

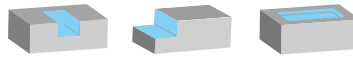


Designed specifically  
for use in dry cutting  
conditions



INDEX

INDEX

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| ○                 | ●   | ●     | ○      |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                                                                                      |                     | 100120<br>100320 |    | Short Length<br>ø1.0mm - 25.0mm                 | P.68-69  |
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| ○                 | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |    |                     | 155120<br>155320 |    | Long Length<br>Corner Radius ø4.0mm - 20.0mm    | P.71     |
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| ○                 | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                                                                                      |                     | 105320           |    | Miniature<br>Ball Nose ø0.6mm - 1.5mm           | P.73     |
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| ○                 | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                                                                                      |                     | 112120<br>112320 |  | Long Length<br>Ball Nose ø1.0mm - 25.0mm        | P.76     |
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| ○                 | ●   | ●     | ○      |    |       |       |       |       |      |      |    |       |       | ●     |  |                     | 103120<br>103320 |  | Miniature<br>ø1.0mm - 20.0mm                    | P.79     |
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| ○                 | ●   | ●     | ○      |    |       |       |       |       |      |      |    |       |       | ●     |  |                     | 109120<br>109320 |  | Short Length<br>ø2.0mm - 25.0mm                 | P.80-81  |
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CONTINUED OVERLEAF

► For material group examples, refer to page 4  
► For full material group tables, refer to pages 334-347

| P                  |     |       | M      |    | K     |       | N     |       |      |      |    | S     |       | H     | MACHINING GUIDE | 6 & 8 FLUTE END MILLS |                                |      |                                                      |                |
|--------------------|-----|-------|--------|----|-------|-------|-------|-------|------|------|----|-------|-------|-------|-----------------|-----------------------|--------------------------------|------|------------------------------------------------------|----------------|
| 1-5                | 6-9 | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1 | 29.2 | 30 | 31-35 | 36-37 | 38-39 |                 |                       | Code                           | Item | Description                                          | Page No.       |
| ○                  | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>149120</b><br><b>149320</b> |      | Long Length<br>45° Helix ø6.0mm - 25.0mm             | <b>P.86</b>    |
| ○                  | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>150120</b><br><b>150320</b> |      | Extra Long Length<br>45° Helix ø6.0mm - 25.0mm       | <b>P.87</b>    |
| ○                  | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>158120</b><br><b>158320</b> |      | Long Length<br>45° Helix, Corner Rad ø6.0mm - 20.0mm | <b>P.88</b>    |
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| ○                  | ●   | ●     | ○      |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>148120</b><br><b>148320</b> |      | Short Length<br>Multiflute ø6.0mm - 25.0mm           | <b>P.89</b>    |
| ○                  | ●   | ●     | ○      |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>147120</b><br><b>147320</b> |      | Long Length<br>Multiflute ø6.0mm - 25.0mm            | <b>P.90</b>    |
| ○                  | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>145120</b><br><b>145320</b> |      | Long Length<br>Ball Nose ø6.0mm - 20.0mm             | <b>P.91</b>    |
| TAPER END MILLS    |     |       |        |    |       |       |       |       |      |      |    |       |       |       |                 |                       |                                |      |                                                      |                |
| ○                  | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>120320</b>                  |      | Rib Processing<br>ø1.0mm - 2.0mm                     | <b>P.92-93</b> |
| ○                  | ●   | ●     |        |    | ○     | ○     |       |       |      |      |    |       |       | ●     |                 |                       | <b>130320</b>                  |      | Rib Processing<br>Ball Nose ø1.0mm - 2.0mm           | <b>P.94-95</b> |
|                    |     |       |        |    |       |       |       |       |      |      |    |       |       |       |                 |                       |                                |      | Cutting Data                                         | <b>P.97</b>    |

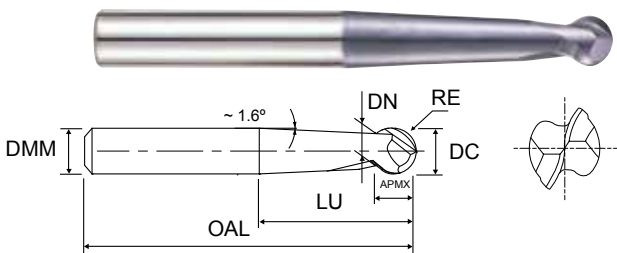
► For material group examples, refer to page 4  
► For full material group tables, refer to pages 334-347

# SPHERE BALL NOSE FULL RADIUS



## Series No. 153320

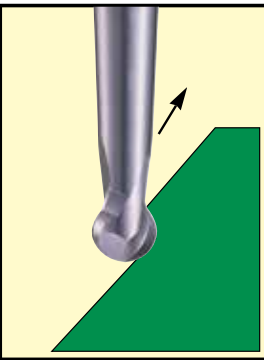
▶ cutting conditions : p.98



| EUROPA CODE ORDCODE | DIAMETER DC | RADIUS RE | SHANK DIAMETER DMM | LENGTH OF CUT APMX | EFFECTIVE LENGTH LU | OVERALL LENGTH OAL | NECK DIAMETER DN |
|---------------------|-------------|-----------|--------------------|--------------------|---------------------|--------------------|------------------|
| 1533200300          | 3.0         | 1.5       | 6                  | 2.3                | 30                  | 80                 | 2.5              |
| 1533200400          | 4.0         | 2.0       | 6                  | 3.1                | 30                  | 80                 | 3.3              |
| 1533200500          | 5.0         | 2.5       | 6                  | 3.9                | 38                  | 80                 | 4.1              |
| 1533200600          | 6.0         | 3.0       | 6                  | 4.9                | 28                  | 100                | 4.7              |
| 1533200800          | 8.0         | 4.0       | 8                  | 6.3                | 33                  | 100                | 6.5              |
| 1533201000          | 10.0        | 5.0       | 10                 | 7.9                | 40                  | 100                | 8.2              |
| 1533201200          | 12.0        | 6.0       | 12                 | 9.5                | 49                  | 100                | 9.8              |
| 1533201600          | 16.0        | 8.0       | 16                 | 12.4               | 59                  | 150                | 13.4             |

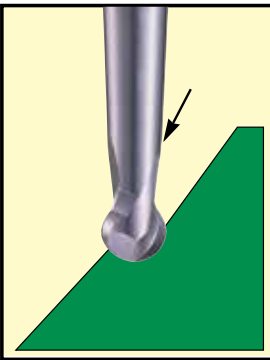
| Mill Dia. Tolerance TCDG(mm) | Radius Tolerance (mm) |        | Shank Dia. Tolerance TCDMM |
|------------------------------|-----------------------|--------|----------------------------|
|                              | RETOLL                | RETOLU |                            |
| 0.00 / -0.03                 | -0.010                | +0.010 | h6                         |

### ADVANCED TECHNIQUE



Favorable Back Milling

### NORMAL TECHNIQUE

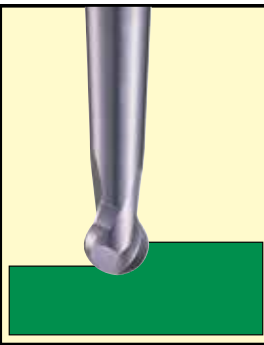


Normal Ball Nose

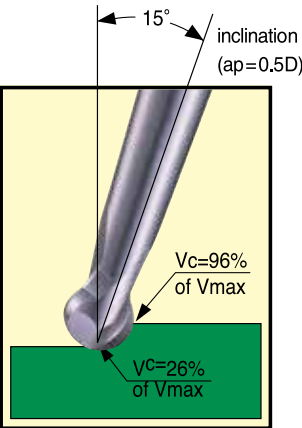
- Operating angle 14° ~ 16°, higher speed and feed are possible, as cutting resistance at the cutting edges is reduced.

- Excellent surface roughness and more secure milling process.

- Higher speed and feed rates are achievable when back milling.



Normal Ball Nose



Favorable Profiling

- Using 15° inclined profiling operation, increased productivity and higher speed and feed are possible.

- Decreased cutting force.

- Excellent surface roughness and finish.

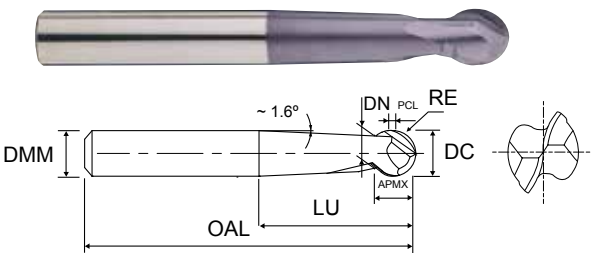
| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ○     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

# SPHERE BALL NOSE ECONOMY TYPE



## Series No. 152320

▶ cutting conditions : p.98



Designed with small flat for ease of regrind. Cannot be used for back milling, but is suitable for inclined profiling.

| EUROPA CODE ORDCODE | DIAMETER DC | RADIUS RE | SHANK DIAMETER DMM | LENGTH OF CUT APMX | EFFECTIVE LENGTH LU | OVERALL LENGTH OAL | NECK DIAMETER DN | FLAT PCL |
|---------------------|-------------|-----------|--------------------|--------------------|---------------------|--------------------|------------------|----------|
| 1523200300          | 3.0         | 1.5       | 6.0                | 4.0                | 30.0                | 80.0               | 2.5              | 1.5      |
| 1523200400          | 4.0         | 2.0       |                    | 5.0                | 30.0                |                    | 3.3              |          |
| 1523200500          | 5.0         | 2.5       |                    | 6.0                | 43.0                |                    | 4.1              | 2        |
| 1523200600          | 6.0         | 3.0       |                    | 7.0                | 30.0                |                    | 4.7              |          |
| 1523200800          | 8.0         | 4.0       | 8.0                | 9.0                | 36.0                | 100.0              | 6.5              | 3        |
| 1523201000          | 10.0        | 5.0       | 10.0               | 11.0               | 43.0                |                    | 8.2              |          |
| 1523201200          | 12.0        | 6.0       | 12.0               | 13.0               | 52.0                |                    | 9.8              |          |
| 1523201600          | 16.0        | 8.0       | 16.0               | 15.0               | 61.0                |                    | 13.4             |          |

| Mill Dia. Tolerance TCDG(mm) | Radius Tolerance (mm) |        | Shank Dia. Tolerance TCDMM |
|------------------------------|-----------------------|--------|----------------------------|
|                              | RETOLL                | RETOLU |                            |
| 0.00 / -0.03                 | -0.010                | +0.010 | h6                         |

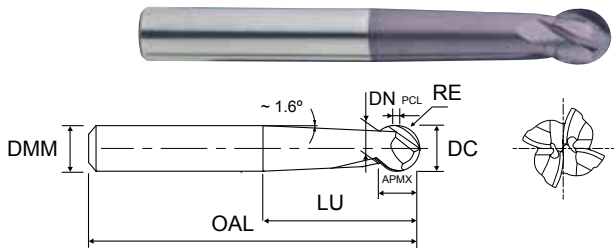
| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ○     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

SPHERE BALL NOSE ECONOMY TYPE



Series No. 154320

► cutting conditions : p.99



Designed with small flat for ease of regrind. Cannot be used for back milling, but is suitable for inclined profiling,

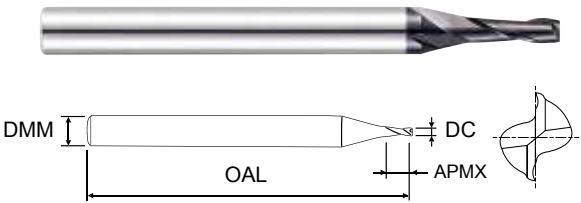
| EUROPA CODE ORDCODE | DIAMETER DC | RADIUS RE | SHANK DIAMETER DMM | LENGTH OF CUT APMX           | EFFECTIVE LENGTH LU | OVERALL LENGTH OAL    | NECK DIAMETER DN | FLAT PCL                   |
|---------------------|-------------|-----------|--------------------|------------------------------|---------------------|-----------------------|------------------|----------------------------|
| 1543200300          | 3.0         | 1.5       | 6.0                | 4.0                          | 30.0                | 80.0                  | 2.5              | 1.5                        |
| 1543200400          | 4.0         | 2.0       |                    | 5.0                          | 30.0                |                       | 3.3              | 2                          |
| 1543200500          | 5.0         | 2.5       |                    | 6.0                          | 43.0                |                       | 4.1              |                            |
| 1543200600          | 6.0         | 3.0       |                    | 7.0                          | 30.0                |                       | 4.7              |                            |
| 1543200800          | 8.0         | 4.0       | 8.0                | 9.0                          | 36.0                | 100.0                 | 6.5              | 3                          |
| 1543201000          | 10.0        | 5.0       | 10.0               | 11.0                         | 43.0                |                       | 8.2              |                            |
| 1543201200          | 12.0        | 6.0       | 12.0               | 13.0                         | 52.0                |                       | 9.8              |                            |
| 1543201600          | 16.0        | 8.0       | 16.0               | 15.0                         | 61.0                | 150.0                 | 13.4             |                            |
|                     |             |           |                    | Mill Dia. Tolerance TCDC(mm) |                     | Radius Tolerance (mm) |                  | Shank Dia. Tolerance TCDMM |
|                     |             |           |                    |                              |                     | RETOLL                | RETOLU           |                            |
|                     |             |           |                    | 0.00 / -0.03                 |                     | -0.010                | +0.010           | h6                         |

MINIATURE



Series No. 100320

► cutting conditions : p.107



High precision milling in medical, optical, electronics and aero space industries.  
Excellent performance on hardened steel

| EUROPA CODE ORDCODE | DIAMETER DC | SHANK DIAMETER DMM | LENGTH OF CUT APMX | OVERALL LENGTH OAL |
|---------------------|-------------|--------------------|--------------------|--------------------|
| 1003200040          | 0.4         | 3                  | 0.8                | 40                 |
| 1003200050          | 0.5         | 3                  | 1.0                | 40                 |
| 1003200060          | 0.6         | 3                  | 1.2                | 40                 |
| 1003200070          | 0.7         | 3                  | 1.4                | 40                 |
| 1003200080          | 0.8         | 3                  | 1.6                | 40                 |
| 1003200090          | 0.9         | 3                  | 2.0                | 40                 |
| 1003200100          | 1.0         | 4                  | 2.5                | 40                 |
| 1003200110          | 1.1         | 4                  | 2.5                | 40                 |
| 1003200120          | 1.2         | 4                  | 4.0                | 40                 |
| 1003200130          | 1.3         | 4                  | 4.0                | 40                 |
| 1003200140          | 1.4         | 4                  | 4.0                | 40                 |
| 1003200150          | 1.5         | 4                  | 4.0                | 40                 |

|                              |                            |
|------------------------------|----------------------------|
| Mill Dia. Tolerance TCDC(mm) | Shank Dia. Tolerance TCDMM |
| 0.00 / -0.03                 | h6                         |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ○     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

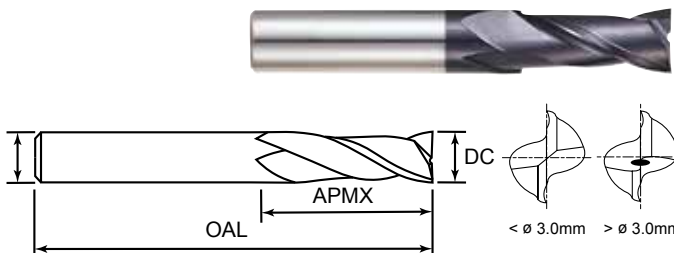
| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ●     | ●     |        |    |       |       |       |       |       |      |    |       |       | ●     |

SHORT LENGTH



Series No. 100120, 100320

► cutting conditions : p.100



Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Superior workpiece finishes, increased feed rates.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|-----------------------|-----------------------|
| -                              | 1003200100                      | 1.0            | 4                        | 2.5                   | 40                    |
| -                              | 1003200150                      | 1.5            |                          | 4.0                   |                       |
| -                              | 1003200200                      | 2.0            |                          | 6.0                   |                       |
| -                              | 1003200250                      | 2.5            |                          | 8.0                   |                       |
| 1001200300                     | 1003200300                      | 3.0            | 6                        | 8.0                   | 45                    |
| 1001200350                     | 1003200350                      | 3.5            |                          | 10.0                  |                       |
| 1001200400                     | 1003200400                      | 4.0            |                          | 11.0                  |                       |
| 1001200450                     | 1003200450                      | 4.5            |                          | 11.0                  |                       |
| 1001200500                     | 1003200500                      | 5.0            | 8                        | 13.0                  | 50                    |
| 1001200550                     | 1003200550                      | 5.5            |                          | 13.0                  |                       |
| 1001200600                     | 1003200600                      | 6.0            |                          | 13.0                  |                       |
| 1001200650                     | 1003200650                      | 6.5            |                          | 16.0                  | 60                    |
| 1001200700                     | 1003200700                      | 7.0            | 10                       | 16.0                  |                       |
| 1001200750                     | 1003200750                      | 7.5            |                          | 16.0                  |                       |
| 1001200800                     | 1003200800                      | 8.0            |                          | 19.0                  |                       |
| 1001200850                     | 1003200850                      | 8.5            | 10                       | 19.0                  | 70                    |
| 1001200900                     | 1003200900                      | 9.0            |                          | 19.0                  |                       |
| 1001200950                     | 1003200950                      | 9.5            |                          | 19.0                  |                       |
| 1001201000                     | 1003201000                      | 10.0           |                          | 22.0                  |                       |

|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

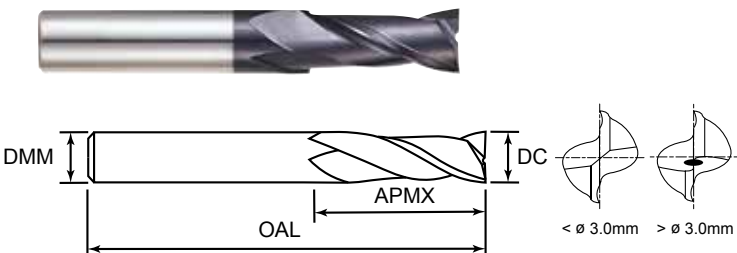
| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      | ○  | ○     | ○     |       |       |       |      |    |       |       |       | ● |

SHORT LENGTH



Series No. 100120, 100320

► cutting conditions : p.100



Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Superior workpiece finishes, increased feed rates.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|-----------------------|-----------------------|
| 1001201050                     | 1003201050                      | 10.5           | 12                       | 22.0                  | 75                    |
| 1001201100                     | 1003201100                      | 11.0           |                          | 22.0                  |                       |
| 1001201150                     | 1003201150                      | 11.5           |                          | 22.0                  |                       |
| 1001201200                     | 1003201200                      | 12.0           |                          | 26.0                  |                       |
| 1001201300                     | 1003201300                      | 13.0           | 14                       | 26.0                  | 85                    |
| 1001201400                     | 1003201400                      | 14.0           |                          | 26.0                  |                       |
| 1001201500                     | 1003201500                      | 15.0           |                          | 26.0                  |                       |
| 1001201600                     | 1003201600                      | 16.0           |                          | 32.0                  | 100                   |
| 1001201700                     | 1003201700                      | 17.0           | 16                       | 32.0                  |                       |
| 1001201800                     | 1003201800                      | 18.0           |                          | 32.0                  |                       |
| 1001201900                     | 1003201900                      | 19.0           |                          | 32.0                  |                       |
| 1001202000                     | 1003202000                      | 20.0           | 18                       | 38.0                  | 105                   |
| 1001202200                     | 1003202200                      | 22.0           |                          | 38.0                  |                       |
| 1001202400                     | 1003202400                      | 24.0           |                          | 45.0                  |                       |
| 1001202500                     | 1003202500                      | 25.0           |                          | 45.0                  |                       |

|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      | ○  | ○     | ○     |       |       |       |      |    |       |       |       | ● |

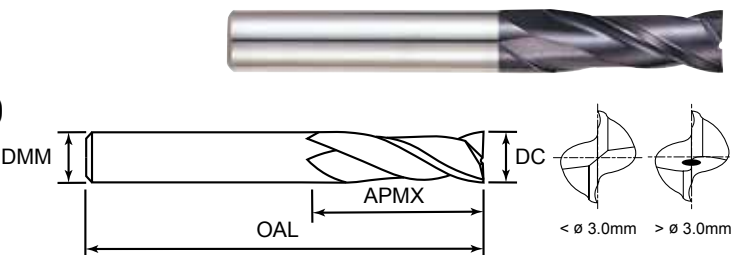


# LONG LENGTH



## Series No. 102120, 102320

► cutting conditions : p.101



Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Superior workpiece finishes, increased feed rates.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|-----------------------|-----------------------|
| -                              | 1023200200                      | 2.0            | 4                        | 8.0                   | 40                    |
| 1021200300                     | 1023200300                      | 3.0            | 6                        | 12.0                  | 50                    |
| 1021200400                     | 1023200400                      | 4.0            |                          | 15.0                  |                       |
| 1021200500                     | 1023200500                      | 5.0            |                          | 20.0                  |                       |
| 1021200600                     | 1023200600                      | 6.0            | 8                        | 20.0                  | 60                    |
| 1021200800                     | 1023200800                      | 8.0            |                          | 25.0                  |                       |
| 1021201000                     | 1023201000                      | 10.0           |                          | 30.0                  |                       |
| 1021201200                     | 1023201200                      | 12.0           | 10                       | 30.0                  | 90                    |
| 1021201400                     | 1023201400                      | 14.0           | 12                       | 30.0                  |                       |
| 1021201600                     | 1023201600                      | 16.0           | 16                       | 40.0                  |                       |
| 1021201800                     | 1023201800                      | 18.0           | 20                       | 50.0                  | 110                   |
| 1021202000                     | 1023202000                      | 20.0           |                          | 50.0                  |                       |
| 1021202500                     | 1023202500                      | 25.0           |                          | 55.0                  |                       |
| 1021202500                     | 1023202500                      | 25.0           | 25                       | 75.0                  | 140                   |

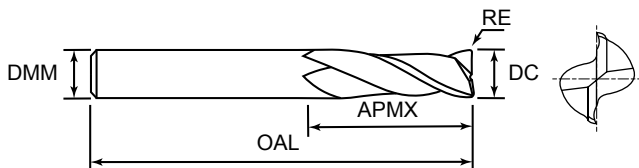
|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

# LONG LENGTH CORNER RADIUS



## Series No. 155120, 155320

► cutting conditions : p.102



Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Superior workpiece finishes, increased feed rates.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | CORNER<br>RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGT<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|------------------------|--------------------------|-------------------------|--------------------------|
| 1551209011                     | 1553209011                      | 4.0            | 0.5                    | 6                        | 15.0                    | 50                       |
| 1551209012                     | 1553209012                      | 5.0            | 0.5                    |                          | 20.0                    | 60                       |
| 1551209013                     | 1553209013                      | 6.0            | 0.3                    |                          | 20.0                    |                          |
| 1551200600                     | 1553200600                      | 6.0            | 0.5                    |                          | 20.0                    |                          |
| 1551209001                     | 1553209001                      | 6.0            | 1.0                    |                          | 20.0                    | 70                       |
| 1551209014                     | 1553209014                      | 8.0            | 0.3                    | 8                        | 25.0                    |                          |
| 1551200800                     | 1553200800                      | 8.0            | 0.5                    |                          | 25.0                    |                          |
| 1551209002                     | 1553209002                      | 8.0            | 1.0                    |                          | 25.0                    |                          |
| 1551209003                     | 1553209003                      | 8.0            | 1.5                    |                          | 25.0                    |                          |
| 1551209004                     | 1553209004                      | 8.0            | 2.0                    |                          | 25.0                    | 90                       |
| 1551209016                     | 1553209016                      | 10.0           | 0.3                    | 10                       | 30.0                    |                          |
| 1551201000                     | 1553201000                      | 10.0           | 0.5                    |                          | 30.0                    |                          |
| 1551209005                     | 1553209005                      | 10.0           | 1.0                    |                          | 30.0                    |                          |
| 1551209006                     | 1553209006                      | 10.0           | 1.5                    |                          | 30.0                    |                          |
| 1551209007                     | 1553209007                      | 10.0           | 2.0                    |                          | 30.0                    |                          |
| 1551201200                     | 1553201200                      | 12.0           | 0.5                    | 12                       | 30.0                    | 110                      |
| 1551209008                     | 1553209008                      | 12.0           | 1.0                    |                          | 30.0                    |                          |
| 1551209009                     | 1553209009                      | 12.0           | 1.5                    |                          | 30.0                    |                          |
| 1551209010                     | 1553209010                      | 12.0           | 2.0                    |                          | 30.0                    |                          |
| 1551201600                     | 1553201600                      | 16.0           | 0.5                    | 16                       | 50.0                    |                          |
| 1551209017                     | 1553209017                      | 16.0           | 1.0                    |                          | 50.0                    |                          |
| 1551209018                     | 1553209018                      | 16.0           | 1.5                    |                          | 50.0                    |                          |
| 1551209019                     | 1553209019                      | 16.0           | 2.0                    |                          | 50.0                    |                          |
| 1551202000                     | 1553202000                      | 20.0           | 0.5                    | 20                       | 55.0                    |                          |
| 1551209020                     | 1553209020                      | 20.0           | 1.0                    |                          | 55.0                    |                          |
| 1551209021                     | 1553209021                      | 20.0           | 1.5                    |                          | 55.0                    |                          |
| 1551209022                     | 1553209022                      | 20.0           | 2.0                    |                          | 55.0                    |                          |

|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       |       | ● |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ● Excellent | ○ Good | ○     | ●     | ●      |    |       |       |       |       |       |      |    |       |       |       | ● |

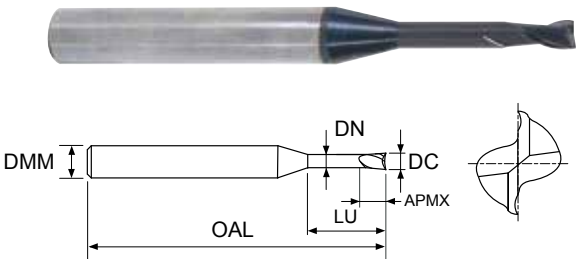


# RIB PROCESSING



## Series No. 107320, 108320

► cutting conditions : p.108

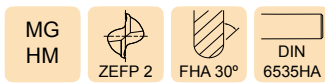


Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Superior workpiece finishes, increased feed rates.

| EUROPA CODE ORDCODE | DIAMETER DC | SHANK DIAMETER DMM | LENGTH OF CUT APMX | EFFECTIVE LENGTH LU | OVERALL LENGTH OAL | NECK DIAMETER DN |
|---------------------|-------------|--------------------|--------------------|---------------------|--------------------|------------------|
| 1073200080          | 0.8         | 4                  | 1.2                | 6                   | 45                 | 0.75             |
| 1083200080          | 0.8         | 4                  | 1.2                | 8                   | 45                 | 0.75             |
| 1073200100          | 1.0         | 4                  | 1.5                | 6                   | 45                 | 0.97             |
| 1083200100          | 1.0         | 4                  | 1.5                | 8                   | 45                 | 0.95             |
| 1073200102          | 1.0         | 4                  | 1.5                | 12                  | 45                 | 0.93             |
| 1073200120          | 1.2         | 4                  | 1.8                | 8                   | 45                 | 1.15             |
| 1083200120          | 1.2         | 4                  | 1.8                | 12                  | 45                 | 1.13             |
| 1073200140          | 1.4         | 4                  | 2.1                | 12                  | 45                 | 1.33             |
| 1073200150          | 1.5         | 4                  | 2.3                | 8                   | 45                 | 1.45             |
| 1083200150          | 1.5         | 4                  | 2.3                | 10                  | 45                 | 1.45             |
| 1073200152          | 1.5         | 4                  | 2.3                | 12                  | 45                 | 1.43             |
| 1073200153          | 1.5         | 4                  | 2.3                | 16                  | 50                 | 1.41             |
| 1073200160          | 1.6         | 4                  | 2.4                | 12                  | 45                 | 1.53             |
| 1073200180          | 1.8         | 4                  | 2.7                | 12                  | 45                 | 1.73             |
| 1073200200          | 2.0         | 4                  | 3.0                | 12                  | 45                 | 1.93             |
| 1083200200          | 2.0         | 4                  | 3.0                | 16                  | 50                 | 1.91             |
| 1073200250          | 2.5         | 4                  | 3.7                | 12                  | 45                 | 2.40             |
| 1083200250          | 2.5         | 4                  | 3.7                | 16                  | 55                 | 2.40             |
| 1073200300          | 3.0         | 6                  | 4.5                | 14                  | 50                 | 2.85             |
| 1083200300          | 3.0         | 6                  | 4.5                | 18                  | 55                 | 2.85             |

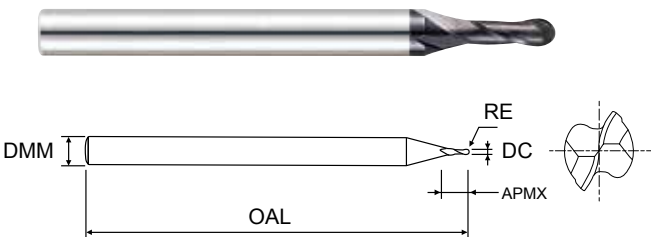
| Mill Dia. Tolerance TCDC(mm) | Shank Dia. Tolerance TCDMM |
|------------------------------|----------------------------|
| 0.00 / -0.015                | h6                         |

# MINIATURE BALL NOSE



## Series No. 105320

► cutting conditions : p.107



High precision milling in medical, optical, electronics and aerospace industries. Excellent performance on hardened steel

| EUROPA CODE ORDCODE | DIAMETER DC | RADIUS RE | SHANK DIAMETER DMM | LENGT OF CUT APMX | OVERALL LENGTH OAL |
|---------------------|-------------|-----------|--------------------|-------------------|--------------------|
| 1053200060          | 0.6         | 0.30      | 3                  | 1.1               | 40                 |
| 1053200070          | 0.7         | 0.35      | 3                  | 1.5               | 40                 |
| 1053200080          | 0.8         | 0.40      | 3                  | 2.0               | 40                 |
| 1053200090          | 0.9         | 0.45      | 3                  | 2.2               | 40                 |
| 1053200100          | 1.0         | 0.50      | 3                  | 2.5               | 40                 |
| 1053200110          | 1.1         | 0.55      | 3                  | 3.0               | 40                 |
| 1053200120          | 1.2         | 0.60      | 3                  | 3.0               | 40                 |
| 1053200130          | 1.3         | 0.65      | 3                  | 3.5               | 40                 |
| 1053200140          | 1.4         | 0.70      | 3                  | 3.5               | 40                 |
| 1053200150          | 1.5         | 0.75      | 3                  | 4.0               | 40                 |

| Mill Dia. Tolerance TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia. Tolerance TCDMM |
|------------------------------|-----------------------|--------|----------------------------|
|                              | RETOLL                | RETOLU |                            |
| 0.00 / -0.03                 | -0.010                | +0.010 | h6                         |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |



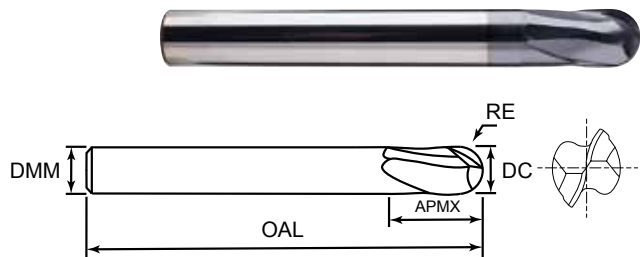
# STUB CUT LENGTH BALL NOSE >HRC55



## Series No. 116120, 116320

▶ cutting conditions : p.106

Suitable for HRC55~HRC65 high hardened materials.  
Strong cutting edges and higher tool rigidity.



| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGT<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------|--------------------------|-------------------------|--------------------------|
| -                              | 1163200100                      | 1.0            | 0.5          | 4                        | 1.0                     | 50                       |
| -                              | 1163200120                      | 1.2            | 0.6          |                          | 1.2                     |                          |
| -                              | 1163200150                      | 1.5            | 0.75         |                          | 1.5                     |                          |
| 1161200200                     | 1163200200                      | 2.0            | 1.0          | 6                        | 2.0                     | 60                       |
| 1161200300                     | 1163200300                      | 3.0            | 1.5          |                          | 3.0                     |                          |
| 1161200400                     | 1163200400                      | 4.0            | 2.0          |                          | 4.0                     |                          |
| 1161200500                     | 1163200500                      | 5.0            | 2.5          |                          | 5.0                     |                          |
| 1161200600                     | 1163200600                      | 6.0            | 3.0          | 8                        | 6.0                     | 80                       |
| 1161200700                     | 1163200700                      | 7.0            | 3.5          |                          | 7.0                     |                          |
| 1161200800                     | 1163200800                      | 8.0            | 4.0          |                          | 8.0                     |                          |
| 1161200900                     | 1163200900                      | 9.0            | 4.5          | 10                       | 9.0                     | 90                       |
| 1161201000                     | 1163201000                      | 10.0           | 5.0          |                          | 10.0                    |                          |
| 1161201200                     | 1163201200                      | 12.0           | 6.0          | 12                       | 12.0                    | 100                      |
| 1161201400                     | 1163201400                      | 14.0           | 7.0          | 14                       | 14.0                    |                          |
| 1161201600                     | 1163201600                      | 16.0           | 8.0          | 16                       | 16.0                    | 110                      |
| 1161201800                     | 1163201800                      | 18.0           | 9.0          | 18                       | 18.0                    |                          |
| 1161202000                     | 1163202000                      | 20.0           | 10.0         | 20                       | 20.0                    | 140                      |
| 1161202500                     | 1163202500                      | 25.0           | 12.5         | 25                       | 25.0                    |                          |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|--------|----------------------------------|
|                                    | RETOLL                | RETOLU |                                  |
| 0.00 / -0.03                       | -0.010                | +0.010 | h6                               |

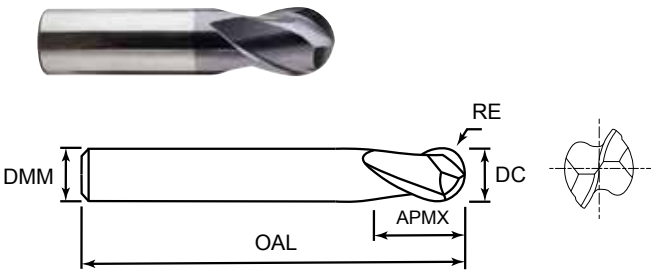
# SHORT LENGTH BALL NOSE



## Series No. 118120, 118320

▶ cutting conditions : p.103

Designed to machine tool steels, alloy steels,  
mould steels and other hardened materials.



| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGT<br>OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------|--------------------------|-------------------------|-----------------------|
| 1181200300                     | 1183200300                      | 3.0            | 1.5          | 6                        | 4.0                     | 50                    |
| 1181200400                     | 1183200400                      | 4.0            | 2.0          |                          | 5.0                     | 54                    |
| 1181200500                     | 1183200500                      | 5.0            | 2.5          |                          | 6.0                     |                       |
| 1181200600                     | 1183200600                      | 6.0            | 3.0          |                          | 7.0                     |                       |
| 1181200700                     | 1183200700                      | 7.0            | 3.5          | 8                        | 8.0                     | 58                    |
| 1181200800                     | 1183200800                      | 8.0            | 4.0          |                          | 9.0                     |                       |
| 1181200900                     | 1183200900                      | 9.0            | 4.5          | 10                       | 10.0                    | 66                    |
| 1181201000                     | 1183201000                      | 10.0           | 5.0          |                          | 11.0                    |                       |
| 1181201200                     | 1183201200                      | 12.0           | 6.0          | 12                       | 12.0                    | 73                    |
| 1181201400                     | 1183201400                      | 14.0           | 7.0          | 14                       | 14.0                    | 75                    |
| 1181201600                     | 1183201600                      | 16.0           | 8.0          | 16                       | 16.0                    | 82                    |
| 1181201800                     | 1183201800                      | 18.0           | 9.0          | 18                       | 18.0                    | 84                    |
| 1181202000                     | 1183202000                      | 20.0           | 10.0         | 20                       | 20.0                    | 92                    |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|--------|----------------------------------|
|                                    | RETOLL                | RETOLU |                                  |
| 0.00 / -0.03                       | -0.020                | +0.020 | h6                               |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    |       |       |       |       |       |      |    |       |       | ●     |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

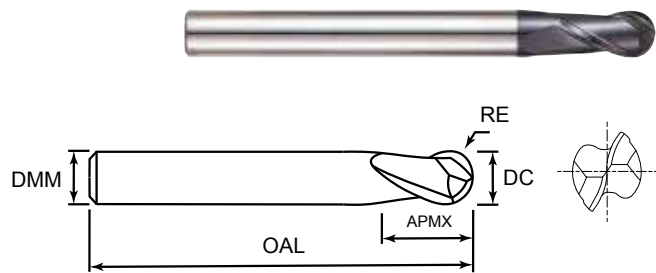
LONG LENGTH BALL NOSE



Series No. 112120, 112320

► cutting conditions : p.104

Designed to machine tool steels, alloy steels, mould steels and other hardened materials.



| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGT<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------|--------------------------|-------------------------|--------------------------|
| -                              | 1123200100                      | 1.0            | 0.5          | 4                        | 2.5                     | 50                       |
| -                              | 1123200120                      | 1.2            | 0.6          |                          | 3.0                     |                          |
| -                              | 1123200150                      | 1.5            | 0.75         |                          | 4.0                     |                          |
| 1121200200                     | 1123200200                      | 2.0            | 1.0          | 6                        | 5.0                     | 60                       |
| 1121200300                     | 1123200300                      | 3.0            | 1.5          |                          | 8.0                     |                          |
| 1121200400                     | 1123200400                      | 4.0            | 2.0          |                          | 8.0                     |                          |
| 1121200500                     | 1123200500                      | 5.0            | 2.5          |                          | 10.0                    |                          |
| 1121200600                     | 1123200600                      | 6.0            | 3.0          | 8                        | 12.0                    | 90                       |
| 1121200700                     | 1123200700                      | 7.0            | 3.5          |                          | 14.0                    |                          |
| 1121200800                     | 1123200800                      | 8.0            | 4.0          | 10                       | 14.0                    | 100                      |
| 1121200900                     | 1123200900                      | 9.0            | 4.5          |                          | 18.0                    |                          |
| 1121201000                     | 1123201000                      | 10.0           | 5.0          | 12                       | 18.0                    | 110                      |
| 1121201200                     | 1123201200                      | 12.0           | 6.0          |                          | 22.0                    |                          |
| 1121201400                     | 1123201400                      | 14.0           | 7.0          | 14                       | 26.0                    | 140                      |
| 1121201600                     | 1123201600                      | 16.0           | 8.0          | 16                       | 30.0                    |                          |
| 1121201800                     | 1123201800                      | 18.0           | 9.0          | 18                       | 34.0                    |                          |
| 1121202000                     | 1123202000                      | 20.0           | 10.0         | 20                       | 38.0                    | 160                      |
| 1121202500                     | 1123202500                      | 25.0           | 12.5         | 25                       | 50.0                    | 180                      |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|--------|----------------------------------|
|                                    | RETOLL                | RETOLU |                                  |
| 0.00 / -0.03                       | -0.020                | +0.020 | h6                               |

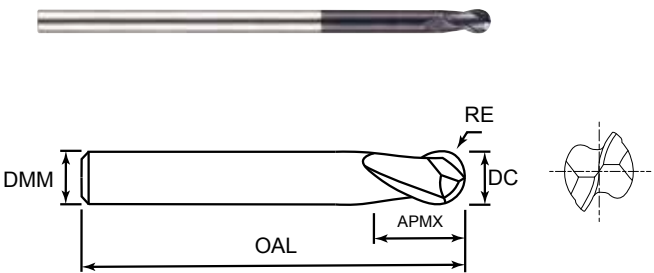
LONG REACH BALL NOSE



Series No. 114320

► cutting conditions : p.105

Designed to machine tool steels, alloy steels, mould steels and other hardened materials.



| EUROPA CODE<br>ORDCODE | DIAMETER<br>DC | RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGT<br>OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|------------------------|----------------|--------------|--------------------------|-------------------------|-----------------------|
| 1143200200             | 2.0            | 1.0          | 3                        | 6.0                     | 80                    |
| 1143200300             | 3.0            | 1.5          |                          | 8.0                     | 100                   |
| 1143200400             | 4.0            | 2.0          | 4                        | 8.0                     |                       |
| 1143200500             | 5.0            | 2.5          | 6                        | 10.0                    | 120                   |
| 1143200600             | 6.0            | 3.0          |                          | 10.0                    |                       |
| 1143200800             | 8.0            | 4.0          | 8                        | 14.0                    | 140                   |
| 1143201000             | 10.0           | 5.0          | 10                       | 18.0                    | 180                   |
| 1143201200             | 12.0           | 6.0          | 12                       | 22.0                    | 200                   |
| 1143201600             | 16.0           | 8.0          | 16                       | 30.0                    | 250                   |
| 1143202000             | 20.0           | 10.0         | 20                       | 38.0                    |                       |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|--------|----------------------------------|
|                                    | RETOLL                | RETOLU |                                  |
| 0.00 / -0.03                       | -0.020                | +0.020 | h6                               |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

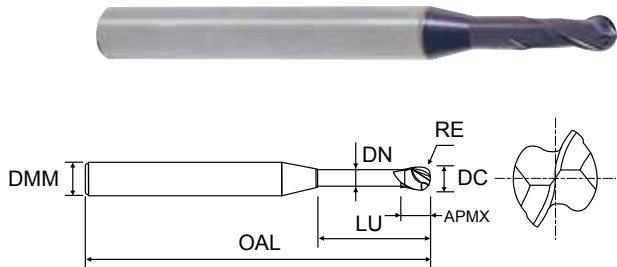
| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

# RIB PROCESSING BALL NOSE



## Series No. 143320

► cutting conditions : p.109



Designed to machine tool steels, alloy steels, mould steels and other hardened materials.

| EUROPA CODE<br>ORDCODE | DIAMETER<br>DC | RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | EFFECTIVE<br>LENGTH<br>LU | OVERALL<br>LENGTH<br>OAL | NECK<br>DIAMETER<br>DN |
|------------------------|----------------|--------------|--------------------------|--------------------------|---------------------------|--------------------------|------------------------|
| 1433200060             | 0.6            | 0.3          | 3                        | 0.9                      | 6                         | 35                       | 0.55                   |
| 1433200080             | 0.8            | 0.4          | 4                        | 1.2                      | 6                         | 45                       | 0.75                   |
| 1433200081             | 0.8            | 0.4          | 4                        | 1.2                      | 8                         | 45                       | 0.75                   |
| 1433200100             | 1.0            | 0.5          | 4                        | 1.5                      | 6                         | 45                       | 0.97                   |
| 1433200101             | 1.0            | 0.5          | 4                        | 1.5                      | 8                         | 45                       | 0.95                   |
| 1433200102             | 1.0            | 0.5          | 4                        | 1.5                      | 12                        | 45                       | 0.93                   |
| 1433200120             | 1.2            | 0.6          | 4                        | 1.8                      | 8                         | 45                       | 1.15                   |
| 1433200121             | 1.2            | 0.6          | 4                        | 1.8                      | 12                        | 45                       | 1.13                   |
| 1433200140             | 1.4            | 0.7          | 4                        | 2.1                      | 12                        | 45                       | 1.33                   |
| 1433200150             | 1.5            | 0.75         | 4                        | 2.3                      | 8                         | 45                       | 1.45                   |
| 1433200151             | 1.5            | 0.75         | 4                        | 2.3                      | 12                        | 50                       | 1.43                   |
| 1433200152             | 1.5            | 0.75         | 4                        | 2.3                      | 16                        | 50                       | 1.41                   |
| 1433200160             | 1.6            | 0.8          | 4                        | 2.4                      | 16                        | 50                       | 1.51                   |
| 1433200180             | 1.8            | 0.9          | 4                        | 2.7                      | 16                        | 50                       | 1.71                   |
| 1433200200             | 2.0            | 1.0          | 4                        | 3.0                      | 8                         | 45                       | 1.95                   |
| 1433200201             | 2.0            | 1.0          | 4                        | 3.0                      | 16                        | 50                       | 1.91                   |
| 1433200202             | 2.0            | 1.0          | 4                        | 3.0                      | 20                        | 55                       | 1.89                   |
| 1433200300             | 3.0            | 1.5          | 6                        | 4.5                      | 16                        | 55                       | 2.85                   |
| 1433200301             | 3.0            | 1.5          | 6                        | 4.5                      | 20                        | 60                       | 2.85                   |
| 1433200400             | 4.0            | 2.0          | 6                        | 6.0                      | 16                        | 60                       | 3.85                   |
| 1433200401             | 4.0            | 2.0          | 6                        | 6.0                      | 20                        | 65                       | 3.85                   |

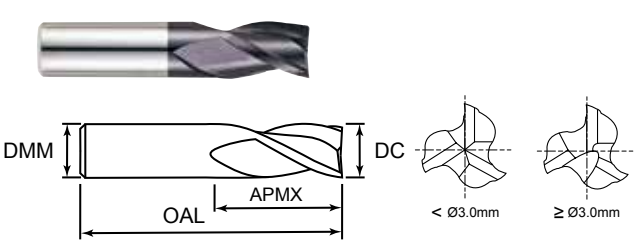
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|--------|----------------------------------|
|                                    | RETOLL                | RETOLU |                                  |
| 0.00 / -0.02                       | -0.010                | +0.010 | h6                               |

# MINIATURE 3-FLUTE



## Series No. 103120, 103320

► cutting conditions : p.110-111



The miniature end mill is universally adopted as the most cost effective system for small milling cutters and has the advantages of 2 flute and 4 flute end mills.

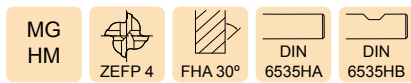
| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|-----------------------|-----------------------|
| -                              | 1033200100                      | 1.0            | 4                        | 2.0                   | 35                    |
| -                              | 1033200200                      | 2.0            |                          | 4.0                   |                       |
| 1031200300                     | 1033200300                      | 3.0            | 6                        | 5.0                   | 36                    |
| 1031200400                     | 1033200400                      | 4.0            |                          | 7.0                   | 38                    |
| 1031200500                     | 1033200500                      | 5.0            |                          | 8.0                   | 39                    |
| 1031200600                     | 1033200600                      | 6.0            |                          | 8.0                   |                       |
| 1031200800                     | 1033200800                      | 8.0            | 8                        | 11.0                  | 43                    |
| 1031201000                     | 1033201000                      | 10.0           | 10                       | 13.0                  | 50                    |
| 1031201200                     | 1033201200                      | 12.0           | 12                       | 15.0                  | 55                    |
| 1031201400                     | 1033201400                      | 14.0           | 14                       | 15.0                  | 58                    |
| 1031201600                     | 1033201600                      | 16.0           | 16                       | 18.0                  | 62                    |
| 1031201800                     | 1033201800                      | 18.0           | 18                       | 20.0                  | 70                    |
| 1031202000                     | 1033202000                      | 20.0           | 20                       | 22.0                  | 75                    |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|----------------------------------|
| 0.00 / -0.03                       | h6                               |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

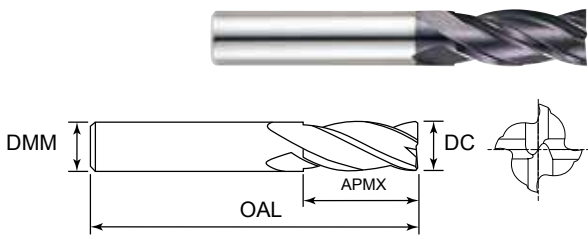
| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      | ○  |       |       |       |       |       |      |    |       |       | ●     |

SHORT LENGTH



Series No. 109120, 109320

► cutting conditions : p.112



Designed to machine tool steels, alloy steels, mould steels and other hardened materials. 4 flutes allow for better workpiece finishes.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|-----------------------|-----------------------|
| -                              | 1093200200                      | 2.0            | 4                        | 6.0                   | 40                    |
| -                              | 1093200250                      | 2.5            |                          | 8.0                   |                       |
| 1091200300                     | 1093200300                      | 3.0            | 6                        | 8.0                   | 45                    |
| 1091200350                     | 1093200350                      | 3.5            |                          | 10.0                  |                       |
| 1091200400                     | 1093200400                      | 4.0            |                          | 11.0                  |                       |
| 1091200450                     | 1093200450                      | 4.5            |                          | 11.0                  | 50                    |
| 1091200500                     | 1093200500                      | 5.0            |                          | 13.0                  |                       |
| 1091200550                     | 1093200550                      | 5.5            | 8                        | 13.0                  |                       |
| 1091200600                     | 1093200600                      | 6.0            |                          | 16.0                  | 60                    |
| 1091200650                     | 1093200650                      | 6.5            |                          | 16.0                  |                       |
| 1091200700                     | 1093200700                      | 7.0            |                          | 16.0                  |                       |
| 1091200750                     | 1093200750                      | 7.5            |                          | 19.0                  | 70                    |
| 1091200800                     | 1093200800                      | 8.0            | 10                       | 19.0                  |                       |
| 1091200850                     | 1093200850                      | 8.5            |                          | 19.0                  |                       |
| 1091200900                     | 1093200900                      | 9.0            |                          | 19.0                  |                       |
| 1091200950                     | 1093200950                      | 9.5            |                          | 19.0                  |                       |
| 1091201000                     | 1093201000                      | 10.0           |                          | 22.0                  |                       |

|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

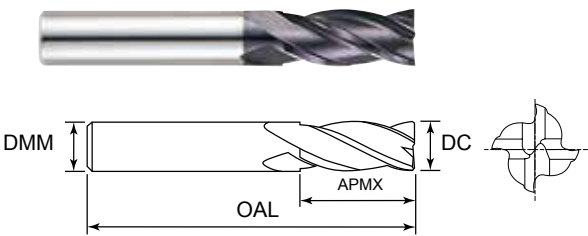
| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      | ○  |       |       |       |       |       |      |    |       |       |       | ● |

SHORT LENGTH



Series No. 109120, 109320

► cutting conditions : p.112



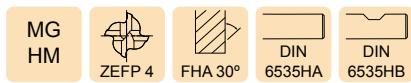
Designed to machine tool steels, alloy steels, mould steels and other hardened materials. 4 flutes allow for better workpiece finishes.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|-----------------------|-----------------------|
| 1091201050                     | 1093201050                      | 10.5           | 12                       | 22.0                  | 75                    |
| 1091201100                     | 1093201100                      | 11.0           |                          | 22.0                  |                       |
| 1091201150                     | 1093201150                      | 11.5           |                          | 22.0                  |                       |
| 1091201200                     | 1093201200                      | 12.0           |                          | 26.0                  |                       |
| 1091201300                     | 1093201300                      | 13.0           | 14                       | 26.0                  | 85                    |
| 1091201400                     | 1093201400                      | 14.0           |                          | 26.0                  |                       |
| 1091201500                     | 1093201500                      | 15.0           | 16                       | 26.0                  | 90                    |
| 1091201600                     | 1093201600                      | 16.0           |                          | 32.0                  |                       |
| 1091201700                     | 1093201700                      | 17.0           |                          | 32.0                  |                       |
| 1091201800                     | 1093201800                      | 18.0           | 18                       | 32.0                  | 100                   |
| 1091201900                     | 1093201900                      | 19.0           |                          | 32.0                  |                       |
| 1091202000                     | 1093202000                      | 20.0           | 20                       | 38.0                  | 105                   |
| 1091202200                     | 1093202200                      | 22.0           |                          | 38.0                  |                       |
| 1091202400                     | 1093202400                      | 24.0           | 25                       | 45.0                  | 120                   |
| 1091202500                     | 1093202500                      | 25.0           |                          | 45.0                  |                       |

|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

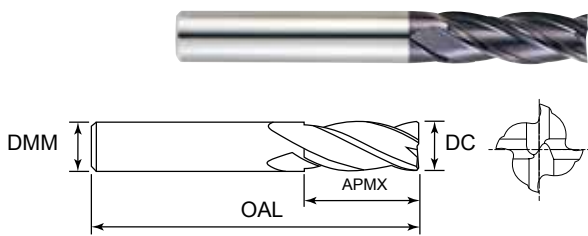
| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      | ○  |       |       |       |       |       |      |    |       |       |       | ● |

LONG LENGTH



Series No. 111120, 111320

▶ cutting conditions : p.113

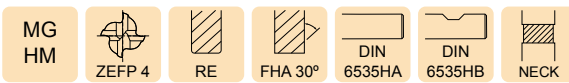


Designed to machine tool steels, alloy steels, mould steels and other hardened materials. 4 flutes allow for better workpiece finishes.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|-----------------------|-----------------------|
| -                              | 1113200200                      | 2.0            | 4                        | 8.0                   | 40                    |
| 1111200300                     | 1113200300                      | 3.0            | 6                        | 12.0                  | 50                    |
| 1111200400                     | 1113200400                      | 4.0            |                          | 15.0                  |                       |
| 1111200500                     | 1113200500                      | 5.0            |                          | 20.0                  |                       |
| 1111200600                     | 1113200600                      | 6.0            | 8                        | 20.0                  | 60                    |
| 1111200800                     | 1113200800                      | 8.0            |                          | 25.0                  |                       |
| 1111201000                     | 1113201000                      | 10.0           |                          | 30.0                  |                       |
| 1111201200                     | 1113201200                      | 12.0           | 10                       | 30.0                  | 90                    |
| 1111201400                     | 1113201400                      | 14.0           | 12                       | 40.0                  |                       |
| 1111201600                     | 1113201600                      | 16.0           |                          | 50.0                  |                       |
| 1111201800                     | 1113201800                      | 18.0           | 16                       | 50.0                  | 110                   |
| 1111202000                     | 1113202000                      | 20.0           |                          | 55.0                  |                       |
| 1111202500                     | 1113202500                      | 25.0           |                          | 75.0                  |                       |

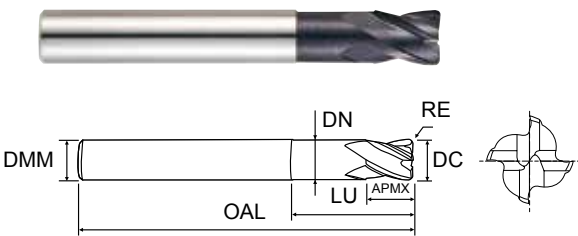
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|----------------------------------|
| 0.00 / -0.03                       | h6                               |

STUB CUT LENGTH CORNER RADIUS



Series No. 156120, 156320

▶ cutting conditions : p.115



Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Superior workpiece finishes, increased feed rates.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | CORNER<br>RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | EFFECTIVE<br>LENGTH<br>LU | OVERALL<br>LENGTH<br>OAL | NECK<br>DIAMETER<br>DN |
|--------------------------------|---------------------------------|----------------|------------------------|--------------------------|--------------------------|---------------------------|--------------------------|------------------------|
| 1561200200                     | 1563200200                      | 2.0            | 0.2                    | 6                        | 2.5                      | 5.0                       | 50                       | 1.9                    |
| 1561200250                     | 1563200250                      | 2.5            | 0.25                   |                          | 3.0                      | 6.0                       |                          | 2.4                    |
| 1561200300                     | 1563200300                      | 3.0            | 0.3                    |                          | 4.0                      | 7.0                       |                          | 2.8                    |
| 1561200350                     | 1563200350                      | 3.5            | 0.35                   |                          | 4.5                      | 8.0                       |                          | 3.2                    |
| 1561200400                     | 1563200400                      | 4.0            | 0.4                    |                          | 5.0                      | 9.0                       |                          | 3.7                    |
| 1561209001                     | 1563209001                      | 4.0            | 0.5                    |                          | 5.0                      | 9.0                       |                          | 3.7                    |
| 1561200500                     | 1563200500                      | 5.0            | 0.5                    |                          | 6.0                      | 12.0                      |                          | 4.6                    |
| 1561209002                     | 1563209002                      | 6.0            | 0.5                    | 8                        | 7.0                      | 14.0                      | 55                       | 5.6                    |
| 1561200600                     | 1563200600                      | 6.0            | 0.6                    |                          | 7.0                      | 14.0                      | 55                       | 5.6                    |
| 1561200800                     | 1563200800                      | 8.0            | 0.8                    |                          | 10.0                     | 18.0                      | 60                       | 7.4                    |
| 1561201000                     | 1563201000                      | 10.0           | 1.0                    | 10                       | 12.0                     | 25.0                      | 70                       | 9.4                    |
| 1561201200                     | 1563201200                      | 12.0           | 1.2                    | 12                       | 15.0                     | 30.0                      | 80                       | 11.4                   |
| 1561201600                     | 1563201600                      | 16.0           | 1.6                    | 16                       | 18.0                     | 35.0                      | 90                       | 15.4                   |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|----------------------------------|
| 0.00 / -0.03                       | h6                               |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ● Excellent | ○ Good | ○     | ●     | ●      |    |       |       |       |       |       |      |    |       |       |       | ● |

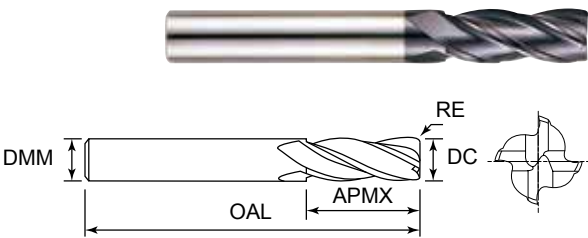
| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ● Excellent | ○ Good | ○     | ●     | ●      |    |       |       |       |       |       |      |    |       |       |       | ● |

LONG LENGTH CORNER RADIUS



Series No. 157120, 157320

► cutting conditions : p.114



Designed to machine tool steels, alloy steels, mould steels and other hardened materials.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | CORNER<br>RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|------------------------|--------------------------|--------------------------|--------------------------|
| 1571200300                     | 1573200300                      | 3.0            | 0.3                    | 6                        | 12.0                     | 50                       |
| 1571200400                     | 1573200400                      | 4.0            | 0.3                    | 6                        | 15.0                     | 50                       |
| 1571209012                     | 1573209012                      | 4.0            | 0.5                    |                          | 15.0                     |                          |
| 1571200500                     | 1573200500                      | 5.0            | 0.3                    | 6                        | 20.0                     | 60                       |
| 1571209013                     | 1573209013                      | 5.0            | 0.5                    |                          | 20.0                     |                          |
| 1571209011                     | 1573209011                      | 6.0            | 0.3                    | 6                        | 20.0                     | 60                       |
| 1571200600                     | 1573200600                      | 6.0            | 0.5                    |                          | 20.0                     |                          |
| 1571209001                     | 1573209001                      | 6.0            | 1.0                    |                          | 20.0                     |                          |
| 1571200800                     | 1573200800                      | 8.0            | 0.5                    | 8                        | 25.0                     | 70                       |
| 1571209002                     | 1573209002                      | 8.0            | 1.0                    |                          | 25.0                     |                          |
| 1571209003                     | 1573209003                      | 8.0            | 1.5                    |                          | 25.0                     |                          |
| 1571209004                     | 1573209004                      | 8.0            | 2.0                    | 10                       | 25.0                     | 90                       |
| 1571201000                     | 1573201000                      | 10.0           | 0.5                    |                          | 30.0                     |                          |
| 1571209005                     | 1573209005                      | 10.0           | 1.0                    |                          | 30.0                     |                          |
| 1571209006                     | 1573209006                      | 10.0           | 1.5                    | 12                       | 30.0                     | 110                      |
| 1571209007                     | 1573209007                      | 10.0           | 2.0                    |                          | 30.0                     |                          |
| 1571201200                     | 1573201200                      | 12.0           | 0.5                    |                          | 30.0                     |                          |
| 1571209008                     | 1573209008                      | 12.0           | 1.0                    | 16                       | 30.0                     | 110                      |
| 1571209009                     | 1573209009                      | 12.0           | 1.5                    |                          | 50.0                     |                          |
| 1571209010                     | 1573209010                      | 12.0           | 2.0                    |                          | 50.0                     |                          |
| 1571201600                     | 1573201600                      | 16.0           | 0.5                    | 16                       | 50.0                     | 110                      |
| 1571209020                     | 1573209020                      | 16.0           | 1.0                    |                          | 50.0                     |                          |
| 1571209021                     | 1573209021                      | 16.0           | 2.0                    |                          | 50.0                     |                          |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|----------------------------------|
| 0.00 / -0.03                       | h6                               |

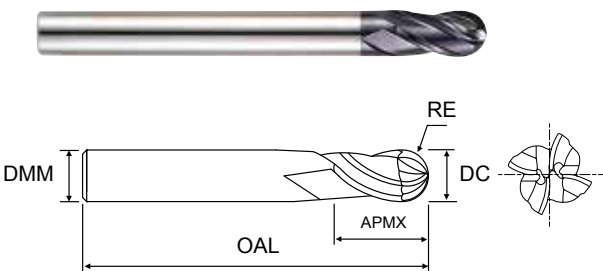
| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ● Excellent | ○ Good | ○     | ●     | ●      | ○  | ○     | ○     |       |       |       |      |    |       |       |       | ● |

LONG LENGTH BALL NOSE



Series No. 115120, 115320

► cutting conditions : p.116



Designed to machine tool steels, alloy steels, mould steels and other hardened materials.  
Can be used with copy milling machines.

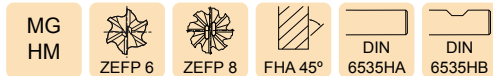
| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------|--------------------------|--------------------------|--------------------------|
| -                              | 1153200100                      | 1.0            | 0.5          | 4                        | 2.5                      | 50                       |
| -                              | 1153200150                      | 1.5            | 0.75         |                          | 4                        |                          |
| 1151200200                     | 1153200200                      | 2.0            | 1.0          | 6                        | 5                        |                          |
| 1151200300                     | 1153200300                      | 3.0            | 1.5          |                          | 8                        | 60                       |
| 1151200400                     | 1153200400                      | 4.0            | 2.0          |                          | 8                        | 70                       |
| 1151200500                     | 1153200500                      | 5.0            | 2.5          |                          | 10                       | 80                       |
| 1151200600                     | 1153200600                      | 6.0            | 3.0          | 8                        | 12                       | 90                       |
| 1151200700                     | 1153200700                      | 7.0            | 3.5          |                          | 14                       |                          |
| 1151200800                     | 1153200800                      | 8.0            | 4.0          |                          | 14                       | 100                      |
| 1151200900                     | 1153200900                      | 9.0            | 4.5          | 10                       | 18                       |                          |
| 1151201000                     | 1153201000                      | 10.0           | 5.0          |                          | 18                       | 110                      |
| 1151201200                     | 1153201200                      | 12.0           | 6.0          | 12                       | 22                       |                          |
| 1151201400                     | 1153201400                      | 14.0           | 7.0          | 14                       | 26                       | 140                      |
| 1151201600                     | 1153201600                      | 16.0           | 8.0          | 16                       | 30                       |                          |
| 1151201800                     | 1153201800                      | 18.0           | 9.0          | 18                       | 34                       | 160                      |
| 1151202000                     | 1153202000                      | 20.0           | 10.0         | 20                       | 38                       |                          |
| 1151202500                     | 1153202500                      | 25.0           | 12.5         | 25                       | 50                       | 180                      |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|--------|----------------------------------|
|                                    | RETOLL                | RETOLU |                                  |
| 0.00 / -0.03                       | -0.010                | +0.010 | h6                               |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     |       | H |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|---|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |   |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |   |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       |       | ● |



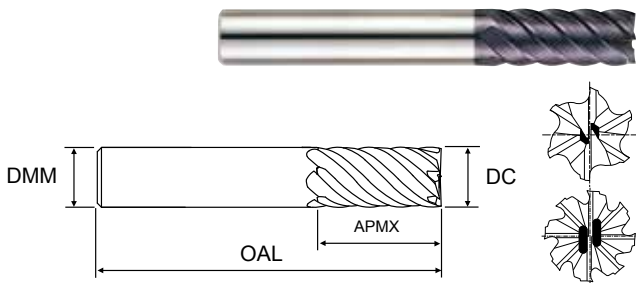
LONG LENGTH 45° HELIX



Series No. 149120, 149320

► cutting conditions : p.118

Designed to machine tool steels, alloy steels, mould steels and other hardened materials.  
Used for high speed, high feed finish milling.



| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL | NO. OF<br>FLUTES<br>ZEFP |
|--------------------------------|---------------------------------|----------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1491200600                     | 1493200600                      | 6.0            | 6                        | 13.0                     | 57                       | 6                        |
| 1491200700                     | 1493200700                      | 7.0            | 8                        | 16.0                     | 63                       | 6                        |
| 1491200800                     | 1493200800                      | 8.0            |                          | 19.0                     |                          | 6                        |
| 1491200900                     | 1493200900                      | 9.0            | 10                       | 19.0                     | 72                       | 6                        |
| 1491201000                     | 1493201000                      | 10.0           |                          | 22.0                     |                          | 6                        |
| 1491201200                     | 1493201200                      | 12.0           | 12                       | 26.0                     | 83                       | 6                        |
| 1491201400                     | 1493201400                      | 14.0           | 14                       | 26.0                     |                          | 6                        |
| 1491201600                     | 1493201600                      | 16.0           | 16                       | 32.0                     | 92                       | 6                        |
| 1491201800                     | 1493201800                      | 18.0           | 18                       | 32.0                     |                          | 8                        |
| 1491202000                     | 1493202000                      | 20.0           | 20                       | 38.0                     | 104                      | 8                        |
| 1491202500                     | 1493202500                      | 25.0           | 25                       | 44.0                     |                          | 8                        |

|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

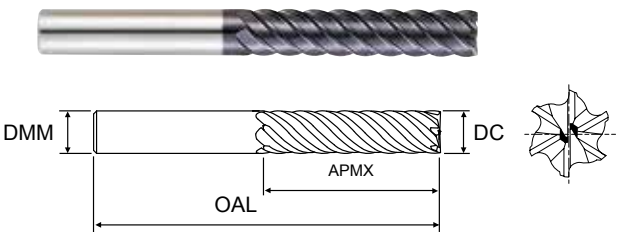
EXTRA LONG LENGTH 45° HELIX



Series No. 150120, 150320

► cutting conditions : p.117

Designed to machine tool steels, alloy steels, mould steels and other hardened materials.  
Used for high speed, high feed finish milling.



| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|--------------------------|--------------------------|--------------------------|
| 1501200600                     | 1503200600                      | 6.0            | 6                        | 26.0                     | 70                       |
| 1501200800                     | 1503200800                      | 8.0            | 8                        | 36.0                     | 90                       |
| 1501201000                     | 1503201000                      | 10.0           | 10                       | 46.0                     | 100                      |
| 1501201200                     | 1503201200                      | 12.0           | 12                       | 56.0                     | 110                      |
| 1501201600                     | 1503201600                      | 16.0           | 16                       | 66.0                     | 130                      |
| 1501202000                     | 1503202000                      | 20.0           | 20                       | 76.0                     | 140                      |
| 1501202500                     | 1503202500                      | 25.0           | 25                       | 92.0                     | 180                      |

|                                    |                                  |
|------------------------------------|----------------------------------|
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
| 0.00 / -0.03                       | h6                               |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

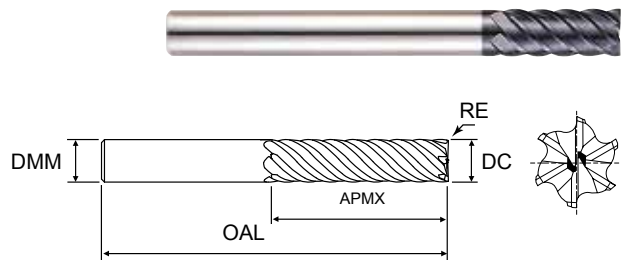


LONG LENGTH 45° HELIX  
CORNER RADIUS



Series No. 158120, 158320

▶ cutting conditions : p.119

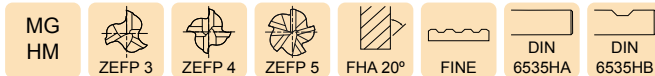


Designed to machine tool steels, alloy steels,  
mould steels and other hardened materials.  
Used for high speed, high feed finish milling.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | CORNER<br>RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL LENGTH<br>OAL |
|--------------------------------|---------------------------------|----------------|------------------------|--------------------------|--------------------------|-----------------------|
| 1581200600                     | 1583200600                      | 6.0            | 0.5                    | 6                        | 13.0                     | 70                    |
| 1581200800                     | 1583200800                      | 8.0            | 0.5                    | 8                        | 19.0                     | 90                    |
| 1581201000                     | 1583201000                      | 10.0           | 0.5                    | 10                       | 22.0                     | 100                   |
| 1581209001                     | 1583209001                      | 10.0           | 1.0                    |                          | 22.0                     |                       |
| 1581201200                     | 1583201200                      | 12.0           | 0.5                    | 12                       | 26.0                     | 110                   |
| 1581209002                     | 1583209002                      | 12.0           | 1.0                    |                          | 26.0                     |                       |
| 1581201600                     | 1583201600                      | 16.0           | 1.0                    | 16                       | 32.0                     | 130                   |
| 1581209003                     | 1583209003                      | 16.0           | 1.5                    |                          | 32.0                     |                       |
| 1581202000                     | 1583202000                      | 20.0           | 1.0                    | 20                       | 38.0                     | 140                   |
| 1581209004                     | 1583209004                      | 20.0           | 1.5                    |                          | 38.0                     |                       |
| 1581209005                     | 1583209005                      | 20.0           | 2.0                    |                          | 38.0                     |                       |

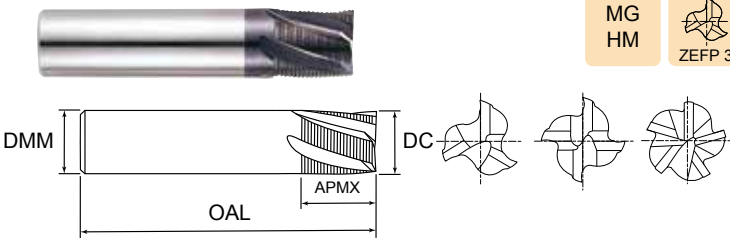
| Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|----------------------------------|
| 0.00 / -0.03                       | h6                               |

SHORT LENGTH 20° HELIX ROUGHING



Series No. 148120, 148320

▶ cutting conditions : p.120



Designed to machine tool steels, alloy steels,  
mould steels and other hardened materials.  
Used for high speed, high feed milling.

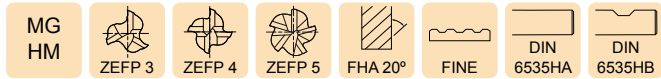
| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL | NO. OF<br>FLUTES<br>ZEFP |
|--------------------------------|---------------------------------|----------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1481200600                     | 1483200600                      | 6.0            | 6                        | 7.0                      | 54                       | 3                        |
| 1481200700                     | 1483200700                      | 7.0            | 8                        | 8.0                      | 58                       | 3                        |
| 1481200800                     | 1483200800                      | 8.0            |                          | 9.0                      |                          | 3                        |
| 1481200900                     | 1483200900                      | 9.0            | 10                       | 13.0                     | 66                       | 4                        |
| 1481201000                     | 1483201000                      | 10.0           |                          | 14.0                     |                          | 4                        |
| 1481201200                     | 1483201200                      | 12.0           | 12                       | 16.0                     | 73                       | 4                        |
| 1481201400                     | 1483201400                      | 14.0           | 14                       | 18.0                     | 75                       | 4                        |
| 1481201600                     | 1483201600                      | 16.0           | 16                       | 22.0                     | 82                       | 4                        |
| 1481201800                     | 1483201800                      | 18.0           | 18                       | 24.0                     | 84                       | 4                        |
| 1481202000                     | 1483202000                      | 20.0           | 20                       | 26.0                     | 92                       | 4                        |
| 1481202500                     | 1483202500                      | 25.0           | 25                       | 25.0                     | 110                      | 5                        |

| Mill Dia.<br>DC | Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
|-----------------|------------------------------------|----------------------------------|
| 6.0 - 10.0      | 0.00 / -0.058                      | h6                               |
| 12.0 - 18.0     | 0.00 / -0.070                      |                                  |
| 20.0, 25.0      | 0.00 / -0.084                      |                                  |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

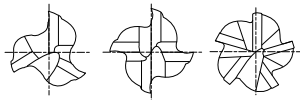
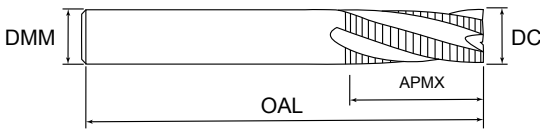
| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    |       | S     | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      | ○  | ○     | ○     |       |       |       |      |    |       |       | ●     |

LONG LENGTH 20° HELIX ROUGHING



Series No. 147120, 147320

▶ cutting conditions : p.120

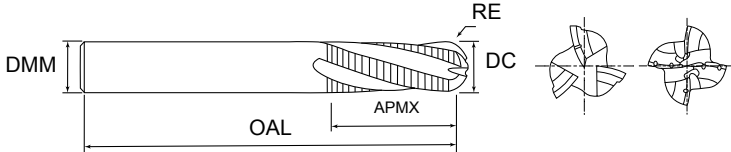


Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Used for high speed, high feed milling.

| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL | NO. OF<br>FLUTES<br>ZEFP |
|--------------------------------|---------------------------------|----------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1471200600                     | 1473200600                      | 6.0            | 6                        | 16.0                     | 57                       | 3                        |
| 1471200700                     | 1473200700                      | 7.0            | 8                        | 16.0                     | 63                       | 3                        |
| 1471200800                     | 1473200800                      | 8.0            |                          | 16.0                     |                          | 3                        |
| 1471200900                     | 1473200900                      | 9.0            | 10                       | 19.0                     | 72                       | 4                        |
| 1471201000                     | 1473201000                      | 10.0           |                          | 22.0                     |                          | 4                        |
| 1471201200                     | 1473201200                      | 12.0           | 12                       | 26.0                     | 83                       | 4                        |
| 1471201400                     | 1473201400                      | 14.0           | 14                       | 26.0                     |                          | 4                        |
| 1471201600                     | 1473201600                      | 16.0           | 16                       | 32.0                     | 92                       | 4                        |
| 1471201800                     | 1473201800                      | 18.0           | 18                       | 32.0                     |                          | 4                        |
| 1471202000                     | 1473202000                      | 20.0           | 20                       | 38.0                     | 104                      | 4                        |
| 1471202500                     | 1473202500                      | 25.0           | 25                       | 45.0                     | 121                      | 5                        |

| Mill Dia.<br>DC | Mill Dia.<br>Tolerance<br>TCDC(mm) | Shank Dia.<br>Tolerance<br>TCDMM |
|-----------------|------------------------------------|----------------------------------|
| 6.0 - 10.0      | 0.00 / -0.058                      | h6                               |
| 12.0 - 18.0     | 0.00 / -0.070                      |                                  |
| 20.0, 25.0      | 0.00 / -0.084                      |                                  |

LONG LENGTH BALL NOSE ROUGHING



Series No. 145120, 145320

▶ cutting conditions : p.121

Designed to machine tool steels, alloy steels, mould steels and other hardened materials. Used for high speed, high feed milling.

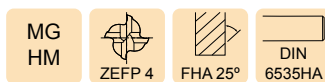
| EUROPA CODE<br>ORDCODE<br>FLAT | EUROPA CODE<br>ORDCODE<br>PLAIN | DIAMETER<br>DC | RADIUS<br>RE | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | OVERALL<br>LENGTH<br>OAL | NO. OF<br>FLUTES<br>ZEFP |
|--------------------------------|---------------------------------|----------------|--------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1451200600                     | 1453200600                      | 6.0            | 3.0          | 6                        | 16.0                     | 57                       | 3                        |
| 1451200800                     | 1453200800                      | 8.0            | 4.0          | 8                        | 16.0                     | 63                       | 3                        |
| 1451201000                     | 1453201000                      | 10.0           | 5.0          | 10                       | 22.0                     | 72                       | 4                        |
| 1451201200                     | 1453201200                      | 12.0           | 6.0          | 12                       | 26.0                     | 83                       | 4                        |
| 1451201400                     | 1453201400                      | 14.0           | 7.0          | 14                       | 26.0                     |                          | 4                        |
| 1451201600                     | 1453201600                      | 16.0           | 8.0          | 16                       | 32.0                     | 92                       | 4                        |
| 1451201800                     | 1453201800                      | 18.0           | 9.0          | 18                       | 32.0                     |                          | 4                        |
| 1451202000                     | 1453202000                      | 20.0           | 10.0         | 20                       | 38.0                     | 104                      | 4                        |

| Mill Dia.<br>DC | Mill Dia.<br>Tolerance<br>TCDC(mm) | Radius Tolerance (mm) |        | Shank Dia.<br>Tolerance<br>TCDMM |
|-----------------|------------------------------------|-----------------------|--------|----------------------------------|
|                 |                                    | RETOLL                | RETOLU |                                  |
| 6.0 - 10.0      | 0.00 / -0.058                      | -0.02                 | +0.02  | h6                               |
| 12.0 - 18.0     | 0.00 / -0.070                      |                       |        |                                  |
| 20.0            | 0.00 / -0.084                      |                       |        |                                  |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      | ○  | ○     | ○     |       |       |       |      |    |       |       | ●     |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

# TAPER RIB PROCESSING



## Series No. 120320

► cutting conditions : p.122

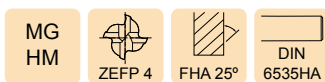
Designed to machine tool steels, alloy steels, mould steels and other hardened materials.

| EUROPA CODE<br>ORDCODE | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | TAPER<br>$\alpha$ | OVERALL<br>LENGTH<br>OAL |
|------------------------|----------------|--------------------------|--------------------------|-------------------|--------------------------|
| 1203200100             | 1.0            | 4                        | 8.0                      | 30'               | 45                       |
| 1203200101             | 1.0            | 4                        | 12.0                     | 30'               | 45                       |
| 1203200102             | 1.0            | 4                        | 8.0                      | 1°                | 45                       |
| 1203200103             | 1.0            | 4                        | 12.0                     | 1°                | 45                       |
| 1203200104             | 1.0            | 4                        | 8.0                      | 1° 30'            | 45                       |
| 1203200105             | 1.0            | 4                        | 12.0                     | 1° 30'            | 45                       |
| 1203200106             | 1.0            | 4                        | 8.0                      | 2°                | 45                       |
| 1203200107             | 1.0            | 4                        | 12.0                     | 2°                | 45                       |
| 1203200120             | 1.2            | 4                        | 8.0                      | 30'               | 45                       |
| 1203200121             | 1.2            | 4                        | 12.0                     | 30'               | 45                       |
| 1203200122             | 1.2            | 4                        | 8.0                      | 1°                | 45                       |
| 1203200123             | 1.2            | 4                        | 12.0                     | 1°                | 45                       |
| 1203200124             | 1.2            | 4                        | 8.0                      | 1° 30'            | 45                       |
| 1203200125             | 1.2            | 4                        | 12.0                     | 1° 30'            | 45                       |
| 1203200126             | 1.2            | 4                        | 8.0                      | 2°                | 45                       |
| 1203200127             | 1.2            | 4                        | 12.0                     | 2°                | 45                       |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | $\alpha$<br>Tolerance | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|----------------------------------|
| 0.00 / -0.015                      | ±5'                   | 0.00 / -0.008                    |

| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

# TAPER RIB PROCESSING



## Series No. 120320

► cutting conditions : p.122

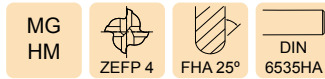
Designed to machine tool steels, alloy steels, mould steels and other hardened materials.

| EUROPA CODE<br>ORDCODE | DIAMETER<br>DC | SHANK<br>DIAMETER<br>DMM | LENGTH<br>OF CUT<br>APMX | TAPER<br>$\alpha$ | OVERALL<br>LENGTH<br>OAL |
|------------------------|----------------|--------------------------|--------------------------|-------------------|--------------------------|
| 1203200150             | 1.5            | 4                        | 8.0                      | 30'               | 45                       |
| 1203209001             | 1.5            | 4                        | 12.0                     | 30'               | 45                       |
| 1203209002             | 1.5            | 4                        | 16.0                     | 30'               | 50                       |
| 1203209003             | 1.5            | 4                        | 8.0                      | 1°                | 45                       |
| 1203209004             | 1.5            | 4                        | 12.0                     | 1°                | 45                       |
| 1203209005             | 1.5            | 4                        | 16.0                     | 1°                | 50                       |
| 1203209006             | 1.5            | 4                        | 8.0                      | 1° 30'            | 45                       |
| 1203209007             | 1.5            | 4                        | 12.0                     | 1° 30'            | 45                       |
| 1203209008             | 1.5            | 4                        | 16.0                     | 1° 30'            | 50                       |
| 1203209009             | 1.5            | 4                        | 8.0                      | 2°                | 45                       |
| 1203209010             | 1.5            | 4                        | 12.0                     | 2°                | 45                       |
| 1203209011             | 1.5            | 4                        | 16.0                     | 2°                | 50                       |
| 1203200200             | 2.0            | 4                        | 12.0                     | 30'               | 45                       |
| 1203200201             | 2.0            | 4                        | 16.0                     | 30'               | 50                       |
| 1203200202             | 2.0            | 4                        | 12.0                     | 1°                | 45                       |
| 1203200203             | 2.0            | 4                        | 16.0                     | 1°                | 50                       |
| 1203200204             | 2.0            | 4                        | 12.0                     | 1° 30'            | 45                       |
| 1203200205             | 2.0            | 4                        | 16.0                     | 1° 30'            | 50                       |
| 1203200206             | 2.0            | 4                        | 12.0                     | 2°                | 45                       |
| 1203200207             | 2.0            | 4                        | 16.0                     | 2°                | 50                       |

| Mill Dia.<br>Tolerance<br>TCDC(mm) | $\alpha$<br>Tolerance | Shank Dia.<br>Tolerance<br>TCDMM |
|------------------------------------|-----------------------|----------------------------------|
| 0.00 / -0.015                      | ±5'                   | 0.00 / -0.008                    |

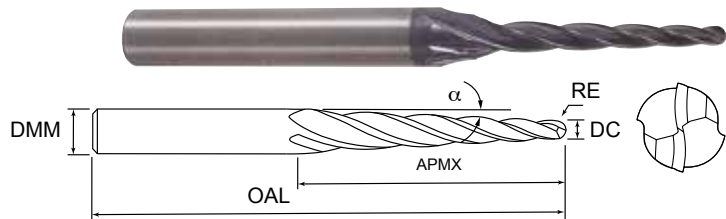
| ISO            | P         |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|----------------|-----------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI            | 1-5       | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG            | 11-12     | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ●<br>Excellent | ○<br>Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

# TAPER RIB PROCESSING BALL NOSE



## Series No. 130320

► cutting conditions : p.123



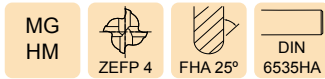
Designed to machine tool steels, alloy steels, mould steels and other hardened materials.

| EUROPA CODE ORDCODE | DIAMETER DC | RADIUS RE | SHANK DIAMETER DMM | LENGTH OF CUT APMX | TAPER α | OVERALL LENGTH OAL |
|---------------------|-------------|-----------|--------------------|--------------------|---------|--------------------|
| 1303200100          | 1.0         | 0.5       | 4                  | 8.0                | 30'     | 45                 |
| 1303200101          | 1.0         | 0.5       | 4                  | 12.0               | 30'     | 45                 |
| 1303200102          | 1.0         | 0.5       | 4                  | 8.0                | 1°      | 45                 |
| 1303200103          | 1.0         | 0.5       | 4                  | 12.0               | 1°      | 45                 |
| 1303200104          | 1.0         | 0.5       | 4                  | 8.0                | 1° 30'  | 45                 |
| 1303200105          | 1.0         | 0.5       | 4                  | 12.0               | 1° 30'  | 45                 |
| 1303200106          | 1.0         | 0.5       | 4                  | 8.0                | 2°      | 45                 |
| 1303200107          | 1.0         | 0.5       | 4                  | 12.0               | 2°      | 45                 |
| 1303200120          | 1.2         | 0.6       | 4                  | 8.0                | 30'     | 45                 |
| 1303200121          | 1.2         | 0.6       | 4                  | 12.0               | 30'     | 45                 |
| 1303200122          | 1.2         | 0.6       | 4                  | 8.0                | 1°      | 45                 |
| 1303200123          | 1.2         | 0.6       | 4                  | 12.0               | 1°      | 45                 |
| 1303200124          | 1.2         | 0.6       | 4                  | 8.0                | 1° 30'  | 45                 |
| 1303200125          | 1.2         | 0.6       | 4                  | 12.0               | 1° 30'  | 45                 |
| 1303200126          | 1.2         | 0.6       | 4                  | 8.0                | 2°      | 45                 |
| 1303200127          | 1.2         | 0.6       | 4                  | 12.0               | 2°      | 45                 |
| 1303200150          | 1.5         | 0.75      | 4                  | 8.0                | 30'     | 45                 |
| 1303209001          | 1.5         | 0.75      | 4                  | 12.0               | 30'     | 45                 |
| 1303209002          | 1.5         | 0.75      | 4                  | 16.0               | 30'     | 50                 |
| 1303209003          | 1.5         | 0.75      | 4                  | 8.0                | 1°      | 45                 |

| Mill Dia. Tolerance TCDC(mm) | α Tolerance | Radius Tolerance (mm) |        | Shank Dia. Tolerance TCDMM |
|------------------------------|-------------|-----------------------|--------|----------------------------|
|                              |             | RETOLL                | RETOLU |                            |
| 0.00 / -0.015                | ±5'         | -0.01                 | +0.01  | 0.00 / -0.008              |

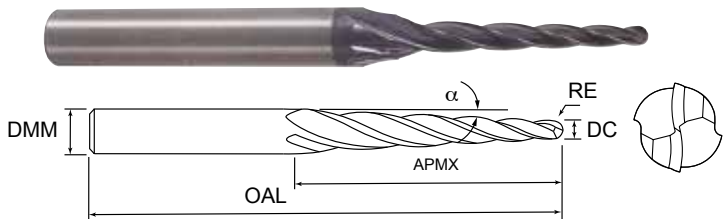
| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |

# TAPER RIB PROCESSING BALL NOSE



## Series No. 130320

► cutting conditions : p.123



Designed to machine tool steels, alloy steels, mould steels and other hardened materials.

| EUROPA CODE ORDCODE | DIAMETER DC | RADIUS RE | SHANK DIAMETER DMM | LENGTH OF CUT APMX | TAPER α | OVERALL LENGTH OAL |
|---------------------|-------------|-----------|--------------------|--------------------|---------|--------------------|
| 1303209004          | 1.5         | 0.75      | 4                  | 12.0               | 1°      | 45                 |
| 1303209005          | 1.5         | 0.75      | 4                  | 16.0               | 1°      | 50                 |
| 1303209006          | 1.5         | 0.75      | 4                  | 8.0                | 1° 30'  | 45                 |
| 1303209007          | 1.5         | 0.75      | 4                  | 12.0               | 1° 30'  | 45                 |
| 1303209008          | 1.5         | 0.75      | 4                  | 16.0               | 1° 30'  | 50                 |
| 1303209009          | 1.5         | 0.75      | 4                  | 8.0                | 2°      | 45                 |
| 1303209010          | 1.5         | 0.75      | 4                  | 12.0               | 2°      | 45                 |
| 1303209011          | 1.5         | 0.75      | 4                  | 16.0               | 2°      | 50                 |
| 1303200200          | 2.0         | 1.0       | 4                  | 12.0               | 30'     | 45                 |
| 1303200201          | 2.0         | 1.0       | 4                  | 16.0               | 30'     | 50                 |
| 1303200202          | 2.0         | 1.0       | 4                  | 12.0               | 1°      | 45                 |
| 1303200203          | 2.0         | 1.0       | 4                  | 16.0               | 1°      | 50                 |
| 1303200204          | 2.0         | 1.0       | 4                  | 12.0               | 1° 30'  | 45                 |
| 1303200205          | 2.0         | 1.0       | 4                  | 16.0               | 1° 30'  | 50                 |
| 1303200206          | 2.0         | 1.0       | 4                  | 12.0               | 2°      | 45                 |
| 1303200207          | 2.0         | 1.0       | 4                  | 16.0               | 2°      | 50                 |

| Mill Dia. Tolerance TCDC(mm) | α Tolerance | Radius Tolerance (mm) |        | Shank Dia. Tolerance TCDMM |
|------------------------------|-------------|-----------------------|--------|----------------------------|
|                              |             | RETOLL                | RETOLU |                            |
| 0.00 / -0.015                | ±5'         | -0.01                 | +0.01  | 0.00 / -0.008              |

| ISO         | P      |       |       | M      |    | K     |       | N     |       |       |      |    | S     |       | H     |
|-------------|--------|-------|-------|--------|----|-------|-------|-------|-------|-------|------|----|-------|-------|-------|
| VDI         | 1-5    | 6-9   | 10-11 | 12, 13 | 14 | 15-16 | 17-20 | 21-25 | 26-28 | 29.1  | 29.2 | 30 | 31-35 | 36-37 | 38-39 |
| EMG         | 11-12  | 13-14 | 15    | 21-22  | 23 | 31-32 | 33-34 | 71-74 | 61-64 | 81-82 | 83   | 84 | 51-53 | 41-43 | 16    |
| ● Excellent | ○ Good | ○     | ●     | ●      |    | ○     | ○     |       |       |       |      |    |       |       | ●     |



# **PULSAR**

## **CUTTING DATA**



# CUTTING DATA



152320, 153320 (2 Flute Sphere)

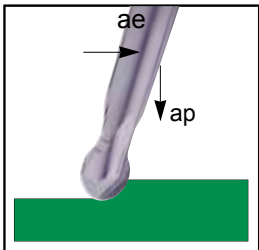


| VDI MATERIAL GROUP |       | HRc   | NORMAL SPEED           | Size (mm) |       |       |       |       |       |       |      |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|------|
|                    |       |       |                        | 3.0       | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0 |
| P                  | 6-11  | 30-40 | v <sub>c</sub> (m/min) | 310       | 315   | 315   | 300   | 300   | 315   | 300   | 275  |
|                    |       |       | n                      | 33000     | 25000 | 20000 | 16000 | 12000 | 10000 | 8000  | 5500 |
|                    |       |       | f <sub>z</sub>         | 0.039     | 0.044 | 0.05  | 0.056 | 0.067 | 0.07  | 0.081 | 0.1  |
|                    |       |       | f (mm/min)             | 2600      | 2200  | 2000  | 1800  | 1600  | 1400  | 1300  | 1100 |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 330       | 325   | 330   | 320   | 325   | 330   | 340   | 300  |
|                    |       |       | n                      | 35000     | 26000 | 21000 | 17000 | 13000 | 10500 | 9000  | 6000 |
|                    |       |       | f <sub>z</sub>         | 0.04      | 0.044 | 0.05  | 0.056 | 0.065 | 0.069 | 0.078 | 0.1  |
|                    |       |       | f (mm/min)             | 2800      | 2300  | 2100  | 1900  | 1700  | 1450  | 1400  | 1200 |
| H                  | 38-39 | 45-65 | v <sub>c</sub> (m/min) | 115       | 115   | 110   | 115   | 115   | 110   | 115   | 100  |
|                    |       |       | n                      | 12000     | 9000  | 7000  | 6000  | 4500  | 3500  | 3000  | 2000 |
|                    |       |       | f <sub>z</sub>         | 0.038     | 0.044 | 0.05  | 0.054 | 0.061 | 0.071 | 0.075 | 0.1  |
|                    |       |       | f (mm/min)             | 900       | 800   | 700   | 650   | 550   | 500   | 450   | 400  |

| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED             | Size (mm) |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 3.0       | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  |
| P                  | 6-11  | 30-40 | v <sub>c</sub> (m/min) | 415       | 415   | 425   | 415   | 425   | 410   | 415   | 400   |
|                    |       |       | n                      | 44000     | 33000 | 27000 | 22000 | 17000 | 13000 | 11000 | 8000  |
|                    |       |       | f <sub>z</sub>         | 0.04      | 0.045 | 0.048 | 0.055 | 0.062 | 0.073 | 0.082 | 0.094 |
|                    |       |       | f (mm/min)             | 3500      | 3000  | 2600  | 2400  | 2100  | 1900  | 1800  | 1500  |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 445       | 440   | 440   | 435   | 450   | 440   | 450   | 450   |
|                    |       |       | n                      | 47000     | 35000 | 28000 | 23000 | 18000 | 14000 | 12000 | 9000  |
|                    |       |       | f <sub>z</sub>         | 0.039     | 0.046 | 0.05  | 0.057 | 0.064 | 0.071 | 0.075 | 0.089 |
|                    |       |       | f (mm/min)             | 3700      | 3200  | 2800  | 2600  | 2300  | 2000  | 1800  | 1600  |
| H                  | 38-39 | 45-65 | v <sub>c</sub> (m/min) | 160       | 165   | 155   | 150   | 150   | 155   | 150   | 165   |
|                    |       |       | n                      | 17000     | 13000 | 10000 | 8000  | 6000  | 5000  | 4000  | 3300  |
|                    |       |       | f <sub>z</sub>         | 0.041     | 0.046 | 0.055 | 0.059 | 0.071 | 0.075 | 0.088 | 0.091 |
|                    |       |       | f (mm/min)             | 1400      | 1200  | 1100  | 950   | 850   | 750   | 700   | 600   |

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

► a<sub>p</sub> = 0.05 x DC  
► a<sub>e</sub> = 0.02 x DC



All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



154320 (4 Flute Sphere)

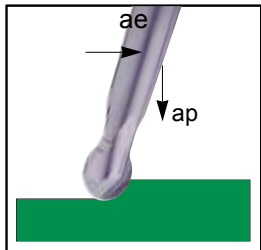


| VDI MATERIAL GROUP |       | HRc   | NORMAL SPEED           | Size (mm) |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 3.0       | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  |
| P                  | 6-11  | 30-40 | v <sub>c</sub> (m/min) | 310       | 315   | 315   | 300   | 300   | 315   | 300   | 375   |
|                    |       |       | n                      | 33000     | 25000 | 20000 | 16000 | 12000 | 10000 | 8000  | 5500  |
|                    |       |       | f <sub>z</sub>         | 0.038     | 0.042 | 0.05  | 0.055 | 0.063 | 0.063 | 0.078 | 0.1   |
|                    |       |       | f (mm/min)             | 5000      | 4200  | 4000  | 3500  | 3000  | 2500  | 2500  | 2200  |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 330       | 325   | 330   | 320   | 325   | 330   | 340   | 300   |
|                    |       |       | n                      | 35000     | 26000 | 21000 | 17000 | 13000 | 10500 | 9000  | 6000  |
|                    |       |       | f <sub>z</sub>         | 0.039     | 0.042 | 0.048 | 0.059 | 0.067 | 0.071 | 0.078 | 0.117 |
|                    |       |       | f (mm/min)             | 5400      | 4300  | 4000  | 4000  | 3500  | 3000  | 2800  | 2800  |
| H                  | 38-39 | 45-65 | v <sub>c</sub> (m/min) | 115       | 115   | 110   | 115   | 115   | 110   | 115   | 100   |
|                    |       |       | n                      | 12000     | 9000  | 7000  | 6000  | 4500  | 3500  | 3000  | 2000  |
|                    |       |       | f <sub>z</sub>         | 0.035     | 0.04  | 0.05  | 0.054 | 0.061 | 0.071 | 0.079 | 0.1   |
|                    |       |       | f (mm/min)             | 1700      | 1400  | 1400  | 1300  | 1100  | 1000  | 950   | 800   |

| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED             | Size (mm) |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 3.0       | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  |
| P                  | 6-11  | 30-40 | v <sub>c</sub> (m/min) | 415       | 415   | 425   | 415   | 425   | 410   | 415   | 400   |
|                    |       |       | n                      | 44000     | 33000 | 27000 | 22000 | 17000 | 13000 | 11000 | 8000  |
|                    |       |       | f <sub>z</sub>         | 0.039     | 0.044 | 0.049 | 0.056 | 0.063 | 0.071 | 0.08  | 0.094 |
|                    |       |       | f (mm/min)             | 6800      | 5800  | 5300  | 4900  | 4300  | 3700  | 3500  | 3000  |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 445       | 440   | 440   | 435   | 450   | 440   | 450   | 450   |
|                    |       |       | n                      | 47000     | 35000 | 28000 | 23000 | 18000 | 14000 | 12000 | 9000  |
|                    |       |       | f <sub>z</sub>         | 0.038     | 0.044 | 0.05  | 0.055 | 0.064 | 0.07  | 0.077 | 0.086 |
|                    |       |       | f (mm/min)             | 7100      | 6100  | 5600  | 5100  | 4600  | 3900  | 3700  | 3100  |
| H                  | 38-39 | 45-65 | v <sub>c</sub> (m/min) | 160       | 165   | 155   | 150   | 150   | 155   | 150   | 165   |
|                    |       |       | n                      | 17000     | 13000 | 10000 | 8000  | 6000  | 5000  | 4000  | 3300  |
|                    |       |       | f <sub>z</sub>         | 0.035     | 0.04  | 0.048 | 0.053 | 0.061 | 0.07  | 0.072 | 0.083 |
|                    |       |       | f (mm/min)             | 2300      | 2100  | 2100  | 1900  | 1700  | 1400  | 1300  | 1100  |

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

► a<sub>p</sub> = 0.05 x DC  
► a<sub>e</sub> = 0.02 x DC



All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.



# CUTTING DATA



100120, 100320 (2 Flute Short)



| VDI MATERIAL GROUP                                                                               |        | HRc                    |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------------------------------------------------------------------------------------|--------|------------------------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                                  |        |                        |                        | 2.0       | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  | 25.0  |
| P                                                                                                | 1-9    | < 30                   | v <sub>c</sub> (m/min) | 60        | 65    | 75    | 80    | 85    | 85    | 80    | 85    | 90    | 85    | 85    |
|                                                                                                  |        |                        | n                      | 9250      | 7150  | 6050  | 5050  | 4450  | 3360  | 2600  | 2200  | 1760  | 1350  | 1090  |
|                                                                                                  |        |                        | f <sub>z</sub>         | 0.01      | 0.015 | 0.025 | 0.032 | 0.039 | 0.057 | 0.063 | 0.064 | 0.063 | 0.063 | 0.06  |
|                                                                                                  |        |                        | f (mm/min)             | 190       | 210   | 300   | 320   | 350   | 380   | 330   | 280   | 220   | 170   | 130   |
|                                                                                                  | 10-11  | 30-45                  | v <sub>c</sub> (m/min) | 40        | 40    | 45    | 45    | 50    | 50    | 50    | 50    | 55    | 55    | 55    |
|                                                                                                  |        |                        | n                      | 6050      | 4450  | 3700  | 3020  | 2690  | 2020  | 1600  | 1350  | 1090  | 850   | 670   |
|                                                                                                  |        |                        | f <sub>z</sub>         | 0.01      | 0.016 | 0.024 | 0.031 | 0.041 | 0.05  | 0.05  | 0.048 | 0.05  | 0.047 | 0.052 |
|                                                                                                  |        |                        | f (mm/min)             | 120       | 140   | 180   | 190   | 220   | 200   | 160   | 130   | 110   | 80    | 70    |
| M                                                                                                | 12, 13 | v <sub>c</sub> (m/min) | 30                     | 35        | 40    | 40    | 45    | 40    | 40    | 40    | 45    | 40    | 45    |       |
|                                                                                                  |        | n                      | 5050                   | 3700      | 3100  | 2530  | 2270  | 1680  | 1350  | 1090  | 850   | 670   | 550   |       |
|                                                                                                  |        | f <sub>z</sub>         | 0.009                  | 0.016     | 0.024 | 0.032 | 0.04  | 0.054 | 0.059 | 0.06  | 0.065 | 0.06  | 0.055 |       |
|                                                                                                  |        | f (mm/min)             | 90                     | 120       | 150   | 160   | 180   | 180   | 160   | 130   | 110   | 80    | 60    |       |
| K                                                                                                | 15-20  | v <sub>c</sub> (m/min) | 60                     | 65        | 75    | 80    | 85    | 85    | 80    | 85    | 90    | 85    | 85    |       |
|                                                                                                  |        | n                      | 9250                   | 7150      | 6050  | 5050  | 4450  | 3360  | 2600  | 2200  | 1760  | 1350  | 1090  |       |
|                                                                                                  |        | f <sub>z</sub>         | 0.01                   | 0.015     | 0.025 | 0.032 | 0.039 | 0.057 | 0.063 | 0.064 | 0.063 | 0.063 | 0.06  |       |
|                                                                                                  |        | f (mm/min)             | 190                    | 210       | 300   | 320   | 350   | 380   | 330   | 280   | 220   | 170   | 130   |       |
| H                                                                                                | 38     | 45-55                  | v <sub>c</sub> (m/min) | 25        | 25    | 30    | 30    | 30    | 35    | 35    | 35    | 35    | 35    | 35    |
|                                                                                                  |        |                        | n                      | 4030      | 2690  | 2350  | 1860  | 1600  | 1350  | 1090  | 930   | 720   | 550   | 430   |
|                                                                                                  |        |                        | f <sub>z</sub>         | 0.004     | 0.007 | 0.009 | 0.013 | 0.017 | 0.028 | 0.028 | 0.03  | 0.028 | 0.027 | 0.023 |
|                                                                                                  |        |                        | f (mm/min)             | 35        | 40    | 40    | 50    | 55    | 75    | 60    | 55    | 40    | 30    | 20    |
|                                                                                                  | 39     | 55-65                  | v <sub>c</sub> (m/min) | 15        | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    |
|                                                                                                  |        |                        | n                      | 2300      | 1900  | 1480  | 1260  | 1100  | 840   | 680   | 560   | 440   | 320   | 260   |
|                                                                                                  |        |                        | f <sub>z</sub>         | 0.008     | 0.011 | 0.014 | 0.016 | 0.018 | 0.024 | 0.026 | 0.031 | 0.023 | 0.031 | 0.029 |
|                                                                                                  |        |                        | f (mm/min)             | 35        | 40    | 40    | 40    | 40    | 40    | 35    | 35    | 20    | 20    | 15    |
| <div><div><div>&lt; ø 3.0mm: 0.2 x DC</div><div>≥ ø 3.0mm: 0.5 x DC</div></div><div></div></div> |        |                        |                        |           |       |       |       |       |       |       |       |       |       |       |

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



102120, 102320 (2 Flute Long)



| MATERIAL GROUP |       | HRc                    |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|----------------|-------|------------------------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                |       |                        |                        | 2.0       | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  | 25.0  |
| P              | 1-9   | < 30                   | v <sub>c</sub> (m/min) | 50        | 50    | 55    | 55    | 60    | 60    | 65    | 60    | 70    | 65    | 65    |
|                |       |                        | n                      | 7560      | 5290  | 4280  | 3660  | 3160  | 2400  | 2020  | 1640  | 1390  | 1010  | 820   |
|                |       |                        | f <sub>z</sub>         | 0.005     | 0.008 | 0.012 | 0.017 | 0.024 | 0.033 | 0.04  | 0.038 | 0.041 | 0.042 | 0.044 |
|                |       |                        | f (mm/min)             | 70        | 85    | 100   | 125   | 150   | 160   | 160   | 125   | 115   | 85    | 70    |
|                | 10-11 | 30-45                  | v <sub>c</sub> (m/min) | 40        | 40    | 45    | 45    | 50    | 50    | 50    | 50    | 55    | 50    | 50    |
|                |       |                        | n                      | 6050      | 4280  | 3410  | 2900  | 2520  | 1900  | 1640  | 1390  | 1070  | 820   | 630   |
|                |       |                        | f <sub>z</sub>         | 0.005     | 0.008 | 0.012 | 0.017 | 0.025 | 0.033 | 0.038 | 0.041 | 0.042 | 0.037 | 0.037 |
|                |       |                        | f (mm/min)             | 60        | 70    | 85    | 100   | 125   | 125   | 125   | 115   | 90    | 60    | 45    |
| K              | 15-20 | v <sub>c</sub> (m/min) | 50                     | 50        | 55    | 55    | 60    | 60    | 65    | 60    | 70    | 65    | 65    |       |
|                |       | n                      | 7560                   | 5290      | 4280  | 3660  | 3160  | 2400  | 2020  | 1640  | 1390  | 1010  | 820   |       |
|                |       | f <sub>z</sub>         | 0.005                  | 0.008     | 0.012 | 0.017 | 0.024 | 0.033 | 0.04  | 0.038 | 0.041 | 0.042 | 0.044 |       |
|                |       | f (mm/min)             | 70                     | 85        | 100   | 125   | 150   | 160   | 160   | 125   | 115   | 85    | 70    |       |
| H              | 38-39 | 45-55                  | v <sub>c</sub> (m/min) | 25        | 25    | 25    | 30    | 30    | 30    | 30    | 30    | 35    | 30    | 30    |
|                |       |                        | n                      | 3780      | 2640  | 2150  | 1900  | 1640  | 1260  | 1010  | 840   | 670   | 500   | 380   |
|                |       |                        | f <sub>z</sub>         | 0.004     | 0.007 | 0.009 | 0.012 | 0.018 | 0.024 | 0.03  | 0.027 | 0.03  | 0.03  | 0.03  |
|                |       |                        | f (mm/min)             | 30        | 35    | 40    | 45    | 60    | 60    | 60    | 45    | 40    | 30    | 20    |

< HRc45

< Ø 3.0mm: 0.4mm

≥ Ø 3.0mm: 0.3 x DC

> HRc45

0.05 x DC

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

## CUTTING DATA



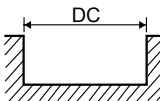
155120, 155320 (2 Flute Long, Corner Radius)



| VDI MATERIAL GROUP |       | HRc           |               | Size (mm) |       |       |       |       |       |       |       |
|--------------------|-------|---------------|---------------|-----------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |               |               | 4.0       | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 1-9   | < 30          | $v_c$ (m/min) | 65        | 70    | 75    | 75    | 80    | 80    | 85    | 80    |
|                    |       |               | n             | 5360      | 4580  | 3950  | 3000  | 2520  | 2060  | 1740  | 1260  |
|                    |       |               | $f_z$         | 0.016     | 0.023 | 0.032 | 0.045 | 0.054 | 0.051 | 0.055 | 0.056 |
|                    |       |               | f (mm/min)    | 170       | 210   | 250   | 270   | 270   | 210   | 190   | 140   |
|                    | 10-11 | 30-45         | $v_c$ (m/min) | 45        | 45    | 50    | 50    | 50    | 50    | 55    | 50    |
|                    |       |               | n             | 3410      | 2900  | 2520  | 1900  | 1640  | 1390  | 1070  | 820   |
|                    |       |               | $f_z$         | 0.012     | 0.017 | 0.025 | 0.033 | 0.038 | 0.041 | 0.042 | 0.037 |
|                    |       |               | f (mm/min)    | 85        | 100   | 125   | 125   | 125   | 115   | 90    | 60    |
| K                  | 15-20 | $v_c$ (m/min) | 65            | 70        | 75    | 75    | 80    | 80    | 85    | 80    |       |
|                    |       | n             | 5360          | 4580      | 3950  | 3000  | 2520  | 2060  | 1740  | 1260  |       |
|                    |       | $f_z$         | 0.016         | 0.023     | 0.032 | 0.045 | 0.054 | 0.051 | 0.055 | 0.056 |       |
|                    |       | f (mm/min)    | 170           | 210       | 250   | 270   | 270   | 210   | 190   | 140   |       |
| H                  | 38    | 45-55         | $v_c$ (m/min) | 25        | 30    | 30    | 30    | 30    | 30    | 35    | 30    |
|                    |       |               | n             | 2150      | 1900  | 1640  | 1260  | 1010  | 840   | 670   | 500   |
|                    |       |               | $f_z$         | 0.009     | 0.013 | 0.018 | 0.024 | 0.03  | 0.03  | 0.03  | 0.03  |
|                    |       |               | f (mm/min)    | 40        | 50    | 60    | 60    | 60    | 50    | 40    | 30    |
|                    | 39    | 55-65         | $v_c$ (m/min) | 20        | 20    | 20    | 20    | 20    | 20    | 20    | 20    |
|                    |       |               | n             | 1470      | 1260  | 1160  | 840   | 670   | 550   | 440   | 340   |
|                    |       |               | $f_z$         | 0.007     | 0.01  | 0.015 | 0.021 | 0.026 | 0.023 | 0.023 | 0.022 |
|                    |       |               | f (mm/min)    | 20        | 25    | 35    | 35    | 35    | 25    | 20    | 15    |

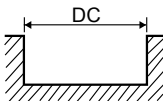
< HRc55

0.3 x DC



> HRc55

0.05 x DC



$v_c$  - cutting speed (m/min)  
 $n$  - RPM (rev/min)  
 $f_z$  - feed rate (mm/tooth)  
 $f$  - feed rate (mm/rev)  
 $z$  - No. of teeth  
 $a_p$  - axial depth of cut  
 $a_e$  - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \phi}$

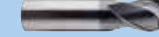
To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \phi}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

## CUTTING DATA



118120, 118320 (2 Flute Short, Ball Nose)



| VDI MATERIAL GROUP |       | HRc          | NORMAL SPEED  | Size (mm) |       |       |      |       |       |      |       |       |
|--------------------|-------|--------------|---------------|-----------|-------|-------|------|-------|-------|------|-------|-------|
|                    |       |              |               | 3.0       | 4.0   | 5.0   | 6.0  | 8.0   | 10.0  | 12.0 | 16.0  | 20.0  |
| <b>P</b>           | 6-11  | <b>30-40</b> | $v_c$ (m/min) | 95        | 105   | 115   | 130  | 145   | 160   | 175  | 190   | 205   |
|                    |       |              | n             | 10000     | 8400  | 7300  | 6900 | 5770  | 5090  | 4640 | 3780  | 3260  |
|                    |       |              | $f_z$         | 0.023     | 0.032 | 0.04  | 0.06 | 0.08  | 0.1   | 0.12 | 0.14  | 0.16  |
|                    |       |              | f (mm/min)    | 460       | 530   | 580   | 830  | 920   | 1020  | 1110 | 1060  | 1040  |
| <b>K</b>           | 15-20 |              | $v_c$ (m/min) | 125       | 130   | 145   | 160  | 180   | 200   | 220  | 240   | 260   |
|                    |       |              | n             | 13100     | 10500 | 9140  | 8490 | 7160  | 6370  | 5840 | 4770  | 4140  |
|                    |       |              | $f_z$         | 0.026     | 0.035 | 0.045 | 0.06 | 0.09  | 0.12  | 0.15 | 0.18  | 0.2   |
|                    |       |              | f (mm/min)    | 680       | 740   | 820   | 1020 | 1290  | 1530  | 1750 | 1720  | 1660  |
| <b>H</b>           | 38-39 | <b>45-65</b> | $v_c$ (m/min) | 45        | 55    | 60    | 60   | 62    | 65    | 65   | 70    | 70    |
|                    |       |              | n             | 4520      | 4200  | 3680  | 3180 | 2470  | 2040  | 1750 | 1350  | 1110  |
|                    |       |              | $f_z$         | 0.017     | 0.021 | 0.024 | 0.03 | 0.045 | 0.055 | 0.07 | 0.091 | 0.113 |
|                    |       |              | f (mm/min)    | 150       | 180   | 180   | 190  | 220   | 225   | 245  | 245   | 250   |

< HRc45

$a_p$

$a_e$

$a_p$ :  $\varnothing 1.0\text{mm} - 6.0\text{mm} = 0.2\text{mm}$   
 $a_p$ :  $\varnothing 8.0\text{mm} - 20.0\text{mm} = 0.3\text{mm}$   
 $a_e$ :  $0.2 \times \text{DC}$

> HRc45

$a_p$

$a_e$

$a_p$ :  $\varnothing 1.0\text{mm} - 6.0\text{mm} = 0.2\text{mm}$   
 $a_p$ :  $\varnothing 8.0\text{mm} - 20.0\text{mm} = 0.3\text{mm}$   
 $a_e$ :  $0.1 \times \text{DC}$

| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED             | Size (mm) |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 3.0       | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 6-11  | 30-40 | v <sub>c</sub> (m/min) | 200       | 265   | 330   | 395   | 420   | 440   | 460   | 480   | 500   |
|                    |       |       | n                      | 21000     | 21000 | 21000 | 21000 | 16700 | 14000 | 12200 | 9550  | 7960  |
|                    |       |       | f <sub>z</sub>         | 0.048     | 0.07  | 0.086 | 0.095 | 0.12  | 0.139 | 0.16  | 0.181 | 0.2   |
|                    |       |       | f (mm/min)             | 2000      | 2940  | 3600  | 4000  | 4000  | 3900  | 3900  | 3450  | 3180  |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 200       | 265   | 330   | 395   | 420   | 440   | 460   | 480   | 500   |
|                    |       |       | n                      | 21000     | 21000 | 21000 | 21000 | 16700 | 14000 | 12200 | 9550  | 7960  |
|                    |       |       | f <sub>z</sub>         | 0.048     | 0.07  | 0.086 | 0.095 | 0.12  | 0.139 | 0.16  | 0.181 | 0.2   |
|                    |       |       | f (mm/min)             | 2000      | 2940  | 3600  | 4000  | 4000  | 3900  | 3900  | 3450  | 3180  |
| H                  | 38-39 | 45-65 | v <sub>c</sub> (m/min) | 160       | 170   | 190   | 200   | 210   | 220   | 230   | 240   | 250   |
|                    |       |       | n                      | 17000     | 13660 | 12000 | 10500 | 8360  | 7000  | 6100  | 4770  | 3980  |
|                    |       |       | f <sub>z</sub>         | 0.031     | 0.042 | 0.05  | 0.06  | 0.075 | 0.086 | 0.095 | 0.105 | 0.116 |
|                    |       |       | f (mm/min)             | 1040      | 1160  | 1200  | 1250  | 1250  | 1200  | 1160  | 1000  | 920   |

<

## CUTTING DATA



112120, 112320 (2 Flute Long, Ball Nose)



| VDI MATERIAL GROUP |       | HRc   | NORMAL SPEED  | Size (mm) |       |       |       |       |      |       |       |      |       |       |
|--------------------|-------|-------|---------------|-----------|-------|-------|-------|-------|------|-------|-------|------|-------|-------|
|                    |       |       |               | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0  | 8.0   | 10.0  | 12.0 | 16.0  | 20.0  |
| P                  | 6-11  | 30-40 | $v_c$ (m/min) | 40        | 65    | 95    | 105   | 115   | 130  | 145   | 160   | 175  | 190   | 205   |
|                    |       |       | n             | 12720     | 10700 | 10000 | 8400  | 7300  | 6900 | 5770  | 5090  | 4640 | 3780  | 3260  |
|                    |       |       | $f_z$         | 0.008     | 0.023 | 0.023 | 0.032 | 0.04  | 0.06 | 0.08  | 0.1   | 0.12 | 0.14  | 0.16  |
|                    |       |       | f (mm/min)    | 200       | 490   | 460   | 530   | 580   | 830  | 920   | 1020  | 1110 | 1060  | 1040  |
| K                  | 15-20 |       | $v_c$ (m/min) | 50        | 90    | 125   | 130   | 145   | 160  | 180   | 200   | 220  | 240   | 260   |
|                    |       |       | n             | 15760     | 14400 | 13100 | 10500 | 9140  | 8490 | 7160  | 6370  | 5840 | 4770  | 4140  |
|                    |       |       | $f_z$         | 0.008     | 0.026 | 0.026 | 0.035 | 0.045 | 0.06 | 0.09  | 0.12  | 0.15 | 0.18  | 0.2   |
|                    |       |       | f (mm/min)    | 250       | 750   | 680   | 740   | 820   | 1020 | 1290  | 1530  | 1750 | 1720  | 1660  |
| H                  | 38-39 | 45-65 | $v_c$ (m/min) | 20        | 30    | 45    | 55    | 60    | 60   | 62    | 65    | 65   | 70    | 70    |
|                    |       |       | n             | 5800      | 4680  | 4520  | 4200  | 3680  | 3180 | 2470  | 2040  | 1750 | 1350  | 1110  |
|                    |       |       | $f_z$         | 0.008     | 0.016 | 0.017 | 0.021 | 0.024 | 0.03 | 0.045 | 0.055 | 0.07 | 0.091 | 0.113 |
|                    |       |       | f (mm/min)    | 90        | 150   | 150   | 180   | 180   | 190  | 220   | 225   | 245  | 245   | 250   |

< HRc45

$a_p$ :  $\varnothing 1.0\text{mm} - 6.0\text{mm} = 0.2\text{mm}$   
 $a_p$ :  $\varnothing 8.0\text{mm} - 20.0\text{mm} = 0.3\text{mm}$   
 $a_e$ :  $0.2 \times \text{DC}$

> HRc45

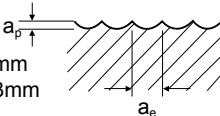
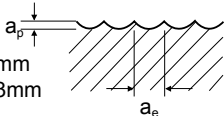
$a_p$ :  $\varnothing 1.0\text{mm} - 6.0\text{mm} = 0.2\text{mm}$   
 $a_p$ :  $\varnothing 8.0\text{mm} - 20.0\text{mm} = 0.3\text{mm}$   
 $a_e$ :  $0.1 \times \text{DC}$

## CUTTING DATA



114320 (2 Flute Long Reach, Ball Nose)



| VDI MATERIAL GROUP                                                                                                  |       | HRc   | NORMAL SPEED           | Size (mm)                                                                                                                                                                                                                        |       |       |       |       |       |       |       |       |       |
|---------------------------------------------------------------------------------------------------------------------|-------|-------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                                                     |       |       |                        | 2.0                                                                                                                                                                                                                              | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                                                                                                                   | 6-11  | 30-40 | v <sub>c</sub> (m/min) | 60                                                                                                                                                                                                                               | 75    | 85    | 90    | 105   | 115   | 130   | 140   | 150   | 165   |
|                                                                                                                     |       |       | n                      | 9250                                                                                                                                                                                                                             | 8000  | 6720  | 5840  | 5500  | 4600  | 4070  | 3700  | 3000  | 2600  |
|                                                                                                                     |       |       | f <sub>z</sub>         | 0.014                                                                                                                                                                                                                            | 0.023 | 0.031 | 0.039 | 0.055 | 0.08  | 0.101 | 0.12  | 0.142 | 0.16  |
|                                                                                                                     |       |       | f (mm/min)             | 260                                                                                                                                                                                                                              | 370   | 420   | 460   | 600   | 740   | 820   | 890   | 850   | 830   |
| K                                                                                                                   | 15-20 |       | v <sub>c</sub> (m/min) | 80                                                                                                                                                                                                                               | 100   | 105   | 115   | 130   | 145   | 160   | 175   | 190   | 205   |
|                                                                                                                     |       |       | n                      | 12600                                                                                                                                                                                                                            | 10500 | 8400  | 7310  | 6800  | 5700  | 5100  | 4700  | 3800  | 3300  |
|                                                                                                                     |       |       | f <sub>z</sub>         | 0.017                                                                                                                                                                                                                            | 0.026 | 0.035 | 0.045 | 0.06  | 0.09  | 0.12  | 0.149 | 0.182 | 0.202 |
|                                                                                                                     |       |       | f (mm/min)             | 420                                                                                                                                                                                                                              | 540   | 590   | 660   | 820   | 1030  | 1220  | 1400  | 1380  | 1330  |
| H                                                                                                                   | 38-39 | 45-65 | v <sub>c</sub> (m/min) | 25                                                                                                                                                                                                                               | 35    | 40    | 45    | 50    | 50    | 50    | 55    | 55    | 55    |
|                                                                                                                     |       |       | n                      | 3870                                                                                                                                                                                                                             | 3620  | 3360  | 2940  | 2550  | 2000  | 1650  | 1400  | 1100  | 890   |
|                                                                                                                     |       |       | f <sub>z</sub>         | 0.012                                                                                                                                                                                                                            | 0.017 | 0.021 | 0.024 | 0.029 | 0.044 | 0.055 | 0.07  | 0.089 | 0.112 |
|                                                                                                                     |       |       | f (mm/min)             | 90                                                                                                                                                                                                                               | 120   | 140   | 140   | 150   | 175   | 180   | 195   | 195   | 200   |
| <b>&lt; HRc45</b>                                                                                                   |       |       |                        |                                                                                                                                               |       |       |       |       |       |       |       |       |       |
| <p>a<sub>p</sub>: ø1.0mm - 6.0mm = 0.2mm<br/>a<sub>p</sub>: ø8.0mm - 20.0mm = 0.3mm<br/>a<sub>e</sub>: 0.2 x DC</p> |       |       |                        | <p><b>&gt; HRc45</b></p>  <p>a<sub>p</sub>: ø1.0mm - 6.0mm = 0.2mm<br/>a<sub>p</sub>: ø8.0mm - 20.0mm = 0.3mm<br/>a<sub>e</sub>: 0.1 x DC</p> |       |       |       |       |       |       |       |       |       |

| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED    | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|---------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |               | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 6-11  | 30-40 | $v_c$ (m/min) | 80        | 130   | 200   | 265   | 330   | 395   | 420   | 440   | 460   | 480   | 500   |
|                    |       |       | $n$           | 25000     | 21000 | 21000 | 21000 | 21000 | 21000 | 16700 | 14000 | 12200 | 9550  | 7960  |
|                    |       |       | $f_z$         | 0.026     | 0.035 | 0.048 | 0.07  | 0.086 | 0.095 | 0.12  | 0.139 | 0.16  | 0.181 | 0.2   |
|                    |       |       | $f$ (mm/min)  | 1300      | 1480  | 2000  | 2940  | 3600  | 4000  | 4000  | 3900  | 3900  | 3450  | 3180  |
| K                  | 15-20 |       | $v_c$ (m/min) | 80        | 130   | 200   | 265   | 330   | 395   | 420   | 440   | 460   | 480   | 500   |
|                    |       |       | $n$           | 25000     | 21000 | 21000 | 21000 | 21000 | 21000 | 16700 | 14000 | 12200 | 9550  | 7960  |
|                    |       |       | $f_z$         | 0.026     | 0.035 | 0.048 | 0.07  | 0.086 | 0.095 | 0.12  | 0.139 | 0.16  | 0.181 | 0.2   |
|                    |       |       | $f$ (mm/min)  | 1300      | 1480  | 2000  | 2940  | 3600  | 4000  | 4000  | 3900  | 3900  | 3450  | 3180  |
| H                  | 38-39 | 45-65 | $v_c$ (m/min) | 80        | 130   | 160   | 170   | 190   | 200   | 210   | 220   | 230   | 240   | 250   |
|                    |       |       | $n$           | 25000     | 21000 | 17000 | 13660 | 12000 | 10500 | 8360  | 7000  | 6100  | 4770  | 3980  |
|                    |       |       | $f_z$         | 0.016     | 0.022 | 0.031 | 0.042 | 0.05  | 0.06  | 0.075 | 0.086 | 0.095 | 0.105 | 0.116 |
|                    |       |       | $f$ (mm/min)  | 800       | 940   | 1040  | 1160  | 1200  | 1250  | 1250  | 1200  | 1160  | 1000  | 920   |

| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED    | Size (mm) |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|---------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |               | 2.0       | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 6-11  | 30-40 | $v_c$ (m/min) | 105       | 160   | 210   | 265   | 315   | 335   | 350   | 370   | 380   | 400   |
|                    |       |       | $n$           | 16800     | 16800 | 16800 | 16800 | 16800 | 13400 | 11200 | 9800  | 7600  | 6400  |
|                    |       |       | $f_z$         | 0.036     | 0.048 | 0.07  | 0.086 | 0.095 | 0.119 | 0.138 | 0.158 | 0.181 | 0.199 |
|                    |       |       | $f$ (mm/min)  | 1200      | 1600  | 2350  | 2880  | 3200  | 3200  | 3100  | 3100  | 2750  | 2550  |
| K                  | 15-20 |       | $v_c$ (m/min) | 105       | 160   | 210   | 265   | 315   | 335   | 350   | 370   | 380   | 400   |
|                    |       |       | $n$           | 16800     | 16800 | 16800 | 16800 | 16800 | 13400 | 11200 | 9800  | 7600  | 6400  |
|                    |       |       | $f_z$         | 0.036     | 0.048 | 0.07  | 0.086 | 0.095 | 0.119 | 0.138 | 0.158 | 0.181 | 0.199 |
|                    |       |       | $f$ (mm/min)  | 1200      | 1600  | 2350  | 2880  | 3200  | 3200  | 3100  | 3100  | 2750  | 2550  |
| H                  | 38-39 | 45-65 | $v_c$ (m/min) | 105       | 130   | 135   | 150   | 160   | 170   | 175   | 185   | 190   | 200   |
|                    |       |       | $n$           | 16800     | 13600 | 10930 | 9600  | 8400  | 6700  | 5600  | 4900  | 3800  | 3200  |
|                    |       |       | $f_z$         | 0.022     | 0.031 | 0.043 | 0.05  | 0.06  | 0.075 | 0.086 | 0.095 | 0.105 | 0.116 |
|                    |       |       | $f$ (mm/min)  | 750       | 830   | 930   | 960   | 1000  | 1000  | 960   | 930   | 800   | 740   |

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# CUTTING DATA

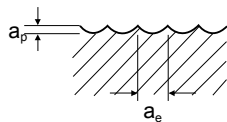


116120, 116320 (2 Flute Stub, Ball Nose, >HRC55)



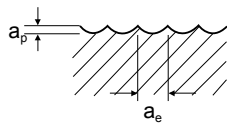
| VDI MATERIAL GROUP |    | HRc   | NORMAL SPEED           | Size (mm) |       |       |       |       |       |        |       |       |       |       |
|--------------------|----|-------|------------------------|-----------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|
|                    |    |       |                        | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0   | 8.0    | 10.0  | 12.0  | 16.0  | 20.0  |
| H                  | 38 | 45-50 | v <sub>c</sub> (m/min) | 65        | 90    | 120   | 135   | 150   | 160   | 175    | 190   | 205   | 220   | 220   |
|                    |    |       | n                      | 20000     | 14500 | 12700 | 10600 | 9400  | 8600  | 7000   | 6050  | 5450  | 4350  | 3500  |
|                    |    |       | f <sub>z</sub>         | 0.012     | 0.028 | 0.043 | 0.052 | 0.059 | 0.067 | 0.0775 | 0.083 | 0.092 | 0.1   | 0.099 |
|                    |    |       | f (mm/min)             | 460       | 800   | 1100  | 1100  | 1100  | 1150  | 1050   | 1000  | 1000  | 870   | 690   |
|                    | 38 | 50-55 | v <sub>c</sub> (m/min) | 65        | 90    | 115   | 130   | 140   | 155   | 170    | 180   | 195   | 210   | 205   |
|                    |    |       | n                      | 20000     | 14200 | 12300 | 10300 | 9050  | 8250  | 6700   | 5800  | 5200  | 4150  | 3300  |
|                    |    |       | f <sub>z</sub>         | 0.01      | 0.026 | 0.043 | 0.051 | 0.058 | 0.067 | 0.075  | 0.083 | 0.092 | 0.1   | 0.098 |
|                    |    |       | f (mm/min)             | 400       | 740   | 1050  | 1050  | 1050  | 1100  | 1000   | 960   | 960   | 830   | 650   |
|                    | 39 | 55-60 | v <sub>c</sub> (m/min) | 65        | 85    | 110   | 125   | 135   | 150   | 160    | 170   | 185   | 195   | 200   |
|                    |    |       | n                      | 20000     | 13850 | 11800 | 9800  | 8600  | 7850  | 6350   | 5450  | 4900  | 3900  | 3150  |
|                    |    |       | f <sub>z</sub>         | 0.009     | 0.027 | 0.042 | 0.051 | 0.055 | 0.061 | 0.075  | 0.083 | 0.092 | 0.105 | 0.1   |
|                    |    |       | f (mm/min)             | 350       | 760   | 1000  | 1000  | 950   | 950   | 950    | 900   | 900   | 820   | 630   |
|                    | 39 | 60-70 | v <sub>c</sub> (m/min) | 65        | 70    | 80    | 85    | 90    | 90    | 95     | 100   | 105   | 110   | 105   |
|                    |    |       | n                      | 20000     | 11300 | 8400  | 6650  | 5600  | 4850  | 3800   | 3200  | 2750  | 2150  | 1700  |
|                    |    |       | f <sub>z</sub>         | 0.006     | 0.021 | 0.039 | 0.049 | 0.061 | 0.072 | 0.086  | 0.097 | 0.111 | 0.062 | 0.065 |
|                    |    |       | f (mm/min)             | 240       | 465   | 660   | 650   | 680   | 700   | 650    | 620   | 610   | 265   | 220   |

$a_p$ :  $\varnothing 1.0\text{mm} - 4.0\text{mm} = 0.05 \times \text{DC}$   
 $a_p$ :  $\varnothing 5.0\text{mm} - 8.0\text{mm} = 0.25\text{mm}$   
 $a_p$ :  $\varnothing 10.0\text{mm} - 20.0\text{mm} = 0.3\text{mm}$   
 $a_e$ :  $0.1 \times \text{DC}$



| VDI MATERIAL GROUP |    | HRC   | HIGH SPEED             | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|----|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |    |       |                        | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| H                  | 38 | 45-50 | v <sub>c</sub> (m/min) | 65        | 90    | 120   | 135   | 150   | 160   | 175   | 190   | 205   | 220   | 220   |
|                    |    |       | n                      | 20000     | 14500 | 12700 | 10600 | 9400  | 8600  | 7000  | 6050  | 5450  | 4350  | 3500  |
|                    |    |       | f <sub>z</sub>         | 0.019     | 0.045 | 0.069 | 0.08  | 0.088 | 0.102 | 0.111 | 0.12  | 0.13  | 0.141 | 0.143 |
|                    |    |       | f (mm/min)             | 770       | 1300  | 1750  | 1700  | 1650  | 1750  | 1550  | 1450  | 1420  | 1230  | 1000  |
|                    | 38 | 50-55 | v <sub>c</sub> (m/min) | 65        | 90    | 115   | 130   | 140   | 155   | 170   | 180   | 195   | 210   | 205   |
|                    |    |       | n                      | 20000     | 14200 | 12300 | 10300 | 9050  | 8250  | 6700  | 5800  | 5200  | 4150  | 3300  |
|                    |    |       | f <sub>z</sub>         | 0.018     | 0.043 | 0.068 | 0.079 | 0.087 | 0.101 | 0.109 | 0.117 | 0.128 | 0.136 | 0.136 |
|                    |    |       | f (mm/min)             | 700       | 1230  | 1670  | 1620  | 1570  | 1670  | 1460  | 1360  | 1330  | 1130  | 900   |
|                    | 39 | 55-70 | v <sub>c</sub> (m/min) | 65        | 85    | 110   | 125   | 135   | 150   | 160   | 170   | 185   | 195   | 200   |
|                    |    |       | n                      | 20000     | 13850 | 11800 | 9800  | 8600  | 7850  | 6350  | 5450  | 4900  | 3900  | 3150  |
|                    |    |       | f <sub>z</sub>         | 0.01      | 0.025 | 0.036 | 0.044 | 0.05  | 0.055 | 0.07  | 0.08  | 0.08  | 0.062 | 0.065 |
|                    |    |       | f (mm/min)             | 410       | 700   | 860   | 860   | 860   | 865   | 890   | 870   | 785   | 485   | 410   |

$a_p$ :  $\varnothing 1.0\text{mm} - 4.0\text{mm} = 0.05 \times \text{DC}$   
 $a_p$ :  $\varnothing 5.0\text{mm} - 8.0\text{mm} = 0.25\text{mm}$   
 $a_p$ :  $\varnothing 10.0\text{mm} - 20.0\text{mm} = 0.3\text{mm}$   
 $a_e$ :  $0.05 \times \text{DC}$



# CUTTING DATA



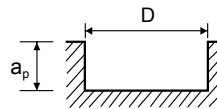
100320 (2 Flute Miniature)



| VDI MATERIAL GROUP |       | HRC   |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 0.4       | 0.5   | 0.6   | 0.7   | 0.8   | 0.9   | 1.0   | 1.1   | 1.2   | 1.3   | 1.4   | 1.5   |
| P                  | 10-11 | 30-45 | v <sub>c</sub> (m/min) | 40        | 45    | 50    | 55    | 60    | 60    | 65    | 65    | 60    | 60    | 55    | 55    |
|                    |       |       | n                      | 30000     | 28500 | 26500 | 25000 | 24000 | 21000 | 20000 | 18500 | 16000 | 14500 | 12500 | 12000 |
|                    |       |       | f <sub>z</sub>         | 0.002     | 0.002 | 0.002 | 0.003 | 0.003 | 0.004 | 0.004 | 0.004 | 0.005 | 0.005 | 0.006 | 0.006 |
|                    |       |       | f (mm/min)             | 90        | 115   | 100   | 150   | 150   | 160   | 160   | 150   | 160   | 150   | 150   | 150   |
| H                  | 38    | 45-55 | v <sub>c</sub> (m/min) | 30        | 35    | 35    | 40    | 45    | 45    | 45    | 45    | 45    | 45    | 40    | 40    |
|                    |       |       | n                      | 23000     | 22000 | 18500 | 1800  | 18000 | 16000 | 15000 | 13000 | 12000 | 11000 | 9000  | 9000  |
|                    |       |       | f <sub>z</sub>         | 0.001     | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 |
|                    |       |       | f (mm/min)             | 50        | 45    | 40    | 40    | 65    | 65    | 75    | 75    | 75    | 70    | 70    | 70    |

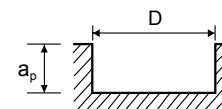
< HRC45

$a_p$ :  $< \varnothing 1.0\text{mm} = 0.15 \times \text{DC}$   
 $a_p$ :  $\geq \varnothing 1.0\text{mm} = 0.25 \times \text{DC}$



> HRC45

$a_p$ :  $< \varnothing 1.0\text{mm} = 0.02 \times \text{DC}$   
 $a_p$ :  $\geq \varnothing 1.0\text{mm} = 0.05 \times \text{DC}$



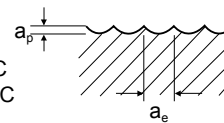
105320 (2 Flute Miniature, Ball Nose)



| VDI MATERIAL GROUP |       | HRC   |                        | Size (mm) |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 0.6       | 0.7   | 0.8   | 0.9   | 1.0   | 1.1   | 1.2   | 1.3   | 1.4   | 1.5   |
| P                  | 6-11  | 30-45 | v <sub>c</sub> (m/min) | 55        | 60    | 70    | 75    | 80    | 85    | 90    | 95    | 100   | 110   |
|                    |       |       | n                      | 30000     | 27000 | 27000 | 26500 | 25000 | 24500 | 24000 | 23500 | 23000 | 23000 |
|                    |       |       | f <sub>z</sub>         | 0.009     | 0.009 | 0.01  | 0.011 | 0.011 | 0.011 | 0.012 | 0.012 | 0.013 | 0.013 |
|                    |       |       | f (mm/min)             | 510       | 490   | 560   | 560   | 560   | 540   | 570   | 550   | 590   | 600   |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 55        | 60    | 70    | 75    | 80    | 85    | 90    | 95    | 100   | 110   |
|                    |       |       | n                      | 30000     | 27000 | 27000 | 26500 | 25000 | 24500 | 24000 | 23500 | 23000 | 23000 |
|                    |       |       | f <sub>z</sub>         | 0.009     | 0.009 | 0.01  | 0.011 | 0.011 | 0.011 | 0.012 | 0.012 | 0.013 | 0.013 |
|                    |       |       | f (mm/min)             | 510       | 490   | 560   | 560   | 560   | 540   | 570   | 550   | 590   | 600   |
| H                  | 38    | 45-55 | v <sub>c</sub> (m/min) | 55        | 60    | 70    | 75    | 80    | 85    | 90    | 95    | 100   | 110   |
|                    |       |       | n                      | 30000     | 27000 | 27000 | 26500 | 25000 | 24500 | 24000 | 23500 | 23000 | 23000 |
|                    |       |       | f <sub>z</sub>         | 0.006     | 0.006 | 0.006 | 0.006 | 0.007 | 0.007 | 0.007 | 0.007 | 0.008 | 0.008 |
|                    |       |       | f (mm/min)             | 360       | 330   | 330   | 320   | 340   | 340   | 350   | 320   | 360   | 370   |

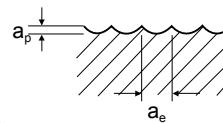
< HRC45

$a_p$ :  $< \varnothing 1.0\text{mm} = 0.05 \times \text{DC}$   
 $a_p$ :  $\geq \varnothing 1.0\text{mm} = 0.075 \times \text{DC}$   
 $a_e$ :  $0.15 \times \text{DC}$



> HRC45

$a_p$ :  $0.05 \times \text{DC}$   
 $a_e$ :  $< \varnothing 1.0\text{mm} = 0.1 \times \text{DC}$   
 $a_e$ :  $\geq \varnothing 1.0\text{mm} = 0.15 \times \text{DC}$



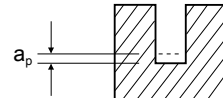
## CUTTING DATA



107320, 108320 (2 Flute Rib Processing)



| VDI MATERIAL GROUP |       | HRc                    |                        | Size (mm) |       |       |       |       |       |       |       |       |       |
|--------------------|-------|------------------------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |                        |                        | 0.8       | 1.0   | 1.2   | 1.4   | 1.5   | 1.6   | 1.8   | 2.0   | 2.5   | 3.0   |
| P                  | 1-9   | < 30                   | a <sub>p</sub> (mm)    | 0.025     | 0.065 | 0.075 | 0.095 | 0.1   | 0.11  | 0.12  | 0.135 | 0.175 | 0.195 |
|                    |       |                        | v <sub>c</sub> (m/min) | 78        | 79    | 79    | 79    | 78    | 80    | 84    | 83    | 85    | 85    |
|                    |       |                        | n                      | 31000     | 25000 | 21000 | 18000 | 16500 | 16000 | 15000 | 13000 | 11000 | 9000  |
|                    |       |                        | f <sub>z</sub>         | 0.007     | 0.01  | 0.014 | 0.016 | 0.017 | 0.018 | 0.019 | 0.021 | 0.023 | 0.031 |
|                    |       |                        | f (mm/min)             | 435       | 500   | 580   | 580   | 560   | 570   | 560   | 550   | 500   | 500   |
|                    | 10-11 | 30-45                  | a <sub>p</sub> (mm)    | 0.023     | 0.064 | 0.074 | 0.093 | 0.098 | 0.1   | 0.11  | 0.12  | 0.16  | 0.19  |
|                    |       |                        | v <sub>c</sub> (m/min) | 55        | 56    | 55    | 56    | 57    | 58    | 59    | 60    | 60    | 60    |
|                    |       |                        | n                      | 22000     | 18000 | 15000 | 13000 | 12000 | 11500 | 10500 | 9500  | 7500  | 6300  |
|                    |       |                        | f <sub>z</sub>         | 0.006     | 0.009 | 0.012 | 0.015 | 0.016 | 0.017 | 0.018 | 0.02  | 0.022 | 0.03  |
|                    |       |                        | f (mm/min)             | 260       | 320   | 350   | 380   | 380   | 390   | 370   | 380   | 330   | 380   |
| K                  | 15-20 | a <sub>p</sub> (mm)    | 0.025                  | 0.065     | 0.075 | 0.095 | 0.1   | 0.11  | 0.12  | 0.135 | 0.175 | 0.195 |       |
|                    |       | v <sub>c</sub> (m/min) | 78                     | 79        | 79    | 79    | 78    | 80    | 84    | 83    | 85    | 85    |       |
|                    |       | n                      | 31000                  | 25000     | 21000 | 18000 | 16500 | 16000 | 15000 | 13000 | 11000 | 9000  |       |
|                    |       | f <sub>z</sub>         | 0.007                  | 0.01      | 0.014 | 0.016 | 0.017 | 0.018 | 0.019 | 0.021 | 0.023 | 0.031 |       |
|                    |       | f (mm/min)             | 435                    | 500       | 580   | 580   | 560   | 570   | 560   | 550   | 500   | 500   |       |
| H                  | 38    | 45-55                  | a <sub>p</sub> (mm)    | 0.011     | 0.013 | 0.015 | 0.018 | 0.021 | 0.023 | 0.024 | 0.026 | 0.033 | 0.042 |
|                    |       |                        | v <sub>c</sub> (m/min) | 34        | 35    | 36    | 36    | 36    | 36    | 37    | 37    | 38    | 37    |
|                    |       |                        | n                      | 13500     | 11000 | 9500  | 8000  | 7500  | 7000  | 6500  | 5500  | 4500  | 4000  |
|                    |       |                        | f <sub>z</sub>         | 0.003     | 0.004 | 0.005 | 0.006 | 0.007 | 0.007 | 0.008 | 0.008 | 0.01  | 0.012 |
|                    |       |                        | f (mm/min)             | 80        | 90    | 95    | 95    | 100   | 100   | 100   | 95    | 95    | 95    |



► The data shown is based on medial length tools. Please adjust machining conditions according to length.

v<sub>c</sub> - cutting speed (m/min)  
 n - RPM (rev/min)  
 f<sub>z</sub> - feed rate (mm/tooth)  
 f - feed rate (mm/rev)  
 z - No. of teeth  
 a<sub>p</sub> - axial depth of cut  
 a<sub>e</sub> - radial depth of cut

$$\text{To calculate RPM from cutting speed: } n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$$

$$\text{To calculate cutting speed from RPM: } v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

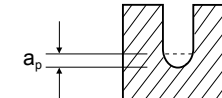
## CUTTING DATA



143320 (2 Flute Rib Processing, Ball Nose)



| VDI MATERIAL GROUP |       | HRc   |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 0.6       | 0.8   | 1.0   | 1.2   | 1.4   | 1.5   | 1.6   | 1.8   | 2.0   | 3.0   | 4.0   |
| P                  | 1-9   | < 30  | a <sub>p</sub> (mm)    | 0.04      | 0.054 | 0.067 | 0.077 | 0.093 | 0.102 | 0.11  | 0.12  | 0.135 | 0.19  | 0.27  |
|                    |       |       | v <sub>c</sub> (m/min) | 66        | 99    | 103   | 102   | 103   | 102   | 104   | 109   | 108   | 111   | 122   |
|                    |       |       | n                      | 35000     | 39500 | 33000 | 27000 | 23500 | 21500 | 20500 | 19500 | 17000 | 12000 | 10000 |
|                    |       |       | f <sub>z</sub>         | 0.006     | 0.006 | 0.007 | 0.009 | 0.009 | 0.011 | 0.012 | 0.012 | 0.014 | 0.021 | 0.025 |
|                    |       |       | f (mm/min)             | 420       | 450   | 450   | 480   | 420   | 475   | 500   | 450   | 480   | 500   | 500   |
|                    | 10-11 | 30-45 | a <sub>p</sub> (mm)    | 0.04      | 0.054 | 0.067 | 0.077 | 0.093 | 0.102 | 0.11  | 0.12  | 0.135 | 0.19  | 0.27  |
|                    |       |       | v <sub>c</sub> (m/min) | 48        | 64    | 73    | 73    | 72    | 73    | 74    | 76    | 77    | 78    | 85    |
|                    |       |       | n                      | 25000     | 25000 | 23000 | 19000 | 16500 | 15500 | 15000 | 13500 | 12500 | 8500  | 7000  |
|                    |       |       | f <sub>z</sub>         | 0.004     | 0.004 | 0.005 | 0.006 | 0.007 | 0.008 | 0.009 | 0.009 | 0.01  | 0.014 | 0.018 |
|                    |       |       | f (mm/min)             | 200       | 200   | 230   | 230   | 230   | 250   | 265   | 250   | 245   | 230   | 250   |
| K                  | 15-20 |       | a <sub>p</sub> (mm)    | 0.04      | 0.054 | 0.067 | 0.077 | 0.093 | 0.102 | 0.11  | 0.12  | 0.135 | 0.19  | 0.27  |
|                    |       |       | v <sub>c</sub> (m/min) | 66        | 99    | 103   | 102   | 103   | 102   | 104   | 109   | 108   | 111   | 122   |
|                    |       |       | n                      | 35000     | 39500 | 33000 | 27000 | 23500 | 21500 | 20500 | 19500 | 17000 | 12000 | 10000 |
|                    |       |       | f <sub>z</sub>         | 0.006     | 0.006 | 0.007 | 0.009 | 0.009 | 0.011 | 0.012 | 0.012 | 0.014 | 0.021 | 0.025 |
|                    |       |       | f (mm/min)             | 420       | 450   | 450   | 480   | 420   | 475   | 500   | 450   | 480   | 500   | 500   |
| H                  | 38    | 45-55 | a <sub>p</sub> (mm)    | 0.008     | 0.01  | 0.013 | 0.015 | 0.018 | 0.021 | 0.022 | 0.024 | 0.026 | 0.041 | 0.052 |
|                    |       |       | v <sub>c</sub> (m/min) | 30        | 40    | 46    | 47    | 46    | 45    | 47    | 48    | 49    | 49    | 55    |
|                    |       |       | n                      | 16000     | 16000 | 14500 | 12500 | 10500 | 9500  | 9000  | 8500  | 7500  | 5500  | 4500  |
|                    |       |       | f <sub>z</sub>         | 0.005     | 0.005 | 0.006 | 0.007 | 0.009 | 0.009 | 0.01  | 0.011 | 0.012 | 0.018 | 0.021 |
|                    |       |       | f (mm/min)             | 160       | 160   | 175   | 175   | 190   | 170   | 185   | 185   | 185   | 185   | 185   |



► The data shown is based on medial length tools. Please adjust machining conditions according to length.

v<sub>c</sub> - cutting speed (m/min)  
 n - RPM (rev/min)  
 f<sub>z</sub> - feed rate (mm/tooth)  
 f - feed rate (mm/rev)  
 z - No. of teeth  
 a<sub>p</sub> - axial depth of cut  
 a<sub>e</sub> - radial depth of cut

$$\text{To calculate RPM from cutting speed: } n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$$

$$\text{To calculate cutting speed from RPM: } v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA

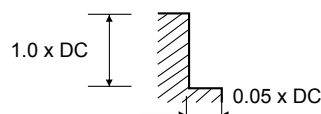


103120, 103320 (3 Flute Miniature)



PROFILING

| VDI MATERIAL GROUP |        | HRc   |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|--------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |        |       |                        | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 1-9    | < 30  | v <sub>c</sub> (m/min) | 50        | 75    | 85    | 95    | 100   | 105   | 105   | 100   | 105   | 110   | 105   |
|                    |        |       | n                      | 15500     | 11560 | 8920  | 7560  | 6300  | 5560  | 4200  | 3260  | 2740  | 2200  | 1680  |
|                    |        |       | f <sub>z</sub>         | 0.004     | 0.006 | 0.009 | 0.019 | 0.024 | 0.03  | 0.042 | 0.047 | 0.047 | 0.047 | 0.048 |
|                    |        |       | f (mm/min)             | 190       | 210   | 240   | 430   | 450   | 500   | 530   | 460   | 390   | 310   | 240   |
|                    | 10-11  | 30-45 | v <sub>c</sub> (m/min) | 30        | 50    | 50    | 60    | 60    | 65    | 65    | 65    | 65    | 75    | 65    |
|                    |        |       | n                      | 9550      | 7560  | 5560  | 4620  | 3780  | 3360  | 2520  | 2000  | 1680  | 1360  | 1060  |
|                    |        |       | f <sub>z</sub>         | 0.004     | 0.006 | 0.009 | 0.018 | 0.024 | 0.029 | 0.042 | 0.046 | 0.044 | 0.047 | 0.046 |
|                    |        |       | f (mm/min)             | 115       | 140   | 150   | 260   | 270   | 310   | 290   | 230   | 190   | 150   | 120   |
| M                  | 12, 13 |       | v <sub>c</sub> (m/min) | 25        | 40    | 45    | 50    | 50    | 55    | 55    | 55    | 50    | 55    | 55    |
|                    |        |       | n                      | 7960      | 6300  | 4620  | 3880  | 3160  | 2840  | 2100  | 1680  | 1360  | 1060  | 840   |
|                    |        |       | f <sub>z</sub>         | 0.004     | 0.006 | 0.009 | 0.018 | 0.024 | 0.029 | 0.042 | 0.046 | 0.044 | 0.047 | 0.046 |
|                    |        |       | f (mm/min)             | 100       | 115   | 125   | 210   | 230   | 250   | 265   | 230   | 180   | 150   | 115   |
| H                  | 38     | 45-55 | v <sub>c</sub> (m/min) | 20        | 30    | 30    | 35    | 35    | 40    | 40    | 45    | 45    | 45    | 45    |
|                    |        |       | n                      | 6360      | 5040  | 3360  | 2940  | 2320  | 2000  | 1680  | 1360  | 1160  | 900   | 680   |
|                    |        |       | f <sub>z</sub>         | 0.001     | 0.002 | 0.004 | 0.005 | 0.008 | 0.01  | 0.016 | 0.017 | 0.017 | 0.017 | 0.015 |
|                    |        |       | f (mm/min)             | 20        | 30    | 40    | 445   | 55    | 60    | 80    | 70    | 60    | 45    | 30    |
|                    | 39     | 55-65 | v <sub>c</sub> (m/min) | -         | -     | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    |
|                    |        |       | n                      | -         | -     | 1900  | 1480  | 1260  | 1100  | 840   | 680   | 560   | 440   | 320   |
|                    |        |       | f <sub>z</sub>         | -         | -     | 0.008 | 0.01  | 0.012 | 0.014 | 0.018 | 0.017 | 0.021 | 0.015 | 0.021 |
|                    |        |       | f (mm/min)             | -         | -     | 45    | 45    | 45    | 45    | 45    | 35    | 35    | 20    | 20    |



v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



103120, 103320 (3 Flute Miniature)

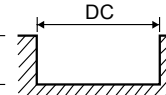


SLOTING

| VDI MATERIAL GROUP |        | HRc   |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|--------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |        |       |                        | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 1-9    | < 30  | v <sub>c</sub> (m/min) | 50        | 75    | 85    | 95    | 100   | 105   | 105   | 100   | 105   | 110   | 105   |
|                    |        |       | n                      | 15500     | 11560 | 8920  | 7560  | 6300  | 5560  | 4200  | 3260  | 2740  | 2200  | 1680  |
|                    |        |       | f <sub>z</sub>         | 0.003     | 0.005 | 0.007 | 0.012 | 0.015 | 0.019 | 0.027 | 0.031 | 0.03  | 0.03  | 0.03  |
|                    |        |       | f (mm/min)             | 140       | 170   | 190   | 270   | 280   | 310   | 340   | 300   | 250   | 200   | 150   |
|                    | 10-11  | 30-45 | v <sub>c</sub> (m/min) | 30        | 50    | 50    | 60    | 60    | 65    | 65    | 65    | 65    | 75    | 65    |
|                    |        |       | n                      | 9550      | 7560  | 5560  | 4620  | 3780  | 3360  | 2520  | 2000  | 1680  | 1360  | 1060  |
|                    |        |       | f <sub>z</sub>         | 0.003     | 0.005 | 0.008 | 0.012 | 0.015 | 0.02  | 0.024 | 0.023 | 0.024 | 0.025 | 0.022 |
|                    |        |       | f (mm/min)             | 90        | 110   | 130   | 160   | 170   | 200   | 180   | 140   | 120   | 100   | 70    |
| M                  | 12, 13 |       | v <sub>c</sub> (m/min) | 25        | 40    | 45    | 50    | 50    | 55    | 55    | 55    | 50    | 55    | 55    |
|                    |        |       | n                      | 7960      | 6300  | 4620  | 3880  | 3160  | 2840  | 2100  | 1680  | 1360  | 1060  | 840   |
|                    |        |       | f <sub>z</sub>         | 0.002     | 0.004 | 0.008 | 0.011 | 0.015 | 0.019 | 0.025 | 0.029 | 0.029 | 0.031 | 0.028 |
|                    |        |       | f (mm/min)             | 50        | 80    | 110   | 130   | 140   | 160   | 160   | 145   | 120   | 100   | 70    |
| H                  | 38     | 45-55 | v <sub>c</sub> (m/min) | 20        | 30    | 30    | 35    | 35    | 40    | 40    | 45    | 45    | 45    | 45    |
|                    |        |       | n                      | 6360      | 5040  | 3360  | 2940  | 2320  | 2000  | 1680  | 1360  | 1160  | 900   | 680   |
|                    |        |       | f <sub>z</sub>         | 0.001     | 0.002 | 0.003 | 0.004 | 0.006 | 0.008 | 0.013 | 0.013 | 0.014 | 0.013 | 0.012 |
|                    |        |       | f (mm/min)             | 20        | 30    | 35    | 35    | 45    | 50    | 65    | 55    | 50    | 35    | 25    |
|                    | 39     | 55-65 | v <sub>c</sub> (m/min) | -         | -     | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    |
|                    |        |       | n                      | -         | -     | 1900  | 1480  | 1260  | 1100  | 840   | 680   | 560   | 440   | 320   |
|                    |        |       | f <sub>z</sub>         | -         | -     | 0.007 | 0.008 | 0.009 | 0.011 | 0.014 | 0.015 | 0.018 | 0.015 | 0.021 |
|                    |        |       | f (mm/min)             | -         | -     | 40    | 35    | 35    | 35    | 35    | 30    | 30    | 20    | 20    |

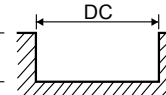
< HRc45

< Ø 3.0mm: 0.2 x DC  
≥ Ø 3.0mm: 0.5 x DC



> HRc45

0.05 x DC



v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.



# CUTTING DATA



109120, 109320 (4 Flute Short Length)



| VDI MATERIAL GROUP |        | HRc                    |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|--------|------------------------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |        |                        |                        | 2.0       | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  | 25.0  |
| P                  | 1-9    | < 30                   | v <sub>c</sub> (m/min) | 75        | 85    | 95    | 100   | 105   | 105   | 100   | 105   | 110   | 105   | 105   |
|                    |        |                        | n                      | 11560     | 8920  | 7560  | 6300  | 5560  | 4200  | 3260  | 2740  | 2200  | 1680  | 1360  |
|                    |        |                        | f <sub>z</sub>         | 0.006     | 0.009 | 0.019 | 0.024 | 0.03  | 0.042 | 0.047 | 0.047 | 0.047 | 0.048 | 0.046 |
|                    |        |                        | f (mm/min)             | 280       | 320   | 570   | 600   | 660   | 710   | 610   | 520   | 410   | 320   | 250   |
|                    | 10-11  | 30-45                  | v <sub>c</sub> (m/min) | 50        | 50    | 60    | 60    | 65    | 65    | 65    | 65    | 70    | 65    | 65    |
|                    |        |                        | n                      | 7560      | 5560  | 4620  | 3780  | 3360  | 2520  | 2000  | 1680  | 1360  | 1060  | 840   |
|                    |        |                        | f <sub>z</sub>         | 0.006     | 0.009 | 0.019 | 0.024 | 0.031 | 0.038 | 0.038 | 0.037 | 0.037 | 0.038 | 0.039 |
|                    |        |                        | f (mm/min)             | 170       | 200   | 350   | 360   | 410   | 380   | 300   | 250   | 200   | 160   | 130   |
| M                  | 12, 13 | v <sub>c</sub> (m/min) | 40                     | 45        | 50    | 50    | 55    | 55    | 55    | 50    | 55    | 55    | 55    |       |
|                    |        | n                      | 6300                   | 4620      | 3880  | 3160  | 2840  | 2100  | 1680  | 1360  | 1100  | 840   | 680   |       |
|                    |        | f <sub>z</sub>         | 0.006                  | 0.009     | 0.018 | 0.024 | 0.029 | 0.042 | 0.045 | 0.044 | 0.045 | 0.045 | 0.044 |       |
|                    |        | f (mm/min)             | 140                    | 170       | 280   | 300   | 330   | 350   | 300   | 240   | 200   | 150   | 120   |       |
| H                  | 38     | 45-55                  | v <sub>c</sub> (m/min) | 30        | 30    | 35    | 35    | 40    | 40    | 45    | 45    | 45    | 45    | 40    |
|                    |        |                        | n                      | 5040      | 3360  | 2940  | 2320  | 2000  | 1680  | 1360  | 1160  | 900   | 680   | 540   |
|                    |        |                        | f <sub>z</sub>         | 0.002     | 0.004 | 0.005 | 0.008 | 0.01  | 0.016 | 0.017 | 0.017 | 0.017 | 0.015 | 0.014 |
|                    |        |                        | f (mm/min)             | 50        | 60    | 60    | 70    | 80    | 110   | 90    | 80    | 60    | 40    | 30    |
|                    | 39     | 55-65                  | v <sub>c</sub> (m/min) | -         | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    |
|                    |        |                        | n                      | -         | 1900  | 1480  | 1260  | 1100  | 840   | 680   | 560   | 440   | 320   | 260   |
|                    |        |                        | f <sub>z</sub>         | -         | 0.007 | 0.008 | 0.01  | 0.011 | 0.015 | 0.015 | 0.018 | 0.014 | 0.02  | 0.019 |
|                    |        |                        | f (mm/min)             | -         | 50    | 50    | 50    | 50    | 50    | 40    | 40    | 25    | 25    | 20    |

1.0 x DC

0.05 x DC

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



111120, 111320 (4 Flute Long Length)



| VDI MATERIAL GROUP |       | HRc   |                        | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 2.0       | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  | 25.0  |
| P                  | 1-9   | < 30  | v <sub>c</sub> (m/min) | 55        | 60    | 65    | 65    | 70    | 70    | 75    | 70    | 80    | 75    | 75    |
|                    |       |       | n                      | 8820      | 6170  | 5000  | 4270  | 3680  | 2800  | 2350  | 1920  | 1620  | 1180  | 955   |
|                    |       |       | f <sub>z</sub>         | 0.006     | 0.009 | 0.014 | 0.021 | 0.029 | 0.041 | 0.049 | 0.047 | 0.049 | 0.049 | 0.047 |
|                    |       |       | f (mm/min)             | 200       | 230   | 280   | 360   | 430   | 460   | 460   | 360   | 320   | 230   | 180   |
|                    | 10-11 | 30-45 | v <sub>c</sub> (m/min) | 30        | 35    | 35    | 40    | 40    | 40    | 45    | 45    | 45    | 45    | 45    |
|                    |       |       | n                      | 5040      | 3570  | 2840  | 2420  | 2100  | 1580  | 1370  | 1160  | 890   | 680   | 570   |
|                    |       |       | f <sub>z</sub>         | 0.004     | 0.007 | 0.01  | 0.014 | 0.021 | 0.028 | 0.033 | 0.034 | 0.035 | 0.033 | 0.033 |
|                    |       |       | f (mm/min)             | 80        | 100   | 115   | 140   | 180   | 180   | 180   | 160   | 125   | 90    | 75    |
| H                  | 38    | 45-55 | v <sub>c</sub> (m/min) | 20        | 20    | 20    | 25    | 25    | 25    | 25    | 25    | 30    | 25    | 25    |
|                    |       |       | n                      | 3150      | 2200  | 1790  | 1580  | 1370  | 1050  | 840   | 700   | 560   | 420   | 320   |
|                    |       |       | f <sub>z</sub>         | 0.004     | 0.006 | 0.008 | 0.011 | 0.016 | 0.021 | 0.027 | 0.025 | 0.027 | 0.027 | 0.025 |
|                    |       |       | f (mm/min)             | 45        | 55    | 60    | 70    | 90    | 90    | 90    | 70    | 60    | 45    | 30    |
|                    | 39    | 55-65 | v <sub>c</sub> (m/min) | -         | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    | 20    |
|                    |       |       | n                      | -         | 1890  | 1470  | 1260  | 1160  | 840   | 670   | 560   | 440   | 340   | 255   |
|                    |       |       | f <sub>z</sub>         | -         | 0.004 | 0.006 | 0.008 | 0.011 | 0.015 | 0.019 | 0.018 | 0.02  | 0.018 | 0.018 |
|                    |       |       | f (mm/min)             | -         | 30    | 35    | 40    | 50    | 50    | 50    | 40    | 35    | 25    | 20    |

< HRc45

2.5 x DC

0.05 x DC

> HRc45

2.0 x DC

0.02 x DC

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

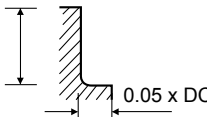
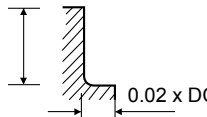
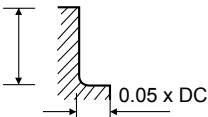
All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



157120, 157320 (4 Flute Long Length, Corner Radius)



| VDI MATERIAL GROUP                                                                                                                                            |       | HRc                    |                        | Size (mm)                                                                                                                                                   |       |       |       |                                                                                                                                                                 |       |       |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|
|                                                                                                                                                               |       |                        |                        | 3.0                                                                                                                                                         | 4.0   | 5.0   | 6.0   | 8.0                                                                                                                                                             | 10.0  | 12.0  | 16.0  |
| P                                                                                                                                                             | 1-9   | < 30                   | v <sub>c</sub> (m/min) | 60                                                                                                                                                          | 65    | 70    | 75    | 75                                                                                                                                                              | 80    | 80    | 85    |
|                                                                                                                                                               |       |                        | n                      | 6620                                                                                                                                                        | 5360  | 4580  | 3950  | 3000                                                                                                                                                            | 2520  | 2060  | 1740  |
|                                                                                                                                                               |       |                        | f <sub>z</sub>         | 0.006                                                                                                                                                       | 0.01  | 0.012 | 0.014 | 0.019                                                                                                                                                           | 0.023 | 0.022 | 0.023 |
|                                                                                                                                                               |       |                        | f (mm/min)             | 170                                                                                                                                                         | 210   | 215   | 215   | 230                                                                                                                                                             | 230   | 180   | 160   |
|                                                                                                                                                               | 10-11 | 30-45                  | v <sub>c</sub> (m/min) | 40                                                                                                                                                          | 45    | 45    | 50    | 50                                                                                                                                                              | 50    | 50    | 55    |
|                                                                                                                                                               |       |                        | n                      | 4280                                                                                                                                                        | 3410  | 2900  | 2520  | 1900                                                                                                                                                            | 1640  | 1390  | 1070  |
|                                                                                                                                                               |       |                        | f <sub>z</sub>         | 0.008                                                                                                                                                       | 0.011 | 0.016 | 0.018 | 0.024                                                                                                                                                           | 0.027 | 0.029 | 0.029 |
|                                                                                                                                                               |       |                        | f (mm/min)             | 130                                                                                                                                                         | 150   | 180   | 180   | 180                                                                                                                                                             | 180   | 160   | 125   |
| K                                                                                                                                                             | 15-20 | v <sub>c</sub> (m/min) | 60                     | 65                                                                                                                                                          | 70    | 75    | 75    | 80                                                                                                                                                              | 80    | 85    |       |
|                                                                                                                                                               |       | n                      | 6620                   | 5360                                                                                                                                                        | 4580  | 3950  | 3000  | 2520                                                                                                                                                            | 2060  | 1740  |       |
|                                                                                                                                                               |       | f <sub>z</sub>         | 0.006                  | 0.01                                                                                                                                                        | 0.012 | 0.014 | 0.019 | 0.023                                                                                                                                                           | 0.022 | 0.023 |       |
|                                                                                                                                                               |       | f (mm/min)             | 170                    | 210                                                                                                                                                         | 215   | 215   | 230   | 230                                                                                                                                                             | 180   | 160   |       |
| H                                                                                                                                                             | 38    | 45-55                  | v <sub>c</sub> (m/min) | 25                                                                                                                                                          | 25    | 30    | 30    | 30                                                                                                                                                              | 30    | 30    | 35    |
|                                                                                                                                                               |       |                        | n                      | 2640                                                                                                                                                        | 2150  | 1900  | 1640  | 1260                                                                                                                                                            | 1010  | 840   | 670   |
|                                                                                                                                                               |       |                        | f <sub>z</sub>         | 0.006                                                                                                                                                       | 0.008 | 0.011 | 0.013 | 0.017                                                                                                                                                           | 0.021 | 0.021 | 0.022 |
|                                                                                                                                                               |       |                        | f (mm/min)             | 65                                                                                                                                                          | 70    | 85    | 85    | 85                                                                                                                                                              | 85    | 70    | 60    |
|                                                                                                                                                               | 39    | 55-65                  | v <sub>c</sub> (m/min) | 20                                                                                                                                                          | 20    | 20    | 20    | 20                                                                                                                                                              | 20    | 20    | 20    |
|                                                                                                                                                               |       |                        | n                      | 1870                                                                                                                                                        | 1470  | 1260  | 1160  | 840                                                                                                                                                             | 670   | 550   | 440   |
|                                                                                                                                                               |       |                        | f <sub>z</sub>         | 0.004                                                                                                                                                       | 0.006 | 0.008 | 0.011 | 0.015                                                                                                                                                           | 0.019 | 0.018 | 0.02  |
|                                                                                                                                                               |       |                        | f (mm/min)             | 30                                                                                                                                                          | 35    | 40    | 50    | 50                                                                                                                                                              | 50    | 40    | 35    |
| <div>&lt; HRc45</div> <div><div><div>2.5 x DC</div><div></div></div></div> |       |                        |                        | <div>HRc45-55</div> <div><div><div>2.0 x DC</div><div></div></div></div> |       |       |       | <div>&gt; HRc55</div> <div><div><div>1.0 x DC</div><div></div></div></div> |       |       |       |

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

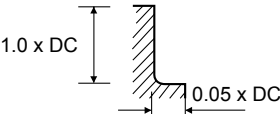
All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



156120, 156320 (4 Flute Stub Length, Corner Radius)



| VDI MATERIAL GROUP |       | HRc                    |                        | Size (mm)                                                                             |       |       |          |       |       |           |       |       |
|--------------------|-------|------------------------|------------------------|---------------------------------------------------------------------------------------|-------|-------|----------|-------|-------|-----------|-------|-------|
|                    |       |                        |                        | 2.0                                                                                   | 3.0   | 4.0   | 5.0      | 6.0   | 8.0   | 10.0      | 12.0  | 16.0  |
| P                  | 1-9   | < 30                   | v <sub>c</sub> (m/min) | 85                                                                                    | 100   | 115   | 120      | 125   | 125   | 125       | 125   | 135   |
|                    |       |                        | n                      | 13870                                                                                 | 10700 | 9070  | 7560     | 6670  | 5040  | 3910      | 3290  | 2640  |
|                    |       |                        | f <sub>z</sub>         | 0.006                                                                                 | 0.009 | 0.019 | 0.024    | 0.03  | 0.042 | 0.047     | 0.047 | 0.046 |
|                    |       |                        | f (mm/min)             | 340                                                                                   | 385   | 685   | 720      | 790   | 850   | 730       | 625   | 490   |
|                    | 10-11 | 30-45                  | v <sub>c</sub> (m/min) | 55                                                                                    | 65    | 70    | 70       | 75    | 75    | 75        | 75    | 80    |
|                    |       |                        | n                      | 9070                                                                                  | 6670  | 5540  | 4540     | 4030  | 3020  | 2400      | 2020  | 1630  |
|                    |       |                        | f <sub>z</sub>         | 0.006                                                                                 | 0.009 | 0.019 | 0.024    | 0.030 | 0.038 | 0.038     | 0.037 | 0.037 |
|                    |       |                        | f (mm/min)             | 205                                                                                   | 240   | 420   | 430      | 490   | 455   | 360       | 300   | 240   |
| K                  | 15-20 | v <sub>c</sub> (m/min) | 85                     | 100                                                                                   | 115   | 120   | 125      | 125   | 125   | 125       | 135   |       |
|                    |       | n                      | 13870                  | 10700                                                                                 | 9070  | 7560  | 6670     | 5040  | 3910  | 3290      | 2640  |       |
|                    |       | f <sub>z</sub>         | 0.006                  | 0.009                                                                                 | 0.019 | 0.024 | 0.03     | 0.042 | 0.047 | 0.047     | 0.046 |       |
|                    |       | f (mm/min)             | 340                    | 385                                                                                   | 685   | 720   | 790      | 850   | 730   | 625       | 490   |       |
| H                  | 38    | 45-55                  | v <sub>c</sub> (m/min) | 40                                                                                    | 40    | 45    | 45       | 45    | 50    | 50        | 50    | 55    |
|                    |       |                        | n                      | 6050                                                                                  | 4030  | 3530  | 2780     | 2400  | 2020  | 1630      | 1390  | 1080  |
|                    |       |                        | f <sub>z</sub>         | 0.002                                                                                 | 0.004 | 0.005 | 0.008    | 0.01  | 0.016 | 0.017     | 0.017 | 0.016 |
|                    |       |                        | f (mm/min)             | 60                                                                                    | 70    | 70    | 85       | 95    | 130   | 110       | 95    | 70    |
|                    | 39    | 55-65                  | v <sub>c</sub> (m/min) | -                                                                                     | 20    | 20    | 25       | 25    | 25    | 25        | 25    | 25    |
|                    |       |                        | n                      | -                                                                                     | 2280  | 1780  | 1510     | 1320  | 1010  | 820       | 670   | 530   |
|                    |       |                        | f <sub>z</sub>         | -                                                                                     | 0.008 | 0.01  | 0.012    | 0.013 | 0.017 | 0.018     | 0.022 | 0.017 |
|                    |       |                        | f (mm/min)             | -                                                                                     | 70    | 70    | 70       | 70    | 70    | 60        | 60    | 35    |
|                    |       |                        |                        |  |       |       | 1.0 x DC |       |       | 0.05 x DC |       |       |

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

## CUTTING DATA



115120, 115320 (4 Flute Long, Ball Nose)



| VDI MATERIAL GROUP |       | HRc   | NORMAL SPEED           | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 6-11  | 30-40 | v <sub>c</sub> (m/min) | 40        | 75    | 95    | 105   | 115   | 130   | 145   | 160   | 175   | 190   | 205   |
|                    |       |       | n                      | 12720     | 11560 | 10000 | 8400  | 7300  | 6900  | 5770  | 5090  | 4640  | 3780  | 3260  |
|                    |       |       | f <sub>z</sub>         | 0.006     | 0.01  | 0.017 | 0.024 | 0.03  | 0.045 | 0.06  | 0.075 | 0.059 | 0.106 | 0.12  |
|                    |       |       | f (mm/min)             | 300       | 480   | 690   | 800   | 870   | 1250  | 1380  | 1530  | 1650  | 1600  | 1560  |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 50        | 100   | 125   | 130   | 145   | 160   | 180   | 200   | 220   | 240   | 260   |
|                    |       |       | n                      | 15760     | 15760 | 13100 | 10500 | 9140  | 8490  | 7160  | 6370  | 5840  | 4770  | 4140  |
|                    |       |       | f <sub>z</sub>         | 0.006     | 0.013 | 0.019 | 0.026 | 0.034 | 0.045 | 0.068 | 0.09  | 0.111 | 0.136 | 0.151 |
|                    |       |       | f (mm/min)             | 380       | 800   | 1020  | 1110  | 1230  | 1530  | 1950  | 2300  | 2600  | 2600  | 2500  |
| H                  | 38-39 | 45-65 | v <sub>c</sub> (m/min) | 20        | 30    | 45    | 55    | 60    | 60    | 60    | 65    | 65    | 70    | 70    |
|                    |       |       | n                      | 5800      | 4840  | 4520  | 4200  | 3680  | 3180  | 2470  | 2040  | 1750  | 1350  | 1110  |
|                    |       |       | f <sub>z</sub>         | 0.006     | 0.008 | 0.012 | 0.016 | 0.018 | 0.022 | 0.033 | 0.042 | 0.053 | 0.069 | 0.084 |
|                    |       |       | f (mm/min)             | 130       | 160   | 220   | 270   | 270   | 280   | 330   | 340   | 370   | 370   | 375   |

< HRc45

a<sub>p</sub>: ø1.0mm - 6.0mm = 0.2mm

a<sub>p</sub>: ø8.0mm - 20.0mm = 0.3mm

a<sub>e</sub>: 0.2 x DC

> HRc45

a<sub>p</sub>: ø1.0mm - 6.0mm = 0.2mm

a<sub>p</sub>: ø8.0mm - 20.0mm = 0.3mm

a<sub>e</sub>: 0.1 x DC

| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED    | Size (mm) |       |       |       |       |       |       |       |       |       |       |
|--------------------|-------|-------|---------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    |       |       |               | 1.0       | 2.0   | 3.0   | 4.0   | 5.0   | 6.0   | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 6-11  | 30-40 | $v_c$ (m/min) | 80        | 130   | 200   | 265   | 330   | 395   | 420   | 440   | 460   | 480   | 500   |
|                    |       |       | $n$           | 25000     | 21000 | 21000 | 21000 | 21000 | 21000 | 16700 | 14000 | 12200 | 9550  | 7960  |
|                    |       |       | $f_z$         | 0.02      | 0.026 | 0.036 | 0.052 | 0.064 | 0.071 | 0.09  | 0.104 | 0.12  | 0.136 | 0.15  |
|                    |       |       | $f$ (mm/min)  | 1950      | 220   | 3000  | 4400  | 5400  | 6000  | 6000  | 5850  | 5850  | 5180  | 4770  |
| K                  | 15-20 |       | $v_c$ (m/min) | 80        | 130   | 200   | 265   | 330   | 395   | 420   | 440   | 460   | 480   | 500   |
|                    |       |       | $n$           | 2500      | 21000 | 21000 | 21000 | 21000 | 21000 | 16700 | 14000 | 12200 | 9550  | 7960  |
|                    |       |       | $f_z$         | 0.02      | 0.026 | 0.036 | 0.052 | 0.064 | 0.071 | 0.09  | 0.104 | 0.12  | 0.136 | 0.15  |
|                    |       |       | $f$ (mm/min)  | 1950      | 220   | 3000  | 4400  | 5400  | 6000  | 6000  | 5850  | 5850  | 5180  | 4770  |
| H                  | 38-39 | 45-65 | $v_c$ (m/min) | 80        | 130   | 160   | 170   | 190   | 200   | 210   | 220   | 230   | 240   | 250   |
|                    |       |       | $n$           | 25000     | 21000 | 17000 | 13660 | 12000 | 10500 | 8360  | 7000  | 6100  | 4770  | 3980  |
|                    |       |       | $f_z$         | 0.012     | 0.017 | 0.023 | 0.032 | 0.038 | 0.045 | 0.056 | 0.064 | 0.071 | 0.079 | 0.087 |
|                    |       |       | $f$ (mm/min)  | 1200      | 1400  | 1560  | 1750  | 1800  | 1880  | 1880  | 1800  | 1740  | 1500  | 1380  |

$a_p$

$a_e$

$a_p$ :  $\varnothing 1.0\text{mm} - 6.0\text{mm} = 0.2\text{mm}$   
 $a_p$ :  $\varnothing 8.0\text{mm} - 20.0\text{mm} = 0.3\text{mm}$   
 $a_e$ :  $0.05 \times \text{DC}$

## CUTTING DATA



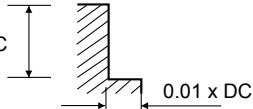
150120, 150320 (6 Flute Extra Length, 45° Helix)



| VDI MATERIAL GROUP |       | HRc   |               | Size (mm) |       |       |       |       |       |       |
|--------------------|-------|-------|---------------|-----------|-------|-------|-------|-------|-------|-------|
|                    |       |       |               | 6.0       | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  | 25.0  |
| P                  | 6-11  | 30-40 | $v_c$ (m/min) | 40        | 40    | 40    | 40    | 40    | 40    | 40    |
|                    |       |       | $n$           | 2230      | 1670  | 1330  | 1110  | 840   | 670   | 540   |
|                    |       |       | $f_z$         | 0.035     | 0.045 | 0.055 | 0.06  | 0.065 | 0.07  | 0.074 |
|                    |       |       | $f$ (mm/min)  | 470       | 450   | 440   | 400   | 33    | 280   | 240   |
| H                  | 38    | 40-50 | $v_c$ (m/min) | 30        | 30    | 30    | 30    | 30    | 30    | 30    |
|                    |       |       | $n$           | 1670      | 1250  | 1000  | 840   | 630   | 500   | 400   |
|                    |       |       | $f_z$         | 0.035     | 0.044 | 0.05  | 0.054 | 0.061 | 0.067 | 0.071 |
|                    |       |       | $f$ (mm/min)  | 350       | 330   | 300   | 270   | 230   | 200   | 170   |
|                    | 38-39 | 50-60 | $v_c$ (m/min) | 25        | 25    | 25    | 25    | 25    | 25    | 25    |
|                    |       |       | $n$           | 1390      | 1050  | 840   | 690   | 530   | 420   | 340   |
|                    |       |       | $f_z$         | 0.03      | 0.038 | 0.046 | 0.051 | 0.053 | 0.06  | 0.064 |
|                    |       |       | $f$ (mm/min)  | 250       | 240   | 230   | 210   | 170   | 150   | 130   |
|                    | 39    | 60-65 | $v_c$ (m/min) | 20        | 20    | 20    | 20    | 20    | 20    | 20    |
|                    |       |       | $n$           | 1110      | 840   | 680   | 560   | 420   | 320   | 270   |
|                    |       |       | $f_z$         | 0.03      | 0.036 | 0.039 | 0.045 | 0.052 | 0.063 | 0.059 |
|                    |       |       | $f$ (mm/min)  | 200       | 180   | 160   | 150   | 130   | 120   | 95    |

< HRc50

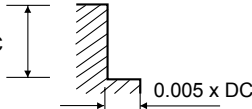
3.0 x DC



0.01 x DC

> HRc50

3.0 x DC



0.005 x DC

$v_c$  - cutting speed (m/min)  
 $n$  - RPM (rev/min)  
 $f_z$  - feed rate (mm/tooth)  
 $f$  - feed rate (mm/rev)  
 $z$  - No. of teeth  
 $a_p$  - axial depth of cut  
 $a_e$  - radial depth of cut

$$\text{To calculate RPM from cutting speed: } n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$$

$$\text{To calculate cutting speed from RPM: } v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$$

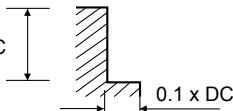
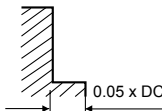
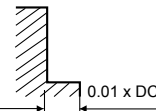
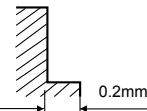
All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA

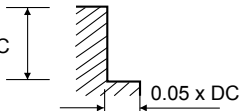
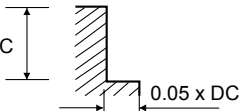
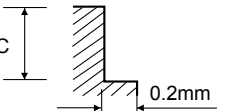


149120, 149320 (6&8 Flute Long, 45° Helix)



| VDI MATERIAL GROUP                                                                  |       | HRc   | NORMAL SPEED                                                                        | Size (mm) |       |                                                                                      |       |       |                                                                                       |       |  |
|-------------------------------------------------------------------------------------|-------|-------|-------------------------------------------------------------------------------------|-----------|-------|--------------------------------------------------------------------------------------|-------|-------|---------------------------------------------------------------------------------------|-------|--|
|                                                                                     |       |       |                                                                                     | 6.0       | 8.0   | 10.0                                                                                 | 12.0  | 16.0  | 20.0                                                                                  | 25.0  |  |
| P                                                                                   | 6-11  | 30-40 | v <sub>c</sub> (m/min)                                                              | 105       | 105   | 105                                                                                  | 105   | 105   | 105                                                                                   | 120   |  |
|                                                                                     |       |       | n                                                                                   | 5560      | 4200  | 3360                                                                                 | 2840  | 2100  | 1680                                                                                  | 1500  |  |
|                                                                                     |       |       | f <sub>z</sub>                                                                      | 0.06      | 0.079 | 0.099                                                                                | 0.099 | 0.1   | 0.075                                                                                 | 0.075 |  |
|                                                                                     |       |       | f (mm/min)                                                                          | 2000      | 2000  | 2000                                                                                 | 1680  | 1260  | 1010                                                                                  | 900   |  |
| H                                                                                   | 38    | < 50  | v <sub>c</sub> (m/min)                                                              | 75        | 75    | 75                                                                                   | 75    | 75    | 75                                                                                    | 85    |  |
|                                                                                     |       |       | n                                                                                   | 3880      | 2940  | 2320                                                                                 | 2000  | 1480  | 1160                                                                                  | 1100  |  |
|                                                                                     |       |       | f <sub>z</sub>                                                                      | 0.059     | 0.078 | 0.098                                                                                | 0.097 | 0.099 | 0.074                                                                                 | 0.068 |  |
|                                                                                     |       |       | f (mm/min)                                                                          | 1370      | 1370  | 1370                                                                                 | 1160  | 880   | 690                                                                                   | 600   |  |
|                                                                                     | 38-39 | 50-60 | v <sub>c</sub> (m/min)                                                              | 30        | 30    | 30                                                                                   | 30    | 30    | 30                                                                                    | 35    |  |
|                                                                                     |       |       | n                                                                                   | 1580      | 1160  | 1000                                                                                 | 840   | 640   | 500                                                                                   | 430   |  |
|                                                                                     |       |       | f <sub>z</sub>                                                                      | 0.022     | 0.03  | 0.035                                                                                | 0.036 | 0.034 | 0.028                                                                                 | 0.026 |  |
|                                                                                     |       |       | f (mm/min)                                                                          | 210       | 210   | 210                                                                                  | 180   | 130   | 110                                                                                   | 90    |  |
|                                                                                     | 39    | > 60  | v <sub>c</sub> (m/min)                                                              | 20        | 20    | 20                                                                                   | 20    | 20    | 20                                                                                    | 20    |  |
|                                                                                     |       |       | n                                                                                   | 1100      | 840   | 680                                                                                  | 560   | 420   | 320                                                                                   | 260   |  |
|                                                                                     |       |       | f <sub>z</sub>                                                                      | 0.02      | 0.026 | 0.032                                                                                | 0.033 | 0.028 | 0.023                                                                                 | 0.024 |  |
|                                                                                     |       |       | f (mm/min)                                                                          | 130       | 130   | 130                                                                                  | 110   | 70    | 60                                                                                    | 50    |  |
| HRc30-40                                                                            |       |       | <HRc50                                                                              |           |       | HRc50-60                                                                             |       |       | > HRc60                                                                               |       |  |
|  |       |       |  |           |       |  |       |       |  |       |  |

| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED             | Size (mm) |       |       |      |      |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|------|------|-------|-------|
|                    |       |       |                        | 6.0       | 8.0   | 10.0  | 12.0 | 16.0 | 20.0  | 25.0  |
| H                  | 38    | < 50  | v <sub>c</sub> (m/min) | 315       | 315   | 315   | 315  | 315  | 315   | 355   |
|                    |       |       | n                      | 16800     | 12600 | 9980  | 8400 | 6300 | 5040  | 4500  |
|                    |       |       | f <sub>z</sub>         | 0.06      | 0.081 | 0.1   | 0.1  | 0.1  | 0.076 | 0.075 |
|                    |       |       | f (mm/min)             | 6090      | 6090  | 5990  | 5040 | 3780 | 3050  | 2700  |
|                    | 38-39 | 50-60 | v <sub>c</sub> (m/min) | 160       | 160   | 160   | 160  | 160  | 160   | 175   |
|                    |       |       | n                      | 8400      | 6300  | 5040  | 4200 | 3160 | 2520  | 2200  |
|                    |       |       | f <sub>z</sub>         | 0.061     | 0.081 | 0.101 | 0.1  | 0.1  | 0.073 | 0.074 |
|                    |       |       | f (mm/min)             | 3050      | 3050  | 3050  | 2520 | 1890 | 1470  | 1300  |
|                    | 39    | > 60  | v <sub>c</sub> (m/min) | 80        | 80    | 80    | 80   | 80   | 80    | 90    |
|                    |       |       | n                      | 4200      | 3160  | 2520  | 2100 | 1580 | 1260  | 1120  |
|                    |       |       | f <sub>z</sub>         | 0.058     | 0.078 | 0.097 | 0.1  | 0.1  | 0.075 | 0.075 |
|                    |       |       | f (mm/min)             | 1470      | 1470  | 1470  | 1260 | 950  | 760   | 670   |

|                                                                                                       |  |                                                                                                     |  |                                                                                                         |  |
|-------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------|--|
| <p>&lt; HRc50</p>  |  | <p>HRc50-60</p>  |  | <p>&gt; HRc60</p>  |  |
|-------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------|--|

# CUTTING DATA



158120, 158320 (6 Flute Long, 45° Helix, Corner Radius)



| VDI MATERIAL GROUP |       | HRc   | HIGH SPEED             | Size (mm) |       |       |      |      |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|------|------|-------|
|                    |       |       |                        | 6.0       | 8.0   | 10.0  | 12.0 | 16.0 | 20.0  |
| H                  | 38    | < 50  | v <sub>c</sub> (m/min) | 315       | 315   | 315   | 315  | 315  | 315   |
|                    |       |       | n                      | 16800     | 12600 | 9980  | 8400 | 6300 | 5040  |
|                    |       |       | f <sub>z</sub>         | 0.06      | 0.081 | 0.1   | 0.1  | 0.1  | 0.101 |
|                    |       |       | f (mm/min)             | 6090      | 6090  | 5990  | 5040 | 3780 | 3050  |
|                    | 38-39 | 50-60 | v <sub>c</sub> (m/min) | 160       | 160   | 160   | 160  | 160  | 160   |
|                    |       |       | n                      | 8400      | 6300  | 5040  | 4200 | 3160 | 2520  |
|                    |       |       | f <sub>z</sub>         | 0.061     | 0.081 | 0.101 | 0.1  | 0.1  | 0.097 |
|                    |       |       | f (mm/min)             | 3050      | 3050  | 3050  | 2520 | 1890 | 1470  |
|                    | 39    | > 60  | v <sub>c</sub> (m/min) | 80        | 80    | 80    | 80   | 80   | 80    |
|                    |       |       | n                      | 4200      | 3160  | 2520  | 2100 | 1580 | 1260  |
|                    |       |       | f <sub>z</sub>         | 0.058     | 0.078 | 0.097 | 0.1  | 0.1  | 0.101 |
|                    |       |       | f (mm/min)             | 1470      | 1470  | 1470  | 1260 | 950  | 760   |

|                   |  |                 |  |                   |  |
|-------------------|--|-----------------|--|-------------------|--|
| <b>&lt; HRc50</b> |  | <b>HRc50-60</b> |  | <b>&gt; HRc60</b> |  |
|                   |  |                 |  |                   |  |

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



148120, 148320, 147120, 147320 (Multiflute Short & Long Roughing)



| VDI MATERIAL GROUP |        | HRc   |                        | Size (mm) |       |       |       |       |       |       |
|--------------------|--------|-------|------------------------|-----------|-------|-------|-------|-------|-------|-------|
|                    |        |       |                        | 6.0       | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  | 25.0  |
| P                  | 1-9    | < 30  | v <sub>c</sub> (m/min) | 295       | 290   | 290   | 300   | 300   | 300   | 340   |
|                    |        |       | n                      | 15600     | 11600 | 9200  | 8000  | 6000  | 4800  | 4300  |
|                    |        |       | f <sub>z</sub>         | 0.05      | 0.067 | 0.063 | 0.075 | 0.1   | 0.113 | 0.1   |
|                    |        |       | f (mm/min)             | 2320      | 2320  | 2320  | 2400  | 2400  | 2160  | 2150  |
|                    | 10-11  | 30-45 | v <sub>c</sub> (m/min) | 235       | 230   | 240   | 225   | 240   | 225   | 250   |
|                    |        |       | n                      | 12400     | 9200  | 7600  | 6000  | 4800  | 3600  | 3200  |
|                    |        |       | f <sub>z</sub>         | 0.023     | 0.03  | 0.028 | 0.033 | 0.04  | 0.039 | 0.039 |
|                    |        |       | f (mm/min)             | 840       | 840   | 840   | 800   | 760   | 560   | 620   |
| M                  | 12, 13 |       | v <sub>c</sub> (m/min) | 160       | 160   | 160   | 160   | 165   | 150   | 170   |
|                    |        |       | n                      | 8400      | 6300  | 5100  | 4200  | 3300  | 2400  | 2160  |
|                    |        |       | f <sub>z</sub>         | 0.023     | 0.03  | 0.028 | 0.034 | 0.039 | 0.038 | 0.038 |
|                    |        |       | f (mm/min)             | 570       | 570   | 570   | 570   | 510   | 360   | 410   |
| K                  | 15-20  |       | v <sub>c</sub> (m/min) | 295       | 290   | 290   | 300   | 300   | 300   | 340   |
|                    |        |       | n                      | 15600     | 11600 | 9200  | 8000  | 6000  | 4800  | 4300  |
|                    |        |       | f <sub>z</sub>         | 0.05      | 0.067 | 0.063 | 0.075 | 0.1   | 0.113 | 0.1   |
|                    |        |       | f (mm/min)             | 2320      | 2320  | 2320  | 2400  | 2400  | 2160  | 2150  |
| H                  | 38     | 45-55 | v <sub>c</sub> (m/min) | 65        | 60    | 65    | 65    | 60    | 65    | 70    |
|                    |        |       | n                      | 3400      | 2400  | 2000  | 1680  | 1200  | 1000  | 900   |
|                    |        |       | f <sub>z</sub>         | 0.025     | 0.033 | 0.036 | 0.039 | 0.033 | 0.038 | 0.036 |
|                    |        |       | f (mm/min)             | 260       | 240   | 290   | 260   | 160   | 150   | 160   |
|                    | 39     | 55-65 | v <sub>c</sub> (m/min) | 45        | 45    | 40    | 45    | 40    | 40    | 45    |
|                    |        |       | n                      | 2400      | 1800  | 1300  | 1200  | 800   | 660   | 600   |
|                    |        |       | f <sub>z</sub>         | 0.026     | 0.033 | 0.037 | 0.04  | 0.034 | 0.038 | 0.033 |
|                    |        |       | f (mm/min)             | 190       | 180   | 190   | 190   | 110   | 100   | 100   |

< HRc45

1.5 x DC

0.3 x DC

> HRc45

1.0 x DC

0.05 x DC

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

# CUTTING DATA



145120, 145320 (3&4 Flute Long, Roughing, Ball Nose)



| VDI MATERIAL GROUP |       | HRc   |                        | Size (mm) |       |       |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|-------|-------|
|                    |       |       |                        | 6.0       | 8.0   | 10.0  | 12.0  | 16.0  | 20.0  |
| P                  | 1-9   | < 30  | v <sub>c</sub> (m/min) | 300       | 300   | 3000  | 295   | 300   | 300   |
|                    |       |       | n                      | 8000      | 6800  | 6000  | 5200  | 4800  | 4700  |
|                    |       |       | f <sub>z</sub>         | 0.075     | 0.088 | 0.1   | 0.112 | 0.113 | 0.112 |
|                    |       |       | f (mm/min)             | 2400      | 2400  | 2400  | 2320  | 2160  | 2140  |
|                    | 10-11 | 30-38 | v <sub>c</sub> (m/min) | 225       | 230   | 240   | 250   | 225   | 225   |
|                    |       |       | n                      | 6000      | 5200  | 4800  | 4400  | 3600  | 3500  |
|                    |       |       | f <sub>z</sub>         | 0.033     | 0.04  | 0.04  | 0.041 | 0.039 | 0.038 |
|                    |       |       | f (mm/min)             | 800       | 840   | 760   | 720   | 560   | 540   |
| K                  | 15-20 |       | v <sub>c</sub> (m/min) | 300       | 300   | 3000  | 295   | 300   | 300   |
|                    |       |       | n                      | 8000      | 6800  | 6000  | 5200  | 4800  | 4700  |
|                    |       |       | f <sub>z</sub>         | 0.075     | 0.088 | 0.1   | 0.112 | 0.113 | 0.112 |
|                    |       |       | f (mm/min)             | 2400      | 2400  | 2400  | 2320  | 2160  | 2140  |
| H                  | 38    | 38-45 | v <sub>c</sub> (m/min) | 160       | 160   | 165   | 155   | 150   | 150   |
|                    |       |       | n                      | 4200      | 3600  | 3300  | 2700  | 2400  | 2300  |
|                    |       |       | f <sub>z</sub>         | 0.034     | 0.04  | 0.039 | 0.039 | 0.038 | 0.037 |
|                    |       |       | f (mm/min)             | 570       | 570   | 510   | 420   | 360   | 350   |
|                    | 38    | 45-55 | v <sub>c</sub> (m/min) | 65        | 60    | 60    | 60    | 65    | 60    |
|                    |       |       | n                      | 1680      | 1400  | 1200  | 1100  | 1000  | 950   |
|                    |       |       | f <sub>z</sub>         | 0.039     | 0.036 | 0.033 | 0.034 | 0.038 | 0.036 |
|                    |       |       | f (mm/min)             | 260       | 200   | 160   | 150   | 150   | 140   |
|                    | 39    | 55-65 | v <sub>c</sub> (m/min) | 45        | 40    | 40    | 40    | 40    | 40    |
|                    |       |       | n                      | 1200      | 900   | 800   | 700   | 660   | 630   |
|                    |       |       | f <sub>z</sub>         | 0.04      | 0.036 | 0.034 | 0.036 | 0.038 | 0.038 |
|                    |       |       | f (mm/min)             | 190       | 130   | 110   | 100   | 100   | 100   |

< HRc45

> HRc45

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

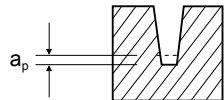
# CUTTING DATA



120320 (4 Flute Taper, 25° Helix, Rib Processing)



| VDI MATERIAL GROUP |       | HRc   |                        | Size (mm) |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|
|                    |       |       |                        | 1.0       | 1.2   | 1.5   | 2.0   |
| P                  | 1-9   | < 30  | a <sub>p</sub> (mm)    | 0.03      | 0.037 | 0.045 | 0.06  |
|                    |       |       | v <sub>c</sub> (m/min) | 65        | 60    | 60    | 65    |
|                    |       |       | n                      | 20000     | 16000 | 13000 | 10000 |
|                    |       |       | f <sub>z</sub>         | 0.009     | 0.011 | 0.013 | 0.018 |
|                    | 10-11 | 30-45 | f (mm/min)             | 700       | 700   | 700   | 700   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.025     | 0.032 | 0.04  | 0.05  |
|                    |       |       | v <sub>c</sub> (m/min) | 45        | 50    | 45    | 50    |
|                    |       |       | n                      | 15000     | 13000 | 10000 | 8000  |
| K                  | 15-20 |       | f <sub>z</sub>         | 0.008     | 0.01  | 0.013 | 0.016 |
|                    |       |       | f (mm/min)             | 500       | 500   | 500   | 500   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.03      | 0.037 | 0.045 | 0.06  |
|                    |       |       | v <sub>c</sub> (m/min) | 65        | 60    | 60    | 65    |
|                    |       |       | n                      | 20000     | 16000 | 13000 | 10000 |
| H                  | 38    | 45-55 | f <sub>z</sub>         | 0.009     | 0.011 | 0.013 | 0.018 |
|                    |       |       | f (mm/min)             | 700       | 700   | 700   | 700   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.015     | 0.018 | 0.022 | 0.03  |
|                    |       |       | v <sub>c</sub> (m/min) | 30        | 30    | 30    | 30    |
|                    |       |       | n                      | 10000     | 8000  | 6500  | 5000  |
|                    |       |       | f <sub>z</sub>         | 0.008     | 0.009 | 0.012 | 0.015 |
|                    |       |       | f (mm/min)             | 300       | 300   | 300   | 300   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.015     | 0.018 | 0.022 | 0.03  |
|                    |       |       | v <sub>c</sub> (m/min) | 30        | 30    | 30    | 30    |
|                    |       |       | n                      | 10000     | 8000  | 6500  | 5000  |
|                    |       |       | f <sub>z</sub>         | 0.008     | 0.009 | 0.012 | 0.015 |
|                    |       |       | f (mm/min)             | 300       | 300   | 300   | 300   |



► The data shown is based on medial length tools. Please adust machining conditions according to length.

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.

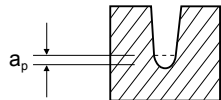
# CUTTING DATA



130320 (4 Flute Taper, 25° Helix, Rib Processing, Ball Nose)



| VDI MATERIAL GROUP |       | HRc   |                        | Size (mm) |       |       |       |
|--------------------|-------|-------|------------------------|-----------|-------|-------|-------|
|                    |       |       |                        | 1.0       | 1.2   | 1.5   | 2.0   |
| P                  | 1-9   | < 30  | a <sub>p</sub> (mm)    | 0.03      | 0.037 | 0.045 | 0.06  |
|                    |       |       | v <sub>c</sub> (m/min) | 65        | 60    | 60    | 65    |
|                    |       |       | n                      | 20000     | 16000 | 13000 | 10000 |
|                    |       |       | f <sub>z</sub>         | 0.009     | 0.011 | 0.013 | 0.018 |
|                    | 10-11 | 30-45 | f (mm/min)             | 700       | 700   | 700   | 700   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.025     | 0.032 | 0.04  | 0.05  |
|                    |       |       | v <sub>c</sub> (m/min) | 45        | 50    | 45    | 50    |
|                    |       |       | n                      | 15000     | 13000 | 10000 | 8000  |
| K                  | 15-20 |       | f <sub>z</sub>         | 0.008     | 0.01  | 0.013 | 0.016 |
|                    |       |       | f (mm/min)             | 500       | 500   | 500   | 500   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.03      | 0.037 | 0.045 | 0.06  |
|                    |       |       | v <sub>c</sub> (m/min) | 65        | 60    | 60    | 65    |
|                    |       |       | n                      | 20000     | 16000 | 13000 | 10000 |
| H                  | 38    | 45-55 | f <sub>z</sub>         | 0.009     | 0.011 | 0.013 | 0.018 |
|                    |       |       | f (mm/min)             | 700       | 700   | 700   | 700   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.015     | 0.018 | 0.022 | 0.03  |
|                    |       |       | v <sub>c</sub> (m/min) | 30        | 30    | 30    | 30    |
|                    |       |       | n                      | 10000     | 8000  | 6500  | 5000  |
|                    |       |       | f <sub>z</sub>         | 0.008     | 0.009 | 0.012 | 0.015 |
|                    |       |       | f (mm/min)             | 300       | 300   | 300   | 300   |
|                    |       |       | a <sub>p</sub> (mm)    | 0.015     | 0.018 | 0.022 | 0.03  |
|                    |       |       | v <sub>c</sub> (m/min) | 30        | 30    | 30    | 30    |
|                    |       |       | n                      | 10000     | 8000  | 6500  | 5000  |
|                    |       |       | f <sub>z</sub>         | 0.008     | 0.009 | 0.012 | 0.015 |
|                    |       |       | f (mm/min)             | 300       | 300   | 300   | 300   |



► The data shown is based on medial length tools. Please adust machining conditions according to length.

v<sub>c</sub> - cutting speed (m/min)  
n - RPM (rev/min)  
f<sub>z</sub> - feed rate (mm/tooth)  
f - feed rate (mm/rev)  
z - No. of teeth  
a<sub>p</sub> - axial depth of cut  
a<sub>e</sub> - radial depth of cut

To calculate RPM from cutting speed:  $n = \frac{v_c \cdot 1000}{\pi \cdot \varnothing}$

To calculate cutting speed from RPM:  $v_c = \frac{n \cdot \pi \cdot \varnothing}{1000}$

All recommendations are based on ideal machining conditions. Adjustments may need to be made according to your set-up. The recommendations for speeds, feeds and other parameters presented in this chart are nominal recommendations and should be considered only as good starting points.