

Mechanical and Physical Properties of Bolts, Screws and Studs

according to ISO 898 - part 1



The mechanical properties are given for tests at room temperature.

Sub-clause number	Mechanical and physical property	Property class												
		3.6	4.6	4.8	5.6	5.8	6.8	8.8 ¹⁾		9.8 ²⁾	10.9	12.9		
								d ≤ 16 ³⁾ mm	d > 16 ³⁾ mm					
5.1 and 5.2	Tensile strength $R_m^{4),5)}$ in, N/mm ²	nominal value	300	400		500		600	800	800	900	1000	1200	
		min.	330	400	420	500	520	600	800	830	900	1040	1220	
5.3	Vickers hardness HV F ≥ 98N	min.	95	120	130	155	160	190	250	255	290	320	385	
		max.	220 ⁶⁾					250	320	335	360	380	435	
5.4	Brinell hardness HB F = 30 D ²	min.	90	114	124	147	152	181	238	242	276	304	366	
		max.	209 ⁶⁾					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
		max.	HRB	95 ⁶⁾					99.5	--	--	--	--	--
			HRC	--					--	32	34	37	39	44
5.6	Surface hardness HV 0.3	max.	--					7)						
5.7	Lower yield stress $R_{el}^{8)}$, N/mm ²	nominal value	180	240	320	300	400	480	--	--	--	--	--	
		min.	190	240	340	300	420	480	--	--	--	--	--	
5.8	Stress at 0.2% non-proportional elongation $R_{p0.2}^{9)}$ N/mm ²	nominal value	--					--	640	640	720	900	1080	
		min.	--					--	640	660	720	940	1100	
5.9	Stress under proofing load S_p	S_p/R_{el} or $S_p/R_{p0.2}$ N/mm ²	0.94	0.94	0.91	0.93	0.9	0.92	0.91	0.91	0.9	0.88	0.88	
			180	225	310	280	380	440	580	600	650	830	970	
5.10	Breaking torque, M_B	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 loading ⁵⁾		The values for full size bolts and screws (not studs) shall not be smaller than the minimum values for tensile strength shown in 5.2											
5.14	Impact strength, KU	min. J	--		25	--		30	30	25	20	15		
5.15	Head soundness		no fracture											
5.16	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						
5.17	Hardness after retempering		--					Reduction of hardness 20 HV maximum						
5.18	Surface integrity		In accordance with ISO 6157-1 or ISO 6157-3 as appropriate											

- 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) Applies only to nominal thread diameters $d \leq 16$ mm.
- 3) For structural bolting the limit is 12 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) When testing full-size bolts, screws and studs, the tensile loads, which are to be applied for the calculation of R_m shall meet the values given in tables 6 and 8
- 6) A hardness reading taken at the end of bolts, screws and studs shall be 250 HV, 238 HB OR 99.5 HRB maximum.
- 7) Surface hardness shall not be more than 30 Vickers points above the measured core hardness on the product when reading of both surface and core 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.
- 8) 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 $R_{p0.2}$. For the property classes 4.8, 5.8 and 6.8 the values for R_{el} are given for calculation purposes only, they are not test values.
- 9) The yield stress ratio according to the designation of the property class and the minimum stress at 0.2% non-proportional elongation $R_{p0.2}$ 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.