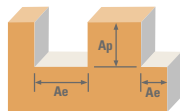


| Series<br>Z5MCR<br>Metric                                                                       | Hardness                    | Profile<br>Ae x DC       | Slot<br>Ap x DC       | Vc<br>(m/min)    | DC • mm       |       |       |       |       |       |       |       |
|-------------------------------------------------------------------------------------------------|-----------------------------|--------------------------|-----------------------|------------------|---------------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                                 |                             |                          |                       |                  | 6             | 8     | 10    | 12    | 16    | 20    | 25    |       |
| P<br><b>CARBON STEELS</b><br>1018, 1040, 1080, 1090,<br>10L50, 1140, 1212,<br>12L15, 1525, 1536 | ≤ 275 Bhn<br>or<br>≤ 28 HRc | Profile<br>Ae x DC ≤ 0.5 | Slot<br>Ap x DC ≤ 1.5 | 169<br>(135-203) | RPM           | 8967  | 6725  | 5380  | 4484  | 3363  | 2690  | 2152  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.029 | 0.049 | 0.061 | 0.074 | 0.087 | 0.099 | 0.108 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 1291  | 1650  | 1650  | 1668  | 1463  | 1327  | 1157  |
|                                                                                                 |                             | Slot<br>Ae x DC 1        | Ap x DC ≤ 1           | 134<br>(107-161) | RPM           | 7109  | 5332  | 4265  | 3555  | 2666  | 2133  | 1706  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.029 | 0.049 | 0.061 | 0.074 | 0.087 | 0.099 | 0.108 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 1024  | 1308  | 1308  | 1322  | 1160  | 1052  | 917   |
|                                                                                                 | ≤ 375 Bhn<br>or<br>≤ 40 HRc | Profile<br>Ae x DC ≤ 0.5 | Slot<br>Ap x DC ≤ 1.5 | 96<br>(77-115)   | RPM           | 5089  | 3817  | 3054  | 2545  | 1909  | 1527  | 1221  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.022 | 0.036 | 0.045 | 0.055 | 0.067 | 0.075 | 0.080 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 550   | 692   | 692   | 702   | 635   | 570   | 489   |
|                                                                                                 |                             | Slot<br>Ae x DC 1        | Ap x DC ≤ 1           | 76<br>(61-91)    | RPM           | 4039  | 3029  | 2424  | 2020  | 1515  | 1212  | 969   |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.022 | 0.036 | 0.045 | 0.055 | 0.067 | 0.075 | 0.080 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 436   | 549   | 549   | 557   | 504   | 452   | 388   |
| K<br><b>CAST IRONS</b><br>(LOW & MEDIUM<br>ALLOY)<br>Gray, Malleable,<br>Ductile                | ≤ 220 Bhn<br>or<br>≤ 19 HRc | Profile<br>Ae x DC ≤ 0.5 | Slot<br>Ap x DC ≤ 1.5 | 136<br>(109-163) | RPM           | 7190  | 5392  | 4314  | 3595  | 2696  | 2157  | 1726  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.026 | 0.045 | 0.056 | 0.067 | 0.079 | 0.091 | 0.098 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 949   | 1208  | 1208  | 1208  | 1070  | 978   | 841   |
|                                                                                                 |                             | Slot<br>Ae x DC 1        | Ap x DC ≤ 1           | 108<br>(87-130)  | RPM           | 5736  | 4302  | 3441  | 2868  | 2151  | 1721  | 1377  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.026 | 0.045 | 0.056 | 0.067 | 0.079 | 0.091 | 0.098 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 757   | 964   | 964   | 964   | 853   | 780   | 671   |
|                                                                                                 | ≤ 260 Bhn<br>or<br>≤ 26 HRc | Profile<br>Ae x DC ≤ 0.5 | Slot<br>Ap x DC ≤ 1.5 | 104<br>(83-124)  | RPM           | 5493  | 4120  | 3296  | 2747  | 2060  | 1648  | 1318  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.020 | 0.034 | 0.043 | 0.050 | 0.059 | 0.067 | 0.073 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 554   | 703   | 703   | 692   | 606   | 549   | 478   |
|                                                                                                 |                             | Slot<br>Ae x DC 1        | Ap x DC ≤ 1           | 82<br>(66-99)    | RPM           | 4362  | 3272  | 2617  | 2181  | 1636  | 1309  | 1047  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.020 | 0.034 | 0.043 | 0.050 | 0.059 | 0.067 | 0.073 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 440   | 558   | 558   | 550   | 482   | 436   | 380   |
| M<br><b>STAINLESS STEELS</b><br>(FREE MACHINING)<br>303, 416, 420F, 430F,<br>440F               | ≤ 275 Bhn<br>or<br>≤ 28 HRc | Profile<br>Ae x DC ≤ 0.5 | Slot<br>Ap x DC ≤ 1.5 | 149<br>(119-179) | RPM           | 7917  | 5938  | 4750  | 3958  | 2969  | 2375  | 1900  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.022 | 0.036 | 0.045 | 0.055 | 0.067 | 0.075 | 0.080 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 855   | 1077  | 1077  | 1092  | 988   | 887   | 760   |
|                                                                                                 |                             | Slot<br>Ae x DC 1        | Ap x DC ≤ 1           | 119<br>(95-143)  | RPM           | 6301  | 4726  | 3781  | 3151  | 2363  | 1890  | 1512  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.022 | 0.036 | 0.045 | 0.055 | 0.067 | 0.075 | 0.080 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 680   | 857   | 857   | 869   | 786   | 706   | 605   |
|                                                                                                 | ≤ 275 Bhn<br>or<br>≤ 28 HRc | Profile<br>Ae x DC ≤ 0.5 | Slot<br>Ap x DC ≤ 1.5 | 104<br>(83-124)  | RPM           | 5493  | 4120  | 3296  | 2747  | 2060  | 1648  | 1318  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.017 | 0.030 | 0.037 | 0.043 | 0.051 | 0.059 | 0.063 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 461   | 615   | 615   | 593   | 527   | 483   | 412   |
|                                                                                                 |                             | Slot<br>Ae x DC 1        | Ap x DC ≤ 1           | 82<br>(66-99)    | RPM           | 4362  | 3272  | 2617  | 2181  | 1636  | 1309  | 1047  |
|                                                                                                 |                             |                          |                       |                  | Fz            | 0.017 | 0.030 | 0.037 | 0.043 | 0.051 | 0.059 | 0.063 |
|                                                                                                 |                             |                          |                       |                  | Feed (mm/min) | 366   | 489   | 489   | 471   | 419   | 384   | 327   |
| ≤ 325 Bhn<br>or<br>≤ 35 HRc                                                                     | Profile<br>Ae x DC ≤ 0.5    | Slot<br>Ap x DC ≤ 1.5    | 94<br>(76-113)        | RPM              | 5009          | 3756  | 3005  | 2504  | 1878  | 1503  | 1202  |       |
|                                                                                                 |                             |                          |                       | Fz               | 0.017         | 0.030 | 0.037 | 0.043 | 0.051 | 0.059 | 0.063 |       |
|                                                                                                 |                             |                          |                       | Feed (mm/min)    | 421           | 561   | 561   | 541   | 481   | 441   | 376   |       |
|                                                                                                 | Slot<br>Ae x DC 1           | Ap x DC ≤ 1              | 76<br>(61-91)         | RPM              | 4039          | 3029  | 2424  | 2020  | 1515  | 1212  | 969   |       |
|                                                                                                 |                             |                          |                       | Fz               | 0.017         | 0.030 | 0.037 | 0.043 | 0.051 | 0.059 | 0.063 |       |
|                                                                                                 |                             |                          |                       | Feed (mm/min)    | 339           | 452   | 452   | 436   | 388   | 355   | 303   |       |

continued on next page

# METRIC Z-Carb-HPR



| Series<br>Z5MCR                                                                                                                       | Metric                                                                                                         | Hardness                    | Ae x DC     | Ap x DC | Vc<br>(m/min) | DC • mm       |               |        |        |        |        |        |        |        |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------|-------------|---------|---------------|---------------|---------------|--------|--------|--------|--------|--------|--------|--------|
|                                                                                                                                       |                                                                                                                |                             |             |         |               | 6             | 8             | 10     | 12     | 16     | 20     | 25     |        |        |
| S                                                                                                                                     | SUPER ALLOYS<br>(NICKEL, COBALT,<br>IRON BASE)<br>Inconel 601, 617, 625,<br>Incoloy, Monel 400                 | ≤ 300 Bhn<br>or<br>≤ 32 HRc | Profile<br> | ≤ 0.5   | ≤ 1.5         | 24<br>(20-29) | RPM           | 1293   | 969    | 776    | 646    | 485    | 388    | 310    |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Fz            | 0.0160 | 0.0272 | 0.0340 | 0.0409 | 0.0478 | 0.0531 | 0.0599 |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Feed (mm/min) | 103    | 132    | 132    | 132    | 116    | 103    | 93     |
|                                                                                                                                       |                                                                                                                |                             | Slot<br>    | 1       | ≤ 1           | 20<br>(16-24) | RPM           | 1050   | 788    | 630    | 525    | 394    | 315    | 252    |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Fz            | 0.0160 | 0.0272 | 0.0340 | 0.0409 | 0.0478 | 0.0531 | 0.0599 |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Feed (mm/min) | 84     | 107    | 107    | 107    | 94     | 84     | 75     |
|                                                                                                                                       | SUPER ALLOYS<br>(NICKEL, COBALT,<br>IRON BASE)<br>Inconel 718, X-750,<br>Incoloy, Waspaloy,<br>Hastelloy, Rene | ≤ 400 Bhn<br>or<br>≤ 43 HRc | Profile<br> | ≤ 0.5   | ≤ 1.5         | 19<br>(15-23) | RPM           | 1002   | 751    | 601    | 501    | 376    | 301    | 240    |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Fz            | 0.0112 | 0.0192 | 0.0239 | 0.0284 | 0.0333 | 0.0371 | 0.0420 |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Feed (mm/min) | 56     | 72     | 72     | 71     | 63     | 56     | 50     |
|                                                                                                                                       |                                                                                                                |                             | Slot<br>    | 1       | ≤ 1           | 15<br>(12-18) | RPM           | 808    | 606    | 485    | 404    | 303    | 242    | 194    |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Fz            | 0.0112 | 0.0192 | 0.0239 | 0.0284 | 0.0333 | 0.0371 | 0.0420 |
|                                                                                                                                       |                                                                                                                |                             |             |         |               |               | Feed (mm/min) | 45     | 58     | 58     | 57     | 50     | 45     | 41     |
| TITANIUM ALLOYS<br>Pure Titanium, Ti6Al4V,<br>Ti6Al2Sn4Zr2Mo,<br>Ti4Al4Mo2Sn0.5Si                                                     | ≤ 350 Bhn<br>or<br>≤ 38 HRc                                                                                    | Profile<br>                 | ≤ 0.5       | ≤ 1.5   | 66<br>(52-79) | RPM           | 3474          | 2605   | 2084   | 1737   | 1303   | 1042   | 834    |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Fz            | 0.019         | 0.032  | 0.040  | 0.048  | 0.056  | 0.064  | 0.070  |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Feed (mm/min) | 333           | 417    | 417    | 417    | 367    | 333    | 292    |        |
|                                                                                                                                       |                                                                                                                | Slot<br>                    | 1           | ≤ 1     | 52<br>(41-62) | RPM           | 2747          | 2060   | 1648   | 1373   | 1030   | 824    | 659    |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Fz            | 0.019         | 0.032  | 0.040  | 0.048  | 0.056  | 0.064  | 0.070  |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Feed (mm/min) | 264           | 330    | 330    | 330    | 290    | 264    | 231    |        |
| TITANIUM ALLOYS<br>(DIFFICULT)<br>Ti10Al2Fe3Al,<br>Ti5Al5V5Mo3Cr,<br>Ti7Al4Mo,<br>Ti3Al8V6Cr4Zr4Mo,<br>Ti6Al6V6Sn,<br>Ti15V3 Cr3Sn3Al | ≤ 440 Bhn<br>or<br>≤ 47 HRc                                                                                    | Profile<br>                 | ≤ 0.5       | ≤ 1.5   | 23<br>(18-27) | RPM           | 1212          | 909    | 727    | 606    | 454    | 364    | 291    |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Fz            | 0.019         | 0.032  | 0.040  | 0.048  | 0.056  | 0.064  | 0.071  |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Feed (mm/min) | 116           | 145    | 145    | 145    | 128    | 116    | 103    |        |
|                                                                                                                                       |                                                                                                                | Slot<br>                    | 1           | ≤ 1     | 18<br>(15-22) | RPM           | 969           | 727    | 582    | 485    | 364    | 291    | 233    |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Fz            | 0.019         | 0.032  | 0.040  | 0.048  | 0.056  | 0.064  | 0.071  |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Feed (mm/min) | 93            | 116    | 116    | 116    | 102    | 93     | 83     |        |
| H<br>TOOL STEELS<br>A2, D2, H13, L2, M2,<br>P20, S7, T15, W2                                                                          | ≤ 375 Bhn<br>or<br>≤ 40 HRc                                                                                    | Profile<br>                 | ≤ 0.5       | ≤ 1.5   | 56<br>(45-68) | RPM           | 2989          | 2242   | 1793   | 1495   | 1121   | 897    | 717    |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Fz            | 0.017         | 0.030  | 0.037  | 0.043  | 0.051  | 0.059  | 0.065  |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Feed (mm/min) | 251           | 335    | 335    | 323    | 287    | 263    | 233    |        |
|                                                                                                                                       |                                                                                                                | Slot<br>                    | 1           | ≤ 1     | 44<br>(35-53) | RPM           | 2343          | 1757   | 1406   | 1171   | 879    | 703    | 562    |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Fz            | 0.017         | 0.030  | 0.037  | 0.043  | 0.051  | 0.059  | 0.065  |        |
|                                                                                                                                       |                                                                                                                |                             |             |         |               | Feed (mm/min) | 197           | 262    | 262    | 253    | 225    | 206    | 183    |        |

Bhn (Brinell)      HRc (Rockwell C)

$rpm = (Vc \times 1000) / (DC \times 3.14)$

$mm/min = Fz \times 5 \times rpm$

ramp up to 5 degrees using slotting speed and feed rates. Do not plunge.

reduce speed and feed for materials harder than listed

reduce feed and Ae when finish milling (.02 x DC maximum)

feed rates listed have chip thinning adjustments included where applicable

refer to the SGS Tool Wizard® for complete technical information ([www.kyocera-sgstool.com](http://www.kyocera-sgstool.com))