

Mechanical & Physical properties of bolts, screws

Mechanical properties

* Grade 4.6, 4.8, 5.6, 6.8, 8.8, 9.8, 10.9, 12.9
 * Threads Metric
 * Values MM

Table 3 — Mechanical and physical properties of bolts, screws and studs

| No. | Mechanical or physical property | Property class | | | | | | | | | | | |
|-----|---|----------------|-------------------------|------------------|------|------------------|------------------------------|--------------------------|----------------|-----------|-----------|------------|------|
| | | 4.6 | 4.8 | 5.6 | 5.8 | 6.8 | 8.8 | | 9.8 | 10.9 | 12.9/12.9 | | |
| | | | | | | | $d \leq 16$ mm ^a | $d > 16$ mm ^b | $d \leq 16$ mm | | | | |
| 1 | Tensile strength, R_m , MPa | nom. c | 400 | | 500 | | 600 | | 800 | | 900 | 1000 | 1200 |
| | | min. | 400 | 420 | 500 | 520 | 600 | 800 | 830 | 900 | 1040 | 1220 | |
| 2 | Lower yield strength, R_{eL} ^d , MPa | nom. c | 240 | — | 300 | — | — | — | — | — | — | — | — |
| | | min. | 240 | — | 300 | — | — | — | — | — | — | — | — |
| 3 | Stress at 0,2 % non-proportional elongation, $R_{p0,2}$, MPa | nom. c | — | — | — | — | — | 640 | 640 | 720 | 900 | 1080 | — |
| | | min. | — | — | — | — | — | 640 | 660 | 720 | 940 | 1100 | — |
| 4 | Stress at 0,0048 d non-proportional elongation for full-size fasteners, R_{pf} , MPa | nom. c | — | 320 | — | 400 | 480 | — | — | — | — | — | — |
| | | min. | — | 340 ^e | — | 420 ^e | 480 ^e | — | — | — | — | — | — |
| 5 | Stress under proof load, S_p^f , MPa Proof strength ratio $S_{p,nom}/R_{eL, min}$ or $S_{p,nom}/R_{p0,2, min}$ or $S_{p,nom}/R_{pf, min}$ | nom. | 225 | 310 | 280 | 380 | 440 | 580 | 600 | 650 | 830 | 970 | — |
| | | | 0,94 | 0,91 | 0,93 | 0,90 | 0,92 | 0,91 | 0,91 | 0,90 | 0,88 | 0,88 | — |
| 6 | Percentage elongation after fracture for machined test pieces, A , % | min. | 22 | — | 20 | — | — | 12 | 12 | 10 | 9 | 8 | — |
| 7 | Percentage reduction of area after fracture for machined test pieces, Z , % | min. | — | | | | 52 | | | 48 | 48 | 44 | — |
| 8 | Elongation after fracture for full-size fasteners, A_f (see also Annex C) | min. | — | 0,24 | — | 0,22 | 0,20 | — | — | — | — | — | — |
| 9 | Head soundness | | No fracture | | | | | | | | | | |
| 10 | Vickers hardness, HV $F \geq 98$ N | min. | 120 | 130 | 155 | 160 | 190 | 250 | 255 | 290 | 320 | 385 | — |
| | | max. | 220 ^g | | | | 250 | 320 | 335 | 360 | 380 | 435 | — |
| 11 | Brinell hardness, HBW $F = 30 D^2$ | min. | 114 | 124 | 147 | 152 | 181 | 238 | 242 | 276 | 304 | 366 | — |
| | | max. | 209 ^g | | | | 238 | 304 | 318 | 342 | 361 | 414 | — |
| 12 | Rockwell hardness, HRB | min. | 67 | 71 | 79 | 82 | 89 | — | | | | | |
| | | max. | 95,0 ^g | | | | 99,5 | — | | | | | |
| 12 | Rockwell hardness, HRC | min. | — | | | | 22 | 23 | 28 | 32 | 39 | — | — |
| | | max. | — | | | | 32 | 34 | 37 | 39 | 44 | — | — |
| 13 | Surface hardness, HV 0,3 | max. | — | | | | h | | | h, i | h, j | — | |
| 14 | Height of non-decarburized thread zone, E , mm | min. | — | | | | $1/2 H_1$ | | | $2/3 H_1$ | $3/4 H_1$ | — | |
| | | max. | — | | | | 0,015 | | | | | | |
| 15 | Reduction of hardness after retempering, HV | max. | — | | | | 20 | | | | | | |
| 16 | Breaking torque, M_B , N·m | min. | — | | | | in accordance with ISO 898-7 | | | | | | |
| 17 | Impact strength, $K_V^{k, l}$, J | min. | — | 27 | — | — | 27 | 27 | 27 | 27 | — | m | |
| 18 | Surface integrity in accordance with | | ISO 6157-1 ⁿ | | | | | | | | | ISO 6157-3 | |

^a Values do not apply for structural bolting.
^b For structural bolting $d \geq M12$.
^c Nominal values are specified only for the purpose of the designation system for property classes. See Clause 5.
^d In cases where the lower yield strength R_{eL} cannot be determined, it is permissible to measure the stress at 0,2 % non-proportional elongation $R_{p0,2}$.
^e For the property classes 4.8, 5.8 and 6.8 the values for $R_{pf, min}$ are under investigation. The present values are given for calculation of the proof stress ratio only. They are not test values.
^f Proof loads are specified in Tables 5 and 7.
^g Hardness determined at the end of a fastener shall be 250 HV, 238 HB or 99,5 HRB maximum.
^h Surface hardness shall not be more than 30 Vickers points above the measured core hardness of the fastener when determination of both surface hardness and core hardness are carried out with HV 0,3.
ⁱ Any increase in hardness at the surface which indicates that the surface hardness exceeds 390 HV is not acceptable.
^j Any increase in hardness at the surface which indicates that the surface hardness exceeds 435 HV is not acceptable.
^k Values are determined at a test temperature of -20 °C, see 9.14.
^l Applies to $d \geq 16$ mm.
^m Value for K_V is under investigation.
ⁿ Instead of ISO 6157-1, ISO 6157-3 may apply by agreement between the manufacturer and the purchaser.