# OSG PHOENIX®

## PSE 90° Shoulder Cutter
## M S Machining Guide

## Face Milling - Roughing & Semi-Finishing (LDR 4xD)

**For LDR Greater See LDR Notes**

### High Speed Machining Guide (Aggressive Parameters)

| Material | | | | Stainless Steel (annealed) | | | | Stainless Steel (hardened) | | | | Titanium Alloys | | | | Heat Resistant Alloys (annealed) | | | | Heat Resistant Alloys (hardened) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Insert Size | Tool Dia. (Inch) | Tool Dia. (mm) | No. Teeth | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) |
| ZDKT11 | 0.625 | 16 | 2 | 1985 | 0.005 | 19.85 | 0.050 | 1620 | 0.004 | 12.96 | 0.050 | 950 | 0.005 | 9.50 | 0.040 | 855 | 0.0025 | 4.28 | 0.040 | 700 | 0.002 | 2.80 | 0.040 |
| | 0.750 | 20 | 3 | 1655 | 0.005 | 24.83 | 0.050 | 1350 | 0.004 | 16.20 | 0.050 | 790 | 0.005 | 11.85 | 0.040 | 715 | 0.0025 | 5.36 | 0.040 | 585 | 0.002 | 3.51 | 0.040 |
| | 1.000 | 25 | 3 | 1240 | 0.005 | 18.60 | 0.050 | 1015 | 0.004 | 12.18 | 0.050 | 595 | 0.005 | 8.93 | 0.040 | 535 | 0.0025 | 4.01 | 0.040 | 440 | 0.002 | 2.64 | 0.040 |
| | | | 4 | 1240 | 0.005 | 24.80 | 0.050 | 1015 | 0.004 | 16.24 | 0.050 | 595 | 0.005 | 11.90 | 0.040 | 535 | 0.0025 | 5.35 | 0.040 | 440 | 0.002 | 3.52 | 0.040 |
| | 1.250 | 32 | 3 | 995 | 0.005 | 14.93 | 0.050 | 810 | 0.004 | 9.72 | 0.050 | 475 | 0.005 | 7.13 | 0.040 | 430 | 0.0025 | 3.23 | 0.040 | 350 | 0.002 | 2.10 | 0.040 |
| | | | 5 | 995 | 0.005 | 24.88 | 0.050 | 810 | 0.004 | 16.20 | 0.050 | 475 | 0.005 | 11.88 | 0.040 | 430 | 0.0025 | 5.38 | 0.040 | 350 | 0.002 | 3.50 | 0.040 |
| | 2.000 | 50 | 5 | 620 | 0.005 | 15.50 | 0.050 | 510 | 0.004 | 10.20 | 0.050 | 300 | 0.005 | 7.50 | 0.040 | 270 | 0.0025 | 3.38 | 0.040 | 220 | 0.002 | 2.20 | 0.040 |
| | | | 7 | 620 | 0.005 | 21.70 | 0.050 | 510 | 0.004 | 14.28 | 0.050 | 300 | 0.005 | 10.50 | 0.040 | 270 | 0.0025 | 4.73 | 0.040 | 220 | 0.002 | 3.08 | 0.040 |
| | 2.500 | 63 | 6 | 495 | 0.005 | 14.85 | 0.050 | 405 | 0.004 | 9.72 | 0.050 | 240 | 0.005 | 7.20 | 0.040 | 215 | 0.0025 | 3.23 | 0.040 | 175 | 0.002 | 2.10 | 0.040 |
| | | | 8 | 495 | 0.005 | 19.80 | 0.050 | 405 | 0.004 | 12.96 | 0.050 | 240 | 0.005 | 9.60 | 0.040 | 215 | 0.0025 | 4.30 | 0.040 | 175 | 0.002 | 2.80 | 0.040 |
| | 3.000 | 80 | 7 | 415 | 0.005 | 14.53 | 0.050 | 340 | 0.004 | 9.52 | 0.050 | 200 | 0.005 | 7.00 | 0.040 | 180 | 0.0025 | 3.15 | 0.040 | 150 | 0.002 | 2.10 | 0.040 |
| | | | 10 | 415 | 0.005 | 20.75 | 0.050 | 340 | 0.004 | 13.60 | 0.050 | 200 | 0.005 | 10.00 | 0.040 | 180 | 0.0025 | 4.50 | 0.040 | 150 | 0.002 | 3.00 | 0.040 |
| ZDKT15 | 1.000 | 25 | 2 | 1240 | 0.006 | 14.88 | 0.100 | 1015 | 0.005 | 10.15 | 0.100 | 595 | 0.005 | 5.95 | 0.080 | 535 | 0.0025 | 2.68 | 0.080 | 440 | 0.002 | 1.76 | 0.080 |
| | 1.250 | 32 | 2 | 995 | 0.006 | 11.94 | 0.100 | 810 | 0.005 | 8.10 | 0.100 | 475 | 0.005 | 4.75 | 0.080 | 430 | 0.0025 | 2.15 | 0.080 | 350 | 0.002 | 1.40 | 0.080 |
| | | | 3 | 995 | 0.006 | 17.91 | 0.100 | 810 | 0.005 | 12.15 | 0.100 | 475 | 0.005 | 7.13 | 0.080 | 430 | 0.0025 | 3.23 | 0.080 | 350 | 0.002 | 2.10 | 0.080 |
| | 1.500 | 40 | 3 | 830 | 0.006 | 14.94 | 0.100 | 675 | 0.005 | 10.13 | 0.100 | 395 | 0.005 | 5.93 | 0.080 | 360 | 0.0025 | 2.70 | 0.080 | 295 | 0.002 | 1.77 | 0.080 |
| | | | 4 | 830 | 0.006 | 19.92 | 0.100 | 675 | 0.005 | 13.50 | 0.100 | 395 | 0.005 | 7.90 | 0.080 | 360 | 0.0025 | 3.60 | 0.080 | 295 | 0.002 | 2.36 | 0.080 |
| | 2.000 | 50 | 3 | 620 | 0.006 | 11.16 | 0.100 | 510 | 0.005 | 7.65 | 0.100 | 300 | 0.005 | 4.50 | 0.080 | 270 | 0.0025 | 2.03 | 0.080 | 220 | 0.002 | 1.32 | 0.080 |
| | | | 5 | 620 | 0.006 | 18.60 | 0.100 | 510 | 0.005 | 12.75 | 0.100 | 300 | 0.005 | 7.50 | 0.080 | 270 | 0.0025 | 3.38 | 0.080 | 220 | 0.002 | 2.20 | 0.080 |
| | 2.500 | 63 | 4 | 495 | 0.006 | 11.88 | 0.100 | 405 | 0.005 | 8.10 | 0.100 | 240 | 0.005 | 4.80 | 0.080 | 215 | 0.0025 | 2.15 | 0.080 | 175 | 0.002 | 1.40 | 0.080 |
| | | | 6 | 495 | 0.006 | 17.82 | 0.100 | 405 | 0.005 | 12.15 | 0.100 | 240 | 0.005 | 7.20 | 0.080 | 215 | 0.0025 | 3.23 | 0.080 | 175 | 0.002 | 2.10 | 0.080 |
| | 3.000 | 80 | 5 | 415 | 0.006 | 12.45 | 0.100 | 340 | 0.005 | 8.50 | 0.100 | 200 | 0.005 | 5.00 | 0.080 | 180 | 0.0025 | 2.25 | 0.080 | 150 | 0.002 | 1.50 | 0.080 |
| | | | 8 | 415 | 0.006 | 19.92 | 0.100 | 340 | 0.005 | 13.60 | 0.100 | 200 | 0.005 | 8.00 | 0.080 | 180 | 0.0025 | 3.60 | 0.080 | 150 | 0.002 | 2.40 | 0.080 |
| | 4.000 | 100 | 7 | 310 | 0.006 | 13.02 | 0.100 | 255 | 0.005 | 8.93 | 0.100 | 150 | 0.005 | 5.25 | 0.080 | 135 | 0.0025 | 2.36 | 0.080 | 110 | 0.002 | 1.54 | 0.080 |
| | | | 10 | 310 | 0.006 | 18.60 | 0.100 | 255 | 0.005 | 12.75 | 0.100 | 150 | 0.005 | 7.50 | 0.080 | 135 | 0.0025 | 3.38 | 0.080 | 110 | 0.002 | 2.20 | 0.080 |
| | 5.000 | 125 | 8 | 250 | 0.006 | 12.00 | 0.100 | 205 | 0.005 | 8.20 | 0.100 | 120 | 0.005 | 4.80 | 0.080 | 110 | 0.0025 | 2.20 | 0.080 | 90 | 0.002 | 1.44 | 0.080 |
| | | | 11 | 250 | 0.006 | 16.50 | 0.100 | 205 | 0.005 | 11.28 | 0.100 | 120 | 0.005 | 6.60 | 0.080 | 110 | 0.0025 | 3.03 | 0.080 | 90 | 0.002 | 1.98 | 0.080 |
| | 6.000 | 160 | 10 | 210 | 0.006 | 12.60 | 0.100 | 170 | 0.005 | 8.50 | 0.100 | 100 | 0.005 | 5.00 | 0.080 | 90 | 0.0025 | 2.25 | 0.080 | 75 | 0.002 | 1.50 | 0.080 |
| | | | 12 | 210 | 0.006 | 15.12 | 0.100 | 170 | 0.005 | 10.20 | 0.100 | 100 | 0.005 | 6.00 | 0.080 | 90 | 0.0025 | 2.70 | 0.080 | 75 | 0.002 | 1.80 | 0.080 |

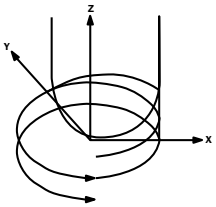
### Machining Guide (Moderate Parameters)

| Material | | | | Stainless Steel (annealed) | | | | Stainless Steel (hardened) | | | | Titanium Alloys | | | | Heat Resistant Alloys (annealed) | | | | Heat Resistant Alloys (hardened) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Insert Size | Tool Dia. (Inch) | Tool Dia. (mm) | No. Teeth | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) | RPM | Feed per Tooth | Feed Rate (IPM) | Axial Cut Depth (aa) |
| ZDKT11 | 0.625 | 16 | 2 | 1620 | 0.004 | 12.96 | 0.050 | 1315 | 0.003 | 7.89 | 0.050 | 795 | 0.004 | 6.36 | 0.050 | 700 | 0.002 | 2.80 | 0.050 | 580 | 0.0016 | 1.86 | 0.050 |
| | 0.750 | 20 | 3 | 1350 | 0.004 | 16.20 | 0.050 | 1095 | 0.003 | 9.86 | 0.050 | 665 | 0.004 | 7.98 | 0.050 | 585 | 0.002 | 3.51 | 0.050 | 485 | 0.0016 | 2.33 | 0.050 |
| | 1.000 | 25 | 3 | 1015 | 0.004 | 12.18 | 0.050 | 820 | 0.003 | 7.38 | 0.050 | 500 | 0.004 | 6.00 | 0.050 | 440 | 0.002 | 2.64 | 0.050 | 365 | 0.0016 | 1.75 | 0.050 |
| | | | 4 | 1015 | 0.004 | 16.24 | 0.050 | 820 | 0.003 | 9.84 | 0.050 | 500 | 0.004 | 8.00 | 0.050 | 440 | 0.002 | 3.52 | 0.050 | 365 | 0.0016 | 2.34 | 0.050 |
| | 1.250 | 32 | 3 | 810 | 0.004 | 9.72 | 0.050 | 660 | 0.003 | 5.94 | 0.050 | 400 | 0.004 | 4.80 | 0.050 | 350 | 0.002 | 2.10 | 0.050 | 290 | 0.0016 | 1.39 | 0.050 |
| | | | 5 | 810 | 0.004 | 16.20 | 0.050 | 660 | 0.003 | 9.90 | 0.050 | 400 | 0.004 | 8.00 | 0.050 | 350 | 0.002 | 3.50 | 0.050 | 290 | 0.0016 | 2.32 | 0.050 |
| | 2.000 | 50 | 5 | 510 | 0.004 | 10.20 | 0.050 | 410 | 0.003 | 6.15 | 0.050 | 250 | 0.004 | 5.00 | 0.050 | 220 | 0.002 | 2.20 | 0.050 | 180 | 0.0016 | 1.44 | 0.050 |
| | | | 7 | 510 | 0.004 | 14.28 | 0.050 | 410 | 0.003 | 8.61 | 0.050 | 250 | 0.004 | 7.00 | 0.050 | 220 | 0.002 | 3.08 | 0.050 | 180 | 0.0016 | 2.02 | 0.050 |
| | 2.500 | 63 | 6 | 405 | 0.004 | 9.72 | 0.050 | 330 | 0.003 | 5.94 | 0.050 | 200 | 0.004 | 4.80 | 0.050 | 175 | 0.002 | 2.10 | 0.050 | 145 | 0.0016 | 1.39 | 0.050 |
| | | | 8 | 405 | 0.004 | 12.96 | 0.050 | 330 | 0.003 | 7.92 | 0.050 | 200 | 0.004 | 6.40 | 0.050 | 175 | 0.002 | 2.80 | 0.050 | 145 | 0.0016 | 1.86 | 0.050 |
| | 3.000 | 80 | 7 | 340 | 0.004 | 9.52 | 0.050 | 275 | 0.003 | 5.78 | 0.050 | 165 | 0.004 | 4.63 | 0.050 | 150 | 0.002 | 2.10 | 0.050 | 120 | 0.0016 | 1.34 | 0.050 |
| | | | 10 | 340 | 0.004 | 13.60 | 0.050 | 275 | 0.003 | 8.25 | 0.050 | 165 | 0.004 | 6.60 | 0.050 | 150 | 0.002 | 3.00 | 0.050 | 120 | 0.0016 | 1.92 | 0.050 |
| ZDKT15 | 1.000 | 25 | 2 | 1015 | 0.005 | 10.15 | 0.100 | 820 | 0.004 | 6.56 | 0.100 | 500 | 0.004 | 4.00 | 0.100 | 440 | 0.002 | 1.76 | 0.100 | 365 | 0.0016 | 1.17 | 0.100 |
| | 1.250 | 32 | 2 | 810 | 0.005 | 8.10 | 0.100 | 660 | 0.004 | 5.28 | 0.100 | 400 | 0.004 | 3.20 | 0.100 | 350 | 0.002 | 1.40 | 0.100 | 290 | 0.0016 | 0.93 | 0.100 |
| | | | 3 | 810 | 0.005 | 12.15 | 0.100 | 660 | 0.004 | 7.92 | 0.100 | 400 | 0.004 | 4.80 | 0.100 | 350 | 0.002 | 2.10 | 0.100 | 290 | 0.0016 | 1.39 | 0.100 |
| | 1.500 | 40 | 3 | 675 | 0.005 | 10.13 | 0.100 | 550 | 0.004 | 6.60 | 0.100 | 330 | 0.004 | 3.96 | 0.100 | 295 | 0.002 | 1.77 | 0.100 | 240 | 0.0016 | 1.15 | 0.100 |
| | | | 4 | 675 | 0.005 | 13.50 | 0.100 | 550 | 0.004 | 8.80 | 0.100 | 330 | 0.004 | 5.28 | 0.100 | 295 | 0.002 | 2.36 | 0.100 | 240 | 0.0016 | 1.54 | 0.100 |
| | 2.000 | 50 | 3 | 510 | 0.005 | 7.65 | 0.100 | 410 | 0.004 | 4.92 | 0.100 | 250 | 0.004 | 3.00 | 0.100 | 220 | 0.002 | 1.32 | 0.100 | 180 | 0.0016 | 0.86 | 0.100 |
| | | | 5 | 510 | 0.005 | 12.75 | 0.100 | 410 | 0.004 | 8.20 | 0.100 | 250 | 0.004 | 5.00 | 0.100 | 220 | 0.002 | 2.20 | 0.100 | 180 | 0.0016 | 1.44 | 0.100 |
| | 2.500 | 63 | 4 | 405 | 0.005 | 8.10 | 0.100 | 330 | 0.004 | 5.28 | 0.100 | 200 | 0.004 | 3.20 | 0.100 | 175 | 0.002 | 1.40 | 0.100 | 145 | 0.0016 | 0.93 | 0.100 |
| | | | 6 | 405 | 0.005 | 12.15 | 0.100 | 330 | 0.004 | 7.92 | 0.100 | 200 | 0.004 | 4.80 | 0.100 | 175 | 0.002 | 2.10 | 0.100 | 145 | 0.0016 | 1.39 | 0.100 |
| | 3.000 | 80 | 5 | 340 | 0.005 | 8.50 | 0.100 | 275 | 0.004 | 5.50 | 0.100 | 165 | 0.004 | 3.30 | 0.100 | 150 | 0.002 | 1.50 | 0.100 | 120 | 0.0016 | 0.96 | 0.100 |
| | | | 8 | 340 | 0.005 | 13.60 | 0.100 | 275 | 0.004 | 8.80 | 0.100 | 165 | 0.004 | 5.28 | 0.100 | 150 | 0.002 | 2.40 | 0.100 | 120 | 0.0016 | 1.54 | 0.100 |
| | 4.000 | 100 | 7 | 255 | 0.005 | 8.93 | 0.100 | 205 | 0.004 | 5.74 | 0.100 | 125 | 0.004 | 3.50 | 0.100 | 110 | 0.002 | 1.54 | 0.100 | 90 | 0.0016 | 1.01 | 0.100 |
| | | | 10 | 255 | 0.005 | 12.75 | 0.100 | 205 | 0.004 | 8.20 | 0.100 | 125 | 0.004 | 5.00 | 0.100 | 110 | 0.002 | 2.20 | 0.100 | 90 | 0.0016 | 1.44 | 0.100 |
| | 5.000 | 125 | 8 | 205 | 0.005 | 8.20 | 0.100 | 165 | 0.004 | 5.28 | 0.100 | 100 | 0.004 | 3.20 | 0.100 | 90 | 0.002 | 1.44 | 0.100 | 75 | 0.0016 | 0.96 | 0.100 |
| | | | 11 | 205 | 0.005 | 11.28 | 0.100 | 165 | 0.004 | 7.26 | 0.100 | 100 | 0.004 | 4.40 | 0.100 | 90 | 0.002 | 1.98 | 0.100 | 75 | 0.0016 | 1.32 | 0.100 |
| | 6.000 | 160 | 10 | 170 | 0.005 | 8.50 | 0.100 | 135 | 0.004 | 5.40 | 0.100 | 85 | 0.004 | 3.40 | 0.100 | 75 | 0.002 | 1.50 | 0.100 | 60 | 0.0016 | 0.96 | 0.100 |
| | | | 12 | 170 | 0.005 | 10.20 | 0.100 | 135 | 0.004 | 6.48 | 0.100 | 85 | 0.004 | 4.08 | 0.100 | 75 | 0.002 | 1.80 | 0.100 | 60 | 0.0016 | 1.15 | 0.100 |

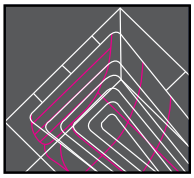
# High Speed Machining Guide

## Machining Tips

- Use Z-Level climb cutting for roughing operations.
- Use Helical for material engagement whenever possible for material entry (See Helical chart for ramp angles and arc limits depending on tool dia.).
- Add radiuses larger than cutter to corner of tool path for smooth operation.
- LDR should always be as short as possible.
- LDR of 4xD or less use chart on reverse side.
- LDR of 6xD to 10xD reduce spindle speed by 35% and feed rate by 25% to get started.
- LDR of 10xD and over reduce RPM by 50% and depth of cut by 65% to get started. **Machining is very difficult over 10xD.**
- Leave extra stock for semi-finishing to prevent gouging of surface when using long reach tools.
- Use air or oil mist for all applications except those involving gummy or sticky materials such as stainless, which machines well with water based coolant.




**Helical Interpolation**



**Corner Rounding on Tool Path**

## Formulas

**RPM** = (3.82 x SFM) / Tool Diameter
**SFM** = 0.262 x RPM x Tool Diameter
**IPM** = RPM x # Flutes x Chip Load
**Chip Load** = IPM / (RPM x # Flutes)

## Depth of Cut

**Adjusting depths of cuts based on LDR (Length Diameter Ratio)**

**Axial Depths of Cuts**

- Depth of cut should be reduced by 5% per increment of LDR.

**Radial Depths of Cuts**

- This cutter performs best with step over amounts 100% to 50% of cutter diameter. Lesser amounts will result in less stability and reduce performance overall.

## Diagnosing Problems

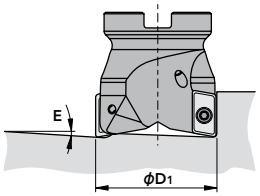
**Insert Chipping** - early during use means chip load too high, please reduce feed rate in increments of 20% until problem is resolved or shorten the length of the tool.

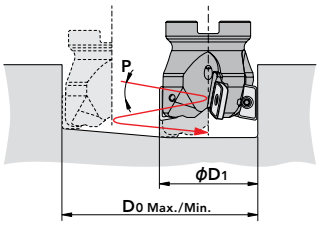
**Insert Burning** - of coating or glowing at the tip means RPM is too high. Reduce RPM by 20% increments until problem is resolved along with feed rate until excessive heat is subdued.

**Chatter** - excessive tool length is a primary cause. After reducing tool length if possible, lower RPM and feed rate until chatter is minimized.

## Maximum Helical Ramping Angle

| Insert Size | ZDKT11 | | | | ZDKT15 | | | |
|---|---|---|---|---|---|---|---|---|
| Diameter (Inch) | Ramping Angle | Helical Milling (Inch) | | Helical Angle | Ramping Angle | Helical Milling (Inch) | | Helical Angle |
| D1 | E | Do Min | Do Max | P | E | Do Min | Do Max | P |
| 0.625 | 10.8° | 0.935 | 1.187 | 9.5° | – | – | – | – |
| 0.750 | 9.8° | 1.185 | 1.437 | 7.0° | – | – | – | – |
| 1.000 | 7.4° | 1.685 | 1.927 | 4.4° | 9.5° | 1.488 | 1.921 | 7.4° |
| 1.250 | 4.8° | 2.158 | 2.437 | 3.2° | 6.8° | 1.988 | 2.421 | 5.0° |
| 1.500 | 2.9° | 2.685 | 2.937 | 2.2° | 5.1° | 2.488 | 2.921 | 3.2° |
| 2.000 | 2.1° | 3.685 | 3.937 | 1.6° | 2.4° | 3.488 | 3.921 | 2.4° |
| 2.500 | 1.8° | 4.685 | 4.937 | 1.4° | 2.3° | 4.488 | 4.921 | 1.4° |
| 3.000 | 1.4° | 5.685 | 5.937 | 1.0° | 2.0° | 5.488 | 5.921 | 1.3° |
| 4.000 | – | – | – | – | 1.4° | 7.488 | 7.921 | 1.0° |
| 5.000 | – | – | – | – | 0.8° | 9.488 | 9.921 | 0.8° |
| 6.000 | – | – | – | – | 0.7° | 11.488 | 11.921 | 0.6° |




## Recommended Materials by Application

| Insert Grade | Chip Breaker | Coolant | Carbon Steels | Stainless Steels | Cast Irons | Non-Ferrous | Hi-Temp Alloys | Hardened Steels |
|---|---|---|---|---|---|---|---|---|
| | | | P | M | K | N | S | H |
| CK010 | NM | Yes | | | | ◎ | | |
| XC3020 | GL / GM / GR | - | ◎ | | ○ | | | |
| XP3025 | GL / GM / GR | Yes | ◎ | | ○ | | | |
| XC3030 | GL / GM / GR | - | ◎ | | ○ | | | |
| XP3035 | GL / GM / GR | - | ◎ | ○ | ○ | | | |
| XP2025 | GL / GM | Yes | ○ | ◎ | | | ○ | |
| XP2040 | GL / GM / GR | - | ○ | ○ | | | | ○ |
| | | Yes | ○ | ◎ | | | ○ | |
| XC1015 | GM / GR | - | | | ◎ | | | |
| XC5035 | SM | - | | ◎ | | | | |
| | | Yes | | ○ | | | ○ | |
| XC5040 | SM | Yes | | ○ | | | ◎ | |
| XP6015 | HR | - | ○ | | ○ | | | ◎ |

GL: Light Cutting GM: Medium Cutting GR: Heavy Cutting NM: Aluminum SM: Heat Resistant Alloy HR: Hardened Steel

○ good ◎ best


**osgtool.com**
**OSG USA, Inc. : 800-837-2223**
OSG Canada, Ltd. : 905-632-8032 • OSG Royco (Mexico) : (52) 477 478-02-00