STANDARD PRODUCTS

FULL-CATALOGUE

TIGGES
Excellence in fastener solutions

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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 harmonizing 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 Nov. 2009).
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 The tables also include draft standards and withdrawn standards.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		Product standards		Product standards		Product standards		Product standards		Basic/Functional standards	
DIN	ISO DIN ISO DIN EN ISO	DIN	ISO DIN ISO DIN EN ISO	DIN	ISO DIN ISO DIN EN ISO	DIN	ISO DIN ISO DIN EN ISO	DIN	ISO DIN ISO DIN EN ISO	DIN	ISO DIN ISO DIN EN ISO
1	2339	792	-	1475	8742 / 8743	6916	EN 14399-6	18182	-	66	15065
7	2338	797, 798*	-	1476	8746	6917-6918	-	21346	-	69	273
39	-	830*	-	1477	8747	6921	EN 1665	21547	-	74	-
84	1207	835	-	1478-1480	-	6922 EN 1665		22424, 22425	-	76-1	3508, 4755
85	1580	906-910	-	1481	8752	6923 EN 1661		25192	-	76-2	228-1
93*	-	911	2936	1587	-	6924 (RG) 7040		25193	-	78	4753
94	1234	912 (RG)	4762	1592-1597	-	6924 (FG) 10512		25195	-	101	1051
95, 96, 97	-	912 (FG)	12474	1804	-	6925 (RG) 7042		25197*	-	267-1	8992
98, 99	-	913	4026	1816	-	6925 (FG) 10513		2200-25203	-	267-2	4759-1
123, 124	1051	914	4027	2093	-	6926 (RG)	EN 1663	26020	-	267-3	898-1
125-1,2	7089, 7090	915	4028	2507	(EN 1515)	6926 (FG)	EN 1666	28030	-	267-4	898-2
126	7091	916	4029	2509*	-	6927 (RG)	EN 1664	28129	-	267-5	3569 (16426)
127*, 128*	-	917	-	2510-1…8	-	6927 (FG)	EN 1667	28152	-	267-6	4759-1
134*, 137*	-	920-927	-	3015-3016	-	6928 (RG) 7053		32500, 32501	13918	267-7	898-1
186, 188	-	928, 929	-	3017	-	6928 (FG) 10509		34800-34802	-	267-8	898-2
258	ISO 8737	931-1	4014	3220	-	733	-	34803, 34804	-	267-9	4042
261	-	931-2	-	3319	-	7337	15973-16585	34810-34816	-	267-10	10684
302	1051	933	4017	3404, 3405	-	7338-7340	-	34817-34819	-	267-11	3506-1…4
314-318	-	934 RG	4032, 4033	3567	-	7341	1051	34820	-	267-12	2702
319	-	934 FG	8673, 8674	3568*	-	7343	8750	46258, 46320	-	267-13	-
338, 340	-	935-1	-	3570	-	7344	8748	46288	-	267-15	2320
388, 390	-	935-3	-	3575	-	7346	13337	58450	-	267-18	8839
404	-	936 RG/FG	4035 / 8675	3670	-	7349	-	70613-70618	-	267-19	6157-1, 3
417	7435	937	-	3870, 3872	-	7500-1	-	70851*	-	267-20	6157-2
427	2342	938-940	-	4109	-	7504	15480-15483	70852	-	267-21	10484
431	-	949-1, 2	-	5299	-	7513	-	70951*	-	267-23	898-6
432*	-	950-959	-	5406	-	7516	-	70852	-	267-24	-
433-1,2	7092	960	8765	5417	-	7603	-	71412	-	267-25	898-7
434-436	-	961	8676	5525, 5526	-	7604	-	71752	-	267-26…30	-
438	7436	963	2009	5586	-	7642, 7643	-	71802-71805	-	475*	272 (EN 1660)
439-1	4036	964	2010	5903, 5906	-	7964	-	74361	-	522	4759-3
439-2 RG/FG	4035, 8675	965	7046-1, 2	5914	-	7965	-	80403	-	918	1891
440	709	966	7047	6303	-	7967*	-	80701	-	946	16047
442, 443	-	967, 968	-	6304-6307	-	7968	-	80704	-	962 (34803)	7378, 8991
444	-	(970)	4032	6311	-	7969	-	80706	-	969	-
462, 463*	-	(971-1, 2)	8673, 8674	6319	-	7971	1481	81698	-	974	-
464, 465*	-	(972)	4034	6324	-	7972	1482	82006-82010	-	2510-2, 8	-
466, 467	-	975	DIN 976	6325	8734	7973	1483	82013	-	7150-7152	286
468, 469	-	976-1, 2	-	6330, 6331	-	7976	1479	82101	-	7154-7157	-
470	-	977	-	6332	-	7977	8737	**Thread Standards**		7160, 7161	286
471, 472	-	979	-	6334*	-	7978	8736	13-1…11	724	7168	2768, 8015
478-480	-	980 RG	7042 (7719)	6335-6337	-	7979	8733, 8735	13-12	261	7172, 7182	286
508	299	980 FG	10513	6340	-	7980*	-	13-13	262, 965-2	7184	1101
525, 529	-	981	-	6378	-	7981	7049	13-14, 15	965-1, 2	7337	14588-589
546-548	-	982 RG	7040	6379	-	7982	7050	13-16, 18	1502	7500-2/7504	- / 10666
551	4766	982 FG	10512	6791, 6892	1051	7983	7051	13-19	68-1	7962	4757
553	7434	983	-	6796	-	7984	-	13-20…16	-	7970	1478
555	4034	985 RG	7040	6797*	-	7985	7045	13-27	965-3	7998	-
557	-	985 FG	10512	6798*	-	7987*, 7988*	-	13-28	-	8140-1…3	-
558	4018	986	-	6799	-	7989-1, 2	-	13-50…52	-	9830	-
561	-	987*	-	6880	-	7990	-	14	-	18800	-
562	-	988	-	6881	-	7991	10642	103-1	2901	34803, 34804	-
564	-	1052	-	6883, 6884	2492	7992	-	103-2	2902	40080	2859-1…3
571	-	1433-1436	-	6885-1, 2	-	7993	-	103-3	2903	50049	EN 10204
580, 582	-	1440	8738	6885-3	-	7995-7997	-	103-4	2904		
601	4016	1441	-	6886, 6887	-	7999	EN 14399-8	103-5…9	-		
603	-	1443	2340	6888	3912	8140	-	202	-		
604-608	-	1444	2341	6899	-	9021	7093-1, 2	224	5408		
609, 610	-	1445	-	6900	10644	9045*	-	2510-2	-		
653	-	1469	-	6901	10510	9841	7379	7953	-		
660-662	1051	1470	8739	6902-6908	10669, 10673	11014	-	7970	1478		
674, 675	1051	1471	8744	6911	-	11023, 11024	-	7998	-		
703*, 705	-	1472	8745	6912	-	15058	-	8140, 8141	-		
741	-	1473	8740	6913*	-	15237	-				
787	299	1474	8741	6914-6915	EN 14399-4	16903	-				

- ISO/EN standard not yet known (as NOV 2009)
() Transitional standard (dimension 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)

Table 2

Product standards				Product standards				Product 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	7053	-	6928	Hex, washer head tapping screws	68	-	13 T 19	Metrics screw thread – profile
-	1661	6923	Hex. nuts with flange	7089	-	125-1, 2	Washers, grade A	228-1…3	-	259-1…3	Ww head cap pipe thread G
-	(1662), 1665	6921, 6922	Hex. bolts with flange	7090	-	125-1, 2	Washers, grade B	261	-	13-12	Selection of pitch threads CT/FT
-	1663, 1664	6926, 6927	Hex. nuts with flange	7091	-	126	Washer, standard design	262	-	13-13	Thread selection series
-	1666, 1667FG	6926, 6927FG	and prevailing torque type	7092	-	433-1, 2	Washers, small series	724	-	13	ISO thread: Basic dimensions
-	14218, 14219	-	Hex. bolts/nuts with flange FT								
-	14399-4	6914-6915	Hex. bolts/nuts (HV)	7093	-	9021	Washer, large series	965-1…5	-	13-13…15, 27	Metric threads, data / principles
-	14399-6	6916	Plain chamfered washers (HV)	7094-1, 2	-	440	Washer, extra large	1478	-	7970	Tapping screws thread
-	14399-8	7999	Hex. fit bolts (HV)	7379	-	9841	Hex. socket head shoulder screws	1502	-	13-16…18	Thread gauges
				7380	-	-	Hex. socket button head screws	2901-2904	-	103-1…4	Trapezoidal thread
299	-	508/787	Screws / Nuts for T-slots	7434	27434	553	Slotted set screws TC	5408	-	2244	Thread: Terms
773	-	6885-1, 2	Parallel keys								
774	-	6886, 6887	Taper keys with grip head	7435	27435	417	Slotted set screws CD	6410-1…3	-	27	Threads description in drawing
1051	-	660	Rivet, rivet pins	7436	27436	438	Slotted set screws CP				
1207	-	84	Slotted cheese head screws	7719, 7720	-	980, 6925	Prevailing torque type hex. nuts	**Basic / Functional Standards**			
				8100, 8102	1665	6921	Hex. bolts with flange				
1234	-	94	Split pins					225	20225	-	Fasteners: Dimensions
1479	-	7976	Hex. head tapping screws	8104	1662	6922	Hex. bolts with flange	272	1660	475-1	Hex. wrench sizes
1481	-	7971	Pan head tapping screws	8673	-	934, 971-1	Hex. nuts FT	273	20273	69	Clearance holes for bolts
1482	-	7972	Csk. head tapping screws	8674	-	934, 972-2	Hex. nuts FT	286-1, 2	20286	7150-7182	ISO System of limits and fits
1483	-	7973	Rcsk. Head tapping screws	8675	-	439-2, 936	Hex. thin nuts (chamfered) FT	885	-	-	Radii under screw head
				8676	-	961	Hex. head screws FT				
1580	-	85	Pan head screws					887	-	-	Plain washers – general plan
2009	-	963	Countersunk head screws	8733	-	7979	Parallel pins, internal thread	888	-	-	Nominal lengths screws / thread
2010	-	964	Rcsk. head screws	8734	-	6325	Parallel pins, hardened	898-1	-	267-3, 7	TDC fasteners: bolts
2338	-	7	Parallel pins	8735	-	7979	Parallel pins, internal thread	898-2	-	267-4, 8	TDC fasteners: nuts CT
2339	22339	1	Taper pins	8736	28736	7978	Taper pins, internal thread	898-3	-	267-3	TDC fasteners: set scres
				8737	28737	7977, 258	Taper pins CD thread				
2340	22340	1443	Clevis pins without head					898-6	-	267-23	TDC fasteners: nuts FT
2341	22341	1444	Clevis pins with head	8738	28738	1440	Washers for clevis pins	898-7	-	267-25	Torsional test M1-M10
2342	-	427	Headless screws	8739	-	1470	Grooved pins	1051	-	101	Rivets: technical specifications
2491	-	6885-3	Parallel keys	8740	-	1473	Grooved pins with chamfer	1101	-	7184	Tolerances of form / position
2492	-	6883, 6884	Gib head / parallel keys	8741	-	1474	Grooved pins	1891	-	918	Fasteners – terminology
				8742	-	1475	Grooved pins				
2936	-	911	Hex. socket head screws					2320	-	267-15	TDC fasteners: locking nuts
3912	-	6888	Woodruff Keys	8743	28743	1475	Grooved pins	2702	-	267-12	TDC fasteners: tapping screws
4014	-	931-1	Hex. head bolts	8744	-	1471	Grooved pins	2768-1, 2	-	7168-1, 2	General tolerances
4016	-	601	Hex. head bolts	8745	-	1472	Grooved pins	2859	-	40080	Sampling plans
4017	-	933	Hex. head bolts	8746	-	1476	Round head grooved pins	3269	-	267-5	TDC fasteners: acceptance inspection
				8747	-	1477	Grooved pins with csk. head				
4018	-	558	Hex. head screws					3506-1…4	-	267-11	TDC fasteners: stainless steel
4026	-	913	Hex. socket set screws CH	8748	-	7344	Spring-type straight pins H	3508	-	76-1	Thread runouts / undercuts
4027	-	914	Hex. socket set screws TC	8750	-	7343	Spring-type straight pins S	4042	-	267-9	TDC fasteners: electroplated coatings
4028	-	915	Hex. socket set screws CD	8751	-	7343	Spring-type straight pins L	4753	-	78	Thread ends / protrusions
4029	-	916	Hex. socket set screws CP	8752	-	1481	Spring pins H	4755	-	76-1	Thread runouts / undercuts
				8765	-	960	Hex. head bolts FT				
4032	-	934	Hex. nuts CT					4757	-	7926	Cross recess for screws
4033	-	934	Hex. nuts II CT	10509	-	6928	Hex. flange head tapping screws	4759-1…3	-	267-2, 6, 522	Tolerances for fasteners
4034	-	555	Hex. nuts	10510	-	6901	Tapping screws	6157-1…3	-	267-19	Surface discontinuities, bolts
4035	-	439-2, 936	Hex. thin nuts (chamfered)	10511	-	985	Hex., thin locking nuts	6157-2	(493)	267-20, 21	Surface discontinuities, nuts
4036	-	439-1	Hex. thin nuts (unchamfered)	10512	-	982, 6924	Hex. locking nuts	7085/7500-1	-	-	Thread rolling screws
				10513	-	980, 6925	Hex. locking nuts				
4161	1661	6923	Hex. nuts with flange					7378	-	962	Split pin holes / wire holes
4162	1662, 1665	6922	Hex. bolts with flange	10642	-	7991	Hex. socket csk. head screws	7721	-	-	Csk. head screws: configuration
4762	-	912	Hex. socket head cap screws	10644	-	6900	Screw and washer assemblies	8749	-	-	Determ. Of shear strength of pins
4766	24766	551	Set screw CR	10663	1661	6923	Hex. nuts with flange FT	8839	28839	267-18	TDC fasteners: non-ferrous metal
4775	780, 783	6915	Hex. nuts (HV)	10666	-	7504	Drilling screws with tapping screw thread	8991	-	962	Designation system for fasteners
				10669/10673	-	6903/6902	Washers for assemblies				
7035, 7036	-	935-1	Hex. slotted castle nuts					8992	-	267-1	TDC fasteners: general requirements
7037	-	935-3	Hex. slotted nuts	10670	-	6976	Conical spring washers	-	10204	50049	Certificates
7038	-	937/979	Hex. thin slotted castle nuts	12125	-	6926	Hex. locking nuts with flange	10484	(493)	267-21	Widening test on nuts
7040, 7041	-	982, 6924	Prevailing torque type hex. nuts	12126	-	6927	Hex. locking nuts with flange	10644	-	6900-1	Screw / washer ass. Hardness cl.
7042	-	980, 6925	Prevailing torque type hex. nuts	12474	-	912 (FG)	Hex. socket head cap screws FT	10664	-	-	Hexalobular socket
				13337	-	7346	Spring-type straight pins L				
7043	1663/1666	6926	Hex. locking nuts with flange					10666	-	7504	MP drilling screws
7044	1664/1667	6927	Hex. locking nuts with flange	13918	-	32500	Welding studs for stud welding	10683	-	-	Zinc flake coatings
7045	-	7985	Raised cheese head screws CR	14579…587	-	-	Hex. socket head cap screws	10684	-	267-10	Hot dip galvanized coatings
7046-1, 2	-	965	Countersunk head screw CR	14588, 14589	-	7337	Blind rivets, terms	12683	-	-	Mechanical zinc coatings
7047	-	966	Rcsk. Head screws CR	15071…073	-	-	Hex. bolts with flange, small S	-	13811	-	Sherardizing
				15480…483	-	7504	Drilling screws				
7048	-	-	Cheese head screws CR					15065	-	66	Countersinking
7049	-	7981	Pan head tapping screws CR	15973…986	-	7337	Blind rivets	15330	-	-	Hydrogen embrittlement
7050	-	7982	Csk. Head tapping screws CR	16582…585	-	7337	Blind rivets	16047	-	946	Torque / clamp force testing
7051	-	7983	Raised countersunk head tapping screws CR	21269	-	-	Hex. socket head cap screws FT	16048	-	-	Passivation of stainless steel
				21670	-	977	Hex. weld nuts with flange	16426	-	-	Fasteners QA system

Standard types, relations, publishers:

DIN National German standard (DeutschesInstitutfurNormung). DIN standards shall still be given for the products / services for which there are no ISO / EN standards and no standardization necessity.

ISO International Standardization Organization.

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

EN European Norm (CEN = ComitéEuropéen 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 standard 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 ISO 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" had not been in use since Jan'95. Standards still in use according to this mode are to be converted accordingly).
The description is carries out according to ISO.

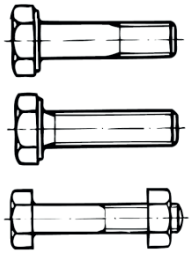
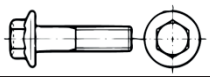
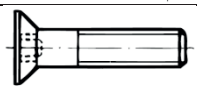
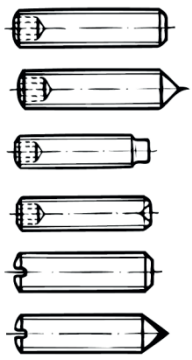
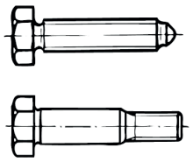
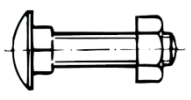
DIN EN ISO National German issue of an unchanged EN standard adopted by ISO. The article naming is done according to ISO.

Legend for table 2

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

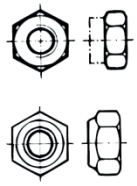
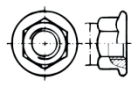
Publisher and author of the standards for "Mechanical fasteners" is German National Standards Organization (DIN - DeutschesInstitutfürNormunge.V.), Berlin, www.fmv.din.de
Reference to the standards sheets from BeuthVerlag, Burggrafenstrasse 6, 10772 Berlin, www.beuth.de

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	Labeling[1]
1. Screws / bolts with ISO/EN standards 	558 931 933 960 961	ISO 4018 ISO 4014 ISO 4017 ISO 8765 ISO 8676	M10, M12, M14, M22	New ISO wrench sizes	ISO standard numbers
			All other diameter	None = DIN & ISO identical	1) ISO standard numbers 2) DIN standard numbers
	601 nut with nut DIN 555	ISO 4016 nut with nut ISO 4034	M10, M12, M14, M22	Screws: new ISO wrench sizes Nuts: new wrench size acc. to ISO + ISO heights	ISO standard number
			Other Ø up to M39	Screws: none = DIN & ISO identical Nuts: new ISO heights	1) ISO standard numbers 2) DIN standard numbers
			Other Ø greater than M39	None = DIN & ISO identical	
	6914	EN 14399-4	TD-102		
	7999	EN 14399-8	TD-102		
	912	ISO 4762	Property class 12.9	Limited wrench size tolerances	ISO standard number
			All other property classes / materials	None	1) ISO standard numbers 2) DIN standard numbers
	6921	EN 1665 (EN 1662 – small series)	All diameter	Marginally increased head heights & wrenching height, property class 12.9 discontinued	ISO standard number
	7991	ISO 10642	M22, M24	Dimensions discontinued	
				Modified head heights + head Ø Adjusted shaft lengths	ISO standard number
2. Set screws with ISO/EN standards 	913 914 915 916 551 553	ISO 4026 ISO 4027 ISO 4028 ISO 4029 ISO 4766 ISO 7434	All diameter	None	1) ISO standard numbers 2) DIN standard numbers
3. Hexagon head screws without ISO/EN standards 	561 564	- -	M12, M16	New ISO wrench sizes	DIN standard numbers + wrench size specifications
			All other diameter	None	DIN standard numbers
	609 ~ 610	- -	M10, M12, M14, M22	New ISO wrench sizes	DIN standard numbers + wrench size specifications
			All other diameter	None	DIN standard numbers
	7968 nut 7990 nut With nut DIN 555	Screw : - with nut ISO 4034	M12, (M22)	Screws: new ISO wrench sizes Nuts: new ISO-SW + ISO heights	DIN standard numbers + wrench size specifications
			All other diameter	Screws: none Nuts: new ISO heights	DIN standard numbers
4. Screws / bolts without drive & without ISO/EN standards - with hexagonal nuts with ISO/EN standards 	186 / 261 nut 525 nut 529 nut 603 nut 604 nut 605 nut 607 nut 608 nut 7679 nut 11014 nut With nut DIN 555	Screws: with nut ISO 4034	M10, M12, M14, M22	Screws: none Nuts: new wrench size according to ISO + ISO heights	DIN standard numbers + wrench size specifications
			All other diameter	Screws: none Nuts: new ISO heights	DIN standard numbers

[1] Labeling with ISO & 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 range①	Changes①	Labeling②
1. Hexagon nuts with ISO/EN standards① 	439-1 (A = without chamfer) 439-1 (B = with chamfer)	ISO 4036 ISO 4035 = coarse pitch thread ISO 8675 = fine pitch thread	M10, M12, M14, M22	New ISO wrench sizes (minor height change)	ISO standard number
			All other diameter	None = DIN & ISO identical (minor height change)	1. ISO standard number 2. DIN standard number
	555 934 Str. cl. 6, 8, 10 Str. cl. 12 Str. cl. 6, 8, 10	ISO 4034 (ISO type 1) ISO 4032 = coarse pitch thread (ISO type 1) ISO 4033 = coarse pitch thread (ISO type2) ISO 8673 = fine pitch thread (ISO type 1)	M10, M12, M14, M22	New ISO wrench sizes + new ISO heights	ISO standard number
			Other Ø (M5 to M39)	New ISO heights (no wrench sizes change)	
			Diameter less than M5 Diameter over M39	None = DIN & ISO identical	1. ISO standard number 2. DIN standard number
	6915	EN 14399-4	See TD-102		
2. Hexagon nuts with [prevailing torque element, with ISO/EN standards① 	980 6925	ISO 7042 = coarse pitch thread ISO 10513 = fine pitch thread	M10, M12, M14, M22	New ISO wrench sizes (DIN 6925 already includes the new ISO wrench sizes) Changed nut heights Larger wrenching height	ISO standard number
			Other diameter	Changed nut heights Larger wrenching height	ISO standard number
	982	DIN 6924	M10, M12, M14, M22	New ISO wrench sizes Changed nut heights	
			Other diameter	Changed nut heights	
	6924	ISO 7040 = coarse pitch thread ISO 10512 = fine pitch thread	All diameter	Greater tolerance range for nut heights (DIN ↔ ISO exchangeable)	1. ISO standard number 2. DIN standard number
	985	ISO 10511	M10, M12, M14	New ISO wrench sizes	ISO standard number
			Other diameter	Reduced nut heights	ISO standard number
	6926	EN 1663 = coarse pitch thread EN 1666 = fine pitch thread	M10	New ISO wrench sizes	EN standard number
			Other diameter	None (DIN ↔ ISO exchangeable)	1. ISO standard number 2. DIN standard number
	6927	EN 1664 = coarse pitch thread EN 1667 = fine pitch thread	M10	New ISO wrench sizes	EN standard number
			Other diameter	None (DIN ↔ ISO exchangeable)	1. ISO standard number 2. DIN standard number
3. Nuts without ISO/EN standards 	557 917 935 986 1587	- - - - -	M10, M12, M14, M22	New ISO wrench sizes	DIN standard number + wrench size specifications
			All other diameter	None	DIN standard number

① Comparison of wrench sizes and nut heights DIN: ISO and classification of standards, mechanical properties for steel nuts, see Table 5.
② Labeling 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

- **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**	**ISO 4034 ISO type 1**	**DIN 934**	**ISO 4032 (RG) 8673 (FG) ISO type 1**	**ISO 4033 (RG) ISO type 2**
M1	2.5		-	-	0.55 – 0.80	-	-
M1.2	3		-	-	0.75 – 1.00	-	-
M1.4	3		-	-	0.95 – 1.20	-	-
M1.6	3.2		-	-	1.05 – 1.30	1.05 – 1.30	-
M2	4		-	-	1.35 – 1.60	1.35 – 1.60	-
M2.5	5		-	-	1.75 – 2.00	1.75 – 2.00	-
M3	5.5		-	-	2.15 – 2.40	2.15 – 2.40	-
(M3.5)	6		-	-	2.55 – 2.80	2.55 – 2.80	-
M4	7		-	-	2.90 – 3.20	2.90 – 3.20	-
M5	8		3.40 – 4.60	4.40 – 5.60	3.70 – 4.00	4.40 – 4.70	4.80 – 5.10
M6	10		4.40 – 5.60	4.60 – 6.10	4.70 – 5.00	4.90 – 5.20	5.40 – 5.70
(M7)	11		-	-	5.20 – 5.50	-	-
M8	13		5.75 – 7.25	6.40 – 7.90	6.14 – 6.50	6.44 – 6.80	7.14 – 7.50
M10	17	16	7.25 – 8.75	8.00 – 9.50	7.64 – 8.00	8.04 – 8.40	8.94 – 9.30
M12	19	18	9.25 – 10.75	10.40 – 12.20	9.64 – 10.00	10.37 – 10.80	11.75 – 12.00
(M14)	22	21	-	12.10 – 13.90	10.30 – 11.00	12.10 – 12.80	13.40 – 14.10
M16	24		12.10 – 13.90	14.10 – 15.90	12.30 – 13.00	14.10 – 14.80	15.70 – 16.40
(M18)	27		-	15.10 – 16.90	14.30 – 15.00	15.10 – 15.80	-
M20	30		15.10 – 16.90	16.90 – 19.00	14.90 – 16.00	16.90 – 18.00	
(M22)	32	34	17.10 – 18.90	18.10 – 20.20	16.90 – 18.00	18.10 – 19.40	19.00 – 20.30
M24	36		17.95 – 20.05	20.20 – 20.30	17.70 – 19.00	20.20 – 21.50	-
(M27)	41		20.95 – 23.05	22.60 – 24.70	20.70 – 22.00	22.50 – 23.80	22.60 – 23.90
M30	46		22.95 – 25.05	24.30 – 26.40	22.70 – 24.00	24.30 – 25.60	-
(M33)	50		24.95 – 27.05	27.40 – 29.50	24.70 – 26.00	27.40 – 28.70	27.30 – 28.60
M36	55		27.95 – 30.05	28.00 – 31.50	27.40 – 29.00	29.40 – 31.00	33.10 – 34.70
(M39)	60		29.75 – 32.25	31.80 – 34.30	29.40 – 31.00	31.80 – 33.40	-
M42	65		32.75 – 35.25	32.40 – 34.90	32.40 – 34.00	32.40 – 34.00	-
(M45)	70		34.75 – 37.25	34.40 – 36.90	34.40 – 36.00	34.40 – 36.00	-
M48	75		36.75 – 39.25	36.40 – 38.90	36.40 – 38.00	36.40 – 38.00	-
(M52)	80		40.75 – 43.25	40.40 – 42.90	40.40 – 42.00	40.40 – 42.00	-
M56	85		43.75 – 46.25	43.40 – 45.90	43.40 – 45.00	43.40 – 45.00	-
(M60)	90		46.75 – 49.25	46.40 – 48.90	46.40 – 48.00	46.40 – 48.00	-
M64	95		49.50 – 52.50	49.40 – 52.40	49.10 – 51.00	49.10 – 51.00	-
Nut height factor Nut height *m* / Nominal thread diameter *M*		≤ M4	-	-	0.8	0.8	-
		M5 – M39	0.8	0.83 – 1.12		0.84 – 0.93	0.93 – 1.03
		≥ M42		~0.8		0.8	-
Product class			C (coarse)		≤ M16 = A (medium) > M16 = B (medium coarse)		
Thread tolerance			7H		6H		
Property class Steel		Core range ~M5 – M39	5 (M16 < d ≤ M39 = 4.5)		6, 8, 10 (ISO 8673 = Fkl. 10 ≤ M16)		12 (9 – 12)
		≥ M39	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 (RG) ISO 898-6 (FG)	ISO 898-2

Notes:
ISO 4032 = also replacement for DIN 970
ISO 4033 = also replacement for DIN 971-2 (fine pitch thread → ISO 8674)
ISO 4034 = also replacement for DIN 972
ISO 8673 = also replacement for DIN 971-1

RG = Coarse pitch thread
FG = Fine pitch thread

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 height *m* 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
M3	5.5		3.4 – 3.7	3.4 – 3.7	-	1.65	1.65	-
M4	7		3.9 – 4.2	3.9 – 4.2	-	2.20	2.20	-
M5	8		4.8 – 5.1	4.8 – 5.1	4.8 – 5.1	2.75	2.27	3.52
M6	10		5.7 – 6.0	5.7 – 6.0	5.4 – 6.0	3.30	3.30	3.92
(M7)	11		6.5 – 7.0	6.5 – 7.0	-	3.85	3.85	-
M8	13		7.5 – 8.0	7.5 – 8.0	7.14 – 8.00	4.40	4.40	5.15
M10	17	16	9.0 – 10.0	9.0 – 10.0	8.94 – 10.00	5.50	5.50	6.43
M12	19	18	11.0 – 12.0	11.0 – 12.0	11.57 – 12.00	6.60	6.60	8.30
(M14)	22	21	12.0 – 14.0	12.0 – 14.0	13.40 – 14.10	7.70	7.70	9.68
M16	24		14.0 – 16.0	14.0 – 16.0	15.70 – 16.40	8.80	8.80	11.28
(M18)	27		16.0 – 18.0	-	-	9.90	-	-
M20	30		18.0 – 20.0	18.0 – 20.0	19.00 – 20.30	11.00	11.00	13.25
(M22)	32	-	20.0 – 22.0	-	-	12.20	-	-
M24	36		22.0 – 24.0	22.0 – 24.0	22.60 – 23.90	13.20	13.50	16.16
(M27)	41		25.0 – 27.0	-	-	14.80	-	-
M30	46		28.0 – 30.0	28.0 – 30.0	27.30 – 30.00	16.50	16.50	19.44
(M33)	50		31.0 – 33.0	-	-	18.20	-	-
M36	55		34.0 – 36.0	34.0 – 36.0	33.10 – 36.10	19.80	19.80	23.52
(M39)	60		37.0 – 39.0	-	-	21.50	-	-

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 height *m* 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
M3	5.5		-	4.2 – 4.5	4.02 – 4.50	-	1.72	1.72
M4	7		-	5.7 – 6.0	5.52 – 6.00	-	2.32	2.32
M5	8		6.00 – 6.30	6.44 – 6.80	6.22 – 6.80	3.52	3.52	3.52
M6	10		7.70 – 8.00	7.64 – 8.00	7.42 – 8.00	3.92	3.92	3.92
(M7)	11		8.20 – 8.50	8.64 – 9.00	-	4.91	4.91	-
M8	13		9.14 – 9.50	9.14 – 9.50	8.92 – 9.50	5.15	5.15	5.15
M10	17	16	11.14 – 11.50	11.14 – 11.90	11.2 – 11.9	6.43	6.43	9.43
M12	19	18	13.64 – 14.00	14.47 – 14.90	14.2 – 14.9	8.30	8.30	8.3
(M14)	22	21	15.30 – 16.00	16.3 – 17.0	15.9 – 17.0	9.68	9.68	9.68
M16	24		17.30 – 18.00	18.26 – 19.10	17.8 – 19.1	11.28	11.28	11.28
(M18)	27		19.16 – 20.00	19.76 – 20.60	-	12.08	12.08	-
M20	30		20.70 – 22.00	21.5 – 22.8	20.7 – 22.8	13.52	13.52	13.52
(M22)	32	34	23.70 – 25.00	23.2 – 24.5	-	14.48	14.48	-
M24	36		26.70 – 28.00	25.8 – 27.1	25.0 – 27.1	16.16	16.16	16.16
(M27)	41		-	29.4 – 31.0	-	-	18.00	-
M30	46		-	31.0 – 32.6	30.1 – 32.6	-	19.44	19.44
(M33)	50		-	33.9 – 35.5	-	-	21.92	-
M36	55		-	37.3 – 38.9	36.4 – 38.9	-	23.52	23.52
(M39)	60		-	40.4 – 42.0	-	-	25.44	-
M42	65		-	43.4 – 45.0	-	-	27.20	-
(M45)	70		-	46.4 – 48.0	-	-	28.80	-
M48	75		-	48.4 – 50.0	-	-	30.40	-

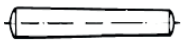
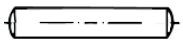
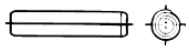
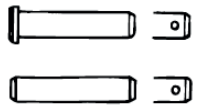
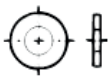
Table 8: Comparison DIN : ISO - Nuts with prevailing torque element according to DIN 985, ISO 10511

Nominal size *d*	Wrench size *s*		Nut height *m* 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
M3	5.5		3.7 – 4.0	3.42 - 3.90	1.65	1.24
M4	7		4.7 – 5.0	4.52 – 5.00	2.2	1.56
M5	8		4.7 – 5.0	4.52 – 5.00	2.75	1.96
M6	10		5.7 – 6.0	5.52 – 6.00	3.3	2.32
(M7)	11		7.14 – 7.50	-	3.85	-
M8	13		7.64 – 8.00	6.18 – 6.76	4.4	2.96
M10	17	16	9.64 – 10.0	7.98 – 8.56	5.5	3.76
M12	19	18	11.57 – 12.00	9.53 – 10.23	6.6	4.56
(M14)	22	21	13.3 – 14.0	10.22 – 11.32	7.7	5.14
M16	24		15.3 – 16.0	11.32 – 12.42	8.8	5.94
(M18)	27		17.66 – 18.50	-	9.9	-
M20	30		18.7 – 20.0	13.1 – 14.9	11	7.28
(M22)	32	34	20.7 – 22.0	-	12.2	-
M24	36		22.7 – 24.0	16.0 – 17.8	13.2	8.72
(M27)	41		25.7 – 27.0	-	14.8	-
M30	46		28.7 – 30.0	20.1 – 22.2	16.5	11.12
(M33)	50		31.4 – 33.0	-	18.2	-
M36	55		34.4 – 36.0	23.4 – 25.5	19.8	13.52
(M39)	60		37.4 – 39.0	-	21.5	-
M42	65		40.4 – 42.0	-	23.1	-
(M45)	70		43.4 – 45.0	-	24.8	-
M48	75		46.4 – 48.0	-	26.5	-

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

The most important are 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. M6 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 chamfer, case hardened
	7977 7978 7979/D	8737 8736 8733,8735	no serious changes DIN 7979/C ~ ISO 8733 (unhardened) DIN 7979/D ~ ISO 8735/A (fully hardened)
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	Type A= regular finish to Ø of ≤ 12mm with 2 chamfers (previously to a Ø of ≤ 6mm) additional type B = non - interlocking
	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 pins 	94	1234	no serious changes
Clevis pins, Pins 	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 Ø and thicknesses changed (in general not in danger of being replaced)
	1441	-	no ISO standard planned

Overview of standards conversion DIN – ISO: Thread screws 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 (Table.11-13)

Table 10: Standard numbers change DIN: ISO

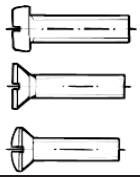
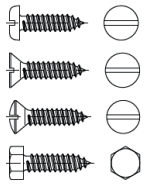
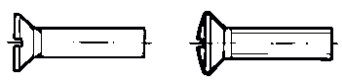
Article group	DIN	ISO	The most important changes
Thread screws 	84	1207	no serious changes
	85	1580	no serious changes
	963	2009	minor differences in head height and head diameter (see Table 11)
	964	2010	
	965	7046-1,-2	
	966	7047	
	7985	7045	no serious changes
Tapping screws 	7971	1481	no serious changes
	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	changes 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	M2	M2.5	M3	M3.5	M4	M5	M6	M8	M10
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. Headheight	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

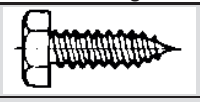
Table 12 : Countersunk head tapping screws

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

	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. Diameter of head	ISO(new)	3.8	5.5	7.3	-	8.4	9.3	10.3	11.3	15.8	18.3
	DIN(old)	4.3	5.5	6.8	7.5	8.1	9.5	10.8	12.4	-	-
Max. Headheight	ISO(new)	1.1	1.7	2.35	-	2.6	2.8	3	3.15	4.65	5.25
	DIN(old)	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 M3.5, M4 and M8).

Table 13: Hexagon head tapping screws



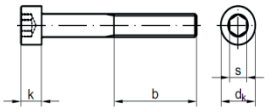
Tapping screws **ISO 1479**
DIN 7976

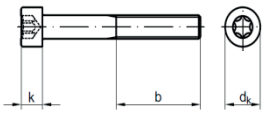
	Thread	ST 2.2	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3	ST 8	ST 9.5
Max head height	ISO (new)	1.6	2.3	2.6	-	3	3.8	4.1	4.7	6	7.5
	DIN (old)	1.42	1.62	2.42	2.42	2.92	3.12	4.15	4.95	5.95	-

Hexagon and hexalobular socket screws

DIN (ISO)

912
(4762)
(14579)





[1] b acc.to ISO 4762

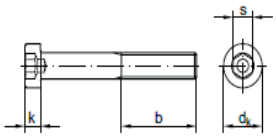
Dimensions	M 1.4	M 1.6	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8	M 10
d_k	2.6	3	3.8	4.5	5.5	7	8.5	10	13	16
k	1.4	1.6	2	2.5	3	4	5	6	8	10
s	1.3	1.5	1.5	5	2.5	3	4	5	6	8
Hexalobular	-	-	T6	T8	T10	T20	T25	T30	T45	T50
b[1]	14	15	16	17	18	20	22	24	28	32

Dimensions	M 12	M 14	M 16	M 18	M 20	M 22	M 24	M 27	M 30	M 33
d_k	18	21	24	27	30	33	36	40	45	50
k	12	14	16	18	20	22	24	27	30	33
s	10	12	14	14	17	17	19	19	22	24
Hexalobular	T55	T60	T70	T80	T90	-	-	-	-	-
b[1]	36	40	44	48	52	56	60	66	72	78

Dimensions	M 36	M 39	M 42	M 45	M 52	M 56	M 64	M 72		
d_k	54	58	63	68	78	84	96	108		
k	36	39	42	45	52	56	64	72		
s	27	27	32	36	36	41	46	55		
Hexalobular	-	-	-	-	-	-	-	-		
b[1]	84	90	96	102	116	124	140	156		

DIN

6912



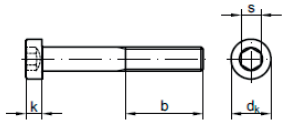
b_1) for ≤125mm
b_2)for 125mm <1≤200mm
b_3)for 1>200mm

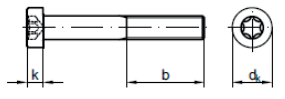
Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16
d_k	7	8.5	10	13	16	18	21	24
k	2.8	3.5	4	5	6.5	7.5	8.5	10
s	3	4	5	6	8	10	12	14
$b_{1)}$	14	16	18	22	26	30	34	38
$b_{2)}$	-	-	-	-	32	36	40	44
$b_{3)}$	-	-	-	-	-	-	-	57

Dimensions	M 20	M 22	M 24	M 27	M 30	M 33	M 36	
d_k	30	33	36	40	45	50	54	
k	12	13	14	16	17.5	19.5	21.5	
s	17	17	19	19	22	24	27	
b_1	46	50	54	60	66	72	78	
b_2	52	56	60	66	72	78	84	
b_3	65	69	73	79	85	91	97	

DIN (ISO)

7984
(14580)





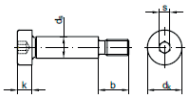
b_1) for 1m 125mm
b_2)for 125mm<1m 200mm
b_3)for 1>200mm

Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12
d_k	5.5	7	8.5	10	13	16	18
k	2	2.5	3.5	4	5	6	7
s	2	2.5	3	4	5	7	8
Hexalobular	T10	T20	T25	T30	T40 (45)	T50	-
b_1	12	74	16	18	22	26	30
b_2	-	-	-	-	28	32	36
b_3	-	-	-	-	-	-	-

Dimensions	M 14	M 16	M 18	M 20	M 22	M 24	
dk	21	24	27	30	33	36	
k	8	9	10	11	12	13	
s	10	12	12	14	14	17	
Hexalobular	-	-	-	-	-	-	
b1	34	38	42	46	50	54	
b2	40	44	48	52	56	60	
b3	-	57	61	65	69	73	

ISO

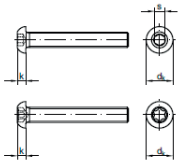
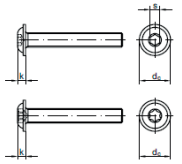
7379

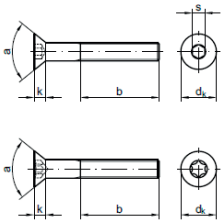


*) adjusting shank tolerance: steel h8 / stainless f9

Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
d_k	10	13	16	18	24	30
d_s*	6.5	8	10	13	16	20
k	4.5	5.5	7	9	11	14
s	3	4	5	6	8	10
b	9.75	11.25	13.25	16.4	18.4	22.4

Hexagon and hexalobular socket screws

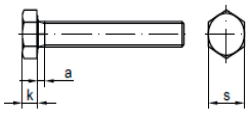
ISO	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 16
7380 	d_k	5.7	7.6	9.5	10.5	14	17.5	21	28
	d_c	6.65	8.85	11.2	13	17.1	21	23.6	-
	k	1.65	2.2	2.75	3.3	4.4	5.5	6.6	8.8
~7380 	s	2	2.5	3	4	5	6	8	10
	Hexalobular	T10	T20	T25	T30	T40	T50	T50	-

ISO	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
10642 	d_k	6.72	8.96	10.2	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
	Hexalobular	-	T20	T25	T30	T40	-
	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	26.8	30.88	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
Hexalobular	-	-	-	-	-	-
a	90°	90°	90°	90°	60°	60°
b	36	40	44	52	56	60

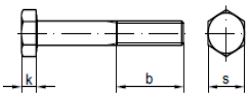
*acc. to DIN 7991

Hexagon head screws / bolts

DIN (ISO)	Dimensions	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 10	M 12
558 (4018) 933 (4017) 961 (8676) 	$S_{DIN/ISO}$	4	5.5	7	8	10	11	13	17 / 16	19 / 18
	k	1.4	2	2.8	3.5	4	4.8	5.3	6.4	7.5
	a_{max}	1.2	1.5	2.1	2.4	3	3	3.75	4.5	5.25
	b_1	10	12	14	16	18	20	22	26	30
	b_2	-	-	-	22	24	26	28	32	36
	b_3	-	-	-	-	-	-	-	45	49

Dimensions	M 14	M 16	M 18	M 20	M 22	M 24	M 27	M 30	M 33
$S_{DIN/ISO}$	22 / 21	24	27	30	32 / 34	36	41	46	50
k	8.8	10	11.5	12.5	14	15	17	18.7	21
a_{max}	6	6	7.5	7.5	7.5	9	9	10.5	10.5
b_1	34	38	42	46	50	54	60	66	72
b_2	40	44	48	52	56	60	66	72	78
b_3	53	57	61	65	69	73	79	85	91

Dimensions	M 36	M 39	M 42	M 45	M 48	M 52	M 56	M 64	
$S_{DIN/ISO}$	55	60	65	70	75	80	85	95	
k	22.5	25	26	28	30	33	35	40	
a_{max}	12	12	13.5	13.5	15	15	16.5	18	
b_1	78	84	90	96	102	-	-	-	
b_2	84	90	69	102	108	116	124	140	
b_3	97	103	109	115	121	129	137	153	

601 (4061)
931 (4014)
960 (8765) 

b_1)for 1≤ 125mm
b_2)for 125mm <1≤ 200mm
b_3)for 1> 200mm

Hexagon head screws / bolts

DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36	M 42	M 48	M 56
561-A 561-B 564-A 561-B	k	5	6	7	9	11	14	17	21	25	30	34	40
	s	8	10	13	16	18	24	30	36	46	55	65	75
	a (type B)	2.5	3	4	4	4.5	6	7	7.5	9	10	12	12
	z_2	3	4	5	6	8	10	12	15	18	21	24	28
	d_p	4	5.5	7	8.5	12	15	18	23	28	32	38	45

DIN	Dimensions	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 24	M 30
609 610	k	5.3	6.4	7.5	8.8	10	11.5	12.5	15	19
	s	13	16	18	21	24	27	30	36	46
	d_s*	9	11	13	15	17	19	21	25	32
	b_1	14.5	17.5	20.5	22	25	27.5	28.5	-	-
	b_2	16.5	19.5	22.5	24	27	29.5	30.5	36.5	43
	b_3	21.5	24.5	27.5	29	32	34.5	35.5	41.5	48

b_1) for l≤125mm
b_2) for 125mm < l ≤ 200mm
b_3) for l > 200mm
*) adjusting shank tol. k6 for drill tol. H7

DIN	Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
6921	k	5.4	6.6	8.1	9.2	11.5	14.4
	s	8	10	13	15	16	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

b_1)for l≤125mm
b_2)for 125mm < l ≤ 200mm
b_3)for l > 200mm

Studs

DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
835	b_1	12	16	20	24	32	40
	x_1	3.2	3.2	3.8	4.3	5.0	6.3
	b_2 1)	22	22	26	30	38	46
	b_2 2)	28	28	32	36	44	52
	b_2 3)	-	-	45	49	57	65

1) b_1)for l≤125mm
2) b_2)for 125mm < l ≤ 200mm
3) b_3)for l > 200mm

DIN	Dimensions	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18
938	$b_{1(DIN\ 938)}$	5	6	8	10	12	14	16	18
	$b_{1(DIN\ 939)}$	6.5	7.5	10	12	15	18	20	22
	x_1	2	2.5	3.2	3.8	4.3	5	5	6.3
	x_2	1	1.25	1.6	1.9	2.2	2.5	2.5	3.2
	b_2 1)	16	18	22	26	30	34	38	42
	b_2 2)	22	24	28	32	36	40	44	48
	b_2 3)	-	-	-	45	49	53	57	61

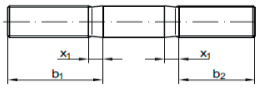
Dimensions	M 20	M 22	M 24	M 27	M 30	M 33	M 36	
$b_{1(DIN\ 938)}$	20	22	24	27	30	33	36	
$b_{1(DIN\ 939)}$	25	28	30	35	38	42	45	
x_1	6.3	6.3	7.5	7.5	9	9	10	
x_2	3.2	3.2	3.8	3.8	4.5	4.5	5	
b_2 1)	46	50	54	60	66	72	78	
b_2 2)	53	56	60	66	72	78	84	
b_2 3)	65	69	73	79	85	91	97	

939

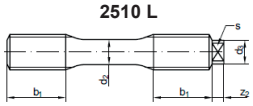
b_1 = screwed-in end
b_2 =nut end

1) b_1)for l≤125mm
2) b_2)for 125mm < l ≤ 200mm
3) b_3)for l > 200mm

Studs

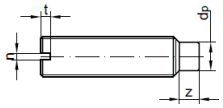
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
940 	b_1	15	20	25	30	40	50
	x_1	2.5	3.2	3.8	4.3	5.0	6.3
	b_2	18	22	26	30	38	46
	b_2	24	28	32	36	44	52
	b_2	-	-	45	49	57	65

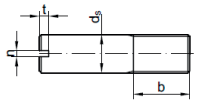
1)for 1≤125mm
2)for 125mm<1≤200mm
3)for 1>200mm

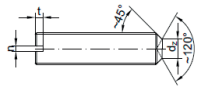
DIN	Dimensions	M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 33	M 36	M 39
2510 L 	d_2	8.5	12	15	16.5	18	20.5	23	25.5	27.5	30.5
	d_3	8	12	14	14	14	18	18	25	25	28
	b_1	20	23	28	30	32	35	39	42	45	48
	z_2	4	5	6	6	6	6	6	9	9	10
	s	7	10	11	11	11	13	13	22	22	24

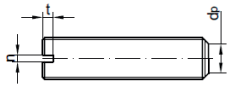
type L : with long thread

Set screws / grub screws

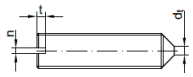
DIN (ISO)	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 16
417 (7435) 	d_p	2	2.5	3.5	4	5.5	7	8.5	12
	z	1.5	2	2.5	3	4	5	6	7
	n	0.4	0.6	0.8	1	1.2	1.6	2	2.5
	t	0.8	0.96	1.12	1.28	1.6	2	2.4	2.8

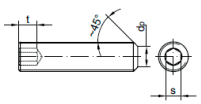
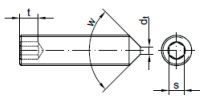
DIN (ISO)	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 16	M 20
427 (2342) 	d_s	3	4	5	6	8	10	12	16	20
	b	3.6	4.8	6	7.2	9.6	12	14	18	22
	n	0.4	0.6	0.8	1	1.2	1.6	2	2.5	3
	t	0.8	1.12	1.28	1.6	2	2.4	2.8	3.2	4

DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
438 (7436) 	$d_{z\,max}$	1.4	2	2.5	3	5	6
	n	0.4	0.6	,8	1	1.2	1.6
	t_{min}	0.8	1.12	1.28	1.6	2	2.4

DIN (ISO)	Dimensions	M 1	M 1.4	M 1.6	M 2	M 2.3*	M 2.5	M 2.6*	M 3
551 (4766) 	n	0.2	0.2	0.25	0.25	0.4	0.4	0.4	0.4
	t	0.4	0.48	0.56	0.64	1	0.72	1	0.8
	d_p	0.5	0.7	0.8	1	1	1.5	1.5	2
	Dimensions	**M 3.5**	**M 4**	**M 5**	**M 6**	**M 6**	**M 10**	**M 12***	
	n	0.5	0.6	0.8	1	1.2	1.6	2	
	t	0.96	1.12	1.28	1.6	2	2.4	2.8	
	d_p	2.2	2.5	3.5	4	5.5	7	8.5	

*) dimensions acc. to DIN 551: April 1956

DIN (ISO)	Dimensions	M 1.4	M 1.6	M 2	M 2.5	M 3	M 3.5	M 4	M 5	M 6	M 8	M 10
553 (7434) 	n	0.2	0.25	0.25	0.4	0.4	0.5	0.6	0.8	1	1.2	1.6
	t	0.48	0.56	0.64	0.72	0.8	0.96	1.12	1.28	1.6	2	2.4
	$d_{t\,max}$	0.14	0.16	0.2	0.25	0.3	0.35	0.4	0.5	1.5	2	2.5

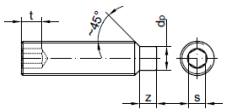
DIN (ISO)	Dimensions	M 1.4	M 1.6	M 2	M 2.5	M 3	M 4	M 5	M 6
913 (4026) 	s	0.7	0.7	0.9	1.3	1.5	2	2.5	3
	$d_{p\,max}/d_{t\,max}$	0.45	0.8	1	1.5	2	2.5	3.5	4
	t_1	0.6	0.7	0.8	1.2	1.2	1.5	2	2
	t_2	1.4	0.5	0.7	2	2	2.5	3	3.5
914 (4027) 									
	Dimensions	**M 8**	**M 10**	**M 12**	**M 14**	**M 16**	**M 20**	**M 24**	
	s	4	5	6	6	8	10	12	
	$d_{p\,max}$	5.5	7	8.5	10	12	15	18	
	t_1	3	4	4.8	5.6	6.4	8	10	
	t_2	5	6	8	9	10	12	15	

t_1) for l above the dashed step line with angle (W_{DIN914}) = 120°
t_2) for l below the dashed step line with angle (W_{DIN914}) = 90°

step line see product standard

Set screws/grub screws

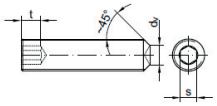
915 (4028)



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

DIN (ISO)	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 20	M 24
	s	1.5	2	2.5	3	4	5	6	6	8	10	12
	$z_{1\ max}$ (short)	1	1.25	1.5	1.75	2.25	2.75	3.25	3.8	4.3	5.3	6.3
	t_1	1.2	1.5	2	2	3	4	4.8	5.6	6.4	8	10
	d_p	2	2.5	3.5	4	5.5	7	8.5	10	12	15	18
	$z_{2\ max}$ (long)	1.75	2.25	2.75	3.25	4.3	5.3	6.3	7.36	8.36	10.36	12.43
	t_2	2	2.5	3	3.5	5	6	8	9	10	12	15

916 (4029)



t1)for I above the dashed step line
t2)for I below the dashed step line
Step line see product standard

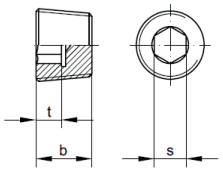
DIN (ISO)	Dimensions	M 1.4	M 1.6	M 1.8	M 2	M 2.5	M 3
	s	0.7	0.7	0.7	0.9	1.3	1.5
	$d_{v\ max}$	0.7	0.8	0.9	1	1.2	1.4
	t_1	0.6	0.7	0.8	0.8	1.2	1.2
	t_2	1.4	1.5	1.6	1.7	2	2

Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
s	2	2.5	3	4	5	6
$d_{v\ max}$	2	2.5	3	5	6	8
t_1	1.5	2	2	3	4	4.8
t_2	2.5	3	3.5	5	6	8

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

Screw plugs/pipe plugs

906



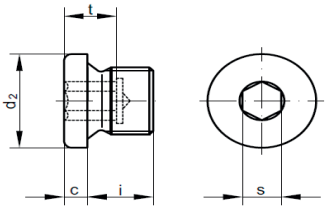
The new product standard with additionally defined hexalobular and triple square socket was not yet in its final version at the editorial deadline

DIN	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
s	12	12	17	17	19	19	22		5
t_{min}	6	6	6	6	7.5	7.5	1.5		4
b	12	12	12	12	15	15	18		8

Dimensions	R 1/4	R 3/8	R 1/2	R 3/4	R 1	R 1 1/4	R 1 1/2	R 1 3/4	R2
s	7	8	10	12	17	22	24	32	32
t_{min}	5	5	5	6	6	11.5	11.5	13	13
b	10	10	10	12	12	18	20	22	22

908



The new product standard with an additional "light series" and hexalobular and triple square socket was not yet in its final version at the editorial deadline.

DIN	Dimensions	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5
	s	5	6	6	8	8	10	10
	t_{min}	5	7	7	7.5	7.5	7.5	7.5
	d_2	14	17	19	21	23	25	27
	c	3	3	4	3	4	4	4

Dimensions	M 24x1.5	M 26x1.5	M 27x2	M 30x1.5	M 30x2	M 33x2	M 36x1.5
s	12	12	12	17	17	17	19
t_{min}	7.5	9	9	9	9	9	10.5
d_2	29	31	32	36	36	39	42
c	4	4	4	4	4	5	5

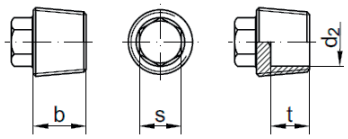
Dimensions	M 36x2	M 38x1.5	M 42x1.5	M 45x1.5	M 48x1.5	M 52x1.5	M 52x2
s	19	19	22	22	24	24	32
t_{min}	1.5	10.5	10.5	10.5	10.5	10.5	10.5
d_2	42	42	49	52	55	60	64
c	5	5	5	5	5	5	5

Dimensions	M 56x2	M 64x2		G 1/8 A	G ¼ A	G 3/8 A	G ½ A
s	32	32		5	6	8	10
t_{min}	14	14		5	7	7.5	7.5
d_2	72	72		14	12	22	26
c	5	5		3	3	3	4

Dimensions	G ¾ A	G 1 A	G 1 1/8 A	G 1 ¼ A	G 1 ½ A	G 1 ¾ 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

Screws plugs/pipe plugs

DIN 909

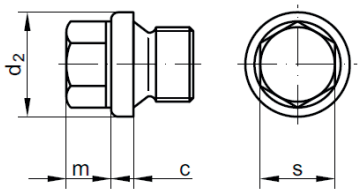


Dimensions	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5
b	8	10	10	10	10	10	10
d_2	-	-	-	-	-	12	14
s	7	7	9	10	10	13	13
t	-	-	-	-	-	6	6

Dimensions	M 24x1.5	M 26x1.5	M 27x2	M 30x1.5	M 30x2	M 33x2
b	12	12	12	12	12	12
d_2	16	16	16	20	23	23
s	17	17	17	19	19	19
t	7	7	7	7	7	7

Dimensions	R 1/8	R 1/4	R 3/8	R 1/2	R 3/4	R 1	R 1 ¼
b	8	10	10	10	12	12	18
d_2	-	-	-	12	16	23	32
s	7	9	10	13	17	19	24
t	-	-	-	6	7	7	13

DIN 910



Dimensions	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5	M 24x1.5
c	3	3	3	3	4	4	4	4
d_2	14	17	19	21	23	25	27	29
m	6	6	6	6	6	8	8	9
s	10	13	13	17	17	19	19	22

Dimensions	M 26x1.5	M 27x2	M 30x1.5	M 30x2	M 33x2	M 36x1.5	M 36x2	M 38x1.5
c	4	4	4	4	5	5	5	4
d_2	31	32	36	36	39	42	42	44
m	10	10	10	10	11	11	11	11
s	24	24	24	24	27	27	27	27

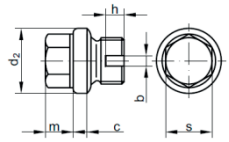
Dimensions	M 42x1.5	M 42x2	M 45x1.5	M 45x2	M 48x1.5	M 48x2	M 52x1.5	M 56x2
c	5	5	5	5	5	5	5	5
d_2	49	49	55	52	55	55	60	64
m	12	12	12	12	12	12	12	15
s	30	30	30	30	36	30	30	36

Dimensions	M 64x2		G 1/8 A	G ¼ A	G 3/8 A	G ½ A	G ¾ A	G 1 A
c	5		3	3	3	4	4	5
d_2	72		14	18	22	26	32	39
m	15		6	6	6	8	10	11
s	36		10	13	17	19	24	27

Dimensions	M 1 1/8 A	G 1 ¼ A	G 1 1/3 A	G 1 ¼ A	G 2 A			
c	4	5	5	5	5			
d_2	44	449	55	62	68			
m	11	12	12	15	15			
s	27	30	30	36	36			

The new product standard with an additional "light series" was not yet in its final version at the editorial deadline.

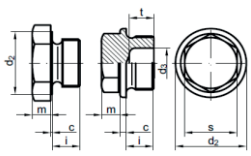
DIN 5586 B



type B : with melted seal

Dimensions	G 1/8 A	G ¼ A	G ½ A	G ¾ A	G 1 A	G 1 ½ A	G 2 A
a	4	6	7	7	7	7	7
b	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

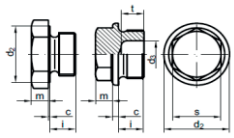
DIN 7604 A



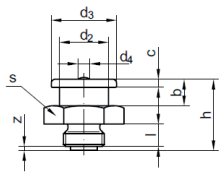
type A : with short stud end

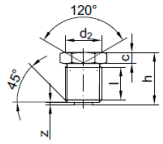
Dimensions	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 22x1.5	M 26x1.5	M 30x1.5
c	0.5	0.5	0.5	0.5	2	2	2.5	2.5
d_2	14	17	19	21	23	27	31	36
d_3	-	-	-	-	10	14	16	20
i	6	9	9	9	9	9	9	9
l	10.5	15.5	15.5	15.5	17	17	19.5	19.5
m	4	6	6	6	6	6	8	8
s	14	17	19	22	17	19	22	22
t	-	-	-	-	8	8	8	8

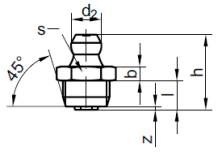
Screw plugs / pipe plugs

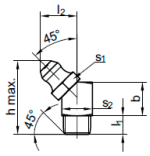
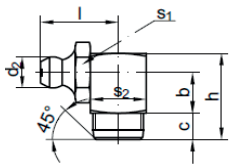
DIN	Dimensions	M 8x1	M 10x1	M 22x1.5	M 26x1.5	M 30x1.5	M 38x1.5	M 45x1.5	M 52x1.5
7604 C  type C : with long stud end	c	0.5	0.5	2	2.5	2.5	3	3	3
	d_2	12	14	27	31	36	44	52	60
	d_3	-	-	14	16	20	26	32	38
	i	8	8	12	12	12	12	12	12
	l	12.5	12.5	20	22.5	22.5	23	23	23
	m	4	4	6	8	8	8	8	8
	s	12	14	19	22	22	22	24	27
	t	-	-	8	10	10	10	10	10

Lubricating nipples

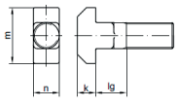
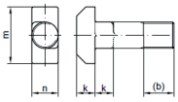
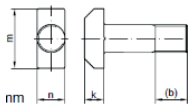
DIN	Dimensions	M 6x1	M 6x1	M 8x1	M 8x1	M 10x1	M 10x1	M 16x1.5	G 1/4	G 1/4	G 3/8
3404 	b	4.8	6.5	4.8	6.5	6.5	6.5	8.5	6.5	8.5	8.5
	c	1.7	2.0	1.7	2.0	2.0	2.0	3.0	2.0	3.0	3.0
	d_2	7.2	12	7.2	12	12	12	18	12	18	18
	d_3	10	16	10	16	16	16	22	16	22	22
	d_{4min}	1.5	1.5	2.5	2.5	2.9	2.9	5.0	2.9	5.0	5.0
	h_{max}	13	17	13.7	16.7	17.6	17.6	23.1	16	22	22
	l	4.9	5.3	4.9	5.3	5.5	5.5	7.5	5.5	7.5	7.5
	s	11	17	11	18	17	17	22	17	22	22
	$z\ m_{ax}$	0.6	0.8	0.6	0.8	1.0	1.0	1.5	1	1.5	1.5

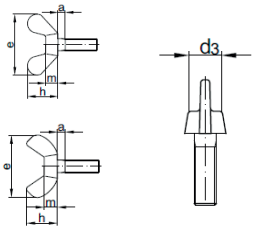
DIN	Dimensions	M 6x1	M 6x1	G 3/8
3405 - A  Type A with thread acc. to DIN 13-5	h_{max}	9.5	9.5	9.5
	l	5.5	5.5	5.5
	d_2	6	8	10
	c	3	3	3
	s	7	9	11
	z_{max}	0.7	0.7	0.7

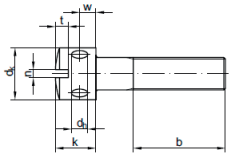
DIN	Dimensions	M 6x1	M 6x1	M 8x1	M 8x1	M 10x1
71412 –A 	h_{max}	16	16	16	16	16
	l	5.5	5.5	5.5	5.5	5.5
	d_2	6.5	6.5	6.5	6.5	6.5
	b	3	3	3	3	3
	s	7	9	11	11	14
	z_{max}	0.7	0.7	0.7	0.7	0.7

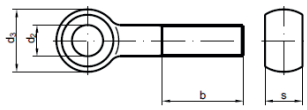
DIN	Dimensions	M 6x1	M 8x1	M 10x1
71412 – B 	$h_{max\ Square}$	21	21	21
	l_1	5.5	5.5	5.5
	l_2	10	10	11
	b	10	10	10
	s_1	7	9	11
	$s_{2\ Square}$	9	9	11
71412 – C 	$h_{max\ Square}$	18	18	18
	c	5.5	5.5	5.5
	d_2	6.5	6.5	6.5
	b	8.5	8.5	8.5
	s_1	9	9	11
	$s_{2\ square}$	9	9	11
	l	14.3	14.3	15.3

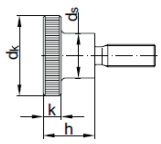
Other screws with metric thread

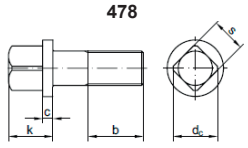
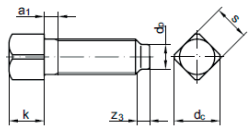
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24
186 B B = with long thread 	m	16	18	21	26	30	36	43
	n	6	8	10	12	16	20	24
188 	k	4.5	5.5	7	8	10.5	13	15
	$l_{g(186\ B)}$	10	13	16	19	25	31	37
261 b_1) for 1≤120mm b_2) for 120mm<1≤200mm 	b_1	18	22	26	30	38	46	54
	b_2	-	-	-	-	44	52	60

DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
316 **318** 	e max	20 / 21	26 / 26.5	33 / 32	39 / 38	51 / 50	65 / 66
	h max	10.5 / 11	13	17 / 16	20 / 19	25 / 24	33.5 / 32
	m max	4.6	6.5 / 6	8 / 7	10 / 8.5	12 / 10	14 / 13
	d_{3max}	7	9	11	12.5	16.5 / 16	19.5 / 19
	a max	2.1	2.4	3	4	4.5	5.3

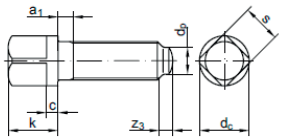
DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
404 	Ø d_k	5.5	7.0	8.5	10.0	13.0	16.0
	k	4	5	6.5	8.0	10.0	12.5
	n	0.8	1	1.2	1.6	2	2.5
	t min	1	1.4	1.7	2.2	2.7	3.5
	Ø d_n	1.5	2.0	2.5	3.0	4.0	5.0
	w	1.5	2.0	2.5	3.0	4.0	5.0
	b	19	22	25	28	34	40

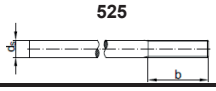
DIN	Dimensions	M 5	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36
444  b_1) for 1≤125mm b_2) for 125mm < 1≤200mm b_3) for1>200mm	d_2	5	6	8	10	12	16	18	22	27/28	32/33
	d_3	12	14	18	20	25	32	40	45	55	65
	s	6	7	9	12	14	17	22	25	30	38
	b_1	16	18	22	26	30	38	46	54	66	-
	b_2	-	-	28	32	36	44	52	60	72	84
	b_3	-	-	-	-	49	57	65	73	85	97

DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
464 	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

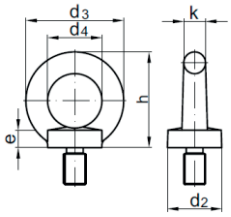
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
478  1)acc. to ISO 272	k	8	10	13	15	20	25
	c	2	2	3	3	4	5
	b	18	22	26	30	38	46
	d_c	10.5	13.5	16.5	19.5	25	31
	s	6	8	10	13	16[1)]/17	21[1)]/22
479  1)acc. to ISO 272	k	6	8	10	12	16	20
	a_1	3	4	4.5	5.3	6	7.5
	s	6	8	10	13	16[1)]/17	21[1)]/22
	d_p	4	5.5	7	8.5	12	15
	z_1	1.5	2	2.5	3	4	5

Other screws with metric thread

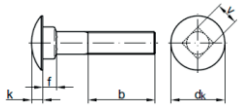
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
480  1)acc. to ISO 272	k	-	11	13	16	20	25
	c_{max}	-	3.12	3.12	4.15	4.15	5.15
	a_1	-	4	4.5	5.3	6	7.5
	s	-	8	10	13	16[1]) / 17	21[1]) / 22
	d_c	-	10	13	17	21[1]) / 22	27[1]) / 28
	z_3	-	2	2.5	3	4	5

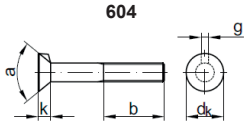
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36
525 	b	35	40	45	55	65	75	85	105	125
	d_s	6	8	10	12	16	20	24	30	36

DIN	Dimensions	M 8	M 10	M 12	M 16	M 20	M 24	M 30
529 C  C = with split swivel	b	20	25	30	40	50	60	75
	a	24	30	36	48	60	75	95
	c	12	15	18	24	30	36	45

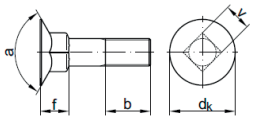
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30
580  lifting eye nuts → TD-35 further Technical Data → TD-74	d_2	17	20	25	30	35	40	50	65
	d_3	28	36	45	54	63	72	90	108
	d_4	16	20	25	30	35	40	50	60
	h	31	36	45	53	62	71	90	109
	e	4	6	8	10	12	14	18	22
	k	6	8	10	12	14	16	20	14

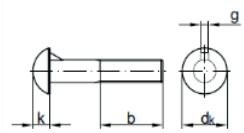
Dimensions	M 36	M 42	M 48	M 56	M 64	M 72x6	M 80x6	M 100x6
d_2	75	85	100	110	120	150	170	190
d_3	126	144	166	184	206	260	296	330
d_4	70	80	90	100	110	140	160	180
h	128	147	168	187	208	260	298	330
e	26	30	35	38	42	50	55	60
k	28	32	38	42	48	60	68	75

DIN	Dimension	M 5	M 6	M 8	M 10	M 12	M 16	M 20
603  b_1) for l ≤ 125mm b_2) for 125mm < l ≤ 200mm b_3) for l > 200mm	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

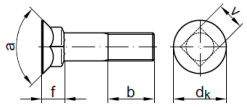
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24
604  b_1) for l ≤ 125mm b_2) for 125mm < l ≤ 200mm b_3) for l > 200mm	d_k	12.55	16.55	19.65	24.65	32.8	32.8	38.8
	k	4	5	5.5	7	9	11.5	13
	a	90°	90°	90°	90°	90°	60°	60°
	g	2.5	3	3.2	3.6	4.2	5.4	6.6
	b_1	18	22	26	30	38	46	54
	b_2	24	28	32	36	44	52	60
	b_3	-	41	45	49	57	65	73

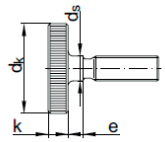
Other screws with metric thread

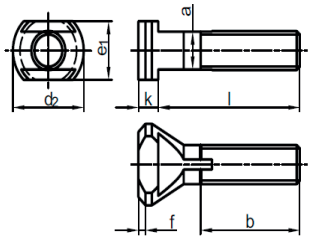
DIN	Dimensions	M 6	M 8	M 10
605 	d_k	16.55	20.65	24.65
	f	7.45	9.45	11.55
	b	18	22	26
	v	6.48	8.58	10.58
	a	120°	120°	120°

DIN	Dimensions	M 8	M 10	M 12	M 16
607 	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

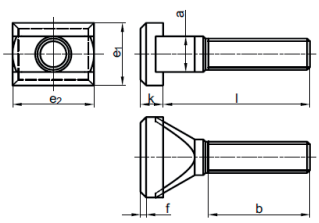
b_1) for l ≤ 125mm
b_2) for 125mm < l ≤ 200mm
b_3) for l > 200mm

DIN	Dimensions	M 8	M 10	M 12	M 16
608 	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
	a	90°	90°	90°	90°

DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
653 	Ø d_k	12	16	20	24	30	36
	k max	2.5	3.5	4.0	5.0	6.0	8.0
	Ø d_s	3	4	5	6	8	10
	e	2	3	3	4	5	6

DIN	Dimensions	M 8	M 10
787head shape up to M12x12 	a max	7.7	9.7
	l	32/40/50/65/80	32/40/50/65/100
	b	20/30/35/40/45	20/30/35/40/60
	e_1/d_2	13/16	15/20
	f	1.6	1.6
	k	6	6
	for T-slots	8	10

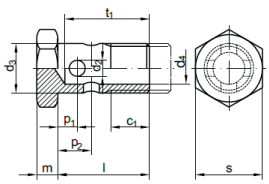
Dimensions	M 12	M 16	
a max	11.7	15.7	17.7
l	40/50/65/80/100/125/200/250/320	65/80/10/125/160/200/250	
b	30/35/40/50/60/70/100/120/120	40/50/60/70/80/100/120	
e_1/d_2	18/25	25	25
f	2.5	2.5	2.5
k	7	9	9
for T -slots	12	16	18

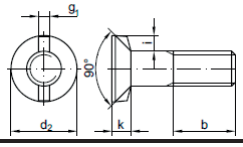
head shape from M12x14* 

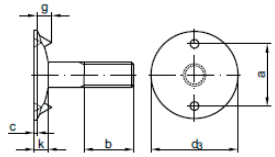
Dimensions	M 20	M 24	
a max	19.7	23.7	27.7
l	65/80/100/125/160/200/250/320/400	100/160/250/315	
b	40/50/60/70/80/100/120/120/120	60/80/120/120	
e_1/d_2	32	40	44
f	2.5	(4)	4
k	12	16	18
for T - slots	20	24	28

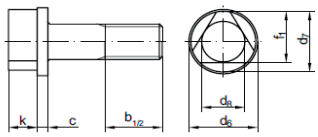
*e2 ≥ e1

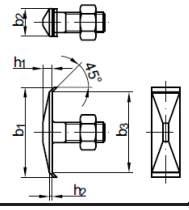
Other screws with metric thread

DIN	Dimensions	M 8x1	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 22x1.5	M 26x1.5
7643 	Pipe Ø	4 and 5	8	8	10	12	15	18	22
	c_1	8.5	8.5	11	11	11	11	13	13
	l_1	17	19	24	26	28	32	39	45
	t_1	15	17	22	24	26	29	35.5	41
	d_2	-	2.8	3.5	4.5	5.5	7	9	11
	d_3	8	10	12	14	16	18	22	26
	d_4	4	5.5	7	9	11	13	16	20
	m	5	6	6	6	6	6	7	7
	p_1	-	4.5	5	5.5	6.5	7.5	9	10.5
	p_2	-	6.5	8	9.5	11.5	14	18	22.5
	s	12	14	17	19	22	24	27	32

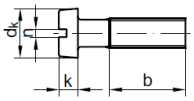
DIN	Dimensions	M 10	M 12
11014 	b	22	25
	d_2	19	24
	g_1	3.2	3.6
	l	4.2	5.7
	k	5.5	7

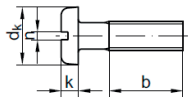
DIN	Dimensions	M 6	M 8	M 10	M 12
15237 *  *with nut DIN 555 or ISO 4034 and cupped washer DIN 15237	d_3	20	28	35	42
	a	14	20	25	30
	c max	1	1	1	1.2
	g	3.5	5	6	7
	k	2.5	3.5	4.5	5.2
	l	20	25/30/35/40	30/35/40/50	35/40/50/60
	b	12	15/18/18/20	18/20/20/20	20/25/28/28

DIN	Dimensions	M 6	M 8	M 10
22424 A 	b_{1min}	14.8	17.8	19.8
	b_{2min}	17.8 (l ≥ 20)	21.8 (l ≥ 25)	24.8 (l ≥ 25)
	c max	2.1	2.4	2.9
	d_{6max}	12.2	15.2	18.2
	d_{7min}	11.4	13.9	16.9
	$d_{8\ min}$	7.8	9.3	11.8
	$f_{1\ min}$	9.55	11.55	14.3
	k max	4.6	6.1	7.7

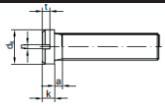
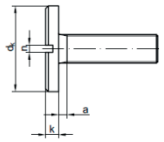
DIN	Dimensions	M 8	M 10
25193 	b_1	55	55
	b_2	20	20
	b_3	49	49
	h_1	6	6
	h_2	1.5	1.5

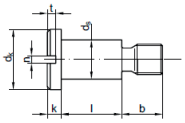
Slotted and cross recessed screws with metric thread

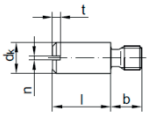
DIN (ISO)	Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8	M 10
84 (1207) 	d_k	3.8	4.5	5.5	7	8.5	10	13	16
	k	1.3	1.6	2	2.6	3.3	3.9	5	6
	n	0.5	0.6	0.8	1.2	1.2	1.6	2	2.5
	b	25	25	25	38	38	38	38	38

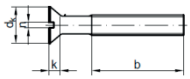
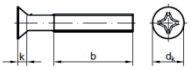
DIN	Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8	M 10
85 (1580) 	d_k	4*	5*	6	8	10	12	16	20
	k	1.3*	1.5*	1.8	2.4	3	3.6	4.8	6
	n	0.5*	0.6*	0.8	1.2	1.1	1.6	2	2.5
	b	25*	25*	25	38	38	38	38	38

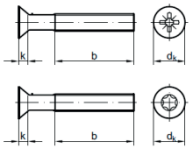
*)acc. to ISO 1580

DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
920 	a_{max}	1	1.4	1.6	2	2.5	3
	d_k	4	5.5	6.5	8	10	13
	k	1.8	2.4	2.7	3.1	3.8	4,60,5
921 	n	0.5	0.6	0.8	1	1.2	1.6
	t_{max}	1.15	1.5	1.6	1.9	2.4	2.8

DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
923 	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

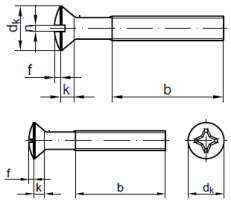
DIN	Dimensions	M 3	M 4	M 5	M 6	M 8
927 	d_k	4	5.5	6.5	8	10
	b	4.5	6	7	8	11
	n	0.5	0.6	0.8	1	1.2
	t_{max}	1.05	1.42	1.63	2.0	1.9

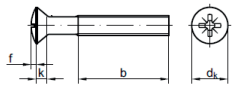
DIN	Dimensions	M 1	M 1.2	M 1.4	M 1.6	M 1.8	M 2	M 2.5	M 3
963 (2009)  	d_k	1.9	2.3	2.6	3	3.4	3.8	4.7	5.6
	k	0.6	0.72	0.84	0.96	1.08	1.2	1.5	1.65
	b*	1)	1)	1)	15	15	16	18	19
	n	0.25	0.3	0.3	0.4	0.4	0.5	0.6	0.8
	CR size	-	-	-	0	0	1	1	1
	Hexalobular	-	-	-	T5	-	T6	T8	T10

965 (7046) 	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16	
	d_k	7.5	9.2	11	14.5	18	22	29	
	k	2.2	2.5	3	4	5	6	8	
	b*	22	25	28	34	40	46	58	
	n	1	1.2	1.6	2	2.5	3	4	
	CR size	2	2	3	4	4	4	4	
	Hexalobular	T20	T25	T30	T40	T50	-	-	

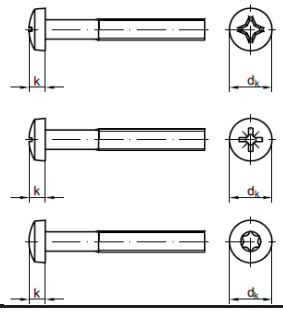
*minimum lengths
1)only with thread up to near the head

Slotted and cross recessed screws with metric thread

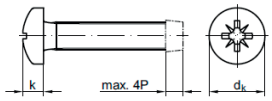
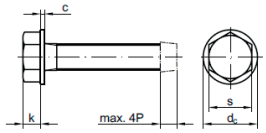
DIN (ISO)	Dimensions	M 1	M 1.2	M 1.4	M 1.6	M 2	M 2.5
964 (2010) 	d_k	1.9	2.3	2.6	3	3.8	4.7
	k	0.6	0.72	0.84	0.96	1.2	1.5
	b*	1)	1)	1)	15	16	18
	f	0.25	0.3	0.35	0.4	0.5	0.6
	n	0.25	0.3	0.3	0.4	0.5	0.6
	CR size	-	-	-	0	1	1

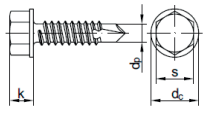
DIN (ISO)	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
966 (7047) 	d_k	5.6	7.5	9.2	11	14.5	18
	k	1.65	2.2	2.5	3	4	5
	b*	19	22	2.5	28	34	40
	f	0.75	1	1.25	1.5	2	2.5
	n	0.8	1	1.2	1.6	2	2.5
	CR size	1	2	2	3	4	4

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

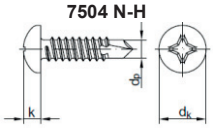
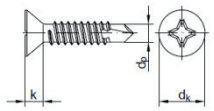
DIN (ISO)	Dimensions	M 1.6	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8	M 10
7985 (14583) 	d_k	3.2	4	5	6	8	10	12	16	20
	k	1.3	1.6	2	2.4	3.1	3.8	4.6	6	7.5
	CR size	0	1	1	1	2	2	3	4	4
	Hexalobular 14583	-	T 6	T 8	T 10	T 20	T 25	T 30	T 45	T 50

Tapping screws thread rolling screws and thread cutting screw

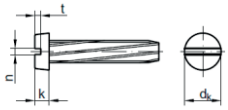
DIN	Dimensions	M 2	M 2.5	M 3	M 4	M 5	M 6	M 8
7500 C – Z  type C-Z: cheese head acc. to DIN 7985 with pozidrive cross recess	max groove section	1.6	1.8	2	2.8	3.2	4	5
	cross recess size	0	1	1	2	2	3	4
	d_{kmax}	4	5	66	8	10	12	16
	k_{max}	1.6	2	2.4	3.1	3.8	4.6	6
~ 7500 D  type D : hexagon head with collar	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
7500 M - Z  type M – Z : countersunk head acc. to acc. to DIN 965 with pozidrive cross recess	cross recess size	1	1	1	2	2	3	4
	d_{kmax}	3.5	4.7	5.6	7.5	9.2	11	14.5
	k_{max}	1.2	1.5	1.65	2.2	2.5	3	4

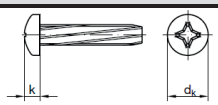
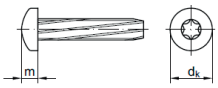
DIN	Dimensions	ST 2.9	ST 3.5	ST 4.2	ST 4.8	ST 5.5	ST 6.3
7504 K  type K : hexagon head with collar	f.sheet thicknesses	0.7 to 1.9	0.7 to 2.25	1.75 to 3.0	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0
	d_{pmax}	2.3	2.8	3.6	4.1	4.8	5.8
	d_{cmax}	6.3	8.3	8.8	10.5	11.0	13.5
	k_{max}	2.8	3.4	4.1	4.3	5.4	5.9
	s	4.0	5.5	7.0	8.0	8.0	10.0

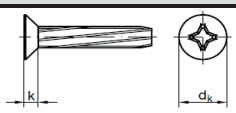
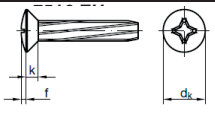
Tapping screws, thread rolling screws and thread cutting screws

DIN	Dimensions	ST 2.9	ST 3.5	ST 4.2	ST 4.8	ST 5.5	ST 6.3
7504 N-H  type N-H: with pan head acc. to DIN 7981 with philips cross recess	f.sheet thicknesses	0.7 to 1.9	0.7 to 2.25	1.75 to 3.0	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0
	d_{pmax}	2.3	2.8	3.6	4.1	4.8	5.8
	$d_{c\,max}$	5.6	6.9	8.2	9.5	10.8	12.5
	k_{max}	2.2	2.6	3.05	3.7	4.0	4.6
	cross recess size	1	2	2	2	3	3
7504 P-H  type P-H: with countersunk head acc.to DIN7982 with Philips cross recess	f.sheet thicknesses	0.7 to 1.9	0.7 to 2.25	1.75 to 3.0	1.75 to 4.4	1.75 to 5.25	2.0 to 6.0
	d_{pmax}	2.3	2.8	3.6	4.1	4.8	5.8
	$d_{c\,max}$	5.5	6.8	8.1	9.5	10.8	12.4
	k_{max}	1.7	2.1	2.5	3.0	3.4	3.8
	cross recess size	1	2	2	2	3	3

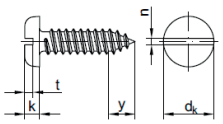
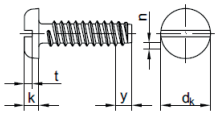
DIN	Dimensions	M 5	M 6	M 8
7513A  type A: with hexagon head acc. to DIN 933 *) for materials with medium property classes	s	8	10	13
	k	3.5	4	5.3
	core hole Ø *)	4.5	5.5	7.4

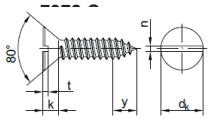
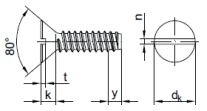
DIN	Dimensions	M 3	M 4	M 5	M 6
7513 B  type B: with slotted cheese head acc. to DIN 84 *) for materials with medium property classes	d_{kmax}	5.5	7	8.5	10
	k	2	2.6	3.3	3.9
	n	0.8	1.2	1.2	1.6
	t_{min}	0.85	1.1	1.3	1.6
	Core hole Ø *)	2.7	3.6	4.5	5.5

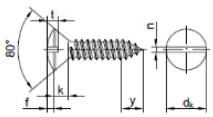
DIN	Dimensions	M 3	M 4	M 5	M 6	M 8
7516 A – H  **7516 AE – ISR**  type A: with pan head acc. to DIN 7985 *) for materials with medium property classes	d_{kmax}	6	8	10	12	16
	k_{max}	2.4	3.1	3.8	4.6	6
	cross recess size	1	2	2	3	4
	Hexalobular	T10	T20	T25	T30	T40
	Core hole Ø *)	2.7	3.6	4.5	5.5	7.4

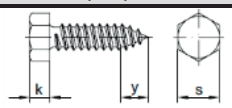
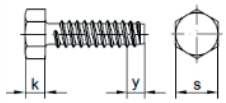
DIN	Dimensions	M 3	M 4	M 5	M 6	M 8
  type D: with countersunk head acc. DIN 965	$d_{k\,max}$	5.6	7.5	9.2	11	14.5
	k_{max}	1.65	2.2	2.5	3	4
	Cross recess size	1	2	2	3	4
	Hexalobular	T10	T20	T25	T30	T40
  type E: with raised countersunk head acc. to DIN 966 *) for materials with medium property classes	d_{kmax}	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
	Hexalobular	T10	T20	T25	T30	T40
	Core hole Ø *)	2.7	3.6	4.5	5.5	7.4

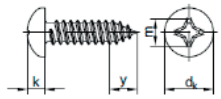
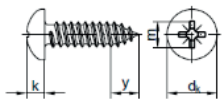
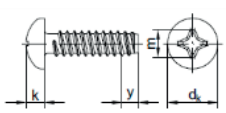
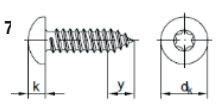
Tapping screws, thread rolling screws and cutting screws

DIN (ISO)	Dimensions	ST 2.2	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3
	d_k DIN/ISO	4.2/4	5.6	6.9/7	7.5	8.2/8	9.5	10.8/11	12.5/12
	k DIN/ISO	1.35/1.3	1.75/1.8	2.1	2.25	2.45/2.4	2.8/3	3.2	3.65/3.6
	n	0.6	0.8	1	1	1.2	1.2	1.6	1.6
	t min	0.55	1.75	0.95	1.05	1.15	1.35	1.55	1.8
	y type C	2	2.6	3.2	3.5	3.7	4.2	5	6
assembly instructions →TD-106	y type F	1.6	2.1	2.5	2.7	2.8	3.2	3.6	3.6

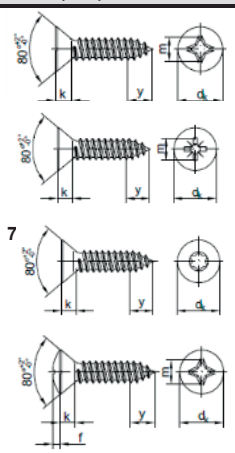
DIN (ISO)	Dimensions	ST 2.2	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3
	$d_{kDIN/ISO}$	4.3/4.4	5.5/6.3	6.8/8.2	7.5	8.1/9.2	9.5/10.4	10.8/11.5	12.4/12.6
	k DIN / ISO	1.3/1.1	1.7	2.1/2.35	2.3	2.5/2.6	3/2.8	3.4/3	3.8/3.15
	n	0.6	0.8	1	1	1.2	1.2	1.6	1.6
	t min	0.55	1.75	0.95	1.05	1.15	1.35	1.55	1.8
	y type C	2	2.6	3.2	3.5	3.7	4.2	5	6
for screws acc. to ISO countersunk 90° assembly instructions →TD-106	y type F	1.6	2.1	2.5	2.7	2.8	3.2	3.6	3.6

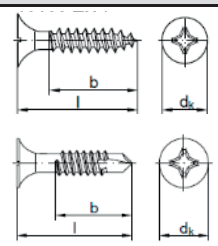
DIN (ISO)	Dimensions	ST 2.2	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3
	$d_{kDIN / ISO}$	4.3/4.4	5.5 / 6.3	6.8 / 8.2	7.5	8.1 / 9.2	9.5 / 10.4	10.8 / 11.5	12.4 / 12.6
	f DIN / ISO	0.7/ 0.5	0.9 / 0.7	1.2 / 0.8	1.3	1.4 / 1	1.5 / 1.2	1.7 / 1.3	2 / 1.4
	k DIN / ISO	1.3 / 1.1	1.7	2.1 / 2.35	2.3	2.5 / 2.6	3 / 2.8	3.4 / 3	3.8 / 3.15
	n	0.5	0.8	1	1	1.2	1.2	1.6	1.6
	t min	0.8	1.2	1.4	1.7	1.6	2	2.2	2.4
for screws acc. to ISO countersunk 90° assembly instructions →TD-106	y	2	2.6	3.2	3.5	3.7	4.3	5	6

DIN (ISO)	Dimensions	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3	ST 8
	k DIN / ISO	1.5 / 2.3	2.3 / 2.6	2.3	2.8 / 3	3 / 3.8	4 / 4.1	4.8 / 4.7	5.8 / 6
	s	5	5.5	7	7	8	8	10	13
	y type C	2.6	3.2	3.5	3.7	4.2	5	6	7.5
assembly instruction →TD-106	y type F	2.1	2.5	2.7	2.8	3.2	3.6	3.6	4.2

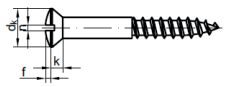
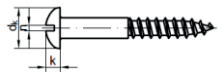
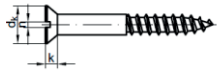
DIN (ISO)	Dimensions	ST 2.2	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3
	$d_{kDIN / ISO}$	4.2 / 4	5.6	6.9 / 7	7.5	8.2 / 8	9.5	10.8 / 11	12.5 / 12
	k max DIN / ISO	1.8 / 1.6	2.2 / 2.4	2.6	2.8	3.05 / 3.1	3.5 / 53.7	3.95 / 4	4.55 / 4.6
	cross recess size	1	1	2	2	2	2	3	3
	Hexalobular		T10	T15		T20	T25	T25	T30
	y type C	2	2.6	3.2	3.5	3.7	4.2	5	6
	y type F	1.6	2.1	2.5	2.7	2.8	3.2	3.6	3.6
assembly instructions →TD-106									

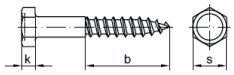
Tapping screws, thread rolling screws and cutting screws

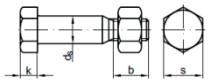
DIN (ISO)	Dimensions	ST 2.2	ST 2.9	ST 3.5	ST 3.9	ST 4.2	ST 4.8	ST 5.5	ST 6.3
	$d_{k\ DIN\ /\ ISO}$	4.3 / 3.8	5.5	6.8 / 7.3	7.5	8.1 / 8.4	9.5 / 9.3	10.8 / 10.3	12.4 / 11.3
	$k_{\ max\ DIN\ /\ ISO}$	1.3 / 1.1	.7	2.1 / 2.35	2.3	2.5 / 2.6	3 / 2.8	3.4 / 3	2.8 / 3.15
	$m_{\ type\ z}$	1.9	31.2	4.4	4.6	4.6	5.2	6.6	6.8
	f	2	3.2	4.3	4.2	4.6	5.1	6.5	6.8
	cross recess size	1	1	2	2	2	2	3	3
	Hexalobular	T6	T10	T15	T20	T25	T25	T25	T30
for screws acc. to ISO countersunk 90° assembly instructions →TD-106	y	2	2.6	3.2	3.5	4.2	5	5	6

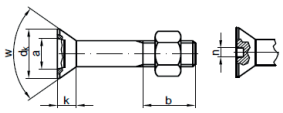
DIN	Dimensions	3.5 type TB	3.9 type TN	4.2 type TN
	d_k	8.5	8.5	8.5
	cross recess size	H2	H2	H2
	l	25/35/45/55	25/35/45/55	65/75
	b	16/26/30/30	16/26/30/30	45
*) D: double – start thread or E: single – start thread	$T_{\ ip}$ length	4.5	9	9

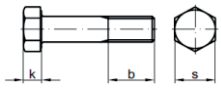
Wood screws

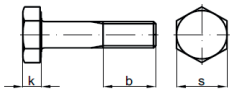
DIN	Dimensions	2	2.5	3	3.5	4	4.5	5	5.5	6	7	8
95 	d_k	3.8	4.7	5.6	6.5	7.5	8.3	9.2	10.2	11	12.5	14.5
	k	1.2	1.5	1.65	1.93	2.2	2.35	2.5	2.75	3	3.5	4
	f	0.5	0.6	0.75	0.9	1	1.1	1.25	1.4	1.5	1.8	2
	n	0.5	0.6	0.8	0.8	1	1	1.2	1.2	1.6	2	2
96 	d_k	4	5	6	7	8	9	10	11	12	14	16
	k	1.4	1.7	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.9	5.6
	n	0.5	0.6	0.8	0.8	1	1	1.2	1.2	1.6	2	2
97 	d_k	3.8	4.7	5.6	6.5	7.5	8.3	9.2	10.2	11	12.5	14.5
	k	1.2	1.5	1.65	1.93	2.2	2.35	2.5	2.75	3	3.5	4
	n	0.5	0.6	0.8	0.8	1	1	1.2	1.2	1.6	2	2

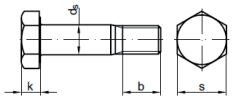
DIN	Dimensions	5	6	7	8	10	12	16	20
571 	b	≥ 0.61	≥ 0.61	≥ 0.61	≥ 0.61	≥ 0.61	≥ 0.61	≥ 0.61	≥ 0.61
	k	3.5	4	5	5.5	7	8	10	13
	s	8	10	12	13	17	19	24	30

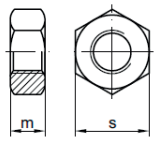
DIN	Dimensions	M 12	M 16	M 20	M 24	M 27	M 30
7968*	b	20.5	24.5	28.5	33	25.5	38.5
	k	8	10	13	15	17	19
	$d_{s\ min}$	12.74	16.74	20.71	24.71	27.71	30.67
*) with nut acc. to ISO 4032 or ISO 4034	s	18	24	30	36	41	46

DIN	Dimensions	M 12	M 16	M 20	M 24
7969 1)	w	75°	75°	60°	60°
	b_1	22	28	32	38
	b_2	28	35	40	50
	d_{kmax}	21	28	32	38
	k	7	9	11.5	13
	n	2.5	2.5	3	3
1)with nut acc. to ISO 4032 or ISO 4034 $b_{1)}$ for l≤60 with M12 and l ≤80 with M12, M24 $b_{1)}$ for l≤60 with M12 and l≤80 with M12, M24	t	3	3	3.5	3.5
	a_{max}	14.7	19.6	22.4	26.6

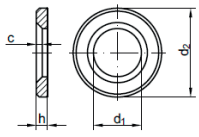
DIN	Dimensions	M 12	M 16	M 20	M 24	M 27	M 30
7990	k	8	10	13	15	17	19
	s	19	24	30	36	41	46
	ISO – s	18	24	30	36	41	46
	b	17.75	21	23.5	26	29	30.5

EN	Dimensions	M 12	M 16	M 20	M 22	M 24	M 27	M 30
14399-4	k	8	10	13	14	15	17	19
	s	22	27	32	36	41	46	50
	b	23	28	33	34	39	41	44
	Dimensions	**M 36**	**M 39**	**M 42***	**M 48***	**M 56***	**M 64***	
	k	23	25	26	30	35	40	
*) acc. to DAST directive 021	s	60	65	70	80	90	100	
	b	52	68	74	82	90	100	

EN	Dimensions	M 12	M 16	M 20	M 22	M 24	M 27	M 30	M 36
14399 – 8	k	8	10	13	14	15	17	19	23
	d_s	13	17	21	23	25	28	31	37
	b	23	28	33	34	39	41	44	52
	s	22	27	32	36	41	46	50	60

EN	Dimensions	M 12	M 16	M 20	M 22	M 24	M 27	M 30
14399-4	m	10	13	16	18	20	22	24
	s	22	27	32	36	41	46	50
	Dimensions	**M 36**	**M 39***	**M 42***	**M 48***	**M 56***	**M 64***	
	m	29	31	34	38	45	51	
*) acc. to DAST directive 021	s	60	65	70	80	90	100	

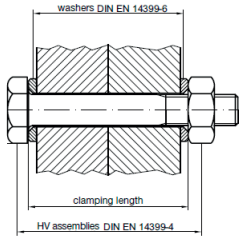
DIN 6917 square taper washers for friction grip bolts **DIN 6918 square taper washers for friction grip bolts**	**Dimensions see TD-42 (washer / rings – square washers)**

EN	Dimensions	M 12	M 16	M 20	M 22	M 24	M 27	M 30
14399 – 6	d_{1min}	13	17	21	23	25	28	31
	d_{2max}	24	30	37	39	44	50	56
	h	3	4	4	4	4	5	5
	c_{min}	1.6	1.6	2	2	2	2.5	2.5
	Dimensions	**M 36**	**M 39***	**M 42**	**M 48**	**M 56***	**M 64***	
	d_{1min}	37	40.4	43.4	49.4	58	66	
	d_{2max}	66	72	78	90.6	103.6	113.60	
*acc. to DAST directive 021	h	5	6	8	8	10	10	
	c_{min}	2.5	3	3	3.4	4	4.5	

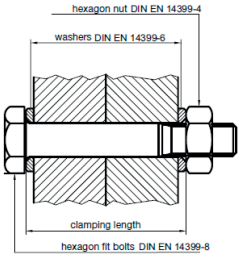
Clamping lengths

Clamping length for bolts for steel constructions

bolts, system HV acc. to EN 14399 – 4



fit bolts acc. to EN 14399 – 8



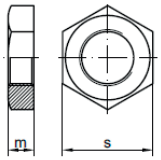
The maximum clamping length values are set in such a way that the bolt thread in preload condition exceeds the nuts by min. 1P. Details on washer thickness EN 14399 – 6 →TD-26, TD-41 & TD-42

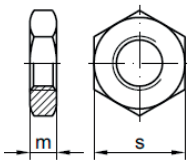
Thread	M 12		M 16		M 20		M 22		M 24		M 27		M 30		M 36	
Nominal length	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
30	11	16														
35	16	21	12	17												
40	21	26	17	22	13	18										
45	26	31	22	27	18	23										
50	31	36	27	32	23	28	22	27	19	24						
55	36	41	32	37	28	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	666	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	186	183	188	182	187	179	184	176	181	174	171	168	173
220			197	201	193	198	192	197	189	194	186	191	184	189	178	183
230					203	208	202	207	199	204	196	201	194	199	188	193
240					213	218	212	217	209	214	206	211	204	209	198	203
250					223	228	222	227	219	224	216	221	214	219	208	213
260					233	238	232	237	229	234	226	230	224	229	218	223

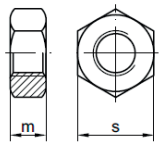
Design standards and assembly instructions → DIN 18000- 1 and DIN 18800 – 7 / EN V 1090 – 1 / EN 1993 - 1, -8

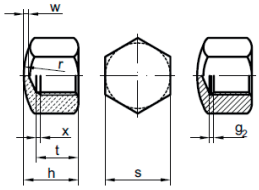
Dimensions for nuts

Hexagon nuts

DIN	Dimensions	G 1/	G 1/	G 3/	G 1/2	G 3/4
431 B	m_{max}	6.48	6.48	7.58	5.58	9.58
	s_{max}	18	21	27	34	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	

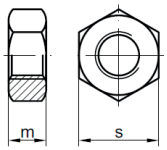
DIN (ISO)	Dimensions	M 2	M 2.5	M 3	M 3.5	M 4	M 5	M 6	M 8
439 (4036)	m_{max}	1.2	1.6	1.8	2	2.2	2.7	3.2	4
	$s_{DIN / ISO}$	4	5	5.5	6	7	8	10	13
Dimensions	**M 10**	**M 12**	**M 14**	**M 16**	**M 18**	**M 20**	**M 22**	**M 24**	
m_{max}	5	6	7	8	9	10	11	12	
$s_{DIN / ISO}$	17/16	19/18	22/21	24	27	30	32/34	36	
Dimensions	**M 27**	**M 30**	**M 33**	**M 36**	**M 42**	**M 48**			
m_{max}	13.5	15	16.5	18	21	24			
$s_{DIN / ISO}$	41	46	50	55	65	75			

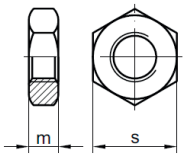
DIN (ISO)	Dimensions	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18
555 (4034)	m_{DIN}	4	8	6.5	8	10	11	13	15
	m_{ISO}	5.6	6.1	7.9	9.5	12.2	13.9	15.9	16.9
	$s_{DIN / ISO}$	8	10	13	17/16	19/18	22/21	24	27
Dimensions	**M 20**	**M 22**	**M 24**	**M 27**	**M 30**	**M 33**	**M 36**	**M 39**	
m_{DIN}	16	18	19	22	24	26	29	31	
m_{ISO}	19	20.2	22.3	24.7	26.4	29.5	31.9	34.3	
$s_{DIN / ISO}$	30	32/34	36	41	46	50	55	60	
Dimensions	**M 42**	**M 45**	**M 48**	**M 52**	**M 56**	**M 60**	**M 64**		
m_{DIN}	34	36	38	42	45	48	51		
m_{ISO}	34.9	36.9	38.9	42.9	45.9	48.9	52.4		
$s_{DIN / ISO}$	65	70	75	80	85	90	95		

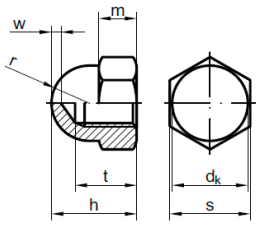
DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16
917	$x_{max/g2\ max}$	1.05	1.2	1.5	1.87	2.25	6.4	7.3	7.3
	h	5.5	7.0	9.0	12.0	14.0	16.0	18.0	20.0
	r	8	10	12	15	20	25	28	30
	DIN/ISO	7	8	10	13	17/16	19/18	22/21	24
	t_{min}	4.16	4.96	6.71	9.21	10.65	13.15	14.65	16.65
	w_{min}	1	1	1.5	2	2	2	2	2
	Dimensions	**M 18**	**M 20**	**M 22**	**M 24**	**M 30**	**M 36**	**M 42**	
	$x_{max/g2\ max}$	9.3	9.3	9.3	10.7	12.7	14	16	
	h	22.0	25.0	28.0	30.0	34.0	44.0	52.0	
	r	32	35	35	40	60	70	80	
	s	27	30	32/34	36	46	55	65	
	t_{min}	18.58	20.58	21.58	23.58	27.58	35.50	41.50	
	w_{min}	2	2.5	3	3	3	4	4	

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

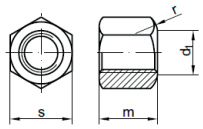
Hexagon nuts

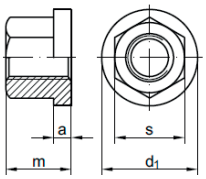
DIN (ISO)	Dimensions	M 1	M 1.2	M 1.4	M 1.6	M 1.7*	M 2	M 2.3	M 2.5
934 (4032) (4033) (8673) (8674)  *acc. to DIN 934:1963	$m_{DIN/ISO}$	0.8	1	1.2	1.3	1.4	1.6	1.8	2
	$s_{DIN/ISO}$	2.5	3	3	3.2	3.5	4	4.5	5
	Dimensions	**M 2.6***	**M 3**	**M 3.5**	**M 4**	**M 5**	**M 6**	**M 7**	**M 8**
	$m_{DIN/ISO}$	2	2.4	2.8	3.2	4/4.7	5/5.2	5.5	6.5/6.8
	$s_{DIN/ISO}$	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**
	$m_{DIN/ISO}$	8/8.4	10/10.8	11/12.8	13/14.8	15/15.8	16/18	18/19.4	19/21.5
	$s_{DIN/ISO}$	17/16	19/18	22/21	24	27	30	32/34	36
	Dimensions	**M 26***	**M 27**	**M 30**	**M 33**	**M 36**	**M 39**	**M 42**	**M 45**
	$m_{DIN/ISO}$	22	22/23.8	24/25.6	26/28.7	29/31	31/33.4	34	36
	$s_{DIN/ISO}$	41	41	46	50	55	60	65	70
	Dimensions	**M 48**	**M 52**	**M 56**	**M 60**	**M 64**	**M 68**	**M 72**	**M 76**
	$m_{DIN/ISO}$	38	42	45	48	51	54	58	61
	$s_{DIN/ISO}$	75	80	85	90	95	100	105	110
	Dimensions	**M 80**	**M 85**	**M 90**	**M 95***	**M 100**	**M 105***	**M 110**	**M 120***
	$m_{DIN/ISO}$	64	68	72	75	80	82	88	95
	$s_{DIN/ISO}$	115	120	130	135	145	150	155	175

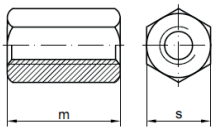
DIN(ISO)	Dimensions	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
936 (4035) (8675)  *acc. to DIN 936:1963	m_{DIN}	5	6	7	8	8	9	9	10	10
	m_{ISO}	4	5	6	7	8	9	10	11	12
	$s_{DIN/ISO}$	13	17/16	19/18	22/21	24	27	30	32/34	36
	Dimensions	**M 26**	**M 27**	**M 28***	**M 30**	**M 32***	**M 33**	**M 35***	**M 36**	**M 38***
	m_{DIN}	12	12	12	12	14	14	14	14	16
	m_{ISO}	13	13.5	14	15	16	16.5	17.5	18	19
	$s_{DIN/ISO}$	41	41	41	46	50	50	55	55	60
	Dimensions	**M 39**	**M 40***	**M 42**	**M 45**	**M 48**	**M 50***	**M 52**		
	m_{DIN}	16	16	16	18	18	20	20		
	m_{ISO}	19.5	20	21	22.5	24	25	26		
	$s_{DIN/ISO}$	60	60	65	70	75	75	80		

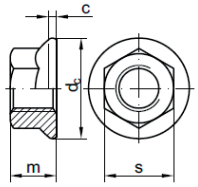
DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 14
1587  	d_{kmax}	5.8	6.5	7.5	9.5	12.5	15	17	20
	m_{max}	2.4	3.2	4	5	6.5	8	10	11
	r	2.9	3.25	3.75	4.75	6.25	7.5	8.5	10
	$s_{DIN/ISO}$	5.5	7	8	10	13	17/16	19/18	22/21
	t_{min}	4.5	5.26	7.21	7.71	10.65	12.65	15.65	17.65
	w_{min}	2	2	2	2	2	2	3	4
	Dimensions	**M 16**	**M 18**	**M 20**	**M 22**	**M 24**	**M 27**	**M 30**	
	d_{kmax}	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	
	$s_{DIN/ISO}$	24	27	30	32/34	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	

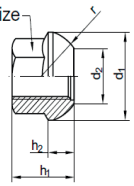
Hexagon nuts

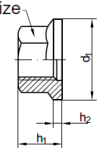
DIN	Dimensions	M 6	M 8	M 10	M 12	M 14	M 16
6330 	d_1	7	9	11.5	14	16	18
	m	9	12	15	18	21	24
	r	9	11	15	17	20	22
	s	10	13	16	18	22	24
	Dimensions	**M 18**	**M 20**	**M 22**	**M 24**	**M 27**	**M 30**
	d_1	20	22	25	26	29	32
	m	27	30	33	36	40	45
	r	25	27	29	32	37	41
	s	27	30	32	36	41	46

DIN	Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 18
6331 	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

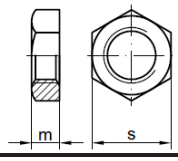
~DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30
6334 	m	18	24	30	36	48	60	72	90
	s	10	13	17	19	24	30	36	46

DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16	M 20
6923 	d_{cmax}	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	7	8	10	13	15	18	24	30

DIN	Dimensions	M 18x1.5	M 20x1.5
wrench size 74361A 	d_1	28	33
	d_2	21	24.5
	h_1	25	27
	h_2	75	9
	r	16	18
	wrench size	24	27

DIN	Dimensions	M 14x1.5	M 18x1.5	M 20x1.5	M 22x1.5
wrench size 74361 B 	d_1	27	29	34	36
	h_1	15	18	20	22
	h_2	3	4	5	6
	wrench size	19	24	27	30

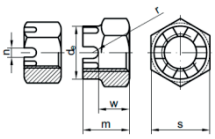
Hexagon nuts

DIN	Dimensions	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5	M 26x1.5	M 30x2
80705 	m	6	6	6	6	7	8	8
	s	19	22	24	27	30	36	41

Locking nuts

DIN	Dimensions	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24
	d_{emax}	-	-	16	18	22	25	28	32	34
	m	9.5	12	15	16	19	21	22	26	27
	n_{min}	2.5	2.8	3.55	3.5	4.5	4.5	4.5	5.5	5.5
	$s_{DIN/ISO}$	13	17/16	19/18	22/21	24	27	30	32/34	36
	w_{max}	6.5	8	10	11	13	15	16	18	19
	split pin	2x16	2.5x20	3.2x22	32x25	4x28	4x32	4x36	5x36	5x40

Dimensions	M 26*	M 27	M 28*	M 30	M 32*	M 33	M 36	M 39	M 42
d_{emax}	38	38	38	42	46	46	50	55	58
m	30	30	30	33	35	35	38	40	46
n_{min}	5.5	5.5	5.5	7	7	7	7	7	9
s	41	41	41	46	50	50	55	60	65
w_{max}	22	22	22	24	26	26	29	31	34
split pin	5x50	5x45	5x50	6.3x50	6.3x50	6.3x56	6.3x63	6.3x71	8x71

935 – 1 

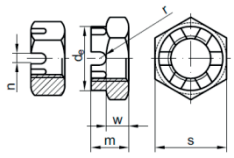
Dimensions	M 45	M 48	M 50*	M 52	M 56	M 58*	M 60	M 64	M 68
d_{emax}	62	65	65	70	75	80	80	85	90
m	48	50	50	54	57	65	63	66	69
n_{min}	9	9	9	9	9	11	11	11	11
s	70	75	75	80	85	90	90	95	100
w_{max}	36	38	38	42	45	48	48	51	54
split pin	8x80	8x80	8x80	8x90	8x100	10x100	10x100	10x100	10x112

Dimensions	M 72	M 76	M 80	M 85	M 90	M 100			
$d_{e\,max}$	95	100	105	110	120	130			
m	73	76	79	88	92	100			
n_{min}	11	11	11	14	14	14			
s	105	110	115	120	130	145			
w_{max}	58	61	64	68	72	80			
split pin	10x112	10x125	10x140	13x140	13x140	13x160			

*acc.to DIN 935:1963

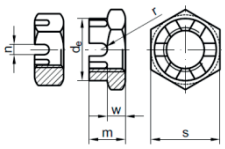
Locking nuts

DIN	Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 20
937	d_{emax}	-	-	-	17	19	22	25	28	30
	m	6	8	9	10	11	12	13	13	15
	n_{min}	2	2.5	2.8	3.5	3.5	4.5	4.5	4.5	5.5
	s	10	13	17	19	22	24	27	30	32
	w_{max}	3.5	4.5	5	6	7	7	8	8	9
	split pin	1.6x14	2x16	2.5x20	3.2x22	3.2x25	4x28	4x32	4x36	5x36
	Dimensions	**M 24**	**M 26***	**M 27**	**M 28***	**M 30**	**M 32***	**M 33**	**M 35***	**M 36**
	d_{emax}	34	38	38	38	42	46	46	50	50
	m	15	30	17	30	18	20	20	20	20
	n_{min}	5.5	5.5	5.5	5.5	7	7	7	7	7
	s	36	41	41	41	46	50	50	55	55
	w_{max}	9	22	11	22	11	13	13	13	13
	split pin	5x40	5x50	5x45	5x50	6.3x50	6x60	6.3x56	6x65	6.3x63
	Dimensions	**M 39**	**M 40***	**M 42**	**M 45**	**M 48**	**M 50***	**M 52**		
	d_{emax}	55	55	58	62	65	65	70		
	m	22	22	23	25	25	27	27		
	n_{min}	7	7	9	9	9	9	9		
	s	60	60	65	70	75	75	80		
	w_{max}	13	13	14	16	16	18	18		
	split pin	6.3x71	6x70	8x71	8x80	8x80	8x80	8x90		

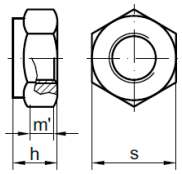


*acc. to DIN 937:1963

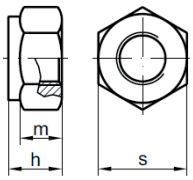
DIN	Dimensions	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22
979	d_{emax}	-	-	16	18	22	25	28	32
	m	6.5	8	10	11	13	15	16	18
	n_{min}	2.5	2.8	3.5	3.5	4.5	4.5	4.5	5.5
	s	13	16	18	21	24	27	30	34
	w_{max}	3.5	4	5	6	7	9	10	10
	split pin	2x16	2.5x20	3.2x22	3.2x25	4x28	4x32	4x36	5x36
	Dimensions	**M 24**	**M 27**	**M 30**	**M 36**	**M 39**	**M 42**	**M 48**	**M 52**
	d_{emax}	34	38	42	50	55	58	65	70
	m	19	22	24	29	31	33	36	38
	n_{min}	5.5	5.5	7	7	7	9	9	9
	s	36	41	46	55	60	65	75	80
	w_{max}	11	14	15	20	22	22	24	26
	split pin	5x40	5x45	6.3x50	6.3x63	6.3x71	8x71	8x80	8x90



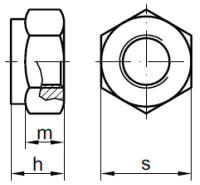
DIN (ISO)	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16
980 6925 (7042/10513)	h_{max}	3.7	4.2	5.1	6	8	10	12	14	16
	m'_{min}	1.65	2.2	2.75	3.3	4.4	5.5	6.6	7.7	8.8
	$s_{980/6925}$	5.5	7	8	10	13	17/16	19/18	22/21	24
	Dimensions	**M 18**	**M 20**	**M 22**	**M 24**	**M 27**	**M 30**	**M 33**	**M 36**	**M 39**
	h_{max}	18	20	22	24	27	30	33	36	39
	m'_{min}	9.9	11	12.2	13.2	14.8	16.5	18.2	19.8	21.5
	$s_{980/6925}$	27	30	32/-	36	41	46	50	55	60

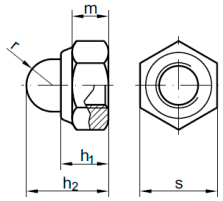


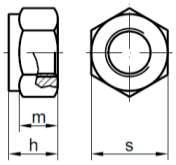
DIN (ISO)	Dimensions	M 4	M 5	M 6	M 8	M 10
982 (7040/10512)	$h_{DIN/ISO}$	6	6.3/6.8	8	9.5	11.5/11.9
	m_{min}	2.9	4.4	4.9	6.44	8.04
	$s_{DIN/ISO}$	7	8	10	13	17/16
	Dimensions	**M 12**	**M 14**	**M 16**	**M 20**	**M 24**
	$h_{DIN/ISO}$	14/14.9	16/17	18/19.1	22/22.8	28/27.1
	m_{min}	10.37	12.1	14.1	16.9	20.2
	$s_{DIN/ISO}$	19/18	22/21	24	30	36

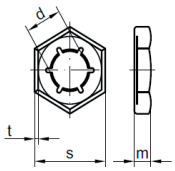


Locking nuts

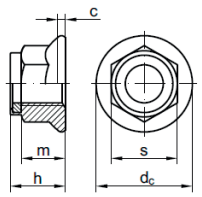
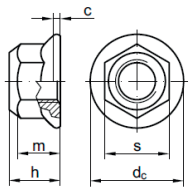
DIN (ISO)	Dimensions	M 3	M 4	M 5	M 6	M 7	M 8	M 10	M 12
985 (10511) 	h_{max}	4	5	5	6	7.5	8	10	12
	m_{min}	2.4	2.9	3.2	4	4.7	5.5	6.5	8
	$s_{DIN/ISO}$	5.5	7	8	10	11	13	17/16	19/18
	Dimensions	**M 14**	**M 16**	**M 18**	**M 20**	**M 22**	**M 24**	**M 27**	**M 30**
	h_{max}	14	16	18.5	20	22	24	27	30
	m_{min}	9.5	10.5	13	14	15	15	17	19
	$s_{DIN/ISO}$	22/21	24	27	30	32/34	36	41	46
	Dimensions	**M 33**	**M 36**	**M 39**	**M 42**	**M 45**	**M 48**		
	h_{max}	33	36	39	42	45	48		
	m_{min}	22	25	27	29	32	36		
	$s_{DIN/ISO}$	50	55	60	65	70	75		

DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16
986 	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

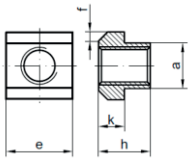
DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16
6924 	h_{max}	6	6.8	8	9.5	11.9	14.9	19.1
	m_{min}	2.9	4.4	4.9	6.44	8.04	8.04	14.1
	s	7	8	10	13	16	16	24

DIN	Dimensions	M 6	M 8	M 10	M 12	M 14	M 16	M 20	M 22
7967 	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	

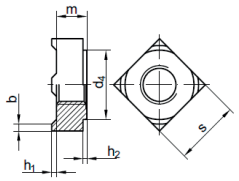
Locking nuts

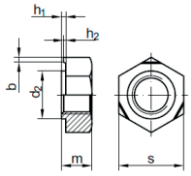
EN	Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
1663  1664 	c_{min}	1	1.1	1.2	1.5	1.8	2.4
	d_c	11.8	14.2	17.9	21.8	26	34.5
	$h_{max\ (1663)}$	7.1	9.1	11.1	13.5	16.1	20.3
	$h_{max\ (1664)}$	6.2	7.3	9.4	11.4	13.8	18.3
	m_{min}	4.7	5.7	7.6	9.6	11.6	15.3
	s	8	10	13	16	18	24

Nuts for T-slots

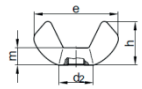
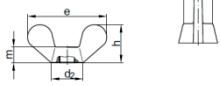
DIN (ISO)	Dimensions	M 5	M 6	M 8	M 10	M 12	M 16	M 20	M 24
508 (299) 	a	6	8	10	12	14	18	22	28
	e	10	13	15	18	22	28	35	44
	f	1.6	1.6	1.6	2.5	2.5	2.5	2.5	4
	h	8	10	12	14	16	20	28	36
	k	4	6	6	7	8	10	14	18

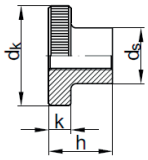
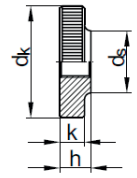
Welding nuts

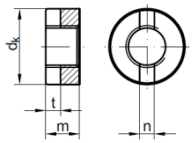
DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
928 	b	0.8	1	1.2	1.5	18	2
	$d_{4\ min}$	6.4	8.2	9.1	9.1	15.6	17.4
	h1	0.6	0.8	0.8	0.8	1.2	1.4
	h_{2min}	0.4	0.6	0.7	0.7	1.25	1.75
	m	3.5	4.2	5	5	8	9.5
	s	7	9	10	10	17	19

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

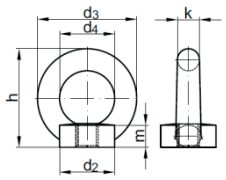
Special Forms

DIN	Dimensions	M 3*	M 4	M 5	M 6	M 8
314 	$e_{max\ 314/315}$	-/16	21/20	26.5/26	32/33	38/39
	h_{max}	8	11/10.5	13	16/17	19/20
	m_{max}	44	4.6	6.5	8	10
	$d_{2\ max}$	6	8	11	13	16
	d_{3max}	5	7	9	11	12.5
315 						
	Dimensions	**M 10**	**M 12**	**M 16**	**M 20**	**M 24**
	$e_{max\ 314/315}$	50/51	66/65	73	90	110
	$h_{max\ 314/315}$	24/25	32/33.5	37.5	46.5	56.5
	m_{max}	12	14	17	21	25
	d_{2max}	20	23	29	35	44
*acc. to DIN 315:1956	d_{3max}	16.5	19.5	23	29	37.5

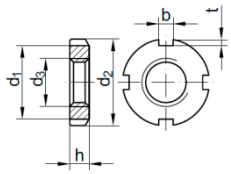
DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
466 	d_k	12	16	20	24	30	36
	d_s	6	8	10	12	16	20
	k	2.5	3.5	4	5	6	8
467 	$h_{DIN\ 466}$	7.5	9.5	11.5	15	18	23
	$h_{DIN\ 467}$	3.0	4.0	5.0	6	8	10

DIN	Dimensions	M 2	M 3	M 4	M 5	M 6	M 8	M 10	M 12	M 16
546 	d_{kmax}	4.5	6	8	9	11	14	18	21	26
	m_{max}	2	2.5	3.5	4.2	5	6.5	8	10	12
	n	1	1.2	1.4	2	2.5	3	3.5	4	4
	t	0.8	1	1.2	1.5	2	2.5	3.2	3.8	3.8

Special Forms

DIN	Dimensions	M 6*	M 8	M 10	M 12	M 14*	M 16	M 18*
582 	d_2	17	20	25	30	35	35	40
	d_3	28	36	45	54	63	63	72
	d_4	16	20	25	30	35	35	40
	m	8.5	8.5	10	11	13	13	16
	h	31	36	45	53	62	62	71
	k	6	8	10	12	14	14	18
	Dimensions	**M 20**	**M 22***	**M 24**	**M 27***	**M 30**	**M 33***	**M 36**
	d_2	40	45	50	50	65	65	75
	d_3	72	81	90	90	108	108	126
	d_4	40	45	50	50	60	60	70
	m	16	18	20	20	25	25	30
	h	71	80.5	90	90	109	109	128
	k	16	18	20	20	24	24	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
	m	35	35	40	40	45	45	50
	h	147	147	168	168	187	187	208
	k	32	32	38	38	42	42	48

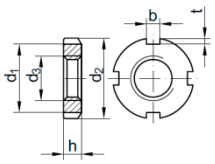
lifting eye bolts → TD-17
further Technical Information → TD-74
*intermediate sizes not included in the standard

DIN	Dimensions	KM 0	KM 1	KM 2	KM 3	KM 4	KM 5	KM 6	KM 7
981 	d_1	M 10x0.75	M 12x1	M 15x1	M 17x1	M 20x1	M 25x1.5	M 30	M 35x1.5
	d_2	18	22	25	28	32	38	45	52
	d_3	13.5	17	21	24	26	32	38	44
	h	4	4	5	5	6	7	7	8
	b	3	3	4	4	4	5	5	5
	t	2	2	2	2	2	2	2	2
	lockwasher*	MB 0	MB 1	MB 2	MB 3	MB 4	MB 5	MB 7	MB 7
	Dimensions	**KM 8**	**KM 9**	**KM 10**	**KM 11**	**KM 12**	**KM 13**	**KM 14**	**KM 15**
	d_1	M 40x1.5	M 45x1.5	M 50x1.5	M 55x2	M 60x2	M 65x2	M 70x2	M 75x2
	d_2	58	65	70	75	80	85	92	98
	d_3	50	56	61	67	73	79	85	90
	h	9	10	11	11	11	12	12	13
	b	6	6	6	7	7	7	8	8
	t	2.5	2.5	2.5	3	3	3	3.5	3.5
	lockwasher*	MB 8	MB 9	MB 10	MB 11	MB 12	MB 13	MB 14	MB 15

*lockwashers DIN 5406 → TD-51

Special Forms

981

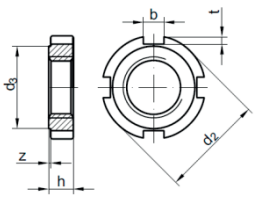


*lockwashers DIN 5406 →TD-51

DIN	Dimensions	KM 0	KM 1	KM 2	KM 3	KM 4	KM 5	KM 6	KM 7
	d_1	M 80x2	M 85x2	M 90x2	M 95x2	M 100x2	M 105x2	M 110x2	M 115x2
	d_2	105	110	120	125	130	140	145	150
	d_3	95	102	108	113	120	126	133	137
	h	15	15	16	17	18	18	19	19
	b	8	8	10	10	10	12	12	12
	t	3.5	3.5	4	4	4	5	5	5
	lockwasher*	MB 16	MB 17	MB 18	MB 19	MB 20	MB 21	MB 22	MB 23

Dimensions	KM 24	KM 25	KM 26	KM 27	KM 28	KM 29	KM 30	
d_1	M 120x2	M 125x2	M 130x2	M 135x2	M 140x2	M 145x2	M 150x2	
d_2	155	160	165	175	180	190	195	
d_3	138	148	149	160	160	171	171	
h	20	21	21	22	22	24	24	
b	12	12	12	14	14	14	14	
t	5	5	5	6	6	6	6	
lockwasher*	MB 24	MB 25	MB 26	MB 27	MB 28	MB 29	MB 30	

1804

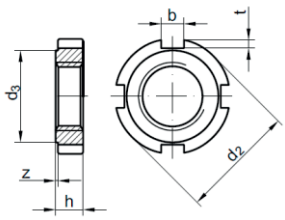


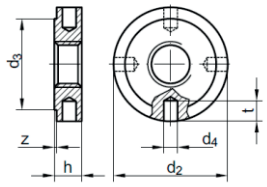
DIN	Dimensions	M 8x1	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5
	d_2	20	25	28	30	32	34	36
	d_3	16	20	23	25	27	28	30
	b	4	5	5	5	5	6	6
	h	5	6	6	7	7	8	8
	t	1.5	2	2	2	2	2.5	2.5
	z	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	qty. slots	4	4	4	4	4	4	4

Dimensions	M 22x1.5	M 24x1.5	M 26x1.5	M 28x1.5	M 30x1.5	M 32x1.5	M 35x1.5
d_2	40	42	45	50	50	52	55
d_3	34	36	38	43	43	45	48
b	6	6	7	7	7	7	7
h	9	9	10	10	10	11	11
t	2.5	2.5	3	3	3	3	3
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 38x1.5	M 40x1.5	M 42x1.5	M 45x1.5	M 48x1.5	M 50x1.5	M 52x1.5
d_2	58	62	62	68	75	75	80
d_3	50	54	54	60	67	67	70
b	8	8	8	8	8	8	10
h	11	12	12	12	13	13	13
t	3.5	3.5	3.5	3.5	3.5	3.5	4
z	0.5	0.5	0.5	0.5	0.5	0.5	0.5
qty. slots	4	4	4	6	6	66	6

Special Forms

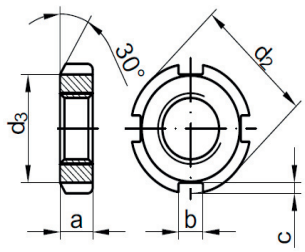
DIN	Dimensions	M 55x1.5	M 58x1.5	M 60x1.5	M 62x1.5	M 65x1.5	M 68x1.5	M 70x1.5
1804 	d_2	80	90	90	95	95	100	100
	d_3	70	80	80	85	85	90	90
	b	10	10	10	10	10	10	10
	h	13	13	13	14	14	14	14
	t	4	4	4	4	4	4	4
	z	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	qty. slots	6	6	6	6	6	6	6
	Dimensions	**M 72x1.5**	**M 80x1.5**	**M 85x2**	**M 90x2**	**M 100x2**	**M 110x2**	**M 120x2**
	d_2	110	115	120	130	145	155	165
	d_3	100	105	110	120	130	140	150
	b	10	10	10	10	12	12	12
	h	14	16	16	16	16	16	18
	t	4	4	4	4	5	5	5
	z	0.5	1	1	1	1	1	1
	qty. slots	6	6	6	6	6	6	6

DIN	Dimensions	M 10x1	M 12x1.5	M 14x1.5	M 16x1.5	M 18x1.5	M 20x1.5	M 22x1.5
1816 	d_2	25	28	30	32	34	36	40
	d_3	20	23	25	27	28	30	34
	d_4	3	3	4	4	4	4	4
	h	6	6	7	7	8	8	9
	t	4.5	5	5	6	66	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 24x1.5**	**M 26x1.5**	**M 28x1.5**	**M 30x1.5**	**M 32x1.5**	**M 35x1.5**	**M 38x1.5**
	d_2	42	45	50	50	52	55	58
	d_3	36	38	43	43	45	48	50
	d_4	4	5	5	5	5	5	5
	h	9	10	10	10	11	11	11
	t	6	6	7	7	7	7	8
	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 40x1.5**	**M 42x1.5**	**M 45x1.5**	**M 48x1.5**	**M 50x1.5**	**M 52x1.5**	**M 55x1.5**
	d_2	62	62	68	75	75	80	80
	d_3	54	54	60	67	67	70	70
	d_4	6	6	6	6	6	6	6
	h	12	12	12	13	13	13	13
	t	8	8	8	10	10	10	10
	z	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	qty. slots	4	4	6	6	6	6	6
	Dimensions	**M 58x1.5**	**M 60x1.5**	**M 62x1.5**	**M 65x1.5**	**M 68x1.5**	**M 70x1.5**	**M 72x1.5**
	d_2	90	90	95	95	100	100	110
	d_3	80	80	85	85	90	90	100
	d_4	6	6	8	8	8	8	8
	h	13	13	14	14	14	14	14
	t	10	10	12	12	12	12	12
	z	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	qty. slots	6	6	6	6	6	6	6
	Dimensions	**M 75x2**	**M 80x2**	**M 85x2**	**M 90x2**	**M 95x2**	**M 100x2**	
	d_2	110	115	120	130	135	145	
	d_3	100	105	110	120	120	130	
	d_4	8	8	8	8	8	8	
	h	14	16	16	16	16	16	
	t	12	12	12	12	12	12	
	z	0.5	1	1	1	1	1	
	qty. slots	6	6	6	6	6	6	

Special Forms

DIN

70852



*lockwashers DIN 70952 →TD-53

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

Dimensions	M 24x1.5	M 26x1.5	M 28x1.5	M 30x1.5	M 32x1.5	M 35x1.5	M 38x1.5
a	7	7	7	7	8	8	8
b	6.5	6.5	6.5	6.5	7	7	7
c	2.8	2.8	2.8	2.8	3.3	3.3	3.3
d_2	38	40	42	44	48	50	54
d_3	32	34	36	38	41	43	47
qty. slots	4	4	4	4	4	4	4
lockwasher*	24	26	28	30	32	35	38

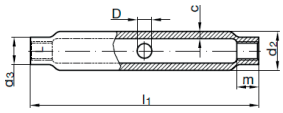
Dimensions	M 40x1.5	M 42x1.5	M 45x1.5	M 48x1.5	M 50x1.5	M 52x1.5	M 55x1.5
a	8	8	8	8	8	8	8
b	7	8	8	8	8	8	8
c	3.3	3.3	3.3	3.3	3.3	3.3	3.3
d_2	56	60	62	65	68	70	75
d_3	49	52	54	57	60	62	67
qty. slots	4	4	6	6	66	6	5
lockwasher*	40	42	45	48	50	52	55

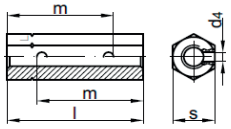
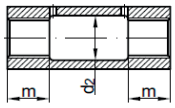
Dimensions	M 60x1.5	M 65x1.5	M 70x1.5	M 75x1.5	M 80x1.5	M 85x1.5	M 90x1.5
a	9	9	9	10	10	10	10
b	11	11	11	11	11	11	11
c	4.3	4.3	4.3	4.3	4.3	4.3	4.3
d_2	80	85	90	95	100	108	112
d_3	71	76	81	86	91	99	103
qty. slots	6	6	6	6	6	6	6
lockwasher*	60	65	70	75	80	85	90

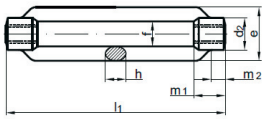
Dimensions	M 95x1.5	M 100x1.5	M 105x1.5	M 110x1.5	M 115x1.5	M 120x1.5	
a	10	10	10	12	12	12	
b	11	11	11	13	13	13	
c	4.3	4.3	4.3	5.5	5.5	5.5	
d_2	118	125	130	138	145	150	
d_3	109	116	121	126	133	138	
qty. slots	6	6	6	6	6	6	
lockwasher*	95	100	105	110	115	120	

Dimensions	M 125x1.5	M 130x1.5	M 140x1.5	M 150x1.5			
a	12	12	12	12			
b	13	13	13	13			
c	5.5	5.5	5.5	5.5			
d_2	155	160	170	180			
d_3	143	148	158	168			
qty. slots	6	6	66	8			
lockwasher*	125	130	140	150			

Turnbuckles

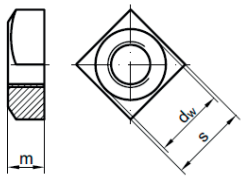
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36
1478 	d_2	17.2	17.2	21.3	25	30	33.7	42.4	51	63.5
	d_3	9	12	15	18	22.5	27	32	38	47.5
	D	6	8	8	10	10	12	12	16	16
	c	2.9	3.6	4	4	4.5	5	5.6	6.3	8
	l_1	110	110	125	125	170	100	255	255	295
	m	7.5	10	12	15	20	24	29	36	43
	adjustability	90	85	95	90	120	140	180	160	180

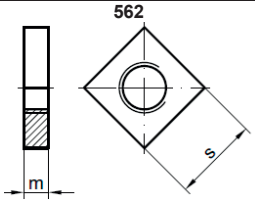
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36
1479 ≤ M 16  ≥ M 20 	d_2	-	-	-	-	-	21	26	32	38
	d_4	4	4	4	4	4	4	4	4	4
	l	30	35	45	55	75	95	115	125	145
	m	22.5	25	33	40	55	24	29	36	45
	s	10	13	17	19	24	30	36	46	55
	adjustability	15	15	21	25	35	47	57	53	70

DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
1480 	d_2	12	15	18	21	27	34
	e	19	23	30	34	42	52
	f	9	11	14	16	20	24
	h_{min}	6	8	9	11	14	17
	l_1	110	110	125	125	170	200
	m_1	12	15	18	21	27	34
	m_2	6	8	9	11	14	17
	adjustability	80	75	85	80	110	130

Dimensions	M 24	M 30	M 36	M 42	M 48	
d_2	39	45	55	63	80	
e	60	74	86	104	135	
f	28	34	40	50	65	
h_{min}	20	23	28	32	40	
l_1	255	255	295	330	355	
m_1	39	45	55	63	78	
m_2	20	23	28	32	39	
adjustability	170	160	180	200	195	

Square nuts

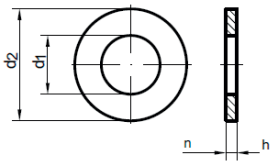
DIN	Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
557 	$d_{w\,min}$	6.7	8.7	11.5	14.5/15.5	16.5/17.2	22
	m	4	5	6.5	8	10	13
	s	8	10	13	16/17	18/19	24

DIN	Dimensions	M 3	M 4	M 5	M 6	M 8	M 10
562 	m	1.8	2.2	2.7	3.2	4	5
	s	5.5	7	8	10	13	16

Plain washer (round)

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

Tolerance for washers acc. to ISO 4759 – 3 (DIN 522)
General overview of "plain washers for general uses "→ ISO 887

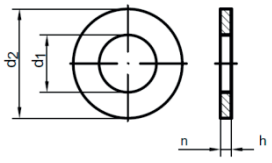


Nominal size = for screws M	Ww	ISO 7089, 7090 (DIN 125 – 1 Pk A)			ISO 7091 (DIN 126 Pk C)			Art. 1/88100 (C)			ISO 7092 (DIN 433 Pk A)			ISO 7094 (DIN 440 R Pk C)			DIN 6340 (Pk A) -		
		d_1	d_2	d_3	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h
1		1.1	3	0.3	In the ISO standards, the nominal sizes for Screw diameter and the dimensions (d1/d2/n) For some washers were minimally adjusted. The functional compliance/exchangeability DIN: ISO washers are given. In this catalogue, the new dimensions are specified in dimensions & price tables. Conversion to new dimensions is done according to the production conversion and sale of stock items.						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															
1.8		2.0	4.5	0.3							2.0	4	0.3						
2		2.2	5	0.3							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 ¼"	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 ½"	42	72	6	42	72	6	40	80	5				42	140	10			
42		45	78	8	45	78	8	43	85	5				*45	150	8			
45	*1 ¾"	48	85	8	48	85	8	46	90	5				*48	160	8			
48		52	92	8	52	92	8	50	97	6				*52	170	10			
52	*2"	56	98	8	56	98	8	54	105	7				*56	180	10			
56		62	105	10	62	105	10	58	110	8									
	*2 ¼"	60	110	9	62	105	10	Suitable combinations of plain washer for screws/nuts acc. to property and product classes (excerpt from ISO 887). For more exact information, see "Application area" of the corresponding washers product standard.													
60		66	110	10.0	66	110	10												
64	*2 ½"	70	115	10	70	115	10	**Washers**	**Hardness class/product class**					**100HV/C**		**200HV/A**		**300HV/A**	
68		74	120	10	74	120	10	**Screws/ nuts**	**Property class**	**Product grade**				**Combination matching?**					
72	*2 ¾"	78	125	10	78	125	10	steel	≤6.8/6	A,B				Yes		Yes		Yes	
76	*3"	82	135	10	82	135	10		≤6.8/6	C				Yes		No		No	
80		86	140	12	86	140	12		8.8/8	A,B				No		Yes		Yes	
90	*3 ½"	96	160	12	96	160	12		10.9/10	A,B				No		No		Yes	
									12.9/12	A,B				No		No		No	
								A1-A5	-50,-70,-80	A,B				-		Yes		-	

Plain washers (round)

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

Tolerance for washers acc. to ISO 4759 – 3 (DIN 522)
General overview of "plain washers for general uses"→ ISO 887



Norminal 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)		
M	Ww	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h	d_1	d_2	h
3		* d1 and d2 are conform for 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	*¼"										7.4	22	2
8	*5/16"				8.4	21	4				8.4	24	2
10	*3/8"				10.5	25	4	11	20	8	10.5	30	2.5
12	*7/16"	13	24	3(2.5)	13	30	6	13.5	24	8	13	37	3
	*½"												
14		15	36	6							15	40	3
16	*5/8"	17	30	4(3)	17	40	6	17.5	30	8	17	50	3
18					19	44	8				20	56	4
20	*¾"	21	37	4(3)	21	44	8	22	37	8	22	60	4
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	69	10	33	56	8	33	92	6
33	*1 ¼"							36	60	8	36	105	6
36	*1 3/8"	37	66	6(5)				39	66	8	39	110	8

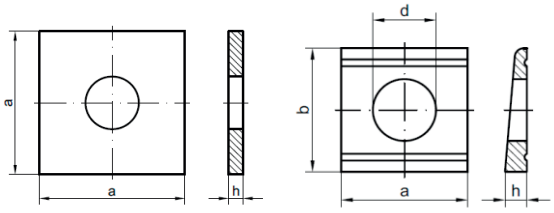
Norminal size = screws/pins		DIN 1052 (Pk C) -			DIN 1440 (Pk C) DIN 1441 (Pk C)*			DIN 988 – S (Pk C)			Art. 88104 (Pk C) -		
M / Ø	Ww	d_1	d_2	h	d_1	d_2	h	d_1	d^2	h	d_1	d_2	h
3					*d_2 and h dimensions identical d1 dimensions DIN 1441 ( )			3	6	1	3.2	20	1.25
3.5													
4	*1/8"							4	8	1	4.3	15/20/25	1.25
5	*3/16"				5 (5.5)	10	0.8				5.3	20/25/30	1.5
6					6(7)	12	1.6	6	12	1.2	6.4	20/25/30/35	1.5
7	*¼"				7(8)	14	1.6						
8	*5/16"				8(9)	16	2	8	14	1.2	8.4	20/25/30/35/40	1.5
10	*3/8"				10(11)	20	2.5	10	13	1.2	10.5	25/30/35/40	1.5
12	*7/16"	14	58	6	12(13)	25	3	12	18	1.2	12.5	30/35/40	1.5
	*½"												
14					14(15)	28	3	14	20	1.5			
15								15	21	1.5			
16	*5/8"	18	68	6	16(17)	28	3	16	22	1.5			
17								17	24	1.5			
18					18(19)	30	4	18	25	1.5			
20	*¾"	23	80	8	20(21)	32	4	20	28	2			
22	*7/8"	25	92	8	22(23)	34	4	22	30/32	2			
24		27	105	8	24(25)	38	4						
25								25	35/36	2			
26								26	37	2			
27	*1"				27(28)	40	5						
28								28	40	2			
30	*1 1/8"				30(31)	45	5	30	42	2.5			
33	*1 ¼"				33(34)	50	5						

Continued next page…

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 in 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 ¾”				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	

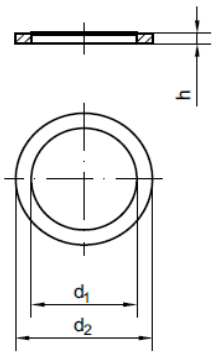
Square washers/taper washers



Norminal 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) 14%		
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						
	*½”	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	*¾”	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 ¼”	36	100	6												
36	*1 3/8”	39	110	8							37	68/68	12.5/3	37*	68/68	9.4/4
39	*1 ½”	42	125	8							**Marking:**					
42		45	135	8							DIN	Pitch	Groove qty:			
45	*1 ¾”	48	140	8							434	8%	2			
48		52	150	10							435	14%	1			
52	*2”	56	160	10							6917	14%	1			
											6918	8% / 5%	2/0 – “Form A			

Sealing washers (plain)

DIN 7603 A**

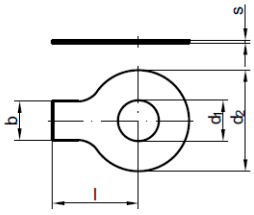


DIN	Dimensions	4x8	5x7.5	5x9*	5.5x8	6x10*	6.5x9.5	6.5x11*	8x11.5
	d_1	4.2	5.2	5.2	5.7	6.2	6.7	6.7	8.2
	d_2	7.9	7.4	8.9	8.9	9.9	9.4	10.9	11.4
	h	1	1	1	1	1	1	1	1
	Dimensions	**8x12***	**8x14**	**10x13.5**	**10x14**	**10x15**	**10x16**	**10x18**	**12x15.5**
	d_1	8.2	8.2	10.2	102	10.2	10.2	10.2	12.2
	d_2	11.9	13.9	13.4	13.9	14.9	15.9	17.9	15.4
	h	1/11.5	1	1	1/1.5	1	1	1.5	1.5
	Dimensions	**12x16**	**12x17***	**12x18***	**13x18***	**14x18**	**14x20**	**15x19**	**16x20**
	d_1	12.2	12.2	12.2	13.2	14.2	14.2	15.2	16.2
	d_2	15.9	16.9	17.9	17.9	17.9	19.9	18.9	19.9
	h	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Dimensions	**16x22***	**17x21**	**17x23***	**18x22**	**20x24**	**21x26**	**22x27**	**22x29***
	d_1	16.2	17.2	17.2	18.2	20.2	21.2	22.2	22.2
	d_2	21.9	20.9	22.9	21.9	23.9	25.9	26.9	28.9
	h	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Dimensions	**23x28**	**24x29**	**24x32**	**26x31**	**26x34***	**27x32**	**28x33**	**30x36**
	d_1	23.3	24.3	24.3	26.3	26.3	27.3	28.3	30.3
	d_2	27.9	28.9	31.9	30.9	33.9	31.9	32.9	35.9
	h	2	2	2	2	2	2	2	2
	Dimensions	**32x38**	**33x38**	**33x41***	**36x42**	**38x44**	**42x49**	**45x52**	**60x74**
	d_1	32.3	33.3	33.3	36.3	38.3	42.3	45.3	60.3
	d_2	37.9	37.9	40.9	41.9	43.9	48.9	51.9	73.9
	h	2	2	2	2	2	2	2	2

*) intermediate sizes not included in the standard.
**) material: Al operating temperature: 200°C
material: Cu operating temperature: 300°C

Retaining/lock washers and rings

DIN 93

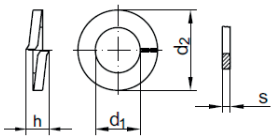


DIN	Dimensions	3.2	3.7	4.3	5.3	6.4	8.4	10.5	13
	d_2	12	12	14	17	19	22	26	30
	b	4	4	5	6	7	8	10	12
	l	13	13	14	16	18	20	22	28
	s	0.38	0.38	0.38	0.5	0.5	0.75	0.75	1
	for thread Ø	3	3.5	4	5	6	8	10	12
	Dimensions	**15**	**17**	**19**	**21**	**23**	**25**	**28**	**31**
	d_2	33	36	40	42	50	50	58	63
	b	12	15	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 Ø	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 Ø	33	36	39	42	45	48	52	

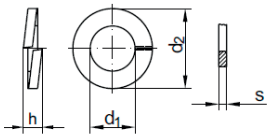
d1 = nominal size

Retaining/lock washers and rings

DIN 127 A



DIN 127 B

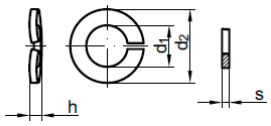


Dimensions	3	3.5	4	5	6	7	8	10
d_1	3.1	3.6	4.1	5.1	6.1	7.1	8.1	10.2
d_2	6.2	6.7	7.6	9.2	11.8	12.8	14.8	18.1
s	0.8	0.8	0.9	1.2	1.6	1.6	2	2.2
$h_{type\ A}$	1.9	1.9	2.1	2.7	3.6	3.6	4.6	5
$h_{type\ B}$	1.6	1.6	1.8	2.4	3.2	3.2	4	4.4

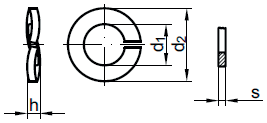
Dimensions	12	14	16	18	20	22	24	27
d_1	12.2	14.2	16.2	18.2	20.2	22.5	24.5	27.5
d_2	21.1	24.1	27.4	29.4	33.6	35.9	40	43
s	2.5	3	3.5	3.5	4	4	5	5
$h_{type\ A}$	5.8	6.8	7.8	7.8	8.8	8.8	11	11
$h_{type\ B}$	5	6	7	7	8	8	10	10

Dimensions	30	33	36	39	42	45	48	52
d_1	30.5	33.5	36.5	39.5	42.5	45.5	49	53
d_2	48.2	53.2	58.2	61.2	68.2	71.2	75	82
s	6	6	6	6	7	7	7	8
$h_{type\ A}$	13.6	13.6	13.6	13.6	15.6	15.6	15.6	18
$h_{type\ B}$	12	12	12	12	14	14	14	16

DIN 128 A



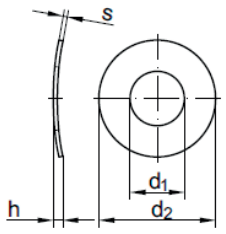
DIN 128 B



Dimensions	3	4	5	6	8	10	12	14
d_1	3.1	4.1	5.1	6.1	8.1	10.2	12.2	14.2
d_2	6.2	7.6	9.2	11.8	14.8	18.1	21.1	24.1
s	0.7	0.8	1	1.3	1.6	1.8	2.1	2.4
h	1.3	1.4	1.7	2.2	2.75	3.15	3.65	4.3

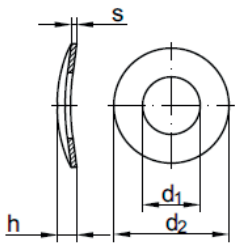
Dimensions	16	18	20	22	24	30	36	
d_1	16.2	18.2	20.2	22.5	24.5	30.5	35.5	
d_2	27.4	29.4	33.6	35.9	40	30.5	58.2	
s	2.8	2.8	3.2	3.2	4	6	33	
h	5.1	5.1	5.9	5.9	7.5	10.5	11.3	

DIN 137 A



Dimensions	2	2.3	2.6	3	3.5	4	5	6	7	8	10
d_1	2.2	2.5	2.8	3.2	3.7	4.3	5.3	6.4	7.4	8.4	10.5
d_2	4.5	5	5.5	6	7	8	10	11	12	15	18
s	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.8
h	1	1	1.1	1.3	1.4	1.6	1.8	2.2	2.4	3.4	4

DIN 137 B



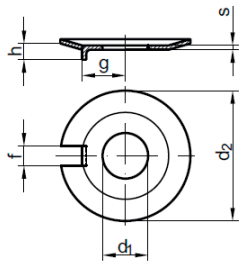
Dimensions	3	3.5	4	5	6	7	8	10
d_1	3.2	3.7	4.3	5.3	6.4	7.4	8.4	10.5
d_2	8	8	9	11	12	14	15	21
s	0.5	0.5	0.5	0.5	0.5	0.8	0.8	1
h	1.6	1.8	2	2.2	2.6	3	3	4.2

Dimensions	12	14	16	18	20	22	24	27
d_1	13	15	17	19	21	23	25	28
d_2	24	28	30	34	36	40	44	50
s	1.2	1.6	1.6	1.6	1.6	1.8	1.8	2
h	5	6	6.4	6.6	7.4	7.8	8.2	9.4

Dimensions	30	33	36	42	45	48	52	
d_1	31	34	37	43	46	50	54	
d_2	56	60	68	78	85	92	98	
s	2.2	2.2	2.5	3	3	3.5	3.5	
h	10	10.6	11.6	13.6	14.2	15.6	16.4	

Retaining/lock washers and rings

DIN 432



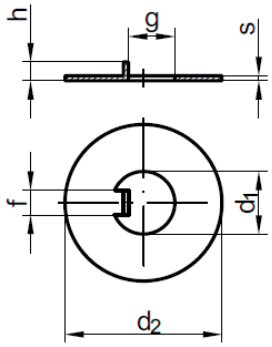
Dimensions	3.2	3.7	4.3	5.3	6.4	8.4	10.5	13	15
d_2	12	12	14	17	19	22	26	30	33
f	2.5	2.5	2.5	3.5	3.5	3.5	4.5	4.5	4.5
g	4.5	4.5	5.5	7	7.5	8.5	10	12	13
h ≈	2	2	2	2.5	3	4	4	4.5	4.5
s	0.4	0.4	0.4	0.75	0.75	1	1	1.2	1.2

Dimensions	17	19	21	23	25	28	31	34	37
d_2	36	40	42	50	50	58	63	68	75
f	5.5	6.5	6.5	7.5	7.5	8.5	8.5	9.5	11
g	15	18	18	20	21	23	25	28	31
h ≈	4.5	4.5	4.5	6.5	6.5	9.5	9.5	9.5	9.5
s	1.2	1.2	1.6	1.6	1.6	1.6	1.6	1.6	2

Dimensions	40	43	46	50	54	58	62	66	104
d_2	82	88	95	100	105	112	118	125	185
f	11	11	13	13	13	16	16	18	23
g	33	36	38	40	42	45	48	52	80
h ≈	11	11	12	13	13	14	13.5	13.5	15.5
s	2	2	2	2	2	2.5	2.5	2.5	2.5

d1 = nominal size

DIN 462



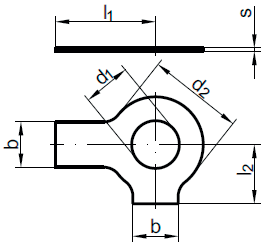
Dimensions	8	10	14	16	18	20	22	24	28	30
d_2	20	25	30	32	34	36	40	42	50	50
s	0.8	0.8	0.8	11	1	1	1	1	1	1.2
f	3	4	5	5	6	6	6	6	7	7
g	5.9	7.4	11.4	13.5	15.4	17.5	19.5	21.6	25.5	27.5
h	2.5	3	3	3	4	4	4	4	5	5

Dimensions	32	35	38	40	42	45	48	50	52	55
d_2	52	55	58	62	62	68	75	75	80	80
s	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
f	7	7	8	8	8	8	8	8	10	10
g	29.6	32.6	35.3	37.3	39.3	42.4	45.4	47.4	49.3	52.3
h	5	5	5	5	5	5	5	5	6	6

Dimensions	58	60	62	65	70	75	80	85	95	100
d_2	90	90	95	95	100	110	115	120	135	145
s	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
f	10	10	10	10	10	10	10	10	12	12
g	55.3	57.3	59.3	62.4	67.4	71.9	76.9	81.9	91.8	96.9
h	6	6	6	6	6	7	7	7	8	8

d1 = nominal size

DIN 463



Dimensions	3.2	3.7	4.3	5.3	6.4	8.4	10.5	13
d_2	7	8	9	10	12.5	17	21	24
b	4	4	5	6	7	8	10	12
l_1	13	13	14	16	18	20	22	28
l_2	5	5.5	6.5	8	9	11	13	15
s	0.38	0.38	0.38	0.5	0.5	0.75	0.75	1
for thread Ø	3	3.5	4	5	6	8	10	12

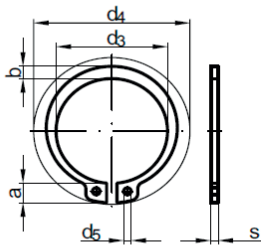
Dimensions	15	17	19	21	23	25	28	31
d_2	28	30	34	37	39	44	50	56
b	12	15	18	18	20	20	23	26
l_1	28	32	36	36	42	42	48	52
l_2	16	18	20	21	23	25	29	32
s	1	1	1	1	1	1	1.6	1.6
for thread Ø	14	16	18	20	22	24	27	30

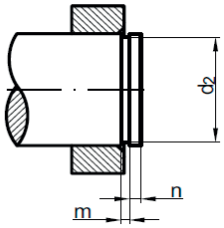
Dimensions	34	37	40	43	46	50	54	
d_2	60	66	72	78	85	92	98	
b	28	30	32	35	38	40	44	
l_1	56	60	64	70	75	80	85	
l_2	34	38	41	44	48	50	53	
s	1.6	1.6	1.6	1.6	1.6	1.6	1.6	
for thread Ø	33	36	39	42	45	48	52	

d1 = nominal size

Retaining/lock washers and rings

DIN 471
normal type





nominal size = for shafts Ø
*intermediate sizes not included in the standard

Dimensions	3	4	5	6	7	8	9	10	11	12	13
s	0.4	0.4	0.6	0.7	0.8	0.8	1	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	11.9
a	1.9	2.2	2.5	2.7	3.1	3.2	3.3	3.3	3.3	3.3	3.4
b	0.8	0.9	1.1	1.3	1.4	1.5	1.7	1.8	1.8	1.8	2
d_5	1	1	1	1.2	1.2	1.2	1.2	1.5	1.5	1.7	1.7
d_2	2.8	3.8	4.8	5.7	6.7	7.6	8.6	9.6	10.5	11.5	12.4
m	0.5	0.5	0.7	0.8	0.9	0.9	1.1	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	0.9
d_4	7	8.6	10.3	11.7	13.5	14.7	16	17	18	19	20.2

Dimensions	14	15	16	17	18	19	20	21	22	23*	24
s	1	1	1	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2
d_3	12.9	13.8	14.7	15.7	16.5	17.5	18.5	19.5	20.5	21.5	22.2
a	3.5	3.6	3.7	3.8	3.9	3.9	4	4.1	4.2	4.3	4.4
b	2.1	2.2	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3
d_5	1.7	1.7	1.7	1.7	2	2	2	2	2	2	2
d_2	13.4	14.3	15.2	16.2	17	18	19	20	21	22	22.9
m	1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3
n	0.9	1.1	1.2	1.2	1.5	1.5	1.5	1.5	1.5	1.5	1.7
d_4	21.4	22.6	23.8	25	26.2	27.2	28.4	29.6	30.8	-	33.2

Dimensions	25	26	27*	28	29	30	31*	32	33*	34	35
s	1.2	1.2	1.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
d_3	23.2	24.2	24.9	25.9	26.9	27.9	28.6	29.6	30.5	31.5	32.2
a	4.4	4.5	4.6	4.7	4.8	5	5.1	5.2	5.2	5.4	5.6
b	3	3.1	3.1	3.2	3.4	3.5	3.5	3.6	3.7	3.8	3.9
d_5	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
d_2	23.9	24.9	25.6	26.6	27.6	28.6	29.3	30.3	31.3	32.3	33
m	1.3	1.3	1.3	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
n	1.7	1.7	2.1	2.1	2.1	2.1	2.6	2.6	2.6	2.6	3
d_4	34.2	35.5	-	37.9	39.1	40.5	-	43	-	45.4	46.8

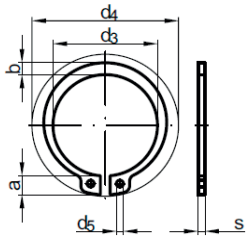
Dimensions	36	37*	38	39*	40	41*	42	44*	45	46*	47*
s	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
d_3	33.2	34.2	35.2	36	36.5	37.5	38.5	40.5	41.5	42.5	43.5
a	5.6	5.7	5.8	5.9	6	6.2	6.5	6.6	6.7	6.7	6.8
b	4	4.1	4.2	4.3	4.4	4.5	4.5	4.6	4.7	4.8	4.9
d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d_2	34	35	36	37	37.5	38.5	39.5	41.5	42.5	43.5	44.5
m	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85
n	3	3	3	3	3.8	3.8	3.8	3.8	3.8	3.8	3.8
d_4	47.8	-	50.2	-	52.6	-	55.7	-	59.1	-	-

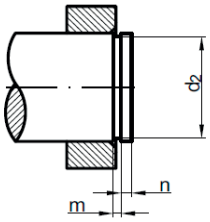
Dimensions	48	50	52	54*	55	56	57*	58	60	62	63
s	1.75	2	2	2	2	2	2	2	2	2	2
d_3	44.5	45.8	47.8	49.8	50.8	51.8	52.8	53.8	55.8	57.8	58.8
a	6.9	6.9	7	7.1	7.2	7.3	7.3	7.3	7.4	7.5	7.6
b	5	5.1	5.2	5.3	5.4	5.5	5.5	5.6	5.8	6	6.2
d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d_2	45.5	47	49	51	52	53	54	55	57	59	60
m	1.85	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
n	3.8	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
d_4	62.5	64.5	66.7	-	70.2	71.6	-	73.6	75.6	77.8	79

Dimensions	65	67*	68	70	72	75	77*	78	80	82	85
s	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3
d_3	60.8	62.5	63.5	65.5	67.5	70.5	72.5	73.5	74.5	76.5	79.5
a	7.8	7.9	8	8.1	8.2	8.4	8.5	8.6	8.6	8.7	8.7
b	6.3	6.4	6.5	6.6	6.8	7	7.2	7.3	7.4	7.6	7.8
d_5	3	3	3	3	3	3	3	3	3	3	3.5
d_2	62	64	65	67	69	72	74	75	76.5	78.5	81.5
m	2.65	2.65	2.65	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	4.5	4.5	4.5	5.3	5.3	5.3
d_4	81.4	-	84.8	87	89.2	92.7	-	96.1	98.1	100.3	103.3

Continued next page…

471
normal type

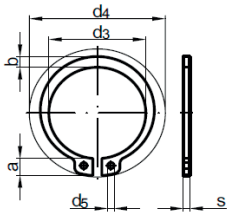


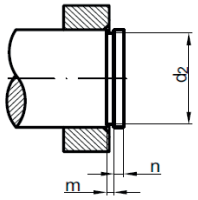


DIN	Dimensions	87*	88	90	92*	95	97*	98*	100	102*	105	107*
	s	3	3	3	3	3	3	3	3	4	4	4
	d_3	81.5	82.5	84.5	86.5	89.5	91.5	91.5	94.5	95	98	100
	a	8.8	8.8	8.8	9	9.4	9.4	9.4	9.6	9.7	9.9	10
	b	7.9	8	8.2	8.4	8.6	8.8	8.8	9	9.2	9.3	9.5
	d_5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	d_2	83.5	84.5	86.5	88.5	91.5	93.5	94.5	96.5	98	101	103
	m	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	4.15	4.15	4.15
	n	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	6	6	6
	d_4	-	106.5	108.5	-	114.8	-	-	120.2	-	125.8	-
	Dimensions	**108***	**110**	**112***	**115**	**117***	**118***	**120**	**122***	**125**	**127***	**128***
	s	4	4	4	4	4	4	4	4	4	4	4
	d_3	100	103	105	108	110	110	113	115	118	120	120
	a	10	10.1	103	106	10.8	10.8	11	11.2	11.4	11.4	11.4
	b	9.5	9.6	9.7	9.8	10	10	10.2	10.3	10.4	10.5	10.5
	d_5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4
	d_2	104	106	108	111	113	114	116	118	121	123	124
	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	-	131.2	-	-	-	-	143.1	-	149	-	-
	Dimensions	**130**	**132***	**135**	**137***	**138***	**140**	**142***	**145**	**147***	**148***	**150**
	s	4	4	4	4	4	4	4	4	4	4	4
	d_3	123	125	128	130	130	133	135	138	140	140	142
	a	11.6	11.7	11.8	11.9	11.9	12	12.1	12.2	12.3	12.3	13
	b	10.7	10.8	11	11	11	11.2	11.3	11.5	11.6	11.6	11.8
	d_5	4	4	4	4	4	4	4	4	4	4	4
	d_2	126	128	131	133	134	136	138	141	143	144	145
	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	7.5
	d_4	154.4	-	159.8	-	-	165.2	-	170.6	-	-	177.3
	Dimensions	**155**	**160**	**165**	**168***	**170**	**175**	**180**	**185**	**190**	**195**	**200**
	s	4	4	4	4	4	4	4	4	4	4	4
	d_3	146	151	155.5	157.5	160.5	165.5	170.5	175.5	180.5	185.5	190.5
	a	13	13.3	13.5	13.5	13.5	13.5	14.2	14.2	14.2	14.2	14.2
	b	12	12.2	12.5	12.9	12.9	12.9	13.5	13.5	14	14	14
	d_5	4	4	4	4	4	4	4	4	4	4	4
	d_2	150	155	160	163	165	170	175	180	185	190	195
	m	4.15	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	7.5
	d_4	182.3	188	193.4	-	198.4	203.4	210	215	220	225	230
	Dimensions	**210**	**215***	**220**	**230**	**240**	**250**	**260**	**270**	**280**	**290**	**300**
	s	5	5	5	5	5	5	5	5	5	5	5
	d_3	198	203	208	218	228	238	245	255	265	275	285
	a	14.2	14.2	14.2	14.2	14.2	14.2	16.2	16.2	16.2	16.2	16.2
	b	14	14	14	14	14	14	16	16	16	16	16
	d_5	4	4	4	4	4	4	5	5	5	5	5
	d_2	204	209	214	224	234	244	252	262	272	282	292
	m	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15
	n	9	9	9	9	9	9	12	12	12	12	12
	d_4	240	-	250	260	270	280	294	304	314	324	334

nominal size = for shafts Ø
*intermediate sizes not included in the standard.

471
heavy type



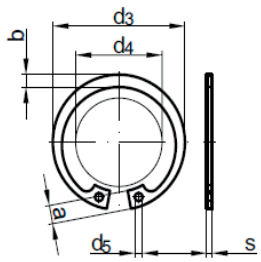


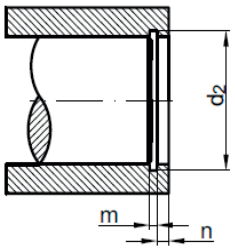
nominal size = for shafts Ø

DIN	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	23.5	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	

Retaining/lock washers and rings

472 normal type





nominal size = bore Ø
*intermediate sizes not included in the standard

DIN	Dimensions	8	9	10	11	12	13	14	15	16	17	18
	s	0.8	0.8	1	1	1	1	1	1	1	1	1
	d_3	8.7	9.8	10.8	11.8	13	14.1	15.1	16.2	17.3	18.3	19.5
	a	2.4	2.5	3.2	3.3	3.4	3.6	3.7	3.7	3.8	3.9	4.1
	b	1.1	1.3	1.4	1.5	1.7	1.8	1.9	2	2	2.1	2.2
	d_5	1	1	1.2	1.2	1.5	1.5	1.7	1.7	1.7	1.7	2
	d_2	8.4	9.4	10.4	11.4	12.5	13.6	14.6	15.7	16.8	17.8	19
	m	0.9	0.9	1.1	1.1	1.1	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	1.2	1.2	1.5
	d_4	3	3.7	3.3	4.1	4.9	5.4	6.2	7.2	8	8.8	9.4

	Dimensions	19	20	21	22	23*	24	25	26	27*	28	29*
	s	1	1	1	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	d_3	20.5	21.5	22.5	23.5	24.6	25.9	26.9	27.9	29.1	30.1	31.1
	a	4.1	4.2	4.2	4.2	4.2	4.4	4.5	4.7	4.7	4.8	4.8
	b	2.2	2.3	2.4	2.5	2.5	2.6	2.7	2.8	2.9	2.9	3
	d_5	2	2	2	2	2	2	2	2	2	2	2
	d_2	20	21	22	23	24.1	25.2	26.2	27.2	28.4	29.4	30.4
	m	1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	n	1.5	1.5	1.5	1.5	1.7	1.8	1.8	1.8	2.1	2.1	2.1
	d_4	10.4	11.2	12.2	13.2	-	14.8	15.5	16.1	-	17.9	-

	Dimensions	30	31	32	33*	34	35	36	37	38	39*	40
	s	1.2	1.2	1.2	1.2	1.5	1.5	1.5	1.5	1.5	1.5	1.75
	d_3	32.1	33.4	34.4	35.5	36.5	37.8	38.8	39.8	40.8	42	43.5
	a	4.8	5.2	5.4	5.4	5.4	5.4	5.4	5.5	5.5	5.6	5.8
	b	3	3.2	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.8	3.9
	d_5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	d_2	31.4	32.7	33.7	34.7	35.7	37	38	39	40	41	42.5
	m	1.3	1.3	1.3	1.3	1.6	1.6	1.6	1.6	1.6	1.6	1.85
	n	2.1	2.6	2.6	2.6	2.6	3	3	3	3	3	3.8
	d_4	19.9	20	20.6	-	22.6	23.6	24.6	25.4	26.4	-	37.8

	Dimensions	41*	42	44*	45	46*	47	48	50	51*	52	53*
	s	1.75	1.75	1.75	1.75	1.75	1.75	1.75	2	2	2	2
	d_3	44.5	45.5	47.5	48.5	49.5	50.5	51.5	54.2	55.2	56.2	57.2
	a	5.9	5.9	6	6.2	6.3	6.4	6.4	6.5	6.5	6.7	6.7
	b	4	4.1	4.2	4.3	4.4	4.4	4.5	4.6	4.7	4.7	4.9
	d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	d_2	43.5	44.5	46.5	47.5	48.5	49.5	50.5	53	54	55	56
	m	1.85	1.85	1.85	1.85	1.85	1.85	1.85	2.15	2.15	2.15	2.15
	n	3.8	3.8	3.8	3.8	3.8	3.8	3.8	4.5	4.5	4.5	4.5
	d_4	-	29.6	-	32	-	33.5	34.5	36.3	-	37.9	-

	Dimensions	54*	55	56	57*	58	60	62	63	64*	65	67*
	s	2	2	2	2	2	2	2	2	2	2.5	2.5
	d_3	58.2	59.2	60.2	61.2	62.2	64.2	66.2	67.2	68.2	669.2	71.5
	a	6.7	6.8	6.8	6.8	6.9	7.3	7.3	7.3	7.4	7.6	7.7
	b	5	5	5.1	5.1	5.2	5.4	5.5	5.6	5.7	5.8	6
	d_5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3
	d_2	57	58	59	60	61	63	65	66	67	68	70
	m	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	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	4.5
	d_4	-	40.7	41.7	-	43.5	44.7	46.7	47.7	-	49	-

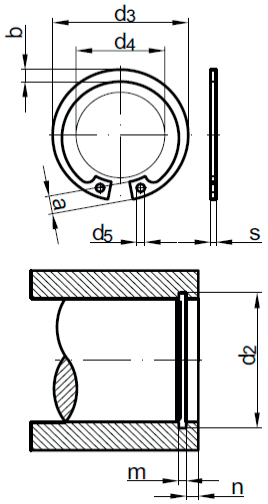
	Dimensions	68	70	72	75	77*	78	80	82	85	88	90
	s	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3
	d_3	72.5	74.5	76.5	79.5	82.5	82.5	85.5	87.5	90.5	93.5	95.5
	a	7.8	7.8	7.8	7.8	8.5	8.5	8.5	8.5	8.6	8.6	8.6
	b	6.1	6.2	6.4	6.6	6.8	6.8	7	7	7.2	7.4	7.6
	d_5	3	3	3	3	3	3	3	3	3.5	3.5	3.5
	d_2	71	73	75	78	80	81	83.5	85.5	88.5	91.5	93.5
	m	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	3.15	3.15	3.15
	n	4.5	4.5	4.5	4.5	4.5	4.5	5.3	5.3	5.3	5.3	5.3
	d_4	51.6	53.6	55.6	58.6	-	60.1	62.1	64.1	66.9	69.9	71.9

	Dimensions	92	95	97*	98	100	102	105	108	110	112	115
	s	3	3	3	3	3	4	4	4	4	4	4
	d_3	97.5	100.5	103.5	103.5	105.5	108	112	115	117	119	122
	a	8.7	8.8	9	9	9.2	9.5	9.5	9.5	10.4	10.5	10.5
	b	7.8	8.1	58.3	8.3	8.4	8.5	8.7	8.9	9	9.1	9.3
	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	95.5	98.5	100.5	101.5	103.5	106	109	112	114	116	119
	m	3.15	3.15	3.15	3.15	3.15	4.15	4.15	4.15	4.15	4.15	4.15
	n	5.3	5.3	5.3	5.3	5.3	6	6	6	6	6	6
	d_4	73.7	76.5	-	79	80.6	82	85	88	88.2	90	93

Continued next page…

Retaining/lock washers and rings

472 normal type



DIN	Dimensions	118*	120	122*	125	128*	130	132*	135	138*	140
	s	4	4	4	4	4	4	4	4	4	4
	d_3	125	127	129	132	135	137	139	142	145	147
	a	10.7	11	11	11	11	11	11	11.2	11.2	11.2
	b	9.6	9.7	9.8	10	10.2	10.2	10.3	10.5	10.6	10.7
	d_5	3.5	3.5	4	4	4	4	4	4	4	4
	d_2	122	124	126	129	132	134	136	139	142	144
	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	-	96.9	-	101.9	-	106.9	-	111.5	-	116.5

Dimensions	142*	145	148*	150	152*	155	160	165	168*	170
s	4	4	4	4	4	4	4	4	4	4
d_3	149	152	155	158	161	164	169	174.5	177.5	179.5
a	11.3	11.4	11.8	12	12	12	13	13	13.5	13.5
b	10.8	10.9	11.1	11.2	11.3	11.4	11.6	11.8	12.1	12.2
d_5	4	4	4	4	4	4	4	4	4	4
d_2	146	149	152	155	157	160	165	170	173	175
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	7.5	7.5	7.5	7.5	7.5	7.5	7.5
d_4	-	121	-	124.8	-	129.8	132.7	137.7	-	141.6

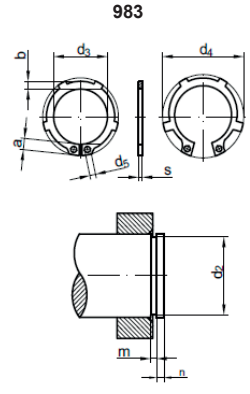
Dimensions	175	180	185	190	195	200	205*	210	215*	220
s	4	4	4	4	4	4	5	5	5	5
d_3	184.5	189.5	194.5	199.5	204.5	209.5	217	222	227	232
a	13.5	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
b	12.7	13.2	13.7	13.8	13.8	14	14	14	14	14
d_5	4	4	4	4	4	4	4	4	4	4
d_2	180	185	190	195	200	205	211	216	221	226
m	4.15	4.15	4.15	4.15	4.15	4.15	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
d_4	146.6	150.2	155.2	160.2	165.2	170.2	-	180.2	-	190.2

Dimensions	225*	230	235*	240	245*	250	255*	260	265*	270
s	5	5	5	5	5	5	5	5	5	5
d_3	237	242	247	252	257	262	270	275	280	285
a	14.2	14.2	14.2	14.2	14.2	14.2	16.2	16.2	16.2	16.2
b	14	14	14	14	14	14	16	16	16	16
d_5	4	4	4	4	4	4	5	5	5	5
d_2	231	236	241	246	251	256	263	268	273	278
m	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15	5.15
n	9	9	9	9	9	9	12	12	12	12
d_4	-	200.2	-	210.2	-	220.2	-	226	-	236

Dimensions	275*	280	285*	290	295*	300	310*	320*	340*	360*
s	5	5	5	5	5	5	6	6	6	6
d_3	290	295	300	305	310	315	327	337	357	377
a	16.2	16.2	16.2	16.2	16.2	16.2	-	-	-	-
b	16	16	16	16	16	16	20	20	20	20
d_5	5	5	5	5	5	5	6	6	6	6
d_2	283	288	293	298	303	308	320	330	350	370
m	5.15	5.15	5.15	5.15	5.15	5.15	3.2	6.2	6.20	6.2
n	12	12	12	12	12	12	15	15	15	15
d_4	-	246	-	256	-	266	-	-	-	-

nominal size = bore Ø
*intermediate sizes not included in the standard

983

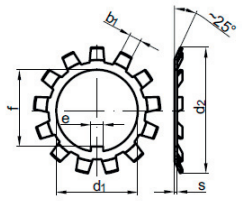


DIN	Dimensions	20	25	30	35	40	45	50
	s	1.2	1.2	1.5	1.5	1.75	1.75	2
	d_3	18.5	23.2	27.9	32.2	36.5	41.5	45.8
	a	3.8	4.3	4.7	5.2	7.2	7.2	8.2
	b	2.6	3	3.5	3.9	4.4	4.7	5.1
	d_5	2	2	2	2.5	2.5	2.5	2.5
	d_2	19	23.9	28.6	33	37.5	42.5	47
	m	1.3	1.3	1.6	1.6	1.85	1.85	2.15
	n	1.5	1.7	2.1	3	3.8	3.8	4.5
	d_4	28	34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

nominal size = for shafts Ø

Retaining/lock washers and rings

5406



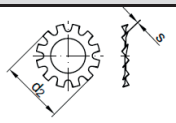
DIN	Dimensions	MB 0	MB 1	MB 2	MB 3	MB 4	MB 5	MB 7	MB 7
	d_1	10	12	15	17	20	25	30	35
	d_2	21	25	28	32	36	42	49	57
	e	3	3	4	4	4	5	5	6
	f	8.5	10.5	13.5	15.5	18.5	23	27.5	32.5
	b_1	3	3	4	4	4	5	5	5
	s	1	1	1	1	1	1.25	1.25	1.25
	for locknut DIN 981	KM 0	KM 1	KM 2	KM 3	KM 4	KM 5	KM 6	KM 7

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

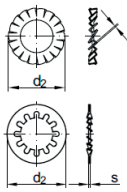
Dimensions	MB 16	MB 17	MB 18	MB 19	MB 20	MB 21	MB 22	MB 23
d_1	80	85	90	95	100	105	110	115
d_2	112	119	126	133	142	145	154	159
e	10	10	10	10	12	12	12	12
f	76.5	81.5	86.5	91.5	96.5	100.5	105.5	110.5
b_1	8	8	10	10	10	12	12	12
s	1.75	1.75	1.75	1.75	1.75	1.75	1.75	2
for locknut DIN 981	KM 16	KM 17	KM 18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

6797 A*
6798 A**



6797 I*
6798 I**



*) h≥2xs
**)h≈3xs

DIN	Dimensions	2.2	2.7	3.2	3.7	4.3	5.3	6.4	7.4	8.4	10.5
6797 A* 6798 A**	d_2	4.5	5.5	6	7	8	10	11	12.5	15	18
	s	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.8	0.9
	for thread Ø	2	2.5	3	3.5	4	5	6	7	8	10

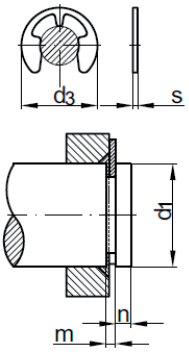
Dimensions	13	15	17	19	21	23	25	28	31	
d_2	20.5	24	26	30	33	36	38	44	48	
s	1	1	1.2	1.4	1.4	1.5	1.5	1.6	1.6	
for thread Ø	12	14	16	18	20	22	24	27	30	

DIN	Dimensions	3.2	3.7	4.3	5.3	6.4	8.4	10.5	13
6797 V * 6798 V **	d_2	6	7	8	9.8	11.8	15.3	19	23
	s	0.2	0.25	0.25	0.3	0.4	0.4	0.5	0.5
	for thread Ø	3	3.5	4	5	6	8	10	12

*) h≥2xs
**) h≈3xs

Retaining/lock washers and rings

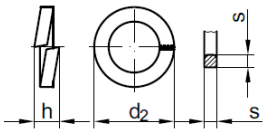
DIN 6799



Dimensions	0.8	1.2	1.5	1.9	2.3	3.2	4	5	6
d_3	2.25	3.25	4.25	4.8	6.3	7.3	9.3	11.3	12.3
s	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.7	0.7
for shafts Ød1	1 - 1.4	1.4 - 2	2 – 2.5	2.5 – 3	3 – 4	4 – 5	5 – 7	6 – 8	7 - 9
m	0.24	0.34	0.44	0.54	0.64	0.64	0.74	0.74	0.74
n	0.4	0.6	0.8	1	1	1	1.2	1.2	1.2

Dimensions	7	8	9	10	12	15	19	24	
d_3	14.3	16.3	18.8	20.4	23.4	29.4	37.6	44.6	
s	0.9	1	1.1	1.2	1.3	1.5	1.75	2	
for shafts Ød1	8 - 11	9 – 12	10 – 14	11 - 15	13 – 18	16 – 24	20 - 31	25 – 38	
m	0.94	1.05	1.15	1.25	1.35	1.55	1.80	2.05	
n	1.5	1.8	2	2	2.5	3	3.5	4	

DIN 7980

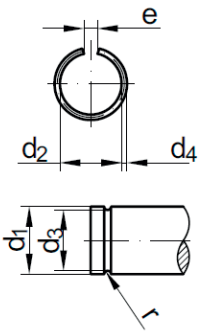


Dimensions	3	4	5	6	8	10	12
d_2	5.6	7	8.8	9.9	12.7	16	18
s	1	1.2	1.6	1.6	2	2.5	2.5
h	2	2.4	3.2	3.2	4	5	5
for thread Ø	3	4	5	6	8	10	12

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 Ø	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 Ø	30	33	36	42	48		

DIN 7993A



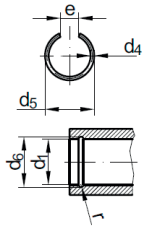
Dimensions	4	5	6	7	8	10	12
d_2	3.1	4.1	5.1	6.1	7.1	9.1	10.8
d_4	0.8	0.8	0.8	0.8	0.8	0.8	1
e	1	1	1	2	2	2	3
for shafts Ø d1	4	55	6	7	8	10	12
Ø d_3	3.2	4.2	5.2	6.2	7.2	9.2	11
r	0.5	0.5	0.5	0.5	0.5	0.5	0.6

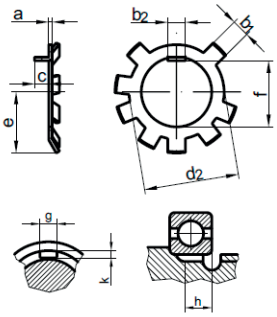
Dimensions	16	18	20	22	25	26	28
d_2	14.2	16.2	17.7	19.7	22.7	23.7	25.7
d_4	1.6	1.6	2	2	2	2	2
e	3	3	3	3	3	3	3
for shafts Ø d1	16	18	20	22	25	26	28
Ø d_3	14	16.4	18	20	23	24	26
r	0.9	0.9	1.1	1.1	1.1	1.1	1.1

Dimensions	30	35	38	40	45	48	50
d_2	27.7	32.1	35.1	37.1	42	45	47
d_4	2	2.5	2.5	2.5	2.5	2.5	2.5
e	3	4	4	4	4	4	4
for shafts Ø d1	30	35	38	40	45	48	50
Ø d_3	28	32.5	35.5	37.5	42.5	45.5	47.5
r	1.1	1.4	1.4	1.4	1.4	1.4	1.4

Dimensions	55	60	65	70			
d_2	51.1	56.1	61.1	66			
d_4	3.2	3.2	3.2	3.2			
e	4	4	4	5			
for shafts Ø d1	55	60	65	70			
Ø d_3	51.8	56.8	61.8	66.8			
r	1.8	1.8	1.8	1.8			

Retaining/lock washers and rings

DIN	Dimensions	10	12	16	18
7993 B 	d_4	0.8	1	1.6	1.6
	d_5	10.9	13.2	17.8	19.8
	e	4	6	8	8
	for bore Ø d_1	10	12	16	18
	Ø d_6	10.8	13	17.6	19.6
	r	0.5	0.06	0.9	0.9

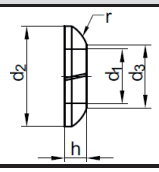
DIN	Dimensions	10	12	14	16	18	20	22	24
70952 A 	a	0.75	0.75	0.75	1	1	1	1	1
	b_1	4	4	4	5	5	5	6	6
	b_2	4	4	5	5	5	5	6	6
	c	3	3	3	3	4	4	4	4
	d_2	16	18	20	23	25	27	30	32
	e	11	12	13	14.5	16.5	17.5	19	20
	f	8.9	10.9	12.9	14.9	16.9	18.9	20.9	22.9
	g shaft*	4	4	5	5	5	5	6	6
	h shaft	3	3	3	3	4	4	4	4
	k shaft	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

Dimensions	26	28	30	32	35	38	40	42
a	1	1	1.2	1.2	1.2	1.2	1.2	1.2
b_1	6	6	6	6	6	6	6	7
b_2	6	7	7	7	7	8	8	8
c	5	5	5	5	5	5	5	5
d_2	34	36	38	41	43	47	49	52
e	22	23	24	25.5	26.5	28.5	29.5	31
f	24.9	26.9	28.9	30.9	33.9	36.6	38.6	40.6
g shaft*	6	7	7	7	7	8	8	8
h shaft	5	5	5	5	5	5	5	5
k shaft	1.2	1.5	1.5	1.5	1.5	1.5	1.5	1.2

Dimensions	45	48	50	52	55	60	65	70
a	1.2	1.2	1.2	1.2	1.2	1.5	1.5	1.5
b_1	7	7	7	7	7	10	10	10
b_2	8	8	8	8	10	10	10	10
c	5	5	5	6	6	6	6	6
d_2	54	57	60	62	67	71	86	81
e	32	33.5	35	37	39.5	41.5	44	46.5
f	43.6	46.7	48.7	50.7	53.7	58.7	63.7	68.7
g shaft*	8	8	8	8	10	10	10	10
h shaft	5	5	5	6	6	6	6	6
k shaft	1.5	1.5	1.5	1.5	1.5	2	2	2

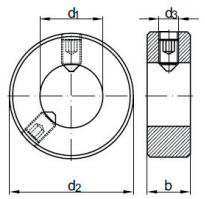
Dimensions	75	80	90	100	115	120	130	
a	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
b_1	10	10	10	10	11	11	11	
b_2	10	10	10	12	12	12	12	
c	7	7	7	8	8	8	10	
d_2	86	91	103	116	133	138	148	
e	50	52.5	58.5	66	74.5	77	84	
f	73.2	78.2	88.2	98.2	113.3	118.3	128.3	
g shaft*	10	10	10	12	12	12	12	
h shaft	7	7	7	8	8	8	10	
k shaft	2	2	2	2	2	2	2	

*tolerance C11 on the shaft

DIN	Dimensions	12.5	14.5	16.5	18.5	20.5	22.5
74361 C 	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

Adjusting rings

DIN 703



Dimensions	20	24	25	26	28	30	32	34
d_2	40	56	56	56	63	63	63	70
d_3	M 10	M 10	M 10	M 10	M 10	M 10	M 10	M 10
b	20	22	22	22	22	22	22	22
set screw *	M 10x15	M 10x15	M 10x15	M 10x15	M 10x15	M 10x15	M 10x15	M 10x15

Dimensions	35	36	38	40	42	45	48	50
d_2	70	70	70	80	80	80	80	80
d_3	M 10	M 10	M 10	M 12	M 12	M 12	M 12	M 12
b	22	22	22	28	28	28	28	28
set screw *	M 10x15	M 10x15	M 10x15	M 12x20	M 12x20	M 12x20	M 12x20	M 12x20

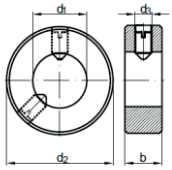
Dimensions	52	55	56	58	60	63	65	68
d_2	90	90	90	100	100	100	100	110
d_3	M 12	M 12	M 12	M 12	M 12	M 12	M 12	M 16
b	28	28	28	28	28	28	28	32
set screw *	M 12x20	M 12x20	M 12x20	M 12x20	M 12x20	M 12x20	M 12x20	M 16x20

Dimensions	70	72	75	80	85	90	95	100
d_2	110	110	110	125	125	125	140	140
d_3	M 16	M 16	M 16	M 16	M 16	M 16	M 16	M 16
b	32	32	32	32	32	32	32	32
set screw *	M 16x20	M 16x20	M 16x20	M 16x20	M 16x20	M 16x20	M 16x25	M 16x25

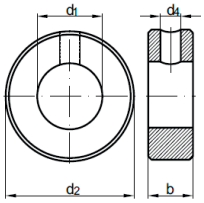
Dimensions	110	120	125	130	140	150		
d_2	160	160	180	180	200	200		
d_3	M 16	M 16	M 16	M 16	M 20x2	M 20x2		
b	32	32	36	36	38	38		
set screw *	M 16x25	M 16x25	M 16x30	M 16x30	M 20x30	M 20x30		

*d_1≤65 :one set screw with slot
**d_1≥68: two set screw with hexagon socket

DIN 705 A



DIN 705 B



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 set screw [1]	M2.5x3	M3x4	M4x5	M4x6	M4x6	M5x8	M6x8	M6x8	M6x8
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 set screw [1]	M6x8	M6x8	M6x8	M6x8	M6x8	M6x10	M8x12	M8x10	M8x10
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 set screw [1]	M8x12	M8x10	M8x12	M8x12	M8x12	M8x12	M8x12	M10x16	M10x16
B for pins [2]	6x45	6x45	8x50	8x50	8x55	8x55	8x55	8x60	8x60

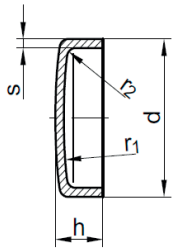
Dimensions	45	50	55	60	65	70	75	80	85
b	18	18	18	20	20	20	22	22	22
d_2	70	80	80	90	100	100	110	110	125
d_3	M 10	M 10	M 10	M 10	M 10	M 10	M 12	M 12	M 12
d_4	8	10	10	10	10	10	10	10	12
A with set screw [1]	M10x16	M10x16	M10x16	M10x16	M10x20	M10x20	M12x20	M12x20	M12x25
B for pins [2]	8x70	10x80	10x80	10x90	10x100	10x100	10x100	10x110	12x120

Dimensions	90	100	110	120	125	130	140		
b	22	25	225	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 set screw [1]	M12x20	M12x25	M12x30	M12x25	M16x35	M16x35	M16x35		
B for pins [2]	12x120	12x140	12x160	12x160	16x180	16x180	16x200		

A=with set screws
B=with drilling for grooved or tapper pins
1)d1 ≤70 a set screw with slot
2)d1≥75 a set screw with hexagon socket

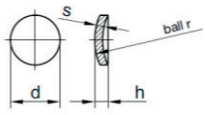
Special Forms

DIN (ISO)	Dimensions	8	10	12	14	16	18	20	22
443 (7094)	h	3	3	4	5	5	6	6	7
	r_1	20	25	30	35	40	45	50	55
	r_2	1	1	1	1	1	1	1	1.6
	s	0.75	0.75	1	1	1	1	1	1.6
	Dimensions	**25**	**28**	**30**	**32**	**34**	**36**	**38**	**40**
	h	8	9	9	10	10	11	12	12
	r_1	60	70	75	80	85	90	95	100
	r_2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	s	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	Dimensions	**42**	**45**	**48**	**50**	**52**	**56**	**60**	**63**
	h	13	14	15	15	16	17	18	19
	r_1	105	110	120	125	130	140	150	160
	r_2	1.6	1.6	1.6	1.6	2.5	2.5	2.5	2.5
	s	1.6	1.6	1.6	1.6	2	2	2	2



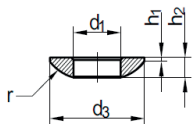
d=nominal size

DIN	Dimensions	3	4	5	6	8	10	12	14
470	h	1.2	1.34	1.35	1.67	1.94	2.67	2.77	2.94
	r	3	4	6	7	9	12	16	19
	s	0.8	0.8	0.8	1	1	1.6	1.6	1.6
	Dimensions	**16**	**18**	**20**	**22**	**25**	**28**	**30**	**32**
	h	3.11	3.28	3.45	4.09	4.38	4.53	4.77	4.95
	r	22	25	28	30	34	40	42	45
	s	1.6	1.6	1.6	2	2	2	2	2
	Dimensions	**34**	**36**	**38**	**40**	**42**	**45**	**48**	**50**
	h	5.11	5.36	5.6	5.7	5.8	6.15	6.38	6.62
	r	48	50	52	56	60	63	68	70
	s	2	2	2	2	2	2	2	2
	Dimensions	**52**	**56**	**60**	**63**	**80**	**100**	**125**	
	h	6.66	7.06	7.47	7.7	10.41	12.23	14.2	
	r	75	80	85	90	112	140	180	
	s	2	2	2	2	3	3	3	



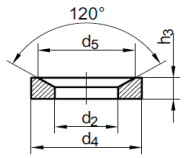
d = nominal size

DIN	Dimensions	6.4	8.4	10.5	13	17	21
6319 C	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_1 [b]	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_1 [b]	32	41	50	58	67	



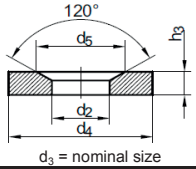
d1= nominal size

DIN	Dimensions	7.1	9.6	12	14.2	19	23.2
6319 D	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	



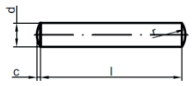
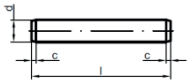
d_3 = nominal size

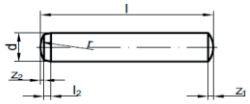
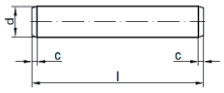
DIN	Dimensions	12	14.2	19	23.2	28	35
6319 – G	d_4	30	36	44	50	60	68
	d_5	18.5	20	26	31	37	49
	h_3	5	6	7	8	10	12

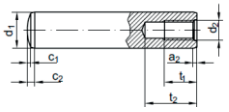


d_3 = nominal size

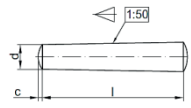
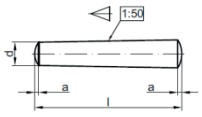
Parallel pins

DIN (ISO)	Dimensions	0.8	1	1.5	2	2.5	3
7 	c max DIN	0.12	0.15	0.23	0.30	0.4	0.45
	c max ISO	0.16	0.20	0.30	0.35	0.4	0.50
	r	0.8	1	1.6	2	2.5	3
	Dimensions	**4**	**5**	**6**	**8**	**10**	**12**
(2338) 	c max DIN	0.60	0.75	0.9	1.2	1.5	1.8
	c max ISO	0.63	0.80	1.2	1.6	2.0	2.5
	r	4	5	6	8	10	12
	Dimensions	**13***	**14**	**16**	**20**	**25**	**30**
d = nominal size	c max DIN	1.9	2	2.5	3.0	4	4.5
*intermediate sizes not included in the standard	c max ISO	-	-	3.0	3.5	4	5.0
	r	14	16	16	20	25	32

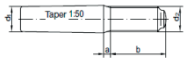
DIN(ISO)	Dimensions	1	1.5	2	2.5	3	4	5
6325 	l_2	0.4	0.5	0.6	0.7	0.8	1	1.2
	r	1	1.6	2	2.5	3	4	5
	z_1	0.15	0.23	0.3	0.4	0.45	0.6	0.75
	z_2	0.08	0.12	0.18	0.25	0.3	0.4	0.5
	c	0.2	0.3	0.35	0.4	0.5	0.63	0.98
	Dimensions	**6**	**8**	**10**	**12**	**14**	**16**	**20**
(8734) 	l_2	1.5	1.8	2	2.5	2.5	3	4
	r	6	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
d = nominal size	c	1.2	1.6	2	2.5	-	3	3.5

DIN (ISO)	Dimensions	4*	5*	6	8	10	12
7979 (8733) (8735) 	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 3	M 3	M 4	M 5	M 6	M 6
	t_1	6	6	6	8	10	10
	t_{2min}	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
d1 = nominal size	d_2	M 8	M 8	M 10	M 16	M 20	M 20
*intermediate sizes not included in the standard	t_1	12	12	16	24	30	30
	t_{2min}	20	20	25	34	42	42

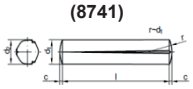
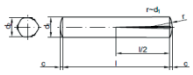
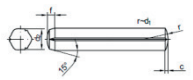
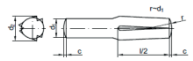
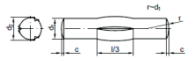
Taper pins

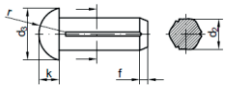
DIN(ISO)	Dimensions	1	1.5	2	2.5	3	4
1 	c max DIN	0.15	0.23	0.30	0.40	0.45	0.6
	a ISO	0.12	0.20	0.25	0.30	0.40	0.5
	Dimensions	**5**	**6**	**6.5***	**7***	**8**	**10**
(2339) 	c max DIN	0.75	0.9	1	1.1	1.2	1.5
	a ISO	0.63	0.8	0.8	0.9	1.0	1.2
	Dimensions	**12**	**13***	**14**	**16**	**20**	
*intermediate sizes not include in the standard	c max DIN	1.8	1.9	2	2.5	3.0	
	a ISO	1.6	1.7	1.8	2.0	2.5	

Taper pins

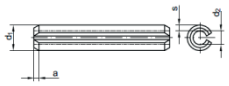
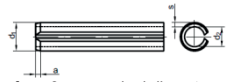
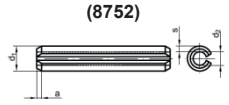
DIN(ISO)	Dimensions	5	6	8	10	12	14	16	20
7977 (8737)  d1 = nominal size	b	14	18	22	24	27	30	35	35
	a_{max}	2.4	3	4	4.5	5.3	6	6	6
	d_2	M 5	M 6	M 8	M 10	M 12	M 12	M 16	M 16
	Dimensions	**6**	**8**	**10**	**12**	**16**	**20**		
	b	0.8	1	1.2	1.6	2	2.5		
	a_{max}	M 4	M 5	M 6	M 8	M 10	M 12		
	t_1	6	8	10	12	16	18		
	t_{2min}	10	12	16	20	25	27		

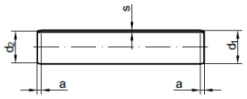
Grooved pins

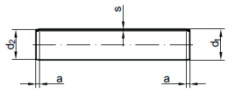
DIN (ISO)	Dimensions	1.5	2	2.5	3	4
1471 (8741)  1472 (8742)  1473 (8740)  1474 (8744)  1475 (8745)  [1]Ø is dependent on the length [2]minimum shear strength, double kN	d_2 [1]	1.60 - 1.63	2.10 - 2.15	2.60 – 2.70	3.20 – 3.30	4.15 – 4.30
	c	0.2	0.25	0.3	0.4	0.5
	shear strength [2] DIN	1.6	2.85	4.25	6.15	10.6
	shear strength [2] ISO	1.6	2.84	4.4	6.4	11.3
	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 [2] DIN	16.5	22.8	40.5	63.2	91.0
	shear strength [2] ISO	17.6	25.4	45.2	70.4	101.8

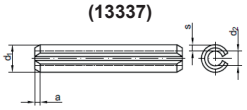
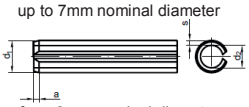
DIN (ISO)	Dimensions	1.4	1.6	2	2.3	2.5	2.6	3	4	2	6
1476 (8746)  *intermediate sizes not included in the standard	d_2	1.5	1.7	2.15	2.5	2.7	2.8	3.2	4.25	5.25	6.3
	d_3	2.4	2.8	3.5	4.0	4.4	4.5	5.2	7	8.8	10.5
	k	0.8	1	1.2	1.4	1.5	1.6	1.8	2.4	3	3.6
	r	1.4	1.6	1.9	2.1	2.4	2.6	2.8	3.8	4.6	5.7
	f	0.5	0.5	0.5	0.7	0.7	0.7	4	1.5	1.5	2

Spring – type straight pins

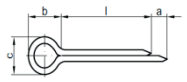
DIN (ISO)	Dimensions	1	1.5	2	2.5	3	3.5	4	4.5	5
1481  up to 6mm nominal diameter  from 8mm nominal diameter	a ISO min	0.15	0.25	0.35	0.4	0.5	0.6	0.65	0.8	0.9
	$d_{1\ max}$ 1)	1.3	1.8	2.4	2.9	3.5	4	4.6	5.1	5.6
	d_2 1)	0.8	1.1	1.5	1.8	2.1	2.3	2.8	2.9	3.4
	s	0.2	0.3	0.4	0.5	0.6	0.75	0.8	1	1
	shear strength 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_{1max} 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	171.10
(8752)  1)dimensions before installation 2) shear strength, double kN *intermediate sizes not included in the standard										
	Dimensions	**18**	**20**	**21**	**25**	**28**	**30**	**35**	**40**	
	a ISO min	2	3	3	3	3	3	3	4	
	d_1 max 1)	16.9	20.9	21.9	25.9	28.9	30.6	35.9	40.9	
	d_2 1)	11.5	12.5	13.5	15.5	17.5	18.5	221.5	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	859.0	1068	

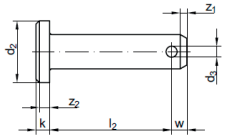
DIN(ISO)	Dimensions	1	1.5	2	2.5	3	3.5	4
7343 (8750)  1)dimensions before installation 2)shear strength, double kN	a	0.3	0.5	0.7	0.8	1	1.2	1.3
	s	0.08	0.13	0.17	0.21	0.25	0.29	0.33
	d_1 1)	1.1	1.62	2.15	2.65	3.15	3.67	4.2
	d_2 1)	0.95	1.4	1.9	2.35	2.85	3.35	3.8
	shear strength 2)	0.6	1.45	2.5	3.9	5.5	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

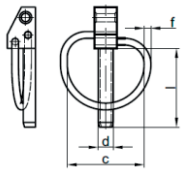
DIN(ISO)	Dimensions	1.5	2	2.5	3	4	5	6	8 3)
7344 (8748)  1)dimensions before installation 2)shear strength, double kN 3)intermediate sizes not included in the standard	a	0.5	0.7	0.8	1	1.3	1.7	2	2
	s	0.17	0.22	0.28	0.33	0.45	0.56	0.67	0.90
	d_1 1)	1.6	2.1	2.6	3.12	4.15	5.15	6.25	8.25
	d_2 1)	1.4	1.9	2.35	2.85	3.8	4.8	5.8	7.80
	shear strength 2)	1.9	3.5	5.5	7.6	13.5	20	30	53

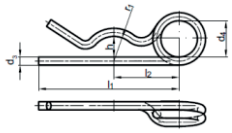
DIN(ISO)	Dimensions	2	2.5	3	4	5	6
7346 (13337)  up to 7mm nominal diameter  from 8mm nominal diameter 1)diameter before installation 2)shear strength, double kN	a	0.2	0.25	0.25	0.5	0.5	0.7
	d_1 1)	2.3	2.8	3.3	4.4	5.4	6.4
	d_2 1)	1.9	2.3	2.7	3.4	4.4	4.9
	s	0.2	0.25	0.3	0.5	0.5	0.75
	shear strength 2)	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

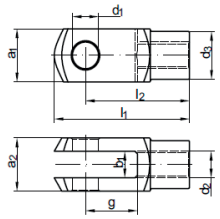
Linch pins / spring cotters/split pins

DIN (ISO)	Dimensions	1	1.2	1.6	2	2.5	3.2	4
94 (1234) 	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 Ø	1	1.2	1.6	2	2.5	3.2	4
	for bolts Ø	3.5 – 4.5	4.5 – 5.5	5.5 – 7	7 – 9	9 – 11	11 – 14	14 – 20
	for cleris pins Ø	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	3.2	3.2	3.2
	b	10		12.6	16	20	26	32
	c_{max}	9.2		11.8	15	19	24.8	30.8
	pin hole	5	5.5	6.3	8	10	13	16
*intermediate sizes not included in the standard	for bolts Ø	20 – 27	21 – 27	27 – 39	39 – 56	56 – 80	80 – 120	120 – 170
	for cleris pins Ø	17 - 23	18 - 23	23 - 29	29 - 44	44 - 69	69 - 110	110 - 160

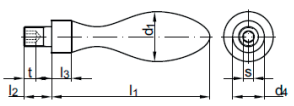
DIN	Dimensions	8	10	12	16	18	20
1444 B 	d_2	14	18	20	25	28	30
	d_3	2	3.2	3.2	4	5	5
	k	3	4	4	4.5	5	5
	f	3.5	4.5	5.5	6	7	8
	$z_{1\ max}$	2	2	3	3	3	4
	z_2	1	1	1.6	1.6	1.6	2
type B: with split pin hole	for split pin Ø	2	3.2	3.2	4	5	5

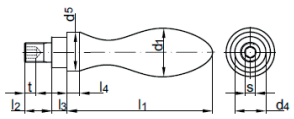
DIN	Dimensions	4.5	6	8	10
~11023 	c	34	41	41	41
	f	3.0	3.4	3.4	3.4
	l	42	42	42	42
	for shafts Ø max	32	32	32	32
	for drilling Ø	4.5	6	8	10
*specification: shaft extension to the central drill point	drill position*	8.5	10	12	14

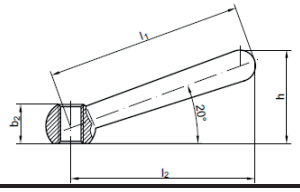
DIN	Dimensions	2.5	3.2	4	5	6.3	7	8
11024 	d_3	2.25	2.8	3.6	4.5	5.6	6.3	7
	d_4	20	20	20	25	25	30	30
	l_1	42	48	64	80	97	125	150
	l_2	24	26	32	39	45	56	63
	h	2.5	3	4.5	7	9	12.5	17.5
	r_1	5.6	7	10	13	17	22.5	28
nominal size = drilling Ø	for shafts Ø	9 – 11.2	11.2 - 14	14 - 20	20 - 26	26 - 34	34 - 45	45 - 56

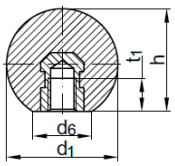
DIN	Dimensions	6	8	10	12	16	20 1)
71752 	g	12/24	16/32	20/40	24/48	32/64	40
	a_1	12	16	20	24	32	40
	a_2	12	16	20	24	32	40
	b_1	6	8	10	12	16	20
	d_2	M 6	M 8	M 10	M 12	M 16	M 20
	d_3	10	14	18	20	26	34
	l_1	31/43	42/58	52/72	62/86	72/101	105
d1 = nominal size 1)intermediate sizes not included in the standard	l_2	24/36	32/48	40/60	48/72	64/96	80

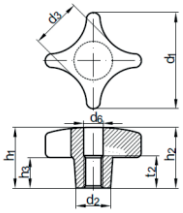
Grips

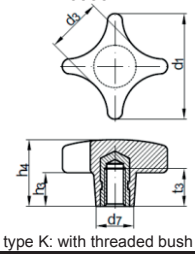
DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16
39 E  type E: with threaded shank	d_1	10	13	16	20	25	32	36
	d_4	7	8	10	13	16	20	22
	l_1	32	40	50	64	80	100	112
	l_2	7	9	11	13	14	21	26
	l_3	4	5	7	8	10	13	14
	s	2	2.5	3	4	5	6	8
	t	2.5	3	3.5	5	6	8	10

DIN	Dimensions	M 6	M 8	M 10	M 12	M 16
98E  type E: with threaded shank	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

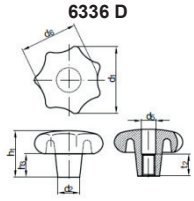
DIN	Dimensions	M 5	M 8	M 10	M 12	M 16	M 20	M 24
99 N 	l_1	40	63	80	100	125	160	200
	b_2	7.5	12.5	15	19	25	31	41
	h	19	30.5	38	47	59.5	75.7	97
	l_2	38	60	76	95	119	152	190

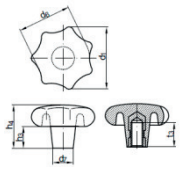
DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12
319 	d_1	16	20	25	32	40	50
	d_6	8	12	15	18	22	28
	t_3	6	7.5	9	12	15	18
	h	15	18	22.9	29	37	46

DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
6335 D  type D: with continuous thread	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

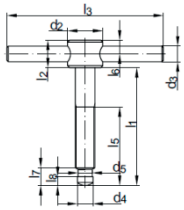
6335 K  type K: with threaded bush	Dimensions	M 5	M 6	M 8	M 10	M 12	M 16
	d_1	25	32	40	50	63	80
	d_3	15	18	21	25	32	40
	d_7	12	14	18	22	26	35
	h_3	8	10	13	20	25	30
	h_4	16	20	25	32	40	50
	t_{3min}	9.5	12	14	18	22	30

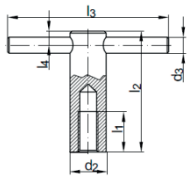
Grips

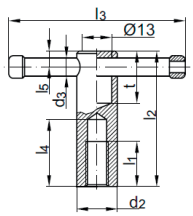
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16
6336 D  type D: with continuous thread	d_1	32	40	50	63	80
	d_2	12	14	18	20	25
	d_5	6.4	8.4	10.5	13	17
	d_6	26	34	42	52	64
	h_1	21	26	34	42	52
	h_3	10	13	17	21	25
	t_2	10	13	16	20	20

DIN	Dimensions	M 4	M 5	M 6	M 8	M 10	M 12	M 16
6336 K  type K : with threaded bush	d_1	20	25	32	40	50	63	80
	d_6	16	20	26	34	42	52	64
	d_7	10	12	14	18	22	26	35
	h_3	7	8	10	13	17	21	25
	h_4	13	16	20	25	32	40	50
	t_{3min}	6.5	9.5	12	14	18	22	30

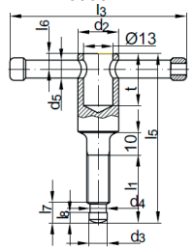
Tommy screws/Tommy nuts

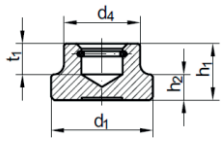
DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
6304 E  type E: without thrust pad thrust pads → DIN 6311	l_1	40/50	50/60	60/70	70/80	75/90/100	75/90/100
	d_2	12	14	18	20	24	30
	d_3	5	6	8	10	12	16
	d_4	4.5	6	8	8	12	15.5
	d_5	4	5.4	7.2	7.2	11	14.4
	l_2	10	12	14	18	20	28
	l_3	50	60	80	100	120	140
	l_5	30/40	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

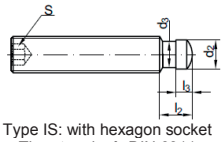
DIN	Dimensions	M 10	M 12	M 16	M 20
6305 	d_2	18	20	24	30
	d_3	8	10	12	16
	l_1	25	25	35	40
	l_2	60	70	85	95
	l_3	80	100	120	140
	l_4	7	9	11	14

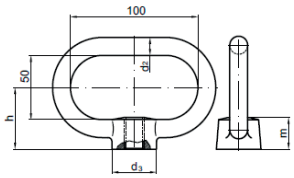
DIN	Dimensions	M 10	M 12	M 16	M 20
6307 	d_2	18	20	24	30
	d_3	8	10	12	16
	l_1	25	25	35	40
	l_2	60	70	85	95
	l_3	80	100	120	140
	l_4	30	35	45	50
	l_5	7	9	11	14
	t	23	26	28	34

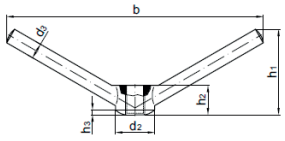
Tommy screws/Tommy nuts

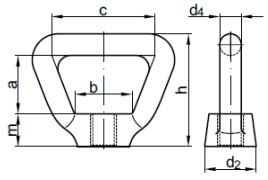
DIN	Dimensions	M 10	M 12	M 16	M 20
6306 D  type D:without thrust pad thrust pads → DIN 6311	l_1	40/50	50/60	55/70/90	55/70/90
	d_2	18	20	24	30
	d_3	8	8	12	15.5
	d_4	7.2	7.2	11	14.4
	d_5	8	10	13	16
	l_3	80	100	120	140
	l_5	72/82	85/95	95/110/130	100/115/135
	l_6	7	9	10	14
	l_7	9	10	12	14
	l_8	4.5	4.5	5	5.5
	t	23	26	28	34

DIN	Dimensions	12	16	20	25	32	40
6311  1)snap rings acc. to DIN 7993 B 2)for grub screws acc. to DIN 6332 S	b	0.7	1	1	1	1.2	1.8
	d_4	10	12	15	18	22	28
	h_1	7	9	11	13	15	16
	h_2	2.5	4	5	6	7	9
	t_1	4	5	6	7	7.5	8
	snap ring [1]	5.1x0.6x2.5	7.0x0.8x2.5	8 [1]	8 [1]	12 [1]	16 [1]
	grub screw [2]	M6	M8	M10	M12	M16	M20

DIN	Dimensions	M 6	M 8	M 10	M 12	M 16	M 20
6332 IS  Type IS: with hexagon socket Thrust pads → DIN 6311	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

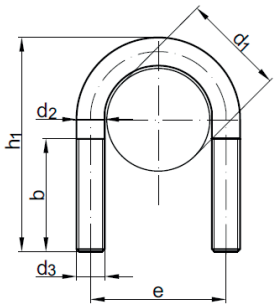
DIN	Dimensions	M 16	M 20	M 24	M 27
28129 	d_2	14	16	18	20
	d_3	35	40	45	50
	h	48	50	55	58
	m	25	28	32	35

DIN	Dimensions	M 16	M 20	M 24
80701 	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

DIN	Dimensions	M 6*	M 8*	M 10*	M 12	M 16	M 20	M 24
80704  *not included in the standard	a	15	20	25	27	29	32	36
	b	14	18	23	27	32	36	45
	c	25	32	42	48	56	64	75
	d_2	14	18	23	24	30	36	45
	d_3	11.5	15	18	20	24	28	36
	d_4	5	6.5	8	10	12	13	14
	h	28	36	50	52	59	66	75
	m	8	10	12	15	18	21	25

Stirrup bolts

3570 A



1)are minimum dimensions and apply for a sheet thickness of 10mm

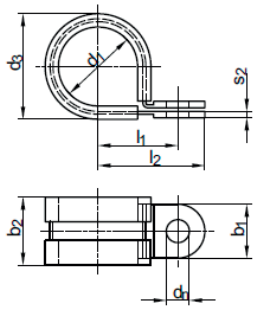
DIN	Dimensions	23	30	38	46	52
	d_1	20 to 21	25 to 26.9	30 to 33.7	38 to 33.7	44.5 to 48.3
	$b^{1)}$	30	40	40	40	50
	d_2	10	10	10	10	10
	d_3	M 10	M 10	M 10	M 10	M 10
	e	33	40	48	48	62
	$h_1^{1)}$	60	70	76	76	92

Dimensions	64	82	94	120	148
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	
d_1	159 to 168.3	216 to 273	267 to 273	318 to 323.9	
$b^{1)}$	60	70	70	70	
d_2	16	20	20	20	
d_3	M 16	M 20	M 20	M 20	
e	192	248	302	352	
$h_1^{1)}$	217	283	334	385	

Hose clamps/pipe clamps

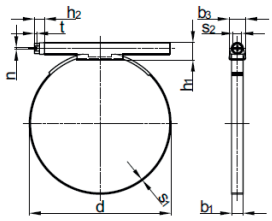
3016 D1



type D: with rubber profile

DIN	Dimensions	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	5.2	5.8	7.4	7.4	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

3017 A

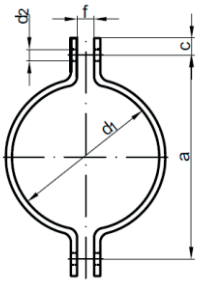


clamping range = nominal sizes

DIN	Dimensions	9 - 12 to 16 - 27	16 - 27 to 90 - 100	16 - 27 to 170 - 190
	b_1	9	9	13
	s_1	0.4 to 0.8	0.5 to 1.0	0.5 to 1.0
	s_2	6	7	7/8
	h_1	14	14	16
	h_2	8	8	8
	n	1.2	1.2	1.2
	t	1.6	1.6	1.6
	tightening torque	2 + 0.5 Nm	3 + 0.5 Nm	5 + 0.5 Nm

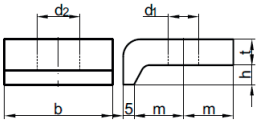
Hose clamps/pipe clamps

DIN	Dimensions	22	27	34	43	45	49
3567	nominal diameter	15	20/3/4"	25/1"	32/11/4"	40	40/1 ½"
	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	M10x30	M10x30	M10x30	M10x30	M10x30	M10x30
	Dimensions	**57**	**61**	**77**	**89**	**108**	**115**
	nominal diameter	50	50/2"	65/2 ½"	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	4	4	4	4	11	11
	flat steel	40x6	40x6	40x6	40x6	50x8	50x8
	screw	M12x35	M12x35	M12x35	M12x35	M16x45	M16x45
	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	M16x45 Mu	M16x45 Mu	M16x45 Mu	M20x50 Mu	M20x50 Mu	



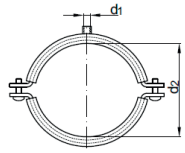
d1= nominal size

DIN	Dimensions	10	12	14
3568	b	60	60	60
	d_1	18	18	18
	d_2	24	24	24
	m	35	35	35
	t	18	18	18
	for screw Ø	M 16	M 16	M 16
	Dimensions	**16**	**18**	**20**
	b	60	60	60
	d_1	18	18	18
	d_2	24	24	24
	m	35	35	35
	t	18	18	18
	for screw Ø	M 16	M 16	M 16

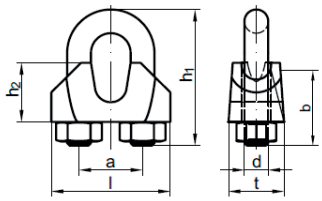


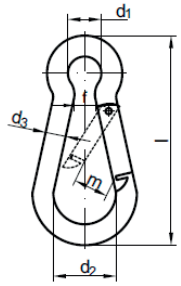
h = nominal size

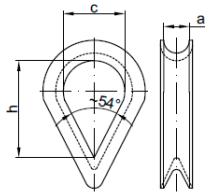
Hose clamps/pipe clamps

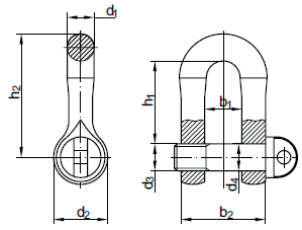
DIN	Dimensions	½"	¾"	1"	1 ¼"	1 ½"	1 ½"	2"
4109  temperature resistance:-50°C to +110 °C *connection to stepped thread	clamping range	20 - 23	25 – 28	32 - 35	40 – 43	48 – 53	50 – 55	57 – 61
	d_1*	M 8/M 10	M 8/M 10	M 8/M 10	M 8/M 10	M 8/M 10	M 8/M 10	M 8/ M 10
	d_2	1.25x20	1.25x20	1.25x20	1.25x20	1.25x20	1.25x20	1.25x10
	payload	1.2 kN	1.2 kN	1.2 kN	1.2 kN	1.2 kN	1.2 kN	1.5 kN

Rope clips/thimble ropes/shackles

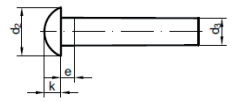
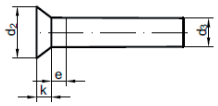
DIN	Dimensions	1/8"	3/16"	¼"	5/16"	7/16"	½"	5/8"
~741  *)with two hexagon nuts DIN 934	for rope Ø	3	5	6.5	8	11	13	16
	d_1 *	M 4	M 5	M 5	M 6	M 8	M 10	M 12
	h_1	20	24	28	34	44	55	63
	b	12	13	15	19	22	30	33
	a	9	11	13	16	20	24	29
	h_2	10	10	11	15	18	21	26
	l	21	23	26	30	36	42	50
	t	10	11	12	14	19	23	26

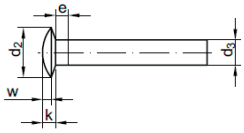
DIN	Dimensions	40x4	50x5	60x6	70x7	80x8	100x10
5299 C 	d_1	6	8	9	10	12	15
	d_{2min}	14	15	17	19	23	29
	d_3	4	5	6	7	8	10
	f	4	4	6	8	8	10
	m	8	7	8	8	10	11
	payload	100 kg	120 kg	120 kg	180 kg	230 kg	350 kg

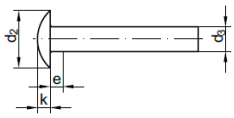
DIN	Dimensions	BF 3.5	BF 4	BF 5	BF 6	BF 7	BF 9	BF 11	BF 16
6899 	c	4	5	6	7	8	10	12	18
	h	21	23	25	26	32	38	45	64
	a	13	14	16	18	20	24	26	40

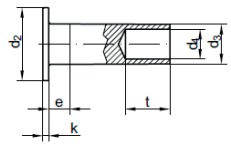
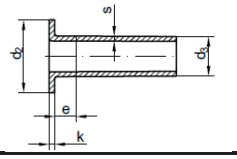
DIN	Dimensions	0.16	0.25	0.4	0.6	1
82101 A 	b_1	8	11	14	17	21
	b_2	18	25	30	37	47
	d_1	5	7	8	10	13
	d_2	12	16	20	24	32
	d_3	M 6	M 8	M 10	M 12	M 16
	d_4	6	8	10	12	16
	h_1	18	24	30	36	49
	h_2	27	36	45	54	72
	wrench size	-	-	-	-	24

Rivets

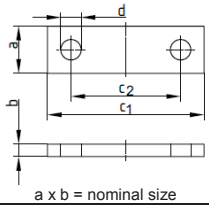
DIN	Dimensions	2	2.5	3	4	5	6	7	8	10*
660  661  *dimensions acc. to DIN 124	d_2	3.5	4.4	5.2	7	8.8	10.5	12.2	14	16
	d_{3min}	1.87	2.37	2.87	3.87	4.82	5.82	6.82	7.76	9.4
	e_{max}	1	1.25	1.5	2	2.5	3	3.5	4	5
	k_{660}	1.2	1.5	1.8	2.4	3	3.6	4.2	4.8	6.5
	k_{661}	1	1.2	1.4	2	2.5	3	3.5	4	-

DIN	Dimensions	2	2.5	3	3.5	4	5	6
662 	d_2	4	5	6	7	8	10	12
	d_{3min}	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
	f	0.7	0.8	1	1.2	1.4	1.7	2

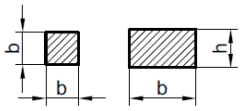
DIN	Dimensions	3	4	5	6
674 	d_2	6.8	9	11.2	13.5
	d_{3min}	2.87	3.87	4.82	5.82
	e_{max}	1.5	2	2.5	3
	k	1.5	2	2.5	3

DIN	Dimensions	3	4	5	6	8
7338 B  7338 C 	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	44
	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

Axle holders

DIN	Dimensions	20x5	25x6	30x8	40x10	50x12
15058  a x b = nominal size	c_1	60	80	100	140	190
	c_2	36	50	70	100	140
	d	9	11	13	17	21
	for axis Ø	16 - 25	25 - 40	40 - 63	63 - 100	100 - 160

Parallel keys

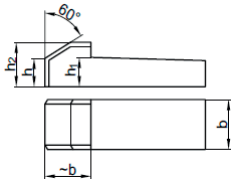
DIN	Use	3x3	4x4	5x5	6x6	8x7	10x8	12x8	14x9
6880*  *length 1000 mm	for DIN 6884	-	-	-	-	-	-	-	-
	for DIN 6885/6886	3x3	4x4	5x5	6x6	8x7	10x8	12x8	14x4
	for DIN 6887	-	-	-	-	-	-	8x7	-
	for DIN 6889	-	-	-	-	-	10x4	12x4	14x4.5

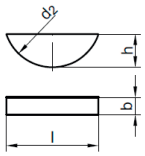
Use	16x10	18x11	20x12	22x14	25x14	28x16	32x18	36x20
for DIN 6884		18x7	20x8	22x9	25x9	28x10	32x11	36x12
for DIN 6885/6886	16x10	18x11	20x12	22x14	25x14	28x16	32x18	36x20
for DIN 6887	-	-	-	-	-	-	-	-
for DIN 6889	-	18x5	-	-	-	-	-	-

DIN	Dimensions	2	3	4	5	6	8	10
6885  b = nominal size	h	2	3	4	5	6	7	8
	for shafts Ød/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	8	9	10	11	12	14	14
for shafts Ød/d_1	38 - 44	44 - 50	50 - 58	58 - 65	65 - 75	75 - 85	85 - 95

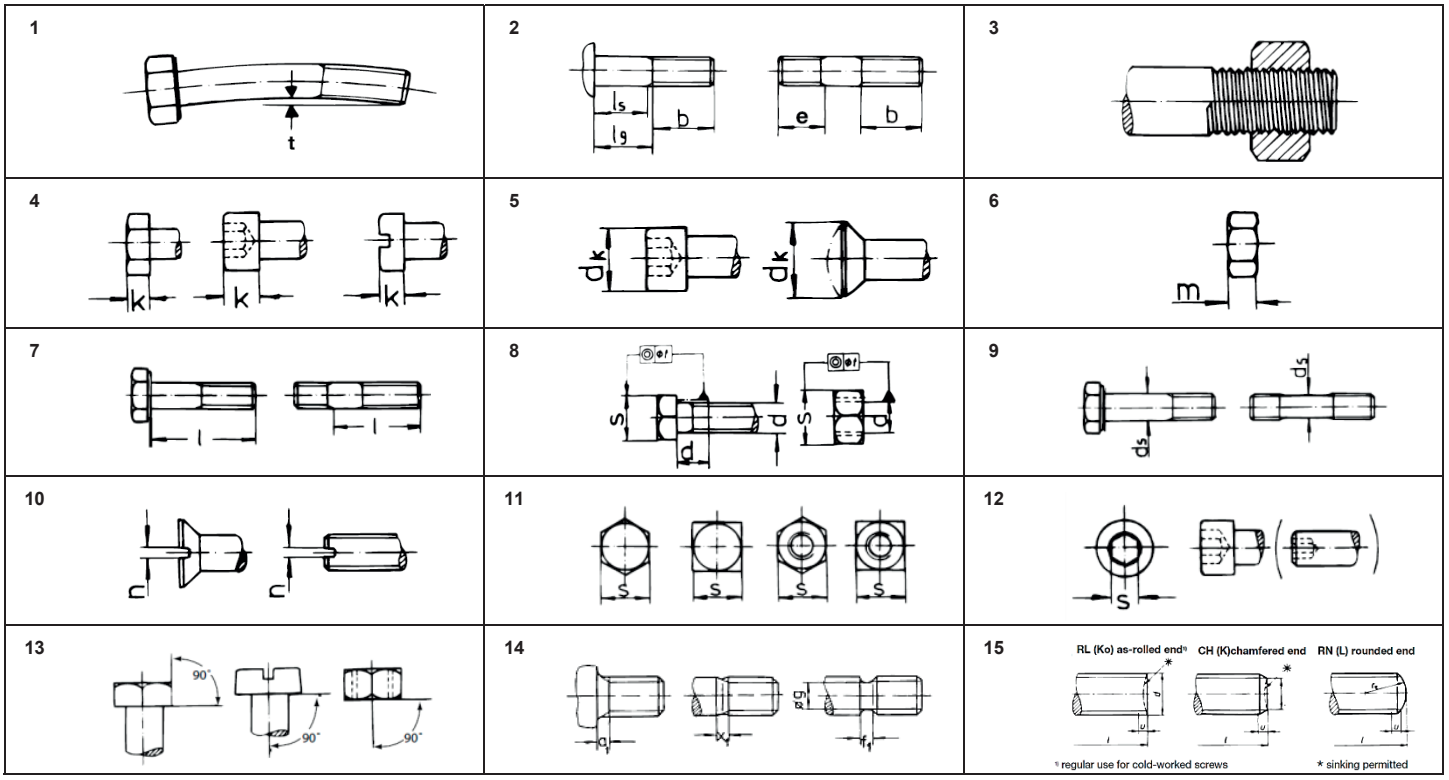
Dimensions	28	32	36	40	45		
h	16	18	20	22	25		
for shafts Ød/d_1	95 - 110	110 - 130	130 - 150	150 - 170	170 - 200		

DIN	Dimensions	6	8	10	12	14	18
6887  b = nominal size	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 Ød/d_1	17 - 22	22 - 30	30 - 38	38 - 44	44 – 50	50 – 58

DIN(ISO)	Dimensions	2		2.5	3			4
6888  b = nominal size 1)for use as a parallel key 6887 2)for use when determine the position	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 Ød/d_1 [1)]	6 – 8	6 – 8	8 – 10	8 -10	8 - 10	-	10 – 12
	for shafts Ød/d_1 [2)]	10 -12	10 – 12	12 - 17	12 - 17	12 - 17	12 - 17	17 - 22

Dimensions	4		5			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 Ød/d_1 [1)]	10 – 12	-	12 – 17	12 – 17	-	17 – 22	17 – 22
for shafts Ød/d_1 [2)]	17 - 22	17 - 22	22 - 30	22 - 30	22 - 30	30 - 38	30 - 38

Dimensions	6	8			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	2735	31.43	43.08
for shafts Ød/d_1 [1)]	-	22 – 30	22 – 30	-	30 – 38	30 – 38	-
for shafts Ød/d_1 [2)]	30 - 38	>38	>38	>38	>38	>38	>38



Characteristic					Dimensions range	Product class A (previously "m" = medium	Product class B (previously "mg" = medium -coarse	Product class C (previously "g" = coarse
1	Straightness		t	l=nominal length	d≤8	0.00201 + 0.05		
				b = thread length	d>8	0.00251 + 0.05		
2	Thread length Length of metal end	Stud	b			0 to 2 P	0 to 2 P	0 to +2 P
			e			js16	js17	js17
3	Thread dimensions	Nut				6H	6H	7H
		Screw				6g	6g	7g
4	Head height	External drive	k		k<10	js14	js15	js16
					k≥10			js17
		Internal drive	k		≤M5	h13	h14	-
					≤M5	h14	h14	-
5	Diameter of head		d_k			h13 (slotted screw h14)	h14	-
6	Nut height		m		≤M12	h14	h14	h17
					>M12≤M18	h15	h15	h17
					>M18	h16	h16	h17
Thread run-out(a,x) and thread undercut (g,f)see ISO 3508/4755 (DIN 76). Chamfered end and rounded end see ISO 4753 (DIN 78). Wire hole and split pin hole see ISO 7378/8991 (DIN 962/34803)				Classification of the product classes among the most conventional standard parts.	Screws acc. to DIN*	84, 85, 444C, 478, 479, 480, 561,564, 609, 610, 653, 787, 835, 912, 931, 933, 938, 939, 940, 960, 961, 963, 964, 965, 966 6912, 7380, 7513, 7516, 7971-7983, 7984, 7985, 7991	444B 609,610≥M12 931,933] >M24 960,961]	95, 96, 186, 188, 261, 316, 444 A, 525, 529, 558, 571, 601, 603, 604, 605, 607, 608, 6914, 7968, 7969, 7990, 11014,
					Nuts acc. to DIN* *or corresponding ISO standard	439, 466, 467, 917, 934, 935, 936, 937, 979, 980, 982≤M12, 986, 1587, 6330, 6331	439, 562, 934, 935 , 936, 980≥M16, 985≥M16, 1587, 6915, 7965	315,555,557,935

Extracts from ISO 3508, 4755 (DIN 76) – ISO 4753 (DIN 78) – ISO 7378, 8991 (DIN 962/34803) and ISO 4759 – 1

Characteristic					Dimensions range	Product class A (previously "m" = medium	Product class B (previously "mg" = medium -coarse	Product class C (previously "g" = coarse
7	Nominal length		l		l ≤150	js15 (slotted screws l >50js 16)	js17	js17
					l >150		js17	2js17
	Surface roughness	Outer surface		Connecting surface, shank		Rt = 25µm		
				Other surfaces		Rt = 25µm		
				End, spanner flat		Rt = 100µm		
		Thread		Flank (screw/nut)		Rt = 25µ(≤M5= 16µm/cutted >M 5=40µm)	Rt = 25µm (cutted = 40µm)	Rt = 40µm
				Core (screw)		Rt = 25µm	Rt = 25µm	Rt = 40µm
				Core (nut)		any	any	any
				External Ø (screw)		any	any	any
8	Run-out, symmetry (screw)	s:d		(Reference dimensions for "t")	(s)	2IT13	2IT14	2IT15
		dk:d			(dk)	2IT13	2IT14	2IT15
		n:d			(d)	2IT12	2IT13	2IT14
	Run-out, symmetry (nut)	s:d (core)			(s)	2IT13	2IT14	2IT15
		n:d(core)			(d)	2IT13	2IT14	2IT15
9	Shank diameter		d_s			h13 Reduced shank: shank diameter ~pitch diameter	h14	±IT15
10	Slot width [1]		n		n≤1	+0.20 to 0.06	-	-
					n>1≤3	+0.31 to +0.06		
					n>3≤6	0.37 to +0.07		
11	Wrench size	External drive	s			s≤32 = h13 s>32 = h14	S ≤ 19 =h14/s > 19≤60 = h15 S >60≤180 = h16/s > 180 = h17	
12	Wrench size	Internal drive	s			s 0.7 = EF8/s 0.9= JS 9/s 1.3 = K9 s 1.5-2 = D10 (D 92)/ s 2.5 = D 11 (D 102) s 3 = D 11/s4 = E11/ s 5 – 14 = E 12(E 112) s>14 = D12	-	-
13	Angle		90°		≤M39	±1°	±1°	±2°
					>M39	±1/2°	±1/2°	±1°

1) Depth for slots and hexagon socket see product (dimension)standards.
2) Tolerance fields for set screws with hexagon socket

Thread run-out (a,x) and thread undercut (g,f) see ISO3508/4755 (DIN 76).

Chamfered end and rounded end see ISO4753 (DIN78).

Wire hole and split pin hole see ISO (7378/8991 (DIN962/34803).

Classification of the product classes among the most conventional standard parts.

Screws acc. to DIN*

84, 85, 444C, 478, 479, 480, 561, 564, 609, 610, 653, 787, 835, 912, 931, 933, 938, 939, 940, 960, 961, 963, 964, 965, 966, 6912, 7380, 7513, 7516, 7971–7983, 7984, 7985, 7991

444 B
609,610≥M12
931,933 } >M24
960,961

95, 96, 97, 186, 188, 261, 316, 318, 444 A, 525, 529, 558, 571, 601, 603, 604, 605, 607, 608, 6914, 7968, 7969, 7990, 11014

Nuts acc. to DIN*

*or corresponding ISO standard

439,466,467,917,934,935,936,937,976,980, 982≤M12,985≤M12,986,1587,6330,6331

439,562,934,935,936,980≥M16,982≥M16,985≥M16,1587,6915,7965

314, 315, 555, 557, 935

14						15		
External thread		a_1	x_1	g_1 (f1)	g_2 (f2)	u	z_1	z_2
Nominal Ø M	Pitch P	max.	max.	min.	max.	2 P Max.	+IT14	+IT14
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
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

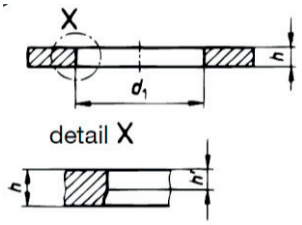
14 = Excerpt from ISO 3508/4755(DIN 76)
a_1 = Distance of the last full threadturn from the contact surface (for parts with threads to the head)
x_1 = Thread run-out general use
g(f) = Thread undercut general use (Type A)

15 = 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

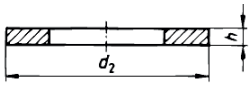
Excerpts from ISO 3508, 4755 (DIN 76) – ISO 4753 (DIN 78) – ISO 7378, 8991 (DIN 962/34803) and ISO 4759-1

Dimensions tolerances

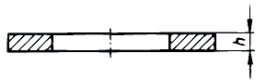
1



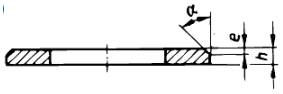
2



3

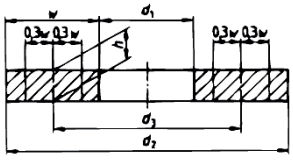


4

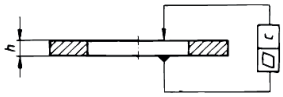


Form and position tolerances

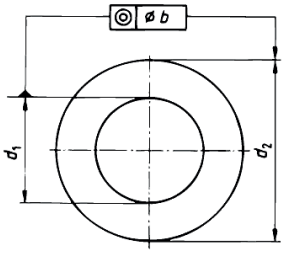
5



6



7



The washers shown are just examples. The specifications are valid correspondingly also for other standardized and non-standardized washer types.

In the following tables, only the specifications for commercially available product classes A and C are listed.

The reference value is the individual value specified in the corresponding product standards. For dimensions without a tolerance specification in the corresponding ISO 2768 (DIN 7168) m for product class A is valid, ISO 2768 (DIN 7168) g for product class C.

Dimensions tolerances

Characteristic	Nominal size >	Nominal size ≤	Product class A (m)	Product class C (g)
① Clearance hole d_1	h		d_1*	
	-	4	H13	H14
	4	-	H14	H15
*h' is the part of the hole within the tolerance specified for d1.	h		(h') min	
	-	4	≥0.5 h	
	4	-	≥0.3 h	
② Outside diameter d_2	h		d_2	
	-	4	h14	h16
	4	-	h15	h16
③ Washer thickness h	h		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
④ Chamfer	α e min e max		30 - 45° 0.25h 0.50h	-

Form and position tolerances

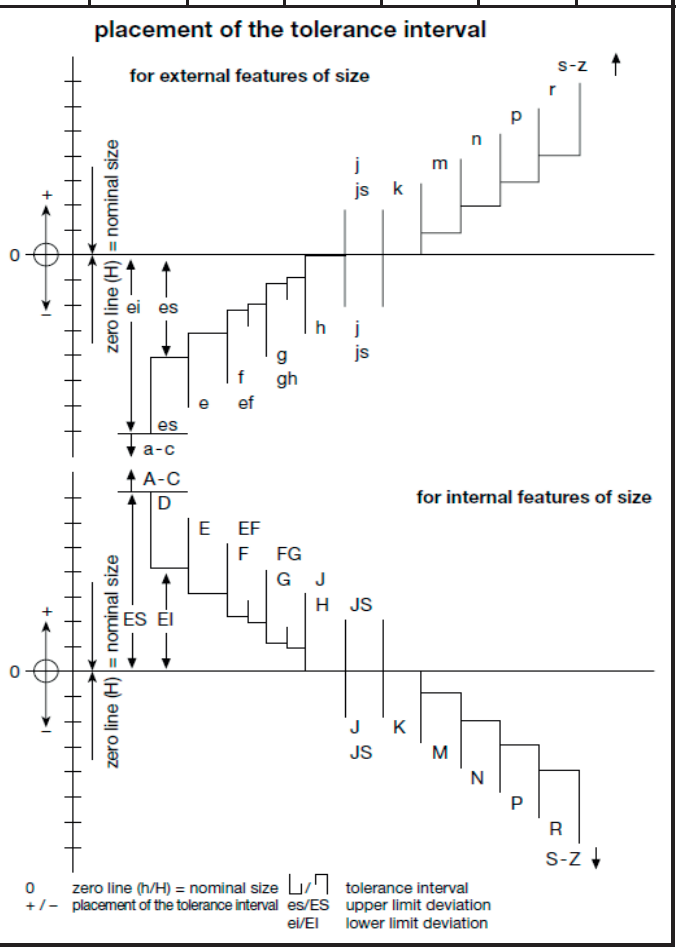
Characteristic	Nominal size >	Nominal size ≤	Product size A (m)	Product size C (g)
⑤ Thickness variation on the same part	h		Δh*	
$w = -\frac{1}{2} - (d2 - d1)$	-	0.5	0.025	
	0.5	1.0	0.05	
$d3 = \frac{d2 + d1}{2}$	1.0	2.5	0.10	
	2.5	4.0	0.15	
*Δ h only applies in the range from d3-0.3w to d3+0.3w	4.0	6.0	0.20	-
	6.0	10	0.30	
	10	20	0.40	
⑥ Flatness	h		c* (t_2)**	
*Tolerance c (t2) is always independent of the thickness tolerance for h.	-	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	
	6.0	10	0.60	
for washers from stainless steel	= 2c (DIN 522) = 1.5c (ISO 4759 -3)			
⑦ Coaxiality b (dependent on d2)	d_2		b(t_1)	
	-	50	2 IT12	2 IT15
	50	-	2 IT13	2 IT16

Excerpt from ISO 4759-3 (DIN 522)

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 -0.33	-0.270 -0.345	-0.280 -0.37	-0.290 -0.40	-0.300 -0.43	-0.310 -0.47							
	c 11	-0.06 -0.12	-0.070 -0.145	-0.080 -0.17	-0.095 -0.205	-0.110 -0.24	-0.120 -0.28							
	f 8	-0.006 -0.020	-0.010 -0.0228	-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							
For internal features of size 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



Excerpts from ISO 286, 965, 4759 (DIN 267-2, 7160, 7161, 7168)

According to DIN 2093 and DIN 2092, 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 [h_0] 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 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); $h_0 = l_0 - t$

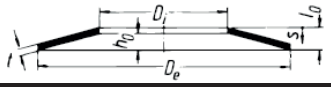


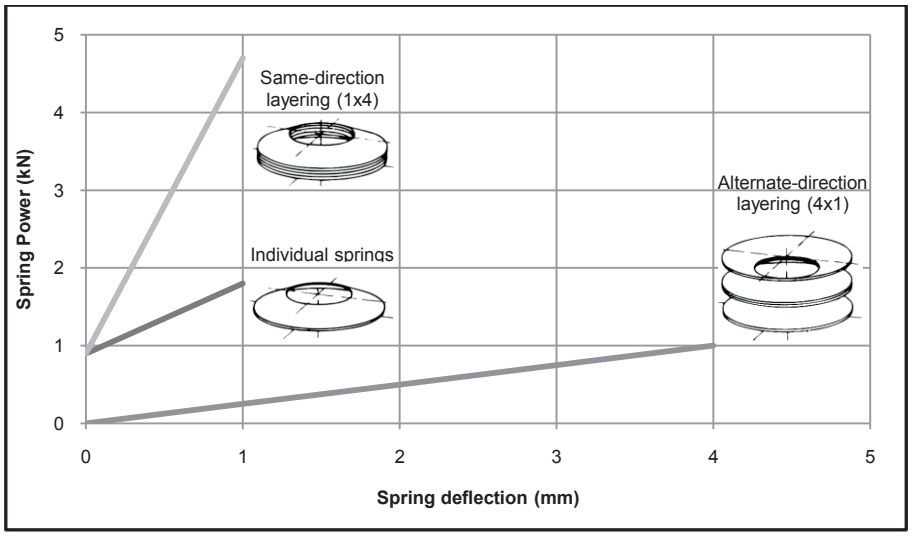
Table 2: Difference according to groups

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, De and D_i turned, without bearing surface
3	>6 mm	cold or hot-formed, turned on all sides, with bearing surface,

Table 3: Difference according to series

Series	Factor from $\frac{De}{t}$	Factor from $\frac{h0}{t}$
A	~18	~0.4
B	~28	~0.75
C	~40	~1.3

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-directions 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.



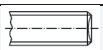
The materials named in EN 10083, EN 10089 and EN 10132-4 are permitted for disc springs (standard is the 1.8159 – 51 CrV 4), C steels, however, only for Group 1 disc springs.
The disc springs are delivered hardness and tempered with a hardness of 42-52 HRC (Group 1 disc springs: 425 HV10 to 510 HV10). 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.

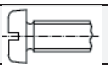
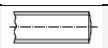
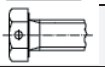
Stainless steels are also used as disc spring material. Compared with the standard, these special springs can have different, but always lower spring power.

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			

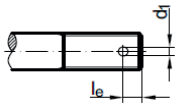
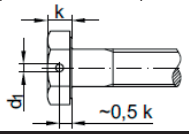
Table 2: Ends of externally threaded fasteners

Description	New name	Old name	Picture (example)	Description example
Short dog point with rounded end (DIN 962)	Ak	Ak		DIN* - M12x50 – Ak -8.8
Chamfered end (ISO 4753)	CH	K		DIN* - M12x50- CH – 8.8
Cone point (ISO 4753)	CN	CN		DIN* - M12x50 – CN – 8.8
Cup point (ISO 4753)	CP	Rs		DIN* - M12x50 – CP – 8.8
Flat point (ISO 4753)	FL	Ks		DIN* - M12x50 – FL – 8.8
Long dog point (ISO 4753)	LD	Za		DIN* - M12x50 – LD – 8.8
Pilot point with truncated cone (ISO 4753)	PC	PC		DIN* - M12x50 – PC – 8.8
Short dog point with truncoated cone (DIN 962)	Asp	Asp		DIN* - M12x50 – Asp – 8.8

Description	New name	Old name	Picture (example)	Description example
Pilot point, flat (ISO 4753)	PF	PF		DIN* - M12x50 – PF – 8.8
Thread undercut (DIN 76-1)	Ri	Ri		DIN* - M12x50 – Ri – 8.8
as – rolled end (ISO 4753)	RL	Ko		DIN* - M12x50 – RL – 8.8
rounded end (ISO 4753)	RN	L		DIN* - M12x50 – RN – 8.8
Split pin hole	s	s		DIN* - M12x50 – S – 8.8
Scrape point (ISO 4753)	SC	Sb		DIN* - M12x50 – SC – 8.8
Short dog point (ISO 4753)	SD	Ka		DIN*- M12x50 – SD – 8.8
Wire hole (DIN 962/34803)	SK	SK		DIN*- M12x50 – SK – 8.8
Truncated cone point (ISO 4753)	TC	Sp		DIN*- M12x50 – TC – 8.8

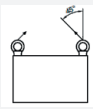
*product standard

Table 3: Dimensions for split pin holes (S) and wire holes (SK)

Thread 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	** The position of the slot at the corners of the hexagon or square is optional							

Taking into account a high safety factor in relation to the minimum breaking strength, the ring bolts according to DIN 580 and the ring nuts according to DIN 582 have the load-bearing capacities as indicated in Table 1. The load-bearing values apply for steel C15 E and stainless steel A2/A4 without restriction in a temperature range of -20°C to + 200°C.
Ring bolts and ring nuts are valid according to the 2006/42/EC Machinery Directive as load-carrying equipment and are subject to CE labeling. Furthermore, they must show a specification of the show a specification of the minimum carrying force (WLL) as well as the specification of the material if required for safe usage. The version of DIN 580-2010 and DIN 582 – 2010 not yet published at the time of printing of this catalogue also prescribes that a marking of an arrow be present in the direction of the axis (picture 1) so that the user tell that the WWL specified on the product only applies in the direction of the axis. Subsequent colour-coded marking of ring bolts and nuts (especially in red) is to be avoided so that they do not get mistaken for high- strength suspension points.

Table 1:

Thread (d1)		M 8	M 10	M 12	M 16	M 20	M 24	M 30	M 36	M 42	M 48	M 56	M 64	M 72x6	M 80x6	M 100x6
capacity axial (WLL) for each eye bolts/nut kg		140	230	340	700	1200	1800	3200	4600	6300	8600	11500	16000	20000	28000	40000
capacity up to max. 45° for each eye bolts/ nut kg		100	170	240	500	860	1290	2300	3300	4500	6100	8200	11000	14000	20000	29000
capacity under max. 90° for each eye bolts/nut kg		70	115	170	350	600	900	1600	2300	3150	4300	5750	8000	10000	14000	20000

User information for lifting eye bolts DIN 580
Eye bolts conforming to this standard are primarily intended as permanent attachments on equipment such as motors, control cabinets, gear boxes, etc. When used as temporary attachments on larger objects such as large tools for transportation only, the next largest thread size should be used.

The safe working load values given in table 1 are based on the following assumptions:

- the eye bolts is firmly screwed down
- the collar sits evenly on the contact surface
- the materials 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

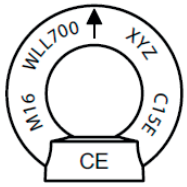
The capacity specified in the second line of table 1 applies up to an inclination angle of 45°. The capacity specified in the third line applies for laterally inserted eye bolts applies up to an inclination angle 45° in all directions in regard to the ring level. Lateral pull should not be applied (see picture 2). Before being used, eye bolts should be checked for correct seating and apparent damage (e.g. corrosion, deformation). Deformed eye bolts should be discarded. In eye bolt assemblies with clearance hole, a washer and nut (not thin nut) should be used.

User information for lifting eye nuts DIN 582
Eye nuts conforming to this standard are primarily intended as permanent attachments on equipment such as motors, control cabinets, gear boxes, etc. When used as temporary attachments on larger objects such as large tools for transportation only, the next largest thread size should be used.

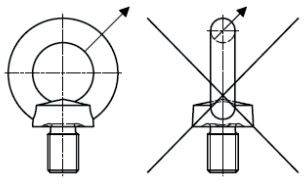
The safe working load values given in table 1 are based on the following assumptions:

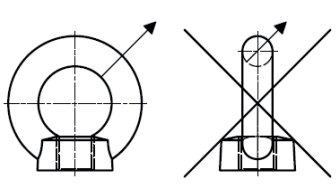
- the eye nut is firmly screwed down and the collar sits evenly on the contact surface
- the length of the bolt thread is sufficient to ensure that the eye nut is fully engaged
- the material of the bolt on which the eye nut is to be screws is of adequate strength

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 applies up to an inclination angle of 45° in all directions in regard to the ring level. Lateral pull should not be applied (see picture 3). Before being used, eye nuts should be checked for correct seating and apparent damage (e.g. corrosion, deformation). Deformed eye nuts should be discarded.



Picture 1


Picture 2


Picture 3

Standard and special parts according to drawings can be delivered for the different cases of application in all necessary special materials – in every 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)] **a) ferritic (F) and martensitic (C)** Greater mechanical properties with less corrosion - resistance	F1	1.4016		X6Cr17 (X8Cr17)	EN 10088 (DIN 17440) ISO 3506 (DIN 267 - 11)
	C 1 C 1 C 3 C 4	1.4006 1.4021 1.4057 1.4104 1.4034	(410) (420) (431) (430 F) (420)	X10Cr13 X20Cr13 X20CrNi172 (X20CrNi17) X12CrMos17 X46Cr13 (X40Cr13)	
b) austenitic (A)	A3	1.4541*	(321)	X6CrNiTi1810	En 10088 (DIN 17440)
Increased corrosion resistance, rust and acid – resistant, tough at sub-zero temperatures	A4 A5 A4	1.4436 1.4571* 1.4580	(319) (316 Ti) (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 Austenitic / ferritic	1.4539 1.4439 1.4529 1.4462		X1NiCrMoCu 25 20 5 X2CrNiMoN 17 13 5 X1NiCrMoCuN 25 20 7 X2CrNiMoN 22 5 3	ISO 3506-1, E1 (especially resistance against chloride – induced stress corrosion)
Steels tough at sub – zero temperatures Increasing strength and stretch limit behavior and high toughness at temperatures as low as – 195°C (SEW)/--253°C (AD)	Marking: KA Marking: KB Marking: KC Marking: KD	1.7219 1.5680 1.6900 1.6903		26 CrMo4 12 Ni 19 X12CrNi189 X10CrNiTi1810	DIN 267 – 13 SEW 680/70
	A2 A2 A3 A4 A5	1.4301 1.4303 1.4541 1.4401 1.4571	(304) (305) (321) (361) (361 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	Alongside materials listed in DIN 267-13, Table 7, the following, among others, are available:				
	Nimonic 80A Nimonic 90 Nimonic 105	2.4631/2.495 2 2.432/2.4969 2.4634		NiCr20TiA17 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 1.4841 1.4845 1.4864	 (309) (310) (310 S) (330)	X10CrA17 X10CrAl13 X10CrAl18 X10CrAl24 X20CrNiSi254 X15CrNiSi2012 X15CrNi2521 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 182M9	1.3805 1.3813 1.3817 1.3819 1.3952 1.3960 1.3965 1.3967	 (202)	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	2.4360* 2.4375		NiCu30Fe NiCu30Al	DIN 17743 *ASTM B 164 Class A
	Inconel 600/625 Nicrofer 7216 Inconel X750 Nimonic 80 A Incolloy 825/ Nicrofer 4221	 2.4816/2.485 6 2.4952* 2.4858		 NiCr15Fe NiCr15Ti7Al/NiCr20TiAl NiCr21Mo	DIN 17742 DIN 17744 *EN 10269 (DIN 17240) *EN 267-13
Titanium, titanium alloys Low specific weight, high corrosion resistance, salt-water proof, anti - magnetic	Titanium 992 (Grade 4) Titanium 993 (Grade 3) Titanium 994 (Grade 2) Titanium 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)
	Titanium Al 6V4 Titanium 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-162

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 (anchor base):**
Plugs and anchors can only ever support as much a load as the anchoring base can handle.
REYHER fixing technology provides the proper technical and commercially economical solution from the catalogues of tried-and-tested proprietary bands FISCHER and UPAT for all uses.

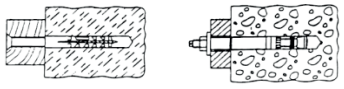
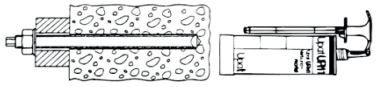
The building material needs to be able to take the expansion force of the plug or anchor during frictional contact (→Section 2) without suffering damage. (Approved plugs/anchors for the corresponding building material → Table 6)

Table 1: Anchoring base acc. To building group

Concrete		Brickwork				Sheets/Panels
Normal concrete B 15 – B55 C 15/20 – C50/55	Light-weight concrete LB 10-LB55 E.G. Pumice / expand 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/ Fiberboard/ Fiber 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

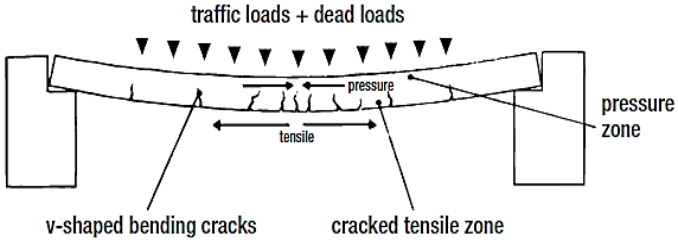
Force transmission	**Frictional contact** (Traction from expansion)	**Adhesive bond** (expansion free)	**Form-fit** (expansion free)
Support mechanism:	Contact pressure of the expansion parts on the wall of the drilling hole = Friction > Tensile Loads	Adhesive mortar joins with the anchor and anchoring base	Plug share / 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)

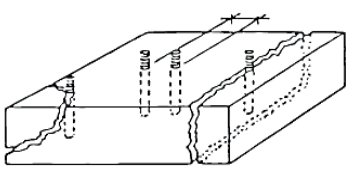
4. **The anchoring position**
Plugs and anchors with high expansion pressure and heavy loads can lead to cracks or concrete edge failure of the component edge failure of the component in any anchoring base, especially with narrow/flat components.

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 length (→ 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 manufactures 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 if 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 – 8mm	I – II = mild – moderate	Closed, dry interior rooms	
Hot dip galvanized steel (tZn) Coating thickness ≥ 40mm	≥ 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 (Material 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.

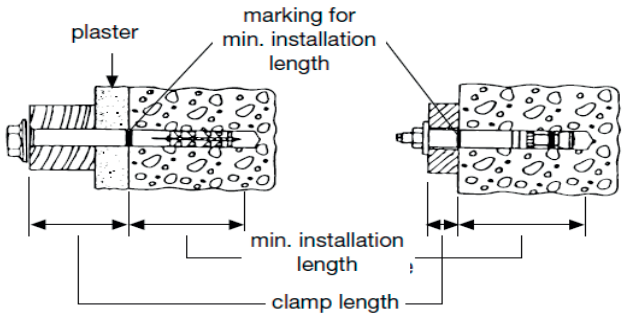
8. The assembly

Plugs and anchors can only achieve their intended task when they are properly installed

The planner is to instruct the following for installations:
- Type, execution and dimension of the plug/anchor
- Edge and axial spacing on the component
- Special specification 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)
- Drill hole 0/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	Hammer drills	Rotary/Hammer drilling Low hammer count and high hammer	Drilling hammer	For very large drillhole Ø or very strong concrete reinforcement or diamond / Core drilling method.
B15	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 drill hole does not get too large and that the bars of the hole/hollow brick stones don's break off
Perforated bricks	Stone drills	Rotary drilling without impact	Drilling machine	
Panels: Plasterboard / Fiber cement	Stone drills			
Chipboard / Wood / Wood-fiber boards	Spiral drill For wood			

8.2 Borehole cleaning

Cleaning drill dust cannot provide grip or can block the space of an undercut, all loose elements need to be removed from the drill hole before the plugs or anchors are inserted, e.g. by air-cleaning

8.3 Assembly types (→Picture 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 drill hole is to be accurately marked out. Internal thread anchors must end flush with the building materials 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 manufactures 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 standardized for DIN/ISO screws apply to standard screws used for fastening, for example, inside thread anchors.

9. The 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 institute fürBautechnik (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)

Picture 1

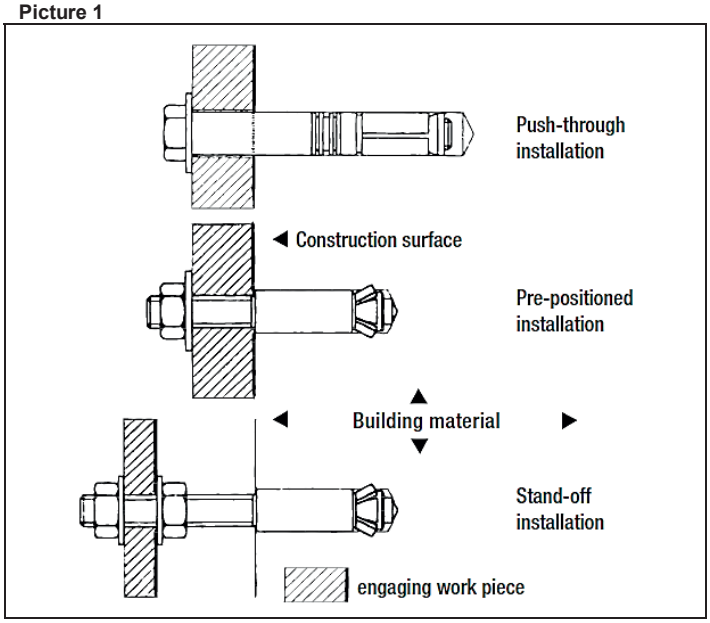


Table 5: Overview of the currently valid types of approval

German approvals	▪ for metal plugs, compound anchors, plastic plugs for facade coverings and curtain walling, plugs for light-weight suspended ceilings only, plugs for special building materials, injection anchoring for holes and hollow building materials, plugs for special requirements. ▪ for plugs with proof of suitability for use in cracks = thus usable in the tension and pressure zones of the concrete. (It is fundamentally recommended that planners and operators use crack plugs/plugs suited for tension zones because attaining this means that pressure zone proof, which is difficult to attain, is not required.)
European approvals	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.

Technically a thread is “a beveled level equally wound around a cylinder”.

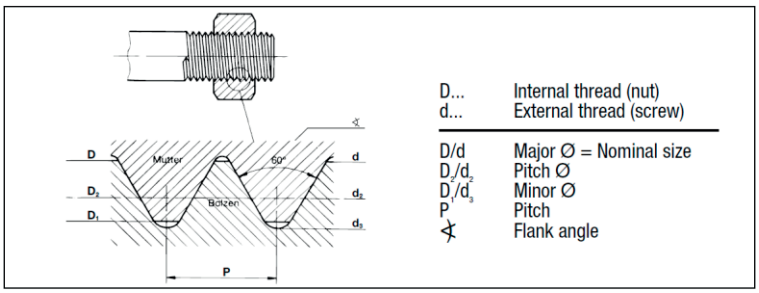
This principle enables both a screw on/in as well as screw off function and thus forms the basic characteristic for “detachable” fastenings = screws and nuts.

The geometric form and the standardized dimension and tolerance system make up 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 picture 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.

Pictures A:
Thread profiles 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 standardization (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 ∢	Acc. to Standard
M	Metric ISO thread	Coarse thread	right-hand	M 20 X 80	60°	ISO 724 (DIN 13-1)
M-LH		Coarse thread	left-hand	M 20 X 80 LH		
M		Fine thread	right-hand	M 20 X 2 X 80		ISO 724 (DIN 13-2…11)
M-LH		Fine thread	left-hand	M 20 X 2 X 80 LH		
M-SN4	Metric ISO threadfor transition fir	Interference fit thread	sealing	M 20 Sn 4 X 80		DIN 13-51
M-SK 6		Interference fit thread	non-sealing	M 20 Sk 4 X 80		
MFS				MFS 20 x 80		DIN 8141 - 1
M	Metric threadWith large clearance	Screw threads with larger thread limit deviation nut tolerance 6H		DIN 2510 M 20 X 80		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 20 X 2		DIN 8140-2
M-taper	Metric external taper screw thread	for screw plugs and lubricating nipples		M 20 x 1.5 taper		DIN 158- 1
G	Cylindrical Ww pipe threads where pressure-tight. Joints are not made on the threads	for pipes/pipe fastenings		G ¾”	55°	ISO228-1
R	Taper We piping thread where pressure-tight Joints are not made on the threads	for external threads pipes / fittings/pipe screwed fastenings		R ¾”		DIN 2999-1 DIN3858
Rp	Cylindrical Ww pipe threads where pressure-tight. Joints are made on the threads	for internal thread pipes/ fitting /pipe screwed		Rp ¾”		
Tr	Metric ISO trapezoidal thread (single-start and multi-start thread)	for general use		Tr 20 x 4	30°	ISO 2901-04
		Precision movement thread		Acc. to specification		DIN 3975
Rd	Cylindrical round thread (single-start and multi-start thread)	For, e.g. flush pipe screwed Fastenings		Rd 20 x 1/8		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		¾-10 UNC	60°	ANSI B 1.1 B.S. 1580-1.2
UNF		Fine thread		¾-16 UNF		
BSW	UK: inch thread	Coarse thread		¾-10 BSW	55°	B.S. 84
BSF		Fine thread		¾-12 BSF		

Thread manufacture

- Non-cutting production
  (= normal for large series production of screws)
  - thread rolling using profile barrels (M2-M30)
  - 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) are additional measures and order requirements 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
  →picture B

- **tolerance interval**
  ("Tolerance quality")
  = Distance of lower to upper limit deviation (internal size es-ei/EI-ES)

- **length of thread engagement**:
  Minor form and position differences, which are visible dependent on the length as a kind of lead deviation, are unavoidable and manufacture-related in rational 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, restricted due to pitch dependency.
  →Table 3

  For higher lengths of thread engagements (L) correspondingly large tolerance intervals are to be selected.

- **Surface discontinuities/damage 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/damage 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 greater tolerance qualities or supplementary "smoothing rolls" with thread protection are needed

Note: the standardized permitted stress loads for screw fastenings are valid for the tolerance assigned in the respective product standards. Understandably, increase in the tolerance placements/intervals lead to a reduction in the stress capacity in the thread.

Picture B: Placement of tolerance
Tolerance interval

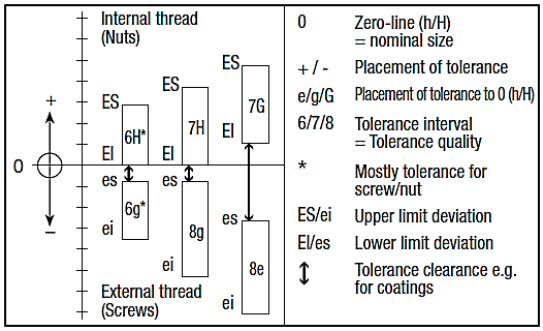


Table 2: Recommended tolerance intervals for length of thread engagement N (before applying a corrosion protection coating*)

Tolerance class		Medium		Coarse	
Thread		Ext. thread (screw)	Int. thread (nut)	Ext. thread (screw)	Int. thread (nut)
For surface corrosion	- without coating (plain)* - thin coating** (electro plated)	6g*	6H*	8g*	7H*
	- with large clearance (plain) - thick coating** (electro plated)	6e	6G	8e	7G
Article product class: = e.g. DIN ISO		A, B (m, mg) 931, 933 4014, 4017	 934 4032	C (g) 558, 601 4018, 4016	 555 4024
* general tolerance without / before application of coatings ** → TD-95, Table 8 / TD-96, Table 9					

Table 3: Length of thread engagement $N_{max.}$ for coarse and fine pitch thread

Thread		M5	M6	M8	M10	M12	M14	M18	M24	M30	M36	M42
Nominal Ø	d/D						M16	M22	M27	M33	M39	M45
Pitch	RG	0.8	1	1.25	1.5	1.75	2	2.5	3	3.5	4	4.5
P	FG	0.5	0.75	1	1.25	1.5	1.5	2	2	2	3	3
Length of thread	RG	7.5	9	12	15	17	24	30	36	45	53	63
Engagement N_{max}	FG	4.5	7.1	9	12	13	16	16	25	25	36	36

Table 4: Limit deviations A_o– A_u (min. – max.) for external and internal threads (bolts/nuts) with coarse and fine pitch thread (RG/GF)
(Extracts from ISO 965-2 /DIN 13 – 20, 21, 22, 27)

				External thread (Bolts/Screws)						Internal thread (Nuts)					
Thread Nom. Ø d/D	Pitch P RG	Pitch P FG	Pitch Ø Zero-line h/H	Tolerance	Major Ø d max.	Major Ø d min.	Pitch Ø d_2 max.	Pitch Ø d_2 min	Minor Ø d_3 max.	Minor Ø d_3 min	Tolerance	Major Ø D min.	Major Ø D_2 max.	Major Ø D_2 min.	Major Ø D_3 max.	Major Ø D_3 min.
M 3	0.5		2.675	6g	2.980	2.874	2.655	2.580	2.367	2.273	6H	3.000	2.675	2.775	2.459	2.599
				6e	2.950	2.844	2.626	2.550	2.337	2.243	6G	3.020	2.695	2.795	2.479	2.619
M 4	0.7		3.545	6g	3.978	3.838	3.523	3.433	3.119	3.002	6H	4.000	3.545	3.663	3.242	3.422
				6e	3.944	3.804	3.489	3.399	3.085	2.968	6G	4.022	3.567	3.685	3.264	3.444
M 5	0.8		4.480	6g	4.976	4.826	4.456	4.361	3.995	3.869	6H	5.000	4.480	4.605	4.134	4.334
				6e	4.960	4.790	4.420	4.325	3.959	3.833	6G	5.024	4.504	4.629	4.158	4.358
M 6	1		5.530	6g	5.974	5.794	5.324	5.212	4.747	4.596	6H	6.000	5.350	5.500	4.917	5.153
				6e	5.940	5.760	5.290	5.178	4.713	4.562	6G	6.026	5.376	5.526	4.943	5.179
M 8	1.25		7.188	6g	7.975	7.760	7.160	7.042	6.438	6.272	6H	8.000	7.188	7.348	6.647	6.912
				8e	7.937	7.602	7.125	6.935	6.403	6.165	6G	8.028	7.216	7.376	6.675	6.940
		1	7.350	6g	7.974	7.794	7.324	7.212	6.747	6.596	6H	8.000	7.350	7.500	6.675	7.153
M 10	1.5		9.026	6g	9.968	9.732	8.994	8.862	8.128	7.938	6H	10.000	9.026	9.206	8.376	8.676
				8e	9.933	9.558	8.959	8.747	8.093	7.823	6G	10.032	9.058	9.238	8.408	8.708
		1.25	9.188	6g	9.972	9.760	9.160	9.042	8.438	8.272	6H	10.000	9.188	9.348	8.647	8.912
M 12	1.75		10.863	6g	11.966	11.701	10.829	10.679	9.819	9.602	6H	12.000	10.863	11.063	10.106	10.441
				8e	11.929	11.504	10.792	10.556	9.782	9.479	6G	12.034	10.897	11.097	10.140	10.475
		1.5	11.026	6g	11.968	11.732	10.994	10.854	10.128	9.930	6H	12.000	11.026	11.216	10.376	10.676
M 14	2		12.701	6g	13.962	13.682	12.663	12.503	11.508	11.271	6H	14.000	12.701	12.913	11.835	12.210
				8e	13.929	13.749	12.630	12.380	11.475	11.148	6G	14.038	12.739	12.951	11.873	12.248
		1.5	13.026	6g	13.968	13.732	12.994	12.854	12.128	11.930	6H	14.000	13.026	13.216	12.376	12.676
M 16	2		14.704	6g	15.962	15.682	14.663	14.503	13.508	13.271	6H	16.000	14.701	14.913	13.835	14.210
				8e	15.929	15.749	14.430	14.380	13.475	13.148	6G	16.038	14.739	14.951	13.873	14.248
		1.5	15.026	6g	15.968	15.732	14.994	14.854	14.128	13.930	6H	16.000	15.026	15.216	14.376	14.676
M 18	2.5		16.376	6g	17.958	17.623	16.334	16.164	14.891	14.625	6H	18.000	16.376	16.600	15.294	15.744
				8e	17.920	17.390	16.296	16.031	14.853	14.492	6G	18.042	16.418	16.642	15.336	15.786
		2	16.701	6g	17.962	17.682	16.663	16.503	15.508	15.271	6H	18.000	16.701	16.913	15.835	16.210
M 20	2.5		18.376	6g	19.958	19.623	18.334	18.164	16.891	16.625	6H	20.000	18.376	18.600	17.294	17.744
				8e	19.920	19.390	18.296	18.031	16.853	16.492	6G	20.042	18.418	18.642	17.336	17.786
		2	18.701	6g	19.962	19.682	18.663	18.503	17.508	17.271	6H	20.000	18.701	18.913	17.835	18.210
M 22	2		20.376	6g	21.958	21.623	20.334	20.164	18.891	18.625	6H	22.000	20.376	20.600	19.294	19.744
				8e	21.920	21.390	20.296	20.031	15.853	18.492	6G	22.042	20.418	20.642	19.336	19.786
		2	20.701	6g	21.962	21.682	20.663	20.503	19.508	19.271	6H	22.000	20.701	20.913	19.835	20.210
M 24	3		22.051	6g	23.952	23.577	22.003	21.803	20.271	19.995	6H	24.000	22.051	22.316	20.752	21.252
				8e	23.915	23.315	21.966	21.651	20.234	19.803	6G	24.048	22.099	22.364	20.800	21.300
		2	22.701	6g	23.962	23.682	22.663	22.493	21.508	21.261	6H	24.000	22.701	22.925	21.835	22.210
M 27	3		25.051	6g	26.952	26.577	25.003	24.803	23.271	22.955	6H	27.000	25.051	25.316	23.752	24.252
				8e	26.915	26.315	24.966	24.651	23.234	22.803	6G	27.048	25.099	25.364	23.800	24.300
		2	25.701	6g	26.962	26.682	25.663	25.493	24.508	24.261	6H	27.000	25.701	25.925	24.835	25.210
M 30	3.5		27.727	6g	29.947	29.522	27.674	27.462	25.653	25.306	6H	30.000	27.727	28.007	26.211	26.711
				8e	29.910	29.240	27.637	27.302	25.616	25.146	6G	30.053	27.780	28.050	26.264	26.824
		2	28.701	6g	29.952	29.577	28.003	27.803	26.271	25.955	6H	30.000	28.051	28.316	26.752	27.252
M 33	3.5		30.727	6g	32.947	32.522	30.674	30.462	28.653	28.306	6H	33.000	30.727	31.007	29.211	29.771
				8e	32.910	32.240	30.637	30.302	28.616	28.146	6G	33.053	30.780	31.060	29.264	29.824
		2	31.701	6g	32.962	32.682	31.663	31.493	30.508	30.261	6H	33.000	31.701	31.925	30.835	31.210
M 36	4		33.402	6g	35.940	35.465	33.342	33.118	31.033	30.655	6H	36.000	33.402	33.702	31.670	32.270
				8e	35.905	35.155	33.307	32.952	30.998	30.489	6G	36.060	33.462	33.762	31.730	32.330
		3	34.051	6g	35.952	35.577	34.003	33.803	32.271	31.955	6H	36.000	34.051	34.316	32.752	33.252

Table 5: Dimensions in millimeters for
- **UNC/UNF/BSW/BSF threads**
- **Ww pipe threads**

UNC UNF BSW BSF	Thread No		0	1	2	3	4	5	6	8	10	12	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
	Nom. Ø Inch																					
	Major Ø d/D		1.524	1.854	2.184	2.515	2.845	3.175	3.505	4.166	4.826	5.486	6.35	7.94	9.53	11.1	12.70	14.29	15.88	19.05	22.23	25.40
	In mm																					
Ww Pipe Thread G/R/R_p	Thread Inch		1/16	1/8	1/4	3/8	1/2	3/4	1	1 ¼	1 ½	2	2 ½	3	G = cylindrical external/internal thread R = taper external thread R_p = cylindrical internal thread							
	Nom. Ø in mm																					
	Major Ø 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	A = distance of the reference level/measuring level from the start of thread in mm							
	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								

Thread: Pitch

Thread pitches P in mm for

ISO-metric coarse pitch thread M
ISO-metric fine pitch thread M-F
Trapezoidal thread Tr

Thread count per inch for

UNC coarse pitch thread
UNF fine pitch thread
BSW coarse pitch thread (Ww)
BSF fine pitch thread
Whitworth pipe thread

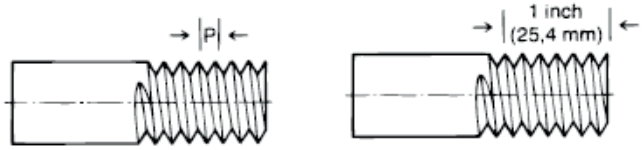


Table 6:

Thread Ø		Pitch P					Thread Ø			Number G (per 1 inch)				
M	Tr	M	M-F	M-F2	M-F3	Tr	UNC/UNF No.	Inch	= mm	UNC (NC)	UNF (NF)	BSW (Ww C)	BSF (Ww F)	R, G Rp
1		0.25	0.2				0		1.54	-	80	-	-	
1.2		0.25	0.2				1		1.854	64	72	-	-	
1.4		0.3	0.2				2		2.184	56	64	-	-	
1.6		0.35	0.2				3		2.515	48	56	-	-	
1.8		0.35	0.2				4		2.845	40	48	-	-	
2		0.4	0.25				5		3.175	40	44	-	-	
2.2		0.45	0.25				6		3.505	32	40	-	-	
2.5		0.45	0.35				8		4.166	32	36	-	-	
3		0.5	0.35				10		4.826	24	32	-	-	
3.5		0.6	0.35				12		5.486	24	28	-	-	
4		0.7	0.5					1/8	3.715	-	-	40	-	28
5		0.8	0.5					5/32	3.969	-	-	32	-	-
6		1	0.75	0.5				3/16	4.763	-	-	24	32	-
8	8	1.25	1	0.75	0.5	1.5		7/32	5.556	-	-	24	28	-
10	10	1.5	1.25	1	0.75	2 1.5		1/4	6.35	20	28	20	26	19
12	12	1.75	1.5	1.25	1	3		5/16	7.938	18	24	18	22	-
14	14	2	1.5	1.25	1	4 3 2		3/8	9.525	16	24	16	20	19
16	16	2	1.5		1	4		7/16	11.113	14	20	14	18	-
18	18	2.5	2	1.5	1	4		1/2	12.70	13	20	12	16	14
20	20	2.5	2	1.5	1	4		9/16	14.288	12	18	12	16	-
22	22	2.5	2	1.5	1	8 5 3		5/8	15.875	11	18	11	14	14
24	24	3	2	1.5	1	8 5 3		3/4	19.050	10	16	10	12	14
27	26/28	3	2	1.5	(1)	8 5 3		7/8	22.225	9	14	9	11	14
30	30	3.5	2	1.5	(1)	10 6 3		1	25.401	8	12	8	10	11
33	33/34	3.5	2	1.5		10 6		1 1/8	28.575	7*	12	7	9	11
36	36	4	3	2	1.5	10 6 3		1 1/4	31.75	7*	12	7	9	11
39	38/40	4	3	2	1.5	10 6 3		1 3/8	34.925	6*	12	6	8	11
42	42	4.5	(4) 3	2	1.5	10 7 3		1 1/2	38.10	6*	12	6	8	11
45	44/46	4.5	(4) 3		1.5	12 7/8		1 3/4	44.45	5*	12	5	7	11
48	48	5	(4) 3	2	1.5	12 8 3		2	50.802	4 1/2*	12	4 1/2	7	11
52	50/52	5	(4) 3	2	1.5	12 8 3		2 1/4	57.15	4 1/2*	-	4	-	11
56	55	5.5	4	3/2	1.5	14 9 3		2 1/2	63.50	4*	-	4	-	11
60	60	5.5	4	3/2	1.5	14 9 3		2 3/4	69.85	4*	-	3 1/2	-	11
64	65	6	4	3	2(1.5)	16 10 4		3	76.20	4*	-	3 ½	-	11
68	70	6	4	3	2(1.5)	16 10 4		4	101.60	4*	-	3	-	11
Flank ≥		60°				30°	-			60°		55°		

With fine pitch thread, M-F insertion is preferred

* Stud bolts Ø≥ 1" = constant 8 threads/inch
**Pipe threads have a larger major diameter (→table 5)

The mechanical properties of steel screws as well as their quality inspection and marking are set in ISO 898-1.

Designation system for the property classes

The most important mechanical properties for steel screws are given a two-number 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 *R*p 0.2) for nominal tensile strength *R*m (yield strength ratio). Multiplying the two numbers results in 1/10 **of the minimum yield strength** in N/mm². Stress at 0.2% non-proportional elongation 8 x 8 x 10 = 640 N/mm².

Table 1: Mechanical properties of screws, bolts and studs

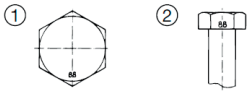
Properties	Property classes		4.6	4.8	5.6	5.8	6.8	8.8 ≤M16	8.8 >M16	10.9	12.9
Tensile strength ** Rm in N/mm²	Nominal value		400		500		600	800		1000	1200
	min		400	420	500	520	600	800	830	1040	1220
Yield stress ** Rel in N/mm²	Nominal value		240	320	300	400	480	-	-	-	-
	min		240	340	300	420	480	-	-	-	-
Stress at 0.2% non-proportional elongation ** Rp 0.2 in N/mm²	Nominal value		-	-	-	-	-	640	640	900	1080
	min		-	-	-	-	-	640	660	940	1100
Lower yield stress R_{eI} / Stress at 0.2% non-proportional elongation at higher temperatures In N/mm² (ISO 898-1)	Continuous use at increased temperatures can lead to significant tensile relaxation.	+100°C	-	-	270	-	-	590		875	1020
		+200°C	-	-	230	-	-	540		790	925
		+250°C	-	-	215	-	-	510		745	875
		+300°C	-	-	195	-	-	480		705	825
Elongation after fracture A in % **	min		22	-	20	-	-	12		9	8
Vickers hardness, HV (F ≤ 98N) **	min – max		120-220	130-220	155-220	160-220	190-250	250-320	255-335	320-380	385-435
	***		250	250	250	250	-	-	-	-	-
Brinell hardness, HBW (F = 30 D2) **	min – max		114-209	124-209	147-209	150-209	181-238	238-304	242-318	304-361	366-414
	***		238	238	238	238	-	-	-	-	-
Rockwell hardness, HRB **	min – max		67-95	71-95	79-95	82-95	89-99.5	-	-	-	-
	***		99.5	99.5	99.5	99.5	-	-	-	-	-
Rockwell hardness, HRC **	min – max		-	-	-	-	-	22-32	23-34	32-39	39-44

* Construction steel bolts from M12 ** values apply at room temperature approximately +20°C *** max. Value at the screw end

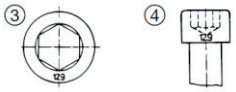
Marking screws, bolts and studs

According to the standard, fasteners from a thread diameter of M5 onward are to be marked with the manufacturer's identification marks and the property class marking as follows*:

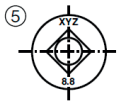
1) **Hexagon and hexalobular head screws and bolts** in all property classes. The marking shall be made preferably on the top of the head by indenting or embossing or on the side of the head by indenting.



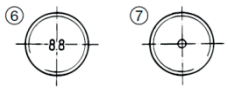
2) **Hexagon and hexalobular socket head cap screws** in all property classes. The marking shall be made preferably on the side of the head by indenting or on the top of the head by indenting or embossing.



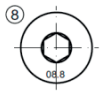
3) **Cup head square neck bolts** in all property classes. The marking shall be made on the head by indenting or embossing.



4) **Studs** of property classes 5.6, 8.8, 9.8, 10.9 and 12.9. The marking shall be on the unthreaded part of the stud. If this is not possible, marking of the property class shall be on the nut end, and the manufacturer's identification mark may be omitted. Alternative marking symbols are 5.6 = –, 8.8 = O, for 10.9 = □ and for 12.9 = Δ



5) **Marking of fasteners which have reduced loadability** like, 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 requirement 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.



* If there is a lack of space, a marking based on the clock system can be used (→ analogue Table 3)

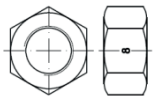
The DIN product and function standards for nuts are being converted to ISO standards. Accordingly, during the transition period standards for previous DIN and new ISO nut designs shall be on the market together.

Information about standards conversion, “Standards conversion DIN → ISO”, sees TD-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/mm^2). 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/mm^2), without marking of two vertical bars (| |), here the proof loads apply according to ISO 898-2.



| 8 |
8

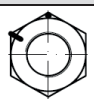
Marking: Hexagon head nuts of this group are to be marked from a thread diameter of ≥ M5 with the manufacturer's identification mark and the property class in accordance with Table 2 or Table 3.

Table 2: 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	3.6 4.6 4.8	> M16	> M16	
5	3.6 4.6 4.8 5.6 5.8	≤ M16 ≤ M39	≤ M39	
6	6.8	≤ M39	≤ M39	
8	8.8	≤ M39	≤ M39	> M16 ≤ M39
10	10.9	≤ M39	≤ M39	
12	12.9	≤ M39	≤ M16	≤ M39

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.

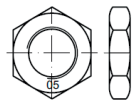
Table 3: Alternative marking of the property class with symbols (clock system)

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/mm^2).
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.

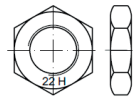
Marking: Hexagon head nuts of this group are to be marked from a thread diameter of ≥ M5 with the manufacturer's identification mark and the property class.



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 1/10of 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 ≥ M5.



22 H

Mechanical Properties: Fasteners from Corrosion-Resistant Stainless Steels

The mechanical properties of fasteners made from corrosion-resistant stainless steels as well as their quality inspection and marking are set in ISO 3506.

Table 4: Mechanical properties for fasteners of the steel groups A1 – A5 at approximate +20°C

Property Class	Diameter range	Screws				Nuts	
		Tensile strength Rm N/mm² min	Stress at 0.2% non-proportional elongation N/mm²		Elongation after fracture A mm min	Proof stress Sp N/mm² min	
						m ≥ 0.8d	0.5d ≤ m < 0.8d
50 soft (turned)	≤ M39	500	210	Lower yield strength R_{el} or stress at 0.2% elongation At 100°C = 85% At 200°C = 80% At 300°C = 75% At 400°C = 70%	0.6d	500	250 (Prop. Cl. -025)
70 cold-worked	≤ M24	700	450		0.4d	700	350 (Prop. Cl. -035)
80 high strength	≤ M24	800	600		0.3d	800	400 (Prop. Cl. -040)

For hexagon head, hexagon / hexalobular socket head cap and slotted/cross recessed screws, property class 70 is the usual. Fasteners made from stainless steels are tough and well suited for sub-zero temperatures (screws with head as low as –60°C, screws without head as low as –200°C according to DIN 267-13).

Austenitic materials cannot be hardened with heat treatment – Fasteners from austenitic materials (A1 – A5) have different assembly behaviour than quenched and tempered steel fasteners. Improper assembly can lead to failure (cold shut / fretting / breakage).

Magnetic properties: The magnetic properties are described by their permeability μ_π. Fasteners made from stainless steels are generally not magnetisable - magnetisation can occur through the manufacturing process: when particular requirements of magnetisability are set, this needs to be arranged accordingly.

A2:	$\mu_\pi \approx 1.8$
A4:	$\mu_\pi \approx 1.015$
A4L:	$\mu_\pi \approx 1.005$

Extract from ISO 3506-1

Finish of fasteners made from stainless steels shall be supplied clean and bright (passivation → ISO 16048).

Marking: Hexagon head screws/bolts, hexagon / hexalobular socket head cap screws, studs and nuts from a nominal thread diameter of ≥ M5 (studs from ≥ M6) are to be marked with the manufacturer's identification mark, the steel group and the property class.

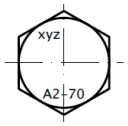


Table 5: Chemical composition in % according to ISO 3506 / EN 10088-3.

Steel group	Usual materials for screws / bolts / studs / nuts		Cr	Ni	Mo	C	Si	Mn	P	S	Other additions
	Material No. (AISI No.)	Material designation acc. EN 10088-3 / DIN 17006. 17440				Max	Max	Max	Max	Max	(ISO 3506 Table 1)
A1	1.4305 (303)	X8CrNiS 18-9	16-19	5-10	0.7	0.12	1.0	6.5	0.20	0.15-0.35	Cu, - Sulphur may be replaced by selenium
A2	1.4301 (304) 1.4303 (305)	X5CrNi 18-10 X4CrNi 18-12	15-20	8-19	*	0.10	1.0	2.0	0.05	0.03	* Mo permitted
A3	1.4541 (321)	X6CrNiTi 18-10	17-19	9-12	*	0.08	1.0	2.0	0.045	0.03	* Mo permitted – must contain Ti, Nb or Ta for stabilisation
A4	1.4401 (316)	X5CrNiMo 17-12-2	16-18.5	10-15	2.0-3.0	0.08	1.0	2.0	0.045	0.03	
A5	1.4571 (316 Ti)	X6CrNiMoTi 17-12-2	16-18.5	10.5-14	2.0-3.0	0.08	1.0	2.0	0.045	0.03	Must contain Ti, Nb or Ta for stabilisation. Austenitic / Austenitic-ferric steels with particular resistance against chloride-induced stress corrosion cracking e.g. in indoor swimming pools.
A-	1.4439	X2CrNiMoN 17-13-5	16.5-18.5	12.5-14.5	4.0-5.0	0.03	1.0	2.0	0.045	0.015	
A-	1.4539	X1NiCrMoCu 25-20-5	19-21	24-26	4.0-5.0	0.02	0.7	2.0	0.03	0.01	
A-	1.4529	X1NiCrMoCuN 25-20-7	19-21	24-26	6.0-7.0	0.02	0.5	1.0	0.03	0.01	
A/F – FA	1.4462	X2CrNiMoN 22-5-3	21-23	4.5-6.5	2.5-3.5	0.03	1.0	2.0	0.035	0.015	
C-	1.4034 (420)	X46Cr 13	12.5-14.5			0.43-0.50	1.0	1.0	0.04	0.03	Material for spring parts – e.g. according to DIN127, 128, 471, 472, 2093, 6797, 6798, 6799, 7967, 7980 **(Caution: Reduced spring load as opposed to spring steel)**
C-	1.4122	X39CrMo 17-1	15.5-17.5	≤ 10	0.80-1.30	0.33-0.45	1.0	1.5	0.04	0.03	
A-	1.4310 (301)	X10CrNi 18-8	16-18	6-9.5	≤ 0.8	0.05-0.15	2.0	2.0	0.045	0.015	
C-	1.4568 (301)	X7GNiAl 17-7	16-18	6.5-7.8		0.09	0.7	1.0	0.04	0.015	Al 0.70 – 1.5

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 6: Extract from the resistance list

Agents	Degree of resistance A2	Degree of resistance A4
Acetic acid, cold	1	1
Acetone, all conc.	1	1
Al (10%), cold	1	1
Saturated solution, boiling	3	1
Aluminium Acetate	1	1
Saturated, cold	2	1
Sulphate (10%), cold	1	1
Ammonium Carbonate	1	1
Nitrate	1	1
Sulphate, cold	1	1
Sulphite	1	1
Aniline	1	1
Azotic Acid up to 60%, cold	1	1
Beer	1	1
Benzene	1	1
Benzoic Acid	1	1
Benzol	1	1
Boric Acid	1	1
Butyl Acetate	1	1
Calcium Bisulphite, boiling	3	1
Bisulphite, cold	1	1
Hydroxide (10 - 50%), cold	1	1
Nitrate	1	1
Camphor	1	1
Carbon Dioxide	1	1
Disulphide	1	1
Tetrachloride, waterless	1	1
Chlorine, dry	1	1
Chloroform, waterless	1	1
Chromic Acid (10%), cold	1	1
Boiling	2	2
Citric Acid 50%, boiling	3	2
Saturated, cold	1	1
Copper Acetate	1	1
Arsenide	1	1
Nitrate	1	1
Sulphate	1	1
Creosote	1	1
Developer (photo)	1	1
Ethyl Acetate	1	1
Alcohol, all conc.	1	1
Ethyl Ether, boiling	1	1
Fatty Acid, 150°C	1	1
Formalin	1	1
Formic Acid, cold	1	1
Fruit Juice	1	1
Glue Oil	1	1
Glycerine	1	1
Hydrogen Cyanide	1	1
Peroxide	1	1
Sulphide	1	1
Iron Nitrate	1	1
Sulphate	1	1
Lactic Acid (80%), boiling	3	2
All conc., cold	1	1
Latex	1	1

Agents	Degree of resistance A2	Degree of resistance A4
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
Amalgam	1	1
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
Potassium Bichromate (25%)	1	1
Bitartrate, cold	1	1
Chlorate	1	1
Cyanide	1	1
Hydroxide (caustic potash)	1	1
Nitrate	1	1
Permanganate	1	1
Sulphate	1	1
Salicylic Acid	1	1
Salt water, 20°C	1L	1L
Soap	1	1
Sodium Aluminate	1	1
Bisulphate, boiling	1	1
Bisulphite, boiling	1	1
Carbonate (soda)	1	1
Hydroxide, cold	1	1
Nitrate	1	1
Perchlorate	1	1
Phosphate	1	1
Silicate	1	1
Sulphide	1	1
Sulphite	1	1
Sulphur (molten)	1	1
Chloride, waterless	1	1
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/m^2 x h)

2 – conditionally resistant (substance loss of 0.1 to 1.0 g/m^2 x h)

3 – not very resistant (substance loss of 1.0 to 10.0 g/m^2 x h)

4 – not resistant (substance loss over 10.1 g/m^2 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 1.4404 1.4571
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
Loaded fasteners without refilling / fasteners which do not come into contact with pool water which do not have to be cleaned regularly (e.g. pendant lamp holders, ceiling suspensions, water slides)	1.4539* 1.4529* 1.4565* 1.4547*

* General technical approval Z-30.3-6 (DIBT / Germany)

The mechanical properties of fasteners from non-ferrous materials as well as their quality inspection and marking are set in ISO 8839.

Table 7: 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
CU1	E-Cu57	2.0060	240	160	14	-
CU2	CuZn37 (MS 63)	2.0321	370-440	250-340	19-11	Storage of compressed parts
CU3	CuZn39Pb3 (MS 58)	2.0401	370-440	250-340	19-11	Storage of tuned parts
CU4	CuSn6	2.1020	400-470	200-340	33-32	-
CU5	CuNi1, 5Si	2.0853	590	540	12	Saltwater-proof
CU6	CuZn40MnPb	2.0580	440	180	18	-
CU7	CuAl10Ni	2.0966	640	270	15	-
AL1	AlMg3	3.3535	250-270	180-230	4-3	Conditionally saltwater-proof
AL2	AlMg5	3.3555	280-310	200	6	Saltwater-proof
AL3	AlMgSi1	3.2315	310	250	10-7	-
AL4	AlCuMg1	3.1325	380-420	260-290	10-6	-
AL5	AlZnMgCu0.5	3.4345	460	380	7	-
AL6	AlZnMgCu1.5	3.4365	510	440	7	-
Ti1	Titanium (Titanium 99.5)	3.7025	290	180	30	Storage
Ti2	TiAl6V4	3.7165	890	820	10	-

Table 8: 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% non-proportional elongation $R_{p0.2}$ 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	450	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 / Mn0.5	340-420	120-300	35-14

Table 9: Plastic materials (thermoplastics) fasteners and special parts
(General values – Further details – Spec. coarse tolerance VDI 2544 or on request)

Material Code	Material group (trade name)	Density g/cm²	Yield stress dry-humid approx. N/mm²	Elongation after fracture Ca. %	Modulus of elasticity dry-humid approx. N/mm²	Operating temperature - / + approx. °C
PA 6	Polymide 6 (Ultramide)	1.14	80-30	130-220	2700-1800	-40 / +80-130
PA 66	Polymide 6.6 (Ultramide)	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 Hostaken PH	0.91	30-35	15	100-1300	-10 / +100-120
PA12	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	-10 / +100-140

Fasteners in stock = PA 6 / PA 66 natural-colour / milky-white, if not specified otherwise.
From the order materials, fasteners can be supplied on short notice, other materials on request.

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, these include:

- **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 like, for example: 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 customer 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 (→ ISO 898-1)
     - hardness testing, proof load testing
     - bolt head impact/diagonal pull testing
     - surface decarburisation testing
   - for nuts (→ 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 (approximately +20°C).

2. **Additional tests – Certificates according to EN 10204**
   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 Certificate (inspection document), which the customer shall receive as either an original or an unmodified copy.

   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 on ordering.

3. **Inspection contents - according to DIN 11204**
   If there are no specifications on the scope of the test contents agreed in the order, DIN 11204 shall apply.
   This standard regulates the test contents of certificates according to EN 10204 for fasteners.

Table 1: Test contents for screws according to DIN 11204

Section Designation	Details
Tensile Test: Shape of test pieces	Tensile test of the entire screw: For the screws M6 to M39 according to ISO 898-1, ISO 3506-1, ISO 8839 or DIN 267-13, as long as the geometry of the screws is suited for the tensile test on the entire screw. In case a tensile test should be carried out on the cylindrical sample, this needs to be arranged at the time of ordering.
Tensile Test: Tensile strength	-
Hardness Test: Test method	Symbol denoting test method.
Hardness Test: Individual values	Does not apply for ISO 8839 and austenitic steels of the types A1 to A5 according to ISO 3506-1 or ISO 3506-2
Torsional Test: Breaking torque	For screws ≤ M5. For all property classes according to ISO 898-1, for austenitic steels of the types A1 to A5 according to ISO 3506-1 and for non-ferrous metals according to ISO 8839 as long as the geometry of the screw is suited to the torsion test according to ISO 898-7.
Chemical Composition	Cast analysis/product analysis according to the product specifications.

Table 2: Test Contents for nuts according to DIN 11204

Section Designation	Details
Proof Load Test	For nuts M6 to M39 according to ISO 898-2, ISO 898-6, ISO 3506-2, ISO 8839 and DIN 267-13, if specified.
Hardness Test: Test method	Code of the hardness testing procedure.
Hardness Test: Individual values	Does not apply for ISO 8839 and austenitic steels of the types A1 to A5 according to ISO 3506-1 or ISO 3506-2.
Chemical Composition	Cast analysis/product analysis according to the product specifications.

Costs for additional testing are not contained in the product price.

Table 3 provides information on types of test certificates which have proven themselves as requirements for screws, nuts and other form and accessory parts.

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 3: Overview of the usual inspection documents for screws, bolts, studs, nuts and accessory parts
Extract from EN 10204 – Jan 2005 (previously DIN 50049)

Standard Marking	2.1 [1]	2.2 [1]	3.1	3.2
Certification	Declaration of compliance with the order	Test report	Inspection certificate	
Type of Inspection	Not specific no testing / evaluation of testing results of the delivery batch / parts of the delivery itself		Specific [2] = Testing is done on the delivery batch/parts of the delivery itself	
Content of the Certification	No test results (= informal manufacturer confirmation, that the delivered products correspond to the agreements made on ordering)	Test result on the basis of non-specific tests (= from current series manufacturing records and not from tests on parts of the delivery batch	Test results on the basis of specific tests [2] = Evaluation and documentation of actual values from testing of parts of the delivery batch itself [2]	
Terms of Delivery	According to the terms of the order		According to the delivery terms of the order [3] = specified testing requirements of the customer (also according to the technical regulations AD / TRD)	
Confirmation Certification by	The manufacturer		The acceptance-testing officer independent of the processing department of the manufacturer	As 3.1 + the technical expert commissioned (prescribed) by the customer [4]
Order example: Addendum to article text: "… with test certification according to EN 10204-3.1"				

[1] not recommended since there is no specific statement on the delivered product
[2] the sample quantities required for destructive inspections are to be taken into account when deciding the order quantity
[3] e.g. specification of the yield strength / impact testing with specified high and low temperatures, particular crack testing procedures, etc.
[4] according to the specifications of the customer, e.g. TÜV, GL, DB...

4. Acceptance testing for "Mechanical fasteners"
Extract from ISO 3269 (previously DIN 267-5)

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.

Since the mass production of standard parts for general use cannot be assumed to be free of individual errors or defective parts for economic reasons, the expectation of zero-error deliveries is fundamentally not standard-compliant (→ ISO 3269, "Introduction").

For sample test instructions during incoming goods inspections, ISO 3269 prescribes values for an "Acceptable Quality Level (AQL)" to which an acceptance number (Ac) is assigned. Ac is the highest count of defective parts in a sample test for which the test batch can still be accepted.

The assignment of AQL values is determined according to the following:
- Product type, e.g. screws, nuts, washers, bolts, pins, rivets
- Product (tolerance) classes: A, B or C
- Function-relevant characteristics = AQL value 1.5-1.0
- Other characteristics = AQL value 4.0-2.5
- Mechanical properties = AQL value 1.5-0.65

Details important for the functional compliance of the parts include, for example drive, thread. Other characteristics include, for example, minor measurement/type deviations which do not negatively affect the usability.

Table 4 shows the ratio of AQL value to the acceptance number for the same sample test extent as an example as well as the mathematical limit value (%) for the number of defective parts in the delivery batch (deliverer's risk max. 5%).

Table 4: Ratio AQL values: Acceptance numbers

Samples Test Scope	AQL Value	Acceptance Number, Ac	Limit Value Nonconforming Fasteners, %
125	0.65	2	1.6
125	1.0	3	2.4
125	1.5	4	3.2
125	2.5	6	4.8
125	4.0	8	6.4

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 work piece.

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 is only part of routine and comparative checks. They are not themselves decisive for determining mechanical characteristics.

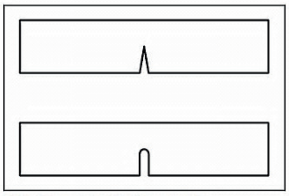
For screws, the tensile test is determining the tensile strength, yield strength limit and elongation. For nuts, proof load tests and expansion tests are applicable. (ISO 898-1, DIN 267-21, ISO 898-2).

Table 2 shows a conversion of the harnesses 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

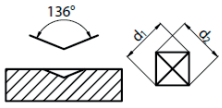
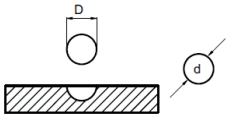
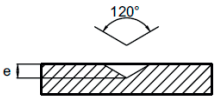
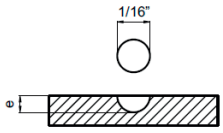
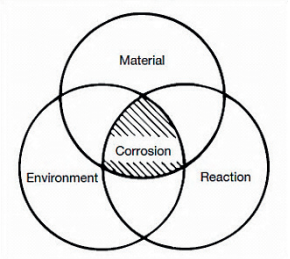
Procedure, Marking	Vickers (HV)	Brinell (HB)	Rockwell	
			HRC	HRB
Standard	ISO 6507-1, 2 (DIN 50133)	ISO 6506 (DIN 50351)	ISO 6508 / EN 10004 (DIN 50103-1)	
Suitable for material	Metallic materials with very low to very high hardness level (specification of medium hardness)	Metallic materials with very 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 approximate (R_m in N/mm^2)	< 250 – 2000	255 – 1520	770 – 2000	250 – 800
Penetrator				
	Diamond pyramid, quadratic base area, surface angle 136° 	Ball from hardened steel, diameter: 10/15/2.5 or 1mm 	Diamond cone, cone angle 120° Tip: Radius of curvature 0.2mm 	Ball from hardened steel Diameter: 1/16" = 1.5875mm 
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 F0 + Test load F1 = 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 — Rockwell Hardness Procedure C; determined hardness value	45 HRB — Rockwell Hardness Procedure B; determined hardness value

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 ≥ 0.5d**					Nuts m < 0.5d Thread Pins				Washers / Rings		
HV10	HB	HRB	HRC	MPa	4.6	5.6	8.8	10.9	12.9	5	6	8 04	10 05	12	14H	17H	22H	45H	St.	St. hardness	FSt.
80	76			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				140		
150	143	78.7		480		155															
155	147			495																	
160	152	81.7		510																	
165	156			530												170					
170	162	85.0		545																	
175	166			560								188 / 233									
180	171	871		575																	
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	204	94.0		690											215		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			≤ M16														
250	238	99.5	22.2	800			250									245					
255	242		23.1	820	250	250													250		
260	247	(101)	24.0	835																	
265	252		24.8	850			> M16						272								
270	257	(102)	25.6	865			255														
275	261		26.4	880																	
280	266	(104)	27.1	900																	
285	271		27.8	915										295	G. St.					295	
290	276	(105)	28.5	930											290						
295	280		29.2	950																	
300	285		29.8	965																	
310	295		31.0	995			≤ M16	320									300			300	
320	304		32.2	1030			320														
330	314		33.3	1060																	
340	323		34.4	1095			> M16														
350	333		35.5	1125			335														
360	342		36.6	1155								302 / 353	353	353							
370	352		37.7	1190					385												
380	361		38.8	1220																	
390	371		39.8	1255				380													
400	380		40.8	1290																	
410	390		41.8	1320																400	
420	399		42.7	1350																	
430	409		43.6	1385																	430
440	418		44.5	1420					435												
450	428		45.3	1455														450			
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														560			530
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 value.

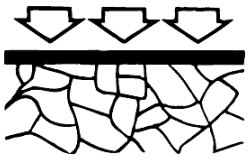
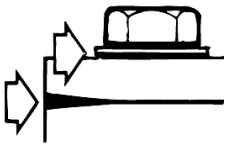
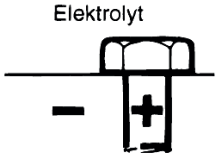
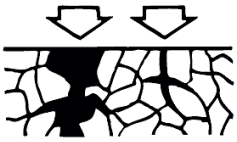
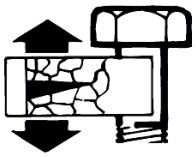
General information



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 show 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 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

S = strong corrosion of the observed material
M = moderate corrosion of the observed material (in very humid environment)
G = negligible zero corrosion of the observed material

In regard to contact corrosion of observed material	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	G	M	S	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	M	G		G	G	
	large	G	G	G	G	G	G	G		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		G	M		
	large	G	G	M	G	G	G	G	G	M	M	M	G	

* 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

Surface measures
Table 3:

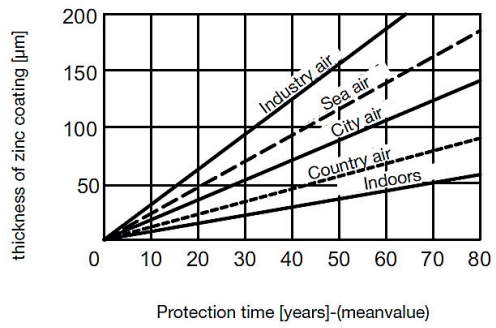
Measures	Procedures	Coatings	Coat Thickness µm	Standards Brand Names
Non-metallic coatings (inorganic / *organic coatings)	Lubrication	Oil	-	ISO 8992
	Browning, oxidising	Iron oxide coat	0.5 – 2	DIN 50938
	Phosphate-coating	Phosphate coat	-	EN 12476 (DIN 50942)
	Thin layer coats of lacquer*	Lacquer / Plastic / Resin (Fluoropolymer / TEFLON)	3 – 20	DELTA-SEAL, IRCO-SEAL, KLEVER-C0L, XYLAN, PTFE, STAND-COTE
	Dip coating*	Epoxide resin / Polyester / Phenolic resin	10 – 20	KTL-KATAPHORESE, ECO 2000
	Powder coating*	Polyester powder	60 - 90	PULVER-COLOUR, 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 Zn	Zinc	Min. 40	ISO 10684 (DIN 267-10) ISO 1461
	Mechanical plating (plated coatings)	Zinc powder on sub-layer copper-plating (chromating possible)	6 – 107	ISO 12683
	Diffusion coatings	Zinc powder burned in / on	15 – 45	EN 13811: SHERARD galvanising ISO 14713-3
	Zinc flake coatings (dispersion coatings)	Zn / Al flake (argentine)	5 - 20	ISO 10683, DACROMET / GEOMET, DELTA-TONE, ZINCTECH
Combi / Duplex coatings (inorganic + organic coatings)	**Metal / Dispersion coatings*** (=inorganic basecoat)	Zn / Al flake + thin lacquer (argentine or coloured)	8 – 15	DELTA-TONE + DELTA SEAL / DELTA-PROTEKT DELTA-PROTEKT KL + VH, GEOMET PLUS VL
	+ Thin layer lacquering*/** (=organic top-coat)	Zn / Al flake + thin lacquer (black)	8 – 15	BACROBLACK, GEOBLACK

* Partial coating possible, lubrication integration possible
** Staining possible

Material measures
Table 4:

Measures	Procedures	Coatings	Standards	Brand Names
Non-ferrous metal (NF)	Copper (Cu) Brass (CuZn) Bronze (CuNiSi, CuSn)	- Ni plated, Cr plated, browned -	ISO 8839 (DIN 267-18) (galv. Coatings ISO 4042 [DIN 167-9])	KURBUS Special brass 59 KUPRODUR
	Aluminium (Al)	Anodised	-	-
	Titanium / Titanium alloys	-	ISO 8893 (DIN 267-18)	-
Non-metallic material (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 17244)	-
	Austenitic steels (A) A1 = 1.4305 A2 = 1.4301, 1.4303 A4 = 1.4401 A3 = 1.4541 A5 = 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.
Special materials	Nickel, nickel alloys	Metallic, bright-polished	DIN 17740, 17742 - 44	INCONEL, HASTELLOY, MONEL …
	Special copper alloys Multi-component bronzed		DIN 17662 – 17665	Sn / Al bronze, NEUSILBER, RESISTIN, CUNIFER …
	Special steels		EN 10269 (DIN 17240), SEW 390	URANUS, SICROMAL, MANOX …

Table 5: Yearly erosion values for zinc
(for flat surface corrosion)



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.

Table 6: Service conditions / Layer thickness for zinc plated steel

Service condition (Areas of application)		Allocation of zinc layer thickness in µm	Description examples
0	"very mild" (Decorative use without strain)	3 – 5 ①	"zinc plated" A 1 A / B / F A 2 A / B / F Fe / Zn 3 / 5
1	"mild" (Indoor conditions in warm, dry atmosphere)	5 – 8 ①	"zinc plated" A 2 C / D A 3 A / B / F Fe / Zn5 / 8
2	"moderate" (Indoor conditions in rooms in which condensation may occur)	8 – 12 ②	A 3 C / D Fe / Zn12 A / F FE / An8 / 12
3	"strong" (Outdoor weathering under moderate conditions)	12 – 25 ②	A 4 C / D A 5-6 / B-G A 7 A / F Fe / Zn 12-25
4	"very strong" (Outdoor weathering under difficult corrosive conditions – e.g. sea / industry environment)	25 ③	A 7 C / D Fe / Zn25 c 2 C / D

① Corresponds to general standard stock type
② ③ Observe maximum layer thickness according to Table 8.
Thread side / oversize required, choose hot dip galvanization if necessary
\- Extract from EN 1403, 12329 (protective effects differ in practice)

Table 7: Reference values for corrosion and temperature resistance of galvanizing on steel

Coating	Cr(VI)-free	Coating thickness (µm)	Salt Spray Test according to ISO 9227		Temperature resistance Coating up to approx. …°C
			White rust (h)	Red rust (h)	
Zinc plated Colourless / blue passivated(1)	Yes	3 5 8	2 12 24	12 36 72	60
Zinc plated Yellow chromated(1)	No	5 8	48 72	72 120	60
Zinc plated Olive chromated(1)	No	5 8	72 96	96 144	60
Zinc plated Black chromated(1)	No	5 8	12 24	- 72	60
Zinc plated colourless / blue passivated with sealing (2)	Yes	5 8	72 72	96 120	60
Zinc plated thick layer passivated (TLP) with sealing (2)	Yes	5 8	48 72	72 120	120
Zinc plated thick layer passivated with sealing (2)	Yes	5 8	96 96	168 240	120
Zinc plated black passivated with sealing (2)	Yes	5 8	24 24	72 96	60
ZnFe black without sealing (2) (3)	Yes	5 8	24 24	48 72	100
ZnFe black with sealing (2)	Yes	5 8	120 120	196 240	
ZnNi black without sealing (2) (3)	Yes	5 8	24 24	360 480	180
ZnNi black with sealing (2)	Yes	5 8	120 120	600 720	
ZnNi transparent without sealing (2)	Yes	5 8	120 120	360 600	180
ZnNi transparent with sealing (2)	Yes	5 8	144 144	480 720	
Zinc flake coating with chromate (Cr-(VI))	No	5 8	- -	480 720	150 / 180 (4)
Zinc flake coating without chromate	Yes	6 8	- -	240 480	150 / 180 (4)

(1) Resistance according to ISO 4042 attachment B (informative)
(2) Typical values for drum goods, before first assembly and without thermal processing. All surfaces with sealant are only electrically conductive to a limited extent.
The friction coefficients vary and need to be inspected when undertaking actual installation work.
(3) Limited abrasion resistance of the black surface
(4) Temperature dependent on the product used

The technical conditions of delivery ISO 4042 apply to electroplated coatings on standard and non-standard fasteners.

Example for a short description of the desired electroplated coatings:

Description according to ISO 4042 – attachment B
(e.g. ISO 4014 – M16 x 60 – 8.8 Fe/Zn5c Bk)

Fe / Zn	5	c	Bk
			Type of chromating Bk = Black
		Chromation	
	Minimum coat thickness of the coating metal 5 = 5µm (eff. detail)		
Type of application of the coating material, whereby Fe = iron / steel describes the basic material and Zn = Zinc, the coating material			

Description according to ISO 4042 – attachment E
(e.g. ISO 4014 – M16 x 60 – 8.8 A2S)

A	2	S
		Degree of gloss and post-processing of the chromation S = blasck
	Code number for the minimum layer thickness and layer composition 2 = 5 µm (encrypted detail)	
Code letter for coating metal A = zinc		

a) Coating metal

A = Zn	= Zinc
B = Cd	= Cadmium
C = Cu	= Copper
D = CuZn	= Brass
E = Ni	= Nickel
F = NiCr	= Nickel-Chrome
G = CuNi	= Copper-Nickel
H = CuNiCr	= Copper-Nickel-Chrome
J = Sn	= Tin

b) Layer thickness / µm
(2 coating metals)

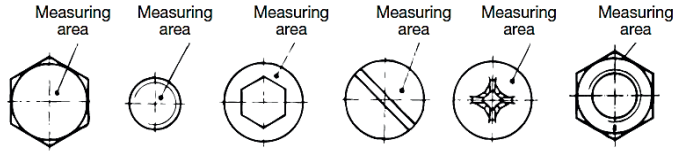
1 = 3	-
2 = 5	(2 + 3)
3 = 8	(3 + 5)
9 = 10	(4 + 6)
4 = 12	(4 + 8)
5 = 15	(5 + 10)
6 = 20	(8 + 12)
7 = 25	(10 + 15)
8 = 30	(12 + 18)

c) Post-processing passivation / chromation)

Degree of gloss			Type of process	Colour
A	=		A	Colourless
B	=	mt	B	Bluish
C	=	(matt)	C	Yellowish*
D	=		D	Olive*
E	=		A	Colourless
F	=	bk	B	Bluish
G	=	(black)	C	Yellowish*
H	=		D	Olive*
J	=		A	Colourless
K	=	gl	B	Bluish
L	=	(glossy)	C	Yellowish*
M	=		D	Olive*
P / U	=	any	Like B, C or D	
R	=	mt (matt)	F / Bk	Black*
S	=	bk (blank)	F / Bk	
T	=	gl (glossy)	F / Bk	

* Attention: Contains chrome VI

When testing, the later thickness at the measuring point applies.



Normal storage:
ZP = zinc plated
YZP = zinc plated yellow
ZPTLP = zinc plated 8 TLP

Layer thickness = Type (≥ M5)
Approximate 5µm = A2A / A2B / A2E / A2F
Approximate 5µm = A2C / A2G / A2L
Approximate 8µm with thick layer passivation

The thread tolerances apply before the coatings are plated (when coating, the zero line may not be exceeded with screw threads or come up short with nut threads). Thus the screw thread with coating can be positioned between the upper size of the tolerance field and the zero line.

In the interest of threadability, the layer thickness for thread parts with a normal degree of tolerance of 6g/6H is logically limited. The empirically recommended limit values possible according to ISO 4042 can be found in Table 8. Thicker coatings require different tolerance zones with larger sizes according to DIN 13-14 (custom-made).

When inspecting the threadability, ISO 6157-1 (DIN 267-19, Section 2.7) needs to be observed.

Table 8: Maximum layer thicknesses for outer threads with thread tolerance group g

Thread Ø M	Pitch	Maximum coat thickness (µm) According to ISO 4042 (1) Screw Length			Practice value (2) 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	9
10 -16	1.5 – 2	8	5	5	5	9
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
65	6	20	15	12	12	10

(1) mathematical limiting value according to ISO 4042, Table 2
(2) recommended limiting value from practice in due consideration of manufacturing and procedural faults according to ISO 6157-1, -2

For electroplated coatings on high-strength fasteners with tensile strengths from approx. 1000 N/mm² (e.g. 10.9 ... 12.9) and hardened fasteners with hardness of approx. 320 HV or more, the danger of hydrogen embrittlement cannot be ruled out with any certainty, even with well-known methods. (ISO 4042 Abs. 6 / attachment A / ISO 15330).
For this reason, these fasteners are only electroplated coated when explicitly requested to do so and on the orderer's own responsibility.
(Alternative coatings → Table 3)

For hot dip galvanized fasteners, the technical conditions of delivery apply according to ISO 10684.

The minimum layer thickness of at least 40µm at the point of measurement stipulated by this standard requires that the thread dimensions be adjusted (see Table 9).

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.

Table 9: Basic measurements of the screw thread before hot dip galvanization – tolerance group 6az according to ISO 10684/ISO 965-4

Thread	M6*	M8	M10	M12	M14 M16	M18 M22	M24 M27	M30 M33	M36 M39	M42 M45	M48 M52	M56 M60	M64
Upper limit dimension (µm)	-290	-295	-330	-335	-340	-350	-360	-370	-380	-390	-400	-410	-420

* Not regulated by standards

After hot dip galvanization, the requirements of ISO 898-1 and ISO 898-2 apply to hot dip galvanized screws and nuts ≥ M12. For thread sizes M8 and M10, reduced resilience applies according to ISO 10684.

Table 10: Min. tensile strength [N] for screws of the 6az tolerance

Property class Marking	4.6 4.6U	5.6 5.6U	8.8 8.8U	10.9 10.9U
M6*	7 075	8 844	14 150	17 687
M8	13 300	16 600	26 600	34 500
M10	21 400	26 800	42 900	55 700
M12	33 700	42 200	67 400	87 700
M16	62 800	78 500	125 000	163 000
M20	98 000	122 000	203 000	255 000
M24	141 000	176 000	293 000	367 000
M30	224 000	280 000	466 000	583 000
M36	327 000	408 000	678 000	850 000

* Not regulated by standards

Table 11: Proof loads [N] for nuts of the tolerance class 6AZ

Property class Marking	5 5z	6 6z	8 8z	10 10z
M6*	7 969	9 962	15 934	19 923
M8	17 300	20 000	25 500	30 600
M10	28 600	33 000	42 200	50 400
M12	51 400	59 000	74 200	88 500
M16	95 800	109 900	138 200	164 900
M20	154 400	176 400	225 400	259 700
M24	222 400	254 200	324 800	374 200
M30	353 400	403 900	516 100	594 700
M36	514 700	588 200	751 600	866 000

* Not regulated by standards

When assembly hot dip galvanized screws and nuts, especially with additional lubrication of the threading, different friction coefficients and tightening torques need to be reckoned with. DIN 18800-7/EN 1993 – 1 – 8 NA need to be considered for hot dip galvanized high-strength structural bolting assemblies! (→TI-attachment).

The zinc coating may give a small excess to the outer measurements (head, shaft).

Articles with hollow sections (e.g. keys for hexagon socket screws, cap nuts, etc.) are not suitable for hot dip galvanizing.

The grey appearance of the hot dip galvanizing is dependent on the material and not characteristic for the quality of the corrosion protection. White rust and/or whitish to dark corrosion points (zinc-oxide) which can occur after hot dip galvanization, e.g. through dampness, do not usually impair the corrosion protection and 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 (→DIN 18800-7, Section 8.3 (2)).

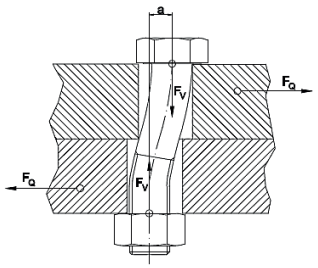
General information and tightening methods

General information
Functional quality and fatigue limit of fasteners are mainly determined with the following factors:

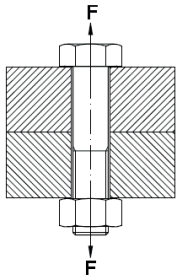
- Mechanical properties (tensile strength, yield strength, elongation)
- Operating conditions (static/dynamic...)
- Service conditions (temperature, corrosion)
- Dimensioning (diameter, length)
- Locking against loosening and unscrewing if necessary
- Assembly (tightening method, preload/clamp load, 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".

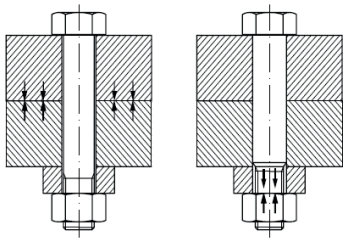
Fasteners should be evaluated and assembled in such a way that transverse loads (F_Q) perpendicular to the centre of the screw do not have any effect because of the sufficiently intact clamp load under operating conditions. Here, loss of clamp load due to intrusions of parts into materials also needs 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.

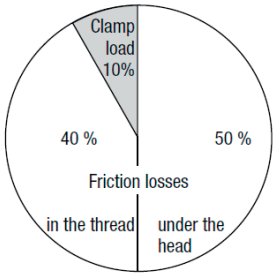


Transverse load F_Q



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 M12 are usually tightened beyond the yield strength, while screws over M14 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 M200 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 - 1.2 1.1 - 12.5	No	▪ elongation-controlled (ultrasound) ▪ elongation measurement (mechanical)	Ultrasound sensor (→PMT system) Setup and length measurement
I	±9 to ±17	1.2 - 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 μ_{total} for steel screws / nuts*

Surface condition		μ_{total} for condition		
Male thread (screw)	**Internal thread (nut / component)**	**Non-lubricated**	**Oiled**	**MoS_{2p} lubricated**
Without coating (black)	Without coating	0.12 – 0.18	0.10 – 0.17	0.06 – 0.12
Mn-phosphate		0.14 – 0.18	0.14 – 0.15	0.06 – 0.11
Zn-phosphate		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 μ_K for screws / nuts* from stainless steel

Screw / bolt and material of screwed part	Nut material	Lubricants		Resilience of the joint	Friction coefficient	
		In the thread	Under the thread		In the thread μ_G	Under the thread μ_K
A2 (~A4)	A2 (~A4)	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.

Preloads and tightening torque for fasteners of steel

Preloads and tightening torque for steel shank screws 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 MA:
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).
All figures are non-binding typical values.

Table 4: Coarse thread, friction coefficient μ_{total} = 0.14

Dimension		Stress area A_s	Preloads F_V (kN) for property class					Tightening torque M_A (Nm) for property class				
Thread Ø	Pitch	(mm^2)	4.6	5.6	8.8	10.9	12.9	4.6	5.6	8.8	10.9	12.9
M4	0.7	8.78	1.28	1.71	4.30	6.30	7.40	1.02	1.37	3.3	4.8	5.6
M5	0.8	14.2	2.10	2.79	7.00	10.3	12.0	2	2.7	6.5	9.5	11.2
M6	1.0	20.1	2.96	3.94	9.90	14.5	17.0	3.5	4.6	11.3	16.5	19.3
M8	1.25	36.6	5.42	7.23	18.1	26.6	31.1	8.4	11	27.3	10.1	46.9
M10	1.5	58.0	8.64	11.5	28.8	42.2	49.4	17	22	54	79	93
M12	1.75	84.3	12.6	16.8	41.9	61.5	72	29	39	93	137	160
M14	2.0	115	17.3	23.1	57.5	84.4	98.8	46	65	148	218	255
M16	2.0	157	23.8	31.7	78.8	115.7	135.4	71	95	230	338	395
M18	2.5	193	28.9	38.6	99.0	141	165	97	130	329	469	549
M20	2.5	245	37.2	49.6	127	181	212	138	184	464	664	773
M22	2.5	303	46.5	62.0	158	225	264	186	250	634	904	1057
M24	3.0	353	53.6	71.4	183	260	305	235	315	798	1136	1329
M27	3.0	459	70.6	94.1	240	342	400	350	470	1176	1674	1959
M30	3.5	561	85.7	114	292	416	487	475	635	1597	2274	2662
M33	3.5	694	107	142	363	517	605	645	865	2161	3078	3601
M36	4.0	817	125	167	427	608	700	1080	1440	2778	3957	4631
M39	4.0	976	151	201	512	729	853	1330	1780	3597	5123	5994
M42	4.5	1117	212	265	584	832	974	1605	2006	4413	6285	7354
M45	4.5	1302	249	311	684	974	1140	2005	2506	5512	7851	9187
M48	5.0	1468	280	350	770	1096	1283	2424	3030	6667	9495	11112
M52	5.0	1753	335	419	922	1314	1537	3116	3896	8570	12206	14284
M56	5.5	2024	387	484	1064	1516	1774	3883	4854	10678	15208	17797
M60	5.5	2356	452	565	1242	1770	2071	4818	6022	13249	18870	22082
M64	6.0	2669	511	639	1406	2003	2344	5802	7252	15955	22724	26592
M68	6.0	3047	585	732	1610	2293	2683	7012	8765	19282	27462	32137
M72	6.0	3451	665	831	1828	2603	3046	8379	10474	23043	32819	38405
M76	6.0	3881	749	936	2059	2933	3432	9903	12378	27232	38785	45387
M80	6.0	4335	838	1047	2304	3282	3840	11610	14514	31930	45476	53216
M90	6.0	5580	1083	1353	2977	4240	4962	16796	20995	46188	65783	76980
M100	6.0	6983	1359	1698	3736	5322	6227	23381	29226	64297	91574	107161

Table 5: Fine pitch thread, friction coefficient μ_{total} = 0.14

Dimension		Stress area A_s	Preloads F_V (kN) for property class			Tightening torque M_A (Nm) for property class		
Thread Ø	Pitch	(mm^2)	8.8	10.9	12.9	8.8	10.9	12.9
M8	1.0	39.2	19.7	28.9	33.9	29.2	42.8	50.1
M10	1.25	61.2	30.8	45.2	52.9	57	83	98
M12	1.25	92.1	46.8	68.7	80.4	101	149	174
M12	1.5	88.1	44.3	65.1	76.2	97	143	167
M14	1.5	125	63.2	92.9	109	159	234	274
M16	1.5	167	85.5	126	147	244	359	420
M18	1.5	216	115	163	191	368	523	613
M20	1.5	272	144	206	241	511	728	852
M22	1.5	333	178	253	296	692	985	1153
M24	2.0	384	204	290	339	865	1232	1442
M27	2.0	496	264	37	439	1262	1797	2103
M30	2.0	621	331	472	552	1756	2502	2927
M33	2.0	761	407	580	678	2352	3350	3921
M36	2.0	915	490	698	817	3082	4390	5137
M39	2.0	1082	581	828	969	3953	5631	6589

Table 4 and 5: up to M39 extract from VDI 2230-1, 2003-02, above M39 calculation based on VDI guideline 2230-1, 2003-02

Preloads and tightening torque for fasteners of steel

Preloads and tightening torque for countersunk head steel screws with hexagon/hexalobular socket

If, for example, countersunk head screws are tightened according to ISO 10642 (DIN 7991) using the hexagon socket, only preloads amounting to some 80% of the preloads of the corresponding property class can be applied. This is due to either the torsion strength of the screwdriver or the contact ratio in the hexagon socket. This also applies when tightening using a nut due to the existing critical stress area between the hexagonal socket and the shank. The same applies for countersunk head screws with hexalobular socket. For screws with fine pitch thread, the same tightening torque is to be used. Table 6 contains non-binding typical values for the total friction coefficient μ = 0.14, valid for screws with coarse thread according to DIN 7991 or ISO 10642 in property classes 8.8 and 10.9.

Table 6: Typical values for countersunk heads screws with hexagon / hexalobular socket, friction coefficient μ_{total} = 0.14

Dimension	Preloads F_V (kN) for property class		Tightening torque M_A (Nm) for property class	
	8.8	10.9	8.8	10.9
M4	3.10	4.40	2.6	3.4
M5	5.10	7.30	5.6	6.7
M6	7.20	10.30	9.6	11.6
M8	13.20	18.90	23	28.3
M10	21.00	30.10	46	56.0
M12	30.70	43.90	81	96.8
M14	42.00	60.30	125	154.0
M16	58.00	82.70	195	239.0
M18	72.80	100.90	275	332.0
M20	93.60	129.40	390	468.0

Preloads and tightening torque for steel shank screws with UNC/UNF threads and head contact area sizes according to ASME B18.2.1, ASME B18.3 and ASME B18.2.2

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 values in Tables 7 and 8 are to be determined using the VDI guideline 2230-1: 2003-02

Table 7: Typical values for hexagon head screws with UNC threads, friction number μ_{total} = 0.14

Dimension		Preloads FV (kN) (lbf) for property class								Tightening torque MA (Nm) (ft-lbs) for property class							
		Grade 5*		Grade 8*		Type 2*		Type 3*		Grade 5*		Grade 8*		Type 2*		Type 3*	
Ø	M	[kN]	[lbf]	[kN]	[lbf]	[kN]	[lbf]	[kN]	[lbf]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]
1/4	20	10.1	2260	14.2	3194	-	-	-	-	12.1	8.95	17.1	12.6	-	-	-	-
5/16	18	16.7	3764	23.7	5319	-	-	-	-	25.7	18.9	36.3	26.7	-	-	-	-
3/8	16	24.9	5594	35.2	7094	-	-	-	-	44.6	32.9	63.0	46.4	-	-	-	-
7/16	14	34.2	7684	48.3	10858	-	-	-	-	70.9	52.3	100	73.9	-	-	-	-
1/2	13	45.8	10300	64.7	14554	45.8	10300	45.8	10300	109	80.3	154	114	109	80.3	109	80.3
5/8	11	73.2	16464	103	23265	73.2	16464	73.2	16464	213	157	301	222	213	157	213	157
3/4	10	109	24485	154	34599	109	24485	109	24485	383	283	541	399	383	283	383	283
7/8	9	151	33891	213	47889	151	33891	151	33891	614	453	868	640	614	453	614	453
1	8	198	44499	280	62879	198	44499	198	44499	922	680	1303	961	922	680	922	680
1 1/8	7	219	49326	252	79166	-	-	219	49326	1153	850	1850	1364	-	-	1153	850
1 1/4	7	280	62934	449	101005	-	-	280	62934	1618	1194	2597	1916	-	-	1618	1194
1 3/8	6	333	74796	534	120043	-	-	333	74796	2121	1565	3405	2511	-	-	2121	1565
1 1/2	6	406	91358	652	146624	-	-	406	91358	2806	2070	4504	3322	-	-	2806	2070

Table 8: Typical values for hexagon head screws with UNF threads, friction number μ_{total} = 0.14

Dimension		Preloads FV (kN) (lbf) for property class								Tightening torque MA (Nm) (ft-lbs) for property class							
		Grade 5*		Grade 8*		Type 2*		Type 3*		Grade 5*		Grade 8*		Type 2*		Type 3*	
Ø	M	[kN]	[lbf]	[kN]	[lbf]	[kN]	[lbf]	[kN]	[lbf]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]	[Nm]	[ft-lbs]
1/4	28	11.8	2653	16.7	3749	-	-	-	-	13.8	10.2	19.5	14.4	-	-	-	-
5/16	24	18.9	4252	26.7	6008	-	-	-	-	28.3	20.9	40.0	29.5	-	-	-	-
3/8	24	28.9	6486	40.8	9165	-	-	-	-	50.0	36.9	70.7	52.2	-	-	-	-
7/16	20	39.0	8758	55.0	12375	-	-	-	-	78.6	57.9	111	81.9	-	-	-	-
1/2	20	52.8	11861	74.6	16760	52.8	11861	52.8	11861	122	89.7	172	127	122	89.7	122	89.7
5/8	18	84.7	19050	120	26918	84.7	19050	84.7	19050	239	176	337	249	239	176	239	176
3/4	16	124	27814	175	39302	124	27814	124	27814	423	312	597	441	423	312	423	312

* Grade 5 (~8.8) and Grade 8 (~10.9) according to SAE J429, Type 2 and Type 3 (~8.8) according to ASTM A325.

Preloads and tightening torques of screwed fastenings from steel with locking elements

Table 9: Typical values for preloads F_V and tightening torques for screws and nuts with lock ribs under the flange

Material of screwed part	Property class 100/10													
	M5		M6		M8		M10		M12		M14x1.5		M16	
	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]
Steel R < 800 MPa	9000	11	12600	19	23200	42	37000	85	54000	130	74000	250	102000	330
Steel R_m ≥ 800 MPa		10		18		37		80		120		240		310
Malleable cast iron		9		16		35		75		115		230		300

Table 10: Typical values for preloads F_V and tightening torques F_V for hexagon socket cap screws with lock ribs under the flange

Material of screwed part	Property class 100/10									
	M5		M6		M8		M10		M12	
	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]
Steel R < 800 MPa	9000	13	12600	24	23200	45	37000	90	54000	150
Steel R_m ≥ 800 MPa		11		20		42		85		140
Malleable cast iron		10		19		39		80		120

Table 11: Typical values for preloads and tightening torques of locking screws and nuts

Material of screwed part	Property class 100/10								Property class 100/10			
	M5		M6		M8		M10		M12		M16	
	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[Nm]	F_V[N]	M_A[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 12: Typical values for tightening torque and pre-stressing forces of screwed fastenings with NORD-LOCK washers

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]	A4-70 [4]	A4-80 [4]	8.8 [1]	10.9 [2]	12.9 [3]	A4-70 [4]	A4-80 [4]
M4	3.5	5.9	7.1	2.6	3.4	3.1	4.1	4.6	2.0	2.7
M5	5.6	9.6	11.5	4.1	5.5	6	8.1	9.1	3.9	5.3
M6	8.0	13.6	16.3	5.9	7.8	10.2	14.1	15.8	6.9	9.2
M8	15	25	30	11	14	25	34	38	17	22
M10	23	39	47	17	23	50	67	75	33	43
M12	33	57	68	25	33	85	115	128	56	75
M14	46	78	94	34	45	136	183	204	89	119
M16	62	106	127	46	61	208	279	311	136	181
M18	76	130	156	56	75	291	391	437	191	254
M20	97	165	198	72	95	408	547	610	267	356
M22	120	205	246	89	118	557	745	831	364	485
M24	140	238	286	103	137	703	942	1052	460	613
M27	182	310	372	134	179	1028	1375	1533	671	895
M30	222	378	454	164	219	1401	1875	2091	915	1220
M33	275	468	562	-	-	1889	2526	2815	-	-
M36	324	551	662	239	319	2436	3259	3633	1591	2121
M39	387	659	790	-	-	3145	4203	4683	-	-
M42	445	757	908	-	-	3890	5202	5799	-	-

Source: www.norlock.com

1) Screws 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 μG = 0.14, friction coefficient of the lock washer μW = 0.15, utilisation of the minimum yield strength = 65%

Table 13: typical values for tightening torques of screwed fastenings with lock washers

Property Class Screws	Tightening torque M_A in Nm													
	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30
5.8	2.0	4.0	7.0	16.5	32	57	-	-	-	-	-	-	-	-
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
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
As a typical value, 10% should be added to normal tightening torque, M_A according to TD-xxx, Table 4 and 5.

High – strength structural bolting – System HV

Unlike, for example, the machinery directive or the pressure equipment directive, the EU directive on construction products 89/106/EWG does not determine any specifications for structures as a whole, but for individual construction products.

In terms of the directive, construction products include all those products which are manufactured in order to be permanently integrated into structures of buildings and ground works. Also fasteners are affected.

The following changes were made in the area of standardisation:

Standard	Contents	Dimension	Property class / hardness	Replaced By
DIN 6914	Hexagon bolts with large wrench size	M12 – M36	10.9	EN 14399 - 4
DIN 6915	Hexagon nuts with large wrench size	M12 – M36	10	EN 14399 - 4
DIN 6916	Round washers	13 - 37	295 – 350 HV	EN 14399 – 6
DIN 6917	Washer, square, wedge-shaped (for 1 profiles)	13 - 37	295 – 350 HV	remain valid
DIN 6918	Washer, square, wedge-shaped (for U profiles)	13 - 37	295 – 350 HV	remain valid
DIN 7999	Hexagon fit bolts with large wrench size	M12 – M30	10.9	EN 14399 – 8
DIN 18800 – 1	design and construction			EN 1993 –1-8*
DIN 18800 – 7	Execution an constructor's qualification			EN 1090–2*
Building rules list A	Includes products with U symbol (German quality approval)			
Building rules list B	Includes products with CE symbol (European quality approval)			

* not yet established in relation to building in Germany, DIN 18800 shall apply until further notice.

Since September 2007, products according to DIN 6914, DIN 6915 and DIN 6916 may no longer be manufactured.
Stocks of these products may continue to be delivered and used without limitation in accordance with Building Rules List B and DIN 18800 – 7.

The newly standardised HR system in DIN EN 14399 – 3 is not yet established in relation to German building law and may not be used for this reason. Alongside property class 10.9/10, this system also uses property class 8.8/8 and a different thread length identical to ISO 888. Furthermore, the system has a different failure principle. Unlike the HV system, which reacts upon stripping the nuts, the screw breaks in the freely loaded thread after ductile expansion in the HR system.

The DAST guideline 021 for bolted fastenings from hot dip galvanized assemblies of sizes M39 to M64 according to DIN 6914, DIN 6915, DIN 6916 has been valid since 2007. These products are to be identified with the U symbol.

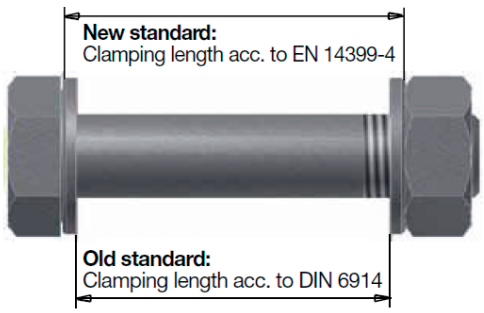
In DIN 18800-7 (525-Note 1), the thread tolerance for hot dip galvanized nuts (system HV) is determined uniformly with 6 AZ (higher limit deviation for the thread) so that the additional "U" identification required by ISO 10684 is no longer necessary.

All HV assemblies supplied by REYHER have batch IDs so that certificate 3.1 in accordance with DIN 18800-7 (527) is no longer required.

Significant changes:
In the EN 14399 standard series, the values for impact testing KV min = 27 J are no longer to be carried out at room temperature, but at -20°C. This promises good ductility even at low application temperatures.

For uncoated HV assemblies, the changed tightening torques according to DIN 18800-7 are to be taken into account. Since the introduction of EN 41399-4, these are identical to those of the hot dip galvanized assemblies.

In the new EU standard, the clamping length between the supporting surface of the screw head and the nut is measured (previously it was determined between the two HV washers). The new clamping table from EN 14399 – 4 is to be taken into account.



High-strength structural bolting – System HV

Table 14: Preloads and tightening torques for torque control, impact turn, angle torqueing and combined preloading methods for high-strength structural bolting assemblies (system HV) of the property class 10.9 according to DIN 18800-7 or the DAST guideline 021.

Dimension	Nominal Preload F_V kN	Torque Method Tightening torque M_A to be applied in order to achieve nominal preload F_V Nm	Impact Turn Method Preload $F_{V.DI}$* to be set in order to achieve nominal preload F_V kN	Angle Torqueing Method Preliminary tightening torque $M_{VZ.DW}$* Nm	Combined Preloading Method Preliminary tightening torque $M_{VA.KV}$ Nm
		Surface condition: hot dip galvanized, nut lubricated with MoS_2 Black assembly, nut lubricated with MoS_2			
M12	50	100	60	10	75
M16	100	250	110	50	190
M20	160	450	175	50	340
M22	190	650	210	100	490
M24	220	800	240	100	600
M27	290	1250	320	200	940
M30	350	1650	390	200	1240
M36	510	2800	560	200	2100
M39	610	3500**	According to factory standards / on request		
M42	710	4500**			
M45	820	5500**			
M48	930	6500**			
M56	1280	10000**			
M64	1680	15000**			

* Independent of the lubrication of the thread and the supporting surface of nut and screw
** Only applies to hot dip galvanized surface condition.

Table 15: Further rotation angle or rotation factor V for the combined preloading method for bolt and nut assemblies of property class 10.9

Total nominal thickness L_k of the components to be connected (including all lining plates and flat washers)	Further rotation angle	Further rotation factor V
$L_k < 2d$	45	1/8
$2d \le L_k < 6d$	60	1/6
$6d \le L_k < 10d$	90	1/4
$10d < L_k$	No recommendation	No recommendation

Table 16: Inspection of the preloading for nominal preloads**

Further rotation angle	Evaluation	Measure
< 30°	Preloading was sufficient	None
30° to 60°	Preloading was sufficient to limited extent	Leave assembly alone and inspect two adjacent joint in the same flange
> 60°	Preloading was sufficient	Change* assembly and inspect two adjacent joint in the same flange

* These inspected fasteners can only be left in the construction with predominantly statically stressed SLV or SLVP joints without any additional tensile stress.
** The inspection of the prestressing force is to be done on the screws in the joint according to DIN 18800-7.

Preloads and tightening torques for fasteners from stainless steel

For fasteners from 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 isrecommended that testing should be carried out under operating conditions.

While it is possible to reduce friction coefficients by using lubricating agents, the very high spread 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 A1–A5, in property classes –50, –70 and –80 at room temperature (approx. +20°C) andutilisation of the minimum yield stress of 90%.

The tightening torques listed in Table 17 may only be used **as very rough and non-binding typical values**.

Table 17

Ø	Prop. Class	Assembly preload in kN for μ_{total}								Tightening torque in Nm for μ_{total}							
		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
M4	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
	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	2.1	2.7	3.0	3.3	3.5	3.7	4.6	5.1
M5	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
	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
M6	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
	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
M8	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
	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
M10	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
	70	21.16	20.63	17.40	19.50	18.92	18.34	15.60	13.29	29.5	33.5	37.3	41.7	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
M12	50	14.38	14.03	13.65	13.27	12.87	12.48	10.62	9.05	23.8	27.1	3.1	32.9	3.4	37.8	46.8	52.3
	70	30.83	30.06	29.26	28.43	28.59	26.75	22.76	19.40	51	58	64.5	70.5	76	81	100.2	112.1
	80	41.10	40.08	39.01	37.90	36.78	35.66	30.35	25.87	68	77.53	85.9	93.9	101	108	133.6	149.5
M14	50	19.74	19.25	18.74	18.21	17.68	17.14	14.59	12.44	37.8	43	47.9	52.4	56.5	60.2	74.6	83.5
	70	42.31	41.26	40.16	39.03	37.88	36.73	31.27	26.65	81.1	92.2	103	112	121	129	160	179
	80	56.41	55.01	53.54	52.04	50.50	48.97	41.69	35.54	108	123	137	150	161	172	212	238.5
M16	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	117	131
	70	57.94	56.55	55.09	53.58	52.04	50.49	43.08	36.77	125	143	159	174	188	201	251	282
	80	77.25	74.40	73.46	71.44	69.39	67.33	57.44	49.03	166	190	212	233	251	269	334	375
M18	50	33.01	32.20	31.35	30.47	29.58	28.68	24.43	20.83	81.3	92.6	103	113	122	130	161	180
	70	70.73	69.00	67.17	65.29	63.38	61.46	52.34	44.64	174	198	221	242	261	278	345	387
	80	94.31	92.00	89.56	87.05	84.51	81.95	69.79	59.52	232	265	295	322	348	371	460	515
M20	50	42.27	41.26	40.20	39.10	37.79	36.84	31.34	26.83	144	130	146	160	173	184	230	258
	70	90.58	88.40	86.14	83.78	81.37	78.95	67.35	57.49	245	280	312	342	370	395	492	552
	80	120.8	117.9	114.9	111.7	108.5	105.3	89.8	76.7	326	373	416	456	493	527	565	736
M22	50	52.67	51.45	50.15	48.80	47.42	46.02	39.32	33.59	156	178	200	219	237	254	318	257
	70	112.87	110.24	107.46	104.56	101.61	98.60	84.25	~	334	382	428	470	508	544	680	~
M24	50	60.88	59.43	57.90	56.30	54.69	53.01	45.27	38.64	197	225	251	275	297	318	396	444
	70	130.5	127.4	124.1	120.7	117.2	113.7	97	~	421	482	537	589	637	680	848	~
M27	50	79.86	78.02	76.05	74.04	71.93	69.82	59.67	50.98	289	332	371	408	442	473	591	666
	70	171	167	163	159	154	150	128	~	620	711	79	873	946	1013	1267	~
M30	50	97.23	94.96	92.54	90.04	87.48	84.90	72.80	67.90	394	451	504	553	599	640	800	900
	70	208	203	198	193	187	182	155	~	844	966	1080	1186	1283	1373	1715	~
M33	50	121	118	115	112	109	106	90	77	531	610	683	751	813	871	1092	1230
M36	50	142	139	135	132	128	124	106	91	684	784	876	954	1044	1117	1398	1573
M39	50	170	166	162	158	154	149	128	109	883	1014	1137	1250	1355	1452	1822	2054

The prevailing torque type hexagon nuts from stainless steel sometimes tend to jam in the locking element due to the high thread flank pressure when inserting the screw thread. Here, treating the screwthread with an anti-friction agent usually helps. Accordingly, the changed friction coefficients are to betaken into account when assembly the screwed fastening.

Tightening torque for fasteners made from brass, polyamide and heat-resisting steel (1.7709)

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 18 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/mm^2 (e.g. MS 58 and MS 63) andutilisation 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 18

Ø	Assembly preload in kN for μ_{total}								Tightening torque in Nm for μ_{total}							
	0.10	0.12	0.14	0.16	0.18	0.20	0.25	0.30	0.10	0.12	0.14	0.16	0.18	0.20	0.25	0.30
M4	1.75	1.70	1.65	1.60	1.55	1.51	1.65	1.28	1.0	1.1	1.2	1.4	1.5	1.6	1.2	1.9
M5	2.85	2.78	2.70	2.62	2.54	2.46	2.7	2.09	2.0	2.2	2.5	2.7	2.9	3.1	2.5	3.8
M6	4.03	3.93	3.82	3.71	3.59	3.48	3.82	2.96	3.4	3.9	4.3	4.7	5.0	5.4	4.6	6.6
M8	7.39	7.20	7.01	6.84	6.60	6.40	7.01	5.44	8.3	9.4	10.5	11.4	12.3	13.1	10.5	16.2
M10	11.75	11.46	11.15	10.83	10.51	10.19	11.15	8.66	16.4	18.6	20.7	22.6	24.4	26.0	20.7	32.1
M12	17.13	16.70	16.25	15.79	15.33	14.86	16.25	12.64	28.3	32.2	35.8	39.1	42.2	45.0	35.8	55.7
M14	23.50	22.92	22.31	21.68	21.04	20.40	22.31	17.37	45.0	51.2	57.0	62.3	67.2	71.7	57	88.8
M16	32.19	31.42	30.61	29.77	28.91	28.05	30.61	23.93	69.3	79.2	88.4	96.9	105	112	88.4	139
M18	39.30	38.33	37.32	36.27	35.21	34.15	37.32	29.08	96.8	110	123	134	145	155	122.7	192
M20	50.32	49.12	47.86	46.54	45.21	43.86	47.86	37.42	136	155	173	190	205	219	173.3	273
M22	62.71	61.25	59.70	58.09	56.45	54.79	59.7	46.81	185	212	238	261	282	302	237.6	378
M24	72.48	70.75	68.93	67.04	65.11	63.17	68.93	53.89	234	268	299	327	354	378	298.5	471
M27	95.07	92.88	90.54	88.11	85.63	83.12	90.54	71.03	344	395	442	485	526	563	441.9	7.4
M30	116	113	110	107	104	101	110.17	86.31	469	537	600	659	713	762	600.1	953
M33	144	141	137	133	130	126	137.1	108	632	726	813	894	968	1036	812.7	1300
M36	169	165	161	157	152	148	161.1	126	814	934	1045	1148	1243	1330	1044.6	1664
M39	203	198	193	188	183	178	193.25	152	1051	1207	1353	1488	1613	1728	1353.1	2169

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 19

Ø	Tightening torque in Nm
M3	0.1
M4	0.25
M5	0.5
M6	0.8
M8	1.8
M10	3.5
M12	6.0
M16	12

Tightening torques for bolts with waisted shank made from steel 21CrMoV5-7 (1.7709)
Table 20 includes non-binding typical values for appropriate tightening torques for bolts according to DIN 2510 made from steel 21CrMoV5-7 +QT (1.7709) and an yield stress utilisation of 70%.

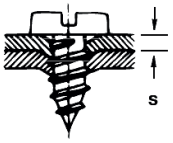
Table 20

Thread	M12		M16		M20		M24		M27	
Shank Ø	8.5		12		15		18		20.5	
μ_{total}	0.10	0.12	0.10	0.12	0.10	0.12	0.10	0.12	0.10	0.12
F_V [kN]	21.6	21.6	43.5	43.5	67.8	67.8	97.8	97.8	126.5	126.5
M_A [Nm]	38	44	98	115	190	220	320	370	465	545

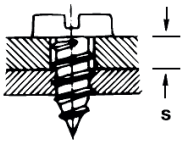
Thread	M30		M33		M36		M39		M42	
Shank Ø	23		25.5		27.5		30.5		32.5	
μ_{total}	0.10	0.12	0.10	0.12	0.10	0.12	0.10	0.12	0.10	0.12
F_V [kN]	160	160	196.5	196.5	228.5	228.5	281	281	319	319
M_A [Nm]	650	770	870	1000	1100	1300	1450	1750	1800	2100

General Assembly Instruction

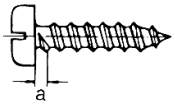
Screwing in of thinner sheet metal with continuous tapping holes or ones enlarged with a drift.



Screwing in of thicker sheet metal with drilled or punched tapping holes



Sheet metal thickness lower/upperlimit* s min/max
(a max = s min)



Ø / ST	2.2	2.9	3.5	3.9	4.2	4.8	5.5	6.3	8
$S_{min} = a_{max}$	0.8	1.1	1.3	1.3	1.4	1.6	1.8	1.8	2.1
S_{max}	1.8	2.2	2.8	3	3.5	4	4.5	5	6.5

S = sheet thickness
a = distance from head to thread

* With very thin metal sheet (< 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 A2/ A4 (→ISO 3506-4)**.**

When using synthetic-based screws, the following conditions apply.

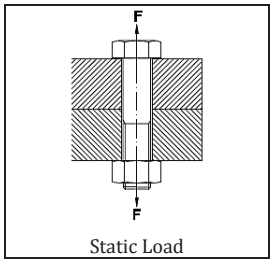
Table 21: Drilling hole diameters

Nominal thread diameter d,	For sheet thickness S		Drilling hole Ø (Tol. H12) for tapping screws from material					
			Hardened steel (min 450 HV)				Stainless Steel A2 / A4 (approximate 250HV)	
			Drift-enlarged / continuous hole Sheet from material		Drift / punched hole Sheet from material		Sheet from material	
	>	≤	St, Ni, MS, Cu, Monel	Al	St, Ni, MS, Cu, Monel	Al	Steel St.37	Al
2.2mm	-	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		
2.9mm		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
3.5mm		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
3.9mm		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

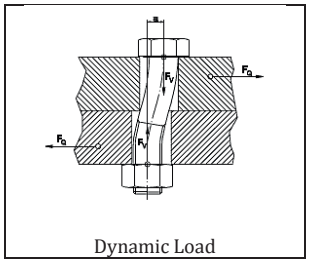
Nominal thread diameter d,	For sheet thickness* S		Drilling hole Ø (Tol. H12) for tapping screws from material					
			Hardened steel (min 450 HV)				Stainless Steel A2 / A4 (approximate 250HV)**	
			Drift-enlarged / continuous hole Sheet from material		Drift / punched hole Sheet from material		Sheet from material	
	>	≤	St, Ni, MS, Cu, Monel	Al	St, Ni, MS, Cu, Monel	Al	Steel St.37	Al
4.2mm	-	0.50	3.50	-	-	-	-	-
	0.50	0.63	3.50	3.50	3.20	-	-	-
	0.63	0.8	3.50	3.50	3.20	2.95	-	-
	0.8	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
4.8mm	-	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	4.10 – 4.20	4.20 – 4.30
5.5mm	-	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
6.30	-	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	5.0	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

A screwed fastening 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. If and how a screwedfastenings can come loose depends mainly on the stress.

With **static loads** in axial direction, settling, which is dependent on the number and shape ofthe separation joints between the tensile building components, can lead to a complete loss ofpreload. With this kind of load, loss of preload may be counteracted with certain constructivemeasures or by using screw-settling locks.
With **dynamic loads** which run laterally to the centre of the screw and are large enough to shiftthe stressed building components against each other, a loosening torque is generated which canovercome the self-retention of the joint. If this is the case, the joints will systematically loosenuntil they come apart or break the joint. These loads become especially critical when they occur alot. Fastener and unscrew locking devices may provide assistance here.



Static Load



Dynamic Load

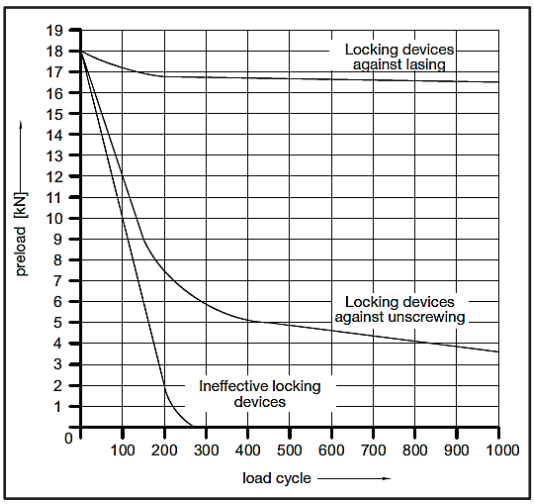
Measures against losing preload with static loads
To keep settling losses in a screwed fastening as low as possible, the number of separation joints between the building components are to be keptto a minimum. Every unnecessary washer is an additional separation joint. Even the insertion of "soft" washers (e.g. DIN 125 with 140 HV) in a highstrengthscrewed fastening (≥ property class 8.8) is to be avoided. By selecting a longer screw grip length, e.g. by using extension sleeves, preloadlosses can be absorbed by greater elastic elongation. The same effects are achieved by using shank expansion screws or screws with full thread or byusing 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 andthat the curved washer does not dig into the building component.

In contrast, DIN 127 and DIN 128 spring lock washers and DIN 137 spring washers are **ineffective**. Normally they are pressed flat, even at propertyclass 5.6 and lower, as determined in the area of use of the product standards, and are not able to balance out any intrusions of parts into materials.For this reason, engineering standards organisations have made allowances for the latest technology and withdrawn these standards.

Additional invalid locking elements are:-

- DIN 6798 serrated lock washers,
- DIN 6797 toothed lock washers,
- DIN 93, DIN 432 and DIN 463 locking plates,
- DIN 526 safety cups,
- DIN 7967 self-locking counter nuts.



In the past the products were assigned according to these standards to the category "Lockingagainst unwinding under dynamic lateral load". However, they do not comply with therequirements. For this reason, the standards mentioned have also been withdrawn. Additionally,sufficient electrical contact, as described in the area of use of these standards, cannot beguaranteed for the serrated lock washers or toothed lock washers, which is why DIN 6797 andDIN 6798 have also been withdrawn.

Measures against losing preload with dynamic lateral loads

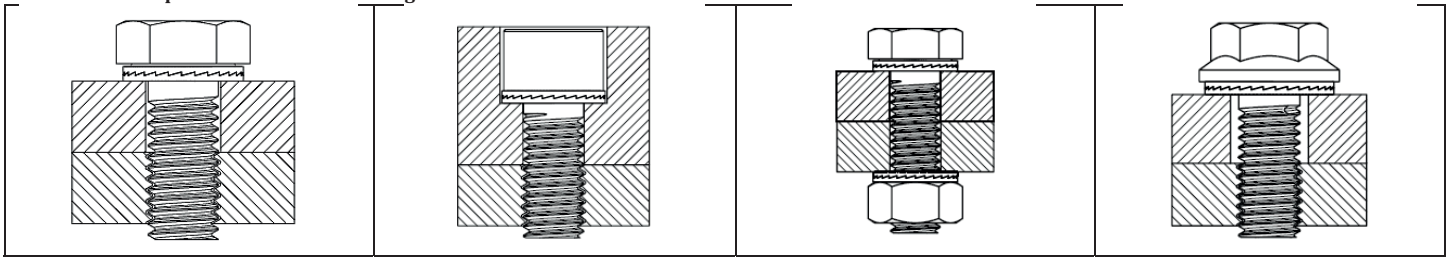
1) Locking devices against losing
While locking devices against losing do not prevent significant loss of preload, they do preventthe joint from coming apart completely. Usually, around 20% of the preload remains. The workingprinciple is based on the gripping action in the thread.

Products included in this category are:
- Prevailing torque type nuts
- Screws with locking element/coating
- Screws with adhesive coating
- Thread rolling screws

Locking coatings are described in DIN 267-28 and serve as locking devices against losing for locking screwed fastenings by generating frictionalcontact. They come in the form of plastic all-over coating, strip coating or spot coating, which have a locking effect when being screwed in (→ TI-109,Table 1).

2) Locking devices against unscrewing
Unscrew locking devices describe elements and methods which are made fundamentally for maintaining the preload in the screwed fastening despitestrong dynamic loads. Normally, this prevents the preload from dropping below 80% of the assembly preload. There are two basic locking methodspossible (form-fitting and adhering).

Installation example of washers with locking serrations



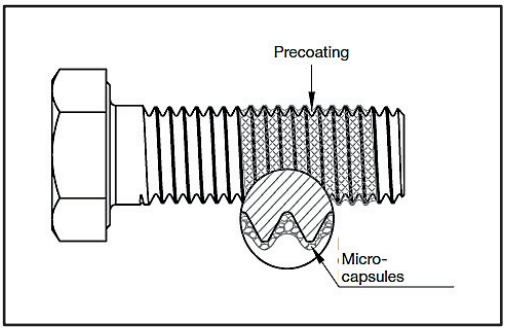
Form-fitting locking devices against unscrewing
Form-fitting is achieved by using locking serrations or ribs on the supporting surfaces of the screw head or nut. The use of washers with lockingserrations or ribs is also possible. Of particular importance here is that the surface hardness of the locking serrations/ribs be considerably strongerthan the building components to be connected so that they can dig themselves into the surface. Fundamentally, during assembly it needs to be madesure that locking occurs both under the screw head and under the nut as one of the two parts (screw or nut) may otherwise loosen from the buildingcomponents to be connected.

A product overview of form-fitting locking devices against unscrewing can be found in Table 3.

Furthermore, it should be noted that the friction coefficients are strongly affected by the locking serrations/ribs. As such, much higher frictioncoefficients (0.2 - 0.3) need to be reckoned with, when dealing with soft contact materials (aluminium alloys, construction steel), into which theserration dig. The tightening torques need to be determined accordingly. Ultimately, the optimum tightening torque are to be determined by testing inenvironments which reflect the actual conditions.

Typical values for tightening torques for form-fitting locking devices against unscrewing can be found in "Technical Data – Assembly TD-101".

Adhesive locking devices against unscrewing
A material bond can be created using an adhesive which is applied to the thread. Locking using an**encapsulated adhesive** is described inDIN 267-27.



The micro-capsules which are applied to the carrier material on the thread contain the adhesive anda 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 lockagainst vibrations and loss of preload and which simultaneously acts as sealant.

Since the micro-capsules are applied to the thread in a special coating process, it is recommended thatthis be used especially with bulk amounts (→Table 1).When applying micro-capsule adhesives to zinc flake coatings, seals on thick layer passivation andcoatings with lubricant additives, a reduction in the breakaway torques vis-à-vis DIN 267-27 maycome about. In this case, the application should be safeguarded by carrying out initial sample inspections and by testing in application conditionsbefore using in bulk. **Anaerobic hardening liquid adhesives** which are applied to the thread when assembling the screwed fastening are suitablefor universal use. These harden when atmospheric oxygen and metal (iron and copper ions) come into contact with each other. Table 4provides anoverview of which adhesives are suitable for which surface coating. Thread friction coefficients which are set by the corresponding surface coatingremain fundamentally unchanged.

Table 1: Product overview of adhesive and locking coatings

Selection of product and brand names for locking coatings		Selection of product and brand names for adhesive coatings	
TUFLOC	Klemm-Tight	LOCTITE	METAFLUX
ES-LOC	Thermo-Tight	INBUS-Plus	OKS
POLYLOC	Heat-Tight	DELO	OMNICOTE
Clemm-Loc	Long-Loc	OMNIFIT	SCOTCH GRIP
Spot-Tight	Hot-Loc	POLYLOC	SPOT-Tight
		WEICON LOCK	STICK-Tight
		PRECOTE	

Table 2: Help for selecting the correct locking device

Design Objective	Locking Variations
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
Readjust ability of the fastenings	▪ Form-fitting locking elements
Assembly condition	▪ Makes it inevitable that the threads to be coupled are free from oil and grease, as such, adhesive locking devices are ineffective
temperatures	▪ Adhesive and locking coatings are subject to restricted temperature ranges

Table 3: Overview of form-fitting locking devices

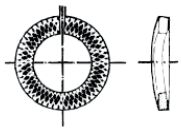
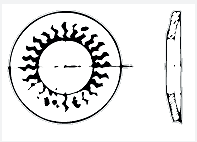
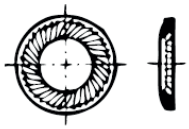
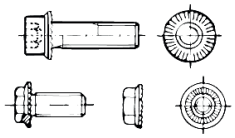
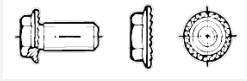
Items		Special features
Lock Rings		Duplex structured surface and bulging ➔ this also balances out small intrusions of parts into materials
Lock Washers		To a certain extent, bulging also balances out intrusions of parts into materials, similar to conical spring washers.
SCHNORR Safety Washers		Duplex serrated surface and bulging ➔ this also balances out small intrusions of parts into materials
Nord-Lock Washer		Each consisting of one washer pair, stuck as a pair for simple assembly.The external surfaces have ridges which are embossed into the surface of thecomponents. 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 itpossible to determine a precise specification for the tightening torque
Flange Screws / Flange Nuts with Ribs		The assembly process is made easier thanks to the pressed flange with ribs asindividual washers do not need to be used.
Locking Screws / Locking Nuts with Serrations		The assembly process is easier thanks to the pressed flange with serrations asindividual washers do not need to be used. The special design of the flange balances out intrusions of parts into materials to a limited degree.

Table 4: Product recommendation for anaerobic adhesives for locking screwed fastenings into place.

Material	Strength classification according to ISO 10964 – M10		
	Low strength screw locking	Medium strength screw locking	High strength screw locking
Steel	Loctite 221, 222, 225	Loctite 241, 243, 245	Loctite 270, 272, 275
Brass	Loctite 222	Loctite 243	Loctite 270, 278
Stainless Steel (A2 to A5)	Loctite 222	Loctite 243	Loctite 2701, 278
Aluminium	Loctite 222	Loctite 243	Loctite 2701
Zinc plated and chromated	Loctite 221, 222, 225	Loctite 241, 243, 245	Loctite 270, 272, 275
Hot dip galvanized	Loctite 222	Loctite 243	Loctite 2701
Browned	Loctite 221, 222, 225	Loctite 241, 243, 245	Loctite 270, 272, 275
Nickel plated	Loctite 222	Loctite 243	Loctite 276
Geomet 321 Plus ML	Loctite 222	Loctite 243	Loctite 2701
Geomet 321 Plus VL	Loctite 222	Loctite 243	Loctite 2701
Geomet 500	Loctite 222	Loctite 243	Loctite 2701
Delta Protect KL 100-131 GZ	Loctite 222	Loctite 243	Loctite 2701
Delta Protect KL 105	Loctite 222	Loctite 243	Loctite 2701, 278
Delta Tone 9000 +DS GZ	Loctite 222	Loctite 243	Loctite 2701

Viscosities and further details can be found in the data sheets - www.loctite.de
Service temperature: -55°C - 150°C, exception: Loctite 278: -55°C - 200°C
Reducing the break-off strength of coatings and inactive materials is possible.
➔ Preliminary experiments are recommended.

Source: LOCTITE

EC Directive 2000/53/EC on end-of-life vehicles (ELV Directive)
(**E**nd-of-**L**ife-**V**ehicles)

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 tonnes, which were put into operation from 1 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 1 July 2008 for hexavalent chromium in corrosion protection layers for screws and nuts to fasten parts of chassis frames.

The EC directive was adopted into German law through the end-of-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).

EC Directive 2002/95/EC on electrical and electronic equipment (ROHS directive)
(**R**estriction **o**f **H**azardous **S**ubstances)

EC Directive 2002/96/EC on the avoidance of waste from electrical and electronic equipment (WEEE Directive)
(**W**aste of **E**lectrical and **E**lectronic **E**quipment)

The aim of the directives is both the prevention of the use of dangerous materials in electrical and electronic equipment and the proper and environmentally-friendly disposal (recycling) of this equipment. All electrical consumer products listed in the EC directive and brought intocirculation from 1 July 2006 onwards are affected by this.

The following are banned from this date:-

1. Lead
2. Cadmium
3. Chromium (VI)
4. Mercury
5. Polybrominated biphenyl (PBB)
6. Polybrominateddiphyenyl ether (PBDE)

ZEK 01-08 PAK
(Polycyclical aromatic hydrocarbons (**PAH**))

The German Federal Institute for Risk Assessment (BundesamtfürRisikobewertung (BfR)) in cooperation with the Central Exchange of Experiences Circle (ZentralerErfahrungsaustauschkreis (ZEK)) specified the changed PAH inspection specifications as well as the new PAH maximum valuesin the document ZEK 01-08. Materials which may contain PAH, for example, elastomers (plastics and rubber materials), black or dark-colouredpolymers, coatings and lacquers as well as materials which were treated with preservatives (naphtaline), like, for example, natural bristles, leatherproducts, bast and wood.

The main causes for PAH contaminations in materials are the use of:

- PAH contaminated softening oils in rubber and flexible plastics (soft plastics)
- PAH contaminated soot as a black pigment in rubber, plastics and varnish

This shows that the products we delivered which were made from steel, stainless steel and non-ferrous metals including all coatings are not affected by this regulation.

HR 4040 – CPSIA
(**C**onsumer **P**roduct **S**afety **I**mprovement**A**ct)

The US Consumer Product Safety Improvement Act of 2008 (HR 4040/CPSIA), was passed in August 2008 and important specifications came into force in February 2009.

The phthalates DEHP, DBP and BBP are forbidden, the phthalate DINP, DIDP and DNOP are provisionally forbidden until an evaluation by the "Chronic Hazard Advisory Panel (CHAP)" has been carried out.

Lead in base material has also been banned in the form of a progressive stipulation of ≤ 600 ppm (10 February 2009) to ≤ 100 ppm (14 August 2011) and in colour coatings of ≤ 90 ppm.

From a technical point of view, this demand cannot be complied with due to nationally and internationally standardised fasteners. This way, for example, all low strength classes up to property class 6.8 can be manufactured from machining steel which can have a lead content of up to 350ppm. With non-ferrous metals, the lead content can amount up to 4000.

EC Directive 76/769/EEC (24th amendment)
(Dangerous materials and preparations)

The aim of this directive is to restrict the introduction and use of certain dangerous materials and preparations. Products affected by this change are those which contain:-

1. Pentabromodiphenyl ether
2. Octabromodiphenyl ether

It was no longer permitted to use these from 15 August 2004 onwards.

EC Directive EU 2006/122/EC (PFOS)
(**P**erf**l**uoro**o**ctan**s**ulphonate)

The EC directive 2006/122/EC refers to the use of perfluorooctanesulfonates (PFOS) in the aerospace industry, semi-conductor and electrics industry as well as in the photography business. If the emissions into the environment and exposure in the workplace can be reduced to aminimum, there is no serious danger to the environment or to human health. According to the directive, special attention needs to be given togalvanic processes and surface treatment of metals and plastics. There are notes here on what legislative measures are to be expected. By usingthe best technology available, it is expected that emissions shall be reduced accordingly. An additional recommendation is to limit PFOS-containingsemi-finished products and manufactured items to which PFOS were intentionally added. The directive should apply to new products and not forones already on the market. Since perfluoro-octanoic acid (PFOA) and its salts represent a similar risk, possible additions to this directive in regardto this group are to be expected. The conversion into national law was planned for 27 Dec 2007 and expected to become effective as of 27 June2008. A fully galvanized product does not contain any quantities of PFOS.

EC Regulation 1907/2006 – Chemicals regulation (REACH)
(**R**egistration, **E**valuation, **A**uthorisation of **Ch**emicals)

This EC regulation centralises and simplifies Europe-wide chemical laws through registration, evaluation and authorisation and came into effect on 1 June 2007. It is the declared objective to increase the level of knowledge of the dangers and risks which arise from chemicals. Here, thecompanies are given more responsibility for the safe handling of their products. While fasteners are fundamentally compiled by the REACHregulation as so-called products, they are exempted for the most part from the obligation to register through corresponding exceptional rules.

According to Art. 3 REACH regulations, products refer to fasteners. Products are objects whose function is defined not by their material properties(e.g. by the metal components in the alloy) but by their exterior form.

However, according to Art. 7, Section 1 REACH regulation, products must only be registered if they contain chemicals which discharge. This is notthe case for fasteners.Even fasteners with corrosion protection coatings, which thus have a sacrificial coating, that is, a coating which is sacrificed in order to protect thecomponent part, are not subject to having to be registered. The reason for this is that it is not the protective layer which is discharged, but ratherspecific reaction products. In this respect, the exception ruling of Art. 2, Section 7 (b) REACH regulation is pertinent in conjunction with AttachmentV, Section 3 REACH regulation. According to this, materials which were created as a result of a chemical reaction, which used other materials,preparations and products at end-use, and which were not manufactured, introduced or put into circulation as such, are exempted from the duty toregister.

The regulations on especially alarming materials (Art. 57, Art. 59, Attachment 14 REACH regulation) in products according to Article 7, Section 2REACH regulation are not affected by this. While these materials do not need to be registered, they are subject to being reported if

a) the material in these products is contained in an amount totalling more than one tonne per year and producer/importer and
b) the material in these products is contained in a concentration of more than 0.1% (mass percentage).

Which materials will be subject to this duty to report still needs to be determined by the European authorities. It is intended that materials likecadmium, mercury, lead, chromium VI, as contained in corrosion protection coatings and as alloy elements, shall belong to this.However, this duty to report should not usually have any effect on fasteners as the mass quantity of the dangerous material should usually besignificantly less than 0.1%. This needs to be inspected accordingly in respective individual cases.

The versions above do not apply to chemical/technical products (e.g. aerosols, adhesives and sealants). Here, this does not refer to products, but to preparations. With preparations, it is not the preparations themselves, but rather their contents which are to be registered. For productsmanufactured in the EU this registration duty affects the manufacturer, for imports from non-EU countries, this affects the importer.

EC Directive 89/106/EEC
(Construction products directive)

This directive should ensure that all necessary measures are taken so that the products selected for use in buildings can only be put into operation when they can actually be used. That is, that the buildings have the characteristics for which the products are to be used (be it through assembly,joining, fitting or installation) and they can satisfy the main requirements with proper planning and constructional execution. Fasteners are alsoaffected by this.

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 converted into national law. In Germany, this has been done by the Equipmentand Product Safety Act (Geräte- und Produktsicherheitsgesetz (GPSG)) and the Machinery Directive based there on (9th GPSGV).

From **29 December 2009** the new Machinery Directive is to be applied in a binding fashion. Up to this time, the directive 98/37/EC still applied.

Essentially, the following changes were made:

- clearer restriction of the area of application for the low-voltage directive and for the lift directive
- incomplete machinery are included in the area of application. Which directive requirements were satisfied can be found in the relateddocuments. Included in the scope of delivery is a declaration of installation and assembly instructions written in the language of thecountry.
- the basic health and safety requirements were modified to meet technical advances made
- selection options for conformity assessment procedure for machinery with particularly high danger rating (see Attachment 4 of the directive)
- safety components receive the CE marking
- inclusion of household devices also commercially used provided they fulfil the machine definition

Equipment and Product Safety Act (Geräte und Produktsicherungsgesetz (GPSG))

The German Equipment and Product Safety Act (GPSG) obligates manufacturers, importers and traders to bring only into circulation such work equipment and consumer products which were made in such a way that they do not endanger the health and safety of either users or third partieswhen used properly.

The GPSG is directed at those persons who are active either commercially or as part of an economic enterprise.

The GPSG brings together the former Equipment Safety Act (GSG) and Product Safety Act (ProdSG). It serves to convert the European ProductSafety Directive RL 2001/95/EC into national law.

In the GPSG, a series of European directives has been converted into German law.
For example, this affects the following directives:

1. GPSGV: Low-voltage Directive 2006/95/EC
2. GPSGV: Toys Directive 88/378/EEC
3. GPSGV: Simple Pressure Vessels Directive 87/404/EEC
4. GPSGV: Directive on appliances burning gaseous fuels 90/396/EEC
5. GPSGV: Directive on personal protective equipment 89/686/EEC
6. GPSGV: Machinery Directive 98/37/EC
7. GPSGV: Recreational Craft Directive 94/25/EEC
8. GPSGV: ATEX Product Directive 94/9/EC
9. GPSGV: Lift Directive 95/16/EC
10. GPSGV: Directive on aerosol dispensers 75/324/EEC
11. GPSGV: Pressure equipment directive 97/23/EC

EC Directive 97/23/EC

(Pressure equipment directive)

In the view of legislation "systems for monitoring" include equipment, vessels, systems and material from which a danger to the public may arise. The state fulfils its obligation (protective measures for its citizens) by creating legal regulations which eliminate the dangers or at leastreduce them to a minimum - or it commissions corresponding experts to do this and to carry out suitable monitoring (e.g. TÜV = TechnischerÜberwachungsverein - German technical supervisory authority). Well-known examples for this include the Road Traffic Licensing Regulations - Straßnverkehrs-Zulassungsordnung (StVZO), the Equipment SafetyAct, the Atomic Energy Act, the regulations on occupational health and safety as well as the directive on pressure vessel regulation.

The directives can be found in the "Technical Regulations", which include instructions on computation and construction, on approved materials(including materials and strength classes for screws and nuts), on acceptance test provisions (factory inspection documents) and on selected andcorrespondingly recognised manufacturers.

The "Technical Rules" for screws and nuts apply in the pressure and vapour vessels area.

- 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
- TRD 106 = for ferritic and austenitic steel parts

Only those materials/property classes listed in these rules and standards may be used for the areas of application mentioned (pressures / temperatures). The recognised manufacturer of screws and nuts made from permitted materials must prove to the responsible authority that therequirements have been satisfied according to AD 2000 data sheet W0. Manufacturers who fulfil these requirements are listed in the VdTÜV datasheet for materials 1253/1. These manufacturers are subject to constant inspection.

The standards for screws and nuts, for instance, named in the "Technical Regulations" take on legally-binding character from the form of the "related reference".

Fastener Quality Act (FQA)

This term stands for the legal initiative in the USA which requires that fasteners introduced to the US market be subject to extensive quality testing and certification carried out by inspection laboratories especially set up for this.

The reason this initiative was set up were a number of claims for damages as a result of failing of fasteners in the 80s. First of all, only vital fasteners were to be affected (= approx. 1% of all parts). However, during the first draft law, the affected article area was expanded to such anextent that almost 70% of all fasteners became affected.

The first draft law was passed by the US Congress in November 1990 as PL (Public Law) 101-592. After some corrections and after amending the execution provisions "CFR part 280", "PL 104-113" emerged from this with a scheduled application date of 27 May 1997. The application date waspostponed on numerous occasions due to objections from various organisations and because the required number of accredited inspection laboratories(min. 400) could not be set up on time: to 28 May 1998, 26 July 1998 and 25 October 1998. (PL105-234/PL 106-34).

The law (FQA – Amendments Act of 1999) was finally passed in simplified form, signed on 8 June 1999 by President Clinton and came into use 180days later on 6 December 1999.

Mechanical fasteners included in the FQA are bolts, nuts, screws and special load-showing clipped washers with a nominal diameter of 6mm (0.25 inches) or larger, which have to be fully hardened and marked (property class) according to valid standards and correspond to valid standards.

Not included in this area, among others, mechanical fasteners which:-

- are part of a composite whole
- are parts which are to be used as spares, replacements or maintenance parts unless the part is in a packet which contains more than 75such parts at the point of sale, or
- the part is one from a construction set or
- parts which are manufactured according to the requirements of a quality assurance system for fasteners (certification according to ISO 9000ff, QS 9000 and VDA 6.1) or
- parts which are manufactured according to the requirements of the company's own standards.

Additionally, electronically saved quality assurance documentation (declaration of conformity) is permitted in order to counteract the “mountains of paperwork”.

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