TECHNICAL INFORMATION (TI)

With the following Technical Information, or TI, we are living up to our reputation of supporting you with current information and customised solutions in everyday business.

In the following more than 260 pages, you will find all relevant information related to fastener and fixing technology. This, for example, includes measurement data sheets and tables with locking torque and pre-loading for assembly. Moreover, there is information on current anti-corrosive systems and new standardisation in the field of stainless steels. In addition, there is an overview of guidelines and regulations, as well as changes to standards, as valuable orientation when selecting products.

REYHER's contribution to standards bodies provides a forum for technical observation of the market, supplying information in good time regarding new technologies and customer-specific requirements.

MEMBER OF DIN

Today, REYHER is helping to shape tomorrow's products!

Source:
F. REYHER Nchfg. GmbH & Co. KG, Hamburg, Germany
As of: 04/2020

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Standards conversion DIN → ISO/EN

The conversion of some national DIN standards to ISO or EN standards is (was) done with the aim of deconstructing trade barriers in international goods exchange and harmonising the technical rules in the common single European market.

Table 1 shows the ISO/EN standards for product standards and the most important thread and basic standards according to the corresponding DIN in ascending order (as of: 10/2019).

Table 2 (next page) shows the EN and DIN standards according to the corresponding ISO in ascending order.
The tables also include draft standards and withdrawn standards.

Table 1

Product standards	
DIN	ISO DIN ISO DIN EN ISO
1	2339
7	2338
39	–
84	1207
85	1580
93*	–
94	1234
95, 96, 97	–
98, 99	–
123,124	1051
125-1,2	7089, 7090
126	7091
127*, 128*	–
134*, 137*	–
186, 188	–
258	ISO 8737
261	–
302	1051
314-318	–
319	–
338, 340	–
388, 390	–
404	–
417	7435
427	2342
431	–
432*	–
433-1,2	7092
434-436	–
438	7436
439-1	4036
439-2 RG/FG	4035, 8675
440	7094
442, 443	–
444	–
462, 463*	–
464, 465*	–
466, 467	–
468, 469	–
470	–
471, 472	–
478-480	–
508	–
525, 529	–
546-548	–
551	4766
553	7434
555	4034
557	–
558	4018
561	–
562	–
564	–
571	–
580, 582	–
601	4016
603	–
604-608	–
609, 610*	–
653	–
660-662	1051
674, 675	1051
703*, 705	–
741	–
787	299
792	–
797, 798*	–
830*	–
835	–
906-910	–

Product standards	
DIN	ISO DIN ISO DIN EN ISO
911	2936
912 (RG)	4762
912 (FG)	12474
913	4026
914	4027
915	4028
916	4029
917	–
920-927	–
928, 929	–
931-1	4014
931-2	–
933	4017
934 RG	4032, 4033
934 FG	8673, 8674
935-1	–
935-3	–
936 RG/FG	(4035/8675)
937	–
938-940	–
949-1,2	–
950-959	–
960	8765
961	8676
963	2009
964	2010
965	7046-1, 2
966	7047
967, 968	–
(970)	4032
(971-1,2)	8673,8674
(972)	4034
975	DIN 976
976-1,2	–
977	–
979	–
980 RG	7042 (7719)
980 FG	10513
981	–
982 RG	7040
982 FG	10512
983	–
985	10511
986	–
987*	–
988	–
1052	–
1433-1436	–
1440	8738
1441	–
1443	2340
1444	2341
1445	–
1469	–
1470	8739
1471	8744
1472	8745
1473	8740
1474	8741
1475	8742/8743
1476	8746
1477	8747
1478-1480	–
1481	8752
1587	–
1592-1597	–
1804	–
1816	–
2093	EN 16983
2507	(EN 1515)

Product standards	
DIN	ISO DIN ISO DIN EN ISO
2509*	–
2510-1...8	–
3015-3016	–
3017	–
3220	–
3319	–
3404, 3405	–
3567	–
3568*	–
3570	–
3575	–
3670	–
3870, 3872	–
4109	–
5299	–
5406	–
5417	–
5525, 5526	–
5586	–
5903, 5906	–
5914	–
6303	–
6304-6307	–
6311	–
6319	–
6324	–
6325	8734
6330, 6331	–
6332	–
6334*	–
6335-6337	–
6340	–
6378	–
6379	–
6791, 6792	1051
6796	–
6797*	–
6798*	–
6799	–
6880	–
6881	–
6883, 6884	2492
6885-1, 2	–
6885-3	–
6886, 6887	–
6888	3912
6899	–
6900	10644
6901	10510
6902-6908	10669, 10673
6911	–
6912	–
6913*	–
6914-6915	EN 14399-4
6916	EN 14399-6
6917-6918	–
6921	EN 1665
6922	EN 1665
6923	EN 1661
6924 (RG)	7040
6924 (FG)	10512
6925 (RG)	7042
6925 (FG)	10513
6926 (RG)	EN 1663
6926 (FG)	EN 1666
6927 (RG)	EN 1664
6927 (FG)	EN 1667
6928 (RG)	7053
6928 (FG)	10509
7331	–

Product standards	
DIN	ISO DIN ISO DIN EN ISO
7337	15973-16585
7338-7340	–
7341	1051
7343	8750
7344	8748
7346	13337
7349	–
7500-1	–
7504	15480-15483
7513	–
7516	–
7603	–
7604	–
7642, 7643	–
7964	–
7965	–
7967*	–
7968	–
7969	–
7971	1481
7972	1482
7973	1483
7976	1479
7977	8737
7978	8736
7979	8733, 8735
7980*	–
7981	7049
7982	7050
7983	7051
7984	–
7985	7045
7987*, 7988*	–
7989-1,2	–
7990	–
7991	10642
7992	–
7993	DIN 9925/9926
7995-7997	–
7999	EN 14399-8
8140	–
9021	7093-1,-2
9045*	–
9841	7379
11014	–
11023, 11024	–
15058	–
15237	–
16903	–
18182	–
21346	–
21547	–
22424, 22425	–
25192	–
25193	–
25195	–
25197*	–
25200-25203	–
26020	–
28030	–
28129	–
28152	–
32500, 32501	13918
34800-34802	–
34803, 34804	–
34805	–
34810-34816	–
34817-34819	–
34820	–
46258, 46320	–

Product standards	
DIN	ISO DIN ISO DIN EN ISO
46288	–
58450	–
70613-70618	–
70851*	–
70852	–
70951*	–
70952	–
71412	–
71752	–
71802-71805	–
74361	–
80403	–
80701	–
80704	–
80705	–
81698	–
82006-82010	–
82013	–
82101	–

Thread standards	
13-1...11	724
13-12	261
13-13	262, 965-2
13-14, 15	965-1, -2
13-16...18	1502
13-19	68-1
13-20...26	–
13-27	965-3
13-28	–
13-50...52	–
14	–
103-1	2901
103-2	2902
103-3	2903
103-4	2904
103-5...9	–
202	–
2244	5408
2510-2	–
7952	–
7970	1478
7998	–
8140, 8141	–
66	15065
69	273
74	–
76-1	3508, 4755
76-2	228-1

Basic/Functional standards	
DIN	ISO DIN ISO DIN EN ISO
78	4753
101	1051
267-1	8992
267-2	4759-1
267-3	898-1
267-4	898-2
267-5	3269 (16426)
267-6	4759-1
267-7	898-1
267-8	898-2
267-9	4042
267-10	10684
267-11	3506-1-4
267-12	2702
267-13	–
267-15	2320
267-18	8839
267-19	6157-1, 3
267-20	6157-2
267-21	10484
267-23	898-6
267-24	–
267-25	898-7
267-26-30	–
475**	272 (EN 1660)
522	4759-3
918	1891
946	16047
962 (34803)	7378, 8991
969	–
974	–
2510-2, 8	–
7150-7152	286
7154-7157	–
7160, 7161	286
7168	2768, 8015
7172, 7182	286
7184	1101
7337	14588-589
7500-2/7504	-/10666
7962	4757
7970	1478
7998	–
8140-1-3	–
9830	–
18800	–
34803, 34804	–
40080	2859-1-3
50049	EN 10204/ ISO 16228

– ISO/EN standard not yet known (as of 10/2019)

( ) Transitional standards (dimensions identical with ISO)

* withdrawn DIN standard without replacement, because, for example, technically reworked
(On issue of DIN EN-/DIN EN ISO standards the corresponding DIN/DIN ISO are/were withdrawn)

Legend for table 2

HV	high strength steel
Csk.	countersunk
Rcsk.	raised countersunk
CT/FT	coarse pitch thread/fine pitch thread
CH/TC/CD/CP	with flat point/with cone point/with dog point/ with cup point
Hex.	hexagon
CR	cross recess
MP	Mechanical Properties
S/H/L	standard/heavy/light version
Ww	Withworth
TDC	technical delivery conditions

Table 2

Product standards				Product standards				Basic/Functional standards			
ISO DIN ISO DIN EN ISO	EN DIN EN	DIN	Title keyword	ISO DIN ISO DIN EN ISO	EN DIN EN	DIN	Title keyword	ISO DIN ISO DIN EN ISO	EN DIN EN	DIN	Title keyword
-	1515	2507	Flange joints	7379	-	9841	Hex. socket head shoulder screws	225	20225	-	Fasteners: Dimensions
-	1661	6923	Hexagon nuts with flange	7380	-	-	Hex. socket button head screws	272	1660	475-1	Hexagon wrench sizes
-	(1662), 1665	6921, 6922	Hexagon bolts with flange	7434	27434	553	Slotted set screws TC	273	20273	69	Clearance holes for bolts
-	1663, 1664	6926, 6927	Hexagon nuts with flange	7435	27435	417	Slotted set screws CD	286-1, 2	20286	7150-7182	ISO system of limits and fits
-	1666, 1667FG	6926, 6927FG	and prevailing torque type	7436	27436	438	Slotted set screws CP	885	-	-	Radi unnder screw head
-	14218,14219	-	Hex. bolts/nuts with flange FT	7719, 7720	-	980, 6925	Prevailing torque type hex. nuts	887	-	-	Plain washers - general plan
-	14399-4	6914-6915	Hexagon bolts/nuts (HV)	8100, 8102	1665	6921	Hexagon bolts with flange	888	-	-	Nominal lengths screws/threads
-	14399-6	6916	Plain chamfered washers (HV)	8104	1662	6922	Hexagon bolts with flange	898-1	-	267-3, 7	TDC fasteners: bolts
-	14399-8	7999	Hexagon fit bolts (HV)	8673	-	934, 971-1	Hexagon nuts FT	898-2	-	4, 8	TDC fasteners: nuts CT
-	16983	2093	Disc springs	8674	-	934, 972-2	Hexagon nuts FT	898-5	-	267-3	TDC fasteners: set screws
299	-	508/787	Screws/nuts for T-slots	8675	-	439-2, 936	Hexagon thin nuts (chamfered) FT	898-6	-	267-23	TDC fasteners: nuts FT
773	-	6885-1, 2	Parallel keys	8676	-	961	Hexagon head screws FT	898-7	-	267-25	Torsional test M 1-M 10
774	-	6886, 6887	Taper keys with gip head	8733	-	7979	Parallel pins, internal thread	1051	-	101	Rivets: technical specifications
1051	-	660	Rivet, rivet pins	8734	-	6325	Parallel pins, hardened	1101	-	7184	Tolerances of form/position
1207	-	84	Slotted cheese head screws	8735	-	7979	Parallel pins, internal thread	1891	-	918	Fasteners: terminology
1234	-	94	Splint pins	8736	28736	7978	Taper pins, internal thread	2320	-	267-15	TDC fasteners: locking nuts
1479	-	7976	Hexagon head tapping screws	8737	28737	7977, 258	Tape pins, CD thread	2702	-	267-12	TDC fasteners: tapping screws
1481	-	7971	Pan head tapping screws	8738	28738	1440	Washers for clevis pins	2768-1...2	-	7168-1, 2	General tolerances
1482	-	7972	Csk. head tapping screws	8739	-	1470	Grooved pins	2859	-	40080	Sampling plans
1483	-	7973	Rcsk. head tapping screws	8740	-	1473	Grooved pins champfer	3269	-	267-5	TDC fasteners: acceptance inspection
1580	-	85	Pan head screws	8741	-	1474	Grooved pins	3506-1...4	-	267-11	TDC fasteners: stainless steel
2009	-	963	Countersunk head screws	8742	-	1475	Grooved pins	3508	-	76-1	Thread runouts/undercuts
2010	-	964	Rcsk. head screws	8743	28743	1475	Grooved pins	4042	-	267-9	TDC fasteners: electroplated coatings
2338	-	7	Parallel pins	8744	-	1471	Grooved pins	4753	-	78	Thread ends/protrusions
2339	22339	1	Taper pins	8745	-	1472	Grooved pins	4755	-	76-1	Thread runouts/undercuts
2340	22340	1443	Clevis pins without head	8746	-	1476	Round head grooved pins	4757	-	7962	Cross recess for screws
2341	22341	1444	Clevis pins with head	8747	-	1477	Grooved pins with csk. head	4759-1...3	-	267-2, 6, 522	Tolerances for fasteners
2342	-	427	Headless screws	8748	-	7344	Spring-type straight pins H	6157-1...3	-	267-19	Surface discontinuities, bolts
2491	-	6885-3	Parallel keys	8750	-	7343	Spring-type straight pins S	6157-2	(493)	267-20, 21	Surface discontinuities, nuts
2492	-	6883, 6884	Gib head/parallel keys	8751	-	7343	Spring-type straight pins L	7085/7500-1	-	-	Thread rolling screws
2936	-	911	Hexagon socket screw keys	8752	-	1481	Spring pins H	7378	-	962	Split pin holes/wire holes
3912	-	6888	Woodruff keys	8765	-	960	Hexagon head bolts FT	7721	-	-	Csk. head screws: configuration
4014	-	931-1	Hexagon head bolts	10509	-	6928	Hex. flange head tapping screws	8749	-	-	Determ. of shear strength of pins
4016	-	601	Hexagon head bolts	10510	-	6901	Tapping screws	8839	28839	267-18	TDC fasteners: non-ferrous metal
4017	-	933	Hexagon head bolts	10511	-	985	Hexagon thin locking nuts	8991	-	962	Designation system for fasteners
4018	-	558	Hexagon head screws	10512	-	982, 6924	Hexagon locking nuts	8992	-	267-1	TDC fasteners: general requirements
4026	-	913	Hexagon socket set screws CH	10513	-	980, 6925	Hexagon locking nuts	-	10204	50049	Certificates
4027	-	914	Hexagon socket set screws TE	10642	-	7991	Hex. socket csk. head screws	10484	(493)	267-21	Widening test on nuts
4028	-	915	Hexagon socket set screws CD	10644	-	6900	Screws and washer assemblies	10644	-	6900-1	Screw/washer ass. hardness d.
4029	-	916	Hexagon socket set screws CP	10663	1661	6923	Hexagon nuts with flange FT	10664	-	-	Hexalobular socket
4032	-	934	Hexagon nuts I CT	10666	-	7504	Drilling screws with tapping screw thread	10666	-	7504	MP drilling screws
4033	-	934	Hexagon nuts II CT	10669/10673	-	6903/6902	Washers for assemblies	10683	-	-	Zinc flake coatings
4034	-	555	Hexagon nuts	12125	-	6926	Hexagon locking nuts with flange	10684	-	267-10	Hot dip galvanized coatings
4035	-	439-2, 936	Hexagon thin nuts	12126	-	6927	Hexagon locking nuts with flange	12683	-	-	Mechanical zinc coatings
4036	-	439-1	Hexagon thin nuts	12474	-	912 (FG)	Hex. socket head cap screws FT	-	13811	-	Sheradizing
4161	1661	6923	Hexagon nuts with flange	13337	-	7346	Spring-type straight pins L	15065	-	66	Countersinking
4162	1662, 1665	6922	Hexagon bolts with flange	13918	-	32500	Welding studs for stud welding	15330	-	-	Hydrogen embrittlement.
4762	-	912	Hexagon socket head cap screws	14579...587	-	-	Hex. socket head cap screws	16047	-	946	Torque/clamp force testing
4766	24766	551	Set screws CR	14588, 14589	-	7337	Blind rivets, terms	16048	-	-	Passivation of stainless steel
4775	780, 783	6915	Hexagon nuts (HV)	15071...073	-	-	Hex. bolts with flange, small S	16426	-	-	Fasteners QA system
7040, 7041	-	982, 6924	Prevailing torque type hex. nuts	15480...483	-	7504	Drilling screws				
7042	-	980, 6925	Prevailing torque type hex. nuts	15973...986	-	7337	Blind rivets				
7043	1663/1666	6926	Prevailing locking nuts with flange	16582-585	-	7337	Blind rivets				
7044	1664/1667	6927	Hexagon locking nuts with flange	21269	-	-	Hex. socket head cap screws FT				
7045	-	7985	Raised cheese head screws CR	21670	-	977	Hexagon weld nuts with flange				
7046-1, 2	-	965	Countersunk head screws CR	68	-	13 T 19	Metric screw threads - profile				
7047	-	966	Rcsk. head screws CR	228-1...3	-	259-1...3	Ww head cap pipe thread G				
7048	-	-	Slotted cheese head screws CR	261	-	13-12	Selection of pitch threads CT/FT				
7049	-	7981	Pan head tapping screws CR	262	-	13-13	Thread selection series				
7050	-	7982	Csk. head tapping screws CR	724	-	13	ISO thread: Basic dimensions				
7051	-	7983	Raised countersunk head	965-1...5	-	13-13...15,27	Metric threads, data/principles				
7053	-	6928	Hex. washer head tapping screws	1478	-	7970	Tapping screws thread				
7089	-	125-1,2	Washers, grade A	1502	-	13-16...18	Thread gauges				
7090	-	125-1, 2	Washers, grade B	2901-2904	-	103-1...4	Trapezoidal thread				
7091	-	126	Washers, standard design	5408	-	2244	Thread: Terms				
7092	-	433-1, 2	Scheiben, Reihe klein	6410-1...3	-	27	Threads description in drawing				
7093-1, 2	-	9021	Scheiben, Reihe groß								
7094	-	440	Scheiben, extra groß								

Standard types, relations, publishers:

DIN National German standard (Deutsches Institut für Normung). DIN standards shall still be given for the products/services for which there are no ISO/EN standards and no standardisation necessity.

ISO International Standardization Organisation

DIN ISO National German issue of an unmodified, adopted ISO standard

EN **E**uropean **N**orm (CEN = Comité Européen de Normalisation). In general, existing ISO standards should be adopted as EN standards with the ISO standard number → EN ISO. If this does not happen at European standards levels, independent EN standards shall be generated with EN standard numbers which are different to those of the ISO.

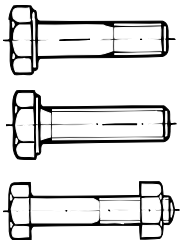
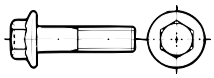
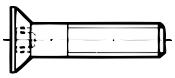
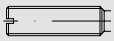
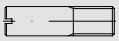
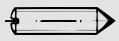
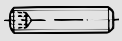
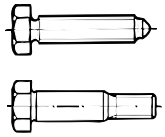
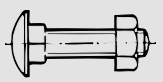
DIN EN National German issue of an unmodified, adopted EN standard.
According to the resolution of the European Council, EN standards are to be adopted unmodified and immediately by the EU member states and the corresponding national standards are to be withdrawn.

EN ISO European standard issue which was adopted unmodified by ISO (EN and ISO standard numbers are identical – the earlier practice of "ISO number + 20,000" has not been in use since Jan. 95. Standards still in use according to this mode are to be converted accordingly). **The description is carried out according to ISO.**

DIN EN ISO National German issue of an unchanged EN standard adopted by ISO. The article naming is done according to ISO.

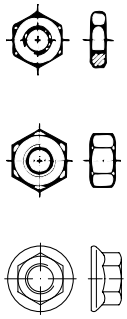
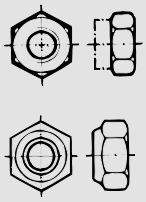
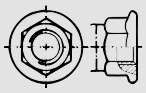
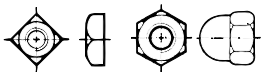
Publisher and author of the standards for "Mechanical fasteners" is the German National Standards Organisation (DIN - Deutsches Institut für Normung e.V.), Berlin, www.fmv.din.de. Reference to the standards sheets from Beuth Verlag GmbH, Burggrafenstrasse 6, 10787 Berlin, www.beuth.de, Fax +030 2601-1260

Table 3: Overview of standards conversion DIN → ISO/EN – Screws/bolts with drive, set screws, screws/bolts without drive

Article group	DIN	→ ISO/EN	Dimension range	Changes	Labelling
1. Screws/bolts, with ISO/EN standards 	**558 931 933 960 961**	**ISO 4018 ISO 4014 ISO 4017 ISO 8765 ISO 8676**	M 10, 12, 14, 22	new ISO wrench sizes	ISO standard numbers
			all other ∅	none = DIN and ISO identical	1. ISO standard numbers 2. DIN standard numbers
	601 Mu with nut DIN 555	**ISO 4016 Mu** with nut ISO 4034	M 10, 12, 14, 22	screws: new ISO wrench sizes nuts: new wrench sizes acc. to ISO + ISO heights	ISO standard number
			other ∅ up to M 39	screws: none = DIN and ISO identical nuts: new ISO heights	1. ISO standard numbers 2. DIN standard numbers
			other ∅ greater than M 39	none = DIN and ISO identical	
	6914	**EN 14399-4**	all ∅	modified calculation of clamping length	EN standard number
	7999	**EN 14399-8**	all ∅	lubrication	
	**912**	**ISO 4762 (CT) ISO 12474 (FT)**	all ∅	none	1. ISO standard number 2. DIN standard number
	**6921**	**EN 1665 (EN 1662 – light series)**	all ∅	marginally increased head heights and wrenching height, property class 12.9 discontinued	ISO standard number
			from M 10	new wrench sizes	
	**7991**	**ISO 10642**	M 22, M 24	dimensions discontinued	
			all other ∅	modified head hights + head ∅- adjusted shaft lengths	ISO standard number
2. Set screws with ISO/EN standards					
	**417**	**ISO 7435**	all ∅	none	1. ISO standard number 2. DIN standard number
	**427**	**ISO 2342**	all ∅	slight differences in slot geometry -> no functional impairment	
	**551**	**ISO 4766**			
	**553**	**ISO 7434**	all ∅	none	
	**913**	**ISO 4026**			
	**914**	**ISO 4027**			
	**915**	**ISO 4028**			
	**916**	**ISO 4029**			
3. Hexagon head screws without ISO/EN standards	**561 564**	**– –**	∅ M 12, 16	new ISO wrench sizes	DIN standard numbers + wrench size specifications
			all other ∅	none	DIN standard numbers
	609 ~ 610	**– –**	∅ M 10, 12, 14, 22	new ISO wrench sizes	DIN standard numbers + wrench size specifications
			all other ∅	none	DIN standard numbers
	**7968 Mu 7990 Mu** with nut DIN 555	screw: – with nut ISO 4034	M 12, (22)	screws: new ISO wrench sizes nuts: new ISO WS + ISO heights	DIN standard numbers + wrench size specifications
			all other ∅	screws: none nuts: new ISO heights	DIN standard numbers
4. Screws/bolts without drive and without ISO/EN standards **– with hexagonal nuts with ISO/EN standards** 	**186/261 Mu 525 Mu 529 Mu 603 Mu 604 Mu 605 Mu 607 Mu 608 Mu 7969 Mu 11014 Mu** with nut DIN 555	screw: – with nut ISO 4034	∅ M 10, 12, 14, 22	screws: none nuts: new ISO WS + ISO heights	DIN standard numbers + wrench size specifications
			all other ∅	screws: none nuts: new ISO heights	DIN standard numbers

① Labelling with ISO and DIN standard numbers are valid for the transition period, later only the ISO standard number will apply.

Table 4: Overview standards conversion DIN → ISO/EN – Hexagon/square nuts
– Hexagon nuts with prevailing torque element

Article group	DIN	→ ISO/EN	Dimension range	Changes	Labelling
1. Hexagon nuts with ISO/EN standards 	**439-1** (A = without chamfer) **439-2** (B = with chamfer)	**ISO 4036** **ISO 4035** = coarse pitch thread **ISO 8675** = fine pitch thread	∅ M 10, 12, 14, 22	new ISO wrench sizes (no height change)	ISO standard number
			all other ∅	none = DIN and ISO identical (no height change)	1. ISO standard number 2. DIN standard numbers
	555 **934** Property classes 6, 8, 10 Property class 12 Property classes 6, 8, 10	**ISO 4034** (ISO type 1) **ISO 4032** = coarse pitch thread (ISO type 1) **ISO 4033** = coarse pitch thread (ISO type 2) **ISO 8673** = fine pitch thread (ISO type 1)	∅ M 10, 12, 14, 22	new ISO WS + ISO heights	ISO standard numbers
			other ∅ M 5 – M 39	new ISO heights (no wrench sizes change)	
			∅ less than M 5 ∅ over M 39	none = DIN and ISO identical	1. ISO standard numbers 2. DIN standard numbers
	6915	**EN 14399-4**	all ∅	without coating = lubricated	EN standard numbers
	6923	**EN 1661**	∅ M 10	new ISO wrench sizes	EN standard numbers
			other ∅	none = DIN and ISO identical	1. EN standard numbers 2. DIN standard numbers
2. Hexagon nuts with prevailing torque element, with ISO/EN standards 	**980** **6925**	**ISO 7042** = coarse pitch thread **ISO 10513** = fine pitch thread	∅ M 10, 12, 14, 22	new ISO wrench sizes (DIN 6925 already includes the new ISO wrench sizes) changed nut heights larger wrenching heights	ISO standard number
			other ∅	changed nut heights larger wrenching heights	ISO standard number
	982	**DIN 6924**	∅ M 10, 12, 14, 22	new ISO wrench sizes changed nut heights	DIN standard number
			other ∅	changed nut heights	DIN standard number
	6924	**ISO 7040** = coarse pitch thread **ISO 10512** = fine pitch thread	all ∅	greater tolerance range for nut heights (DIN ↔ ISO exchangeable)	1. ISO standard numbers 2. DIN standard numbers
	985	**ISO 10511**	∅ M 10, 12, 14	new ISO wrench sizes	ISO standard number
			other ∅	reduced nut heights	ISO standard number
	**6926**	**EN 1663** = coarse pitch thread **EN 1666** = fine pitch thread	∅ M 10	new ISO wrench sizes	EN standard number
			other ∅	none (DIN ↔ EN exchangeable)	1. EN standard numbers 2. DIN standard numbers
	6927	**EN 1664** = coarse pitch thread **EN 1667** = fine pitch thread	∅ M 10	new ISO wrench sizes	EN standard number
			other ∅	none (DIN ↔ EN exchangeable)	1. EN standard numbers 2. DIN standard numbers
3. Nuts without ISO/EN standards 	**557** **917** **935** **986** **1587**	– – – – –	∅ M 10, 12, 14, 22	new ISO wrench sizes	DIN standard numbers + wrench size spezifications
			all other ∅	none	DIN standard numbers

① Comparison of wrench sizes and nut heights DIN : ISO and classification of standards, mechanical properties for steel nuts, see table 5

② Labelling with ISO and DIN standard numbers are valid for the transition period, later only the ISO standard number will apply.

Table 5: Comparison DIN : ISO DIN : ISO – Wrench sizes for screws and nuts with standard wrench sizes – Nut heights

Nominal size d	Wrench size s		Nut height m min. – max.				
(sizes to be avoided as much as possible)	DIN	ISO	DIN 555	DIN 4034 ISO-type 1	DIN 934	ISO 4032 (CT) 8673 (FT) ISO type 1	ISO 4033 (CT) ISO type 2
M 1	2.5		–	–	0.55 – 0.8	–	–
M 1.2	3		–	–	0.75 – 1	–	–
M 1.4	3		–	–	0.95 – 1.2	–	–
M 1.6	3.2		–	–	1.05 – 1.3	1.05 – 1.3	–
M 2	4		–	–	1.35 – 1.6	1.35 – 1.6	–
M 2.5	5		–	–	1.75 – 2	1.75 – 2	–
M 3	5.5		–	–	2.15 – 2.4	2.15 – 2.4	–
(M 3.5)	6		–	–	2.55 – 2.8	2.55 – 2.8	–
M 4	7		–	–	2.9 – 3.2	2.9 – 3.2	–
M 5	8		3.4 – 4.6	4.4 – 5.6	3.7 – 4	4.4 – 4.7	4.8 – 5.1
M 6	10		4.4 – 5.6	4.6 – 6.1	4.7 – 5	4.9 – 5.2	5.4 – 5.7
(M 7)	11		–	–	5.2 – 5.5	–	6.84 – 7.2 *
M 8	13		5.75 – 7.25	6.4 – 7.9	6.14 – 6.5	6.44 – 6.8	7.14 – 7.5
M 10	17	16	7.25 – 8.75	8 – 9.5	7.64 – 8	8.04 – 8.4	8.94 – 9.3
M 12	19	18	9.25 – 10.75	10.4 – 12.2	9.64 – 10	10.37 – 10.8	11.75 – 12
(M 14)	22	21	–	12.1 – 13.9	10.3 – 11	12.1 – 12.8	13.4 – 14.1
M 16	24		12.1 – 13.9	14.1 – 15.9	12.3 – 13	14.1 – 14.8	15.7 – 16.4
(M 18)	27		–	15.1 – 16.9	14.3 – 15	15.1 – 15.8	16.9 – 17.6 *
M 20	30		15.1 – 16.9	16.9 – 19	14.9 – 16	16.9 – 18	19 – 20.3
(M 22)	32	34	17.1 – 18.9	18.1 – 20.2	16.9 – 18	18.1 – 19.4	20.5 – 21.8 *
M 24	36		17.95 – 20.05	20.2 – 22.3	17.7 – 19	20.2 – 21.5	22.6 – 23.9
(M 27)	41		20.95 – 23.05	22.6 – 24.7	20.7 – 22	22.5 – 23.8	25.4 – 26.7 *
M 30	46		22.95 – 25.05	24.3 – 26.4	22.7 – 24	24.3 – 25.6	27.3 – 28.6
(M 33)	50		24.95 – 27.05	27.4 – 29.5	24.7 – 26	27.4 – 28.7	30.9 – 32.5 *
M 36	55		27.95 – 30.05	28 – 31.5	27.4 – 29	29.4 – 31	33.1 – 34.7
(M 39)	60		29.75 – 32.25	31.8 – 34.3	29.4 – 31	31.8 – 33.4	35.9 – 37.5 *
M 42	65		32.75 – 35.25	32.4 – 34.9	32.4 – 34	32.4 – 34	–
(M 45)	70		34.75 – 37.25	34.4 – 36.9	34.4 – 36	34.4 – 36	–
M 48	75		36.75 – 39.25	36.4 – 38.9	36.4 – 38	36.4 – 38	–
(M 52)	80		40.75 – 43.25	40.4 – 42.9	40.4 – 42	40.4 – 42	–
M 56	85		43.75 – 46.25	43.4 – 45.9	43.4 – 45	43.4 – 45	–
(M 60)	90		46.75 – 49.25	46.4 – 48.9	46.4 – 48	46.4 – 48	–
M 64	95		49.5 – 52.5	49.4 – 52.4	49.1 – 51	49.1 – 51	–
Nut height factor Nut heigth m / Nominal thread diameter M	≤ M 4		–	–	0.8	0.8	–
	M 5 – M 39		0.8	0.83 – 1.12		0.84 – 0.93	0.93 – 1.03
	≥ M 42			~ 0.8		0.8	–
Product class			C (roughly)		≤ M 16 = A (medium) > M 16 = B (medium coarse)		
Thread tolerance			7 H		6 H		
Property class Steel	Core range ~ M 5 – M 39		5 (M 16 < d ≤ M 39 = 4.5)		6, 8, 10 (ISO 8673 = Property classes 10 ≤ M 16)		12 (9 – 12)
	≥ M 39		to be agreed upon		to be agreed upon		–
Mechanical properties according to standard			DIN 267-4	ISO 898-2	DIN 267-4	ISO 898 -2 (CT) -6 (FT)	ISO 898-2

Notes: ISO 4032 = also replacement for DIN 970 – CT = Coarse pitch thread ISO 4034 = also replacement for DIN 972
ISO 8673 = also replacement for DIN 971-1 – FT = Fine pitch thread ISO 4033 = also replacement for DIN 971-2 (Fine pitch thread ➔ ISO 8674)

*Values according to the draft standard ISO 4033:2016-05

Table 6: Comparison DIN : ISO – Nuts with prevailing torque element according to DIN 980, DIN 6925, ISO 7042, ISO 10513

Nominal size d	Wrench size s		Nut heigth h min. – max.		Minimum wrenching height m'/m_w	
(sizes to be avoided as much as possible)	DIN 980	DIN 6925 ISO 7042 ISO 10513	DIN 980 DIN 6925	ISO 7042 ISO 10513	DIN 980 DIN 6925	ISO 7042 ISO 10513
M 3	5.5		3.4 – 3.7	–	1.65	–
M 4	7		3.9 – 4.2	–	2.2	–
M 5	8		4.8 – 5.1	4.8 – 5.1	2.75	3.52
M 6	10		5.7 – 6.0	5.4 – 6.0	3.3	3.92
(M 7)	11		6.5 – 7.0	–	3.85	–
M 8	13		7.5 – 8.0	7.14 – 8.00	4.4	5.15
M 10	17	16	9 – 10	8.94 – 10.0	5.5	6.43
M 12	19	18	11 – 12	11.57 – 12.00	6.6	8.30
(M 14)	22	21	12 – 14	13.4 – 14.1	7.7	9.68
M 16	24		14 – 16	15.7 – 16.4	8.8	11.28
(M 18)	27		16 – 18	–	9.9	–
M 20	30		18 – 20	19.0 – 20.3	11	13.52
(M 22)	32	-	20 – 22	–	12.2	–
M 24	36		22 – 24	22.6 – 23.9	13.2	16.16
(M 27)	41		25 – 27	–	14.8	–
M 30	46		28 – 30	27.3 – 30.0	16.5	19.44
(M 33)	50		31 – 33	–	18.2	–
M 36	55		34 – 36	33.1 – 36.1	19.8	23.52
(M 39)	60		37 – 39	–	21.5	–

Table 7: Comparison DIN : ISO – Nuts with prevailing torque element according to DIN 982, DIN 6924, ISO 7040, ISO 10512

Nominal size d	Wrench size s		Nut heigth h min. – max.			Minimum wrenching height m'/m_w	
(sizes to be avoided as much as possible)	DIN 982	DIN 6924 ISO 7040 ISO 10512	DIN 982	DIN 6924	ISO 7040 ISO 10512	DIN 982 DIN 6924	ISO 7040 ISO 10512
M 3	5.5		–	4.2 – 4.5	4.02 – 4.50	1.72	1.72
M 4	7		–	5.7 – 6.0	5.52 – 6.00	2.32	2.32
M 5	8		6.00 – 6.30	6.44 – 6.80	6.22 – 6.80	3.52	3.52
M 6	10		7.70 – 8.00	7.64 – 8.00	7.42 – 8.00	3.92	3.92
(M 7)	11		8.20 – 8.50	8.64 – 9.00	-	4.91	–
M 8	13		9.14 – 9.50	9.14 – 9.50	8.92 – 9.50	5.15	5.15
M 10	17	16	11.14 – 11.50	11.14 – 11.90	11.2 – 11.9	6.43	6.43
M 12	19	18	13.64 – 14.00	14.47 – 14.90	14.2 – 14.9	8.30	8.30
(M 14)	22	21	15.3 – 16.0	16.3 – 17.0	15.9 – 17.0	9.68	9.68
M 16	24		17.3 – 18.0	18.26 – 19.10	17.8 – 19.1	11.28	11.28
(M 18)	27		19.16 – 20.00	19.76 – 20.60	–	12.08	–
M 20	30		20.7 – 22.0	21.5 – 22.8	20.7 – 22.8	13.52	13.52
(M 22)	32	34	23.7 – 25.0	23.2 – 24.5	–	14.48	–
M 24	36		26.7 – 28.0	25.8 – 27.1	25.0 – 27.1	16.16	16.16
(M 27)	41		–	29.4 – 31.0	–	18.00	–
M 30	46		–	31.0 – 32.6	30.1 – 32.6	19.44	19.44
(M 33)	50		–	33.9 – 35.5	–	21.92	–
M 36	55		–	37.3 – 38.9	36.4 – 38.9	23.52	23.52
(M 39)	60		–	40.4 – 42.0	–	25.44	–
M 42	65		–	43.4 – 45.0	–	27.20	–
(M 45)	70		–	46.4 – 48.0	–	28.80	–
M 48	75		–	48.4 – 50.0	–	30.40	–

Table 8: Comparison DIN : ISO – Nuts with prevailing torque element according to DIN 985, ISO 10511

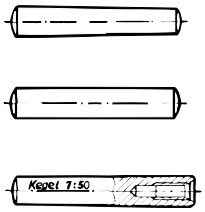
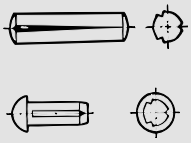
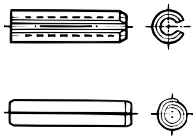
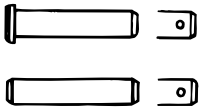
Nominal size d	Wrench size s		Nut heigth h min. – max.		Minimum wrenching height m'/m_w	
(sizes to be avoided as much as possible)	DIN 985	ISO 10511	DIN 985	ISO 10511	DIN 985	ISO 10511
M 3	5.5		3.7 – 4.0	3.42 – 3.90	1.65	1.24
M 4	7		4.7 – 5.0	4.52 – 5.00	2.2	1.56
M 5	8		4.7 – 5.0	4.52 – 5.00	2.75	1.96
M 6	10		5.7 – 6.0	5.52 – 6.00	3.3	2.32
(M 7)	11		7.14 – 7.50	–	3.85	–
M 8	13		7.64 – 8.00	6.18 – 6.76	4.4	2.96
M 10	17	16	9.64 – 10.0	7.98 – 8.56	5.5	3.76
M 12	19	18	11.57 – 12.00	9.53 – 10.23	6.6	4.56
(M 14)	22	21	13.3 – 14.0	10.22 – 11.32	7.7	5.14
M 16	24		15.3 – 16.0	11.32 – 12.42	8.8	5.94
(M 18)	27		17.66 – 18.50	–	9.9	–
M 20	30		18.7 – 20.0	13.1 – 14.9	11	7.28
(M 22)	32	34	20.7 – 22.0	–	12.2	–
M 24	36		22.7 – 24.0	16.0 – 17.8	13.2	8.72
(M 27)	41		25.7 – 27.0	–	14.8	–
M 30	46		28.7 – 30.0	20.1 – 22.2	16.5	11.12
(M 33)	50		31.4 – 33.0	–	18.2	–
M 36	55		34.4 – 36.0	23.4 – 25.5	19.8	13.52
(M 39)	60		37.4 – 39.0	–	21.5	–
M 42	65		40.4 – 42.0	–	23.1	–
(M 45)	70		43.4 – 45.0	–	24.8	–
M 48	75		46.4 – 48.0	–	26.5	–

Overview of standards DIN → ISO: Bolts, pins, washers for bolts

The most important changes are listed in table 9. For some articles, the DIN and ISO versions are identical or the minor changes are hardly relevant to the function at all so that exchangeability is possible.

The conversion is done in an appropriate transition time according to the availability from manufacturing or according to the customer's wishes. Further information on request.

Table 9

Article group	DIN	ISO DIN ISO DIN EN ISO	The most important changes
Taper pins, parallel pins 	1	2339	length l new according to ISO **incl.** round end (previously according to DIN **excl.** round end)
	7	2338	length l new according to ISO **incl.** round end (previously according to DIN **excl.** round end) types A, B, C (type A/tol. m 6 new with chamfer/round end)
	6325	8734	new: type A with chamfer/round end, fully hardened (for the most part identical with DIN 6325) type B with champfer, case hardened
	7977 7978	8737 8736	no serious changes
	7979/D	8733 8735	DIN 7979/C ~ ISO 8733 [unhardened] DIN 7979/D ~ ISO 8735/A [fully hardened], lower hardness for ISO
Grooved pins 	1470 1471 1472 1473 1474 1475	8739 8744 8745 8740 8741 8742	length l new according to ISO **incl.** round end (previously according to DIN **excl.** round end)
	–	8743	new: grooved pins, half-length centre grooved
	1476 1477	8746 8747	type A = no serious changes additional: type B with pilot end
Spring-type straight pin	1481	8752	regular finish to ∅ of m 8 mm with 2 chamfers (previously to a ∅ of m 6 mm)
	7343 7344 7346	8750 8748 13337	no serious changes
	– –	8749 8751	new: pins, grooved pins: shear test new: spring-types straight pin, light duty
Split pin 	94	1234	no serious changes
Clevis pin 	1443 1444	2340 2341	partially other nominal lengths length tolerances changed
	1433 1434 1435 1436	– – – –	these DIN standards were withdrawn ISO standards are not planned
Washers for pins 	1440	8738	Some outer ∅ and thicknesses changed (in general not in danger of being replaced)
	1441	–	no ISO standard planned

Overview of standards conversion DIN → ISO: Thread srews and tapping screws

ISO standards for thread screws and tapping screws include the following changes different to DIN standards:

– new countersunk angle for tapping screws with countersunk/raised countersunk head = 90° according to DIN 66/ISO 7721 (previously 80°)

– tapping screws: cancellation of diameter ST 3.9

– partial changes to the head dimensions

The tables show the standard numbers change DIN : ISO (Tab. 10) and head dimension changes DIN : ISO (Tab. 11–13)

Table 10: Standard numbers change DIN : ISO

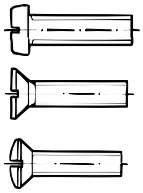
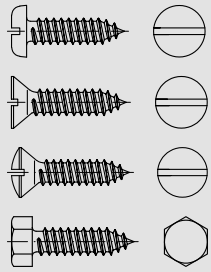
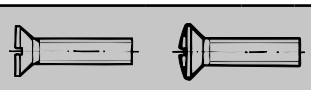
Article group	DIN	ISO	The most important changes
Thread screws 	84	1207	no serious changes
	85	1580	no serious changes
	963	2009	minor differences in head height and head diameter (see Table 11)
	964	2010	
	965	7046-1, -2	
	966	7047	
	7985	7045	no serious changes
Tapping screws 	7971	1481	no serious changes
	7972	1482	changed countersunk angle (DIN = 80° : ISO = 90°) minor differences in head height and head diameter (see Table 12)
	7973	1483	
	7976	1479	minor differences in the head height – no risk of being replaced (see Table 13)
	7981	7049	no serious changes
	7982	7050	changed countersunk angle (DIN = 80° : ISO = 90°) minor differences in head height and head diameter (see Table 12)
	7983	7051	

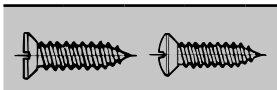
Table 11: Slotted and cross recessed countersunk head screws with metric thread



Metric screws
ISO 2009, 2010, 7046, 7047
DIN 963, 964, 965, 966

	Thread	M 1.6	M 2	M 2.5	M 3	M 3.5	M 4	M 5	M 6	M 8	M 10
max. Diameter of head	ISO (new)	3	3.8	4.7	5.5	7.3	8.4	9.3	11.3	15.8	18.3
	DIN (old)	3	3.8	4.7	5.6	6.5	7.5	9.2	11	14.5	18
max. Head height	ISO (new)	1	1.2	1.5	1.65	2.35	2.7	2.7	3.3	4.65	5
	DIN (old)	0.96	1.2	1.5	1.65	1.93	2.2	2.5	3	4	5

Table 12: Countersunk head tapping screws



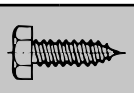
Tapping screws
ISO 1482, 1483, 7050, 7051 (⊰ = 90°)
DIN 7972, 7973, 7982, 7983 (⊰ = 80°)

ST 2.2	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3	ST 8	ST 9.5
3.8	5.5	7.3	–	8.4	9.3	10.3	11.3	15.8	18.3
4.3	5.5	6.8	7.5	8.1	9.5	10.8	12.4	–	–
1.1	1.7	2.35	–	2.6	2.8	3	3.15	4.65	5.25
1.3	1.7	2.1	2.3	2.5	3	3.4	3.8	–	–

Note on countersunk head screws with metric threading

When countersinking according to ISO 15065 (for ISO countersunk heads) screws can also be used according to DIN 963 – 966.
These merely lie a little deeper in the countersink.
If the countersink is executed according to the withdrawn DIN 74-1:1980, a protrusion may, under certain circumstances, be visible when using ISO countersunk heads above the component part (especially with the diameters M 3.5, M 4 and M 8).

Table 13: Hexagon head tapping screws



Tapping screws ISO 1479 DIN 7976

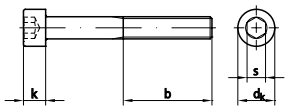
Thread		ST 2.2	ST 2.9	ST 3.5	(ST 3.9)	ST 4.2	ST 4.8	(ST 5.5)	ST 6.3	ST 8	ST 9.5
max. head height	ISO (new)	1.6	2.3	2.6	–	3	3.8	4.1	4.7	6	7.5
	DIN (old)	1.42	1.62	2.42	2.42	2.92	3.12	4.15	4.95	5.95	–

Hexagon and hexalobular socket screws

ISO 4762, 12474

similar DIN 912

Hexagon socket head cap screws
ISO 12474 with metric fine pitch thread



Dimensions	M 1,4	M 1,6	M 2	M 2,5	M 3	M 4	M 5	M 6	M 8
d_k	2,6	3	3,8	4,5	5,5	7	8,5	10	13
k	1,4	1,6	2	2,5	3	4	5	6	8
s	1,3	1,5	1,5	2	2,5	3	4	5	6
b	14	15	16	17	18	20	22	24	28

Dimensions	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24	M 27
d_k	16	18	21	24	27	30	33	36	40
k	10	12	14	16	18	20	22	24	27
s	8	10	12	14	14	17	17	19	19
b	32	36	40	44	48	52	56	60	66

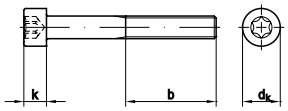
Dimensions	M 30	M 33	M 36	M 39*	M 42	M 48	M 56		
d_k	45	50	54	58	63	72	84		
k	30	33	36	39	42	48	56		
s	22	24	27	27	32	36	41		
b	72	78	84	90	96	108	124		

*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 286, pg. 395, pg. 115 | Stainless steel: pg. 547, pg. 477

ISO 14579

Hexalobular socket head cap screws



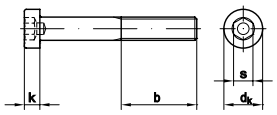
Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8
d_k	3.8	4.5	5.5	7	8.5	10	13
k	2	2.5	3	4	5	6	8
ISR	T6	T8	T10	T20	T25	T30	T45
b	16	17	18	20	22	24	28

Dimensions	M 10	M 12	M 14	M 16	M 18	M 20	
d_k	16	18	21	24	27	30	
k	10	12	14	16	18	20	
ISR	T50	T55	T60	T70	T80	T90	
b	32	36	40	44	48	52	

Dimensions in stock:
Steel/Steel coated: pg. 402

DIN 6912

Hexagon socket head cap screws, low head, with centre



Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
d_k	7	8,5	10	13	16	18
k	2,8	3,5	4	5	6,5	7,5
s	3	4	5	6	8	10
b^1	14	16	18	22	26	30
b^2	–	–	–	–	32	36
b^3	–	–	–	–	–	–

Dimensions	M 14	M 16	M 20	M 24	M 30	M 36
d_k	21	24	30	36	45	54
k	8,5	10	12	14	17,5	21,5
s	12	14	17	19	22	27
b^1	34	38	46	54	66	78
b^2	40	44	52	60	72	84
b^3	–	57	65	73	85	97

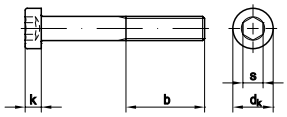
b^1 for l ≤ 125 mm
b^2 for 125 mm
b^3 for l > 200mm

Dimensions in stock:
Steel/Steel coated: pg. 317 | Stainless steel: pg. 555

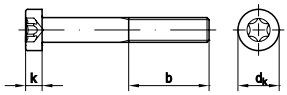
Hexagon and hexalobular socket screws

DIN 7984

Hexagon or hexalobular socket head cap screws with low head



with hexagon socket



with hexalobular socket
~ISO 14580

b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm
b^3 for l > 200 mm

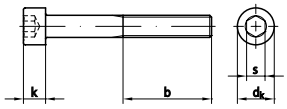
Dimensions	M 3	M 4	M 5	M 6	M 8
d_k	5.5	7	8.5	10	13
k	2	2.5	3.5	4	5
s	2	2.5	3	4	5
ISR size	T10	T20	T25	T30	T40
b^1	12	14	16	18	22
b^2	–	–	–	–	28
b^3	–	–	–	–	–

Dimensions	M 10	M 12	M 16	M 20	M 24
d_k	16	18	24	30	36
k	6	7	9	11	13
s	7	8	12	14	17
ISR size	–	–	–	–	–
b^1	26	30	38	46	54
b^2	32	36	44	52	60
b^3	–	–	57	65	73

Dimensions in stock:
Steel/Steel coated: pg. 362 | Stainless steel: pg. 579

ASME B 18.3

Hexagon socket head cap screws* with unified inch thread



all dimensions in inches
*acc. to ASME B 18.3: 2003 table 1A

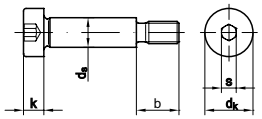
Dimensions	#2	#4	#5	#6	#8	#10	1/4	5/16
d	0.086	0.112	0.125	0.138	0.164	0.190	0.250	0.3125
d_k	0.140	0.183	0.205	0.226	0.270	0.312	0.375	0.469
k	0.086	0.112	0.125	0.138	0.164	0.190	0.250	0.312
s	5/64	3/32	3/32	7/64	9/64	5/32	3/16	1/4
b	0.62	0.75	0.75	0.75	0.88	0.88	1.00	1.12

Dimensions	3/8	1/2	5/8	7/8	1	1 1/4	1 1/2	
d	0.375	0.500	0.625	0.875	1.000	1.250	1.500	
d_k	0.562	0.750	0.938	1.312	1.500	1.875	1.250	
k	0.375	0.500	0.625	0.875	1.000	1.250	1.500	
s	5/16	3/8	1/2	3/4	3/4	7/8	1	
b	1.25	1.50	1.75	2.25	2.50	3.12	3.75	

Dimensions in stock:
Steel/Steel coated: pg. 415

ISO 7379

Hexagon socket head shoulder screws



*adjusting shank tolerance:
• steel h8 or f9
• stainless steel f9
**on stock ∅12, standard value ∅13
***not standardized dimensions

Dimensions	M 5	M 6	M 8
d_k	10	13	16
d_s*	6***	8	10
k	4.5	5.5	7
s	3	4	5
b	9.75	11.25	13.25

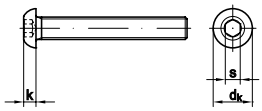
Dimensions	M 10	M 12	M 16
d_k	18	24	30
d_s*	12**/13	16	20
k	9	11	14
s	6	8	10
b	16.4	18.4	22.4

Dimensions in stock:
Steel/Steel coated: pg. 342 | Stainless steel: pg. 572

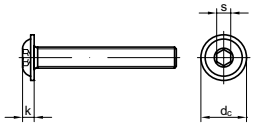
Hexagon and hexalobular socket screws

ISO 7380 -1/-2

Hexagon socket button head screws



ISO 7380-1



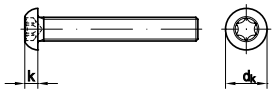
ISO 7380-2

Dimensions	M 3	M 4	M 5	M 6
$d_{k\ max.}$	5.7	7.6	9.5	10.5
$d_{c\ max.}$	6.9	9.4	11.8	13.6
$k_{max.}$	1.65	2.2	2.75	3.3
s	2	2.5	3	4

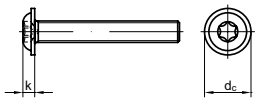
Dimensions	M 8	M 10	M 12	M 16
$d_{k\ max.}$	14	17.5	21	28
$d_{c\ max.}$	17.8	21.9	26	34
$k_{max.}$	4.4	5.5	6.6	8.8
s	5	6	8	10

DIN 34805 -1/-2

Hexalobular socket button head screws



DIN 34805-1



DIN 34805-2

Dimensions	M 3	M 4	M 5	M 6
$d_{k\ max.}$	5.7	7.6	9.5	10.5
$d_{c\ max.}$	6.9	9.4	11.8	13.6
$k_{max.}$	1.8	2.45	3	3.3
ISR	10	20	25	30

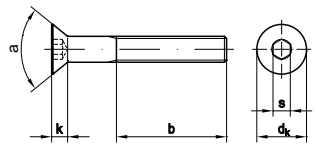
Dimensions	M 8	M 10	M 12	M 16
$d_{k\ max.}$	14	17.5	21	-
$d_{c\ max.}$	17.8	21.9	26	-
$k_{max.}$	4.5	5.5	6.6	-
ISR	45	50	55	-

Dimensions in stock:
Steel/Steel coated: pg. 342 | **Stainless steel:** pg. 572

ISO 10642

replaces DIN 7991

Hexagon socket countersunk head screws



with hexagon

dimensions for countersinks ➔ DIN 74
*dimensions acc. to DIN 7991

Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
d_k	6.72	8.96	11.2	13.44	17.92	22.4
$k_{max.}$	1.86	2.48	3.1	3.72	4.96	6.2
s	2	2,5	3	4	5	6
a	90°	90°	90°	90°	90°	90°
b	18	20	22	24	28	32

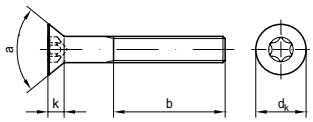
Dimensions	M 12	M 14	M 16	M 20	M 22*	M 24*
d_k	26.88	30.8	33.6	40.32	36	39
$k_{max.}$	7.44	8.4	8.8	10.16	13.1	14
s	8	10	10	12	14	14
a	90°	90°	90°	90°	60°	60°
b	36	40	44	52	56	60

Dimensions on stock:
Steel/Steel coated: pg. 389 | **Stainless steel:** pg. 587

Hexagon and hexalobular socket screws

ISO 14581

Hexalobular socket countersunk head screws



Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8
d_k	4.4	5.5	6.3	9.4	10.4	12.6	17.3
$k_{max.}$	1.2	1.5	1.65	2.7	2.7	3.3	4.65
ISR	6	8	10	20	25	30	45
a	90°	90°	90°	90°	90°	90°	90°
b	25	25	25	38	38	38	38

Dimensions for countersinks ➔ DIN 74

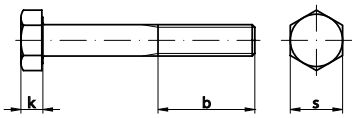
Dimensions in stock:
Steel/Steel coated: pg. 403 | **Stainless steel:** pg. 589

Hexagon screws/bolts

ISO 4014, 8765
Article 89601

replaces DIN 931, 960, 601

Hexagon head bolts with socket
ISO 8765/DIN 960 with fine pitch thread



Dimensions	M 3	M 4	M 5	M 6	M 7	M 8	M 10	M 12	M 14
$s_{ISO/DIN}$	5.5	7	8	10	11	13	16/17	18/19	21/22
k	2	2.8	3.5	4	4.8	5.3	6.4	7.5	8.8
b^1	12	14	16	18	20	22	26	30	34
b^2	–	–	22	24	26	28	32	36	40
b^3	–	–	–	–	–	–	45	49	53

Dimensions	M 16	M 18	M 20	M 22	M 24	M 27	M 30	M 33	M 36
$s_{ISO/DIN}$	24	27	30	34/32	36	41	46	50	55
k	10	11.5	12.5	14	15	17	18.7	21	22.5
b^1	38	42	46	50	54	60	66	72	78
b^2	44	48	52	56	60	66	72	78	84
b^3	57	61	65	69	73	79	85	91	97

Dimensions	M 39	M 42	M 45	M 48	M 52	M 56	M 64		
$s_{ISO/DIN}$	60	65	70	75	80	85	95		
k	25	26	28	30	33	35	40		
b^1	84	90	96	102	–	–	–		
b^2	90	96	102	108	116	124	140		
b^3	103	109	115	121	129	137	153		

b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm
b^3 for l > 200 mm
Article 89601: CE acc. to EN 14592
(M 12, 16, 20, 24)

Dimensions in stock:
Steel/Steel coated: pg. 236, pg. 384, pg. 143, pg. 182, pg. 100 | **Stainless steel:** pg. 529, pg. 486 | **Non-ferrous materials:** pg. 636, pg. 625

ISO 4017, 8676

replaces DIN 933, 961

Hexagon head screws with thread up to head
ISO 8676/DIN 961 with fine pitch thread

Dimensions	M 3	M 4	M 5	M 6	M 7	M 8	M 10	M 12
$s_{ISO/DIN}$	5.5	7	8	10	11	13	16/17	18/19
k	2	2.8	3.5	4	4.8	5.3	6.4	7.5
$a_{max.}$	1.5	2.1	2.4	3	3	3.75	4.5	5.25

Dimensions	M 14	M 16	M 18	M 20	M 22	M 24	M 27	M 30
$s_{ISO/DIN}$	21/22	24	27	30	34/32	36	41	46
k	8.8	10	11.5	12.5	14	15	17	18.7
$a_{max.}$	6	6	7.5	7.5	7.5	9	9	10.5

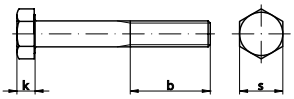
Dimensions	M 33	M 36	M 39	M 42	M 45	M 48		
$s_{ISO/DIN}$	50	55	60	65	70	75		
k	21	22.5	25	26	28	30		
$a_{max.}$	10.5	12	12	13.5	13.5	15		

Dimensions in stock:
Steel/Steel coated: pg. 254, pg. 372, pg. 156, pg. 184 | **Stainless steel:** pg. 534, pg. 490 | **Non-ferrous materials:** pg. 636, pg. 625

Hexagon screws/bolts

ASME B 18.2.1

Hex cap screws*



short dimensions with shank
long dimensions with shank

Dimensions	1/4	5/16	3/8	7/16	1/2	5/8
s	7/16	1/2	9/16	5/8	3/4	15/16
k	5/32	13/64	15/64	9/32	5/16	25/64
b^1	0.750	0.875	1.000	1.125	1.250	1.500
b^2	1.000	1.125	1.250	1.375	1.500	1.750

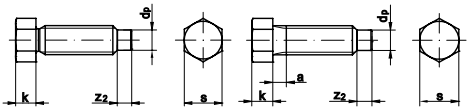
Dimensions	3/4	7/8	1	1 1/4	1 1/2	
s	1 1/8	1 5/16	1 1/2	1 7/8	2 1/4	
k	15/32	35/64	39/64	25/32	15/16	
b^1	1.750	2.000	2.250	2.750	3.250	
b^2	2.000	2.250	2.500	3.000	3.500	

all dimensions in inches
*acc. to ASME B 18.2.1: 2010 table 6,
b^1 for length 2 for length > 6 inch

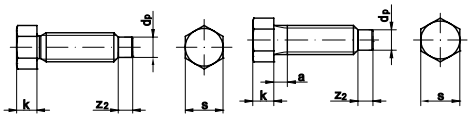
Dimensions in stock:
Steel/Steel coated: pg. 410, pg. 412

DIN 561, 564

Hexagon head set screws with small hexagon and dog point or short dog point



DIN 561 type A = with thread undercut
DIN 561 type B = with thread run-cut



DIN 564 type A = with thread undercut
DIN 564 type B = with thread run-cut

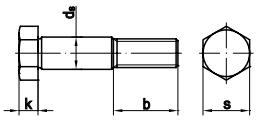
Dimensions	M 6	M 8	M 10	M 12
k	5	6	7	9
s	8	10	13	16
a (type B)	2.5	3	4	4
z_2	3	4	5	6
d_p	4	5.5	7	8.5

Dimensions	M 16	M 20	M 24	M 30
k	11	14	17	21
s	18	24	30	36
a (type B)	4.5	6	7	7.5
z_2	8	10	12	15
d_p	12	15	18	23

Dimensions in stock:
Steel/Steel coated: pg. 95, pg. 97

DIN 609

Hexagon fit bolts with long thread



*adjusting shank tol. k6 for drill tol. H7
b^1 for l ≤ 50 mm
b^2 for 50 mm 3 for l > 150mm
b^3 for l > 150 mm

Dimensions	M 8	M 10	M 12	M 14	M 16
k	5.3	6.4	7.5	8.8	10
s	13	16	18	21	24
d_s*	9	11	13	15	17
b^1	14.5	17.5	20.5	22	25
b^2	16.5	19.5	22.5	24	27
b^3	21.5	24.5	27.5	29	32

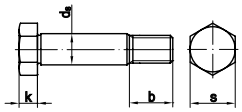
Dimensions	M 20	M 24	M 30	M 36	
k	12.5	15	19	22	
s	30	36	46	55	
d_s*	21	25	32	38	
b^1	28.5	-	-	-	
b^2	30.5	36.5	43	49	
b^3	35.5	41.5	48	54	

Dimensions in stock:
Steel/Steel coated: pg. 107

Hexagon screws/bolts

DIN 610

Hexagon fit bolts with short thread



*adjusting shank tol. k6 for drill tol. H7
b^1 for l ≤ 50 mm
b^2 for l ≤ 150 mm
b^3 for l > 150 mm

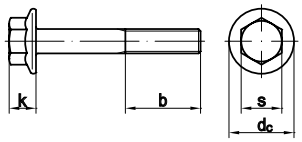
Dimensions	M 8	M 10	M 12	M 14	M 16
k	5.3	6.4	7.5	8.8	10
s	13	16	18	21	24
d_s*	9	11	13	15	17
b^1	11.5	13.5	15.5	17	19
b^2	13.5	15.5	17.5	19	21
b^3	18.5	20.5	22.5	24	26

Dimensions	M 20	M 24	M 30	M 36	
k	12.5	15	19	22	
s	30	36	46	55	
d_s*	21	25	32	38	
b^1	22.5	25.5	-	-	
b^2	24.5	28.5	34	40	
b^3	29.5	33.5	39	45	

Dimensions in stock:
Steel/Steel coated: pg. 108

EN 1665

replaces DIN 6921
Hexagon flange bolts, heavy series



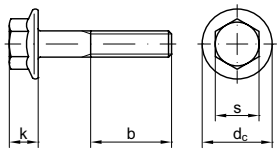
b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm
b^3 for l > 200 mm

Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
$k_{EN/DIN}$	5.8/5.4	6.6/6.6	8.1/8.1	10.4/9.2	11.8/11.5	15.4/14.4
$s_{EN/DIN}$	8/8	10/10	13/13	16/15	18/16	24/21
d_c	11.58	14.2	18	22.3	26.6	35
b^1	16	18	22	26	30	38
b^2	-	-	28	32	36	44
b^3	-	-	-	-	-	57

Dimensions in stock:
Steel/Steel coated: pg. 223, pg. 320 | Stainless steel: pg. 521, pg. 557

Article 10105

Hexagon head bolts with flange acc. to MBN 10105



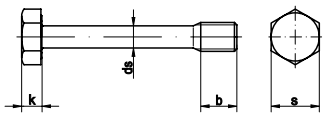
up to length 80 thread to head

Dimensions	M 10	M 12 x 1.5	M 14 x 1.5	M 16 x 1.5
$k_{max.}$	9.2	11.5	12.8	14.4
s	16	18	21	24
$d_{c\ max.}$	21.8	26	29.9	34.5
b	80	80	80	80

Dimensions in stock:
Steel/Steel coated: pg. 388

~DIN 7964

Bolts with waisted shank
type D1 = hexagon head acc. to ISO 4014, with short thread



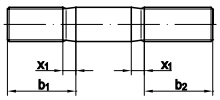
Dimensions	M 8	M 10
s	13	16
k	5.3	6.4
$d_{s\ min.}$	6	7.5
b	10	12.5

Dimensions in stock:
Stainless steel: pg. 574

Studs

DIN 835

Studs



screwed-in end ≈ 2 d
b_1 = screwed-in end
b_2 = nut end

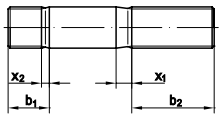
b_2^1 for l ≤ 125 mm
b_2^2 for l ≤ 200 mm
b^3 for l > 200 mm

Dimensions	M 6	M 8	M 10	M 12	M 16
b^1	12	16	20	24	32
x_1	2.5	3.2	3.8	4.3	5.0
b_2^1	18	22	26	30	38
b_2^2	24	28	32	36	44
b_2^3	-	-	45	49	57

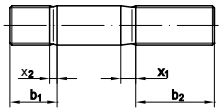
Dimensions in stock:
Steel/Steel coated: pg. 112 | Stainless steel: pg. 476

DIN 938, 939

Studs



DIN 938 = with screwed-in end ≈ 1 d



DIN 939 = with screwed-in end ≈ 1,25 d

b_1 = screwed-in end
b_2 = nut end

b_2^1 for l ≤ 125 mm
b_2^2 for l ≤ 200 mm
b^3 for l > 200 mm

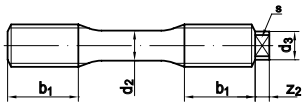
Dimensions	M 5	M 6	M 8	M 10	M 12	M 14
$b_{1\ (DIN\ 938)}$	5	6	8	10	12	14
$b_{1\ (DIN\ 939)}$	6.5	7.5	10	12	15	18
x_1	2	2.5	3.2	3.8	4.3	5
x_2	1	1.25	1.6	1.9	2.2	2.5
b_2^1	16	18	22	26	30	34
b_2^2	22	24	28	32	36	40
b_2^3	-	-	-	45	49	53

Dimensions	M 16	M 20	M 24	M 27	M 30	
$b_{1\ (DIN\ 938)}$	16	20	24	27	30	
$b_{1\ (DIN\ 939)}$	20	25	30	35	38	
x_1	5	6.3	7.5	7.5	9	
x_2	2.5	3.2	3.8	3.8	4.5	
b_2^1	38	46	54	60	66	
b_2^2	44	53	60	66	72	
b_2^3	57	65	73	79	85	

Dimensions in stock:
Steel/Steel coated: pg. 177, pg. 179 | Stainless steel: pg. 498, pg. 499

DIN 2510

Bolts with waisted shank
type L = with long thread



Dimensions	M 12	M 16	M 20	M 22	M 24
d_2	8.5	12	15	16.5	18
d_3	8	12	14	14	14
b^1	20	23	28	30	32
z_2	4	5	6	6	6
s	7	10	11	11	11

Dimensions	M 27	M 30	M 33	M 36	M 39
d_2	20.5	23	25.5	27.5	30.5
d_3	18	18	25	25	28
b^1	35	39	42	45	48
z_2	6	6	9	9	10
s	13	13	22	22	24

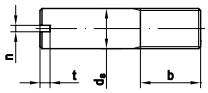
Dimensions in stock:
Steel/Steel coated: pg. 232

Set screws/grub screw

ISO 2342

similar DIN 427

Slotted headless screws with shank



Dimensions	M 3	M 4	M 5	M 6
d_s	3	4	5	6
b*	3.6	4.8	6	7.2
n	0.4	0.6	0.8	1
t	0.8	1.12	1.28	1.6

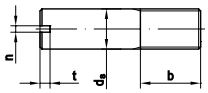
Dimensions	M 8	M 10	M 12	
d_s	8	10	12	
b*	9.6	12	14	
n	1.2	1.6	2	
t	2	2.4	2.8	

Dimensions in stock:
Steel/Steel coated: pg. 232, pg. 79 | Stainless steel: pg. 527, pg. 465

ISO 7435

similar DIN 417

Slotted headless screws with shank



Dimensions	M 3	M 4	M 5	M 6
d_p	2	2.5	3.5	4
z	1.5	2	2.5	3
n	0.4	0.6	0.8	1
t	0.8	0.96	1.12	1.28

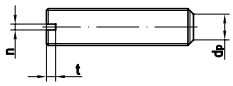
Dimensions	M 8	M 10	M 12	
d_p	5.5	7	8.5	
z	4	5	6	
n	1.2	1.6	2	
t	1.6	2	2.4	

Dimensions in stock:
Steel/Steel coated: pg. 345, pg. 79

ISO 4766

similar DIN 551

Slotted grub screws with flat point



Dimensions	M 1.6	M 2	M 2.5	M 3	M 4
n	0.25	0.25	0.4	0.4	0.6
t	0.56	0.64	0.72	0.8	1.12
d_p	0.8	1	1.5	2	2.5

Dimensions	M 5	M 6	M 8	M 10	M 12*
n	0.8	1	1.2	1.6	2
t	1.28	1.6	2	2.4	2.8
d_p	3.5	4	5.5	7	8.5

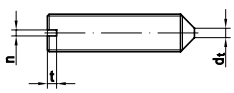
*dimensions acc. to DIN 551: 1956-04

Dimensions in stock:
Steel/Steel coated: pg. 305, pg. 93 | Stainless steel: pg. 552, pg. 470 | Non-ferrous materials: pg. 638, pg. 620

ISO 7434

similar DIN 553

Slotted grub screws with cone point



Dimensions	M 1.6	M 2	M 2.5	M 3	M 4
n	0.25	0.25	0.4	0.4	0.6
t	0.56	0.64	0.72	0.8	1.12
$d_{t\ max.}$	0.16	0.2	0.25	0.3	0.4

Dimensions	M 5	M 6	M 8	M 10	
n	0.8	1	1.2	1.6	
t	1.28	1.6	2	2.4	
$d_{t\ max.}$	0.5	1.5	2	2.5	

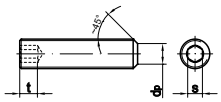
Dimensions in stock:
Steel/Steel coated: pg. 345, pg. 94 | Stainless steel: pg. 573, pg. 471 | Non-ferrous materials: pg. 641, pg. 621

Set screws/grub screw

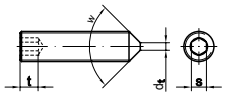
ISO 4026, 4027

similar DIN 913, 914

Hexagon socket set screws, with flat point or cone point
screws only for pressure load, hardness class 45H



ISO 4026, DIN 913 = with flat point



ISO 4027, DIN 914 = with cone point

t_1 for l above the dashed step line with angle $W_{DIN\ 914}$ = 120°
t_2 for below the dashed step line with angle $W_{DIN\ 914}$ = 90°

➔ step line see product standard

Dimensions	M 1.6	M 2	M 2.5	M 3	M 4
s	0.7	0.9	1.3	1.5	2
$d_{p\ max.}/d_{t\ max.}$	0.8	1	1.5	2	2.5
t_1	0.7	0.8	1.2	1.2	1.5
t_2	0.5	0.7	2	2	2.5

Dimensions	M 5	M 6	M 8	M 10	M 12
s	2.5	3	4	5	6
$d_{p\ max.}/d_{t\ max.}$	3.5	4	5.5	7	8.5
t_1	2	2	3	4	4.8
t_2	3	3.5	5	6	8

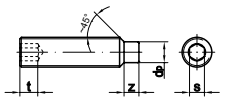
Dimensions	M 14	M 16	M 20	M 24	
s	6	8	10	12	
$d_{p\ max.}/d_{t\ max.}$	10	12	15	18	
t_1	5.6	6.4	8	10	
t_2	9	10	12	15	

Dimensions in stock:
Steel/Steel coated: pg. 272, pg. 274, pg. 134, pg. 137 | Stainless steel: pg. 541, pg. 542, pg. 481, pg. 482

ISO 4028

similar DIN 915

Hexagon socket set screws with full dog point



z_1 and t_1 for above dashed step line
z_2 and t_2 for below the dashed step line

➔ step line see product standard
*dimensions acc. to DIN 915

Dimensions	M 2*	M 3	M 4	M 5	M 6	M 8
s	0.9	1.5	2	2.5	3	4
$z_{1\ max.\ (kurz)}$	0.75	1	1.25	1.5	1.75	2.25
t_1	0.8	1.2	1.5	2	2	3
d_p	1	2	2.5	3.5	4	5.5
$z_{2\ max.\ (lang)}$	1.25	1.75	2.25	2.75	3.25	4.3
t_2	1.7	2	2.5	3	3.5	5

Dimensions	M 10	M 12	M 14	M 16	M 20	M 24
s	5	6	6	8	10	12
$z_{1\ max.\ (kurz)}$	2.75	3.25	3.8	4.3	5.3	6.3
t_1	4	4.8	5.6	6.4	8	10
d_p	7	8.5	10	12	15	18
$z_{2\ max.\ (lang)}$	5.3	6.3	7.36	8.36	10.36	12.43
t_2	6	8	9	10	12	15

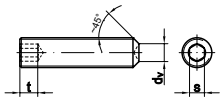
Dimensions in stock:
Steel/Steel coated: pg. 275, pg. 138 | Stainless steel: pg. 543, pg. 483

Set screws/grub screw

ISO 4029

similar DIN 916

Hexagon socket set screws with cup point



t_1 for l above the dashed step line
t_2 for l below the dashed step line

➔ step line see product standard

Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8
s	0.9	1.3	1.5	2	2.5	3	4
$d_{v\ max.}$	1	1.2	1.4	2	2.5	3	5
t_1	0.8	1.2	1.2	1.5	2	2	3
t_2	1.7	2	2	2.5	3	3.5	5

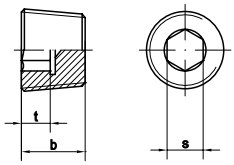
Dimensions	M 10	M 12	M 14	M 16	M 20	M 24	
s	5	6	6	8	10	12	
$d_{v\ max.}$	6	8	9	10	14	16	
t_1	4	4.8	5.6	6.4	8	10	
t_2	6	8	9	10	12	15	

Dimensions in stock:
Steel/Steel coated: pg. 277, pg. 139 | Stainless steel: pg. 543, pg. 484

Screw plugs/pipe plugs

DIN 906

Hexagon socket pipe plugs with taper thread



Dimensions	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
s	4	5	6	7	8	8	10	10	12
$t_{min.}$	4	4	5	5	5	5	5	5	6
b*	8	8	10	10	10	10	10	10	12

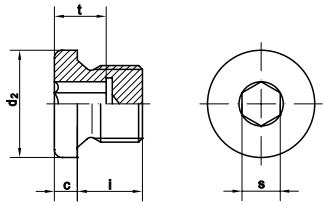
Dimensions	M 26	M 27	M 30	M 33	M 36	M 38	M 42	R 1/8	R 1/4
s	12	12	17	17	19	19	22	5	7
$t_{min.}$	6	6	6	6	7.5	7.5	11.5	4	5
b*	12	12	12	12	15	15	18	8	10

Dimensions	R 3/8	R 1/2	R 3/4	R 1	R 1 1/4	R 1 1/2	R 1 3/4	R 2	
s	8	10	12	17	22	24	32	32	
$t_{min.}$	5	5	6	6	11.5	11.5	13	13	
b*	10	10	12	12	18	20	22	22	

Dimensions in stock:
Steel/Steel coated: pg. 112 | Stainless steel: pg. 476 | Non-ferrous materials: pg. 624

DIN 908

Hexagon socket screw plugs with cylindrical thread



Dimensions	M 8x1*	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5
s	5	5	6	6	8	8	10
$t_{min.}$	2.4	5	7	7	7.5	7.5	7.5
d_2	12	14	17	19	21	23	25
c	3	3	3	4	3	4	4
i	8	8	12	12	12	12	14

Dimensions	M 22x1.5	M 24x1.5	M 26x1.5	M 27x2	M 30x1.5	M 30x2	M 33x2
s	10	12	12	12	17	17	17
$t_{min.}$	7.5	7.5	9	9	9	9	9
d_2	27	29	31	32	36	36	39
c	4	4	4	4	4	4	5
i	14	14	16	16	16	16	16

Dimensions	M 36x1.5	M 36x2	M 38x1.5	M 42x1.5	M 45x1.5	M 48x1.5	M 52x1.5
s	19	19	19	22	22	24	24
$t_{min.}$	10.5	10.5	10.5	10.5	10.5	10.5	10.5
d_2	42	42	42	49	52	55	60
c	5	5	5	5	5	5	5
i	16	16	16	16	16	16	16

Dimensions	M 52x2	M 56x2	M 64x2	G 1/8 A	G 1/4 A	G 3/8 A	G 1/2 A
s	32	32	32	5	6	8	10
$t_{min.}$	10.5	14	14	5	7	7.5	7.5
d_2	64	72	72	14	12	22	26
c	5	5	5	3	3	3	4
i	16	20	20	8	12	12	14

Dimensions	G 3/4 A	G 1 A	G 1 1/8 A	G 1 1/4 A	G 1 1/2 A	G 1 3/4 A	G 2 A
s	12	17	19	22	24	32	32
$t_{min.}$	9	9	10.5	10.5	10.5	14	14
d_2	32	39	44	49	55	62	68
c	4	5	5	5	5	5	5
i	16	16	16	16	16	20	20

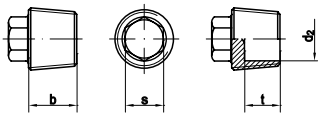
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 113 | Stainless steel: pg. 476 | Non-ferrous materials: pg. 624

Screw plugs/pipe plugs

DIN 909

Hexagon head pipe plugs with taper thread



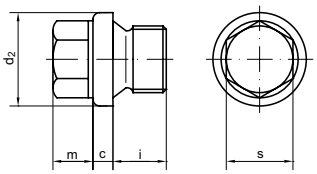
Dimensions	M 16x1,5	M 18x1,5	M 24x1,5	M 30x1,5	R 1/8
b*	10	10	12	12	8
d_2	-	-	16	20	-
s	10	10	17	19	7
t	-	-	7	7	-

Dimensions	R 1/4	R 3/8	R 1/2	R 3/4	R 1
b*	10	10	10	12	12
d_2	-	-	12	16	23
s	9	10	13	17	19
t	-	-	6	7	7

Dimensions in stock:
Steel/Steel coated: pg. 113

DIN 910

Hexagon head screw plugs, heavy type, cylindrical thread



Dimensions	M 8x1*	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5
c	3	3	3	3	3	4	4	4
d_2	14	14	17	19	21	23	25	27
m	6	6	6	6	6	6	8	8
s	10	10	13	13	17	17	19	19
i	8	8	12	12	12	12	14	14

Dimensions	M 24x1.5	M 26x1.5	M 27x2	M 30x1.5	M 30x2	M 33x2	M 36x1.5	M 36x2
c	4	4	4	4	4	5	5	5
d_2	29	31	32	36	36	39	42	42
m	9	10	10	10	10	11	11	11
s	22	24	24	24	24	27	27	27
i	14	16	16	16	16	16	16	16

Dimensions	M 38x1.5	M 42x1.5	M 42x2	M 45x1.5	M 45x2	M 48x1.5	M 48x2	M 52x1.5
c	4	5	5	5	5	5	5	5
d_2	44	49	49	55	52	55	55	60
m	11	12	12	12	12	12	12	12
s	27	30	30	30	30	36	30	30
i	16	16	16	16	16	16	16	16

Dimensions	M 56x2	M 64x2	G 1/8 A	G 1/4 A	G 3/8 A	G 1/2 A	G 5/8 A*	G 3/4 A
c	5	5	3	3	3	4	4	4
d_2	64	72	14	18	22	26	28	32
m	15	15	6	6	6	8	8	10
s	36	36	10	13	17	19	22	24
i	20	20	8	12	12	14	14	16

Dimensions	G 7/8 A*	G 1 A	G 1 1/8 A	G 1 1/4 A	G 1 1/2 A	G 1 3/4 A	G 2 A	
c	4	5	4	5	5	5	5	
d_2	36	39	44	49	55	62	68	
m	10	11	11	12	12	15	15	
s	24	27	27	30	30	36	36	
i	14	16	16	16	16	20	20	

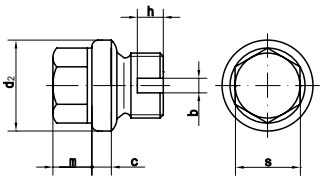
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 1134 | Stainless steel: pg. 476 | Non-ferrous materials: pg. 624

Screw plugs/pipe plugs

DIN 5586

Hexagon head screw plugs with collar and vent
type B = with melted sealing

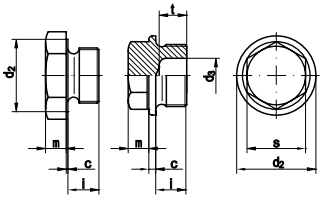


Dimensions	G 1/8 A	G 1/4 A	G 1/2 A	G 3/4 A	G 1 A	G 1 1/2 A	G 2 A
a	4	6	7	7	7	7	7
h	3	3	4	6	6	6	6
h	5	7	8	10	10	10	10
c	3	3	4	4	5	5	5
d_2	14	18	26	32	39	55	68
m	8	6	8	10	11	12	15

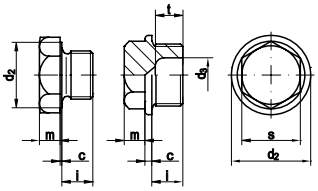
Dimensions in stock:
Steel/Steel coated: pg. 306

DIN 7604

Hexagon head screw plugs with collar, light type, cylindrical fine pitch thread



≤M 16 ≥M 18
type A = short stud end



≤M 16 ≥M 18
type C = long stud end

Dimensions	M 8x1	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5
c	0.5	0.5	0.5	0.5	0.5	2
d_2	12	14	17	19	21	23
d_3	–	–	–	–	–	10
$i_{\text{type A/type C}}$	–/8	6/8	9	9/–	9/–	9/–
$l_{\text{type A/type C}}$	–/12.5	10.5/12.5	15.5	15.5/–	15.5/–	17/–
m	4	4	6	6	6	6
s	12	14	17	19	22	17
$t_{\text{type A/type C}}$	–	–	–	–	–	8/–

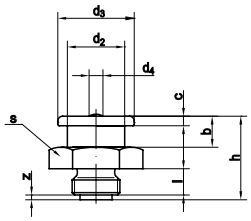
Dimensions	M 22x1.5	M 26x1.5	M 30x1.5	M 38x1.5	M 45x1.5	M 52x1.5
c	2	2.5	2.5	3	3	3
d_2	27	31	36	44	52	60
d_3	14	16	20	26	32	38
$i_{\text{type A/type C}}$	9/–	9/12	9/12	–/12	–/12	–/12
$l_{\text{type A/type C}}$	17/–	19.5/22.5	19.5/22.5	–/23	–/23	–/23
m	6	8	8	8	8	8
s	19	22	22	22	24	27
$t_{\text{type A/type C}}$	8/–	8/10	8/10	–/10	–/10	–/10

Dimensions in stock:
Steel/Steel coated: pg. 351 | Stainless steel: pg. 574

Lubricating nipples

DIN 3404

Lubricating nipples



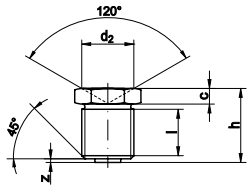
Dimensions	M 6x1	M 6x1	M 8x1	M 8x1	M 10x1
b	4.8	6.5	4.8	6.5	6.5
c	1.7	2.0	1.7	2.0	2.0
d_2	7.2	12	7.2	12	12
d_3	10	16	10	16	16
d_4	1.5	1.5	2.5	2.5	2.9
$h_{max.}$	13	17	13.7	16.7	17.6
l	4.9	5.3	4.9	5.3	5.5
s	11	17	11	17	17
$z_{max.}$	0.6	0.8	0.6	0.8	1.0

Dimensions	M 16x1.5	G 1/4	G 1/4	G 3/8	
b	8.5	6.5	8.5	8.5	
c	3.0	2.0	3.0	3.0	
d_2	18	12	18	18	
d_3	22	16	22	22	
d_4	5.0	2.9	5.0	5.0	
$h_{max.}$	23.1	16	22	22	
l	7.5	5.5	7.5	7.5	
s	22	17	22	22	
$z_{max.}$	1.5	1	1.5	1.5	

Dimensions in stock:
Steel/Steel coated: pg. 234 | Non-ferrous materials: pg. 636

DIN 3405

Lubricating nipples, cupped type
type A = with thread acc. to DIN 13-5

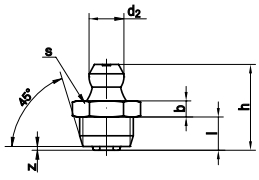


Dimensions	M 6x1	M 8x1
$h_{max.}$	9.5	9.5
l	5.5	5.5
d_2	6	8
c	3	3
s	7	9
$z_{max.}$	0.7	0.7

Dimensions in stock:
Steel/Steel coated: pg. 235

DIN 71412

Lubricating nipples, cone type, with hexagon
type A = cone head straight/axial



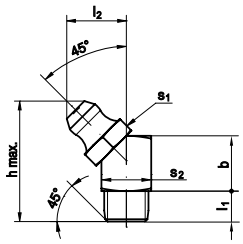
Dimensions	M 6x1	M 6x1	M 8x1	AR 1/8	M 10x1	AR 1/4
$h_{max.}$	16	16	16	16	16	16
l	5.5	5.5	5.5	5.5	5.5	5.5
d_2	6.5	6.5	6.5	6.5	6.5	6.5
b*	3	3	3	3	3	3
s	7	9	9	11	11	14
$z_{max.}$	0.7	0.7	0.7	0.7	0.7	0.7

Dimensions in stock:
Steel/Steel coated: pg. 409 | Stainless steel: pg. 592

Lubricating nipples

DIN 71412

Lubricating nipples, cone type, with hexagon or square
type B = cone head 45° angled

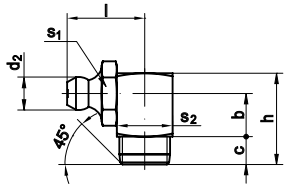


Dimensions	M 6x1	M 8x1	M 10x1
$h_{max.}$	21	21	21
l_1	5.5	5.5	5.5
l_2	10	10	11
b	10	10	10
s_1	7	9	11
$s_{2\ square}$	9	9	11

Dimensions in stock:
Steel/Steel coated: pg. 409

DIN 71412

Lubricating nipples, cone type, with hexagon or square
type C = cone head 90° angled



*intermediate sizes not included in the standard

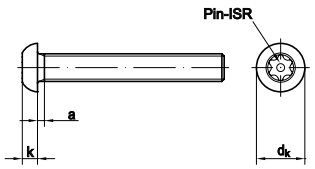
Dimensions	M 6x1	M 8x1	M 8x1.5*	M 10x1
$h_{max.}$	18	18	18	18
c	5.5	5.5	5.5	5.5
d_2	6.5	6.5	6.5	6.5
b	8.5	8.5	8.5	8.5
s_1	9	9	9	11
$s_{2\ square}$	9	9	9	11
l	14.3	14.3	14.3	15.3

Dimensions in stock:
Steel/Steel coated: pg. 409

Theft resistant screw/locking screws

Article 88116

Theft resistant screws with button head, metric thread and pin hex. socket drive
similar to ISO 7380



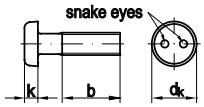
Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
d_k	5.7	7.6	9.5	10.5	14	17.5
$a_{min.}$	0.5	0.7	0.8	1	1.25	1.5
$k_{min.}$	1.4	1.95	2.5	3	4.1	5.2
PIN ISR size	T10	T20	T25	T30	T40	T45

Dimensions in stock:
Stainless steel: pg. 598

Theft resistant screw/locking screws

Article 88111

Theft resistant screws with pan head, metric thread and snake eyes drive
similar to DIN 85

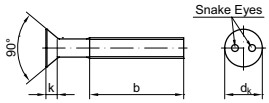


Dimensions	M 3	M 4	M 5	M 6
$b_{min.}$	25	38	38	38
d_k	6	8	10	12
k	1.8	2.4	3	3.6

Dimensions in stock:
Stainless steel: pg. 596

Article 88112

Theft resistant screws with pan head, metric thread and snake eyes drive
similar to DIN 963

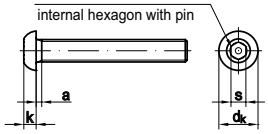


Dimensions	M 3	M 4	M 5	M 6
$b_{min.}$	19	22	25	28
d_k	5.6	7.5	9.2	11
k	1.65	2.2	2.5	3

Dimensions in stock:
Stainless steel: pg. 596

Article 88113

Theft resistant screws with button head, metric thread and hexagon socket with pin
similar to ISO 7380

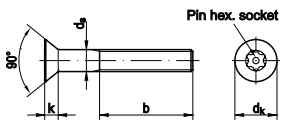


Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12
$a_{min.}$	0.5	0.7	0.8	1	1.25	1.5	1.75
$d_{K\ max.}$	5.7	7.6	9.5	10.5	14	17.5	21
$k_{min.}$	1.4	1.95	2.5	3	4.1	5.2	6.24
s	2	2.5	3	4	5	6	8

Dimensions in stock:
Stainless steel: pg. 597

Article 88117

Theft resistant screws with countersunk head, metric thread and pin hex. socket drive
similar to ISO 10642



b_1 for l ≤ 125 mm
b_2 for l > 125 mm, b_3 for l > 200 mm

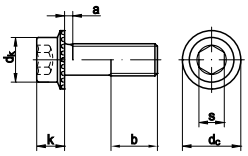
Dimensions	M 3	M 3.5	M 4	M 5	M 6	M 8	M 10
$d_{K\ max.}$	6	7	8	10	12	16	20
$a_{min.}$	0.5	0.6	0.7	0.8	1	1.25	1.5
$k_{max.}$	1.7	2	2.3	2.8	3.3	4.4	5.5
ISR-size	T10	T15	T20	T25	T30	T40	T45
b_1	12	12	14	16	18	22	26
b_2	-	-	-	-	24	28	32
b_3	-	-	-	-	-	-	45

Dimensions in stock:
Stainless steel: pg. 598

Theft resistant screw/locking screws

Article 88912

Hexagon socket cap screws with flange and ribs

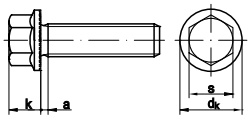


Dimensions	M 5	M 6	M 8	M 10	M 12
$a_{max.}$	2.4	3	3.7	4.5	5.2
b	22	24	28	32	36
d_c	11	13.5	17	19.5	22.5
d_k	9	11	14	17	19
k	5	6	8	10	12
s	4	5	6	8	10
qty. ribs	28	36	48	60	72

Dimensions in stock:
Steel/Steel coated: pg. 438

Article 88913

Hexagon head screws with flange and ribs

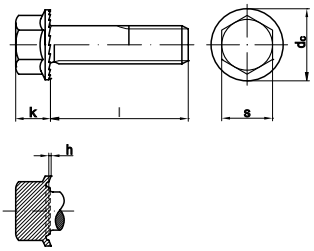


Dimensions	M 5	M 6	M 8	M 10	M 12	M 14	M 16
$a_{max.}$	1.6	2	2.5	3	3.5	4	4
d_k	11.2	14.2	18.2	21	24	27.5	31
k	4.3	5.5	7	8.5	10	12	14
s	8	10	13	15	17	19	22
qty. ribs	28	36	48	48	60	60	72

Dimensions in stock:
Steel/Steel coated: pg. 438

Article 88933

Hexagon head locking screws with flange



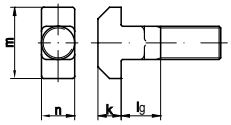
Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
d_c	11.2	14.25	18.25	21	24	31
$h_{min.}$	0.15	0.17	0.2	0.25	0.25	0.28
k	4.3	5.5	7	7.9	8.7	11.2
s	8	10	13	15	17	22
qty. serrations	24	24	24	24	24	24

Dimensions in stock:
Steel/Steel coated: pg. 441

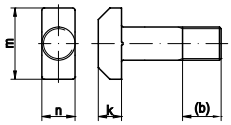
Other screws with metric thread

DIN 186, 261

T-head bolts



DIN 186 type B = with square neck and long thread



DIN 261

b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm

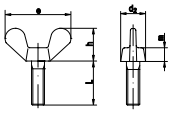
Dimensions	M 6	M 8	M 10	M 12
m	16	18	21	26
n	6	8	10	12
k	4.5	5.5	7	8
$l_{g\ (186\ B)}$	10	13	16	19
b_1	18	22	26	30
b_2	-	-	-	-

Dimensions	M 16	M 20	M 24	
m	30	36	43	
n	16	20	24	
k	10.5	13	15	
$l_{g\ (186\ B)}$	25	31	37	
b_1	38	46	54	
b_2	44	52	60	

Dimensions in stock:
Steel/Steel coated: pg. 77

DIN 316

Wing screws with rounded wings

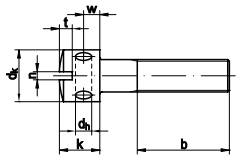


Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16
d_2	7	9.5	11.5	14.5	18.5	21.5	27.5
e	20	25	31.5	37	49.5	63.5	71.5
g	1.5	1.9	1.9	2.4	4	4.5	6
h	9.5	12	16	19	24	32.3	36.3
m	3.9	5.3	6.5	8.3	10	12	15

Dimensions in stock:
Steel/Steel coated: pg. 78 | Stainless steel: pg. 464 | Non-ferrous materials: pg. 618

DIN 404

Slotted capstan screws



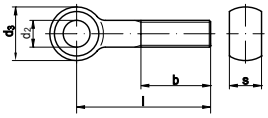
Dimensions	M 3	M 4	M 5	M 6
∅ d_k	5.5	7	8.5	10
k	4	5	6.5	8
n	0.8	1	1.2	1.6
$t_{min.}$	1	1.4	1.7	2.2
∅ d_h	1.5	2	2.5	3
w	1.5	2	2.5	3
b	19	22	25	28

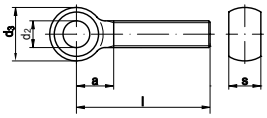
Dimensions in stock:
Steel/Steel coated: pg. 78 | Stainless steel: pg. 465

Other screws with metric thread

DIN 444

Eye bolts
type B = product grade B





with thread near the eye

b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm
b^3 for l > 200 mm

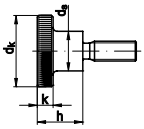
Dimensions	M 5	M 6	M 8	M 10	M 12
d_2	5	6	8	10	12
d_3	12	14	18	20	25
s	6	7	9	12	14
a	11	14	16	18	23
b_1	16	18	22	26	30
b_2	–	–	28	32	36
b_3	–	–	–	–	49

Dimensions	M 16	M 20	M 24	M 30	
d_2	16	18	22	27/28	
d_3	32	40	45	55	
s	17	22	25	30	
a	27	32	40	46	
b_1	38	46	54	66	
b_2	44	52	60	72	
b_3	57	65	73	85	

Dimensions in stock:
Steel/Steel coated: pg. 85 | Stainless steel: pg. 468 | Non-ferrous materials: pg. 619

DIN 464

Knurled thumb screws, high type

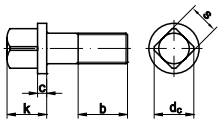


Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
d_k	12	16	20	24	30	36
k	2.5	3.5	4.0	5.0	6.0	8.0
h	5.7	7.64	9.64	11.57	15.57	19.48
d_s	6	8	10	12	16	20

Dimensions in stock:
Steel/Steel coated: pg. 87 | Stainless steel: pg. 469 | Non-ferrous materials: pg. 619

DIN 478

Square head bolts with collar



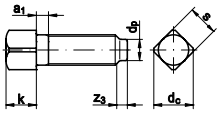
[1] acc. to ISO 272

Dimensions	M 8	M 10	M 12	M 16
k	10	13	15	20
c	2	3	3	4
b	22	26	30	38
d_c	13.5	16.5	19.5	25
s	8	10	13	16^1/17

Dimensions in stock:
Steel/Steel coated: pg. 91

DIN 479

Square head bolts with short dog point



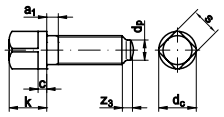
Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
k	6	8	10	12	16	20
a_1	3	4	4.5	5.3	6	7.5
s	6	8	10	13	16^1/17	21^1 /22
d_p	4	5.5	7	8.5	12	15
z_1	1.5	2	2.5	3	4	5

Dimensions in stock:
Steel/Steel coated: pg. 91

Other screws with metric thread

DIN 480

Square head bolts with collar and short dog point with rounded end



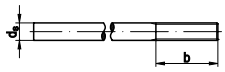
[1]acc. to ISO 272

Dimensions	M 10	M 12	M 16	M 20
k	13	16	20	25
$c_{max.}$	3.12	4.15	4.15	5.15
a_1	4.5	5.3	6	7.5
s	10	13	16[1]/17	21[1]/22
d_c	13	17	21[1]/22	27[1]/28
z_3	2.5	3	4	5

Dimensions in stock:
Steel/Steel coated: pg. 92

DIN 525

Studs for welding



*not standardized, reference values

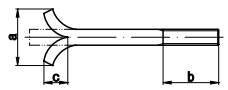
Dimensions	M 6	M 8	M 10	M 12	M 14*	M 16
b	35	40	45	55	60	65
d_s	6	8	10	12	14	16

Dimensions	M 20	M 22*	M 24	M 27*	M 30	M 36
b	75	80	85	95	105	125
d_s	20	22	24	27	30	36

Dimensions in stock:
Steel/Steel coated: pg. 92

DIN 529

Masonry bolts
type C = with split swivel



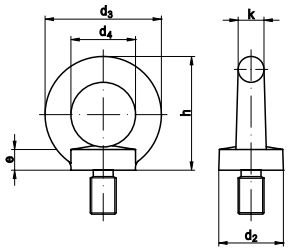
Dimensions	M 8	M 10	M 12	M 16	M 20	M 24	M 30
b	20	25	30	40	50	60	75
a	24	30	36	48	60	75	95
c	12	15	18	24	30	36	45

Dimensions in stock:
Steel/Steel coated: pg. 92

Other screws with metric thread

DIN 580

Lifting eye bolts



Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 18
d_2	20	20	25	30	35	35	40
d_3	36	36	45	54	63	63	72
d_4	20	20	25	30	35	35	40
h	36	36	45	53	62	62	71
e	6	6	8	10	12	12	14
k	8	8	10	12	14	14	16

Dimensions	M 20	M 22	M 24	M 27	M 30	M 33	M 36
d_2	40	50	50	65	65	75	75
d_3	72	90	90	108	108	126	126
d_4	40	50	50	60	60	70	70
h	71	90	90	109	109	128	128
e	14	18	18	22	22	26	26
k	16	20	20	24	24	28	28

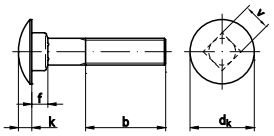
Dimensions	M 39	M 42	M 45	M 48	M 52	M 56	M 64
d_2	85	85	100	100	110	110	120
d_3	144	144	166	166	184	184	206
d_4	80	80	90	90	100	100	110
h	147	147	168	168	187	187	208
e	30	30	35	35	38	38	42
k	32	32	38	38	42	42	48

more information ➔ TI-148

Dimensions in stock:
Steel/Steel coated: pg. 99 | Stainless steel: pg. 472

DIN 603

Cup head square neck bolts



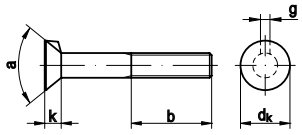
b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm
b^3 for l > 200 mm

Dimensions	M 5	M 6	M 8	M 10	M 12	M 16	M 20
d_k	13.5	16.55	20.65	24.65	30.65	38.8	46.8
k	3.3	3.88	4.88	5.38	6.95	8.95	11.05
f	4.1	4.6	5.6	6.6	8.75	12.9	15.9
v	5.48	6.48	8.58	10.58	12.7	16.7	20.84
b_1	16	18	22	26	30	38	46
b_2	22	24	28	32	36	44	52
b_3	-	-	41	45	49	57	65

Dimensions in stock:
Steel/Steel coated: pg. 103 | Stainless steel: pg. 473 | Non-ferrous materials: pg. 621

DIN 604

Flat countersunk nib bolts



b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm
b^3 for l > 200 mm

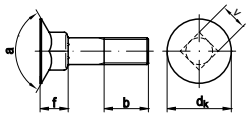
Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24
d_k	12.55	16.55	19.65	24.65	32.8	32.8	38.8
k	4	5	5.5	7	9	11.5	13
a	90°	90°	90°	90°	90°	60°	60°
g	2.5	3	3.2	3.6	4.2	5.4	6.6
b_1	18	22	26	30	38	46	54
b_2	24	28	32	36	44	52	60
b_3	-	41	45	49	57	65	73

Dimensions in stock:
Steel/Steel coated: pg. 106

Other screws with metric thread

DIN 605

Flat countersunk square neck bolts with long square

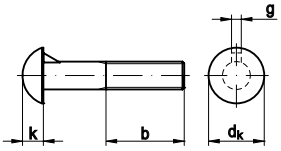


Dimensions	M 6	M 8	M 10
d_k	16.55	20.65	24.65
f	7.45	9.45	11.55
b	18	22	26
v	6.48	8.58	10.58
countersunk angle	120°	120°	120°

Dimensions in stock:
Steel/Steel coated: pg. 106

DIN 607

Cub head nib bolts



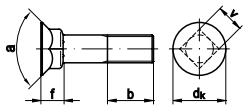
b^1 for l ≤ 125 mm
b^2 for l ≤ 200 mm
b^3 for l > 200 mm

Dimensions	M 8	M 10	M 12	M 16
d_k	16.55	19.65	24.65	30.65
k	6.38	7.45	9.65	11.75
g	3	3.2	3.6	4.2
b_1	22	26	30	38
b_2	28	32	36	44
b_3	–	–	–	57

Dimensions in stock:
Steel/Steel coated: pg. 106

DIN 608

Flat countersunk square neck bolts with short square

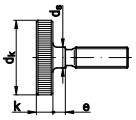


Dimensions	M 8	M 10	M 12	M 16
d_k	16	19.65	24.65	32
f	7	8.45	11.05	13.5
b	22	26	30	38
v	8	10.58	12.7	16
countersunk angle	90°	90°	90°	90°

Dimensions in stock:
Steel/Steel coated: pg. 106

DIN 653

Knurled thumb screws, low type



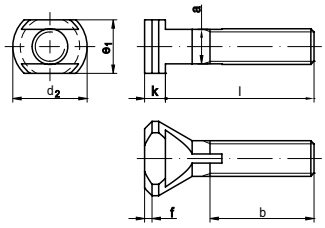
Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
∅ d_k	12	16	20	24	30	36
$k_{max.}$	2.5	3.5	4	5	6	8
∅ d_s	3	4	5	6	8	10
e	2	3	3	4	5	6

Dimensions in stock:
Steel/Steel coated: pg. 108 | Stainless steel: pg. 474

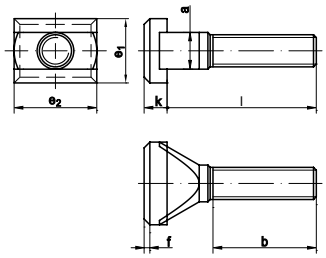
Other screws with metric thread

DIN 787

T-slot screws



head shape up to M 12x12



head shape from M 12x14*

Dimensions	M 8	M 10	M 12	M 16
$a_{max.}$	7.7	9.7	11.7	15.7
e_1/d_2	13/16	15/20	18/25	25
f	1.6	1.6	2.5	2.5
k	6	6	7	9
for T-slots	8	10	12	16

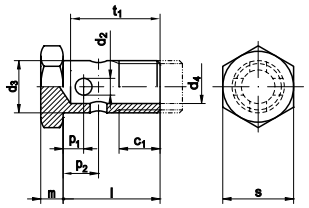
Dimensions	M 16	M 20	M 24	M 24
$a_{max.}$	17.7	19.7	23.7	27.7
e_1/d_2	25	32	40	44
f	2.5	2.5	(4)	4
k	9	12	16	18
for T-slots	18	20	24	28

*$e_2 \geq e_1$

Dimensions in stock:
Steel/Steel coated: pg. 111

DIN 7643

Hollow screws for ring type banjos short thread length



Dimensions	M 8x1	M 10x1	M 12x1.5	M 14x1.5
pipe ∅	4 und 5	5	8	10
c_1	8.5	8.5	11	11
l_1	17	19	24	26
t_1	15	17	22	24
b_2	-	2.8	3.5	4.5
d_3	8	10	12	14
d_4	4	5.5	7	9
m	5	6	6	6
p_1	-	4.5	5	5.5
p_2	-	6.5	8	9.5
s	12	14	17	19

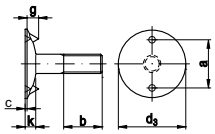
Dimensions	M 16x1.5	M 18x1.5	M 22x1.5	M 26x1.5
pipe ∅	12	15	18	22
c_1	11	11	13	13
l_1	28	32	39	45
t_1	26	29	35.5	41
b_2	5.5	7	9	11
d_3	16	18	22	26
d_4	11	13	16	20
m	6	6	7	7
p_1	6.5	7.5	9	10.5
p_2	11.5	14	18	22.5
s	22	24	27	32

Dimensions in stock:
Steel/Steel coated: pg. 352

Other screws with metric thread

DIN 15237

Seating screws
for the attachment of components

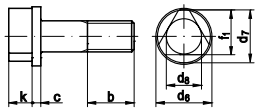


Dimensions	M 6	M 8	M 10	M 12
d_3	20	28	35	42
a	14	20	25	30
$c_{max.}$	1	1	1	1.2
g	3.5	5	6	7
k	2.5	3.5	4.5	5.2
l	20	25/30/35/40	30/35/40/50	35/40/50/60
b	12	15/18/18/20	18/20/20/20	20/25/28/28

Dimensions in stock:
Steel/Steel coated: pg. 407

DIN 22424

Triangle head bolts
type A = with full shank

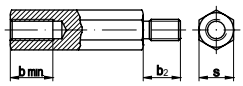


Dimensions	M 8	M 10
$c_{max.}$	1	1
k	3.5	4.5
$d_{6\ max.}$	15.2	18.2
$d_{7\ min.}$	13.9	16.9
$d_{8\ min.}$	9.3	11.8
b	15/18/18/20	18/20/20/20
$f_{1\ min.}$	11.55	14.3

Dimensions in stock:
Steel/Steel coated: pg. 408

Article 88086

Spacers with thread



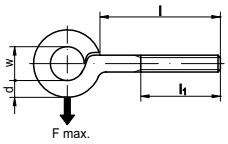
Dimensions	M 3	M 4	M 5	M 6
$b_{min.}$	2.5/3/3.5/ 5/6/7	5/6/8/9	11	10/15/16
b_2	6	8	10	13
s	5.5	7	8	10

Dimensions in stock:
Steel/Steel coated: pg. 416

Other screws with metric thread

Article 88136

Screw eyes
type 48



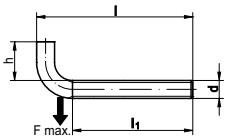
Dimensions	M 3	M 4	M 5	M 6
w	5	6	8	10
d	2.6	3.5	4.4	5.2
l	11/16	11/16/21/26/32/42	16/21/26/32/42/52/62	11/16/21/26/32/42/52/62/72/82
l_1	10/15	10/15/20/25/30/40	15/20/25/30/40/50/60	10/15/20/25/30/40/50/60/70/80
$F_{max.}$	7.50 kg	12.50 kg	20 kg	35 kg

Dimensions	M 8	M 10	M 12	
w	12	14	18	
d	7	8.9	10.6	
l	21/26/32/42/52/62/82/102	32/42/52/62/72/82/102	102	
l_1	20/25/30/40/50/60/80/100	30/40/50/60/80/70/100	100	
$F_{max.}$	50 kg	100 kg	175 kg	

Dimensions in stock:
Steel/Steel coated: pg. 434 | Stainless steel: pg. 601

Article 88138

Straight screw hooks
type 4E

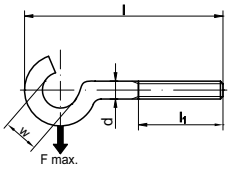


Dimensions	M 4	M 5	M 6	M 8
h	10	12	14	18
d	3.5	4.4	5.2	7
l	40	50	60	60
l_1	25	35	45	45
$F_{max.}$	12.5 kg	20 kg	35 kg	50 kg

Dimensions in stock:
Steel/Steel coated: pg. 435

Article 88142

Cup hooks
type 11E



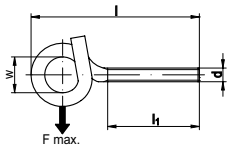
Dimensions	M 4	M 5	M 6	M 8
w	12/16	16	18	22
d	3.5	4.4	5.2	7
l	40/50	50/60	50/60	70/80
l_1	20/25	23/30	20/30	32/42
$F_{max.}$	9 kg	12.50 kg	25 kg	40 kg

Dimensions in stock:
Steel/Steel coated: pg. 435

Other screws with metric thread

Article 88145

Heavy ceiling hooks
type 18E



Dimensions	M 10	M 12	M 12
w	22	22	22
d	8.9	10.6	10.6
l	120/140	160	180
l_1	73	93	115
$F_{max.}$	125 kg	175 kg	175 kg

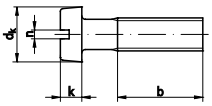
Dimensions in stock:
Steel/Steel coated: pg. 436

Slotted and cross recessed screws with metric thread

ISO 1207

similar DIN 84

Slotted cheese head screws



Dimensions	M 1	M 1.2	M 1.4	M 1.6	M 2	M 2.5	M 3
d_k	2	2.3	2.6	3	3.8	4.5	5.5
k	0.7	0.8	0.9	1.1	1.3	1.6	2
n	0.25	0.3	0.3	0.4	0.5	0.6	0.8
b	25	25	25	25	25	25	25

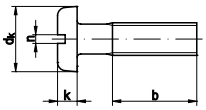
Dimensions	M 3.5	M 4	M 5	M 6	M 8	M 10	
d_k	6	7	8.5	10	13	16	
k	2.4	2.6	3.3	3.9	5	6	
n	1	1.2	1.2	1.6	2	2.5	
b	38	38	38	38	38	38	

Dimensions in stock:
Steel/Steel coated: pg. 205, pg. 65 | Stainless steel: pg. 513, pg. 455 | Non-ferrous materials: pg. 630, pg. 611

ISO 1580

similar DIN 85

Slotted pan head screws

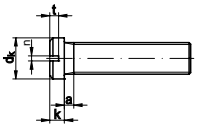


Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8
d_k	4	5	6	8	10	12	16
k	1.3	1.5	1.8	2.4	3	3.6	4.8
n	0.5	0.6	0.8	1.2	1.1	1.6	2
b	25	25	25	38	38	38	38

Dimensions in stock:
Steel/Steel coated: pg. 220, pg. 67 | Stainless steel: pg. 520, pg. 457 | Non-ferrous materials: pg. 633, pg. 612

DIN 920

Slotted pan head screws with small head



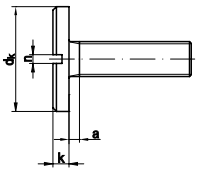
Dimensions	M 3	M 4	M 5
$a_{max.}$	1	1.4	1.6
d_k	4	5.5	6.5
k	1.8	2.4	2.7
n	0.5	0.6	0.8
$t_{max.}$	1.15	1.5	1.6

Dimensions in stock:
Steel/Steel coated: pg. 141

Slotted and cross recessed screws with metric thread

DIN 921

Slotted pan head screws with large head

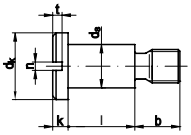


Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
$a_{max.}$	1	1.4	1.6	2	2.5	3
d_k	8	12	16	20	25	30
k	1.8	2.4	2.7	3.1	3.8	4.6
n	0.8	1	1.2	1.6	2	2.5
$t_{max.}$	1.15	1.5	1.6	1.9	2.4	2.8

Dimensions in stock:
Steel/Steel coated: pg. 142

DIN 923

Slotted pan head screws with shoulder

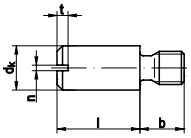


Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
d_k	7	8.5	11	13	16	20
k	1.8	2.4	2.7	3.1	3.8	4.6
b	4.5	6	7	9	11	13.5
d_s	4	5.5	7	8	10	13

Dimensions in stock:
Steel/Steel coated: pg. 142 | Stainless steel: pg. 485

DIN 927

Slotted shoulder screws



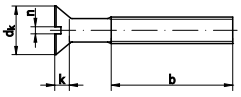
Dimensions	M 3	M 4	M 5	M 6	M 8
d_k	4	5.5	6.5	8	10
b	4.5	6	7	8	11
n	0.5	0.6	0.8	1	1.2
$t_{max.}$	1.05	1.42	1.63	2	1.9

Dimensions in stock:
Steel/Steel coated: pg. 143

ISO 2009

replaces DIN 963

Slotted countersunk head screws



Dimensions	M 1	M 1.2	M 1.4	M 1 ,6	M 2	M 2.5
$d_{k\ ISO/DIN}$	1.9	2.3	2.6	3	3.8	4.7
$k_{\ ISO/DIN}$	0.6	0.72	0.84	1/0.96	1.2	1.5
b*	1)	1)	1)	15	16	18
n	0.25	0.3	0.3	0.4	0.5	0.6

Dimensions	M 3	M 3.5	M 4	M 5	M 6	M 8
$d_{k\ ISO/DIN}$	5.5/5.6	7.3/6.5	8.4/7.5	9.3/9.2	11.3/11	15.8/14.5
$k_{\ ISO/DIN}$	1.65	2.35/1.93	2.7/2.2	2.7/2.5	3.3/3	4.65/4
b*	19	38	22	25	28	34
n	0.8	1	1.2	1.2	1.6	2

Dimensions	M 10	M 12	M 16	M 20		
$d_{k\ ISO/DIN}$	18.3/18	22	29	36		
$k_{\ ISO/DIN}$	5	6	8	10		
b*	40	46	58	70		
n	2.5	3	4	5		

*minimum lengths
1) only with thread up to near the head

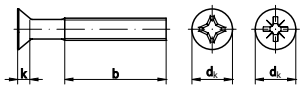
Dimensions in stock:
Steel/Steel coated: pg. 225, pg. 187 | Stainless steel: pg. 522, pg. 500 | Non-ferrous materials: pg. 634, pg. 627

Slotted and cross recessed screws with metric thread

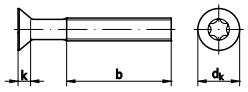
ISO 7046

replaces DIN 965

Countersunk head screws



with Phillips cross recess H
with Pozidriv cross recess Z



with hexalobular socket

*minimum length

Dimensions	M 1 ,6	M 2	M 2.5	M 3	M 4
$d_{k\ ISO/DIN}$	3	3.8	4.7	5.5/5.6	8.4/7.5
$k_{\ ISO/DIN}$	1/0.96	1.2	1.5	1.65	2.7/2.2
b*	15	16	18	19	22
n	0.4	0.5	0.6	0.8	1
cross recess size	0	1	1	1	2
ISR	T5	T6	T8	T10	T20

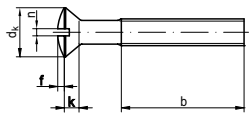
Dimensions	M 5	M 6	M 8	M 10	
$d_{k\ ISO/DIN}$	9.3/9.2	11.3/11	15.8/14.5	18.3/18	
$k_{\ ISO/DIN}$	2.7/2.5	3.3/3	4.65/4	5	
b*	25	28	34	40	
n	1.2	1.6	2	2.5	
cross recess size	2	3	4	4	
ISR	T25	T30	T40	T50	

Dimensions in stock:
Steel/Steel coated: pg. 328, pg. 190 | Stainless steel: pg. 563, pg. 503

ISO 2010

replaces DIN 964

Slotted raised countersunk head screws



Dimensions	M 2	M 2.5	M 3	M 4
$d_{k\ ISO/DIN}$	3.8	4.7	5.6	8.4/7.5
$k_{\ ISO/DIN}$	1.2	1.5	1.65	2.7/2.2
b	16	18	19	22
f	0.5	0.6	0.75	1
n	0.5	0.6	0.8	1

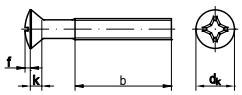
Dimensions	M 5	M 6	M 8	M 10
$d_{k\ ISO/DIN}$	9.3/9.2	11.3/11	15.8/14.5	18.3/18
$k_{\ ISO/DIN}$	2.7/2.5	3.3/3	4.65/4	5
b	25	28	34	40
f	1.25	1.5	2	2.5
n	1.2	1.6	2	2.5

Dimensions in stock:
Steel/Steel coated: pg. 227, pg. 189 | Stainless steel: pg. 524, pg. 502 | Non-ferrous materials: pg. 635, pg. 628

ISO 7047

replaces DIN 966

Raised countersunk head screws with Phillips cross recess H



Dimensions	M 2.5	M 3	M 4	M 5	M 6	M 8
$d_{k\ ISO/DIN}$	4.7	5.6	8.4/7.5	9.3/9.2	11.3/11	15.8/14.5
$k_{\ ISO/DIN}$	1.5	1.65	2.7/2.2	2.7/2.5	3.3/3	4.65/4
b	18	19	22	25	28	34
f	0.6	0.75	1	1.25	1.5	2
n	0.6	0.8	1	1.2	1.6	2
cross recess size	1	1	2	2	3	4

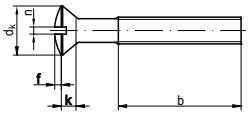
Dimensions in stock:
Steel/Steel coated: pg. 329, pg. 192 | Stainless steel: pg. 565, pg. 506

Slotted and cross recessed screws with metric thread

ISO 2010

replaces DIN 964

Slotted raised countersunk head screws



Dimensions	M 2	M 2.5	M 3	M 4
$d_{k\ ISO/DIN}$	3.8	4.7	5.6	8.4/7.5
$k_{\ ISO/DIN}$	1.2	1.5	1.65	2.7/2.2
b	16	18	19	22
f	0.5	0.6	0.75	1
n	0.5	0.6	0.8	1

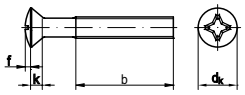
Dimensions	M 5	M 6	M 8	M 10
$d_{k\ ISO/DIN}$	9.3/9.2	11.3/11	15.8/14.5	18.3/18
$k_{\ ISO/DIN}$	2.7/2.5	3.3/3	4.65/4	5
b	25	28	34	40
f	1.25	1.5	2	2.5
n	1.2	1.6	2	2.5

Dimensions in stock:
Steel/Steel coated: pg. 227, pg. 189 | Stainless steel: pg. 524, pg. 502 | Non-ferrous materials: pg. 635, pg. 628

ISO 7047

replaces DIN 966

Raised countersunk head screws with Phillips cross recess H



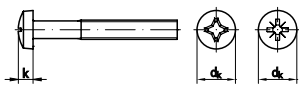
Dimensions	M 2.5	M 3	M 4	M 5	M 6	M 8
$d_{k\ ISO/DIN}$	4.7	5.6	8.4/7.5	9.3/9.2	11.3/11	15.8/14.5
$k_{\ ISO/DIN}$	1.5	1.65	2.7/2.2	2.7/2.5	3.3/3	4.65/4
b	18	19	22	25	28	34
f	0.6	0.75	1	1.25	1.5	2
n	0.6	0.8	1	1.2	1.6	2
cross recess size	1	1	2	2	3	4

Dimensions in stock:
Steel/Steel coated: pg. 329, pg. 192 | Stainless steel: pg. 565, pg. 506

ISO 7045

similar DIN 7985

Pan head screws with cross recess



with Phillips cross recess H
with Pozidriv cross recess Z

Dimensions	M 1.6	M 2	M 2.5	M 3	M 3.5
$d_{k\ ISO/DIN}$	3.2	4	5	5.6/6	7
$k_{ISO/DIN}$	1.3	1.6	2.1/2	2.4	2.6/2.7
KS size	0	1	1	1	2

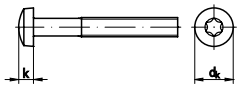
Dimensions	M 4	M 5	M 6	M 8	M 10
$d_{k\ ISO/DIN}$	8	9.5/10	12	16	20
$k_{ISO/DIN}$	3.1	3.7/3.8	4.6	6	7.5
KS size	2	2	3	4	4

Dimensions in stock:
Steel/Steel coated: pg. 326 | Stainless steel: pg. 561

ISO 14583

~DIN 7985

Hexalobular socket pan head screws



Dimensions	M 1.6	M 2	M 2.5	M 3	M 4
d_k	3.2	4	5	6	8
k	1.3	1.6	2	2.4	3.1
ISR	T5	T6	T8	T10	T20

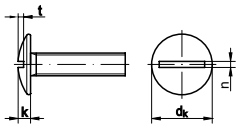
Dimensions	M 5	M 6	M 8	M 10	
d_k	10	12	16	20	
k	3.8	4.6	6	7.5	
ISR	T25	T30	T45	T50	

Dimensions in stock:
Steel/Steel coated: pg. 405, pg. 366 | Stainless steel: pg. 590, pg. 581

Slotted and cross recessed screws with metric thread

Article 88107

Slotted mushroom head screws with thread up to head



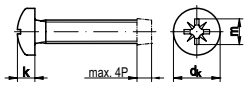
Dimensions	M 5	M 6	M 8
d_k	12	15	19
k	2.8	3.3	4.3
$n_{min.}$	1.3	1.6	1.8
t	1.5	2	2.7

Dimensions in stock:
Steel/Steel coated: pg. 428 | Stainless steel: pg. 596

Tapping screws, thread rolling screws and thread cutting screws

DIN 7500 C

Thread rolling screws with metric thread and Pozidriv cross recess Z
type C = pan head acc. to DIN 7985

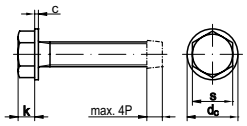


Dimensions	M 2	M 2.5	M 3	M 3.5	M 4	M 5	M 6	M 8
max. groove section	1.6	1.8	2	2.4	2.8	3.2	4	5
cross recess size	1	1	1	2	2	2	3	4
$d_{k\ max.}$	4	5	6	7	8	10	12	16
$k_{max.}$	1.6	2	2.4	2.7	3.1	3.8	4.6	6

Dimensions in stock:
Steel/Steel coated: pg. 346

DIN 7500 ~D

Thread rolling screws with metric thread
~ type D = hexagon head with collar

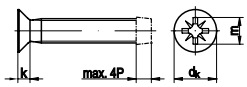


Dimensions	M 4	M 5	M 6	M 8
max. groove section	2.8	3.2	4	5
s	7	8	10	13
d_c	8.1	10.1	12.6	16.4
c	0.55	0.75	0.9	1.2
k	3.1	3.8	4.6	6

Dimensions in stock:
Steel/Steel coated: pg. 346

DIN 7500 M

Thread rolling screws with metric thread and Pozidriv cross recess Z
type M = countersunk head acc. to DIN 965



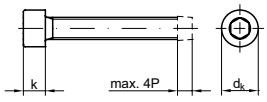
Dimensions	M 2.5	M 3	M 4	M 5	M 6	M 8
max. groove section	1.8	2	2.8	3.2	4	5
cross recess size	1	1	2	2	3	4
$d_{k\ max.}$	4.7	5.6	7.5	9.2	11	14.5
$k_{max.}$	1.5	1.65	2.2	2.5	3	4

Dimensions in stock:
Steel/Steel coated: pg. 347

Tapping screws, thread rolling screws and thread cutting screws

DIN 7500 E

Thread rolling screws with metric thread
type E = hexagon socket head cap
acc. to DIN 912

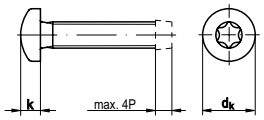


Dimensions	M 4	M 5	M 6	M 8
$d_{K\ max.}$	7	8.5	10	13
$k_{max.}$	4	5	6	8
s	2.5	3	4	5

Dimensions in stock:
Steel/Steel coated: pg. 347

DIN 7500 CE/PE

Drilling screws
with tapping screw thread
type K = hexagon head with collar
acc. to DIN 6928

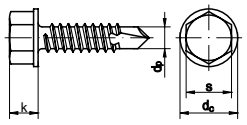


Dimensions	M 3	M 4	M 5	M 6	M 8
$d_{K\ max.}$	5.6	8	9.50	12	16
$d_{p\ max.}$	2.4	3.1	3.7	4.6	6
$d_{c\ max}$	T10	T20	T25	T30	T40

Dimensions in stock:
Steel/Steel coated: pg. 346

DIN 7504 K

Drilling screws
with tapping screw thread
type K = hexagon head with collar acc. to
DIN 6928



Dimensions	ST 3.5	ST 3.9	ST 4.2
f. sheet thicknesses	0.7 to 2.25	0.7 to 2.4	1.75 to 3.0
$d_{p\ max.}$	2.8	3.1	3.6
$d_{c\ max.}$	8.3	8.3	8.8
$k_{max.}$	3.4	3.4	4.1
s	5.5	5.5	7

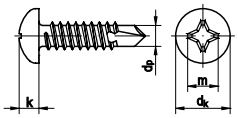
Dimensions	ST 4.8	ST 5.5	ST 6.3
f. sheet thicknesses	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0
$d_{p\ max.}$	4.1	4.8	5.8
$d_{c\ max.}$	10.5	11	13.5
$k_{max.}$	4.3	5.4	5.9
s	8	8	10

Dimensions in stock:
Steel/Steel coated: pg. 347

Tapping screws, thread rolling screws and thread cutting screws

DIN 7504 N

Drilling screws with tapping screw thread and Phillips cross recess H
type N = pan head acc. to DIN 7981



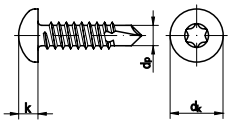
Dimensions	ST 2.9	ST 3.5	ST 3.9	ST 4.2
f. sheet thicknesses	0.7 to 1.9	0.7 to 2.25	0.7 to 2.4	1.75 to 3.0
$d_{p\ max.}$	2.3	2.8	3.1	3.6
$d_{k\ max.}$	5.6	6.9	7.5	8.2
$k_{max.}$	2.2	2.6	2.8	3.05
cross recess size	1	2	2	2

Dimensions	ST 4.8	ST 5.5	ST 6.3	
f. sheet thicknesses	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0	
$d_{p\ max.}$	4.1	4.8	5.8	
$d_{k\ max.}$	9.5	10.8	12.5	
$k_{max.}$	3.7	4	4.6	
cross recess size	2	3	3	

Dimensions in stock:
Steel/Steel coated: pg. 348

DIN 7504 N

Drilling screws with tapping screw thread and hexalobular socket
type N = pan head acc. to ISO 14583



* not standardized, reference values

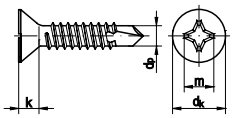
Dimensions	ST 2.9	ST 3.5	ST 3.9*	ST 4.2
f. sheet thicknesses	0.7 to 1.9	0.7 to 2.25	0.7 to 2.4	1.75 to 3.0
$d_{p\ max.}$	2.3	2.8	3.2	3.6
$d_{K\ max.}$	5.6	7	7.5	8
$k_{max.}$	2.4	2.6	2.8	3.1
ISR size	T10	T15	T20	T20

Dimensions	ST 4.8	ST 5.5	ST 6.3	
f. sheet thicknesses	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0	
$d_{p\ max.}$	4.1	4.8	5.8	
$d_{K\ max.}$	9.5	11	12	
$k_{max.}$	3.7	4	4.6	
ISR size	T25	T25	T30	

Dimensions in stock:
Steel/Steel coated: pg. 348

DIN 7504 P

Drilling screws with tapping screw thread and Phillips cross recess H
type P = countersunk head acc. to DIN 7982



countersunk head = 80°

Dimensions	ST 2.9	ST 3.5	ST 3.9	ST 4.2
f. sheet thicknesses	0.7 to 1.9	0.7 to 2.25	0.7 to 2.4	1.75 to 3.0
$d_{p\ max.}$	2.3	2.8	3.2	3.6
$d_{K\ max.}$	5.5	6.8	7.5	8.1
$k_{max.}$	1.7	2.1	2.3	2.5
cross recess size	1	2	2	2

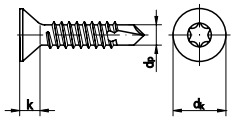
Dimensions	ST 4.8	ST 5.5	ST 6.3	
f. sheet thicknesses	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0	
$d_{p\ max.}$	4.1	4.8	5.8	
$d_{K\ max.}$	9.5	10.8	12.4	
$k_{max.}$	3.0	3.4	3.8	
cross recess size	2	3	3	

Dimensions in stock:
Steel/Steel coated: pg. 349

Tapping screws, thread rolling screws and thread cutting screws

DIN 7504 P

Drilling screws with tapping screw thread and hexalobular socket
type P = countersunk head acc. to DIN 7982



countersunk head = 80°

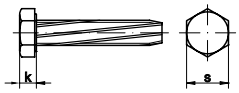
Dimensions	ST 2.9	ST 3.5	ST 3.9	ST 4.2
f. sheet thicknesses	0.7 to 1.9	0.7 to 2.25	0.7 to 2.4	1.75 to 3.0
$d_{p\ max.}$	2.3	2.8	3.2	3.6
$d_{K\ max.}$	5.5	6.8	7.5	8.1
$k_{max.}$	1.7	2.1	2.3	2.5
ISR size	T10	T15	T20	T20

Dimensions	ST 4.8	ST 5.5	ST 6.3	
f. sheet thicknesses	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0	
$d_{p\ max.}$	4.1	4.8	5.8	
$d_{K\ max.}$	9.5	10.8	12.4	
$k_{max.}$	3	3.4	3.8	
ISR size	T25	T25	T30	

Dimensions in stock:
Steel/Steel coated: pg. 349

DIN 7513 A

Thread cutting screws
type A = hexagon head acc. to DIN 933



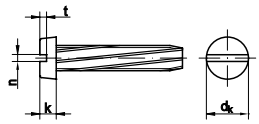
*for materials with medium property classes

Dimensions	M 4	M 5	M 6	M 8
s	7	8	10	13
k	2.8	3.5	4	5.3
core hole ∅*	3.6	4.5	5.5	7.4

Dimensions in stock:
Steel/Steel coated: pg. 349

DIN 7513 B

Thread cutting screws
type B = slotted cheese head acc. to DIN 84



*for materials with medium property classes

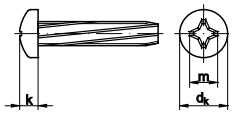
Dimensions	M 3	M 4	M 5	M 6
$d_{k\ max.}$	5.5	7	8.5	10
k	2	2.6	3.3	3.9
n	0.8	1.2	1.2	1.6
$t_{min.}$	0.85	1.1	1.3	1.6
core hole ∅*	2.7	3.6	4.5	5.5

Dimensions in stock:
Steel/Steel coated: pg. 349

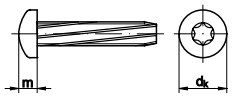
Tapping screws, thread rolling screws and thread cutting screws

DIN 7516 A

Thread cutting screws
type A = pan head acc. to DIN 7985



with Phillips cross recess H



with hexalobular socket

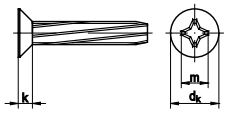
*for materials with medium property classes

Dimensions	M 3	M 4	M 5	M 6	M 8
$d_{k\ max.}$	6	8	10	12	16
$k_{max.}$	2.4	3.1	3.8	4.6	6
cross recess size	1	2	2	3	4
ISR	T10	T20	T25	T30	T40
core hole ∅*	2.7	3.6	4.5	5.5	7.4

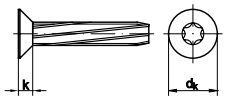
Dimensions in stock:
Steel/Steel coated: pg. 350

DIN 7516 D

Thread cutting screws
type D = countersunk head acc. to DIN 965



with Phillips cross recess H



with hexalobular socket

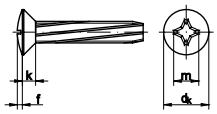
*for materials with medium property classes

Dimensions	M 3	M 4	M 5	M 6	M 8
$d_{k\ max.}$	5.6	7.5	9.2	11	14.5
$k_{max.}$	1.65	2.2	2.5	3	4
cross recess size	1	2	2	3	4
ISR	T10	T20	T25	T30	T40

Dimensions in stock:
Steel/Steel coated: pg. 350

DIN 7516 E

Thread cutting screws
with Phillips cross recess H
type E = raised countersunk head acc. to DIN 966



*for materials with medium property classes

Dimensions	M 3	M 4	M 5	M 6	M 8
$d_{k\ max.}$	5.6	7.5	9.2	11	14.5
f	0.75	1	1.25	1.5	2
$k_{max.}$	1.65	2.2	2.5	3	4
cross recess size	1	2	2	3	4
core hole ∅*	2.7	3.6	4.5	5.5	7.4

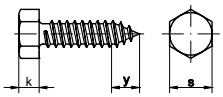
Dimensions in stock:
Steel/Steel coated: pg. 350

Tapping screws, thread rolling screws and thread cutting screws

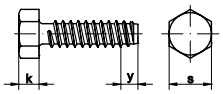
ISO 1479

replaces DIN 7976

Hexagon head tapping screws



type C = with cone end



type F = with flat end

*dimension not ISO standardized, values from DIN 7976
assembly instructions ➔ TI-184

Dimensions	ST 2.9	ST 3.5	ST 3.9*	ST 4.2
$k_{ISO/DIN}$	2.3/1.5	2.6/2.3	2.3	3/2.8
s	5	5.5	7	7
$y_{type\ C}$	2.6	3.2	3.5	3.7
$y_{type\ F}$	–	–	–	2.8

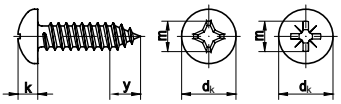
Dimensions	ST 4.8	ST 5.5	ST 6.3	ST 8
$k_{ISO/DIN}$	3.8/3	4.1/4	4.7/4.8	6/5.8
s	7	8	10	13
$y_{type\ C}$	4.2	5	6	7.5
$y_{type\ F}$	3.2	–	3.6	–

Dimensions in stock:
Steel/Steel coated: pg. 214, pg. 354 | Stainless steel: pg. 518, pg. 575

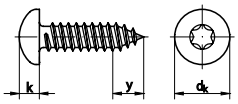
ISO 7049, 14585

replaces DIN 7981

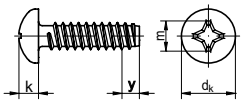
Pan head tapping screws with cross recess or hexalobular socket



type C-H = with cone end and Phillips cross recess H
type C-Z = with cone end and Pozidriv cross recess Z



type C-ISR = with cone end and hexalobular drive



type F-H = with flat end and Phillips cross recess H

*dimension not ISO standardized, values from DIN 7981
assembly instructions ➔ TI-184

Dimensions	ST 2.2	ST 2.9	ST 3.5	ST 3.9*
$d_{k\ ISO/DIN}$	4/4.2	5.6	7/6.9	7.5
$k_{max.\ ISO/DIN}$	1.6/1.8	2.4/2.2	2.6	2.8
cross recess size	1	1	2	2
ISR	T6	T10	T15	T15
$y_{type\ C}$	2	2.6	3.2	3.5
$y_{type\ F}$	1.6	2.1	2.5	2.7

Dimensions	ST 4.2	ST 4.8	ST 5.5	ST 6.3
$d_{k\ ISO/DIN}$	8/8.2	9.5	11/10.8	12/12.5
$k_{max.\ ISO/DIN}$	3.1/3.05	3.7/3.5	4/3.95	4.6/4.55
cross recess size	2	2	3	3
ISR	T20	T25	T25	T30
$y_{type\ C}$	3.7	4.2	5	6
$y_{type\ F}$	2.8	3.2	3.6	3.6

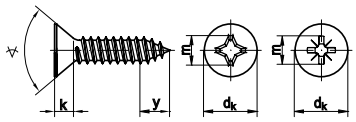
Dimensions in stock:
Steel/Steel coated: pg. 330, pg. 405, pg. 357 | Stainless steel: pg. 566, pg. 590, pg. 575

Tapping screws, thread rolling screws and thread cutting screws

ISO 7050, 14586

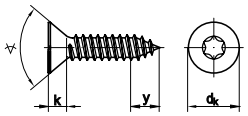
replaces DIN 7982

Countersunk head tapping screws with cross recess acc. to ISO 7050 or hexalobular drive acc. to ISO 14586

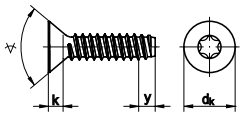


Type C-H = with cone end and Phillips cross recess H
Type C-Z = with cone end and Pozidriv cross recess Z

Dimensions	ST 2.2	ST 2.9	ST 3.5	ST 3.9*
$d_{k\ ISO/DIN}$	3.8/4.3	5.5	7.3/6.8	-/7.5
$k_{max.\ ISO/DIN}$	1.1/1.3	1.7	2.35/2.1	-/2.3
cross recess size	0	1	2	2
ISR	-	10	15	15
$y_{type\ C}$	2	2.6	3.2	3.2
$y_{type\ F}$	1.6	2.1	2.5	2.7



Type C-ISR = with cone end and hexalobular drive**



Type F-ISR = with flat end and hexalobular drive

Dimensions	ST 4.2	ST 4.8	ST 5.5	ST 6.3
$d_{k\ ISO/DIN}$	8.4/8.1	9.3/9.5	10.3/10.8	11.3/12.4
$k_{max.\ ISO/DIN}$	2.6/2.5	2.8/3	3/3.4	3.15/3.8
cross recess size	2	2	3	3
ISR	20	25	25	30
$y_{type\ C}$	3.7	4.3	5	6
$y_{type\ F}$	2.8	3.2	3.6	3.6

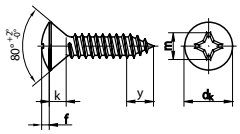
*dimension not ISO standardized
**also available as DIN 7982
assembly instructions ➔ TI-184

Dimensions in stock:
Steel/Steel coated: pg. 332, pg. 404, pg. 360 | Stainless steel: pg. 567, pg. 591, pg. 577

ISO 7051

replaces DIN 7983

Countersunk head tapping screws with Phillips cross recess H
type C = with cone end



Dimensions	ST 2.9	ST 3.5	ST 3.9*	ST 4.2
$d_{k\ ISO/DIN}$	5.5	7.3/6.8	-/7.5	8.4/8.1
$k_{max.\ ISO/DIN}$	1.7/1.7	2.35/2.1	-/2.3	2.6/2.5
cross recess size	1	2	2	2
$y_{type\ C}$	2.6	3.2	3.5	3.7

Dimensions	ST 4.8	ST 5.5	ST 6.3	
$d_{k\ ISO/DIN}$	9.3/9.5	10.3/10.8	11.3/12.4	
$k_{max.\ ISO/DIN}$	2.8/3	3/3.4	3.15/3.8	
cross recess size	2	3	3	
$y_{type\ C}$	4.3	5	6	

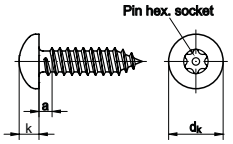
*dimension not ISO standardized, values from DIN 7983
assembly instructions ➔ TI-184

Dimensions in stock:
Steel/Steel coated: pg. 333, pg. 362 | Stainless steel: pg. 567, pg. 578

Tapping screws, thread rolling screws and thread cutting screws

Article 88114

Theft resistant screws with raised head and hex. socket drive
type C = with cone end



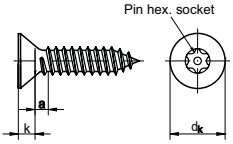
assembly instructions ➔ TI-184

Dimensions	ST 3.5	ST 4.2	ST 4.8	ST 5.5	ST 6.3
d_k	6.9	8.2	9.5	10.8	12.5
k	2.6	3.05	3.55	3.95	4.55
$a_{max.}$	1.3	1.4	1.6	1.8	1.8
Pin-ISR-size	T10	T15	T25	T27	T27

Dimensions in stock:
Stainless steel: pg. 597

Article 88115

Theft resistant screws with countersunk head and hex. socket drive
type C = with cone end



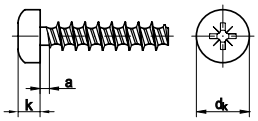
assembly instructions ➔ TI-184

Dimensions	ST 2.9	ST 3.5	ST 4.2	ST 4.8	ST 5.5	ST 6.3
d_k	5.5	6.8	8.1	9.5	10.8	12.4
k	1.7	2.1	2.5	3	3.4	3.8
$a_{max.}$	1.1	1.3	1.4	1.6	1.8	1.8
Pin-ISR-size	T10	T15	T20	T25	T27	T30

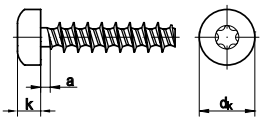
Dimensions in stock:
Stainless steel: pg. 597

Article 88200

Pan head screws with thread for plastic (thermoplastics)



with Pozidriv cross recess Z



with hexalobular socket

a_1 for (L > 3xd)
a_2 for (L > 3xd)

ISR = hexalobular socket
CR = cross recess

Dimensions	2.2	2.5	3	3.5
dk KS /ISR	3.9/4	4.4/4.2	5.3/5.6	6.1/6.9
k CR/ISR	1.5/1.5	1.7/1.6	2/2.1	2.5/2.3
a_1	2.2	2.5	3	3.5
a_2	1.1	1.3	1.5	1.8
cross recess size	1	1	1	1
ISR size	T6	T8	T10	T10

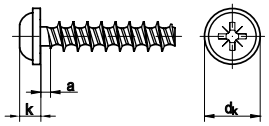
Dimensions	4	5	6	
dk KS /ISR	7/7.5	8.8/8.2	10.5/10.8	
k CR/ISR	2.7/2.6	3.4/2.9	4/3.8	
a_1	4	6	7	
a_2	2	3	3.5	
cross recess size	2	2	2	
ISR size	T20	T20	T25	

Dimensions in stock:
Steel/Steel coated: pg. 436, pg. 436

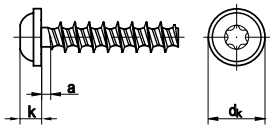
Tapping screws, thread rolling screws and thread cutting screws

Article 88202

Pan head screws with collar with screw thread for plastic (thermoplastics)



with Pozidriv cross recess Z



with hexalobular socket

a_1 for (L > 3xd)
a_2 for (L > 3xd)

ISR = hexalobular socket
CR = cross recess

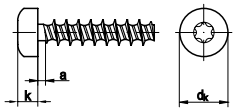
Dimensions	2.2	2.5	3	3.5
$d_{k\ KS/ISR}$	4.4/4.5	5	6	7
$k_{\ CR/ISR}$	1.6/1.4	1.8/1.5	2.1	2.4
a_1	2.2	2.5	3	3.5
a_2	1.1	1.3	1.5	1.8
cross recess size	1	1	1	1
ISR size	T6	T6	T10	T10

Dimensions	4	5	6	
$d_{k\ KS/ISR}$	8	10	12	
$k_{\ CR/ISR}$	2.5/2.6	3.2/3.3	4/3.6	
a_1	4	6	7	
a_2	2	3	3.5	
cross recess size	2	2	2	
ISR size	T20	T20	T25	

Dimensions in stock:
Steel/Steel coated: pg. 437

Article 88203

Pan head screws with screw thread for plastic (thermoplastics), with hexalobular socket
RSTplus = higher preloads



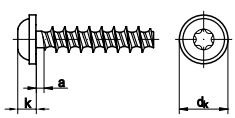
Dimensions	2.2	2.5	3	3.5
d_k	3.9	4.4	5.3	6.1
k	1.6	1.9	2.3	2.7
$a_{max.}$	1.1	1.3	1.5	1.8
ISR size	T6	T8	T10	T15

Dimensions	4	5	6	
d_k	7	8.8	10.5	
k	3.1	3.5	4.2	
$a_{max.}$	2	2.5	3	
ISR size	T20	T25	T30	

Dimensions in stock:
Steel/Steel coated: pg. 437

Article 88204

Pan head screws with collar with screw thread for plastic (thermoplastics), with hexalobular socket
RSTplus = higher preloads



Dimensions	2.2	2.5	3	3.5
d_k	5	5.5	6.5	7.5
k	1.6	1.9	2.3	2.7
$a_{max.}$	1.1	1.3	1.5	1.8
ISR size	T6	T8	T10	T15

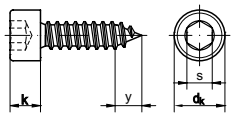
Dimensions	4	5	6	
d_k	9	11	13.5	
k	3.1	3.5	4.2	
$a_{max.}$	2	2.5	3	
ISR size	T20	T25	T30	

Dimensions in stock:
Steel/Steel coated: pg. 437

Tapping screws, thread rolling screws and thread cutting screws

Article 88312

Cylindrical head tapping screws with hexagon socket
type C = with cone end



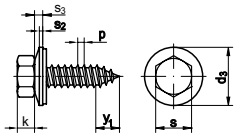
Dimensions	ST 4.8	ST 5.5	ST 6.3
d_k	8.5	10	10
k	5	6	6
s	4	5	5
y~	4.3	5	6

assembly instructions ➔ TI-184

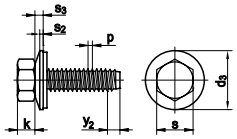
Dimensions in stock:
Stainless steel: pg. 574

Article 88176, 88276

Tapping screws for facing with assembled sealing washer



88176 type A = with cone end



88276 type BZ = with flat end

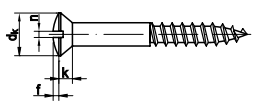
Dimensions	88176 6.5
s	3/8“
k	4
p	2.54
y_1	6
y_2	-
$d_{3\ (washer)}$	16/18*
$s_{2\ (washer)}$	1
$s_{3\ (washer)}$	2
f. sheet thicknesses	0.60 – 1.50
for drilling ∅	4.5

Dimensions in stock:
Stainless steel: pg. 602

Wood screws

DIN 95

Slotted raised countersunk head wood screws



Dimensions	1.6	2	2.5	3	3.5
d_k	3	3.8	4.7	5.6	6.5
k	0.96	1.2	1.5	1.65	1.93
f	0.4	0.5	0.6	0.75	0.9
n	0.4	0.5	0.6	0.8	0.8

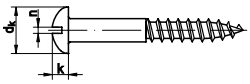
Dimensions	4	4.5	5	6	8
d_k	7.5	8.3	9.2	11	14.5
k	2.2	2.35	2.5	3	4
f	1	1.1	1.25	1.5	2
n	1	1	1.2	1.6	2

Dimensions in stock:
Steel/Steel coated: pg. 70 | Stainless steel: pg. 459 | Non-ferrous materials: pg. 613

Wood screws

DIN 96

Slotted round head wood screws



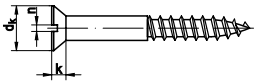
Dimensions	1.6	2	2.5	3	3.5
d_k	3.2	4	5	6	7
k	1.1	1.4	1.7	2.1	2.4
n	0.4	0.5	0.6	0.8	0.8

Dimensions	4	4.5	5	6	
d_k	8	9	10	12	
k	2.8	3.1	3.5	4.2	
n	1	1	1.2	1.6	

Dimensions in stock:
Steel/Steel coated: pg. 70 | Stainless steel: pg. 460 | Non-ferrous materials: pg. 615

DIN 97

Slotted countersunk head wood screws



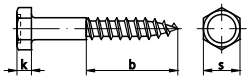
Dimensions	1.6	2	2.5	3	3.5	4
d_k	3	3.8	4.7	5.6	6.5	7.5
k	0.96	1.2	1.5	1.65	1.93	2.2
n	0.4	0.5	0.6	0.8	0.8	1

Dimensions	4.5	5	5.5	6	8	
d_k	8.3	9.2	10.2	11	14.5	
k	2.35	2.5	2.75	3	4	
n	1	1.2	1.2	1.6	2	

Dimensions in stock:
Steel/Steel coated: pg. 70 | Stainless steel: pg. 460 | Non-ferrous materials: pg. 615

DIN 571

Hexagon head wood screws



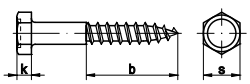
Dimensions	5	6	7	8
b	> 0.6 l	> 0.6 l	> 0.6 l	> 0.6 l
k	3.5	4	5	5.5
s	8	10	12	13

Dimensions	10	12	16	20
b	> 0.6 l	> 0.6 l	> 0.6 l	> 0.6 l
k	7	8	10	13
s	17	19	24	30

Dimensions in stock:
Steel/Steel coated: pg. 98 | Stainless steel: pg. 471

Article 89571

Hexagon wood building screws



EN 14592

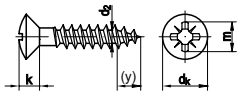
Dimensions	8	12
b	> 0,6 l	> 0,6 l
k	5,5	8
s	13	19

Dimensions in stock:
Steel/Steel coated: pg. 450

Chipboard screws

Article 88095

Chipboard screws with countersunk head and Pozidriv cross recess Z

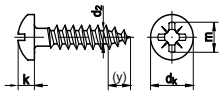


Dimensions	ST 3.5	ST 4
d_k	7	8
$k_{min.}$	2.1	2.4
d_2	2.5	2.67
cross recess size	2	2

Dimensions in stock:
Non-ferrous materials: pg. 645

Article 89096

Chipboard screws with round head and Pozidriv cross recess Z



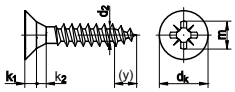
EN 14592

Dimensions	ST 3	ST 3.5	ST 4	ST 4.5	ST 5	ST 6
d_2	1.9	2.5	2.67	2.7	3	3.7
d_k	6	7	8	9	10	12
$k_{1\ max.}$	2.25	2.6	2.8	3	3.5	4.1
y	3	3.4	4	4.3	4.8	5.7
cross recess size	1	2	2	2	2	3

Dimensions in stock:
Steel/Steel coated: pg. 447 | Stainless steel: pg. 607

Article 89097

Chipboard screws with countersunk head and Pozidriv cross recess Z



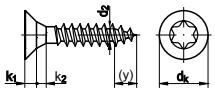
EN 14592

Dimensions	ST 3	ST 3.5	ST 4	ST 4.5	ST 5	ST 6
d_2	1.9	2.5	2.67	2.7	3	3.7
d_k	6	7	8	9	10	12
$k_{1\ max.}$	1.9	2.1	2.5	2.7	3	3.6
$k_{2\ max.}$	1.6	1.8	2	2.2	2.5	3
y	3	3.4	4	4.3	4.8	5.7
cross recess size	1	2	2	2	2	3

Dimensions in stock:
Steel/Steel coated: pg. 448 | Stainless steel: pg. 607

Article 89098

Chipboard screws with countersunk head and hexalobular socket



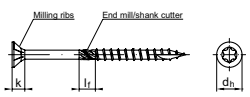
EN 14592

Dimensions	ST 3	ST 3.5	ST 4	ST 4.5	ST 5	ST 6	ST 8
d_2	1.9	2.5	2.67	2.7	3	3.7	5
d_k	6	7	8	9	10	12	15.1
$k_{1\ max.}$	1.9	2.1	2.5	2.7	3	3.6	4.4
$k_{2\ max.}$	1.6	1.8	2	2.2	2.5	3	3.8
y	3	3.4	4	4.3	4.8	5.7	6.5
cross recess size	T10	T15	T20	T20	T25	T30	T40

Dimensions in stock:
Steel/Steel coated: pg. 449 | Stainless steel: pg. 608

Article 89091

Wood building screws with countersunk head



ETA-12/0276

for use with countersunk washer R 89184

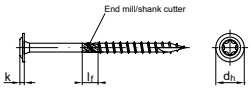
Maße	3.5	4	4.5	5	6	8	10
d_h	6.8	7.8	8.8	9.8	11.8	14.5	18
k	3.4	4.2	4.5	5.1	5.6	7	8.7
l_f	6	6	6	6	12	12	12
ISR	15	20	25	25	30	40	40
Characteristic yield moment $M_{y.Rk}$ [Nm]	2.3	3.3	4.5	5.9	9.5	20	36
Characteristic tensile capacity $f_{tens.k}$ [kN]	4	5	6	8	9.5	19	25
Characteristic breaking torque $f_{tor.k}$ [Nm]	2.2	3.3	4.5	6.1	9	24	40

Dimensions in stock:
Steel/Steel coated: pg. 446

Chipboard screws

Article 89092

Wood building screws with flange head



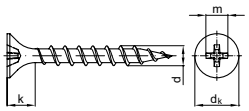
ETA-12/0276

Dimensions	6	8	10
d_h	15.3	22	25
k	3.1	3.4	4
l_f	12	12	12
ISR	30	40	40
Characteristic yield moment $M_{y.Rk}$ [Nm]	9.5	20	36
Characteristic tensile capacity $f_{tens.k}$ [kN]	9.5	19	25
Characteristic breaking torque $f_{tor.k}$ [Nm]	9	24	40

Dimensions in stock:
Steel/Steel coated: pg. 447

Article 89150

Drywall screws
with trumpet head and coarse thread



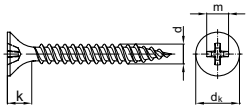
EN 14566

Dimensions	3.9
$d_{max.}$	4.3
$k_{max.}$	5
$d_{k\ max.}$	8.5
m	PH2

Dimensions in stock:
Steel/Steel coated: pg. 450

Article 89151

Drywall screws
with trumpet head and fine pitch thread



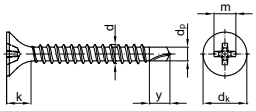
EN 14566

Dimensions	3,9
$d_{max.}$	4
$k_{max.}$	5
$d_{k\ max.}$	8,5
m	PH2

Dimensions in stock:
Steel/Steel coated: pg. 451

Article 89152

Drywall screws
with trumpet head and drilling point



EN 14566

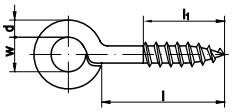
Dimensions	3.5
$d_{max.}$	3.53
$k_{max.}$	6
y~	3.9
d_p~	2.8
$d_{k\ max.}$	8.4
m	PH2

Dimensions in stock:
Steel/Steel coated: pg. 451

Hooks/special bolts with wood screw thread

Article 88133

Screw eyes
with wood screw thread
type 1



Dimensions	6x3	8x3	8x4	10x3	10x4	10x6	12x3	12x4
w	3	8	4	3	4	6	3	4
d	2	2	2.3	2	2.3	2.9	2	2.3
l	6	8	8	10	10	10	12	12
l_1	4	5	5	7	7	7	8	8

Dimensions	12x6	12x8	12x10	16x4	16x6	16x8	16x10	16x12
w	6	8	10	4	6	8	10	12
d	2.9	3.3	3.7	2.3	2.9	3.3	3.7	3.9
l	12	12	12	16	16	16	16	16
l_1	8	8	8	10	10	10	10	10

Dimensions	20x6	20x8	20x10	20x12	25x8	25x10	25x12	25x14
w	6	8	10	12	8	10	12	14
d	2.9	3.3	3.7	3.9	3.3	3.7	3.7	4
l	20	20	20	20	25	25	25	25
l_1	12	12	12	12	15	15	15	15

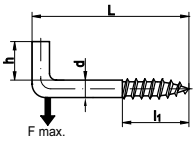
Dimensions	25x16	30x8	30x10	30x12	30x14	30x16	30x18	40x12
w	16	8	10	12	14	16	18	12
d	4.6	3.3	3.7	3.9	4	4.6	5	3.9
l	25	30	30	30	30	30	30	40
l_1	15	18	18	18	20	18	18	22

Dimensions	40x14	40x16	40x18	40x20	50x14	50x16	50x18	50x20
w	14	16	18	20	14	16	18	20
d	4	4.6	5	5.2	4	4.6	5	5.2
l	40	40	40	40	50	50	50	50
l_1	25	22	22	22	25	25	25	25

Dimensions in stock:
Steel/Steel coated: pg. 434

Article 88137

Square bend screw hooks
with wood screw thread
type 4



Dimensions	2.8	2.8	3.3	4.1
h	8	10	11	11
d	2.3	2.3	2.6	3.2
l	20	25	30	40
l_1	8	10	12	15
$F_{max.}$	7.5 kg	7.5 kg	10 kg	12.5 kg
for plugs	4	4	5	6

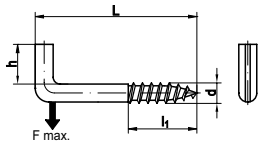
Dimensions	4.8	4.8	5.5	6
h	13	13	18	18
d	3.8	3.8	4.2	4.7
l	50	60	80	100
l_1	22	25	32	38
$F_{max.}$	15 kg	15 kg	20 kg	25 kg
for plugs	6	6	8	8

Dimensions in stock:
Steel/Steel coated: pg. 435

Hooks/special bolts with wood screw thread

Article 88139

Square bend slotted screw hooks with wood screw thread
type 7

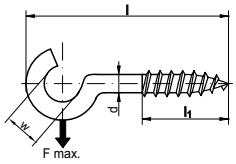


Dimensions	4.4	5.2	5.8
h	9	10	12
d	4.4	5.2	5.8
l	40/50	30/40/50/60	80/100
l_1	18/22	13/18/22/25	30/38
$F_{max.}$	25 kg	40 kg	50 kg
for plugs	6	8	8

Dimensions in stock:
Steel/Steel coated: pg. 435

Article 88140/88141

Screw hooks/Cup hooks with wood screw thread
type 11/type 11 k



Dimensions	2.8	3.3	3.6	4.1
w	6/8	10 – 11	12 – 14	16 – 20
d	2.3	2.6	2.8	3.2
l	20/25	30	40	50/60
l_1	6/8	10	12	15/22
$F_{max.}$	4 kg	4 kg	7.5 kg	9 kg
for plugs	4	5	5	6

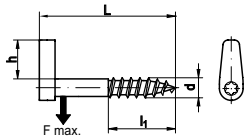
Dimensions	4.8	5.5	6	
w	22 – 23	25 – 26	25 – 30	
d	3.8	4.2	4.7	
l	70	80	100	
l_1	22	26	30	
$F_{max.}$	10 kg	12.5 kg	15 kg	
for plugs	6	8	8	

type 11 k = coated white

Dimensions in stock:
Steel/Steel coated: pg. 435

Article 88143

Right angle screw hooks with hexalobular drive and wood screw thread
type 10



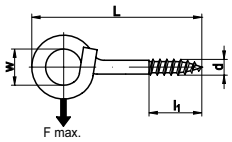
Dimensions	5.2	5.8
h	9	10
d	5.2	5.8
l	50	
l_1	25	30
ISR	T15	T20
$F_{max.}$	40 kg	50 kg
for plugs	8	8

Dimensions in stock:
Steel/Steel coated: pg. 436

Hooks/special bolts with wood screw thread

Article 88144

Heavy duty screw eyes with wood screw thread
type 18



Caution: unfit for swings

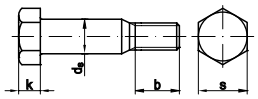
Dimensions	8.2	9	10
w	22	22	22
d	8.2	8.9	9.9
l	100	120/140	140
l_1	40	45/48	48
$F_{max.}$	100 kg	125 kg	150 kg
for plugs	12	12	14

Dimensions in stock:
Steel/Steel coated: pg. 436

Steel constr. bolts, nuts and washers

DIN 7968

Hexagon fit bolts for steel structure



EN 15048

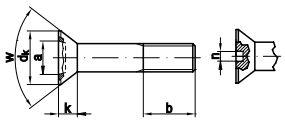
Dimensions	M 12	M 16	M 20	M 24	M 27	M 30
b	20.5	24.5	28.5	33	35.5	38.5
k	8	10	13	15	17	19
$d_{s\ min.}$	12.74	16.74	20.71	24.71	27.71	30.67
s	18	24	30	36	41	46

with nut acc. to ISO 4032 or ISO 4034

Dimensions in stock:
Steel/Steel coated: pg. 352

DIN 7969

Slotted countersunk head bolts for steel structures



EN 15048

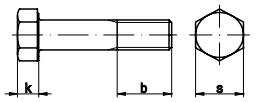
Dimensions	M 12	M 16	M 20	M 24
W	75°	75°	60°	60°
b_1	22	28	32	38
b_2	28	35	40	50
$d_{k\ max.}$	21	28	32	38
k	7	9	11.5	13
n	2.5	2.5	3	3
t	3	3	3.5	3.5
$a_{max.}$	14.7	19.6	22.4	26.6

with nut acc. to ISO 4032 or ISO 4034,
b_1 for l ≤ 60 with M 12 and l ≤ 80 with M 16 – M 24
b_2 for l > 60 with M 12 and l > 80 with M 16 – M 24

Dimensions in stock:
Steel/Steel coated: pg. 354

DIN 7990

Hexagon head bolts with hexagon nut for steel structures



EN 15048

Dimensions	M 12	M 16	M 20	M 24	M 27	M 30
k	8	10	13	15	17	19
s	18	24	30	36	41	46
b	20.5	24.5	28.5	33	35.5	38.5

with nut acc. to ISO 4032 or ISO 4034

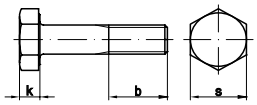
Dimensions in stock:
Steel/Steel coated: pg. 367

Steel constr. bolts, nuts and washers

EN 14399-4

replaces DIN 6914

Hexagon bolts with large head for high-strength structural bolting, system HV



EN 14399

*acc. to DAST directive pg. 021

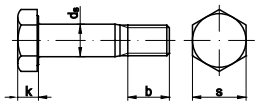
Dimensions	M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 36	M 42*
k	8	10	13	14	15	17	19	23	26
s	22	27	32	36	41	46	50	60	70
b	23	28	33	34	39	41	44	52	74

Dimensions in stock:
Steel/Steel coated: pg. 397

EN 14399-8

replaces DIN 7999

Hexagon fit bolts with large head for high-strength structural bolting, system HV



EN 14399

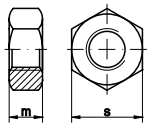
Dimensions	M 16	M 20	M 22	M 24	M 27	M 30
k	10	13	14	15	17	19
d_s	17	21	23	25	28	31
b	28	33	34	39	41	44
s	27	32	36	41	46	50

Dimensions in stock:
Steel/Steel coated: pg. 402

EN 14399-4

replaces DIN 6915

Hexagon nuts for high-strength structural bolting, system HV



EN 14399

*acc. to DAST directive pg. 021

Dimensions	M 12	M 16	M 20	M 22	M 24
m	10	13	16	18	20
s	22	27	32	36	41

Dimensions	M 27	M 30	M 36	M 42*	
m	22	24	29	34	
s	46	50	60	70	

Dimensions in stock:
Steel/Steel coated: pg. 402

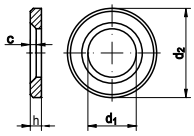
DIN 6917 Square taper washers for friction grip bolts	Dimensions see TI-86 (washers/rings - square washers)
DIN 6918 Square taper washers for friction grip bolts	

Steel constr. bolts, nuts and washers

EN 14399-6

replaces DIN 6916

Plain chamfered washers for high-strength structural bolting, system HV



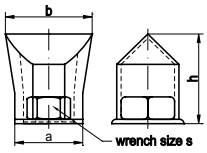
*acc. to DAST directive pg. 021

Dimensions	M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 36	M 42*
$d_{1\ min.}$	13	17	21	23	25	28	31	37	43.4
$d_{2\ max.}$	24	30	37	39	44	50	56	66	78
h	3	4	4	4	4	5	5	6	8
$c_{min.}$	1.6	1.6	2	2	2	2.5	2.5	2.5	3

Dimensions in stock:
Steel/Steel coated: pg. 402

Article 88916

Safety sockets for HV

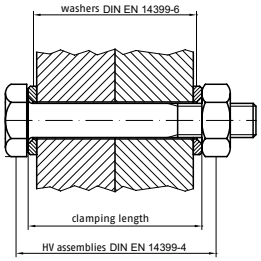


Dimensions	M 12	M 16	M 20	M 24	M 27	M 30	M 36
a	32	40	45	56	61	69	76
b	45	54	61	80	85	89	110
h	39	52	54	64	68	73	86
s	22	27	32	41	46	50	60

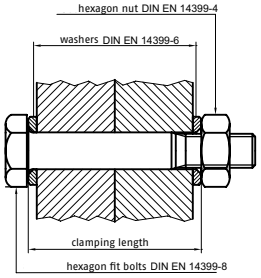
Dimensions in stock:
Steel/Steel coated: pg. 402

Clamping length for bolts for steel constructions

Bolts, system HV acc. to EN 14399 - 4



fit bolts acc. to EN 14399 - 8



Thread	M 12		M 16		M 20		M 22		M 24		M 27		M 30		M 36	
Nominal length	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
30	11	16														
35	16	21	12	17												
40	21	26	17	22	13	18										
45	26	31	22	27	18	23										
50	31	36	27	32	23	28	22	27	19	24						
55	36	41	32	37	28	33	27	32	24	29						
60	41	46	37	42	33	38	32	37	29	34	26	31				
65	46	51	42	47	38	43	37	42	34	39	31	36				
70	51	56	47	52	43	48	42	47	39	44	36	41	34	39		
75	56	61	52	57	48	53	47	52	44	49	41	46	39	44		
80	61	66	57	62	53	58	52	57	49	54	46	51	44	49		
85	66	71	62	67	58	63	57	62	54	59	51	56	49	54	43	48
90	71	76	67	72	63	68	62	67	59	64	56	61	54	59	48	53
95	76	81	72	77	68	73	67	72	64	69	61	66	59	64	53	58
100	81	86	77	82	73	78	72	77	69	74	66	71	64	69	58	63
105	86	91	82	87	78	83	77	82	74	79	71	76	69	74	63	68
110	91	96	87	92	83	88	82	87	79	84	76	81	74	79	68	73
115	96	101	92	97	88	93	87	92	84	89	81	86	79	84	73	78
120	101	106	97	102	93	98	92	97	89	94	86	91	84	89	78	83
125			102	107	98	103	97	102	94	99	91	96	89	94	83	88
130			107	112	103	108	102	107	99	104	96	101	94	99	88	93
135			112	117	108	113	107	112	104	109	101	106	99	104	93	98
140			117	122	113	118	112	117	109	114	106	111	104	109	98	103
145			122	127	118	123	117	122	114	119	111	116	109	114	103	108
150			127	132	123	128	122	127	119	124	116	121	114	119	108	113
155			132	137	128	133	127	132	124	129	121	126	119	124	113	118
160			137	142	133	138	132	137	129	134	126	131	124	129	118	123
165			142	147	138	143	137	142	134	139	131	136	129	134	123	128
170			147	152	143	148	142	147	139	144	136	141	134	139	128	133
175			152	157	148	153	147	152	144	149	141	146	139	144	133	138
180			157	162	153	158	152	157	149	154	146	151	144	149	138	143
185			162	166	158	162	157	161	154	159	151	156	149	154	143	148
190			167	171	163	167	162	166	159	164	156	161	154	159	148	153
195			172	176	168	172	167	171	164	169	161	166	159	164	153	158
200			177	181	173	177	172	176	169	174	166	171	164	169	158	163
210			187	191	183	187	182	186	179	184	176	181	174	179	168	173
220			197	201	193	197	192	196	189	194	186	191	184	189	178	183
230					203	207	202	206	199	204	196	201	194	199	188	193
240					213	217	212	216	209	214	206	211	204	209	198	203
250					223	227	222	226	219	224	216	221	214	219	208	213
260					233	237	232	236	229	233	226	230	224	228	218	222

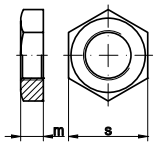
The maximum clamping length values are set in such a way that the bolt thread in preload condition exceeds the nuts by min. 1P. Details on washer thickness EN 14399-6 ➔ TI-58, -85, -86

Design standards and assembly instructions ➔ EN 1090-1/EN 1993-1, -8

Hexagon nuts

DIN 431

Pipe nuts with thread acc. to ISO 228-1
type B = with thread one-sided countersunk



Dimensions	G 1/8	G 1/4	G 3/8	G 1/2	G 3/4
$m_{max.}$	6,48	6,48	7,58	5,58	9,58
$s_{max.}$	19	22	27	32	36

Dimensions	G 1	G 1 1/4	G 1 1/2	G 1 3/4	G 2
$m_{max.}$	10,58	11,7	12,7	13,7	13,7
$s_{max.}$	46	55	60	70	75

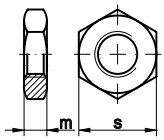
Dimensions in stock:
Steel/Steel coated: pg. 80 | Stainless steel: pg. 465 | Non-ferrous materials: pg. 618

Hexagon nuts

ISO 4035

replaces DIN 439

Hexagon thin nuts
type B = chamfered



Dimensions	M 2	M 2.5	M 3	M 3.5	M 4	M 5	M 6	M 8
$m_{max.}$	1.2	1.6	1.8	2	2.2	2.7	3.2	4
$s_{ISO/DIN}$	4	5	5.5	6	7	8	10	13

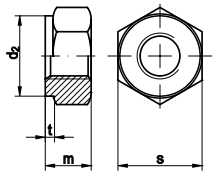
Dimensions	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
$m_{max.}$	5	6	7	8	9	10	11	12
$s_{ISO/DIN}$	16/17	18/19	21/22	24	27	30	34/32	36

Dimensions	M 27	M 30	M 33	M 35	M 36	M 39	M 42	M 48
$m_{max.}$	13.5	15	16.5	17.5	18	19.5	21	24
$s_{ISO/DIN}$	41	46	50	55	55	60	65	75

Dimensions in stock:
Steel/Steel coated: pg. 284, pg. 82 | Stainless steel: pg. 547, pg. 467 | Non-ferrous materials: pg. 638, pg. 619

DIN 2510

Hexagon nuts
for bolted connections with reduced shank
type NF = standard



Dimensions	M 12	M 14*	M 16	M 20	M 24	M 27	M 30
s	22	24	27	32	36	41	46
m	12	14	16	20	24	27	30
d_2	21	23	26	31	35	40	45
t	2	2	2	2	3	3	3

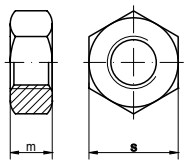
Dimensions	M 33	M 36	M 39	M 42	M 45	M 48	
s	50	55	60	65	70	75	
m	33	36	39	42	45	48	
d_2	49	53.5	58.5	63.5	68.5	73.5	
t	3	3	3	3	3	4	

*not standardized, reference values

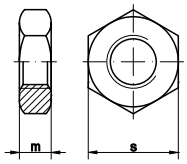
Dimensions in stock:
Steel/Steel coated: pg. 233

ASME B 18.2.2

Nuts with unified inch thread



Hex nuts*



Hex jam nuts*

Dimensions	1/4	5/16	3/8	7/16	1/2	9/16	5/8
s	7/16	1/2	9/16	11/16	3/4	7/8	15/16
m (hex nuts)	0.226	0.273	0.337	0.385	0.448	0.496	0.559
m (jam nuts)	0.163	0.195	0.227	0.26	0.323	0.324	0.387

Dimensions	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4
s	1 1/8	1 5/16	1 1/2	1 11/16	1 7/8	2 1/4	2 5/8
m (hex nuts)	0.665	0.776	0.887	0.999	1.094	1.317	1.540
m (jam nuts)	0.446	0.51	0.575	0.639	0.751	0.88	1.009

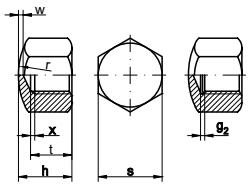
all dimensions in inches
*acc. to ASME B 18.2.2: 2010 table 4

Dimensions in stock:
Steel/Steel coated: pg. 414 | Stainless steel: pg. 592

Hexagon nuts

DIN 917

Hexagon cap nuts, low type



from M 10 thread undercuts acc. to DIN 76-1 (type D short) with the dimension $g_{2\ MAX}$

Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
$x_{max.}/g_{2\ max.}$	1.05	1.2	1.5	1.87	2.25	6.4
h	5.5	7	9	12	14	16
r	8	10	12	15	20	25
$s_{ISO/DIN}$	7	8	10	13	16/17	18/19
$t_{min.}$	4.16	4.96	6.71	9.21	10.65	13.15
$w_{min.}$	1	1	1.5	2	2	2

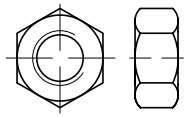
Dimensions	M 14	M 16	M 20	M 24	M 30	M 36
$x_{max.}/g_{2\ max.}$	7.3	7.3	9.3	10.7	12.7	14
h	18	20	25	30	34	44
r	28	30	35	40	60	70
$s_{ISO/DIN}$	21/22	24	30	36	46	55
$t_{min.}$	14.65	16.65	20.58	23.58	27.58	35.5
$w_{min.}$	2	2	2.5	3	3	4

Dimensions in stock:
Steel/Steel coated: pg. 141 | Stainless steel: pg. 485 | Non-ferrous materials: pg. 624

ISO 4032, 8673

replaces DIN 934

Hexagon regular nuts
ISO 8673 with metric fine pitch thread



Dimensions	M 1*	M 1,2*	M 1,4*	M 1,6	M 1,7**	M 2	M 2,3**	M 2,5
$m_{ISO/DIN}$	0,8	1	1,2	1,3	1,4	1,6	1,8	2
$s_{ISO/DIN}$	2,5	3	3	3,2	3,5	4	4,5	5

Dimensions	M 2,6**	M 3	M 3,5	M 4	M 5	M 6	M 7*	M 8
$m_{ISO/DIN}$	2	2,4	2,8	3,2	4,7/4	5,2/5	5,5	6,8/6,5
$s_{ISO/DIN}$	5	5,5	6	7	8	10	11	13

Dimensions	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
$m_{ISO/DIN}$	8,4/8	10,8/10	12,8/11	14,8/13	15,8/15	18/16	19,4/18	21,5/19
$s_{ISO/DIN}$	16/17	18/19	21/22	24	27	30	34/32	36

Dimensions	M 26**	M 27	M 28**	M 30	M 32**	M 33	M 35**	M 36
$m_{ISO/DIN}$	22	23,8/22	22	25,6/24	26	28,7/26	29	31/29
$s_{ISO/DIN}$	41	41	41	46	50	50	55	55

Dimensions	M 38**	M 39	M 40**	M 42	M 45	M 48	M 50**	M 52
$m_{ISO/DIN}$	31	33,4/31	31	34	36	38	38	42
$s_{ISO/DIN}$	60	60	60	65	70	75	75	80

Dimensions	M 56	M 58**	M 60	M 64	M 68*	M 72*	M 76*	M 80*
$m_{ISO/DIN}$	45	48	48	51	54	58	61	64
$s_{ISO/DIN}$	85	90	90	95	100	105	110	115

Dimensions	M 85*	M 90*	M 95**	M 100*	M 105**	M 110*	M 120**	
$m_{ISO/DIN}$	68	72	76	80	84	88	96	
$s_{ISO/DIN}$	120	130	135	145	150	155	170	

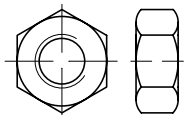
*dimensions acc. to DIN 934
**dimensions acc. to DIN 934:1968

Dimensions in stock:
Steel/Steel coated: pg. 278, pg. 369, pg. 168 | Stainless steel: pg. 544, pg. 582, pg. 495 | Non-ferrous materials: pg. 637, pg. 642, pg. 626

Hexagon nuts

ISO 4033

Hexagon thin nuts type 2



Dimensions	M 6	M 8	M 10	M 12	M 16
m	5.7	7.5	9.3	12	16.4
s	10	13	16	18	24

Dimensions	M 20	M 24	M 27*	M 30	M 36
m	20.3	23.9	26.7	28.6	34.7
s	30	36	41	46	55

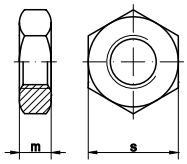
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 284

ISO 4035, 8675

replaces DIN 439-2, 936

Hexagon thin nuts chamfered
ISO 8675 with metric fine pitch thread



*not standardized,
reference values acc. to 936:1963

Dimensions	M 2	M 2.5	M 3	M 3.5	M 4	M 5	M 6	M 8
$m_{ISO/DIN}$	1.2	1.6	1.8	2	2.2	2.7	3.2	4/5
$s_{ISO/DIN}$	4	5	5.5	6	7	8	10	13

Dimensions	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
$m_{ISO/DIN}$	5/6	6/7	7/8	8	9	10/9	11/10	12/10
$s_{ISO/DIN}$	16/17	18/19	21/22	24	27	30	34/32	36

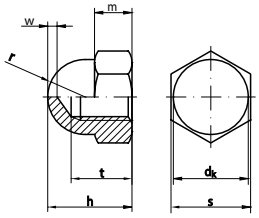
Dimensions	M 26	M 27	M 28*	M 30	M 32*	M 33	M 35*	M 36
$m_{ISO/DIN}$	13/12	13.5/12	14/12	15/12	16/14	16.5/14	17.5/14	18/14
$s_{ISO/DIN}$	41	41	41	46	50	50	55	55

Dimensions	M 38*	M 39	M 40*	M 42	M 45	M 48	M 50*	M 52
$m_{ISO/DIN}$	19/16	19.5/16	20/16	21/16	22.5/18	24/18	25/20	26/20
$s_{ISO/DIN}$	60	60	60	65	70	75	75	80

Dimensions in stock:
Steel/Steel coated: pg. 284, pg. 371, pg. 174 | Stainless steel: pg. 547, pg. 582, pg. 497 | Non-ferrous materials: pg. 638, pg. 643, pg. 627

DIN 1587

Hexagon domed cap nuts, high type



Dimensions	M 3*	M 4	M 5	M 6	M 8	M 10	M 12	M 14
$d_{k\ max.}$	5.8	6.5	7.5	9.5	12.5	15	17	20
$m_{max.}$	2.4	3.2	4	5	6.5	8	10	11
r	2.9	3.25	3.75	4.75	6.25	7.5	8.5	10
$s_{ISO/DIN}$	5.5	7	8	10	13	16/17	18/19	21/22
$t_{min.}$	4.5	5.26	7.21	7.71	10.65	12.65	15.65	17.65
$w_{min.}$	2	2	2	2	2	2	3	4
h	6	8	10	12	15	18	22	25

Dimensions	M 16	M 18	M 20	M 22	M 24	M 27*	M 30*	
$d_{k\ max.}$	23	26	28	33	34	39	44	
$m_{max.}$	13	15	16	18	19	22	24	
r	11.5	13	14	16.5	17	19.5	22	
$s_{ISO/DIN}$	24	27	30	34/32	36	41	46	
$t_{min.}$	20.58	24.58	25.58	28.58	30.5	35	39	
$w_{min.}$	4	5	5	5	6	7	7	
h	28	32	34	39	42	45	50	

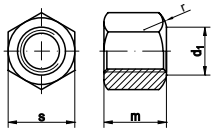
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 221 | Stainless steel: pg. 521 | Non-ferrous materials: pg. 633

Hexagon nuts

DIN 6330

Hexagon nuts with a height of 1,5 d
type B = with one spherical bearing face



Dimensions	M 6	M 8	M 10	M 12	M 14	M 16
d_1	7	9	11.5	14	16	18
m	9	12	15	18	21	24
r	9	11	15	17	20	22
s	10	13	16/17*	18/19*	22	24

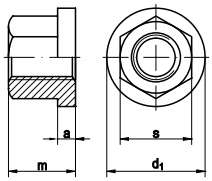
Dimensions	M 18	M 20	M 22	M 24	M 27	M 30
d_1	20	22	25	26	29	32
m	27	30	33	36	40	45
r	25	27	29	32	37	41
s	27	30	32	36	41	46

*wrench sizes acc. to DIN 6330: 1965-03

Dimensions in stock:
Steel/Steel coated: pg. 309 | Stainless steel: pg. 553

DIN 6331

Hexagon nuts with a height of 1.5 d, with collar



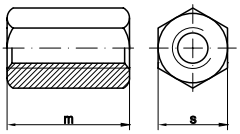
Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 18
a	3	3.5	4	4	4	5	5
d_1	14	18	22	25	28	31	34
m	9	12	15	18	21	24	27
s	10	13	16	18	22	24	27

Dimensions	M 20	M 22	M 24	M 27	M 30	M 36	M 42
a	6	6	6	7	8	10	12
d_1	37	40	45	50	58	68	80
m	30	33	36	40	45	54	63
s	30	32	36	41	46	55	65

Dimensions in stock:
Steel/Steel coated: pg. 309 | Stainless steel: pg. 553

~DIN 6334

Hexagon nuts, with a height of 3 d



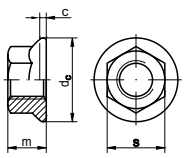
Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36
m	18	24	30	36	48	60	72	90	108
s	10	13	17	19	24	30	36	46	55

Dimensions in stock:
Steel/Steel coated: pg. 310 | Stainless steel: pg. 553

EN 1661

replaces DIN 6923

Hexagon flange nuts



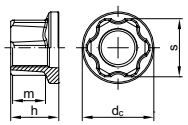
Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16	M 20
$d_{c\ max.}$	10	11.8	14.2	17.9	21.8	26	34.5	42.8
$m_{max.}$	4.65	5	6	8	10	12	16	20
$s_{EN/DIN}$	7	8	10	13	16/15	18	24	30

Dimensions in stock:
Steel/Steel coated: pg. 222, pg. 322 | Stainless steel: pg. 521, pg. 558

Hexagon nuts

EN 13024

Lightweight nuts with flange

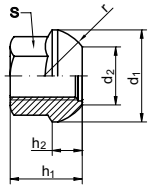


Dimensions	M 16x1.5
$d_{c\ max.}$	30.5
$h_{max.}$	20.5
$m_{min.}$	9.5
s	24

Dimensions in stock:
Steel/Steel coated: pg. 396

DIN 74361

Domed anchor nuts
type A

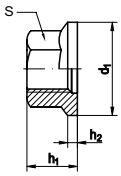


Dimensions	M 14x1.5	M 18x1.5	M 20x1.5
d_1	26	28	33
d_2	17	21	24.5
h_1	20	25	27
h_2	7.5	7.5	9
r	14	16	18
s	19	24	27

Dimensions in stock:
Steel/Steel coated: pg. 410

DIN 74361

Flat collar nuts
type B

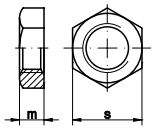


Dimensions	M 14x1.5	M 18x1.5	M 20x1.5	M 22x1.5
d_1	27	29	34	36
h_1	15	18	20	22
h_2	3	4	5	6
s	19	24	27	30

Dimensions in stock:
Steel/Steel coated: pg. 410

DIN 80705

Thin hexagonal nuts with small wrench size



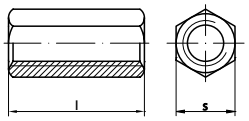
Dimensions	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5	M 26x1.5	M 30x2
m	6	6	6	6	7	8	8
s	19	22	24	27	30	36	41

Dimensions in stock:
Steel/Steel coated: please refer www.rio.reyher.de

Hexagon nuts

Article 88087

**Hexagon couplings
with continuous metric internal thread**

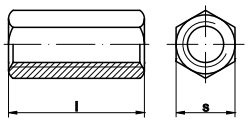


Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30
s	10	13	17	19	24	30	36	46
l	20/25/ 30/40	30	30	40/50	50	50	50	90

Dimensions in stock:
Steel/Steel coated: pg. 417 | Stainless steel: pg. 592

Article 88090

**Hexagon nuts with trapezoidal thread,
with a height of 1.5 d**



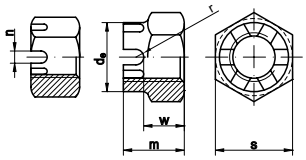
Dimensions	TR 16x4	TR 20x4	TR 24x5	TR 30x6
s	27	30	36	46
m	24	30	36	45

Dimensions in stock:
Steel/Steel coated: pg. 417

Locking nuts

DIN 935-1

Hexagon slotted and castle nuts



≤ M 10 ≥ M 12

Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16
$d_{e\ max.}$	–	–	–	–	–	16	18	22
m	5	6	7.5	9.5	12	15	16	19
$n_{min.}$	1.2	1.4	2	2.5	2.8	3.5	3.5	4.5
$s_{ISO/DIN}$	7	8	10	13	16/17	18/19	21/22	24
$w_{max.}$	3.2	4	5	6.5	8	10	11	13
split pin	1x10	1.2x12	1.6x14	2x16	2.5x20	3.2x22	3.2x25	4x28

Dimensions	M 18	M 20	M 22	M 24	M 27	M 28*	M 30	M 32*
$d_{e\ max.}$	25	28	32	34	38	38	42	46
m	21	22	26	27	30	30	33	35
$n_{min.}$	4.5	4.5	5.5	5.5	5.5	5.5	7	7
$s_{ISO/DIN}$	27	30	34/32	36	41	41	46	50
$w_{max.}$	15	16	18	19	22	22	24	26
split pin	4x32	4x36	5x36	5x40	5x45	5x50	6.3x50	6.3x56

Dimensions	M 33	M 36	M 38*	M 39	M 40*	M 42	M 45	M 48
$d_{e\ max.}$	46	50	55	55	55	58	62	65
m	35	38	40	40	48	46	48	50
$n_{min.}$	7	7	7	7	7	9	9	9
$s_{ISO/DIN}$	50	55	60	60	60	65	70	75
$w_{max.}$	26	29	31	31	31	34	36	38
split pin	6.3x56	6.3x63	6.3x70	6.3x71	6.3x70	8x71	8x80	8x80

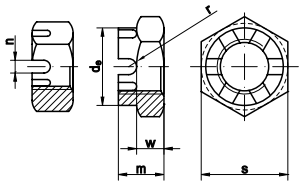
Dimensions	M 52	M 56	M 60	M 64	M 68	M 72	M 76	M 80
$d_{e\ max.}$	70	75	80	85	90	95	100	105
m	54	57	63	66	69	73	76	79
$n_{min.}$	9	9	11	11	11	11	11	11
$s_{ISO/DIN}$	80	85	90	95	100	105	110	115
$w_{max.}$	42	45	48	51	54	58	61	64
split pin	8x90	8x100	10x100	10x100	10x112	10x112	10x125	10x140

*acc. to DIN 935:1963

Dimensions in stock:
Steel/Steel coated: pg. 173 | Stainless steel: pg. 497

DIN 937

Hexagon thin slotted and castle nuts



≤ M 10 ≥ M 12

Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20
$d_{e\ max.}$	–	–	–	17	19	22	25	28
m	6	8	9	10	11	12	13	13
$n_{min.}$	2	2.5	2.8	3.5	3.5	4.5	4.5	4.5
s	10	13	17	19	22	24	27	30
$w_{max.}$	3.5	4.5	5	6	7	7	8	8
split pin	1.6x14	2x16	2.5x20	3.2x22	3.2x25	4x28	4x32	4x36

Dimensions	M 22	M 24	M 26*	M 27	M 28*	M 30	M 32*	M 33
$d_{e\ max.}$	30	34	38	38	38	42	46	46
m	15	15	30	17	30	18	20	20
$n_{min.}$	5.5	5.5	5.5	5.5	5.5	7	7	7
s	32	36	41	41	41	46	50	50
$w_{max.}$	9	9	22	11	22	11	13	13
split pin	5x36	5x40	5x50	5x45	5x50	6.3x50	6x60	6.3x56

Dimensions	M 35*	M 36	M 39	M 40*	M 42	M 48	M 52	
$d_{e\ max.}$	50	50	55	55	58	65	70	
m	20	20	22	22	23	25	27	
$n_{min.}$	7	7	7	7	9	9	9	
s	55	55	60	60	65	75	80	
$w_{max.}$	13	13	13	13	14	16	18	
split pin	6x65	6.3x63	6.3x71	6x70	8x71	8x80	8x90	

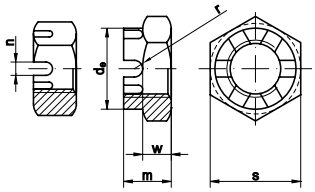
*acc. to DIN 937: 1963

Dimensions in stock:
Steel/Steel coated: pg. 176

Locking nuts

DIN 979

Hexagon thin slotted and castle nuts



≤ M 10 ≥ M 12

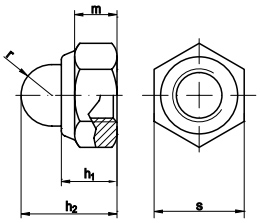
Dimensions	M 16	M 18	M 20	M 24	M 30	M 36	M 42	M 48	M 52
$d_{e\ max.}$	22	25	28	34	42	50	58	65	70
m	13	15	16	19	24	29	33	36	38
$n_{min.}$	4.5	4.5	4.5	5.5	7	7	9	9	9
s	24	27	30	36	46	55	65	75	80
$w_{max.}$	7	9	10	11	15	20	22	24	26
split pin	4x28	4x32	4x36	5x40	6.3x50	6.3x63	8x71	8x80	8x90

Dimensions in stock:
Steel/Steel coated: pg. 198

ISO 7042, 10513 replaces DIN 980, 6925	Standards conversions and dimensions overview ➔ TI-9
ISO 7040, 10512 replaces DIN 982, 6924	
ISO 10511 replaces DIN 985	

DIN 986

Prevailing torque type hexagon domed cap nuts
with non-metallic insert



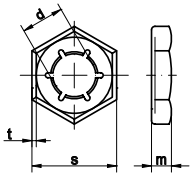
temperature resistance of the insert
see price pages

Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16
h_1	5.6	6	7.5	8.9	10.5	13.5	16.5
h_2	9.6	10.5	12	14	18.1	22.5	27.5
$m_{min.}$	2.9	4.4	4.9	6.44	8.04	10.37	14.1
r	2.5	3	3.5	4.6	5.8	6.8	8.8
s	7	8	10	13	17	19	24

Dimensions in stock:
Steel/Steel coated: pg. 203 | Stainless steel: pg. 512

DIN 7967

Self locking counter nuts



Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 20	M 22
d	5.3	6.9	8.6	10.4	12	14.1	17.6	19.6
m	3	3.5	4	4.5	5	5	6	6
s	10	13	17	19	22	24	30	32
t	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8

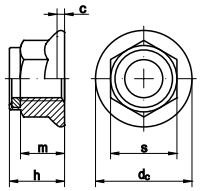
Dimensions	M 24	M 27	M 30	M 33	M 36	M 42	M 48	
d	21	24.2	26.6	29.8	32.2	37.6	43.9	
m	7	7	8	8	9	11	14	
s	36	41	46	50	55	65	75	
t	0.9	1	1.1	1.2	1.3	1.4	1.6	

Dimensions in stock:
Steel/Steel coated: pg. 352 | Stainless steel: pg. 574

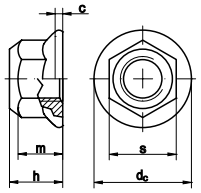
Locking nuts

EN 1663, 1664

Prevailing torque type hexagon nuts with flange



EN 1663 = with non-metallic insert



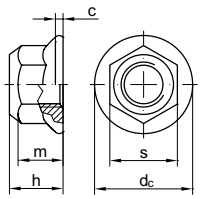
EN 1664 = all-metal hexagon nut

Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
$c_{min.}$	1	1.1	1.2	1.5	1.8	2.4
d_c	11.8	14.2	17.9	21.8	26	34.5
$h_{max.\ (1663)}$	7.1	9.1	11.1	13.5	16.1	20.3
$h_{max.\ (1664)}$	6.2	7.3	9.4	11.4	13.8	18.3
$m_{min.}$	4.7	5.7	7.6	9.6	11.6	15.3
s	8	10	13	16	18	24

Dimensions in stock:
Steel/Steel coated: pg. 223, pg. 223

Article 13023

Hexagon nuts with flange, acc. to MBN 13023 type A

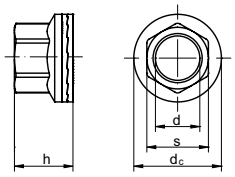


Dimensions	M 12x1.5	M 14x1.5	M 16x1.5
$c_{min.}$	1.8	2.1	2.4
$d_{c\ max.}$	26	29.9	34.5
$h_{max.}$	13.8	15.9	18.3
$m_{min.}$	11.6	13.3	15.3
s	18	21	24

Dimensions in stock:
Steel/Steel coated: pg. 396

Article 88034

HEICO-LOCK wedge lock nuts



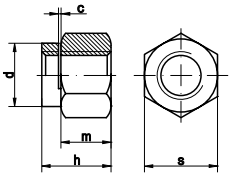
Dimensions	M 6	M 8	M 10	M 12	M 16
type	HLM	HLM	HLM	HLM	HLM
h	9.2	12.2	15.2	17.2	21.2
d_c	14.2	17.9	21.8	26	34.5
s	10	13	16	18	24

Dimensions in stock:
Steel/Steel coated: pg. 434

Locking nuts

Article 88105

Prevailing torque type hexagon nuts, THERMAG nuts
all-metal nut

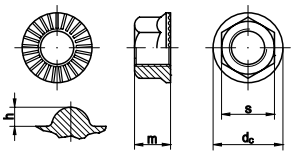


Dimensions	M 8 WS12	M 8 WS13	M 10 WS14	M 10 WS17	M 12 WS17	M 12 WS19
d	11.5	12.5	13.5	16.5	16.5	18.5
s	12	13	14	17	17	19
m	5.5	5.5	6.5	6.5	7.5	7.5
c	0.5	0.5	0.5	0.5	0.5	0.5

Dimensions in stock:
Steel/Steel coated: pg. 199

Article 88914

Hexagon nuts with flange and lock ribs

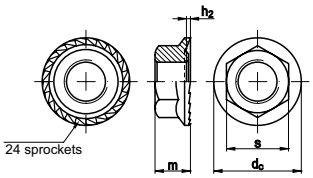


Dimensions	M 5	M 6	M 8	M 10	M 12	M 14	M 16
d_c	11.2	14.2	18.2	21	24	27.5	31
m	4.3	5.5	7	8.5	10	12	14
h	0.1	0.1	0.1	0.1	0.1	0.1	0.1
s	8	10	13	15	17	19	22
qty. ribs	28	36	48	48	60	60	72

Dimensions in stock:
Steel/Steel coated: pg. 440

Article 88934

Hexagon locking nuts with flange

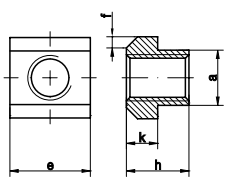


Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
d_c	11.2	14.25	18.25	21	24	31
m	4.3	5.5	7	7.9	8.7	11.2
$h_{2\ min.}$	0.15	0.17	0.2	0.25	0.25	0.28
qty. serrations	24	24	24	24	24	24

Dimensions in stock:
Steel/Steel coated: pg. 442

DIN 508

T-slot nuts



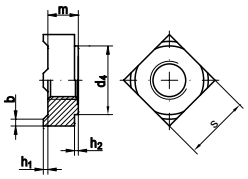
Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 20	M 24
a	5	6	8	10	12	14	16	18	22	28
e	9	10	13	15	18	22	25	28	35	44
f	1	1.6	1.6	1.6	2.5	2.5	2.5	2.5	2.5	4
h	6.5	8	10	12	14	16	18	20	28	36
k	3	4	6	6	7	8	9	10	14	18

Dimensions in stock:
Steel/Steel coated: pg. 92

Welding nuts

DIN 928

Square weld nuts

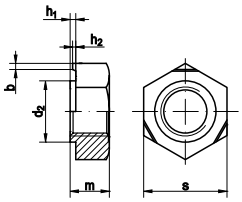


Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
b	0.8	1	1.2	1.5	1.8	2
$d_{4\ min.}$	6.4	8.2	9.1	12.8	15.6	17.4
h_1	0.6	0.8	0.8	1	1.2	1.4
$h_{2\ min.}$	0.4	0.6	0.7	1.1	1.25	1.75
m	3.5	4.2	5	6.5	8	9.5
s	7	9	10	14	17	19

Dimensions in stock:
Steel/Steel coated: pg. 143

DIN 929

Hexagon weld nuts



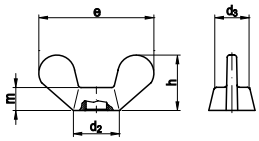
Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16
b	0.8	0.8	0.8	0.9	1	1.25	1.25	1.5	1.5
d_2	4.5	6	7	8	10.5	12.5	14.8	16.8	18.8
h_1	0.55	0.65	0.7	0.75	0.9	1.15	1.4	1.8	1.8
h_2	0.25	0.35	0.4	0.4	0.5	0.65	0.8	1	1
m	3	3.5	4	5	6.5	8	10	11	13
s	7.5	9	10	11	14	17	19	22	24

Dimensions in stock:
Steel/Steel coated: pg. 143 | Stainless steel: pg. 486

Special forms

DIN 315

Wing nuts
rounded wings



Dimensions	M 3*	M 4	M 5	M 6	M 8	M 10
$e_{max.}$	19	20	26	33	39	51
$h_{max.}$	9.5	10.5	13	17	20	25
$m_{max.}$	3.9	4.6	6.5	8	10	12
$d_{2\ max.}$	7	8	11	13	16	20
$d_{3\ max.}$	6	7	9	11	12.5	16.5

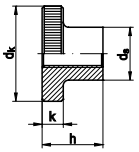
Dimensions	M 12	M 14**	M 16	M 20	M 24	
$e_{max.}$	65	63.5	73	90	110	
$h_{max.}$	33.5	32.3	37.5	46.5	56.5	
$m_{max.}$	14	12	17	21	25	
$d_{2\ max.}$	23	21.5	29	35	44	
$d_{3\ max.}$	19.5	–	23	29	37.5	

*acc. to DIN 315:1956
**not standardized, reference values

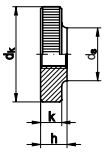
Dimensions in stock:
Steel/Steel coated: pg. 77 | Stainless steel: pg. 464 | Non-ferrous materials: pg. 617

DIN 466, 467

Knurled nuts



DIN 466 = high type



DIN 467 = low type

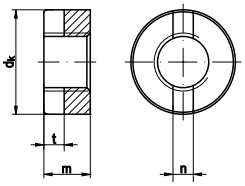
Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12*
d_k	12	16	20	24	30	36	35
d_s	6	8	10	12	16	20	20
k	2.5	3.5	4	5	6	8	8
$h_{DIN\ 466}$	7.5	9.5	11.5	15	18	23	23
$h_{DIN\ 467}$	3	4	5	6	8	10	10

*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 88 | Stainless steel: pg. 469 | Non-ferrous materials: pg. 620

DIN 546

Slotted round nuts



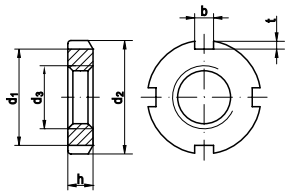
Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 16
$d_{k\ max.}$	6	8	9	11	14	18	21	26
$m_{max.}$	2.5	3.5	4.2	5	6.5	8	10	12
n	1.2	1.4	2	2.5	3	3.5	4	4
t	1	1.2	1.5	2	2.5	3.2	3.8	3.8

Dimensions in stock:
Steel/Steel coated: pg. 92 | Stainless steel: pg. 470 | Non-ferrous materials: pg. 620

Special forms

DIN 981

Locknuts for rolling bearings



Dimensions	KM 0	KM 1	KM 2	KM 3	KM 4	KM 5	KM 6
d_1	M 10x0.75	M 12x1	M 15x1	M 17x1	M 20x1	M 25x1.5	M 30
d_2	18	22	25	28	32	38	45
d_3	13.5	17	21	24	26	32	38
h	4	4	5	5	6	7	7
b	3	3	4	4	4	5	5
t	2	2	2	2	2	2	2
lockwasher*	MB 0	MB 1	MB 2	MB 3	MB 4	MB 5	MB 7

Dimensions	KM 7	KM 8	KM 9	KM 10	KM 11	KM 12	KM 13
d_1	M 35x1.5	M 40x1.5	M 45x1.5	M 50x1.5	M 55x2	M 60x2	M 65x2
d_2	52	58	65	70	75	80	85
d_3	44	50	56	61	67	73	79
h	8	9	10	11	11	11	12
b	5	6	6	6	7	7	7
t	2	2.5	2.5	2.5	3	3	3
lockwasher*	MB 7	MB 8	MB 9	MB 10	MB 11	MB 12	MB 13

Dimensions	KM 14	KM 15	KM 16	KM 17	KM 18	KM 19	KM 20
d_1	M 70x2	M 75x2	M 80x2	M 85x2	M 90x2	M 95x2	M 100x2
d_2	92	98	105	110	120	125	130
d_3	85	90	95	102	108	113	120
h	12	13	15	15	16	17	18
b	8	8	8	8	10	10	10
t	3.5	3.5	3.5	3.5	4	4	4
lockwasher*	MB 14	MB 15	MB 16	MB 17	MB 18	MB 19	MB 20

Dimensions	KM 22	KM 23	KM 24	KM 25	KM 26	KM 27	KM 28
d_1	M 110x2	M 115x2	M 120x2	M 125x2	M 130x2	M 135x2	M 140x2
d_2	145	150	155	160	165	175	180
d_3	133	137	138	148	149	160	160
h	19	19	20	21	21	22	22
b	12	12	12	12	12	14	14
t	5	5	5	5	5	6	6
lockwasher*	MB 22	MB 23	MB 24	MB 25	MB 26	MB 27	MB 28

Dimensions	KM 29	KM 30	KM 31	KM 32	KM 34		
d_1	M 145x2	M 150x2	M 155x3	M 160x3	M 165x3		
d_2	190	195	200	210	210		
d_3	171	171	182	182	193		
h	24	24	25	25	26		
b	14	14	16	16	16		
t	6	6	7	7	7		
lockwasher*	MB 29	MB 30	MB 31	MB 32	MB 33		

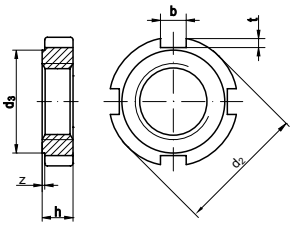
*Lockwashers DIN 5406

Dimensions in stock:
Steel/Steel coated: pg. 200

Special forms

DIN 1804

Slotted round nuts



Dimensions	M 8x1	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5
d_2	20	25	28	30	32	34	36	40
d_3	16	20	23	25	27	28	30	34
b	4	5	5	5	5	6	6	6
h	5	6	6	7	7	8	8	9
t	1.5	2	2	2	2	2.5	2.5	2.5
z	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
qty. slots	4	4	4	4	4	4	4	4

Dimensions	M 24x1.5	M 26x1.5	M 28x1.5	M 30x1.5	M 32x1.5	M 35x1.5	M 38x1.5	M 40x1.5
d_2	42	45	50	50	52	55	58	62
d_3	36	38	43	43	45	48	50	54
b	6	7	7	7	7	7	8	8
h	9	10	10	10	11	11	11	12
t	2.5	3	3	3	3	3	3.5	3.5
z	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
qty. slots	4	4	4	4	4	4	4	4

Dimensions	M 42x1.5	M 45x1.5	M 48x1.5	M 50x1.5	M 52x1.5	M 55x1.5	M 58x1.5	M 60x1.5
d_2	62	68	75	75	80	80	90	90
d_3	54	60	67	67	70	70	80	80
b	8	8	8	8	10	10	10	10
h	12	12	13	13	13	13	13	13
t	3.5	3.5	3.5	3.5	4	4	4	4
z	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
qty. slots	4	6	6	6	6	6	6	6

Dimensions	M 62x1.5	M 65x1.5	M 68x1.5	M 70x1.5	M 72x1.5	M 75x1.5	M 80x2	M 85x2
d_2	95	95	100	100	110	110	115	120
d_3	85	85	90	90	100	100	105	110
b	10	10	10	10	10	10	10	10
h	14	14	14	14	14	14	16	16
t	4	4	4	4	4	4	4	4
z	0.5	0.5	0.5	0.5	0.5	0.5	1	1
qty. slots	6	6	6	6	6	6	6	6

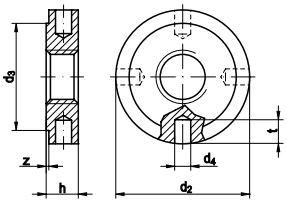
Dimensions	M 90x2	M 95x2	M 100x2	M 110x2	M 120x2			
d_2	130	135	145	155	165			
d_3	120	120	130	140	150			
b	10	12	12	12	12			
h	16	16	16	16	18			
t	4	5	5	5	5			
z	1	1	1	1	1			
qty. slots	6	6	6	6	6			

Dimensions in stock:
Steel/Steel coated: pg. 224 | Stainless steel: pg. 522

Special forms

DIN 1816

Round nuts
with set pin holes inside



Dimensions	M 12x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5	M 24x1.5	M 26x1.5
d_2	28	32	34	36	40	42	45
d_3	23	27	28	30	34	36	38
d_4	3	4	4	4	4	4	5
h	6	7	8	8	9	9	10
t	5	6	6	6	6	6	6
z	0.5	0.5	0.5	0.5	0.5	0.5	0.5
qty. slots	4	4	4	4	4	4	4

Dimensions	M 28x1.5	M 30x1.5	M 35x1.5	M 40x1.5	M 42x1.5	M 45x1.5	M 48x1.5
d_2	50	50	55	62	62	68	75
d_3	43	43	48	54	54	60	67
d_4	5	5	5	6	6	6	6
h	10	10	11	12	12	12	13
t	7	7	7	8	8	8	10
z	0.5	0.5	0.5	0.5	0.5	0.5	0.5
qty. slots	4	4	4	4	4	6	6

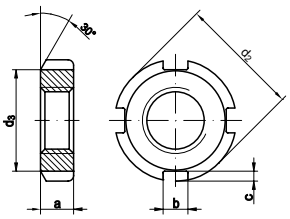
Dimensions	M 50x1.5	M 55x1.5	M 60x1.5	M 70x1.5	M 75x2	M 80x2	
d_2	75	80	90	100	110	115	
d_3	67	70	80	90	100	105	
d_4	6	6	6	8	8	8	
h	13	13	13	14	14	16	
t	10	10	10	12	12	12	
z	0.5	0.5	0.5	0.5	0.5	1	
qty. slots	6	6	6	6	6	6	

Dimensions in stock:
Steel/Steel coated: pg. 225

Special forms

DIN 70852

Locknuts for hook spanners



Dimensions	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5	M 24x1.5
a	5	6	6	6	6	6	7	7
b	4.5	4.5	4.5	5.5	5.5	5.5	6.5	6.5
c	1.8	1.8	1.8	2.3	2.3	2.3	2.8	2.8
d_2	20	22	24	28	30	32	36	38
d_3	18	18	20	23	25	27	30	32
qty. slots	4	4	4	4	4	4	4	4
lockwasher*	10	12	14	16	18	20	22	24

Dimensions	M 26x1.5	M 28x1.5	M 30x1.5	M 32x1.5	M 35x1.5	M 38x1.5	M 40x1.5	M 42x1.5
a	7	7	7	8	8	8	8	8
b	6.5	6.5	6.5	7	7	7	7	8
c	2.8	2.8	2.8	3.3	3.3	3.3	3.3	3.3
d_2	40	42	44	48	50	54	56	60
d_3	34	36	38	41	43	47	49	52
qty. slots	4	4	4	4	4	4	4	4
lockwasher*	26	28	30	32	35	38	40	42

Dimensions	M 45x1.5	M 48x1.5	M 50x1.5	M 52x1.5	M 55x1.5	M 60x1.5	M 65x1.5	M 70x1.5
a	8	8	8	8	8	9	9	9
b	8	8	8	8	8	11	11	11
c	3.3	3.3	3.3	3.3	3.3	4.3	4.3	4.3
d_2	62	65	68	70	75	80	85	90
d_3	54	57	60	62	67	71	76	81
qty. slots	6	6	6	6	6	6	6	6
lockwasher*	45	48	50	52	55	60	65	70

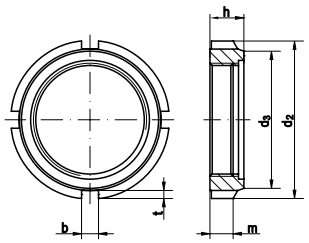
Dimensions	M 75x1.5	M 80x1.5	M 85x1.5	M 90x1.5	M 95x1.5
a	10	10	10	10	10
b	11	11	11	11	11
c	4.3	4.3	4.3	4.3	4.3
d_2	95	100	108	112	118
d_3	86	91	99	103	109
qty. slots	6	6	6	6	6
lockwasher*	75	80	85	90	95

*Lockwashers DIN 70952

Dimensions in stock:
Steel/Steel coated: pg. 408

Article 88081

Locknuts GUK
with non-metallic insert



Dimensions	M 12x1	M 15x1	M 17x1	M 20x1	M 25x1.5	M 30x1.5
d_2	21	24	28	32	38	44
d_3	18	21	24	27	33	38
h	7.6	8.6	8.7	9.6	10.5	10.7
m	4.5	5.5	5.5	6	6.5	6.6
b	3	4	4	4	5	5
t	1.5	1.5	2	2.5	2.5	3
qty. slots	4	4	4	4	4	4

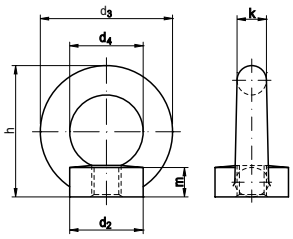
Dimensions	M 35x1.5	M 40x1.5	M 45x1.5	M 50x1.5	M 55x2	M 60x2
d_2	50	56	62	68	75	80
d_3	44	50	55	61	68	73
h	11.3	12.3	12.3	12.9	13.4	13.4
m	7	7.7	7.8	8.1	8.2	8.2
b	5	6	6	6	7	7
t	3	3	3.5	3.5	3.5	3.5
qty. slots	4	4	4	4	6	6

Dimensions in stock:
Steel/Steel coated: pg. 416

Special forms

DIN 582

Lifting eye nuts



Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22
d_2	20	20	25	30	35	35	40	40	50
d_3	36	36	45	54	63	63	72	72	90
d_4	20	20	25	30	35	35	40	40	50
m	8,5	8,5	10	11	13	13	16	16	20
h	36	36	45	53	62	62	71	71	90
k	8	8	10	12	14	14	16	16	20

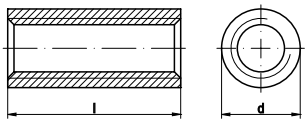
Dimensions	M 24	M 27	M 30	M 33	M 36	M 42	M 48	M 56	
d_2	50	65	65	75	75	85	100	110	
d_3	90	108	108	126	126	144	166	184	
d_4	50	60	60	70	70	80	90	100	
m	20	25	25	30	30	35	40	45	
h	90	109	109	128	128	147	168	187	
k	20	24	24	28	28	32	38	42	

more information ➔ TI-148
*not standardized,
geometry of the next higher dimension

Dimensions in stock:
Steel/Steel coated: pg. 99 | Stainless steel: pg. 473

Article 88088

Round couplings with metric thread



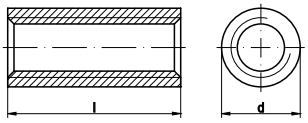
Dimensions	M 6	M 8	M 10
d	10	11	13
l	20/25/30/40	20/25/30/40/45	25/30/40/50

Dimensions	M 12	M 16	M 20
d	15	20	25
l	30/40/50	40	50

Dimensions in stock:
Steel/Steel coated: pg. 417 | Stainless steel: pg. 593

Article 88089

Round nuts with trapezoidal thread



Dimensions	TR 12x3	TR 14x4	TR 16x4	TR 18x4	TR 20x4	TR 22x5	TR 24x5
d	22	36	36	36	36	50	50
l	18	21	24	27	30	33	36

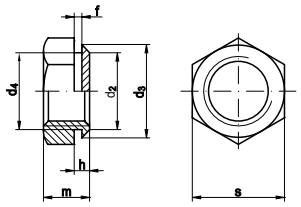
Dimensions	TR 26x5	TR 28x5	TR 30x6	TR 32x6	TR 36x6	TR 40x7	TR 44x7
d	50	60	60	60	75	75	75
l	39	42	45	48	54	60	66

Dimensions in stock:
Steel/Steel coated: pg. 417 | Stainless steel: pg. 593

Special forms

Article 88106

Rivet nuts



Dimensions	M 3	M 4	M 5	M 6
d_2*	4.5	5.5	6.5	8
d_3	4.7	5.7	6.75	8.3
d_4	4.5	5.5	6.5	8
m	3	3.2	4	5
f	0.4	0.4	0.4	0.4
h	0.9	0.9	0.9	0.9
s	5.5	7	8	10

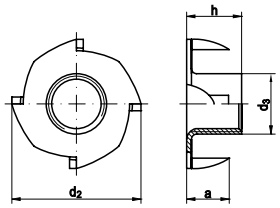
Dimensions	M 8	M 10	M 12	M 16
d_2*	10	12.5	14.5	18.5
d_3	10.3	12.85	14.85	18.85
d_4	10	12.5	14.5	18.5
m	6.5	8	10	13
f	0.9	0.9	1.3	1.5
h	1.9	1.9	2.9	2.4
s	13	15	17	22

*corresponds to drill hole diameter with tol. H11

Dimensions in stock:
Steel/Steel coated: pg. 428 | Stainless steel: pg. 596

Article 88108

Tee nuts with pronge

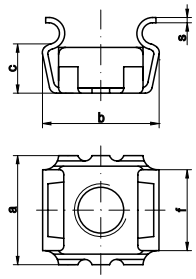


Dimensions	M 4	M 5	M 6	M 8	M 10
d_2	15	17	19	22	25
d_3	5	6.5	7.5	10	11.5
h	6	8	9/12	11/15	13
a	5	7	7	9	11

Dimensions in stock:
Steel/Steel coated: pg. 428

Article 88109

Square caged nuts
type SMG



Dimensions	M 4 - 8/9.5	M 5 - 8/9.5	M 6 - 6/9.5
s	0.5	0.5	0.5
c	4.6	6.3	6.4
b	13.5	13.7	13.9
a	13.1	13.1	13.4
f	8.7	8.8	8.8
f. sheet thicknesses	1.8 - 2.6	1.8 - 2.6	0.7 - 1.7

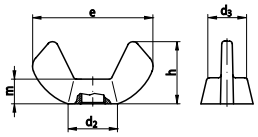
Dimensions	M 6 - 8/9.5	M 8 - 8/12.5	M 10 - 8/12.5
s	0.5	0.6	0.6
c	6.3	7.4	7.4
b	13.7	17.8	17.8
a	13.1	16.6	16.6
f	8.8	11.4	11.4
f. sheet thicknesses	1.8 - 2.6	1.8 - 2.6	1.8 - 2.6

Dimensions in stock:
Steel/Steel coated: pg. 428

Special forms

Article 88215

Wing nuts,
small type, edged wings

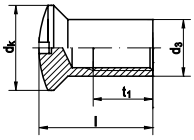


Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12
e	18.5	18.5	22	26.8	30.3	35.3	47.5
h	8.8	8.8	10.5	12.9	14.8	17.3	22.5
m	3	3	4	4.9	5.4	6.3	7.9
D	7.8	7.8	9.5	11.9	13.5	15.3	20.5

Dimensions in stock:
Steel/Steel coated: pg. 78 | Stainless steel: pg. 464

Article 88964

Sleeve nut
with raised countersunk head

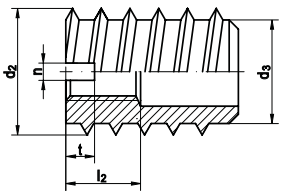


Dimensions	M 4	M 5	M 6	M 8
l	7/12/14/20	15	15/20	15/20
t_1	3/7/8/13	9	9 /13	7/12
d_3	5	6	7.5	10
d_k	7	9	10	15

Dimensions in stock:
Stainless steel: pg. 607 | Non-ferrous materials: pg. 647

DIN 7965

Screwed inserts "RAMPA"



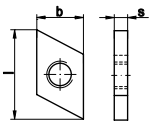
Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12
d_2	6	8	10	12	16	18.5	22
d_3	4.5	5.5	7.5	9.5	12.5	15	18
l_2	5	6	7	9	11	13	16
n	1	1.2	1.6	2	2.5	3	3
t	2	2	3	3	4	5	5
for drilling ∅	5.0	6.5	8.5	10.5	14.5	17	20

Dimensions in stock:
Steel/Steel coated: pg. 352 | Non-ferrous materials: pg. 642

Threaded plates

Article 88951

T-Head thread plates/slide nuts
type 28/15
for profiles 28/15, 28/12,28/28, 26/26, 26/18



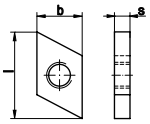
Dimensions	M 6	M 8	M 10
l	27.7	27.7	29.3
b	12.6	12.6	17.4
h	4	4	5

Dimensions in stock:
Steel/Steel coated: pg. 444

Threaded plates

Article 88952

T-Head thread plates/slide nuts type 38/17
for profiles 35/45, 38/17, 36/36, 36/20

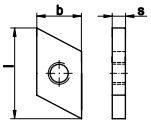


Dimensions	M 6	M 8	M 10	M 12
l	34	34	34	34
b	17.6	17.6	17.6	17.6
h	6.5	6.5	6.5	6.5

Dimensions in stock:
Steel/Steel coated: pg. 444

Article 88953

T-Head thread plates/slide nuts type 50/40
for profiles 50/40, 486

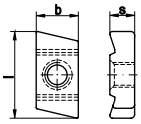


Dimensions	M 6	M 8	M 10	M 12	M 16
l	41.5	41.5	41.5	41.5	41.5
b	20.5	20.5	20.5	20.5	20.5
h	2.2	4	4	4	4

Dimensions in stock:
Steel/Steel coated: pg. 445

Article 88954

T-Head thread plates/slide nuts type 40/22
for profiles 40/22, 40/25, K422

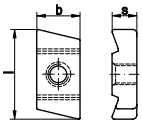


Dimensions	M 5	M 6	M 8	M 10	M 12
l	35	35	35	35	35
b	17	17	17	17	17
h	10	10	10	10	11.5

Dimensions in stock:
Steel/Steel coated: pg. 445

Article 88955

T-Head thread plates/slide nuts type 50/30
for profiles 54/33, 52/34, 50/40, 49/30, 486



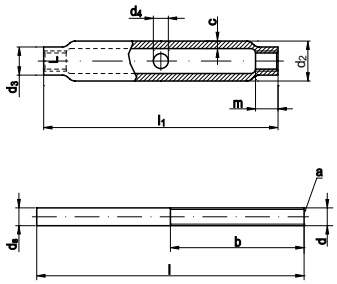
Dimensions	M 8	M 10	M 12	M 16
l	42	42	42	42
b	21	21	21	21
h	12	12	12	13

Dimensions in stock:
Steel/Steel coated: pg. 445

Turnbuckles

DIN 1478

Turnbuckles
made from tubes or bars



Loadability only for turnbuckles with ÜZ

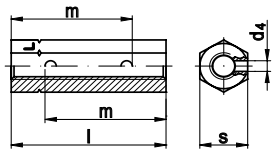
Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36
d_2	17.2	17.2	21.3	25	30	33.7	42.4	51	63.5
d_3	9	12	15	18	22.5	27	32	38	47.5
D	6	8	8	10	10	12	12	16	16
c	2.9	3.6	4	4	4.5	5	5.6	6.3	8
l_1	110	110	125	125	170	200	255	255	295
m	7.5	10	12	15	20	24	29	36	43
adjustability	90	85	95	90	120	140	180	160	180
loadability [kN]	3.9	7.2	11	16	30	48	69	110	160

Dimensions in stock:
Steel/Steel coated: pg. 202

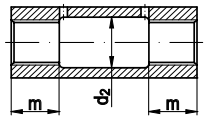
DIN 1479

Hexagon turnbuckles

≤ M 16



≥ M 20



Loadability only for turnbuckles with ÜZ

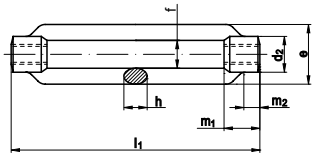
Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36
d_2	-	-	-	-	-	21	26	32	38
d_4	4	4	4	4	4	4	4	4	4
l	30	35	45	55	75	95	115	125	145
m	22.5	25	33	40	55	24	29	36	45
s	10	13	17	19	24	30	36	46	55
adjustability	15	15	21	25	35	47	57	53	70
loadability [kN]	3.9	7.2	11	16	30	48	69	110	160

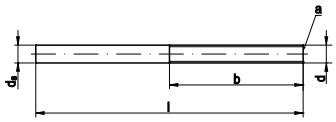
Dimensions in stock:
Steel/Steel coated: pg. 214 | Stainless steel: pg. 518

Turnbuckles

DIN 1480

Forged turnbuckles
with and without welding studs





Welding stud (AE) acc. to DIN 34828
(d_s ~ pitch diameter)

Dimensions	M 6	M 8	M 10	M 12	M 14*	M 16	M 20
d_2	12	15	18	21	25	27	34
e	19	23	30	34	38	42	52
$h_{min.}$	6	8	9	11	10	14	17
l_1	110	110	125	125	140	170	200
m_1	12	15	18	21	24	27	34
m_2	6	8	9	11	9	14	17
l	120	120	150	150	165	200	220
b	65	65	75	75	85	100	120
adjustability with AE**	80	75	85	80	92	110	130
loadability with AE [kN]**	3.9	7.2	11	16	22	30	48

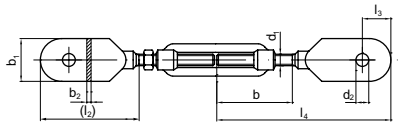
Dimensions	M 22*	M 24	M 27*	M 30	M 36	M 42	M 48
d_2	36	39	43	45	55	63	80
e	57	60	68	74	86	104	135
$h_{min.}$	16	20	23	23	28	32	40
l_1	220	255	255	255	295	330	355
m_1	37	39	45	45	55	63	78
m_2	15	20	23	23	28	32	39
l	220	260	260	260	300	350	380
b	130	150	150	160	180	200	220
adjustability with AE**	146	170	171	160	180	200	195
loadability with AE [kN]**	59	69	90	110	160	-	-

Loadability only for turnbuckles with ÜZ
*not standardized, reference values
**values apply only to products with ÜZ

Dimensions in stock:
Steel/Steel coated: 215 | **Stainless steel**: pg. 518

DIN 1480 BS-S

Forged turnbuckles
with heavy flat leaf screws



Dimensions	M 12	M 16	M 20	M 24	M 27*	M 30	M 36
d_2	13.5	17.5	22	26	30	33	39
l_2	90	100	110	120	140	160	180
l_3	30	40	50	55	60	70	80
l_4	200	230	260	320	340	370	420
b_1	45	55	70	80	90	100	120
b_2	6	7	9	11	12	13	15
b	70	90	120	160	180	200	220
adjustability	83	111	132	177	165	165	185
loadability $F_{t,Rd}$ [kN]	21.85	40.69	63.5	91.5	118.9	145.4	211.7

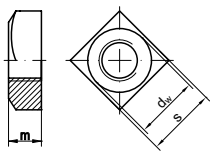
Dimensions for turnbuckle ➔ see DIN 1480
Loadability only for turnbuckles with CE
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 217

Square nuts

DIN 557

Square nuts



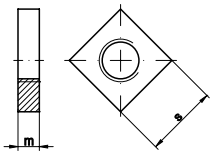
Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
$d_{w\ min.}$	6.7	8.7	11.5	14.5/15.5	16.5/17.2	22
m	4	5	6.5	8	10	13
s	8	10	13	16/17	18/19	24

Dimensions in stock:
Steel/Steel coated: pg. 95 | Stainless steel: pg. 471

Square nuts

DIN 562

Square thin nuts



Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8	M 10
m	1.2	1.6	1.8	2.2	2.7	3.2	4	5
s	4	5	5.5	7	8	10	13	16/17*

*former DIN width across flats

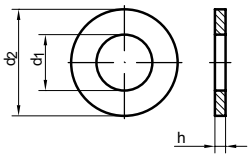
Dimensions in stock:
Steel/Steel coated: pg. 97 | Stainless steel: pg. 471

Plain washers (round)

Pk = product (tolerance) class
A = medium
C = coarse

Tolerances for washers acc. to ISO 4759-3 (DIN 522)

General overview of "plain washers for general use" ➔ ISO 887



Nominal size = for screws		ISO 7089, 7090 (DIN 125-1 Pk A)			ISO 7091 (DIN 126 Pk C)			Art. 1/88100 (C) –			ISO 7092 (DIN 433 Pk A)			ISO 7094 (DIN 440 R Pk C)			DIN 6340 (Pk A) –		
M	Ww	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h
1		1.1	3	0.3	In the ISO standards, the nominal sizes for screw diameters and the dimensions (d1/ d2/n) for some washers have been minimally adjusted.						1.1	2.5	0.3						
1.2		1.3	3.5	0.3							1.3	3	0.3						
1.4		1.5	4	0.3							1.5	3	0.3						
1.6		1.7	4	0.3							1.7	3.5	0.3						
*1.7		1.8	4.5	0.3	The functional compliance/exchangeability DIN:ISO washers are given.														
1.8		2.0	4.5	0.3							2.0	4	0.3						
2		2.2	5	0.3	In this catalogue, the new dimensions are specified in dimension & price tables. Conversion to new dimensions is done according to the production conversion and sale of stock items.						2.2	4.5	0.3						
2.2		2.4	6	0.5							2.4	4.5	0.3						
2.5		2.7	6	0.5							2.7	5	0.5						
*2.6		2.8	7	0.5															
3		3.2	7	0.5				3.2	8	0.5	3.2	6	0.5						
3.5		3.7	8	0.5							3.7	7	0.5						
4	*1/8"	4.3	9	0.8				4.3	10	0.8	4.3	8	0.5						
5	*3/16"	5.3	10	1	5.5	10	1	5.3	12	1	5.3	9	1	5.5	18	2			
6		6.4	12	1.6	6.6	12	1.6	6.5	13	1.25	6.4	11	1.6	6.6	22	2	6.4	17	3
7	*1/4"	7.4	14	1.6	7.6	14	1.6	8	16	1.25	7.4	12	1.6	7.6	24	2			
8	*5/16"	8.4	16	1.6	9	16	1.6	10	20	1.5	8.4	15	1.6	9	28	3	8.4	23	4
10	*3/8"	10.5	20	2	11	20	2	11.5	23	1.5	10.5	18	1.6	11	34	3	10.5	28	4
12	*7/16"	13	24	2.5	13.5	24	2.5	13	26	1.75	13	20	2	13.5	44	4	13	35	5
	*1/2"	13.5	24	2.5	13.5	24	2.5	14.5	29	1.75				13.5	44	4			
14		15	28	2.5	15.5	28	2.5	14.5	29	1.75	15	24	2.5	15.5	50	4			
	*9/16"							16	32	2									
16	*5/8"	17	30	3	17.5	30	3	17.5	35	2	17	28	2.5	17.5	56	5	17	45	6
18		19	34	3	20	34	3	19.5	39	2.5	19	30	3	20	60	5			
20	*3/4"	21	37	3	22	37	3	21	42	2.5	21	34	3	22	72	6	21	50	6
	*13/16"							23	46	3									
22	*7/8"	23	39	3	24	39	3	24.5	49	3	23	37	3	24	80	6			
24		25	44	4	26	44	4	27.5	55	3.5	25	39	4	26	85	6	25	60	8
	*1"	27	50	4	26	44	4	27.5	55	3.5				26	85	6			
27		28	50	4	30	50	4	29	58	3.5	28	44	4	30	98	6			
30	*1 1/8"	31	56	4	33	56	4	31	62	3.5	31	50	4	33	105	6	31	68	10
33	*1 1/4"	34	60	5	36	60	5	34	68	4	34	56	5	36	115	8			
	*1 3/8"							36	72	5									
36	*1 3/8"	37	66	5	39	66	5	40	80	5	37	60	5	39	125	8			
39	*1 1/2"	42 (40)	72	6	42	72	6	40	80	5				42	140	10			
42		45 (43)	78	8	45	78	8	43	85	5				*45	150	8			
45	*1 3/4"	48 (46)	85	8	48	85	8	46	90	5				*48	160	8			
48		52 (50)	92	8	52	92	8	50	97	6				*52	170	10			
52	*2"	56 (54)	98	8	56	98	8	54	105	7				*56	180	10			
56		62 (58)	105	10	62	105	10	58	110	8									
	*2 1/4"	60	110	9	62	105	10												
60		66 (62)	110	10.0	66	110	10												
64	*2 1/2"	70 (66)	115	10	70	115	10												
68		74 (70)	120	10	74	120	10												
72	*2 3/4"	78 (74)	125	10	78	125	10												
76	*3"	82 (78)	135	10	82	135	10												
80		86 (82)	140	12	86	140	12												
90	*3 1/2"	96 (93)	160	12	96	160	12												

Suitable combinations of plain washers for screws/nuts acc. to property and product classes (excerpt from ISO 887 informative Annex). For more exact information, see "Application area" of the corresponding washers product standard

Washers	Hardness class/product class		100 HV/C	200 HV/A	300 HV/A
Screws/nuts	Property class	Product grade	Combination matching?		
Stahl	≤ 6.8/ 6	A, B	yes	yes	yes
	≤ 6.8/ 6	C	yes	no	no
	8.8/ 8	A, B	no	yes	yes
	10.9/10	A, B	no	no	yes
	12.9/12	A, B	no	no	no
A 1 - A 5	-50, -70, -80	A, B	–	yes	–

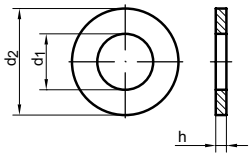
*not included in ISO product standards ➔ ISO 887

Plain washers (round)

Pk = product (tolerance) class
A = medium
C = coarse

Tolerances for washers acc. to ISO 4759-3 (DIN 522)

General overview of "plain washers for general use" ➔ ISO 887



Nominal size = for screws		EN 14399-6 (Pk A) DIN 34820 (Pk A)*			DIN 7349 (Pk A) –			DIN 7989-1 (Pk C) DIN 7989-2 (Pk A)			ISO 7093-1.2 (DIN 9021 Pk A/Pk C)			ANSI B 18.22.1 Typ A N = narrow			ANSI B 18.22.1 Typ A W = wide		
M	Ww	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h
3		* d_1 and d_2 conform to EN 14399-6 and DIN 34820:h dimensions DIN 34820 in			3.2	9	1				3.2	9	0.8						
3.5											3.7	11	0.8						
4	*1/8"				4.3	12	1.6				4.3	12	1						
5	*3/16"				5.3	15	2				5.3	15	1.2						
6					6.4	17	3				6.4	18	1.6						
7	*1/4"										7.4	22	2	0,281	0,625	0,065	0,312	0,734	0,065
8	*5/16"				8.4	21	4				8.4	24	2	0,344	0,688	0,065	0,375	0,875	0,083
10	*3/8"				10.5	25	4	11	20	8	10.5	30	2.5	0,406	0,812	0,065	0,438	1,000	0,083
12	*7/16"	13	24	3 (2.5)	13	30	6	13.5	24	8	13	37	3	0,469	0,922	0,065	0,500	1,250	0,083
	*1/2"													0,531	1,062	0,095	0,562	1,375	0,109
14					15	36	6				15	44	3						
	*9/16"													0,594	1,156	0,095	0,625	1,469	0,109
16	*5/8"	17	30	4 (3)	17	40	6	17.5	30	8	17	50	3	0,656	1,312	0,095	0,688	1,750	0,134
18					19	44	8				20	56	4						
20	*3/4"	21	37	4 (3)	21	44	8	22	37	8	22	60	4	0,812	1,469	0,134	0,812	2,000	0,148
22	*7/8"	23	39	4 (3)	23	50	8	24	39	8	23/24	66	5						
24		25	44	4 (4)	25	50	10	26	44	8	26	72	5						
27	*1"	28	50	5 (4)	28	60	10	30	50	8	30	85	6						
30	*1 1/8"	31	56	5 (4)	31	68	10	33	56	8	33	92	6						
33	*1 1/4"							36	60	8	36	105	6						
36	*1 3/8"	37	66	6 (5)				39	66	8	39	110	8						

Dimensions in inch

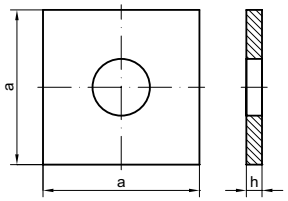
Nominal size = screws/pins		DIN 1052 (Pk C) –			ISO 8738 (Pk A) (DIN 1440 (Pk A)) DIN 1441 (Pk C)			DIN 988 -S (Pk C) –			Art. 88104 (Pk C) –		
M/Ø	Ww	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h
3					d_1-dimensions DIN 1441 ( ) d_2-dimensions DIN 1441 in ( )			3	6	1	3.2	20	1.25
3.5													
4	*1/8"							4	8	1	4.3	15/20/25	1.25
5	*3/16"				5 (5.5)	10 (10)	0.8				5.3	20/25/30	1.5
6					6 (7)	12 (12)	1.6	6	12	1.2	6.4	20/25/30/35	1.5
7	*1/4"				7 (8)	– (14)	1.6						
8	*5/16"				8 (9)	15 (16)	2	8	14	1.2	8.4	20/25/30/35/40	1.5
10	*3/8"				10 (11)	18 (20)	2.5	10	13	1.2	10.5	25/30/35/40	1.5
12	*7/16"	14	58	6	12 (13)	20 (25)	3	12	18	1.2	12.5	30/35/40	1.5
14					14 (15)	22 (28)	3	14	20	1.5			
15								15	21	1.5			
16	*5/8"	18	68	6	16 (17)	24 (28)	3	16	22	1.5			
17								17	24	1.5			
18					18 (19)	– (30)	4	18	25	1.5			
20	*3/4"	23	80	8	20 (21)	30 (32)	4	20	28	2			
22	*7/8"	25	92	8	22 (23)	34 (34)	4	22	30/32	2			
24		27	105	8	24 (25)	37 (38)	4						
25								25	35/36	2			
26								26	37	2			
27	*1"				27 (28)	39 (40)	5						
28								28	40	2			
30	*1 1/8"				30 (31)	44 (45)	5	30	42	2.5			
33	*1 1/4"				33 (34)	47 (50)	5						

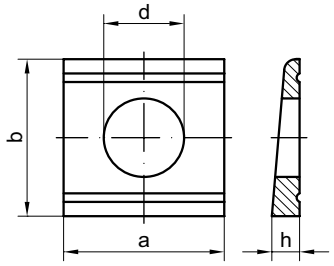
continued ➔ TI-86

Plain washers (round)

Nominal size = screws/pins		DIN 1052 (Pk C) –			DIN 1440 (Pk C) DIN 1441 (Pk C)*			DIN 988 –S (Pk C) –			Note
M/Ø	Ww	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	
35					35	52	6	35	45	2.5	Washers of special design – punched – turned – burned – in all sizes and materials **on request**
36	*1 3/8“				36 (37)	52	6				
37								37	47	2.5	
40					40 (41)	58	6	40	50	2.5	
45	*1 3/4“				45 (46)	62	7	45	55	3	
50					50 (51)	68	8	50	62/63	3	
55					55 (56)	75	9	55	68	3	
60					60 (62)	80	9	60	75	3	
63								63	80	3	
65					65 (68)	90	9	65	85	3.5	
70					70 (72)	95	10	70	90	3.5	
75					75 (78)	100	10	75	95	3.5	
80					80 (82)	110	12	80	100	3.5	
85					85 (86)	110	12	85	105	3.5	
90					90 (92)	115	12	90	110	3.5	
100					100 (102)	125	14	100	120/125	3.5	

Square washers/taper washers





Nominal size = for screws		DIN 436 (Pk C) 0%			DIN 434 (Pk C) 8%			DIN 435 (Pk C) 14%			DIN 6917 (Pk C) 14%			DIN 6918 (Pk C) 8%		
M	Ww	d	a	h	d	a/b	h	d	a/b	h	d	a/b	h	d	a/b	h
8	5/16“				9	22/22	3.8/2	9	22/22	4.6/1.5						
10	3/8“	11	30	3	11	22/22	3.8/2	11	22/22	4.6/1.5	13	26/30	6.2/2	13	26/30	4.9/2.5
12	7/16“	13.5	40	4	13.5	26/30	4.9/2.5	13.5	26/30	6.2/2						
	1/2“	13.5	40	4	13.5	26/30	4.9/2.5	13.5	26/30	6.2/2						
14																
16	5/8“	17.5	50	5	17.5	32/36	5.9/3	17.5	32/36	7.5/2.5	17	32/36	7.5/2.5	17	32/36	5.9/3
18																
20	3/4“	22	60	5	22	40/44	7/3.5	22	40/44	9.2/3	21	40/44	9.2/3	21	40/44	7/3.5
22	7/8“	24	70	6	24	44/50	8/4	24	44/50	10/3	23	44/50	10/3	23	44/50	8/4
24		26	80	6	26	56/56	8.5/4	26	56/56	10.8/3	25	56/56	10.8/3	25*	56/56	8.5/4
	1“	26	80	6	26	56/56	8.5/4	26	56/56	10.8/3						
27		30	90	6	30	56/56	8.5/4	30	56/56	10.8/3	28	56/56	10.8/3	28*	56/56	8.5/4
30	1 1/8“	33	95	6	33	62/62	9/4	33	62/62	11.7/3	31	62/62	11.7/3	31*	62/62	9/4
33	1 1/4“	36	100	6												
36	1 3/8“	39	110	8							37	68/68	12.5/3	37*	68/68	9.4/4
39	1 1/2“	42	125	8												
42		45	135	8												
45	1 3/4“	48	140	8												
48		52	150	10												
52	2“	56	160	10												

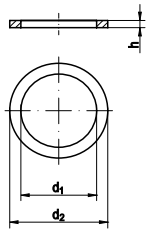
Marking:

DIN	Pitch	Groove qty.
434	8%	2
435	14%	1
6917	14%	1
6918	8%/5%	2/0 – „Form A“

Sealing washers (plain)

DIN 7603

Flat sealing rings



Dimensions	4x8	5x7.5	5x9*	6x10*	6.5x9.5	6.5x11*
d_1	4.2	5.2	5.2	6.2	6.7	6.7
d_2	7.9	7.4	8.9	9.9	9.4	10.9
h	1	1	1	1	1	1

Dimensions	8x11.5	8x12*	8x14	10x13.5	10x14*	10x15*
d_1	8.2	8.2	8.2	10.2	10.2	10.2
d_2	11.4	11.9	13.9	13.4	13.9	14.9
h	1	1/1.5	1	1	1/1.5	1

Dimensions	10x16	10x18	12x15.5	12x16	12x17*	12x18*
d_1	10.2	10.2	12.2	12.2	12.2	12.2
d_2	15.9	17.9	15.4	15.9	16.9	17.9
h	1	1.5	1.5	1.5	1.5	1.5

Dimensions	13x18*	14x18	14x20	15x19	16x20	16x22*
d_1	13.2	14.2	14.2	15.2	16.2	16.2
d_2	17.9	17.9	19.9	18.9	19.9	21.9
h	1.5	1.5	1.5	1.5	1.5	1.5

Dimensions	17x21	17x23*	18x22	18x24	20x24	20x26
d_1	17.2	17.2	18.2	18	20.2	20
d_2	20.9	22.9	21.9	24	23.9	26
h	1.5	1.5	1.5	1.5	1.5	1.5

Dimensions	21x26	22x27	22x29*	23x28	24x29	24x32
d_1	21.2	22.2	22.2	23.3	24.3	24.3
d_2	25.9	26.9	28.9	27.9	28.9	31.9
h	1.5	1.5	1.5	2	2	2

Dimensions	26x31	26x34*	27x32	28x33	30x36	32x38
d_1	26.3	26.3	27.3	28.3	30.3	32.3
d_2	30.9	33.9	31.9	32.9	35.9	37.9
h	2	2	2	2	2	2

Dimensions	33x38	33x41*	36x42	38x44	42x49	45x52
d_1	33.3	33.3	36.3	38.3	42.3	45.3
d_2	37.9	40.9	41.9	43.9	48.9	51.9
h	2	2	2	2	2	2

Dimensions	48x55*	60x68*				
d_1	48.3	60.5				
d_2	54.9	67.8				
h	2	2.5				

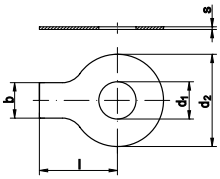
material: Al operating temperature: max. 200 °C
material: Cu operating temperature: max. 300 °C
*not standardized, reference values

Dimensions in stock:
Non-ferrous materials: pg. 642

Retaining/lock washers and rings

DIN 93

Tap washers with a long tap



Dimensions	3.2	4.3	4.3	5.3	6.4	8.4	10.5	13
d_2	12	14	14	17	19	22	26	30
b	4	5	5	6	7	8	10	12
l	13	14	14	16	18	20	22	28
s	0.38	0.38	0.38	0.5	0.5	0.75	0.75	1
for thread ∅	3	4	4	5	6	8	10	12

Dimensions	15	17	19	21	23	25	28	31
d_2	33	36	40	42	50	50	58	63
b	12	15	18	18	20	20	23	26
l	28	32	36	36	42	42	48	52
s	1	1	1	1	1	1	1.6	1.6
for thread ∅	14	16	18	20	22	24	27	30

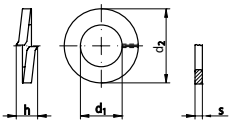
Dimensions	34	37	40	43	46	50	54
d_2	68	75	82	88	95	100	105
b	28	30	32	35	38	40	44
l	56	60	64	70	75	80	85
s	1.6	1.6	1.6	1.6	1.6	1.6	1.6
for thread ∅	33	36	39	42	45	48	52

d_1 = nominal size

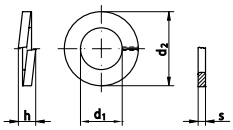
Dimensions in stock:
Steel/Steel coated: pg. 68 | Stainless steel: pg. 458

DIN 127

Spring lock washers with bent end or flat end



type A = bent end



type B = flat end

Dimensions	2	2.3	2.5	2.6 *	3	3.5	4	5	6
d_1	2.1	2.3	2.6	3	3.1	3.6	4.1	5.1	6.1
d_2	4.4	4.8	5.1	5.2	6.2	6.7	7.6	9.2	11.8
s	0.5	0.6	0.6	0.6	0.8	0.8	0.9	1.2	1.6
$h_{tpye\ A}$	–	–	–	–	1.9	1.9	2.1	2.7	3.6
$h_{tpye\ B}$	1.2	1.4	1.4	1.4	1.6	1.6	1.8	2.4	3.2

Dimensions	7	8	10	12	14	16	18	20	22
d_1	7.1	8.1	10.2	12.2	14.2	16.2	18.2	20.2	22.5
d_2	12.8	14.8	18.1	21.1	24.1	27.4	29.4	33.6	35.9
s	1.6	2	2.2	2.5	3	3.5	3.5	4	4
$h_{tpye\ A}$	3.6	4.6	5	5.8	6.8	7.8	7.8	8.8	8.8
$h_{tpye\ B}$	3.2	4	4.4	5	6	7	7	8	8

Dimensions	24	27	30	33	36	39	42	45	48
d_1	24.5	27.5	30.5	33.5	36.5	39.5	42.5	45.5	49
d_2	40	43	48.2	53.2	58.2	61.2	68.2	71.2	75
s	5	5	6	6	6	6	7	7	7
$h_{tpye\ A}$	11	11	13.6	13.6	13.6	13.6	15.6	15.6	15.6
$h_{tpye\ B}$	10	10	12	12	12	12	14	14	14

Dimensions	52	56	64	80	90	100			
d_1	53	57	65	81	91	101			
d_2	82	87	95	111	121	131			
s	8	8	8	8	8	8			
$h_{tpye\ A}$	18	18	18	18	18	18			
$h_{tpye\ B}$	16	16	16	16	16	16			

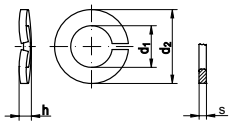
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 73 | Stainless steel: pg. 462 | Non-ferrous materials: pg. 617

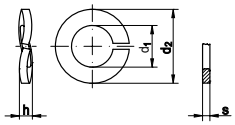
Retaining/lock washers and rings

DIN 128

Curved or waved spring lock washers



type A = curved



type B = waved

*not standardized, reference values

Dimensions	2.2 *	2.5	3	4	5	6
d_1	2.4	2.6	3.1	4.1	5.1	6.1
d_2	4.8	5.1	6.2	7.6	9.2	11.8
s	0.6	0.6	0.7	0.8	1	1.3
h	1	1.1	1.3	1.4	1.7	2.2

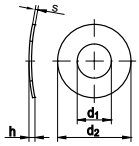
Dimensions	8	10	12	14	16	18
d_1	8.1	10.2	12.2	14.2	16.2	18.2
d_2	14.8	18.1	21.1	24.1	27.4	29.4
s	1.6	1.8	2.1	2.4	2.8	2.8
h	2.75	3.15	3.65	4.3	5.1	5.1

Dimensions	20	22	24	27	30	36
d_1	20.2	22.5	24.5	27.5	30.5	35.5
d_2	33.6	35.9	40	43	30.5	58.2
s	3.2	3.2	4	4	6	3
h	5.9	5.9	7.5	7.5	10.5	11.3

Dimensions in stock:
Steel/Steel coated: pg. 75 | Stainless steel: pg. 463

DIN 137

Spring washers
type A = curved



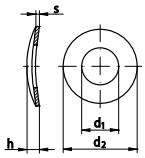
Dimensions	2	2.3	2.6	3	3.5	4
d_1	2.2	2.5	2.8	3.2	3.7	4.3
d_2	4.5	5	5.5	6	7	8
s	0.3	0.3	0.3	0.4	0.4	0.5
h	1	1	1.1	1.3	1.4	1.6

Dimensions	5	6	7	8	10	
d_1	5.3	6.4	7.4	8.4	10.5	
d_2	10	11	12	15	18	
s	0.5	0.5	0.5	0.5	0.8	
h	1.8	2.2	2.4	3.4	4	

Dimensions in stock:
Steel/Steel coated: pg. 76 | Stainless steel: pg. 463

DIN 137

Spring washers
type B = waved



Dimensions	3	3.5	4	5	6	7	8
d_1	3.2	3.7	4.3	5.3	6.4	7.4	8.4
d_2	8	8	9	11	12	14	15
s	0.5	0.5	0.5	0.5	0.5	0.8	0.8
h	1.6	1.8	2	2.2	2.6	3	3

Dimensions	10	12	14	16	18	20	22
d_1	10.5	13	15	17	19	21	23
d_2	21	24	28	30	34	36	40
s	1	1.2	1.6	1.6	1.6	1.6	1.8
h	4.2	5	6	6.4	6.6	7.4	7.8

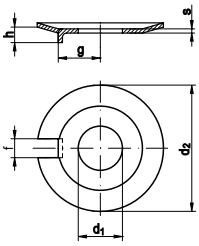
Dimensions	24	27	30	33	36		
d_1	25	28	31	34	37		
d_2	44	50	56	60	68		
s	1.8	2	2.2	2.2	2.5		
h	8.2	9.4	10	10.6	11.6		

Dimensions in stock:
Steel/Steel coated: pg. 76 | Stainless steel: pg. 463

Retaining/lock washers and rings

DIN 432

Washers with external tap



Dimensions	4.3	5.3	6.4	8.4	10.5	13	15	17
d_2	14	17	19	22	26	30	33	36
f	2.5	3.5	3.5	3.5	4.5	4.5	4.5	5.5
g	5.5	7	7.5	8.5	10	12	13	15
h ≈	2	2.5	3	4	4	4.5	4.5	4.5
s	0.4	0.75	0.75	1	1	1.2	1.2	1.2

Dimensions	19	21	23	25	28	31	34	37
d_2	40	42	50	50	58	63	68	75
f	6.5	6.5	7.5	7.5	8.5	8.5	9.5	11
g	18	18	20	21	23	25	28	31
h ≈	4.5	4.5	6.5	6.5	9.5	9.5	9.5	9.5
s	1.2	1.6	1.6	1.6	1.6	1.6	1.6	2

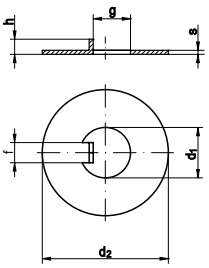
Dimensions	40	43	46	50	54	58	66	
d_2	82	88	95	100	105	112	125	
f	11	11	13	13	13	16	18	
g	33	36	38	40	42	45	52	
h ≈	11	11	12	13	13	14	13.5	
s	2	2	2	2	2	2.5	2.5	

d_1 = nominal size

Dimensions in stock:
Steel/Steel coated: pg. 80 | Stainless steel: pg. 465

DIN 462

Internal tap washers



Dimensions	8	10	14	16	18	20	22	24
d_2	20	25	30	32	34	36	40	42
s	0.8	0.8	0.8	11	1	1	1	1
f	3	4	5	5	6	6	6	6
g	5.9	7.4	11.4	13.5	15.4	17.5	19.5	21.6
h	2.5	3	3	3	4	4	4	4

Dimensions	28	30	32	35	38	40	42	45
d_2	50	50	52	55	58	62	62	68
s	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2
f	7	7	7	7	8	8	8	8
g	25.5	27.5	29.6	32.6	35.3	37.3	39.3	42.4
h	5	5	5	5	5	5	5	5

Dimensions	48	50	52	55	58	60	62	65
d_2	75	75	80	80	90	90	95	95
s	1.2	1.2	1.2	1.2	1.5	1.5	1.5	1.5
f	8	8	10	10	10	10	10	10
g	45.4	47.4	49.3	52.3	55.3	57.3	59.3	62.4
h	5	5	6	6	6	6	6	6

Dimensions	70	72	75	80	85	95	100	
d_2	100	110	110	115	120	135	145	
s	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
f	10	10	10	10	10	12	12	
g	67.4	68.9	71.9	76.9	81.9	91.8	96.9	
h	6	7	7	7	7	8	8	

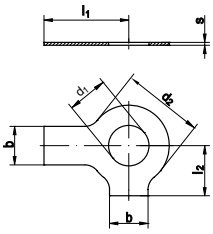
d_1 = nominal size

Dimensions in stock:
Steel/Steel coated: pg. 87

Retaining/lock washers and rings

DIN 463

Washers with 2 taps



Dimensions	3.2	4.3	5.3	6.4	8.4	10.5	13
d_2	7	9	10	12.5	17	21	24
b	4	5	6	7	8	10	12
l_1	13	14	16	18	20	22	28
l_2	5	6.5	8	9	11	13	15
s	0.38	0.38	0.5	0.5	0.75	0.75	1
for thread ∅	3	4	5	6	8	10	12

Dimensions	15	17	19	21	23	25	28
d_2	28	30	34	37	39	44	50
b	12	15	18	18	20	20	23
l_1	28	32	36	36	42	42	48
l_2	16	18	20	21	23	25	29
s	1	1	1	1	1	1	1.6
for thread ∅	14	16	18	20	22	24	27

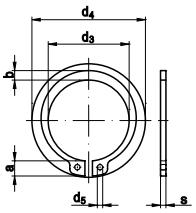
Dimensions	31	34	37	40	43	50	54
d_2	56	60	66	72	78	92	98
b	26	28	30	32	35	40	44
l_1	52	56	60	64	70	80	85
l_2	32	34	38	41	44	50	53
s	1.6	1.6	1.6	1.6	1.6	1.6	1.6
for thread ∅	30	33	36	39	42	48	52

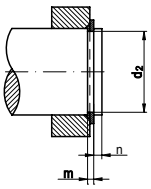
d_1 = nominal size

Dimensions in stock:
Steel/Steel coated: pg. 87 | Stainless steel: pg. 469 | Non-ferrous materials: pg. 619

DIN 471

Retaining rings for shafts
normal type





nominal size = for shafts ∅

*intermediate size not included in the standard

Dimensions	3	4	5	6	7	8	9	10	11	12
s	0.4	0.4	0.6	0.7	0.8	0.8	1	1	1	1
d_3	2.7	3.7	4.7	5.6	6.5	7.4	8.4	9.3	10.2	11
a	1.9	2.2	2.5	2.7	3.1	3.2	3.3	3.3	3.3	3.3
b	0.8	0.9	1.1	1.3	1.4	1.5	1.7	1.8	1.8	1.8
d_5	1	1	1	1.2	1.2	1.2	1.2	1.5	1.5	1.7
d_2	2.8	3.8	4.8	5.7	6.7	7.6	8.6	9.6	10.5	11.5
m	0.5	0.5	0.7	0.8	0.9	0.9	1.1	1.1	1.1	1.1
n	0.3	0.3	0.3	0.5	0.5	0.6	0.6	0.6	0.8	0.8
d_4	7	8.6	10.3	11.7	13.5	14.7	16	17	18	19

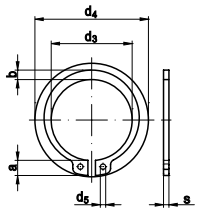
Dimensions	13	14	15	16	17	18	19	20	21	22
s	1	1	1	1	1	1.2	1.2	1.2	1.2	1.2
d_3	11.9	12.9	13.8	14.7	15.7	16.5	17.5	18.5	19.5	20.5
a	3.4	3.5	3.6	3.7	3.8	3.9	3.9	4	4.1	4.2
b	2	2.1	2.2	2.2	2.3	2.4	2.5	2.6	2.7	2.8
d_5	1.7	1.7	1.7	1.7	1.7	2	2	2	2	2
d_2	12.4	13.4	14.3	15.2	16.2	17	18	19	20	21
m	1.1	1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3	1.3
n	0.9	0.9	1.1	1.2	1.2	1.5	1.5	1.5	1.5	1.5
d_4	20.2	21.4	22.6	23.8	25	26.2	27.2	28.4	29.6	30.8

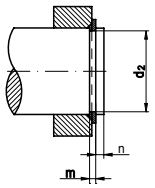
Dimensions in stock:
Steel/Steel coated: pg. 89 | Stainless steel: pg. 469

Retaining/lock washers and rings

DIN 471

Retaining rings for shafts
normal type





Dimensions	23*	24	25	26	27*	28	29	30	31*	32
s	1.2	1.2	1.2	1.2	1.2	1.5	1.5	1.5	1.5	1.5
d_3	21.5	22.2	23.2	24.2	24.9	25.9	26.9	27.9	28.6	29.6
a	4.3	4.4	4.4	4.5	4.6	4.7	4.8	5	5.1	5.2
b	2.9	3	3	3.1	3.1	3.2	3.4	3.5	3.5	3.6
d_5	2	2	2	2	2	2	2	2	2.5	2.5
d_2	22	22.9	23.9	24.9	25.6	26.6	27.6	28.6	29.3	30.3
m	1.3	1.3	1.3	1.3	1.3	1.6	1.6	1.6	1.6	1.6
n	1.5	1.7	1.7	1.7	2.1	2.1	2.1	2.1	2.6	2.6
d_4	–	33.2	34.2	35.5	–	37.9	39.1	40.5	–	43

Dimensions	33*	34	35	36	37*	38	39*	40	41*	42
s	1.5	1.5	1.5	1.75	1.75	1.75	1.75	1.75	1.75	1.75
d_3	30.5	31.5	32.2	33.2	34.2	35.2	36	36.5	37.5	38.5
a	5.2	5.4	5.6	5.6	5.7	5.8	5.9	6	6.2	6.5
b	3.7	3.8	3.9	4	4.1	4.2	4.3	4.4	4.5	4.5
d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d_2	31.3	32.3	33	34	35	36	37	37.5	38.5	39.5
m	1.6	1.6	1.6	1.85	1.85	1.85	1.85	1.85	1.85	1.85
n	2.6	2.6	3	3	3	3	3	3.8	3.8	3.8
d_4	–	45.4	46.8	47.8	–	50.2	–	52.6	–	55.7

Dimensions	44*	45	46*	47*	48	50	52	54*	55	56
s	1.75	1.75	1.75	1.75	1.75	2	2	2	2	2
d_3	40.5	41.5	42.5	43.5	44.5	45.8	47.8	49.8	50.8	51.8
a	6.6	6.7	6.7	6.8	6.9	6.9	7	7.1	7.2	7.3
b	4.6	4.7	4.8	4.9	5	5.1	5.2	5.3	5.4	5.5
d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d_2	41.5	42.5	43.5	44.5	45.5	47	49	51	52	53
m	1.85	1.85	1.85	1.85	1.85	2.15	2.15	2.15	2.15	2.15
n	3.8	3.8	3.8	3.8	3.8	4.5	4.5	4.5	4.5	4.5
d_4	–	59.1	–	–	62.5	64.5	66.7	–	70.2	71.6

Dimensions	57*	58	60	62	63	65	67*	68	70	72
s	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
d_3	52.8	53.8	55.8	57.8	58.8	60.8	62.5	63.5	65.5	67.5
a	7.3	7.3	7.4	7.5	7.6	7.8	7.9	8	8.1	8.2
b	5.5	5.6	5.8	6	6.2	6.3	6.4	6.5	6.6	6.8
d_5	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3
d_2	54	55	57	59	60	62	64	65	67	69
m	2.15	2.15	2.15	2.15	2.15	2.65	2.65	2.65	2.65	2.65
n	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
d_4	–	73.6	75.6	77.8	79	81.4	–	84.8	87	89.2

Dimensions	75	77*	78	80	82	85	87*	88	90	92*
s	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3
d_3	70.5	72.5	73.5	74.5	76.5	79.5	81.5	82.5	84.5	86.5
a	8.4	8.5	8.6	8.6	8.7	8.7	8.8	8.8	8.8	9
b	7	7.2	7.3	7.4	7.6	7.8	7.9	8	8.2	8.4
d_5	3	3	3	3	3	3.5	3.5	3.5	3.5	3.5
d_2	72	74	75	76.5	78.5	81.5	83.5	84.5	86.5	88.5
m	2.65	2.65	2.65	2.65	2.65	3.15	3.15	3.15	3.15	3.15
n	4.5	4.5	4.5	5.3	5.3	5.3	5.3	5.3	5.3	5.3
d_4	92.7	–	96.1	98.1	100.3	103.3	–	106.5	108.5	–

nominal size = for shafts ∅

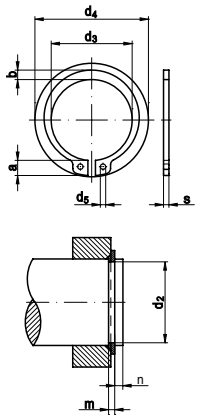
*intermediate size not included in the standard

Dimensions in stock:
Steel/Steel coated: pg. 89 | Stainless steel: pg. 469

Retaining/lock washers and rings

DIN 471

Retaining rings for shafts
normal type



Dimensions	95	97*	98*	100	102*	105	107*	108*	110	112*	115
s	3	3	3	3	4	4	4	4	4	4	4
d_3	89,5	91,5	91,5	94,5	95	98	100	100	103	105	108
a	9,4	9,4	9,4	9,6	9,7	9,9	10	10	10,1	103	10,6
b	8,6	8,8	8,8	9	9,2	9,3	9,5	9,5	9,6	9,7	9,8
d_5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5
d_2	91,5	93,5	94,5	96,5	98	101	103	104	106	108	111
m	3,15	3,15	3,15	3,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15
n	5,3	5,3	5,3	5,3	6	6	6	6	6	6	6
d_4	114,8	–	–	120,2	–	125,8	–	–	131,2	–	137,3

Dimensions	117*	118*	120	122*	125	127*	128*	130	132*	135	137*
s	4	4	4	4	4	4	4	4	4	4	4
d_3	110	110	113	115	118	120	120	123	125	128	130
a	10,8	10,8	11	11,2	11,4	11,4	11,4	11,6	11,7	11,8	11,9
b	10	10	10,2	10,3	10,4	10,5	10,5	10,7	10,8	11	11
d_5	3,5	3,5	3,5	4	4	4	4	4	4	4	4
d_2	113	114	116	118	121	123	124	126	128	131	133
m	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15
n	6	6	6	6	6	6	6	6	6	6	6
d_4	–	–	143,1	–	149	–	–	154,4	–	159,8	–

Dimensions	138*	140	145	147*	148*	150	155	160	165	168*	170
s	4	4	4	4	4	4	4	4	4	4	4
d_3	130	133	138	140	140	142	146	151	155,5	157,5	160,5
a	11,9	12	12,2	12,3	12,3	13	13	13,3	13,5	13,5	13,5
b	11	11,2	11,5	11,6	11,6	11,8	12	12,2	12,5	12,9	12,9
d_5	4	4	4	4	4	4	4	4	4	4	4
d_2	134	136	141	143	144	145	150	155	160	163	165
m	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15	4,15
n	6	6	6	6	6	7,5	7,5	7,5	7,5	7,5	7,5
d_4	–	165,2	170,6	–	–	177,3	182,3	188	193,4	–	198,4

Dimensions	175	180	185	190	195	200	210	215*	220	230	240
s	4	4	4	4	4	4	5	5	5	5	5
d_3	165,5	170,5	175,5	180,5	185,5	190,5	198	203	208	218	228
a	13,5	14,2	14,2	14,2	14,2	14,2	14,2	14,2	14,2	14,2	14,2
b	12,9	13,5	13,5	14	14	14	14	14	14	14	14
d_5	4	4	4	4	4	4	4	4	4	4	4
d_2	170	175	180	185	190	195	204	209	214	224	234
m	4,15	4,15	4,15	4,15	4,15	4,15	5,15	5,15	5,15	5,15	5,15
n	7,5	7,5	7,5	7,5	7,5	7,5	9	9	9	9	9
d_4	203,4	210	215	220	225	230	240	–	250	260	270

Dimensions	250	255*	260	270	280	290	300	400*			
s	5	5	5	5	5	5	5	6			
d_3	238	240	245	255	265	275	285	283			
a	14,2	16,2	16,2	16,2	16,2	16,2	16,2	–			
b	14	16	16	16	16	16	16	20			
d_5	4	5	5	5	5	5	5	6			
d_2	244	247	252	262	272	282	292	390			
m	5,15	5,15	5,15	5,15	5,15	5,15	5,15	6,2			
n	9	12	12	12	12	12	12	15			
d_4	280	–	294	304	314	324	334	–			

nominal size = for shafts ∅

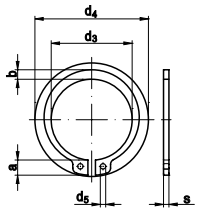
*intermediate size not included in the standard

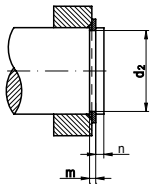
Dimensions in stock:
Steel/Steel coated: pg. 89 | Stainless steel: pg. 469

Retaining/lock washers and rings

DIN 471

Retaining rings for shafts
heavy type





nominal size = for shafts ∅

Dimensions	15	16	20	25	30	35
s	1.5	1.5	1.75	2	2	2.5
d_3	13.8	14.7	18.5	23.2	27.9	32.2
a	4.8	5	5.5	6.4	6.5	6.7
b	2.4	2.5	3	3.4	4.1	4.2
d_5	2	2	2	2	2	2.5
d_2	14.3	15.2	19	23.9	28.6	33
m	1.6	1.6	1.85	2.15	2.15	2.65
n	1.1	1.2	1.5	1.7	2.1	3
d_4	25.1	26.5	31.6	38.5	43.7	49.1

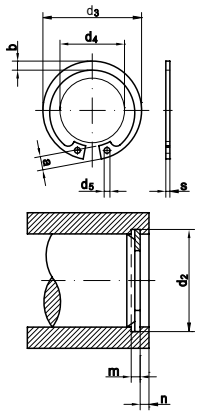
Dimensions	40	45	50	55	60	
s	2.5	2.5	3	3	3	
d_3	36.5	41.5	45.8	50.8	55.8	
a	7	7.5	8	8.5	9	
b	4.4	4.7	5.1	5.4	5.8	
d_5	2.5	2.5	2.5	2.5	2.5	
d_2	37.5	42.5	47	52	57	
m	2.65	2.65	3.15	3.15	3.15	
n	3.8	3.8	4.5	4.5	4.5	
d_4	54.7	60.8	66.8	72.9	78.9	

Dimensions in stock:
Steel/Steel coated: pg. 89

Retaining/lock washers and rings

DIN 472

Retaining rings for bores
normal type



Dimensions	8	9	10	11	12	13	14	15
s	0.8	0.8	1	1	1	1	1	1
d_3	8.7	9.8	10.8	11.8	13	14.1	15.1	16.2
a	2.4	2.5	3.2	3.3	3.4	3.6	3.7	3.7
b	1.1	1.3	1.4	1.5	1.7	1.8	1.9	2
d_5	1	1	1.2	1.2	1.5	1.5	1.7	1.7
d_2	8.4	9.4	10.4	11.4	12.5	13.6	14.6	15.7
m	0.9	0.9	1.1	1.1	1.1	1.1	1.1	1.1
n	0.6	0.6	0.6	0.6	0.8	0.9	0.9	1.1
d_4	3	3.7	3.3	4.1	4.9	5.4	6.2	7.2

Dimensions	16	17	18	19	20	21	22	23*
s	1	1	1	1	1	1	1	1.2
d_3	17.3	18.3	19.5	20.5	21.5	22.5	23.5	24.6
a	3.8	3.9	4.1	4.1	4.2	4.2	4.2	4.2
b	2	2.1	2.2	2.2	2.3	2.4	2.5	2.5
d_5	1.7	1.7	2	2	2	2	2	2
d_2	16.8	17.8	19	20	21	22	23	24.1
m	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.3
n	1.2	1.2	1.5	1.5	1.5	1.5	1.5	1.7
d_4	8	8.8	9.4	10.4	11.2	12.2	13.2	-

Dimensions	24	25	26	27*	28	29*	30	31
s	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
d_3	25.9	26.9	27.9	29.1	30.1	31.1	32.1	33.4
a	4.4	4.5	4.7	4.7	4.8	4.8	4.8	5.2
b	2.6	2.7	2.8	2.9	2.9	3	3	3.2
d_5	2	2	2	2	2	2	2	2.5
d_2	25.2	26.2	27.2	28.4	29.4	30.4	31.4	32.7
m	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
n	1.8	1.8	1.8	2.1	2.1	2.1	2.1	2.6
d_4	14.8	15.5	16.1	-	17.9	-	19.9	20

Dimensions	32	33*	34	35	36	37	38	39*
s	1.2	1.2	1.5	1.5	1.5	1.5	1.5	1.5
d_3	34.4	35.5	36.5	37.8	38.8	39.8	40.8	42
a	5.4	5.4	5.4	5.4	5.4	5.5	5.5	5.6
b	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.8
d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d_2	33.7	34.7	35.7	37	38	39	40	41
m	1.3	1.3	1.6	1.6	1.6	1.6	1.6	1.6
n	2.6	2.6	2.6	3	3	3	3	3
d_4	20.6	-	22.6	23.6	24.6	25.4	26.4	-

Dimensions	40	41*	42	44*	45	46*	47	48
s	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
d_3	43.5	44.5	45.5	47.5	48.5	49.5	50.5	51.5
a	5.8	5.9	5.9	6	6.2	6.3	6.4	6.4
b	3.9	4	4.1	4.2	4.3	4.4	4.4	4.5
d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d_2	42.5	43.5	44.5	46.5	47.5	48.5	49.5	50.5
m	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85
n	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
d_4	27.8	-	29.6	-	32	-	33.5	34.5

nominal size = for shafts ∅

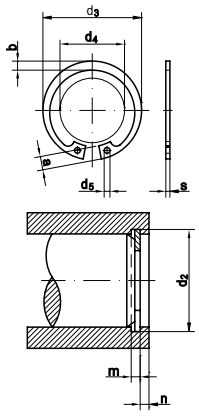
*intermediate size not included in the standard

Dimensions in stock:
Steel/Steel coated: pg. 90 | Stainless steel: pg. 470

Retaining/lock washers and rings

DIN 472

Retaining rings for bores
normal type



Dimensions	50	51*	52	53*	54*	55	56	57*
s	2	2	2	2	2	2	2	2
d_3	54.2	55.2	56.2	57.2	58.2	59.2	60.2	61.2
a	6.5	6.5	6.7	6.7	6.7	6.8	6.8	6.8
b	4.6	4.7	4.7	4.9	5	5	5.1	5.1
d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d_2	53	54	55	56	57	58	59	60
m	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
n	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
d_4	36.3	–	37.9	–	–	40.7	41.7	–

Dimensions	58	60	62	63	64*	65	67*	68
s	2	2	2	2	2	2.5	2.5	2.5
d_3	62.2	64.2	66.2	67.2	68.2	69.2	71.5	72.5
a	6.9	7.3	7.3	7.3	7.4	7.6	7.7	7.8
b	5.2	5.4	5.5	5.6	5.7	5.8	6	6.1
d_5	2.5	2.5	2.5	2.5	2.5	3	3	3
d_2	61	63	65	66	67	68	70	71
m	2.15	2.15	2.15	2.15	2.15	2.65	2.65	2.65
n	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
d_4	43.5	44.7	46.7	47.7	–	49	–	51.6

Dimensions	70	72	75	77*	78	80	82	85
s	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3
d_3	74.5	76.5	79.5	82.5	82.5	85.5	87.5	90.5
a	7.8	7.8	7.8	8.5	8.5	8.5	8.5	8.6
b	6.2	6.4	6.6	6.8	6.8	7	7	7.2
d_5	3	3	3	3	3	3	3	3.5
d_2	73	75	78	80	81	83.5	85.5	88.5
m	2.65	2.65	2.65	2.65	2.65	2.65	2.65	3.15
n	4.5	4.5	4.5	4.5	4.5	5.3	5.3	5.3
d_4	53.6	55.6	58.6	–	60.1	62.1	64.1	66.9

Dimensions	88	90	92	95	97*	98	100	102
s	3	3	3	3	3	3	3	4
d_3	93.5	95.5	97.5	100.5	103.5	103.5	105.5	108
a	8.6	8.6	8.7	8.8	9	9	9.2	9.5
b	7.4	7.6	7.8	8.1	8.3	8.3	8.4	8.5
d_5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
d_2	91.5	93.5	95.5	98.5	100.5	101.5	103.5	106
m	3.15	3.15	3.15	3.15	3.15	3.15	3.15	4.15
n	5.3	5.3	5.3	5.3	5.3	5.3	5.3	6
d_4	69.9	71.9	73.7	76.5	–	79	80.6	82

Dimensions	105	108	110	112	115	118*	120	122*
s	4	4	4	4	4	4	4	4
d_3	112	115	117	119	122	125	127	129
a	9.5	9.5	10.4	10.5	10.5	10.7	11	11
b	8.7	8.9	9	9.1	9.3	9.6	9.7	9.8
d_5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4
d_2	109	112	114	116	119	122	124	126
m	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15
n	6	6	6	6	6	6	6	6
d_4	85	88	88.2	90	93	–	96.9	–

nominal size = for shafts ∅

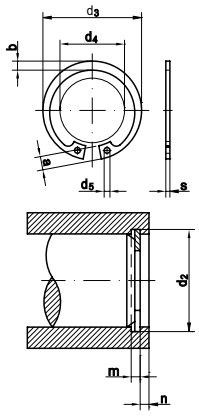
*intermediate size not included in the standard

Dimensions in stock:
Steel/Steel coated: pg. 90 | Stainless steel: pg. 470

Retaining/lock washers and rings

DIN 472

Retaining rings for bores
normal type



Dimensions	125	128*	130	132*	135	138*	140	142*	145	148*
s	4	4	4	4	4	4	4	4	4	4
d_3	132	135	137	139	142	145	147	149	152	155
a	11	11	11	11	11.2	11.2	11.2	11.3	11.4	11.8
b	10	10.2	10.2	10.3	10.5	10.6	10.7	10.8	10.9	11.1
d_5	4	4	4	4	4	4	4	4	4	4
d_2	129	132	134	136	139	142	144	146	149	152
m	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15
n	6	6	6	6	6	6	6	6	6	6
d_4	101.9	–	106.9	–	111.5	–	116.5	–	121	–

Dimensions	150	152*	155	160	165	168*	170	175	180	185
s	4	4	4	4	4	4	4	4	4	4
d_3	158	161	164	169	174.5	177.5	179.5	184.5	189.5	194.5
a	12	12	12	13	13	13.5	13.5	13.5	14.2	14.2
b	11.2	11.3	11.4	11.6	11.8	12.1	12.2	12.7	13.2	13.7
d_5	4	4	4	4	4	4	4	4	4	4
d_2	155	157	160	165	170	173	175	180	185	190
m	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15
n	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
d_4	124.8	–	129.8	132.7	137.7	–	141.6	146.6	150.2	155.2

Dimensions	190	195	200	205*	210	215*	220	225*	230	240
s	4	4	4	5	5	5	5	5	5	5
d_3	199.5	204.5	209.5	217	222	227	232	237	242	252
a	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
b	13.8	13.8	14	14	14	14	14	14	14	14
d_5	4	4	4	4	4	4	4	4	4	4
d_2	195	200	205	211	216	221	226	231	236	246
m	4.15	4.15	4.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15
n	7.5	7.5	7.5	9	9	9	9	9	9	9
d_4	160.2	165.2	170.2	–	180.2	–	190.2	–	200.2	210.2

Dimensions	245*	250	255*	260	265*	270	275*	280	285*	290
s	5	5	5	5	5	5	5	5	5	5
d_3	257	262	270	275	280	285	290	295	300	305
a	14.2	14.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2
b	14	14	16	16	16	16	16	16	16	16
d_5	4	4	5	5	5	5	5	5	5	5
d_2	251	256	263	268	273	278	283	288	293	298
m	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15
n	9	9	12	12	12	12	12	12	12	12
d_4	–	220.2	–	226	–	236	–	246	–	256

Dimensions	295*	300	310*	320*	340*	360*				
s	5	5	6	6	6	6				
d_3	310	315	327	337	357	377				
a	16.2	16.2	–	–	–	–				
b	16	16	20	20	20	20				
d_5	5	5	6	6	6	6				
d_2	303	308	320	330	350	370				
m	5.15	5.15	3.2	6.2	6.2	6.2				
n	12	12	15	15	15	15				
d_4	–	266	–	–	–	–				

nominal size = for shafts ∅

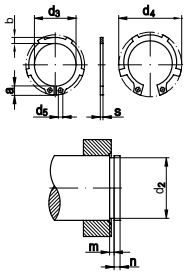
*intermediate size not included in the standard

Dimensions in stock:
Steel/Steel coated: pg. 90 | Stainless steel: pg. 470

Retaining/lock washers and rings

DIN 983

Retaining rings with lugs for shafts (retainer rings)



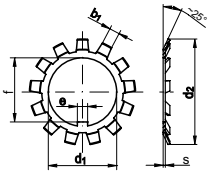
nominal size = for shafts ∅

Dimensions	20	25	30	35	40	45	50
s	1.2	1.2	1.5	1.5	1.75	1.75	2
d_3	18.5	23.2	27.9	32.2	36.5	41.5	45.8
a	3.8	4.3	4.7	5.2	7.2	7.2	8.2
b	2.6	3	3.5	3.9	4.4	4.7	5.1
d_5	2	2	2	2.5	2.5	2.5	2.5
d_2	19	23.9	28.6	33	37.5	42.5	47
m	1.3	1.3	1.6	1.6	1.85	1.85	2.15
n	1.5	1.7	2.1	3	3.8	3.8	4.5
d_4	28	34	39.9	45.9	55.1	60.1	67.2

Dimensions in stock:
Steel/Steel coated: pg. 201

DIN 5406

Lockwashers/safety plates
for locknuts acc. to DIN 981



Dimensions	MB 0	MB 1	MB 2	MB 3	MB 4	MB 5	MB 6	MB 7
d_1	10	12	15	17	20	25	30	35
d_2	21	25	28	32	36	42	49	57
e	3	3	4	4	4	5	5	6
f	8.5	10.5	13.5	15.5	18.5	23	27.5	32.5
b_1	3	3	4	4	4	5	5	5
s	1	1	1	1	1	1.25	1.25	1.25
for locknut DIN 981	KM 0	KM 1	KM 2	KM 3	KM 4	KM 5	KM 6	KM 7

Dimensions	MB 8	MB 9	MB 10	MB 11	MB 12	MB 13	MB 14	MB 15
d_1	40	45	50	55	60	65	70	75
d_2	62	69	74	81	864	92	98	104
e	6	6	6	8	8	8	8	8
f	37.5	42.5	47.5	52.5	57.5	62.5	66.5	71.5
b_1	6	6	6	7	7	7	8	8
s	1.25	1.25	1.25	1.5	1.5	1.5	1.5	1.5
for locknut DIN 981	KM 8	KM 9	KM 10	KM 11	KM 12	KM 13	KM 14	KM 15

Dimensions	MB 16	MB 17	MB 18	MB 19	MB 20	MB 21	MB 22	MB 23
d_1	80	85	90	95	100	105	110	115
d_2	112	119	126	133	142	145	154	159
e	10	10	10	10	12	12	12	12
f	76.5	81.5	86.5	91.5	96.5	100.5	105.5	110.5
b_1	8	8	10	10	10	12	12	12
s	1.75	1.75	1.75	1.75	1.75	1.75	1.75	2
for locknut DIN 981	KM 16	KM 17	KM 18	KM 19	KM 20	KM 21	KM 22	KM 23

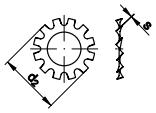
Dimensions	MB 24	MB 25	MB 26	MB 27	MB 28	MB 29	MB 30	
d_1	120	125	130	135	140	145	150	
d_2	164	170	175	185	192	202	205	
e	14	14	14	14	16	16	16	
f	115	120	125	130	135	140	145	
b_1	12	12	12	14	14	14	14	
s	2	2	2	2	2	2	2	
for locknut DIN 981	KM 24	KM 25	KM 26	KM 27	KM 28	KM 29	KM 30	

Dimensions in stock:
Steel/Steel coated: pg. 306

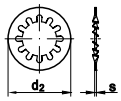
Retaining/lock washers and rings

DIN 6797

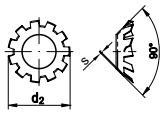
Toothed lock washers



type A = external teeth



type I = internal teeth



Type V = countersunk

*acc. to DIN 6797:1971

Dimensions	3.2	3.7	4.3	5.3	6.4	7.4
$d_{2\ form\ A/I}$	6	7	8	10	11	12.5
$d_{2\ type\ V}$	6	7	8	9.8	11.8	–
$s_{type\ A/I}$	0.4	0.5	0.5	0.6	0.7	0.8
$s_{type\ V}$	0.2	0.25	0.25	0.3	0.4	–
for thread ∅	3	3.5	4	5	6	7

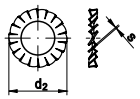
Dimensions	8.4	10.5	12.5*	13	15	17
$d_{2\ form\ A/I}$	15	18	20.5	20.5	24	26
$d_{2\ type\ V}$	15.3	19	23	23	–	–
$s_{type\ A/I}$	0.8	0.9	1	1	1	1.2
$s_{type\ V}$	0.4	0.5	0.5	0.5	–	–
for thread ∅	8	10	12	12	14	16

Dimensions	19	21	23	25	28	31
$d_{2\ form\ A/I}$	30	33	36	38	44	48
$d_{2\ type\ V}$	–	–	–	–	–	–
$s_{type\ A/I}$	1.4	1.4	1.5	1.5	1.6	1.6
$s_{type\ V}$	–	–	–	–	–	–
for thread ∅	18	20	22	24	27	30

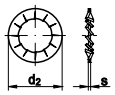
Dimensions in stock:
Steel/Steel coated: pg. 311 | Stainless steel: pg. 553

DIN 6798

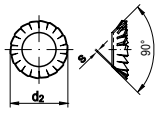
Serrated lock washers



type A = external teeth



type I = internal teeth



type V = countersunk

*acc. to DIN 6798:1971

Dimensions	2.2	2.5*	2.7	3.2	3.7	4.3	5.3
$d_{2\ form\ A/I}$	4.5	5	5.5	6	7	8	10
$d_{2\ type\ V}$	–	–	–	6	7	8	9.8
$s_{type\ A/I}$	0.3	0.4	0.4	0.4	0.5	0.5	0.6
$s_{type\ V}$	–	–	–	0.2	0.25	0.25	0.3
for thread ∅	2	2.3	2.5	3	3.5	4	5

Dimensions	6.4	7.4	8.4	10.5	13	15	17
$d_{2\ form\ A/I}$	11	12.5	15	18	20.5	24	26
$d_{2\ type\ V}$	11.8	–	15.3	19	23	–	–
$s_{type\ A/I}$	0.7	0.8	0.8	0.9	1	1	1.2
$s_{type\ V}$	0.4	–	0.4	0.5	0.5	–	–
for thread ∅	6	7	8	10	12	14	16

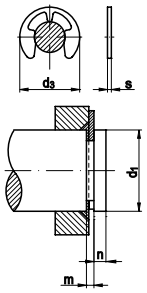
Dimensions	19	21	23	25	28	31	
$d_{2\ form\ A/I}$	30	33	36	38	44	48	
$d_{2\ type\ V}$	–	–	–	–	–	–	
$s_{type\ A/I}$	1.4	1.4	1.5	1.5	1.6	1.6	
$s_{type\ V}$	–	–	–	–	–	–	
for thread ∅	18	20	22	24	27	30	

Dimensions in stock:
Steel/Steel coated: pg. 313 | Stainless steel: pg. 554 | Non-ferrous materials: pg. 639

Retaining/lock washers and rings

DIN 6799

Retaining rings for shafts



Dimensions	0.8	1.2	1.5	1.9	2.3	3.2
d_3	2.25	3.25	4.25	4.8	6.3	7.3
s	0.2	0.3	0.4	0.5	0.6	0.6
for shafts ∅ d_1	1 – 1.4	1.4 – 2	2 – 2.5	2.5 – 3	3 – 4	4 – 5
m	0.24	0.34	0.44	0.54	0.64	0.64
n	0.4	0.6	0.8	1	1	1

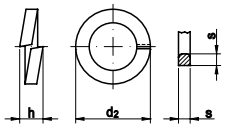
Dimensions	4	5	6	7	8	9
d_3	9.3	11.3	12.3	14.3	16.3	18.8
s	0.7	0.7	0.7	0.9	1	1.1
for shafts ∅ d_1	5 – 7	6 – 8	7 – 9	8 – 11	9 – 12	10 – 14
m	0.74	0.74	0.74	0.94	1.05	1.15
n	1.2	1.2	1.2	1.5	1.8	2

Dimensions	10	12	15	19	24	
d_3	20.4	23.4	29.4	37.6	44.6	
s	1.2	1.3	1.5	1.75	2	
for shafts ∅ d_1	11 – 15	13 – 18	16 – 24	20 – 31	25 – 38	
m	1.25	1.35	1.55	1.80	2.05	
n	2	2.5	3	3.5	4	

Dimensions in stock:
Steel/Steel coated: pg. 314 | Stainless steel: pg. 554

DIN 7980

Spring lock washers for cheese head screws



Dimensions	3	4	5	6	8	10	12
d_2	5.6	7	8.8	9.9	12.7	16	18
s	1	1.2	1.6	1.6	2	2.5	2.5
h	2	2.4	3.2	3.2	4	5	5
for thread ∅	3	4	5	6	8	10	12

Dimensions	14	16	18	20	22	24	27
d_2	21.1	24.4	26.4	30.6	32.9	35.9	38.9
s	3	3.5	3.5	4.5	4.5	5	5
h	6	7	7	9	9	10	10
for thread ∅	14	16	18	20	22	24	27

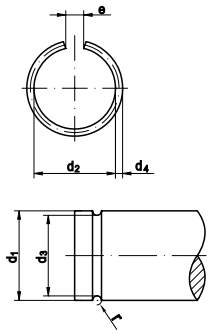
Dimensions	30	33	36	42	48		
d_2	44.1	47.1	52.2	60.2	67		
s	6	6	7	8	8		
h	12	12	14	16	16		
for thread ∅	30	33	36	42	48		

Dimensions in stock:
Steel/Steel coated: pg. 357 | Stainless steel: pg. 575

Retaining/lock washers and rings

DIN 7993, 9925

Snap rings
type A = for shafts



Dimensions	4	5	6	7	8	10	12
$d_{2\ max.\ 7993/9925}$	3.1/3.4	4.1/4.4	5.1/5.3	6.1/6.3	7.1	9.1	10.8
$d_{4\ 7993/9925}$	0.8/0.5	0.8/0.5	0.8/0.6	0.8/0.6	0.8	0.8	1
e	1	1	1	2	2	2	3
for shafts ∅ d_1	4	5	6	7	8	10	12
for shaft slot ∅ $d_{3\ 7993/9925}$	3.2/3.5	4.2/4.5	5.2/5.4	6.2/6.4	7.2	9.2	11
Slot crossover $r_{\ 7993/9925}$	0.5/0.3	0.5/0.3	0.5/0.4	0.5/0.4	0.5	0.5	0.6

Dimensions	16	18	20	22	25	26	28
$d_{2\ max.\ 7993/9925}$	14.2	16.2	17.7	19.7	22.7	23.7	25.7
$d_{4\ 7993/9925}$	1.6	1.6	2	2	2	2	2
e	3	3	3	3	3	3	3
for shafts ∅ d_1	16	19	20	22	25	26	28
for shaft slot ∅ $d_{3\ 7993/9925}$	14.4	16.4	18	20	23	24	26
Slot crossover $r_{\ 7993/9925}$	0.9	0.9	1.1	1.1	1.1	1.1	1.1

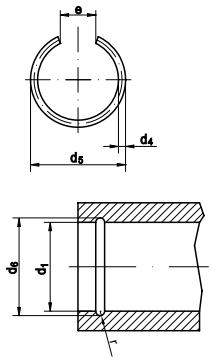
Dimensions	30	32	35	38	40	45	48
$d_{2\ max.\ 7993/9925}$	27.7	29.1	32.1	35.1	37.1	42	45
$d_{4\ 7993/9925}$	2	2.5	2.5	2.5	2.5	2.5	2.5
e	3	4	4	4	4	4	4
for shafts ∅ d_1	30	32	35	38	40	45	48
for shaft slot ∅ $d_{3\ 7993/9925}$	28	29.5	32.5	35.5	37.5	42.5	45.5
Slot crossover $r_{\ 7993/9925}$	1.1	1.4	1.4	1.4	1.4	1.4	1.4

Dimensions	50	55	60	65	70		
$d_{2\ max.\ 7993/9925}$	47	51.1	56.1	61.1	66		
$d_{4\ 7993/9925}$	2.5	3.2	3.2	3.2	3.2		
e	4	4	4	4	5		
for shafts ∅ d_1	50	55	60	65	70		
for shaft slot ∅ $d_{3\ 7993/9925}$	47.5	51.8	56.8	61.8	66.8		
Slot crossover $r_{\ 7993/9925}$	1.4	1.8	1.8	1.8	1.8		

Dimensions in stock:
Steel/Steel coated: pg. 369, pg. 388

DIN 7993, 9926

Snap rings
type B = for bores



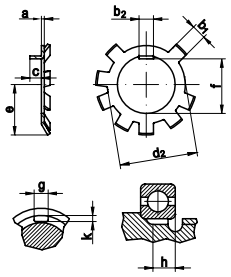
Dimensions	7	8	10	12	16	18
$d_{4\ max.\ 7993/9926}$	0.8/0.6	0.8/0.6	0.8	1	1.6	1.6
$d_{5\ 7993/9926}$	8.2/8	9.2/9	11.2	13.6	18.2	20.2
e	4	4	4	6	8	8
for drilling ∅ d_1	7	8	10	12	16	18
for shaft slot ∅ $d_{6\ 7993/9926}$	7.8/7.6	8.8/8.6	10.8	13	17.6	19.6
Slot crossover $r_{\ 7993/9926}$	0.5/0.4	0.5/0.4	0.5	0.6	0.9	0.9

Dimensions in stock:
Steel/Steel coated: pg. 369, pg. 388

Retaining/lock washers and rings

DIN 70952

Safety plates
for locknuts acc. to DIN 70852



Dimensions	10	12	14	16	18	20	22	24	26
a	0.75	0.75	0.75	1	1	1	1	1	1
b_1	4	4	4	5	5	5	6	6	6
b_2	4	4	5	5	5	5	6	6	6
c	3	3	3	3	4	4	4	4	5
d_2	16	18	20	23	25	27	30	32	34
e	11	12	13	14.5	16.5	17.5	19	20	22
f	8.9	10.9	12.9	14.9	16.9	18.9	20.9	22.9	24.9
g_{shaft}*	4	4	5	5	5	5	6	6	6
h_{shaft}	3	3	3	3	4	4	4	4	5
k_{shaft}	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

Dimensions	28	30	32	35	38	40	42	45	48
a	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
b_1	6	6	6	6	6	6	7	7	7
b_2	7	7	7	7	8	8	8	8	8
c	5	5	5	5	5	5	5	5	5
d_2	36	38	41	43	47	49	52	54	57
e	23	24	25.5	26.5	28.5	29.5	31	32	33.5
f	26.9	28.9	30.9	33.9	36.6	38.6	40.6	43.6	46.7
g_{shaft}*	7	7	7	7	8	8	8	8	8
h_{shaft}	5	5	5	5	5	5	5	5	5
k_{shaft}	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

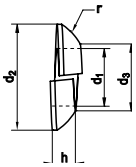
Dimensions	50	52	55	60	65	70	75	80	90
a	1.2	1.2	1.2	1.5	1.5	1.5	1.5	1.5	1.5
b_1	7	7	7	10	10	10	10	10	10
b_2	8	8	10	10	10	10	10	10	10
c	5	6	6	6	6	6	7	7	7
d_2	60	62	67	71	76	81	86	91	103
e	35	37	39.5	41.5	44	46.5	50	52.5	58.5
f	48.7	50.7	53.7	58.7	63.7	68.7	73.2	78.2	88.2
g_{shaft}*	8	8	10	10	10	10	10	10	10
h_{shaft}	5	6	6	6	6	6	7	7	7
k_{shaft}	1.5	1.5	1.5	2	2	2	2	2	2

*tolerance C11 on the shaft

Dimensions in stock:
Steel/Steel coated: pg. 409

DIN 74361

Spherical springwashers
type C



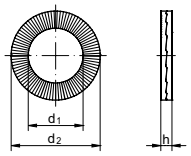
Dimensions	12.5	14.5	16.5	18.5	20.5	22.5
d_2	23	26	26.5	29	34	34
d_3	14.5	17	18	20	24	24
h	5	6	6.5	7	8	8
r	12	14	15	16	18	18

Dimensions in stock:
Steel/Steel coated: pg. 410

Retaining/lock washers and rings

Article 88032

HEICO-LOCK-wedge lock washers



Dimensions	M 3	M 3.5	M 3.5	M 4	M 4	M 5	M 5
type	HLS	HLS	HLB	HLS	HLB	HLS	HLB
d_1	3.4	3.9	3.9	4.4	4.4	5.4	5.4
d_2	7	7.6	9	7.6	9	9	10.8
h steel/stainless steel	1.7/1.6	1.7/1.6	1.7/1.6	1.7/1.6	1.7/1.6	1.7/1.6	1.7/1.6

Dimensions	M 6	M 6	M 8	M 8	M 10	M 10	M 12
type	HLS	HLB	HLS	HLB	HLS	HLB	HLS
d_1	6.5	6.5	8.6	8.6	10.7	10.7	13
d_2	10.8	13.5	13.5	16.6	16.6	21	19.5
h steel/stainless steel	1.7/1.6	2.7/2.6	2.7/2.6	2.7/2.6	2.7/2.6	2.7/2.6	2.7/2.6

Dimensions	M 12	M 12	M 14	M 14	M 16	M 16	M 16
type	HLB	HLK	HLS	HLB	HLS	HLB	HLK
d_1	13	13	15.2	15.2	17	17	17
d_2	25.4	24	23	30.7	25.4	30.7	30
h steel/stainless steel	3.7/3.6	3.7/–	3.7/3.6	3.7/3.6	3.7/3.6	3.7/3.6	3.7/–

Dimensions	M 18	M 18	M 20	M 20	M 20	M 22	M 22
type	HLS	HLB	HLS	HLB	HLK	HLS	HLB
d_1	19.5	19.5	21.4	21.4	21	23.4	23.4
d_2	29	34.5	30.7	39	37	34.5	42
h steel/stainless steel	3.7/3.6	3.7/3.6	3.7/3.6	3.8	3.7/–	3.7/3.6	4.7/4.6

Dimensions	M 22	M 24	M 24	M 24	M 27	M 27	M 27
type	HLK	HLS	HLB	HLK	HLS	HLB	HLK
d_1	23	25.3	25.3	25	28.4	28.4	28
d_2	39	39	48.5	44	42	48.5	50
h steel/stainless steel	4.7/–	3.7/3.6	4.7/4.6	4.7/–	5.4/5.3	6.7/6.6	6.7/–

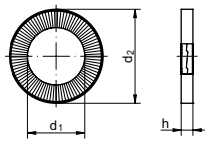
Dimensions	M 30	M 30	M 33	M 36	M 36	M 39	M 42
type	HLS	HLK	HLS	HLS	HLK	HLS	HLS
d_1	31.4	31	34.4	37.4	37	40.4	43.2
d_2	47	56	48.5	55	66	58.5	63
h steel/stainless steel	5.7/5.6	6.7/–	5.5/5.6	6.2/6.1	6.7/–	6.2/6	6.3/6.2

Typen: HLS = standard
HLB = enlarged outer diameter
HLK = for HV screws

Dimensions in stock:
Steel/Steel coated: pg. 433 I Stainless steel: pg. 600

Article 88033

HEICO-LOCK-ring lock washers



Dimensions	M 4	M 5	M 5	M 6	M 6	M 8	M 8
type	HLRB	HLRS	HLRB	HLRS	HLRB	HLRS	HLRB
d_1	4.4	5.4	5.4	6.5	6.5	8.6	8.6
d_2	9	9	10.8	10.8	13.5	13.5	16.6
h	1.5	1.5	1.5	1.5	2.5	2.5	2.5

Dimensions	M 10	M 10	M 12	M 12	M 14	M 16	M 16
type	HLRS	HLRB	HLRS	HLRB	HLRB	HLRS	HLRB
d_1	10.7	10.7	13	13	15.2	17	17
d_2	16.6	19.5	19.5	25.4	30.7	25.4	30.7
h	2.5	2.5	2.5	3.8	3.8	3.5	3.8

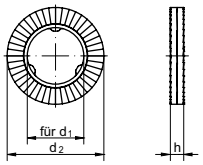
Typen: HLRS = standard
HLRB = enlarged outer diameter

Dimensions in stock: Steel/
Steel coated: pg. 433

Retaining/lock washers and rings

Article 88035

HEICO-LOCK-combi-washers



Typen: HKS = standard
HKB = enlarged outer diameter

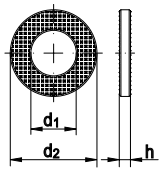
Dimensions	M 8	M 8	M 10	M 10
type	HKS	HKB	HKS	HKB
d_2	13.5	16.6	16.6	21
h	2.4	2.7	2.4	2.7

Dimensions	M 12	M 12	M 16	M 16
type	HKS	HKB	HKS	HKB
d_2	19.5	25.4	25.4	30.7
h	2.5	2.7	3.6	3.7

Dimensions in stock:
Steel/Steel coated: pg. 434 I Stainless steel: pg. 601

Article 88119

Locktix-washers



for screws with property class 8.8/10.9/12.9

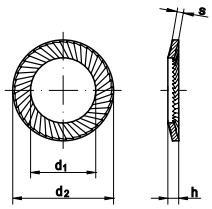
Dimensions	8	10	12	14
$d_{1\ min.}$	8.4	10.5	13	14.2
$d_{2\ max.}$	16	20	24	28
h	2.5	2.5	3	3

Dimensions	16	18	20	24
$d_{1\ min.}$	16.5	18.2	20.2	24.2
$d_{2\ max.}$	30	34	37	44
h	4	4	4	4

Dimensions in stock:
Steel/Steel coated: pg. 432

Article 88120

SCHNORR safety washers
type S = standard



for screws with property class ≤ 5.8

Dimensions	2	2.5	3	3.5	4	5	6
d_1	2.2	2.7	3.2	3.7	4.3	5.3	6.4
d_2	4	4.8	5.5	6	7	9	10
s	0.35	0.45	0.45	0.45	0.5	0.6	0.7
h	0.6	0.9	0.9	0.9	1	1.1	1.2
for inch thread ∅	–	–	1/8"	–	5/32"	3/16"	–

Dimensions	7	8	10	12	14	16	18
d_1	7.4	8.4	10.5	13	15	17	19
d_2	12	13	16	18	22	24	27
s	0.7	0.8	1	1.1	1.2	1.3	1.5
h	1.3	1.4	1.6	1.7	2	2.1	2.3
for inch thread ∅	–	5/16"	3/8"	–	9/16"	5/8"	–

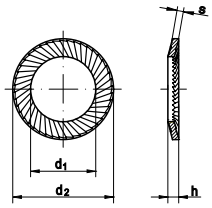
Dimensions	20	22	24	27	30	36	
d_1	21	23	25.6	28.6	31.6	38	
d_2	30	33	36	39	45	54	
s	1.5	1.5	1.8	2	2	2.5	
h	2.5	2.7	2.9	3.1	3.6	4.2	
for inch thread ∅	–	7/8"	–	–	1 1/8"	1 3/8"	

Dimensions in stock:
Steel/Steel coated: pg. 429 | Stainless steel: pg. 598

Retaining/lock washers and rings

Article 88121

SCHNORR safety washers
type VS = extra strong



for screws with property class 8.8/10.9

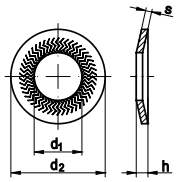
Dimensions	5	6	8	10	12	14	16
d_1 [1]	5.3	6.4	8.4	10.5	13	15	17
d_2 [2]	9	10	13	16	18	22	24
s	1	1	1.2	1.5	1.5	1.5	2
h	1.3	1.4	1.7	2	2.1	2.2	2.6
for inch thread ∅	3/16"	–	5/16"	3/8"	–	9/16"	5/8"

Dimensions	18	20	22	24	27	30	
d_1 [1]	19	21	23	25.6	28.6	31.6	
d_2 [2]	27	30	33	36	39	45	
s	2	2	2	2.5	2.5	2.5	
h	2.7	2.8	3	3.4	3.5	3.8	
for inch thread ∅	–	–	7/8"	–	–	1 1/8"	

Dimensions in stock:
Steel/Steel coated: pg. 429 | Stainless steel: pg. 599

Article 88123

TECKENTRUP-lock washers SK-S/NSK-S
type S = standard



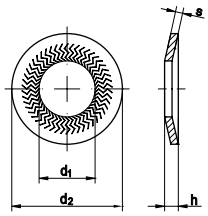
Dimensions	4	5	6	8	10	12
d_1	4.1	5.1	6.1	8.2	10.2	12.4
d_2	8.2	10.2	12.2	16.2	20.25	24.25
s	1	1	1.2	1.4	1.6	1.6
$h_{SK-S/NSK-S}$	1.35/1.3	1.5	1.8/1.75	2.4	2.4/2.75	2.6/3

for screws with property class ≤ 5.8

Dimensions in stock:
Steel/Steel coated: pg. 430 | Stainless steel: pg. 599

Article 88124

TECKENTRUP-lock washers SK-M/NSK-M
type M = medium



Dimensions	4	5	6	8	10	12
d_1	4.1	5.1	6.1	8.2	10.2	12.4
d_2	10.2	12.2	14.2	18.2	22.25	27.25
s	1	1.2	1.4	1.4	1.6	1.8
$h_{SK-M/NSK-M}$	1.5/1.45	1.8/1.75	2.2/2.15	2.4/2.7	2.75/3.1	3.05/3.65

Dimensions	14	16	18	20	24	
d_1	14.4	16.4	18	21	25	
d_2	30.25	32.5	35	40	50	
s	2.4	2.5	3	3	3.5	
$h_{SK-M/NSK-M}$	3.5/3.9	3.95/4.6	4.8	4.7/5	5.8	

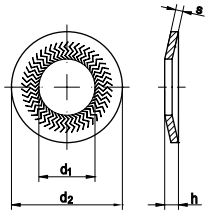
for screws with property class ≤ 10.9

Dimensions in stock:
Steel/Steel coated: pg. 430 | Stainless steel: pg. 599

Retaining/lock washers and rings

Article 88125

TECKENTRUP-lock washers SK-B/NSK-B
type B = width



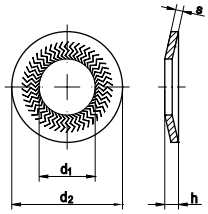
Dimensions	6	8	10	12
d_1	6.1	8.2	10.2	12.4
d_2	18.2	22.25	27.25	32.3
s	1.4	1.9	2.4	2.8
$h_{SK-B/NSK-B}$	2.55/2.6	2.9/3.1	3.65/3.6	4.5/4.8

for screws with property class ≤ 10.9

Dimensions in stock:
Steel/Steel coated: pg. 430 | Stainless steel: pg. 599

Article 88126

TECKENTRUP-lock washers SK-Z
type Z = for cheese head screws



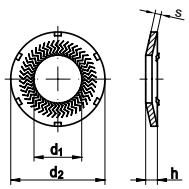
Dimensions	6	8	10	12	16
d_1	6.1	8.2	10.2	12.4	16.4
d_2	9.9	12.7	16.1	18.3	24.6
s	1.4	1.4	1.6	1.8	2.5
h	1.6	1.7	2	2.2	3.1

for cap screws with property class ≤ 10.9

Dimensions in stock:
Steel/Steel coated: pg. 431

Article 88129

TECKENTRUP-lock washers SK-K/NSK-K
type K = for contact serrations



Dimensions	4	5	6	8	10	12
d_1	4.1	5.1	6.1	8.2	10.2	12.4
d_2	8.2	10.2	12.2	16.2	20.25	24.25
s	1	1	1.2	1.4	1.6	1.6
$h_{SK-K/NSK-K}$	1.35/1.3	1.5	1.8/1.9	2.4	2.6/2.75	2.6/3

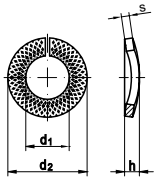
for screws with property class ≤ 5.8

Dimensions in stock:
Steel/Steel coated: pg. 431 | Stainless steel: pg. 600

Retaining/lock washers and rings

Article 88130

Lock rings
type VSK = standard type



for screws with property class ≤ 8.8

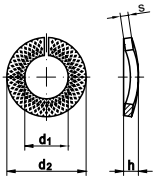
Dimensions	4	5	6	8	10	12	14
d_1	4.1	5.1	6.1	8.1	10.2	12.2	14.2
d_2	7.6	9.2	11.8	14.8	18.1	21.1	24.1
s	0.8	1	1.3	1.6	1.8	2.1	2.4
$h_{max.}$	1.4	1.7	2.2	2.75	3.15	3.15	4.3

Dimensions	16	18	20	22	24	27	30
d_1	16.2	18.2	20.2	22.5	24.5	27.5	30.5
d_2	27.4	29.4	33.6	35.9	40	43	48.2
s	2.8	2.8	3.2	3.2	4	4	6
$h_{max.}$	5.1	5.1	5.9	5.9	7.5	7.5	10.5

Dimensions in stock:
Steel/Steel coated: pg. 431 | Stainless steel: pg. 600

Article 88131

Lock rings
type VSK-Z = for cylindrical head screws



for cap screws with property class ≤ 8.8

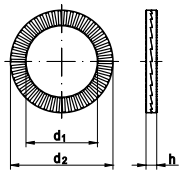
Dimensions	4	5	6	8
d_1	4.1	5.1	6.1	8.1
d_2	7	8.8	9.9	12.7
s	1.2	1.6	1.6	2
h	1.7	2.1	2.1	2.8

Dimensions	10	12	16	20
d_1	10.2	12.2	16.2	20.2
d_2	16.1	18.3	24.6	30.6
s	2.5	2.5	3.5	4.5
h	3.7	3.7	5.2	6.4

Dimensions in stock:
Steel/Steel coated: pg. 431

Article 88132

NORD-LOCK washers
standard type



for screws with property class ≤ 12.9

Dimensions	5	6	8	10	12	14	16	18
d_1	5.4	6.5	8.7	10.7	13	15.2	17	19.5
d_2	9	10.8	13.5	16.6	19.5	23	25.4	29
h	1.8	1.8	2.5	2.5	2.5	3.4	3.4	3.4
for inch thread ∅	No. 10	-	5/16"	-	-	9/16"	5/8"	-

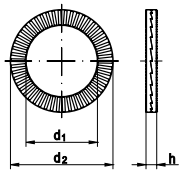
Dimensions	20	22	24	27	30	33	36	
d_1	21.4	23.4	25.3	28.4	31.4	34.4	37.4	
d_2	30.7	34.5	39	42	47	48.5	55	
h	3.4	3.4	3.4	6.6	6.6	6.6	6.6	
for inch thread ∅	-	7/8"	-	-	1 1/8"	1 1/4"	1 3/8"	

Dimensions in stock:
Steel/Steel coated: pg. 432 | Stainless steel: pg. 600

Retaining/lock washers and rings

Article 88132

NORD-LOCK washers
type SP = with enlarged outer diameter



Dimensions	3	3,5	4	5	6	8
d_1	3,4	3,9	4,4	5,4	6,5	8,7
d_2	7	9	9	10,8	13,5	16,6
h	1,8	2,2	2,2	1,8	2,5	2,5
for inch thread ∅	5	6	8	No. 10	–	5/16“

Dimensions	10	12	14	16	18	20
d_1	10,7	13	15,2	17	19,5	21,4
d_2	21	25,4	30,7	30,7	34,5	39
h	2,5	3,4	3,4	3,4	3,4	3,4
for inch thread ∅	–	–	9/16“	5/8“	–	–

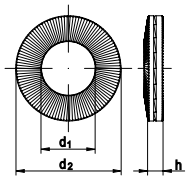
Dimensions	22	24	27	30	33	36
d_1	23,4	25,3	28,4	32,4	34,4	37,4
d_2	42	48,5	48,5	58,5	58,5	63
h	4,6	4,6	6,6	6,6	6,6	6,6
for inch thread ∅	7/8“	–	–	1 1/8“	1 1/4“	1 3/8“

for screws with property class ≤ 12.9

Dimensions in stock:
Steel/Steel coated: pg. 432

Article 88132

NORD-LOCK washers X-series
standard type



Dimensions	6	8	10	11	12	14	16
d_1	6.3	8.4	10.5	11.5	12.5	14.6	16.6
d_2	10.8	13.5	16.6	18.5	19.5	23	25.4
h	1.77	2.29	2.95	3.24	3.5	4.03	4.74
for inch thread ∅	–	5/16"	–	7/16"	–	9/16"	5/8"

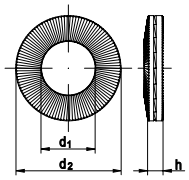
Dimensions	18	20	22	24	27	30	
d_1	18.7	20.7	22.8	24.8	27.9	31	
d_2	29	30.7	34.5	39	42	47	
h	5.36	6.01	6.8	7.19	8.28	9.06	
for inch thread ∅	–	–	7/8"	–	–	1 1/8"	

for screws with property class ≤ 12.9

Dimensions in stock:
Steel/Steel coated: pg. 432

Article 88132

NORD-LOCK washers X-series
type SP = with enlarged outer diameter



Dimensions	6	8	10	12	14	16
d_1	6.3	8.4	10.5	12.5	14.6	16.6
d_2	13.5	16.6	21	25.4	29	30.7
h	1.77	2.29	2.95	3.5	4.03	4.74
for inch thread ∅	–	5/16"	–	–	9/16"	5/8"

Dimensions	18	20	22	24	27	30
d_1	18.7	20.7	22.8	24.8	27.9	31
d_2	34.5	39	42	47	51	55
h	5.36	6.01	6.8	7.19	8.28	9.06
for inch thread ∅	–	–	7/8"	–	–	1 1/8"

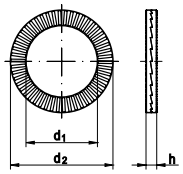
for screws with property class ≤ 12.9

Dimensions in stock:
Steel/Steel coated: pg. 432

Retaining/lock washers and rings

Article 88132

NORD-LOCK washers
type SC = for usage with HV assemblies acc. to EN 14399-4



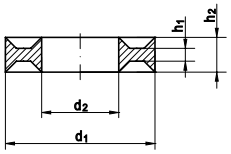
Dimensions	12	16	20	22
d_1	13.1	17.1	21.4	23.4
d_2	23.7	29.7	36.7	38.7
h	4.64	4.6	4.6	4.6

Dimensions	24	27	30	36
d_1	25.3	28.4	31.4	37.4
d_2	43.7	49.5	55.4	65.4
h	4.6	5.8	5.8	6

Dimensions in stock:
Steel/Steel coated: pg. 432

Article 88494

DUBO profile washers for hexagon head screws



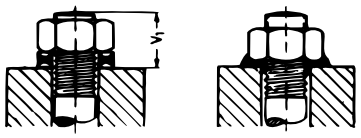
Dimensions	198	199	200	201	203	205
for thread	M 3	M 4	M 5	M 6	M 8	M 10
d_1	8	9.5	10.6	12.7	16.2	19.6
d_2	3.2	4.15	5.15	6.2/6.5	8.1	10.2
h_2	2.2	2.6	3	3.5	4	4.5
h_1	0.8	1	1.2	1.4	1.6	1.8
V_1	5	6	7	8.5	10.5	12.5
V_2	–	–	–	9.25	11.5	13.5

Dimensions	207	209	211	213	215	217
for thread	M 12	M 14	M 16	M 18	M 20	M 22
d_1	23.6	25.4	29.4	35.1	35.7	41.6
d_2	12.2	14.2	16.2	18.2	20.3	22.5
h_2	5	5.5	6	6.5	7	7.5
h_1	2	2.1	2.2	2.3	2.4	2.5
V_1	14.5	16.5	19	21.5	23	24.5
V_2	16	18	20.75	23.25	24.75	26.5

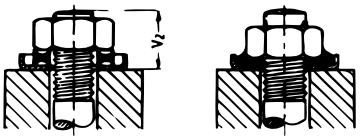
Dimensions	219	222	225	231	243	
for thread	M 24	M 27	M 30	M 36	M 48	
d_1	41.6	47.3	53.1	63.5	86.5	
d_2	24.3	27.3	30.2	36.2	48.2	
h_2	8	8.5	8.5	10	17	
h_1	2.6	2.7	2.8	3.2	4.5	
V_1	26	28.5	30.5	38	55	
V_2	28	30.5	–	–	–	

Examples:

without plate ring (V_1)
before tightening after tightening



with plate ring (V_2)
before tightening after tightening

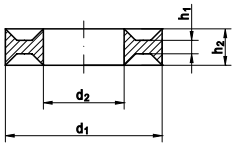


Dimensions in stock:
Non-ferrous materials: pg. 646

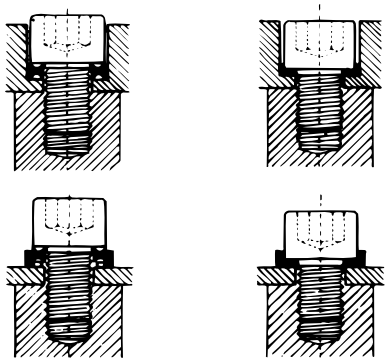
Retaining/lock washers and rings

Article 88495

DUBO profile washers
for hexagon socket cap screws



Examples:



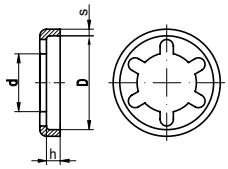
Dimensions	299	300	301	303
for thread	M 4	M 5	M 6	M 8
d_1	7.7	9.8	10.5	14
d_2	4.1	5.15	6.1	8.1
h_2	2	3	2.5	3.3
h_1	0.8	2	1	1.5

Dimensions	305	307	311	315
for thread	M 10	M 12	M 16	M 20
d_1	17	19	25	31.5
d_2	10.2	12.2	16.2	20.2
h_2	3.8	4.4	5.6	6.5
h_1	1.5	2	2	2.5

Dimensions in stock:
Non-ferrous materials: pg. 646

Article 88496

DUBO lock washers,
for DUBO profile washers



Dimensions	404	406	408	410	412
D	11.2	13.2	17.2	21.3	24.5
d	6.8	9	12	13.5	15.5
h	2.5	3.4	3.8	4.2	4.5
s	0.65	0.75	1	1.5	1.5
f. hexagon head screws	M 4/5 3/16"	M 6 1/4"	M 8 5/16"	M 10 3/8"	M 12 7/16"
f. cheese head screws	M 6 1/4"	–	M 10 3/8"	M 12 1/2"	M 14

Dimensions	414	416	417	418	419
D	27	31.25	33	37.5	39.5
d	17.5	21	23	26	27
h	4.8	5	5	5.5	5.5
s	1.5	1.75	1.75	1.75	2
f. hexagon head screws	1/2"	M 16	5/8"	M 18/20	3/4"
f. cheese head screws	M 16 5/8"	M 18	M 20	M 22 7/8"	M 24

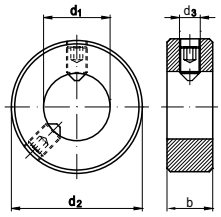
Dimensions	422	427	430	433	436
D	44	50.5	56	61	67
d	30.5	35	40	45	50
h	6	7	7.5	8	8.3
s	2	2	2.5	2.5	2.75
f. hexagon head screws	7/8"	M 27 1"	M 30 1 1/8"	M 33 1 1/4"	M 36 1 3/8"
f. cheese head screws	–	–	–	–	–

Dimensions in stock:
Steel/Steel coated: pg. 646

Retaining/lock washers and rings

DIN 703

Adjusting rings



*d_1 ≤ 65: one set screw with slot
d_1 ≥ 68: two set screws with hexagon socket

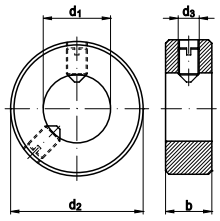
Dimensions	20	25	30	35	40	45
d_2	40	56	63	70	80	80
d_3	M 10	M 10	M 10	M 10	M 12	M 12
b	20	22	22	22	28	28
grub screw*	M 10x15	M 10x15	M 10x15	M 10x15	M 12x20	M 12x20

Dimensions	50	60	70	80	90	100
d_2	90	100	110	125	125	140
d_3	M 12	M 12	M 16	M 16	M 16	M 16
b	28	28	32	32	32	32
grub screw*	M 12x20	M 12x20	M 16x20	M 16x20	M 16x20	M 16x25

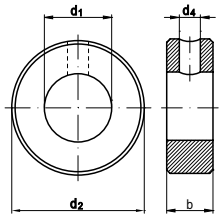
Dimensions in stock:
Steel/Steel coated: pg. 110

DIN 705

Adjusting rings



type A = with set screws



type B = with drilling for grooved or taper pins

Dimensions	4	5	6	8	9	10	12	13	14
b	5	6	8	8	10	10	12	12	12
d_2	8	10	12	16	18	20	22	22	25
d_3	M 2.5	M 3	M 4	M 4	M 4	M 5	M 6	M 6	M 6
d_4	1	1.5	1.5	2	2	3	4	4	4
A with pins[1]	M 2.5x4	M 3x4	M 4x5	M 4x6	M 4x6	M 5x8	M 6x8	M 6x8	M 6x8
B for pins[2]	1x8	1.5x10	1.5x12	2x16	2x16	3x20	4x22	4x22	4x24

Dimensions	15	16	17	18	20	22	24	25	26
b	12	12	12	14	14	14	16	16	16
d_2	25	28	28	32	32	36	40	40	40
d_3	M 6	M 6	M 6	M 6	M 6	M 6	M 8	M 8	M 8
d_4	4	4	4	5	5	5	6	6	6
A with pins[1]	M 6x8	M 6x8	M 6x8	M 6x8	M 6x8	M 6x10	M 8x12	M 10x16	M 10x16
B for pins[2]	4x24	4x28	4x28	5x32	5x32	5x36	6x40	6x40	6x40

Dimensions	28	30	32	34	35	36	38	40	42
b	16	16	16	16	16	16	16	18	18
d_2	45	45	50	50	56	56	56	63	63
d_3	M 8	M 8	M 8	M 8	M 8	M 8	M 8	M 10	M 10
d_4	6	6	8	8	8	8	8	8	8
A with pins[1]	M 8x12	M 8x10	M 8x12	M 8x12	M 8x12	M 8x12	M 8x12	M 10x16	M 10x16
B for pins[2]	6x45	6x45	8x50	8x50	8x55	8x55	8x55	8x60	8x60

Dimensions	45	50	55	60	65	70	75	80	85
b	18	18	18	20	20	20	22	22	22
d_2	70	80	80	90	100	100	110	110	125
d_3	M 10	M 10	M 10	M 10	M 10	M 10	M 12	M 12	M 12
d_4	8	10	10	10	10	10	10	10	12
A with pins[1]	M 10x16	M 10x16	M 10x16	M 10x16	M 10x20	M 10x20	M 12x20	M 12x20	M 12x25
B for pins[2]	8x70	10x80	10x80	10x90	10x100	10x100	10x100	10x110	12x120

Dimensions	90	100	110	120	125	130	140		
b	22	25	25	25	28	28	28		
d_2	125	140	160	160	180	180	200		
d_3	M 12	M 12	M 12	M 12	M 16	M 16	M 16		
d_4	12	12	12	12	16	16	16		
A with pins[1]	M 12x20	M 12x25	M 12x30	M 12x25	M 16x35	M 16x35	M 16x35		
B for pins[2]	12x120	12x140	12x160	12x160	16x180	16x180	16x200		

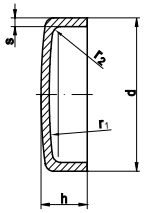
[1] d_1 ≤ 70 one set screw with slot
[2] d_2 ≥ 75 one set screw with hexagon socket

Dimensions in stock:
Steel/Steel coated: pg. 110 | Stainless steel: pg. 475

Special forms

DIN 443

Sealing push-in caps



d = nominal size

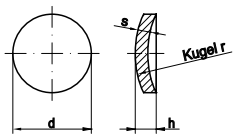
Dimensions	8	10	12	14	16	18	20	22	25	28
h	3	3	4	5	5	6	6	7	8	9
r_1	20	25	30	35	40	45	50	55	60	70
r_2	1	1	1	1	1	1	1	1.6	1.6	1.6
s	0.75	0.75	1	1	1	1	1	1.6	1.6	1.6

Dimensions	30	32	36	38	40	42	45	50	56	
h	9	10	11	12	12	13	14	15	17	
r_1	75	80	90	95	100	105	110	125	140	
r_2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.5	
s	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2	

Dimensions in stock:
Steel/Steel coated: pg. 85

DIN 470

Sealing discs



d = nominal size

Dimensions	6	8	10	12	14	16	18	20	22	25
h	1.67	1.94	2.67	2.77	2.94	3.11	3.28	3.45	4.09	4.38
r	7	9	12	16	19	22	25	28	30	34
s	1	1	1.6	1.6	1.6	1.6	1.6	1.6	2	2

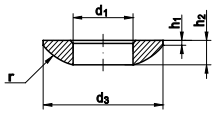
Dimensions	28	30	32	34	36	38	40	42	45	48
h	4.53	4.77	4.95	5.11	5.36	5.6	5.7	5.8	6.15	6.38
r	40	42	45	48	50	52	56	60	63	68
s	2	2	2	2	2	2	2	2	2	2

Dimensions	50	52	56	60	63	80	100	125		
h	6.62	6.66	7.06	7.47	7.7	10.41	12.23	14.2		
r	70	75	80	85	90	112	140	180		
s	2	2	2	2	2	3	3	3		

Dimensions in stock:
Steel/Steel coated: pg. 89

DIN 6319

Spherical washers
type C



d_1 = nominal size

Dimensions	6.4	8.4	10.5	13	17	21
d_3	12	17	21	24	30	36
h_1	0.7	0.6	0.8	1.1	1.3	2
h_2	2.3	3.2	4	4.6	5.3	6.3
r_{1b}	9	12	15	17	22	27

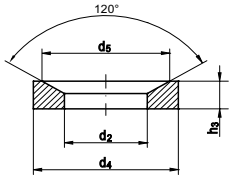
Dimensions	25	31	37	43	50
d_3	44	56	68	78	92
h_1	2.4	3.6	4.6	6.5	8
h_2	8.2	11.2	14	17	21
r_{1b}	32	41	50	58	67

Dimensions in stock:
Steel/Steel coated: pg. 307

Special forms

DIN 6319

Conical seats
type D



d_2 = nominal size

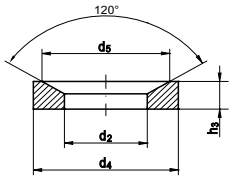
Dimensions	7.1	9.6	12	14.2	19	23.2
d_4	12	17	21	24	30	36
d_5	11	14.5	18.5	20	26	31
h_3	2.8	3.5	4.2	5	6.2	7.5

Dimensions	28	35	42	49	56	
d_4	44	56	68	78	92	
d_5	37	49	60	70	82	
h_3	9.5	12	15	18	22	

Dimensions in stock:
Steel/Steel coated: pg. 307

DIN 6319

Conical seats
type G



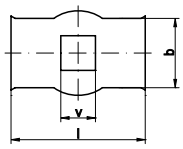
d_2 = nominal size

Dimensions	12	14.2	19	23.2	28	35
d_4	30	36	44	50	60	68
d_5	18.5	20	26	31	37	49
h_3	5	6	7	8	10	12

Dimensions in stock:
Steel/Steel coated: pg. 308

Article 88102

Joint washers
to use with DIN 603



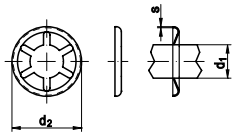
Dimensions	9	11
b	22	22
l	40	40
v	9	11
for screw	M 8	M 10

Dimensions in stock:
Steel/Steel coated: pg. 427

Special forms

Article 88122

Axle locking rings
quick fixing elements for shafts



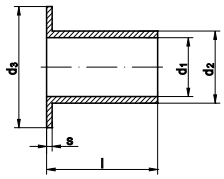
d_1 = nominal size

Dimensions	3	4	5	6	8	10	12
d_2	11	11	11	15	15	18	21
d_3	1.3	1.3	1.3	1.6	1.6	2.1	3
s	0.2	0.2	0.2	0.25	0.25	0.3	0.4
F_a	200 N	400 N	600 N	800 N	1000 N	1100 N	2500 N

Dimensions in stock:
Steel/Steel coated: pg. 430

Article 88498

KORREX Insulating tubes



Dimensions	M 4/10	M 4/15	M 4/20	M 5/10	M 5/15	M 5/20	M 6/10	M 6/15
for screw	M 4	M 4	M 4	M 5	M 5	M 5	M 6	M 6
l	10	15	20	10	15	20	10	15
d_1	4.3	4.3	4.3	5.3	5.3	5.3	6.5	6.5
d_2	5.8	5.8	5.8	6.8	6.8	6.8	8	8
d_3	9.5	9.5	9.5	12	12	12	13	13
s	1	1	1	1	1	1	1	1

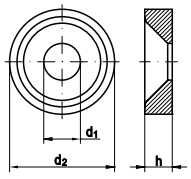
Dimensions	M 6/20	M 8/10	M 8/15	M 8/22	M 10/10	M 10/20	M 10/25	M 12/15
for screw	M 6	M 8	M 8	M 8	M 10	M 10	M 10	M 12
l	20	10	15	22	10	20	25	15
d_1	6.5	8.2	8.2	8.2	10.2	10.2	10.2	12.3
d_2	8	10.4	10.4	10.4	12.5	12.5	12.5	15
d_3	13	18	18	18	21	21	21	24
s	1	1	1	1	1	1	1	1

Dimensions	M 12/25	M 16/10	M 16/15	M 16/20	M 16/25	M 20/15	M 20/20	M 20/25
for screw	M 12	M 16	M 16	M 16	M 16	M 20	M 20	M 20
l	25	10	15	20	25	15	20	25
d_1	12.3	16.3	16.3	16.3	16.3	20.3	20.3	20.3
d_2	15	19.3	19.3	19.3	19.3	23.3	23.3	23.3
d_3	24	30	30	30	30	36	36	36
s	1	2	2	2	2	2	2	2

Dimensions in stock:
Non-ferrous materials: pg. 646

Article 88499

KORREX rosettes
for countersunk heads



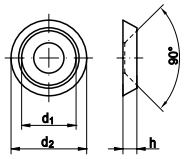
Dimensions	803	804	805	806	808
d_1	3.1	4.1	5.2	6.3	8.2
d_2	8.1	7.6	11.3	13.4	18
h	2.2	2	2.4	2.6	4
for screw	M 3	M 4	M 5	M 6	M 8

Dimensions in stock:
Non-ferrous materials: pg. 647

Special forms

Article 88965

Rosettes/finishing washers, open connecting surface
for countersunk heads



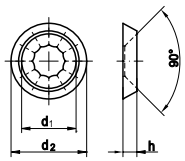
hole ∅ = nominal sizes

Dimensions	3	4.1	5	6	7	8.6
d_1	7	6.5	9	10	12.5	13
d_2	9.8	9	12.5	13	18	18
h	2.1	1.8	2.3	2.3	3.2	3
for screws acc. to DIN 95	3	3.5	4	5	6.0/7.0	6.0/7.0
for screws acc. to DIN 964	M 3	M 3.5	M 4	M 5	M 6	M 6/M 8
for screws acc. to DIN 7973	ST 2.9	ST 3.5	ST 3.9/4.2	ST 4.8	ST 5.5	ST 6.3

Dimensions in stock:
Non-ferrous materials: pg. 647

Article 88966

Rosettes/finishing washers open connecting surface
for countersunk heads

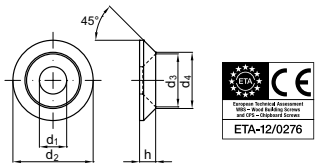


Dimensions	4.8	5	6	7
d_1	8.8	8	10.5	12
d_2	12.7	11	13	15
h	2.7	2.4	3	3.4
for screws acc. to DIN 95	4	4.5	5	6
for screws acc. to DIN 964	M 4	M 4	M 5	M 6
for screws acc. to DIN 7973	ST 4.2	ST 4.2	ST 4.8	ST 5.5

Dimensions in stock:
Non-ferrous materials: pg. 647

Artikel 89184

Countersunk washers, type B



ETA-12/0276
for use with the
wood building screw R 89091

Dimensions	6	8	10
d_1	8	8.5	11
d_2	19.5	25	32
d_3	8.5	16.5	21.5
d_4	9.5	17.5	22.5
h	4.8	5	6

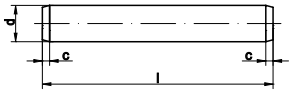
Dimensions in stock:
Steel/Steel coated: 447

Paralellel pins

ISO 2338

replaces DIN 7

Parallel pins



d = nominal size
tolerance m6

Dimensions	0.8	1	1.5	2	2.5	3	4	5	6
$c_{max.\ ISO}$	0.16	0.2	0.3	0.35	0.4	0.5	0.63	0.8	1.2
$c_{max.\ DIN}$	0.12	0.15	0.23	0.3	0.4	0.45	0.6	0.75	0.9
r	0.8	1	1.6	2	2.5	3	4	5	6

Dimensions	8	10	12	13	14	16	20	25	30
$c_{max.\ ISO}$	1.6	2	2.5	–	–	3	3.5	4	5
$c_{max.\ DIN}$	1.2	1.5	1.8	1.9	2	2.5	3	4	4.5
r	8	10	12	14	16	16	20	25	32

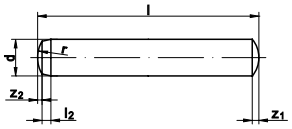
Dimensions in stock:
Steel/Steel coated: pg. 229, pg. 453 | Stainless steel: pg. 525, pg. 453

ISO 8734

replaces DIN 6325

Parallel pins
type A = through hardened

ISO 8734



DIN 6325

d = nominal size

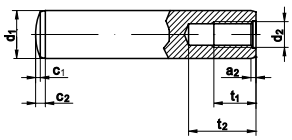
Dimensions	1	1.5	2	2.5	3	4	5
l_2	0.4	0.5	0.6	0.7	0.8	1	1.2
r	1	1.5	2	2.5	3	4	5
z_1	0.15	0.23	0.3	0.4	0.45	0.6	0.75
z_2	0.08	0.12	0.18	0.25	0.3	0.4	0.5
c	0.2	0.3	0.35	0.4	0.5	0.63	0.98

Dimensions	6	8	10	12	14	16	20
l_2	1.5	1.8	2	2.5	2.5	3	4
r	6	8	10	12	16	16	20
z_1	0.9	1.2	1.5	1.8	2	2.5	3
z_2	0.6	0.8	1	1.3	1.3	1.7	2
c	1.2	1.6	2	2.5	–	3	3.5

Dimensions in stock:
Steel/Steel coated: pg. 374, pg. 308

DIN 7979

Parallel pins
with internal thread
type D = hardened



d = nominal size
tolerance m6
*not standardized, reference values

Dimensions	4*	5*	6	8	10	12
a_2	0.5	0.6	0.8	1	1.2	1.6
c_1	0.4	0.5	0.6	0.8	1	1.2
c_2	1.3	1.7	2.1	2.6	3	3.8
d_2	(M 2)	(M 3)	M 4	M 5	M 6	M 6
t_1	6	6	6	8	10	10
$t_{2\ min.}$	7	7	10	12	16	16

Dimensions	14	16	20	25	30	40
a_2	1.8	2	2.5	3	4	5
c_1	1.4	1.6	2	2.5	3	4
c_2	4	4.7	6	6	7	8
d_2	M 8	M 8	M 10	M 16	M 20	M 20
t_1	12	12	16	24	30	30
$t_{2\ min.}$	20	20	25	34	42	42

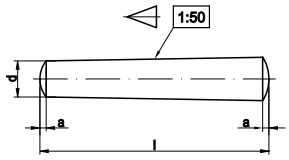
Dimensions in stock:
Steel/Steel coated: 356

Taper pins

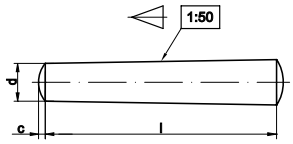
ISO 2339

replaces DIN 1

Taper pins
type B = turned



ISO 2339



DIN 1

*not standardized, reference values

Dimensions	1	1.5	2	2.5	3	4
a_{ISO}	0.12	0.2	0.25	0.3	0.4	0.5
$c_{max.\ DIN}$	0.15	0.23	0.3	0.4	0.45	0.6

Dimensions	5	6	6.5*	7*	8	10
a_{ISO}	0.63	0.8	0.8	0.9	1	1.2
$c_{max.\ DIN}$	0.75	0.9	1	1.1	1.2	1.5

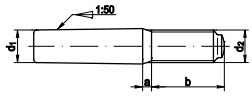
Dimensions	12	13*	14	16	20	
a_{ISO}	1.6	1.7	1.8	2	2.5	
$c_{max.\ DIN}$	1.8	1.9	2	2.5	3	

Dimensions in stock:
Steel/Steel coated: pg. 230, pg. 63 | Stainless steel: pg. 527, pg. 453

ISO 8737

similar DIN 7977

Taper pins with external thread and constant threaded part



d_1 = nominal size
*not standardized, reference values

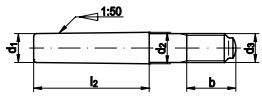
Dimensions	5	6	8	10	12
b	14	18	22	24	27
$a_{max.}$	2.4	3	4	4.5	5.3
d_2	M 5	M 6	M 8	M 10	M 12

Dimensions	13*	14	16	20	
b	27	30	35	35	
$a_{max.}$	5.3	6	6	6	
d_2	M 13	M 12	M 16	M 16	

Dimensions in stock:
Steel/Steel coated: pg. 376, pg. 355*

DIN 258

Taper pins with thread ends and constant taper lengths



d_1 = nominal size

Dimensions	5	6	8	10
$b_{min.}$	14	18	22	24
d_2	5.5	6.6	8.8	10.9
d_3	M 5	M 6	M 8	M 10
l_2	25	30	40	45

Dimensions	12	16	20	25
$b_{min.}$	27	35	35	40
d_2	13.1	17.4	21.7	27
d_3	M 12	M 16	M 20	M 25
l_2	55	72	85	100

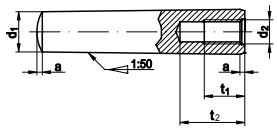
Dimensions in stock:
Steel/Steel coated: pg. 77

Taper pins

ISO 8736

similar DIN 7978

Taper pins with internal thread
type A = polished



d = nominal size

Dimensions	6	8	10
a	0.8	1	1.2
d_2	M 4	M 5	M 6
t_1	6	8	10
$t_{2\ min.}$	10	12	16

Dimensions	12	16	20
a	1.6	2	2.5
d_2	M 8	M 10	M 12
t_1	12	16	18
$t_{2\ min.}$	20	25	27

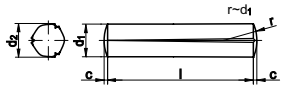
Dimensions in stock:
Steel/Steel coated: pg. 376, pg. 355

Grooved pins

ISO 8744

replaces DIN 1471

Grooved pins full-length taper grooved



[1]∅ depends on the length
[2]minimum shear strength, double kN

Dimensions	1.5	2	2.5	3	4
d_2 [1]	1.60 – 1.63	2.10 – 2.15	2.60 – 2.70	3.20 – 3.30	4.15 – 4.30
c	0.2	0.25	0.3	0.4	0.5
shear strength ISO	1.6	2.84	4.4	6.4	11.3
shear strength[2] DIN	1.6	2.85	4.25	6.15	10.6

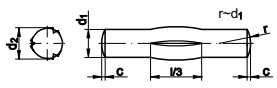
Dimensions	5	6	8	10	12
d_2 [1]	5.15 – 5.30	6.15 – 6.35	8.20 – 8.40	10.20 – 10.45	12.25 – 12.50
c	0.63	0.85	1	1.2	1.6
shear strength ISO	17.6	25.4	45.2	70.4	101.8
shear strength[2] DIN	16.5	22.8	40.5	63.2	91

Dimensions in stock:
Steel/Steel coated: pg. 378, pg. 210 | Stainless steel: pg. 583, pg. 517

ISO 8742

replaces DIN 1475

Grooved pins, one-third-length centre grooved



[1]∅ depends on the length
[2]minimum shear strength, double Kn

Dimensions	1.5	2	2.5	3	4
d_2 [1]	1.60 – 1.63	2.10 – 2.15	2.60 – 2.70	3.20 – 3.30	4.15 – 4.30
c	0.2	0.25	0.3	0.4	0.5
shear strength ISO	1.6	2.84	4.4	6.4	11.3
shear strength[2] DIN	1.6	2.85	4.25	6.15	10.6

Dimensions	5	6	8	10	12
d_2 [1]	5.15 – 5.30	6.15 – 6.35	8.20 – 8.40	10.20 – 10.45	12.25 – 12.50
c	0.63	0.85	1	1.2	1.6
shear strength ISO	17.6	25.4	45.2	70.4	101.8
shear strength[2] DIN	16.5	22.8	40.5	63.2	91

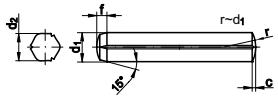
Dimensions in stock:
Steel/Steel coated: pg. 378, pg. 212 | Stainless steel: pg. 517

Grooved pins

ISO 8740

replaces DIN 1473

Grooved pins, full-length parallel-grooved, with chamfer



Dimensions	1.5	2	2.5	3	4
d_2[1]	1.60 – 1.63	2.10 – 2.15	2.60 – 2.70	3.20 – 3.30	4.15 – 4.30
c	0.2	0.25	0.3	0.4	0.5
shear strength ISO	1.6	2.84	4.4	6.4	11.3
shear strength[2] DIN	1.6	2.85	4.25	6.15	10.6

Dimensions	5	6	8	10	12
d_2[1]	5.15 – 5.30	6.15 – 6.35	8.20 – 8.40	10.20 – 10.45	12.25 – 12.50
c	0.63	0.85	1	1.2	1.6
shear strength ISO	17.6	25.4	45.2	70.4	101.8
shear strength[2] DIN	16.5	22.8	40.5	63.2	91

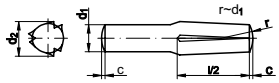
[1]∅ depends on the length
[2]minimum shear strength, double kN

Dimensions in stock:
Steel/Steel coated: pg. 377, pg. 211 | Stainless steel: pg. 583, pg. 517

ISO 8741

replaces DIN 1474

Grooved pins, half-length reverse-taper grooved



Dimensions	1.5	2	2.5	3	4
d_2[1]	1.60 – 1.63	2.10 – 2.15	2.60 – 2.70	3.20 – 3.30	4.15 – 4.30
c	0.2	0.25	0.3	0.4	0.5
shear strength ISO	1.6	2.84	4.4	6.4	11.3
shear strength[2] DIN	1.6	2.85	4.25	6.15	10.6

Dimensions	5	6	8	10	12
d_2[1]	5.15 – 5.30	6.15 – 6.35	8.20 – 8.40	10.20 – 10.45	12.25 – 12.50
c	0.63	0.85	1	1.2	1.6
shear strength ISO	17.6	25.4	45.2	70.4	101.8
shear strength[2] DIN	16.5	22.8	40.5	63.2	91

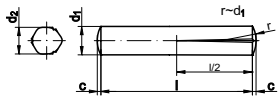
[1]∅ depends on the length
[2]minimum shear strength, double kN

Dimensions in stock:
Steel/Steel coated: pg. 378, pg. 212

ISO 8745

replaces DIN 1472

Grooved pins, half-length taper grooved



Dimensions	1.5	2	2.5	3	4
d_2[1]	1.60 – 1.63	2.10 – 2.15	2.60 – 2.70	3.20 – 3.30	4.15 – 4.30
c	0.2	0.25	0.3	0.4	0.5
shear strength ISO	1.6	2.84	4.4	6.4	11.3
shear strength[2] DIN	1.6	2.85	4.25	6.15	10.6

Dimensions	5	6	8	10	12
d_2[1]	5.15 – 5.30	6.15 – 6.35	8.20 – 8.40	10.20 – 10.45	12.25 – 12.50
c	0.63	0.85	1	1.2	1.6
shear strength ISO	17.6	25.4	45.2	70.4	101.8
shear strength[2] DIN	16.5	22.8	40.5	63.2	91

[1]∅ depends on the length
[2]minimum shear strength, double kN

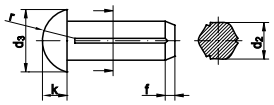
Dimensions in stock:
Steel/Steel coated: pg. 379, pg. 211 | Stainless steel: pg. 584, pg. 517

Grooved pins

ISO 8746

similar DIN 1476

Grooved pins with round head
type A = with chamfer



Dimensions	1.4	1.6	2	2.3	2.5
d_2	1.5	1.7	2.15	2.5	2.7
d_3	2.4	2.8	3.5	4.0	4.4
k	0.8	1	1.2	1.4	1.5
r	1.4	1.6	1.9	2.1	2.4
f	0.5	0.5	0.5	0.7	0.7

Dimensions	3	4	5	6	
d_2	3.2	4.25	5.25	6.3	
d_3	5.2	7	8.8	10.5	
k	1.8	2.4	3	3.6	
r	2.8	3.8	4.6	5.7	
f	4	1.5	1.5	2	

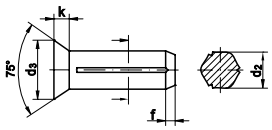
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 380, pg. 213 | Stainless steel: pg. 584, pg. 518 | Non-ferrous materials: pg. 643, pg. 632

ISO 8747

similar DIN 1477

Grooved pins with countersunk head
type A = with chamfer



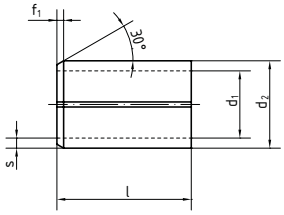
Dimensions	2	3	4	5	6
d_2	2.15	3.20	4.25	5.25	6.30
d_3	3.5	5.2	7	8.8	10.5
k	1	1.4	2	2.5	3
f	0.5	1	1.15	1.15	2

Dimensions in stock:
Steel/Steel coated: pg. 380, pg. 213

Tension bushes

DIN 1498

Tension bushes



Dimensions	16	20	25	25	25	28
d_2	20	26	32	32	32	35
l	20	20	20	28	30	25
s	2	3	3.5	3.5	3.5	3.5
f_1	1.5	2	2	2	2	2

Dimensions	30	40	40	40	50	
d_2	38	50	50	50	60	
l	25	25	30	40	50	
s	4	5	5	5	5	
f_1	2	2.5	2.5	2.5	2.5	

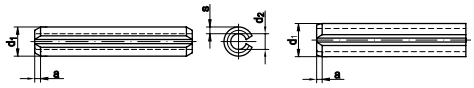
Dimensions in stock:
Steel/Steel coated: 220

Spring-type straight pins

ISO 8752

replaces DIN 1481

Spring-type straight pins
slotted, heavy duty



Dimensions	1	1.5	2	2.5	3	3.5	4	4.5	5
$a_{ISO\ min.}$	0.15	0.25	0.35	0.4	0.5	0.6	0.65	0.8	0.9
$d_{1\ max.}$[1]	1.3	1.8	2.4	2.9	3.5	4	4.6	5.1	5.6
d_2[1]	0.8	1.1	1.5	1.8	2.1	2.3	2.8	2.9	3.4
s	0.2	0.3	0.4	0.5	0.6	0.75	0.8	1	1
shear strength[2]	0.7	1.58	2.82	4.38	6.32	9.06	11.24	15.36	17.54

Dimensions	6	7*	8	9*	10	12	13	14	16
$a_{ISO\ min.}$	1.2	1.8	2	2	2	2	2	2	2
$d_{1\ max.}$[1]	6.7	7.8	8.8	9.5	10.8	12.8	13.8	14.8	16.8
d_2[1]	3.9	4	5.5	6	6.5	7.5	8.5	8.5	10.5
s	1.25	1.5	1.5	2	2	2.5	2.5	3	3
shear strength[2]	26.04	–	42.76	–	70.16	104.1	115.12	144.7	171

Dimensions	18	20	21	25	28	30	35	40	
$a_{ISO\ min.}$	2	3	3	3	3	3	3	4	
$d_{1\ max.}$[1]	18.9	20.9	21.9	25.9	28.9	30.9	35.9	40.9	
d_2[1]	11.5	12.5	13.5	15.5	17.5	18.5	21.5	25.5	
s	3.5	4	4	5	5.5	6	7	7.5	
shear strength[2]	222.5	280.6	298.2	438.5	542.6	631.4	859	1068	

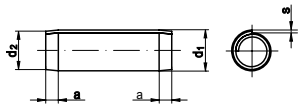
[1]dimensions before installation
[2]shear strength, double kN, only for spring steel
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 381, pg. 217 | Stainless steel: pg. 585, pg. 519

ISO 8750

similar DIN 7343

Spring-type straight pins
coiled, standard duty



Dimensions	1	1.5	2	2.5	3	3.5	4
a	0.3	0.5	0.7	0.8	1	1.2	1.3
s	0.08	0.13	0.17	0.21	0.25	0.29	0.33
d_1[1]	1.1	1.62	2.15	2.65	3.15	3.67	4.2
d_2[1]	0.95	1.4	1.9	2.35	2.85	3.35	3.8
shear strength[2]	0.6	1.45	2.5	3.9	5.5	7.5	9.6

Dimensions	5	6	8	10	12	14	16
a	1.7	2	3	3	4	4.5	5
s	0.42	0.5	0.67	0.84	1	1.2	1.3
d_1[1]	5.25	6.25	8.35	10.45	12.5	14.55	16.55
d_2[1]	4.8	5.8	7.75	9.6	11.5	13.5	15.4
shear strength[2]	15	22	39	62	89	120	155

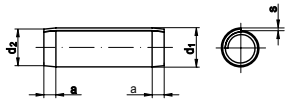
[1]dimensions before installation
[2]shear strength, double kN, only for spring steel

Dimensions in stock:
Steel/Steel coated: pg. 381, pg. 339 | Stainless steel: pg. 584, pg. 571

ISO 8748

similar DIN 7344

Spring-type straight pins
coiled, heavy duty



Dimensions	1.5	2	2.5	3
a	0.5	0.7	0.8	1
s	0.17	0.22	0.28	0.33
d_1[1]	1.6	2.1	2.6	3.12
d_2[1]	1.4	1.9	2.35	2.85
shear strength[2]	1.9	3.5	5.5	7.6

Dimensions	4	5	6	8*
a	1.3	1.7	2	2
s	0.45	0.56	0.67	0.9
d_1[1]	4.15	5.15	6.25	8.25
d_2[1]	3.8	4.8	5.8	7.8
shear strength[2]	13.5	20	30	53

[1]dimensions before installation
[2]shear strength, double kN, only for spring steel
*not standardized, reference values

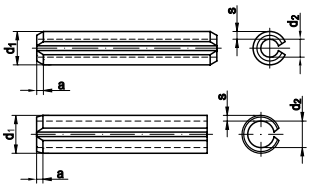
Dimensions in stock:
Steel/Steel coated: pg. 380, pg. 339

Spring-type straight pins

ISO 13337

similar DIN 7346

Spring-type straight pins
slotted, light duty



[1]dimensions before installation
[2]shear strength, double kN, only for spring steel

Dimensions	2	2.5	3	4	5	6
a	0.2	0.25	0.25	0.5	0.5	0.7
d_1[1]	2.3	2.8	3.3	4.4	5.4	6.4
d_2[1]	1.9	2.3	2.7	3.4	4.4	4.9
s	0.2	0.25	0.3	0.5	0.5	0.75
shear strength[2]	1.5	2.4	3.5	8	10.4	18

Dimensions	8	10	12	13	16	21
a	1.5	2	2	2	2	2
d_1[1]	8.5	10.5	12.5	13.5	16.5	21.5
d_2[1]	7	8.5	10.5	11	13.5	17.5
s	0.75	1	1	1.25	1.5	2
shear strength[2]	24	40	48	66	98	168

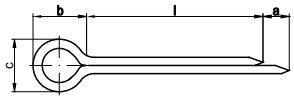
Dimensions in stock:
Steel/Steel coated: pg. 396, pg. 340

Linch pins/spring cotters/split pins

ISO 1234

similar DIN 94

Split pins



Dimensions	1	1.2	1.6	2	2.5	3.2	4
$a_{min.}$	0.8	1.25	1.25	1.25	1.25	1.6	2
b	3	3	3.2	4	5	6.4	8
$c_{max.}$	1.8	2	2.8	3.6	4.6	5.8	7.4
pin hole ∅	1	1.2	1.6	2	2.5	3.2	4
for screw ∅	3.5 - 4.5	4.5 - 5.5	5.5 - 7	7 - 9	9 - 11	11 - 14	14 - 20
for clevis pin ∅	3 - 4	4 - 5	5 - 6	6 - 8	8 - 9	9 - 12	12 - 17

Dimensions	5	5.5*	6.3	8	10	13	16
$a_{min.}$	2	2	2	2	3.2	3.2	3.2
b	10	12.6	12.6	16	20	26	32
$c_{max.}$	9.2	11	11.8	15	19	24.8	30.8
pin hole ∅	5	5.5	6.3	8	10	13	16
for screw ∅	20 - 27	21 - 27	27 - 39	39 - 56	56 - 80	80 - 120	120 - 170
for clevis pin ∅	17 - 23	18 - 23	23 - 29	29 - 44	44 - 69	69 - 110	110 - 160

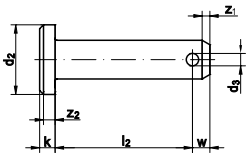
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 208, pg. 69 | Stainless steel: pg. 516, pg. 458 | Non-ferrous materials: pg. 632, pg. 613

ISO 2341

similar DIN 1444 B

Clevis pins with head
type B = with split pin hole



pin ∅ with tolerance h11

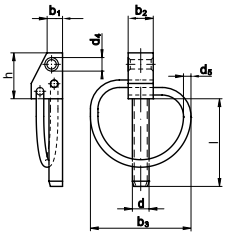
Dimensions	8	10	12	16	18	20
d_2	14	18	20	25	28	30
d_3	2	3.2	3.2	4	5	5
k	3	4	4	4.5	5	5
w	3.5	4.5	5.5	6	7	8
$z_{1\ max.}$	2	2	3	3	3	4
z_2	1	1	1.6	1.6	1.6	2
for split pin ∅	2	3.2	3.2	4	5	5

Dimensions in stock:
Steel/Steel coated: pg. 210

Linch pins/spring cotters/split pins

DIN 11023

Linch pins



Maße	5	6	8	10
l	32	42	42	45
$b_{1\ max.}$	11.5	14	15	15
$b_{2\ max.}$	7	8	9	12
$b_{3\ max.}$	36	52	52	52
$h_{\ max.}$	18	22	22	22
d_4	3.5	4	4	4.5
$d_{5\ min.}$	2.5	3.6	3.6	3.6
for shafts $\varnothing_{\ max.}$	25	32	32	32
for drilling $\varnothing$	5	6	8	10
hole position*	8	10	12	14

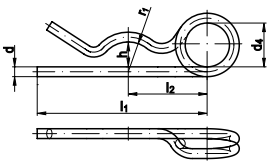
Maße	12	12	17	
l	45	55	60	
$b_{1\ max.}$	15	15	21	
$b_{2\ max.}$	14	14	20	
$b_{3\ max.}$	52	60	60	
$h_{\ max.}$	22	22	29	
d_4	4.5	4.5	6	
$d_{5\ min.}$	3.6	4	4	
for shafts $\varnothing_{\ max.}$	32	45	45	
for drilling $\varnothing$	12	12	17	
hole position*	18	18	21	

*Indication: shaft end to bore center
also used as version of ~ DIN 11023
without chain bore available

Dimensions in stock:
Steel/Steel coated: 394

DIN 11024

Spring cotters of a bolt



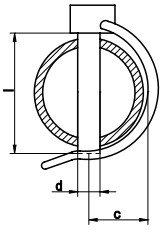
nominal size = drilling ∅

Dimensions	2.5	3.2	4	5	6.3	7	8
d_3	2.25	2.8	3.6	4.5	5.6	6.3	7
d_4	20	20	20	25	25	30	30
l_1	42	48	64	80	97	125	150
l_2	24	26	32	39	45	56	63
h	2.5	3	4.5	7	9	12.5	17.5
r_1	5.6	7	10	13	17	22.5	28
for shafts ∅	9 - 11.2	11.2 - 14	14 - 20	20 - 26	26 - 34	34 - 45	45 - 56

Dimensions in stock:
Steel/Steel coated: pg. 395 | Stainless steel: pg. 589

Article 88023

Linch pins for tubes



Dimensions	6	8	8
c	22	22	25
l	40	40	50

Dimensions	10	10	
c	25	32	
l	50	60	

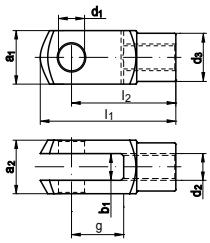
d = nominal size

Dimensions in stock:
Steel/Steel coated: pg. 394

Linch pins/spring cotters/split pins

DIN 71752

Fork joints
type G = yokes
matching spring flap bolts ➔ article 88752



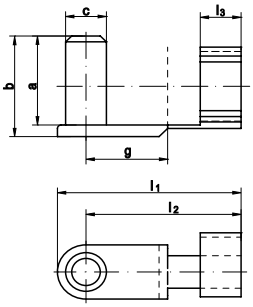
nominal size = drilling ∅
*not standardized, reference values

Dimensions	6	8	10	12	16	20*
g	12/24	16/32	20/40	24/48	32/64	40
a_1	12	16	20	24	32	40
a_2	12	16	20	24	32	40
b_1	6	8	10	12	16	20
d_2	M 6	M 8	M 10	M 12	M 16	M 20
d_3	10	14	18	20	26	34
l_1	31/43	42/58	52/72	62/86	72/101	105
l_2	24/36	32/48	40/60	48/72	64/96	80

Dimensions in stock:
Steel/Steel coated: pg. 409

Article 88752

Spring flap bolts ("ES bolts")
for fork joints ➔ DIN 71752



c x g = nominal size

Dimensions	6x12	6x24	8x16	8x32	10x20	10x40
c	6	6	8	8	10	10
a	14	14	19	19	23	23
b	16	16	21.5	21.5	26	26
l_1	28	40	37	52	45	65
l_2	23	35	30	46	38	58
l_3	6.5	6.5	8	8	10	10

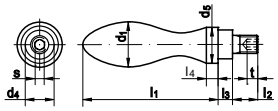
Dimensions	12x24	12x48	16x32	16x64	20x40	
c	12	12	16	16	20	
a	28	28	34	34	44	
b	31	31	38	38	47	
l_1	53	78	73	103	98	
l_2	45	69	62	92	81	
l_3	12	12	16	16	19	

Dimensions in stock:
Steel/Steel coated: pg. 410

Grips

DIN 98

Rotatable ball handles
type E = with threaded shank and hexagon socket

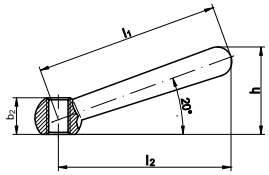


Dimensions	M 6	M 8	M 10	M 12	M 16
d_1	16	20	25	32	36
d_4	10	13	16	20	22
d_5	14	18	21	26	29
l_1	49	61	75	96	106
l_2	11	13	14	21	26
l_3	5.5	6	8	10.5	11
l_4	5	6	6.5	8	9
s	3	4	5	6	8
t	3.5	5	6	8	10

Dimensions in stock:
Steel/Steel coated: pg. 70

DIN 99

Tapered handles
with handle bracket via thread
type N = tilted handle

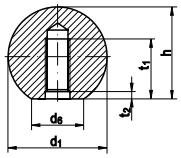


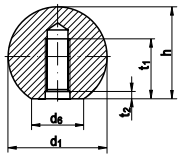
Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24
l_1	50	63	80	100	125	160	200
b_2	9.5	12.5	15	19	25	31	4
h	24	30.5	38	47	59.5	75.7	97
l_2	38	60	76	95	119	152	190
l_2	48	60	76	95	119	152	190

Dimensions in stock:
Steel/Steel coated: pg. 70 | Stainless steel: pg. 460

DIN 319

Ball knobs





type C = with thread
type E = with threaded bush

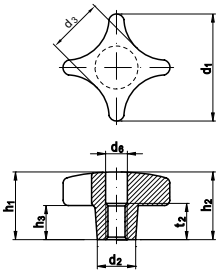
Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
d_1	16	20	25	32	40	50
d_6	8	12	15	18	22	28
t_3	6	7.5	9	12	15	18
h	15	18	22.5	29	37	46
t_1	6	7.5	9	12	15	18
t_2	1.2	1.6	2.0	2.5	3	3

Dimensions in stock:
Non-ferrous materials: pg. 618

Grips

DIN 6335

Palm grips
type D = with continuous thread

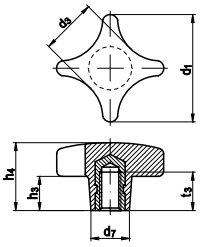


Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
d_1	32	40	50	63	80	100
d_2	12	14	18	20	25	32
d_3	18	21	25	32	40	48
d_6	6.4	8.4	10.5	13	17	21
h_1	21	26	34	42	52	65
h_3	10	14	20	25	30	38
t_2	10	13	16	20	20	25

Dimensions in stock:
Steel/Steel coated: pg. 310

DIN 6335

Palm grips
type K = with threaded bush



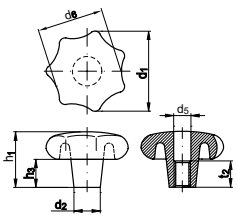
Dimensions	M 5	M 6	M 8	M 10	M 12	M 16	M 20*
d_1	25	32	40	50	63	80	100
d_3	15	18	21	25	32	40	50
d_7	12	14	18	22	26	35	34
h_3	8	10	13	20	25	30	38
h_4	16	20	25	32	40	50	65
$t_{3\ min.}$	9.5	12	14	18	22	30	30

*not standardized, reference values

Dimensions in stock:
Non-ferrous materials: pg. 639

DIN 6336

Star grips
type D = with continuous thread



Dimensions	M 6	M 8	M 8*	M 10	M 10*	M 12	M 12*	M 16
d_1	32	40	50	50	63	63	80	80
d_2	12	14	18	18	20	20	25	25
d_5	6.4	8.4	8.4	10.5	10.5	13	13	17
d_6	26	34	42	42	52	52	64	64
h_1	21	26	32	34	40	42	50	52
h_3	10	13	18	17	20	21	25	25
t_2	10	13	16	16	20	20	20	20

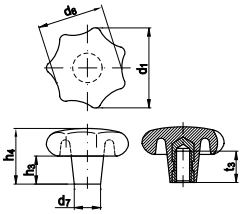
*not standardized, reference values

Dimensions in stock:
Steel/Steel coated: pg. 310

Grips

DIN 6336

Star grips
type K = with threaded bush



Dimensions	M 4	M 5	M 6	M 6*	M 8	M 8*
d_1	20	25	32	40	40	50
d_6	16	20	26	34	34	42
d_7	10	12	14	18	18	21
h_3	7	8	10	13	13	17
h_4	13	16	20	25	25	32
$t_{3\ min.}$	6.5	9.5	12	16	14	18

Dimensions	M 10	M 10*	M 12	M 12*	M 16	
d_1	50	63	63	80	80	
d_6	42	52	52	64	64	
d_7	22	26	26	36	35	
h_3	17	21	21	25	25	
h_4	32	40	40	48	50	
$t_{3\ min.}$	18	25	22	27	30	

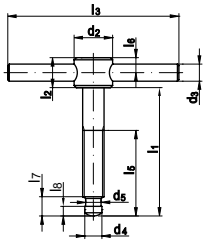
*not standardized, reference values

Dimensions in stock:
Non-ferrous materials: pg. 639

Tommy screws/Tommy nuts

DIN 6304

Tommy screws with fixed clamping bolt
type E = without thrust pad



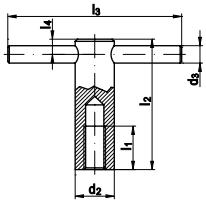
thrust pads ➔ DIN 6311

Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
l_1	40/50	50/60	60/70	70/80	75/90/100	75/90/100
d_2	12	14	18	20	24	30
d_3	5	6	8	10	12	16
d_4	4.5	6	8	8	12	15.5
d_5	4	5.4	7.2	7.2	11	14.4
l_2	10	12	14	18	20	28
l_3	50	60	80	100	120	140
l_5	30/40	35/45	40/50	50/60	55/70/90	55/70/90
l_6	5	5	7	9	10	14
l_7	6	7.5	9	10	12	14
l_8	2.5	3	4.5	4.5	5	5.5

Dimensions in stock:
Steel/Steel coated: pg. 306

DIN 6305

Tommy nuts with fixed clamping bolt



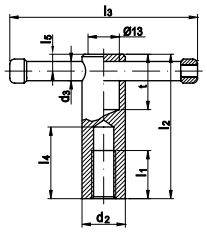
Dimensions	M 10	M 12	M 16	M 20
d_2	18	20	24	30
d_3	8	10	12	16
l_1	25	25	35	40
l_2	60	70	85	95
l_3	80	100	120	140
l_4	7	9	11	14

Dimensions in stock:
Steel/Steel coated: pg. 307

Tommy screws/Tommy nuts

DIN 6307

Tommy nuts with movable clamping bolt

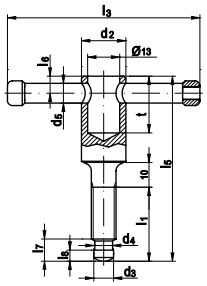


Dimensions	M 10	M 12	M 16	M 20
d_2	18	20	24	30
d_3	8	10	12	16
l_1	25	25	35	40
l_2	60	70	85	95
l_3	80	100	120	140
l_4	30	35	45	50
l_5	7	9	11	14
t	23	26	28	34

Dimensions in stock:
Steel/Steel coated: pg. 307

DIN 6306

Tommy screw with movable clamping bolt
type D = without thrust pad



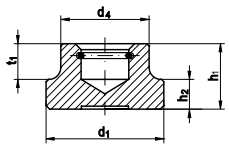
thrust pads ➔ DIN 6311

Dimensions	M 10	M 12	M 16	M 20
l_1	40/50	50/60	55/70/90	55/70/90
d_2	18	20	24	30
d_3	8	8	12	15.5
d_4	7.2	7.2	11	14.4
d_5	8	10	13	16
l_3	80	100	120	140
l_5	72/82	85/95	95/110/130	100/115/135
l_6	7	9	10	14
l_7	9	10	12	14
l_8	4.5	4.5	5	5.5
t	23	26	28	34

Dimensions in stock:
Steel/Steel coated: pg. 307

DIN 6311

Thrust pads
type S = with snap ring



Dimensions	12	16	20
b	0.7	1	1
d_4	10	12	15
h_1	7	9	11
h_2	2.5	4	5
t_1	4	5	6
snap ring[1]	5.1x0.6x2.5	7.0x0.8x2.5	8[1]
grub screw[2]	M 6	M 8	M 10

Dimensions	25	32	40
b	1	1.2	1.8
d_4	18	22	28
h_1	13	15	16
h_2	6	7	9
t_1	7	7.5	8
snap ring[1]	8[1]	12[1]	16[1]
grub screw[2]	M 12	M 16	M 20

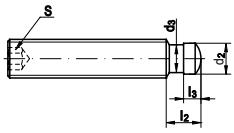
[1]Snap rings – acc. to DIN 7993
[2]for grub screws acc. to DIN 6332

Dimensions in stock:
Steel/Steel coated: pg. 307

Tommy screws/Tommy nuts

DIN 6332

Grub screws with thrust point
type IS = with hexagon socket



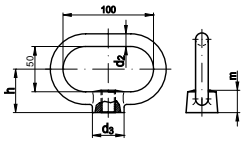
thrust pads ➔ DIN 6311

Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
s	3	4	5	6	8	10
d_2	4.5	6	8	8	12	15.5
d_3	4	5.4	7.2	7.2	11	14.4
l_2	6	7.5	9	10	12	14
l_3	2.5	3	4.5	4.5	5	5.5

Dimensions in stock:
Steel/Steel coated: pg. 310

DIN 28129

Clamp nuts (lifting nuts)



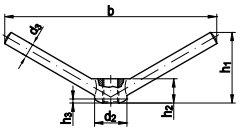
for container const. acc. to AD Regulation, TÜV accepted

Dimensions	M 16	M 20	M 24	M 27
d_2	14	16	18	20
d_3	35	40	45	50
h	48	50	55	58
m	25	28	32	35

Dimensions in stock:
Steel/Steel coated: pg. 408

DIN 80701

Butterfly nuts

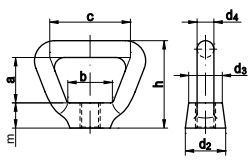


Dimensions	M 16	M 20	M 24
b	200	240	280
d_2	30	40	50
d_3	12	16	20
h_1	65	75	90
h_2	20	25	32
h_3	4	5	5

Dimensions in stock:
Non-ferrous materials: pg. 644

DIN 80704

Bow nuts



*not standardized, reference values

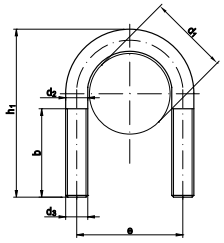
Dimensions	M 6*	M 8*	M 10*	M 12	M 16	M 20	M 22*	M 24
a	15	20	25	27	29	32	32	36
b	14	18	23	27	32	36	36	45
c	25	32	42	48	56	64	64	75
d_2	14	18	23	24	30	36	36	45
d_3	11.5	15	18	20	24	28	28	36
d_4	5	6.5	8	10	12	13	13	14
h	28	36	45	52	59	66	66	75
m	8	10	12	15	18	21	21	25

Dimensions in stock:
Stainless steel: pg. 592 | Non-ferrous materials: pg. 644

Stirup bolts

DIN 3570

Steel strap
type A = double-sided fixing thread



Dimensions	23*	30	38	46	52
for pipe nominal width	15	20	25	32	40
d_1	20 to 21	25 to 26.9	30 to 33.7	38 to 42.4	44.5 to 48.3
b^1	30	40	40	50	50
d_2	10	10	10	10	10
d_3	M 10	M 10	M 10	M 10	M 10
e	33	40	48	56	62
$h_1{}^1$	60	70	76	86	92

Dimensions	64	82	94	120	148
for pipe nominal width	50	65	80	100	125
d_1	57 to 60.3	76.1	88.9	108 to 114.3	133 to 139.7
b^1	50	50	50	60	60
d_2	12	12	12	16	16
d_3	M 12	M 12	M 12	M 16	M 16
e	76	94	106	136	164
$h_1{}^1$	109	125	138	171	191

Dimensions	176	228	282	332	530
for pipe nominal width	150	200	250	300	500
d_1	159 to 168.3	216 to 219.1	267 to 273	318 to 323.9	508 to 521
b^1	60	70	70	70	70
d_2	16	20	20	20	24
d_3	M 16	M 20	M 20	M 20	M 24
e	192	248	302	352	554
$h_1{}^1$	217	283	334	385	589

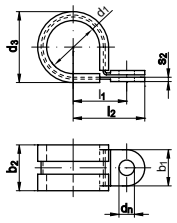
*not standardized, reference values
[1]are minimum dimensions and apply for a sheet thickness of 10 mm

Dimensions in stock:
Steel/Steel coated: pg. 235 | Stainless steel: pg. 528

Hose clamps/pipe clamps

DIN 3016

Fastening clamps
type D1 = with rubber profile



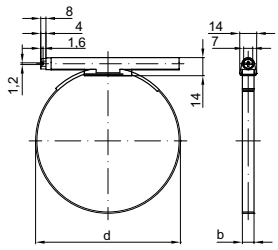
Dimensions (d_1)	4 to 20	4 to 25	5 to 14	15 to 45	10 to 25
b_1	9	12	15	15	20
b_2	13	15	19	19	25
d_n	4.3	5.3	6.4	6.4	8.4
d_3	d1 + 5.2	d1 + 5.8	d1 + 7.4	d1 + 7.4	d1 + 9
l_1	d1/2 + 4.7	d1/2 + 6.8	d1/2 + 9.7	d1/2 + 9.7	d1/2 + 12.5
l_2	d1/2 + 9.2	d1/2 + 13	d1/2 + 17.2	d1/2 + 17.2	d1/2 + 22.5

Dimensions in stock:
Steel/Steel coated: pg. 233

Hose clamps/pipe clamps

DIN 3017

Hose clamps with worm gear drive
type A



Dimensions	8-12	10-16	12-22	16-27	16- 27	20-32	20-32
b	9	9	9	9	12	9	12

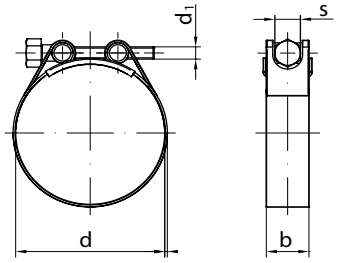
Dimensions	25-40	25-40	30-45	30-45	35-50	35-50	40-60
b	9	12	9	12	9	12	9

Dimensions	40-60	50-70	50-70	60-80	60-80	70-90	70-90
b	12	9	12	9	12	9	12

Dimensions	80-100	80-100	90-110	90-110	100-120	110-130	120-140
b	9	12	9	12	12	12	12

Dimensions	130-150	140-160	150-170	160-180	170-190		
b	12	12	12	12	12		

Hose clamps with hinge bolts
type C1



Dimensions	17-19	19-21	21-23	23-25	25-27	27-29	29-31
b	18	18	18	18	18	18	18
d_1	M 6	M 6	M 6	M 6	M 6	M 6	M 6
s	8	8	8	8	8	8	8

Dimensions	31-34	34-37	37-40	40-43	43-47	47-51	51-55
b	18	18	18	18	20	20	20
d_1	M 6	M 6	M 6	M 6	M 6	M 6	M 6
s	8	8	8	8	10	10	10

Dimensions	55-59	59-63	63-68	68- 73	73-79	79-85	85-91
b	20	20	20	25	25	25	25
d_1	M 6	M 6	M 6	M 8	M 8	M 8	M 8
s	10	10	10	13	13	13	13

Dimensions	91-97	97-104	104-112	112-121	121-130	130-140	140-150
b	25	25	25	25	25	30	30
d_1	M 8	M 8	M 8	M 8	M 8	M 8	M 10
s	13	13	13	13	13	13	16

Dimensions	150-162	162-174	174-187	187-200	200-213	213-226	226-239
b	30	30	30	30	30	30	30
d_1	M 10	M 10	M 10	M 10	M 10	M 10	M 10
s	16	16	16	16	16	16	16

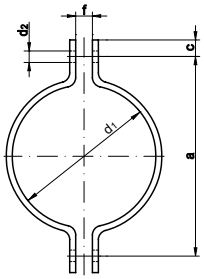
Dimensions	239-252						
b	30						
d_1	M 10						
s	16						

Dimensions in stock: Steel/
Steel coated: pg. 234, 528

Hose clamps/pipe clamps

DIN 3567

Pipe clamps
type A = equal sided



Dimensions	22	27	34	43	45	49
nominal diameter	15	20/¾"	25/1"	32/1¼"	40	40/1½"
a	59	66	72	82	84	88
c	15	15	15	15	15	15
d_2	11.5	11.5	11.5	11.5	11.5	11.5
f	7	7	7	7	7	7
flat steel	30x5	30x5	30x5	30x5	30x5	30x5
screw	M 10x30	M 10x30	M 10x30	M 10x30	M 10x30	M 10x30

Dimensions	57	61	77	89	108	115
nominal diameter	50	50/2"	65/2½"	80/3"	100	100/4"
a	104	108	122	136	172	178
c	18	18	18	18	24	24
d_2	14	14	14	14	18	18
f	9	9	9	9	11	11
flat steel	40x6	40x6	40x6	40x6	50x8	50x8
screw	M 12x35	M 12x35	M 12x35	M 12x35	M 16x45	M 16x45

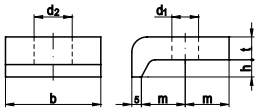
Dimensions	140	169	220	273	305	
nominal diameter	125	150	200	250	300	
a	204	232	284	348	379	
c	24	24	24	30	30	
d_2	18	18	18	23	23	
f	11	11	11	14	14	
flat steel	50x8	50x8	50x8	60x8	60x8	
screw	M 16x45	M 16x45	M 16x45	M 20x50	M 20x50	

d^1 = nominal size

Dimensions in stock:
Steel/Steel coated: pg. 235 | Stainless steel: pg. 528

DIN 3568

Clamping plates for pipe fixings for double-T carriers



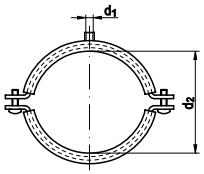
h = nominal size

Dimensions	10	12	14	16	18	20
b	60	60	60	60	60	60
d_1	18	18	18	18	18	18
d_2	24	24	24	24	24	24
m	35	35	35	35	35	35
t	18	18	18	18	18	18
for screw	M 16	M 16	M 16	M 16	M 16	M 16

Dimensions in stock:
Steel/Steel coated: pg. 235

DIN 4109

screwed tubular clamps with noise protection inlay ~DIN 4109



temperature resistance: -50 °C to +110 °C
*connection to stepped thread

Dimensions	1/2"	3/4"	1"	1 1/4"
clamping range	20 - 23	25 - 28	32 - 35	40 - 43
d_1*	M 8/M 10	M 8/M 10	M 8/M 10	M 8/M 10
d_2	1.25 x 20	1.25 x 20	1.25 x 20	1.25 x 20
payload	1.2 kN	1.2 kN	1.2 kN	1.2 kN

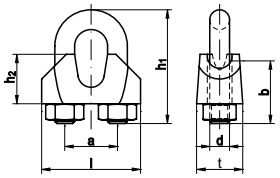
Dimensions	1 1/2"	1 1/2"	2"	
clamping range	48 - 53	57 - 61	60 - 64	
d_1*	M 8/M 10	M 8/M 10	M 8/M 10	
d_2	1.25 x 20	1.25 x 20	1.25 x 20	
payload	1.2 KN	1.2 kN	1.5 kN	

Dimensions in stock:
Steel/Steel coated: pg. 286

Rope clips/thimble ropes/shackles

~DIN 741

U-bolt wire-rope grips
with two hexagon nuts

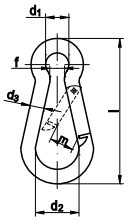


Dimensions	1/8"	3/16"	1/4"	5/16"	7/16"	1/2"	5/8"
for rope ∅	3	5	6.5	8	11	13	16
d_1*	M 4	M 5	M 5	M 6	M 8	M 10	M 12
h_1	20	24	28	34	44	55	63
b	12	13	15	19	22	30	33
a	9	11	13	16	20	24	29
h_2	10	10	11	15	18	21	26
l	21	23	26	30	36	42	50
t	10	11	12	14	19	23	26

Dimensions in stock:
Steel/Steel coated: pg. 111 | Stainless steel: pg. 475

DIN 5299

Snap hooks
type C = pear-shaped

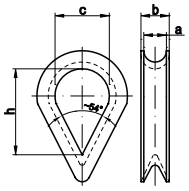


Dimensions	40x4	50x5	60x6	70x7	80x8	100x10
d_1	6	8	9	10	12	15
$d_{2\ min.}$	14	15	17	19	23	29
d_3	4	5	6	7	8	10
f	4	4	6	8	8	10
m	8	7	8	8	10	11
loadability	100 kg	120 kg	120 kg	180 kg	230 kg	350 kg

Dimensions in stock:
Steel/Steel coated: pg. 306

DIN 6899

thimbles for fibre ropes
type BF = medium heavy, with deep groove



Dimensions	BF 3.5	BF 4	BF 5	BF 6
a	4	5	6	7
h	21	23	25	26
c	13	14	16	18

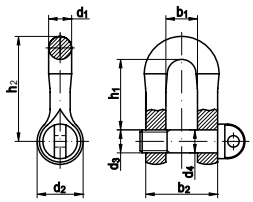
Dimensions	BF 7	BF 9	BF 11	
a	8	10	12	
h	32	38	45	
c	20	24	26	

Dimensions in stock:
Steel/Steel coated: pg. 316

Rope clips/thimble ropes/shackles

DIN 82101

D-shackles
type A = forged



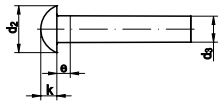
Dimensions	0.16	0.25	0.4	0.6	1
b_1	8	11	14	17	21
b_2	18	25	30	37	47
d_1	5	7	8	10	13
d_2	12	16	20	24	32
d_3	M 6	M 8	M 10	M 12	M 16
d_4	6	8	10	12	16
h_1	18	24	30	36	49
h_2	27	36	45	54	72
wrench size	-	-	-	-	24

Dimensions in stock:
Steel/Steel coated: pg. 410

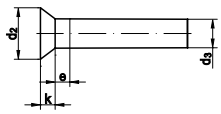
Rivets

DIN 660, 661

Rivets



DIN 660 = round head rivets



DIN 661 = countersunk head rivets

*dimensions acc. to DIN 124

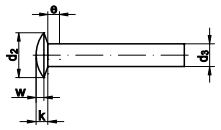
Dimensions	1	2	2.5	3	4
d_2	1.8	3.5	4.4	5.2	7
$d_{3\ min.}$	0.93	1.87	2.37	2.87	3.87
$e_{max.}$	0.5	1	1.25	1.5	2
$k_{DIN\ 660}$	0.6	1.2	1.5	1.8	2.4
$k_{DIN\ 661}$	0.5	1	1.2	1.4	2

Dimensions	5	6	7	8	10*
d_2	8.8	10.5	12.2	14	16
$d_{3\ min.}$	4.82	5.82	6.82	7.76	9.4
$e_{max.}$	2.5	3	3.5	4	5
$k_{DIN\ 660}$	3	3.6	4.2	4.8	6.5
$k_{DIN\ 661}$	2.5	3	3.5	4	-

Dimensions in stock:
Steel/Steel coated: pg. 109 | Stainless steel: pg. 474, pg. 475 | Non-ferrous materials: pg. 621, pg. 622

DIN 662

Mushroom head rivets



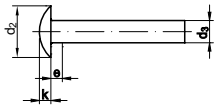
Dimensions	2	2.5	3	3.5	4	5	6
d_2	4	5	6	7	8	10	12
d_3	1.87	2.37	2.87	3.37	3.87	4.82	5.82
$e_{max.}$	1	1.25	1.5	1.75	2	2.5	3
k	1	1.2	1.5	1.8	2.1	2.5	3
w	0.7	0.8	1	1.2	1.4	1.7	2

Dimensions in stock:
Steel/Steel coated: pg. 110 | Non-ferrous materials: pg. 623

Rivets

DIN 674

Flat round head rivets

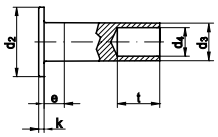


Dimensions	3	4	5
d_2	6.8	9	11.2
$d_{3\ min.}$	2.87	3.87	4.82
$e_{max.}$	1.5	2	2.5
k	1.5	2	2.5

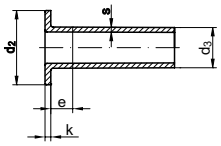
Dimensions in stock:
Steel/Steel coated: pg. 110

DIN 7338

Rivets for brake linings and clutch linings



type B = semi-tubular rivet



type C = tubular rivet

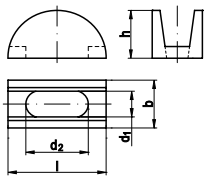
Dimensions	3	4	5	6	8
d_2	5.5	7.5	9.5	11.5	15.5
$d_{3\ min.}$	2.85	3.8	4.8	5.8	7.75
d_4	1.7	2.7	3.5	4.2	6
$e_{max.}$	1.5	2	2.5	3	4
k	0.8	1	1	1.2	1.2
$r_{max.}$	0.2	0.3	0.3	0.4	0.4
s	0.5	0.5	0.6	0.75	1.2

Dimensions in stock:
Steel/Steel coated: pg. 641

Cam segments and washers for diagonal-pull tensions

Article 88060

Cam segments
for tension anchors for diagonal-pull tension



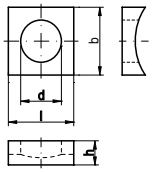
usage only with adjusting washers article 88061

Dimensions	M 12	M 20	M 24
l	59	64	77
b	30	41	53
d_1	17	22	31
d_2	30	45	47
h	30	32	31

Dimensions in stock:
Fixing systems: pg. 687

Article 88061

Adjusting washer for cam segments
for tension anchors for diagonal-pull tension



usage only with cam segments article 88060

Dimensions	M 12	M 16	M 20	M 24	M 27	M 30
l	30	30	41	51	51	51
b	30	30	41	51	51	51
d	13	17	22	25	28	31
h	10	10	11	18	18	18

Dimensions in stock:
Fixing systems: pg. 688

Hooks

Article 88135

Hooks
s-hooks typ 45

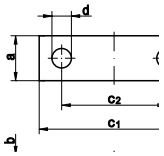
Dimensions	2.3	2.8	3.8	4.7	5.8	6.8	7.6
w	8	9	11	16	18	20	22
L	25	30	40	50	60	70	80
F max.	5 kg	7.5 kg	10 kg	15 kg	30 kg	50 kg	70 kg

Dimensions in stock:
Steel/Steel coated: pg. 434

Axle holders

DIN 15058

Axle holder (for lifting appliances)



a x b = nominal size

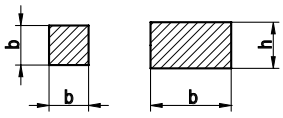
Dimensions	20x5	25x6	30x8	40x10	50x12
c_1	60	80	100	140	190
c_2	36	50	70	100	140
d	9	11	13	17	21
for axis ∅	16 - 25	25 - 40	40 - 63	63 - 100	100 - 160

Dimensions in stock:
Steel/Steel coated: pg. 407

Parallel keys

DIN 6880

Key steel
length 1000 mm



Dimensions	3x3	4x4	5x5	6x6	8x7	10x8	12x8	14x9
for DIN 6884								
for DIN 6885/6886	3x3	4x4	5x5	6x6	8x7	10x8	12x8	14x4
for DIN 6887							8x7	
for DIN 6889						10x4	12x4	14x4.5

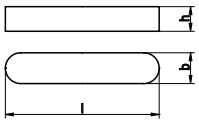
Dimensions	16x10	18x11	20x12	22x14	25x14	28x16	32x18	36x20
for DIN 6884		18x7	20x8	22x9	25x9	28x10	32x11	36x12
for DIN 6885/6886	16x10	18x11	20x12	22x14	25x14	28x16	32x18	36x20
for DIN 6887								
for DIN 6889		18x5						

Dimensions in stock:
Steel/Steel coated: pg. 314

Parallel keys

DIN 6885

Parallel keys, deep pattern
type A = round-ended without holes



b = nominal size

Dimensions	2	3	4	5	6	8	10
h	2	3	4	5	6	8	10
for shafts ∅ d/d_1	6 – 8	8 –10	10 – 12	12 – 17	17 – 22	22 – 30	30 – 38

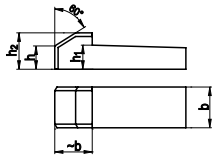
Dimensions	12	14	16	18	20	22	25
h	12	14	16	18	20	22	25
for shafts ∅ d/d_1	38 – 44	44 – 50	50 – 58	58 – 65	65 – 75	75 – 85	85 – 95

Dimensions	28	32	36	40	45		
h	28	32	36	40	45		
for shafts ∅ d/d_1	95 – 110	110 – 130	130 – 150	150 – 170	170 – 200		

Dimensions in stock:
Steel/Steel coated: pg. 315 | Stainless steel: pg. 555

DIN 6887

Taper keys with gib head



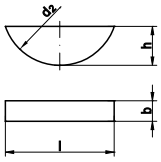
b = nominal size

Dimensions	6	8	10	12	14	16
h	6	7	8	8	9	10
h_1	6.1	7.2	8.2	8.2	9.2	10.2
h_2	10	11	12	12	14	16
for shafts ∅ d/d_1	17 – 22	22 – 30	30 – 38	38 – 44	44 – 50	50 – 58

Dimensions in stock:
Steel/Steel coated: pg. 316

DIN 6888

Woodruff keys



b = nominal size
[1)]for use as a parallel key DIN 6887
[2)]for use when determining the position

Dimensions	2	2	2.5	3	3	3	4
h	2.6	3.7	3.7	3.7	5	6.5	5
d_2	7	10	10	10	13	16	13
l	6.76	9.66	9.66	9.66	12.65	15.72	12.65
for shafts ∅ d/d_1[1)]	6 – 8	6 – 8	8 – 10	8 – 10	8 – 10	–	10 – 12
for shafts ∅ d/d_1	10 – 12	10 – 12	12 – 17	12 – 17	12 – 17	12 – 17	17 – 22

Dimensions	4	4	5	5	5	6	6
h	6.5	7.5	6.5	7.5	9	7.5	9
d_2	16	19	16	19	22	19	22
l							
for shafts ∅ d/d_1[1)]	10 – 12	–	12 – 17	12 – 17	–	17 – 22	17 – 22
for shafts ∅ d/d_1[2)]	17 – 12	17 – 22	22 – 30	22 – 30	22 – 30	30 – 38	30 – 38

Dimensions	6	8	8	8	10	10	10
h	11	9	11	13	11	13	16
d_2	28	22	28	32	28	32	45
l	27.35	21.63	27.35	31.43	27.35	31.43	43.08
for shafts ∅ d/d_1[1)]	–	22 – 30	22 – 30	–	30 – 38	30 – 38	–
for shafts ∅ d/d_1[2)]	30 – 38	>38	>38	>38	>38	>38	>38

Dimensions in stock:
Steel/Steel coated: pg. 316

Table 1: Drive features

Slot		Hexalobular socket		Triangle	
Phillips cross recess H		Triple square socket		Hexalobular	
Pozidriv cross recess Z		12 point socket		Triple square	
Supradriv cross recess		Torque set		Hexagon with slot	
Cross recess combi H+		Tri – Wing		Theft resistant drives	
Cross recess combi Z+		Hi torque			
Square socket		Hexagon			
Hexagon socket		Square			

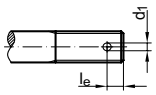
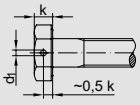
Table 2: Ends of externaly threaded fasteners

Description	New name	Old name	Picture (example)	Description example
Short dog point with rounded end (DIN 962)	Ak	Ak		ISO* – M 12 x 50 – Ak – 8.8
Chamfered end (ISO 4753)	CH	K		ISO* – M 12 x 50 – CH – 8.8
Cone point (ISO 4753)	CN	–		ISO* – M 12 x 50 – CN – 8.8
Cup point (ISO 4753)	CP	Rs		ISO* – M 12 x 50 – CP – 8.8
Flat point (ISO 4753)	FL	Ks		ISO* – M 12 x 50 – FL – 8.8
Long dog point (ISO 4753)	LD	Za		ISO* – M 12 x 50 – LD – 8.8
Pilot point with truncated cone (ISO 4753)	PC	PC		ISO* – M 12 x 50 – PC – 8.8
Short dog point with truncoated cone (DIN 962)	Asp	Asp		ISO* – M 12 x 50 – Asp – 8.8

Description	New name	Old name	Picture (example)	Description example
Pilot point, flat (ISO 4753)	PF	PF		ISO* – M 12 x 50 – PF – 8.8
Thread undercut (DIN 76-1)	Ri	Ri		ISO* – M 12 x 50 – Ri – 8.8
as-rolled end (ISO 4753)	RL	Ko		ISO* – M 12 x 50 – RL – 8.8
rounded end (ISO 4753)	RN	L		ISO* – M 12 x 50 – RN – 8.8
Split pin hole (DIN 962/34803)	S	S		ISO* – M 12 x 50 – S – 8.8
Scrape point (ISO 4753)	SC	Sb		ISO* – M 12 x 50 – SC – 8.8
Short dog point (ISO 4753)	SD	Ka		ISO* – M 12 x 50 – SD –8.8
Wire hole (DIN 962/34803)	SK	SK		ISO* – M 12 x 50 – SK – 8.8
Truncated cone point (ISO 4753)	TC	Sp		ISO* – M 12 x 50 – TC – 8.8

*product standard

Table 3: Dimensions for split pin holes (S) and wire holes (SK)

Gewinde-Ø M		3	4	5	6	7	8	10	12	14	16	18	20	22	24	27	30	33	36
Pin holes S* (DIN 962/34803)	d_1	0.8	1	1.2	1.6	1.6	2	2.5	3.2	3.2	4	4	4	5	5	5	6.3	6.3	6.3
	l_e	2	2.2	2.6	3.3	3.3	4	5	6	6.5	7	7.7	7.7	8.7	10	10	11.3	11.3	12.5
Wire holes SK* (DIN 962/34803)	d_1	–	1.2	1.2	1.6	1.6	2	2	2	2	3	3	3	3	3	3	3	4	4
	*Position tolerance t = 2 IT13 (PK A), 2 IT14 (PK B), 2 IT15 (PK C)																		
Dimensions for slots**	~	0.8	1	1.2	1.6	1.6	2	2.5	3	3	4	**position of the slot at the corners of the hexagon or square is optional							

Product information: Disc springs DIN 2093

According to DIN 2092 and DIN 2093, disc springs are cone-shaped discs which can be stressed along the axis. Compared to other spring-types, these fully concentric bending springs with symmetric-rotation cross section have low spring deflection with high spring power. The characteristic line of the disc springs depends to a large extent on the relationship of the free spring height [h0] to the flatness and disc thickness [t]. This is why the characteristic line is split into three series.

Each series is split into three groups according to their thickness. These groups differentiate themselves from each other with various production processes.

Table 1: Names

D_e	Outside diameter
D_i	Inside diameter
t	Thickness of the individual disc
l_0	Construction height of the unstressed individual disc
s	Spring deflection of the individual disc
h_0	Information parameter (spring deflection up to the height for disc springs without bearing surface); $h_0 = l_0 - t$

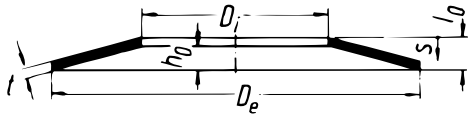


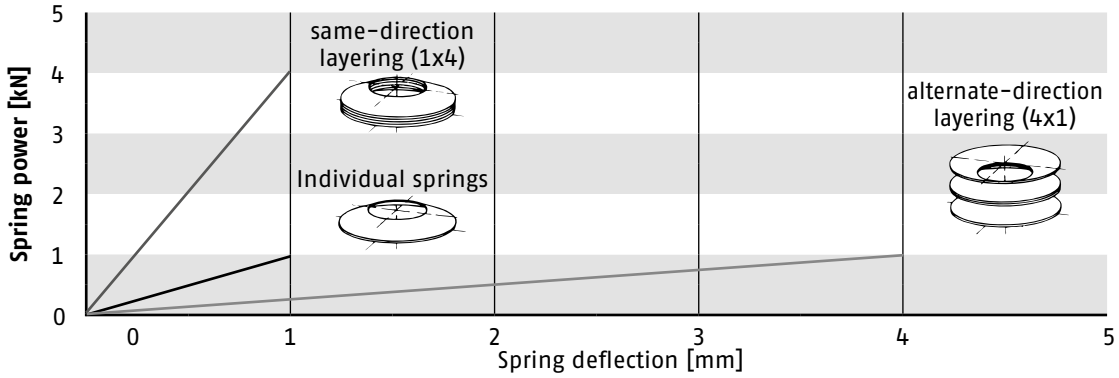
Table 2: Difference according to series

Series	Factor from $\frac{D_e}{t}$	Factor from $\frac{h_0}{t}$
A	~ 18	~ 0.4
B	~ 28	~0.75
C	~ 40	~ 1.3

Table 3: Difference according to groups

Group	Thickness t	Manufacture/Processing
1	< 1.25 mm	cold-formed (punched), edges rounded, without bearing surface,
2	1.25 – 6 mm	cold-formed finely cut, D_e and D_i turned, without bearing surface
3	> 6 mm	cold or hot-formed, turned on all sides, with bearing surface,

Same-direction layering, alternate-direction layering or a combination of the two let disc springs be formed into columns with freely configurable characteristics. If, for example, a spring column is made up of four alternate-direction individual disc springs with the same geometry, the spring deflection increases fourfold in comparison with individual springs. With a spring packet of four same-direction layering springs, the spring power increases fourfold in relation to individual springs.



The materials named in EN 10083, EN 10089 and EN 10132-4 are permitted for disc springs
(standard is the material 1.8159 – 51 CrV 4),
C steels, however, only for Group 1 disc springs.
The disc springs are delivered hardened and tempered with a hardness of 42-52 HRC (Group 1 disc springs: 425 HV10 to 510 HV10).
The standard surface is coated in phosphate and oiled. Many additional surfaces for increasing corrosion-resistance, like for example, mechanical galvanization or zinc-flake coating, are possible.

Stainless steels are also used as disc spring material. Compared with the standard, these special springs can have different, but always lower spring power.

Disc springs DIN 2093 – in stock

- from Cr/CrV alloy stainless steels
  (REYHER catalogue ➔ green pages 227)
- from stainless steels 1.4310/ 1.4568
  (REYHER catalogue ➔ blue pages 525)

Disc springs – available on request

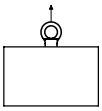
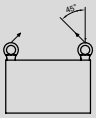
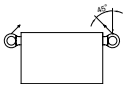
- Disc springs in special dimensions
- Disc springs in special materials
- Disc springs with special coatings

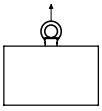
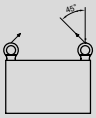
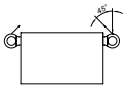
Taking into account a high safety factor in relation to the minimum breaking strength, the lifting eye bolts according to DIN 580 and the lifting eye nuts according to DIN 582 have the load-bearing capacities as indicated in table 1. The load-bearing capacity values apply for steel C15 E and stainless steel A2/A4 without restriction in a temperature range of -20 °C to +200 °C.

Lifting eye bolts and lifting eye nuts are considered load-carrying equipment according to the 2006/42/EC Machinery Directive and are subject to CE labelling. Furthermore, they must show a specification of the minimum carrying force (WLL) as well as the specification of the material if required for safe usage. Furthermore, a marking of an arrow must be present (picture 1), so that the user can tell that the WLL specified on the product only applies in the direction of the axis.

Subsequent colour-coded marking of lifting eye bolts and nuts (especially in red) is to be avoided so that they are not mistaken for high-strength suspension points.

Table 1

Thread (d_1)		M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24	M 27	M 30
capacity axial (WLL) for each eye bolt kg		75	140	230	340	490	700	850	1200	1400	1800	2100	3200
capacity up to max.45° for each eye bolt kg		55	100	170	240	350	500	600	860	1000	1290	1500	2300
capacity under max. 90° for each eye bolt kg		38	70	115	170	245	350	425	600	700	900	1050	1600

Thread (d_1)		M 33	M 36	M 39	M 42	M 45	M 48	M 52	M 56	M 64	M 72x6	M 80x6	M 100x6
capacity axial (WLL) for each eye bolt kg		3200	4600	4600	6300	6300	8600	8600	11500	16000	20000	28000	40000
capacity up to max.45° for each eye bolt kg		2300	3300	3300	4500	4500	6100	6100	8200	11000	14000	20000	29000
capacity under max. 90° for each eye bolt kg		1600	2300	2300	3150	3150	4300	4300	5750	8000	10000	14000	20000

User information for lifting eye bolts DIN 580

Eye bolts conforming to DIN 580 are primarily intended as permanent attachments on equipment such as motors, control cabinets, gear boxes, etc. for their transportation. When used as temporary attachments on objects to be transported such as large tools, the next largest thread size should be used.

The safety working load values in table 1 are based on the following conditions:

- the eye bolt is firmly screwed down
- the collar sits evenly on the contact surface
- the material of the equipment is capable of accommodating the stresses induced without any deformation liable to impair safety
- tapped holes have a threaded length sufficient to ensure that the eye bolt shank is fully engaged and the collar fully seated.

The capacity specified in the second line of table 1 applies up to an inclination angle of 45°. The capacity specified in the third line applies for laterally inserted eye bolts (eye nuts) up to an inclination angle of 45° in all directions in regard to the eye level. Lateral pull shall not be applied (see picture 2).

Before being used, lifting eye bolts should be checked for correct seating and apparent damage (e.g. corrosion, deformation).

Deformed eye bolts should be discarded and not be reinstalled.

In eye bolt assemblies with clearance hole, a nut (no thin nut) should be screwed on completely and firmly.

In case of sufficient thread length of the bolt, the additional use of a washer is recommended.

Product information: Lifting eye bolts and lifting eye nuts

User information for lifting eye nuts DIN 582

Eye nuts conforming to DIN 582 are primarily intended as permanent attachments on equipment such as e.g. control cabinets etc. for their transportation. When used as temporary attachments on objects to be transported, the next largest thread size should be used.

The safety working load values in table 1 are based on the following conditions:

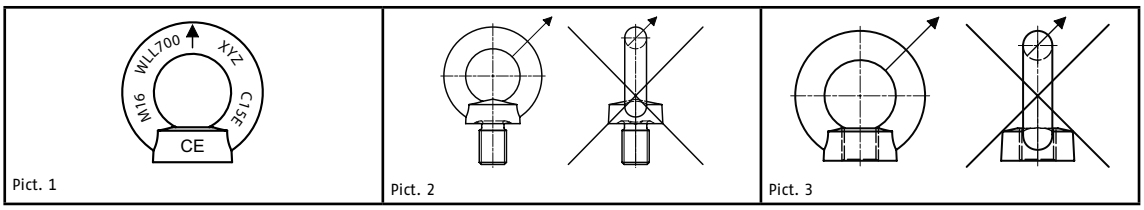
- the eye bolt is firmly screwed down
- the collar sits evenly on the contact surface
- the length of the bolt thread is sufficient and the material is capable of accommodating the stresses induced without any deformation liable to impair safety,
- the material of the bolt on which the eye nut is to screwed is of adequate strength.

In eye nut assemblies with clearance hole a washer should be used.

The capacity specified in the second line of table 1 applies up to an inclination angle of 45°, the capacity specified in the third line applies for laterally inserted eye nuts (eye bolts) up to an inclination angle of 45° in all directions in regard to the ring level. Lateral pull shall not be applied (see picture 3).

Before being used, lifting eye nuts should be checked for correct seating and apparent damage (e.g. corrosion, deformation).

Deformed eye nuts should be discarded and not be reinstalled.

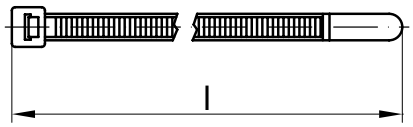


Pict. 1 Pict. 2 Pict. 3

Cable ties

Articles R 82500 – 82515

Cable ties, inside serration
T-series



fire protection
UL94 V2

cable tie width = nominal size

T = R 82500
T- HS = R 82505
T- W = R 82510
T- HR = R 82515

Dimensions	2.3	2.5			2.8		3.3
l	83	100	145	205	240	330	260
Bundle ∅ max.	16	22	35	55	65	95	65
min. tensile strength (N)	80	80	80	80	110	110	180
Type	T18S	T18R T18R-HS T18R-W T 18R-HR	T18I T 18I-HS T18I-W	T18L T18L-HS T18L-W	T25L	T25LL-W	T30LR T30LR-HS T30LR-W

Dimensions	3.5				4		
l	150	198	290	300	175		
Bundle ∅ max.	35	50	80	75	40		
min. tensile strength (N)	135	135	135	135	180		
Type	T30R T30R-HS T30R-W T 30R-HR	T30L T30L-HS T30L-W	T30LL T30LL-W	T30LL-HS	T40R T40R-HS T40R-W		

Dimensions	4.6				4.7		
l	150	200	300	390	210	300	390
Bundle ∅ max.	35	50	81	110	55	85	110
min. tensile strength (N)	225	225	225	225	355	355	355
Type	T50S T50S-HS T50S-W	T 50R-HR	T 50I-HS	T50L T 50L-HR	T80R T80R-HS T80R-W	T80I T80I-W	T80L-HS T80L-W

Dimensions	7.6					8.8	
l	225	365	387	460	760	820	
Bundle ∅ max.	55	100	100	125	225	245	
min. tensile strength (N)	535	670	535	535	535	780	
Type	T120S T120S-W	T150R T150R-HS T150R-W	T120R T120R-HS T120R-W T120R-HR	T120M	T120L T120L-HS T120L-W	T150L-W	

Dimensions	8.9						
l	530	530	820	1095			
Bundle ∅ max.	150	150	245	330			
min. tensile strength (N)	780	780	780	780			
Type	T150M-W	T150M	T150L	T150XL			

Version	T
Material	Polyamide 6.6 (PA66), HF = halogen free
Colour	NA = natural
Properties	Operating temperature: -40 °C to 85 °C, short-term up to 105 °C (500 h)

Version	T- HS
Material	Polyamide 6.6 heat stabilised (PA66HS), HF = halogen free
Colour	NA = natural/BK = black
Properties	Operating temperature: -40 °C to 105 °C

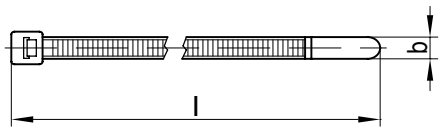
Version	T- W
Material	Polyamide 6.6 UV stabilised (PA66W), HF = halogen free
Colour	BK = black
Properties	Operating temperature: -40 °C to 85 °C, short-term up to 105 °C (500 h)

Version	T- HR
Material	Polyamide 4.6 High-temperature resistance (PA46), HF = halogen free
Colour	NA = natural
Properties	Operating temperature: -40 °C to 150 °C, short-term up to bis 195 °C (500 h)

Cable ties

Article R 82520

Cable ties, inside serration
LK-series



Dimensions	2.3	13.2
l	120	535
Bundle ∅ max	28	150
Tensile strength (N)	135	1.115
Type	LK2	LK5

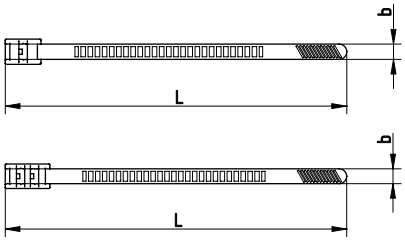
Version	PA66
Material	Polyamide 6.6, HF = halogen free, RoHS conform
Colour	NA = natural
Properties	Operating temperature: -40 °C to 85 °C, short-term up to 105 °C (500 h)

fire protection UL94 V2

cable tie width = nominal size

Article R 82516

Cable ties, outside serrated,
with flat head
Robusto series



Dimension	9.0		
l	180	260	355
Bundle ∅ max	42	62	92
Tensile strength (N)	360	530	530
Type	LPH942	LPH962	LPH992

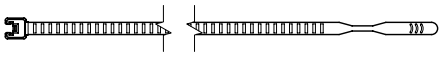
Version	PA11
Material	Polyamide 11, HF = halogen free; RoHS conform
Colour	BK = black
Properties	Operating temperature: -40 °C to 85 °C, short-term up to 105 °C (500 h)

fire protection UL94 HB

cable tie width = nominal size

Article R 82517

Cable ties Q-tie, inside serrated,
with open head and
pre-locking functionality



Dimension	3.6	4.7	7.7
l	160	210	420
Bundle ∅ max	38	50	110
Tensile strength (N)	130	220	530
Type	Q30R	Q50R	Q120R

Version	PA11
Material	Polyamide 6.6, UV-stabilised, HF = halogen free, RoHS conform
Colour	BK = black
Properties	Operating temperature: -40 °C to 85 °C, short-term up to 105 °C (500 h)

fire protection UL94 V2

cable tie width = nominal size

(R = REYHER article numbers)

Cable ties with fixing elements

Article R 82518

2-piece fixing ties for parallel separation

fire protection UL94 HB

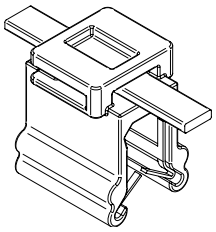
cable tie width = nominal size

Dimensions	4.6	7.6
l	202	390
Bundle ∅ max.	47	105
Tensile strength (N)	225	535
Type	T50RCOUPLER	T120RCOUPLER

Version	Cable tie PA66HIR(S)	Food part PA66HIRHS
Material	Polyamide 6.6. impact resistant	Polyamide 6.6. impact resistant
Colour	BK = black	BK = black
Properties	Operating temperature: -40 °C to 80 °C. short-term up to 105 °C (500 h)	Operating temperature: -40 °C to 105 °C (500 h)

Article R 82521

fixing ties for edges, 2 pieces, edge width 1-3 mm, tie channel top-axial



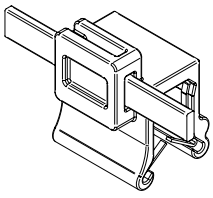
fire protection UL94 V2

Cable tie width	4.6
l	200
Bundle ∅ max	45
Tensile strength (N)	225
Type	T50ROSEC4A-W

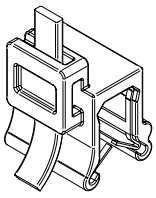
Version	PA66W
Material	Polyamide 6.6, UV-stabilised, HF = halogen free, RoHS conform
Colour	BK = black
Properties	Operating temperature: -40 °C to 85 °C, short-term up to 105 °C (500 h)

Article R 82522

fixing ties for edges, 2 pieces, edge width 1-3 mm



S-A = tie channel lateral-axial



S-Q = tie channel lateral-cross

Cable tie width	3.6 S-Q	4.6 S-Q	4.6 S-A	
l	150	150	150	200
Bundle ∅ max	33	45	31	45
Tensile strength (N)	135	225	225	225
Type	T30REC5A	T50ROSEC5A	T50SOSEC5B	T50ROSEC5B

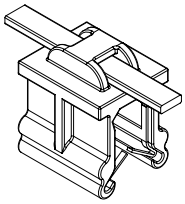
Version	Cable tie PA66HS	Food part PA66HIRHS
Material	Polyamide 6.6, heat stabilised, RoHS conform	Polyamide 6.6, impact resistant, RoHS conform
Colour	BK = black	BK = black
Properties	Operating temperature: -40 °C to 105 °C fire protection UL94 V2	Operating temperature: -40 °C to 105 °C (500 h) fire protection UL94 HB

(R = REYHER article numbers)

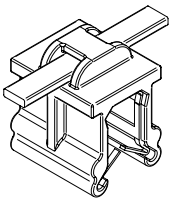
Cable ties with fixing elements

Article R 82523

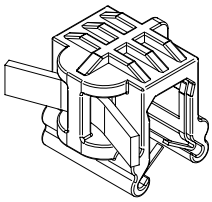
Fixing ties for edges, 2 pieces, edge width 3-6 mm



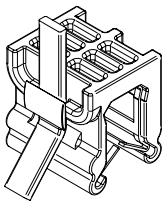
0-A = tie channel top-axis



0-Q = tie channel top-cross



S-A = tie channel lateral-axial



S-Q = tie channel lateral-cross

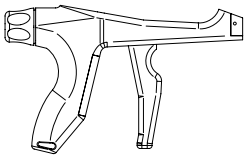
Cable tie width	4.6 0-A	4.6 0-Q		4.6 S-A	4.6 S-Q
l	200	150	200	200	200
Bundle ∅ max	45	35	45	45	45
Tensile strength (N)	225	225	225	225	225
Type	T50R0SEC19	T50S0SEC20	T50R0SEC20	T50R0SEC23	T50R0SEC24

Version	Cable tie PA66HS	Foot part PA66HIRHS
Material	Polyamide 6.6, heat stabilised	Polyamide 6.6, impact resistant
Colour	BK = black	BK = black
Properties	Operating temperature: -40 °C to 105 °C fire protection UL94 V2	Operating temperature: -40 °C to 105 °C (500 h) fire protection UL94 HB

Application tools for cable ties

Article R 82535

Man. application tool E0V7

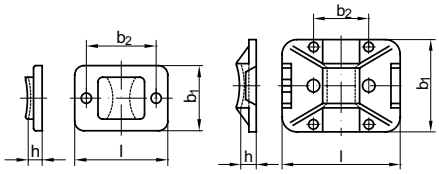


Tie width max.	Tie thickness max.	Weight	Comment
4.8	1.5	280 g	- Manual application tool - Fast and precise application with minimum effort - Convenient and simple tension adjustment - Incl. cutting device - Slip-proof handle - Grip span 90 mm - Housing made of lightweight fibreglass-reinforced plastic

Fixings for cable ties

Article R 82540

**Cable tie mounts,
type TY-G1, self adhesive**



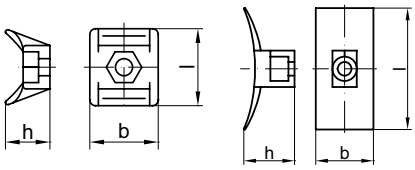
fire protection UL94 V2

Cable tie width	4.0	8.0
l	20	32
b_1	14	25
h	3.7	5.2
b_2	15	15
Fastening-∅	2.2	3.2
Type	TY3G1S	TY8G1S

Version	TY-G1
Material	Polyamide 6.6 (PA66), HF = halogen free, RoHS conform
Colour	NA = natural
Properties	Operating temperature: -40 °C to 85 °C, short-term 105 °C (500 h)
Fastening	self-adhesive and screw mounting

Article R 82543/82546

**cable tie mounts,
type NY/LKC, screw mounting**



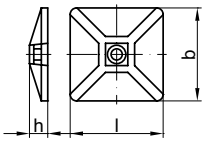
fire protection UL94 V2

Cable tie width	8.0	8.0
l	13.5	25
b	12	17
h	7.8	13.5
Fastening-∅	3.1	5.5
Type	NY3256	LKC

Version	NY und LKC
Material	Polyamide 6.6 (PA66). HF = halogen free
Colour	NA = natural
Properties	Operating temperature: -40 °C to 85 °C. short-term up to 105 °C (500 h)
Fastening	screw mounting

Article R 82550

**Cable tie mounts, type MB-CA,
self adhesive**



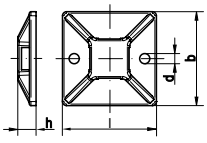
fire protection UL94 V2

Cable tie width	5.4
l	29
b	29
h	5.7
Fastening-∅	4.2
Type	MB4CAS [2)]

Version	PA66
Material	Polyamide 6.6 (PA66). HF = halogen free
Colour	NA = natural
Properties	Operating temperature: -40 °C to 85 °C. short-term up to 105 °C (500 h)
Fastening	self-adhesive

Article R 82553

**Cable tie mounts, type MB-A,
screw mounting and adhesive**



fire protection UL94 V2

Cable tie width	5.4
l	28
b	28
h	4.7
Fastening-∅	4.0
Type	MB4A

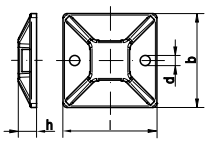
Version	PA66
Material	Polyamide 6.6 (PA66). HF = halogen free
Colour	NA = natural
Properties	Operating temperature: -40 °C to 85 °C. short-term up to 105 °C (500 h)
Fastening	self-adhesive and screw mounting

(R = REYHER article numbers)

Fixings for cable ties

Article R 82554

Cable tie mounts with special glue, SolidTack series



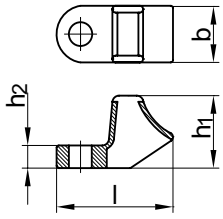
fire protection
UL94 V2

Cable tie width	4.1	5.4
l	19	28
b	19	28
h	3.8	4.7
Fastening-∅	3.1	4
Type	MB3APT	MB4APT

Version	NY und LKC
Material	Polyamide 6.6 (PA66). HF = halogen free
Colour	NA = natural/BK = black
Properties	Operating temperature: -40 °C to 85 °C. short-term up to 105 °C (500 h)
Fastening	self-adhesive with special adhesive (modified acrylate) and screw mounting

Article R 82560

Cable tie mounts, Typ CL8, screw mounting



fire protection
UL94 V2

Cable tie width	8.0
l	27.3
b	12.5
h_1	16.0
h_2	5.0
Fastening-∅	6.5
Type	CL8

Version	CL8
Material	Polyamide 6.6 (PA66). HF = halogen free
Colour	NA = natural
Properties	Operating temperature: -40 °C to 85 °C. short-term up to 105 °C (500 h)
Fastening	screw mounting

1. Standards

The following standards apply for "wire thread inserts for the metric ISO thread"

- DIN 8140-1 dimensions, technical specifications
- DIN 8140-2 helical coil threads for inserts, thread tolerances
- DIN 8140-3 gauges and gauge sizes

These standards apply for ISO metric coarse pitch threads and fine pitch threads.

Details for additional deliverable thread types (BSW/BSF, UNC/UNJC/UNF/UNJF, GAZ, BSP) are available upon request.

2. Field of application/materials/properties

- Initial use: for heavy-duty and long-lasting inside threads partly from metallic and non-metallic materials
- Use during repairs/follow-up work: as a replacement for unusable threads (= damaged/worn).

The particular properties of wire thread inserts are

- reduced inclination for cold welding with screwed fastenings
- mostly constant friction coefficient
- good temperature and corrosion resistance
- with profile B "locking" (➜ 4) additional resistance against independent loosening of the screwed fastenings thanks to increased frictional locking in the thread.

Beyond the standard material in stock "Stainless steel 18.8 (A 2)", wire thread inserts from special materials are deliverable for particular usage requirements ➜ Table 1.

Tabelle 1: Materials for various fields of application

Material	Max. temperature	Options for coatings	Applications
Standard material Stainless steel 18.8 (A 2)	425 °C (short-term) 315 °C (longer periods)	Dry lubrication Cadmium plating Silver plating Zinc plating Tin plating	All standard applications for all materials
AISI 304 (1.4301) AISI 302 (1.4310)			Special use – resistant to acid, rust, high temperatures, non-magnetic
Special stainless steel AISI 304L, 316, 316L, 316Ti, 321	Up to 400 °C over longer periods		
Phosphorous bronze	300 °C (short-term) 250 °C (longer period)	Cadmium plating	Copper parts - resistant to certain electrolytic processes
Inconel x 750 Nc 15 Fe Nba	750 °C (short-term)	Silver plating	Thermal power stations Astronautics Aviation Turbo compressor
Nimonic 90 Nc 20 C 18 Ti	538 °C (longer periods)		

3. Manufacture

The thread inserts are manufactured from a wire with rhombus-shaped cross-section. After the winding process, they have two threaded profiles, one outside for the insertion into the tool's receiving thread according to DIN 8140-2 and one inside (after insertion) for receiving a screw thread.

4. Types

According to DIN 8140-1, the profiles are differentiated according to:

- Type A = cylindrical shape* for coarse and fine threads.
- Type B = "locking" (like type A, but with centrally positioned, polygon, elastic windings (➜ 2)
  (type B thread inserts are identifiable by their red colour).

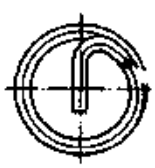
*The new generation of the "Type SR" AMECOIL thread inserts is designed in such a way that insertion is now easier and safer, thus increasing productivity.

5. Drive systems for insertion

DIN 8140-1 shows an engaging tang as the drive system, which is to be removed at the groove using a tang breaker after insertion.
AMECOIL thread inserts, for example, have this drive system.

6. Determining the nominal length

The nominal lengths of the threaded inserts to be chosen are,
a) dependent on the tool material and,
b) dependent on the strength class of the screw
(recommended nominal lengths ➜ DIN 8140-1, Table 1).

Type A	Type B
	
	

with engaging tang and groove according to DIN 8140-1 (z.B. AMECOIL)

7. Dimensions/Measuring techniques during acceptance inspection

In the order text, the following dimensions are to be specified (example M 10x15):

- the use/inside thread required after insertion – e.g. M 10
- the chosen nominal length according to DIN 8140-1, Table 1, l_1 – e.g. 15 (= 1.5 d).

In as-delivered condition, only the outside diameter and the number of windings are measurable during acceptance inspection (➔ Table 2) – the nominal length l_1 is first determinable in inserted condition.

Tabelle 2: Dimensions – outside Ø and winding count in as delivered condition

Characteristics		for coarse pitch threads with nominal size use/inside thread														
		M 2	M 2.5	M 3	M 4	M 5	M 6	M 7	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
Outside-Ø	min.	2.6	3.3	3.8	5.15	6.35	7.6	8.65	9.85	12.1	14.4	16.8	19.0	21.5	23.7	26.3	28.6
	max.	2.8	3.5	4.0	5.35	6.6	7.85	8.9	10.1	12.5	14.8	17.2	19.4	22.0	24.2	26.8	29.1
Drill-Ø	mm	2.1	2.6	3.2	4.2	5.2	6.3	7.3	8.4	10.5	12.5	14.5	16.5	18.75	20.75	22.75	24.75
Winding count AW* at nominal length d/mm	1d = mm	2	2.5	3	4	5	6	7	8	10	12	14	16	18	20	22	24
	AW	2.9	3.5	3.9	3.7	4.3	4.2	5.3	4.7	5.0	5.2	5.6	6.5	5.6	6.3	6.9	6.2
	1.5d = mm	3	3.75	4.5	6	7.5	9	10.5	12	15	18	21	24	27	30	33	36
	AW	4.9	5.9	6.3	6.1	6.9	6.9	8.2	7.4	8.1	8.4	8.8	10.1	9.0	10.0	10.9	10.0
	2d = mm	4	5	6	8	10	12	14	16	20	24	28	32	36	40	44	48
	AW	6.9	8.1	8.7	8.4	9.7	9.6	11.1	10.6	11.2	11.7	12.0	13.8	12.3	13.7	15.1	14.0
(*Tol. –0.25)	2.5d = mm	5	6.25	7.5	10	12.5	15	17.5	20	25	30	35	40	45	–	–	–
	AW	8.9	10.5	11.1	10.9	12.3	12.3	14.3	13.5	14.2	14.7	15.2	17.5	15.5	–	–	–

Characteristics		for fine pitch threads with nominal size use/inside thread										
		M 8x1	M 10x1	M 10x1.25	M 12x1	M 12x1.25	M 14x1.5	M 14x1.25	M 16x1.5	M 20x1.5	M 20x2	M 24x1.5	M 24x2
Outside-Ø	min.	9.85	12.1	12.1	14.4	14.4	16.8	16.8	19.0	23.7	23.7	28.6	28.6
	max.	10.1	12.5	12.5	14.8	14.8	17.2	17.2	19.4	24.2	24.2	29.1	29.1
Drill-Ø	mm	8.3	10.25	10.4	12.3	12.4	14.5	14.4	16.5	20.5	20.5	24.5	24.5
Winding count AW* at nominal length d/mm	1d = mm	8	10	10	12	12	14	8.4 ①	16	20	20	24	24
	AW	6.1	7.6	6.0	9.3	7.4	7.4	(15.2)	8.7	10.7	8.0	12.9	9.6
	1.5d = mm	12	15	15	18	18	21	12.4 ①	24	30	30	36	36
	AW	9.5	12.1	9.7	14.5	11.6	11.6	(18.2)	13.4	16.7	12.5	19.8	15.0
	2d = mm	16	20	20	24	24	28	14.4 ①	32	40	40	48	48
	AW	12.9	16.3	13.1	19.5	15.9	15.7	(19.4)	18.1	22.4	16.8	26.6	20.2
(*Tol. –0.25)	2.5d = mm	20	25	–	–	–	35	16.4 ①	40	a ignition plug threads with special d-dimensions			
	AW	16.5	20.7	–	–	–	19.9	(10.6)	22.9				

Tabelle 3: Overview: Tools, accessories and REYHER article number

Tool/Accessory	REYHER art. no.	
	Coarse pitch thread SR	Fine pitch thread
Thread insert article number	R 88330	R 88331
Drill for tapping hole-Ø	R 88988, R 88989	
Roughing tap	R 88339 from M 18	–
Finish tap	R 88338	R 88338
Assembly tools		
• Multidim. hand fitting tool	–	R 88333 fine
• Mandrel and threaded nose	–	R 88334 fine
• Specific hand fitting tool	R 88333 SR	–
• Threaded mandrel	R 88334 SR	–
• Unidim. hand fitting tool	R 88335 SR from M 18	R 88335 fine ab M 20
Tang breaker	R 88336	
Extractor	R 88337	
Assortment boxes with tools	R 88342, R 88344	

Dimensions/tools in stock:
steel: pg. 561-563

Fitting principle

Drilling

Tapping

Fitting with classic range tool

Fitting with SR range tools

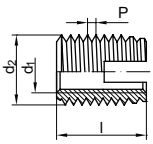
Breaking the engaging tang

Thread insert fitted

Dimensions for self tapping Ensat® thread inserts

Article 88302

Ensat® 302



d_1 = nominal size

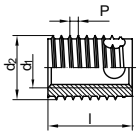
Dimensions	M 2.5	M 3	M 4	M 5	M 6	M 8
d_2	4.5	5	6.5	8	10	12
P	0.5	0.5	0.75	1	1.5	1.5
l	6	6	8	10	14	15
blind hole depth $_{min.}$	8	8	10	13	17	18

Dimensions	M 10	M 12	M 14	M 16	M 18	M 20
d_2	14	16	18	20	22	26
P	1.5	1.5	1.5	1.5	1.5	1.5
l	18	22	24	22	24	27
blind hole depth $_{min.}$	22	26	28	27	29	32

Dimensions	M 22	M 24	M 27	M 30		
d_2	26	30	34	36		
P	1.5	1.5	1.5	1.5		
l	30	30	30	40		
blind hole depth $_{min.}$	36	36	36	46		

Article 88307

Ensat® 307

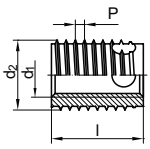


d_1 = nominal size

Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
d_2	6.5	8	10	12	14	16
P	0.8	1	1.25	1.5	1.5	1.75
l	6	7	8	9	10	12
blind hole depth $_{min.}$	8	9	10	11	13	15

Article 88308

Ensat® 308



d_1 = nominal size

Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
d_2	6.5	8	10	12	14	16
P	0.8	1	1.25	1.5	1.5	1.75
l	8	10	12	14	18	22
blind hole depth $_{min.}$	10	13	15	17	22	26

Table 4: Standard values for borehole diameter

Borehole-∅ [mm]		R 88302 (Ensat® 302)				R 88307/R 88308 (Ensat® 307/308)			
Workpieces material	Aluminium alloys Rm= tensile strength [N/mm²]	R_m < 250							
		R_m < 300				R_m < 300			
			R_m < 350				R_m < 350		
				R_m > 350				R_m > 350	
	Brass, bronze, non-ferrous metal			R_m > 350				R_m > 350	
	Cast iron HB = brinell hardness	< 150 HB				< 150 HB			
			< 200 HB				< 200 HB		
				> 200 HB				> 200 HB	
Thread flank overlap approx.		**60%**	**50%**	**40%**	**30%**	**80%**	**70%**	**60%**	**50%**
Ensat® internal thread	M 2/M 2.5	-	4.1	4.2	4.3	-	-	-	-
	M 3	-	4.6	4.7	4.8	4.6	4.7	4.7	4.8
	M 3.5	5.4	5.5	5.6	5.7	5.5	5.6	5.7	-
	M 4	5.9	6.0	6.1	6.2	6.0	6.1	6.2	-
	M 5	7.2	7.3	7.5	7.6	7.4	7.5	7.6	7.7
	M 6	8.8	9.0	9.2	9.4	9.3	9.4	9.5	9.6
	M 8	10.8	11.0	11.2	11.4	11.1	11.2	11.3	11.5
	M 10	12.8	13.0	13.2	13.4	13.1	13.2	13.3	13.5
	M 12	14.8	15.0	15.2	15.4	15.0	15.1	15.2	15.4
	M 14	16.8	17.0	17.2	17.4	17.0	17.1	17.2	17.4
	M 16	18.8	19.0	19.2	19.4	19.0	19.1	19.2	19.4
	M 18	21.0	21.0	21.2	21.4	-	-	-	-
	M 20/M 22	25.0	25.0	25.2	25.4	-	-	-	-
	M 24	29.0	29.2	29.2	29.4	-	-	-	-
	M 27	33.0	33.2	33.2	33.4	-	-	-	-
	M 30	35.0	35.0	35.2	35.4	-	-	-	-

Dimensions in stock:
stainless steel: pg. 603


8 POINT LED

Description of assembly symbols

In case of profiles with closed ends, they cannot be inserted subsequently. Nuts for T-slots must be inserted from the slot end.

Swivel-in nuts can be inserted into the slot at any position. Thus, they are perfectly suitable for assembly in existing structures. However, T-slot and nut for T-slot sizes have to match. The nut can be swiveled into the slot at any position.

Screw-in type nuts can be inserted into the slot at any position. They are also perfectly suitable for assembly in existing structures. Rhomboidal and hammer head nuts have this property. This is also applicable for hammer head bolts. For this type of nuts, inserting aids such as e.g. slot in the T-nut, thread pitch error, marking or plastic tang in the thread are helpful.

Fixing systems

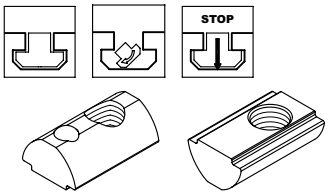
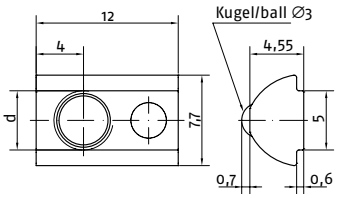
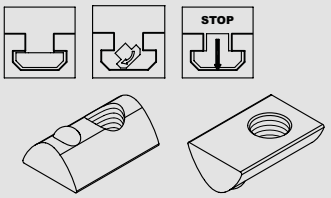
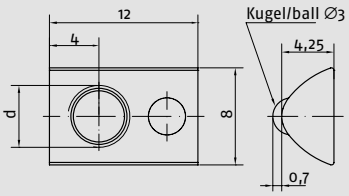
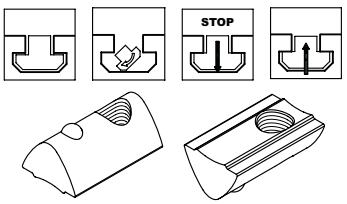
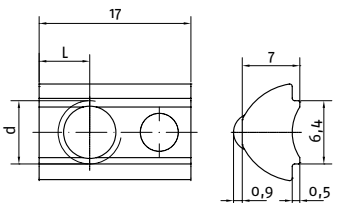
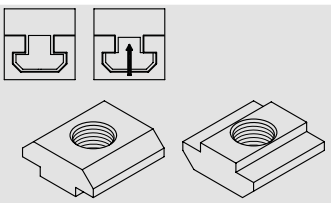
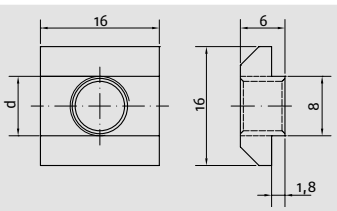
Fixing systems are intended to prevent displacement of nuts before, during and after assembly as well as during disassembly, particularly in case of perpendicular mounting rail. The fixing systems can be combined with the individual assembly types. The nuts can be fixed in the T-slot so as to facilitate assembly.

Versions

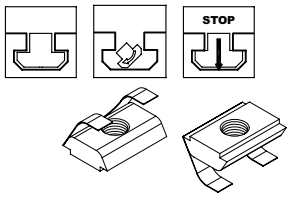
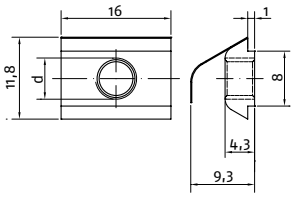
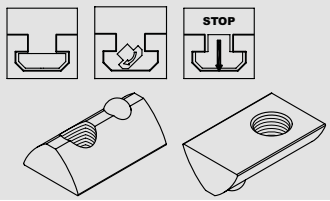
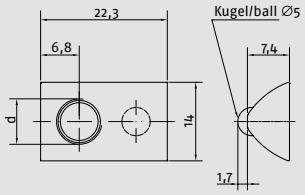
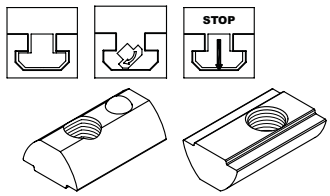
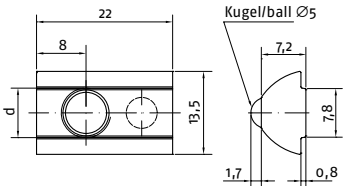
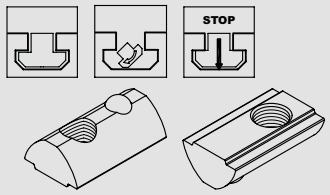
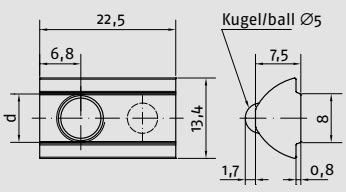
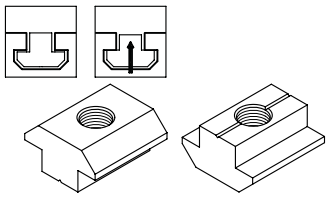
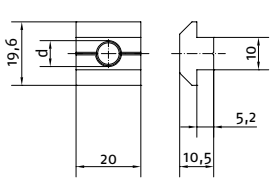
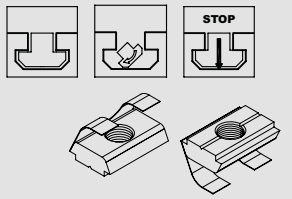
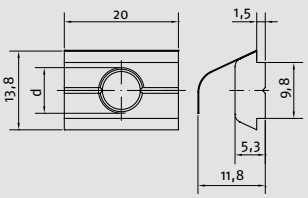
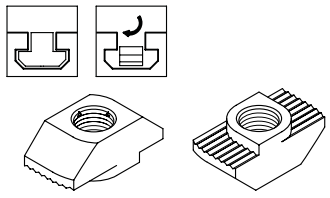
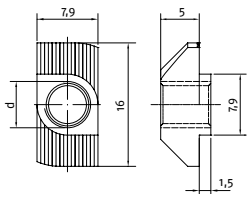
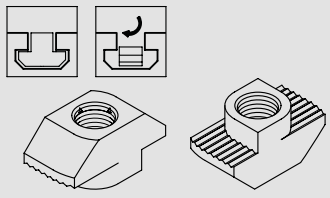
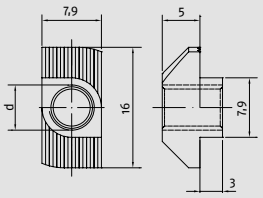
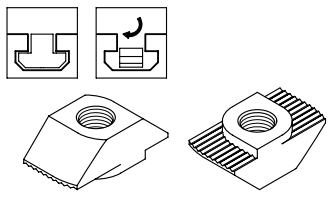
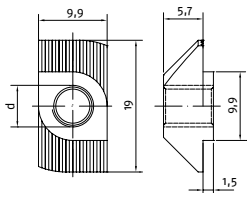
Nuts without guide step for T slots usually show greater allowance for the bolts to be fixed in lateral direction. They are particularly suitable for situations, in which the connecting parts cannot be prepared accurately.

Nuts with guide step for T-slots are centred in the rail by their step. Therefore, these nuts can also be used in rails, in which the lower groove width is considerably larger that the nut width. In addition, the step facilitates assembly and, due to the step, more usable thread leads are available, which helps increase the nut's load bearing value.

Fixing component

Article number	Description		
87010.011	T-slot nuts, (M 4/M 5) profile 5 with guide step and spring-loaded ball, zinc-plated steel		
87010.012	T-slot nuts, (M 4/M 5) profile 5 without guide step and with spring-loaded ball, zinc-plated steel		
87011.013	T-slot nuts, (M 5/M 6) profile 6 with 6 mm external guide step and spring-loaded ball, zinc-plated steel		
87012.011	T-slot nuts, (M 6/M 8) profile 8 with guide step, zinc-plated steel		

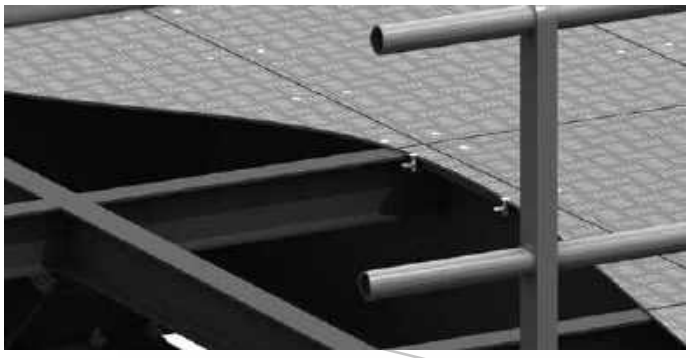
Fixing component

Article number	Description		
87012.015	T-slot nuts, (M 6/M 8) profile 8 with guide step and spring, zinc-plated steel		
87012.012	T-slot nuts, (M 6/M 8) profile 8 without guide step and with spring-loaded ball, zinc-plated steel		
87012.016	T-slot nuts, (M 6/M 8) profile 8 with guide step and spring-loaded ball, zinc-plated steel		
87012.017	T-slot nuts, (M 6/M 8) profile 8 with guide step and spring-loaded ball, zinc-plated steel		
87013.011	T-slot nuts, (M 6/M 8) profile 10 with guide step, zinc-plated steel		
87013.015	T-slot nuts, (M 6/M 8) profile 10 with spring, zinc-plated steel		
87014.011	Hammer head nuts for T-slots, (M 5/M 6) profile 8, low profile, zinc-plated steel		
87014.012	Hammer head nuts for T-slots, (M 5/M 6) profile 8, high profile, steel, zinc-plated		
87015.011	Hammer head nuts for T-slots, (M 6/M 8) profile 10, low profile, zinc-plated steel		

Areas of application

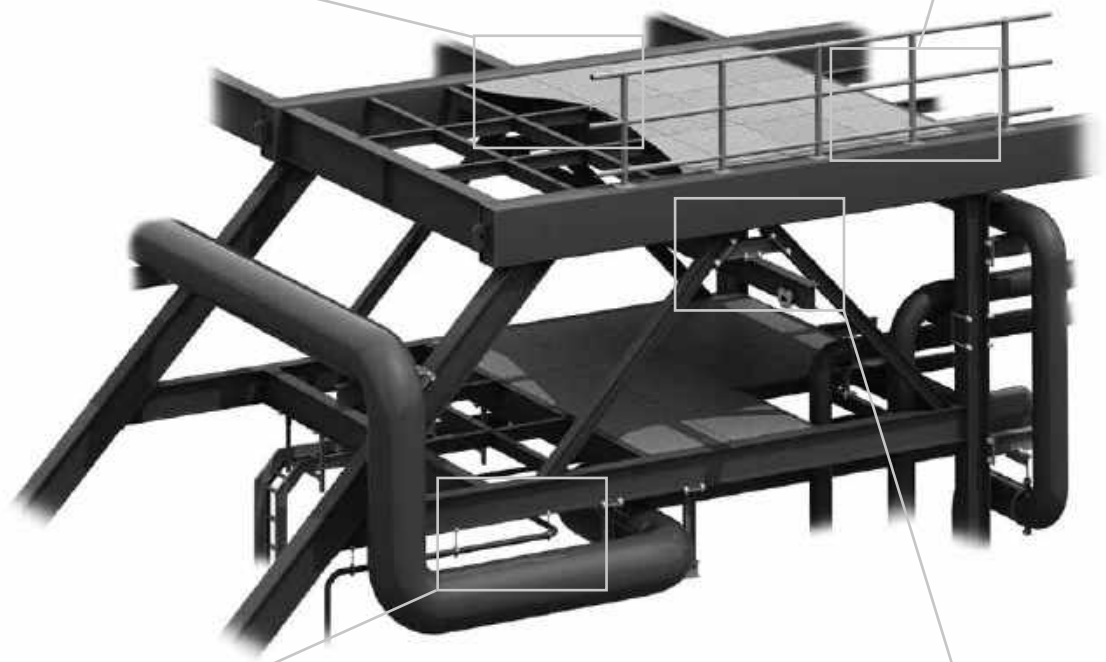
Floor Fixings

It is now possible to connect steel flooring to supporting steelwork without on-site drilling or welding for a fast, low cost operation. Lindapter fixings allow installation to be carried out safely from above, often by one person, without elevated floors thus significantly reducing costs.



Cavity Fixings

The legendary Hollo-Bolt® and Lindibolt® allow fast, cost-effective connections to SHS and other hollow sections, or conventional steelwork where access is available from one side only. The Hollo-Bolt can be used as a primary structural connection as detailed in the SCI/BCSA publication 'Joints in Steel Construction – Simple Connections'. Plug-like fixing element for hollow profiles, pipes and other constructions which are difficult to access from the rear.



Support Fixings

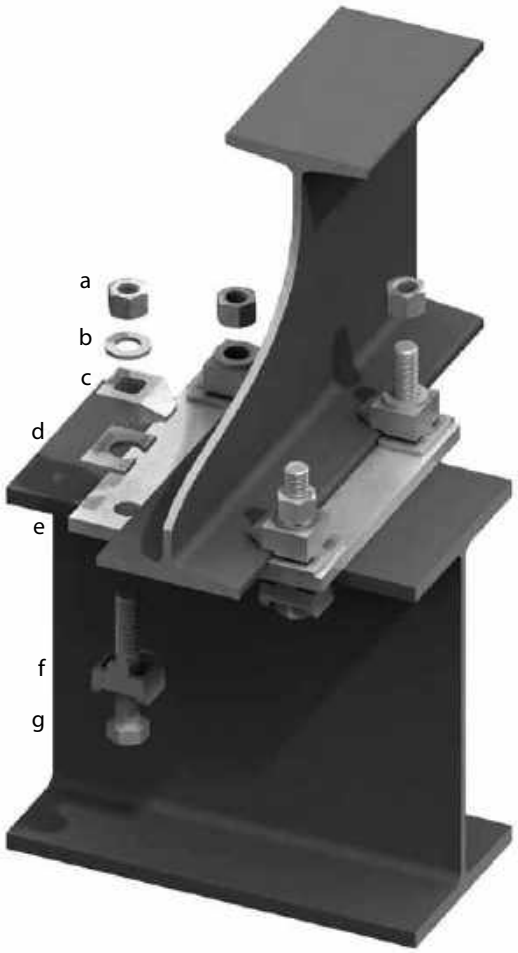
Lindapter provides easy-to-install solutions for supporting building services from structural or secondary beams, including: the suspension of HVAC equipment, pipe work, fire protection/sprinkler systems, suspended ceilings and electrical equipment.

Steelwork Fixings

Lindapter has pioneered the development of steelwork clamping systems for over 75 years, and continues to innovate with their unique and proven concept: eliminate the need to drill or weld, to reduce installation time and labour costs. Lindapter steelwork fixings and girder clamps transform this concept into reality and are ideal for new construction and the refurbishment of existing structures.

Components of a girder clamp

1. **hexagon nuts, property class 8**
   according to DIN 934 (ISO 4032)
2. **washers**
   according to DIN 125 (ISO 7089)
3. **Lindapter clamps**
   Denpending on the application, different clamps may be used, such as e.g.: A, B, BR, AF, LR, LS, D2, or D3.
4. **Packing piece**
   In combination with the above-mentioned clamps these parts increase the tail length to enable the product to sit correctly on the beam.
5. **Location plate**
   This is an essential part of the girder clamp assembly that enables all the components to be located in the correct position. The dimensions depend on the Lindapter type, beams and loads.
6. **Lindapter clamp**
   Same as no. 3.
7. **hexagon bolts, property class 8.8**
   according to DIN 931 (ISO 4014) or DIN 933 (ISO 4017)



Loads

The table beneath shows tensile and frictional load capacities for a standard four-bolt girder clamp using 4 bolts and 8 Lindapter clamps. Lindapter will gladly prepare a customized parts list for any girder clamp connection based on the following customer details:

- Load per connection
- Size and type of both beams
- Flange widths
- Flange thicknesses
- Angle of crossover
- Inclination between beams

Clamps Type A,B, and LR

Screw (Property class 8.8)	Permitted load (5:1 safety factor) Tensile force / 1 screw kN	Tensile force / 2 screw kN	Tightening torque* Nm
M 8	1.0	–	6
M 10	1.5	–	20
M 12	4.5	0.9	69
M 16	8.5	1.7	147
M 20	13.2	2.6	285
M 24	19.0	3.8	491

* Bolts and nuts not lubricated

Clamps Type AF and AAF

Screw ø	Property class	Tensile force / 1 screw (5:1 safety factor) kN	Shearing force / 2 screw (2:1 safety factor) Beam coated kN	Beam zinc-plated kN	Tightening torque Non-lubricated Nm	HV Set* Nm
M 12	8.8	8.5	3.4	3.9	90	–
M 16	8.8	16.0	8.0	10.0	240	–
M 20	8.8	26.3	13.0	16.0	470	–
M 24	8.8	40.0	24.0	30.0	800	–
M 12	10.9	10.0	4.0	5.2	130	100
M 16	10.9	19.5	11.0	12.0	300	250
M 20	10.9	30.0	20.0	25.0	647	450

* K class K1

Note:
All loads are based on actual test data having a safety factor for friction against slip and for tensile against ultimate failure.
Use of lower safety factor is not recommended.

Approvals

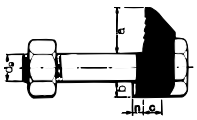
Lindapter girder clamps, types A and B, in sizes from M 12 to M 24 have been approved as construction products via ETA-13/0300.
For use of girder clamps under dynamic load (e.g. crane runways) the applicable calculation provisions according to the approval notification shall be observed.

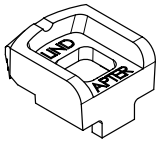
**You can find more detailed information in the Lindapter catalogue.
This can be requested directly from REYHER or downloaded from www.lindapter.de.**

Girder clamps

Type A and B

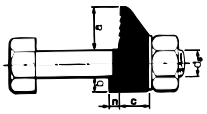
Type A
(R 82001)

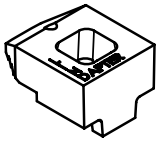




ETA CE

Type B
(R 82002)

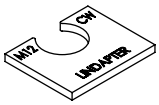




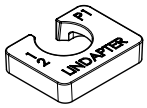
ETA CE

Accessories for type A and B

Type CW
(R 82011)

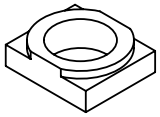


Type P1k/P2k
(R 82012/82013)



Washers for adjustment of different flange thicknesses

Type W
(R 82021)



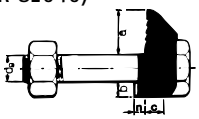
Recess filling plates for type A

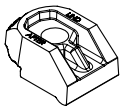
Application examples

Clamps for static and dynamic loads with adjustment of flange inclinations of up to 8°

Girder clamp type AF

Type AF
(R 82040)

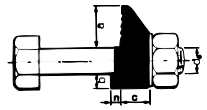




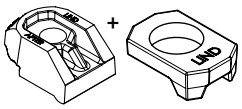
ETA CE

Accessories for type AF

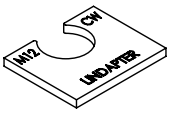
Type AF + AFW
(R 82040 + R 82041)



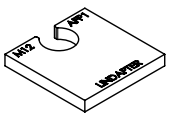
ETA CE



Type AFCW
(R 82042)



Type AFP1/AFP2
(R 82043/82044)



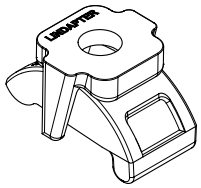
Washers for adjustment of different flange thicknesses

Application examples

Clamps for high friction loads with adjustment of flange inclinations of up to 10°.
Type AF force is preferably combined with type CF.

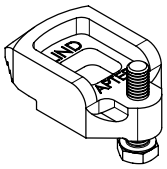
Girder clamp of type LR and D2

Type LR
(R 82010)



ETA CE

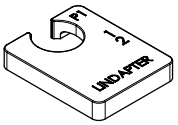
Type D2
(R 82007)



ETA CE

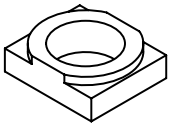
Accessories of type LR and D2

Type P1L/P2L
(R 82015/82016)



Washer for adjustment of different flange thicknesses

Type W
(R 82021)



Recess filling plates for type D2

Application examples

Type LR
Adjustable two-part clamp with large clamping range and anti-turn locking device. Adjustment of flange inclinations of up to 15°.

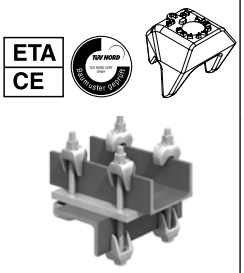
Type D2
Clamp with adjustable screw for large clamping range and anti-turn locking device. Adjustment of flange inclinations of up to 5°.

(R = REYHER article number)

Information on the dimensioning and loads can be found in the Lindapter catalogue.
This can be requested directly from REYHER of downloaded from **www.lindapter.de**.

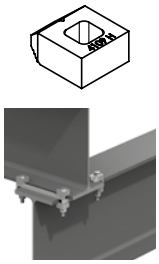
Girder clamps – special clamps

Type CF
(R 82045)



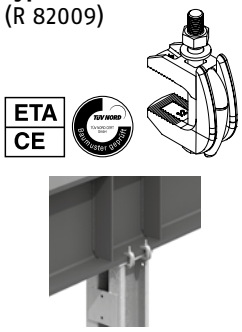
Preferably used in connection with type AF. This type hooks around the flange edge of the profiles.

Type BSNT
(R 82003)



Special clamps for the assembly of girders – flange on flange. The inner plate is replaced by a flat steel frame which is welded onto the clamp.

Type F9
(R 82009)



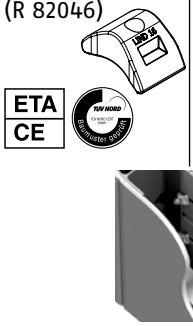
Flange clamp for parallel girders with identical width. Not suitable for tapered flanges.

Type BR
(R 82048)

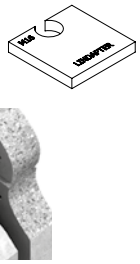
Accessories
Type CW/P1K/P2K

A versatile clamp for beams or rails. The skirt prevents the clamp from rotating during installation. Also suitable for slotted holes. Suitable for flange inclinations of up to 8°.

Type LS
(R 82046)



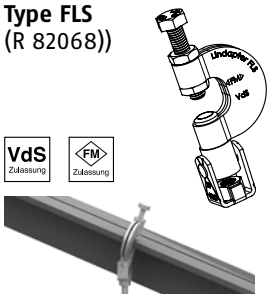
Accessories
Type LSP2
(R 82047)



Adjustable single-part clamp with large clamping range. Serrated cams help secure against twisting on the flange. Wide cam for application in slotted holes. Suitable for flange inclinations of up to 10°.

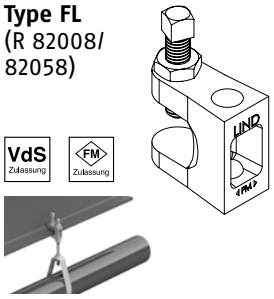
Support fixings

Type FLS
(R 82068))



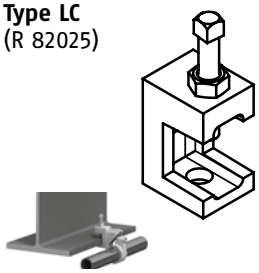
Girder clamp with swivel for use with parallel and inclined flanges.

Type FL
(R 82008/ 82058)



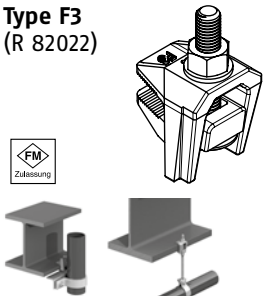
Girder clamp for parallel and inclined flanges with clearance hole or connection thread.

Type LC
(R 82025)



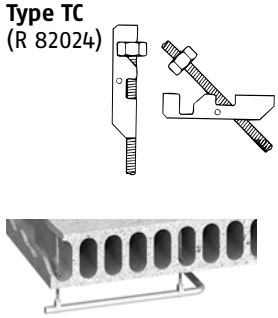
Girder clamp for parallel and inclined flanges with connection thread parallel and perpendicular to the adjusting screw.

Type F3
(R 82022)



Two-part flange clamp with large clamping area for use on parallel flanges.

Type TC
(R 82024)

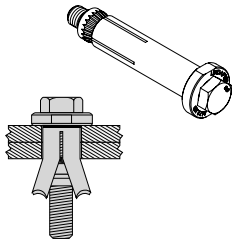


Toggle fixings for mounting to hollow ceilings or steel profiles.

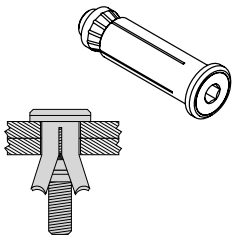
Cavity fixings

Examples of use

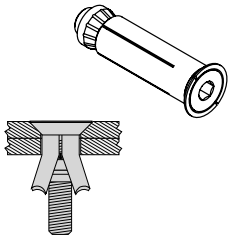
Type HB – Hexagon head
(R 82031)

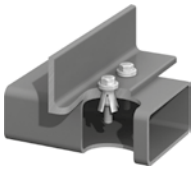


Type HBCSK – Countersunk head
(R 82031)



Type HBFF – Flush Fit
(R 82031)



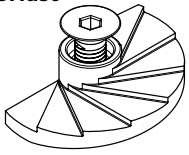


Plug-like connecting element, suitable for hollow sections, tubes and where access is available from one side only.

Floor fixings

Examples of use

Type FF – Floorfast
(R 82019)



Eccentric stepped web of this clamp is suitable for floor fixings. After fixing the Floorfast to the baseplate, the plate can be assembled from the top. The clamp will automatically lock in the right position when torque is applied.
Lloyds' Register Type Approval covers clamping force and vibration.

(R = REYHER article numbers)

When selecting the right plug or anchor for all purposes of use the following important factors need to be taken into consideration – here is some advice to help you make your choice:

1. The building material (anchoring base):
Plugs and anchors can only ever support as much of a load as the anchoring base can handle.
REYHER fixing technology provides the proper technical and commercially economic solution from the catalogues of tried-and-tested proprietary brands FISCHER and UPAT for all intended uses.

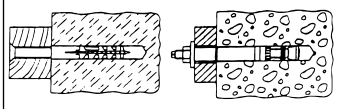
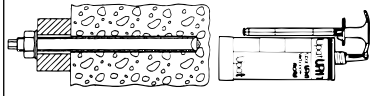
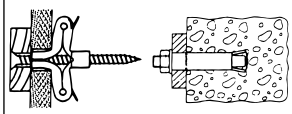
The building material needs to be able to take the expansion force of the plug or anchor during frictional contact (➔ Section. 2) without suffering damage. (Approved plugs/anchors for the corresponding building material ➔ Table 6)

Table 1: Anchoring base acc. to building group

Concrete		Brickwork				Sheets/Panels
Normal concrete B 15 – B 55 C 15/20 – C 50/55	Light-weight concrete LB 10 – LB 55 e.g. Pumice/ expanded/porous (gas) concrete	**Solid brick dense structure** e.g. Solid brick (MZ)/ Sand lime solid bricks (KS)	**Perforated brick dense structure** e.g. Honeycomb brick Sand lime Perforated bricks (KSL)	**Solid brick porous structure** e.g. Porous concrete (G) Light-weight concrete (V)	**Perforated brick porous structure** e.g. Honeycomb brick Light-weight concrete Hbl	Plasterboard/ Chipboard/ Fibreboard/ Fibre cement panels
BN	**BL**	**VD**	**LD**	**VP**	**LP**	**HP**

2. Mode of operation (load anchoring in the building material)
Plugs and anchors are classified into three groups according to their force transmission in the anchoring base.
This type of carrier mechanism is also a decisive factor for the anchoring base, resilience, edge distances and centre distances.

Table 2: Types of force transmission from plugs and anchors in the building ground

Force transmission:	**Frictional contact** (Traction from expansion)	**Adhesive bond** (expansion free)	**Formschluss** (expansion free)
Support mechanism:	Contact pressure of the expansion parts on the wall of the drilling hole = Friction > Tensile loads 	Adhesive mortar joins with the anchor and anchoring base 	Plug shape/Anchor part shape adapts to the drill hole shape 
Plug/ Anchor types:	Plastic expansion plug Metal expansion anchor	Compound/Reaction anchor Injection anchor	Cavity plug Zykon anchor

3. The area of use (pressure zone or tension zone?)
When using heavy-duty plugs/anchors in concrete it is decisive to know if the anchoring is to be carried out in the area of a proven pressure zone (consistently non-cracked concrete) or in a tension zone by itself (cracking concrete/concrete inclined to crack).

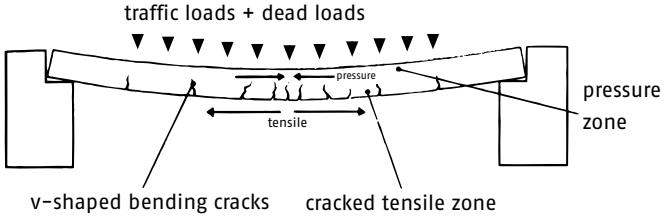
Tension zones with V-shaped bending cracks form in concrete due to its own weight, superficial loads, e.g. below ceilings. In this area of use, only plugs and anchors suited for crack/tension zones are permitted. Other plugs and anchors are only permitted for proved pressure zones.

(Tension-zone approved plugs and anchors ➔ Table 5)

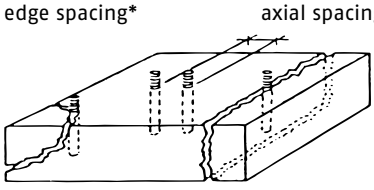
4. The anchoring position
Plugs and anchors with high expansion pressure and heavy loads can lead to cracks or concrete edge failure of the component in any anchoring base, especially with narrow/flat components.

According to their mode of operation, dimensions and load magnitudes, the plugs and anchors have been assigned the following to prevent
undesirable damage from happening:

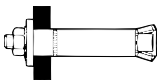
- Minimum component thicknesses
- Edge spacing
- Axial spacing (with plug pairs/groups)
- Minimum anchoring depths/installation lengths (➔ Section 7) in the relevant technical approvals (➔ Section. 9)



If in doubt, it is recommended to use tension zone approved plugs and anchors.



Non-binding typical values:
Edge spacing ≥ 2 x minimum anchoring depth
Axial spacing ≤ 4 x minimum anchoring depth
(the approval details are to be observed on a case-by-case basis)



5. Loading

Alongside the criteria treated in 1–4, the permitted load (F) per plug or anchor is influenced by:

a) Plug/Anchor dimensioning, installation depth, distances
b) Material/Property class of the plug/anchor and the building component into which the loads were inserted
c) Building component thickness, load working point, load type (pull, diagonal pull, pressure, transverse force, bending)
d) Safety factors, details in the approvals

For a) The basis used for the calculation is the size of the actually supporting threaded part (nominal size partially relate to the outer/sheath/drill diameters)

For b) The basis used for the values in approvals/from manufacturers apply to the corresponding form of delivery – e.g. steel, 8.8 or stainless steel A2/A4

6. Corrosion protection

The following guideline applies when specifying the proper protection of fixings against various types of corrosion:
The "Plug/Anchor fixing corrosion system" needs to be at least as fixed, durable and corrosion-resistant in the conditions of use as the parts to be fitted

The task of constructive planning is to determine the necessary corrosion protection measures:
Here the wear-and-tear contingency of the corrosion protection in known operating conditions is to be taken into account until maintenance is due or until the limitation of damages has been reached. Surface or material specifications are to be set accordingly in the article order text.

Table 3: Overview of the surface and material corrosion protection options

Delivery condition/ Corrosion protection	Extent of load/ Protective effect	Area of use	Notes
Zinc plated steel Coating thickness ~ 5–8 mm	I – II = mild – moderate	closed, dry interior rooms	
Hot dip galvanized steel (tZn) Coating thickness ≥ 40 mm	≧ IV = very strong	outdoor area e.g. pole/ crash barrier fixing	only with thicker dimensions due to the necessary play of the thread not a component of the tech. approval
Plastic (Nylon)	> IV = very durable	all atmospheric conditions	only special models on offer
Stainless steel A 4 (Werkst.1.4401/ 1.4571)	> IV = very durable	general atmospheric conditions rear-ventilated facades/roofs seawater/sea air	not for atmospheres containing chlorine (danger of pitting/stress corrosion)
Stainless steel Material 1.4529	> IV = very durable	specifically, indoor swimming pools, tunnels, parking garages, seawater areas	specifically for areas with high chlorine/chloride exposure

7. The clamp length – the installation length

The entire length of ready-to-install complete plugs/anchors for push-through installations is subdivided into:

- **Clamp length** ("use length", "grip strength", "grip thickness") $d_a/t_{fix}/d_p + t_{fix}$
  These need to be chosen as at least as large as the entire thickness of the assembly components to be fastened + non-structural construction material layers (plaster)
  – for stand-off fixing + distance
- **Installation length/Anchoring length h_{ef}**
  This needs to be integrated as a minimum anchoring depth in the fully load-bearing building material section. Load values only apply with the correct installation depth. See assembly instructions.

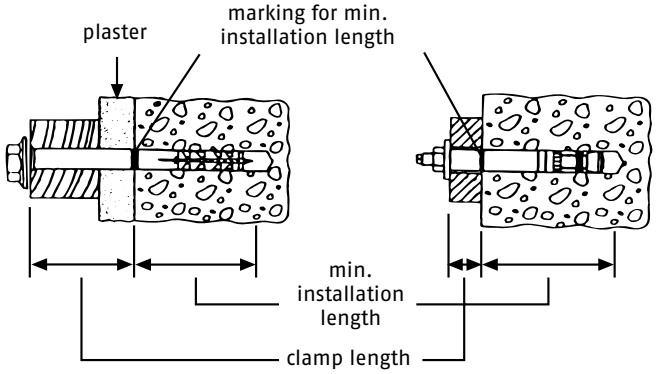
8. The assembly

Plugs and anchors can only achieve their intended task when they are properly installed.

The planner is to instruct the following for installation:
– Type, execution and dimension of the plug/anchor
– Edge and axial spacing on the component
– Special specifications of the technical approval

The grip/use lengths and the installation lengths/depths for the corresponding plugs and anchors are listed in the REYHER catalogue.

The following needs to be taken into consideration for correct assembly:
– The specifications of the planner according to sections 1 – 7
– Drills and drill techniques (➔ 8.1 Table 4)
– Drillhole ∅/depth (➔ Assembly instructions of the manufacturer)
– Borehole cleaning (➔ 8.2)
– Assembly type (➔ 8.3)
– Minimum anchoring depth/clamp length (➔ 7)



8.1 Drilling

Table 4:

Anchoring base		Drill	Drilling technique	Machine	Notes
Concrete	≧ B 25/C20/25	Hammer drills	Rotary/Hammer drilling low hammer count and high hammer power	Drilling hammer	for very large drillhole ∅ or very strong concrete reinforcement, if necessary diamond/core drilling method.
	B 15/C12/15	Stone drills	Impact drilling	Impact drilling machine	–
Solid building materials with dense/fixed structure		Stone drills Hammer drills	Impact drilling Rotary/Hammer drilling	Impact drilling machine Drilling hammer	depending on the component thickness and component stability
Light-weight building material with low strength (Porous/Light-weight concrete)		Stone drills	Rotary drilling without impact	Drilling machine	
			Impact drilling	Impact drilling machine	make sure that the drillhole does not get too large and that the bars of the hole/hollow brick stones don't break off
Perforated bricks		Stone drills	Rotary drilling without impact	Drilling machine	
Panels:	Plasterboard/ Fibre cement	Stone drills			
	Chipboard/ Wood/Wood-fibre boards	Spiral drill for wood			

8.2 Borehole cleaning

Since drill dust can not provide grip or can block the space of an undercut, all loose elements need to be removed from the drillhole before the plugs or anchors are inserted, e.g. by air-cleaning.

8.3 Assembly types (→ Figure 1)

8.3.1 The **push-through installation** is usually easiest for series assemblies and plug pairs as the insert holes of the building component can be used as drill gauges.

8.3.2 With **pre-positioned installation** the drillhole is to be accurately marked out. Internal thread anchors must end flush with the building material surface.

8.3.3 With **stand-off installation** pre-positioned inside thread/compound anchors with sufficiently long projecting lengths are to be used or fastening should be done with a suitably long screw.

8.4 Tightening torques/preloads

The values applicable for the various manufacturers and types are to be specified according to the technical approval by the construction engineer. Typical values can be found on the package or in the package insert.

8.5 Wrench sizes

For ready-to-install plugs and anchors, the wrench sizes are indicated on the package/in the package insert. The wrench sizes standardised for DIN/ISO screws apply to standard screws used for fastening, for example, inside thread anchors.

9. Approvals

For fasteners and anchors whose failure presents a danger to public safety, only plugs and anchors may be used which have been given approval for the use intended. General technical approvals are granted after type testing by the Deutsche Institut für Bautechnik (German Institute for Civil Engineering), Berlin (DIBT). Special approvals for particular uses are granted by the institutes declared responsible for them or the inspection centres of the relevant professional associations.
Plugs and anchors with CE logos require "European Technical Approval" (ETA).

Figure 1

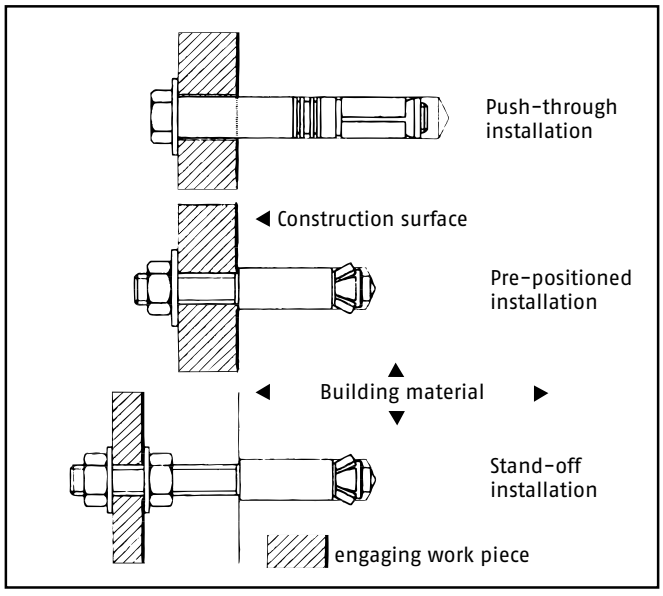
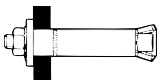


Table 5: Overview of the currently valid types of approval

European Approvals ETA CE	Building materials with the CE symbol may be traded freely in the EU economic zone. One of the requirements for the CE logo on plugs is the prior granting of European Technical Approval =ETA. ETA approvals are classified according to the use of the plug into options 1–6 for cracked concrete and 7–12 for non-cracked concrete. Approvals are granted based on • ETAG 001-1, -2, -3, -4 (future EAD 33-0232), • ETAG 001-5 (future EAD 33-0499), • ETAG 001-06 (future EAD 33-0747),



Overview of alternative plug/anchor systems of various manufacturers

General fixings

REYHER articles	Fischer	Upat	Sormat	TOX	Hilti	Würth	MKT	Mungo	Mea
88554	SX			AS-K/TRI/TRIKA	HUD-1			MQ	FX
88500	S	U		AS-K/TRI/TRIKA		master		MN	F
88520, 88381-383	UX	UVD II	L4 KA/L4 A	AS-K/TRI/TRIKA	HUD-1	W-ZX	UD	MU	MZ/MZK
88507	GB			YTOX	HGN	W-GB			GB
88545	FMD	UMA	4 M	MKD		W-MG		MEF	MSD
88510	M								
88506	M-S								
88521	PA 4								

High performance steel anchors

88583-589	FZA		BLS, SLS, SLKS, ILS		HSC				
88597	FZEA II								
88561/88741	FAZ II	MAX	BoA-X	S-FIX	HST 3			m3	BAZ/BZ
88590-594	FH II		B/S/SK/AB/AS	SZ	HSL-3	W-HAZ-S	SZ	HL	SWA
88582/88764	FBN II	IMC	BoA	S-FN	HSA	W-FA	B	m2	BA/BAN
88715	EXA		BoA	S-KA				m2	BA/BAN
88513	FHY				HKH	W-HD	Easy	MHDA	
88683	TA-M				HAM	W-TM	SL		
88567	EA II			E	HKD	W-ED	E	ESA	SA/SA-N
88546-549	FNA II		T-DN	TDN	HK	W-NA	N	MAN	MDA L
-	FDN				DBZ	W-DN	TDN		
88531	MR								
88688	FPX-I				HPD	W-PA			
-	FBS								

Chemical fixings

88579	FHB II				HVU-TZ				
88686	FIS SB				HIT-HY 200A				
88579	FHB II PF				HVU-TZ				
88687/88534/88720-722	RSB/RGM	UKA 3, ASTA	KLS/KLP	TVA	HVU2/HAS	W-VD	V-P/VMU-A	MVA	VA
88522/88733	FIS V360S	UPM 44		TVM-STV/STP		WIT-VM 250	VMU plus	MIT-SE	MIS-V-V
88522, 88774, 88775	FIS V/VL	UPM 33, UPM 11			HIT-HY 170	WIT-PM 200	VMU		
88522/88772	FIS EM	UPM 55			HIT-RE 500	WIT-PE 500	VME		
88579	FHB dynamik				HAS-TZ	W-VIZ-A	VMZ-A dyn.		

Cavity fixings

88512	HM	UH		MHD	HHD	W-MH		MHD-S	HR/HRM
88509, 88518/519	K/KD/KDH/KM			Kippdübel	EFD/KD	W-FK /W-KD		MF/MK	FKS/FK-KS
88598	GK		LGK	GDK		W-GS Typ K		MFJ	GKD
88598	GKM			GD 37	HSP	W-GS Typ ZD	GKD	MJP	GKDZ

Long-shaft anchors/frame fixings/adjustment fixings

88542, 88782	SXR	UDR			HRD	W-UR		MBR-X	R
88551	SXRL	UDRL			HRD	W-UR			
88504	SXS			SDF	HRD	W-UR		MBR	R
88563-564	FUR			SDF	HRD-U	W-UR			
88503	N	UN	LNS/LNZ	LSN /MSB-LSN	HPS-1	W-ZND	ND	MNA	NP
88515	JUSS			JS-S				MJB	JS
88516	F-S								FR
88516	F-S								FR

Scaffold fixings

88536	S14R0E + GS 12							MGD + MGV	GR + ÖS

Insulation fixings

88514	DHK			DH	HIF	W-IN		MDS,MDP,MIS MIP	DSH

Note: This overview is non-binding. A final testing of applicability and approvals is the responsibility of the user.

Selection aids, dimensioning programmes and product information

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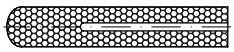
Chemical fixings

Article 88579 FHB II-P/PF

FISCHER resin capsules FHB II-P/PF
building materials: BN



ETA CE | R120 fire resistance classification | Z suitable for tensil zone | BZS shock - approval

For use with anchors FHB-A.
Observe the period of hardening according to the package's specifications.
PF= quickly curing

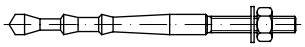
Dimensions	8x60	10x60	10x75	10x95	12x75	12x100	12x120	16x95
d_0	10	10	10	12	12	14	14	16
$h_0 = t$	75	75	90	110	90	115	135	110
h_{ef}	60	60	75	95	75	100	120	95
matching for	FHB II-A L	FHB II-A S	FHB II-A S	FHB II-A L	FHB II-A S	FHB II-A L	FHB II-A L	FHB II-A S

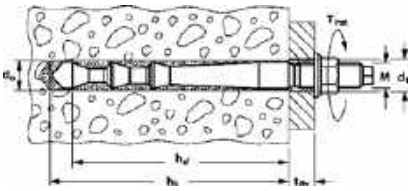
Dimensions	16x125	16x145	16x160	20x170	20x210	24x170	24x210	
d_0	18	18	18	25	25	25	25	
$h_0 = t$	145	165	175	190	235	190	235	
h_{ef}	125	145	160	170	210	170	210	
matching for	FHB II-A L	FHB II-A L	FHB II-A L	FHB II-A S	FHB II-A L	FHB II-A S	FHB-A L	

Dimensions in stock:
Fixing systems: pg. 662

Article 88579 FHB II-A L

FISCHER highbond-anchors FHB II-A L
building materials: BN





ETA CE | R120 fire resistance classification | Z suitable for tensil zone | BZS shock - approval

Dimensions	M 8x60/10	M 8x60/30	M 8x60/50	M 10x95/10	M 10x95/20
d_0	10	10	10	12	12
$h_0 = t$	75	75	75	110	110
h_{ef}	60	60	60	95	95
t_{fix}	10	30	50	10	20
thread	M 8	M 8	M 8	M 10	M 10
SW	13	13	13	17	17

Dimensions	M 10x95/40	M 10x95/60	M 10x95/100	M 12x100/10	M 12x100/25
d_0	12	12	12	14	14
$h_0 = t$	110	110	110	115	115
h_{ef}	95	95	95	100	100
t_{fix}	40	60	100	10	25
thread	M 10	M 10	M 10	M 12	M 12
SW	17	17	17	19	19

Dimensions	M 12x100/40	M 12x100/60	M 12x100/100	M 12x120/10	M 12x120/25
d_0	14	14	14	14	14
$h_0 = t$	115	115	115	135	135
h_{ef}	100	100	100	120	120
t_{fix}	40	60	100	10	25
thread	M 12	M 12	M 12	M 12	M 12
SW	19	19	19	19	19

Dimensions	M 12x120/40	M 12x120/60	M 12x120/100	M 16x125/30	M 16x125/60
d_0	14	14	14	18	18
$h_0 = t$	135	135	135	140	140
h_{ef}	120	120	120	125	125
t_{fix}	40	60	100	30	60
thread	M 12	M 12	M 12	M 16	M 16
SW	19	19	19	24	24

Dimensions	M 16x125/100	M 16x145/30	M 16x145/60	M 16x145/100	M 16x160/30
d_0	18	18	18	18	18
$h_0 = t$	140	160	160	160	175
h_{ef}	125	145	145	145	160
t_{fix}	100	30	60	100	30
thread	M 16	M 16	M 16	M 16	M 16
SW	24	24	24	24	24

Dimensions	M 16x160/60	M 16x160/100	M 20x210/50	M 20x210/150	M 24x210/50
d_0	18	18	25	25	25
$h_0 = t$	175	175	235	235	235
h_{ef}	160	160	210	210	210
t_{fix}	60	100	50	150	50
thread	M 16	M 16	M 20	M 20	M 24
SW	24	24	30	30	36

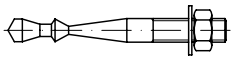
For use with FHB II-P resin capsules

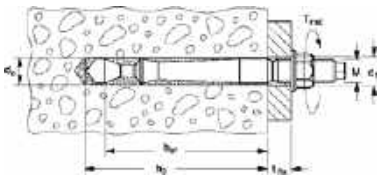
Dimensions in stock:
Fixing systems: pg. 664

Chemical fixings

Article 88579 FHB II-A S

FISCHER highbond-anchors FHB II-A S
building materials: BN





ETA CE | R120 fire resistance classification | Z suitable for tensil zone | BZS shock - approval

Dimensions	M 10x60/10	M 10x60/20	M 10x60/40	M 10x60/60	M 10x60/100	M 10x75/10
d_0	10	10	10	10	10	10
$h_0 = t$	75	75	75	75	75	90
h_{ef}	60	60	60	60	60	75
t_{fix}	10	20	40	60	100	10
M	M 10	M 10	M 10	M 10	M 10	M 10
SW	17	17	17	17	17	17

Dimensions	M 10x75/20	M 10x75/40	M 10x75/60	M 10x75/100	M 12x75/10	M 12x75/25
d_0	10	10	10	10	12	12
$h_0 = t$	90	90	90	90	90	90
h_{ef}	75	75	75	75	75	75
t_{fix}	20	40	60	100	10	25
M	M 10	M10	M 10	M 10	M 12	M 12
SW	17	17	17	17	19	19

Dimensions	M 12x75/40	M 12x75/60	M 12x75/100	M 12x75/165	M 16x95/30	M 16x95/60
d_0	12	12	12	12	16	16
$h_0 = t$	90	90	90	90	110	110
h_{ef}	75	75	75	75	95	95
t_{fix}	40	60	100	165	30	60
M	M 12	M 12	M 12	M 12	M 16	M 16
SW	19	19	19	19	24	24

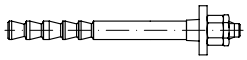
Dimensions	M 16x95/100	M 16x95/165	M 20x170/50	M 24x170/50		
d_0	16	16	25	25		
$h_0 = t$	110	110	190	190		
h_{ef}	95	95	170	170		
t_{fix}	100	165	50	50		
M	M 16	M 16	M 20	M 24		
SW	24	24	30	36		

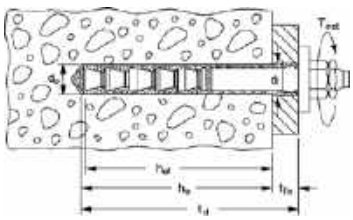
For use with resin capsules FHB II-P and FHB II-PF

Dimensions in stock:
Fixing systems: pg. 664

Article 88579 FHB-A dyn

FISCHER highbond-anchors FHB-A dyn
building materials: BN





dynamic | Z suitable for tensil zone | R120 fire resistance classification

For use with injection mortar FIS HB (REYHER article 88578)

Dimensions	12x100/25	12x100/50	16x125/25
d_0	14	14	18
t_d	130	155	155
$t = h_{ef}$	100	100	125
t_{fix}	8 - 25	8 - 50	10 - 25
d_1	15	15	19
SW	19	19	24

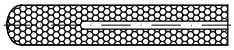
Dimensions	16x125/50	20x170/50	24x220/50
d_0	18	24	28
t_d	180	225	275
$t = h_{ef}$	125	170	220
t_{fix}	10 - 50	12 - 50	14 - 50
d_1	19	25	29
SW	24	30	36

Dimensions in stock:
Fixing systems: pg. 665

Chemical fixings

Article 88687 RSB

FISCHER resin capsules RSB
building materials: BN, VD



ETA CE | R120 fire resistance classification | Z suitable for tensil zone

ETA 12/0258

For use with anchor rods RGM.
Note curing times according to package information!

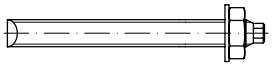
Dimensions	8	10 mini	10	12 mini	12	
d_0	10	12	12/14	14	14/18	
$h_0 = h_{ef}$	80	75/150	90	75/150	110	
matching for RGM	M 8	M 10	M 10	M 12	M 12	
matching for RGM I	-	-	M 8	-	M 10	

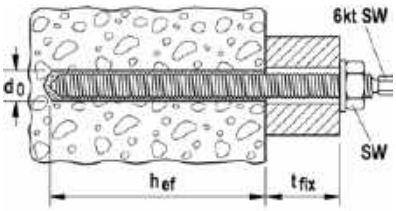
Dimensions	16 mini	16	16 E	20	20 E / 24	30
d_0	18	18/20	24	25	25/28/32	35
$h_0 = h_{ef}$	95/190	125	160	170	210	280
matching for RGM	M 16	M 16	-	M 20	M 20/24	M 30
matching for RGM I	-	M 12	M 16	-	M 20	-

Dimensions in stock:
Fixing systems: pg. 662

Article 88534 RG M

FISCHER anchor rods RG M
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tensil zone

ETA-12/0258

Dimensions	M 8x110	M 8x150	M 10x110	M 10x130	M 10x165	M 10x190	M 10x220
d_0	10	10	12	12	12	12	12
t_{fix}	14	54	15	35/20	70/55	95/80/20	125/110/50
h_{ef}	80	80	75	75/90	75/90	75/90/150	75/90/150
SW hexagon	5	5	7	7	7	7	7

Dimensions	M 10x250	M 10x350	M 12x120	M 12x160	M 12x180	M 12x220	M 12x250
d_0	12	12	14	14	14	14	14
t_{fix}	155/140/80	255/240/180	21/-/-	61/26	81/46/6	121/86/46	151/116/76
h_{ef}	75/90/150	75/90/150	75/-/-	75/110	75/110/150	75/110/150	75/110/150
SW hexagon	7	7	8	8	8	8	8

Dimensions	M 12x300	M 12x380	M 16x165	M 16x190	M 16x250	M 16x270	M 16x300
d_0	14	14	18	18	18	18	18
t_{fix}	201/166/126	281/246/206	38/8	63/33	123/93/28	143/113/48	173/143/78
h_{ef}	75/110/150	75/110/150	95/125	95/125	95/125/190	95/125190	95/125/190
SW hexagon	8	8	12	12	12	12	12

Dimensions	M 16x380	M 16x500	M 20x220	M 20x260	M 20x290	M 20x350	M 20x500
d_0	18	18	25	25	25	25	25
t_{fix}	253/223/158	373/343/278	-/14/-	54/14	84/44	144/104	294/254
h_{ef}	95/125/190	95/125/190	-/170/-	170/210	170/210	170/210	170/210
SW hexagon	-	-	12	12	12	12	-

Dimensions	M 24x295	M 24x300	M 24x400	M 24x600	M 30x380	M 30x500	
d_0	28	28	28	28	35	35	
t_{fix}	56	61	161	361	65	185	
h_{ef}	210	210	210	210	280	280	
SW hexagon	-	-	-	-	-	-	

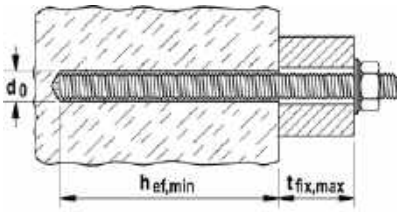
For use with cartridge RSB
(REYHER article 88687)

Dimensions in stock:
Fixing systems: pg. 665

Chemical fixings

Article 88523 FIS A

FISCHER threaded rods FIS A
building materials with
anchor sleeve: LD, VD, BN
building materials without
anchor sleeve: BL, VD, VP



ETA CE | Z suitable for tenell zone | R120 fire resistance classification

Dimensions	6x75	6x85	6x110	8x90	8x110	8x130	10x110
d_0 for BN, VD	8	8	8	10	10	10	12
d_0 for LD	12	12	12	12	12/12/16	12/16	16
h_{ef} for BN	–	–	–	60 – 78	60 – 98	60 – 118	60 – 96
h_{ef} for LD	50	50	50/85	50	50/85/85	50/85/85	85
h_{ef} for VD	50	50	50	50	50	50	50
t_{fix} for BN	–	–	–	1 – 19	1 – 39	1 – 59	1 – 37
t_{fix} for LD	16	26	52/17	29	49/14/14	69/34/34	12
t_{fix} for VD	17	27	52	29	49	69	47

Dimensions	10x130	10x150	10x200	12x120	12x140	12x160	12x180
d_0 for BN, VD	12	12	12	14	14	14	14
d_0 for LD	16	16	16	20	20	20	20
h_{ef} for BN	60 – 116	60 – 136	60 – 186	70 – 103	70 – 123	70 – 143	70 – 163
h_{ef} for LD	85	85/130	85/130	85	85	85/130	85/103
h_{ef} for VD	50	50	50	50	50	50	50
t_{fix} for BN	1 – 57	1 – 77	1 – 127	1 – 34	1 – 54	1 – 74	1 – 94
t_{fix} for LD	32	52/7	102/57	19	39	59/14	79/34
t_{fix} for VD	67	87	137	54	74	94	114

Dimensions	12x210	12x260	16x130	16x175	16x200	16x250	16x300
d_0 for BN, VD	14	14	18	18	18	18	18
d_0 for LD	20	20	20	20	20	20	20
h_{ef} for BN	70 – 193	70 – 240	80 – 109	80 – 154	80 – 179	80 – 229	80 – 279
h_{ef} for LD	85/130	85/130/200	85	85/130	85/130	85/130/200	85/130/200
h_{ef} for VD	50	50	50	50	50	50	50
t_{fix} for BN	1 – 124	4 – 174	1 – 30	1 – 75	1 – 100	1 – 150	1 – 200
t_{fix} for LD	109/64	169/114/44	25	70/25	95/50	145/100/30	–
t_{fix} for VD	144	194	60	105	130	180	230

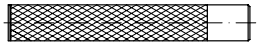
Dimensions	20x245	20x290	24x290	24x380	30x430		
d_0 for BN, VD	24	24	28	28	35		
d_0 for LD	–	–	–	–	–		
h_{ef} for BN	90 – 220	90 – 265	96 – 260	96 – 350	120 – 394		
h_{ef} for LD	–	–	–	–	–		
h_{ef} for VD	–	–	–	–	–		
t_{fix} for BN	1 – 131	1 – 176	1 – 165	1 – 255	1 – 275		
t_{fix} for LD	–	–	–	–	–		
t_{fix} for VD	–	–	–	–	–		

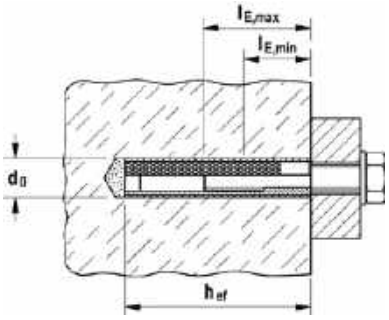
Dimensions in stock:
Fixing systems: pg. 665

Chemical fixings

Article 88529 FIS-E

FISCHER internal threaded sockets FIS-E
building materials: VD





ETA CE R120

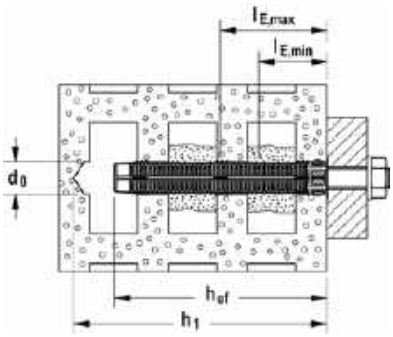
For use with injection mortar
FIS-V, FIS-VS and FIS-VW
l_E = length of thread engagement

Dimensions	11x85	11x85	15x85	15x85
d_0	14	14	18	18
$t = h_{ef}$	85	85	85	85
$l_{E,\,min.}$	6	8	10	12
$l_{E,\,max.}$	60	60	60	60
d_s	M 6	M 8	M 10	M 12

Dimensions in stock:
Fixing systems: pg. 666

Article 88562 FIS H K

FISCHER injection anchor sleeves FIS H K
building materials: LP, (VD)



Dimensions	12x50	12x85	16x85
d_0	12	12	16
t_d	60	95	95
h_{ef}	50	85	85
matching for	FIS-A (M 6/M 8)	FIS-A (M 6/M 8	FIS-A (M 8/M 10) FIS-E (M 6/M 8)
anchors per 360ml capsule*	34	17	14

Dimensions	16x130	20x85	20x130
d_0	16	20	20
t_d	140	95	140
h_{ef}	110	85	110
matching for	FIS-A (M 8/M 10)	FIS-A (M 12/M 16) FIS-E (M 6 - M 12)	FIS A (M 12 - M 16)
anchors per 360ml capsule*	11	11	

Dimensions	20x200		
d_0	20		
t_d	210		
h_{ef}	200		
matching for	FIS A (M 12 - M 16)		
anchors per 360ml capsule*			

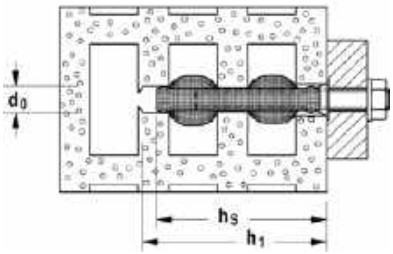
For use with injection mortar
FIS-V, FIS-VS and FIS-VW
*max. number when processing with 1 static mixer

Dimensions in stock:
Fixing systems: pg. 666

Chemical fixings

Article 88526 FIS H N

FISCHER injection anchor sleeves FIS H N
building materials: LP, VD



For use with injection mortar
FIS-V, FIS-VS and FIS-VW
hs = anchor depth sleeve min.
h_1 = anchor depth anchor part min.

Dimensions	16x85	18x85
d_0	16	18
h_1	95	95
h_s	90	90
matching for FIS-A	M 8	M 10

Dimensions	20x85	
d_0	20	
h_1	95	
h_s	90	
matching for FIS-A	M 12	

Dimensions in stock:
Fixing systems: pg. 666

Article 88526 FIS H L

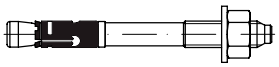
Dimensions	12x1000	16x1000	22x1000
d_0	12	16	22
l	1000	1000	1000
matching for FIS-A	M 6 – M 8	M 10 – M 12	M 12 – M 16

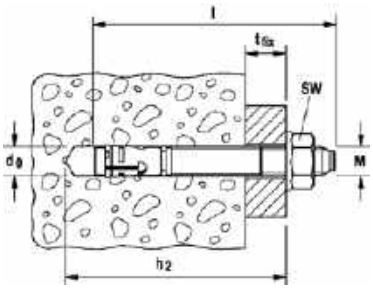
Dimensions in stock:
Fixing systems: pg. 666

High performance steel anchors

Article 88561 FAZ II

FISCHER Anchor bolts FAZ II
FISCHER Anchor bolts FAZ II GZ II K
building materials: BN, VD





ETA CE · FM approval · R120 fire resistance classification · VdS approval · Z suitable for tenell zone

ETA-05/0069

Dimensions	6/10	6/20	8/10	8/30	8/50	8/100	8/160	10/10
d_0	6	6	8	8	8	8	8	10
h_2	60	70	65	85	105	155	215	85
l	65	75	75	95	115	165	225	95
t_{fix}	10/-	20/-	10/20	30/40	50/60	100/110	160/170	10/30
SW	10	10	13	13	13	13	13	17
Washer ∅ at GS	-	-	22x2,5	22x2,5	-	-	-	25x3

Dimensions	10/10 K	10/20	10/20 K	10/30	10/50	10/70	10/80	10/100
d_0	10	10	10	10	10	10	10	10
h_2	65	95	75	105	125	145	155	175
l	75	105	85	115	135	155	165	185
t_{fix}	10	20/40	20	30/50	50/70	70/90	80/100	100/120
SW	-	17	-	17	17	17	17	17
Washer ∅ at GS	20x2	-	20x2	25x3	-	-	-	-

Dimensions	10/160	12/10	12/10 K	12/20	12/20 K	12/30	12/50	12/60
d_0	10	12	12	12	12	12	12	12
h_2	235	100	80	110	90	120	140	150
l	245	110	90	120	100	130	150	160
t_{fix}	160/180	10/30	10	20/40	20	30/50	50/70	60/80
SW	17	19	-	19	-	19	19	19
Washer ∅ at GS	-	30x3	24x2,5	30x3	24x2,5	30x3	30x3	-

Dimensions	12/80	12/100	12/160	12/200	16/5	16/25	16/50	16/100
d_0	12	12	12	12	16	16	16	16
h_2	170	190	250	290	115	135	160	210
l	180	200	260	300	128	148	173	223
t_{fix}	80/100	100/120	160/180	200/220	5/25	25/45	50/70	100/120
SW	19	19	19	19	24	24	24	24
Washer ∅ at GS	44x4	30x3	44x4	44x4	-	-	-	-

Dimensions	16/160	16/200	16/250	16/300	20/30	20/60	20/160	24/30	24/60
d_0	16	16	16	16	20	20	20	24	24
h_2	270	310	360	410	155	185	285	185	215
l	283	323	373	423	172	202	302	205	235
t_{fix}	160/180	200/220	250/270	300/320	30	60	160	30	60
SW	24	24	24	24	30	30	30	36	36
Washer ∅ at GS	56x5	68x6	-	-	-	-	-	-	-

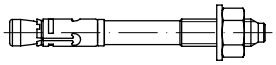
VdS approval M 8-M 20
FM approval starting from M 10

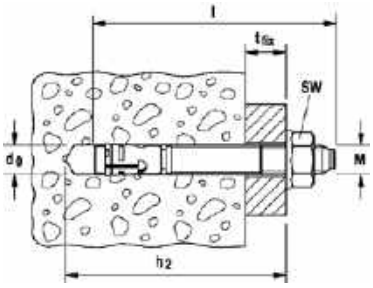
Dimensions in stock:
Fixing systems: pg. 666

High performance steel anchors

Article 88694 FBZ

FISCHER anchor bolts FBZ
building materials: BN





ETA CE | R120 fire resistance classification | Z suitable for tensil zone

ETA-17/0624

Dimensions	8/10	8/10 GS*	10/10	10/10 GS*	10/20	10/30
d_0	8	8	10	10	10	10
h_2	70	70	87	87	97	107
l	75	75	95	95	105	115
$h_{ef\,1}$ red.	35	35	40	40	40	40
$h_{ef\,1}$ stand.	45	45	60	60	60	60
t_{fix}	10/20	10/20	10/30	10/30	20/40	30/50
U-washer	16 x 1,6	22 x 2,5	20 x 2	25 x 3	20 x 2	20 x 2
Thread	M 8 x 38	M 10 x 53	M 10 x 53	M 10 x 53	M 10 x 63	M 10 x 73

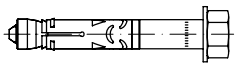
Dimensions	12/10	12/10 GS*	12/20	12/30	16/25	
d_0	12	12	12	12	16	
h_2	99	99	109	119	133	
l	110	110	120	130	148	
$h_{ef\,1}$ red.	50	50	50	50	65	
$h_{ef\,1}$ stand.	70	70	70	70	85	
t_{fix}	10/30	10/30	20/40	30/50	25/45	
U-washer	24 x 23,5	30 x 3	24 x 2,5	24 x 2,5	30 x 3	
Thread	M 12 x 61	M 12 x 61	M 12 x 71	M 12 x 84	M 16 x 84	

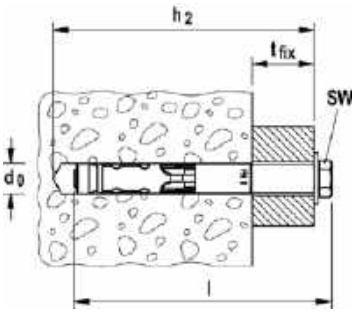
*with large washer

Dimensions in stock:
Fixing systems: pg. 668

Article 88593 FH II-S

FISCHER high performance anchors FH II-S
building materials: BN, VD





ETA CE | R120 fire resistance classification | VdS approval | Z suitable for tensil zone | FM approval

ETA-07/0025
l = total anchor length
VdS approval M 8 – M 20
FM approval starting from M 10

Dimensions	10/10	10/25	10/50	12/10	12/25	12/50	15/10	15/25	18/10
d_0	10	10	10	12	12	12	15	15	18
h_2	65	80	105	90	105	130	100	115	119
h_{ef}	40	40	40	60	60	60	70	70	80
$l_{steel/A\,4}$	70/69	85/84	110	90	105	130	106/107	121/122	118
t_{fix}	10	25	50	10	25	50	10	25	10
thread	M 6	M 6	M 6	M 8	M 8	M 8	M 10	M 10	M 12
SW	10	10	10	13	13	13	17	17	19

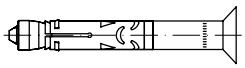
Dimensions	15/50	18/25	18/50	24/25	24/50	28/30	28/60	32/30	32/60
d_0	15	18	18	24	24	28	28	32	32
h_2	140	130	155	150	175	185	215	210	240
h_{ef}	70	80	80	100	100	125	125	150	150
$l_{steel/A\,4}$	146	132/133	157	160	185	192	222	215	245
t_{fix}	50	25	50	25	50	30	60	30	60
thread	M 10	M 12	M 12	M 16	M 16	M 20	M 20	M 24	M 24
SW	17	19	19	24	24	30	30	36	36

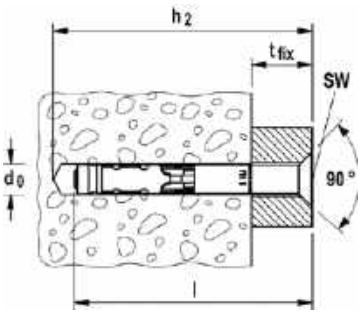
Dimensions in stock:
Fixing systems: pg. 668

High performance steel anchors

Article 88594 FH II-SK

FISCHER high performance anchors FH II-SK
building materials: BN, VD





ETA CE | R120 | VdS approval | Z suitable for tenell zone | FM approval

VdS approval M 8 – M 20
FM approval starting from M 10

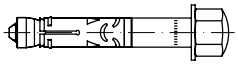
Dimensions	10/15	10/25	10/50	12/15	12/25	12/30	12/50
d_0	10	10	10	12	12	12	12
t_d	70	80	105	95	105	110	130
h_{ef}	40	40	40	60	60		60
l	65	75	100	90	100	105	125
t_{fix}	10	25	50	15	25	30	50
thread	M 6	M 6	M 6	M 8	M 8		M 8
SW	4	4	4	5	5	6	5
x	5	5	5	5.8	5.8		5.8
D	18	18	18	22	22		22

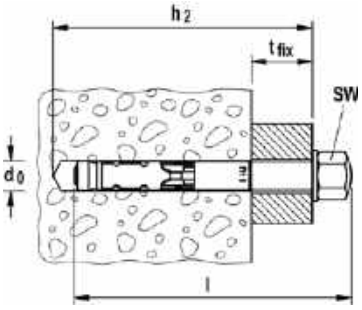
Dimensions	15/15	15/25	15/50	18/15	18/25	18/30	18/50
d_0	15	15	15	18	18	18	18
t_d	105	115	140	120	130	135	155
h_{ef}	70	70	70	80	80		80
l	100	110	135	115	125	130	150
t_{fix}	15	25	50	15	25	30	50
thread	M 10	M 10	M 10	M 12	M 12		M 12
SW	6	6	6	8	8	8	8
x	5.8	5.8	5.8	8	8		8
D	25	25	25	32	32		32

Dimensions in stock:
Fixing systems: pg. 669

Article 88590 FH II-H

FISCHER high performance anchors FH II-H
building materials: BN, VD





ETA CE | R120 | VdS approval | Z suitable for tenell zone | FM approval

ETA-07/0025

l = total anchor length
VdS approval M 8 – M 20
FM approval starting from M 10

Dimensions	10/10	10/25	10/50	12/10	12/25	12/50
d_0	10	10	10	12	12	12
h_2	65	80	105	90	105	130
h_{ef}	40	40	40	60	60	60
l	75	90	115	100	115	140
t_{fix}	10	25	50	10	25	50
thread	M 6	M 6	M 6	M 8	M 8	M 8
SW	13	13	13	17	17	17

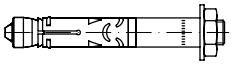
Dimensions	15/10	15/25	15/50	18/25	18/50	
d_0	15	15	15	18	18	
h_2	100	115	140	130	155	
h_{ef}	70	70	70	80	80	
l	115	130	155	145	170	
t_{fix}	10	25	50	25	50	
thread	M 10	M 10	M 10	M 12	M 12	
SW	17	17	17	19	19	

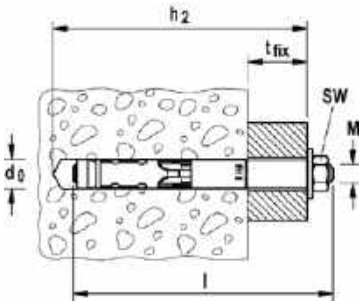
Dimensions in stock:
Fixing systems: pg. 669

High performance steel anchors

Article 88592 FH II-B

FISCHER high performance anchors FH II-B
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tenali zone | FM approval | VdS approval

Dimensions	10/10	10/25	10/50	12/10	12/25	12/50	12/100	15/10	15/25	15/50	15/100
d_0	10	10	10	12	12	12	12	15	15	15	15
h_2	65	80	105	90	105	130	180	100	115	140	190
h_{ef}	40	40	40	60	60	60	60	70	70	70	70
l	70	85	110	95	110	135	185	110	125	150	200
t_{fix}	10	25	50	10	25	50	100	10	25	50	100
thread	M 6	M 6	M 6	M 8	M 8	M 8	M 8	M 10	M 10	M 10	M 10
SW	10	10	10	13	13	13	13	17	17	17	17

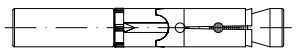
Dimensions	18/25	18/50	18/100	24/25	24/50	24/100	28/30	28/60	32/30	32/60	
d_0	18	18	18	24	24	24	28	28	32	32	
h_2	130	155	205	150	175	225	185	215	210	240	
h_{ef}	80	80	80	100	100	100	125	125	150	150	
l	140	165	215	167	192	242	199	229	231	261	
t_{fix}	25	50	100	25	50	100	30	60	30	60	
thread	M 12	M 12	M 12	M 16	M 16	M 16	M 20	M 20	M 24	M 24	
SW	19	19	19	24	24	24	30	30	36	36	

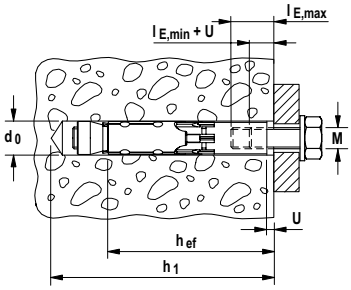
l = total anchor length
VdS approval M 8 – M 20
FM approval starting from M 10

Dimensions in stock:
Fixing systems: pg. 669

Article 88689 FH II-I

FISCHER high performance anchors FH II-I
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tenali zone | VdS approval

ETA-07/0025

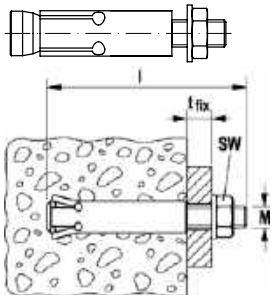
Dimensions	M 6	M 8	M 10	M 12
d_0	12	12	15	15
h_1	85	85	95	95
h_{ef}	60	60	70	70
l	77,5	77,5	90	90
$l_{E,min}$	11 + U	13 + U	10 + U	12 + U
$l_{E,max}$	25	25	25	25
U	3 – 5	3 – 5	3 – 5	3 – 5

Dimensions in stock:
Fixing systems: pg. 668

High performance steel anchors

Article 88583 FZA

FISCHER ZYKON bolt anchors FZA
building materials: BN, VD



ETA CE | R120 fire resistance classification | Z suitable for tensile zone | VdS approval

ETA-98/004

VdS approval starting from M 8

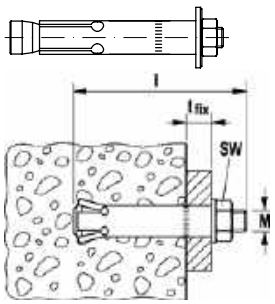
Dimensions	10x40 M 6/10	12x40 M 8/15	12x50 M 8/15	12x50 M 8/50	14x40 M 10/25	14x60 M 10/25
l	60	69	79	114	79	102
t_{fix}	10	15	15	50	25	25
thread	M 6	M 8	M 8	M 8	M 10	M 10
SW	10	13	13	13	17	17
drill FZUR	10 x 40	12 x 40	12 x 50	12 x 50	14 x 40	14 x 60

Dimensions	14x60 M 10/50	18x80 M 12/25	18x80 M 12/55	22x100 M 16/60	22x125 M 16/60	
l	126	126	156	186	209	
t_{fix}	50	25	55	60	60	
thread	M 10	M 12	M 12	M 16	M 16	
SW	17	19	19	24	24	
drill FZUR	14 x 60	18/80	18/80	22 x 100	22 x 125	

Dimensions in stock:
Fixing systems: pg. 668

Article 88584 FZA-D

FISCHER ZYKON through anchors FZA-D
building materials: BN, VD



ETA CE | R120 fire resistance classification | Z suitable for tensile zone | VdS approval

ETA-98/004

VdS approval starting from M 8

Dimensions	12x50 M 8/10	12x60 M 8/10	12x80 M 8/30
l	69	79	99
t_{fix}	10	10	30
thread	M 8	M 8	M 8
SW	13	13	13
drill FZUB	12 x 50	12 x 60	12 x 80

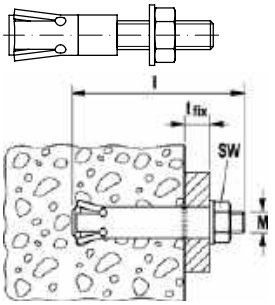
Dimensions	14x80 M 10/20	14x100 M 10/40	18x100 M 12/20
l	102	126	126
t_{fix}	20	40	20
thread	M 10	M 10	M 12
SW	17	17	19
drill FZUB	14 x 80	14 x 100	18 x 100

Dimensions	18x130 M 12/50	22x125 M 16/25	
l	156	156	
t_{fix}	50	25	
thread	M 12	M 16	
SW	19	24	
drill FZUB	18 x 130	22 x 125	

Dimensions in stock:
Fixing systems: pg. 670

Article 88589 FZA ST

FISCHER ZYKON anchors for fixing step irons FZA ST
building materials: BN, VD



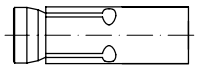
Dimensions	14/40	14/60
t_{fix}	30	30
thread	M 10	M 10
SW	16	16
drill FZUB	14 x 40	14 x 60

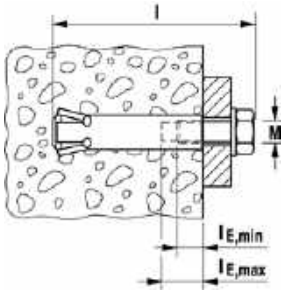
Dimensions in stock:
Fixing systems: pg. 670

High performance steel anchors

Article 88585 FZA-I

FISCHER ZYKON internally threaded anchors FZA-I
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tenell zone | VdS approval

ETA-98/004

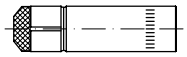
VdS approval starting from M 8

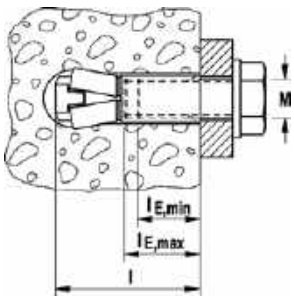
Dimensions	12x40 M 6	12x50 M 6	14x60 M 8	18 x 80 M 10	22 x 100 M 12	22 x 125 M 12
A1	M 6	M 6	M 8	M 10	M 12	M 12
$l_{E,\,min}$	10	10	11	13	15	15
$l_{E,\,max}$	15	15	17	21	25	25

Dimensions in stock:
Fixing systems: pg. 670

Article 88597 FZEA II

FISCHER ZYKON hammerset anchors FZEA II
building materials: BN, VD





ETA CE | FM approval | R120 fire resistance classification | VdS approval | Z suitable for tenell zone

ETA-06/0271

*internal thread
FM approval starting from M 10
VdS approval M 8 – M 20

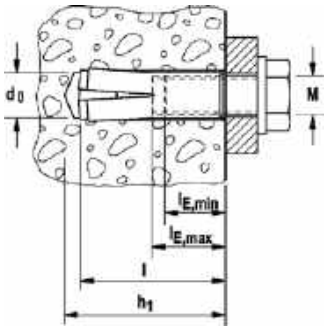
Dimensions	10x40 M 8	12x40 M 10	14x40 M 12
l	43	43	43
A1	M 8	M 10	M 12
$l_{E,\,min}$	11	13	15
$l_{E,\,max}$	17	19	21

Dimensions in stock:
Fixing systems: pg. 670

High performance steel anchors

Article 88567 EA II

FISCHER hammerset anchors EA II
building materials: BN, VD



ETA CE | R120 fire resistance classification | Z suitable for tensil zone | FM approval | VdS approval

ETA-07/0135
ETA-07/0142

FM approval starting from M 10

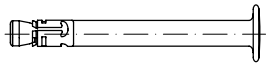
Dimensions	M 6x30	M 8x30	M 8x40	M 10x40
d_0	8	10	10	12
l	30	30	40	40
$l_{E,min}$	6	8	8	10
$l_{E,max}$	14	14	14	17
h_1	32	33	43	43

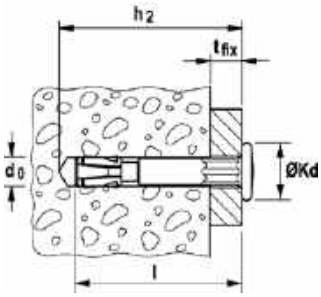
Dimensions	M 12x50	M 16x65	M 20x80	
d_0	15	20	25	
l	50	65	80	
$l_{E,min}$	12	16	20	
$l_{E,max}$	22	28	34	
h_1	54	70	85	

Dimensions in stock:
Fixing systems: pg. 671

Article 88546 FNA II

FISCHER nail anchors FNA II
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tensil zone

ETA-06/0175

Dimensions	6x25/5	6x30/5	6x30/30	6x30/50
d_0	6	6	6	6
h_2	40	45	70	90
h_{ef}	30	30	30	30
l	35	40	65	85
t_{fix}	5	5	30	50
d_K	13	13	13	13

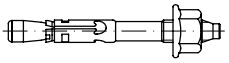
Dimensions	6x30/75	6x30/100	6x30/120	
d_0	6	6	6	
h_2	115	140	160	
h_{ef}	30	30	30	
l	110	135	155	
t_{fix}	75	100	120	
d_K	13	13	13	

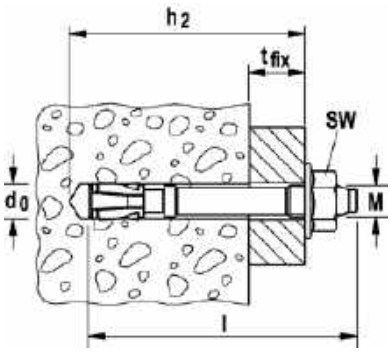
Dimensions in stock:
Fixing systems: pg. 672

High performance steel anchors

Article 88547 FNA II M

FISCHER nail anchors FNA II M
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tenail zone

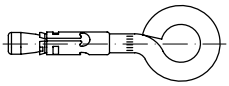
ETA-06/0175

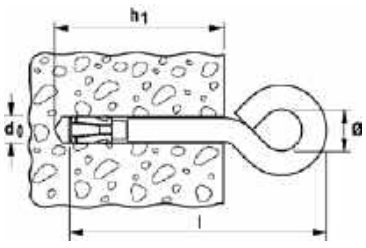
Dimensions	6x30 M 6/5
d_0	6
h_2	45
h_{ef}	30
l	50
t_{fix}	5
thread	M 6
SW	10

Dimensions in stock:
Fixing systems: pg. 672

Article 88548 FNA II-OE

FISCHER nail anchors FNA II-OE
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tenail zone

ETA-06/0175

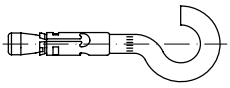
Dimensions	6x25 OE
d_0	6
h_1	35
h_{ef}	25
l	54
inner ∅ eye	10

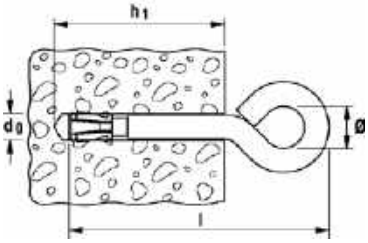
Dimensions in stock:
Fixing systems: pg. 672

High performance steel anchors

Article 88549 FNA II-H

FISCHER nail anchors FNA II-H
building materials: BN, VD





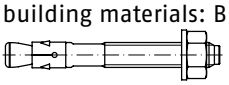
R120 fire resistance classification | Z suitable for tenell zone

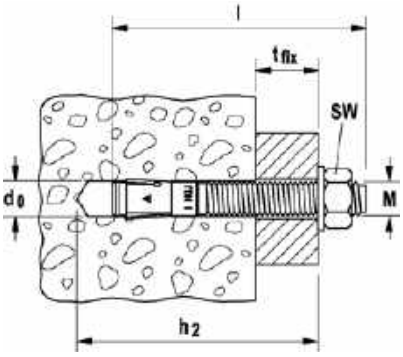
Dimensions	6x25 h
d_0	6
h_1	35
h_{ef}	25
l	54
inner ∅ hook	10

Dimensions in stock:
Fixing systems: pg. 672

Article 88582 FBN II/FBN II K

FISCHER bolt anchors FBN II/FBN II K
building materials: BN, VD





ETA CE | R120 fire resistance classification

ETA-07/0211

Dimensions	6/5	6/10	6/30	8/5	8/5 K	8/10	8/10 K	8/20	8/30	8/50
d_0	6	6	6	8	8	8	8	8	8	8
h_2	45	50	70	61	51	66	56	76	86	106
l	50	55	75	66	56	71	61	81	91	111
t_{fix}	5/-	10/-	30/-	5/15	-/5	10/20	-/10	20/30	30/40	50/60
SW	10	10	10	13	13	13	13	13	13	13

Dimensions	8/70	8/100	10/5 K	10/10	10/10 K	10/20	10/30	10/50	10/70	10/100
d_0	8	8	10	10	10	10	10	10	10	10
h_2	126	156	63	78	68	88	98	118	138	168
l	131	161	71	86	76	96	106	126	146	176
t_{fix}	70/80	100/110	-/5	10/20	-/10	20/30	30/40	50/60	70/80	100/110
SW	13	13	17	17	17	17	17	17	17	17

Dimensions	10/140	10/160	12/5 K	12/10	12/10 K	12/20	12/30	12/30 K	12/50	12/80
d_0	10	10	12	12	12	12	12	12	12	12
h_2	208	228	75	95	80	105	115	100	135	165
l	216	236	86	106	91	116	126	111	146	176
t_{fix}	140/150	160/170	-/5	10/25	-/10	20/35	30/45	-/30	50/65	80/95
SW	17	17	19	19	19	19	19	19	19	19

Dimensions	12/100	12/120	12/140	12/160	16/10	16/15 K	16/25	16/25 K	16/50	16/80
d_0	12	12	12	12	16	16	16	16	16	16
h_2	185	205	225	245	114	104	129	114	154	184
l	196	216	236	256	130	120	145	130	170	200
t_{fix}	100/115	120/135	140/155	160/175	10/25	-/15	25/40	-/25	50/65	80/95
SW	19	19	19	19	24	24	24	24	24	24

Dimensions	16/100	16/140	16/160	16/200	20/10 K	20/30	20/60	20/80	20/120	
d_0	16	16	16	16	20	20	20	20	20	
h_2	204	244	264	304	120	165	195	215	255	
l	220	260	280	320	142	187	217	237	277	
t_{fix}	100/115	140/155	160/175	200/215	-/10	30/55	60/85	80/105	120/145	
SW	24	24	24	24	30	30	30	30	30	

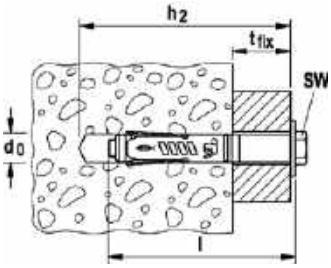
K = short version
with reduced anchor depth

Dimensions in stock:
Fixing systems: pg. 672

High performance steel anchors

Article 88683 TA M

FISCHER heavy duty anchors TA M
building materials: BN, VD



ETA CE R120 fire resistance classification

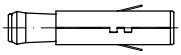
ETA-04/0003

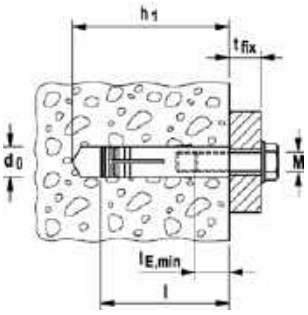
Dimensions	M 6	M 8	M 10	M 12
d_0	10	12	15	18
h_1	65	70	90	105
h_{ef}	40	45	55	70
l	49	56	69	86

Dimensions in stock:
Fixing systems: pg. 673

Article 88530 SL M/SL M-N

FISCHER heavy duty anchors SL M/SL M-N
building materials: VD





R120 fire resistance classification

ls = hef + ds + tfix
*= internal thread

Dimensions	8	10	16
d_0	12	16	24
h_1	60	70	110
h_{ef}	45	50	62
l	54	62	90
d_s*	M 8	M 10	M 16

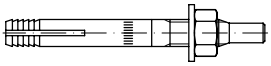
Dimensions	20	24	
d_0	30	35	
h_1	130	150	
h_{ef}	77	90	
l	110	125	
d_s*	M 20	M 24	

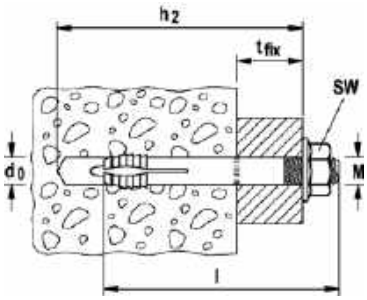
Dimensions in stock:
Fixing systems: pg. 674

High performance steel anchors

Article 88531 MR

FISCHER wall screws MR
building materials: BN



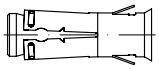


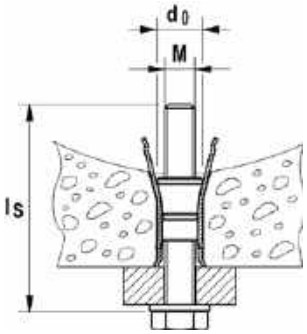
Dimensions	8	10	12
d_0	8	10	12
h_2	70	85	100
l	70	85	100
t_{fix}	22	24	27
SW	13	15	18
thread	M 8	M 10	M 12

Dimensions in stock:
Fixing systems: pg. 674

Article 88513 FHY

FISCHER hollow ceiling anchors FHY
building materials: BN





Dimensions	M 6	M 8	M 10
d_0	10	12	16
h_1	50	60	65
$l=l_{E,\,min}$	37	43	52

R120 fire resistance classification
VdS approval

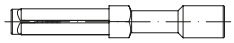
Approval only valid for zinc plated steel,
VdS approval starting from M 8

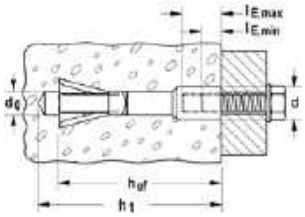
Dimensions in stock:
Fixing systems: pg. 674

High performance steel anchors

Article 88688 FPX-I

FISCHER aircrete anchors FPX-I
building materials: VP





ETA CE | R120 fire resistance classification | VdS approval

ETA-12/0456

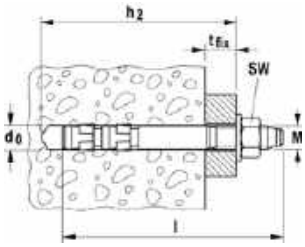
VdS-Zulassung M 8 to M 12

Dimensions	M 6	M 8	M 10	M 12
d_0	10	10	10	10
h_1	95	95	95	95
h_{ef}	70	70	70	70
l	75	75	75	75
$l_{E,\,min}$	10	8	10	12
$l_{E,\,max}$	15	15	15	15

Dimensions in stock:
Fixing systems: pg. 674

Article 88715 EXA

FISCHER bolt anchors EXA
building materials: BN, VD



Dimensions	6/5	6/10	6/40	8/5	8/15	8/28
d_0	6	6	6	8	8	8
h_2	50	70	100	60	80	95
l	50	70	100	60	85	98
t_{fix}	5	10	40	5	15	28
thread	M 6 x 17	M 6 x 17	M 6 x 17	M 8 x 22	M 8 x 22	M 8 x 22
SW	10	10	10	13	13	13

Dimensions	8/55	10/5	10/15	10/45	10/90	10/140
d_0	8	10	10	10	10	10
h_2	120	65	85	115	160	210
l	125	70	92	122	167	217
t_{fix}	55	5	15	45	90	140
thread	M 8 x 22	M 10 x 28	M 10 x 28	M 10 x 28	M 10 x 28	M 10 x 28
SW	13	17	17	17	17	17

Dimensions	10/160	12/5	12/15	12/35	12/55	12/85
d_0	10	12	12	12	12	12
h_2	230	75	105	125	145	175
l	237	76	112	132	152	182
t_{fix}	160	5	15	35	55	85
thread	M 10 x 28	M 12 x 30	M 12 x 33	M 12 x 33	M 12 x 33	M 12 x 33
SW	17	19	19	19	19	19

Dimensions	12/105	16/10	16/30	16/75	20/10	20/25
d_0	12	16	16	16	20	20
h_2	195	100	140	185	110	155
l	202	110	153	198	127	172
t_{fix}	105	10	30	75	10	25
thread	M 12 x 33	M 16 x 44	M 16 x 44	M 16 x 44	M 20 x 60	M 20 x 60
SW	19	24	24	24	30	30

Dimensions	20/80	20/220	24/40	M 8 K	M 10 K	
d_0	20	20	24	8	10	
h_2	210	350	230	50	55	
l	227	367	253	52	58	
t_{fix}	80	220	40	5	5	
thread	M 20 x 60	M 20 x 60	M 24 x 70	M 8 x 22	M 10 x 28	
SW	30	30	36	11	17	

ETA CE

ETA-05/0185

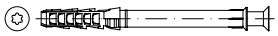
K = short version

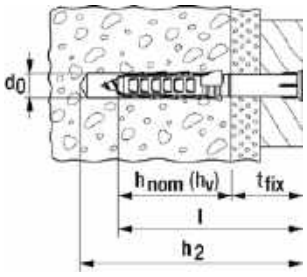
Dimensions in stock:
Fixing systems: pg. 673

Long-shaft anchors/frame fixings/adjustment fixings

Article 88542 SXR-T

FISCHER frame fixings SXR-T
building materials: BN, VD, LD, LP, BL, VP





ETA CE | R90 fire resistance classification | HF halogen free

ETA-07/0121

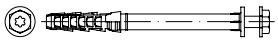
Dimensions	10x80	10x100	10x120	10x140	10x160
d_0	10	10	10	10	10
h_2	90	110	130	150	170
h_{nom} (hv)	50	50	50	50	50
l	80	100	120	140	160
t_{fix}	30	50	70	90	110
drive	T40	T40	T40	T40	T40

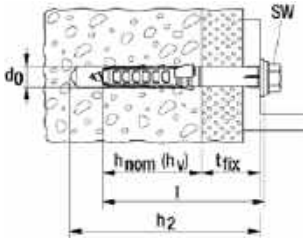
Dimensions	10x180	10x200	10x230	10x260	
d_0	10	10	10	10	
h_2	190	210	240	270	
h_{nom} (hv)	50	50	50	50	
l	180	200	230	260	
t_{fix}	130	150	180	210	
drive	T40	T40	T40	T40	

Dimensions in stock:
Fixing systems: pg. 674

Article 88542 SXR-FUS

FISCHER frame fixings SXR-FUS
building materials: BN, VD, LD, LP, BL, VP





ETA CE | R90 fire resistance classification | HF halogen free

ETA-07/0121

Dimensions	10x52	10x60	10x80	10x100	10x120	10x140
d_0	10	10	10	10	10	10
h_2	62	70	90	110	130	150
h_{nom} (hv)	50	50	50	50	50	50
l	52	60	80	100	120	140
t_{fix}	2	10	30	50	70	90
drive	T40/SW13	T40/SW13	T40/SW13	T40/SW13	T40/SW13	T40/SW13

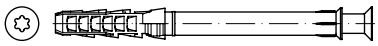
Dimensions	10x160	10x180	10x200	10x230	10x260	
d_0	10	10	10	10	10	
h_2	170	190	210	240	270	
h_{nom} (hv)	50	50	50	50	50	
l	160	180	200	230	260	
t_{fix}	110	130	150	180	210	
drive	T40/SW13	T40/SW13	T40/SW13	T40/SW13	T40/SW13	

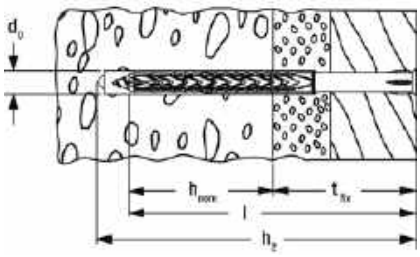
Dimensions in stock:
Fixing systems: pg. 675

Long-shaft anchors/frame fixings/adjustment fixings

Article 88551 SXRL-T

FISCHER frame fixings SXRL-T
building materials: BN, VD, LD, LP, BL, VP





ETA-07/0121
ETA-14/0297

*tfix = Useful length at anchoring depth
50 mm / 70 mm / 90 mm

Dimensions	8x80	8x100	8x120	10x80	10x100
d_0	8	8	8	10	10
h_2	90	110	130	90	110
t_{fix*}	30/10/-	50/30/10	70/50/30	30/10/-	50/30/10
l	80	100	120	80	100
drive	T30	T30	T30	T40	T40

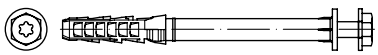
Dimensions	10x120	10x140	10x160	10x180	10x200
d_0	10	10	10	10	10
h_2	130	150	170	190	210
t_{fix*}	70/50/30	90/70/50	110/90/70	130/110/90	150/130/110
l	120	140	160	180	200
drive	T40	T40	T40	T40	T40

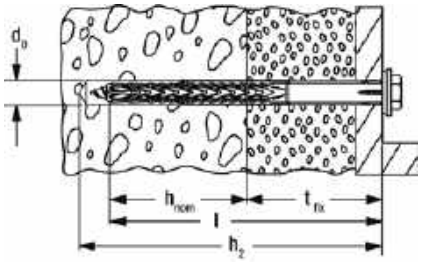
Dimensions	10x230	10x260	10x290		
d_0	10	10	10		
h_2	240	270	300		
t_{fix*}	180/160/140	210/190/170	240/220/200		
l	230	260	290		
drive	T40	T40	T40		

Dimensions in stock:
Fixing systems: pg. 675

Article 88551 SXRL-FUS

FISCHER frame fixings SXRL-FUS
building materials: BN, VD, LD, LP, BL, VP





ETA-07/0121
ETA-14/0297

*tfix = Useful length at anchoring depth
50 mm / 70 mm / 90 mm

Dimensions	8x80	8x100	8x120	10x80	10x100
d_0	8	8	8	10	10
h_2	90	110	130	90	110
t_{fix*}	30/10/-	50/30/10	70/50/30	30/10/-	50/30/10
l	80	100	120	80	100
drive	T30/SW10	T30/SW10	T30/SW10	T40/SW13	T40/SW13

Dimensions	10x120	10x140	10x160	10x180	10x200
d_0	10	10	10	10	10
h_2	130	150	170	190	210
t_{fix*}	70/50/30	90/70/50	110/90/70	130/110/90	150/130/110
l	120	140	160	180	200
drive	T40/SW13	T40/SW13	T40/SW13	T40/SW13	T40/SW13

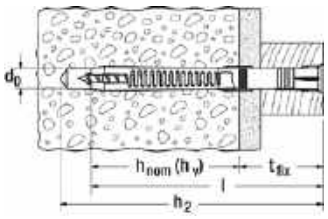
Dimensions	10x230	10x260	10x290		
d_0	10	10	10		
h_2	240	270	300		
t_{fix*}	180/160/140	210/190/170	240/220/200		
l	230	260	290		
drive	T40/SW13	T40/SW13	T40/SW13		

Dimensions in stock:
Fixing systems: pg. 675

Long-shaft anchors/frame fixings/adjustment fixings

Article 88563 FUR-T

FISCHER frame fixings FUR-T
building materials: BN, VD, LD



ETA CE · HF halogen free

ETA-13/0235

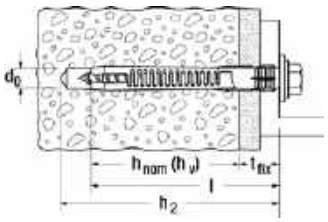
Dimensions	10x80	10x100	10x115	10x135
d_0	10	10	10	10
h_2	90	110	125	145
h_{nom} (hv)	70	70	70	70
l	80	100	115	135
t_{fix}	10	30	45	65
drive	T40	T40	T40	T40

Dimensions	10x160	10x185	10x200	10x230
d_0	10	10	10	10
h_2	170	195	210	240
h_{nom} (hv)	70	70	70	70
l	160	185	200	230
t_{fix}	90	115	130	160
drive	T40	T40	T40	T40

Dimensions in stock:
Fixing systems: pg. 676

Article 88564 FUR-SS

FISCHER frame fixings FUR-SS
building materials: BN, VD, LD



ETA CE · HF halogen free · R90 fire resistance classification

ETA-123/0235

Dimensions	10x80	10x100	10x115	10x135
d_0	10	10	10	10
h_2	90	110	125	145
h_{nom} (hv)	70	70	70	70
l	80	100	115	135
t_{fix}	10	30	45	65
SW	13	13	13	13

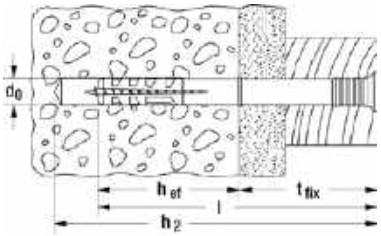
Dimensions	10x160	10x185	10x200	10x230
d_0	10	10	10	10
h_2	170	195	210	240
h_{nom} (hv)	70	70	70	70
l	160	185	200	230
t_{fix}	90	115	130	160
SW	13	13	13	13

Dimensions in stock:
Fixing systems: pg. 676

Long-shaft anchors/frame fixings/adjustment fixings

Article 88503 N-S

FISCHER nail plugs N-S
building materials: BN, VD, VP, HP, LD, LP



HF halogen free

Dimensions	5x30	5x40	5x50	6x40	6x60	6x80	8x60
d_0	5	5	5	6	6	6	8
h_2	45	55	65	55	75	95	75
h_{ef}	25	25	25	30	30	30	40
l	30	40	50	40	60	80	60
t_{fix}	5	15	25	10	30	50	20

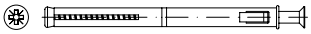
Dimensions	8x80	8x100	8x120	10x100	10x135	10x160	10x230
d_0	8	8	8	10	10	10	10
h_2	95	115	135	115	150	175	245
h_{ef}	40	40	40	50	50	50	50
l	80	100	120	100	135	160	230
t_{fix}	40	60	80	50	85	110	180

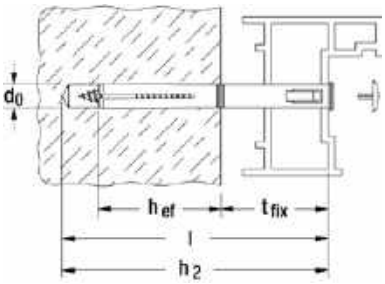
delivery ∅ 5, 6, 8 mounted pre-finished

Dimensions in stock:
Fixing systems: pg. 676

Article 88516 F-S

FISCHER frame fixings F-S
building materials: BN, VD, VP, BL, HP, LP





HF halogen free

Dimensions	F 8 S 100	F 8 S 120	F 8 S 140	F 10 S 75
d_0	8	8	8	10
h_2	115	135	155	90
h_{ef}	40	40	40	50
l	100	120	140	75
t_{fix}	50	70	90	15

Dimensions	F 10 S 100	F 10 S 120	F 10 S 140	F 10 S 165
d_0	10	10	10	10
h_2	115	135	155	180
h_{ef}	50	50	50	50
l	100	120	140	165
t_{fix}	40	60	80	105

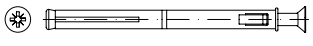
screw head ∅ 10 mm/∅ 12 mm

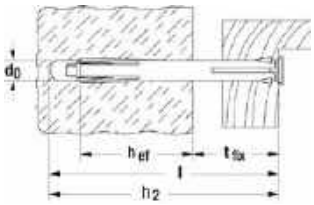
Dimensions in stock:
Fixing systems: pg. 677

Long-shaft anchors/frame fixings/adjustment fixings

Article 88680 F-M

FISCHER metal frame fixings F-M
building materials: BN, VD, VP, BL, HP





F120 fire resistance classification

Screw head ∅ 9 mm/∅ 13 mm

Dimensions	F 8 M 72	F 8 M 92	F 8 M 112	F 8 M 132
d_0	8	8	8	8
h_2	90	110	130	150
h_{ef}	30	30	30	30
l	72	92	112	132
t_{fix}	42	62	82	102

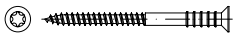
Dimensions	F 10 M 72	F 10 M 92	F 10 M 112	F 10 M 132
d_0	10	10	10	10
h_2	90	110	130	150
h_{ef}	30	30	30	30
l	72	92	112	132
t_{fix}	42	62	82	102

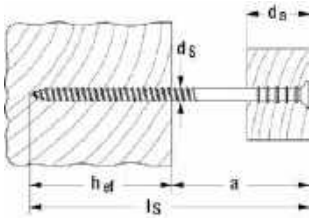
Dimensions	F 10 M 152	F 10 M 182	F 10 M 202	
d_0	10	10	10	
h_2	170	200	220	
h_{ef}	30	30	30	
l	152	182	202	
t_{fix}	122	152	172	

Dimensions in stock:
Fixing systems: pg. 677

Article 88515 JUSS

FISCHER adjustment screws JUSS
building materials: Wood and wood materials





Dimensions	6x60	6x70	6x80	6x90
h_{ef}	30	30	30	30
a	30	40	50	60
$d_s x l_s$	6x60	6x70	6x80	6x90
d_a	20	25	25	25
drive	T25	T25	T25	T25

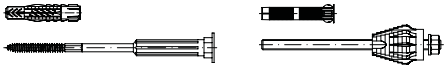
Dimensions	6x100	6x110	6x120	6x145
h_{ef}	30	30	30	30
a	70	80	90	115
$d_s x l_s$	6x100	6x110	6x120	6x145
d_a	25	25	25	25
drive	T25	T25	T25	T25

Dimensions in stock:
Fixing systems: pg. 677

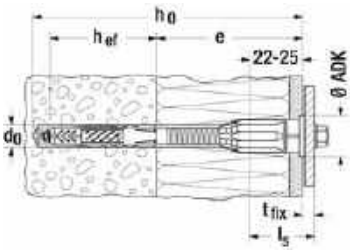
Long-shaft anchors/frame fixings/adjustment fixings

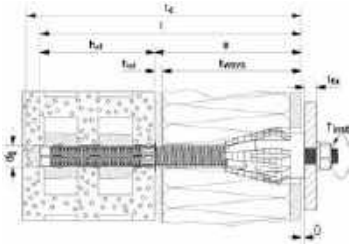
Article 88695 Thermax

FISCHER stand-off installation Thermax
building materials: BN, BL, VD, LD, VP, LP



8/10 12/16





Z suitable for tenell zone

Dimensions	8/80 M 6	8/100 M 6	8/120 M 6	8/140 M 6	8/160 M 6	10/120 M 8	10/140 M 10
d_0	10	10	10	10	10	12	12
h_0	140	160	180	200	220	180	200
e	60 - 80	80 - 100	100 - 120	120 - 140	140 - 160	100 - 120	120 - 140
h_{ef}	60	60	60	60	60	70	70
ADK	18	18	18	18	18	22	22
SW	10	10	10	10	10	13	13

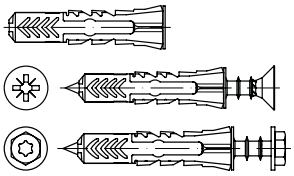
Dimensions	10/160 M 8	10/160 M 10	10/180 M 6	10/200 M 8	10/200 M 10	10/240 M 8	
d_0	12	12	12	12	12	12	
h_0	220	220	240	260	260	300	
e	140 - 160	140 - 160	160 - 180	180 - 200	180 - 200	220 - 240	
h_{ef}	70	70	70	70	70	70	
ADK	22	22	22	22	22	22	
SW	13	13	13	13	13	13	

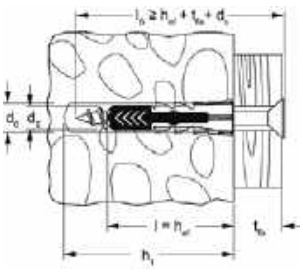
Dimensions	12/110 M 12				16/170 M 12			
building material	BN	VD	LD	BL	BN	VD	LD	BL
d_0	14	14	20	14	18	18	20	18
h_{ef}	70	80	130	100	80	80	200	100
t_d	h_{ef} + e	h_{ef} + e	h_{ef}+e+10mm	h_{ef} + e	h_{ef} + e	h_{ef} + e	h_{ef}+e+10mm	h_{ef} + e
e	62 - 170	62 - 160	62 - 110	62 - 140	62 - 290	62 - 290	62 - 170	62 - 270
t_{fix}	16	16	16	16	16	16	16	16
l	240	240	240	240	370	370	370	370

Dimensions in stock:
Fixing systems: pg. 681

Article 88690 DUOPOWER

FISCHER plugs DUOPOWER
building materials: BN, BL, VD, LD, VP, LP, HP





HF halogen free

Dimensions	5x25	5x25 S*	6x30	6x30 S*	6x50	8x40	8x40 S*
d_0	5	5	6	6	6	8	8
h_1	35	40	40	45	60	50	65
d_p	12.5	12.5	12.5	12.5	12.5	12.5	12.5
$l_{E.\,min}$	29	29	35	35	55	46	45
l	25	25	30	30	50	40	40
d_s / d_s x l_s	3 - 4	4 x 35	4 - 5	4.5 x 40	4 - 5	4.5 - 6	5 x 60
drive	-	PZ2	-	PZ2	-	-	PZ2
t_{fix}	-	6	-	5	-	-	15

Dimensions	8x65	10x50	10x50 S**	10x80	12x60	14x70	
d_0	8	10	10	10	12	14	
h_1	75	70	74	100	80	90	
d_p	2 x 12.5	12.5	12.5	-	-	-	
$l_{E.\,min}$	71	58	57	88	70	82	
l	65	50	50	80	60	70	
d_s / d_s x l_s	4.5 - 6	6 - 8	7 x 69	6 - 8	8 - 10	10 - 12	
drive	-	-	SW13/T40	-	-	-	
t_{fix}	-	-	13	-	-	-	

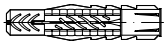
*with countersunk bolt
**with hexagon head bolt

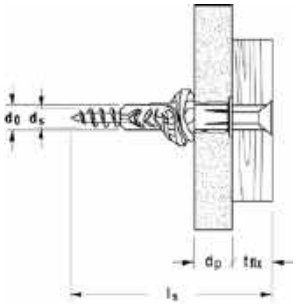
Dimensions in stock:
Fixing systems: pg. 678

General fixings

Article 88520 UX

FISCHER universal plugs UX
building materials: BN, BL, VD, LD, VP, LP, HP





HF halogen free

ls = l + dp + tfix + ds

*also with border

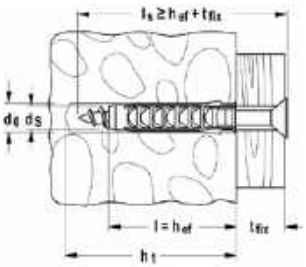
Dimensions	5x30*	6x35*	6x50*	8x40*
d_0	5	6	6	8
h_1	40	45	60	50
d_p	9.5	9.5	9.5	9.5
l	30	35	50	40
d_s	3 - 4	4 - 5	4 - 5	4.5 - 6

Dimensions	8x50*	10x60*	12x70	14x75
d_0	8	10	12	14
h_1	60	75	85	95
d_p	9.5	12.5	-	-
l	50	60	70	75
d_s	4.5 - 6	6 - 8	8 - 10	10 - 12

Dimensions in stock:
Fixing systems: pg. 677

Article 88554 SX

FISCHER expansion plugs SX
building materials: BN, VD, VP, BL, HP, LP, LD



HF halogen free

*with screw

Dimensions	4x20	5x25	6x30	6x30 S/10*	6x50	8x40
d_0	4	5	6	6	6	8
h_1	25	35	40	45	60	50
$l = h_{ef}$	20	25	30	30	50	40
d_s	2 - 3	3 - 4	4 - 5	4.5x40	4 - 5	4.5 - 6

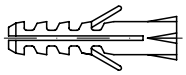
Dimensions	8x40 S/20*	8x65	10x50	12x60	14x70	16x80
d_0	8	8	10	12	14	16
h_1	65	75	70	80	90	100
$l = h_{ef}$	40	65	50	60	70	80
d_s	5x60	4.5 - 6	6 - 8	8 - 10	10 - 12	12 (1/2")

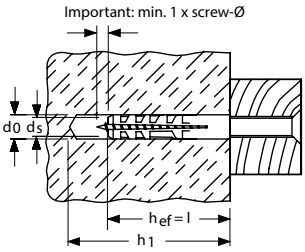
Dimensions in stock:
Fixing systems: pg. 678

General fixings

Article 88500 S

FISCHER expansion plugs S
building materials: BN, VD, VP





HF halogen free

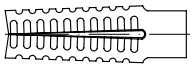
Dimensions	4	5	6	8	10
d_0	4	5	6	8	10
h_1	25	35	40	55	70
l	20	25	30	40	50
d_s	2 - 3	3 - 4	4 - 5	4.5 - 6	6 - 8

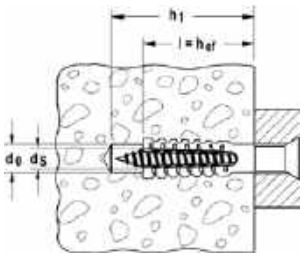
Dimensions	12	14	16	20	
d_0	12	14	16	20	
h_1	80	90	100	120	
l	60	75	80	90	
d_s	8 - 10	10 - 12	12 (1/2")	16	

Dimensions in stock:
Fixing systems: pg. 678

Article 88545 FMD

FISCHER steel expansion plugs FMD
building materials: BN, VD, VP, BL, HP, LP, LD





Dimensions	6x32	8x38	8x60	10x60
d_0*	6 - 7	10 - 12	10 -12	12 - 14
l	32	38	60	60
h_1	38	46	68	68
d_s	5 - 6	6 - 8	6 - 8	8 - 10

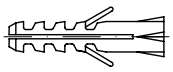
*the higher the building material pressure resistance the larger the drill diameter

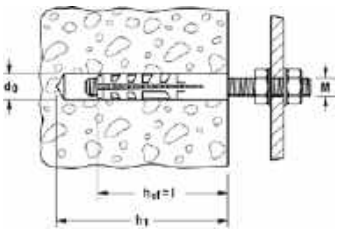
Dimensions in stock:
Fixing systems: pg. 678

General fixings

Article 88506 M-S

FISCHER expansion plugs M-S
building materials: BN, VD, VP, HP, LP, LD, BL





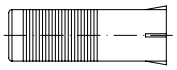
HF halogen free

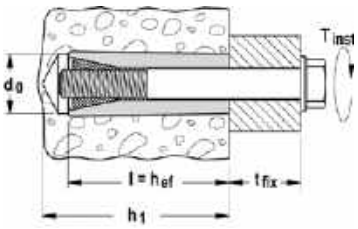
Dimensions	6	8	10	12
d_0	8	10	14	16
h_1	55	70	90	100
$l = h_{ef}$	40	50	70	80
thread	M 6	M 8	M 10	M 12

Dimensions in stock:
Fixing systems: pg. 679

Article 88510 M

FISCHER anchors M
building materials: BN, VD, VP, BL, HP





HF halogen free

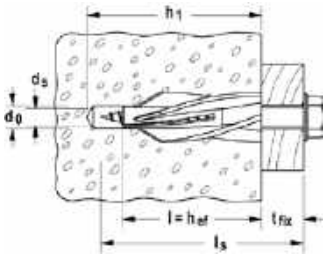
Dimensions	M 5	M 6	M 8	M 10	M 12
d_0	10	12	16	20	24
h_1	45	50	65	80	90
$l = h_{ef}$	35	40	50	60	65

Dimensions in stock:
Fixing systems: pg. 679

General fixings

Article 88507 GB

FISCHER aircrete anchors GB
building materials: VP



HF halogen free

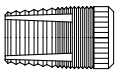
ls = hef + ds + tfix

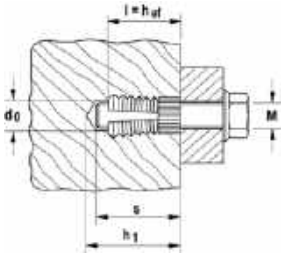
Dimensions	8	10	14
d_0	8	10	14
h_1	60	65	90
l	50	55	75
d_s x l_s	5	7	10

Dimensions in stock:
Fixing systems: pg. 679

Article 88521 PA 4

FISCHER brass fixings PA 4
building materials: BN, VD, HP





*with soft building material drill ∅ reduce by 0.5 mm

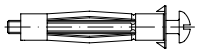
Dimensions	M 6/7.5	M 6/10.5	M 6/13.5	M 8/25	M 10/25
d_0*	8	8	8	10	12
h_1	7.5	10.5	13.5	25	25
l	7.5	10.5	13.5	25	25
thread	M 6	M 6	M 6	M 8	M 10
s	7.5	10.5	13.5	25	25

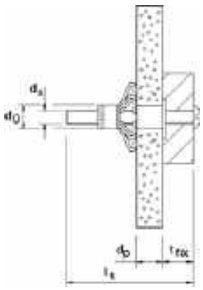
Dimensions in stock:
Fixing systems: pg. 679

Cavity fixings

Article 88512 HM-S

FISCHER cavity metal fixings HM-S
building materials: HP





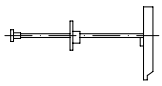
Dimensions	4x32	4x46	4x59	5x37	5x52
d_0	8	8	8	10	10
h_1	40	52	65	45	58
l	32	45	60	37	52
$d_s x l_s$	M 4x40	M 4x52	M 4x65	M 5x45	M 5x58
d_p	3 - 13	16 - 23	31 - 40	6 - 15	7 - 21
t_{fix}	≤ 15 - 25	≤ 12 - 21	≤ 12 - 21	≤ 8 - 17	≤ 10 - 24

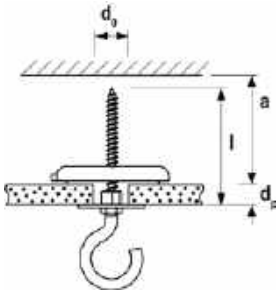
Dimensions	5x65	6x37	6x52	6x65	6x80
d_0	10	12	12	12	12
h_1	71	45	58	71	88
l	65	37	52	65	80
$d_s x l_s$	M 5x71	M 6x45	M 6x58	M 6x71	M 6x88
d_p	20 - 34	6 - 15	7 - 21	17 - 34	32 - 50
t_{fix}	≤ 12 - 26	≤ 12 - 21	≤ 14 - 28	≤ 13 - 30	≤ 16 - 34

Dimensions in stock:
Fixing systems: pg. 679

Article 88509 K 54

FISCHER toggle fixings K 54
building materials: HP, LP





HF halogen free

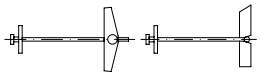
Dimensions	54
d_0	10
d_p	65
a	58
l	125
thread	wood screw 4 mm

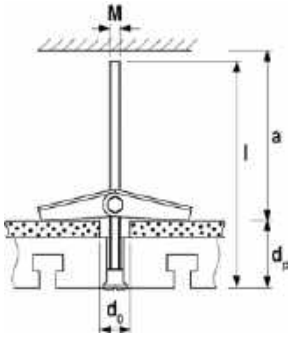
Dimensions in stock:
Fixing systems: pg. 679

Cavity fixings

Article 88518 KD

FISCHER spring toggles KD
building materials: HP, LP



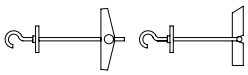


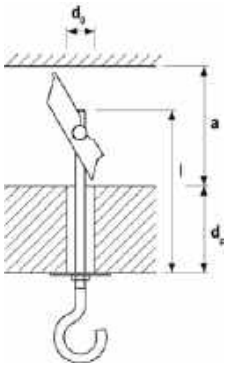
Dimensions	3	4	5	6	8
d_0	12	14	16	16	20
d_p	65	69	63	63	55
a	27	34	70	70	75
l	95	105	100	100	100
thread	M 3x90	M 4x100	M 5x100	M 6x100	M 8x100

Dimensions in stock:
Fixing systems: pg. 679

Article 88519 KDH

FISCHER spring toggles KDH
building materials: HP, LP





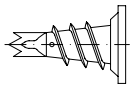
Dimensions	3	4	5	6	8
d_0	12	14	16	16	20
d_p	51	35	60	60	55
a	27	34	70	70	75
l	105	95	130	130	130
thread	M 3x80	M 4x70	M 5x90	M 6x100	M 8x100

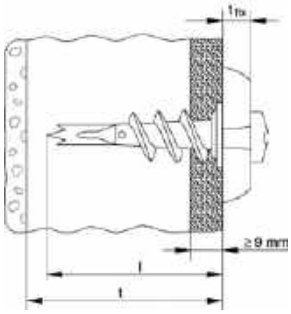
Dimensions in stock:
Fixing systems: pg. 680

Cavity fixings

Article 88598 GKM

FISCHER plasterboard fixings GKM
self-tapping thread, Pozidriv cross recess Z2
building materials: HP



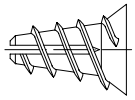


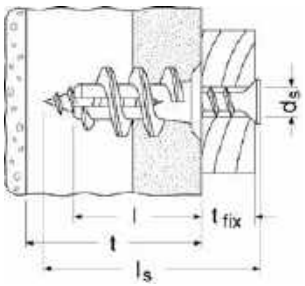
Dimensions	5
l	31
t	35
for screw diameter	4 – 5
t_{fix}	-

Dimensions in stock:
Fixing systems: pg. 680

Article 88598 GK

FISCHER plasterboard fixings GK
with setting tool
building materials: HP





HF halogen free

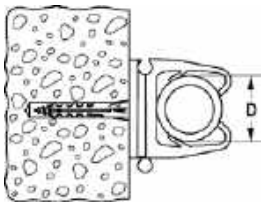
Dimensions	5
l	22
t	25
d_s	4 – 5 x ls
t_{fix}	-

Dimensions in stock:
Fixing systems: pg. 680

Electrical fixings

Article 88558 FC

FISCHER pipe clips FC
for conduits and pipes



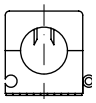
HF halogen free

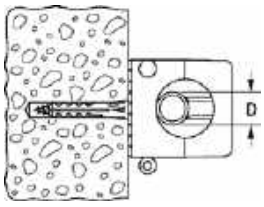
Dimensions	6 - 9	9 - 12	12 - 16	16 - 20
$d_{min.}$ - $d_{max.}$	6 - 9	9 - 12	12 - 16	16 - 20

Dimensions in stock:
Fixing systems: pg. 680

Article 88559 SCH

FISCHER saddle clips SCH
for conduits and pipes





HF halogen free

Dimensions	812*	1216**	1619**
$d_{min.}$ - $d_{max.}$	8 - 12	12 - 16	16 - 19
for WICU pipes	6x1 - 8x1	10x1 - 12x1	-

Dimensions	1623**	2332*	3242**
$d_{min.}$ - $d_{max.}$	16 - 23	23 -32	32 - 42
for WICU pipes	15x1 - 18x1	22x1 - 22x1.5	22x1 - 22x1.5

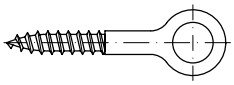
*only available in white
**available in grey or white

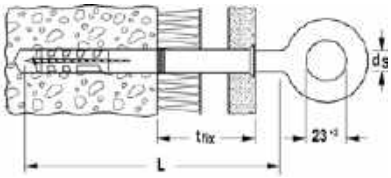
Dimensions in stock:
Fixing systems: pg. 680

Scaffold fixings

Article 88536

FISCHER scaffold eyebolts GS 12
for use with plugs S 14 ROE
building materials: BN, VD



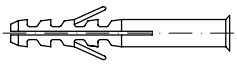


Dimensions	12x90	12x120	12x160	12x190	12x230	12x300	12x350
d_s	12	12	12	12	12	12	12
L	90	120	160	190	230	300	350
t_{fix}	15	30/10	65/45	110/70	110/70	110/70	110/70
eye ∅	23	23	23	23	23	23	23

Dimensions in stock:
Fixing systems: pg. 680

Article 88536

FISCHER plugs S 14 ROE
building materials: BN, VD



HF halogen free

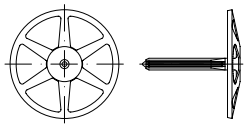
Dimensions	70	100	135	185
d_0	14	14	14	14
h_2	80	110	145	195
h_{ef}	70	70	70	70
l	70	100	135	185
t_{fix}	-	30	65	110
l + 5 mm	75	105	140	190

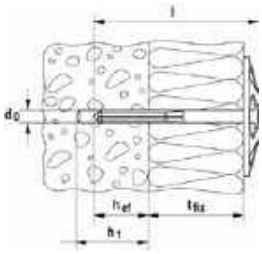
Dimensions in stock:
Fixing systems: pg. 680

Insulation supports

Article 88514 DHK

FISCHER insulation supports DHK
building materials: BN, VD, VP, BL, LP, LD





disc ∅ 90 for soft insulation

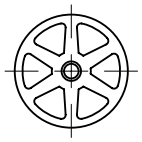
Dimensions	40	60	80	100	120
d_0	8	8	8	8	8
h_1	30	30	30	30	30
h_{ef}	20	20	20	20	20
l	65	85	105	125	145
t_{fix}	40	60	80	100	120

Dimensions	140	160	180	200	220
d_0	8	8	8	8	8
h_1	30	30	30	30	30
h_{ef}	20	20	20	20	20
l	165	185	205	225	245
t_{fix}	140	160	180	200	220

Dimensions in stock:
Fixing systems: pg. 681

Article 88580 DT

FISCHER insulation discs DT
for use with nail plug N

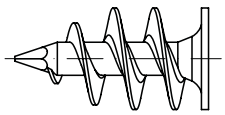


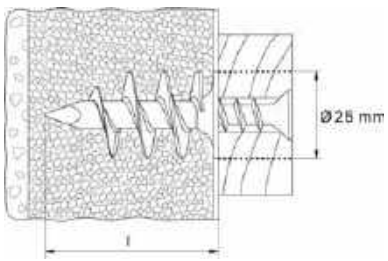
Dimensions	90/4	90/8
disc ∅	90	90
disc height	9.3	9.3
d_f	4	8.2

Dimensions in stock:
Fixing systems: pg. 681

Article 88696 FID

FISCHER insulation fixings FID
building materials: HP





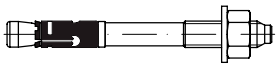
Dimensions	50	90
l	50	90
d_s	4.5 - 5	6
drive	T40	6 mm / 6-kt

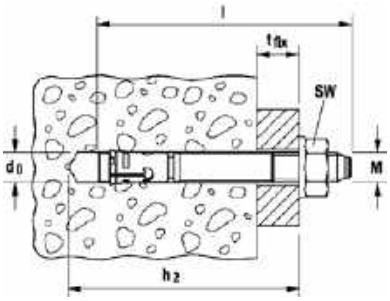
Dimensions in stock:
Fixing systems: pg. 681

High performance steel anchors

Article 88741

UPAT express anchors MAX
with 1 expanding cone, nut and washer
building materials: BN, VD





ETA CE | R120 fire resistance classification | Z suitable for tenell zone | VdS approval

ETA-10/0170

Dimensions	8/10/75	8/30/95	8/50/115	10/10/95	10/20/105	10/30/115	10/50/135
d_0	8	8	8	10	10	10	10
h_2	65	85	105	85	95	105	125
l	75	95	115	95	105	115	135
t_{fix}	10	30	50	10	20	30	50
SW	13	13	13	17	17	17	17

Dimensions	10/80/165	10/100/185	12/10/110	12/20/120	12/30/130	12/50/150	12/80/180
d_0	10	10	12	12	12	12	12
h_2	165	175	100	110	120	140	180
l	80	185	110	120	130	150	80
t_{fix}	100	100	10	20	30	50	100
SW	17	17	19	19	19	19	19

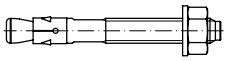
Dimensions	12/100/200	12/120/220	12/160/260	12/200/300	16/25/148	16/50/173	16/100/223
d_0	12	12	12	12	16	16	16
h_2	190	210	250	290	135	160	210
l	200	220	260	300	148	173	223
t_{fix}	100	120	160	200	25	50	100
SW	19	19	19	19	24	24	24

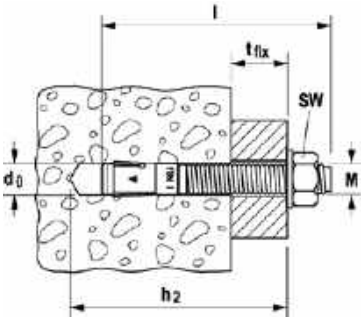
Dimensions	16/160/283	16/200/323	16/250/373	16/300/423	20/30/172	20/60/202	
d_0	16	16	16	16	20	20	
h_2	270	310	360	410	155	185	
l	283	323	373	423	172	202	
t_{fix}	160	200	250	300	30	60	
SW	24	24	24	24	30	30	

Dimensions in stock:
Fixing systems: pg. 681

Article 88764

UPAT express anchors IMC
with 1 expanding cone, nut and washer
building materials: BN, VD





ETA CE | F120 fire resistance classification

ETA-10/0169

Dimensions	6/10/55	8/5/56 K	8/5/66	8/10/71	8/20/81	8/30/91	8/50/111	8/100/161
d_0	6	8	8	8	8	8	8	8
h_2	50	51	61	66	76	86	106	156
l	55	56	66	71	81	91	111	161
t_{fix}	10/-	-/5	5/15	10/20	20/30	30/40	50/60	100/110
SW	13	13	13	13	13	13	13	13

Dimensions	10/5/71 K	10/10/86	10/20/96	10/30/106	10/50/126	10/100/176	12/5/86 K	12/10/106
d_0	10	10	10	10	10	10	12	12
h_2	63	78	88	98	118	168	75	95
l	71	86	96	106	126	176	86	106
t_{fix}	-/5	10/20	20/30	30/40	50/60	100/110	-/5	10/25
SW	17	17	17	17	17	17	19	19

Dimensions	12/20/116	12/30/126	12/50/146	12/100/196	12/120/216	12/140/236	12/160/256	12/180/276
d_0	12	12	12	12	12	12	12	12
h_2	105	115	135	185	205	225	245	265
l	116	126	146	196	216	236	256	276
t_{fix}	20/35	30/45	50/65	100/115	120/135	140/155	160/175	185/195
SW	19	19	19	19	19	19	19	19

Dimensions	12/200/296	12/250/346	16/15/120 K	16/25/145	16/50/170	16/100/220	16/140/260	16/160/280
d_0	12	12	16	16	16	16	16	16
h_2	285	335	105	129	154	204	244	264
l	296	346	120	145	170	220	260	280
t_{fix}	200/215	250/265	-/15	25/40	50/65	100/115	140/155	160/175
SW	19	19	24	24	24	24	24	24

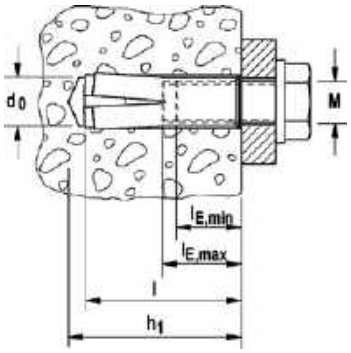
Dimensions	16/200/321	16/250/371	16/300/421	20/30/184	20/60/214			
d_0	16	16	16	20	20			
h_2	304	354	404	165	195			
l	321	371	421	184	214			
t_{fix}	200/215	250/265	300/315	30/55	60/85			
SW	24	24	24	30	30			

Dimensions in stock:
Fixing systems: pg. 682

High performance steel anchors

Article 88716

UPAT impact anchors USA
with internal thread M



ETA CE R120 fire resistance classification

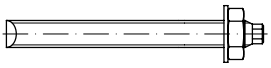
ETA-10/0172
ETA-10/0168

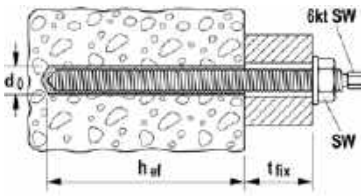
Dimensions	M 6	M 8	M 8x40	M 10	M 12	M 16	M 20
d_0	8	10	10	12	15	20	25
$l = h_{ef}$	30	30	40	40	50	65	80
$l_{E,min}$. $l_{E,min}$.	6	8	8	10	12	16	20
$l_{E,min}$. $l_{E,max}$.	13	13	13	17	22	28	34
h_1	32	33	43	43	54	70	85

Dimensions in stock:
Fixing systems: pg. 682

Article 88722

UPAT threaded rods UKA 3-ASTA
with nut and washer





ETA CE F120 fire resistance classification

for use with UKA 3-cartridges and injection mortar UPM 55, UPM 44, UPM 33

Dimensions	M 8x110	M 8x150	M 8x190	M 10x130	M 10x165	M 10x190
d_0	10	10	10	12	12	12
t_{fix}	13	60	96	20	57	82
h_{ef}	80	80	80	90	90	90
wrench size hexagon	5	5	5	5	7	7

Dimensions	M 12x160	M 12x180	M 12x220	M 12x250	M 12x300	M 14x170
d_0	14	14	14	14	14	16
t_{fix}	25	50	90	120	170	38
h_{ef}	110	110	110	110	110	120
wrench size hexagon	8	8	8	8	8	10

Dimensions	M 16x165	M 16x190	M 16x250	M 16x300	M 20x220	M 20x260
d_0	18	18	18	188	25	25
t_{fix}	13	35	98	148	30	65
h_{ef}	125	125	125	125	170	170
wrench size hexagon	12	12	12	12	12	12

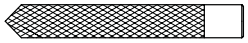
Dimensions	M 20x300	M 20x350	M 22x280	M 24x300	M 27x340	M 30x380
d_0	25	25	30	28	32	35
t_{fix}	105	155	65	65	60	65
h_{ef}	170	170	210	210	250	280
wrench size hexagon	12	12	12	-	-	-

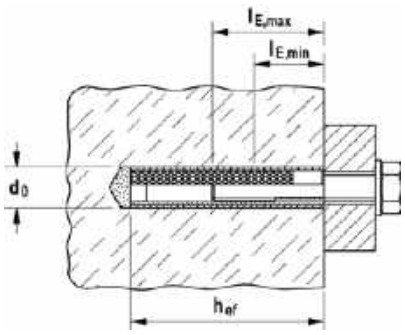
Dimensions in stock:
Fixing systems: pg. 683

High performance steel anchors – Chemical

Article 88714

UPAT internal thread bushes UKA 3-IST





Dimensions	M 5	M 6	M 8	M 10	M 12	M 16	M 20
d_0	10	12	14	18	20	24	32
$h_{ef\ min.}$*	75/-	75/-	90/80	90/80	125/115	160/160	200/-

*steel zinc plated/A 4

Dimensions in stock:
Fixing systems: pg. 632

Article 88770

UPAT internal thread anchors UPM-I

Dimensions	M 6	M 8	M 10	M 12
d_0	14	14	18	18

d_0 = drill hole ∅

Dimensions in stock:
Fixing systems: pg. 633

Chemical fixings

Article 88735

UPAT mesh bushes UPM-SH-K

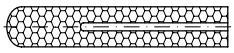
Dimensions	12	16	20
d_0	12	16	20
matching for UPM-A	M 6 - M 8	M 8 - M 10	M 12 - M 16
matching for UPM-I	-	M 6 - M 8	M 6 - M 12

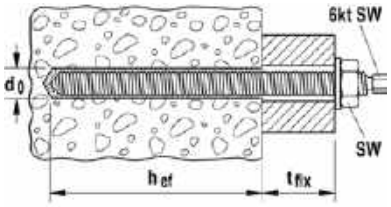
d_0 = drill hole ∅

Dimensions in stock:
Fixing systems: pg. 633

Article 88720

UPAT resin capsules UKA 3-PLUS





Dimensions	M 8	M 10	M 12	M 14	M 16
t = h_{ef}	80	90	110	120	125
matching for ASTA	M 8	M 10	M 12	M 14	M 16
matching for IST	M 5	M 6	M 8	M 10	-

Dimensions	M 20	M 22	M 24	M 27	M 30
t = h_{ef}	170	210	210	250	280
matching for ASTA	M 20	M 22	M 24	M 27	M 30
matching for IST	M 20	-	-	-	-

ETA CE | R120 fire resistance classification | Z suitable for tensil zone

ETA-17/0197

Dimensions in stock:
Fixing systems: pg. 633

The "MULTI-MONTI® fastener system" is a fast, secure, time-saving and cost-cutting screw fastening method.

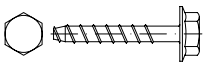
Without plugs and without expansion pressure, "MULTI-MONTI® screw anchors" can be mounted into building materials like
- Concrete, natural stone
- Lime sand brick
- Solid brick, clinker brick
- Hollow-block concrete

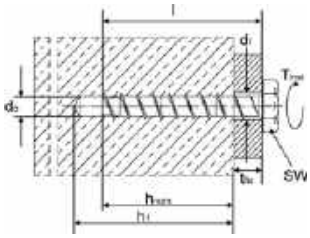
"MULTI-MONTI® screw anchors MMS-plus are well-suited to all regular standard fastenings.

REYHER ARTICLE/MULTI-MONTI® TYPE

88902

Type MMS-plus SS
Hexagon head
steel, ZP





ETA 15/0784

Z-21.1-2103

Z suitable for tenell zone

F120 fire resistance classification

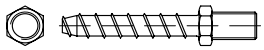
∅ x l	Wrench size hexagon	Drill ∅	Clamping length t_{fix}	Anchor depth h_{nom}	Washer-∅
6 x 40	8	5.0	5	35	11.0
6 x 50	8	5.0	5 - 15	45 - 35	11.0
6 x 60	8	5.0	15 - 25	45 - 35	11.0
6 x 80	8	5.0	35 - 45	45 - 35	11.0
7.5 x 35	10	6.0	1	35	14.0
7.5 x 40	10	6.0	5	35	14.0
7.5 x 50	10	6.0	15	35	14.0
7.5 x 60	10	6.0	5 - 25	55 - 35	14.0
7.5 x 80	10	6.0	25 - 45	55 - 35	14.0
7.5 x 100	10	6.0	45 - 65	55 - 35	14.0
7.5 x 120	10	6.0	65 - 85	55 - 35	14.0
7.5 x 140	10	6.0	85 - 105	55 - 35	14.0
10 x 60	13	8.0	10	50	19.0
10 x 70	13	8.0	5 - 20	65 - 50	19.0
10 x 80	13	8.0	15 - 30	65 - 50	19.0
10 x 100	13	8.0	35 - 50	65 - 50	19.0
10 x 120	13	8.0	55 - 70	65 - 50	19.0
10 x 140	13	8.0	75 - 90	65 - 50	19.0
10 x 160	13	8.0	95 - 110	65 - 50	19.0
12 x 80	15	10.0	5	75	22.0
12 x 90	15	10.0	1 - 15	90 - 75	22.0
12 x 100	15	10.0	10 - 25	90 - 75	22.0
12 x 120	15	10.0	30 - 45	90 - 75	22.0
12 x 140	15	10.0	50 - 65	90 - 75	22.0
12 x 160	15	10.0	70 - 85	90 - 75	22.0
16 x 120	21	14.0	5 - 20	115 - 100	30.0
16 x 130	21	14.0	15 - 30	115 - 100	30.0

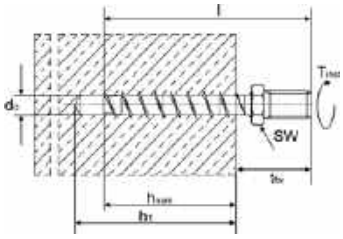
loading capacity ➔ TI-204

REYHER ARTICLE/MULTI-MONTI® TYPE

88903

Type St
Metric stud
steel. ZP





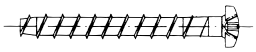
ETA CE ETA 15/0784 · Z-21.1-2103 · Z suitable for tensil zone · VdS approval · F120 fire resistance classification

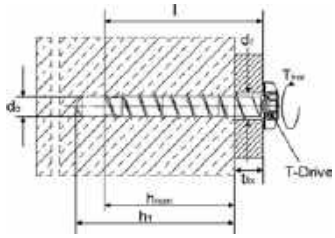
∅ x l	Wrench size hexagon	Drill ∅	Clamping length t_{fix}	Anchor depth h_{nom}	Connecting thread
6 x 55	10	5.0	10 - 20	45 - 35	M 6 x 5
6 x 65	10	5.0	20 - 30	45 - 35	M 6 x 5
7.5 x 60	10	6.0	25	35	M 8 x 14
7.5 x 70	10	6.0	35	35	M 8 x 14
7.5 x 80	10	6.0	25 - 45	55 - 35	M 8 x 14
7.5 x 100	10	6.0	45 - 65	55 - 35	M 8 x 14
7.5 x 120	10	6.0	65 - 85	55 - 35	M 8 x 14
10 x 75	13	8.0	25	50	M 10 x 11
10 x 85	13	8.0	20 - 35	65 - 50	M 10 x 11

REYHER ARTICLE/MULTI-MONTI® TYPE

88908

Type P
Pan head
steel. ZP





ETA CE ETA 15/0784 · Z-21.1-2103 · Z suitable for tensil zone · VdS approval · F120 fire resistance classification

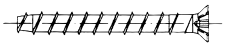
∅ x l	Drive	Drill ∅	Clamping length t_{fix}	Anchor depth h_{nom}	Head-∅
6 x 35	T30	5.0	1	35	11.2
6 x 40	T30	5.0	5	35	11.2
6 x 50	T30	5.0	5 - 15	45 - 35	11.2
6 x 60	T30	5.0	15 - 25	45 - 35	11.2
7.5 x 35	T30	6.0	1	35	14.5
7.5 x 40	T30	6.0	5	35	14.5
7.5 x 50	T30	6.0	15	35	14.5
7.5 x 60	T30	6.0	5 - 25	55 - 35	14.5
10 x 60	T40	8.0	10	50	19.5
10 x 70	T40	8.0	5 - 20	65 - 50	19.5

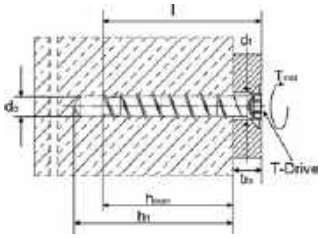
loading capacity ➔ TI-202

REYHER Article/MULTI-MONTI® TYPE

88905

Type F
Countersunk head



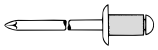


ETA CE ETA 15/0784 · Z-21.1-2103 · Z suitable for tensil zone · VdS approval · F120 fire resistance classification

∅ x l	Drive	Drill ∅	Clamping length t_{fix}	Anchor depth h_{nom}	Head-∅
6 x 40	T30	5.0	5	35	11.5
6 x 50	T30	5.0	5 - 15	45 - 35	11.5
6 x 60	T30	5.0	15 - 25	45 - 35	11.5
6 x 70	T30	5.0	25 - 35	45 - 35	11.5
6 x 80	T30	5.0	35 - 45	45 - 35	11.5
6 x 100	T30	5.0	55 - 65	45 - 35	11.5
6 x 120	T30	5.0	75 - 85	45 - 35	11.5
6 x 140	T30	5.0	95 - 105	45 - 35	11.5
7.5 x 45	T40	6.0	10	35	15.5
7.5 x 50	T40	6.0	15	35	15.5
7.5 x 60	T40	6.0	5 - 25	55 - 35	15.5
7.5 x 70	T40	6.0	15 - 35	55 - 35	15.5
7.5 x 80	T40	6.0	25 - 45	55 - 35	15.5
7.5 x 100	T40	6.0	45 - 65	55 - 35	15.5
7.5 x 120	T40	6.0	65 - 85	55 - 35	15.5
7.5 x 140	T40	6.0	85 - 105	55 - 35	15.5
7.5 x 160	T40	6.0	105 - 125	55 - 35	15.5
10 x 60	T45	8.0	10	50	19.5
10 x 70	T45	8.0	5 - 20	65 - 50	19.5
10 x 80	T45	8.0	15 - 30	65 - 50	19.5
12 x 90	T50	10.0	15	75	24.0
12 x 100	T50	10.0	10 - 25	90 - 75	24.0
12 x 120	T50	10.0	30 - 45	90 - 75	24.0

Table: Loading capacities from MULTI-MONTI®-plus screw anchors

MULTI-MONTI®-plus	∅ 6	∅ 7,5	∅ 10	∅ 12
Bricks		Approval: Z-21.1-2103		
Anchor depth	35/45	35/55	65	75
Load capacity N_{RK} [kN]	0.9/1.5	0.75/1.2	2.5	1.5
Load capacity V_{RK} [kN]	0.9/1.5	0.75/1.2	2.5	1.5
Sand-lime brick		Approval: Z-21.1-2103		
Anchor depth	35/45	35/55	65	75
Load capacity N_{RK} [kN]	1.5	0.9/1.2	0.9	0.9
Load capacity V_{RK} [kN]	1.5	0.9/1.2	0.9	0.9
Perforated sand-lime bricks		Approval: Z-21.1-2103		
Anchor depth	35/45	35/55	65	75
Load capacity N_{RK} [kN]	0.9	0.9	1.5	1.5
Load capacity V_{RK} [kN]	0.9	0.9	1.5	1.5
Lightweight concrete		Approval: Z-21.1-2103		
Anchor depth	-	-	65	75
Load capacity N_{RK} [kN]	-	-	0.75	0.75
Load capacity V_{RK} [kN]	-	-	0.75	0.75
Cracked concrete C20/25		Approval: ETA-15/0784		
Anchor depth	35/45	35/55	50/65	75/90
Admissible load capacity N_{zul} [kN]	0.5/0.7	1.0/2.0	3.0/4.4	5.9/7.9
Non-cracked concrete C20/25		Approval: ETA-15/0784		
Anchor depth	35/45	35/55	50/65	75/90
Admissible load capacity N_{zul} [kN]	2.7/4.0	2.0/7.1	5.4/8.8	10.7/14.6



Standards and standard conversion for blind rivets

For the use of blind rivets as calculable construction elements, it was necessary to normatively and uniformly regulate dimensions, mechanical properties, such as tension and shearing loads, as well as general quality-related requirements.

This was done in the national standard DIN 7337 "Blind rivets with break pull mandrel" - first publication May 1985 - amended version July 1985 - follow-up version August 1991.

DIN 7337 – August 1991 included the version: Type A protruding head and type B countersunk head. In May 1997, the version "Open rivets with break pull mandrel" included published as the intended follow-up version for DIN 7337 – August 1991 with additional type C large protruding head.

In 1997, the international and European standards, ISO and EN, adopted the standardisation of the blind rivets.

Then, the basic standards, ISO 14588 and 14589, were published in August 2001.

In April 2003, the product standards, ISO 15973-16585 followed – a separate standard for each material combination/version/type. Here, DIN 7337 incl. design were withdrawn.

For the standardised versions and higher, special types are offered for particular uses.

Standards, versions, head types	DIN 7337		ISO - standards		Reyher-article-Nr.
	Material Rivet/Mandrel	in DIN 7337	Material Rivet/Mandrel	ISO	
Basic standards:					
– "Blind rivets: Terms and definition"	–	included	–	14588	–
– "Blind rivets: Mechanical test"	–		–	14589	–
Product standards:	Al alloy/steel zinc plated	included as type A–	AlA/St.	15977	88402, 88417
– Open-end blind rivets with protruding head	steel zinc plated/steel zinc plated		St./St.	15979	88401
	Al alloy/Al alloy		AlA/AlA	15981	88410
	A 2/A 2		A 2/A 2	15983	88404
	copper/steel zinc plated		Cu/St.	16582	88406
	copper/bronze		Cu/Br	16582	88407
	–		Cu/SSt	16582	–
	NiCu/steel zinc plated		NiCu/St.	16584	–
	NiCu/A 4		NiCu/SSt	16584	88493
	–		A 2/SSt	16585	–
	A 2/steel zinc plated		–	–	88405
	A 4/A 4		–	–	88415
	Al alloy/A 2		–	–	88403
	plastic/plastic		–		88408
– Open-end blind rivets with countersunk head	Al alloy/steel zinc plated	included as type B	AlA/St.	15978	88412
	steel zinc plated/steel zinc plated		St./St.	15980	88411
	–		AlA/AlA	15982	–
	–		A 2/A 2	15984	–
	–		Cu/St.	16583	–
	–		Cu/Br	16583	–
	–		Cu/SSt	16583	–
– Open-end blind rivets with large protruding head	Al alloy/steel zinc plated	included as type C	–	–	88409
	steel zinc plated/steel zinc plated		–	–	88413
	Al alloy/Al alloy		–	–	88414
	Al alloy/A 2		–	–	88416
– Closed-end blind rivets with protruding head	Al alloy/steel phosphated	–	AlA/St.	15973	88420(CAP)
	–		Al/AlA	15975	–
	–		St./St.	15976	–
	–		A 2/SSt	16585	–
	Al alloy/A 2		–	–	88420(CAP)
	copper/steel		–	–	88420(CAP)
	copper alloy/A 2		–	–	88420(CAP)
– Closed-end blind rivets with countersunk head	–	–	AlA/St.	15974	–

For the conversion to ISO standards, production needs a certain amount of customisation/transition time. Until otherwise regulated, the article descriptions and REYHER article numbers in the article heads of this catalogue apply to the blind rivets offered. The Technical Information in the TI section of this catalogue also applies here.
For versions and/or material combinations for which standards currently do not exist, subsequent ISO standardisation or a remaining standard, DIN 7337, may have to be reckoned with.

AlA = aluminium alloy (Al alloy) – SSt = stainless steel
St. = steel (should be protected for storage – e.g. zinc plated version)

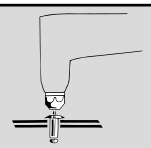
Blind rivets: Function and assembly process

Blind rivet technology was developed as a fastening procedure for hollow profiles and similar single-side access use fields.

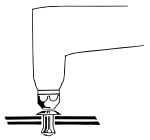
The simple, fast, and thus very economical, blind rivet principle has since replaced conventional fastening tasks in many assembly fields and is continually finding new fields of application.

REYHER has a comprehensive range of blind rivets so that a suitable design is available for every purpose.

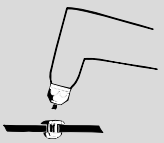
The placement devices provided are ergonomically formed and designed for long-term professional use.



The blind rivet is inserted into the drill hole from the front of the work piece. The drift pin is incorporated until the head fit from the die of the setting tool. The blind rivet size is based on load and material strength.



Through operation of the setting tool the protruding end of the rivet body is reformed through the drift pin head into a closing-head.
At the same time the materials are compressed.

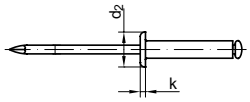


c the rivet pin is pre-programmed to snap off at the predetermined breaking point – a secure rivet fastening is completed.

Dimensions blind rivets

Open-end blind rivet with protruding head

R 88401
steel zinc plated/steel zinc plated
R 88402
Al alloy/steel zinc plated
R 88403
Al alloy/A 2
R 88404
A 2/A 2
R 88405
A 2/steel zinc plated
R 88406
copper/steel zinc plated
R 88407
copper/bronze
R 88410
Al alloy/Al alloy
R 88415
A 4/A 4
R 88417
Al alloy/steel zinc plated
R 88493
NiCu/A 4



1) A 4 ~ ISO 15983

Nominal ∅	2.4	3	3.2	4	4.8	5	6	6.4
d_2	5	6.5	6.5	8	9.5	9.5	12	13
k	0.65	1.0	1.0	1.2	1.3	1.3	1.5	1.8
drill ∅	2.5	3.1	3.3	4.1	4.9	5.1	6.1	6.5

Material rivet	Shear strength (Tensile strength)							
Al alloy (ISO 15977)	350 (550)	550 (850)	750 (1100)	1250 (1800)	1850 (2600)	2150 (3100)	3200 (4600)	3400 (4850)
Steel (ISO 15979)	650 (700)	950 (1100)	1100 (1200)	1700 (2200)	2900 (3100)	3100 (4000)	4300 (4800)	4900 (5700)
A 2, A 4[1] (ISO 15983)	–	1800 (2200)	1900 (2500)	2700 (3500)	4000 (5000)	4700 (5800)	–	–
Cu (ISO 16582)	–	760 (950)	800 (1000)	1500 (1800)	2000 (2500)	–	–	–
NiCu-Monel (ISO 16584)	–	–	1400 (1900)	2200 (3000)	3300 (3700)	–	–	5500 (6800)

Length	Clamping length range (min. – max.)							
4	0.5-1.5	0.5-1.5	0.5-1.5	–	–	–	–	–
5	–	1.5-2.5	–	0.5-1.5	–	–	–	–
6	1.5-3.5	2.5-3.5	1.5-3.5	1.5-3.0	2.0-2.5	2.0-2.5	–	–
8	3.5-5.0	4.5-5.0	3.5-5.0	4.0-5.0	2.5-4.5	2.5-4.5	2.0-3.0	–
10	–	5.0-7.0	5.0-7.0	5.0-6.5	4.5-6.0	4.5-6.0	3.0-5.0	–
12	–	7.0-9.0	7.0-9.0	6.5-8.5	6.0-8.0	6.0-8.0	5.0-7.0	2.0-6.0
14	–	9.0-11.0	9.0-11.0	8.5-10.5	8.0-10.0	8.0-10.0	–	–
16	–	11.0-13.0	11.0-13.0	10.5-12.5	10.0-12.0	10.0-12.0	7.0-11.0	6.0-10.0
18	–	13.0-15.0	13.0-15.0	10.5-12.5	12.0-14.0	12.0-14.0	11.0-13.0	10.0-12.0
20	–	15.0-17.0	15.0-17.0	14.5-16.5	14.0-15.0	14.0-15.0	13.0-15.0	12.0-14.0
25	–	17.0-22.0	17.0-22.0	16.5-21.5	15.0-20.0	15.0-20.0	15.0-20.0	14.0-18.0
30	–	22.0-26.0	–	21.5-26.0	20.0-25.0	20.0-25.0	20.0-24.0	18.0-23.0
35	–	–	–	26.0-30.0	–	25.0-30.0	24.0-29.0	–
40	–	–	–	30.0-35.0	–	30.0-35.0	29.0-34.0	–
45	–	–	–	–	–	35.0-40.0	–	–
50	–	–	–	–	–	40.0-45.0	34.0-44.0	–
60	–	–	–	–	–	48.0-52.0	–	–
65	–	–	–	–	–	52.0-57.0	–	–
70	–	–	–	–	–	57.0-62.0	–	–
80	–	–	–	–	–	62.0-72.0	–	–

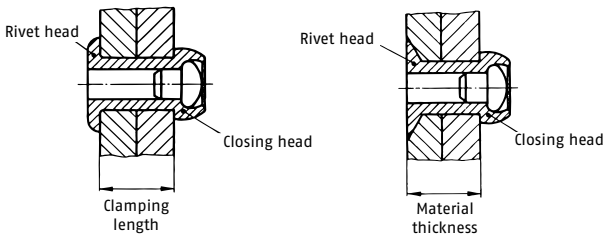
Rivet length specification:

For blind rivets with smooth rivet shafts and head types A, B, C or similar, the suitable nominal length can be set according to the rule of thumb:

Clamping length (material thickness) + 1 x rivet nom. Ø = rivet nominal length min.*

(*for interim results, the next-largest rivet length is to be chosen)

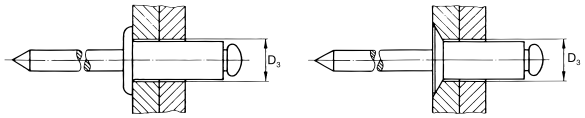
The allocation of the rivet nominal length according to clamping length/ material thickness differs minimally for standard blind rivets – between standard specifications (DIN 7337, attachment A and B) and factory specifications – according to various material combinations.



Rivet hole/Drill diameter:

For blind rivets of the types A, B or C corresponding or similar to DIN 7337 as well as for "CAP" and "PolyGrip" multi-section blind rivets, the rivet/ drill hole diameter is specified according to the following rule of thumb:

Rivet nom. Ø: d1 + 0.1 mm (tol. +0.1 mm) = Rivet hole/Drill hole Ø D3



The following applies for blind-rivet nuts:
Shaft Ø: d1/wrench size + 0.1 mm = Drill/Punch/Hole Ø D3

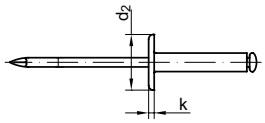
Dimensions blind rivets

Open-end blind rivets with protruding head

similar to DIN 7337-A

R 88408

plastic



Nominal Ø	4	5	6
d_2	9	11	13
k	1.2	1.5	1.5
drill Ø	4.1	5.1	6.1
Material rivet	**Shear strength min. in N (Tensile strength min. in N)**		
plastic	180 (-)	290 (-)	440 (-)
Length	**Clamping length range (min. - max.)**		
8	0.5 – 5.0	0.5 – 5.0	0.5 – 5.0
12	5.0 – 9.0	5.0 – 9.0	5.0 – 9.0

Open-end blind rivets with large protruding head

acc. to DIN 7337-C

R 88409

Al alloy/steel zinc plated

R 88413

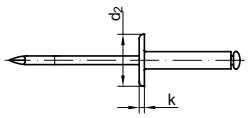
steel zinc plated

R 88414

Al alloy/Al alloy

R 88416

Al alloy/A 2



Nominal Ø	3.2	4	4.8	5
d_2	9.5	12	16	11/14
k	1.3	1.6	1.8	1.8
drill Ø	3.3	4.1	4.9	5.1
Material rivet	**Shear strength min. in N (Tensile strength min. in N)**			
Al alloy/steel	720 (950)	1400 (2000)	1800 (2700)	2000 (2800)
Length	**Clamping length range (min. – max.)**			
6	1.5 - 3.5	1.5 - 3.0	-	-
8	3.5 - 5.0	3.0 - 5.0	2.5 - 4.5	2.5 - 4.5
10	5.0 - 7.0	5.0 - 6.5	4.5 - 6.0	4.5 - 6.0
12	7.0 - 9.0	6.5 - 8.5	6.0 - 8.0	6.0 - 8.0
14	-	-	-	8.0 -10.0
16	9.0 - 13.0	8.5 - 12.5	8.0 - 12.0	10.0 - 12.0
18	-	12.5 - 16.5	-	12.0 - 14.0
20	-	-	12.0 - 15.0	14.0 - 15.0
25	-	-	15.0 - 20.0	15.0 - 20.0
30	-	-	-	20.0 - 25.0

acc. to DIN 7337

Dimensions blind rivets

Open-end blind rivets with countersunk head

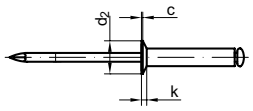
acc. to DIN 7337-B

R 88411

steel zinc plated/steel zinc plated

R 88412

Al alloy/steel zinc plated



Nominal ∅	3	4	5
d_2	6.0	7.5	9.0
k	0.9	1.0	1.2
c	0.3	0.3	0.4
drill ∅	3.1	4.1	5.1

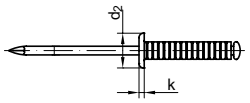
Shear strength (Tensile strenght)			
Force specifications are identical to the specifications for Article 88401 (see TI-200)			
Length	**Clamping length range (min. – max.)**		
4 St./Al.	-/1.0 – 1.5	-	-
6 St./Al.	1.0 – 3.0/1.5 – 3.5	1.0 – 2.5/1.0 – 3.0	1.0 – 2.0/-
8 St./Al.	3.0 – 5.0/3.5 – 5.0	2.5 – 4.5/3.0 – 5.0	2.0 – 4.0/2.0 – 4.5
10 St./Al.	5.0 – 6.5/5.0 – 7.0	4.5 – 6.5/5.0 – 6.5	4.0 – 6.0/4.5 – 6.0
12 St./Al.	6.5 – 8.5/7.0 – 9.0	6.5 – 8.5/6.5 – 8.5	6.0 – 8.0/6.0 – 8.0
14 St./Al.	-	-	8.0 – 9.5/-
16 St./Al.	-/9.0 – 13.0	8.5 – 12.0/8.5 – 12.5	
18 St./Al.	-	-/12.5 – 14.5	
20 St./Al.	-	12.0 – 16.0/14.5 – 16.5	
25 St./Al.	-	-	

Open-end blind rivets with grooved rivet body

for blind holes

R 88419 G

Al alloy/steel zinc plated



Nominal Ø	3,2	4
d_2	6,5	8
k	1	1,2
drill ∅	3,3	4,1

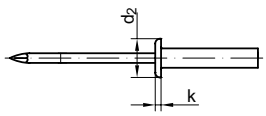
Material rivet	Shear strength min. in N (Tensile strenght min. in N)	
Al alloy	720 (950)	1400 (2000)
Length	**plate thickness (– max.)**	
8	-	4
10	6	-
12	-	8
14	-	-
16	12	12
18	-	-
20	-	-
25	-	-

Closed-end blind rivets with protruding head

for air- and water-tight riveting drill

R 88420 F

Al alloy/steel phos.
Al alloy/A 2
Cu/steel oiled
Cu/steel oiled
Cu/A 2



Dimensions	3.2	4	4.8
d_2	6	8	9.5
k	1.1	1.3	1.8
Drill ∅	3.3	4.1	4.9

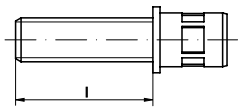
Material rivet	Shear strength min. in N (Tensile strenght min. in N)		
Al alloy (~ISO 15973)	1050 (1250)	1550 (2100)	2400 (3500)
Cu	1000 (1400)	1500 (2200)	2100 (3100)
Length	**Clamping length range (min. – max.)**		
6.5	0.5 - 2.0	-	-
7.5	1.0 – 3.0	-	-
8	1.5 - 3.0	0.5 - 3.0	1.0 - 3.0
9.5	3.0 - 5.0	3.0 - 5.0	3.0 - 5.0
10.5	5.0 - 6.5	-	-
11	4.5 - 6.5	4.5 - 6.5	4.5 - 6.5
12.5	6.0 - 8.0	6.0 - 8.0	6.0 - 8.0
14	-	-	7.5 - 9.5
16	-	-	9.0 - 11.0
18	-	-	10.5 - 13.0
21	-	-	13.0 - 16.0

Manufacturer specification

Dimensions blind rivets

Open-end blind rivets with connection thread

R 88421
steel zinc plated/steel zinc plated
> property class screw=8.8

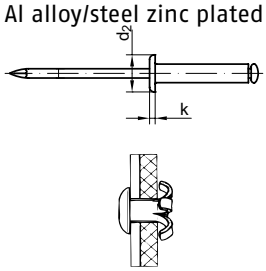


Nominal ∅	M 4	M 5	M 6	M 8
hole diam. ∅	6.1	7.1	9.1	11.1
l	10	11.5	13	15.5

Material rivet	Shear strength min. in N (Thread breaking strength min. in N)			
steel	5160 (6030)	7200 (10800)	10800 (17800)	18400 (27800)
	Clamping length range (min. – max.)			
	0.25 – 3.0	0.25 – 3.0	0.25 – 3.0	0.25 – 3.0

Open-end blind rivets with protruding head and peel rivet body

R 88422
Al alloy/steel zinc plated

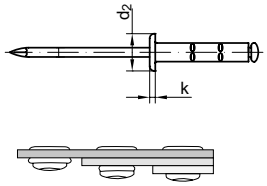


Nominal ∅	3.2	4	4.8
d_2	6.5	8	9.5
k	1	1.2	1.3
drill ∅	3.3	4.1	4.9

Material rivet	Shear strength min. in N (Tensile strength min. in N)		
Al alloy	800 (950)	1.400 (2.000)	2.000 (2.700)
Length	**Clamping length range (min. – max.)**		
8	1.0 – 3.5	1.0 – 3.0	–
10	2.5 – 5.0	2.5 – 5.0	2.5 – 5.0
12	4.5 – 7.0	4.5 – 6.5	4.5 – 7.0
14	–	6.0 – 8.0	6.5 – 9.0
16	6.5 – 11.0	7.5 – 10.0	8.5 – 10.0
18	–	9.0 – 12.0	9.5 – 12.0
20	–	11.5 – 14.0	11.5 – 14.0
25	–	–	13.5 – 19.0

Open-end blind rivets with protruding head and multigrip rivet body

R 88474
Al alloy/steel zinc plated
steel zinc plated/steel zinc plated
Al alloy/A 2
A 2/A 2
A 4/A 4



Nominal ∅	3,2	4	4,8	6,4
d_2	6.5	8	9.5	13
k	0.8	1	1.3	
drill ∅	3.3	4.1	4.9	6.5

Material rivet	Shear strength min. in N (Tensile strength min. in N)			
Al alloy	720 (1.050)	1.060 (1.680)	1.500 (2.300)	2.800 (4.000)
Steel	1.200 (1.600)	1.650 (2.400)	2.400 (3.200)	4.000 (6.100)
A 2/A 4	1.450 (2.300)	2.650 (3.600)	4.000 (5.000)	7.800 (8.800)
Length	**Clamping length range (min. – max.)**			
8	0.5 – 5.0	–	–	–
9.5	1.5 – 6.5	–	–	–
10	–	0.5 – 6.5	0.5 – 6.5	–
11	3.0 – 8.0	–	–	–
13	–	3.5 – 9.5	–	–
15	–	–	4.5 – 11.0	1.5 – 9.0
17	–	7.0 – 13.0	6.5 – 13.0	–
20	–	–	–	6.0 – 14.0
25	–	–	11.0 – 19.5	10.0 – 18.0
30	–	–	16.0 – 24.0	–

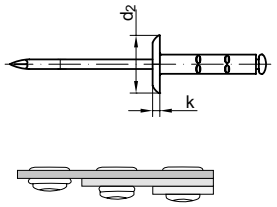
DIBt approval no. Z14.1-4 for ∅ 4.8 Al alloy/steel and Al alloy/A 2

Dimensions blind rivets

Open-end blind rivets with large protruding head and multigrip rivet body

R 88475

Al alloy/steel zinc plated
steel zinc plated/steel zinc plated
Al alloy/A 2



Nominal ∅	3.2	4	4.8
d_2	9.5	12	16
k	1.3	1.5	1.8
drill ∅	3.3	4.1	4.9

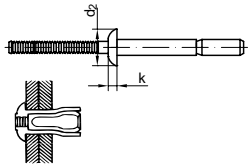
Material rivet	Shear strength min. in N (Tensile strength min. in N)		
Al alloy	720 (1.050)	1.060 (1.680)	1.600 (2.270)
steel	1.200 (1.600)	1.650 (2.400)	2.400 (3.200)

Length	Clamping length range (min. – max.)		
8	0.5 – 5.0	–	–
9.5	1.5 – 6.5	–	–
10	–	0.5 – 6.5	0.5 – 6.5
11	3.0 – 8.0	–	–
13	–	3.5 – 9.5	–
15	–	–	4.5 – 11.0
17	–	7.0 – 13.0	6.5 – 13.0
25	–	–	11.0 – 19.5
30	–	–	16.0 – 24.0

Open-end blind rivets with protruding head for high strength assembly

R 88476

steel zinc plated/steel zinc plated



Nominal ∅	4.8	6.4
d_2	9.2	12.4
k	2.2	2.6
drill ∅	4.9	6.5

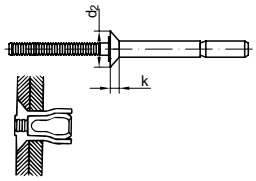
Material rivet	Shear strength min. in N (Tensile strength min. in N)	
steel	6.850 (4.500)	12.500 (8.200)

Length	Clamping length range (min. – max.)	
10.5	1.6 – 6.4	–
14.1	–	2.0 – 9.5
14.5	5.5 – 11.1	–
20.5	–	2.0 – 15.9

Open-end blind rivets with countersunk head for high strength assembly

R 88477

steel zinc plated/steel zinc plated



Nominal ∅	4.8	6.4
d_2	8.9	11
k	2.2	2.6
drill ∅	4.9	6.5

Material rivet	Shear strength min. in N (Tensile strength min. in N)	
steel	6.850 (4.500)	12.500 (8.200)

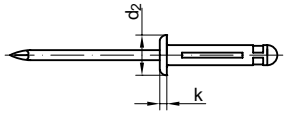
Length	Clamping length range (min. – max.)	
10.5	1.6 – 6.4	–
14.1	–	2.0 – 9.5
14.5	5.5 – 11.1	–

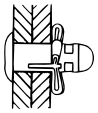
Dimensions blind rivets

Dimensions blind rivets

R 88488

Al alloy/Al alloy





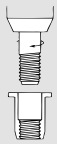
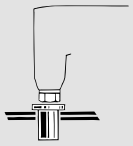
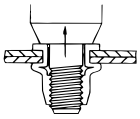
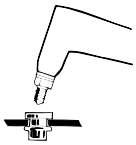
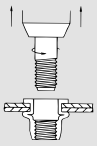
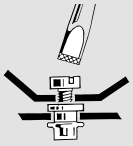
Nominal Ø	4.8
d_2	10.1
d_m	2.9
drill Ø	4.9

Material rivet	Shear strength min. in N (Tensile strength min. in N)
Al alloy	1.100 (1.400)

Length	Clamping length range (min. – max.)
22.2	4.7 – 9.5
25.4	7.9 – 12.7

Blind rivet nuts: Function and assembly process

By combining two fastening options, blind rivet nuts provide cost and quality benefits. On the one hand, a rivet fastening is made by rivetting the nuts with sheet metal and, on the other hand, a screw fastening is created. This combination makes it possible to use thin-walled component parts for which the inclusion of a thread is sometimes problematic due to the low material strength. A further advantage is that a detachable screw fastening is created without any heat impact and thus, an unchecked thermal lag in the components can be prevented. Additionally, various materials can be connected with each other.

			The blind rivet nut is screwed onto the thread mandrel and inserted into the drill hole from the front side of the workpiece. The length of the blind rivet nut is based on the material strength.
		b	By using the setting tool the blind rivet nut is reshaped, which creates a firmly-sitting, immovable thread in seconds. At the same time, materials can be pressed together in this process.
		c	After unscrewing the thread mandrel, a metric screw can be used to fasten an additional part.

The following table shows the minimum thread breaking force and guide values for a tightening torque.
The thread breaking force is determined under axial tensile load in the smallest and largest clamping range of the blind rivet nut.
The tightening torque is tested with a grease-free screw of property class 10.9 and a hardened washer as a clamping part.

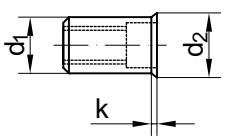
Table 1: Minimum thread breaking force and guide values for tightening torques

Thread nominal -Ø	Material	Blind rivet nuts round		Closed blind rivet nuts		Multi-range blind rivet nuts		Blind rivet nuts with hexagon	
		Thread breaking force [N]	Tightening torque [Nm]	Thread breaking force [N]	Tightening torque [Nm]	Thread breaking force [N]	Tightening torque [Nm]	Thread breaking force [N]	Tightening torque [Nm]
M 4	Steel zinc plated	6800	3	5000	3	5200	4	5200	3
	Alu	2400	2	–	–	3000	3	–	–
	A 2/A 4	5800	2.5	–	–	–	–	6800	3
M 5	Steel zinc plated	7000	6	9500	6	9500	6	10000	6
	Alu	4000	4	4300	4	4200	4	–	–
	A 2/A 4	10000	6	–	–	15000	14	10000	6
M 6	Steel zinc plated	13500	10	13000	9	15500	11	15000	12
	Alu	6000	6	6700	6	6500	6	–	–
	A 2/A 4	15000	10	–	–	25000	27	15000	10
M 8	Steel zinc plated	22000	4	21000	18	21500	24	23500	24
	Alu	10500	17.5	11000	17.5	10500	17.5	–	–
	A 2/A 4	27000	24	–	–	30000	40	28000	30
M 10	Steel zinc plated	28000	30	37000	50	–	–	–	–
	Alu	14000	28	–	–	–	–	–	–
	A 2	–	–	–	–	–	–	37000	48

Blind rivet nuts dimensions

Open blind rivet nuts with small countersunk head

R 88418
Al alloy
Steel ZP**
A 2**
A 4**



Dimensions	M 4	M 5	M 6	M 8
d_1	6	7	9	11
d_2*	7	8	10	12
k*	0.6	0.6	0.6	0.6
drill ∅	6.1	7.1	9.1	11.1

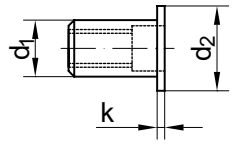
Available clamping lengths → price pages

*dimensions may vary depending on the product.
**successive conversion to curved shaft.

Blind rivet nuts dimensions

Open blind rivet nuts with protruding head

R 88423
Al alloy
Steel ZP**
A 2**
A 4**



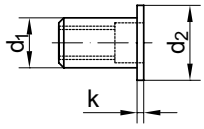
Dimensions	M 4	M 5	M 6	M 8	M 10
d_1	6	7	9	11	12
d_2*	9	10	12	15	15
k*	0.8	1	1.5	1.5	1.5
drill ∅	6.1	7.1	9.1	11.1	12.1

Available clamping lengths → price pages

Open blind rivet nuts with protruding head, with multigrip rivet body

for variable clamping length

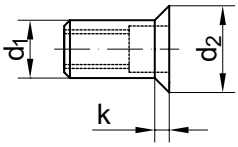
R 88490
Al alloy
Steel ZP
A 2



Dimensions	M 4	M 5	M 6	M 8
d_1	6	7	9	11
d_2*	10	11	13	16
k*	0.8	1.0	1.5	1.5
drill ∅	6.1	7.1	9.1	11.1
clamping length	0.5 – 6.0	0.5 – 6.0	0.5 – 6.0	0.5 – 7.5

Open blind rivet nuts with countersunk head

R 88424
Al alloy
Steel ZP**
A 2*
A 4*



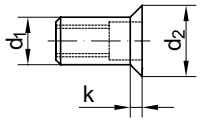
Dimensions	M 4	M 5	M 6	M 8	M 10
d_1	6	7	9	11	12
d_2	9	10	12	14	15
k	1.5	1.5	1.5	1.5	1.5
drill ∅	6.1	7.1	9.1	11.1	12.1

Available clamping lengths → price pages

Open blind rivet nuts with countersunk head, with multigrip rivet body

for variable clamping length

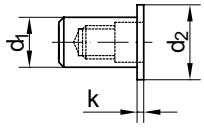
R 88491
Al alloy
Steel ZP



Dimensions	M 4	M 5	M 6	M 8
d_1	6	7	9	11
d_2*	10	11	13	16
k*	1.5	1.5	1.5	1.5
drill ∅	6.1	7.1	9.1	11.1
Clamping length	1.5 – 6.0	1.5 – 6.0	1.5 – 6.0	1.5 – 7.5

Closed blind rivet nuts with flat head

R 88480
Al alloy
Steel ZP

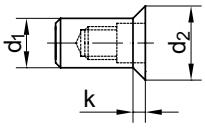


Dimensions	M 5	M 6	M 8	M 10
d_1	7	9	11	13
d_2*	11	12	15	19
k*	1.0	1.3	1.4	2.0
drill ∅	7.1	9.1	11.1	13.1

Available clamping lengths → price pages

Closed blind rivet nuts with countersunk head

R 88481
Al alloy
Steel ZP



Dimensions	M 4	M 5	M 6	M 8
d_1	6	7	9	11
d_2*	9	10	12	14
k*	1,5	1,5	1,5	1,5
drill ∅	6,1	7,1	9,1	11,1

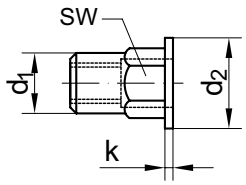
Available clamping lengths → price pages

*dimensions may vary depending on the product.
**successive conversion to curved shaft.

Blind rivet nuts dimensions

Open blind rivet nuts with hexagonal protruding head

R 88483
Steel ZP
A 2

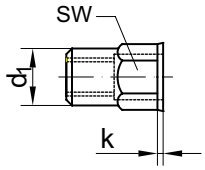


Dimensions	M 4	M 5	M 6	M 8	M 10
d_1	6	7	9	11	13
d_2*	9	10	13	16	16.5
k*	0.8	1	1.5	1.5	2.0
Hexagon size	SW 6	SW 7	SW 9	SW 11	SW 13
Mounting hole	6 +0.1	7 +0.1	9 +0.1	11 +0.1	13 +0.1

Available clamping lengths → price pages

Open blind rivet nuts with hexagonal small countersunk head

R 88484
Steel ZP
A 2



Dimensions	M 4	M 5	M 6	M 8	M 10
d_1	6	7	9	11	13
k*	0.6	0.6	0.6	0.6	0.7
Hexagon size	SW 6	SW 7	SW 9	SW 11	SW 13
Mounting hole	6 +0.1	7 +0.1	9 +0.1	11 +0.1	13 +0.1

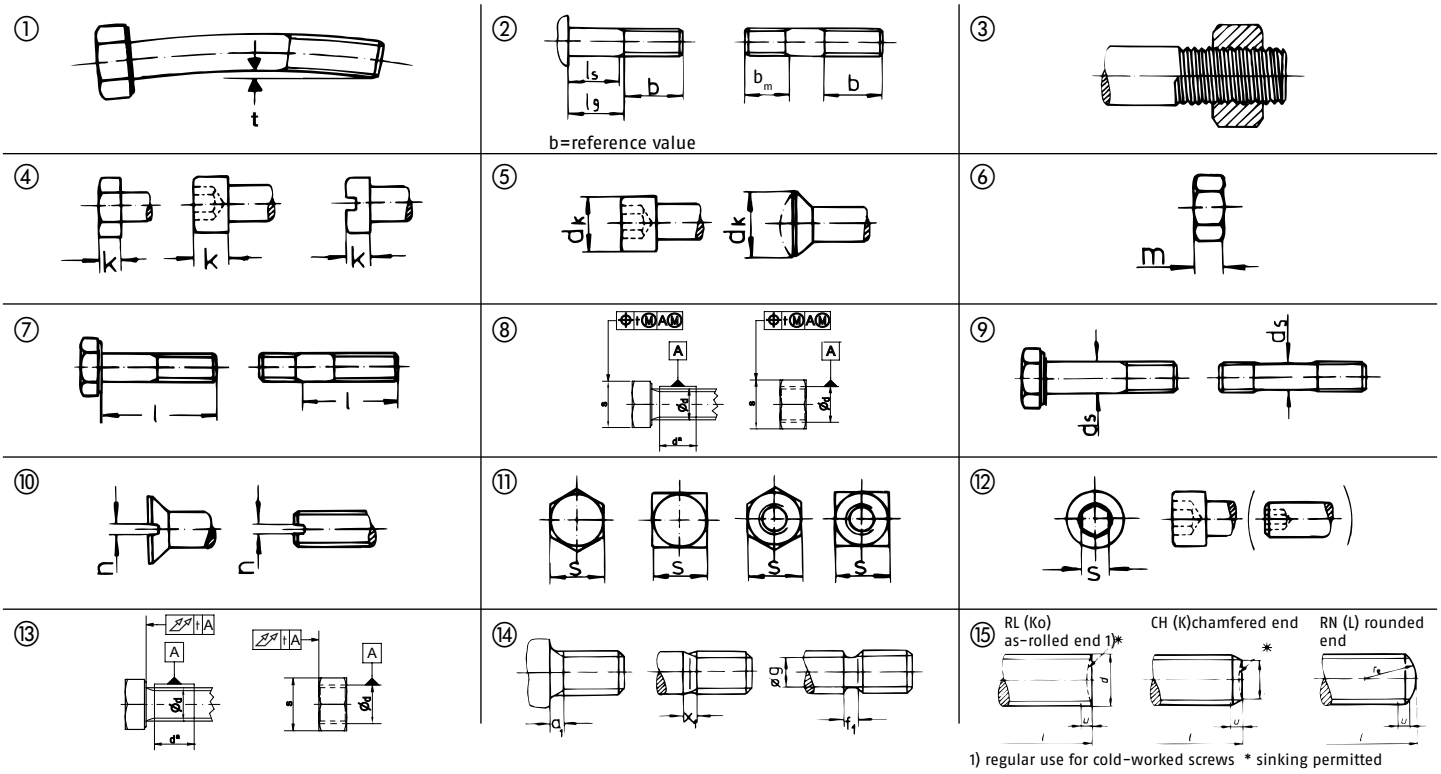
Available clamping lengths → price pages

*dimensions may vary depending on the product.


17
30

Dimensional, shape and position tolerances for screws and nuts are mainly defined in ISO 4759-1.
In addition, the following standards also define tolerances for specific requirements:

Thread runs and thread undercuts	Thread ends (→ TI-140)	Cotter pin holes	Surface roughness
• ISO 3508 • ISO 4755 • DIN 76-1	• ISO 4753 • DIN 78 • DIN 962	• ISO 7378 • DIN 34803	• DIN 267-2



	Characteristic			Dimension range	Procuct class A	Procuct class B	Procuct class C
①	Straightness (permissible deflection) (l = nominal length)		t	d ≤ 8	0,0020 l + 0,05		2x(0,0020 l + 0,05)
				d > 8	0,0025 l + 0,05		2x(0,0025 l + 0,05)
②	Thread length		b		0 bis + 2 P	0 bis + 2 P	0 bis + 2 P
	Length of metal end	Stud	b_m		js 16	js 17	js 17
③	Thread dimension	Mutter			6 H	6 H	7H
		Nut			6 g	6 g	8 g
④	Head hight	External drive	k	k < 10	js 14	js 15	js 16
				k ≥ 10			js 17
		Internal drive	k	≤ M 5	h 13	–	–
				≤ M 5	h 14	–	–
⑤	Diameter of head		d_k		h 13 (slotted screws h 14)	–	–
⑥	Nut hight		m	≤ M 12	h 14	h 14	h 17
				> M 12 ≤ M 18	h 15	h 15	h 17
				> M 18	h 16	h 16	h 17
⑦	Nominal length		l	l ≤ 150	js 15 (slotted screws l > 50 js 16)	js 17	js 17
				l > 150		js 17	2 js 17
⑧	Tolerances of position (screws)	s:d		Reference dimension for t: s	2 IT 13	2 IT 14	2 IT 15
		d_k:d		Reference dimension for t: d_k	2 IT 13	2 IT 14	2 IT 15
		n:d		Reference dimension for t: d	2 IT 12	2 IT 13	2 IT 14
	Tolerances of position (nuts)	s:d (core)		Reference dimension for t: s	2 IT 13	2 IT 14	2 IT 15
		n:d (core)		Reference dimension for t: d	2 IT 13	2 IT 14	2 IT 15

Tolerances for screws and nuts

	Characteristic			Dimension range	Product class A	Product class B	Product class C
i	**Shank diameter**		ds		h 13	h 14	± IT 15
					Reduced shank: shank diameter ~ pitch diameter		
j	**Slot width**		n	n ≤ 1	+0.20 to +0.06	–	–
				n > 1 ≤ 3	+0.31 to +0.06		
				n > 3 ≤ 6	+0.37 to +0.07		
k	**Wrench size**	**External drive**	s		s ≤ 32 = h 13 s > 32 = h 14	s ≤ 19 = h 14/s > 19 ≤ 60 = h 15 s > 60 ≤ 180 = h 16/s > 180 = h 17	
l	**Wrench size**	**Internal drive**	s		s *Tol.* *0.7 EF8* *0.9 FS9* *1.3 K9* *1.5–3 D11* *4 E11* *5–14 E12* *> 14 D12*	–	–
m	**Tolerance of total run-out t[b]** (= angularity) acc. to ISO 4759-1 article 3.2.2.3 (for screws) 4.2.2.2 (for nuts)		∢	≤ M 39	(± 1°)[a]	(± 1°)[a]	(± 2°)[a]
				> M 39	(± 1/2°)[a]	(± 1/2°)[a]	(± 1°)[a]

a) Tolerances of total run-out is conform to angular deviation of...
b) Values for t see ISO 4759-1

n						o		
External thread		a_1	x_1	g_1 (f_1)	g_2 (f_2)	u	z_1 +	z_2 +
Nominal ∅ M	Pitch P	max.	max.	min.	max.	2 p max.	IT 14	IT 14
3	0.5	1.5	1.25	1.1	1.75	1	0.75	1.5
4	0.7	2.1	1.75	1.5	2.45	1.4	1	2
5	0.8	2.4	2	1.7	2.8	1.6	1.25	2.5
6	1	3	2.5	2.1	3.5	2	1.5	3
8	1.25	3.75	3.2	2.7	4.4	2.5	2	4
10	1.5	4.5	3.8	3.2	5.2	3	2.5	5
12	1.75	5.25	4.3	3.9	6.1	3.5	3	6
14	2	6	5	4.5	7	4	3.5	7
16	2	6	5	4.5	7	4	4	8
18	2.5	7.5	6.3	5.6	8.7	5	4.5	9

n						o		
External thread		a_1	x_1	g_1 (f_1)	g_2 (f_2)	u	z_1 +	z_2 +
Nominal ∅ M	Pitch P	max.	max.	min.	max.	2 p max.	IT 14	IT 14
20	2.5	7.5	6.3	5.6	8.7	5	5	10
22	2.5	7.5	6.3	5.6	8.7	5	5.5	11
24	3	9	7.5	6.7	10.5	6	6.7	12
27	3	9	7.5	6.7	10.5	6	6.7	13.5
30	3.5	10.5	9	7.7	12	7	7.5	15
33	3.5	10.5	9	7.7	12	7	8.2	16.5
36	4	12	10	9	14	8	9	18
39	4	12	10	9	14	8	9.7	19.5
42	4.5	13.5	11	10.5	16	9	10.5	21
45	4.5	13.5	11	10.5	16	9		22.5

n = Excerpt from ISO 3508/4755 (DIN 76)
a_1 = Distance of the last full threadturn from the contact surface (for parts with threads to the head)
x_1 = Thread run-out general use
g (f) = Thread undercut general use (Type A)

o = Excerpt from ISO 4753 (DIN 78)
u = Incomplete thread at screw ends (general use for screws with rolled threading)
z_1 = Length of dog point in ISD (Ka) finish
z_2 = Length of dog point in LD (Za) finish

Surface roughness (acc. to DIN 267-2, not regulated by ISO-standard)			R_z P < 2,5 l_m = 0,4 λ_c = 0,08	R_z P ≥ 2,5 l_m = 1,25 λ_c = 0,25	R_z nach DIN 4768 Teil 1
Thread flank	Screws	rolled	6,3	10	–
		cut	16	25	–
	Nuts		25	40	–
Connecting surface	Cold forging		16	25	–
	Warm forging		25	40	–
Shank (screws)	Cold forging		–	–	50
	Warm forging		–	–	100
Visible surface			10	–	–

Dimension, form and position tolerances for washers are determined in theISO 4759-3.

For dimensions without tolerance specification applies ISO 2768 (DIN 7168) m for product class A and ISO 2768 (DIN 7168) g for product class C.

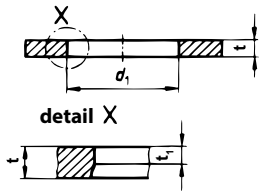
The washers shown are only examples. The information also applies for other standard and non-standard washers.

In the following tables, only the information for the standard product classes A and C.

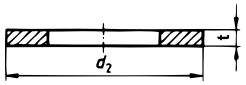
The reference measure is the information specified in the respective product standards individual measure.

Dimension tolerances

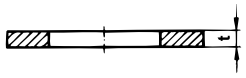
a



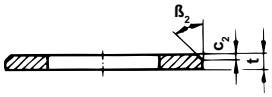
b



c

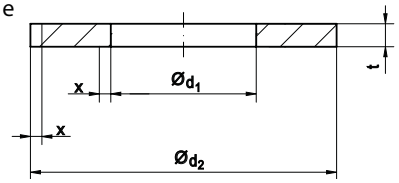


d

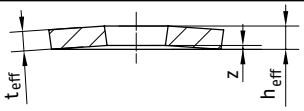


Form and position tolerances

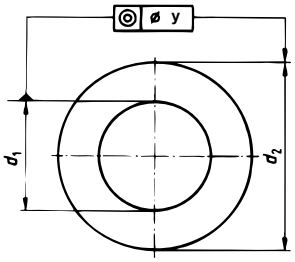
e



f



g



Dimension tolerances

Characteristic	Nominal dimension ≧	Nominal dimension <	Product class A (m)	Product class C (g)
a **Hole diameter d_1**	**t**		**d_1**	
	–	4	H 13	H 14
	4	–	H 14	H 15
* The tolerances for the hole diameter do not apply on the outbreak side ($t-t_1$).	**t**		**t_1 min.**	
	–	2	0.3t	–
	2	4	0.25t	–
	4	–	0.2t	–
b **Outside diameter d_2**	**t**		**d_2**	
	–	4	h 14	h 16
	4	–	h 15	h 16
c **Washer thickness t**	**> t ≦**		**Tol. mm**	
	–	0.5	± 0.05	± 0.10
	0.5	1.0	± 0.10	± 0.20
	1.0	2.5	± 0.20	± 0.30
	2.5	4.0	± 0.30	± 0.60
	4.0	6.0	± 0.60	± 1.00
	6.0	10	± 1.00	± 1.20
	10	20	± 1.20	± 1.60
d **Chamfer** $ß_2$ = 35 ° to 45 °	**> t ≦**		**c_2 min.**	
	1	2	0.25t	0.25t
	2	4	0.22t	0.22t
	4	–	0.20t	0.20t

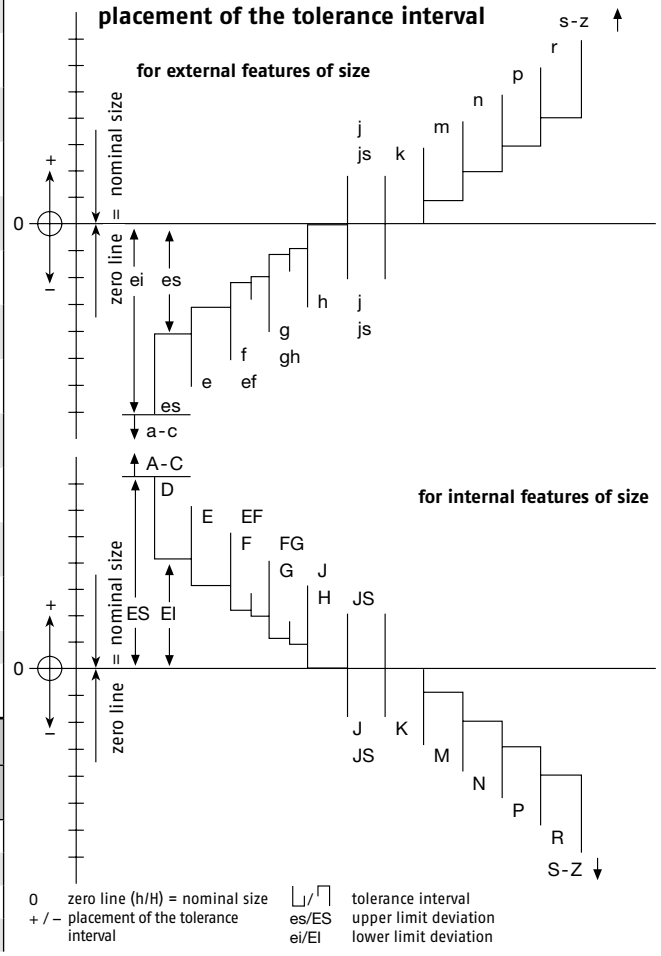
Form and position tolerances

Characteristic	Nominal dimension >	Nominal dimension ≦	Product class A (m)	Product class C (g)
e **Thickness variation on the same part**	**t**		**Δ t***	
	–	0.5	0.025	
	0.5	1.0	0.05	
	1.0	2.5	0.10	
* Δ *t* apply at a distance of x = 0.1 ($d_2 - d_1$) from the edge of the hole and the outer edge: i.e. only 60% of the ring width	2.5	4.0	0.15	–
	4.0	6.0	0.20	
	6.0	10	0.30	
	10	20	0.40	
f **Flatness**	**t**		**z**	
The flatness is determined after measured for deburring.	stainless steel excluded			
	–	0.5	0.10	
	0.5	1.0	0.15	
	1.0	2.5	0.20	–
	2.5	4.0	0.30	
	4.0	6.0	0.40	
	6.0	10	0.60	
	stainless steel			
	–	0.5	0.15	
	0.5	1	0.22	
	1	2.5	0.30	
	2.5	4	0.45	–
	4	6	0.60	
	6	10	0.90	
	10	20	1.5	
g **Coaxiality y** (Reference element for tolerance y is d_2)	**≧ t <**		y max	
	–	2	2 IT 12	2 IT 13
	2	4	2 IT 13	2 IT 14
	4	–	2 IT 14	2 IT 15

Excerpt from ISO 4759-3

Tolerances, ISO deviations

Tolerances		Nominal dimensions												
		≤ 3	> 3 ≤ 6	> 6 ≤ 10	> 10 ≤ 18	> 18 ≤ 30	> 30 ≤ 50 (40)	> 50 ≤ 80	> 80 ≤ 120	> 120 ≤ 180	> 180 ≤ 250	> 250 ≤ 315	> 315 ≤ 400	> 400 ≤ 500
IT values in mm standard tolerances	IT 12	0.10	0.12	0.15	0.18	0.21	0.25	0.30	0.35	0.40	0.46	0.52	0.57	0.63
	IT 13	0.14	0.18	0.22	0.27	0.33	0.39	0.46	0.54	0.63	0.72	0.81	0.89	0.97
	IT 14	0.25	0.30	0.36	0.43	0.52	0.62	0.74	0.87	1.00	1.15	1.30	1.40	1.55
	IT 15	0.40	0.48	0.58	0.70	0.84	1.00	1.20	1.40	1.60	1.85	2.10	2.30	2.50
	IT 16	0.60	0.75	0.90	1.10	1.30	1.60	1.90	2.20	2.60	2.90	3.20	3.60	4.00
	IT 17	1.00	1.20	1.50	1.80	2.10	2.50	3.00	3.50	4.00	4.60	5.20	5.70	6.30
for external features of size in mm	a 11	− 0.270 − 0.330	− 0.270 − 0.345	− 0.280 − 0.370	− 0.290 − 0.400	− 0.300 − 0.430	− 0.310 − 0.470							
	c 11	− 0.060 − 0.120	− 0.070 − 0.145	− 0.080 − 0.170	− 0.095 − 0.205	− 0.110 − 0.240	− 0.120 − 0.280							
	f 8	− 0.006 − 0.020	− 0.010 − 0.028	− 0.013 − 0.035	− 0.016 − 0.043	− 0.020 − 0.053	− 0.025 − 0.064	− 0.030 − 0.076	− 0.036 − 0.090	− 0.043 − 0.106	− 0.050 − 0.122	− 0.056 − 0.137	− 0.062 − 0.151	− 0.068 − 0.165
	h 8 h 9	0/− 0.014 0/− 0.025	0/− 0.018 0/− 0.030	0/− 0.022 0/− 0.036	0/− 0.027 0/− 0.043	0/− 0.033 0/− 0.052	0/− 0.039 0/− 0.062	0/− 0.046 0/− 0.074	0/− 0.054 0/− 0.087	0/− 0.063 0/− 0.100	0/− 0.072 0/− 0.115	0/− 0.081 0/− 0.130	0/− 0.089 0/− 0.140	0/− 0.097 0/− 0.155
	h 10 h 11	0/− 0.040 0/− 0.060	0/− 0.048 0/− 0.075	0/− 0.058 0/− 0.090	0/− 0.070 0/− 0.110	0/− 0.084 0/− 0.130	0/− 0.100 0/− 0.160	0/− 0.120 0/− 0.190	0/− 0.140 0/− 0.220	0/− 0.160 0/− 0.250	0/− 0.185 0/− 0.290	0/− 0.210 0/− 0.320	0/− 0.230 0/− 0.360	0/− 0.250 0/− 0.400
	h 13 h 14	0/− 0.14 0/− 0.25	0/− 0.18 0/− 0.30	0/− 0.22 0/− 0.36	0/− 0.27 0/− 0.43	0/− 0.33 0/− 0.52	0/− 0.39 0/− 0.62	0/− 0.46 0/− 0.74	0/− 0.54 0/− 0.87	0/− 0.63 0/− 1.00	0/− 0.72 0/− 1.15	0/− 0.81 0/− 1.30	0/− 0.89 0/− 1.40	0/− 0.97 0/− 1.55
	h 15 h 16	0/− 0.40 0/− 0.60	0/− 0.48 0/− 0.75	0/− 0.58 0/− 0.90	0/− 0.70 0/− 1.10	0/− 0.84 0/− 1.30	0/− 1.00 0/− 1.60	0/− 1.20 0/− 1.90	0/− 1.40 0/− 2.20	0/− 1.60 0/− 2.50	0/− 1.85 0/− 2.90	0/− 2.10 0/− 3.20	0/− 2.30 0/− 3.60	0/− 2.50 0/− 4.00
	h 17 js 14	0/− 1.00 ± 0.125	0/− 1.20 ± 0.150	0/− 1.50 ± 0.180	0/− 1.80 ± 0.215	0/− 2.10 ± 0.260	0/− 2.50 ± 0.310	0/− 3.00 ± 0.370	0/− 3.50 ± 0.435	0/− 4.00 ± 0.500	0/− 4.60 ± 0.575	0/− 5.20 ± 0.650	0/− 5.70 ± 0.700	0/− 6.30 ± 0.775
	js 15 js 16 js 17	± 0.200 ± 0.300 ± 0.500	± 0.240 ± 0.375 ± 0.600	± 0.290 ± 0.450 ± 0.750	± 0.350 ± 0.550 ± 0.900	± 0.420 ± 0.650 ± 1.050	± 0.500 ± 0.800 ± 1.250	± 0.600 ± 0.950 ± 1.500	± 0.700 ± 1.100 ± 1.750	± 0.800 ± 1.250 ± 2.000	± 0.925 ± 1.450 ± 2.300	± 1.050 ± 1.600 ± 2.600	± 1.150 ± 1.800 ± 2.850	± 1.250 ± 2.000 ± 3.150
	k 6	+ 0.006 0	+ 0.009 + 0.001	+ 0.010 + 0.001	+ 0.012 + 0.001	+ 0.015 + 0.002	+ 0.018 + 0.002							
	m 6	+ 0.008 + 0.002	+ 0.012 + 0.004	+ 0.015 + 0.006	+ 0.018 + 0.007	+ 0.021 + 0.008	+ 0.025 + 0.009							
inside dimension in mm	D 9	+ 0.045 + 0.020	+ 0.060 + 0.030	+ 0.076 + 0.040	+ 0.093 + 0.050	+ 0.117 + 0.065	+ 0.142 + 0.080							
	D 10	+ 0.060 + 0.020	+ 0.078 + 0.030	+ 0.098 + 0.040	+ 0.120 + 0.050	+ 0.149 + 0.065	+ 0.180 + 0.080							
	D 11	+ 0.080 + 0.020	+ 0.105 + 0.030	+ 0.130 + 0.040	+ 0.160 + 0.050	+ 0.195 + 0.065	+ 0.240 + 0.080							
	D 12	+ 0.120 + 0.020	+ 0.150 + 0.030	+ 0.190 + 0.040	+ 0.230 + 0.050	+ 0.275 + 0.065	+ 0.330 + 0.080							
	E 11	+ 0.074 + 0.014	+ 0.095 + 0.020	+ 0.115 + 0.025	+ 0.142 + 0.032	– –	– –							
	E 12	+ 0.100 + 0.014	+ 0.140 + 0.020	+ 0.175 + 0.025	+ 0.212 + 0.032	– –	– –							
	EF 8	+ 0.024 + 0.010	+ 0.032 + 0.014	+ 0.040 + 0.018	– –	– –	– –							
	H 9	+ 0.025 0	+ 0.030 0	+ 0.036 0	+ 0.043 0	+ 0.052 0	+ 0.062 0							
	H 11	+ 0.060 0	+ 0.075 0	+ 0.090 0	+ 0.110 0	+ 0.130 0	+ 0.160 0							
	H 13	+ 0.140 0	+ 0.180 0	+ 0.220 0	+ 0.270 0	+ 0.330 0	+ 0.390 0							
	H 14	+ 0.250 0	+ 0.300 0	+ 0.360 0	+ 0.430 0	+ 0.520 0	+ 0.620 0							
	H 15	+ 0.400 0	+ 0.480 0	+ 0.580 0	+ 0.700 0	+ 0.840 0	+ 1.000 0							
	JS 9	± 0.0125	± 0.015	± 0.018	± 0.0215	± 0.026	± 0.031							
	K 9	0 − 0.025	0 − 0.030	0 − 0.036	–	–	–							



General tolerance for linear dimensions

Tolerance class		≥ 0.5 ≤ 3	> 3 ≤ 6	> 6 ≤ 30	> 30 ≤ 120	> 120 ≤ 400	> 400 ≤ 1000
f	(fine)	± 0.050	± 0.050	± 0.100	± 0.150	± 0.200	± 0.300
m	(medium)	± 0.100	± 0.100	± 0.200	± 0.300	±0.500	± 0.800
g	(coarse)	± 0.150	± 0.200	± 0.500	± 0.800	±1.200	± 2.000
sg	(very coarse)	–	± 0.500	± 1.000	± 1.500	± 2.000	± 3.000

Excerpts from ISO 286, 965, 4759 (DIN 267-2, 7160, 7161, 7168)

Technically a thread is "a bevelled level equally wound around a cylinder".

This principle enables both a screw on/in as well as screw off function and thus forms the basic characteristic for "detachable" fastenings = screws and nuts.

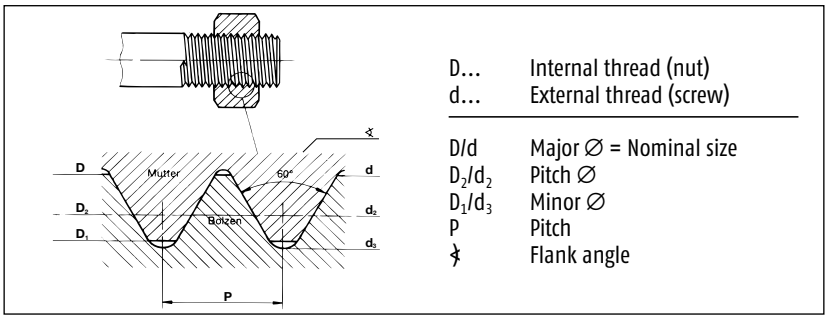
The geometric shape and the standardised dimension and tolerance system are the requirements for the coupling and exchangeability of the same kinds of thread profiles.

Thread profile, thread measuring points

The basic profile and the five measuring points of the thread are illustrated in figure A.

For external threads (screw) the dimension inspection is executed using ring gauges, flank micrometers and optical measuring devices, for internal threads (nuts), this is done using plug gauges.

Figure A:
Thread profile with 5 measuring points



Thread types

Table 1 shows an overview of the most common thread types for screws and nuts. The metric ISO thread has been valid since 1963 as a basis for global, uniform standardisation (ISO) for "Mechanical Fasteners".

Table 1: Overview of the most conventional thread types for mechanical fasteners (excerpt from DIN 202)

Code letter	Description	Version Usage		Designation Example	Flank α	acc. to Standard
M	Metric ISO thread	Coarse thread	right-hand	M 20x80	60°	ISO 724 (DIN 13-1)
M-LH		Coarse thread	left-hand	M 20x80 LH		
M		Fine thread	right-hand	M 20x2x80		ISO 724 (DIN 13-2...11)
M-LH		Fine thread	left-hand	M 20x2x80 LH		
M-SN 4	Metric ISO thread for transition fit	Interference fit thread	sealing	M 20 Sn 4x80		DIN 13-51
M-Sk 6		Interference fit thread	non-sealing	M 20 Sk 6x80		
MFS				MFS 20x80		DIN 8141-1
M	Metric thread with large clearance	Screw threads with larger thread limit deviation nut tolerance 6H		DIN 2510 M 20x80		DIN 2510-2
EG-M	Metric ISO thread: helical coil threads for inserts	External thread dimensions for thread inserts with coarse and fine threading		EG M 20 / EG M 20x2		DIN 8140-2
M-az/M-AZ	Metric ISO thread for HDG items	undersized and oversized thread for HDG external and internal threads		M 12-6az	60°	ISO 965-4 ISO 965-5
M-keg.	Metric external taper screw thread	for screw plugs and lubricating nipples		M 20x1.5 taper		DIN 158-1
G	Cylindrical Ww pipe threads where pressure-tight joints are not made on the threads	for pipes/pipe fastenings		G 3/4"	55°	ISO 228-1
R	Taper Ww piping thread where pressure-tight joints are not made on the threads	for external threads pipes/ fittings/pipe screwed fastenings		R 3/4"		DIN 2999-1 DIN 3858
Rp	Cylindrical Ww Pipe threads where pressure-tight joints are made on the thread	for internal thread pipes/ fittings/pipe screwed fastenings		Rp 3/4"		
Tr	Metric ISO trapezoidal thread (single-start and multi-start thread)	for general use		Tr 20x4	30°	ISO 2901-04
		Precision movement thread		nach Angabe		DIN 3975
Rd	Cylindrical round thread (single-start and multi-start thread)	for, e.g. flush pipe screwed fastenings		Rd 20x1/8		DIN 405-1,2
ST	Tapping screw thread			ST 4,2	60°	ISO 1478
–	Wooden screw thread			–		DIN 7998
UNC	USA: inch thread	Coarse thread		3/4-10 UNC	60°	ANSI B 1.1 B.S. 1580-1.2
UNF		Fine thread		3/4-16 UNF		
BSW	UK: inch thread	Coarse thread		3/4-10 BSW	55°	B.S. 84
BSF		Fine thread		3/4-12 BSF		

Thread manufacture

- Non-cutting production
  (= normal for large series production of screws)
  – thread rolling using profile barrels (M 2–M 30)
  – thread rolling using profile rolls ≥ M 20
- Metal-cutting production
  – cutting using profile threading die
  – thread-chasing using profile clip
  – reeling using profile threading die
  – milling, grinding (for special movement threads)

Fit of thread/threadability

For the screw-in function of internal and external threads (e.g. screw with nut), the standards are generally based on the functional quality upon assembly with the corresponding tool.

With additional thicker layers/coatings and/or required light-running clearance in the thread (manual assembly) additional measures and order information are necessary!

The basic parameters for threadability:

- **placement of tolerance**
  = Distance of the upper dimension of the external thread to the lower limit deviation of the internal thread
  ➔ Figure B
- **tolerance interval**
  („Tolerance quality")
  = Distance of lower to upper limit deviation
  (interval size es–ei/EI–ES)
- **length of thread engagement:**
  Minor form and position differences which can occur depending on the length as a kind of lead deviation are unavoidable in mass production.

  For this reason, length of thread engagement of the external thread into the internal thread for normal screw fastenings (= screw-in group N) according to ISO 965/DIN 13-14 is restricted due to pitch dependency.
  ➔ Table 3

  For higher lengths of thread engagements (L) correspondingly larger tolerance intervals are to be selected.

- **Surface discontinuities/damages to the thread**
  During thread production, small laps and/or profile deviations may occur – in the later manufacturing process (quenching and tempering, transport, drum-coating) minor damage like dents, nicks and gouges are unavoidable and make the threadability with thread gauges and mating threads more difficult.

  These manufacturing-related surface discontinuities/damages are permitted up to specific limits according to ISO 6157-1/-3 (DIN 267-19) for screws or according to ISO 6157-2 (DIN 267-20) for nuts.

  Should especially smooth-running threads be necessary for specific operating situations, either higher tolerance qualities or supplementary "smoothing rolls" with thread protection are needed.

Note: The standardised permitted stress loads for screw fastenings are valid for the tolerances assigned in the respective product standards. Understandably, increases in the tolerance placements/intervals lead to a reduction in the stress capacity in the thread.

Figure B: Placement of tolerance tolerance interval

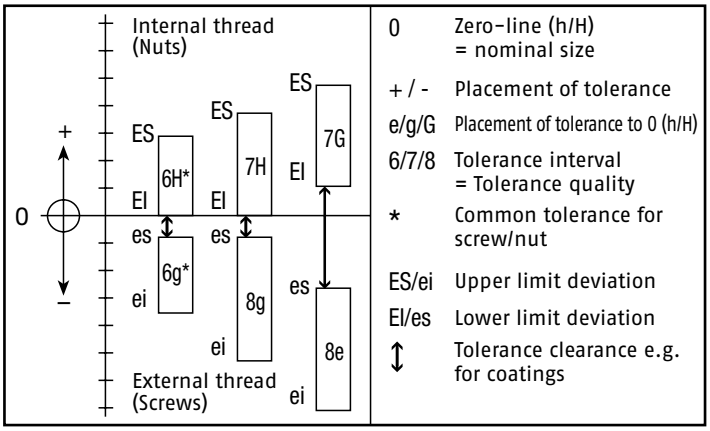


Table 2: Recommended tolerance intervals for length of thread engagement N
(before applying a corrosion protection coating*)

Tolerance class: / Thread		medium		coarse	
		Ext. thread. (screw)	Int. thread. (nut)	Ext. thread. (screw)	Int. thread (nut)
for surface condition	– without coating (plain)* – thin coatings** (electro plated)	6g*	6H*	8g*	7H*
	– with large clearance (plain) – thick coatings** (electro plated)	6e	6G	8e	7G
Article product class:		A, B (m, mg)		C (g)	
= e. g. DIN		931, 933	934	558, 601	555
ISO		4014, 4017	4032	4018, 4016	4034

* general tolerance without/before application of coatings
** ➔ TI-217, Table 8/TI-219, Table 9

Table 3: Length of thread engagement $N_{max.}$ for coarse and fine pitch thread

Nominal ∅ d/D	d/D	M 5	M 6	M 8	M 10	M 12	M 14 / M 16	M 18 / -M 22	M 24 / M 27	M 30 / M 33	M 36 / M 39	M 42 / M 45
Pitch P	RG	0.8	1	1.25	1.5	1.75	2	2.5	3	3.5	4	4.5
	FG	0.5	0.75	1	1.25	1.5	1.5	2	2	2	3	3
Length of thread engagement $N_{max.}$	RG	7.5	9	12	15	18	24	30	36	45	53	63
	FG	4.5	7.1	9	12	13	16	16	25	25	36	36

Table 4: Limit deviations A0 – AU (min. – max.) for external and internal threads (bolts/nuts) with coarse and fine pitch thread (RG/FG)
(Extracts from ISO 965-2 /DIN 13 – 20, 21, 22, 27)

				External thread (Bolts/Screws)							Internal thread (Nuts)					
Thread Nom. ∅	Pitch P		Pitch ∅ Zero-line	Tolerance	Major ∅ d		Pitch ∅ d_2		Minor ∅ d_3		Tolerance	Major ∅ D	Pitch ∅ D_2		Minor ∅ D_3	
d/D	RG	FG	h/H		max.	min.	max.	min.	max.	min.		min.	max.	min.	max.	min.
M 3	0.5		2,675	6g	2,980	2,874	2,655	2,580	2,367	2,273	6H	3,000	2,775	2,675	2,599	2,459
				6e	2,950	2,844	2,625	2,550	2,337	2,243	6G	3,020	2,795	2,695	2,619	2,479
M 4	0.7		3,545	6g	3,978	3,838	3,523	3,433	3,119	3,002	6H	4,000	3,663	3,545	3,422	3,242
				6e	3,944	3,804	3,489	3,399	3,085	2,968	6G	4,022	3,685	3,567	3,444	3,264
M 5	0.8		4,480	6g	4,976	4,826	4,456	4,361	3,995	3,869	6H	5,000	4,605	4,480	4,334	4,134
				6e	4,940	4,790	4,420	4,325	3,959	3,833	6G	5,024	4,629	4,504	4,358	4,158
M 6	1		5,350	6g	5,974	5,794	5,324	5,212	4,747	4,596	6H	6,000	5,500	5,350	5,153	4,917
				6e	5,940	5,760	5,290	5,178	4,713	4,562	6G	6,026	5,526	5,376	5,179	4,943
M 8	1.25		7,188	6g	7,972	7,760	7,160	7,042	6,438	6,272	6H	8,000	7,348	7,188	6,912	6,647
				8e	7,937	7,602	7,125	6,935	6,403	6,165	6G	8,028	7,376	7,216	6,940	6,675
		1	7,350	6g	7,974	7,794	7,324	7,212	6,747	6,596	6H	8,000	7,500	7,350	7,153	6,917
M 10	1.5		9,026	6g	9,968	9,732	8,994	8,862	8,128	7,938	6H	10,000	9,206	9,026	8,676	8,376
				8e	9,933	9,558	8,959	8,747	8,093	7,823	6G	10,032	9,238	9,058	8,708	8,408
		1.25	9,188	6g	9,972	9,760	9,160	9,042	8,438	8,272	6H	10,000	9,348	9,188	8,912	8,647
M 12	1.75		10,863	6g	11,966	11,701	10,829	10,679	9,819	9,602	6H	12,000	11,063	10,863	10,441	10,106
				8e	11,929	11,504	10,792	10,556	9,782	9,479	6G	12,034	11,097	10,897	10,475	10,140
		1.5	11,026	6g	11,968	11,732	10,994	10,854	10,128	9,930	6H	12,000	11,216	11,026	10,676	10,376
M 14	2		12,701	6g	13,962	13,682	12,663	12,503	11,508	11,271	6H	14,000	12,913	12,701	12,210	11,835
				8e	13,929	13,479	12,630	12,380	11,475	11,148	6G	14,038	12,951	12,739	12,248	11,873
		1.5	13,026	6g	13,968	13,732	12,994	12,854	12,128	11,930	6H	14,000	13,216	13,026	12,676	12,376
M 16	2		14,701	6g	15,962	15,682	14,663	14,503	13,508	13,271	6H	16,000	14,913	14,701	14,210	13,835
				8e	15,929	15,479	14,630	14,380	13,475	13,148	6G	16,038	14,951	14,739	14,248	13,873
		1.5	15,026	6g	15,968	15,732	14,994	14,854	14,128	13,930	6H	16,000	15,216	15,026	14,676	14,376
M 18	2.5		16,376	6g	17,958	17,623	16,334	16,164	14,891	14,625	6H	18,000	16,600	16,376	15,744	15,294
				8e	17,920	17,390	16,296	16,031	14,853	14,492	6G	18,042	16,642	16,418	15,786	15,336
		2	16,701	6g	17,962	17,682	16,663	16,503	15,508	15,271	6H	18,000	16,913	16,701	16,210	15,835
M 20	2.5		18,376	6g	19,958	19,623	18,334	18,164	16,891	16,625	6H	20,000	18,600	18,376	17,744	17,294
				8e	19,920	19,390	18,296	18,031	16,853	16,492	6G	20,042	18,642	18,418	17,786	17,336
		2	18,701	6g	19,962	19,682	18,663	18,503	17,508	17,271	6H	20,000	18,913	18,701	18,210	17,835
M 22	2.5		20,376	6g	21,958	21,623	20,334	20,164	18,891	18,625	6H	22,000	20,600	20,376	19,744	19,294
				8e	21,920	21,390	20,296	20,031	18,853	18,492	6G	22,042	20,642	20,418	19,786	19,336
		2	20,701	6g	21,962	21,682	20,663	20,503	19,508	19,271	6H	22,000	20,913	20,701	20,210	19,835
M 24	3		22,051	6g	23,952	23,577	22,003	21,803	20,271	19,955	6H	24,000	22,316	22,051	21,252	20,752
				8e	23,915	23,315	21,966	21,651	20,234	19,803	6G	24,048	22,364	22,099	21,300	20,800
		2	22,701	6g	23,962	23,682	22,663	22,493	21,508	21,261	6H	24,000	22,925	22,701	22,210	21,835
M 27	3		25,051	6g	26,952	26,577	25,003	24,803	23,271	22,955	6H	27,000	25,316	25,051	24,252	23,752
				8e	26,915	26,315	24,966	24,651	23,234	22,803	6G	27,048	25,364	25,099	24,300	23,800
		2	25,701	6g	26,962	26,682	25,663	25,493	24,508	24,261	6H	27,000	25,925	25,701	25,210	24,835
M 30	3.5		27,727	6g	29,947	29,522	27,674	27,462	25,653	25,306	6H	30,000	28,007	27,727	26,771	26,211
				8e	29,910	29,240	27,637	27,302	25,616	25,146	6G	30,053	28,060	27,780	26,824	26,264
		2	28,701	6g	29,952	29,577	28,003	27,803	26,271	25,955	6H	30,000	28,316	28,051	27,252	26,752
M 33	3.5		30,727	6g	32,947	32,522	30,674	30,462	28,653	28,306	6H	33,000	31,007	30,727	29,771	29,211
				8e	32,910	32,240	30,637	30,302	28,616	28,146	6G	33,053	31,060	30,780	29,824	29,264
		2	31,701	6g	32,962	32,682	31,663	31,493	30,508	30,261	6H	33,000	31,925	31,701	31,210	30,835
M 36	4		33,402	6g	35,940	35,465	33,342	33,118	31,033	30,655	6H	36,000	33,702	33,402	32,270	31,670
				8e	35,905	35,155	33,307	32,952	30,998	30,489	6G	36,060	33,762	33,462	32,330	31,730
		3	34,051	6g	35,952	35,577	34,003	33,803	32,271	31,955	6H	36,000	34,316	34,051	33,252	32,752

Table 5: Dimensions in millimeters for Ww pipe threads

Thread Nom. ∅ in mm	Zoll	1/16	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
Major ∅ in mm	d/D	7.72	9.73	13.16	16.66	20.96	26.44	33.25	41.91	47.80	59.61	75.18	87.88
Distance measuring level a		4.0	4.0	6.0	6.4	8.2	9.5	10.4	12.7	12.7	15.9	17.5	20.6

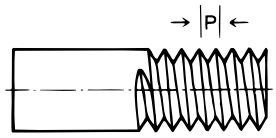
G = cylindrical external/internal thread
R = taper external thread
R_P = cylindrical internal thread
a = distance of the reference level/measuring level from the start of thread in mm

Table 6: Limit deviation for UNC and UNF threads acc. to ASME B 1.1

Thread Nom. ∅ UNC/UNF Nr.	UNC/ UNF	Pitches	Tolerances for external thread in inch Tolerance class 2A					Tolerances for internal thread in inch Tolerance class 2B				
			Major ∅	Pitch ∅		Minor ∅		Major ∅	Pitch ∅		Minor ∅	
			min.	max.	min.	max.	min.	min.	min.	max.	min.	max.
2	UNC	56	0,0813	0,0854	0,0717	0,0738	0,0641	0,0860	0,0744	0,0772	0,0667	0,0737
	UNF	64	0,0816	0,0854	0,0733	0,0753	0,0668	0,0860	0,0759	0,0786	0,0691	0,0752
3	UNC	48	0,0938	0,0983	0,0825	0,0848	0,0735	0,0990	0,0855	0,0885	0,0764	0,0845
	UNF	56	0,0942	0,0983	0,0845	0,0867	0,0770	0,0990	0,0874	0,0902	0,0797	0,0865
4	UNC	40	0,1061	0,1112	0,0925	0,0950	0,0814	0,1120	0,0958	0,0991	0,0849	0,0939
	UNF	48	0,1068	0,1113	0,0954	0,0978	0,0865	0,1120	0,0985	0,1016	0,0894	0,0968
5	UNC	40	0,1191	0,1242	0,1054	0,1080	0,0944	0,1250	0,1088	0,1121	0,0979	0,1062
	UNF	44	0,1195	0,1243	0,1070	0,1095	0,0972	0,1250	0,1102	0,1134	0,1004	0,1079
6	UNC	32	0,1312	0,1372	0,1141	0,1169	0,1000	0,1380	0,1177	0,1214	0,1040	0,1140
	UNF	40	0,1321	0,1372	0,1184	0,1210	0,1074	0,1380	0,1218	0,1252	0,1110	0,1190
8	UNC	32	0,1571	0,1631	0,1399	0,1428	0,1259	0,1640	0,1437	0,1475	0,1300	0,1390
	UNF	36	0,1577	0,1632	0,1424	0,1452	0,1301	0,1640	0,1460	0,1496	0,1340	0,1420
10	UNC	24	0,1818	0,1890	0,1586	0,1619	0,1394	0,1900	0,1629	0,1672	0,1450	0,1550
	UNF	32	0,1831	0,1891	0,1658	0,1688	0,1519	0,1900	0,1697	0,1736	0,1560	0,1640
12	UNC	24	0,2078	0,2150	0,1845	0,1879	0,1654	0,2160	0,1889	0,1933	0,1710	0,1810
	UNF	28	0,2085	0,2150	0,1886	0,1918	0,1725	0,2160	0,1928	0,1970	0,1770	0,1860
1/4	UNC	20	0,2408	0,2489	0,2127	0,2164	0,1894	0,2500	0,2175	0,2224	0,1960	0,2070
	UNF	28	0,2425	0,2490	0,2225	0,2258	0,2065	0,2500	0,2268	0,2311	0,2110	0,2200
5/16	UNC	18	0,3026	0,3113	0,2712	0,2752	0,2451	0,3125	0,2764	0,2817	0,2520	0,2650
	UNF	24	0,3042	0,3114	0,2806	0,2843	0,2618	0,3125	0,2854	0,2902	0,2670	0,2770
3/8	UNC	16	0,3643	0,3737	0,3287	0,3331	0,2993	0,3750	0,3344	0,3401	0,3070	0,3210
	UNF	24	0,3667	0,3739	0,3430	0,3468	0,3243	0,3750	0,3479	0,3528	0,3300	0,3400
7/16	UNC	14	0,4206	0,4361	0,3826	0,3897	0,3510	0,4375	0,3911	0,4003	0,3600	0,3760
	UNF	20	0,4281	0,4362	0,3995	0,4037	0,3767	0,4375	0,4050	0,4104	0,3830	0,3950
1/2	UNC	13	0,4876	0,4985	0,4435	0,4485	0,4069	0,5000	0,4500	0,4565	0,4170	0,4340
	UNF	20	0,4906	0,4987	0,4619	0,4662	0,4392	0,5000	0,4675	0,4731	0,4460	0,4570
9/16	UNC	12	0,5495	0,5609	0,5016	0,5068	0,4617	0,5625	0,5084	0,5152	0,4720	0,4900
	UNF	18	0,5524	0,5611	0,5205	0,5250	0,4949	0,5625	0,5264	0,5323	0,4050	0,5150
5/8	UNC	11	0,6112	0,6233	0,5588	0,5643	0,5150	0,6250	0,5660	0,5732	0,5270	0,5460
	UNF	18	0,6149	0,6236	0,5828	0,5875	0,5574	0,6250	0,5889	0,5949	0,5650	0,5780
3/4	UNC	10	0,7353	0,7482	0,6773	0,6832	0,6291	0,7500	0,6850	0,6927	0,6420	0,6630
	UNF	16	0,7391	0,7485	0,7029	0,7079	0,6741	0,7500	0,7094	0,7159	0,6820	0,6960
7/8	UNC	9	0,8592	0,8731	0,7946	0,8009	0,7408	0,8750	0,8028	0,8110	0,7550	0,7780
	UNF	14	0,8631	0,8734	0,8216	0,8270	0,7883	0,8750	0,8286	0,8356	0,7980	0,8130
1	UNC	8	0,9830	0,9980	0,9101	0,9168	0,8492	1,0000	0,9188	0,9276	0,8650	0,8900
	UNF	12	0,9868	0,9982	0,9382	0,9441	0,8990	1,0000	0,9459	0,9535	0,9100	0,9280
1 1/8	UNC	7	1,1064	1,1228	1,0228	1,0300	0,9527	1,1250	1,0322	1,0416	0,9700	0,9980
	UNF	12	1,1118	1,1232	1,0631	1,0691	1,0240	1,1250	1,0709	1,0787	1,0350	1,0530
1 1/4	UNC	7	1,2314	1,2478	1,1476	0,1550	1,0777	1,2500	1,1572	1,6680	1,0950	1,1230
	UNF	12	1,2368	1,2482	1,1879	1,1941	1,1490	1,2500	1,1959	1,2039	1,1600	1,1780
1 3/8	UNC	6	1,3544	1,3726	1,2563	1,2643	1,1741	1,3750	1,2667	1,2771	1,1950	1,2250
	UNF	12	1,3617	1,3731	1,3127	1,3190	1,2739	1,3750	1,3209	1,3291	1,2850	1,3030
1 1/2	UNC	6	1,4794	1,4976	1,3812	1,3893	1,2991	1,5000	1,3917	1,4022	1,3200	1,3500
	UNF	12	1,4867	1,4981	1,4376	1,4440	1,3989	1,5000	1,4459	1,4542	1,4100	1,4280
1 3/4	UNC	5	1,7268	1,7473	1,6085	1,6175	1,5091	1,7500	1,6201	1,6317	1,5330	1,5670
	UNF	12	1,7368	1,7482	1,6881	1,6941	1,6490	1,7500	1,6959	1,7037	1,6600	1,6780
2	UNC	4 1/2	1,9751	1,9971	1,8433	1,8528	1,7325	2,0000	1,8557	1,8681	1,7590	1,7950
	UNF	12	1,9868	1,9982	1,9380	1,9441	1,8990	2,0000	1,9459	1,9538	1,9100	1,9280
3	UNC	4	2,9730	2,9968	2,8237	2,8344	2,6991	3,0000	2,8376	2,8515	2,7290	2,7670
4	UNC	4	3,9728	3,9966	3,8229	3,8342	3,6989	4,0000	3,8376	3,8523	3,7290	3,7670

Thread pitches P in mm for

- **ISO-metric coarse pitch thread M**
- **ISO-metric fine pitch thread M-F**
- **Trapezoidal thread Tr**



Threadturn count per inch for

- **UNC coarse pitch thread**
- **UNF fine pitch thread**
- **BSW coarse pitch thread (Ww)**
- **BSF fine pitch thread**
- **Whitworth pipe thread**

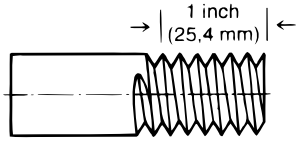


Table 6:

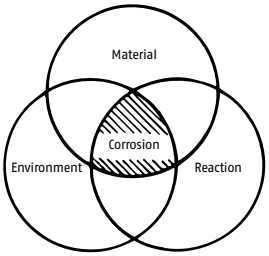
Thread Ø		Pitch P						
M	Tr	M	M-F	M-F2	M-F3	Tr		
1		0.25	(0.2)					
1.2		0.25	(0.2)					
1.4		0.3	(0.2)					
1.6		0.35	(0.2)					
1.8		0.35	(0.2)					
2		0.4	(0.25)					
2.2		0.45	(0.25)					
2.5		0.45	(0.35)					
3		0.5	(0.35)					
3.5		0.6	(0.35)					
4		0.7	0.5					
5		0.8	0.5					
6		1	0.75	0.5				
8	8	1.25	1	0.75	0.5		1,5	
10	10	1.5	1.25	1	0.75		2	1,5
12	12	1.75	1.5	1.25	1		3	2
14	14	2	1.5	1.25	1	4	3	2
16	16	2	1.5		1		4	2
18	18	2.5	2	1.5	1		4	2
20	20	2.5	2	1.5	1		4	2
22	22	2.5	2	1.5	1	8	5	3
24	24	3	2	1.5	1	8	5	3
27	26/28	3	2	1.5	(1)	8	5	3
30	30	3.5	2	1.5	(1)	10	6	3
33	32/34	3.5	2	1.5		10	6	3
36	36	4	3	2	1.5	10	6	3
39	38/40	4	3	2	1.5	10	7	3
42	42	4.5	(4) 3	2	1.5	10	7	3
45	44/46	4.5	(4) 3		1.5	12	7/8	3
48	48	5	(4) 3	2	1.5	12	8	3
52	50/52	5	(4) 3	2	1.5	12	8	3
56	55	5.5	4	3/2	1.5	14	9	3
60	60	5.5	4	3/2	1.5	14	9	3
64	65	6	4	3	2 (1.5)	16	10	4
68	70	6	4	3	2 (1.5)	16	10	4
Flank ∢		60°				30°		

With fine pitch thread, M-F insertion is preferred

Thread Ø			Number G (per 1 inch)				
UNC/UNF No.	Inch	= mm	UNC (NC)	UNF (NF)	BSW (Ww C)	BSF (Ww F)	R, G Rp
0		1,524	–	80	–	–	–
1		1,854	64	72	–	–	–
2		2,184	56	64	–	–	–
3		2,515	48	56	–	–	–
4		2,845	40	48	–	–	–
5		3,175	40	44	–	–	–
6		3,505	32	40	–	–	–
8		4,166	32	36	–	–	–
10		4,826	24	32	–	–	–
12		5,486	24	28	–	–	–
	1/8	3,175	–	–	40	–	28
	5/32	3,969	–	–	32	–	–
	3/16	4,763	–	–	24	32	–
	7/32	5,556	–	–	24	28	–
	1/4	6,350	20	28	20	26	19
	5/16	7,938	18	24	18	22	–
	3/8	9,525	16	24	16	20	19
	7/16	11,113	14	20	14	18	–
	1/2	12,700	13	20	12	16	14
	9/16	14,288	12	18	12	16	–
	5/8	15,875	11	18	11	14	14
	3/4	19,050	10	16	10	12	14
	7/8	22,225	9	14	9	11	14
	1	25,401	8	12	8	10	11
	1 1/8	28,575	7*	12	7	9	11
	1 1/4	31,750	7*	12	7	9	11
	1 3/8	34,925	6*	12	6	8	11
	1 1/2	38,100	6*	12	6	8	11
	1 3/4	44,450	5*	12	5	7	11
	2	50,802	4 1/2*	12	4 1/2	7	11
	2 1/4	57,150	4 1/2*	–	4	–	11
	2 1/2	63,500	4*	–	4	–	11
	2 3/4	69,850	4*	–	3 1/2	–	11
	3	76,200	4*	–	3 1/2	–	11
	4	101,60	4*	–	3	–	11
–			60°		55°		

* Studbolts ∅ ≥ 1" = constant 8 threads/inch
** Pipe threads have a larger major diameter (➜ Table 5)

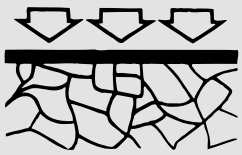
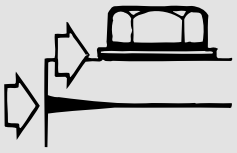
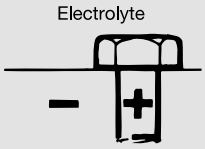
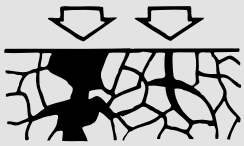
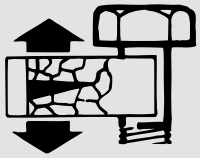
General information



Corrosion is the reaction of a metallic material with its environment which causes a measurable change in the material and can negatively influence the function of a metallic component or an entire system. In most cases, this reaction is of an electrochemical nature, but, in some cases, it can be of a chemical or a metal-physical nature. (Definition: Basic principle of "Corrosion" according to ISO 8044)

Table 1 shows the most important corrosion types from a selection of different corrosions which need to be considered with "mechanical fasteners".

Table 1: Corrosion types

				
Surface corrosion, e.g. rust, pitting corrosion	Crevice corrosion	Electrochemical corrosion (Contact corrosion) (see Table 2)	intergranular/ transgranular corrosion	Stress corrosion cracking

Corrosion is unavoidable, but damage due to corrosion is avoidable, provided the proper planning of suitable corrosion protection measures is in place. The corrosion protection of screw fastenings needs to be at least as corrosion-resistant as the components to be connected.

The task of constructive planning is to determine the necessary corrosion protection measures. Here the resilience of the corrosion protection in known operating conditions is to be taken into account until maintenance is due or until the limitation of damages has been reached. Surface or material specifications are to be listed in the article order text according to standards.

The next page provides a rough overview of the corrosion protection options for fasteners.

Inspection standards for corrosion protection procedures, compiled in DIN pocketbook 175, stipulate uniform conditions for the type and setup of equipment and methods for checking adherence to the specified coating type, layer thickness and optical appearance. The inspections according to these standards do not provide any information on the effect or fatigue strength of the corrosion protection under practical operating conditions.

An overview of the friction coefficients for various surface combinations → TI assembly. The friction ratios in the screw fastenings are vital when determining the correct tightening torque (→ VDI 2230)

Electrochemical corrosion

The combination of electrochemical noble and ignoble metals in humid conditions (= electrolyte) generates corrosion currents which spread from ignoble (anodic) metal to more noble metal (cathode). This means that less noble metal will be more eroded or corroded. The corrosion current thicknesses are also vital. If the ignoble, anodic part is small in comparison with the surrounding cathodic area (screw head on sheet surface), a very high anodic current thickness will generate which will carry off a lot of material.

Example 1:
Zinc plated screws for fastening a copper sheet:
Zinc is considerably less noble compared to copper. In humid conditions, a very high corrosion current thickness occurs on the small, ignoble, anodic screw head (left column zinc – small) in the direction of the noble, cathodic copper sheet (upper row – copper). The galvanized surface of the screw erodes in a short space of time and red rust appears on the steel.

Remedy:
In relation to the metallic building component, the fasteners should be as similar as possible if not more noble.

Screw	Component
zinc plated	zinc plated
nickel plated	steel, copper, brass
stainless	steel, zinc plated, aluminium, copper, brass

Example 2:
Copper or stainless steel screws which work in a similar way for fastening a zinc plated metal sheet:
This time, the ignoble, anodal, galvanized section is very large in relation to the small, noble, cathodic screw head. The corrosion current which stretches over the entire surface has very low tightness in the anode. The material degradation occurs across the entire surface and shows hardly any corrosion. This process actually additionally protects the nobler screw head against corrosion.

If unfavourable metal pairings cannot be avoided, they should be isolated from each other, e.g. using intermediate layers or coatings. Here, it must be made sure that the full strength of the connection remains intact.

Table 2: Electrochemical corrosion with metal pairings

In regard to contact corrosion of observed material t	Area ratio*	Magnesium alloy	Zinc	Hot-dip galvanized steel	Aluminium alloy	Cadmium coating	Construction steel	Low-alloy steel	Cast steel	Chrome steel	Lead	Tin	Copper	Stainless steel
Magnesium alloy	small		S	S	S	S	S	S	S	S	S	S	S	S
	large		M	M	M	M	S	S	S	S	S	S	S	S
Zinc	small	M		G	M	M	S	S	S	S	S	S	S	S
	large	G		G	G	G	G	G	G	G	G	G	G	G
Hot dip galvanized steel	small	M	G		M	M	S	S	S	S	S	S	S	S
	large	G	G		G	G	G	G	G	G	G	G	G	G
Aluminium alloy	small	M	G	G		G	M	G	S	M	S	S	S	S
	large	G	M	M		G	G		M	S	S		S	M
Cadmium coating	small	G	G	G	G		S	S	S	S	S	S	S	S
	large	M	G	M	G		G	G	G	G	G	G	G	G
Construction steel	small	G	G	G	G	G		M	S	S	S	S	S	S
	large	G	G	G	G	G		G	G	G	G	G	G	G
Low-alloy steel	small	G	G	G	G	G	G		G	S	S	S	S	S
	large	G	G	G	G	G	G		G	G	G	G	G	G
Cast steel	small	G	G	G	G	G	G	M		S	S	S	S	S
	large	G	G	G	G	G	G	G		G	G	G		
Chrome steel	small	G	G	G	G	G	G	G			M	M	S	S
	large	G	G	G	G	G	G	G			G	G		G
Lead	small	G	G	G	G	G	G	G	G	G		G	G	
	large	G	G	G	G	G	G	G	M	G		G		G
Tin	small	G	G	G	G	G	G	G		M	G			
	large	G	G	G	G	G	G	G	G	M	G			
Copper	small	G	G	G	G	G	G	G		M	M	S		
	large	G	G	G	G	G	G	G	G		G	M		G
Stainless steel	small	G	G	G	G	G		G	G	M	M	M	G	
	large	G	G	M	G	G	G	G	G		M	M		

S = strong corrosion of the observed material
M = moderate corrosion of the observed material (in very humid environments)
G = negligible or zero corrosion of the observed material

* ratio of the surface of the "observed" material to the surface of the "pairing material" (Source: "FEUERVERZINKEN" (HOT DIP GALVANIZATION) information centre)

Corrosion protection measures

Constructive measures e.g. isolation, avoidance of crevices...
Electrochemical measures e.g. cathodic protection, ventilation

Table 3: Surface measures

Measures	Procedures	Coatings	Coat-thicknesses µm	Standards Brand names
· **Non-metallic coatings** (inorganic/ *organic coatings)	Lubrication	Oil	–	
	Browning, oxidising	Iron oxide coat	0.5 – 2	DIN 50938
	Phosphate-coating	Phosphate coat	–	EN 12476 (DIN 50942)
	Thin-layer coats of lacquer*	Lacquer/Plastic / Resin (Fluoropolymer/TEFLON)	3 – 20	IRCO-SEAL, KLEVER-COL, XYLAN, PTFE, STAND-COTE
	Dip coating*	Epoxide resin/Polyester/ Phenolic resin	10 – 20	KTL-KATAPHORESE, ECO 2000
	Powder coatings*	Polyester powder	60 – 90	PULVER-COLOR, WEMA-KOR-EX
· **Metallic coatings** (inorganic coatings)	**Electroplated coatings:** (electrolytic/chemical/acidic/ alkaline/cyanidic)	Zinc Cadmium Copper Copper-zinc Nickel Nickel-chrome Copper-nickel Copper-nickel-chrome Tin Copper-tin Silver Copper-silver Zinc-nickel Zinc-cobalt Zinc-iron	3 – 25	ISO 4042
	+ Conversion layers (e.g. passivation/ chromating – ISO 4520)			
	Hot dip galvanization tZn	Zinc	min. 40	ISO 10684 (DIN 267-10) for fasteners ISO 1461 for batch galvanizing
	Mechanical plating (plated coatings)	Zinc powder on sub-layer copper-plating (chromating possible)	6 – 107	ISO 12683
	Diffusion coatings	Zinc power burned in/on	15 – 45	EN 13811: SHERARD-galvanizing ISO 14713-3
· **Zinc flake coating**	**Basecoat** (dispersions coatings = inorganic)	Zn-/Al lamellas (silver)	5 – 20	ISO 10683, DACROMET/GEOMET, DELTA-TONE, ZINCTECH
	Topcoat (thin-layer lacquering = organic)	Thin layer argentine or coloured, lubrication integration possible	8 – 15	DELTA-SEAL, DELTA-PROTEKT KL + VH, GEOMET PLUS VL

Table 4: Material measures

Measures	Procedure	Coatings	Standards	Brand names
· **Non-ferrous metals (NE)**	Copper (Cu) Brass (CuZn) Bronze (CuNiSi, CuSn)	– Ni plated, Cr plated, browned –	ISO 8839 (DIN 267-18) (galv. coatings ISO 4042 [DIN 267-9])	KURBUS Special brass 59 KUPRODUR
	Aluminium (Al)	anodised	–	–
	Titanium/Titanium alloys	–	ISO 8839 (DIN 267-18)	–
· **Non-metallic materials (K)***	Plastics PA, POM, PP, PVDF, Nylon	–	VDI 2544 DIN 34810 - 34816	ULTRAMID, DELRIN, HOSTALEN...
· **Stainless steels**	**Ferritic steels (F)** 1.4016, 1.4568	clean and metallic, bright-polished	ISO 3506 (DIN 267-11) EN 10088 (DIN 17224)	–
	Martensite steels (C) 1.4016, 1.4057, 1.4122...		ISO 3506 (DIN 267-11) EN 10088 (DIN 17442)	–
	Austenitic steels (A) A 1= 1. 4305 A 2 = 1.4301, 1.4303 A 4 = 1.4401 A 3 = 1.4541 A 5 = 1.4571 FSt = 1.4310		ISO 3506 (DIN 267-11) EN 10088 (DIN 17440, 17244) EN 10088 (DIN 17224)	NIRO, NIROSTA, INOX, CRONIFER, REMANIT, UNOX, SINOX ... Austenitic/austenitic-ferritic steels with particular resistance against chlorine-induced stress corrosion, e.g. indoor swimming pools ➔ TI-226
· **Special materials**	Nickel, nickel alloys	metallic, bright-polished	DIN 17740, 17742-44	INCONEL, HASTELLOY, MONEL...
	Special copper alloys Multi-component bronzes		DIN 17662-17665	Sn-/Al-Bronze, NEUSILBER, RESISTIN, CUNIFER...
	Special steels		EN 10269 (DIN 17240), SEW 390	URANUS, SICROMAL, MANOX...

*mechanical properties ➔ TI-227

Table 5:
Standard references for corrosion protection of surfaces

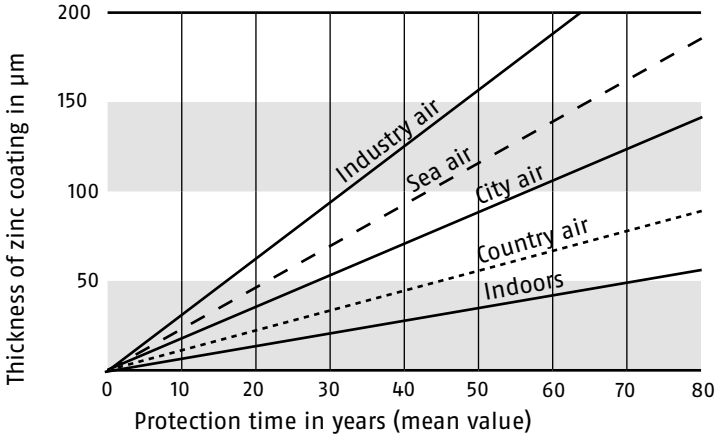
Standard no.	Title
ISO 4042	Fasteners – Electroplated coatings
ISO 10683	Fasteners – Non-electrolytically applied zinc flake coatings
ISO 10684	Fasteners – Hot dip galvanized coating
ISO 1891-2	Fasteners – Terminology. Vocabulary and definitions for coatings
ISO 19598	Metallic coatings – Electroplated coatings of zinc and zinc alloys on iron or steel with supplementary Cr(VI)-free treatment
ISO 2081	Metallic and other inorganic coatings – Electroplated coatings of zinc with supplementary treatments on iron or steel
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles
EN 1403	Electrodeposited coatings – Method of specifying general requirements
ISO 12944 Part 1 to part 6	Corrosion protection of steel structures

Table 6:
Service conditions for zinc plated steel

	Service condition	Duration of salt spray test without base metal corrosion (NSS) in hours
0	Decorative use (without strain)	48
1	Indoor conditions in warm, dry atmosphere	72
2	Indoor condition in rooms, in which condensation may occur	120
3	Outdoor weathering under moderate conditions	192
4	Outdoor weathering under difficult corrosive conditions – e.g. salt/industry environment	360

- Extract from ISO 2081:2009-05, EN 1403
- The listed protective effects vary in practice and are mere reference values
- Suitable coatings are listed below

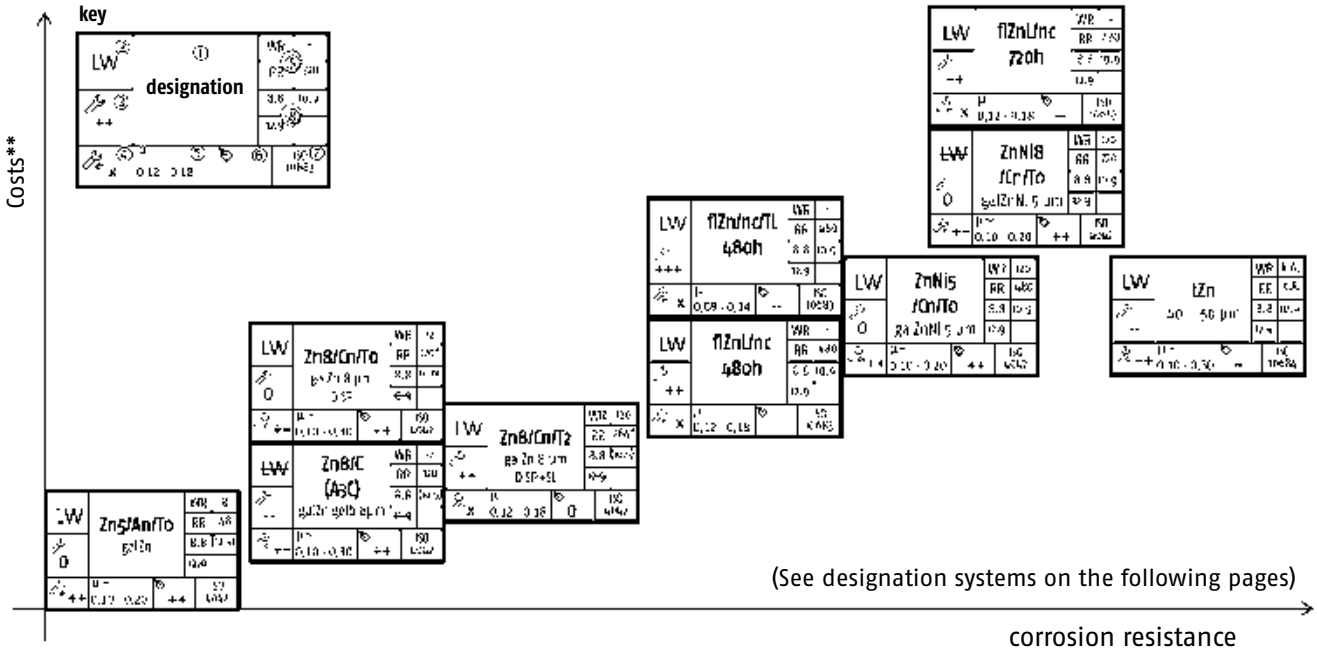
Table 7:
Yearly erosion values for zinc



Service condition	µm/year
Indoors	1.0 – 2.0
Country air*	1.3 – 2.5
City air*	1.9 – 5.6
Industry air*	6.4 – 19
Sea air*	2.2 – 7.2

*In practice, a mixed climate is to be reckoned with.

Overview of common coating systems



1) Designation of surface; 2) Products with this surface in stock; 3) assembly behaviour (friction coefficient spread) without additional lubrication (-- = bad to ++ = very good); 4) assembly behaviour (friction coefficient spread) with additional lubrication (-- = bad to ++ = very good / x = lubrication already contained in surface); 5) friction coefficient range in delivery condition (µ~ = typical values) 6) Bonding suitability of surface (-- = bad to ++ = good); 7) Standard for technical delivery conditions; 8) Suitability of surface for property classes; 9) corrosion resistance in salt spray test (WR = white rust; RR = red rust)

*Deviating from ISO 4042
**the categorization gives an approximate, nonbinding overview of costs

Corrosion protection: Electroplated coatings

The technical conditions of delivery ISO 4042 apply to electroplated coatings on standard and non-standard fasteners.
The coating metal is applied onto the parts to be coated in an electrolytic precipitation process in an electroplating bath.

Layer composition and description system of electroplated coatings

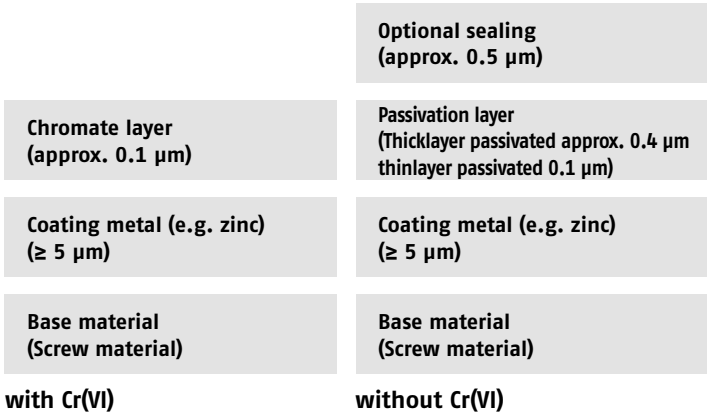


Table 8: Coating metals (Extract from ISO 4042)

Symbol	Description	Type
Zn	Zinc	Metal
ZnNi	Zinc-nickel	Alloy
ZnFe	Zinc-iron	Alloy
Ni	Nickel	Metal
Ni+Cr	Nickel-Chrome	Multi-layer
Cu+Ni	Copper-Nickel	Multi-layer
Cu+Ni+Cr	Copper-Nickel-Chrome	Multi-layer
CuZn	Brass	Alloy
CuSn	Copper-Tin (Bronze)	Alloy
Cu	Copper	Metal
Sn	Tin	Metal

Table 9: Sealings/topcoats/lubricants

Code	Description	Requirement
–		Manufacturer's choice
T0	No sealing or topcoat	To achieve a certain function, no sealing or topcoat shall be applied
T2	Sealing	Sealing to increase corrosion resistance with or without integrated lubricant
T4	Subsequently applied lubricant	A lubricant shall be applied to the metal coating or the conversion layer or the sealing/topcoat
T7	Topcoat	e.g. increase chemical resistance or colouring scheme
nL	No lubricant	There shall be no integrated lubricant in T2 or T7

Table 10: Conversion layers for zinc and zinc alloy coatings

Code	Name	Typical look	Type of conversion layer
An	Transparent	Transparent, clear to bluish	Passivation without Cr(VI)
Cn	Iridescent (Thick layer passivation)	Transparent, clear to iridescent	Passivation without Cr(VI)
Fn	Black	Black, dark iridescent permitted	Passivation without Cr(VI)
A	Clear	Transparent, clear to bluish	Chromation with Cr(VI)
C	Iridescent	Yellow iridescent	Chromation with Cr(VI)
D	Matt	Olive	Chromation with Cr(VI)
F	Black	Black, dark iridescent permitted	Chromation with Cr(VI)
U	–	No conversion layer	–

Designation example of electroplating surface treatment as per ISO 4042

ISO 4014 – M 16x60 – 8.8 /Zn8/Cn/T2(µ0.12–0.18)

Zn8	Cn	T2	(µ0.12–0.18)
			Set friction coefficient range – to be implemented with integrated lubricant in the sealing or subsequently applied lubricant
		Sealing with or without integrated lubricant	
	Conversion layer Cn = Cr(VI)-free passivation iridescent (thick layer passivation)		
Coating metal Zn = zinc with a minimum layer thickness of 8µm			

General/common descriptions

Table 11: Coating metals (extract from ISO 4042)

Description old	Description new	common descriptions
A2A; A2B; A2K	ISO 4042 Zn5/An/T0	galZn; VZB; elVZ; ZP; BZP;VZ
–	ISO 4042 Zn5/Cn/T0	galZnDiSP; VZD;...
A2C	ISO 4042 Zn5/C/T0	galZnC; VG; GVZ; YZP; VZG

Corrosion resistance of electroplated zinc and zinc alloy coatings with Cr(VI)-free conversion layers

Table 12: Corrosion resistance as per ISO 4042

Coating system	Code	Minimum time for neutral salt spray test in hours		
		White rust	Red rust layer thickness	
			5 µm	8 µm
Zn, transparent passivated	Zn/An/T0	8	48	72
Zn, iridescent passivated	Zn/Cn/T0	72	120	192
Zn, iridescent passivated, sealed	Zn/Cn/T2	120	168	240
Zn, black passivated, sealed	Zn/Fn/T2	24	72	144
ZnFe, iridescent passivated	ZnFe/Cn/T0	96	144	216
ZnFe, iridescent, passivated, sealed	ZnFe/Cn/T2	120	216	288
ZnFE, black passivated, sealed	ZnFe/Fn/T2	96	192	240
ZnNi, silver grey, passivated	ZnNi/Cn/T0	120	480	720
ZnNi, silver grey, passivated, sealed	ZnNi/Cn/T2	168	600	720
ZnNi, black, passivated	ZnNi/Fn/T0	48	360	600
ZnNi, black, passivated, sealed	ZnNi/Fn/T2	120	480	720
1) in drum-coating; inspection is performed directly after coating				

Note: These are only extracts from standards. For inspection purposes, please refer to the relevant standard.

Requirements for gaugeability and assemblability of fasteners as per ISO 4042

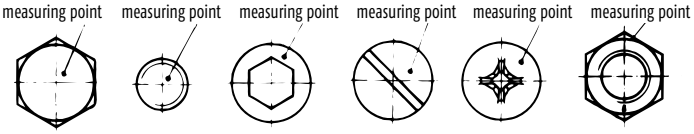
The tread tolerances apply before the coatings are plated – when coating, the zero line of a screw thread (tolerance range h) or nut thread (tolerance range H) shall not be exceeded and deceeded, respectively. Thus, the screw thread with coating may be in between the upper tolerance limit and the zero line. The threads shall be gaugable over the complete thread length. Deviating from this, the threads may be damaged in delivery condition due to transport and pouring processes. In this case the maximum torques of a thread gauge shall not exceed the value of $0.001 d_3$ in Nm (Table 13). Alternatively, order and supplier may agree on an inspection for assemblability with a suitable nut or screw.

In the interest of threadability, the layer thickness for thread parts with a normal degree of tolerance of 6g/6H is of course limited. The empirically recommended limit values possible according to ISO 4042 can be found in Table 14. Thicker coatings require different tolerance zones with larger sizes according to DIN 13-14 (custom-made).

Layer thickness inspection of electroplated coatings on fasteners

In order to determine the layer thickness, different testing methods can be applied (X-ray spectrometric method as per ISO 3497, coulometric method as per ISO 2177, microscopical method as per ISO 1463, magnetic method as per ISO 1463, or eddy current method as per ISO 21968). In case of arbitration, the microscopical method shall be applied.

The test shall be performed at the reference areas marked in the figure.



Normal storage:	Layer thickness = Type (≥ M 5)
"galZn"	approx. 5 µm
"galZnC" yellow chromate	approx. 5 µm
"galZn 8 DiSP"	approx. 8 µm thick layer passivation

Table 13: Maximum torque for gauging of coated metric threads as per ISO 4042

Thread	Max. Torque [Nm]	Thread	Max. Torque [Nm]
M 3	0.03	M 18	5.8
M 4	0.06	M 20	8.0
M 5	0.13	M 22	11.0
M 6	0.22	M 24	14.0
M 8	0.51	M 27	20.0
M 10	1.0	M 30	27.0
M 12	1.7	M 33	36.0
M 14	2.7	M 36	47.0
M 16	4.1	M 39	59.0

Table 14: Maximum layer thicknesses for outer threads with thread tolerance group g

Thread Ø M	Pitch	Max. Layer thickness [µm] as per ISO 4042 a Screw length			Practice values b Screw length	
		< 5d	5d – 10d	10d – 15d	< 5d	5d – 15d
1 – 2	0.2 – 0.4	3	3	3	–	–
2,5 – 7	0.45 – 1	5	3	3	3	3
8	1.25	5	5	3	5	3
10 – 16	1.5 – 2	8	5	5	5	3
18 – 22	2.5	10	8	5	8	5
24 – 27	3	12	8	8	8	5
30 – 33	3.5	12	10	8	8	8
36 – 52	4 – 5	15	12	10	10	8
56 – 60	5.5	15	15	12	12	10
64	6	20	15	12	12	10

a Mathematical limiting value according to ISO 4042, Tab. 2
b Recommended limiting value from practice in due consideration of manufacturing and procedural faults according to ISO 6157-1, -3

Notes on manufacturing-related hydrogen embrittlement (ISO 4042)

The risk of manufacturing-related hydrogen embrittlement exists (IHE = internal hydrogen embrittlement), if the fastener has high hardness or tensile strength, is subjected to tensile stress and can absorb atomic hydrogen during the manufacturing process.

Table 15: Measures to reduce hydrogen embrittlement with regard to hardness as per ISO 4042

Measure	A	B	C[a]
Description measure	No supplementary process verification or product testing with regard to IHE AND No malleablizing required	Supplementary process verification and/or product testing with regard to IHE OR Malleablizing	Supplementary process verification and/or product testing with regard to IHE AND Malleablizing
Applicable for screws of property class as per ISO 898-1	≤ 8.8	10.9	12.9
Applicable for nuts of property class and hardness as per ISO 898-2	≤ property class 12 and < 360 HV	≤ property class 12 and < 360 HV	-
Applicable for washers of property class as per ISO 898-3	≤ 200 HV	300 HV	380 HV

[a] As, despite measure C the risk of hydrogen embrittlement cannot be ruled out completely for the listed screws and washers, they are manufactured only upon explicit order.

Corrosion protection: Zinc flake coatings

The technical conditions of delivery ISO 10683 apply to non-electrolytically applied zinc flake coating on standard and non-standard fasteners. The coating is composed of zinc and aluminium flakes linked by an inorganic matrix. It is applied onto the part surface in a dipping or spraying process and then burned in at temperatures between 200 ° - 320 °C.

Layer composition and description system of zinc flake coatings

Variations in layer composition:

- Basecoat only
- Basecoat + lubricant
- Basecoat + topcoat
- Basecoat + topcoat + lubricant

Optional - lubricant

Optional topcoat optional with integrated lubricant (topcoat)

Basecoat optional with integrated lubricant (basecoat)

Base metal

Table 16: Comparison of resistance in the salt spray test to reference layer thickness according to ISO 10683

Duration NSS without red rust [h]	Reference layer thickness a) [µm]
240	4
480	5
600	6
720	8
960	10

a) The reference layer thickness includes basecoat layer(s) and topcoat layer(s), if present, with or without cr(VI). For approval, the corrosion resistance is decisive; the indication of the reference layer thickness is merely for orientation.

Table 17: Designation system according to ISO 10683

Basecoat	Chromium(VI)	Topcoat	Additional lubricant	Duration of salt spray test until red rust	Requirements for the friction coefficient range
1. Without integrated lubricant = **flZn**	1. Not specified (manufacturer's choice)	1. With integrated lubricant in the top layer = **TL**	**L**	e.g. **480 h**	**C**[a]
2.With integrated lubricant = **flZnL**	2.With Cr(VI) = **yc**	2.Without integrated lubricant in the top layer = **Tn**			
	3. Without Cr(VI) = 3: **nc**				

a) Friction coefficient range µ must be named in the order

Description example for a screw with zinc flake coating as per ISO 10683
ISO 4014 – M 16 x 60 – 8.8 flZnL/nc/480h/C (µ = 0.12–0.18)

flZnL	nc	480h	C (µ=0.12-0.18)
			Requirement for a friction coefficient range µ between 0.12 and 0.18
		Corrosion resistance in salt spray test 480 h to red rust	
	Coating system Cr(VI) free		
Zinc flake coating with integrated lubricant in the basecoat			

Table 18: Typical products

Manufacturers	Product examples	
MAGNI EUROP	Basecoat: Topcoat:	MAGNI FLAKE MAGNI TOP
ATOTECH	Basecoat: Topcoat:	ZINKTEK TECHSEAL
DÖRKEN	Basecoat: Topcoat:	DELTA-PROTEKT ® DELTA-SEAL ® DELTACOLL ®
NOF	Basecoat: Topcoat:	GEOMET PLUS L ® PLUS VL ®

Requirements for gaugeability and assemblability of fasteners as per ISO 10683

The thread tolerances apply before the coatings are plated – when coating, the zero line of a screw thread (tolerance range h) or nut thread (tolerance range H) shall not be exceeded and deceeded, respectively. Thus, the screw thread with coating may be in between the upper tolerance limit and the zero line. Threads may be damaged in delivery condition due to transport and pouring processes. In this case, the maximum torques of a thread gauge shall not exceed the value of 0.001d3 in Nm (Table 19). Alternatively, order and supplier may agree on an inspection for assemblability with a suitable nut or screw.

Table 19: Maximum torque for gauging of coated metric threads per ISO 10683

Thread	Max. Torque [Nm]	Thread	Max. Torque [Nm]
M 3	0.03	M 18	5.8
M 4	0.06	M 20	8
M 5	0.13	M 22	11
M 6	0.22	M 24	14
M 8	0.51	M 27	20
M 10	1	M 30	27
M 12	1.7	M 33	36
M 14	2.7	M 36	47
M 16	4.1	M 39	59

Properties of zinc flake technology at a glance:

- No hydrogen embrittlement as a result of the application process
- Virtually all systems are now Cr(VI)-free in accordance with according to RoHS and EU-End-of-Life-Vehicles Directives
- Extremely thin coatings of typically 5 - 12 µm
- Caution, however, with cropped parts with internal drive and small diameters ≤ M 6
- High cathodic corrosion protection compared to electroplated standard surfaces

Note: These are only extracts from standards. For inspection purposes, please refer to the relevant standard.

Corrosion protection: Hot dip galvanized fasteners

For hot dip fasteners, the technical conditions of delivery apply according to ISO 10684.

Requirements for thread and geometry tolerances

The minimum layer thickness of at least 40 µm at the point of measurement stipulated by this standard requires that the thread dimensions be adjusted (see Table 10).

The undersize is usually to be found in the screw thread with the tolerance group 6az so that the hot dip galvanized screw thread does not exceed the (ISO-compatible) zero line (h tolerance). These screws are also identified with a "U".
Rethreading the screw is not permitted.

For high-strength structural bolting assemblies -system HV- according to EN 14399-4, a non-rethreaded screw (g tolerance) is coated which means that the screw thread with hot dip galvanization is above the zero line. In this case the necessary oversize is in the nut thread (= 6 az).
The nut thread is later cut into the hot dip galvanized castings. The corrosion protection of the bare nut thread comes from the zinc coating of the screw thread with remote cathodic protection.

In case of external dimensions (head, shaft), there may be a minor oversize due to the zinc layer.

Table 20: Basic dimensions of the screw thread before hot dip galvanization – tolerance group 6az according to ISO 10684/ISO 965-4

Coarse thread	M 6*	M 8	M 10	M 12	M 14 M 16	M 18 M 22	M 24 M 27	M 30 M 33	M 36 M 39	M 42 M 45	M 48 M 52	M 56 M 60	M 64
Upper limit dimension es [µm]	-290	-295	-330	-335	-340	-350	-360	-370	-380	-390	-400	-410	-420

*not regulated by standards

Requirements for mechanical properties

After hot dip galvanization, the requirements of ISO 898-1 and ISO 898-2 apply to hot dip galvanized screws and nuts ≥ M 12.
For thread sizes M 8 and M 10, reduced load bearing capacities apply according to ISO 10684.

Table 21:
Minimum tensile strength [N] for screws of the 6az tolerance

Property class Marking	4.6 4.6 U	5.6 5.6 U	8.8 8.8 U	10.9 10.9 U
M 6*	7 075	8 844	14 150	17 687
M 8	13 300	16 600	26 600	34 500
M 10	21 400	26 800	42 900	55 700
M 12	33 700	42 200	67 400	87 700
M 16	62 800	78 500	125 000	163 000
M 20	98 000	122 000	203 000	255 000
M 24	141 000	176 000	293 000	367 000
M 30	224 000	280 000	466 000	583 000
M 36	327 000	408 000	678 000	850 000

*reference values not regulated by standards

Table 22:
Proof loads [N] for nuts of the 6az tolerance

Property class Marking	5 5 Z	6 6 Z	8 8 Z	10 10 Z
M 6*	7 969	9 962	15 934	19 923
M 8	17 300	20 000	25 500	30 600
M 10	28 600	33 000	42 200	50 400
M 12	51 400	59 000	74 200	88 500
M 16	95 800	109 900	138 200	164 900
M 20	154 400	176 400	225 400	259 700
M 24	222 400	254 200	324 800	374 200
M 30	353 400	403 900	516 100	594 700
M 36	514 700	588 200	751 600	866 000

*reference values not regulated by standards

Assembly

When assembling hot dip galvanized screws and nuts, especially with additional lubrication of the threading, different friction coefficients and tightening torques need to be reckoned with. EN 1993 – 1 – 8 NA needs to be considered for hot dip galvanized high strength structural bolting assemblies!
(→TI - Assembly)

Requirements for coating and surface

The grey appearance of the hot dip galvanized surface is dependent on the material and not a characteristic for the quality of corrosion protection. White rust and/or whitish to dark corrosion points (zinc oxide), which may occur after hot dip galvanization, e.g. through dampness, do not usually impair the corrosion protection and are no reason for rejection (→ ISO 1461, section 6.1).

A certain surface rawness and small dents in the thread tips are dependent on the procedure. For this reason, an assembly tool may be required for initial screwing.

Suitability of hot dip galvanizing for fasteners

Due to the great layer thicknesses and the coating process, coating is standardized only for thread diameters starting from M 8. Fasteners with a diameter of M 6 are suitable for hot dip galvanizing to a limited extent.

Articles with hollow sections (e.g. cap nuts, hexagon socket screws) are not suitable for hot dip galvanizing.

Properties: Steel screws, bolts and studs with metric thread

The mechanical properties of steel metric screws as well as their quality inspection and marking are set in ISO 898-1.
For fasteners under compressive stress with external thread, such as e.g. studs, only hardness classes are defined acc. to ISO 898-5.

Designation system for property classes
The most important mechanical properties for steel screws are given a two-digit combination name – here's an example:

The first number gives 1/100 of the **minimum tensile strength** in N/mm² stress area.
Tensile strength 8 x 100 = 800 N/mm².

← **8.8** →

The second number specifies the 10-fold ratio of the lower yield strength limit (R_{el} or Rp 0.2) over nominal tensile strength R_m (yield strength ratio).
Multiplying the two numbers results in 1/10 of the **minimum yield strength** in N/mm².
Tensile strength 8 x 10 = 640 N/mm².

Table 1: Mechanical properties of screws, bolts and studs as per ISO 898-1

Properties	Property classes	3.6	4.6	4.8	5.6	5.8	6.8	8.8 ≤ M 16	8.8 >M 16*	10.9	12.9
Tensile strength **	Nominal value	300	400		500		600	800		1000	1200
R_m in N/mm²	min.	330	400	420	500	520	600	800	830	1040	1220
Lower yield strength **	Nominal value	180	240	320	300	400	480	–	–	–	–
R_{el} in N/mm²	min.	190	240	340	300	420	480	–	–	–	–
Stress at 0,2 % non-proportional elongation**	Nominal value				–			640	640	900	1080
$R_{p\,0,2}$ in N/mm²	min.				–			640	660	940	1100
R_{el} / $R_{p0.2}$ Continuous use at increased temperatures can lead to significant tensile relaxation!	+ 100° C	–	–	–	270	–	–	590		875	1020
at higher temperatures in N/mm² (ISO 898-1 Issue 11/99 A1)	+ 200° C	–	–	–	230	–	–	540		790	925
	+ 250° C	–	–	–	215	–	–	510		745	875
	+ 300° C	–	–	–	195	–	–	480		705	825
Elongation after fracture A in % **	min	25	22	–	20	–	–	12		9	8
Vickers hardness(F ≤ 98 N)**	HV min-max	95-220	120-220	130-220	155-220	160-220	190-250	250-320	255-335	320-380	385-435
	***	250	250	250	250	250					
Brinell hardness (F = 30 D2)**	HB min-max	90-209	114-209	124-209	147-209	152-209	181-238	238-304	242-318	304-361	366-414
	***	238	238	238	238	238					
Rockwell hardness**	HRB min-max	52-95	67-95	71-95	79-95	82-95	89-99,5				
	***	99.5	99.5	99.5	99.5	99.5	–	–	–	–	–
	HRC min-max	–	–	–	–	–	–	22-32	23-34	32-39	39-44

*construction steel bolts from M 12 **values apply at room temperature approx. +20 °C ***max. value at the screw end

Marking screws, bolts and studs
According to the standard, fasteners from a thread diameter of M 5 onward are to be marked with the manufacturer's identification marks and the property class marking as follows*:

Hexagon and hexalobular head screws and bolts in all property classes. The marking shall be made preferably on the top of the head by indenting or embossing.

Hexagon and hexalobular socket head cap screws in all property classes. The marking shall be made preferably on the top of the head by indenting or embossing.

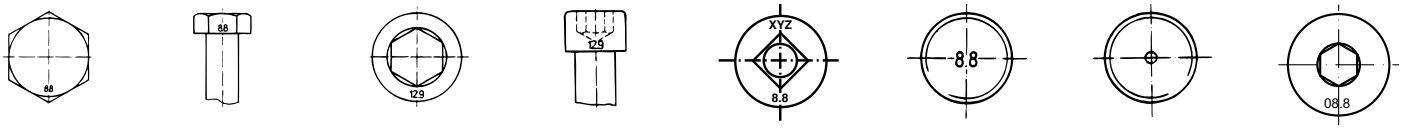
Cup head square neck bolts in all property classes. The marking shall be made on the head by indenting or embossing.

Studs 5.6 and starting from property class 8.8. The marking shall be on the unthreaded part of the stud or on the tip of the nut end. If this is not possible, marking symbols an be used as follows: 5.6 = –, 8.8 = p, for 10.9 = l and for 12.9 = g

Threaded rods acc. to DIN 976 (DIN 975) are marked with the property class starting from 5.6. The manufacturer's identification is not required.
Alternatively, the following colour marking is allowed:

Property class/ material	Colour
5.6	brown
5.8	blue
8.8	yellow
10.9	white
12.9	black
A2-70	green
A4-70	red

Marking of fasteners which have reduced loadability, such as, hexagon socket head cap screws with low head for example (DIN 7984): Fasteners shall be marked with the property class, except that the marking symbol for property class shall be preceded by the digit "0" (e.g. "08.8"). The obligation to add a marking is regulated in the product standards. Other screws with reduced loadability are, for example, hexagon socket countersunk head screws acc. to ISO 10642.



*According to ISO 898-1, in case of limited space marking can be made clockwise (➔ analogue table 3)

Table 2: Hardness classes for set screws per ISO 898-5

Designation	14 H	22 H	33 H	45 H
Vickers hardness HV min.	140	220	330	450

Marking of products is not mandatory or only regulated in the product standards.

Properties: Steel nuts with metric thread

The DIN product and function standards for nuts are being converted to ISO standards. Accordingly, during the transition period standards for previous DIN and new ISO nut designs shall be on the market together.

Information about standards conversion, "Standards conversion DIN ➔ ISO", see TI-7:

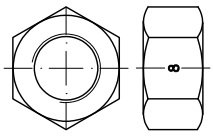
The properties of nuts with coarse threads is specified in ISO 898-2 (EN 20898-2/DIN 267-4) and for nuts with fine threads in ISO 898-6. The loadability of a nut is set by the hardness & nut height and defined by the proof load.
It is regulated that specific nut types must be marked with the property class.
The type of marking as well as the place where it needs to appear is prescribed in the standards ISO 898-2, DIN 267-24 and DIN 267-13, among others.
The key number specifies a direct assignment of property classes of the screws, bolts and studs (➔ Table 2).

Nuts with nominal height ≥ 0.8 D

The first number of the property class of the screw/bolt/stud is the assignment of the property class of the nut. For nuts with a nominal height of ~0.8 D, e.g. nuts according to DIN 555 and DIN 934, the marking is a number, for instance (8 = 1/100 of the proof stress in N/mm²). The marking of two vertical bars (| |) refers to the applicable proof loads according to DIN 267-4.

For nuts with a nominal height of ≥ 0.8 D, e.g. nuts according to ISO 4032, ISO 8673, the marking is a number, for instance (8 = 1/100 of the proof stress in N/mm²), without marking of two vertical bars (| |), here the proof loads apply according to ISO 898-2.

Marking: Hexagon head nuts of this group are to be marked from a thread diameter of ≥ M 5 with the manufacturer's identification mark and the property class in accordance with Table 2 or Table 3.



8
8

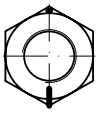
Table 3: Assignment of the nut property classes to the screw property classes

Property class of the nut	Associated screw/bolt/stud		Nut - Thread range	
	Property class	Thread range	Type 1[1)]	Type 2[1)]
4	4.6 4.8	> M 16	> M 16	
5	4.6 4.8 5.6 5.8	≤ M 16 ≤ M 39	≤ M 39	
6	6.8	≤ M 39	≤ M 39	
8	8.8	≤ M 39	≤ M 39	> M 16 ≤ M 39
10	10.9	≤ M 39	≤ M 39	
12	12.9	≤ M 39	≤ M 16	≤ M 39

1) The type determines the necessary proof loads in ISO 898-2.

Note in accordance with ISO 898-2: In general, nuts from the higher property class can be used instead of nuts from the lower property class. This is recommended for a screw-nut fastening with loads above the yield stress or above the proof stress.

Table 4: Alternative marking of the property class with symbols (clock system)

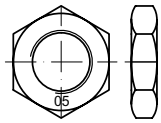
Property class	4	5	6	8	10	12 [2)]
Marking						

2) The marking placement cannot be replaced by the manufacturer's identification mark

Nuts with nominal height ≥ 0.5 D < 0.8 D

For nuts with a nominal height of ≥ 0.5 D < 0.8 D, e.g. nuts according to ISO 4035, ISO 8675 and DIN 439-2 the marking is a number prefixed with "0", e.g. (05 = 1/100 of the proof stress in N/mm²).
The prefixed 0 shows that nuts from this group cannot or can only limitedly take on the loads of a screw due to the low nut height.

Marking: Hexagon head nuts of this group are to be marked from a thread diameter of ≥ M 5 with the manufacturer's identification mark and the property class.



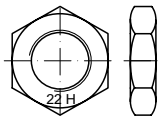
05

Nuts with nominal height < 0.5 D

For nuts with nominal height < 0.5 D, for example, nuts according to DIN 936, there is a marking of 1/10 of the minimum hardness according to Vickers, e.g. 22 H (= 220 HV).

Nuts for easy fastenings without specified proof load values are included in this group.
The hardness classes for these nuts are specified in DIN 267-24.

Marking: Nuts of the hardness class 22 H are to be marked with a hardness class if the thread diameter ≥ M 5.



22 H

Properties for fasteners made of steel with inch thread as per ASME standards

The properties of fasteners as per American ASME standards are regulated in the following standards among others:

- Hexagon head and square head screws: ASME B18.2.1-2010
- Hexagon socket head cap screws: ASME B18.3-2012
- Nuts: ASME B18.2.2-2010
- Plain washers: ASME B18.22.1-1965

The property classes/mechanical properties for these fasteners are regulated in different norms and standards that are partly included in the product standards. A clear and strict separation as in the field of DIN/EN/ISO standards in product and function standards is not present in the field of ASME standards.

Properties of hexagon head screws as per ASME B18.2.1-2010 Table 6

The ASME B18.2.1-2010 standard regulates the properties of hexagon head and square head screws with inch thread. The standard specifies 8 different product geometries here. An important difference is the difference between so-called "bolts" and "screws". Unfortunately there is no generally valid definition of "bolts" and "screws". In the area of hexagon head screws, "bolts" are always screws without a pronounced washer face; in contrast "screws" always have a washer face. The properties of hex cap screws (ASME B18.2.1-2010 Table 6) are dealt with in more detail in the following. There is no difference between partial and full thread in this standard; screws up to a specific length are supplied with full thread, longer products with partial thread.

Table 5: Overview of full thread/partial thread as per ASME B18.2.1-2010

Diameter in inches	Dimensions with full thread (R 83933)	Dimensions with partial thread (R 83931)	Minimum and maximum length of partial thread in inch	
	Length to in inch	Length from to in inch	min.	max,
1/2	1 1/8	1 1/4 to 6	3/4	1,000
5/16	1 1/4	1 5/16 to 6	7/8	1,153
3/8	1 3/8	1 1/2 to 6	1	1,312
7/16	1 5/8	1 3/4 to 6	1 1/8	1,482
1/2	1 3/4	1 7/8 to 6	1 1/4	1,635
9/16	2	2 1/8 to 6	1 3/8	1,792
5/8	2 1/8	2 1/4 to 6	1 1/2	1,955
3/4	2 1/2	2 5/8 to 6	1 3/4	2,250
7/8	2 3/4	2 7/8 to 6	2	2,556
1	3	3 1/8 to 6	2 1/4	2,875
1 1/8	3 1/2	3 5/8 to 6	2 1/2	3,214
1 1/4	3 3/4	3 7/8 to 6	2 3/4	3,464
1 3/8	4 1/4	4 5/16 to 6	3	3,833
1 1/2	4 1/2	4 5/8 to 6	3 1/4	4,083
1 3/4	5 1/8	5 1/4 to 6	3 3/4	4,75
2	5 3/4	5 7/8 to 6	4 1/4	5,361
2 1/4	6 1/2	6 5/8 to 12	5	5,861
2 1/2	7 1/8	7 1/4 to 12	5 1/2	6,500
2 3/4	7 5/8	7 3/4 to 12	5 3/4	7,000
3	8 1/8	8 1/4 to 12	6 1/2	7,500

REYHER nevertheless offers a separation here, item 83931 corresponds to the longer dimensions with partial thread and item 83933 corresponds to the shorter dimensions with full thread.

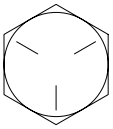
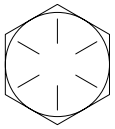
The thread tolerances for inch screws are regulated in the ASME B18.1.1 standard where the following tolerances apply:

- Tolerance limit 2A prior to galvanic coating,
- Tolerance limit 3A (go-master ring) and 2A (no-go gauge) after the coating

unless otherwise agreed.

The mechanical properties for screws as per ASME B18.2.1 are defined in accordance with the SAE J429 standard (see Table 5). Strengths are normally specified there in psi (pound-force per square inch), 1000 psi = 6,895 N/mm².

Table 6: Mechanical properties of hexagon head screws as per ASME B18.2.1/SAE J429

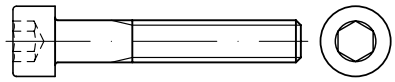
Property class	Grade 5 (~ 8.8)		Grade 8 (~ 10.9)
Properties	Ø > ¼ – 1	Ø > 1 – 1½	Ø > ¼ – 1
Tensile strength N/mm²	827	724	1034
psi	120.000	105.000	150.000
0.2 % yield strength N/mm²	634	558	896
psi	92.000	81.000	130.000
Elongation at fracture in %	Min. 14%		Min. 12%
Rockwell core hardness in HRC min.-max.	25 - 34	19 - 30	33 - 39
Marking of the property class			

Screws as per ASME B18.2.1 should be marked with the manufacturer's mark and the property class as per SAE J429.

Properties for fasteners made of steel with inch thread as per ASME standards

Properties of hexagon socket head cap screws as per ASME B18.3-2012 Table 1

The ASME B18.3-2012 standard regulates the properties of hexagon socket head cap screws with inch thread. The 1936 version of the standard was thoroughly revised in 1960. The head geometry had also changed. The goods supplied by REYHER comply fully with the "1960 series"; the "1936 series" can be obtained on request. The ASME B18.3 standard specifies 5 different product geometries here (including countersunk head and lower head height). The hexagon socket head cap screws (comparable to DIN 912/ISO 4762) are described in detail in the following.



The thread tolerances for inch screws are regulated in the ASME B18.1.1 standard where the following tolerances apply:

- Up to and including 1 inch: Class 3A,
- Above 1 inch: Class 2A.

The mechanical properties for screws as per ASME B18.3-2012 Table 1 are only defined in accordance with the ASTM A574 standard (see Table 6). Strengths are normally specified there in psi (pound-force per square inch), 1000 psi = 6.895 N/mm².

These screws should only be marked with the manufacturer's mark as only one property class is provided for this product. The head of the hexagon socket head cap screw can be knurled at the choice of the manufacturer. A galvanic coating should be avoided due to the high tensile strength and the associated danger of hydrogen embrittlement.

Table 7: Mechanical properties of hexagon socket head cap screws as per ASME B18.3/ASTM A574

Properties	Steel as per ASTM A574 (~ 12.9)	
	Ø ≤ ½	Ø > ½
Tensile strength N/mm² psi	1241 180.000	1172 170.000
0.2 % yield strength N/mm² psi	1054 153.000	
Elongation at fracture in %	Min. 10%	
Rockwell core hardness in HRC min.-max.	39 - 45	37 - 45

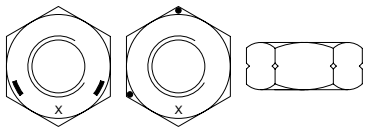
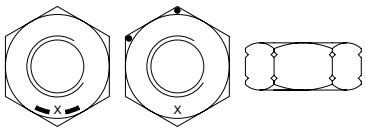
Properties of nuts as per ASME B18.2.2-2010 Table 7

The ASME B18.2.2 standard regulates the properties of nuts with inch thread. On the other hand, this standard specifies 14 different product types, thus "hex nuts" are the products that are listed as item 83934 in this catalogue.

The thread tolerances for nuts are also regulated in the ASME B18.1.1 standard; the nuts are supplied in tolerance class 2B unless agreed otherwise. These nuts can be screwed together with zinc plated and non zinc plated products.

The mechanical properties for nuts as per ASME B18.2.2 are defined in accordance with the SAE J995 standard (see Table 7). Strengths are normally specified there in psi (pound-force per square inch), 1000 psi = 6.895 N/mm².

Table 8: Mechanical properties of "hex nuts" as per ASME B18.2.2/SAE J 995

Property class Properties	Grade 5 (~ 8)		Grade 8 (~ 10)		
	Ø > ¼ – 1 UNC	Ø > 1 – 1½ UNC	Ø > ¼ – ⅝ UNC	Ø > ⅝ – 1" UNC	Ø > 1 – 1½ UNC
Tension under test force N/mm² psi	827 120.000	723 105.000	1034 150.000		
Rockwell core hardness in HRC min.-max.	≤ 32		24 - 32	26 - 34	26 - 36
Marking of the property class					

Nuts as per ASME B18.2.2 should be marked with the manufacturer's mark and the property class.

Properties of washers as per ASME B18.22.1-1965 Type A

The ASME B18.22.1 standard regulates the properties of washers for screws with inch thread. The standard essentially differentiates 2 versions: "Narrow " and "Wide". The difference between the two versions is in the larger outside diameter for the washers of the "wide" version (see table of dimension pages).

There are no requirements on mechanical properties for the "plain" version washers; they should only be produced from steel materials. An overview of washer properties is given in Table 8.

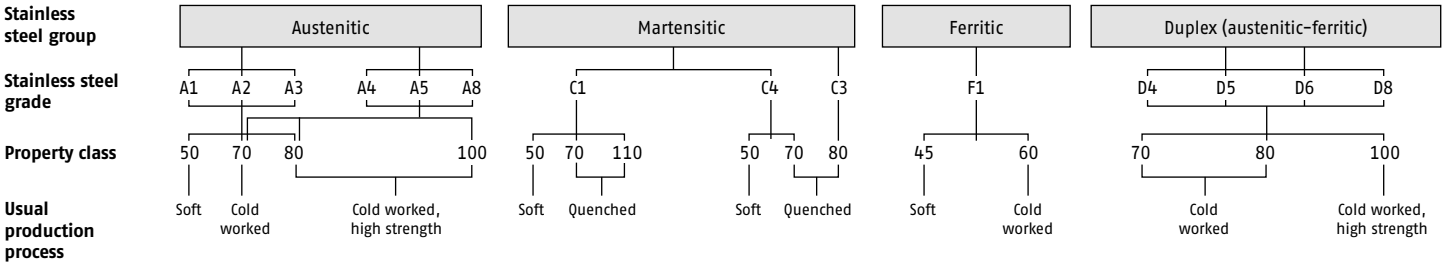
Table 9: Mechanical properties of washers as per ASME B18.22.1/ASTM F436

Properties	Plain washers	Hardened washers as per ASTM F436		
	ASME B18.22.1	Hardened, bare or ZP	Hardened, HDG	Case hardened
Rockwell core hardness in HRC min.-max.	No specification	38 - 45	26 - 45	Min. 30 HRC
Case hardness depth/case hardness HR15N - Bare/ZP - HDG				 0.015"/79 – 83 0.015"/73 - 83

Properties: Fasteners from stainless steels

The mechanical properties of fasteners from corrosion-resistant stainless steel as well as their quality inspection and marking are set in ISO 3506. Parts 1 and 2 are currently being revised, and a new part 6 (General rules for the selection of stainless steels and nickel alloys for fasteners) is under development. Extracts from these drafts and scripts are also presented here.

According to ISO 3506, stainless steels are divided into four steel groups according to their steel structure. The different steel types of stainless steels can be obtained with various materials and have different properties in terms of corrosion resistance and function.



The fasteners' surface condition (passivation ➔ ISO 16048, surface roughness etc.) may affect the corrosion resistance of the fastener. Fasteners made of stainless steels can be used in low temperature environments as follows:

- martensitic, ferritic, and Duplex steel are suitable for working environments of down to -40 °C
- austenitic steel is suitable for operating environments of down to -196 °C (screws with head down to -60 °C, headless screw down to -200 °C per DIN 267-13)

Austenitic steels (A)

Austenitic stainless steels are generally divided into austenitic chrome nickel steels (A1 to A3) and austenitic chrome nickel molybdenum steels (A4 to A8). Austenitic stainless steels cannot be hardened with heat treatment. The mechanical properties of the fasteners are normally achieved by cold working. Copper can help improve the workability of the austenitic structure.

Under the following conditions, A2 and A4 steels can be more susceptible to intercrystalline corrosion:

- the carbon content is higher than 0.030% and/or
- the steel is exposed to high temperatures (either during the manufacturing process, a welding process or in its operating environment)

In these cases, steels with a carbon content of less than 0.030% (A2L or A4L) or stabilized austenitic steels of the types A3 or A5 may be used.

A8 is a high-alloy austenitic stainless steel with significantly higher corrosion resistance compared to A4.

Austenitic steels are usually not magnetic in annealed condition, however, cold forming that occurs during the manufacturing process of fasteners, may lead to a certain degree of residual magnetism.

The steel types A1 – A3 are **not** suitable for use in oxidizing acids or in an environment with chloride (e.g. in swimming pools where chloride is used as a cleaning agent, or in marine environments).

Permeability

A 2:	μ_r P 1.8
A 4:	μ_r P 1.015
A 4L:	μ_r P 1.005

Excerpt from ISO 3506-1 Annex H

A1: Stainless steels of steel type 1 are designed particularly for mechanical processing. Due its high sulphur content this type is less corrosion resistant than the respective steels with normal sulphur content.

A2: Type A2 stainless steels are the steel types that are mostly used for compressed fasteners. They are more resistant to corrosion than A1.

A3: Type A3 stainless steels have similar properties to type A2 steels; however, their temperature resistance is increased (typically up to 350 °C) They are stabilized by adding titanium or niobium, which combine carbon and nitrogen.

A4: A4 type stainless steels are often called "acid-resistant steels", contain molybdenum as an alloy and are much more corrosion resistant. This steel type can be used in environments containing chloride, but not in swimming pool areas with chloride as a cleaning agent and not in many maritime environments.

A5: Type A5 stainless steels are stabilized steels with the same properties as A4 type steels; however they are more temperature-resistant (typically up to 350 °C). They are stabilized by adding titanium or niobium, which combine carbon and nitrogen. This steel type can be used in environments containing chloride, but not in swimming pool areas with chloride as a cleaning agent and not in many maritime environments.

A8: Type A8 steels are also known as "6% Mo" steels. They are highly resistant against all types of corrosion, including pitting corrosion, crevice corrosion and stress crack corrosion. They are suitable for use in swimming pools, where chloride is used as a cleaning agent; however, specific requirements and/or regulations for buildings and structures should be considered. They can also be applied in maritime environments.

Martensitic steels (C)

Three martensitic steel types C1,C3, and C4 are contained in the ISO 3506 standard. They can be hardened by quenching.
The mechanical properties are increased with increasing carbon content. For this reason, the chromium content is increased in order to achieve suitable corrosion resistance. The martensitic steel types are normally less corrosion resistant than austenitic steel types.
In temperatures below zero, their use shall be considered carefully, as martensitic stainless steels are less resistant to impacts and less ductile than austenitic steels. Martensitic steels are always highly magnetic.

Properties: Fasteners from stainless steels

Ferritic steels (F)
The mechanical properties of ferritic steels are achieved with cold working (cold forming), where the efficiency is however reduced in comparison to austenitic stainless steels. Ferritic steels are always magnetic. If the corrosion resistance required for a certain application can be lower than that of steel types A2 or A3, the stainless steel type F1 may be a good economic solution. Type F1 steel shall however not be used in temperatures below –20 °C, as ferritic stainless steels are less resistant to impacts and less ductile.

Duplex steels (D)
The structure of duplex steels is composed of a mixture of ferrite and austenite grains with a ferrite content of typically 40 to 60 percentage by volume. In solution heat treated condition, the strength of stainless duplex steels is considerably higher than the strength of austenitic stainless steels and can be additionally increased through cold working. However, ductility will be reduced in this process. Duplex steel types are normally described as follows:

- "Lean-Duplex" with low alloy content of particularly nickel and molybdenum (D2 and D4),
- "Standard-Duplex" (D6),
- "Super-Duplex" with high alloy content (D8).

In comparison to austenitic stainless steels A1 to A5, Duplex steels show clearly improved resistance to stress crack corrosion. Duplex steels should be applied only within a temperature range of –40 °C to +250 °C.

D2/D4: In terms of pitting corrosion and crevice corrosion, corrosion resistance of D2 is at least equivalent to that of A2, and corrosion resistance of D4 is at least equivalent to that of A4.

D6: "Standard-Duplex" contains more than 2.5% molybdenum. This helps to improve its corrosion resistance in terms of pitting corrosion and crevice corrosion in comparison to A1 to A5 and D4.

D8: The corrosion resistance of this "Super-Duplex" is comparable to that of A8.

Marking: Hexagon head, hexagon and hexalobular socket head cap screws, studs and nuts with a thread diameter of ≥ M 5 (studs ≥ M 6) are to be marked with manufacturer symbol, steel grade and property class.

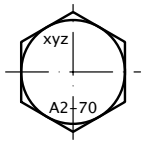


Table 9: Mechanical properties for fasteners of A 1 – A 8, D2 – D8 and BUMAX88/109 at approx. +20 °C

		Screws				Nuts	
						Proof stress Sp/N/mm² min.	
Property class	Diameter range	Tensile strength Rm N/mm² min.	0.2 % Yield strength N/mm² min.	Temperature impact on 0.2% Yield strength	Elongation after fracture A mm min.	m ≥ 0.8 d	0.5 d ≤ m < 0.8 d
50	≤ M 39	500	210		0.6 d	500	250 (property class - 025)
70	≤ M 24	700	450	Only for austenitic materials A 1 – A 8 at 100 °C = 85% at 200 °C = 80% at 300 °C = 75% at 400 °C = 70%	0.4 d	700	350 (property class - 035)
80	≤ M 24	800	600		0.3 d	800	400 (property class - 040)
100*	not specified	1000	800		0.2 d	1000	500 (property class - 050)
BUMAX88	≤ M 36	800	640	at 200 °C = 90% at 300 °C = 85% at 400 °C = 80%	0.3 d	800	–
BUMAX109	≤ M 12 M14 - M 20	1000 1000	900 800	at 200 °C = 95% at 300 °C = 95% at 400 °C = 90%	0.2 d	1000	–

*Property class 100 as per draft ISO 3506-1/-2:2018-02

Table 10: Chemical composition in % acc. to ISO 3506/EN 10088-3

Steel grade	Common materials (ISO/DIS 3506-6)	C	Cr	Mo	Ni	Cu
A1	1.4305 (303)	0.12	16 - 19	0.7	5 - 10	(1.75-) 2.25
A2	1.4301 (304)	0.10	15 - 20	-	8 - 19	4
A3	1.4541 (321)	0.08	17 - 19	-	9 - 12	1
A4	1.4401 (316) BUMAX88 BUMAX109	0.08	16 - 18.5	2.0 - 3.0	10 - 15	4
A5	1.4571 (316 TI)	0.08	16 - 18.5	2.0 - 3.0	10.5 - 14	1
A8*	1.4529	0.03	19 - 22	6.0 - 7.0	17.5 - 26	1.5
C1	1. 4021	0.09 - 0.15	11.5 - 14	-	1	
C3	1. 4057	0.17 - 0.25	16 - 18	-	1.5 - 2.5	
C4	1. 4005	0.08 - 0.15	12 - 14	0.6	1	
F1	1. 4016	0.08	15 - 18	-	1	
D2*	1. 4482	0.04	19 - 24	0.10 - 1.0	1.5 - 5.5	3
D4*	1. 4062	0.04	21 - 25	0.10 - 2.0	1.0 - 5.5	3
D6*	1. 4462	0.03	21 - 26	2.5 - 3.5	4.5 - 7.5	
D8*	1. 4410	0.03	24 - 26	3.0 - 4.5	6.0 - 8.0	2.5

Extract from ISO 3506-1 with the most important chemical elements (more details ➔ ISO 3506).
*New steel types as per draft ISO 3605-1/-2: 2018-02

Chemical resistance of stainless steel fasteners A 2 and A 4

In practice, the resistance specifications can change; the pure agents rarely have an effect, admixtures often strengthen or weaken the attack. Residue on the part can also change the conditions. The safest approach is always to check the operating conditions.

Table 16: Extract from the resistance list
(Further information on request and from www.reyher.de)

Agents	Degree of resistance	
	A 2	A 4
Acetic acid, cold	1	1
Acetone, all conc.	1	1
Al (10%), cold	1	1
Alum saturated solution, boiling	3	1
Aluminium acetate	1	1
Aluminium saturated, cold	2	1
Aluminium sulphate (10%), cold	1	1
Ammonium carbonate	1	1
Ammonium nitrate	1	1
Ammonium sulphate, cold	1	1
Ammonium sulphite	1	1
Aniline	1	1
Azotic acid up to 60%, cold	1	1
Beer	1	1
Benzine	1	1
Benzoic acid	1	1
Benzol	1	1
Boric acid	1	1
Butyl acetate	1	1
Calcium bisulphite, boiling	3	1
Calcium bisulphite, cold	1	1
Calcium hydroxyde (10–50%), cold	1	1
Calcium nitrate	1	1
Camphor	1	1
Carbon dioxide	1	1
Carbon disulphide	1	1
Carbon tetrachloride, waterless	1	1
Chlorine, dry	1	1
Chloroform, waterless	1	1
Chromic acid (10%), cold	1	1
Chromic boiling	2	2
Citric acid 50%, boiling	3	2
Citric acid saturated, cold	1	1
Copper acetate	1	1
Copper arsenite	1	1
Copper nitrate	1	1
Copper sulphate	1	1

Agents	Degree of resistance	
	A 2	A 4
Creosote	1	1
Developer (photo)	1	1
Ethyl acetate	1	1
Ethyl alcohol, all conc.	1	1
Ethylether, boiling	1	1
Fatty acid, 150 °C	1	1
Formalin	1	1
Formic acid, cold	1	1
Fruit juices	1	1
Glue oil	1	1
Glycerine	1	1
Hydrogen cyanide	1	1
Hydrogen peroxide	1	1
Hydrogen sulphide	1	1
Iron nitrate	1	1
Iron sulphate	1	1
Lactic acid (80%), boiling	3	2
Lactic acid all conc., cold	1	1
Latex	1	1
Lime milk	1	1
Liquid ammonia	1	1
Liquid gases (propane, butane)	1	1
Magnesium sulphate	1	1
Maleic acid	1	1
Mercury	1	1
Mercury amalgam	1	1
Mercury nitrate	1	1
Methyl alcohol	1	1
Molasses	1	1
Nickel sulphate	1	1
Nitrous acid	2	1
Oils (lubricating and vegetable oils)	1	1
Oxalic acid, 5%, cold	1	1
Phenol, boiling	2	1
Phosphoric acid up to 70%, cold	1	1
Photograph. Developer/Fixer	1	1
Potash	1	1

Agents	Degree of resistance	
	A 2	A 4
Potassium bichromate (25%)	1	1
Potassium bitartrate, cold	1	1
Potassium chlorate	1	1
Potassium cyanide	1	1
Potassium hydroxyde (caustic potash)	1	1
Potassium nitrate	1	1
Potassium permanganate	1	1
Potassium sulphate	1	1
Salicylic acid	1	1
Salt water, 20 °C	1L	1L
Soap	1	1
Sodium aluminate	1	1
Sodium bisulphate, boiling	1	1
Sodium bisulphide, boiling	1	1
Sodium carbonate (soda)	1	1
Sodium hydroxide, cold	1	1
Sodium nitrate	1	1
Sodium perchlorate	1	1
Sodium phosphate	1	1
Sodium silicate	1	1
Sodium sulphide	1	1
Sodium sulphite	1	1
Sulphur (molten)	1	1
Sulphur chloride, waterless	1	1
Sulphur dioxide	1	1
Sulphuric acids, saturated, 20 °C	1	1
Tannic acid	1	1
Tar	1	1
Tartaric acid	1	1
Treacle	1	1
Trichloroethylene, waterless	1	1
Viscose	1	1
Waste waters without acid sulphur	1	1
Wine	1	1
Zinc sulphate	1	1

1 – resistant (substance loss less than 0.1 g/m² x h)
2 – conditionally resistant (substance loss of 0.1 to 1.0 g/m² x h)
3 – not very resistant (substance loss of 1.0 to 10.0 g/m² x h)
4 – not resistant (substance loss over 10.1 g/m² x h)
L – danger of hole, crack or stress corrosion

Fasteners in indoor swimming pool environments Field of application	Materials
Non-loaded fasteners with occasional refilling/areas which come into contact with pool water which have to be cleaned regularly (e.g. section at the side of the pool, decorative linings)	1.4401 (A 4) 1.4404 (A 4L) 1.4571 (A 5)
Non-loaded fasteners with occasional refilling/areas which come into contact with pool water which do not have to be cleaned regularly (e.g. overflow basins, steel gratings and slides)	1.4439 1.4539 1.4462 (D 6)
Non-loaded fasteners with occasional refilling/areas which come into contact with pool water which do not have to be cleaned regularly (e.g. overflow basins, steel gratings and slides)	1.4539* 1.4529* (A 8) 1.4565* 1.4547* (A 8)

*general technical approval Z-30.3-6

On the blue catalogue pages: The large REYHER article range of stainless steels.

Properties: Fasteners from non-ferrous materials

The mechanical properties of fasteners from non-ferrous materials as well as their quality inspection and marking are set in ISO 8839.

Table 17: Metallic non-ferrous materials (Cu, MS, Al, Ti) for fasteners and special parts
(Extract from ISO 8839/DIN 267-18)

Material Marking	Material code	Material no.	Tensile strength R_m N/mm² min.	Stress at 0.2% non-proportional elongation N/mm² min.	Elongation after fracture A % min.	Notes
CU 1	E-Cu57	2.0060	240	160	14	–
CU 2	CuZn37 (MS 63)	2.0321	370-440	250-340	19-11	Storage of compressed parts
CU 3	CuZn39Pb3 (MS 58)	2.0401	370-440	250-340	19-11	Storage of turned parts
CU 4	CuSn6	2.1020	400-470	200-340	33-32	–
CU 5	CuNi1, 5Si	2.0853	590	540	12	saltwater-proof
CU 6	CuZn40MnPb	2.0580	440	180	18	–
CU 7	CuAl10Ni	2.0966	640	270	15	–
AL 1	AlMg3	3.3535	250-270	180-230	4-3	conditionally saltwater-proof
AL 2	AlMg5	3.3555	280-310	200	6	saltwater-proof
AL 3	AlMgSi1	3.2315	310	250	10-7	–
AL 4	AlCuMg1	3.1325	380-420	260-290	10-6	–
AL 5	AlZnMgCu0,5	3.4345	460	380	7	–
AL 6	AlZnMgCu1,5	3.4365	510	440	7	–
Ti 1	Titanium (Titanium 99.5)	3.7025	290	180	30	Storage (➔ yellow catalogue pages)
Ti 2	TiAl6V4	3.7165	890	820	10	–

Table 18: Saltwater-proof copper alloys for fasteners and special parts
(Extract from DIN 17660, 17664, 17666)

Description	Material no.	Composition approx. %	Tensile strength Rm approx N/mm²	Stress at 0.2% nonproportional elongation $R_{p\,0,2}$ approx N/mm²	Elongation after fracture As approx %
SO-MS 59	2.0540	Cu 59/Zn 36/Ni 2/Mn 1,5	500	300	18
RESISTIN	–	Cu 85/Mn 14/Fe 1	520	400	17-12
CuNiSi	2.0853	Cu 98/Ni 1,5/Si 0,5	590	540	10
CUNIFER	2.0872	Cu 88/Ni 10/Fe 1/Mn 0,5	280-360	100-250	30-10
CUNIFER	2.0882	Cu 69/Ni 30/Fe 0,5/Mn 0,5	340-420	120-300	35-14

Table 19: Plastic materials (thermoplastics) fasteners and special parts
(General values – Further details – Spec. coarse tolerances ➔ VDI 2544 or on request)

Material code	Material group (trade name)	Density g/cm³	Yield stress dry-humid approx. N/mm²	Elongation after fracture approx. %	Modulus of elasticity dry-humid approx. N/mm²	Operating temperature -/+ approx. °C
PA 6	Polyamide 6 (Ultramide)	1.14	80-30	130-220	2700-1800	-40/+80-130
PA 66	Polyamide 6.6 (Ultramide A)	1.14	85-50	40-170	3000-1900	-20/+80-140
POM	Polyacetal (Delrin 150)	1.42	69	30	3000	-40/+100-130
PP	Polypropylene (Hostalen PPH)	0.91	30-35	15	1000-1300	-10/+100-120
PA 12	Polyamide 12	1.01	55-48	150-350	1800-1300	-0/+100
PC	Polycarbonate	1.2	60	80-100	2100	-0/+130
PA 66 (gfv)	with 35% glass fibre	1.39	190-140	5	9500-8500	-40/+100-140

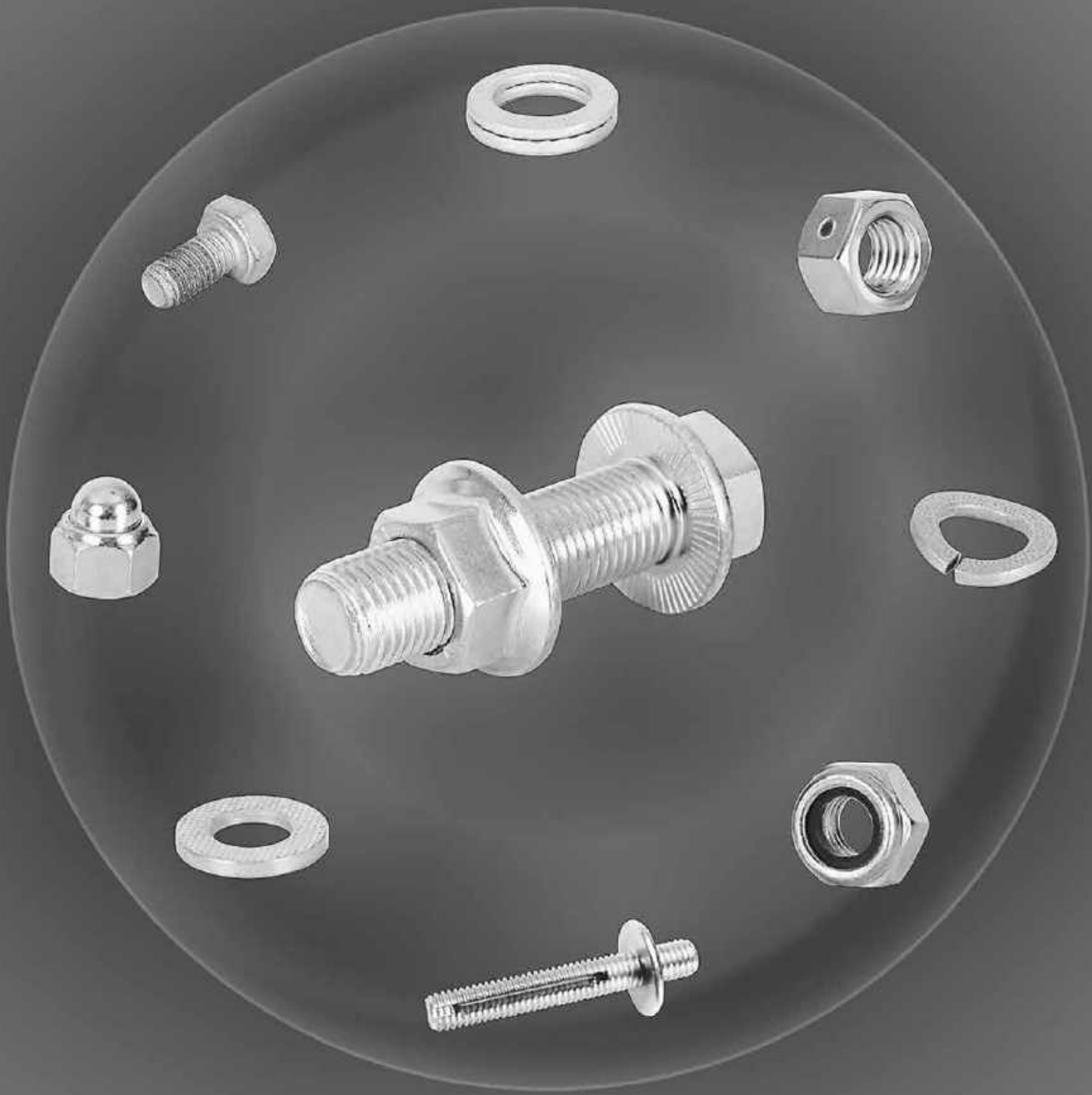
Fasteners in stock = PA 6/PA 6.6 natural-colour/milky-white, if not specified otherwise.
From the other materials, fasteners can be supplied on short notice, other materials on request.

*Information from DIN 34810

Standard and special parts according to drawings can be delivered for different applications in all necessary special materials – in any amount required.
The table shows some examples of frequently requested special materials, roughly ordered according to application area:

Material group Particular properties/areas of application		Material no. (AISI)	Material designation (previous)	Standard/ Material data sheet
Stainless steels – [1]	F 1	1.4016	X6Cr17 (X8Cr17)	EN 10088 (DIN 17440)
a) ferritic (F) and martensitic (C) Greater mechanical properties with less corrosion-resistance	C 1 C 1 C 3 C 4	1.4006 (410) 1.4021 (420) 1.4057 (431) 1.4104 (430 F)	X10Cr13 X20Cr13 X20CrNi172 (X20CrNi17) X12CrMoS17	ISO 3506 (DIN 267-11)
		1.4034 (420)	X46Cr13 (X40Cr13)	
b) austenitic (A) Increased corrosion resistance, rust and acid-resistant, tough at sub-zero temperatures	A 3	1.4541* (321)	X6CrNiTi1810	EN 10088 (DIN 17440)
	A 4 A 5 A 4	1.4436 (319) 1.4571* (316 Ti) 1.4580 (316 Cb)	X5CrNiMo17133 (X5CrNiMo1812) X6CrNiMoTi1722 X6CrNiMoNb17122 (X10CrNiMoNb1810)	ISO 3506 (DIN 267-11) * DIN 267-13
		1.4310** (301)	X12CrNi177	** SEW 400
Rust and acid-resistant steel For particular corrosion media e.g. for use in indoor swimming pools	Uranus B 6 Austenitic Austenitic	1.4539 1.4439 1.4529	X1NiCrMoCu 25 20 5 X2CrNiMoN 17 13 5 X1NiCrMoCuN 25 20 7	ISO 3506-1, E1 (especially resistant against chloride-induced stress corrosion)
	Austen./ferritic	1.4462	X2CrNiMoN 22 5 3	
Steels tough at sub-zero temperatures Increasing strength and stretch limit behaviour and high toughness at temperatures as low as – 195 °C (SEW) or – 253 °C (AD)	Marking KA Marking KB Marking KC Marking KD	1.7219 1.5680 1.6900 1.6903	26CrMo4 12Ni19 X12CrNi189 X10CrNiTi1810	DIN 267-13 SEW 680/70
	A 2 A 2 A 3 A 4 A 5	1.4301 (304) 1.4303 (305) 1.4541 (321) 1.4401 (316) 1.4571 (316 Ti)	X5CrNi1810 X5CrNi1812 X6CrNiTi1810 X5CrNiMo17122 X6CrNiMoTi17122	ISO 3506 (DIN 267-11) DIN 267-13 EN 10088 (DIN 17440) ADW 2/ADW 10
Highly heat-resisting and heat-resistant steels Good temperature-resistance with medium to lower mechanical properties		1.1181 1.7218 1.7709	C35E 25CrMo4 21CrMoV5-7	DIN 267-13 EN 10269
	Nimonic 80 A Nimonic 90 Nimonic 105	2.4631/2.4952 2.4632/2.4969 2.4634	NiCr20TiAl NiCr20Co18Ti NiCo20Cr15MoAlTi	EN 10269 (DIN 17240, DIN 17480 DIN 17225)
	(Sicromal 8) (Sicromal 10) (Sicromal 12)	1.4713 1.4724 1.4742 1.4762 1.4821 1.4828 (309) 1.4841 (310) 1.4845 (310 S) 1.4864 (330)	X10CrAl7 X10CrAl13 X10CrAl18 X10CrAl24 X20CrNiSi254 X15CrNiSi2012 X15CrNiSi2520 X12CrNi2521 X12NiCrSi3616	SEW 470/76
Non-magnetisable steels – [1] Mechanical properties (tensile strength, stretch limit, toughness) are dependent on the processing state - e.g. quenched, hot/cold-shaped, fully hardened	Amanox 182M 9	1.3805 1.3813 1.3817 1.3819 1.3952 1.3960 1.3965 (202) 1.3967	X35Mn18 X40MnCrN19 X40MnCr18 X50MnCrV2014 X4CrNiMoN1814 X45MnNiCrV1376 X8CrMnNi188 X50CrMnNi229	SEW 390/61
Nickel, nickel alloys High corrosion resistance, saltwater-proof, very high to highest resistance against aggressive chemical agents, higher oxidation resistance, high to optimum mechanical properties and fatigue strength - also at higher temperatures	Nickel 99.6 Nickel 99.2 Nickel 99	2.4060 2.4066 2.4068	Ni 99.6 Ni 99.2 LC-Ni 99	EN 10088 (DIN 17740)
	Hastelloy B Hastelloy C	2.4617 2.4610	NiMo28 NiMo16Cr16Ti	DIN 17744
	Monel 400/Silverin K-Monel/Silverin Al	2.4360* 2.4375	NiCu30Fe NiCu30Al	DIN 17743 * ASTM B 164 Class A
	Inconel 600/625 Nicrofer 7216 Inconel X 750/ Nimonic 80 A Incolloy 825/ Nicrofer 4221	2.4816/2.4856 2.4952* 2.4858	NiCr15Fe NiCr15Ti7Al/NiCr20TiAl NiCr21Mo	DIN 17742 DIN 17744 * EN 10269 (DIN 17240) * DIN 267-13
Titanium, titanium alloys Low specific weight, high corrosion resistance, salt-water proof, anti-magnetic	Titan 992 (Grade 4) Titan 993 (Grade 3) Titan 994 (Grade 2) Titan 995 (Grade 1) Ti 1	3.7065 3.7055 3.7035 3.7025*	Ti 99.2 Ti 99.3 Ti 99.4 Ti 99.5	DIN 17850 DIN 17860 DIN 17862 DIN 17863 DIN 17864 * ISO 8839 (DIN 267-18)
	Titan Al 6V4 Titan Grade 5/Ti 2	3.7164 3.7165*	TiAl6V4 TiAl6V4	DIN 17851 WL-sheets * ISO 8839 (DIN 267-18)

1) further austenitic materials, see "Parts made from stainless steels" ➔ TI-224



General information and tightening methods

General information

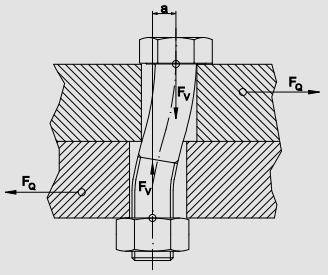
Functional quality and fatigue limit of fasteners are mainly determined with the following factors:

- Mechanical properties (tensile strength, yield strength, elongation)
- Operating conditions (static/dynamic...)
- Service conditions (temperature, corrosion)
- Dimensioning (diameter, length)
- Locking against loosening and unscrewing if necessary
- Assembly (tightening method, preload/clamp load, tightening torque...)

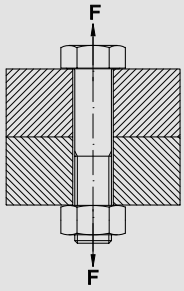
While taking into account all requirements, the task of constructive planning is to determine the suitable fasteners, to define them with the standardised descriptions and to provide the necessary assembly instructions.

The VDI guideline 2230 is available as the recognised standard reference for the "systematic evaluation of highly stressed fasteners".

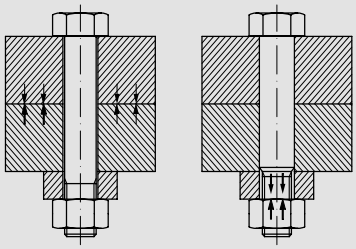
Fasteners should be evaluated and assembled in such a way that transverse loads (FQ) perpendicular to the centre of the screw do not have any effect because of the sufficiently intact clamp load under operating conditions. Here, loss of clamp load due to intrusions of parts into materials also needs to be taken into account. If the transverse loads are larger than the clamp load, this will lead to the screwed fastening loosening, and ultimately, to its failure.



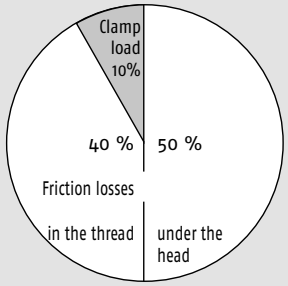
Transverse load F_Q



Preload F_V,
Clamp load F_S



Clamp load F_{KL}



Reaction ratio of tightening torque in clamp load

Tightening method

Essential for the quality and fatigue limit of a fastening is the precise setting/adherence to the assembly preload. Thus alongside the size of the screw, the property class and the friction ratios, the tightening/assembly method is of vital importance during assembly. Numerous tests and theory observations have shown that 80–90% of the tightening torque is required to overcome the friction under the head and in the thread. Only a small part is actually put into generating preload.

Differentiations are made between the following methods:

Manual tightening
In general, tightening by feel with manual tools should not be done. Even with experienced workers, the spread is very large. Empirical values show that screws/bolts up to M 12 are usually tightened beyond the yield strength, while screws over M 14 are usually not tightened enough.

Torque-controlled tightening
Tightening with a torque wrench still shows quite a large spread in the preload due to the friction coefficient differences.

Impact-controlled tightening
When assembling with impact screwdrivers, the motor power of the screwdriver in the impact mechanism is converted into tangential angular momentum. This preloaded the screw step-by-step. The advantage of using the impact screwdriver is that the worker absorbs hardly any reaction torque. The disadvantage is to be found in the numerous factors of influence on the screw preloading:

- Elasticity and friction coefficients of the screwed fastening
- Elasticity of the attached tool and the extensions
- Impact strengths and frequency duration or entire impact count

Elongation-controlled tightening
The preload can be calculated from the change in length of the screw, which, for example, can be determined using an ultrasound method during assembly. This method currently offers the highest level of accuracy. However, it is quite complex and expensive.

Angle controlled-tightening
With this method the screw is first preloaded by rotation torque then turned further by a mathematically calculated rotation angle until the ductile deformation starts. The method requires complex trials and is thus quite expensive. Furthermore, it can only be used for screwed fastenings with a long enough stretching length. The mostly ductile deformation of the screw makes it impossible to reuse.

Yield-controlled tightening
This method requires a screwing system consisting of a screwdriver, a control unit and a computer and uses the technical data for controlling, i.e. that upon reaching the yield strength of the screw, the tightening rotational torque no longer increases. The mostly ductile deformation of the screw makes it impossible to reuse.

Hydraulic tightening
Hydraulic preloading is done via the overlong end of the screw. The preloading device supports itself around the nut. The nut can be tightened in a form-fitting way or with a small amount of torque. The centre point of the hydraulic tightening is with large screws up to M 200 in system construction. For example, all screws of a flange can be tightened simultaneously which brings about a uniform distribution of load.

**Table 1: Accuracy classes of the tightening methods
Influence of the friction ratios, spread of the preloads**

Accuracy class	Spread of the preload %	Tightening factor	Influence of the friction coefficient?	Tightening method (tools)	Adjustment/Inspection method
–	± 2 to +10 ± 5 to ± 20	1.05 to 1.2 1.1 to 1.5	no	• elongation-controlled (ultrasound) • elongation measurement (mechanical)	Ultrasound sensor (PMT system) Set up and length measurement
I	± 9 to ±17	1.2 to 1.4	no	• yield-controlled • angle-controlled (power-assisted or manually)	Empirical specification of pre-tightening torque/rotation angle
II	± 9 to ± 23	1.2 – 1.6	no	• hydraulic tightening	Length/pressure measurement
III	± 17 to ± 23	1.4 – 1.6	yes	• torque-controlled (torque wrench, extension measurement, precision screwdriver)	Empirical specification of the reference tightening torque/ dynamic torque measurement
IV	± 23 to ± 33	1.6 – 2.0	yes	• torque-controlled	Reference tightening torque according to estimated friction coefficient
V	± 26 to ± 43	1.7 – 2.5	yes	• torque-controlled (screwdriver) • impulse-controlled (impact wrench)	with post-tightening torque, taken from reference tightening torque (according to estimated friction coefficient) + extra
VI	± 43 to ± 60	2.5 – 4.0	yes	• impulse-controlled (impact wrench) • manually (wrench)	without (via post-tightening torque if necessary)

**Table 2: Friction coefficients $\mu_{ges.}$
for steel screws/nuts***

Surface condition		$\mu_{ges.}$ for condition		
Male thread (screw)	Internal thread (nut/component)	non-lubricated	oiled	MoS_2-lubricated
without coating (black)	without coating	0.12 – 0.18	0.10 – 0.17	0.06 – 0.12
Mn-phosphated		0.14 – 0.18	0.14 – 0.15	0.06 – 0.11
Zn-phosphated		0.14 – 0.21	0.14 – 0.17	0.06 – 0.12
zinc plated		0.12 – 0.20	0.10 – 0.18	Attention! The friction coefficient can considerably differ depending on the type/extent of the lubrication! Protection with screw connect test recommended!
cadmium plated		0.08 – 0.14	0.08 – 0.11	
zinc plated	zinc plated	0.12 – 0.20	0.10 – 0.18	
cadmium plated	cadmium plated	0.12 – 0.16	0.12 – 0.14	

**Table 3: Friction coefficients μ_G and µK
for screws/nuts* from stainless steel**

Screw/bolt and material of screwed part	nut material	lubricants		Resilience of the joint	Friction coefficients	
		in the thread	under the head		in the thread μ_G	under the head μ_K
A 2 (~ A 4)	A 2 (~ A 4)	without	without	very big	0.26 – 0.50	0.35 – 0.50
		Special lubricating agent (chlorine-paraffin basis)			0.12 – 0.23	0.08 – 0.12
		Corrosion protection grease			0.26 – 0.45	0.25 – 0.35
		without	without	small	0.23 – 0.35	0.08 – 0.12
		Special lubricating agent (chlorine-paraffin basis)			0.10 – 0.16	0.08 – 0.12
	AlMgSi	without		very big	0.32 – 0.43	0.08 – 0.11
		Special lubricating agent (chlorine-paraffin basis)			0.32 – 0.43	0.08 – 0.11
					0.28 – 0.35	0.08 – 0.11

*Typical values according to VDI 2230-1, issue 07.86, tab. 5-6 for screws/nuts with standard contact surfaces, e.g. according to DIN 912, 931, 933, 934/ISO 4762, 4014, 4017, 4032

Blind hole thread - minimum engagement depth

The minimum engagement depth is dependent on the strength of the nut thread and the thread pitch. Reference values see table 4

Table 4: Reference values for minimum engagement depth in blind hole threads

Property class screws/bolts		8.8	8.8 10.9	10.9 12.9
Proportion Ø thread pitch *d/P*		< 9	≥ 9 < 9	≥ 9 < 9
Nut material	hard Al-alloy	1.1 *d*	1.4 *d*	–
	grey iron	1.1 *d*	1.25 *d*	1.4 *d*
	steel $R_m \leq 400$ MPa	1.0 *d*	1.25 *d*	1.4 *d*
	steel $R_m \leq 500$ MPa	0.9 *d*	1.0 *d*	1.2 *d*
	steel $R_m \leq 800$ MPa	0.8 *d*	0.9 *d*	1.0 *d*

Source: Dabel book for the mechanical engineering

Preloads and tightening torque for fasteners of steel

Preloads and tightening torque for steel shank screws with full loadability with head contact area sizes like DIN 912, 931, 933, 934, ISO 4762, 4014, 4017, 4032*

The following are taken into account in table values for M_A:

a) Friction coefficient μ_{total} = 0.14*
b) Utilisation of the minimum yield strength = 90%
c) Torsion torque when tightening

(* The friction coefficient of μ_{total} = 0.14 is generally assumed for screws and nuts in standard commercial deliveries)

Additional lubrication of the thread considerably changes the friction coefficient and brings about unspecified tightening ratios! Tightening methods and tools have different spreads (→ Tab. 1/VDI 2230-1, Tab. A8).

Table 5: Typical values for shank screws/bolts with coarse thread, friction coefficient μ_{total} =0.14

Dimensions		Stress area AS (mm²)	Preloads F_V (kN) for property class					Tightening torque M_A (Nm) for property class				
	P		4.6	5.6	8.8	10.9	12.9	4.6	5.6	8.8	10.9	12.9
M 4	0.7	8.78	1.28	1.71	4.30	6.30	7.40	1.02	1.37	3.3	4.8	5.6
M 5	0.8	14.2	2.10	2.79	7.00	10.3	12.0	2.0	2.7	6.5	9.5	11.2
M 6	1.0	20.1	2.96	3.94	9.90	14.5	17.0	3.5	4.6	11.3	16.5	19.3
M 8	1.25	36.6	5.42	7.23	18.1	26.6	31.1	8.4	11.0	27.3	40.1	46.9
M 10	1.5	58.0	8.64	11.5	28.8	42.2	49.4	17.0	22.0	54.0	79.0	93.0
M 12	1.75	84.3	12.6	16.8	41.9	61.5	72.0	29.0	39.0	93.0	137.0	160.0
M 14	2.0	115.0	17.3	23.1	57.5	84.4	98.8	46.0	62.0	148.0	218.0	255.0
M 16	2.0	157.0	23.8	31.7	78.8	115.7	135.4	71.0	95.0	230.0	338.0	395.0
M 18	2.5	193.0	28.9	38.6	99.0	141.0	165.0	97.0	130.0	329.0	469.0	549.0
M 20	2.5	245.0	37.2	49.6	127.0	181.0	212.0	138.0	184.0	464.0	661.0	773.0
M 22	2.5	303.0	46.5	62.0	158.0	225.0	264.0	186.0	250.0	634.0	904.0	1057.0
M 24	3.0	353.0	53.6	71.4	183.0	260.0	305.0	235.0	315.0	798.0	1136.0	1329.0
M 27	3.0	459.0	70.6	94.1	240.0	342.0	400.0	350.0	470.0	1176.0	1674.0	1959.0
M 30	3.5	561.0	85.7	114.0	292.0	416.0	487.0	475.0	635.0	1597.0	2274.0	2662.0
M 33	3.5	694.0	107.0	142.0	363.0	517.0	605.0	645.0	865.0	2161.0	3078.0	3601.0
M 36	4.0	817.0	125.0	167.0	427.0	608.0	711.0	1080.0	1440.0	2778.0	3957.0	4631.0
M 39	4.0	976.0	151.0	201.0	512.0	729.0	853.0	1330.0	1780.0	3597.0	5123.0	5994.0
M 42	4.5	1117.0	212.0	265.0	584.0	832.0	974.0	1605.0	2006.0	4413.0	6285.0	7354.0
M 45	4.5	1302.0	249.0	311.0	684.0	974.0	1140.0	2005.0	2506.0	5512.0	7851.0	9187.0
M 48	5.0	1468.0	280.0	350.0	770.0	1096.0	1283.0	2424.0	3030.0	6667.0	9495.0	11112.0
M 52	5.0	1753.0	335.0	419.0	922.0	1314.0	1537.0	3116.0	3896.0	8570.0	12206.0	14284.0
M 56	5.5	2024.0	387.0	484.0	1064.0	1516.0	1774.0	3883.0	4854.0	10678.0	15208.0	17797.0
M 60	5.5	2356.0	452.0	565.0	1242.0	1770.0	2071.0	4818.0	6022.0	13249.0	18870.0	22082.0
M 64	6.0	2669.0	511.0	639.0	1406.0	2003.0	2344.0	5802.0	7252.0	15955.0	22724.0	26592.0
M 68	6.0	3047.0	585.0	732.0	1610.0	2293.0	2683.0	7012.0	8765.0	19282.0	27462.0	32137.0
M 72	6.0	3451.0	665.0	831.0	1828.0	2603.0	3046.0	8379.0	10474.0	23043.0	32819.0	38405.0
M 76	6.0	3881.0	749.0	936.0	2059.0	2933.0	3432.0	9903.0	12378.0	27232.0	38785.0	45387.0
M 80	6.0	4335.0	838.0	1047.0	2304.0	3282.0	3840.0	11610.0	14514.0	31930.0	45476.0	53216.0
M 90	6.0	5580.0	1083.0	1353.0	2977.0	4240.0	4962.0	16796.0	20995.0	46188.0	65783.0	76980.0
M 100	6.0	6983.0	1359.0	1698.0	3736.0	5322.0	6227.0	23381.0	29226.0	64297.0	91574.0	107161.0

Table 6: Typical values for shank screws/bolts with fine pitch thread, friction coefficient μ_{total} = 0,14

Dimensions		Stress area AS (mm²)	Preloads F_V (kN) for property class			Tightening torque M_A (Nm) for property class		
	P		8.8	10.9	12.9	8.8	10.9	12.9
M 8	1.0	39.2	19.7	28.9	33.9	29.2	42.8	50.1
M 10	1.25	61.2	30.8	45.2	52.9	57.0	83.0	98.0
M 12	1.25	92.1	46.8	68.7	80.4	101.0	149.0	174.0
M 12	1.5	88.1	44.3	65.1	76.2	97.0	143.0	167.0
M 14	1.5	125.0	63.2	92.9	109.0	159.0	234.0	274.0
M 16	1.5	167.0	85.5	126.0	147.0	244.0	359.0	420.0
M 18	1.5	216.0	115.0	163.0	191.0	368.0	523.0	613.0
M 20	1.5	272.0	144.0	206.0	241.0	511.0	728.0	852.0
M 22	1.5	333.0	178.0	253.0	296.0	692.0	985.0	1153.0
M 24	2.0	384.0	204.0	290.0	339.0	865.0	1232.0	1442.0
M 27	2.0	496.0	264.0	375.0	439.0	1262.0	1797.0	2103.0
M 30	2.0	621.0	331.0	472.0	552.0	1756.0	2502.0	2927.0
M 33	2.0	761.0	407.0	580.0	678.0	2352.0	3350.0	3921.0
M 36	2.0	915.0	490.0	698.0	817.0	3082.0	4390.0	5137.0
M 39	2.0	1082.0	581.0	828.0	969.0	3953.0	5631.0	6589.0

Tables 5 and 6: up to M 39 extract from VDI 2230-1: 2003-02, above M 39 calculation based on VDI guideline 2230-1: 2003-02

Preloads and tightening torques for fasteners of steel

Preloads and tightening torque for steel shank screws with defined friction coefficient range* with head contact area sizes like DIN 912, 931, 933, 934, ISO 4762, 4014, 4017, 4032

*the coeficient of friction μ_{ges} is shown for the applicable fasteners on the price pages of this catalogue.

Table 7: Typical values for shank screws/bolts with coarse thread, utilisation of the minimum yield strength of 90%

Dimensions		Stress area A (mm²)	Preloads F_V (kN) for property class and μ_{ges}						Tightening torque M_V (kN) for property class and μ_{ges}					
			8.8		10.9		12.9		8.8		10.9		12.9	
	P		0.09	0.12	0.09	0.12	0.09	0.12	0.09	0.12	0.09	0.12	0.09	0.12
M 4	0.7	8.8	4.5	4.4	6.6	6.5	7.8	7.6	2.5	3.0	3.5	4.6	4.1	5.1
M 5	0.8	14.2	7.5	7.2	11.0	10.6	12.7	12.4	4.8	5.9	7.1	8.6	8.0	10.0
M 6	1.0	20.1	10.6	10.2	15.5	14.9	17.9	17.5	8.4	10.1	12.3	14.9	14.0	17.4
M 8	1.25	36.6	19.3	18.6	28.4	27.3	32.9	32.0	20.2	24.6	29.6	36.1	34.0	42.2
M 10	1.5	58.0	30.7	29.6	45.1	43.4	52.3	50.8	39.7	48.0	58.3	71.0	67.0	83.0
M 12	1.75	84.3	44.7	43.0	65.1	63.2	76.3	74.0	68.3	84.0	100.0	123.0	115.6	144.0
M 14	2.0	115.0	61.3	59.1	90.0	86.7	104.6	101.5	109.0	133.0	160.0	195.0	183.8	229.0
M 16	2.0	157.0	83.8	80.9	123.0	118.8	143.2	139.0	167.0	206.0	245.0	302.0	282.1	354.0
M 18	2.5	193.0	106.0	102.0	150.0	145.0	174.9	170.0	241.0	295.0	343.0	421.0	394.7	492.0
M 20	2.5	245.0	135.0	130.0	192.0	186.0	223.9	217.0	337.0	415.0	480.0	592.0	553.0	692.0
M 22	2.5	303.0	168.0	162.0	239.0	231.0	278.9	271.0	458.0	567.0	652.0	807.0	753.3	945.0
M 24	3.0	353.0	194.0	188.0	277.0	267.0	322.5	313.0	580.0	714.0	825.0	1017.0	952.9	1190.0
M 27	3.0	459.0	255.0	246.0	363.0	351.0	422.9	410.0	847.0	1050.0	1207.0	1496.0	1398.7	1750.0
M 30	3.5	561.0	310.0	300.0	442.0	427.0	514.9	499.0	1154.0	1428.0	1644.0	2033.0	1905.5	2380.0
M 33	3.5	694.0	385.0	373.0	549.0	531.0	639.9	621.0	1552.0	1928.0	2211.0	2747.0	2565.8	3214.0
M 36	4.0	817.0	453.0	438.0	645.0	623.0	752.0	729.0	2001.0	2482.0	2850.0	3535.0	3307.3	4136.0
M 39	4.0	976.0	543.0	525.0	773.0	748.0	901.6	875.0	2578.0	3208.0	3672.0	4569.0	4263.2	5346.0

Preloads and tightening torques for steel shank screws of the material 25CrMo4 +QT (1.7218) with head dimensions such as ISO 4762, 4014, 4017, 4032

Table 8: Typical values for shank screws/bolts with coarse thread made of 25CrMo4 +QT ($R_m \geq 600$ MPa, $R_{p0.2} \geq 440$ MPa) and utilisation of the minimum yield strength of 90%

Dimensions		Stress area A (mm²)	Preloads F_V (kN) for μ_{ges}			Tightening torques M_A (Nm) for μ_{ges}		
	P		0.10	0.12	0.14	0.10	0.12	0.14
M 8	1.25	36.6	13.0	12.7	12.3	14.6	16.6	18.4
M 10	1.5	58.0	20.7	20.2	19.6	28.9	32.8	36.5
M 12	1.75	84.3	30.1	29.4	28.6	49.8	56.7	63.0
M 14	2.0	115.0	41.2	40.3	39.3	79.3	90.2	100.3
M 16	2.0	157.0	56.6	55.3	53.9	122.0	139.3	155.5
M 18	2.5	193.0	69.2	67.5	65.7	170.3	194.0	216.0
M 20	2.5	245.0	88.6	86.5	84.2	239.1	273.2	304.9
M 22	2.5	303.0	110.4	107.8	105.1	326.3	373.9	418.2
M 24	3.0	353.0	127.6	124.5	121.3	412.0	470.8	525.4
M 27	3.0	459.0	167.3	163.5	159.3	606.1	694.9	777.7
M 30	3.5	561.0	203.7	198.9	193.9	825.0	944.7	1056.2
M 33	3.5	694.0	253.3	247.5	241.3	1112.6	1277.0	1430.4
M 36	4.0	817.0	297.6	290.7	283.4	1433.1	1642.9	1838.5
M 39	4.0	976.0	356.9	348.8	340.1	1849.6	2124.8	2381.5

Preloads and tightening torques for bolts with waisted shank made from material 21CrMoV5-7 +QT (1.7709) acc. to DIN 2510

Table 9: Typical values for bolts with waisted shank with coarse thread made of 21CrMoV5-7 +QT ($R_m \geq 700$ MPa, $R_{p0.2} \geq 550$ MPa) utilisation of the minimum yield strength of 70%

Dimensions		Shank Ø	Preloads F_V (kN) for μ_{ges}		Tightening torques M_A (Nm) for μ_{ges}	
	P		0.10	0.12	0.10	0.12
M 12	1.75	8.5	21.6	21.6	38.0	44.0
M 16	2.0	12.0	43.5	43.5	98.0	115.0
M 20	2.5	15.0	67.8	67.8	190.0	220.0
M 24	3.0	18.0	97.8	97.8	320.0	370.0
M 27	3.0	20.5	126.5	126.5	465.0	545.0
M 30	3.5	23.0	160.0	160.0	650.0	770.0
M 33	3.5	25.5	196.5	196.5	870.0	1000.0
M 36	4.0	27.5	228.5	228.5	1100.0	1300.0
M 39	4.0	30.5	281.0	281.0	1450.0	1750.0
M 42	4.5	32.5	319.0	319.0	1800.0	2100.0
M 45	4.5	35.5	381.0	381.0	2300.0	2700.0
M 48	5.0	37.5	425.0	425.0	2750.0	3250.0

Preloads and tightening torques for fasteners from steel

Preloads and tightening torques for fasteners with reduced loadability like e.g. DIN 6912, 7984, ISO 7380 -1/-2, 10642

Fasteners with reduced loadability are standardized or non-standardized fasteners with material and mechanical properties according ISO 898-1, due to its geometry, does not fulfil the test requirements for full loadability fasteners.

Fasteners with reduced loadability does not normally break in the free threaded length.

Basically, there are two geometrical reasons for reduced loadability of fasteners:

a) head design which applies to
- bolts and screws with low head with or
- without external driving feature, or
- with low round or cylindrical head with internal driving feature or
- countersunk head with internal driving feature.

b) shank design: e.g. screws with waisted shank.

The identification of screws and bolts with reduced loadability is a "0" before the property class, e.g. 08.8 or 010.9.
Fasteners according to above mentioned product standards can hold about 80% of the preloads of fasteners with full loadability.

Table 10: Typical values for fasteners according DIN 6912, 7984, ISO 7380 -1/-2, 10642, total friction coefficient μ_{ges} = 0.14

Dimensions	Preloads F_V (kN) for property class		Tightening torque M_A (Nm) for propery class	
	08.8	010.9	08.8	010.9
M 3	1.9	2.9	1.1	1.6
M 4	3.4	5.0	2.6	3.8
M 5	5.5	8.1	5.1	7.4
M 6	7.8	11.0	8.8	13.0
M 8	14.0	21.0	21.0	31.0
M 10	23.0	34.0	42.0	62.0
M 12	33.0	49.0	73.0	108.0
M 14	46.0	67.0	117.0	171.0
M 16	63.0	92.0	181.0	266.0
M 18	79.0	112.0	259.0	370.0
M 20	101.0	144.0	366.0	521.0
M 22	126.0	180.0	502.0	715.0
M 24	146.0	207.0	630.0	898.0
M 30	233.0	331.0	1 267.0	1 805.0
M 36	340.0	484.0	2 206.0	3 140.0

Preloads and tightening torques for fasteners with shank from steel, with UNC/UNF thread acc. to ASME B18.2.1, ASME B18.3 and ASME B18.2.2

Table 11: Typical values for fasteners with UNC thread, total friction coefficient µges = 0,14 and utilisation of the minimum yield strength of 90%

Dimensions		Preloads F_A for property class						Tightening torque M_A for property class					
		Grade 5*		Grade 8*		ASTM A 574		Grade 5*		Grade 8*		ASTM A 574	
Ø	G	[kN]	[lbf]	[kN]	[lbf]	[kN]	[lbf]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]
#2	56	1.2	262	1.7	370	1.9	435	0.5	0.4	0.7	0.5	0.8	6.0
#4	40	1.9	423	2.7	598	3.1	704	1.1	0.8	1.5	1.1	1.8	1.3
#5	40	2.5	565	3.6	798	4.2	940	1.6	1.2	2.2	1.6	2.6	1.9
#6	32	2.8	636	4.0	899	4.7	1058	2.0	1.5	2.8	2.1	3.3	2.4
#8	32	4.5	1000	6.3	1413	7.4	1663	3.6	2.7	5.1	3.8	6.1	4.5
#10	24	5.5	1232	7.8	1741	9.1	2050	5.3	3.9	7.4	5.5	8.7	6.4
1/4	20	10.1	2260	14.2	3194	16.7	3759	12.1	8.95	17.1	12.6	20.2	14.9
5/16	18	16.7	3764	23.7	5319	27.8	6260	25.7	18.9	36.3	26.7	42.7	31.5
3/8	16	24.9	5594	35.2	7904	41.4	9303	44.6	32.9	63.0	46.4	74.1	54.7
7/16	14	34.2	7684	48.3	10858	56.8	12780	70.9	52.3	100.0	73.9	117.9	87.0
1/2	13	45.8	10300	64.7	14554	76.2	17131	109.0	80.3	154.0	114.0	181.1	133.6
5/8	11	73.2	16464	103.0	23265	121.8	27384	213.0	157.0	301.0	222.0	354.5	261.4
3/4	10	109.0	24485	154.0	34599	181.2	40725	383.0	283.0	541.0	399.0	637.2	470.0
7/8	9	151.0	33891	213.0	47889	250.7	56368	614.0	453.0	868.0	640.0	1021.5	753.4
1	8	198.0	44499	280.0	62879	329.2	74012	922.0	680.0	1303.0	961.0	1533.3	1130.9
1 1/8	7	219.0	49326	252.0	79166	414.5	93183	1153.0	850.0	1850.0	1364.0	2178.0	1606.4
1 1/4	7	280.0	62934	449.0	101005	528.8	118888	1618.0	1194.0	2597.0	1916.0	3057.2	2254.9
1 3/8	6	333.0	74796	534.0	120043	628.5	141297	2121.0	1565.0	3405.0	2511.0	4007.4	2955.7
1 1/2	6	406.0	91358	652.0	146624	767.7	172585	2806.0	2070.0	4504.0	3322.0	5301.5	3910.2

Table 12: Typical values for fasteners with UNF thread , total friction coefficient µges = 0,14 and utilisation of the minimum yield strength of 90%

Dimensions		Preloads F_A for property class						Tightening torque M_A for property class					
		Grade 5*		Grade 8*		ASTM A 574*		Grade 5*		Grade 8*		ASTM A 574*	
Ø	G	[kN]	[lbf]	[kN]	[lbf]	[kN]	[lbf]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]
1/4	28	11.8	2653	16.7	3749	19.6	4413	13.8	10.2	19.5	14.4	22.9	16.9
5/16	24	18.9	4252	26.7	6008	31.5	7071	28.3	20.9	40.0	29.5	47.0	34.7
3/8	24	28.9	6486	40.8	9165	47.9	10788	50.0	36.9	70.7	52.2	83.2	61.4
7/16	20	39.0	8758	55.0	12375	64.8	14566	78.6	57.9	111.0	81.9	130.7	96.4
1/2	20	52.8	11861	74.6	16760	87.8	19727	122.0	89.7	172.0	127.0	202.2	149.1
5/8	18	84.7	19050	120.0	26918	140.9	31684	239.0	176.0	337.0	249.0	396.6	292.5
3/4	16	124.0	27814	175.0	39302	250.8	46261	423.0	312.0	597.0	441.0	703.0	518.5
7/8	14	170.5	38321	240.8	54150	283.5	63737	677.3	499.6	957.1	705.9	1126.6	830.9
1	12	221.5	49803	313.0	70373	368.5	82833	1008.6	743.9	1425.2	1051.1	1677.5	1237.2
1 1/4	12	360.7	81088	509.68	114581	599.9	134868	2030.6	1497.7	2869.4	2116.4	3377.4	2491.1
1 1/2	12	533.28	119886	753.5	169404	886.9	199398	3568.9	2632.3	5043.0	3719.6	5935.9	4378.1

*Grade 5 (~ 8.8) and Grade 8 (~ 10.9) acc. to SAE J 429, ASTM A 574 for hexagon head cap screws (~ 12.9)

Preloads and tightening torques of screwed fastenings from steel with locking elements

Table 13: Typical values for preloads F_V and tightening torques for screws and nuts with lock ribs under the flange
(REYHER articles 88913 and 88914)

Material of screwed part	Property class 100/10													
	M 5		M 6		M 8		M 10		M 12		M 14x1.5		M 16	
	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]	F_V [N]	MA[Nm]	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]
Steel R_m < 800 MPa		11		19		42		85		130		250		330
Steel R_m ≥ 800 MPa	9000	10	12600	18	23200	37	37000	80	54000	120	74000	240	102000	310
malleable cast iron		9		16		35		75		115		230		300

Table 14: Typical values for preloads F_V and tightening torques F_V for hexagon socket cap screws with lock ribs under the flange
(REYHER articles 88912)

Material of screwed part	Property class 100/10									
	M 5		M 6		M 8		M 10		M 12	
	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]	F_V [N]	MA[Nm]	F_V [N]	M_A [Nm]
Steel R_m < 800 MPa		13		24		45		90		150
Steel R_m ≥ 800 MPa	9000	11	12600	20	23200	42	37000	85	54000	140
malleable cast iron		10		19		39		80		120

Table 15: Typical values for preloads and tightening torques of locking screws and nuts
(REYHER articles 88933 und 88934)

Material of screwed part	Property class 100/10								Property class 100/10			
	M 5		M 6		M 8		M 10		M 12		M 16	
	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]	F_V [N]	MA[Nm]	F_V [N]	M_A [Nm]	F_V [N]	M_A [Nm]
Steel	6350	9	9000	16	16500	34	26200	58	54000	120	102000	280
malleable cast iron		7		13		28		49		105		260

Table 16: Typical values for tightening torques and prestressing forces of screwed fastenings with wedge lock washers
(REYHER article 88132, 88032)

NL washers for threads	Preloads F_V (kN) for property class					Tightening torque M_A (Nm) for property class				
	8.8 [1]	10.9 [2]	12.9 [3]	A 4 -70 [4]	A 4-80 [4]	8.8 [1]	10.9 [2]	12.9 [3]	A 4 -70 [4]	A 4-80 [4]
M 4	3.5	5.9	7.1	2.6	3.4	3.1	4.1	4.6	2.0	2.7
M 5	5.6	9.6	11.5	4.1	5.5	6.0	8.1	9.1	3.9	5.3
M 6	8.0	13.6	16.3	5.9	7.8	10.2	14.1	15.8	6.9	9.2
M 8	15.0	25.0	30.0	11.0	14.0	25.0	34.0	38.0	17.0	22.0
M 10	23.0	39.0	47.0	17.0	23.0	50.0	67.0	75.0	33.0	43.0
M 12	33.0	57.0	68.0	25.0	33.0	85.0	115.0	128.0	56.0	75.0
M 14	46.0	78.0	94.0	34.0	45.0	136.0	183.0	204.0	89.0	119.0
M 16	62.0	106.0	127.0	46.0	61.0	208.0	279.0	311.0	136.0	181.0
M 18	76.0	130.0	156.0	56.0	75.0	291.0	391.0	437.0	191.0	254.0
M 20	97.0	165.0	198.0	72.0	95.0	408.0	547.0	610.0	267.0	356.0
M 22	120.0	205.0	246.0	89.0	118.0	557.0	745.0	831.0	364.0	485.0
M 24	140.0	238.0	286.0	103.0	137.0	703.0	942.0	1052.0	460.0	613.0
M 27	182.0	310.0	372.0	134.0	179.0	1028.0	1375.0	1533.0	671.0	895.0
M 30	222.0	378.0	454.0	164.0	219.0	1401.0	1875.0	2091.0	915.0	1220.0
M 33	275.0	468.0	562.0	-	-	1889.0	2526.0	2815.0	-	-
M 36	324.0	551.0	662.0	239.0	319.0	2436.0	3259.0	3633.0	1591.0	2121.0
M 39	387.0	659.0	790.0	-	-	3145.0	4203.0	4683.0	-	-
M 42	445.0	757.0	908.0	-	-	3890.0	5202.0	5799.0	-	-

Source: www.nordlock.com

1) Screw zinc plated, dry, thread friction μ_G = 0,15, friction coefficient of the lock washer μ_W = 0,18, utilisation of the minimum yield strength = 62%
2) Screw uncoated, oiled, thread friction μ_G = 0,13, friction coefficient of the lock washer μ_W = 0,14, utilisation of the minimum yield strength = 71%
3) Screw uncoated, oiled, thread friction μ_G = 0,13, friction coefficient of the lock washer μ_W = 0,12, utilisation of the minimum yield strength = 71%
4) Screw lubricated with graphite paste, thread friction μ_G = 0,14, friction coefficient of the lock washer μ_W = 0,15, utilisation of the minimum yield strength = 65%

Table 17: Typical values for tightening torques of screwed fastenings with lock washers

REYHER-articles	Property class Screws	Tightening torque M_A in Nm													
		M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24	M 27	M 30
88123 type S	5.8	2.0	4.0	7.0	16.5	32	57	-	-	-	-	-	-	-	-
88124 type M	8.8	3.3	6.7	11.5	27	54	92	145	225	320	460	620	790	1160	1550
	10.9	4.9	9.8	16.5	40	79	135	215	330	460	650	890	1120	1650	2250
88125 type B	10.9	-	-	16.5	40	79	135	-	-	-	-	-	-	-	-
	12.9	-	-	19.5	47	92	158	-	-	-	-	-	-	-	-

Source: www.teckentrup.de

Typical values for tightening torques of screwed fastenings with SCHNORR washers
REYHER article 88120 and REYHER article 88121:
As a typical value, 10% should be added to the normal tightening torque M_A according to TI-244, Tabels 5 and 6.

Assembly of fastenings in steel constructions

Systematic preloaded connections with HV sets

The following two assembly methods for achieving the preload force are permitted in Germany for the assembly of HV sets.

Standard	Preload	Assembly method	*k* class
EN 1090-2	$F_{p,C}$ (full preload force)	Combined method	K1
DIN EN 1993-1-8 NA DAST Guideline 024	$F_{p,C}$* (modified preload force)	Modified torque method	K1

Preload forces and tightening torques for the respective methods for *k*-class K1 and property class 10.9 are listed in the following table. Refer to EN 1090-2 for the corresponding assembly steps required.

Table 18: Preloads and tightening torques for HV fastenings of property class 10.9 as per EN 14399-4 or DAST Guideline 012 with *k*-class K1

Ø	Combined tightening procedure with $F_{p,C}$				Modified method with $F_{p,C}$*		
	Reference preloads $F_{p,C}$ in kN	Reference torques $M_{r,1}$ in Nm	EN 1090-2	DAST-Guideline 024	Modified torque preload method acc. to DIN EN 1993-1-8 and DAST Guideline 024		Modified combined method acc. to DIN EN 1993-1-8 NA
			Pre-tightening torques 0,75 $M_{r,1}$ in Nm	Pre-tightening torques M_{Vor} in Nm	Modified preloads $F_{p,C}$* in kN	Modified torques M_A in Nm	Pre-tightening torques $M_{A,MKV}$ in Nm
M 12	59	92	67	75	50	100	75
M 16	110	229	165	190	100	250	190
M 20	172	447	322	340	160	450	340
M 22	212	606	439	490	190	650	490
M 24	247	771	557	600	220	800	600
M 27	321	1127	815	940	290	1250	940
M 30	393	1533	1107	1240	350	1650	1240
M 36	572	2677	1935	2100	510	2800	2100
M 39*					610	3500	
M 42*					710	4500	
M 45*					820	5500	
M 48*					930	6500	
M 56*					1280	10000	
M 64*					1680	15000	

*as per DASt Directive 021; these values only apply to hot dip galvanized HV sets

Table 19: Prevailing angle for combined assembly method

Standard	Prevailing angle in ° t = grip length with washers, d = screw diameter		
	t < 2d	2d ≤ t < 6d	6d ≤ t ≤ 10d
EN 1090-2 / DAST Guideline 024	60	90	120
DIN EN 1993-1-8/NA	45	60	90

Securing of HV connection against loosening

Using self-locking washers, an HV fastening can be secured against loosening. Tables 20 and 21 indicate two products and their assembly parametres.

Table 20: Preload forces and tightening torpqes for HV fastenings with NL SC self-locking washers (Art. 88132) per ETA-13-0246

Ø	Modified preloads $F_{p,cr}NL$* in kN	Modified torques $M_{A,NL}$ in Nm	Pre-tighening torques for modified combined method Process $M_{A,MKV,NL}$ in Nm
M 12	45	130	100
M 16	90	330	250
M 20	145	660	490
M 22	170	850	640
M 24	200	1100	825
M 27	260	1600	1220
M 30	315	2150	1650
M 36	460	3750	2800

Table 21: Preload forces and tightening torques for HV fastenings with HLK self-locking washers (Art. 88032) acc. to Z Z-Z-14.4-702

Ø	Modified pre-loads $F_{p,crHLK}$* in kN	Modified torques $M_{A,HLK}$ in Nm	Pre-tighening torques 1) for modified combined method Process $M_{A,\ MKV,\ NL}$ in Nm
M 12	45	150	100
M 16	80	330	210
M 20	120	560	365
M 22	145	730	475
M 24	165	880	575
M 27	200	1160	755
M 30	252	1580	1030
M 36	367	2530	1650

1) Prevailing angle for modified combined method according to DIN EN 1993-1-8/NA (see Table 19)

Non-preloaded structural bolting assemblies – SB sets

For the area of non-preloaded fastenings, SB sets such as e.g. ISO 4014/4017/4032/7090 but also DIN7990 and more in the future are used that, contrary to the HV system, are only hand-tightened. Screws and nuts must also be marked with "SB" for "structural bolting".

Table 22: Recommended "hand-tight" tightening torques for non-preloaded fastenings, independent of the property class of the screws according to DAST regulation 024.

Ø	M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 36
$M_{A,\ hand-tight}$ in Nm	15	35	60	90	110	165	220	350

Preloads and tightening torques for fasteners made of stainless steel

Preloads and tightening torques for fasteners with full loadability from stainless steel

For fasteners made of stainless steel, the friction coefficients in the thread and on the contact surfaces are much higher than with quenched and tempered steel screws. Even the spread of the friction coefficients is much higher here (up to and over 100%). To finally determine the correct torque it is recommended that testing should be carried out under operating conditions.

While it is possible to reduce friction coefficients by using lubricating agents, the very high range of variation will remain.

The table lists non-binding typical values for various friction coefficients, valid for screws and nuts according to DIN 912, 931, 933 and 934/ISO 4762, 4014, 4017, 4032 made from stainless steels A 1–A 5, in property classes –50, –70 and –80 at room temperature (approx. +20 °C) and utilisation of the minimum yield stress of $R_{p0.2}$ = 90%.

Table 23: Typical values for fasteners from A 2/A 4

⌀	Prop. Class	Assembly preload in kN for μ_{ges} =								Tightening torque in Nm for μ_{ges} =							
		0.10	0.12	0.14	0.16	0.18	0.20	0.30	0.40	0.10	0.12	0.14	0.16	0.18	0.20	0.30	0.40
	50	1.47	1.48	1.39	1.35	1.31	1.26	1.07	0.91	0.8	0.9	1.0	1.1	1.2	1.3	1.6	1.8
M 4	70	3.14	2.71	2.97	2.89	2.80	2.71	2.30	1.95	1.8	2.0	2.2	2.4	2.6	2.8	3.4	3.8
	80	4.19	4.08	3.96	3.85	3.73	3.61	3.06	2.61	2.4	2.7	3.0	3.3	3.5	3.7	4.6	5.1
	50	2.39	2.33	2.27	2.20	2.14	2.07	1.76	1.50	1.7	1.9	2.1	2.3	2.4	2.6	3.2	3.6
M 5	70	5.13	5.00	4.86	4.72	4.58	4.44	3.77	3.21	3.5	4.0	4.5	4.9	5.2	5.6	6.8	7.6
	80	6.84	6.66	6.48	6.29	6.10	5.91	5.02	4.28	4.7	5.4	5.9	6.5	7.0	7.4	9.1	10.2
	50	3.39	3.30	3.21	3.11	3.02	2.93	2.48	2.11	2.9	3.3	3.6	3.9	4.2	4.5	5.5	6.2
M 6	70	7.26	7.07	6.87	6.67	6.47	6.27	5.32	4.53	6.2	7.0	7.7	8.4	9.1	9.7	11.9	13.2
	80	9.68	9.43	9.13	8.90	8.63	8.36	7.09	6.04	8.2	9.3	10.3	11.3	12.1	12.9	15.8	17.7
	50	6.21	6.05	5.88	5.72	5.54	5.37	4.57	3.89	7.0	7.9	8.8	9.6	10.3	11.0	13.6	15.2
M 8	70	13.30	12.96	12.61	12.25	11.88	11.51	9.79	8.34	15.0	17.0	18.8	20.6	22.2	23.6	29.1	32.5
	80	17.74	17.29	16.81	16.33	15.84	15.35	13.05	11.11	19.9	22.6	25.1	27.4	29.5	31.5	38.8	43.4
	50	9.87	9.62	9.37	9.10	8.83	8.56	7.28	6.20	13.8	15.7	17.4	19.0	20.5	21.8	27.0	30.2
M 10	70	21.16	20.63	18.40	19.50	18.92	18.34	15.60	13.29	29.5	33.5	37.3	40.7	41.9	46.8	57.8	67.7
	80	28.21	27.50	26.76	25.99	25.22	24.45	20.79	17.72	39.4	44.7	49.7	54.3	58.5	62.4	77.1	86.2
	50	14.38	14.03	13.65	13.27	12.87	12.48	10.62	9.05	23.8	27.1	30.1	32.9	35.4	37.8	46.8	52.3
M 12	70	30.83	30.06	29.26	28.43	28.59	26.75	22.76	19.40	51.0	58.0	64.5	70.5	76.0	81.0	100.2	112.1
	80	41.10	40.08	39.01	37.90	36.78	35.66	30.35	25.87	68.0	77.3	85.9	93.9	101.0	108.0	133.6	149.5
	50	19.74	19.25	18.74	18.21	17.68	17.14	14.59	12.44	37.8	43.0	47.9	52.4	56.5	60.2	74.6	83.5
M 14	70	42.31	41.26	40.16	39.03	37.88	36.73	31.27	26.65	81.1	92.2	103.0	112.0	121.0	129.0	160.0	179.0
	80	56.41	55.01	53.54	52.04	50.50	48.97	41.69	35.54	108.0	123.0	137.0	150.0	161.0	172.0	212.0	238.5
	50	27.04	26.39	25.71	25.01	24.29	23.56	20.10	17.16	58.2	66.5	74.2	81.4	87.9	94.0	117.0	131.0
M 16	70	57.94	56.55	55.09	53.58	52.04	50.49	43.08	36.77	125.0	143.0	159.0	174.0	188.0	201.0	251.0	282.0
	80	77.25	74.40	73.46	71.44	69.39	67.33	57.44	49.03	166.0	190.0	212.0	233.0	251.0	269.0	334.0	375.0
	50	33.01	32.20	31.35	30.47	29.58	28.68	24.43	20.83	81.3	92.6	103.0	113.0	122.0	130.0	161.0	180.0
M 18	70	70.73	69.00	67.17	65.29	63.38	61.46	52.34	44.64	174.0	198.0	221.0	242.0	261.0	278.0	345.0	387.0
	80	94.31	92.00	89.56	87.05	84.51	81.95	69.79	59.52	232.0	265.0	295.0	322.0	348.0	371.0	460.0	515.0
	50	42.27	41.26	40.20	39.10	37.79	36.84	31.34	26.83	114.0	130.0	146.0	160.0	173.0	184.0	230.0	258.0
M 20	70	90.58	88.40	86.14	83.78	81.37	78.95	67.35	57.49	245.0	280.0	312.0	342.0	370.0	395.0	492.0	552.0
	80	120.80	117.90	114.90	111.70	108.50	105.30	89.80	76.70	326.0	373.0	416.0	456.0	493.0	527.0	656.0	736.0
M 22	50	52.67	51.45	50.15	48.80	47.42	46.02	39.32	33.59	156.0	178.0	200.0	219.0	237.0	254.0	318.0	257.0
	70	112.87	110.24	107.46	104.56	101.61	98.61	84.25	–	334.0	382.0	428.0	470.0	508.0	544.0	680.0	–
M 24	50	60.88	59.43	57.90	56.30	54.69	53.01	45.27	38.64	197.0	225.0	251.0	275.0	297.0	318.0	396.0	444.0
	70	130.50	127.40	124.10	120.70	117.20	113.70	97.00	–	421.0	482.0	537.0	589.0	637.0	680.0	848.0	–
M 27	50	79.86	78.02	76.05	74.01	71.93	69.82	59.67	50.98	289.0	332.0	371.0	408.0	442.0	473.0	591.0	666.0
	70	171.00	167.00	163.00	159.00	154.00	150.00	128.00	–	620.0	711.0	795.0	873.0	946.0	1013.0	1267.0	–
M 30	50	97.23	94.96	92.54	90.04	87.48	84.90	72.50	61.90	394.0	451.0	504.0	553.0	599.0	640.0	800.0	900.0
	70	208.00	203.00	198.00	193.00	187.00	182.00	155.00	–	844.0	966.0	1080.0	1186.0	1283.0	1373.0	1715.0	–
M 33	50	121.00	118.00	115.00	112.00	109.00	106.00	90.00	77.00	531.0	610.0	683.0	751.0	813.0	871.0	1092.0	1230.0
M 36	50	142.00	139.00	135.00	132.00	128.00	124.00	106.00	91.00	684.0	784.0	876.0	964.0	1044.0	1117.0	1398.0	1573.0
M 39	50	170.00	166.00	162.00	158.00	154.00	149.00	128.00	109.00	883.0	1014.0	1137.0	1250.0	1355.0	1452.0	1822.0	2054.0

Tightening torques and preloads

for fasteners with reduced loadability from stainless steel.

Fasteners according to DIN 6912, 7984, ISO 7380-1/-2, and 10642 have a reduced loadability due to their head geometry. As a guideline for preloads and tightening torques of 80% of the values of the above table 22 can be assumed. (➔ see also TI-246)

Torque typ hexagon nuts

from stainless steels sometimes tend to jam in the locking element due to the high flank pressure when inserting the screw head. Here, treating the screw thread with an anti-friction agent usually helps.

Lubricated nuts

For optimal assembly of austenitic fasteners the use of a lubricant is recommended.

REYHER offers lubricated nuts in A2/A4 as part of our product range.

Tightening torque for fasteners made from BUMAX 88/109 brass, polyamide

Tightening torques and preloads for fasteners made from stainless steel BUMAX 88/109

Fasteners made from BUMAX 88/109 have an adjusted coefficient of friction by a specific lubrication. In contrast to this, this allows usually unlubricated fasteners made of stainless steel (A 2/A 4) are applied to targeted pre-tensioning forces.

Table 24: Typical values for fasteners made from BUMAX 88/109

Dimensions	P	Stress area A_s (mm²)	Preloads F_V (kN) for BUMAX 88	109	Tightening Torques M_A (Nm) for BUMAX 88	109
M 3	0.5	5.03	2.1	2.9	1.3	1.7
M 4	0.7	8.78	3.6	5.2	2.9	4.1
M 5	0.8	14.2	5.9	8.6	5.7	8.1
M 6	1.0	20.1	8.4	12.0	9.8	14.0
M 8	1.25	34.4	15.0	21.0	25.0	34.0
M 10	1.5	58.0	24.0	34.0	47.0	66.0
M 12	1.75	84.3	35.0	49.0	82.0	115.0
M 14	2.0	115.0	48.0	60.0	129.0	161.0
M 16	2.0	157.0	65.0	81.0	198.0	248.0
M 18	2.5	192.0	80.0	100.0	275.0	344.0
M 20	2.5	245.0	102.0	128.0	385.0	481.0
M 24	3.0	353.0	181.0	-	665.0	-
M 27	3.0	459.0	235.0	-	961.0	-
M 30	3.5	561.0	287.0	-	1310.0	-
M 36	4.0	817.0	418.0	-	2280.0	-

Preloads and tightening torque for fasteners made from brass

For fasteners made from brass, the friction coefficients in the thread and on the contact surfaces are much higher than with quenched and tempered steel screws. In order to determine the correct torque, it is recommended that experiments should be carried out under operating conditions. It is possible to reduce friction coefficients by using lubricating agents.

Table 24 lists non-binding typical values for various friction coefficients, valid for screws and nuts according to DIN 912, 931, 933 and 934/ISO 4762, 4014, 4017, 4032 made from brass with a minimum stress at 0.2% non-proportional elongation of 250 N/mm² (e.g. MS 58 and MS 63) and utilisation of the yield stress of 90%.

The tightening torques listed in the table may **only be used as very rough and non-binding typical values.**

Table 25: Typical values for fasteners made from brass

Ø	Assembly preloads in kN for μ_{ges}								Tightening torque in Nm for μ_{ges}							
	0.10	0.12	0.14	0.16	0.18	0.20	0.30	0.40	0.10	0.12	0.14	0.16	0.18	0.20	0.30	0.40
M 4	1.75	1.70	1.65	1.60	1.55	1.51	1.28	1.09	1.0	1.1	1.2	1.4	1.5	1.6	1.9	2.1
M 5	2.85	2.78	2.70	2.62	2.54	2.46	2.09	1.78	2.0	2.2	2.5	2.7	2.9	3.1	3.8	4.2
M 6	4.03	3.93	3.82	3.71	3.59	3.48	2.96	2.52	3.4	3.9	4.3	4.7	5.0	5.4	6.6	7.4
M 8	7.39	7.20	7.01	6.84	6.60	6.40	5.44	4.63	8.3	9.4	10.5	11.4	12.3	13.1	16.2	18.1
M 10	11.75	11.46	11.15	10.83	10.51	10.19	8.66	7.38	16.4	18.6	20.7	22.6	24.4	26.0	32.1	35.9
M 12	17.13	16.70	16.25	15.79	15.33	14.86	12.64	10.78	28.3	32.2	35.8	39.1	42.2	45.0	55.7	62.3
M 14	23.50	22.92	22.31	21.68	21.04	20.40	17.37	14.81	45.0	51.2	57.0	62.3	67.2	71.7	88.8	99.4
M 16	32.19	31.42	30.61	29.77	28.91	28.05	23.93	20.43	69.3	79.2	88.4	96.9	105.0	112.0	139.0	156.0
M 18	39.30	38.33	37.32	36.27	35.21	34.15	29.08	24.80	96.8	110.0	123.0	134.0	145.0	155.0	192.0	215.0
M 20	50.32	49.12	47.86	46.54	45.21	43.86	37.42	31.94	136.0	155.0	173.0	190.0	205.0	219.0	273.0	307.0
M 22	62.71	61.25	59.70	58.09	56.45	54.79	46.81	40.00	185.0	212.0	238.0	261.0	282.0	302.0	378.0	425.0
M 24	72.48	70.75	68.93	67.04	65.11	63.17	53.89	46.00	234.0	268.0	299.0	327.0	354.0	378.0	471.0	529.0
M 27	95.07	92.88	90.54	88.11	85.63	83.12	71.03	60.70	344.0	395.0	442.0	485.0	526.0	563.0	704.0	793.0
M 30	116.00	113.00	110.00	107.00	104.00	101.00	86.31	73.70	469.0	537.0	600.0	659.0	713.0	762.0	953.0	1071.0
M 33	144.00	141.00	137.00	133.00	130.00	126.00	108.00	92.00	632.0	726.0	813.0	894.0	968.0	1036.0	1300.0	1464.0
M 36	169.00	165.00	161.00	157.00	152.00	148.00	126.00	108.00	814.0	934.0	1045.0	1148.0	1243.0	1330.0	1664.0	1873.0
M 39	203.00	198.00	193.00	188.00	183.00	178.00	152.00	130.00	1051.0	1207.0	1353.0	1488.0	1613.0	1728.0	2169.0	2445.0

Tightening torques for polyamide screws and nuts

Table 19 includes non-binding typical values for appropriate tightening torques for screws and nuts made from polyamide 6.6 at 20 °C after storage in a normal climate.

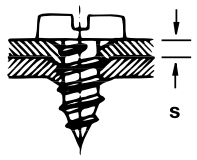
The preload can ease off somewhat as a result of relaxation processes.

Table 26

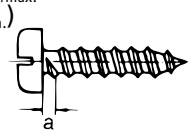
Ø	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 16
Tightening torque Nm	0.1	0.25	0.5	0.8	1.8	3.5	6.0	12

General assembly instructions

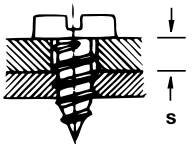
Screwing in of thinner sheet metal with continuous tapping holes or ones enlarged with a drift



Sheet metal thickness lower/upper limit* $s_{min./max.}$ ($a_{max.} = s_{min.}$)



Screwing in of thicker sheet metal with drilled or punched tapping holes



Screwable plate thickness

Ø/ST	2.2	2.9	3.5	3.9	4.2
$s_{min.} = a_{max.}$	0.8	1.1	1.3	1.3	1.4
$s_{max.}$	1.8	2.2	2.8	3	3.5

Ø/ST	4.8	5.5	6.3	8	
$s_{min.} = a_{max.}$	1.6	1.8	1.8	2.1	
$s_{max.}$	4	4.5	5	6.5	

s = sheet thickness
a = distance from head to thread

* With very thin metal sheets (< a max.) the usage of special thin tapping screws or clamping nuts (spring nuts) is recommended.

Drilling hole diameters for tapping screws

The tapping hole diameters in the following tables are non-binding approximate values for round holes.

The values may differ depending on the material or assembly conditions – this applies in particular to screws made from non-hardenable, stainless steels of the austenitic material groups A 2/A 4 (→ ISO 3506-4).

When using synthetic-based screws, the following conditions apply.

Table 27: Drilling hole für tapping screws

Nominal thread diameter d_1	Drilling hole-Ø (Tol. H 12) for tapping screws from material							
	for sheet thickness s		Hardened steel (min. 450 HV)				Stainless steels A 2/A 4 (ca. 250 HV)**	
			Drift-enlarged/Continuous hole Sheet from material		Drilled/Punched hole Sheet from material		Sheet from material	
	>	≤	St, Ni, MS, Cu, Monel	Al	St, Ni, MS, Cu, Monel	Al	Baustahl St. 37	Al
2.2 mm	–	0.56	–	–	1.60	–		
	0.56	0.75	–	–	1.70	1.60		
	0.75	0.88	–	–	1.80	1.60		
	0.88	1.13	–	–	1.85	1.60		
	1.13	1.38	–	–	1.85	1.70		
	1.38	1.50	–	–	1.90	1.80		
2.9 mm		0.56	2.20	–	2.20	–		
	0.56	0.63	2.50	2.20	2.25	–	2.30	2.40
	0.63	0.75	2.50	2.20	2.25	2.20	2.30	2.40
	0.75	0.88	2.50	2.20	2.40	2.20	2.30	2.40
	0.88	1.25	–	2.20	2.40	2.20	2.30	2.40
	1.25	1.38	–	–	2.40	2.20	2.30	2.40
	1.38	1.75	–	–	2.50	2.25	2.30	2.40
	1.75	2.50	–	–	2.60	2.40	2.40	2.50
3.5 mm		0.56	2.80	–	2.60	–	2.70	2.80
	0.56	0.75	2.80	2.80	2.70	–	2.70	2.80
	0.75	0.88	2.80	2.80	2.70	2.65	2.70	2.80
	0.88	1.25	–	2.80	2.80	2.65	2.70	2.80
	1.25	1.38	–	–	2.80	2.65	2.70	2.80
	1.38	1.75	–	–	2.90	2.75	2.80	2.90
	1.75	2.50	–	–	3.00	2.85	2.80	2.90
	2.50	3.00	–	–	3.20	3.00	2.90	3.00
	3.00	6.00	–	–	–	3.00	2.90	3.00
3.9 mm		0.50	3.00	–	2.95	–	3.00	3.10
	0.50	0.63	3.00	3.00	2.95	–	3.00	3.10
	0.63	0.88	3.00	3.00	2.95	2.90	3.00	3.10
	0.88	1.13	3.00	3.00	2.95	2.95	3.00	3.10
	1.13	1.25	3.00	3.00	3.00	2.95	3.00	3.10
	1.25	1.38	–	–	3.00	2.95	3.00	3.10
	1.38	1.75	–	–	3.20	3.00	3.00	3.10
	1.75	2.00	–	–	3.20	3.50	3.00	3.10
	2.00	2.50	–	–	3.50	3.50	3.10	3.20
	2.50	3.50	–	–	3.60	3.50	3.20	3.30
4.2 mm	–	0.50	3.50	–	–	–	–	–
	0.50	0.63	3.50	3.50	3.20	–	–	–
	0.63	0.88	3.50	3.50	3.20	2.95	–	–
	0.88	1.13	3.50	3.50	3.20	3.00	3.20	3.30
	1.13	1.38	3.50	3.50	3.30	3.20	3.20	3.30
	1.38	2.50	–	–	3.50	3.50	3.30	3.40
	2.50	3.00	–	–	3.80	3.70	3.30	3.40
	3.00	3.50	–	–	3.90	3.80	3.40	3.50
	3.50	10.00	–	–	–	3.90	3.5–3.6	3.6–3.7
4.8 mm	–	0.50	4.00	–	–	–	–	–
	0.50	0.75	4.00	4.00	3.70	–	–	–
	0.75	1.13	4.00	4.00	3.70	3.70	–	–
	1.13	1.38	4.00	4.00	3.90	3.70	3.70	3.90
	1.38	1.75	–	–	3.90	3.70	3.70	3.90
	1.75	2.50	–	–	4.00	3.80	3.80	3.90
	2.50	3.00	–	–	4.10	3.80	3.80	3.90
	3.00	3.50	–	–	4.30	3.90	3.90	4.00
	3.50	4.00	–	–	4.40	3.90	3.90	4.00
	4.00	4.75	–	–	4.40	4.00	4.00	4.10
	4.75	10.00	–	–	–	4.20	4.1–4.2	4.2–4.3
5.5 mm	–	1.13	4.70	–	4.20	–	–	–
	1.13	1.38	4.70	–	4.30	4.10	–	–
	1.38	1.50	–	–	4.30	4.10	–	–
	1.50	1.75	–	–	4.50	4.20	–	–
	1.75	2.25	–	–	4.60	4.40	4.50	4.60
	2.25	3.00	–	–	4.70	4.60	4.50	4.60
	3.00	3.50	–	–	5.00	4.60	4.60	4.70
	3.50	4.00	–	–	5.00	4.80	4.60	4.70
	4.00	4.75	–	–	5.10	4.80	4.70	4.80
	4.75	10.00	–	–	–	4.90	4.7–4.9	4.8–5.0
6.3 mm	–	1.38	5.30	–	4.90	–	–	–
	1.38	1.75	–	–	5.00	5.00	–	–
	1.75	2.00	–	–	5.20	5.00	–	–
	2.00	3.00	–	–	5.30	5.20	5.30	5.40
	3.00	4.00	–	–	5.80	5.30	5.40	5.50
	4.00	4.75	–	–	5.90	5.40	5.50	5.60
	4.75	5.00	–	–	–	5.60	5.50	5.60
	5.00	10.00	–	–	–	5.80	5.6–5.7	5.7–5.8

For "Mechanical fasteners" (screws, nuts and accessory parts), all function-relevant external and internal characteristics are regulated in detail in DIN, ISO or EN standards, this includes:

- **Product standards** (e.g. DIN 931/ISO 4014)
  Specifications on the figure of the product, assigned version and product class (tolerance group), usual strength classes and/or materials and nominal sizes. Furthermore, each product standard contains "normative references" to relevantly applicable basic function standards.

Basic/Function standards (e.g. DIN 13, 267/ISO 898, 4759, 3269...)
Regulations for joint characteristics of the various products such as e.g. thread, tolerances, surface versions, corrosion protection, mechanical properties and corresponding factory test programme as well as acceptance testing conditions.

By naming an article with a product standard number, all referred basic standards are automatically included and applicable as "Technical Delivery Conditions". This also applies for non-standardised thread and form parts when no particular arrangements have been made between the orderer and the supplier.

Standards always can only regulate just one general standard for products "for general use", this also applies for "Mechanical fasteners" (➔ ISO 3269/8992). For higher requirements for specific cases exceeding these normative regulations, it is the job of the user to define these requirements and specify necessary additional inspection requirements.

1. Quality checks during manufacture:
For basic/functional standards, testing programmes and procedures are given within which the manufacturer has to ensure the compliance with the proper standards quality of its products by carrying out constant sample checks. Alongside the obligatory checks for dimensional accuracy and surface condition, the following checks are also listed, among others:

- for screws and similar thread parts (➔ e.g. ISO 898-1)
  - hardness testing, proof load testing
  - bolt head impact/diagonal pull testing
  - surface decarburisation testing
- for nuts (➔ e.g. ISO 898-2)
  - hardness test, proof load test
  - expansion test

The procedure to be used in arbitration is specified in the standards. All standardised mechanical properties are generally valid at room temperature (approx. +20 °C).

2. Additional tests – Certificates

For particular requirements and/or safety-related use cases, additional articles or use-specific tests can be carried out either in the factory or by a commissioned factory independent technical expert or testing institute. The results of these extra tests shall be documented in a test certificate.

The type and scope of these additional tests and who is to carry out and document them is to be determined by the user due to his knowledge on the use and particular requirements, and specified accordingly upon ordering. The costs for additional tests are usually not part of the product price.

2.1. Inspection documents according to ISO 16228

For fasteners, ISO 16228 was released in May 2018 and replaces DIN 11204. This standard regulates the various types of inspection documents for fasteners, and it also contains 4 document types according to ISO 10204, starting with F (for fasteners), i. e. F2.1, F2.2, F3.1, F3.2. Furthermore, the scope of content of inspection documents for fasteners is specified and can be applied to finished fasteners such as bolts, screws, threaded bolts, nuts, washers, pins, rivets, and so forth, made of steel, stainless steel, non-ferrous metals or non-metallic material. In the inspection documents (F2.2, F3.1, F3.2) all inspection results are taken over from the certificates of the material suppliers and/or the reference inspections on the finished fasteners. In case of F3.1 this can be made by the actual manufacturer or the distributor. ISO 16228 is thus a useful summary of EN 10204 and DIN 11204 and facilitates the handling of inspection documents for fasteners.

2.2. Inspection contents according to ISO 16228 (former DIN 11204)

If there are no specifications on the scope of the test contents agreed in the order, ISO 16228 shall apply.

Table 1 – Test contents for fasteners (excerpt from ISO 16228)

Screws	Type of test	
	Material properties/ mechanical and physical properties	functional properties
Screws ISO 898-1	Chemical composition except for F2.2 (M) tensile strength a) (M) hardness for quenched property class (M)	Thread reduction (A)
Screws ISO 3506-1	Chemical composition except for F2.2 (M) tensile strength and elongation after fracture (M) hardness for fasteners made of martensitic and ferritic stainless steel (M)	Thread reduction (A)

Nuts	Type of test	
	Material properties/ mechanical and physical properties	functional properties
Nuts ISO 898-2	Chemical composition except for F2.2 (M) test load a) (M) hardness for quenched property class (M)	Thread reduction (A)
Nuts ISO 3506-2	Chemical composition except for F2.2 (M) test load a) (M) hardness for fasteners made of martensitic and ferritic stainless steel (M)	Thread reduction (A)

(M) = Measurement, (A) with attribute test

a) If possible, the tensile strength of mechanical fasteners shall be tested on whole screws according to the FF test programme as per ISO 898-1. If none of the tensile inspections specified in ISO 898-1, the substitute inspection that has to be performed, shall be agreed at the time of order placement.

General information:

- The values determined by additional testing and documented in certificates are not "committed properties" or "guarantees of quality" according to Section 267 of the German Civil Code (BGB) and do not mean that the user does not have to perform the proper inspection of incoming goods (Section 377 of the German Commercial Code (HGB)).
- All tests named in 1 and 2 are carried out in general on samples. While their results are representative for the most part of the delivery batch of a load, a 100% guarantee for each part of the batch can be derived from this just as little as its suitability for a specific purpose can be.

Table 2: Overview of the usual inspection documents for screws, nuts and accessory parts according to ISO 16228
Excerpt from ISO 16228 – 05.2018

Type and name of test certificate for mechanical fasteners		When	Content	Confirmed by
F2.1	Declaration of Conformity for fasteners	requested on ordering	Declaration of Conformity for delivered fasteners, no results	Authorized representative of manufacturer or distributor
F2.2	Inspection certificate for fasteners	requested on ordering	Declaration of Conformity for delivered fasteners, with results on the basis of non-specific tests	Authorized representative of manufacturer
F3.1	Inspection certificate for fasteners	requested on ordering	Declaration of Conformity for delivered fasteners, with results of specific tests	Authorized representative of manufacturer or distributor
F3.2	Inspection certificate for fasteners	requested on ordering	Declaration of Conformity for delivered fasteners, with results of specific tests	Authorized representative of manufacturer or distributor and either an authorized representative of the buyer or an external authorized representative

not recommended since there is no specific statement on the delivered product.
the sample quantities for destructive inspections are to be taken into account when deciding the order quantity
e.g. TÜV, GL, DB ...

3. Acceptance testing for "Mechanical fasteners" according to ISO 3269

This standard is always included as applicable when "Mechanical fasteners" are ordered according to standard or similar form parts, if not expressly agreed otherwise beforehand.

It does not apply to fasteners which

- are intended for automatic screw-in,
- are supposed to fulfil particularly high requirements,
- require particular processing procedures/testing measures,
- require specific traceability.

Here, special corresponding arrangements always need to be made on request, on ordering at the latest (e.g. according to ISO 16426). In general, standard commercial stock is not suitable for these specific requirements.

The final draft ISO 3269 – FprISO 3269:2019 now defines scopes of random samples, acceptance numbers and rejection numbers for certain test categories. The test categories are allocated to certain characteristics. Tables 3 and 4 show an extract from this draft with the most important details.

Table 3: Sample test scope, acceptance number N_A and number of rejections N_R
per FprISO 3269:2019

Batch size	Category 1	Category 2		Category 3
		Initial sample test	Additional sample test	
	N_A=0 N_R=1	N_A=0 N_R=2	N_A=0 N_R=1	
2 to 50	1	4	4	not applicable
51 to 90	1	5	5	5 N_A=1 N_R=2
91 to 150	1	6	6	6 N_A=1 N_R=2
151 to 280	1	7	7	7 N_A=1 N_R=2
281 to 500	2	9	9	9 N_A=1 N_R=2
501 to 1200	2	11	11	11 N_A=1 N_R=2
1201 to 3200	2	13	13	13 N_A=1 N_R=2
3201 to 35000	3	15	15	15 N_A=2 N_R=3
35001 to 500000	5	20	20	20 N_A=2 N_R=3
more than 500 000	8	20	20	20 N_A=2 N_R=3

Table 4: Test categories according to FprISO 3269:2019

Test category	Description
Category 1	Characteristics, for which the acceptance number N_A is zero. Category 1 characteristics comprise all mechanical and functional properties that are usually tested with destructive testing. In case deviations are detected during random sampling, the batch or delivery will be rejected.
Category 2	Characteristics, for which the acceptance number N_A is zero; however, in case of deviation, a second sample may be taken. Category 2 characteristics are important dimensional characteristics, which may have negative effects on fit or function of the fastener. If, however, a single deviation is detected in the first sample, another sample with regard to this respective characteristic shall be tested, the scope of which shall correspond to the first sample. If no deviation is detected in this additional sample with regard to the respective characteristic, the batch will be accepted.
Category 3	Characteristics, for which the acceptance number N_A matches one or more deviations, as indicated respectively. Category 3 characteristics are minor dimensional characteristics and certain functional properties, for which deviations are tolerated to a certain extent. In case more deviations are detected during random sampling than those stated as acceptable, the batch or delivery will be rejected.

Test method: Hardness measurement and notch impact test

The hardness measurement serves to determine the resistance of a material against the penetration of a test specimen which acts upon it with a specific type, force and time. Depending on the applied procedure, the hardness value is determined from the measured depth or size of the impression the test specimen makes on the workpiece.

The most common standardised methods are shown in Table 1. If in doubt, the Vickers Hardness test shall be applied for the mechanical fasteners. The measurements are taken on prepared samples. Here it needs to be differentiated between:

- **"Routine testing"**
  The measurement is taken on an even cut on the surface of the sample. Common hardness test procedures are Rockwell (HRC) and Vickers (HV 10 – HV 30).
- **"Arbitration testing"**
  The measurement is taken on a lengthwise or diagonal polished section of the cut-up specimen. The testing procedure according to ISO 898 is Vickers (HV).

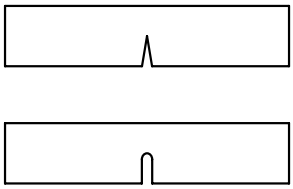
With the acceptance test of "Mechanical fasteners" hardness measurements are only part of routine and comparative checks. They are not themselves decisive for determining mechanical characteristics.

For screws, the tensile test determines the tensile strength, yield strength limit and elongation. For nuts, proof load tests and expansion tests are applicable. (ISO 898-1, DIN 267-21, ISO 898-2).

Table 2 shows a conversion of the hardnesses according to Vickers, Rockwell and Brinell into each other and for the tensile strength of non-alloy to low-alloy steels in hot-formed or heat-treated conditions. Beside these, the hardness ranges of screws, nuts and washers of the various strength classes are specified according to the standard.

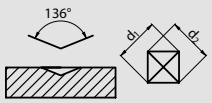
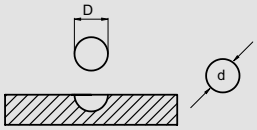
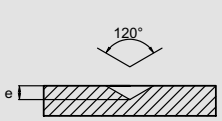
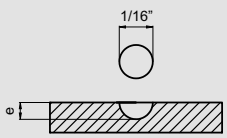
Low load-hardness testing
The low load-hardness test with test loads between 2 and 30 N (HV 0.2 to HV 3) is the link between the conventional hardness testing (HV 5 to HV 100) and micro-hardness testing. It is suitable for determining the hardness in surface layers and for absorbing hardness gradient curves. For fasteners, especially quenched and tempered screws from property class 8.8 or higher, the low load-hardness testing according to ISO 898-1 is used to determine the carburisation state in the thread range.

Impact testing
Impact testing is used to measure the toughness. This shows the extent of the damage which needs to be done in order to shatter a sample. Tough steels can absorb a lot. Brittle steels require less effort. The result of impact testing is used in particular to estimate the usability of steel at low temperatures.
For testing, quadratic test specimens with a defined chamfer are made out of the screws. ISO-V and ISO-U samples are distinguished from each other. In practice, using the ISO-V sample was approved as this reacts more sensitively to the embrittlement of the screw due to the stronger notch effect compared to the ISO-U sample.



ISO-V- and ISO-U-sample

Table 1: Comparison of hardness measuring procedures

Procedure, Marking	Vickers HV	Brinell HB	Rockwell HRC	Rockwell HRB
Norm, Standard	ISO 6507-1.2 (DIN 50133)	ISO 6506 (DIN 50351)	ISO 6508/EN 10004 (DIN 50103-1)	
Suitable for materials	Metallic materials with very low to very high hardness level (specification of medium hardness)	Metallic materials with very low to high hardness level (specification of partial hardness)	Hardened steels, hardened and tempered alloys	Materials of medium hardness, steels with low to medium C-content of brass, bronze ...
Tensile strength range approx. (R_m in N/mm²)	< 250 – 2000	255 – 1520	770 – 2000	250 – 800 250 – 800
Penetrator	Diamond pyramids, quadratic base area, surface angle 136° 	Ball from hardened steel, diameter: 10/15/2.5 or 1 mm 	Diamond cone, cone angle 120° Tip: Radius of curvature 0.2 mm 	Ball from hardened steel Diameter: 1/16" = 1.5875 mm 
General dwell time (for arbitration tests, min.)	Material-dependent 10 – 30 (30) sec.	Material-dependent 10 – 30 (30) sec.	Material-dependent 2 – 25 (30) sec. (two-stage impression Test load F_0 + Test load F_1 = Total test load F)	
Code (examples)	640 HV 30 applied test load F = 294 N/30 kp Vickers Hardness determined hardness value 180 HV 50/30 Dwell time/sec	350 HB Hardness Brinell determined hardness value for ball diameter of 10mm Test load 29420 N/3000 kp Dwell time 10–15 sec. 120 HB 5/250/30 Dwell time/sec. Test load/kp Ball-Ø	45 HRC Hardness Rockwell procedure C determined hardness value	45 HRB Hardness Rockwell procedure B determined hardness value

Test method: Hardness measurement

Table 2: Hardness re-evaluation*/comparison
Hardness ranges of screws, bolts, studs, nuts, washers and rings

Vickers hardness	Brinell hardness	Rockwell hardness		~ Tensile strength	Rough hardness range (based on Vickers Hardness) for																
					Screws					Nuts m ≥ 0.5 d**					Nuts m < 0.5 d Set screws				Washers/Rings		
HV 10	HB	HRB	HRC	MPa	4.6	5.6	8.8	10.9	12.9	5	6	8 04	10 05	12	14 H	17 H	22 H	45 H	St.	St. hard.	SSt.
80	76.0			255																	
85	80.7	41.0		270																	
90	85.5	48.0		285																	
95	90.2	52.0		305																	
100	95.0	56.2		320															100		
105	99.8			335																	
110	105	62.3		350																	
115	109			370	120																
120	114	66.7		385																	
125	119			400						130/142											
130	124	71.2		415																	
135	128			430																	
140	133	75.0		450							150/170										
145	138			465											140						
150	143	78.7		480		155													140		
155	147			495																	
160	152	81.7		510																	
165	156			530												170					
170	162	85.0		545																	
175	166			560																	
180	171	87.1		575								188/233									
185	176			595																	
190	181	89.5		610																	
195	185			625																	
200	190	91.5		640																	
205	195	92.5		660																	
210	199	93.5		675											Mu 215						
215	204	94.0		690													220				
220	209	95.0		705																	
225	214	96.0		720																	
230	219	96.7		740																	
235	223			755																	
240	228	98.1	20.3	770																	
245	233		21.3	785			≤ M 16 250														
250	238	99.5	22.2	800												245					
255	242		23.1	820	250	250													250		
260	247	(101)	24.0	835																	
265	252		24.8	850			> M 16 255						272								
270	257	(102)	25.6	865																	
275	261		26.4	880																	
280	266	(104)	27.1	900																	
285	271		27.8	915																295	
290	276	(105)	28.5	930										295	G. St./290						
295	280		29.2	950																	
300	285		29.8	965																	
310	295		31.0	995			≤ M 16 320	320									300			300	
320	304		32.2	1030																	
330	314		33.3	1060																	
340	323		34.4	1095			> M 16 335														
350	333		35.5	1125																	
360	342		36.6	1155																	
370	352		37.7	1190								302/353	353	353							
380	361		38.8	1220					385												
390	371		39.8	1255				380													
400	380		40.8	1290																	
410	390		41.8	1320																400	
420	399		42.7	1350																	430
430	409		43.6	1385																	
440	418		44.5	1420					435									450			
450	428		45.3	1455																	
460	437		46.1	1485																	
470	447		46.9	1520																	
480	456		47.7	1555																	
490	466		48.4	1595																	
500	475		49.1	1630																	
520	494		50.5	1700																	
540	513		51.7	1775																	530
560	532		53.0	1845																	
580	551		54.1	1920														560			
600	570		55.2	1195																	
ISO 18265 Table A.1					ISO 898-1					ISO 898-2					DIN 267-24 ISO 898-5				e.g DIN 125-1	e.g DIN 125-2	e.g DIN 267-26

* Limitations according to ISO 18265 need to be taken into consideration.
** Hardness ranges differ according to the dimension ranges in min./max. values

Screwed fastenings should be designed in such a way that the preload applied under working stress remains as intact as possible.
While in some cases a clear drop in preload can indeed be tolerated, the screwed fastenings coming undone completely must be prevented.

Mechanism of independent loosening

Creep
Time-dependent exceeding of material yield strength

Settling
Balancing of intrusions in the surface

Relative movement
between the contact surfaces

until final balance:
inner loosening torque ≤ self-retention torque

until connection comes undone completely due to the self-retention torque compensation

Loosening

Independent unscrewing

Loss of preload

Measures

Maintain frictional contact (preload)

Avoid unscrewing

Avoid connection from coming undone

Reduce bearing stress

Balance intrusions

Create material bond

Create form fitting

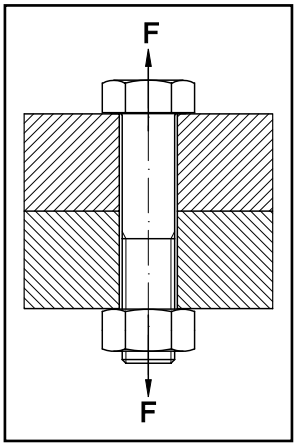
Increase self-retention

Provide locking device against loosening

Provide locking device against unscrewing

Provide locking device against losing

Source: DIN 25201-4



Loosening

Risk
Static loads in axial direction due to assembly forces and/or first operating loads may lead to settling losses. This may lead to a complete loss of preload in the screwed connection.

Settling is not only dependent on forces applied, but also on the number and shape of the separation joints between the tensile building components and the surface condition of the component, such as roughness or coating layers. Low strength of the component may also cause settling, which is caused by yield/creep of the soft material.

Measures
Loss of preload may be counteracted with certain constructive measures or by using screw-settling locks.
To keep settling losses in a screwed connection as low as possible, the number of separation joints between the building components are to be kept to a minimum. Every unnecessary washer is an additional separation joint. The insertion of "soft" washers according to DIN 125 with a hardness of 140 HV in a high-strength screwed fastening with screws of a property class of ≥ 8.8 is to be avoided.

By selecting a longer screw grip length, e.g. by using extension sleeves, preload losses can be absorbed by greater elastic elongation. The same effects are achieved by using shank expansion screws or screws with full thread or by using higher preloads from higher-strength materials.

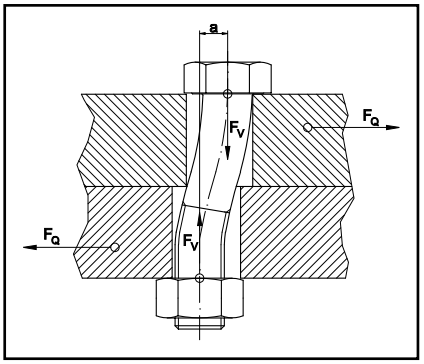
If these measures cannot be used, a curved washer can be used in accordance with DIN 6796 to partially balance out intrusions of parts into materials. Here, it should be made sure that the building component onto which the curved washer is placed is strong enough to not move under the strain and that the curved washer does not dig into the building component.

Independent unscrewing

Risk
If dynamic loads in lateral direction are large enough to shift the fastened component to each other, a loosening torque is generated which can overcome the self-retention in the threaded joint and in the bearing areas. Depending on the frequency in change of load direction, the joints will systematically loosen until they come apart.

Measures
Depending on the structural conditions, either constructive measures or locking devices are applied. The following measures may be applied (see also DIN 252014).

- Increase in initial load (preload)
- Increase in elasticity of the screw
- Increase in friction at the bearing areas of screw and nut and/or in the threaded joint
- Limitation of lateral slipping (use of fit bolts or pins)
- Use of locking fasteners in order to avoid relative movement of screw or nut
- Bonding (liquid adhesive or encapsulated adhesive)



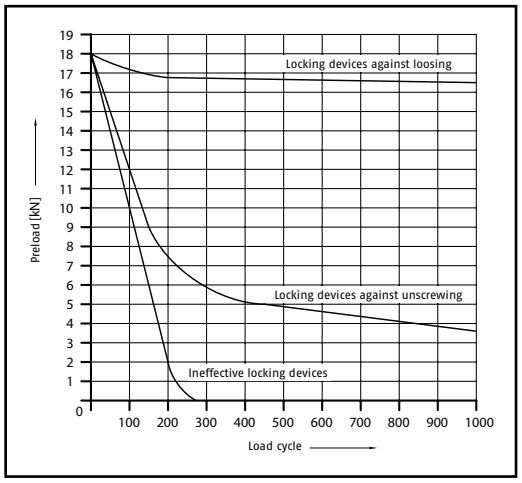
Locking of screwed fastenings

Locking devices against losing

While locking devices against losing do not prevent significant loss of preload, they do prevent the joint from coming apart completely. Usually, around 20% of the preload remains. The working principle is based on the gripping action in the thread. Nuts and screws with locking element or coating, thread rolling screws, all-over coating, strip coating or spot coating are used as locking devices against losing in practice.

The requirements for locking coatings on screws are specified in DIN 26728.
The functional properties of nuts with locking elements (prevailing torque nuts) are defined in ISO 2320.

Locking devices against losing are nuts and screws with locking element or as well as thread rolling screws.



Locking device against unscrewing

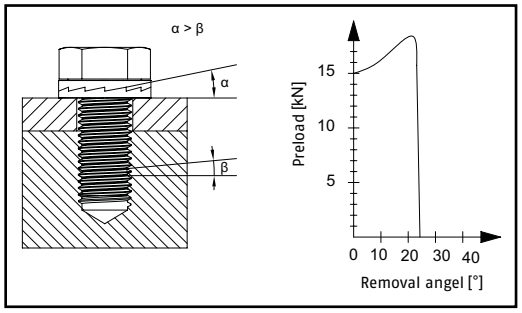
Unscrew locking devices describe elements and methods which are made fundamentally for maintaining the preload in the screwed fastening despite strong dynamic loads to avoid the screwed connections from coming apart. Normally, this prevents the preload from dropping below 80% of the assembly preload. The following basic locking methods are possible:

- Formfitting locking devices against unscrewing
- Locking through increase in preload
- Adhesive locking devices against unscrewing

Formfitting locking devices against unscrewing

Form fitting is achieved by using locking serrations or ribs on the supporting surfaces of the screw head or nut. The use of washers with locking serrations or ribs is also possible. Of particular importance here is that the surface hardness of the locking serrations/ribs be considerably stronger than the building components to be connected so that they can dig themselves into the surface. It should be noted that the serrations and ribs strongly affect the friction coefficients.

As such, much higher friction coefficients (μ_{total} = 0.2–0.3) need to be considered when dealing with soft contact materials such as aluminium alloys and construction steels, into which the serrations dig. The tightening torques need to be determined accordingly in order to achieve the desired preloads. Ultimately, the optimum tightening torques are to be determined by testing in environments which reflect the actual conditions. Typical values for tightening torques can be found on the TI pages TI-247.

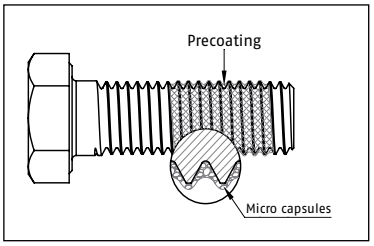


Locking through increase in preload

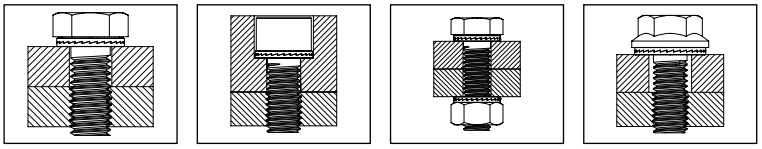
With this locking method, the exterior radial ribs of the self-locking washers are embossed into the respective component surface. In case of dynamic load and the related unscrewing attempt of the screwed connection, only a movement between the inner wedge surfaces is possible.

Due to the washers' increased wedge angle compared to the screw thread pitch angle the preload in the connection is increased, which is shown clearly in the following two figures.

Adhesive locking devices against unscrewing



In an adhesive locking device against unscrewing, micro-capsules are applied on the thread with a carrier material. These contain the adhesive and a hardening agent. The capsules break open during screwing and the adhesive begins to harden. The hardening process usually takes 24 hours to complete. A screwed fastening results which is locked against vibrations and loss of preload and which simultaneously acts as a sealant. The adhesive creates a bonded connection, which prevents unscrewing as well as locking by form fitting. DIN 267-27 describes the adhesive coating with encapsulated adhesive. Since the micro-capsules are applied to the thread in a special coating process, it is recommended that this be used especially with bulk amounts. When applying micro-capsule adhesives to zinc flake coatings, seals and/or coatings with lubricant additives, a reduction in the breakaway torques vis-à-vis DIN 267-27 may come about. In this case, the application should be safeguarded by testing in application conditions before using in bulk. The shelf life of micro-encapsulated coatings according to DIN 267-27 is determined to be at least 4 years from date of manufacturing. For smaller batches and universal use, anaerobic hardening liquid adhesives are suitable. They are applied to the thread when assembling the screwed fastening and harden when atmospheric oxygen and metal (iron and copper ions) come into contact with each other. The temperature resistance of adhesive coatings is limited. For more information please refer to TI-258.



Installation examples

Assembly instructions for form-fitting and preload-increasing locking device against unscrewing

The connection must be locked under the screw head and under the nut in order to prevent unscrewing. The figures show which versions are possible.

Information on the use of austenitic and stainless steels

Austenitic steels of the steel groups A1 to A5 do not have any spring-hard properties. Therefore, the locking elements made of these steels cannot balance any intrusions with a spring effect. Steels 1.4310 and 1.4568 represent an alternative.

Other than the steels A 1 to A 5 have partial spring-hard properties, which, however, do not fulfil the requirements for spring steel in full. For this reason, locking elements made of these two steels can obtain the spring properties of steel products only to a limited extent.

Comparison of locking and adhesive coatings

Adhesive bonding

Product/Description	Colour	Temperature resistance, locked [°C]	Thread friction coefficient µ	Curing time [h]	Property
Precote 30	yellow	-60 to +150	0.10 - 0.15	6	medium strength, sealing
Precote 80	red/green	-60 to +170	> 0.25	6	high strength, sealing
Precote 85	turquoise	-60 to +170	0.10 - 0.15	6	high strength, sealing
ScotchGrip 2353	blue	-30 to +110	0.13 - 0.19	24	high strength, sealing
ScotchGrip 2510	orange	-30 to +200	0.13 - 0.19	72	high strength, sealing

All indications are given by the manufacturer. We are not responsible for the accuracy of the given information.

Locking and sealing

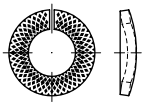
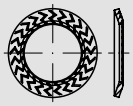
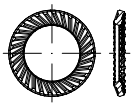
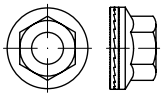
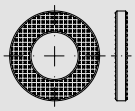
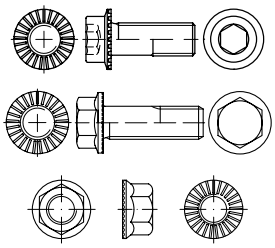
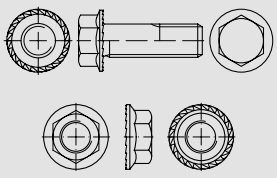
Product/Description	Colour	Temperature resistance, locked [°C]	Thread friction coefficient µ	Property
PolyamidFleck (GESI)	blue, red	-60 to +120		Locking
PolyamidRundum (GESI)	blue, red	-60 to +120	0.12 - 0.14	Locking and sealing
TUFLOKFleck (NYLOK)	blue/red	-56 to +121		Locking
TUFLOKRundum (NYLOK)	blue/red	-56 to +121		Locking and sealing
LongLok Polycap Nylon	green	-51 to +121		Locking
LongLok KelF	blue	-196 to +199		Locking
LongLok Vespel	brown	-268 to +260		Locking
HotLok	silver	-240 to +649		Locking
Klemmtight	-	-60 to +200		Locking
Alutight	-	-60 to +500		Locking
Heattight	-	up to +1000		Locking
Thermotight	-	-240 to +220		Locking
precote 2	blue	-60 to +90	0.10 - 0.15	Locking
precote 6	white	-60 to +110	0.25 - 0.30	Locking
precote 9	white/redbrown	-60 to +180	0.10 - 0.15	Locking
precote 10	grey/green/blue	-60 to +130	0.16 - 0.20	Locking and sealing
precote 101	green	-60 to +150	0.18 - 0.23	Locking and sealing
precote 192	red/transparent	-60 to +90	0.18 - 0.23	Locking
precote 197	yellow/transparent	-60 to +150	0.10 - 0.15	Locking

All indications are given by the manufacturer. We are not responsible for the accuracy of the given information.

Help for selecting the correct locking device

Design objectives	Locking elements
Reusability	Form-fitting locking elements
Defined/constant friction coefficients	Nord-lock washers, adhesive locking devices
Low assembly costs	Flange screws and nuts with locking serrations/ribs, adhesive locking device
Readjustability of the fastenings	Form-fitting locking elements
Assembly conditions	If it cannot be avoided that the threads to be coupled are free from oil and grease, form fitting locking devices shall be preferred.
Temperature	Depending on the product, adhesive locking devices can bear temperatures between 110 and 200 °C maximum – see overview on page 13. Otherwise metal locking devices are recommended, which lock by form or friction.

Table 3: Overview of locking devices against unscrewing in the REYHER product range

REYHER article			Special properties
88130 – 88131	Lock rings		Duplex structured surface and bulging ➔ this also balances out small intrusions of parts into materials
88123 – 88126	Lock washers		To a certain extent, bulging also balances out intrusions of parts into materials, similar to conical spring washers.
88120 – 88121	SCHNORR safety washers		Duplex serrated surface and bulging ➔ this also balances out small intrusions of parts into materials
88132 88032 88033	Nord-Lock washers – Standard – SP (enlarged outer Ø) – SC for HV connections – Nord-Lock X-series		Each consisting of one washer pair, stuck as a pair for easy assembly. The external surfaces have ridges which are embossed into the surface of the components. The interior surfaces are wedge-shaped. During assembly, the interior surfaces only slide on top of each other ➔ this means that the friction coefficient remains constant, which makes it possible to determine a precise specification for the tightening torque. The Nord-Lock X-series washers are additionally convex. This also balances out small intrusions of parts into materials.
88034	Wedge lock nuts		With captive wedge lock washer fixed to a flange nut with a plastic ring. ➔ for easier assembly
88119	LOCKTIX washers		Duplex structured surface and large bearing area.
88912 88913 88914	Flange screws Flange nuts		The assembly process is made easier thanks to the pressed flange with ribs as individual washers do not need to be used.
88933 88934	Locking screws Locking nuts		The assembly process is made easier thanks to the pressed flange with serrations as individual washers do not need to be used. The special design of the flange balances out intrusions of parts into materials to a limited degree.

EC Directive 2000/53/EC on end-of-life vehicles (ELV Directive)
(End-of-Live-Vehicles)

The aim of this European directive is to avoid having materials which are dangerous to health in vehicles or to prevent this from happening as much as possible.
All cars and utility vehicles up to 3.5 t, which were put into operation from 1st July 2007 onwards are affected by this.

The following are banned from this date

1. Lead
2. Cadmium
3. Chromium (VI)
4. Mercury

Exceptional approval was granted until 1st July 2008 for hexavalent chromium in corrosion protection layers for screws and nuts to fasten parts of chassis frames.

This EC directive was adopted into German law through the end-to-life vehicles directive.

The automotive industry implemented the requirements of the EC directive in the form of

1. VDA data sheet 232-101 (list of materials which must be declared)
2. International material data system (IMDS)

The IDMS is a portal on which all environmentally relevant information in the supply chain are summarized and reported to the vehicle manufacturer.

➔ **These products from the REYHER catalogue comply with this directive**
All products made of steel, stainless steel and non-ferrous metals uncoated or zinc-plated with blue/transparent thick layer passivation, with zinc flake coatings without hexavalent chromates (flZnnc) and hot dip galvanization

EC Directive 2011/65/EU on electrical and electronic equipment (ROHS directive)
(Restriction of Hazardous Substances)

The Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment has been updated with the Directive 2015/863/EU (RoHS III).

It is implemented by the Electrical and Electronic Equipment Ordinance (ElektroStoffV) in Germany. According to this ordinance, waste electrical and electronic equipment, including cables and spare parts that contain more than 0.1 percent by weight of lead, mercury, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers or more than 0.01 percent by weight of cadmium per homogeneous material may not be placed on the market. For certain substances and applications there are exceptions.

For lead as an alloying element there are exemptions applicable according to Annex III:

- 6(a) -I (steel up to 0.35%, galvanised steel containing up to 0.2% by weight)
- 6(b) -I (as an alloying element in aluminium containing up to 0.4% lead by weight)
- 6(c) -I (copper alloy containing up to 4% by weight)

➔ **These products from the REYHER catalogue comply with this directive**
To this current date, products that are marked with the RoHS symbol on the price pages do not contain amounts of any hazardous substances exceeding the above-mentioned limit values or are exemptions according to Annex III. If there are products that are not marked with this symbols, these might contain amounts of the mentioned substances exceeding the limit value. More detailed information is available on request.

ZEK 01.2-08 PAK
(Polycyclic aromatic hydrocarbons)

This directive replaces directive ZEK 01-08. Products (technical work equipment and consumer products) must comply with legal requirements to avoid any risk to health, such as § 30, 31 LFGB, the Chemicals Prohibition Ordinance and

§ 4 the Equipment and Product Safety Act (GPSG), which is why the revised PAH test specifications as well as the new PAH maximum values were specified in this document. Materials that may contain PAHs are, for example, elastomers (plastics and rubber materials), black or dark-coloured polymers, coatings and lacquers as well as materials treated with preservatives (naphtalene) such as natural bristles, leather products, bast and wood.

The main causes of PAH contamination in materials are the use of:

- PAH-contaminated softening oils in rubber and flexible plastics (soft plastics)
- PAH-contaminated soot as a black pigment used in rubber, plastics and varnish

This shows that products we delivered which were made of steel, stainless steel and non-ferrous metals including all coatings are not affected by this regulation.

➔ **All products from the REYHER catalogue comply with this directive**

California Proposition 65
(The Safe Drinking Water and Toxic Enforcement Act of 1986)

California Proposition 65 is a Californian law to protect drinking water sources from contamination with chemicals known to cause cancer and/or birth defects or other reproductive harm. This law does not prohibit any substances, but sets limit values for exposure to certain substances. It requires businesses to provide "clear and adequate" warnings to individuals prior to exposure to listed chemicals. These chemicals can be in the products that people purchase, in their homes or workplaces, or that are released into the environment.

The list of chemicals causing cancer and/or birth defects or other reproductive harm is maintained by the Office of Environmental Health Hazard Assessment (OEHHA),and updated every year. Currently, it contains more than 900 chemicals.

SJ/T 11364-2014 (China RoHS 2)
(Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products)

The China RoHS 2 is very close to the EU RoHS and can be compared to the EC Directive 2011/65/EU (RoHS 2). According to the China RoHS 2, waste electrical and electronic equipment that contains more than 0.1 percent by weight of lead, mercury, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers or more than 0.01 percent by weight of cadmium per homogeneous material. Other than the EU RoHS, the China RoHS 2 does not state exemptions. That is why products, that are in compliance with the EU RoHS, do not automatically fulfil the China RoHS conditions. China RoHS 2 requires that all electronic and electrical products that are sold in the People's Republic of China be marked with a label. The "e" label is applied to products that do not contain any hazardous substances exceeding concentration limits. Products that contain certain hazardous substances are marked with an orange label and can be used safely during its environmental protection use period (as indicated by the number in the center) which should enter into the recycling system after its environmental protection use period. In the case of the orange label, the amount of substances to be declared shall also be stated on the component or, in case of limited space, in the user manual. This indication must be made in Mandarin.

Conflict minerals
(Dodd Frank Act)

With the 15th title of the Dodd Frank Act the use of "conflict minerals" shall be avoided that are originating in or near the Democratic Republic of the Congo and are benefiting armed groups in the area. The relevant raw materials comprise tin, tantalum, tungsten, and gold from the African Great Lakes region including the Democratic Republic of the Congo, Angola, Burundi, Rwanda, Tanzania, Uganda and the Central African Republic of Zambia. According to section 1502 Dodd-Frank Act, companies that, according to US legislation, are required to issue annual reports on their stock trade to disclose whether so-called "conflict minerals" required for manufacturing products are originating in or near the Democratic Republic of the Congo. This way, all companies are affected that are allocated allong the supply chain of companies listed on US stock exchanges,
be it as a direct supplier or intermediate supplier. The material data communication in the supply chain is made via a CMRT template, that we will gladly send to you upon request.

EC Regulation EC 2006/122 (PFOS)
(Perfluoroctansulfonate)

The EU directive 2006/122/EC relates to the use of perflouroctane sulfonates (PFOS). PFOS are mainly used in the aerospace, semiconductor, and electronics industries, as well as in the photographic trade. If emissions into the environment and exposure in the workplace can be reduced to a minimum, there is no serious threat to the environment or to human health. According to the directive, special attention needs to be given to galvanic processes and surface treatment of metals and plastics. There are indications and experience shows that legislative measures are to be expected in this regard. By using the best technology available, it is expected that emissions shall be reduced accordingly. Another proposal is for restricting semi-finished products and products containing PFOS to which PFOS were intentionally added. The directive would apply only to new products and not to products that are already on the market. Since perfluoro-octanoic acid (PFOA) and its salts pose a similar risk, possible additions to this directive with regard to this group are to be expected. A fully galvanized product does not contain any measureable quantities of PFOS.

➜ All products from the REYHER catalogue comply with this directive

EC Regulations 1907/2006 – Chemicals regulation (REACh)
(Registration, Evaluation, Authorisation of Chemicals)

This EC regulation centralises and simplifies Europe-wide chemical laws through registration, evaluation and authorisation and came into effect on 1st June 2007. It is the dedicated objective to increase the level of knowledge of the dangers and risks which arise from chemicals. Here, companies are given more responsibility for the safe handling of their products. Although fasteners are in principle included as articles by the REACh regulation, most fall under exemptions and are thus exempt from the registration requirement.

According to Article 3 of REACh regulation fasteners are articles. Articles are objects, whose function is defined not by its chemical composition (e.g.by the metal components in the alloy), but by their external shape.

However, according to Article 7, Section 1 REACh regulation articles are only subject to registration if they also contain substances that are intended to be released. This is however not the case for fasteners.

Even fasteners with corrosion protection coatings, which thus have a sacrificial coating, i.e. a coating which is sacrificed to protect the component part, is not subject to having to be registered. This is because the protective layer is not released as such, but only certain reaction products. What is relevant is the exemption under Article 2 section 7 (b) REACh regulation in conjunction with Annex V section 3 of the REACh regulation. According to this, the substances which result from a chemical reaction occurring upon end use of other substances, mixtures or articles and which are not themselves manufactured, imported or placed on the market, are exempted from the obligation to register.

However, this does not affect provisions regarding substances of very high concern (SVHC) (Articles 57, 59, Annex 14 REACh regulation) in articles under Article 7 section 2 REACh regulation. These substances are not subject to registration, but must be reported, provided

a) the substance is present in those articles in quantities totalling over one tonne per year per producer or importer
b) the substance in these articles contain a concentration of more than 0.1% (by mass).

The statements above do not apply to chemical/technical products (e. g. aerosols, adhesives and sealants). These are preparations, not articles. For preparations it is not the preparations themselves, but the ingredients that are subject to registration. For products manufactured in the EU this obligation to register affects the manufacturer and the importer for imports from non-EU countries.

Next to the obligation to register and report, the REACh regulation also describes an obligation to inform according to article 33. Every supplier of every product, which contains at least one substance listed according to Article 59 (SVHC) in a concentration of more than 0.1% (by mass), must inform all participants within the supply chain. In doing so at least the name of the substance must be given. The list of substances according to Article 59 is revised and extended every half year. The Court of Justice of the European Union decided on the concept of articles, 10th September 2015 "Once and article – always an article". This means that each individual article and not the number of articles a product is composed of, serves as a reference for determining the obligation to inform. If a product contains more than 0.1% (by mass) of an SVHC candidate and thus be subject to information obligation this does not affect the production, distribution or processing of the product.

On 27th June 2018 lead (CAS-No. 7439-92-1, EG-No. 231-100-4) was added to the list of SVHC candidates, and some of our products are affected. Lead may be contained as an alloy in machine elements > 0.1 percent per pass in the following property classes/materials:

-Property classes: 4.6, 4.8, 5.8, 6.8, 04, 4, 5, 6, 11H, 14H, 17H, 22H, 33H, 45H
-free cutting steel
-copper alloys (e.g. brass, bronze)
-Aluminium alloys

Although lead has been classified as a substance causing reproductive harm, this does not mean that materials containing lead represent imminent danger. Apart from that, the potentially toxic properties of lead have been known for years and must be considered depending on the use.

➜ **The following products from the REYHER catalogue do not contain any SVHC**
All products marked with a "REACh SVHC free" symbol in the price pages do currently not contain any SVHC candidate in a concentration of more than 0.1% (by mass). If there are products that are not marked with this symbol, these might contain SVHC candidates in concentrations of more than 0.1% (by mass).

EC Construction Products Regulation 305/2011/EU
(Construction products directive)

On 1st July 2013 this regulation repealed Construction Products Directive 89/106/EEG.

This regulation defines the conditions for the marketing and provision of construction as well as their CE marking.

For more detailed information, please refer to the REYHER special publication "Fasteners Metal and Steel Construction"

➜ **These products from the REYHER catalogue comply with this directive***
- Fasteners for steel construction: EN 14399-4, EN 14399-6, EN 14399-8, DIN 7968, DIN 7969, DIN 7989, DIN 7990, Sets from ISO 4014/4017 according to EN 15048.
- Fasteners for steel construction:
  - o Chipboard screws: REYHER Article numbers 89096 – 89098, SPAX articles
  - o Wood building screws: REYHER Article numbers 89091, 89092
  - o Hexagon wood building screws: REYHER Article numbers 89571, 89092
  - o Bolts with hexagon nuts: REYHER Article number 89601

EC Directive 2006/42/EC
(Machinery Directive)

The **Directive** regulates a unified protection level for accident prevention when bringing machinery into circulation inside the European Economic Area (EEA).

This Machinery Directive is supposed to reduce non-tariff barriers in the Union. Like all directives decreed on the basis of the EC Treaty, the Machinery Directive does not have any direct effect. It needs to be adopted into national law. In Germany, this has been done by the Equipment and Product Safety Act (Geräte- und Produktsicherheitsgesetz (GPSG)) and the Machinery Directive based thereon (9th GPSGV).

From **29th December 2009** the new Machinery Directive is to be applied in a binding fashion.

Essentially, the following change were made:

- Clearer restriction of the scope of application for the low-voltage directive and for the lift directive
- Incomplete machinery are included in the scope of application. Which directive requirements were satisfied can be found in the related documents. Included in the scope of delivery are a declaration of installation and assembly instructions written in the language of the country.
- The basic health and safety requirements were modified to meet technical advances made
- Selection options for conformity assessment procedures for machinery with inherently dangerous machines (see Annex 4 of the directive)
- Safety components receive the CE marking
- Inclusion of household appliances also commercially used, provided they fulfil the machine definition

➔ **These products from the REYHER catalogue can be used to implement this directive**
DIN 7964 and REYHER article numbers 88151, 88152 and 88153

Product Safety Act (ProdSG)

The German Product Safety Act, formerly the Equipment and Product Safety Act (GPSG), applies whenever products are made available on the market, exhibited on the market or used for the first time in the context of a commercial activity as well as tot he erection and the operation of installations subject to mandatory inspection, which are used for commercial or economic purposes or which may put employees at risk, with the exception of installations subject to mandatory inspection.

The Product Safety Act (ProdSG) includes a number of regulations which have implemented a number of European directives into German law.

1. ProdSV – Regulation relating to making available on the market electrical equipment designed for use within certain voltage limits
2. ProdSV – Regulation relating to the safety of toys
6. ProdSV – Regulation relating to making available on the market simple pressure vessels
7. ProdSV – Appliances burning gaseous fuels regulation
8. ProdSV – Regulation relating to making available on the market personal protective equipment
9. ProdSV – Machinery regulation
10. ProdSV – Regulation relating to making available on the market recreation craft and transport using recreational craft
11. ProdSV – Explosion protection regulation
12. ProdSV – Lift regulation
13. ProdSV – Aerosol dispenser regulation
14. ProdSV – Pressure equipment regulation

EU Directive 97/23/EC
(Pressure equipment directive)

The EU Directive is implemented by the 6th and 14th ProdSV Regulation relating to making available on the market simple pressure vessels.

The Regulation is reflected in the Technical Regulations (standards), which include instructions on computation and construction, on approved materials (including materials and strength classes for bolts and nuts), on acceptance test provisions (factory inspection documents) and on selected and correspondingly recognised manufacturers.

In addition or if not otherwise specified, the Technical Regulations apply to bolts and nuts among others:

AD 2000 data sheet W 0 = General principles for materials
AD 2000 data sheet W 2 = For austenitic steel parts
AD 2000 data sheet W 7 = For ferritic steel parts
AD 2000 data sheet W 10 = For ferrous material parts for low temperatures

The recognised manufacturer of bolts and nuts made from permitted materials must prove to the responsible authority that the requirements have been satisfied according to AD 2000 data sheet W0. Manufacturers who fulfil these requirements are listed in the VdTÜV data sheet for materials 1253/1. These manufacturers are subject to constant inspection.

➔ **These products from the REYHER catalogue are in compliance with this regulation***
DIN 938 (5.6), DIN 939 (5.6), DIN 28129 (C 35)
ISO 4014/4017 (5.6, 8.8, A 2-70, A 4-70, A 4-80, BUMAX 88), ISO 4032 (5, 8, A 2-70, A 4-70, A 4-80, BUMAX 88), ISO 4762 (8.8, A 2-70, A 4-70, A 4-80, BUMAX 88)

*See the information on the corresponding products on the price pages