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Hexagon socket countersunk head cap screws

DIN 7991

Senkschrauben mit Innensechskant

Supersedes May 1985 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

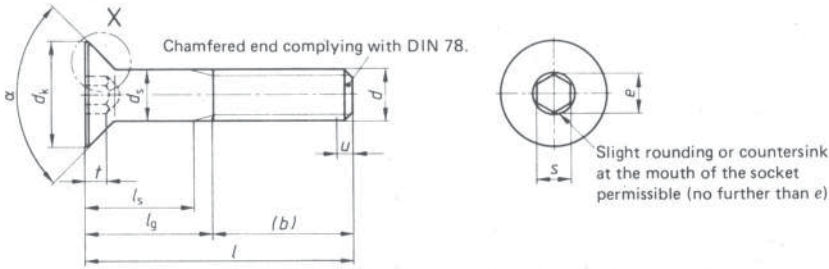
This standard specifies product grade A hexagon socket countersunk head cap screws with ISO metric screw thread from size M3 up to and including size M24.

If, in special cases, the screws are to meet requirements other than those given in this standard, e.g. with regard to property class or material, these shall be selected in accordance with the appropriate standard. This also applies to the fine pitch thread conforming to DIN 13 Part 13 required in exceptional cases.

As a consequence of the head geometry and the form of the wrench engagement, the critical cross section of screws covered by this standard is located below the hexagon socket and not in the thread. It is thus recommended that the screws should not be used for the transmission of high axial loads involving prestressing.

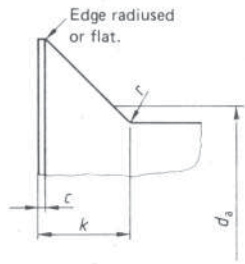
If a DIN 911 double offset screwdriver is used to tighten the screws by way of their socket, the torsional strength and the design of the key only permit the application of prestressing loads corresponding to about 80 % of the prestressing loads specified for the commonly used property class 8.8 screws.

2 Dimensions



d_s is applicable only for screws with unthreaded portion of shank.
$u = 2P$ maximum; incomplete thread.

Detail X



Continued on pages 2 to 6

Thread size d		M3	M4	M5	M6	M8	M10	M12
P [1]		0,5	0,7	0,8	1	1,25	1,5	1,75
a	$+\frac{2}{0}°$	90°						
b Thread length	[2]	12	14	16	18	22	26	30
	[3]	–	–	–	24	28	32	36
	[4]	–	–	–	–	–	45	49
c	≈	0,2	0,3	0,3	0,3	0,4	0,5	0,5
d_k	max. = nominal dimension	6	8	10	12	16	20	24
	min.	5,7	7,64	9,64	11,57	15,57	19,48	23,48
d_a	max.	3,6	4,7	5,7	6,8	9,2	11,2	13,7
d_s	max. = nominal dimension	3	4	5	6	8	10	12
	min.	2,86	3,82	4,82	5,82	7,78	9,78	11,73
e [5]	min.	2,3	2,87	3,44	4,58	5,72	6,86	9,15
k [6]	max.	1,7	2,3	2,8	3,3	4,4	5,5	6,5
r	min.	0,1	0,2	0,2	0,3	0,5	0,5	1
s	Nominal dimension	2	2,5	3	4	5	6	8
	min.	2,02	2,52	3,02	4,02	5,02	6,02	8,025
	max.	2,10	2,60	3,10	4,12	5,14	6,14	8,175
t	max. = nominal dimension	1,2	1,8	2,3	2,5	3,5	4,4	4,6
	min.	0,95	1,55	2,05	2,25	3,2	4,1	4,3

Nominal length	l min.	l max.	Shank lengths l_s and l_g [6]													
			l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.
8	7,71	8,29	–	3,2	–	4,4	–	5,2	–	6,3						
10	9,71	10,29	–	3,2	–	4,4	–	5,2	–	6,3	–	8,2				
12	11,65	12,35	–	3,2	–	4,4	–	5,2	–	6,3	–	8,2	–	10		
16	15,65	16,35	–	3,2	–	4,4	–	5,2	–	6,3	–	8,2	–	10		
20	19,58	20,42	–	3,2	–	4,4	–	5,2	–	6,3	–	8,2	–	10	–	11,8
25	24,58	25,42	10,5	13	–	4,4	–	5,2	–	6,3	–	8,2	–	10	–	11,8
30	29,58	30,42	15,5	18	12,5	16	–	5,2	–	6,3	–	8,2	–	10	–	11,8
35	34,5	35,5			17,5	21	15	19	–	6,3	–	8,2	–	10	–	11,8
40	39,5	40,5			22,5	26	20	24	17	22	–	8,2	–	10	–	11,8
50	49,5	50,5					30	34	27	32	21,7	28	16,5	24	–	11,8
60	59,4	60,6									31,7	38	26,5	34	21,25	30
70	69,4	70,6											36,5	44	31,25	40

[1] P = pitch of thread (coarse pitch thread).

[2] For lengths $l \leq 125$ mm.

[3] For lengths $l > 125$ mm ≤ 200 mm.

[4] For lengths $l > 200$ mm.

[5] e min. = 1,14 s min.

[6] The head height k is included in the shank lengths.

Thread size d			(M 14)	M 16	(M 18)	M 20	(M 22)	M 24
P [1]			2	2	2,5	2,5	2,5	3
a	$^{+2}_{0}$ °		90°				60°	
b Thread length		[2]	34	38	42	46	50	54
		[3]	40	44	48	52	56	60
		[4]	53	57	61	65	69	73
c		≈	0,5	0,5	0,5	0,5	1	1
d_k	max. = nominal dimension		27	30	33	36	36	39
		min.	26,48	29,48	32,38	35,38	35,38	38,38
d_a		max.	15,7	17,7	20,2	22,4	24,4	26,4
d_s	max. = nominal dimension		14	16	18	20	22	24
		min.	13,73	15,73	17,73	19,67	21,67	23,67
e [5]		min.	11,43	11,43	13,72	13,72	16	16
k [6]		max.	7	7,5	8	8,5	13,1	14
r		min.	1	1	1	1	1	1,6
s	Nominal dimension		10	10	12	12	14	14
		min.	10,025	10,025	12,032	12,032	14,032	14,032
		max.	10,175	10,175	12,212	12,212	14,212	14,212
t	max. = nominal dimension		4,8	5,3	5,5	5,9	8,8	10,3
		min.	4,5	5	5,2	5,6	8,44	9,87

Nominal length	l min.	l max.	Shank lengths l_s and l_g [6]											
			l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.	l_s min.	l_g max.
20	19,58	20,42												
25	24,58	25,42	–	13										
30	29,58	30,42	–	13	–	13,5								
35	34,5	35,5	–	13	–	13,5	–	15,5	–	16				
40	39,5	40,5	–	13	–	13,5	–	15,5	–	16	–	20,6		
50	49,5	50,5	–	13	–	13,5	–	15,5	–	16	–	20,6	–	23
60	59,4	60,6	16	26	–	13,5	–	15,5	–	16	–	20,6	–	23
70	69,4	70,6	26	36	22	32	15,5	28	–	16	–	20,6	–	23
80	79,4	80,6	36	46	32	42	25,5	38	21,5	34	–	20,6	–	23
90	89,3	90,7			42	52	35,5	48	31,5	44	27,5	40	–	23
100	99,3	100,7					45,5	58	41,5	54	37,5	50	31	46

See page 2 for [1] to [6].

The commercial nominal lengths are designated by giving the shank lengths.

The thread sizes and intermediate lengths given in brackets shall be avoided where possible.

Nominal lengths above 100 mm shall be graded by steps of 10 mm, and those above 200 mm by steps of 20 mm.

Screws with nominal lengths above the dashed stepped line shall be threaded up to the head (the maximum distance from the last full form thread to the head bearing surface, l_g, is k max. + 3 P). The l_g and l_s values for bolts with nominal lengths below the dashed stepped line shall be determined in accordance with the following equations:

l_g max. = l (nominal length) − b (nominal length); l_s min. = l_g max. − 5 P.

3 Technical delivery conditions

Material		Steel	Stainless steel	Nonferrous metal
General requirements		As specified in DIN 267 Part 1.		
Thread	Tolerance class	6 g		
	Standard	DIN 13 Part 12 and Part 15		
Mechanical Properties	Property class (material)	8.8	≤ M 20: A2-70; > M 20: A2-50	CuZn = copper-zinc alloy [2]
		Other property classes or materials subject to agreement.		
	Standard	ISO 898 Part 1 [1]	DIN 267 Part 11	DIN 267 Part 18
Permissible dimensional deviations and deviations of form	Product grade	A		
	Standard	ISO 4759 Part 1		
Surface finish		(Thermally or chemically) blackened.	Bright.	Bright.
		DIN 267 Part 2 shall apply with regard to the surface roughness. DIN 267 Part 19 shall apply with regard to the permissible surface discontinuities. DIN 267 Part 9 shall apply with regard to electroplating. If a different kind of electroplating or a different kind of surface protection is desired, this shall be agreed upon at the time of ordering.		
Acceptance inspection		DIN 267 Part 5 shall apply with regard to acceptance inspection.		

[1]) The acceptance inspection shall include hardness testing of property class 8.8 screws, with hardness values of HV 250 to 320 for sizes up to and including M 16, and HV 255 to 335 for sizes greater than M 16 (see Explanatory notes).

[2]) Preferably CU2 or CU3, at the manufacturer's discretion.

4 Designation

Designation of an M 12 hexagon socket countersunk head cap screw, of nominal length l = 60 mm and assigned to property class 8.8 [1]:

Hexagon socket countersunk head cap screw DIN 7991 – M 12 × 60 – 8.8

DIN 962 shall apply with regard to the designation of types and designs, with additional information to be given on ordering.

The DIN 4000 – 2 – 1 tabular layout of article characteristics shall apply for screws covered by this standard.

5 Masses

Thread size d	M 3	M 4	M 5	M 6	M 8	M 10	M 12	(M 14)	M 16	(M 18)	M 20	(M 22)	M 24
Nominal length l	Mass (7,85 kg/dm³), in kg per 1000 units ≈												
8	0,47	0,92	1,6	2,35									
10	0,56	1,07	1,85	2,7	5,47								
12	0,65	1,23	2,1	3,05	6,1	10,1							
16	0,83	1,53	2,59	3,76	7,35	12,1							
20	1	1,84	3,09	4,46	8,6	14,1	21,2						
25	1,35	2,23	3,71	5,34	10,2	16,6	24,8						
30	1,63	2,9	4,33	6,22	11,7	19,1	28,5		51,8				
35		3,4	5,43	7,1	13,3	21,6	32,1		58,4		91,4		
40		3,9	6,2	8,83	14,8	24,1	35,7		65,1		102		
50			7,74	11	19,9	30,1	43		78,4		123		179
60					24,8	35,7	54		91,7		143		209
70						41,2	62,9		111		164		239
80									127		200		269
90									143		226		299
100											253		340

The values of mass specified for the commercial sizes are for guidance only.

[1]) If no property class is specified in the documents available, property class 8.8 shall apply.

Standards referred to

DIN 13 Part 12	ISO metric screw threads; coarse and fine pitch threads from 1 to 300 mm diameter; selection of diameters and pitches
DIN 13 Part 13	ISO metric screw threads; selected sizes for screws, bolts and nuts from 1 to 52 mm screw thread diameter and limits of size
DIN 13 Part 15	ISO metric screw threads; fundamental deviations and tolerances for screw threads of 1 mm diameter and larger
DIN 78	Thread ends and lengths of projection of bolt ends for ISO metric threads in accordance with DIN 13
DIN 267 Part 1	Fasteners; technical delivery conditions; general requirements
DIN 267 Part 2	Fasteners; technical delivery conditions; types of finish and dimensional accuracy
DIN 267 Part 5	Fasteners; technical delivery conditions; acceptance inspection
DIN 267 Part 9	Fasteners; technical delivery conditions; electroplated components
DIN 267 Part 11	Fasteners; technical delivery conditions with addenda to ISO 3506; stainless and acid resistant steel components
DIN 267 Part 18	Fasteners; technical delivery conditions; nonferrous metal components
DIN 267 Part 19	Fasteners; technical delivery conditions; surface discontinuities on bolts
DIN 911	Hexagon socket screw key
DIN 962	Bolts, screws, studs and nuts; designations, types and finishes
DIN 4000 Part 2	Tabular layout of article characteristics for bolts, screws and nuts
ISO 898 Part 1	Mechanical properties of fasteners; bolts, screws and studs
ISO 4759 Part 1	Tolerances for fasteners; bolts screws, and nuts with thread diameters $\geq 1{,}6$ and ≤ 150 mm and product grades A, B and C

Previous editions

DIN 7991: 08.57, 01.70, 05.85

Amendments

The following amendments have been made in comparison with the January 1970 edition:

a) The content of the standard has been editorially revised and harmonized with DIN 912.

b) Shank lengths have been adopted (see Explanatory notes).

c) Details of the underhead fillet have been specified for strength reasons (see Explanatory notes).

d) The technical delivery conditions have been supplemented and harmonized with the corresponding basic standards.

e) Maximum and minimum values have been adopted for the individual dimensions.

f) In the field of application, attention has been drawn to the limited axial loadability of the screws.

g) Screws with fine pitch thread have been deleted.

h) The hardness test has been specified as the determining test for the acceptance inspection.

Some printing errors of the May 1985 edition have been corrected.

Explanatory notes

Re amendment a):

In respect of its dimensional specifications and its layout, Standard DIN 912, December 1983 edition, corresponds to International Standard ISO 4762 – 1977. The national amendments and/or supplements required have been identified. The same layout has been selected for the present standard and the other standards covering hexagon socket screws, DIN 6912 and DIN 7984, although no international standards comparable to these standards have yet been published.

Re amendment b):

As an addition to the previous specifications, dimensions have been specified for the shank lengths, l_s and l_g, (including the countersink). l_g can be considered to represent the minimum grip length. Thread length b, which has remained unamended at $2 \times d + 6$ mm or $2 \times d + 12$ or 25 mm is now only applicable as a reference dimension for calculating l_g and l_s. This dimension also covers the tolerance on nominal length and the previous tolerance on thread length, i.e. the difference between l_g and l_s ($= 5P$) covers tolerances and the thread runout. There is no risk to interchangeability as a consequence of the amended dimensioning.

Re amendment c):

The radius of the underhead fillet on countersunk head screws complying with DIN 7991 was specified in the past as a minimum dimension. Although it is difficult to measure this dimension on the head, dimension d_a max. has been adopted from the other standards as the upper limit value of the radius. These specifications make allowance for the cross section (shear cross section) between the base of the hexagon socket and the shank, the strength of which has to be regarded as critical. A reduction in the hexagon socket depth would indeed lead to an improvement in the cross section but worsen the tightening conditions. Raising the height of the countersunk head slightly, thus following the trend in ISO, was also considered a possible solution, but this was not done at this time in order to ensure interchangeability.

Re amendment g):

Countersunk head screws complying with this standard are only seldom required with fine pitch thread. This thread has been deleted from the standard for this reason. However, according to the field of application, screws with fine pitch thread may continue to be ordered in accordance with this standard, if required.

Re amendment h):

As it is possible for the critical cross section in these screws to lie between the hexagon socket and the threaded portion of the shank, they are not to be subjected to the wedge loading test (see ISO 898 Part 1, April 1979 edition, table 5). Furthermore, according to a revision agreed in October 1984 by Subcommittee SC 1 of Technical Committee ISO/TC 2, the hardness test has been made mandatory for acceptance inspection as specified in ISO 898 Part 1, table 3. In addition to revised hardness values, it has been specified that screws having a head which, as a function of its design, is (or could be) weaker than the threaded portion, shall be accepted on the basis of hardness testing.

International Patent Classification

F 16 B 23/00