## HSV-4 / HSV-RN-4

| Material Guide |  | Hardness | SFM | Inches per Tooth (IPT) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 1/8 |  | 3/16 |  |  | 1/4 |  |  | 3/8 |  |  | 1/2 |  |  | 3/4 |  |  | 1 |  |  |
|  |  | Slot |  | Rgh | Fin | Slot | Rgh | Fin | Slot | Rgh | Fin | Slot | Rgh | Fin | Slot | Rgh | Fin | Slot | Rgh | Fin | Slot | Rgh | Fin |
| CARBON STEEL | 10XX, 11XX, 12XX, 12L ASTM A27, ASTM A36 |  | $\begin{array}{r} <75 \text { HRB } \\ 75-98 \text { HRB } \\ 21-36 \text { HRC } \end{array}$ | $\begin{aligned} & 455 \\ & 445 \\ & 400 \end{aligned}$ | $\left.\begin{array}{\|c} .0007 \\ .0005 \\ .0003 \end{array}\right]$ | $\begin{array}{\|c} \hline 0012 \\ .0009 \\ .0006 \\ \hline \end{array}$ | $\begin{array}{\|l\|l\|} \hline 0016 \\ .0014 \\ .0011 \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0010 \\ .0008 \\ .0005 \end{array} \right\rvert\,$ | $\begin{array}{\|c} \hline 0018 \\ \hline 0013 \\ .0009 \\ \hline \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0019 \\ .0016 \end{array} \right\rvert\,$ | $\begin{array}{\|c} \hline 0014 \\ .0010 \\ .0007 \end{array}$ | $\left.\begin{array}{\|} \hline .0244 \\ .0018 \\ .0011 \end{array} \right\rvert\,$ | $\begin{array}{\|l\|l\|} \hline \\ \beta & .0021 \\ 1.0018 \\ \hline 0014 \end{array}$ | $\left.\begin{array}{\|l\|} \hline .0020 \\ .0015 \\ .0010 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|c\|} \hline .0036 \\ .0026 \\ .0017 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|} .00224 \\ .0021 \\ .0017 \end{array} \right\rvert\,$ | $\begin{array}{\|c\|} \hline .0027 \\ .0020 \\ .0013 \end{array}$ | $\begin{array}{\|l\|} \hline .0047 \\ .0034 \\ .0022 \end{array}$ | $\begin{array}{\|} .0028 \\ .0024 \\ .0019 \\ \hline \end{array}$ | .0018 | $\left.\begin{array}{\|c} \hline 0067 \\ .0049 \\ .0032 \end{array} \right\rvert\,$ | $\begin{aligned} & .0034 \\ & .0029 \\ & .0023 \end{aligned}$ | $\begin{array}{\|r} \hline 0036 \\ \hline 0023 \end{array}$ | $\left\|\begin{array}{\|c\|} \hline .0086 \\ .0063 \\ .0041 \end{array}\right\|$ | 0041 <br> 0035 <br> 0028 <br> 0 |
| LOWALLO STEEL | 13XX, 41XX, 43XX, 51XX 86XX, 93XX |  | 75-98 HRB $21-36 \mathrm{HRC}$ $36-50 \mathrm{HRC}$ $>50 \mathrm{HRC}$ | $\begin{aligned} & 390 \\ & 340 \\ & 260 \\ & 155 \\ & \hline \end{aligned}$ | .0005 <br> .0003 <br> .0003 <br> .002 | $\begin{array}{\|l} \hline .0008 \\ .0006 \\ .0005 \\ .0004 \\ \hline \end{array}$ | .0013 <br> .0011 <br> .0011 <br> .0009 | $\begin{array}{\|l\|} \hline .0007 \\ .0005 \\ .0004 \\ .0033 \\ \hline \end{array}$ | $\begin{array}{\|} \hline .0011 \\ .0009 \\ .0007 \\ .0006 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0015 \\ .0013 \\ .0012 \\ .0010 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0009 \\ .0007 \\ .0006 \\ .0005 \\ \hline \end{array}$ | .0015 <br> .0012 <br> .0010 <br> .0008 | $\begin{array}{\|l\|l\|} \hline 0.0017 \\ 2 & .0014 \\ 0 & .0013 \\ 8 & 0012 \\ \hline \end{array}$ | .0013 <br> .0010 <br> .0008 <br> .007 | $\begin{array}{\|l\|} \hline .0023 \\ .0017 \\ .0015 \\ .0012 \\ \hline \end{array}$ | $\begin{array}{\|c\|} \hline .0019 \\ .0017 \\ .0016 \\ .0014 \\ \hline \end{array}$ | $\begin{array}{\|c\|} \hline .0017 \\ .0013 \\ .0011 \\ .0009 \\ \hline \end{array}$ | $\left.\begin{array}{\|c} \hline .022 \\ .0019 \\ .0015 \end{array} \right\rvert\,$ | .0023 <br> .0019 <br> .0018 <br> .0016 | $\begin{array}{\|l\|} \hline .0024 \\ .0018 \\ .0016 \\ .0012 \\ \hline \end{array}$ | $\begin{array}{\|} \hline .0043 \\ .0032 \\ .0028 \\ .0022 \\ \hline \end{array}$ | $\begin{aligned} & .0027 \\ & .0023 \\ & .0022 \\ & .0019 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline .0031 \\ .0023 \\ .0020 \\ .0016 \\ \hline \end{array}$ | .0054 <br> .0040 <br> .0035 <br> .0288 | .0028 <br> 0026 <br> .0023 <br> 0 |
| TOOL STEEL | A2, H13, L6, P20, S7 | 75-98 HRB $21-36 \mathrm{HRC}$ $36-50 \mathrm{HRC}$ $>50 \mathrm{HRC}$ | $\begin{aligned} & 340 \\ & 250 \\ & 145 \\ & 85 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline .0005 \\ .0004 \\ .003 \\ .0022 \\ \hline \end{array}$ | $\begin{array}{\|l} \hline .0008 \\ .0006 \\ .0005 \\ .0004 \end{array}$ | .0013 <br> .0012 <br> .0010 <br> .0009 | $\begin{array}{\|c\|} \hline .0007 \\ .0005 \\ .0004 \\ .0033 \\ \hline \end{array}$ | .0011 <br> .000 <br> .007 <br> .0006 | $\begin{array}{\|c\|} \hline .0015 \\ .0013 \\ .0012 \\ .0010 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0009 \\ .0007 \\ .0005 \\ .0005 \\ \hline \end{array}$ | .0015 <br> .0012 <br> .0010 <br> .0008 | $\begin{array}{\|l\|l\|} \hline 0 & .0017 \\ 2 & .0015 \\ 0 & 0013 \\ 8 & .0012 \\ \hline \end{array}$ | .0013 <br> .0010 <br> .0008 <br> .007 | $\begin{array}{\|} \hline .0023 \\ .0018 \\ .0014 \\ .0012 \\ \hline \end{array}$ | $\begin{array}{\|c\|} \hline .0019 \\ .0017 \\ .0015 \\ .0014 \\ \hline \end{array}$ | .0017 <br> .0013 <br> .0010 <br> .0009 | $\begin{array}{\|l\|} \hline .0030 \\ .0024 \\ .0019 \\ .0015 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0023 \\ .0020 \\ .0018 \\ .0016 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0024 \\ .0019 \\ .0015 \\ .0012 \\ \hline \end{array}$ | $\begin{array}{\|l} \hline .0043 \\ .0034 \\ .0027 \\ .0022 \\ \hline \end{array}$ | $\begin{aligned} & .0027 \\ & .0024 \\ & .0021 \\ & \hline .0019 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline .0031 \\ .0025 \\ .0019 \\ .0016 \\ \hline \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0054 \\ .0043 \\ .0034 \end{array} \right\rvert\,$ | .0033 .0029 .0026 .0023 |
| SPECIALTY STEEL | Maraging 200, Maraging <br> 250, Maraging 300, <br> Maraging 350 | $\begin{array}{\|r\|} \hline<75 \mathrm{HRB} \\ 75-98 \mathrm{HRB} \\ 21-36 \mathrm{HRC} \\ 36-50 \mathrm{HRC} \\ >50 \mathrm{HRC} \\ \hline \end{array}$ | $\begin{aligned} & 290 \\ & 255 \\ & 175 \\ & 150 \\ & 55 \\ & \hline 5 \end{aligned}$ | $\begin{array}{\|c} .0000 \\ .0004 \\ .0004 \\ .0003 \\ .0002 \end{array}$ | $\begin{array}{\|c} \hline .0010 \\ .0007 \\ .0006 \\ .0006 \\ .0004 \\ \hline \end{array}$ | .0015 <br> .0012 <br> .0012 <br> .0011 <br> .0009 | .0000 <br> .0006 <br> .0005 <br> .0005 <br> .0003 | $\begin{aligned} & .0015 \\ & .0010 \\ & .0009 \\ & .0008 \\ & .0005 \\ & .0005 \end{aligned}$ | $\begin{array}{\|c} .0017 \\ .0014 \\ .0013 \\ .0012 \\ .0010 \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0011 \\ .0008 \\ .0007 \\ .0006 \\ .0004 \end{array} \right\rvert\,$ | .0020 <br> .0014 <br> .0012 <br> .0011 <br> .0007 | .0019 <br> .0016 <br> .0015 <br> .0014 <br> .0011 | .0017 <br> .0012 <br> .0010 <br> .0009 <br> .0006 | $\begin{array}{\|} \hline .0030 \\ .0021 \\ .0018 \\ .0016 \\ .0010 \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0022 \\ .0018 \\ .0017 \\ .0016 \\ .0013 \end{array} \right\rvert\,$ | $\begin{array}{\|c} .0022 \\ .0015 \\ .0014 \\ .0012 \\ .0008 \end{array}$ | $\begin{array}{\|} \hline .0039 \\ .0027 \\ .0024 \\ .0021 \\ .0013 \\ \hline \end{array}$ | .0026 <br> .0021 <br> .0020 <br> .0019 <br> .0015 | $\left.\begin{array}{\|c\|} \hline .0032 \\ .0022 \\ .0020 \\ .0017 \\ .0011 \end{array} \right\rvert\,$ | $\begin{aligned} & .0056 \\ & .0038 \\ & .0034 \\ & .0031 \\ & .0019 \end{aligned}$ | $\begin{gathered} .0025 \\ .0024 \\ .0023 \\ \hline 0018 \end{gathered}$ | $\begin{array}{\|} \hline .0040 \\ .0028 \\ .0025 \\ .0022 \end{array}$ | $\left.\begin{array}{\|} .0077 \\ .0049 \\ .0044 \\ .0039 \end{array} \right\rvert\,$ | 0037 .0031 0029 0028 |
| AUSTENITIC STAINLESS STEEL STEEL | 301, 303, 304, 304L, <br> Incoloy 27-7MO, 316, 316L 321, 347 | $\begin{aligned} & 21-36 \mathrm{HRC} \\ & 36-50 \mathrm{HRC} \end{aligned}$ | $\begin{aligned} & 265 \\ & 225 \\ & 180 \end{aligned}$ | $\left\|\begin{array}{l} .0004 \\ .0003 \end{array}\right\|$ | $\begin{array}{\|l} .0008 \\ .0007 \\ .0006 \\ .000 \end{array}$ | $\begin{aligned} & .0013 \\ & .0012 \\ & .0011 \\ & .00 \end{aligned}$ | $\left.\begin{array}{\|} .0006 \\ .0006 \\ .0005 \end{array} \right\rvert\,$ | $\begin{array}{\|l} .0011 \\ .0010 \\ .0008 \\ .008 \end{array}$ | $\left\|\begin{array}{l} .0015 \\ .0014 \\ .0012 \end{array}\right\|$ | $\left.\begin{array}{\|c} .0009 \\ .0008 \\ .0006 \end{array} \right\rvert\,$ | $\begin{aligned} & .0015 \\ & .0014 \\ & .0011 \\ & .0014 \end{aligned}$ | $\begin{aligned} & .0017 \\ & .0016 \\ & .01414 \end{aligned}$ | $\left[\left.\begin{array}{\|c} .0013 \\ .0011 \\ .0009 \end{array} \right\rvert\, .\right.$ | $\begin{aligned} & .0022 \\ & .0020 \\ & .0016 \end{aligned}$ | $\left[\left.\begin{array}{\|c} .0019 \\ .0018 \\ .0016 \end{array} \right\rvert\,\right.$ | $\begin{aligned} & .0017 \\ & .0015 \\ & .0012 \end{aligned}$ | $\begin{aligned} & .0029 \\ & .0026 \\ & .0021 \end{aligned}$ | $\left.\begin{array}{\|} .0022 \\ .0021 \\ .0019 \end{array} \right\rvert\,$ | . 00021 | . 0038 | 0025 | . 0027 | .0048 | (1032 |
| $\begin{array}{\|c\|} \hline \text { MARTENSITIC } \\ \text { \& FRRRITIC } \\ \text { STAANLESS } \\ \text { STEEL } \end{array}$ | 403, 410, 416, 420, 440, 430, 446 | 21-36 HRC | $\begin{aligned} & 300 \\ & 280 \end{aligned}$ | $\left\|\begin{array}{l} .0005 \\ .0004 \end{array}\right\|$ | $\mid .0008$ | $\left.\begin{array}{\|l\|} \hline .0013 \\ .0012 \end{array} \right\rvert\,$ | $\begin{array}{\|l} .0007 \\ .0006 \end{array}$ | $\begin{array}{\|l\|} \hline .0011 \\ \hline 0010 \end{array}$ | $\begin{array}{\|c} \hline 0015 \\ \hline 0014 \end{array}$ | $\begin{array}{\|c} \hline .0009 \\ .0008 \end{array}$ | $\left.\begin{array}{\|l\|} \hline .0016 \\ .0013 \end{array} \right\rvert\,$ | $\begin{array}{\|l\|l\|} \hline 00017 \\ \hline \end{array}$ | $\begin{array}{\|l} .0013 \\ .0011 \end{array}$ | $\begin{array}{\|l} .0023 \\ .0020 \end{array}$ | $\begin{array}{\|} .0019 \\ .0018 \end{array}$ | $.0017$ | $\left\|\begin{array}{\|} .0030 \\ .0026 \end{array}\right\|$ | $\begin{array}{\|l} .0023 \\ .0021 \end{array}$ | $\left.\begin{array}{\|l\|} \hline .024 \\ .0021 \end{array} \right\rvert\,$ | $\begin{array}{\|l} .0043 \\ .0037 \end{array}$ | $.0027$ | $\left.\begin{array}{\|l} \hline .0031 \\ .0027 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|l\|} \hline .055 \\ .0047 \end{array}\right)$ | . 0033 |
| STAINLES STEEL | 15-5, 17-4, Ca Carpenter 465 | $36-50 \mathrm{HRC}$ | $\begin{aligned} & 200 \\ & 145 \end{aligned}$ | .0003 |  | $00011$ |  | $\begin{array}{\|l\|} \hline .008 \\ \hline .0007 \end{array}$ | . 0012 | $\left\lvert\, \begin{array}{\|c\|} \hline .0006 \\ \hline .0006 \end{array}\right.$ | $.0011$ | $.0014$ | $\begin{array}{\|c\|} \hline .0010 \\ .0008 \end{array}$ |  | $\begin{aligned} & .0016 \\ & .0015 \end{aligned}$ |  |  |  |  |  |  | 023 |  | 2028 |
| GRAY CAST IRON | SAE J431, ASTM A48 | 21 - 36 HRC | $\begin{aligned} & 410 \\ & 370 \\ & \hline \end{aligned}$ | .0004 | $\begin{array}{\|l\|l\|} \hline .0013 \\ \hline .0007 \end{array}$ | $\begin{array}{\|l\|} \hline 0019 \\ .0012 \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0011 \\ .0006 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|c} \hline 0019 \\ \hline .0010 \end{array}\right)$ | $\begin{array}{\|} \hline .0019 \\ \hline .0014 \\ \hline \end{array}$ | $\left\lvert\, \begin{array}{\|c\|c\|c\|} \hline .0014 \\ \hline .0008 \end{array}\right.$ | $\left\|\begin{array}{\|c} .0025 \\ .0013 \end{array}\right\|$ | $\begin{array}{\|l\|l\|} \hline 0 & 0021 \\ 3 & .0016 \end{array}$ | $\left.\begin{array}{\|c} \hline .0021 \\ .0011 \end{array} \right\rvert\,$ | $\mid .00371 .$ | $\begin{aligned} & .0025 \\ & .0018 \\ & \hline \end{aligned}$ | $3.0027$ | $\begin{array}{\|l\|} \hline .0048 \\ .0026 \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0029 \\ .0021 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|c} \hline 0039 \\ \hline 0021 \end{array} \right\rvert\,$ | $\begin{array}{\|l} .0069 \\ .0038 \end{array}$ | $.0034$ | $\begin{array}{\|l} \hline .0050 \\ .0027 \end{array}$ | $.0088$ | 031 |
| MALLEABLE CAST IRON | ASTM A47, ASTM A220, ASTM A602 | $\begin{array}{\|l\|} \hline 75-98 \text { HRB } \\ 21-36 \text { HRC } \end{array}$ | $\begin{aligned} & 345 \\ & 335 \\ & \hline \end{aligned}$ | $\begin{array}{\|c\|} \hline .0005 \\ .0004 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0008 \\ \hline .0007 \end{array}$ | $\begin{array}{\|l\|} \hline 0013 \\ .0012 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0007 \\ .0006 \\ \hline \end{array}$ | $\begin{array}{\|} \hline 0012 \\ .0010 \end{array}$ | $\begin{array}{\|c\|} \hline .0015 \\ .0014 \\ \hline \end{array}$ | $\begin{array}{\|c} \hline .0009 \\ \hline 0008 \end{array}$ | $\begin{array}{\|c} \hline 0016 \\ .0014 \\ \hline \end{array}$ | $\begin{array}{\|c\|} \hline 0.0017 \\ 4.0016 \\ \hline \end{array}$ | $\begin{array}{\|} \hline .0013 \\ .0011 \\ \hline \end{array}$ | $\begin{array}{\|l\|l\|} \hline .0023 \\ .0020 \end{array}$ | $\begin{aligned} & .0019 \\ & .0018 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline .0017 \\ .0015 \\ \hline \end{array}$ | $\begin{aligned} & .0031 \\ & .0026 \\ & \hline \end{aligned}$ | $\begin{array}{\|} \hline .0023 \\ \hline .0021 \\ \hline \end{array}$ | $\begin{array}{\|c\|c\|c\|} \hline .0025 \\ \hline .0021 \end{array}$ | $\begin{array}{\|c} \hline .0044 \\ \hline .0038 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .027 \\ .0025 \\ \hline \end{array}$ | $\begin{array}{\|l\|l\|} \hline .032 \\ .0027 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0056 \\ \hline .0048 \\ \hline \end{array}$ | ${ }^{0033}$ |
| NODULAR (DUCTILE) CAST IRON | ASTM A536, ASTM 897 | $\begin{array}{\|l\|} \hline 75-98 \mathrm{HRB} \\ 21-36 \mathrm{HRC} \\ 36-50 \mathrm{HRC} \end{array}$ | $\begin{aligned} & 310 \\ & 260 \\ & 135 \\ & 135 \end{aligned}$ | $\begin{array}{\|c\|} \hline .0005 \\ .0003 \\ .0002 \end{array}$ | $\left.\begin{array}{\|c} \hline .000 \\ .0006 \\ .0004 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|l\|} \hline .0014 \\ .0011 \\ .0009 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|l\|} \hline .0007 \\ .0005 \\ .0003 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|c} \hline .012 \\ \hline .008 \\ \hline \\ \hline 0005 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|c\|} \hline .0015 \\ .0012 \\ .0010 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|l\|} \hline .0000 \\ .0006 \\ .0004 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|l\|} \hline .0016 \\ .0011 \\ .00077 \end{array} \right\rvert\,$ | .0017 <br> .0014 <br> .0011 | $\left.\begin{array}{\|} .0014 \\ .0009 \\ .0006 \end{array} \right\rvert\,$ | $\begin{array}{\|} .0024 \\ .0016 \\ .0010 \end{array}$ | $\begin{array}{\|} 0020 \\ .0016 \\ .0013 \end{array}$ | $\begin{array}{\|l\|} \hline .0018 \\ .0012 \\ .0008 \\ \hline \end{array}$ | $\begin{array}{\|l\|l\|} \hline 032 \\ .0021 \\ .0013 \end{array}$ | $\left.\begin{array}{\|} .0023 \\ .0019 \\ .0015 \end{array} \right\rvert\,$ | $\left\|\begin{array}{\|c\|} \hline .0026 \\ .0017 \\ .0011 \end{array}\right\|$ | $\left.\begin{array}{\|c} \hline .0046 \\ .0033 \\ .0019 \end{array}\right)$ | $\left\|\begin{array}{l} .0028 \\ .0023 \\ .0018 \end{array}\right\|$ | $\begin{aligned} & 0.033 \\ & .0022 \\ & .0014 \\ & \hline 004 \end{aligned}$ | $\begin{aligned} & .0058 \\ & .0039 \\ & .0024 \end{aligned}$ | .0034 <br> .0027 <br> 0022 |
| PURE NCKEL | Nickel 200, Nickel 201 | $\begin{array}{r} \hline<75 \mathrm{HRB} \\ 75-98 \mathrm{HRB} \end{array}$ | $\begin{aligned} & 285 \\ & 250 \\ & \hline \end{aligned}$ | $\begin{array}{\|r\|} \hline .0006 \\ .0005 \\ \hline \end{array}$ | $\begin{aligned} & \hline .0011 \\ & .0009 \\ & \hline \end{aligned}$ | $\begin{aligned} & .0015 \\ & .0014 \\ & \hline \end{aligned}$ | $\begin{aligned} & \hline .0009 \\ & .0008 \\ & \hline \end{aligned}$ | $\begin{aligned} & .0016 \\ & .0013 \\ & \hline \end{aligned}$ | $\begin{array}{\|} 0.0017 \\ .0016 \\ \hline \end{array}$ | $\begin{array}{\|c\|} \hline .0012 \\ .0010 \\ \hline \end{array}$ | $\begin{array}{\|} \hline 0021 \\ .0018 \\ \hline \end{array}$ | $\begin{aligned} & \hline .0020 \\ & 8.0018 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline .0018 \\ .0015 \\ \hline \end{array}$ | $\begin{array}{\|r\|} \hline .0031 \\ .0026 \\ \hline \end{array}$ | $\begin{aligned} & .0023 \\ & .0021 \\ & \hline \end{aligned}$ | $\begin{array}{\|} \hline .0023 \\ .0019 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0041 \\ .0034 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline .0026 \\ .0024 \\ \hline \end{array}$ | $\begin{array}{\|c} .0033 \\ \hline 0028 \\ \hline \end{array}$ | $\begin{aligned} & .0059 \\ & .0049 \\ & \hline \end{aligned}$ | $.0032$ | $\begin{array}{\|l} \hline .0042 \\ .0035 \\ \hline \end{array}$ | $\begin{array}{\|} \hline .0075 \\ .0063 \\ \hline \end{array}$ | $\begin{array}{r}.0038 \\ .0035 \\ \hline\end{array}$ |
| $\begin{aligned} & \text { NICKEL } \\ & \text { ALLOY } \end{aligned}$ | Hastelloy C-22, Inconel 625, Waspaloy, René 41 Inconel 718, Incoloy 20 | $\begin{aligned} & 21-36 \mathrm{HRC} \\ & 36-50 \mathrm{HRC} \end{aligned}$ | $\begin{aligned} & 80 \\ & 75 \\ & 70 \end{aligned}$ | $\left[\begin{array}{l} .0000 \\ .0003 \\ .0003 \end{array}\right]$ | $\begin{array}{\|l} \hline 0005 \\ .0005 \\ .0005 \\ .000 \end{array}$ | $\begin{aligned} & .0011 \\ & .0011 \\ & .0010 \end{aligned}$ | . 00004 | $\begin{array}{\|l} \hline 0008 \\ \hline 0008 \end{array}$ | $\left\|\begin{array}{l} .0012 \\ .0012 \end{array}\right\|$ | $\begin{array}{\|l\|} \hline .0006 \\ .0006 \\ \hline \end{array}$ | $\left.\begin{array}{\|l\|} \hline .0011 \\ .0010 \end{array} \right\rvert\,$ | . 0014 | $\left.\begin{array}{\|c} \hline .0009 \\ .0009 \end{array}\right)$ | $\begin{array}{\|c} \hline 0016 \\ \hline .0015 \end{array}$ | $\left\{\begin{array}{l} .0016 \\ .0016 \end{array}\right.$ | $\begin{array}{\|l\|} \hline .0012 \\ .0011 \end{array}$ | . 0021 | . 0019 | $\begin{array}{\|c} \hline 0017 \\ .0016 \end{array}$ | . 0030 | .0023 | $\begin{aligned} & .0022 \\ & .0021 \\ & \hline \end{aligned}$ | $\begin{array}{\|c} .0038 \\ .0036 \end{array}$ | . 0027 |
| PURE TITANUM | Ti Grade 3, Ti Grade 4, Ti Grade 7, Ti Grade 12 | $\begin{aligned} & \text { 75-98 HRB } \\ & 21-36 \text { HRC } \end{aligned}$ | $\begin{aligned} & 300 \\ & 275 \\ & 250 \end{aligned}$ | $\begin{array}{\|c\|c\|c\|c\|} \hline .0007 \\ \hline .0005 \end{array}$ | $\begin{array}{\|} .0015 \\ .0012 \\ .0009 \end{array}$ | $\left.\begin{array}{\|l\|} \hline 0018 \\ .0017 \\ .0014 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|} \hline .0013 \\ .0010 \\ .0008 \end{array}\right]$ | $\begin{array}{\|l} .0022 \\ .0018 \\ .0014 \end{array}$ | $\left[\left.\begin{array}{l} .0020 \\ .0019 \\ .0016 \end{array} \right\rvert\,\right.$ | $\begin{array}{\|c} .0017 \\ .0014 \\ .0010 \end{array}$ | $\begin{array}{\|c\|} \hline .029 \\ .0024 \\ .0018 \\ \hline \end{array}$ | $\begin{array}{l\|l\|l\|l\|l\|l\|l\|} \hline 0023 \\ 4 & 0021 \\ \hline \end{array}$ | $\begin{aligned} & .0025 \\ & .0021 \\ & .0015 \end{aligned}$ | $\left\|\begin{array}{\|} \hline .0043 \\ .0036 \\ .0027 \end{array}\right\|$ | $\left.\begin{array}{\|} \hline .0027 \\ .0024 \\ .0021 \end{array} \right\rvert\,$ | $\left(\left.\begin{array}{l} .0032 \\ .0027 \\ .0020 \end{array} \right\rvert\,\right.$ | $\begin{array}{\|l} \hline 0057 \\ .0047 \\ .0036 \end{array}$ | $\begin{aligned} & .0031 \\ & .0028 \\ & .0025 \end{aligned}$ | $\begin{array}{\|c} \hline 0046 \\ .0039 \\ .0029 \end{array}$ | $\begin{array}{\|l\|} \hline .0081 \\ .0068 \\ .0051 \end{array}$ | $\begin{gathered} .0037 \\ .0034 \\ .0029 \end{gathered}$ | $.0049$ | $\left.\begin{array}{\|} .0103 \\ .0087 \\ .0065 \end{array} \right\rvert\,$ | .0045 <br> .0041 <br> .0036 |
| TITANUM ALLOY | $\begin{aligned} & \mathrm{Ti} 3 \mathrm{Al}-2.5 \mathrm{~V}, \mathrm{Ti} 6 \mathrm{Al}-4 \mathrm{~V}, \mathrm{Ti} \\ & 1 \mathrm{VV}-2 \mathrm{Fe}-\mathrm{Al} \end{aligned}$ | $\begin{aligned} & 21-36 \text { HRC } \\ & 36-50 \text { HRC } \end{aligned}$ | $\begin{aligned} & 180 \\ & 160 \\ & \hline \end{aligned}$ | $\left[\left.\begin{array}{l} .0004 \\ .0004 \end{array} \right\rvert\,\right.$ | $\mid .0007$ | $\begin{array}{\|l} \hline 0010 \\ \hline 0012 \end{array}$ | $\begin{array}{\|l\|} \hline .0006 \\ \hline 0006 \end{array}$ | $\begin{aligned} & .0011 \\ & \hline .0010 \end{aligned}$ | $\left\|\begin{array}{\|c\|c\|c\|} \hline .0014 \\ .0014 \end{array}\right\|$ | $\left\lvert\, \begin{array}{\|c\|c\|} \hline .0008 \\ \hline \end{array}\right.$ | $\begin{array}{\|l\|} \hline 0014 \\ \hline 0013 \end{array}$ | $\begin{aligned} & .0016 \\ & .0016 \end{aligned}$ | $\left.\begin{array}{\|c\|} \hline 0012 \\ \hline 0011 \end{array}\right)$ | $.0021 .020$ | $\begin{array}{\|} \hline 0019 \\ .0018 \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline 0016 \\ \hline 0015 \end{array}$ | $\begin{array}{\|l\|} \hline 0028 \\ \hline 0026 \end{array}$ | $\left.\begin{array}{\|l\|} \hline 0022 \\ .0021 \end{array} \right\rvert\,$ | $\begin{array}{\|l\|l\|} \hline 0023 \\ \hline 0021 \end{array}$ | $1.0040$ | $.0026$ | $\begin{array}{\|l\|} \hline .0029 \\ \hline 0026 \end{array}$ | $\left.\begin{array}{\|l\|} \hline 0051 \\ \hline 0047 \end{array} \right\rvert\,$ | .0033 |
| $\begin{aligned} & \text { COBALT } \\ & \text { ALLOY } \end{aligned}$ | ASTM F562, ASTM F90, ASTM F75, ASTM F799 | $\begin{aligned} & \text { 75-98 HRB } \\ & \text { 21-36 HRC } \\ & 36-50 \text { HRC } \end{aligned}$ | $\begin{aligned} & 210 \\ & 170 \\ & 65 \end{aligned}$ | $\left\|\begin{array}{l} .0004 \\ .0003 \\ .0002 \end{array}\right\|$ | $\begin{array}{\|l} \hline 0006 \\ .0006 \\ .0004 \\ \hline 004 \end{array}$ | $\begin{array}{\|} \hline 0012 \\ .0011 \\ .0009 \\ \hline \end{array}$ | $\left.\begin{array}{\|} \hline .0005 \\ .0005 \\ .0003 \end{array} \right\rvert\,$ | $\begin{array}{\|c} \hline 0000 \\ .0009 \\ \hline 0006 \end{array}$ | $\left.\begin{array}{\|} \hline .0013 \\ .0013 \\ .0011 \end{array} \right\rvert\,$ | $\begin{array}{\|c} \hline 0007 \\ .0007 \\ \hline .0005 \end{array}$ | $\left.\begin{array}{\|c\|} \hline .0012 \\ .0012 \\ .0008 \\ \hline \end{array} \right\rvert\,$ | $\begin{array}{l\|l\|l\|l\|l\|l\|} \hline 0015 \\ 2 & 0015 \\ 3 & 0012 \end{array}$ | $\begin{array}{\|} \hline .0010 \\ .0010 \\ .0007 \\ \hline \end{array}$ | $\left\|\begin{array}{l} .0018 \\ .0017 \\ .0012 \end{array}\right\|$ | $\left.\begin{array}{\|c} .0017 \\ 0017 \\ .0014 \end{array} \right\rvert\,$ | $\left.\begin{array}{\|l} .0013 \\ .0013 \\ .0009 \end{array} \right\rvert\,$ | $\begin{array}{\|l} \hline 024 \\ .0023 \\ .0016 \end{array}$ | $\left.\begin{array}{\|} \hline .0020 \\ .0020 \\ .0016 \end{array} \right\rvert\,$ | $\begin{array}{\|c} \hline .019 \\ .0019 \\ .0013 \end{array}$ | $\left.\begin{array}{\|c} \hline .034 \\ .0033 \\ .0022 \end{array} \right\rvert\,$ | $\left(\left.\begin{array}{l} .024 \\ .0023 \\ .0019 \end{array} \right\rvert\,\right.$ | $\begin{aligned} & .0025 \\ & .0024 \\ & .0021 \end{aligned}$ | $\begin{aligned} & .0043 \\ & .0042 \\ & .0028 \end{aligned}$ | .0029 .0028 .0023 |


| Milling Process | Hardness | ADOC | RDOC |
| :---: | :---: | :---: | :---: |
| Slot (Full Slotting) | $<35$ HRC | $75 \%$-125\% Diameter | $100 \%$ Diameter |
|  | $\geq 35$ HRC | $60 \%-100 \%$ Diameter | $100 \%$ Diameter |
| Rgh (Traditional Roughing) | $<35$ HRC | Up to Max LOC | $30 \%-40 \%$ Diameter |
|  | $\geq 35$ HRC | Up to Max LOC | $25 \%-35 \%$ Diameter |
| Fin (Finishing) | N/A | Up to Max LOC | $4 \%-6 \%$ Diameter |

## NOTES:

Hardness Scales: | $H R B=$ Rockwell B |
| :---: |
| HRC $=$ Rockwell C |

IPT values shown are for $2.5 \times \mathrm{D}$ length of cut tools, and should be adjusted for longer or shorter lengths of cut. Values shown are for non-reached tools. For tools with reaches greater than 3xD, IPT should be reduced. For more accurate running parameters, please refer to Machining Advisor Pro.

