

Uncoated Carbide Grade Machining Recommendations for Milling

| Type of Material | Hardness | | Maximum Surface Speeds (ft/min) | | | | | | | | |
|--|----------|-----|---------------------------------|------|------|--------------|------|-------|-------|------|------|
| | Rc | BHN | G-60 G-53 | G-70 | G-50 | G-10 G-02 | G-23 | G-20M | G-01M | G-40 | G-74 |
| Non-Alloy Carbon Steel: | | | | | | | | | | | |
| <i>C < 0.25 %</i> | | 110 | 720 | 780 | 460 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>C < 0.80 %</i> | 6 | 150 | 550 | 600 | 350 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>C < 1.40 %</i> | 33 | 310 | 440 | 480 | 280 | N/A | N/A | N/A | N/A | N/A | N/A |
| Low-Alloy Steels: | | | | | | | | | | | |
| <i>Annealed, Medium - High Carbon</i> | 12 | 180 | 460 | 500 | 290 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>Hardened</i> | 36 | 330 | 300 | 320 | 190 | N/A | N/A | N/A | N/A | N/A | N/A |
| High-Alloy Steels: | | | | | | | | | | | |
| <i>Annealed</i> | 16 | 200 | 280 | 300 | 180 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>Hardened</i> | 41 | 380 | 200 | 220 | 130 | N/A | N/A | N/A | N/A | N/A | N/A |
| High-Alloy Tool Steel: | | | | | | | | | | | |
| <i>Hardened</i> | 36 | 330 | 290 | 310 | 180 | N/A | N/A | N/A | N/A | N/A | N/A |
| Cast Steel: | | | | | | | | | | | |
| <i>Non-Alloy</i> | 6 | 150 | 550 | 600 | 350 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>Low-Alloy</i> | 16 | 200 | 440 | 480 | 280 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>High-Alloy</i> | 16 | 200 | 390 | 420 | 250 | N/A | N/A | N/A | N/A | N/A | N/A |
| Stainless Steels: | | | | | | | | | | | |
| <i>Ferritic, 400 Series</i> | 16 | 200 | 440 | 480 | 280 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>Austenitic, 300 Series</i> | 16 | 200 | N/A | N/A | N/A | 310 | 400 | 350 | N/A | N/A | N/A |
| Gray, Pearlitic Cast Irons: | | | | | | | | | | | |
| <i>Low Tensile</i> | 12 | 180 | N/A | N/A | N/A | 450 | 600 | 500 | N/A | N/A | N/A |
| <i>High Tensile</i> | 26 | 260 | N/A | N/A | N/A | 200 | 250 | 230 | N/A | N/A | N/A |
| Nodular / Malleable Irons: | | | | | | | | | | | |
| <i>Short Chipping</i> | 6 | 150 | 680 | 740 | 440 | N/A | N/A | N/A | N/A | N/A | N/A |
| <i>Long Chipping</i> | 21 | 230 | 400 | 440 | 250 | N/A | N/A | N/A | N/A | N/A | N/A |
| Aluminum Alloys: | | | N/A | N/A | N/A | 1400 | 1800 | 1500 | N/A | N/A | N/A |
| Brass, Copper, Bronze: | | | N/A | N/A | N/A | 500 | 600 | 550 | N/A | N/A | N/A |
| Hardened Steels (> 50 Rc): | | | N/A | 50 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Chilled, Hardened Irons (> 50 Rc): | | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Titanium, Refractory Metals: | | | N/A | N/A | N/A | 100 | 150 | 130 | N/A | N/A | N/A |
| Nickel & Iron Based Superalloys: | | | | | | | | | | | |
| <i>Inconels</i> | | | N/A | N/A | N/A | 80 | N/A | 100 | N/A | N/A | N/A |
| <i>Hastelloys</i> | | | N/A | N/A | N/A | 120 | N/A | 140 | N/A | N/A | N/A |
| <i>Waspaloys</i> | | | N/A | N/A | N/A | 80 | N/A | 100 | N/A | N/A | N/A |
| <i>Renes</i> | | | N/A | N/A | N/A | 60 | N/A | 80 | N/A | N/A | N/A |
| <i>Monels</i> | | | N/A | N/A | N/A | 60 | N/A | 80 | N/A | N/A | N/A |
| Cobalt Based Superalloys: | | | | | | | | | | | |
| <i>Stellites</i> | | | N/A | N/A | N/A | 50 | N/A | 60 | N/A | N/A | N/A |
| <i>Haynes Alloys</i> | | | N/A | N/A | N/A | 50 | N/A | 60 | N/A | N/A | N/A |

Feeds should be in the range of 0.003 in/tooth to 0.012 in/tooth.
Higher speeds require lower feeds, whereas, low speeds use higher feed rates.
A good general starting point for feed rate in milling is 0.004 in/tooth.