



# APOLLO

Variable Helix Corner Radius End Mills



Excellent for Alloy Steel, Nickel Inconel Alloys, Stainless and Carbon Steel

**Unequal Flute Design for Chatter Resistance**

**Great for Roughing or Finishing**

**High Performance AlCrN Coating for Wear Resistance**

**Available in 4 and 5 Flute Designs**



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Variable Helix Design for Chatter Resistance

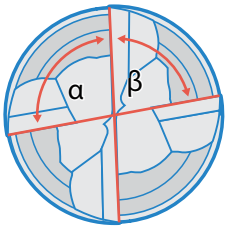
## 1 APOLLO End Mill Features & Benefits

- Unequal flute design for greater chatter resistance
- Great for roughing and finishing
- High performance AlCrN coating for tool wear resistance
- Better performance at higher speeds and feeds
- Unique honing technology
- Available in 4 and 5 flute designs

## 2 Chatter Resistance with Unique Variable Helix Design

High Quality Surface Finish without Chattering

Unequal Spacing of Teeth



Cutting force varies due to unequal flute width, which prevents periodical vibration during machining

$$\alpha \neq \beta$$

Variable Helix



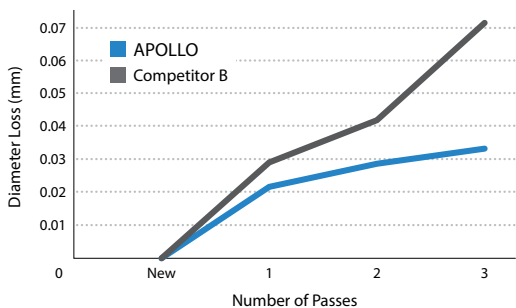
Each flute has an optimized helix angle (lead angle  $\theta$ ), which provides excellent anti-vibration benefits with better surface finish

$$\theta_1 \neq \theta_2$$

## 3 High Performance AlCrN Coating Improves Wear and Chipping Resistance

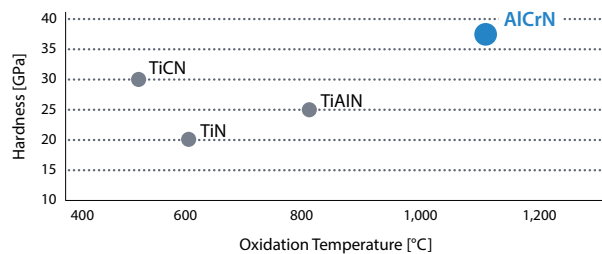
Achieve long tool life with a high performance AlCrN coating layer

Diameter Loss Comparison (Internal Evaluation)



Cutting Conditions:  $n = 305 \text{ rpm}$ ,  $V_c = 80 \text{ sfm}$ ,  $V_f = 1.8 \text{ ipm}$ ,  $D.O.C. \times ae = 0.500'' \times 0.250''$   
Cutter Dia.  $\varnothing 10\text{mm}$ , Profile, Wet, Workpiece: Inconel 718

Coating Properties



Low Oxidation Resistance High

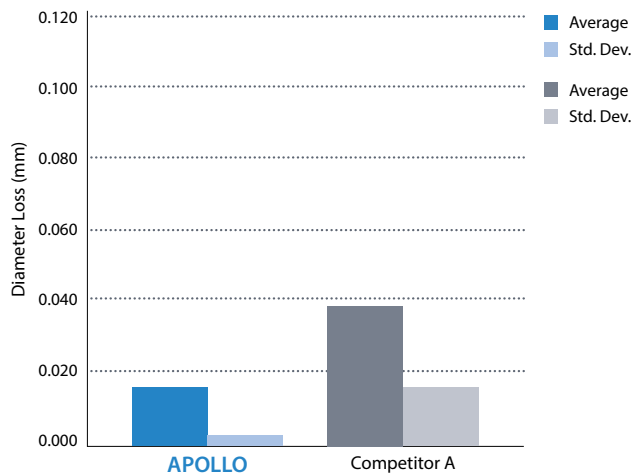
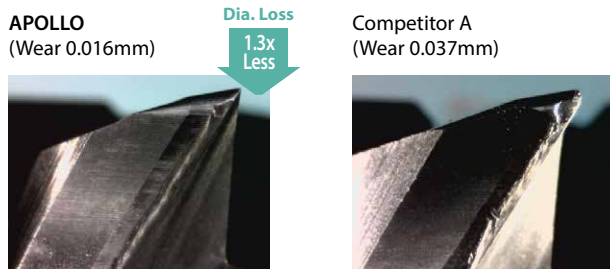


# 4 Long Tool Life and Stable Machining

## Machining Inconel 718

Long Tool Life and Reduced Chatter

Edge Condition after Machining (Internal Evaluation)

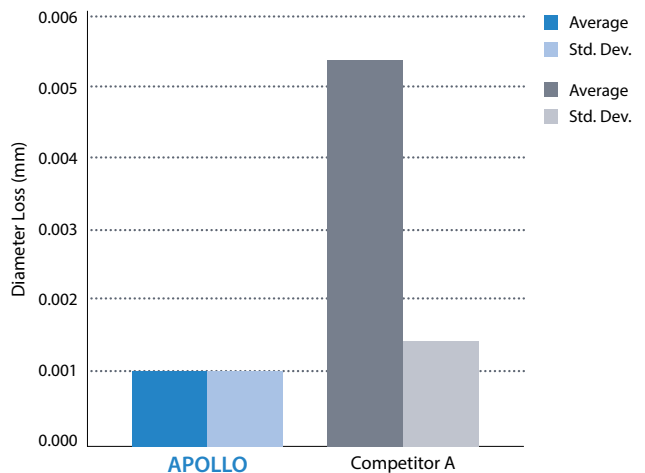
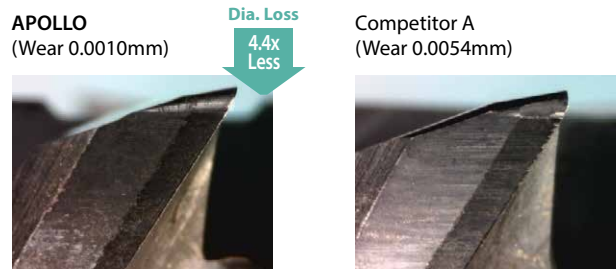


Cutting Conditions: n = 3,201 rpm, Vc = 330 sfm, Vf = 25 ipm, D.O.C. = 0.750"  
Cutter Dia. Ø10mm, Trochoidal, Wet, Workpiece: Inconel 718

## Machining 17-4PH900 (Stainless Steel)

Stable Machining with Excellent Wear Resistance

Edge Condition after Machining (Internal Evaluation)

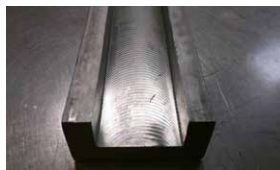


Cutting Conditions: n = 1,280 rpm, Vc = 130 sfm, Vf = 4 ipm, D.O.C. = 0.400"  
Cutter Dia. Ø10mm, Wet, Workpiece: 17-4PH900

### Case Studies

#### Block - Inconel 718

Vc = 130 sfm  
f = 0.007 ipr  
D.O.C. 0.500", Dry  
AP4-5000.625 (4 Flute - Ø0.5")



Margin Wear

**APOLLO** **0.292 mm** **8x** Tool Life

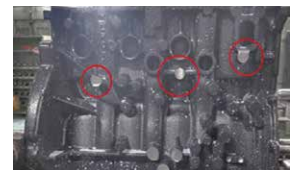
Competitor C **1.960 mm**

The APOLLO showed 8 times the tool life of Competitor C when machining Inconel.

(User Evaluation)

#### Automotive - Gray Cast Iron

Vc = 400 sfm (n = 2,400 rpm)  
Vf = 18.898 ipm  
D.O.C. 0.157" ~ 0.197", Wet  
AP5M-9843.1496 (5 Flute - Ø25mm)



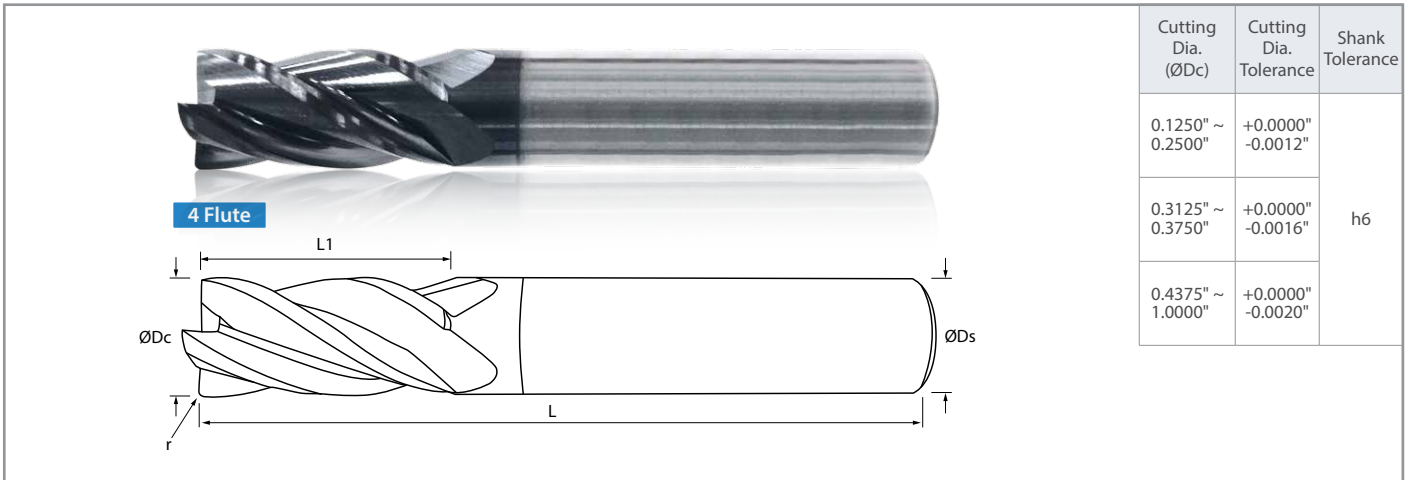
Tool Life

**APOLLO** **2,300 pcs** **4.6x** Tool Life

Competitor D **500 pcs**

The APOLLO used side coolant and showed 4.6 times the tool life of Competitor D using center thru coolant.

(User Evaluation)



Cutting Dia. (ØDc)	Cutting Dia. Tolerance	Shank Tolerance
0.1250" ~ 0.2500"	+0.0000" -0.0012"	h6
0.3125" ~ 0.3750"	+0.0000" -0.0016"	
0.4375" ~ 1.0000"	+0.0000" -0.0020"	

Stub Length Dimensions (Inch Size)

Part Number	Stock	Dimensions (in)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc	ØDs	L	L1	r
AP4-2500.500	●	0.2500 (1/4)	1/4	2	1/2	0.015 - 0.020
AP4-3125.500	●	0.3125 (5/16)	5/16	2	1/2	0.015 - 0.020
AP4-3750.625	●	0.3750 (3/8)	3/8	2	5/8	0.015 - 0.020
AP4-5000.625	●	0.5000 (1/2)	1/2	2-1/2	5/8	0.025 - 0.030
AP4-6250.750	●	0.6250 (5/8)	5/8	3	3/4	0.030 - 0.035
AP4-7500.1000	●	0.7500 (3/4)	3/4	3	1	0.030 - 0.035

Standard Length Dimensions (Inch Size)

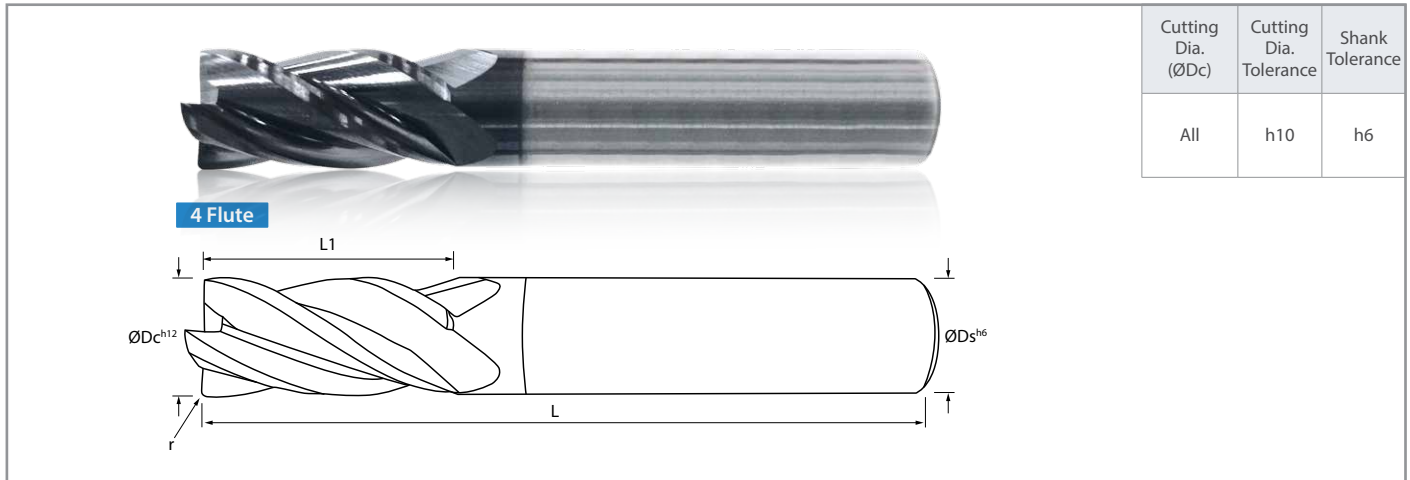
Part Number	Stock	Dimensions (in)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc	ØDs	L	L1	r
AP4-1250.500	●	0.1250 (1/8)	1/8	1-1/2	1/2	0.010 - 0.015
AP4-1875.625	●	0.1875 (3/16)	3/16	2	5/8	0.015 - 0.020
AP4-2500.750	●	0.2500 (1/4)	1/4	2-1/2	3/4	0.015 - 0.020
AP4-3125.813	●	0.3125 (5/16)	5/16	2-1/2	13/16	0.015 - 0.020
AP4-3750.1000	●	0.3750 (3/8)	3/8	2-1/2	1	0.015 - 0.020
AP4-4375.1000	●	0.4375 (7/16)	7/16	2-3/4	1	0.015 - 0.020
AP4-5000.1000	●	0.5000 (1/2)	1/2	3	1	0.025 - 0.030
AP4-6250.1250	●	0.6250 (5/8)	5/8	3-1/2	1-1/4	0.030 - 0.035
AP4-7500.1500	●	0.7500 (3/4)	3/4	4	1-1/2	0.030 - 0.035
AP4-10000.1500	●	1.0000 (1)	1	4	1-1/2	0.030 - 0.035

Long Length Dimensions (Inch Size)

Part Number	Stock	Dimensions (in)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc	ØDs	L	L1	r
AP4-2500.1125	●	0.2500 (1/4)	1/4	3	1-1/8	0.015 - 0.020
AP4-3125.1125	●	0.3125 (5/16)	5/16	3	1-1/8	0.015 - 0.020
AP4-3750.1125	●	0.3750 (3/8)	3/8	3	1-1/8	0.015 - 0.020
AP4-5000.2000	●	0.5000 (1/2)	1/2	4	2	0.025 - 0.030
AP4-6250.2250	●	0.6250 (5/8)	5/8	5	2-1/4	0.030 - 0.035
AP4-7500.2250	●	0.7500 (3/4)	3/4	5	2-1/4	0.030 - 0.035

L1 dimension refers to the Max. Length of Cut.

● : U.S. Stock



Stub Length Dimensions (Metric Size)

Part Number	Stock	Dimensions (mm)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc <sup>h10</sup>	ØDs <sup>h6</sup>	L	L1	r
AP4M-1181.236	●	3	3	38	6	0.4
AP4M-2362.394	●	6	6	50	10	0.4
AP4M-3150.472	●	8	8	50	12	0.4
AP4M-3937.787	●	10	10	50	12	0.4
AP4M-4724.630	●	12	12	63	16	0.7
AP4M-6299.787	●	16	16	89	20	0.7
AP4M-7874.866	●	20	20	100	22	0.7

Standard Length Dimensions (Metric Size)

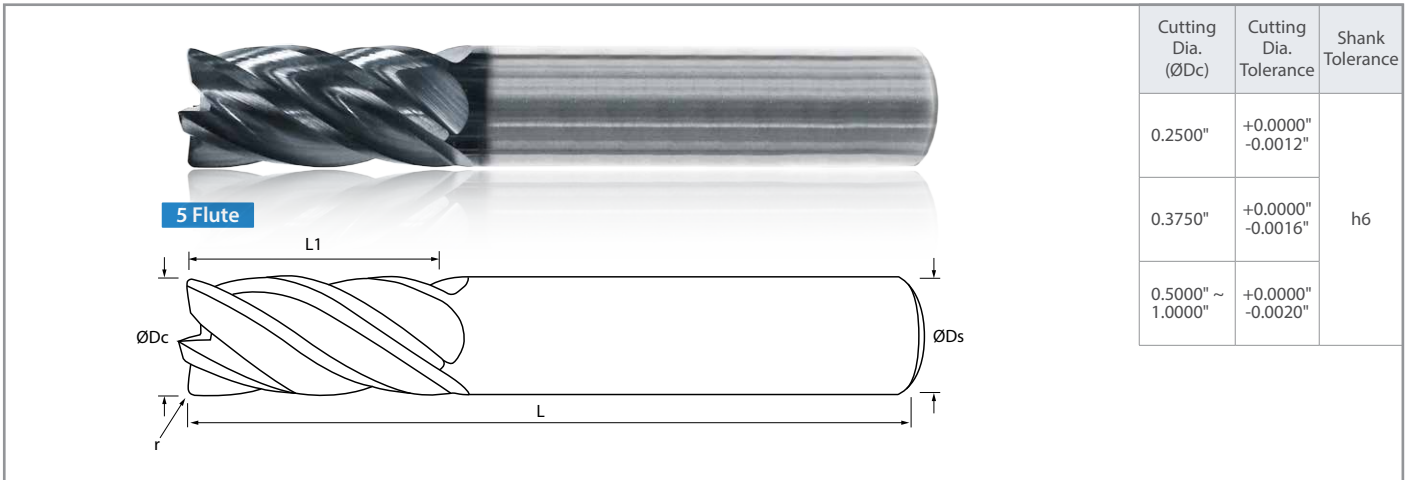
Part Number	Stock	Dimensions (mm)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc <sup>h10</sup>	ØDs <sup>h6</sup>	L	L1	r
AP4M-1575.551	●	4	4	50	14	0.4
AP4M-2362.787	●	6	6	63	20	0.4
AP4M-3150.787	●	8	8	63	20	0.4
AP4M-3937.984	●	10	10	70	25	0.4
AP4M-4724.984	●	12	12	75	25	0.6
AP4M-6299.1260	●	16	16	89	32	0.7
AP4M-7874.1496	●	20	20	100	38	0.7
AP4M-9843.1496	●	25	25	100	38	0.7

Long Length Dimensions (Metric Size)

Part Number	Stock	Dimensions (mm)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc <sup>h10</sup>	ØDs <sup>h6</sup>	L	L1	r
AP4M-2362.984	●	6	6	75	25	0.4
AP4M-3150.984	●	8	8	75	25	0.4
AP4M-3937.1181	●	10	10	75	30	0.4
AP4M-4724.1969	●	12	12	100	50	0.6
AP4M-5511.1969	●	14	14	125	50	0.6
AP4M-6299.1969	●	16	16	125	50	0.7
AP4M-7087.1969	●	18	18	125	50	0.7
AP4M-7874.1969	●	20	20	125	50	0.8
AP4M-9843.1969	●	25	25	125	50	0.8

L1 dimension refers to the Max. Length of Cut.

● : U.S. Stock



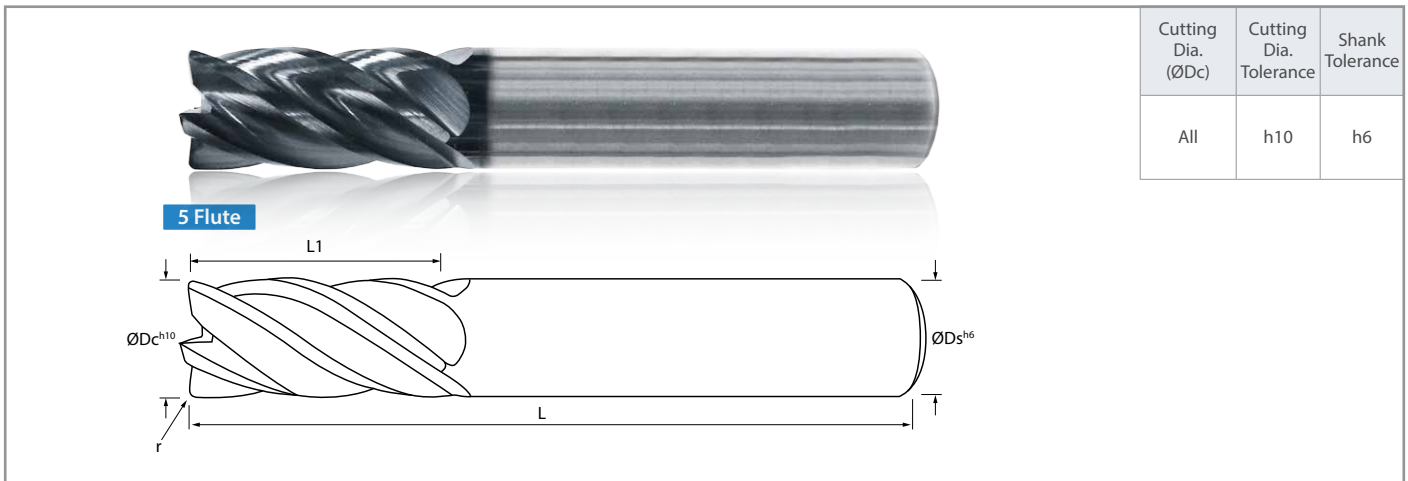
Cutting Dia. (ØDc)	Cutting Dia. Tolerance	Shank Tolerance
0.2500"	+0.0000" -0.0012"	h6
0.3750"	+0.0000" -0.0016"	
0.5000" ~ 1.0000"	+0.0000" -0.0020"	

Standard Length Dimensions (Inch Size)

Part Number	Stock	Dimensions (in)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc	ØDs	L	L1	r
AP5-2500.750	●	0.2500 (1/4)	1/4	2-1/2	3/4	0.015 - 0.020
AP5-3750.1000	●	0.3750 (3/8)	3/8	2-1/2	1	0.015 - 0.020
AP5-5000.1000	●	0.5000 (1/2)	1/2	3	1	0.025 - 0.030
AP5-6250.1250	●	0.6250 (5/8)	5/8	3-1/2	1-1/4	0.030 - 0.035
AP5-7500.1500	●	0.7500 (3/4)	3/4	4	1-1/2	0.030 - 0.035
AP5-10000.1500	●	1.0000 (1)	1	4	1-1/2	0.030 - 0.035

L1 dimension refers to the Max. Length of Cut.

● : U.S. Stock



Cutting Dia. (ØDc)	Cutting Dia. Tolerance	Shank Tolerance
All	h10	h6

Standard Length Dimensions (Metric Size)

Part Number	Stock	Dimensions (mm)				
		Cutting Diameter	Shank Diameter	Overall Length	Length of Cut	Corner Radius
		ØDc <sup>h10</sup>	ØDs <sup>h6</sup>	L	L1	r
AP5M-1575.551	●	4	4	50	14	0.4
AP5M-2362.787	●	6	6	63	20	0.4
AP5M-3150.787	●	8	8	63	20	0.4
AP5M-3937.984	●	10	10	70	25	0.4
AP5M-4724.984	●	12	12	75	25	0.6
AP5M-6299.1260	●	16	16	89	32	0.7
AP5M-7874.1496	●	20	20	100	38	0.7
AP5M-9843.1496	●	25	25	100	38	0.7

L1 dimension refers to the Max. Length of Cut.

● : U.S. Stock

# Recommended Cutting Conditions ★ 1st Recommendation ☆ 2nd Recommendation

Material	Property	Cutting Speed (sfm)	Diameter / Feed Rate (ipt)								
			Application	Ø.1250" Ø4mm	Ø.2500" Ø6mm	Ø.3125" Ø8mm	Ø.3750" Ø10mm	Ø.4375"-Ø.500" Ø12mm-Ø14mm	Ø.6250" Ø16mm	Ø.7500" Ø20mm	Ø1.000" Ø25mm
Low Carbon Steel <30 HRC	<60 ksi	☆ 490	Roughing	0.00067	0.00138	0.00181	0.00224	0.00280	0.00346	0.00402	0.00445
			Finishing	0.00094	0.00189	0.00252	0.00315	0.00390	0.00448	0.00563	0.00626
			Slotting	0.00047	0.00094	0.00126	0.00157	0.00197	0.00244	0.00087	0.00311
	<100 ksi	☆ 490	Roughing	0.00063	0.00126	0.00165	0.00205	0.00256	0.00319	0.00370	0.00409
			Finishing	0.00087	0.00173	0.00232	0.00287	0.00358	0.00445	0.00520	0.00575
			Slotting	0.00043	0.00087	0.00114	0.00146	0.00181	0.00224	0.00260	0.00287
Alloy Steel 30 - 40 HRC	<145 ksi	☆ 360	Roughing	0.00051	0.00102	0.00134	0.00169	0.00209	0.00260	0.00303	0.00335
			Finishing	0.00071	0.00142	0.00189	0.00236	0.00295	0.00366	0.00425	0.00469
			Slotting	0.00035	0.00071	0.00094	0.00118	0.00146	0.00181	0.00213	0.00236
	<190 ksi	☆ 330	Roughing	0.00047	0.00091	0.00122	0.00150	0.00185	0.00232	0.00268	0.00299
			Finishing	0.00063	0.00126	0.00169	0.00209	0.00260	0.00323	0.00378	0.00417
			Slotting	0.00031	0.00063	0.00083	0.00106	0.00130	0.00161	0.00189	0.00209
Stainless Steel	<130 ksi	★ 295	Roughing	0.00051	0.00102	0.00134	0.00169	0.00209	0.00260	0.00303	0.00335
			Finishing	0.00071	0.00142	0.00189	0.00236	0.00295	0.00366	0.00425	0.00469
			Slotting	0.00035	0.00071	0.00094	0.00118	0.00146	0.00181	0.00213	0.00236
	>130 ksi	★ 260	Roughing	0.00047	0.00091	0.00122	0.00150	0.00185	0.00232	0.00268	0.00299
			Finishing	0.00063	0.00126	0.00169	0.00209	0.00260	0.00323	0.00378	0.00417
			Slotting	0.00031	0.00063	0.00083	0.00106	0.00130	0.00161	0.00189	0.00209
Cast Iron	<8HRC	☆ 490	Roughing	0.00063	0.00126	0.00165	0.00205	0.00256	0.00319	0.00370	0.00409
			Finishing	0.00087	0.00173	0.00232	0.00287	0.00358	0.00445	0.00520	0.00575
			Slotting	0.00043	0.00087	0.00114	0.00146	0.00181	0.00224	0.00260	0.00287
	>8HRC	☆ 395	Roughing	0.00055	0.00114	0.00150	0.00189	0.00232	0.00291	0.00335	0.00374
			Finishing	0.00079	0.00157	0.00213	0.00264	0.00327	0.00406	0.00472	0.00520
			Slotting	0.00039	0.00079	0.00106	0.00130	0.00161	0.00201	0.00236	0.00260
Copper Alloy	Bronze	☆ 490	Roughing	0.00055	0.00114	0.00150	0.00189	0.00232	0.00291	0.00335	0.00374
			Finishing	0.00079	0.00157	0.00213	0.00264	0.00327	0.00406	0.00472	0.00520
			Slotting	0.00039	0.00079	0.00106	0.00130	0.00161	0.00201	0.00236	0.00260
	Brass	☆ 395	Roughing	0.00055	0.00114	0.00150	0.00189	0.00232	0.00291	0.00335	0.00374
			Finishing	0.00079	0.00157	0.00213	0.00264	0.00327	0.00406	0.00472	0.00520
			Slotting	0.00039	0.00079	0.00106	0.00130	0.00161	0.00201	0.00236	0.00260
Heat-Resistant Alloy	<130 ksi	☆ 195	Roughing	0.00039	0.00079	0.00106	0.00130	0.00161	0.00201	0.00236	0.00260
			Finishing	0.00055	0.00110	0.00146	0.00185	0.00228	0.00283	0.00331	0.00366
			Slotting	0.00028	0.00055	0.00075	0.00091	0.00114	0.00142	0.00165	0.00181
	>130 ksi	☆ 165	Roughing	0.00035	0.00067	0.00091	0.00114	0.00142	0.00173	0.00201	0.00224
			Finishing	0.00047	0.00094	0.00126	0.00157	0.00197	0.00244	0.00283	0.00311
			Slotting	0.00024	0.00047	0.00063	0.00079	0.00098	0.00122	0.00142	0.00157
Titanium Alloy	<130 ksi	☆ 165	Roughing	0.00039	0.00079	0.00106	0.00130	0.00161	0.00201	0.00236	0.00260
			Finishing	0.00055	0.00110	0.00146	0.00185	0.00228	0.00283	0.00331	0.00366
			Slotting	0.00028	0.00055	0.00075	0.00091	0.00114	0.00142	0.00165	0.00181
	>130 ksi	☆ 130	Roughing	0.00035	0.00067	0.00091	0.00114	0.00142	0.00173	0.00201	0.00224
			Finishing	0.00047	0.00094	0.00126	0.00157	0.00197	0.00244	0.00283	0.00311
			Slotting	0.00024	0.00047	0.00063	0.00079	0.00098	0.00122	0.00142	0.00157
Hardened Steel	55HRC	★ 195	Roughing	0.00039	0.00079	0.00106	0.00130	0.00161	0.00201	0.00236	0.00260
			Finishing	0.00055	0.00110	0.00146	0.00185	0.00228	0.00283	0.00331	0.00366
			Slotting	0.00028	0.00055	0.00075	0.00091	0.00114	0.00142	0.00165	0.00181
Tool Steel	68HRC	★ 130	Roughing	0.00035	0.00067	0.00091	0.00114	0.00142	0.00173	0.00201	0.00224
			Finishing	0.00047	0.00094	0.00126	0.00157	0.00197	0.00244	0.00283	0.00311
			Slotting	0.00024	0.00047	0.00063	0.00079	0.00098	0.00122	0.00142	0.00157

• Above recommendations are suggested starting parameters. Cutting speeds and feed rates may vary according to machining application.



**KYOCERA Precision Tools, Inc.**

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