

Table 13. Strength Data for Iron and Steel

Material	Ultimate Strength			Yield Point, Thousands of Pounds per Square Inch	Modulus of Elasticity	
	Tension, Thousands of Pounds per Square Inch, <i>T</i>	Compression, in terms of <i>T</i>	Shear, in terms of <i>T</i>		Tension, Millions of psi, <i>E</i>	Shear, <sup>a</sup> in terms of <i>E</i>
Cast iron, gray, class 20	20 <sup>b</sup>	3.6 <i>T</i> to 4.4 <i>T</i>	1.6 <i>T</i>	...	11.6	0.40 <i>E</i>
class 25	25 <sup>b</sup>	3.6 <i>T</i> to 4.4 <i>T</i>	1.4 <i>T</i>	...	14.2	0.40 <i>E</i>
class 30	30 <sup>b</sup>	3.7 <i>T</i>	1.4 <i>T</i>	...	14.5	0.40 <i>E</i>
class 35	35 <sup>b</sup>	3.2 <i>T</i> to 3.9 <i>T</i>	1.4 <i>T</i>	...	16.0	0.40 <i>E</i>
class 40	40 <sup>b</sup>	3.1 <i>T</i> to 3.4 <i>T</i>	1.3 <i>T</i>	...	17	0.40 <i>E</i>
class 50	50 <sup>b</sup>	3.0 <i>T</i> to 3.4 <i>T</i>	1.3 <i>T</i>	...	18	0.40 <i>E</i>
class 60	60 <sup>b</sup>	2.8 <i>T</i>	1.0 <i>T</i>	...	19.9	0.40 <i>E</i>
malleable	40 to 100 <sup>c</sup>	...	...	30 to 80 <sup>c</sup>	25	0.43 <i>E</i>
nodular (ductile iron)	60 to 120 <sup>d</sup>	...	...	40 to 90 <sup>d</sup>	23	...
Cast steel, carbon	60 to 100	<i>T</i>	0.75 <i>T</i>	30 to 70	30	0.38 <i>E</i>
low-alloy	70 to 200	<i>T</i>	0.75 <i>T</i>	45 to 170	30	0.38 <i>E</i>
Steel, SAE 950 (low-alloy)	65 to 70	<i>T</i>	0.75 <i>T</i>	45 to 50	30	0.38 <i>E</i>
1025 (low-carbon)	60 to 103	<i>T</i>	0.75 <i>T</i>	40 to 90	30	0.38 <i>E</i>
1045 (medium-carbon)	80 to 182	<i>T</i>	0.75 <i>T</i>	50 to 162	30	0.38 <i>E</i>
1095 (high-carbon)	90 to 213	<i>T</i>	0.75 <i>T</i>	20 to 150	30	0.39 <i>E</i>
1112 (free-cutting)*	60 to 100	<i>T</i>	0.75 <i>T</i>	30 to 95	30	0.38 <i>E</i>
1212 (free-cutting)	57 to 80	<i>T</i>	0.75 <i>T</i>	25 to 72	30	0.38 <i>E</i>
1330 (alloy)	90 to 162	<i>T</i>	0.75 <i>T</i>	27 to 149	30	0.38 <i>E</i>
2517 (alloy) <sup>e</sup>	88 to 190	<i>T</i>	0.75 <i>T</i>	60 to 155	30	0.38 <i>E</i>
3140 (alloy)	93 to 188	<i>T</i>	0.75 <i>T</i>	62 to 162	30	0.38 <i>E</i>
3310 (alloy) <sup>e</sup>	104 to 172	<i>T</i>	0.75 <i>T</i>	56 to 142	30	0.38 <i>E</i>
4023 (alloy) <sup>e</sup>	105 to 170	<i>T</i>	0.75 <i>T</i>	60 to 114	30	0.38 <i>E</i>
4130 (alloy)	81 to 179	<i>T</i>	0.75 <i>T</i>	46 to 161	30	0.38 <i>E</i>
4340 (alloy)	109 to 220	<i>T</i>	0.75 <i>T</i>	68 to 200	30	0.38 <i>E</i>
4640 (alloy)	98 to 192	<i>T</i>	0.75 <i>T</i>	62 to 169	30	0.38 <i>E</i>
4820 (alloy) <sup>e</sup>	98 to 209	<i>T</i>	0.75 <i>T</i>	68 to 184	30	0.38 <i>E</i>
5150 (alloy)	98 to 210	<i>T</i>	0.75 <i>T</i>	51 to 190	30	0.38 <i>E</i>
52100 (alloy)	100 to 238	<i>T</i>	0.75 <i>T</i>	81 to 228	30	0.38 <i>E</i>
6150 (alloy)	96 to 228	<i>T</i>	0.75 <i>T</i>	59 to 210	30	0.38 <i>E</i>
8650 (alloy)	110 to 228	<i>T</i>	0.75 <i>T</i>	69 to 206	30	0.38 <i>E</i>
8740 (alloy)	100 to 179	<i>T</i>	0.75 <i>T</i>	60 to 165	30	0.38 <i>E</i>
9310 (alloy) <sup>e</sup>	117 to 187	<i>T</i>	0.75 <i>T</i>	63 to 162	30	0.38 <i>E</i>
9840 (alloy)	120 to 285	<i>T</i>	0.75 <i>T</i>	45 to 50	30	0.38 <i>E</i>
Steel, stainless, SAE						
30302 <sup>f</sup>	85 to 125	<i>T</i>	...	35 to 95	28	0.45 <i>E</i>
30321 <sup>f</sup>	85 to 95	<i>T</i>	...	30 to 60	28	...
30347 <sup>f</sup>	90 to 100	<i>T</i>	...	35 to 65	28	...
51420 <sup>g</sup>	95 to 230	<i>T</i>	...	50 to 195	29	0.40 <i>E</i>
51430 <sup>h</sup>	75 to 85	<i>T</i>	...	40 to 70	29	...
51446 <sup>h</sup>	80 to 85	<i>T</i>	...	50 to 70	29	...
51501 <sup>h</sup>	70 to 175	<i>T</i>	...	30 to 135	29	...
Steel, structural						
common	60 to 75	<i>T</i>	0.75 <i>T</i>	33 <sup>b</sup>	29	0.41 <i>E</i>
rivet	52 to 62	<i>T</i>	0.75 <i>T</i>	28 <sup>b</sup>	29	...
rivet, high-strength	68 to 82	<i>T</i>	0.75 <i>T</i>	38 <sup>b</sup>	29	...
Wrought iron	34 to 54	<i>T</i>	0.83 <i>T</i>	23 to 32	28	...

<sup>a</sup> Synonymous in other literature to the modulus of elasticity in torsion and the modulus of rigidity, *G*.

<sup>b</sup> Minimum specified value of the American Society for Testing and Materials. The specifications for the various materials are as follows: Cast iron, ASTM A48; structural steel for bridges and structures, ASTM A7; structural rivet steel, ASTM A141; high-strength structural rivet steel, ASTM A195.

<sup>c</sup> Range of minimum specified values of the ASTM (ASTM A47, A197, and A220).

<sup>d</sup> Range of minimum specified values of the ASTM (ASTM A339) and the Munitions Board Standards Agency (MIL-I-17166A and MIL-I-11466).

<sup>e</sup> Carburizing grades of steel.

<sup>f</sup> Nonhardenable nickel-chromium and Chromium-nickel-manganese steel (austenitic).

<sup>g</sup> Hardenable chromium steel (martensitic).

<sup>h</sup> Nonhardenable chromium steel (ferritic).