Table 8–11

Metric Mechanical-Property Classes for Steel Bolts, Screws, and Studs*

Property Class	Size Range, Inclusive	Minimum Proof Strength,† MPa	Minimum Tensile Strength,† MPa	Minimum Yield Strength,† MPa	Material	Head Marking
4.6	M5–M36	225	400	240	Low or medium carbon	
4.8	M1.6–M16	310	420	340	Low or medium carbon	
5.8	M5–M24	380	520	420	Low or medium carbon	
8.8	M16–M36	600	830	660	Medium carbon, Q&T	
9.8	M1.6–M16	650	900	720	Medium carbon, Q&T	
10.9	M5–M36	830	1040	940	Low-carbon martensite, Q&T	
12.9	M1.6–M36	970	1220	1100	Alloy, Q&T	

*The thread length for bolts and cap screws is

$$L_T = \begin{cases} 2d+6 & L \le 125 \\ 2d+12 & 125 < L \le 200 \\ 2d+25 & L > 200 \end{cases}$$

where L is the bolt length. The thread length for structural bolts is slightly shorter than given above.

† Minimum strengths are strength exceeded by 99 percent of fasteners.

head, it has a value of K_f from 2.1 to 2.3, *and* this shoulder fillet is protected f scratching or scoring by a washer. If the thread runout has a 15° or less half-cone a the stress is higher at the first engaged thread in the nut. Bolts are sized by examining loading at the plane of the washer face of the nut. This is the weakest part of the b *and only if* the conditions above are satisfied (washer protection of the shoulder fillet thread runout $\le 15°$). Inattention to this requirement has led to a record of 15 pe fastener fatigue failure under the head, 20 percent at thread runout, and 65 percent w the designer is focusing attention. It does little good to concentrate on the plane of nut washer face if it is not the weakest location.