

Mechanical properties of bolts, screws, and studs according DIN-ISO 898, part 1

Property (at 20 °C)		Property class										
		3.6	4.6	4.8	5.6	5.8	6.8	8.8 ¹⁾ ≤ M 16	8.8 ¹⁾ > M 16 ²⁾	9.8 ³⁾	10.9	12.9
Tensile strength, R_m ⁴⁾ , N/mm ²	nominal	300	400		500		600	800	800	900	1000	1200
	min.	330	400	420	500	520	600	800	830	900	1040	1220
Vickers hardness HV, F \$ 98 N	min.	95	120	130	155	160	190	250	255	290	320	385
	max.	220 (250 at the screw end)					250	320	335	360	380	435
Brinell hardness HB, F = 30 D ²	min.	90	114	124	147	152	181	238	242	276	304	366
	max.	209 (238 at the screw end)					238	304	318	342	361	414
Rockwell hardness HR	min. HRB	52	67	71	79	82	89	-	-	-	-	-
	min. HRC	-	-	-	-	-	-	22	23	28	32	39
	max. HRB	95,0 (99,5 at the screw end)					99,5	-	-	-	-	-
	max. HRC	-					-	32	34	37	39	44
Surface hardness, HV 0,3		-					see foot note ⁶⁾					
Lower yield stress, R_{eL} ⁷⁾ , N/mm ²	nominal	180	240	320	300	400	480	-	-	-	-	-
	min.	190	240	340	300	420	480	-	-	-	-	-
Stress at 0,2% non-proportional elongation, $R_{p0,2}$ in N/mm ²	nominal	-					640	640	720	900	1080	
	min.	-					640	660	720	940	1100	
Stress ratio	S_p/R_{eL} or $S_p/R_{p0,2}$	0,94	0,94	0,91	0,93	0,90	0,92	0,91	0,91	0,90	0,88	0,88
Stress under proof load S_p	N/mm ²	180	225	310	280	380	440	580	600	650	830	970
Elongation after fracture, A	min. %	25	22	-	20	-	-	12	12	10	9	8
Reduction of area after fracture	min. %	-	52	52	48	48	44					
Strength under wedge loading ⁵⁾		The values for full size bolts and screws (not studs) shall not be smaller than the minimum values for tensile strength.										
Impact strength, J	min.	-		25	-			30	30	25	20	15
Head soundness		no fracture										
Minimum height of non-decarburized thread zone, E		-					$\frac{1}{2} H_1$			$\frac{2}{3} H_1$	$\frac{3}{4} H_1$	
Maximum depth of complete decarburization, G	mm	-					0,015					

¹⁾ For bolts of property class 8.8 in diameters $d \leq 16$ 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.

²⁾ For structural bolting the limit is 12 mm.

³⁾ Property class 9.8 applies only to nominal thread diameters $d \leq 16$ mm.

⁴⁾ Minimum tensile properties apply to products of nominal length $l \geq 2,5 d$. 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).

⁵⁾ Surface hardness shall not be more than 30 Vickers points above the measured core hardness on the product when readings of both surface and core are carried out at HV 0,3. For property class 10.9, any increase in hardness at the surface which indicates that the surface hardness exceeds 390 HV is not acceptable.

⁷⁾ In cases where the lower yield stress R_{eL} cannot be determined, it is permissible to measure the stress at 0,2% non-proportional elongation $R_{0,2}$