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Fasteners
Technical delivery conditions
Hot-dip galvanized parts

DIN 267 Part 10

Mechanische Verbindungselemente;
technische Lieferbedingungen; feuerverzinkte Teile

Supersedes March 1977 edition.

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Dimensions in mm

1 Field of application

This standard specifies the technical delivery conditions for fasteners (mainly screws, bolts and nuts) with an M 6 to M 36 coarse thread and provided with a zinc coating applied by hot-dip galvanizing, assigned to property classes up to 10.9 for bolts and 10 for nuts.

The minimum coating thicknesses specified in this standard also apply to hot-dip galvanized accessories such as plain washers and lock washers.

2 General

For most applications, the most important characteristic of hot-dip galvanized fasteners is the thickness of the zinc coating, and not its mass per unit area. This standard thus specifies the coating thickness together with the relevant methods of test. Where an order specifies the mass per unit area, a 100 µm coating thickness may be taken as being equivalent to 700 g/m^2.

As the fundamental deviations of ISO metric bolt threads produced to tolerance class 6g are not large enough to permit a coating to be applied to the minimum thickness specified in clause 4 without impairing the thread function, one of the two following methods shall be used to ensure that the bolt/nut assembly continues to function properly after hot-dip galvanizing.

a) The bolt thread shall be produced to tolerance position a as specified in DIN 13 Part 15 to give fundamental deviations as specified in table 1 and an actual thread profile corresponding to tolerance class 8 (for product grade C) or tolerance class 6 (for product grade A) before hot-dip galvanizing. After coating, the thread profile shall not at any point transgress the maximum material limit for position h (zero line).

b) The nut shall be produced to the deviation required for the zinc coating process so that the bolt thread may transgress the zero line after coating, this procedure being permissible if bolt and nut are supplied as a set.

The bolt thread shall not be recut after galvanizing. The minimum dimensions of a hot-dip galvanized thread are to be calculated from the minimum dimensions prior to coating, plus the minimum coating thickness (see table 1).

The thread of nuts shall not be hot-dip galvanized, but cut into the blank after coating.

The limit deviations specified in ISO 4759 Part 1 apply to the fastener before galvanizing. Coating shall not impair the ease with which components may be assembled.

Any greyness of hot-dip galvanized coatings is inherent to the material and thus not an indication of inferior quality of corrosion protection.

See DIN 50 976 for requirements relating to hot-dip galvanized coatings on finished ferrous products.

ISO 898 Parts 1 and 2 or DIN 267 Part 4 shall apply for the assessment of the mechanical properties of zinc-coated fasteners. However, as a departure from those standards, lower failure loads and proof loads have been specified taking into account the relatively large fundamental deviations (associated with tolerance position a) and/or the reduced overlap of the bolt and nut threads (see tables 3 and 4).

3 Designation

Hot-dip galvanized fasteners shall be designated as specified in the relevant dimensional standards, additionally using symbol tZn as specified in DIN 50 976, which indicates that the coating thickness is as given in table 1.

Example of designation:

Designation of an M 12 X 50 hexagon head bolt as specified in DIN 601, assigned to property class 4.6, with zinc coating applied by hot-dip galvanizing (tZn):

Hexagon head bolt
DIN 601 – M 12 X 50 – 4.6 – tZn

Table 1. **Fundamental deviations for bolt threads and minimum coating thickness**

Thread size (coarse thread)	Pitch, P	Fundamental deviation, A_o, in µm	Minimum coating thickness at measuring point, in µm
M 6	1	– 290	40
M 8	1,25	– 295	40
M 10	1,5	– 300	40
M 12	1,75	– 310	40
M 14; M 16	2	– 315	40
M 18; M 20; M 22	2,5	– 325	40
M 24; M 27	3	– 335	40
M 30; M 33	3,5	– 345	40
M 36	4	– 355	40

Continued on pages 2 to 5

Table 2. **Limit dimensions for bolt threads prior to hot-dip galvanizing**
(calculated on the basis of the screw thread tolerance system specified in DIN 13 Parts 14 and 15)

Thread size	Pitch, P	Major diameter, d			Pitch diameter, d_2			Minor diameter, d_3		
		Maximum tolerance class	Minimum tolerance class		Maximum tolerance class	Minimum tolerance class		Maximum tolerance class	Minimum tolerance class	
		8 and 6	8	6	8 and 6	8	6	8 and 6	8	6
M 6	1	5,710	5,430	5,530	5,060	4,880	4,948	4,483	4,264	4,332
M 8	1,25	7,705	7,370	7,493	6,893	6,703	6,775	6,171	5,933	6,005
M 10	1,5	9,700	9,325	9,464	8,726	8,514	8,594	7,860	7,590	7,670
M 12	1,75	11,690	11,265	11,425	10,553	10,317	10,403	9,543	9,240	9,326
M 14	2	13,685	13,235	13,405	12,386	12,136	12,226	11,231	10,904	10,994
M 16	2	15,685	15,235	15,405	14,386	14,136	14,226	13,231	12,904	12,994
M 18	2,5	17,675	17,145	17,340	16,051	15,786	15,881	14,608	14,247	14,342
M 20	2,5	19,675	19,145	19,340	18,051	17,786	17,881	16,608	16,247	16,342
M 22	2,5	21,675	21,145	21,340	20,051	19,786	19,881	18,608	18,247	18,342
M 24	3	23,665	23,065	23,290	21,716	21,401	21,516	19,984	19,553	19,668
M 27	3	26,665	26,065	26,290	24,716	24,401	24,516	22,984	22,553	22,668
M 30	3,5	29,655	28,985	29,230	27,382	27,047	27,170	25,361	24,891	25,014
M 33	3,5	32,655	31,985	32,230	30,382	30,047	30,170	28,361	27,891	28,014
M 36	4,0	35,645	34,895	35,170	33,047	32,692	32,823	30,738	30,229	30,360

Note. The limit dimensions specified in table 2 cannot be checked following chemical removal of the zinc coating since steel is dissolved in the hot-dip galvanizing process.

4 Fundamental deviations, coating thicknesses and limit dimensions for bolt threads

Table 1 specifies the fundamental deviations for tolerance position a for bolt threads and the minimum coating thickness at the point of measurement (see subclause 7.2.1), whilst table 2 lists the thread limit dimensions prior to hot-dip galvanizing.

5 Coating thickness for nuts

As the thread of nuts is only cut in the blank after hot-dip galvanizing, there is no specification with regard to the relationship between coating thickness and nominal thread diameter or pitch required.

Hot-dip galvanized nuts shall have the same minimum coating thickness on their bearing faces as hot-dip galvanized bolts, i.e. 40 µm.

6 Minimum failure loads and proof loads

The minimum failure loads and proof loads as specified in tables 3 and 4 have been calculated on the basis of the minimum values of tensile strength, R_m, or proof stress, S_p, as specified in ISO 898 Part 1. These values were not, however, multiplied by the nominal stress area as specified in DIN 13 Part 28 as is the case in ISO 898 Part 1, but by the minimum stress area, $A_{S\,min}$, which derives from tolerance position a and tolerance class 8. It is given by:

$$A_{S\,min} = \frac{\pi}{4} \left(\frac{d_{2\,min} + d_{3\,min}}{2} \right)^2$$

where

$d_{2\,min}$ is the minimum thread pitch diameter;

$d_{3\,min}$ is the minimum thread minor diameter.

The minimum failure loads and proof loads for property classes other than those listed in tables 3 and 4 may be calculated in the same way.

Table 3. **Minimum failure loads for hot-dip galvanized bolts and proof loads for hot-dip galvanized nuts with oversize thread**

Thread size	Pitch, P	Stress area, $A_{S\,min}$, in mm²	Property class bolt/nut			
			4.6/4	5.6/5	8.8/8	10.9/10
			Minimum failure load of bolt or proof load for nut, $(A_{S\,min} \cdot R_m)$, in N			
M 6	1	16,4	6 560	8 200	13 100	17 100
M 8	1,25	31,3	12 500	15 700	25 000	32 600
M 10	1,5	50,9	20 400	25 500	40 700	52 900
M 12	1,75	75,1	30 000	37 600	60 100	78 100
M 14	2	104	41 600	52 000	83 200	108 000
M 16	2	144	57 600	72 000	115 000	150 000
M 18	2,5	177	70 800	88 500	147 000	184 000
M 20	2,5	227	90 800	114 000	188 000	236 000
M 22	2,5	284	114 000	142 000	236 000	295 000
M 24	3	329	132 000	165 000	273 000	342 000
M 27	3	433	173 000	216 000	359 000	450 000
M 30	3,5	530	212 000	265 000	440 000	551 000
M 33	3,5	659	264 000	330 000	547 000	685 000
M 36	4	777	311 000	389 000	645 000	808 000

Table 4. **Proof loads for hot-dip galvanized nuts**

Thread size	Pitch, P	Stress area, A_S, in mm²	Property class			
			4.6	5.6	8.8	10.9
			Proof load, $(A_{S\,min} \cdot S_p)$, in N			
M 6	1	16,4	3 690	4 590	9 510	13 610
M 8	1,25	31,3	7 040	8 760	18 150	25 980
M 10	1,5	50,9	11 500	14 300	29 500	42 200
M 12	1,75	75,1	16 900	21 000	43 600	62 300
M 14	2	104	23 400	29 100	60 300	86 300
M 16	2	144	32 400	40 300	83 500	119 000
M 18	2,5	177	39 800	49 600	106 000	147 000
M 20	2,5	227	51 100	63 600	136 000	188 000
M 22	2,5	284	63 900	79 500	170 000	236 000
M 24	3	329	74 000	92 100	197 000	273 000
M 27	3	433	97 400	121 000	260 000	359 000
M 30	3,5	530	119 000	148 000	318 000	440 000
M 33	3,5	659	148 000	185 000	395 000	547 000
M 36	4	777	175 000	218 000	466 000	645 000

7 Testing

DIN 267 Part 5 shall apply for the acceptance inspection of hot-dip galvanized fasteners.

7.1 Proof load test and determination of failure load

The proof load test and the determination of the failure load for bolts shall be carried out as described in ISO 898 Part 1 and the proof load test on nuts with oversize thread, as specified in DIN 267 Part 4. Although, given the special thread tolerances applying here, failure of the bolt during tensile is acceptable as a result of thread stripping, the minimum failure loads specified in table 3 shall still be achieved.

7.2 Determination of coating thickness

7.2.1 Measuring points

The thickness of the coating on bolts or screws shall be measured at a point approximately in the centre of the head, and in the case of nuts, approximately in the middle of one flat (see figure 3).

Examples of measuring points

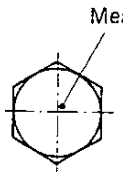

Figure 1.

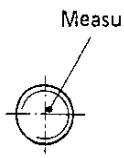

Figure 2.

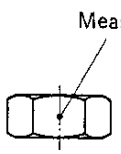

Figure 3.

Where the above specifications cannot be applied to other types of fastener by analogy, location of the measuring points shall be agreed.

7.2.2 Method of determining the coating thickness

DIN 50 933 shall apply for the direct determination of coating thickness. Methods of magnetic measurement, e.g. those complying with DIN 50 981, or any other methods may, however, also be used if they give the same results.

Standards referred to

DIN 13 Part 14	ISO metric screw thread; principles of a tolerance system for threads greater than 1 mm in diameter
DIN 13 Part 15	ISO metric screw thread; fundamental deviations and tolerances for threads greater than 1 mm in diameter
DIN 13 Part 28	ISO metric screw thread; coarse and fine pitch threads from 1 to 250 mm thread diameter; core cross sections, stress areas and pitch angle
DIN 267 Part 4	Fasteners; technical delivery conditions; property classes for nuts (previous classes)
DIN 267 Part 5	Fasteners; technical delivery conditions; acceptance inspection (modified version of ISO 3269, 1984 edition)
DIN 601	M 5 to M 52 hexagon head bolts; product grade C
DIN 50 933	Measurement of coating thickness; measurement of coating thickness by differential measurement using calipers
DIN 50 976	Corrosion protection; coating of iron and steel components by hot-dip galvanizing; requirements and testing
DIN 50 981	Measurement of coating thickness; magnetic methods of determining the thickness of non-ferromagnetic coatings on ferromagnetic substrates
ISO 898 Part 1	Mechanical properties of fasteners; bolts, screws and studs
ISO 898 Part 2	Mechanical properties of fasteners; nuts with specified proof loads
ISO 4759 Part 1	Tolerances for fasteners; bolts, screws and nuts with thread diameters between 1,6 and 150 mm and product grades A, B and C

Previous edition

DIN 267 Part 10: 03.77.

Amendments

The following amendments have been made to the March 1977 edition.

a) Values for the bolt thread minor diameter have been corrected.

b) Minimum failure loads and proof loads have been specified taking into consideration the larger fundamental deviations for hot-dip galvanized bolts produced to a modified tolerance position or for nuts with oversize thread.

c) The standard has been editorially revised.

Explanatory notes

In comparison with the March 1977 edition of this standard, this edition includes minimum failure loads and proof loads for bolts and nuts. These loads are smaller than the values specified in ISO 898 Part 1 or DIN 267 Part 4. This is intended to take account of the increased fundamental deviations (derived from tolerance position a) specified for hot-dip galvanized bolts and screws, the effective stress area here being markedly smaller than the nominal stress area, and the reduced overlap of the bolt and nut threads.

The scope of the standard has been limited to M 6 to M 36 fasteners with coarse thread as, owing to lack of experience in hot-dip galvanizing of bolts larger than size M 36, standard specifications cannot as yet be given and production of fasteners smaller than M 6 (or a pitch smaller than 1 mm) is uneconomical.

Although the specifications given in this standard chiefly apply to bolts, screws and nuts, i.e. to threaded components, they may also be applied to accessories such as plain washers and lock washers.

Despite the fact that there is at present little evidence for hydrogen-induced brittle fracture, such fracture cannot be ruled out in the case of hot-dip galvanized steel bolts having the chemical composition and minimum tempering temperatures specified in ISO 898 Part 1, owing to the pretreatment (pickling) required for components with a tensile strength exceeding 1000 N/mm^2. Such fracture, however, can generally be prevented by using suitable materials and by ensuring that pickling is properly carried out.

The specification given in subclause 7.2.2, that other methods of measurement should give the same results does not only mean the same absolute (or mean) values when these test methods are used, but also that these other, unspecified, methods involve the same uncertainty of measurement and the same variability as the methods specified in DIN 50 933. This permits other methods of measurement to be applied without additional inaccuracies or variations in results being introduced.

International Patent Classification

C 23 C 2/06
F 16 B 33/00