Technical data

Mechanical properties at room temperature	NR	SBR	NBR	CR	EPDM
Tensile strength (in the case of active fillers)	1	2	2	2	2
Elongation (high)	1	2	2	2	3
Resilience (high)	1	3	4	3	3
Tear propagation resistance	2	3	3	2	2
Abrade resistance (in the case of reinforced fillers)	2	2	2	3	3
Resistance to continuous deforming at high temperatures	4-5	4	3	4	3
Resistance to continuous deforming at low temperatures	2	3	4	4	3
Thermic behaviour					
Cold flexibility	2	3	4	3	3
Resistance to heat	6	5	4	4	4
Resistance to ...					
Fuel	6	5	2	3	6
Mineral oil (at 100 °C)	6	5	1	3	5
Acids (25% H2SO4 at 50 °C)	4	4	2	2	1
Solutions (50% NaOH at 50 °C)	2	2	6	2	1
Water (100 °C)	5	5	2	3	1

Mechanical properties: 1= excellent .... 6= poor

Resistance to: 1= resistant .... 6= unsuitable

Compounds

The below table is only a guide for the selection of compounds.

There might be significant differences in terms of the compound components

	ADVANTAGES	DISADVANTAGES
NR - NATURAL RUBBER	High static and dynamic breaking resistance	Poor ageing-proof quality
	High flexibility	Poor ozone-proof quality
	Very good characteristics at low temperature	
SBR - STYROL-BUTADIEN-RUBBER	Better heat-proof quality than the NR	Moderate ageing-proof quality
	Average flexibility	Non ozone-proof quality
	Very high friction-proof and wearing quality	Non oil-proof quality
NBR - ACRYLNITRIL-BUTADIEN-RUBBER	High oil-proof quality	Average ageing-proof quality
	High flexibility	Poor ozone-proof quality
	High friction-proof and wearing quality	Poor characteristics at low temperature
CR - CHLOROPREN RUBBER	Better heat-, weather- and ozone proof quality than the NR and SBR	Difficult to manufacture
	Average oil-proof quality	
	Very good characteristics at low temperature	
EPDM - ETHYLEN-PROPYLENDIEN-RUBBER	Very high heat-proof quality	Non oil-proof quality
	Very high ozone-proof quality	
	Very good characteristics at low temperature	
	Very good lye- and acid-proof quality	

Tensile torque for the standard vibration absorber rubber jacks manufactured by us, taking into consideration various friction factors

Screw quality classification: 4.6

Friction factor	Tensile torque MA [Nm]										
	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M24
?ges = 0,08	0,8	1,6	2,7	6,4	13	22	36	54	79	111	191
?ges = 0,14	1,1	2,2	3,8	9,4	18	32	51	79	113	159	274
?ges = 0,20	1,4	2,7	4,5	11,3	23	39	62	98	137	195	334

Pre-stressing forces and tensile torque for screws with metric threads and head-seating sizes pursuant to DIN912, 931, 933, 934

Friction factor: ?ges = 0,08

Screw-plugs with metric regular threads, pursuant to DIN 13, 13. sheet

Size	Pre-tensioning force Fv [N]			Tensile torque MA [Nm]		
	8.8	10.9	12.9	8.8	10.9	12.9
M 4	4 400	6 450	7 550	2,1	3,1	3,6
M 5	7 150	10 500	12 300	4,2	6,1	7,2
M 6	10 100	14 900	17 400	7,3	11,0	12,0
M 8	18 600	27 300	31 900	17,0	26,0	30,0
M 10	29 500	43 400	50 500	34,0	51,0	59,0
M 12	43 000	63 000	74 000	59,0	87,0	100,0
M 14	59 000	86 500	101 000	95,0	140,0	165,0
M 16	81 000	119 000	139 000	145,0	215,0	250,0
M 18	102 000	145 000	170 000	210,0	300,0	350,0
M 20	131 000	186 000	218 000	295,0	420,0	490,0
M 22	163 000	232 000	272 000	395,0	560,0	660,0
M 24	188 000	268 000	313 000	510,0	720,0	840,0
M 27	247 000	352 000	412 000	740,0	1050,0	1250,0
M 30	300 000	428 000	501 000	1 000,0	1450,0	1700,0

Friction factor: ?ges = 0,14

Screw-plugs with metric regular threads, pursuant to DIN 13, 13. sheet

Size	Pre-tensioning force Fv [N]			Tensile torque MA [Nm]		
	8.8	10.9	12.9	8.8	10.9	12.9
M 4	3 900	5 750	6 700	3,0	4,4	5,1
M 5	6 400	9 400	11 000	5,9	8,7	10,0
M 6	9 000	13 200	15 500	10,0	15,0	18,0
M 8	16 500	24 300	28 400	25,0	36,0	43,0
M 10	26 300	38 700	45 200	49,0	72,0	84,0
M 12	38 400	56 500	66 000	85,0	125,0	145,0
M 14	52 500	77 500	90 500	135,0	200,0	235,0
M 16	72 500	107 000	125 000	210,0	310,0	365,0
M 18	91 000	129 000	152 000	300,0	430,0	500,0
M 20	117 000	166 000	195 000	425,0	610,0	710,0
M 22	146 000	208 000	244 000	580,0	820,0	960,0
M 24	168 000	240 000	281 000	730,0	1 050,0	1 220,0
M 27	222 000	316 000	369 000	1 100,0	1 550,0	1 800,0
M 30	269 000	384 000	449 000	1 450,0	2 100,0	2 450,0

Friction factor : ?ges = 0,20
Screw-plugs with metric regular threads, pursuant to DIN 13, 13. sheet

Size	Pre-tensioning force Fv [N]			Tensile torque MA [Nm]		
	8.8	10.9	12.9	8.8	10.9	12.9
M 4	3 450	5 050	5 900	3,6	5,3	6,1
M 5	5 650	8 250	9 650	7,1	10,0	12,0
M 6	7 950	11 700	13 600	12,0	18,0	21,0
M 8	14 600	21 400	25 100	30,0	44,0	52,0
M 10	23 200	34 100	39 900	60,0	87,0	100,0
M 12	33 900	49 800	58 000	105,0	151,0	177,0
M 14	46 500	68 500	80 000	165,0	240,0	285,0
M 16	64 000	94 000	110 000	260,0	380,0	445,0
M 18	80 500	114 000	134 000	365,0	520,0	610,0
M 20	103 000	147 000	172 000	520,0	740,0	870,0
M 22	129 000	184 000	216 000	710,0	1 000,0	1 200,0
M 24	149 000	212 000	248 000	890,0	1 250,0	1 500,0
M 27	196 000	279 000	327 000	1 350,0	1 900,0	2 200,0
M 30	238 000	339 000	397 000	1 800,0	2 550,0	3 000,0

Calculation of the tensile torque

The tensile torque and the pre-tensioning force can be calculated without any difficulties in the case of other, but not in the case of the property class listed in this screw selector in such way that we need to multiply the values of tensile torque and pre-tensioning, force by the ratio of the limit values of the required and known property class.

Example:

For property class 8.8, M10 size MA = 49 Nm, a 0,2% limit value Rp0,2 = 640 N/mm2. Look for the tensile torque with regards to M10 in the 5.6 property class (minimum limit value ReL = 300 N/mm2).

$$M_{A/5.6} = \frac{R_{eL/5.6}}{R_{p0,2/8.8}} \cdot M_{A/8.8}$$

$$M_{A/5.6} = \frac{300}{640} \cdot 49 = 23 Nm$$

Mechanical properties of fasteners made of carbon steel and alloy steel

Table specifies steels and tempering temperatures for the different property classes of bolts, screws and studs. The chemical composition shall be assessed in accordance with the relevant ISO standards.

Table : Steels

Property class	Material and treatment	Chemical composition limits(check analysis)% (m/m)					Tempering temperature
		C		P	S	Ba	oC
		Min	Max.	Max.	Max.	Max.	Min.
3.6b	Carbon steel	-	0,20	0,05	0,06	0,003	-
4.6b		-	0,55	0,05	0,06	0,003	-
4.8b							
5.6		0,13	0,55	0,05	0,06	0,003	-
5.8b		-	0,55	0,05	0,06		
6.8b							
8.8c	Carbon steel with additives (e.g. B, Mn, or Cr) quenched and tempered	0,15 d	0,40	0,035	0,035	0,003	425
	Carbon steel quenched and tempered	0,25	0,55	0,035	0,035		
9.8	Carbon steel with additives (e.g. B, Mn, or Cr) quenched and tempered	0,15 d	0,35	0,035	0,035	0,003	425
	Carbon steel quenched and tempered	0,25	0,55	0,035	0,035		
10.9e f	Carbon steel with additives (e.g. B, Mn, or Cr) quenched and tempered	0,15 d	0,35	0,035	0,035	0,003	340
10.9f	Carbon steel quenched and tempered	0,25	0,55	0,035	0,035	0,003	425
	Carbon steel with additives (e.g. B, Mn, or Cr) quenched and tempered	0,20 d	0,55	0,035	0,035		
	Alloy steel quenched and tempered g	0,20	0,55	0,035	0,035		
12.9f h i	Alloy steel quenched and tempered g	0,28	0,50	0,035	0,035	0,003	380

a. - Boron content reach 0,005% provided that non-effective boron is controlled by addition of titanium and/or aluminum.

b. - Free cutting steel is allowed for these property classes with the following maximum sulfur, phosphorus and lead contents: sulfur 0,34%; phosphorus 0,11%; lead 0,35%.

c. - For nominal diameters above 20 mm the steels specified for property class 10.9 may be necessary in order to achieve sufficient hardenability.

d. - In case of plain carbon boron steel with a carbon content bellow 0,25% (ladle analysis), the minimum manganese content shall be 0,6% for property class 8.8 and 0,7% for 9.8 and 10.9

e. - Products can be additionally identified by underlining the symbol of the property class (see clause 9). All properties of 10.9 as specified in table 3 shall be met by 10.9, however, its lower tempering temperature gives it different stress relaxation characteristic at elevated temperatures (see annex A).

f. - For the materials of these property classes, it is intended that there should be sufficient hardenability to ensure a structure consisting of approximately 90% martensite in the core of the threaded section for the fasteners in the "as-hardened" condition before tempering.

g. - This alloy steel shall contain at least one of the following elements in the minimum quantity given: chromium 0,30%; nickel 0,30%; molybdenum 0,20%; vanadium 0,10%. Where elements are specified in combination of two, three or four and have alloy contents less those given above, the limit value to be applied for class determination is 70% of the sum of the individual limit values shown above for the two, three or four elements concerned.

h. A metallographically detectable white phosphorus enriched layer is not permitted for property class 12.9 on surfaces subjected to tensile stress.

i. - The chemical composition and tempering temperature are under investigation.

Mechanical and physical properties

When tested by the methods described in clause 8, the bolts, screws and studs shall, at ambient temperature, have the mechanical and physical properties set out in table.

Table: Mechanical and physical properties of bolt, screws and studs

Sub clause number	Mechanical and physical property		Property class										
			3.6	4.6	4.8	5.6	5.8	6.8	8.8 a d<16 mm	8.8 a d>16 mm	9.8 b	10.9	12.9
5.1	Nominal tensile strength , Rm Nenn	N/mm2	300	400		500		600	800	800	900	1000	1200
5.2	Minimum tensile strength,Rm min d e	N/mm2	330	400	420	500	520	600	800	830	900	1040	1220
5.3	Vickers hardness, HVF ? 98 N	Min.	95	120	130	155	160	190	250	255	290	320	385
		Max	220f					250	320	335	360	380	435
5.4	Brinell hardness, HBF = 30 D2	Min	90	114	124	147	152	181	238	242	276	304	366
		Max	209f					238	304	318	342	361	414
5.5	Rockwell hardness HR Min	HRB	52	67	71	79	82	89					
		HRC							22	23	28	32	39
	Rockwell hardness HR Max	HRB	95,0f					99,5					
		HRC							32	34	37	39	44
5.6	Surface hardness, HV 0,3	Max.	-						g				
5.7	Lower yield stressReL in N/mm2	Nennwert	180	240	320	300	400	480	-	-	-	-	-
		Min	180	240	340	300	420	480	-	-	-	-	-
5.8	Stress at 0,2% non proportional elongation Rp0,2 in N/mm2	Nennwert	-						640	640	720	900	1080
		Min	-						640	660	720	940	1100
5.9	Stress under proof load, Sp	Sp/ReL Sp/Rp0,2	0,94	0,94	0,91	0,93	0,90	0,92	0,91	0,91	0,90	0,88	0,88
		N/mm2	180	225	310	280	380	440	580	600	650	830	970
5.10	Breaking torque, MB	Nm min							See ISO 898-7				
5.11	Percent elongation after fracture, A	Min	25	22	-	20	-	-	12	12	10	9	8
5.12	Reduction area after fracture Z	% min							-	52	48	48	44
5.13	Strength under wedge loadinge		The values for full size bolts and screws (no studs) shall not be smaller than the minimum values for tensile strength shown in 5.2.										
5.14	Impact strength, KU	J min				25			30	30	25	20	15
5.15	Head soundness		No fracture										
5.16	Minimum height of non-decarburized thread zone, E		-						1H1			2/3H1	3H1
	Maximum depth of complete decarburization, G	Mm							0,015				
5.17	Hardness after tempering								Reduction of hardness 20 HV maximum				
5.18	Surface integrity		In accordance with ISO 6157-1 or ISO 6157-3 as appropriate										

a. - For bolts of property class 8.8 in diameters d ? 16 mm, there is an increased risk of nut stripping in the case of inadvertent over-tightening inducing a load in excess of proof load. Reference to ISO 898-2 is recommended.

b. - Applies only to nominal thread diameters d ? 16 mm.

c. **-** For structural bolting the limit is 12 mm.d Minimum tensile properties apply to products of nominal length l ? 2,5

d. - Minimum hardness applies to products of length l < 2,5 d and other products which cannot be tensile tested (e.g. due to head configuration)

e. - When testing full-size bolts, screws and studs, the tensile loads, which are to be applied for the calculation of Rm, shall meet the values given in tables 6 and 8.

f. - A hardness reading taken at the end of bolts, screws and studs shall be 250 HV, 238 HB or 99,5 HRB maximum.

g. - Surface hardness shall not be more then 30 Vickers points above the measured core hardness on the product when readings of bolt surface and core are carried out at HV0,3. For property class 10.9, any increase in hardness at the surface which indicates that the surface hardness exceeds 390 HV is not acceptable.

h. - In cases where the lower yield stress ReL cannot be determined, it is permissible to measure the stress at 0,2% non proportional elongation Rp 0,2. For the property classes 4.8, 5.8 and 6.8 the values for ReL are given for calculation purposes only, they are not test values.

i. - The yield stress ratio according to the designation of the property class and the minimum stress at 0,2% non-proportional elongation Rp 0,2 apply to machined test specimens. These values if received from tests of full size bolts and screws will vary because of processing method and size effects