip galvanized coating.....	19
Annex F (informative) Strength of hot dip galvanized bolt or screw and nut assemblies	20

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10684 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 1, *Mechanical properties of fasteners*.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 10684:2004](https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004)

<https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004>

Fasteners — Hot dip galvanized coatings

1 Scope

This International Standard specifies material, process, dimensional and some performance requirements for hot dip spun galvanized coatings applied to coarse threaded steel fasteners from M8 up to and including M64 and for property classes up to and including 10.9 for bolts, screws and studs and 12 for nuts. It is not recommended to hot dip galvanize threaded fasteners in diameters smaller than M8 and/or with pitches below 1,25 mm.

NOTE Attention is drawn to the fact that the proof loads and stresses under proof load of oversize tapped nuts with threads M8 and M10 and the ultimate tensile loads and proof loads of undersize threaded bolts and screws with threads M8 and M10 are reduced as compared to the values specified in ISO 898-2 and ISO 898-1 respectively and are specified in Annex A.

It primarily concerns the spun hot dip galvanizing of threaded steel fasteners, but it may also be applied to other threaded steel parts.

The specifications given in this International Standard may also be applied to non-threaded steel parts such as washers.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

2 Normative references

ISO 10684:2004

[https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-](https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100a/iso-10684-2004)

[5fa012e100a/iso-10684-2004](https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100a/iso-10684-2004)

The following referenced documents 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.

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

ISO 898-2, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

ISO 965-1, *ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data*

ISO 965-2, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*

ISO 965-3, *ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads*

ISO 965-4, *ISO general purpose metric screw threads — Tolerances — Part 4: Limits of sizes for hot-dip galvanized external screw threads to mate with internal screw threads tapped with tolerance position H or G after galvanizing*

ISO 965-5, *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*

ISO 10684:2004(E)

ISO 1460, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area*

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

ISO 2064, *Metallic and other inorganic coatings — Definitions and conventions concerning the measurement of thickness*

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 8991, *Designation system for fasteners*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064 (in particular, the definitions of significant surface, measuring area, local thickness, minimum local thickness and average thickness) and the following apply.

3.1 batch

quantity of identical parts cleaned, pickled, fluxed and galvanized together at one time in a galvanizing basket

3.2 production lot

batches of parts originating from the same manufacturing lot, processed continuously through cleaning, pickling, fluxing, dipping in molten zinc and spun in a centrifuge without any change in temperature and concentration of the constituents of the process

3.3 batch average thickness

calculated average thickness of a coating as if it was uniformly distributed over the surface of the parts of the batch

3.4 baking

process of heating parts for a definite time at a given temperature in order to minimize the risk of hydrogen embrittlement

3.5 stress relief

process of heating parts for a definite time at a given temperature in order to relieve stress induced by work hardening

3.6 hot dip galvanizing of fasteners

process whereby steel fasteners are zinc coated by immersion in a bath of molten zinc, resulting in the formation of a zinc-iron alloy coating or a zinc-iron alloy coating plus a zinc coating at the surface of the fastener

NOTE This process involves the removal of excess zinc by spinning the parts in a centrifuge or by an equivalent method.

4 Materials

4.1 Raw material of parts

4.1.1 Chemical composition

Materials as included in ISO 898-1 and ISO 898-2 are suitable for hot dip galvanizing except if the total content of phosphorus and silicon is between 0,03 % and 0,13 %, in which case high temperature galvanizing (530 °C to 560 °C) is recommended.

4.1.2 Surface condition

The surface of the fastener, before immersion in the molten zinc, shall be clean and free from all contaminants that would adversely effect the galvanizing.

4.2 Zinc

The zinc used for this process shall be in accordance with ISO 1461.

5 Hot dip galvanizing procedures and precautions

5.1 Stress relief

Fasteners subjected to severe work hardening may require stress relief before acid cleaning and hot dip galvanizing.

5.2 Cleaning and pickling

Parts shall be cleaned. During the cleaning process, hydrogen could be absorbed into the steel. The hydrogen may not effuse completely in the galvanizing bath and consequently, may lead to brittle failure. Unless otherwise agreed, parts heat treated or work hardened to a hardness of ≥ 320 HV shall be cleaned using an inhibited acid, alkaline or mechanical process. Immersion time in the inhibited acid depends on the as-received surface condition and should be of minimum duration.

NOTE An inhibited acid is an acid to which a suitable inhibitor has been added to reduce corrosive attack on the steel and absorption of hydrogen.

5.3 Baking

If baking is carried out, it shall be carried out prior to surface activation.

5.4 Fluxing

Parts shall be surface activated, and dried if necessary.

5.5 Hot dip galvanizing

Normal temperature galvanizing is carried out at a bath temperature of 455 °C to 480 °C. High temperature galvanizing is used to produce a smoother and thinner coating and is carried out at a bath temperature of 530 °C to 560 °C. The finish obtained using the high temperature process is dull. In order to avoid micro-cracks, bolts, screws and studs of property class 10.9 in sizes M27 and above, shall not be high temperature galvanized.

Galvanizing shall not be carried out at bath temperatures between 480 °C and 530 °C.

5.6 Spinning and quenching

Parts shall be spun immediately following removal from the galvanizing bath and quenched in water or air cooled depending on size consideration.

5.7 Special requirements for nuts

Nut threads and other internal threads shall be tapped after hot dip galvanizing. Retapping shall not be permitted.

5.8 Post-treatment

Most galvanized parts do not require any post treatment. When required by the purchaser, treatments such as chromating or phosphating may be applied to reduce the possibility of wet storage staining (white corrosion) or to assist subsequent painting.

6 Requirements on thread tolerances and additional marking

6.1 General

Dimensional limits for ISO metric screw threads M10 to M64 before and after coating are specified in ISO 965-1 to ISO 965-5. All other dimensions and tolerances of fasteners apply before hot dip galvanizing. Dimensional limits for internal and external screw threads M8 with thread tolerances 6AX and 6AZ for internal threads and 6az for external threads are specified in Annex B.

NOTE It is not possible to check the thread tolerance of a hot dip galvanized part by stripping the coating and gauging the thread thereafter, since some steel is dissolved from the part during the galvanizing process.

6.2 Requirements and precautions in assembling hot dip galvanized threaded fasteners

6.2.1 General

This clause applies only to parts with thread tolerances in accordance with ISO 965-1 to ISO 965-5 and with marking according to the marking requirements for fasteners as given in ISO 898-1 and ISO 898-2. The marking specified in 6.2.2 and 6.2.3 shall be carried out in addition to the marking according to ISO 898-1 and ISO 898-2.

The application of zinc coating by the hot dip process results in the deposition of a heavy coating thickness of zinc (always in excess of 40 μm). Hence, it is necessary to manufacture screw threads to special limits in order to accommodate such heavy coatings.

There are two different methods provided for, which give the necessary fundamental deviations (clearances) for the zinc layer applied to fasteners by hot dip galvanizing.

The first method (see 6.2.2) consists of using nuts tapped oversize to tolerance class 6AZ or 6AX after coating, to mate with bolts or screws manufactured with screw threads to tolerance position g or h before coating.

The second method (see 6.2.3) consists of using bolts or screws manufactured with threads undersized to tolerance class 6az before coating, to mate with nuts tapped to tolerance position H or G after coating.

Nuts tapped oversize (marked with Z or X) shall never be mated with bolts or screws with undersized threads (marked with U), because such combinations create a high probability of thread stripping.

Assembling hot dip galvanized nuts tapped to tolerance position H or G after coating with hot dip galvanized bolts or screws manufactured with threads to tolerance position g or h before coating results in thread interference.

6.2.2 Nuts tapped oversize to tolerance class 6AZ or 6AX after coating

Oversize tapping of nuts and internal threads to tolerance class 6AZ or 6AX in accordance with ISO 965-5 is required after hot dip galvanizing when the mating bolts or screws or external threads are manufactured to tolerance position g or h in accordance with ISO 965-1 to ISO 965-3 before hot dip galvanizing.

Nuts tapped oversize shall be marked with the letter Z immediately after the property class mark in case of tolerance class 6AZ or with the letter X in case of tolerance class 6AX. See example in Figure 1.

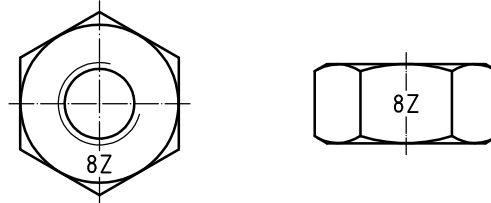


Figure 1 — Example of marking of hot dip galvanized nuts tapped oversize to tolerance position 6AZ after coating

In order to reduce the risk of interference on assembly of threads with hot dip galvanized coatings, the coating thickness on the mating bolts or screws or external threads advisably should not exceed one quarter of the minimum clearance of the thread combination. These values are given in Table 1 for information.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10684:2004](https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004)

<https://standards.iteh.ai/catalog/standards/sist/c552ca38-988c-4e06-8752-5fa012e100af/iso-10684-2004>

Table 1 — Fundamental deviations and upper limits of coating thicknesses for assemblies with nuts tapped oversize

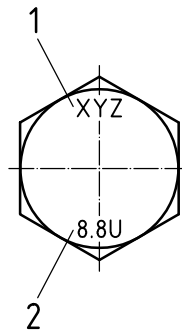
Pitch	Nominal thread diameter	Fundamental deviation						Minimum clearance and maximum coating thickness for thread combinations (for information)									
		Internal thread			External thread			AZ/g		AX/h		AX/g					
		AZ	AX	h	g	Minimum clearance	Maximum coating thickness	Minimum clearance	Maximum coating thickness	Minimum clearance	Maximum coating thickness	Minimum clearance	Maximum coating thickness				
<i>P</i>	<i>d</i>	<i>mm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>	<i>μm</i>
1,25	8	+ 325 ^a	+ 255 ^a	0	- 28	325	81	353	88	255	64	283	71				
1,5	10	+ 330	+ 310	0	- 32	330	83	362	91	310	78	342	86				
1,75	12	+ 335	+ 365	0	- 34	335	84	369	92	365	91	399	100				
2	16 (14)	+ 340	+ 420	0	- 38	340	85	378	95	420	105	458	115				
2,5	20 (18,22)	+ 350	+ 530	0	- 42	350	88	392	98	530	133	572	143				
3	24 (27)	+ 360	+ 640	0	- 48	360	90	408	102	640	160	688	172				
3,5	30 (33)	+ 370	+ 750	0	- 53	370	93	423	106	750	188	803	201				
4	36 (39)	+ 380	+ 860	0	- 60	380	95	440	110	860	215	920	230				
4,5	42 (45)	+ 390	+ 970	0	- 63	390	98	453	113	970	243	1 033	258				
5	48 (52)	+ 400	+ 1 080	0	- 71	400	100	471	118	1 080	270	1 151	288				
5,5	56 (60)	+ 410	+ 1 190	0	- 75	410	103	485	121	1 190	398	1 265	316				
6	64	+ 420	+ 1 300	0	- 80	420	105	500	125	1 300	325	1 380	345				

^a The fundamental deviations for AZ and AX are calculated according to the formulae given in ISO 965-5 on the basis of the thread dimensions specified in Annex B.

6.2.3 Bolts and screws with threads undersized to tolerance class 6az before coating

Undersize threading of bolts, screws and external threads to tolerance class 6az in accordance with ISO 965-4 is required before hot dip galvanizing, when the mating nuts or internal threads have tolerance position G or H in accordance with ISO 965-1 to ISO 965-3 after hot dip galvanizing.

Bolts and screws with undersized threads shall be marked with the letter U immediately after the property class mark. See example in Figure 2.



Key

- 1 manufacturer's identification mark
- 2 property class and additional marking

Figure 2 — Example of marking of hot dip galvanized bolts and screws with threads undersized to tolerance class 6az before coating

In order to reduce the risk of interference on assembly of threads with hot dip galvanized coatings, the coating thickness advisably should not exceed one quarter of the minimum clearance of the thread combination. These values are given in Table 2 for information.

Table 2 — Fundamental deviations and upper limits of coating thicknesses for assemblies with bolts and screws with undersized threads

Pitch <i>P</i> mm	Nominal thread diameter <i>d</i> mm	Fundamental deviation			Minimum clearance and maximum coating thickness for thread combinations (for information)			
		External thread <i>az</i> µm	Internal thread		az/H		az/G	
			H µm	G µm	Minimum clearance µm	Maximum coating thickness µm	Minimum clearance µm	Maximum coating thickness µm
1,25	8	- 325 ^a	0	+ 28	325	81	353	88
1,5	10	- 330	0	+ 32	330	83	362	91
1,75	12	- 335	0	+ 34	335	84	369	92
2	16 (14)	- 340	0	+ 38	340	85	378	95
2,5	20 (18, 22)	- 350	0	+ 42	350	88	392	98
3	24 (27)	- 360	0	+ 48	360	90	408	102
3,5	30 (33)	- 370	0	+ 53	370	93	423	106
4	36 (39)	- 380	0	+ 60	380	95	440	110
4,5	42 (45)	- 390	0	+ 63	390	98	453	113
5	48 (52)	- 400	0	+ 71	400	100	471	118
5,5	56 (60)	- 410	0	+ 75	410	103	485	121
6	64	- 420	0	+ 80	420	105	500	125

^a The fundamental deviation for az is calculated according to the formula given in ISO 965-4 on the basis of the thread dimensions specified in Annex B.