



**Product Table:** Miniature End Mills - Ball - Long Reach, Standard Flute  
**Characteristics:** 12x Reach Multiple, 2 Flutes  
**Series:** 9502xx

| MATERIAL   | SFM  | Hardness: ≤ 28 Rc (≤ 271 HBn) |        |        |              |           |                               |        |        |        |        |        |        |              |        |           |           |
|--|------|-------------------------------|--------|--------|--------------|-----------|-------------------------------|--------|--------|--------|--------|--------|--------|--------------|--------|-----------|-----------|
|  |      | Chip Load (IPT) by Dia        |        |        | Depth of Cut |           | Chip Load (IPT) by Cutter Dia |        |        |        |        |        |        | Depth of Cut |        |           |           |
|  |      | 0.015                         | 0.031  | 0.047  | Radial       | Axial     | 0.062                         | 0.078  | 0.093  | 0.125  | 0.187  | 0.250  | 0.375  | 0.500        | Radial | Axial     |           |
| ALUMINUM ALLOYS  | 750  | Slotting                      | .00010 | .00021 | .00032       | 1 x Dia   | .06 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00013 | .00026 | .00040       | 23 x Dia  | .25 x Dia                     | .00046 | .00058 | .00069 | .00093 | .00139 | .00186 | .00278       | .00371 | 45 x Dia  | .25 x Dia |
| Wrought (1xxx, 2xxx, 3xxx, 5xxx, 6xxx, 7xxx, 8xxx)   | 1000 | Finishing                     | .00024 | .00050 | .00076       | .04 x Dia | 3 x Dia                       | .00087 | .00110 | .00131 | .00176 | .00263 | .00352 | .00528       | .00704 | .08 x Dia | 3 x Dia   |
|  |      | Slotting                      | .00009 | .00019 | .00029       | 1 x Dia   | .06 x Dia                     | .00033 | .00042 | .00050 | .00067 | .00100 | .00134 | .00200       | .00267 | 1 x Dia   | .15 x Dia |
| Casting - 3%-5% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)  | 750  | Slotting                      | .00009 | .00019 | .00029       | 1 x Dia   | .06 x Dia                     | .00033 | .00042 | .00050 | .00067 | .00100 | .00134 | .00200       | .00267 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00012 | .00024 | .00036       | 23 x Dia  | .25 x Dia                     | .00041 | .00052 | .00062 | .00084 | .00125 | .00167 | .00251       | .00334 | 45 x Dia  | .25 x Dia |
| Casting - 5%-8% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)  | 700  | Slotting                      | .00009 | .00019 | .00029       | 1 x Dia   | .06 x Dia                     | .00033 | .00042 | .00050 | .00067 | .00100 | .00134 | .00200       | .00267 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00012 | .00024 | .00036       | 23 x Dia  | .25 x Dia                     | .00041 | .00052 | .00062 | .00084 | .00125 | .00167 | .00251       | .00334 | 45 x Dia  | .25 x Dia |
| Casting - 8%-12% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)   | 650  | Slotting                      | .00009 | .00019 | .00029       | 1 x Dia   | .06 x Dia                     | .00033 | .00042 | .00050 | .00067 | .00100 | .00134 | .00200       | .00267 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00012 | .00024 | .00036       | 23 x Dia  | .25 x Dia                     | .00041 | .00052 | .00062 | .00084 | .00125 | .00167 | .00251       | .00334 | 45 x Dia  | .25 x Dia |
| Casting - 12%-16% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)  | 475  | Slotting                      | .00009 | .00019 | .00029       | 1 x Dia   | .06 x Dia                     | .00033 | .00042 | .00050 | .00067 | .00100 | .00134 | .00200       | .00267 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00012 | .00024 | .00036       | 23 x Dia  | .25 x Dia                     | .00041 | .00052 | .00062 | .00084 | .00125 | .00167 | .00251       | .00334 | 45 x Dia  | .25 x Dia |
| Wrought - 5%-8% Si (4xxx)  | 1000 | Finishing                     | .00022 | .00045 | .00068       | .04 x Dia | 3 x Dia                       | .00079 | .00099 | .00118 | .00158 | .00237 | .00317 | .00475       | .00634 | .08 x Dia | 3 x Dia   |
|  |      | Slotting                      | .00010 | .00021 | .00032       | 1 x Dia   | .06 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 1 x Dia   | .15 x Dia |
| Wrought - 8%-12% Si (4xxx)   | 800  | Finishing                     | .00022 | .00045 | .00068       | .04 x Dia | 3 x Dia                       | .00079 | .00099 | .00118 | .00158 | .00237 | .00317 | .00475       | .00634 | .08 x Dia | 3 x Dia   |
|  |      | Slotting                      | .00010 | .00021 | .00032       | 1 x Dia   | .06 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 1 x Dia   | .15 x Dia |
| MAGNESIUM ALLOYS   | 1500 | Slotting                      | .00010 | .00021 | .00032       | 1 x Dia   | .06 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 1 x Dia   | .15 x Dia |
| ZINC ALLOYS  | 800  | Roughing                      | .00013 | .00026 | .00040       | 23 x Dia  | .25 x Dia                     | .00046 | .00058 | .00069 | .00093 | .00139 | .00186 | .00278       | .00371 | 45 x Dia  | .25 x Dia |
|  |      | Finishing                     | .00024 | .00050 | .00076       | .04 x Dia | 3 x Dia                       | .00087 | .00110 | .00131 | .00176 | .00263 | .00352 | .00528       | .00704 | .08 x Dia | 3 x Dia   |
| COPPER ALLOYS  | 225  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |
| High Coppers - 90%+ (C1xxx)  | 500  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |
| Brass (Copper Zinc alloys, C2xxx, C3xxx, C4xxx, C66400-C69800)                                 | 225  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |
| Phosphor Bronzes (Copper Tin alloys, C5xxx)  | 500  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |
| Aluminum Bronzes (Copper Aluminum alloys, C60600-C64200)                                       | 500  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |
| Silicon Bronzes (Copper Silicon alloys, C64700-C66100)   | 500  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |
| Copper Nickels, Nickel Silvers (Copper Nickel alloys, C7xxx)                                   | 225  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |
| Cast Copper Alloys (C83300-C86200, C86400-C87900, C92200-C95800, C97300-C97800, C99400-C99700) | 550  | Slotting                      | .00008 | .00017 | .00026       | 1 x Dia   | .06 x Dia                     | .00029 | .00037 | .00044 | .00059 | .00089 | .00119 | .00178       | .00238 | 1 x Dia   | .15 x Dia |
|  |      | Roughing                      | .00010 | .00021 | .00032       | 23 x Dia  | .25 x Dia                     | .00037 | .00046 | .00055 | .00074 | .00111 | .00149 | .00223       | .00297 | 45 x Dia  | .25 x Dia |

**Please note:**

All posted speed and feed parameters are suggested starting values that may be increased given optimal setup conditions. Chip loads reflect uncoated cutters and may be increased 10%-20% if coated. For ferrous materials with hardness ≤ 28 Rc, chip loads can be increased 10%-20%.

If you require additional information, Harvey Tool has a team of technical experts available to assist you through even the most challenging applications. Please contact us at **800-645-5609** or [Harveytech@harveyperformance.com](mailto:Harveytech@harveyperformance.com).

WARNING: Cutting tools may shatter under improper use. Government regulations require use of safety glasses and other appropriate safety equipment in the vicinity of use.

| MATERIAL  | SFM | Hardness: 29-37 Rc (279-344 HBn) |        |        |              |           |                               |        |        |        |        |        |        |              |        |           |           |
|---|-----|----------------------------------|--------|--------|--------------|-----------|-------------------------------|--------|--------|--------|--------|--------|--------|--------------|--------|-----------|-----------|
|   |     | Chip Load (IPT) by Dia           |        |        | Depth of Cut |           | Chip Load (IPT) by Cutter Dia |        |        |        |        |        |        | Depth of Cut |        |           |           |
|   |     | 0.015                            | 0.031  | 0.047  | Radial       | Axial     | 0.062                         | 0.078  | 0.093  | 0.125  | 0.187  | 0.250  | 0.375  | 0.500        | Radial | Axial     |           |
| CARBON STEELS   | 600 | Slotting                         | .00004 | .00007 | .00011       | 1 x Dia   | .06 x Dia                     | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00077       | .00102 | 1 x Dia   | .15 x Dia |
|   |     | Roughing                         | .00004 | .00008 | .00012       | 23 x Dia  | .25 x Dia                     | .00014 | .00018 | .00021 | .00029 | .00043 | .00057 | .00086       | .00115 | 45 x Dia  | .25 x Dia |
|   |     | Finishing                        | .00008 | .00016 | .00024       | .04 x Dia | 3 x Dia                       | .00027 | .00034 | .00041 | .00055 | .00082 | .00110 | .00165       | .00220 | .08 x Dia | 3 x Dia   |
| 1030 - 1095, 1140 - 1151, 13xx, 15xx, 2xxx, 3xxx, 4xxx & 4Lxx, 5xxx & 5Lxx, 50xxx & 50Lxx, 51xxx & 51Lxx, 52xxx & 52Lxx, 6xxx, 8xx, 9xxx  | 200 | Slotting                         | .00003 | .00007 | .00010       | 1 x Dia   | .06 x Dia                     | .00012 | .00015 | .00017 | .00023 | .00035 | .00047 | .00070       | .00093 | 1 x Dia   | .15 x Dia |
|   |     | Roughing                         | .00004 | .00007 | .00011       | 23 x Dia  | .25 x Dia                     | .00013 | .00016 | .00020 | .00026 | .00039 | .00052 | .00079       | .00105 | 45 x Dia  | .25 x Dia |
|   |     | Finishing                        | .00007 | .00014 | .00022       | .04 x Dia | 3 x Dia                       | .00025 | .00031 | .00037 | .00050 | .00075 | .00101 | .00151       | .00201 | .08 x Dia | 3 x Dia   |
| STAINLESS STEELS  | 450 | Slotting                         | .00004 | .00007 | .00011       | 1 x Dia   | .06 x Dia                     | .00013 | .00016 | .00019 | .00026 | .00038 | .00051 | .00077       | .00102 | 1 x Dia   | .15 x Dia |
|   |     | Roughing                         | .00004 | .00008 | .00012       | 23 x Dia  | .25 x Dia                     | .00014 | .00018 | .00021 | .00029 | .00043 | .00057 | .00086       | .00115 | 45 x Dia  | .25 x Dia |
|   |     | Finishing                        | .00008 | .00016 | .00024       | .04 x Dia | 3 x Dia                       | .00027 | .00034 | .00041 | .00055 | .00082 | .00110 | .00165       | .00220 | .08 x Dia | 3 x Dia   |
| 201, 202, 203, 205, 301, 302, 304, 304L, 308, 309, 310, 314, 316, 316L, 317, 321, 329, 330, 347, 348, 385, 403, 405, 409, 410, 413, 420, 429, 430, 434, 436, 442, 446, 501, 502 | 200 | Slotting                         | .00003 | .00007 | .00010       | 1 x Dia   | .06 x Dia                     | .00012 | .00015 | .00017 | .00023 | .00035 | .00047 | .00070       | .00093 | 1 x Dia   | .15 x Dia |
|   |     | Roughing                         | .00004 | .00007 | .00011       | 23 x Dia  | .25 x Dia                     | .00013 | .00016 | .00020 | .00026 | .00039 | .00052 | .00079       | .00105 | 45 x Dia  | .25 x Dia |
|   |     | Finishing                        | .00007 | .00014 | .00022       | .04 x Dia | 3 x Dia                       | .00025 | .00031 | .00037 | .00050 | .00075 | .00101 | .00151       | .00201 | .08 x Dia | 3 x Dia   |
| 414, 431, 440A, 440B, 440C, 13-8, 15-5, 15-7, 17-4, 17-7  | 150 | Slotting                         | .00002 | .00004 | .00006       | 1 x Dia   | .06 x Dia                     | .00007 | .00009 | .00011 | .00015 | .00022 | .00029 | .00044       | .00058 | 1 x Dia   | .15 x Dia |
|   |     | Roughing                         | .00002 | .00005 | .00007       | 23 x Dia  | .25 x Dia                     | .00008 | .00010 | .00012 | .00016 | .00025 | .00033 | .00049       | .00066 | 45 x Dia  | .25 x Dia |
|   |     | Finishing                        | .00004 | .00009 | .00014       | .04 x Dia | 3 x Dia                       | .00016 | .00020 | .00023 | .00031 | .00047 | .00063 | .00094       | .00126 | .08 x Dia | 3 x Dia   |
| TOOL STEELS   | 200 | Slotting                         | .00003 | .00007 | .00010       | 1 x Dia   | .06 x Dia                     | .00012 | .00015 | .00017 | .00023 | .00035 | .00047 | .00070       | .00093 | 1 x Dia   | .15 x Dia |
|   |     | Roughing                         | .00004 | .00007 | .00011       | 23 x Dia  | .25 x Dia                     | .00013 | .00016 | .00020 | .00026 | .00039 | .00052 | .00079       | .00105 | 45 x Dia  | .25 x Dia |
|   |     | Finishing                        | .00007 | .00014 | .00022       | .04 x Dia | 3 x Dia                       | .00025 | .00031 | .00037 | .00050 | .00075 | .00101 | .00151       | .00201 | .08 x Dia | 3 x Dia   |
| A, L, O, P, W series  | 150 | Slotting                         | .00002 | .00004 | .00006       | 1 x Dia   | .06 x Dia                     | .00007 | .00009 | .00011 | .00015 | .00022 | .00029 | .00044       | .00058 | 1 x Dia   | .15 x Dia |
|   |     | Roughing                         | .00002 | .00005 | .00007       | 23 x Dia  | .25 x Dia                     | .00008 | .00010 | .00012 | .00016 | .00025 | .00033 | .00049       | .00066 | 45 x Dia  | .25 x Dia |
|   |     | Finishing                        | .00004 | .00009 | .00014       | .04 x Dia | 3 x Dia                       | .00016 | .00020 | .00023 | .00031 | .00047 | .00063 | .00094       | .00126 | .08 x Dia | 3 x Dia   |
| D, H, M, T, S series  | 150 | Slotting                         | .00002 | .00004 | .00006       | 1 x Dia   | .06 x Dia                     | .00007 | .00009 | .00011 | .00015 | .00022 | .00029 | .00044       | .00058 | 1         |           |