




## Revolution Drill® and Opening Drill® | Metric (mm)

| ISO | Material   | Hardness (BHN) | Speed (M/min)  |   |   | Feed Rate (mm/rev) |
|-----|--|----------------|--|---|---|--------------------|
|     |  |                |  AM300® |  AM200® |  TiN |                    |
| P   | <b>Free Machining Steel</b><br>1118, 1215, 12L14, etc.                 | 100 - 250      | 274 - 396  | 259 - 366   | 213 - 274   | 0.09 - 0.18        |
|     | <b>Low Carbon Steel</b><br>1010, 1020, 1025, 1522, 1144, etc.          | 85 - 275       | 259 - 381  | 244 - 351   | 198 - 259   | 0.08 - 0.17        |
|     | <b>Medium Carbon Steel</b><br>1030, 1040, 1050, 1527, 1140, 1151, etc. | 125 - 325      | 244 - 320  | 229 - 290   | 183 - 259   | 0.09 - 0.17        |
|     | <b>Alloy Steel</b><br>4140, 5140, 8640, etc.                           | 125 - 375      | 229 - 305  | 213 - 274   | 183 - 259   | 0.09 - 0.17        |
|     | <b>High Strength Alloy</b><br>4340, 4330V, 300M, etc.                  | 225 - 400      | 183 - 259  | 168 - 229   | 122 - 198   | 0.08 - 0.13        |
|     | <b>Structural Steel</b><br>A36, A285, A516, etc.                       | 100 - 350      | 259 - 320  | 244 - 290   | 198 - 259   | 0.08 - 0.17        |
|     | <b>Tool Steel</b><br>H-13, H-21, A-4, O-2, S-3, etc.                   | 150 - 250      | 122 - 244  | 107 - 213   | 76 - 198  | 0.06 - 0.13        |
| S   | <b>High Temp Alloy</b><br>Hastelloy B, Inconel 600, etc.               | 140 - 310      | 76 - 137   | 76 - 107  | 46 - 91   | 0.06 - 0.11        |
| M   | <b>Stainless Steel 400 Series</b><br>416, 420, etc.                    | 185 - 350      | 183 - 259  | 168 - 229   | 122 - 198   | 0.08 - 0.15        |
|     | <b>Stainless Steel 300 Series</b><br>304, 316, 17-4PH, etc.            | 135 - 275      | 183 - 259  | 168 - 229   | 122 - 198   | 0.08 - 0.15        |
|     | <b>Super Duplex Stainless Steel</b>                                    | 135 - 275      | 152 - 228  | 137 - 198   | 91 - 152  | 0.05 - 0.12        |
| K   | <b>Nodular, Grey, Ductile Cast Iron</b>                                | 120 - 320      | 213 - 274  | 198 - 244   | 152 - 213   | 0.10 - 0.20        |
| N   | <b>Cast Aluminum</b>   | 30 - 180       | 381 - 503  | 381 - 472   | 290 - 335   | 0.15 - 0.30        |
|     | <b>Wrought Aluminum</b>  | 30 - 180       | 381 - 503  | 381 - 472   | 290 - 335   | 0.15 - 0.30        |
|     | <b>Brass</b>   | 30 - 100       | 290 - 411  | 274 - 381   | 229 - 335   | 0.13 - 0.23        |

## Material Constants

| Type of Material             | Hardness (BHN) | $K_m$<br>(lbs/in <sup>2</sup> ) |
|------------------------------|----------------|---------------------------------|
| Free Machining Steel         | 100 - 250      | 5.17                            |
| Low Carbon Steel             | 85 - 275       | 5.86                            |
| Medium Carbon Steel          | 125 - 325      | 6.21                            |
| Alloy Steel                  | 125 - 375      | 6.90                            |
| High Strength Steel          | 225 - 400      | 7.93                            |
| Structural Steel             | 100 - 350      | 6.90                            |
| Tool Steel                   | 150 - 250      | 6.21                            |
| High Temperature Alloy       | 140 - 310      | 9.93                            |
| Titanium Alloy               | 140 - 310      | 4.97                            |
| Aerospace Alloy              | 185 - 350      | 4.48                            |
| Stainless Steel 400 Series   | 185 - 350      | 7.45                            |
| Stainless Steel 300 Series   | 135 - 275      | 6.48                            |
| Super Duplex Stainless Steel | 135 - 275      | 6.48                            |
| Wear Plate                   | 400 - 600      | 11.04                           |
| Hardened Steel               | 300 - 500      | 9.66                            |
| Nodular, Ductile Cast Iron   | 120 - 320      | 4.48                            |
| Grey Cast Iron               | 120 - 320      | 5.17                            |
| Cast Aluminum                | 30 - 180       | 2.76                            |
| Wrought Aluminum             | 30 - 180       | 2.76                            |
| Aluminum Bronze              | 100 - 250      | 3.45                            |
| Brass                        | 100            | 2.41                            |
| Copper                       | 60             | 2.07                            |

## Formulas

|    |  |
|----|--|
| 1. | <b>RPM</b> = $(318.31 \bullet M/min) / DIA$<br>where:<br>RPM = revolutions per minute (rev/min)<br>M/min = speed (M/min)<br>DIA = diameter of drill (mm)   |
| 2. | <b>kW</b> = $(DIA^2 \bullet mm/rev \bullet RPM \bullet K_m) / 181,018$<br>where:<br>kW = tool power (kW)<br>DIA = diameter of drill (mm)<br>mm/rev = feed rate (mm/rev)<br>RPM = revolutions per minute (rev/min)<br>$K_m$ = specific cutting energy (kPa)<br>machine efficiency (using 181,018 as constant) |
| 3. | <b>Thrust</b> = $148.78 \bullet mm/rev \bullet DIA \bullet K_m$<br>where:<br>Thrust = axial thrust (N)<br>mm/rev = feed rate (mm/rev)<br>DIA = diameter of drill (mm)<br>$K_m$ = specific cutting energy (kPa)   |
| 5. | <b>Torque</b> = $(kW \bullet 9549.3) / RPM$<br>where:<br>Torque = torque (Nm)<br>HP = tool power (kW)<br>RPM = revolutions per minute (rev/min)  |

 The table and equations on this page are found in the *Machinery's Handbook*. Permission to simplify and print the equations is granted by the Editor of the *Machinery's Handbook*.

**IMPORTANT:** The speeds and feeds listed above are considered a general starting point for all applications. Factory technical assistance is available for your specific applications through our Application Engineering department.