



Roughing & Semi-Finishing

| Diam. | RPM | | |
|-------|---------------|---------------|---------------|
| | 30-40 Hrc | 40-50 Hrc | 50-60 Hrc |
| 1/32" | 38,400-60,000 | 32,000-50,000 | 24,600-40,000 |
| 1/16" | 26,400-42,000 | 22,000-35,000 | 16,600-28,000 |
| 3/32" | 21,600-31,200 | 18,000-26,000 | 13,400-20,800 |
| 1/8" | 19,200-28,800 | 16,000-24,000 | 11,800-19,200 |
| 3/16" | 15,000-19,776 | 12,500-16,480 | 9,000-13,184 |
| 1/4" | 12,120-16,800 | 10,100-14,000 | 7,080-11,200 |
| 5/16" | 11,400-15,900 | 9,200-13,250 | 6,360-10,600 |
| 3/8" | 10,560-14,520 | 8,800-12,100 | 6,040-9,680 |
| 7/16" | 9,480-12,480 | 7,900-10,400 | 5,320-8,320 |
| 1/2" | 8,280-10,920 | 6,900-9,100 | 4,520-7,280 |

Finishing

| Diam. | RPM | | |
|-------|---------------|---------------|---------------|
| | 30-40 Hrc | 40-50 Hrc | 50-60 Hrc |
| 1/32" | 20,000-50,000 | 20,000-50,000 | 20,000-50,000 |
| 1/16" | 20,000-50,000 | 20,000-50,000 | 20,000-50,000 |
| 3/32" | 20,000-50,000 | 20,000-50,000 | 20,000-50,000 |
| 1/8" | 20,000-38,000 | 20,000-50,000 | 20,000-30,500 |
| 3/16" | 20,000-26,000 | 20,000-34,000 | 16,000-20,300 |
| 1/4" | 15,000-18,000 | 18,000-24,400 | 12,000-15,000 |
| 5/16" | 12,000-14,000 | 14,600-19,000 | 9,700-12,000 |
| 3/8" | 10,000-12,000 | 12,000-16,200 | 8,100-10,000 |
| 7/16" | 8,700-10,400 | 10,000-13,900 | 6,900-8,700 |
| 1/2" | 7,800-9,800 | 9,100-12,200 | 6,100-7,600 |

Chip Load per Tooth

| Diam. | 30-40 Hrc | | 40-50 Hrc | | 50-60 Hrc | |
|-------|--------------|-------------|--------------|-------------|--------------|-------------|
| | Rough & Semi | Finishing | Rough & Semi | Finishing | Rough & Semi | Finishing |
| 1/32" | .0006-.0010 | .0006-.0009 | .0005-.0008 | .0006-.0007 | .0004-.0007 | .0004-.0006 |
| 1/16" | .0012-.0015 | .0010-.0016 | .0010-.0015 | .0010-.0014 | .0008-.0012 | .0007-.0010 |
| 3/32" | .0020-.0025 | .0014-.0024 | .0015-.0020 | .0014-.0022 | .0010-.0014 | .0012-.0020 |
| 1/8" | .0025-.0030 | .0019-.0028 | .0020-.0027 | .0019-.0026 | .0015-.0020 | .0017-.0022 |
| 3/16" | .0035-.0042 | .0032-.0043 | .0032-.0041 | .0030-.0040 | .0030-.0039 | .0023-.0031 |
| 1/4" | .0050-.0060 | .0040-.0053 | .0050-.0057 | .0040-.0051 | .0040-.0050 | .0038-.0048 |
| 5/16" | .0063-.0070 | .0053-.0068 | .0053-.0066 | .0052-.0063 | .0051-.0062 | .0046-.0054 |
| 3/8" | .0070-.0080 | .0062-.0079 | .0062-.0077 | .0054-.0065 | .0060-.0072 | .0050-.0061 |
| 7/16" | .0080-.0087 | .0068-.0086 | .0068-.0084 | .0060-.0078 | .0066-.0080 | .0053-.0070 |
| 1/2" | .0087-.0100 | .0080-.0094 | .0080-.0092 | .0070-.0090 | .0078-.0090 | .0062-.0081 |

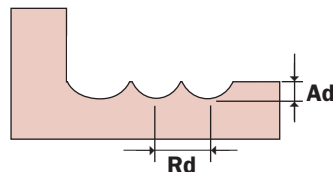


Machining Tips

- Use Helical Engagement in materials above 40 Hrc.
- Ensure cusp left for next operation is manageable.
- Use two fluted end mills in all roughing operations.
- Balanced holders and tools are critical when operating at 8000 RPM and above.
- Ensure runout of cutting tool is less than .0003" to get the best tool life.
- LDR should be as short as possible.
- Use Z-Level climb cutting for roughing operations.
- Use air for all applications except those involving sticky materials such as stainless.

Formulas

- $RPM = \frac{3.82 \times SFM}{Effective\ Diam.}$
- $IPM = RPM \times \# Flutes \times Chip\ Load$
- $Chip\ Load = \frac{IPM}{(RPM \times \# Flutes)}$
- $SFM = \frac{Effective\ Diam. \times RPM}{3.82}$
- $E.D. = 2 \times \sqrt{(R^2 - (R - Ad)^2)}$



30-40 Hrc Axial depth = 10% of tool diameter
 40-50 Hrc Axial depth = 7% of tool diameter
 50-60 Hrc Axial depth = 5% of tool diameter

- Radial depths can be up to 35% of the cutter diameter for roughing and semi-finishing operations.
- Radial depths of cut for finishing are determined by the surface finish requirements unique to each application.

Just a few tools that could help you!

List 3113 EXOCARB®-HP 3µm Radius Tolerance Ball End Mill



Features:

- 3µm radius tolerance
- OSG's patented multi-layered EXO® coating
- 3µm T.I.R. shank tolerance

Benefits:

- Exceptional accuracy & fine finishes
- Extended tool life over standard TiAlN coated tools
- Extended tool life & T.I.R. accuracy at higher speeds

List 4510 EXOCARB®-SHP WXS™ Ball End Mill



Features:

- WXS™ nano coating technology
- Higher oxidation temperature than TiAlN
- Greater surface hardness than TiAlN

Benefits:

- Permits higher SFM for reduced cycle times
- Faster spindle speeds = faster feed rates
- Longer life in hardened steels up to 70 HRC

List 7390 EXOCARB®-Diamond Rib Processing Ball End Mill for Graphite



Features:

- Die Mold Series
- OSG's patented multi-layered Diamond coating
- Various reduced neck lengths

Benefits:

- Tight tolerance for high accuracy milling
- Extended tool life for non-ferrous materials such as Graphite, Aluminum, and Copper Alloys
- Greater versatility in long reach milling applications

List 9112 EXOCARB®-MAX Cermet Ball End Mill



Features:

- Harder than carbide, for a stable cutting interface
- OSG's patented multi-layered EXO® coating

Benefits:

- Mirror finishes under 40 HRC
- Cutting edge retains shape longer under 40 HRC
- Extended tool life over standard TiAlN coated tools



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