Standards . Introduction

Standards in transition.

Since the end of the 1980s, associations and institutes have been trying to achieve a smooth transition from the German DIN standard to European and international standards, the objective being to take account of the increasing globalisation of markets and the European internal market. This reform, however, is making it more difficult to deal with large numbers of articles, above all in the transitional phase – and not least because of the length of that phase.
Lederer is nevertheless supporting the standardization trends and taking them into consideration when it designs its product range. The best example of this is the classification by standards in this catalogue.
The supplementary explanations necessitated by the changeover in standards are presented in detail on the following pages.

If you require information that goes beyond these, we will be glad to help you at any time. Our specialists in the fields of standards, materials and technology will answer your inquiries in double-quick time.

Standards . Principles

Principles of the change in standards.

The completion of the common European market that is being striven for is leading to a harmonisation of the national standardization systems that exist across the continent. In many cases this means integrating the European norms/standards (EN), which are binding for every country, into the respective national body of regulations. In contrast to the ISO standards, EN standards must be adopted by all EU countries. Relevant national standards (in Germany DIN and DIN-ISO standards) must be withdrawn when the EN standards are announced.

In principle, existing ISO standards should (if possible) be adopted unchanged as EN standards.
If no agreement at EN level is possible, a consensus at ISO level must be the first objective. If ISO standards are adopted unchanged, the product designation is ISO.

DIN standards will be largely replaced by European or international standards. In the future, DIN standards will apply only to products for which there are no ISO or EN standards.

Types of standards.

At present there are seven valid standard types for mechanical fasteners (national, European and international). In this system it may well be the case that different products/services are standardized under the same numbers in the different types of standard (e.g. ISO 7380: countersunk screws with hexagon socket / DIN 7380: section rollers for beading machines).

Original standard	Description	Article designation with
DIN	DIN standards will continue to exist for products and services for which there are no standards at ISO/EN level and for which no standardization is required.	DIN
ISO	International standard (International Standardization Organisation)	ISO
DIN ISO	National German issuance of an ISO standard that was adopted unchanged	ISO
EN	European Norm (CEN = Comité Européen de Normalisation). Independent standard if it is not possible to adopt an existing ISO standard unchanged as an EN ISO standard. EN number divergent from ISO no.	EN
DIN EN	National German issuance of an EN standard that was adopted unchanged.	EN
EN ISO	European standard that was adopted unchanged from ISO. EN no. the same as ISO no	ISO
DIN EN ISO	National German issuance of an EN standard that was adopted unchanged from ISO.	ISO

Comparative overview DIN - EN - ISO.

The following overview shows the current standards for all of the articles in the catalogue, including the original European and international standards and the most important changes in abbreviated form.
Where the changeover involves considerable deviations, detailed views of these are provided after this overview.

The standard numbers printed in bold face are currently valid in EU. In general, the individual application cases should be examined when standards are being changed.

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Taper pins	1		**22339**		2339	*Length according to ISO incl. caps (according to DIN excl. caps), length tolerance and cap height changed*	*largely interchangeable, gradual changeover of stocks from DIN to ISO (EN)*
Cylindrical pins	7	**2338**					
Slotted cheese head screws	84	**1207**			1207	*head heights and base thickness changed; lapse of thread diameters M1, M1,2, M1,4, M1,8*	*see detailed overview*
Slotted pan head screws	85	**1580**			1580	*head diameters (M3 u. M5) and base thickness (M3,5, M5, M8) changed and/or newly defined*	
Tabwashers with long tab	93	*standard withdrawn*					
Split pins	94	**1234**			1234	*Length tolerance changed (for l = 4-18, 32-50, 90-112, 200-280)*	*largely interchangeable*
Wood screws, raised countersunk head, slotted	**95**	*no new standard planned*					
Wood screws, round head, slotted	**96**						
Wood screws, countersunk head, slotted	**97**						

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Plain washers type A (without chamfer)	125	**7089**			7089	*Nominal sizes on the basis of the thread diameter (ISO) instead of the hole diameter (DIN), hardness classes changed*	*no alterations to measurements*
Plain washers type B (with chamfer)	125	**7090**			7090		
Spring lock washers type B (plain pattern)	127	*standard withdrawn*					
Spring lock washers type A (curved)	128						
Plain washers	134						*reference to DIN 125 and 9021, or ISO 7089, 7090, 7093*
Wave spring washers type A (curved)	137						
Wave spring washers type B (crinkled)	137						
T-head bolts with square neck	**186**	*no new standard planned*					
T-head bolts with double nib	**188**						
Wing nuts, american type (edged wings)	**314**						
Wing nuts, heavy type (rounded) wings	**315**						
Wing screws, heavy type (rounded) wings	**316**						
Wing screws, american type (edged wings)	**318**						
Capstan screws, slotted	**404**						
Slotted set screws with full dog point	417		**27435**		7435		*no alterations to measurements, interchangeable*

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Slotted headless screws with chamfered end	427	**2342**			2342	*Slot depths changed; dimensions M1,4 and M10 or larger no longer normed*	*largely interchangeable*
Pipe nuts type B (one-sided thread countersinking)	**431**	*no new standard planned*				*New key sizes according to ISO 272 for G⅛, G¼, G½ and G⅝.*	
Washers with external tab	432	*standard withdrawn*					
Washers for hexagon socket head cap screws	433	**7092**			7092	*Nominal sizes on the basis of the thread diameter (ISO) instead of the hole diameter (DIN), hardness classes changed, nominal sizes 1, 1,2, 1,4, 1,8 have lapsed, nominal sizes 22, 27, 33 have been added, nominal size 36 outer diameter changed, nominal diameter 18 washer thickness changed*	*largely interchangeable*
Square taper washers for U-sections	**434**	*no new standard planned*				*Alterations to the hole widths for M 12 and 16*	*largely interchangeable*
Square taper washers for I-sections	**435**						
Square washers for wood constructions	**436**						
Slotted set screws with cup point	438		**27436**		7436		*no alterations to measurements, interchangeable*
Hexagon nuts (thin type, with chamfer)	439	**4035**	24035	4035	4035	*New key sizes for M 10, 12, 14 and 22; in connection with this, also change in width across corners and bearing surface; actuation heights rounded up/down*	*largely interchangeable*
Hexagon nuts (thin type, with chamfer and fine pitch)	439	**8675**	28675		8675		

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Washers for wood construction, type R (round hole)	440	**7094**			7094	*Nominal sizes on the basis of the thread diameter (ISO) instead of the hole diameter (DIN), form V with square hole does not apply in ISO*	*interchangeable*
Washers for wood construction, type V (square hole)	**440**	*no new standard planned*					
Eye bolts type B (medium coarse)	**444**						
Internal tab washers	**462**						
Tabwashers with two tabs	463	*standard withdrawn*					
Knurled thumb screws (high type)	**464**	*no new standard planned*				*Model with slit used as replacement for DIN 465*	
Knurled thumb screws, slotted (high type)	465	*standard withdrawn*					*reference to DIN 464*
Knurled thumb nuts (high type)	**466**	*no new standard planned*					
Knurled thumb nuts (thin type)	**467**						
Retaining rings for shafts	**471**						
Retaining rings for bores	**472**						
Slotted round nuts	**546**						
Slotted set screws with flat point	551		**24766**		4766	*M1 and M1,4 have lapsed*	*no alterations to measurements, interchangeable*
Slotted set screws with cone point	553		**27434**		7434		

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Square nuts	**557**	*no new standard planned*					
Square thin nuts	**562**						
Wood screws, hexagon head	**571**						
Lifting eye screws	**580**						
Lifting eye nuts	**582**						
Mushroom head square neck bolts	**603**			8677			*DIN ISO 8677 withdrawn in 2002*
Round head rivets	**660**	*no new standard planned*					
Countersunk head rivets	**661**						
Bright set collars type A, with set screw	**705**						
Studs, metal end e ~ 2d	**835**						
Hexagon socket pipe plugs	**906**						
Hexagon socket screw plugs	**908**						
Hexagon socket screw plugs, heavy type	**910**						
Hexagon socket head cap screws	912	**4762**			4762	*fine thread deleted; M1,4, M18, M22, M27, M33, ≥ M72 have lapsed*	*no alterations to measurements, interchangeable*
Hexagon socket set screws with flat point	913	**4026**			4026	*higher tolerances for the key sizes (ISO); M1,4, M1,8, M14, M18, M22 lapsed*	

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Hexagon socket set screws with cone point	914	**4027**			4027	*higher tolerances for the key sizes (ISO); M1,4, M1,8, M14, M18, M22 lapsed; flattening of tip for M1.6 to M5 added*	*no alterations to measurements, interchangeable*
Hexagon socket set screws with dog point	915	**4028**			4028	*higher tolerances for the key sizes (ISO); M1,4, M1,8, M14, M18, M22 lapsed*	
Hexagon socket set screws with cup point	916	**4029**			4029		
Hexagon cap nuts	**917**	*no new standard planned*				*New key sizes for M 10, 12, 14 and 22; in connection with this, also change in width across corners and bearing surface*	*largely interchangeable*
Slotted pan head screws with small head	**920**						
Slotted pan head screws with large head	**921**						
Slotted pan head screws with shoulder	**923**						
Slotted set screws with full dog point	**926**	*standard withdrawn*					
Slotted shoulder screws	**927**	*no new standard planned*					
Square weld nuts	**928**						*No new key sizes!*
Hexagon weld nuts	**929**						
Hexagon head screws with shank	931	**4014**	24014	4014	4014	*New key sizes M 10, 12, 14 and 22; in connection with this, also change in width across corners and bearing surface DIN 931-2 still valid for dimensions M42-M160 (ISO 4014 to M64)*	*largely interchangeable*

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Hexagon head screws, fully threaded	933	**4017**	24017	4017	4017	*New key sizes M 10, 12, 14 and 22; in connection with this, also change in width across corners and bearing surface; some very small changes in bearing surface, head height and actuation height*	*largely interchangeable*
Hexagon nuts	934	**4032**	24032	4032	4032	*New key sizes for M 10, 12, 14, 22; in connection with this, also change in width across corners and bearing surface; and new height for nuts for M5-M39; in connection with this, also change in actuation heights; actuation heights were rounded up/down with the other diameters; M1, M1,2, M1,4 have lapsed*	*largely interchangeable, see detailed overview*
Hexagon nuts, fine pitch	934	**8673**	28673		8673		
Hexagon castle nuts	**935**	*no new standard planned*				*New key sizes for M 10, 12, 14 and 22*	
Studs, metal end e ~ 1d	**938**						
Studs, metal end e ~ 1,25d	**939**						
Countersunk flat head screws, slotted	963	**2009**		2009	2009	*several head diameters and heights changed; thread lengths changed; dimensions < M1,6 and > M10 have lapsed*	*largely interchangeable, see detailed overview*
Raised countersunk head screws, slotted	964	**2010**		2010	2010		

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Countersunk flat head screws, cross recessed	965	**7046**		7046	7046	*several head diameters and heights changed; thread lengths changed; dimension M1,6 for rust-free screws has lapsed; some changes in cross-recess penetration depths*	*largely interchangeable, see detailed overview*
Raised countersunk head screws, cross recessed	966	**7047**		7047	7047		
Thread rods	**975**	*standard withdrawn*					*reference to DIN 976*
Thread pins	**976**	*no new standard planned*					*replacement for DIN 975*
Hexagon castle nuts, thin type	**979**						
Prevailing torque type hexagon nuts, all-metal	980	**7042**			7042	*New key sizes for M 10, 12, 14 and 22; in connection with this, also change in width across corners and bearing surface; new height for nuts; in connection with this, also change in actuation heights; dimensions < M5, M18, M22, M27, M33 have lapsed*	*largely interchangeable, see detailed overview*
Prevailing torque type hexagon nuts, all-metal, fine pitch	980	**10513**			10513		
Prevailing torque type hexagon nuts, non-metallic insert, high type	982	**7040**			7040	*New key sizes for M10, 12 and 14; in connection with this, also change in width across corners and bearing surface; new height for nuts; in connection with this, also change in actuation heights; dimensions M7, M18, M22 have lapsed; dimensions M3, M4, M30, M36 have been added*	
Prevailing torque type hexagon nuts, non-metallic insert, high type, fine pitch	982	**10512**			10512		

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Prevailing torque type hexagon nuts, non-metallic insert, thin type	985	**10511**				*New key sizes for M 10, 12 and 14; in connection with this, also change in width across corners and bearing surface; new height for nuts; in connection with this, also change in actuation heights; dimensions M7, M18, M22, M27, M33, > M36 and fine thread have lapsed*	*largely interchangeable, see detailed overview*
Prevailing torque type hexagon domed cap nuts, non-metallic insert	**986**	*no new standard planned*					
Shim rings and supporting rings	**988**						
Washers for wood constructions	**1052**						*DIN 1052 "wood working plants" not a pure product norm, mechanical connections described in 1052, part 2.*
Plain washers for clevis pins (medium)	1440		**28738**		8738	*several alterations to the outside diameter and widths (8-20 and 24-100) and thickness (5, 45, 55, 60,100); dimensions 13, 23, 25, 26, 28, 32, 35, 65, 75, 85, 95 have lapsed*	*largely interchangeable*
Plain washers for clevis pins (coarse)	1441	*no new standard planned*					

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Grooved pins, full length parallel grooved with chamfer and pilot	1470	**8739**	28739		8739	*Length according to ISO incl. caps (according to DIN excl. caps); length tolerance changed*	*largely interchangeable*
Grooved pins, full length taper grooved	1471	**8744**	28744		8744		
Grooved pins, half length taper grooved	1472	**8745**	28745		8745		
Grooved pins, full length parallel grooved with chamfer	1473	**8740**	28740		8740	*Length according to ISO incl. caps (according to DIN excl. caps); length tolerance and chamfer height changed*	
Grooved pins, half length reverse taper grooved	1474	**8741**	28741		8741	*Length according to ISO incl. caps (according to DIN excl. caps); l ength tolerance changed; length tolerance changed*	
Grooved pins, third length taper grooved	1475	**8742**	28742		8742		
Grooved pins with round head	1476	**8746**	28746		8746	*New form B (with pilot) in ISO, only form A (with chamfer) until now in DIN ; changed length tolerances*	
Spring-type straight pins, slotted (heavy type)	1481	**8752**	28752		8752	*New form B (not interlocking) according to ISO, only form A (regular model) so far in DIN, two chamfers for diameter up to and including 10mm (ISO), previously up to 6mm (DIN) ; changed length tolerances*	

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Hexagon domed cap nuts, high type	**1587**	*no new standard planned*					
Disc springs	**2093**						
Hose clamps	**3017**						
Spherical washers, conical seats	**6319**						
Hexagon nuts (height = 1,5d)	**6330**						
Hexagon nuts with collar (height = 1,5d)	**6331**						
Hexagon nuts (height = 3d)	6334	*standard withdrawn*					
Conical spring washers	**6796**	*no new standard planned*					
Toothed lock washers	6797	*standard withdrawn*					
Serrated lock washers	6798						
Retaining washers for shafts	**6799**	*no new standard planned*					
Parallel keys, deep pattern	**6885**						
Hexagon socket head cap screws	**6912**						
Hexagon screws with flange	6921		**1665**			*Key sizes M10 to M20 enlarged, in connection with this, also change in width across corners; head heights (not for M6, M8) and actuation heights changed*	

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Hexagon screws with flange	6921		**1662**		15071	*Key sizes M5 to M10 enlarged, in connection with this, also change in width across corners; head heights and actuation heights changed; max. flange diameter reduced; M20 has lapsed*	*ISO 15071 corresponds to DIN EN 1662, but the key size is 15 for M12 (16 in EN 1662)*
Hexagon screws with flange, fine pitch	6921		**14219**		15072	*Key sizes M8 to M10 enlarged, in connection with this, also change in width across corners; head heights and actuation heights changed; max. flange diameter reduced; M20x1,5 has lapsed*	*ISO 15072 corresponds to DIN EN 14219, but the key size is 15 for M12 (16 in EN 14219)*
Hexagon flange nuts	6923		**1661**	4161	4161	*Key size for M 10 = 16 mm; in connection with this, also change in width across corners; fine thread lapsed*	*largely interchangeable*
Blind rivets, type A (pan head)	7337	**15983**			15983	*Slight alterations to the measurements*	*Form B (countersunk head) DIN EN ISO 15984*
Spring-type straight pins	7343	**8750**			8750	*Slight alterations to dimensions and tolerances*	*largely interchangeable*
Spring-type straight pins, slotted (light type)	7346	**13337**			13337	*New form B (not interlocking) according to ISO, only form A (regular model) so far in DIN, two chamfers for diameter up to and including 10 mm (ISO), previously up to 7 mm (DIN); small changes in dimensions and tolerances (e.g. length tolerances)*	*largely interchangeable*

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Washers for bolts with heavy type spring pins	**7349**	*no new standard planned*					
Thread rolling screws	**7500**						*mechanical and functional properties newly defined in DIN EN ISO 7085, authoritative standards remain in DIN 7500*
Self drilling screws, hexagonal head with flange	7504	**15480**			15480	*St3,9 has lapsed; form L (hexagon head drilling screw with collar and slot) has lapsed; specification of drilling tip diameter has lapsed*	*no alterations to measurements, interchangeable*
Self drilling screws, pan head	7504	**15481**			15481		
Self drilling screws, countersunk head	7504	**15482**			15482		
Self locking counter nuts	7967	*standard withdrawn*					
Tapping screws, pan head, slotted	7971			**1481**	1481	*Several head diameters and heights changed; slot depth changed; St3,9 has lapsed; St8 and St9,5 added*	*largely interchangeable, see detailed overview*
Tapping screws, countersunk head, slotted	7972			**1482**	1482	*Several head diameters and heights changed, new countersinking angle 90° (ISO) instead of the previous 80° (DIN); slot depth changed; St3,9 has lapsed; St8 and St9,5 added*	*not interchangeable (due to countersinking angle), see detailed overview*
Tapping screws, raised countersunk head, slotted	7973			**1483**	1483		
Tapping screws, hexagon head	7976			**1479**	1479	*Several head heights changed; St3,9 lapsed; St9,5 added*	*largely interchangeable, see detailed overview*
Spring lock washers for cheese head screws	7980	*standard withdrawn*					
Tapping screws, pan head, cross recessed	7981			**7049**	7049	*Several head diameters and heights changed; St3,9 lapsed; St8 and St9,5 added*	*largely interchangeable, see detailed overview*

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Tapping screws, countersunk head, cross recessed	7982			**7050**	7050	*Several head diameters and heights changed, new countersinking angle 90° (ISO) instead of the previous 80° (DIN); cross-recess penetration depth changed; St3,9 lapsed; St8 and St9,5 added*	*not interchangeable (due to countersinking angle), see detailed overview*
Tapping screws, raised countersunk head, cross recessed	7983			**7051**	7051		
Hexagon socket head cap screws, low head	**7984**	*no new standard planned*					
Pan head screws, cross recessed	7985	**7045**			7045	*Several head diameters and heights changed; cross-recess penetration depth changed; thread lengths changed*	*largely interchangeable, see detailed overview*
Washers for steel constructions	7989	*no new standard planned*					
Countersunk flat head screws, hexagon socket	7991	**10642**		10642	10642	*Several head diameters and heights changed, some changes in tolerance of the key size, depth of hexagon socket changed*	*largely interchangeable, see detailed overview*
Wood screws, raised countersunk head, cross recessed	**7995**	*no new standard planned*					
Wood screws, round head, cross recessed	**7996**						
Wood screws, countersunk head, cross recessed	**7997**						

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Plain washers, outside diameter ~ 3d	9021	**7093**			7093	*nominal sizes on the basis of the thread diameter (ISO) instead of the hole diameter (DIN), hardness classes changed; hardness categories changed; nominal sizes 2,5 and 7 have lapsed, nominal sizes 27 and 33 added, nominal size 5 washer thickness changed*	*largely interchangeable*
Beltings bolts	**15237**	*no new standard planned*					
Hexagon socket button head screws		**7380**			7380		
Socket head cap screws		**14579**			14579	*corresponds to ISO 4762 but with six lobe drive instead of hexagon socket*	
Socket head cap screws (low head)		**14580**			14580	*similar to ISO 1207 and DIN 7984 but with six lobe drive instead of hexagon socket and changed head height and in some cases thread length*	
Countersunk socket screws		**14581**			14581	*corresponds to ISO 7046 but with six lobe drive instead of cross-recess; similar to DIN 965 with six lobe drive*	
Pan head screws, six lobe drive		**14583**			14583	*corresponds to ISO 7045 but with six lobe drive instead of cross-recess; similar to DIN 7985 with six lobe drive*	
Raised countersunk socket screws		**14584**			14584	*corresponds to ISO 7047 and ISO 2010 but with six lobe drive instead of cross-recess and slot*	

Designation	**DIN**	DIN EN ISO	DIN EN	DIN ISO	*comparable* **ISO**	*The most important changes*	*Remarks*
Tapping screws, pan head, six lobe drive		**14585**			14585	*corresponds to ISO 7049 but with six lobe drive instead of cross-recess and slot; similar to DIN 7981 with six lobe drive*	
Tapping screws, countersunk head, six lobe drive		**14586**			14586	*corresponds to ISO 7050 and ISO 1482 but with six lobe drive instead of cross-recess and slot; similar to DIN 7982 with six lobe drive*	
Countersunk-head socket tapping screws		**14587**			14587	*corresponds to ISO 7051 and ISO 1483 but with six lobe drive instead of cross-recess and slot*	

Detailed overview.

The changes in dimensions caused by the changes in the standards are shown below. For the sake of clarity, the changed values are emphasized. All data in mm.

Hexagon head screws and nuts

New key sizes for
DIN 439, 557, 562, 917, 931, 933, 934, 935, 979, 980, 982, 985, 986, 1587, 6330, 6331, 6923
ISO 4014, 4017, 4032, 4035, 4161, 7040, 7042, 8673, 8675, 10511
EN 1661

	M1	M1,2	M1,4	M1,6	M2	M2,5	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36
ISO	2,5	3	3	3,2	4	5	5,5	7	8	10	13	**16**	**18**	**21**	24	28	30	**34**	36	41	46	50	55
DIN												17	19	22				32					

The changed key sizes means that the corner width „e“ has also changed

	M1	M1,2	M1,4	M1,6	M2	M2,5	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36
ISO	2,71	3,28	3,28	3,48	4,38	5,45	6,01	7,66	8,79	11,05	14,38	**17,77**	**20,03**	**23,36**	26,75	29,56	32,95	**37,29**	39,55	45,2	50,85	55,37	60,79
DIN												18,90	21,10	24,49				35,03					

nut height changes

Heagon thin nuts (regular thread) DIN 439 - ISO 4035: no alterations
Hexagon nuts DIN 934 - ISO 4032/8673

		M1	M1,2	M1,6	M2	M2,5	M3	M3,5	M4	M5	M6	M8	M10	M12	M14	M16
max.	ISO	–	–	1,3	1,6	2	2,4	2,8	3,2	**4,7**	**5,2**	**6,8**	**8,4**	**10,8**	**12,8**	**14,8**
	DIN	0,8	1							4	5	6,5	8	10	11	13
min.	ISO	–	–	1,05	1,35	1,75	2,15	2,55	2,9	**4,4**	**4,9**	**6,44**	**8,04**	**10,37**	**12,1**	**14,1**
	DIN	0,55	0,75							3,7	4,7	6,14	7,64	9,64	10,3	12,3

		M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56	M64
max.	ISO	**15,8**	**18**	**19,4**	**21,5**	**23,8**	**25,6**	**28,7**	**31**	**33,4**	34	36	38	42	45	51
	DIN	15	16	18	19	22	24	26	29	31						
min.	ISO	**15,1**	**16,9**	**18,1**	**20,2**	**22,5**	**24,3**	**27,4**	**29,4**	**31,8**	32,4	34,4	36,4	40,4	43,4	49,1
	DIN	14,3	14,9	16,9	17,7	20,7	22,7	24,7	27,4	29,4						

– = (dimensions not defined in relevant standard)

Prevailing torque type hexagon nuts DIN 980 - ISO 7042

		M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36
max.	ISO	–	–	5,1	6	8	10	12	14,1	16,4	–	20,3	–	23,9	–	30	–	36
	DIN	3,7	4,2						14	16	18	20	22	24	27		33	
min.	ISO	–	–	4,8	5,4	7,14	8,94	11,57	13,4	15,7	–	19	–	22,6	–	27,3	–	33,1
	DIN	3,4	3,9		5,7	7,5	9	11	12	14	16	18	20	22	25	28	31	34

Prevailing torque type hexagon nuts, non-metallic insert DIN 982 - ISO 7040

		M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36
max.	ISO	4,5	6	6,8	8	9,5	11,9	14,9	17	19,1	–	22,8	–	27,1	–	32,6	–	38,9
	DIN	–	–	6,3			11,5	14	16	18	20	22	25	28	–	30	–	36
min.	ISO	4,02	5,52	6,22	7,42	8,92	11,2	14,2	15,9	17,8	–	20,7	–	25	–	30,1	–	36,4
	DIN	–	–	6	7,7	9,14	11,14	13,64	15,3	17,3	19,16		23,7	26,7	–	28	–	34

Prevailing torque type hexagon nuts, low type DIN 985 - ISO 10511

		M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36
max.	ISO	3,9	5	5	6	6,76	8,56	10,23	11,23	12,42	–	14,9	–	17,8	–	22,2	–	25,5
	DIN	4				8	10	12	14	16	18,5	20	22	24	27	30	33	36
min.	ISO	3,42	4,52	4,52	5,52	6,18	7,98	9,53	10,22	11,32	–	13,1	–	16	–	20,1	–	23,4
	DIN	3,7	4,7	4,7	5,7	7,64	9,64	11,57	13,3	15,3	17,66	18,7	20,7	22,7	25,7	28,7	31,4	34,4

– = (dimensions not defined in relevant standard)

Metric and tapping screws Changed head dimensions for slotted cheese head screws ISO 1207 - DIN 84

		M1	M1,2	M1,4	M1,6	M1,8	M2	M2,5	M3	M3,5	M4	M5	M6	M8	M10
max. head diameter	ISO	–	–	–	3	–	3,8	4,5	5,5	6	7	8,5	10	13	16
	DIN	2	2,3	2,6		3,4									
max. head height	ISO	–	–	–	1,1	–	1,4	1,8	2	2,4	2,6	3,3	3,9	5	6
	DIN	0,7	0,8	0,9	1	1,2	1,3	1,6							

tappings screws with hexagon head ISO 1479 - DIN 7976

		ST2,2	ST2,9	ST3,5	ST3,9	ST4,2	ST4,8	ST5,5	ST6,3	ST8	ST9,5
max. head diameter	ISO	1,6	2,3	2,6	–	3	3,8	4,1	4,7	6	7,5
	DIN	1,42	1,62	2,42	2,42	2,92	3,12	4,15	4,95	5,95	–

– = (dimensions not defined in relevant standard)

slotted pan head screws
metric screws ISO 1580 - DIN 85

		M1,6	M2	M2,5	M3	M3,5	M4	M5	M6	M8	M10
max. head diameter	**ISO**	**3,2**	**4**	**5**	**5,6**	7	8	**9,5**	12	16	20
	DIN	–	–	–	6			10			
max. head height	**ISO**	**1**	**1,3**	**1,5**	1,8	2,1	2,4	3	3,6	4,8	6
	DIN	–	–	–							

tapping screws ISO 1481 - DIN 7971

		ST2,2	ST2,9	ST3,5	ST3,9	ST4,2	ST4,8	ST5,5	ST6,3	ST8	ST9,5
max. head diameter	**ISO**	**4**	5,6	**7**	**–**	**8**	**9,5**	**11**	**12**	**16**	**20**
	DIN	4,2		6,9	7,5	8,2	9,5	10,8	12,5	–	–
max. head height	**ISO**	**1,3**	**1,8**	2,1	**–**	**2,4**	**3**	3,2	**3,6**	**4,8**	**6**
	DIN	1,35	1,75		2,25	2,45	2,8		3,65	–	–

cross recessed pan head screws
metric screws ISO 7045, 14583 - DIN 7985

		M1,6	M2	M2,5	M3	M3,5	M4	M5	M6	M8	M10
max. head diameter	**ISO**	3,2	4	5	**5,6**	7	8	**9,5**	12	16	20
	DIN				6			10			
max. head height	**ISO**	1,3	1,6	**2,1**	2,4	**2,6**	3,1	**3,7**	4,6	6	7,5
	DIN			2		2,7		3,8			

tapping screws ISO 7049 - DIN 7981

		ST2,2	ST2,9	ST3,5	ST3,9	ST4,2	ST4,8	ST5,5	ST6,3	ST8	ST9,5
max. head diameter	**ISO**	**4**	5,6	**7**	**–**	**8**	**9,5**	**11**	**12**	**16**	**20**
	DIN	4,2		6,9	7,5	8,2	9,5	10,8	12,5	–	–
max. head height	**ISO**	**1,6**	**2,4**	2,6	**–**	**3,1**	**3,7**	**4**	**4,6**	**6**	**7,5**
	DIN	1,8	2,2		2,8	3,05	3,55	3,95	4,55	–	–

– = (dimensions not defined in relevant standard)

Standards . Detailed Overview

cross recessed and slotted pan head screws
metric screws ISO 2009, 2010, 7046, 7047 - DIN 963, 964, 965, 966

		M1,6	M2	M2,5	M3	M3,5	M4	M5	M6	M8	M10
max. head diameter	ISO	3	3,8	4,7	**5,5**	**7,3**	**8,4**	**9,3**	**11,3**	**15,8**	**18,3**
	DIN				5,6	6,5	7,5	9,2	11	14,5	18
max. head height	ISO	**1**	1,2	1,5	**1,65**	**2,35**	**2,7**	**2,7**	**3,3**	**4,65**	5
	DIN	0,96			1,65	1,93	2,2	2,5	3	4	

tapping screws ISO 1482, 1483, 7050, 7051 - DIN 7972, 7973, 7982, 7983

		ST2,2	ST2,9	ST3,5	ST3,9	ST4,2	ST4,8	ST5,5	ST6,3	ST8	ST9,5
max. head diameter	ISO	**3,8**	5,5	**7,3**	**–**	**8,4**	**9,3**	**10,3**	**11,3**	**15,8**	**18,3**
	DIN	4,3		6,8	7,5	8,1	9,5	10,8	12,4	–	–
max. head height	ISO	**1,1**	1,7	**2,35**	**–**	**2,6**	**2,8**	**3**	**3,15**	**4,65**	**5,25**
	DIN	1,3		2,1	2,3	2,5	3	3,4	3,8	–	–
countersinking angle	ISO	**90°**									
	DIN	80°									

socket countersunk screws
countersunk screws ISO 10642 - DIN 7991

		M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
max. head diameter	ISO	**6,72**	**8,96**	**11,2**	**13,44**	**17,92**	**22,4**	**26,88**	**30,8**	**33,6**	**–**	**40,32**	**–**	**–**
	DIN	6	8	10	12	16	20	24	27	30	33	36	36	39
max. head height	ISO	**1,86**	**2,48**	**3,1**	**3,72**	**4,96**	**6,2**	**7,44**	**8,4**	**8,8**	**–**	**10,16**	**–**	**–**
	DIN	1,7	2,3	2,8	3,3	4,4	5,5	6,5	7	7,5	8	8,5	13,1	14

– = (dimensions not defined in relevant standard)

Materials . Overview

„May the steel be high-grade, rustproof and good“
Overview of the material.

The metal generally referred to as high-grade steel, stainless steel or (expressed academically) „rustproof and acid-resisting steel“ has been around for almost 100 years.
Its industrial use began in 1912 when the patent application was submitted for steels with “high resistance to corrosion”. These humble beginnings have led to the development – particularly since 1950 – of a materials group comprising more than 120 stainless steel types that are used in every segment worldwide.

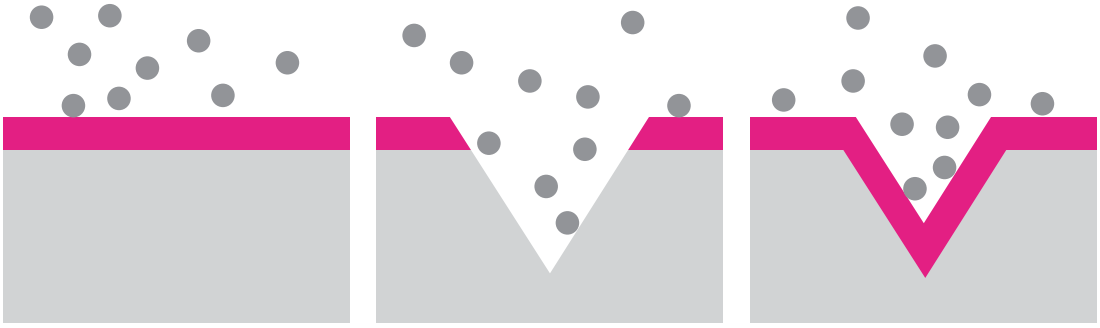
Areas of application
- architecture and construction
- automobile technology and transport
- chemical plant construction
- offshore technology and shipbuilding
- environmental technology and water industry
- household and consumer goods
- food processing
- medicine and pharmaceuticals

This trend is also reflected in the production figures: between 1990 and 2000, annual production of stainless steel increased by almost 50% to approx. 18.4 million tons.
More and more steel users are coming to know and appreciate the advantages of the stainless steel materials.

Benefits
- corrosion-resistant
- high-tensile, wear-resistant
- weldable
- temperature-resistant
- hygienic
- conductive
- low-maintenance
- long-lasting
- efficient

What makes stainless steel so resistant?

A common feature of all stainless steels is that their steel alloys contain a chromium element of at least 12%. The contact with the oxygen in the surrounding media (air, water, other substances) leads to the formation of a thin – only a few atom layers – transparent layer of chromium oxide (passivation) on the steel surface. This layer protects the steel beneath it from further chemical influences. If the surface is damaged this passive layer rebuilds itself autonomously under the influence of oxygen; for this reason we can justifiably call it a “self-healing “ or “self-repairing mechanism”.



Understanding this process is important for, among other things, the use of stainless steel in low-oxygen or oxygen-free environments; here there can be no subsequent passivation of the surface and the material is exposed to the aggressive influences.

The addition of other alloying elements further improves the mechanical and chemical properties of stainless steel:
nickel increases the resistance to acid and is contained in all commonly used stainless steels; sulphur improves the machining qualities (A 1); titanium, niobium or tantalum stabilizes the material structure at higher temperatures (A 3 and A 5); manganese, molybdenum and copper are other commonly used alloying elements that increase the resistance to reducing acids and localized corrosion.

Once the right types of stainless steel for the individual application case have been chosen, nothing can stand in the way of a long lifespan and therefore a secure fastening element.

Designations.

The designation system for stainless steel types and property classes of screws and nuts is described in the following overview. The designation of the material consists of two blocks that are separated by a hyphen.

The first block designates the steel type as follows:

A for austenitic nickel chromium steel with an alloying constituent of 15-20% chromium and 5-15% nickel. It cannot be hardened with heat treatment and is generally not magnetizable.
C for martensitic steel, which can be strengthened by hardening and is magnetizable. It is less resistant to corrosion than austenitic steels.
F for ferritic steel, which cannot normally be hardened. It is magnetizable and the environments in which it can be used include those with higher chloride content.

The letter is supplemented with a number that indicates the chemical composition within this steel group.

A 1 The steel type A 1 is intended especially for processing by cutting (turning parts). Due to their high sulphur content, steels of this type are less resistant to corrosion than the other steel types.
A 2 Steels of the type A 2 are the most frequently used. They are, however, unsuitable for use in non-oxidizing acids and media containing chloride (e.g. swimming pools, salt water). Suitable for temperatures down to -200°C.
A 3 Same properties as A 2 steels, but stabilised with titanium, niobium or tantalum. These improve its resistance to corrosion in high temperatures.
A 4 Same properties as A 2 steels, but alloyed with 2-3% molybdenum. This makes it substan tially more resistant to corrosion and acids. Suitable for temperatures down to -60°C.
A 5 Same properties as A 4 steels, but stabilised with titanium, niobium or tantalum. This also makes it resistant to high temperatures.

The second block denotes the property class, with the numbers indicating 1/10 of the minimum tensile strength of the fasteners (in N/mm^2).

A 2-70 = austenitic steel, strain-hardened,
tensile strength at least 700 N/mm^2
Notwithstanding the aforementioned regulation, the property class of thin nuts (height = 0.5 – 0.8d, e.g. DIN 439, ISO 4035) is indicated with three digits, with the 0 in front referring to the lower stability.

A 2-035= austenitic steel, strain-hardened,
testing stress up to at least 350 N/mm^2
Stainless steel with a particularly low carbon content of no more than 0,03% may be designated additionally with the letter L (e.gA 4L-80).

Steel group	Austenitic			Martensitic						Ferritic	
steel type	A1 A2 A3 A4 A5			C1			C4		C3	F1	
Property classes, screws and nuts type 1	50	70	80	50	70	110	50	70	80	45	60
Nuts, thin type	025	035	040	025	035	055	025	035	040	020	030
	malleable	cold worked	high tensile	malleable	heat treated		malleable	heat treated		malleable	cold worked

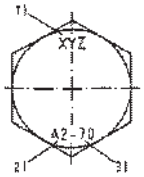
Labelling.

Fasteners may be labelled and/or described in accordance with the aforementioned designation system only when all of the requirements of the DIN EN ISO 3506-1 have been fulfilled.

Screws

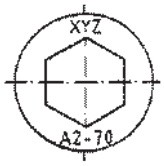
All hexagon head screws and cheese head screws with a hexagon socket or six lobe drive and a thread diameter≥ 5 mm must be labelled as shown below. This labelling is mandatory and must contain the steel type, the property class and additionally the manufacturer reference. Other screws can be labelled in the same way wherever possible (but only on the screw head). Additional labels may be affixed if they do not cause confusion.

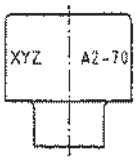
Certifi cation of hexagon head screws



1) Manufacturer reference
2) Steel type
3) Property class

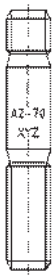
Certifi cation of cheese head srews with hexagon socket or six lobe drive





Studs

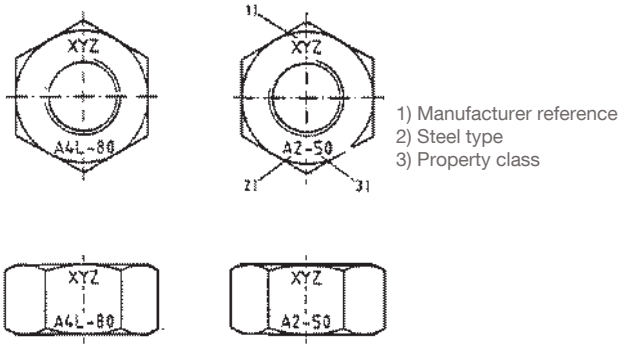
Studs with a thread diameter ≥ 5 mm must also be labelled as shown below. The labels must be placed on the thread-free part of the stud and contain the stamp of origin, the steel type and the property class. Should labelling not be possible on the thread-free section, only the indication of the steel type on the cap at the end adjacent to the nut is permissible as labelling.



Nuts

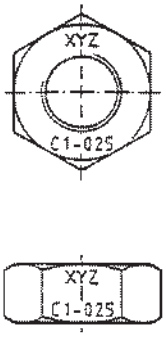
It is mandatory for nuts with a thread diameter ≥ 5 mm to be labelled with the stamp of origin, the steel type and the property class if this is technically possible. Labelling on the supporting surface is permissible; in this case it may be affixed only in sunken form. Labelling on the key surfaces is also permissible if this is preferred. If the nuts are labelled with grooves (for the materials) and the property class is not indicated, the property class 50 or 025 applies.

Nuts, high Type

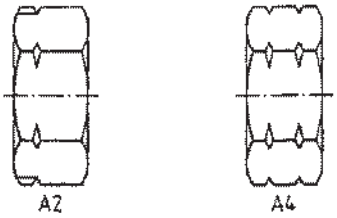


1) Manufacturer reference
2) Steel type
3) Property class

Nuts, thin type



Alternative labelling with groovs
(only for steel groups A 2 and A 4)



Mechanical properties.

The mechanical properties of nuts and screws according to DIN EN ISO 3506 must correspond to the values indicated in tables 1 and 2 (nuts) or tables 3 and 4 (screws).

Tab. 1 Mechanical properties of nuts – austenitic steel

Steel group	*Steel type*	*Property class*		*Diameter range d* **mm**	*Test signal S_p* **N/mm² min.**	
		nuts, high type **m ≥ 0,8 d**	*nuts, thin type* **0,5 d ≤ m < 0,8 d**		*nuts, high type* **m ≥ 0,8 d**	*nuts, thin type* **0,5 d ≤ m < 0,8 d**
Austenitic	A1, A2, A3, A4, A5	50	025	≤ 39	500	250
		70	035	≤ 24 [1]	700	350
		80	040		800	400

1) *For fasteners with a nominal thread diameter d > 24 mm, the mechanical properties must be agreed between the user and the manufacture. They must be indicated with the steel type and the property class in accordance with this table.*

Tab.2 Mechanical properties of nuts – martensitic and ferritic steel

Steel group	*Steel type*	*Property class*		*Test signal S_p* **N/mm² min.**		*hardness*		
		nuts, high type **m ≥ 0,8 d**	*nuts, thin type* **0,5 d ≤ m < 0,8 d**	*nuts, high type* **m ≥ 0,8 d**	*nuts, thin type* **0,5 d ≤ m < 0,8 d**	**HB**	**HRC**	**HV**
Martensitic	C1	50	025	500	250	147 bis 209	–	155 bis 220
		70	–	700	–	209 bis 314	20 bis 34	220 bis 330
		110 [2]	055 [2]	1100	550	–	36 bis 45	350 bis 440
	C3	80	040	800	400	228 bis 323	21 bis 35	240 bis 340
	C4	50	–	500	–	147 bis 209	–	155 bis 220
		70	035	700	350	209 bis 314	20 bis 34	220 bis 330
Ferritic	F1 [1]	45	020	450	200	128 bis 209	–	135 bis 220
		60	030	600	300	171 bis 271	–	180 bis 285

1) *Nominal thread diameter d ≤ 24 mm.*

2) *Hardened at a tempering temperature of at least 275 °C.*

Tab.3 Mechanical properties of screws – austenitic steel

Steel group	*Steel type*	*Property class*	*Diameter range*	*Tensile strength* R_m [1] N/mm² min.	*0,2% proof stress* $R_{p\,0,2}$ [1] N/mm² min.	*breaking elongation* A [2] mm min.
Austenitic	A1, A2, A3, A4, A5	50	≤ 39	500	210	0,6 d
		70	≤ 24 [3]	700	450	0,4 d
		80		800	600	0,3 d

1)The tensile stress is calculated in relation to the stressed cross section.

2)The breaking elongation must be established in accordance with the length of the respective screw and not turned type samples. d = nominal diameter

3)For fasteners with a nominal thread diameter d > 24 mm, the mechanical properties must be agreed between the user and the manufacture. They must be indicated with the steel type and the property class in accordance with this table.

Tab.4 Mechanical properties of screws – martensitic and ferritic steel

Steel group	*Steel type*	*Property class*	*Tensile strength* R_m [1] N/mm² min.	*0,2% proof stress* $R_{p\,0,2}$ [1] N/mm² min.	*breaking elongation* A [2] mm min.	*hardness* HB	HRC	HV
Martensitic [5]	C1	50	500	250	0,2 d	147–209	–	155–220
		70	700	410		209–314	20–34	220–330
		110 [4]	1100	820		–	36–45	350–440
	C3	80	800	640		228–323	21–35	240–340
	C4	50	500	250		147–209	–	155–220
		70	700	410		209–314	20–34	220–330
Ferritic	F1 [3]	45	450	250		128–209	–	135–220
		60	600	410		171–271	–	180–285

1)The tensile stress is calculated in relation to the stressed cross section.

2)The breaking elongation must be established in accordance with the length of the respective screw and not turned type samples.d = nominal diameter.

3)Nominal thread diameter d ≤ 24 mm.

4)Hardened at a tempering temperature of at least 275 °C

5)In the case of screws made from martensitic steel, the resistance under diagonal pressure may not be lower than the minimum values stipulated for tensile strength).

Chemical composition.

The chemical composition of the stainless steels that are suitable for fasteners according to DIN EN ISO 3506 is indicated in the following table.
If nothing to the contrary was agreed between the customer and the manufacturer, the manufacturer is at liberty to choose the chemical composition within the agreed steel type.
In cases of application where there is a danger of intercrystalline corrosion, testing in accordance with DIN EN ISO 3651-1 (corrosion trial in nitric acid) or -2 (in sulphuric acid) is recommended. In these cases, the use of stabilized stainless steels A 3 and A 5 (or A 2 and A 4 steels with a carbon content of less than 0,03%) is recommended.

Stainless steels – Chemical composition

Steel group	*Steel type*	*Chemical compound (percentage by mass)* [1]									*Remarks*
		C	**Si**	**Mn**	**P**	**S**	**Cr**	**Mo**	**Ni**	**Cu**	
Austenitic	A1	0,12	1	6,5	0,2	0,15–0,35	16–19	0,7	5–10	1,75–2,25	2), 3), 4)
	A2	0,1		2	0,05	0,03	15–20	5)	8–19	4	6), 7), 8)
	A3	0,08			0,045		17–19		9–12	1	6), 9)
	A4						16–18,5	2–3	10–15		8), 10)
	A5	0,08							10,5–14		9), 10)
Martensitic	C1	0,09–0,15		1	0,05		11,5–14	–	1	–	10)
	C3	0,17–0,25			0,04		16–18		1,5–2,5		
	C4	0,08–0,15		1,5	0,06	0,15–0,35	12–14	0,6	1		2), 10)
Ferritic	F1	0,12		1	0,04	0,03	15–18	5)			11), 12)

1) *Maximum values, provided that no other figures have been given.*

2) *Sulphur may be replaced by selenium.*

3) *If the percentage of nickel by mass is below 8 %, the percentage of manganese by mass must be at least 5 %.*

4) *If the percentage of nickel by mass is higher than 8 %, there is no minimum level for the percentage of copper by mass.*

5) *Molybdenum is permissible if chosen by the manufacturer. Should a limit to the molybdenum content nevertheless be necessary for certain applications, this must be established by the customer when the order is placed.*

6) *Molybdenum is also permissible if chosen by the manufacturer.*

7) *If the percentage of chromium by mass is below 17 %, the percentage of nickel by mass must be at least 12 %.*

8) *In the case of austenitic steels with a percentage of carbon by mass of max. 0.03%, the maximum nitrogen content may be 0.22 %.*

9) *For stabilisation purposes, there must be a titanium content of ≥ 5 x C up to max. 0.8 % or niobium and/or tantalum content ≥ 10 x C up to max. 1.0 % and these must be indicated suitably in accordance with this table.*

10) *The carbon content may be higher if preferred by the manufacturer, provided that this is necessary to achieve the set mechanical properties where the diameters are larger, although this is not permitted in the case of austenitic steels.*

11) *May contain titanium ≥ 5 x C up to max. 0.8 %.*

12) *May contain niobium and/or tantalum ≥ 10 x C up to max. 1.0 %.*

Chemical stability.

Fasteners made from the most common stainless steel types A 2 and A 4 come into contact with all kinds of substances. Using them will be problematic if their chemical stability vis-à-vis some substance or other is restricted.
To make it easier to use fasteners made from these special steel types, we are showing you an extract from the stability list. Please note that the stability information can change in practice, since the substances seldom appear in their purest form. For safety reasons we would always recommend a test under operational conditions.

Extract from the chemical stability list (further information on request)
1 = stable (loss of volume < 0,1 g/m² x h)
2 = conditionally stable (loss of volume 0,1 - 1,0 g/m² x h)
3 = low stability (loss of volume 1,0 - 10 g/m² x h)
4 = unstable (loss of volume >10 g/m² x h)

Substance	Degree of stability	
	A2	A4
Acetate of copper	1	1
Acetic acid, cold	1	1
Acetone, all conc.	1	1
Alum (10 %), cold	1	1
saturated solution, boiling	2	1
Aluminium acetate	1	1
Aluminium sulphate (10 %), cold	1	1
saturated, cold	2	1
Ammonia solution	1	1
Ammonium carbonate	1	1
Ammonium nitrate	1	1
Ammonium sulphate, cold	1	1
Ammonium sulphite	1	1
Aniline	1	1
Beer	1	1
Benzine	1	1
Benzoic acid	1	1
Benzol	1	1

Substance	Degree of stability	
	A2	A4
Boric acid	1	1
Butyl acetate	1	1
Calcium bisulphite, cold	1	1
boiling	3	1
Calcium hydroxide (10–50 %), cold	1	1
Calcium nitrate	1	1
Camphor	1	1
Carbon bisulphide	1	1
Carbon dioxide	1	1
Carbon tetrachloride, anhydrous	1	1
Chlorine, dry	1	1
Chloroform, anhydrous	1	1
Chromic acid (10 %), cold	1	1
boiling	3	2
Citric acid 50 %, boiling	4	1
Citric acid, saturated, cold	1	1
Copper arsenite	1	1
Copper nitrate	1	1

Materials . Chemical stability

Substance	Degree of stability	
	A2	A4
Copper sulphate	1	1
Creosote	1	1
Developer (photo)	1	1
Ethyl acetate	1	1
Ethyl alcohol, all conc.	1	1
Ethyl ether, boiling	1	1
Fatty acid, 150 °C	1	1
Ferrous nitrate	1	1
Formalin	1	1
Formic acid, cold	1	1
Fruit juices	2	1
Glycerine	1	1
Hydrocyanic acid	1	1
Hydrogen sulphide	1	1
Hydrogen superoxide	1	1
Iron sulphate	1	1
Lactic acid, all conc., boiling	3	2
Lactic acid, cold	1	1
Latex	1	1
Linseed oil	1	1
Liquid gases (propane, butane)	1	1
Magnesium sulphate	1	1
Maleic acid	1	1
Mercury	1	1
Mercury amalgam	1	1
Mercury nitrate	1	1
Methyl alcohol	1	1
Milk of lime	1	1
Molasses	1	1
Nickel sulphate	1	1
Nitric acid up to 60 %, cold	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

Substance	Degree of stability	
	A2	A4
Phtalic acid	1	1
Potash	1	1
Potassium bichromate (25 %)	1	1
Potassium bitartrate	1	1
Potassium chlorate	1	1
Potassium cyanide	1	1
Potassium hydroxide	1	1
Potassium nitrate	1	1
Potassium permanganate	1	1
Potassium sulphate	1	1
Salicylic acid	1	1
Soap	1	1
Sodium aluminate	1	1
Sodium bisulphate, boiling	1	1
Sodium carbonate (soda)	1	1
Sodium disulphide, boiling	1	1
Sodium hydroxide, cold	1	1
Sodium nitrate	1	1
Sodium perchlorate	1	1
Sodium phosphate	1	1
Sodium sulfide	1	1
Sodium sulphate	1	1
Sodium sulphite	1	1
Sugar solution	1	1
Sulphur (molten)	1	1
Sulphur chloride, anhydrous	1	1
Sulphur dioxide	1	1
Sulphurous acid	1	1
Tannic acid	1	1
Tar	1	1
Tartaric acid	1	1
Trichlorethylene, anhydrous	1	1
Viscose	1	1
Water glass	1	1
Wine	1	1
Zinc sulphate	1	1

Fields of Application.

Every material has certain corrosion and processing properties that are determined by its alloying elements. In cases of doubt, the Lederer application advisers will help you to choose the right material.

Steel group	*Material No.*	*Abbreviation*	*Properties and characteristic features*
13% chromium steels			
C1	1.4006	X12Cr13	*heat treatable stainless machine steel, smoothly polished, water and steam resistant* *Restricted weldability due to the possibility of increased hardness around the weld seam, hard and soft annealing possible, corresponds to DIN 17440.*
	1.4021	X20Cr13	*resistant to corrosion from water and steam in annealed condition, can be polished with mirror finish, corresponds to DIN 17440*
17% chromium and chromium molybdenum steels			
F1	1.4016	X12Cr17	*ferritic nickel chromium steel, can be polished to a mirror finish, resistant to water, steam, weak acids and caustic solutions and oxidizing acids such as nitric acid. After welding, no longer resistant to intercrystalline corrosion if not given subsequent heat treatment (2 hours at 650-800˚C).* *Hard and soft soldering possible. Corresponds to DIN 17440.*
C3	1.4057	X19CrNi17-2	*heat treatable 17% chromium steel, resistant to water, steam, weak acids and caustic solutions and strong oxidizing acids such as nitric acid. Due to good operating characteristics and high wear resistance, can be used for highly stressed machine parts, e.g. shafts, axes, valves and pump parts. Corresponds to DIN 17440.*
C4	1.4104	X14CrMoS17	*stainless free cutting steel, good machining property due to sulphur content. As corrosion resistant as 13% chromium steel. This steel is not used for welding. Corresponds to DIN 17440.*
C-	1.4122	X39CrMo17-1	*heat treatable chromium steel, largely resistant to numerous organic and inorganic acids due to its molybdenum content. Relatively good resistance to salt water. Improved resistance to crevice corrosion. Can be polished with mirror finish, working temperature max. 450-500˚C. Corresponds to SEW 400.*

Steel group	*Material No.*	*Abbreviation*	*Properties and characteristic features*
Austenitische Chrom-Nickel-St hle, *Austenitic nickel chromium steels*			
A2	1.4301	X4CrNi1 8-10	*Standard type of austenitic nickel chromium steel, highly corrosion resistant, can be used in pressure vessel manufacturing according to AD instructions W2 up to at least 300°C. Used in the food industry; resistant to intercrystalline corrosion up to a 6mm sheet thickness or a 40mm rod diameter; suitable for welding. Corresponds to DIN 17440 and VdT V 411.*
	1.4303	X4CrNi1 8-12	*Can be used as bar stock or wire for the production of screws, nuts and cold pressure flow parts, resistant to intercrystalline corrosion up to a 6mm sheet thickness or a 40mm rod diameter; suitable for welding.*
A1	1.4305	X 8CrNiS18-9	*Austenitic free cutting steel, better than normal austenitic free cutting steels due to the addition of sulphur, easy machining, especially suitable for swivel parts. Corresponds to DIN 17440.*
A -	1.4306	X2CrNi19-11	*Highly corrosion resistant, can be used in pressure vessel manufacturing according to AD instructions W2 up to at least 300°C. Resistant to intercrystalline corrosion in accordance with DIN 17440 and DIN 17441, suitable for welding.*
	1.4310	X12CrNi17-7	*Austenitic nickel chromium steel that is mostly used in cold-hammered or rolled condition for making into rustproof springs. Continuous operation only up to max. 250°C, otherwise reduction in firmness.*
A3	1.4541 1.4550	X6CrNiTi18-10 X6CrNiNb18-10	*Used for welded parts in chemical apparatus engineering, the foodstuffs, luxury foods, fat and soap industries and leather and sugar factories. Can be used in pressure vessel manufacturing according to AD instructions W2 up to at least 300°C. Cannot be polished to a mirror finish because of the titanium and/or niobium addition. Corresponds to DIN 17440 and VdT v 411.*
A -	1.4567	X3CrNiCu18-9 X3CrNiCu18-9-4	*Austenitic nickel chromium steel, highly corrosion resistant. Since it may contain up to 4% copper, it is particularly suitable for cold forming. According to DIN 24567 it belongs to the group of A2 materials.*

Steel group	Material No.	Abbreviation	Properties and characteristic features
Austenitic nickel chromium molybdenum steels			
A4	1.4401	X5CrNiMo17 12 2 X4CrNiMo17-12-2	*This austenitic nickel chromium steel achieves a far higher level of corrosion resistance thanks to a molybdenum alloying element. Increased resistance to non-oxidizing acids and chlorous agents. The material can be used to a limited extent in the salt water sphere. Can be used in pressure vessel manufacturing according to AD instructions W2 up to at least 300°C. Corresponds to DIN 17440 and VdT v 411.*
	1.4404	X2CrNiMo17 13 2 X2CrNiMo 17-2-2 G X2CrNiMo18-14-3	*This austenitic nickel chromium steel achieves a far higher level of corrosion resistance thanks to a molybdenum alloying element. Increased resistance to non-oxidizing acids and chlorous agents. The material can be used to a limited extent in the salt water area. Can be used in pressure vessel manufacturing according to AD instructions W2 up to at least 400°C. Resistant to intercrystalline corrosion in accordance with DIN 17440 and DIN 17441, suitable for welding.*
A -	1.4438	X2CrNiMo18-16-4	*Due to the high molybdenum content of ≥ 3.0%, highly resistant to non-oxidizing acids and halogenated agents, can be polished to a mirror finish and has good plasticity. Can be used in pressure vessel manufacturing according to AD instructions W2 up to at least 300°C. Resistant to intercrystalline corrosion in accordance with DIN 17440 and DIN 17441, suitable for welding.*
	1.4439	X2CrNiMoN17-13-5	*Maximum corrosion resistance and high resistance to pitting and crevice corrosion, increased resistance to stress corrosion. Can be used in pressure vessel manufacturing according to AD instructions W2 up to at least 400°C. Also used in marine technology and the reactor industry. Resistant to intercrystalline corrosion in accordance with DIN 17440 and DIN 17441; suitable for welding. Corresponds to VdT V 411-458.*
A5	1.4571	X6CrNiMoTi17-2-2	*Molybdenum gives increased corrosion resistance, particularly to non-oxidizing acids and halogenated agents. Can be used in pressure vessel manufacturing according to AD instructions W2 up to 300°C. Cannot be polished to a mirror finish because of the stabilising element titanium. Corresponds to VdT V 411-451.*
Ferritic austenitic nickel chromium molybdenum steels			
F/A	1.4462	X2CrNiMoN22-5-3	*High resistance to stress corrosion, in chlorous agents, to local and also, in welded condition, to intercrystalline corrosion. General corrosion resistance to many organic and inorganic acids. Good hot and cold forming properties and highly suitable for welding. Can be used in pressure vessel manufacturing according to AD instructions W2 from -10°C to 280°C.*

International steel key.

The specific properties of the material depend on the composition of the alloying elements. These alloys, however, are designated differently in many countries. The following overview makes it easier to compare internationally common designations from Germany, France, the UK and the USA.

Material No.	*Abbreviation*	**AISI (USA)**	**AFNOR (France)**	**B.S. (Great Britain)**
13% chromium steels				
1.4005	X6CrS13	416	Z12CF13	416 S 21
1.4006		410 CA-15		410 C 21 / ANC 1A
1.4021		420		420 S 37
17% chromium and chromium molybdenum steels				
1.4016	X12Cr17	430	Z8C17	430 S 17
1.4057	X2OCrNi17-2	431	Z15CN16-02	431 S 29
1.4104	X12CrMoS17	430F	Z13CF17	
1.4122	X35CrMo17			
Austenitic nickel chromium steels				
1.4301	X5CrNi18-10	304	Z4CN10-10FF	304 S 11/15/16/17
		304H	Z5CN17-08	LW21
			Z6CN18-09	LWCF 21
			Z7CN19-09	304 S 31
1.4303	X5CrNi18-12	305/308	Z5CNI 8-11FF	305 S I7/19
1.4305	X1 OCrNiS18-9	303	Z8CNF18-09	303 S 22
1.4306	X2CrNi19-11	304L	Z1CN18-12	304 S 11
			Z2CN18-10	LW20
			Z3CN19-10M	LWCF20
			Z3CN18-10	304 C 12
			Z3CN19-11	305 S 11
			Z3CN19-10FF	
1.4310	X12CrNi17 7	301	Z12C N17-07	
1.4541	X6CrNiTi18-10	321	Z6CNT18-10	321 S 31
				321 S 51
				LW24
				LWCF24
1.4550	X6CrNiNb18-10	347	Z6CNNb18-10	347 S 31
1.4567	X3CrNiCu18-9	304		

Materials . International steel key

Material No.	*Abbreviation*	**AISI (USA)**	**AFNOR (France)**	**B.S. (Great Britain)**
Austenitic nickel chromium molybdenum steels				
1.4401	X5CrNiMo17-12-2	316	Z3CND17-11 -01	316 S 13
	X4CrNiMo17-12-2		Z6CND17-11	316 S 17
			Z6CND17-11-02FF	316 S 19
			Z7CND1711-02	316 S 31
			Z7CND17-12-02	316 S 33
1.4404	X2CrNiMo17-13-2	316L	Z2CND17-12	316 S 11
	X2CrNiMo17-12-2		Z2CND18-13	316 S 13
			Z3CND17-11-02	316 S 14
			Z3CND17-12-02FF	316 S 31
			Z3CND18-12-02	316 S 42
			Z3CND18-12-03	
			Z3CND18-14-03	
1.4435	X2CrNiMo18-14-3	316L	Z3CND17-12-03	316 S 11
			Z3CND18-14-03	316 S 13
				316 S 14
				316 S 31
				LW22
				LWCF22
1.4438	X2CrNiMo18-16-4	317L	Z2CND19-15	317 S 12
1.4439	X2CrNiMoN17-13-5	317LNM		
1.4571	X6CrNiMoTi17-12-2	316Ti	Z6CNDT17-12	320 S 18/31
Ferritic austenitic nickel chromium molybdenum steels				
1.4462	X2CrNiMoN22-5-3		Z3CND22-05-AZ	318 S 13
			Z2CND24-08-AZ	
			Z3CND25-06-03-AZ	
1.4713	X10CrAl7			
1.4828	X15CrNiSi20-12	309	Z19CN24-13	309 S 24
			Z17CNS20-12	
1.4841	X15CrNiSi25-20	314, 310	Z15CNS25-20	314 S 25
1.4980	X5NiCrTi26-15			
Special austenitic materials				
2.4360	(S-)NiCu30Fe			
2.4610	NiMo16Cr16Ti			
2.4816	NiCr1 5Fe			
3.7025	Ti2			

Assembly Aids . Special properties

Special properties of stainless steel.

We would like to do more than just provide its customers with information about the properties of screws, nuts and accessories. The company also wants to impart knowledge about their proper use. Below we provide important information about material properties, pilot-drill data, hole diameters, torques and securing elements. This information is designed to help you use the specified fasteners in a technically correct and efficient way. In cases of doubt, you should establish the values for specific application cases with experiments.

Hardenability
Stainless steels A 1 – A 5 cannot be hardened with heat treatment (the hardness is achieved solely via the mould pressures used in production). The reaction of fasteners made from these materials to being assembled/erected therefore differs from that of fasteners made from tempered steel. Improper assembly can lead to the failure of the properly created joint. In particular when similar matings of materials are screwed together, the danger of cold fretting ("eating away") exists.

Magnetic properties
Generally, fasteners made from austenitic steel (A 1 – A 5) are not magnetizable. Since the higher property classes 70 and 80 are reached with the mould pressures during cold forming, however, the material can become slightly magnetic as a result.

Temperature ranges
Stainless steels are resistant to the cold, which also makes them highly suitable for use at low temperatures: A 2 down to -200°C, A 4 down to -60°C.

Strength
The property class 70 generally applies to hexagon head, hexagon socket, six lobe drive, slotted, recessed screws and studs. If no agreement to the contrary is made when the order is placed, screws of this property class will be delivered

Assembly Aids . Pilot drilling values

Pilot-drilling values for thread rolling screws.

This standard establishes the hole diameter for thread rolling screws in accordance with DIN 7500 (part 1). The hole diameters have emerged from practical trials carried out by manufacturers and users. These are regarded as guidelines and are assigned to various materials and thread reaches.
It is also advisable to examine the fixed hole diameters for the various types of thread rolling screws (whose rolling area is defined in the standard only by a maximum length) by conducting your own trials, particularly in mass production.
Processes that lead to a strengthening of the hole wall during the creation of the hole (e.g. punching) can require hole diameters that exceed those of the guidelines specified in the standard. The outer crust means that these can also apply for cast holes.
The standard does not take account of holes with special forms (triangular, octagonal, etc.).

Materials . Pilot drilling values

Material thickness or screw depth	Hole diameters d_h (range of tolerance H11)																							
	M 2,5			M 3			M 3,5			M 4			M 5			M 6			M 8			M 10		
	St	Al	Cu	St	Al	Cu	St	Al	Cu	St	Al	Cu	St	Al	Cu	St	Al	Cu	St	Al	Cu	St	Al	Cu
0,8		2,25																						
0,9		2,25																						
1		2,25			2,7																			
1,2		2,25			2,7			3,15																
1,5		2,25			2,7			3,15			3,6			4,5										
1,6		2,25			2,7			3,2			3,6			4,5										
1,7		2,25			2,7			3,2			3,6			4,5										
1,8		2,25		2,75	2,7			3,2			3,6			4,5										
2		2,25		2,75	2,7			3,2			3,6			4,5			5,4							
2,2		2,25			2,75			3,2			3,6			4,5			5,4			7,25				
2,5		2,25			2,75			3,2		3,65	3,6			4,5			5,4			7,25		9,2		
3		2,3			2,75			3,2		3,65	3,6			4,5			5,45			7,25		9,2	9,15	
3,.2		2,3			2,75			3,2		3,65	3,6		4,55	4,5			5,45			7,25		9,2	9,15	
3,5		2,3			2,75			3,2			3,65			4,55			5,45			7,25		9,2	9,15	
4		2,3			2,75			3,2			3,65			4,55		5,5	5,45			7,3		9,3	9,15	
5		2,3			2,75		3,2	3,25		3,7	3,65			4,6		5,5	5,45		7,4	7,3		9,3	9,2	9,25
5,5					2,75		3,2	3,25		3,7	3,65			4,6			5,5		7,4	7,3		9,3	9,2	9,25
6					2,75					3,7	3,65			4,6			5,5		7,4	7,3		9,3	9,2	9,25
6,3																								
6,5											3,7			4,65			5,5		7,4	7,35		9,3	9,2	9,25
7																								
7,5											3,7			4,65		5,5	5,5		7,5	7,4		9,4	9,3	
8 bis ≤ 10																								
> 10 bis ≤ 12																				7,5		9,5	9,4	
> 12 bis ≤ 15																								
> 15 bis ≤ 20																							9,5	

St = St 12, St 37-2

Al = Al99.5F13, AlMn F10

Cu = E-Cu57 F30, E-Cu58 F30, CuZn F38

All dimensions in mm.

Assembly aids . Drill hole diameter

Tapping screw threads according to DIN EN ISO 1478 / DIN 7970 screws made of stainless steel A 2 / A 4		*Sheet thickness*		*Sheet material*	
nominal diameter	*No. according to ISO*	*from*	*to*	*Steel St. 37*	*Aluminium*
2,9	No. 4	–	0,56	–	–
		0,57	0,63	2,30	2,40
		0,64	0,75		
		0,76	0,88		
		0,89	1,25		
		1,26	1,38		
		1,39	1,75		
		1,76	2,50	2,40	2,50
3,5	No. 6	–	0,56	2,70	2,80
		0,57	0,75		
		0,76	0,88		
		1,01	1,25		
		1,26	1,38		
		1,39	1,75	2,80	2,90
		1,76	2,50		
		2,51	3,00	2,90	3,00
		3,01	6,00		
3,9	No. 7	–	0,50	3,00	3,10
		0,51	0,63		
		0,64	0,88		
		0,89	1,13		
		1,14	1,25		
		1,26	1,38		
		1,39	1,75		
		1,76	2,00		
		2,01	2,50	3,10	3,20
		2,51	3,50	3,20	3,30
4,2	No. 8	–	0,50	–	–
		0,51	0,63		
		0,64	0,88		
		0,89	1,13	3,20	3,30
		1,14	1,38		
		1,39	2,50	3,30	3,40
		2,51	3,00		
		3,01	3,50	3,40	3,50
		3,51	10,00	3,50–3,60	3,60–3,70
4,8	No. 10	–	0,50	–	–
		0,51	0,75		
		0,76	1,13		
		1,14	1,38	3,70	3,90
		1,39	1,75		
		1,76	2,50	3,80	
		2,51	3,00		
		3,01	3,50	3,90	4,00
		3,51	4,00		
		4,01	4,75	4,00	4,10
		4,76	10,00	4,10–4,20	4,20–4,30
5,5	No. 12	–	1,13	–	–
		1,14	1,38		
		1,39	1,50		
		1,51	1,75		
		1,76	2,25	4,50	4,60
		2,26	3,00		
		3,01	3,50	4,60	4,70
		3,51	4,00		
		4,01	4,75	4,70	4,80
		4,76	10,00	4,70–4,90	4,80–5,00
6,3	No. 14	–	1,38	–	–
		1,39	1,75		
		1,76	2,00		
		2,01	3,00	5,30	5,40
		3,01	4,00	5,40	5,50
		4,01	4,75	5,50	5,60
		4,76	5,00		
		5,01	10,00	5,60–5,70	5,70–5,80

Permissible torques for screws M 5 - M 30.

The following list of torques apply for screws according to DIN 931/933 resp. ISO 4014/4017 in hardness classes 50, 70 and 80 at room temperature.

These torques should be seen as approximate guidelines because variations in friction values may occur in practice. To determine the correct torque for each application, we recommend you carry out an relevant trial turning.

Please note that the torques listed in the tables for the classes 70 and 80 apply only for a screw length up to 8 x the thread nominal diameter.

A2-50 and A4-50 without length limits

Coefficient of friction	*Permissible torque Nm*												
µ	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M22	M 24	M 27	M 30
0,12	1,7	3	7,1	14	24	39	59	81	114	153	198	287	393
0,14	2	3,4	8,2	16	28	44	67	93	131	175	226	330	450
0,16	2,2	3,8	9,2	18	31	50	76	105	148	198	255	372	508
0,18	2,5	4,2	10,2	20	35	55	84	116	164	220	284	415	566

A2-70 und A4- 70 for lengths up to 8 x nominal thread diameter

Coefficient of friction	*Permissible torque Nm*												
µ	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M22	M 24	M 27	M 30
0,12	3,7	6,4	15,3	31	52	83	126	174	245	328	423	617	845
0,14	4,2	7,3	17,5	35	60	94	144	199	281	376	485	708	969
0,16	4,7	8,2	19,6	39	67	106	162	225	316	423	546	797	1092
0,18	5,3	9,1	21,8	44	75	118	180	250	352	471	607	886	1213

A2-80 und A4- 80 for lengths up to 8 x nominal thread diameter

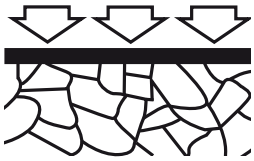
Coefficient of friction	*Permissible torque Nm*								
µ	M 5	M 6	M 8	M 10	M 12	M 14	M 16	M 18	M 20
0,12	4,9	8,5	20,4	41	70	110	167	233	326
0,14	5,6	9,7	23,3	47	79	126	192	266	374
0,16	6,3	10,9	26,2	53	89	142	216	299	422
0,18	7	12,1	29,1	58	99	157	241	333	469

Corrosion protection.

As a specialist in the field of fasteners for stainless steel, Wenaturally knows about the benefits of stainless screws, nuts and accessories. Their resistance to corrosion is usually the decisive argument when the material is being chosen.
Basic knowledge of corrosion protection and corrosion types is nevertheless important for the proper construction of modern and up-to-date mechanical linkages.
The basic term of corrosion according to DIN EN ISO 8044 (former DIN 50900):
"Corrosion is the reaction of a metallic material to its environment, which effects measurable change in the material and can lead to impairment of the function of a metal construction part or of an entire system. In most cases this reaction is of an electro-chemical nature; but sometimes it can be also be of a chemical or metal-physical nature".

Surface corrosion

Evenly spread abrasion on the affected surfaces as a result of the surrounding medium. → general rust

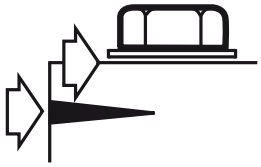


localized corrosion

Restricted to one area, e.g. as a result of protective coatings being damaged by e.g. chlorine.→ e.g. in swimming pools

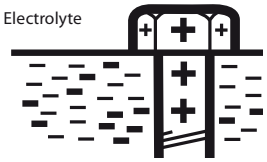
Crevive corrosion

In crevices in the material or between connected building components, resulting from aggressive media and too little oxygen for the restoration of passivation. →e.g. with gas hoods, digesters



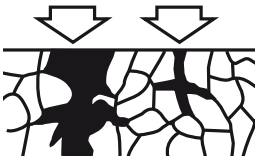
Contact corrosion

Electro-chemical process triggered by different metals coming into contact. → e.g. under screw heads



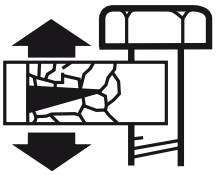
Intercrystalline/Transcrystalline corrosion

An increase in the temperature to 400 – 800°C leads to the elimination of chromium carbides at the grain boundaries of the metal structure. Washing out in acidic media then leads to the reduction of the chromium element in the alloy that is required for the passivation.
→ e.g. as a result of faulty welding fillers



Stress corrosion

Where there are simultaneous effects from a corrosion medium and mechanical stresses in the building component.
→ e.g. in bridge construction



Measures to prevent corrosion.

There are four types of corrosion prevention measures, which can be differentiated in descending order of priority as follows:
The right choice of material (stainless steels and special materials, nonferrous metals such as copper, brass, bronze, aluminium or titanium and synthetic materials)
Subsequent surface coatings (lubrication, zinc coating, lacquering, phosphatizing, bronzing, chromizing, galvanizing)
Electro-chemical measures (cathodic protection)
Structural measures (insulation, avoidance of crevices, etc.)

We are the right contact when it comes to the choice of materials. We provide you with detailed advice and help you to choose the best article/material combination. Similarly, we can offer you all of the commonly used procedures for surface coating and carry them out for you.
Knowing the right matings of materials is certainly one of the relevant electro-chemical and structural measures. After all, the possibility of contact corrosion should always be considered when different metals are being used simultaneously in fastening elements and the elements earmarked for fastening. The following overview provides reference values for suitable material matings as well as those that should be avoided.

Material observed for contact corrosion	*area ratio to**	*Stainless steel*	*Copper*	*Tin*	*Lead*	*Chrome steel*	*Cast steel*	*Low alloy steel*	*Construction steel*	*Acid zinc coating*	*Aluminium alloy*	*Hot galvanized steel*	*Zinc*	*Magnesium alloy*
Stainless steel	*small*			+	+		+	+		+	+	+	+	+
	large		+	o	o	o	+	+	+	+	+	o	+	+
Copper	*small*			–	o	o		+	+	+	+	+	+	+
	large	+		o	+		+	+	+	+	+	+	+	+
Tin	*small*				+	+		+	+	+	+	+	+	+
	large				+	o	+	+	+	+	+	+	+	+
Lead	*small*		+	+		+	+	+	+	+	+	+	+	+
	large	+		+		+	o	+	+	+	+	+	+	+
Chrome steel	*small*	–	–	o	o			+	+	+	+	+	+	+
	large	+		+	+			+	+	+	+	+	+	+
Cast steel	*small*	–	–	–	–	–		o	+	+	+	+	+	+
	large			+	+	+		+	+	+	+	+	+	+
Low alloy steel	*small*	–	–	–	–	–	+		+	+	+	+	+	+
	large	+	+	+	+	+	+		+	+	+	+	+	+
Construction steel	*small*	–	–	–	–	–	–	o		+	+	+	+	+
	large	+	+	+	+	+	+	+		+	+	+	+	+
Acid zinc coating	*small*	–	–	–	–	–	–	–	–		+	+	+	+
	large	+	+	+	+	+	+	+	+		+	o	+	o
Aluminium alloy	*small*	–	–		–		–		o	+		+	+	o
	large	o	–	–	–	o	o	+	+	+		o	o	+
Hot galvanized steel	*small*	–	–	–	–	–	–	–	–	o	o		+	o
	large	+	+	+	+	+	+	+	+	+	+		+	+
Zinc	*small*	–	–	–	–	–	–	–	–	o	o	+		o
	large	+	+	+	+	+	+	+	+	+	+	+		+
Magnesium alloy	*small*	–	–	–	–	–	–	–	–	–	–	–	–	
	large	–	–	–	–	–	–	–	–	o	o	o	o	

**Relation of the surface of the material observed (column) to the surface of the second material (line)*

– = heavy corrosion of the material observed

o = moderate corrosion of the material observed

+ = slight or no corrosion of the material observed

Source: Hot Galvanising Advisory Unit