Boring & Profiling Tools Speeds & Feeds

Material	Grades	Speed		Feed	Tool Diameter (Max FPR)				
		Uncoated	AltiN Coated		.060-.080	.090-.125	.180-.220	.250-.312	.375 +
		SFM	SFM	IPR	Max DOC	Max DOC	Max DOC	Max DOC	Max DOC
P - Steels									
High Strength Tool Steel	A2, D2, P20, H11, H13, S2, 01	75-175	175-300	.0005-.005	.0005	.0006	.0008	.0015	.0022
Low Carbon	A36, 12L14, 12L15, 1005, 1018, 1020, 1108-1119, 1213-1215, 1513-1518, 4012, 5015, 9310	75-200	200-450	.0005-.007	.0007	.0008	.0011	.0022	.0030
Medium Carbon	1040-1095, 1140-1151, 1330-1345, 1520-1572, 4023-4063, 4120-4161, 4330-4340, 4620-4640, 8620-8660, 8740-8750, 6150, 51000, 52100	75-200	200-425	.0005-.007	.0006	.0007	.0010	.0019	.0026
M - Stainless Steels									
Austenitic	301-304L, 310, 316L, 321, 347	75-175	75-350	.0005-.005	.0006	.0007	.0010	.0019	.0026
Martensitic	403, 410, 416, 420, 430, 431, 440	75-210	130-420	.0005-.005	.0005	.0006	.0008	.0016	.0023
Precipitation Hardening	12/8, 15/5, 17/4, AM 350/355/363, PH13-8MO, PH14-8/MO	75-230	130-600	.0005-.005	.0005	.0006	.0008	.0016	.0023
K - Cast Irons									
Ductile	A536, J434, 60-40-18	120-350	200-550	.0005-.0010	.0010	.0012	.0017	.0031	.0044
Gray	A48, A436, A319, Class 20, G4000	120-350	200-550	.0005-.0010	.0010	.0012	.0017	.0031	.0044
Malleable	A220, A602, J158	120-350	200-550	.0005-.0010	.0010	.0012	.0017	.0031	.0044
N - Non-Ferrous									
Aluminum Alloys	2014, 2024, 6061, 7075	75-250	250-750	.0005-.0015	.0022	.0026	.0037	.0065	.0085
Aluminum High Silicon	A380, A390	75-250	250-750	.0005-.0015	.0022	.0026	.0037	.0065	.0085
Brass/Bronze	Aluminum Bronze, Low Silicon Bronze	250-300	250-650	.001-.010	.0018	.0021	.0030	.0053	.0079
Composites	G-10, Fiberglass, Graphite, Graphite Epoxy, Plastics	250-300	250-650	.001-.010	.0018	.0021	.0030	.0053	.0079
Copper	101-707, 834-97	75-250	250-750	.0005-.0015	.0022	.0026	.0037	.0065	.0085
Magnesium		75-250	250-750	.0005-.0015	.0022	.0026	.0037	.0065	.0085
S - High Temp Alloys									
Cobalt Base	Stellite, HS-21, Haynes 25/188, X40, L605	50-130	130-300	.0005-.004	.0004	.0005	.0007	.0013	.0017
Iron Base	Incoloy 800-802, Multmet N-155, Timkin 16-25-6, Carpenter 22-b3	50-100	100-200	.0005-.005	.0004	.0004	.0006	.0011	.0016
Nickel Base	Inconel 625/718, Inco 700, 713C, 718, Monel 400-401, 404, K401, Rene, Rene 41 & 95 Hastelloy, Waspoloy, Udimet 500 & 700	50-130	130-300	.0005-.004	.0004	.0005	.0007	.0013	.0017
Titanium	Commercially Pure, 6Al-4V, ASTM 1/2/3, 6Al-25N-4Zr-2Mo-Si, Ti-8Al-1Mo, Ti-8Al-4Mo	50-120	120-275	.0005-.005	.0005	.0006	.0008	.0016	.0022

NOTE: Speeds and Feeds listed are estimated and will vary by application.

These tools can be found on pages 500, 501, 504, 506-517, 537-541.

Boring & Profiling Tools Troubleshooting

Problems	Causes	Solutions
Built Up Edge	Cutting Forces	Check (IPR) for excessive feed rate
	Heat	Use coolant or air blast and a coated tool
	Tool	Use a coated tool
Corner Breaking	Cutting Conditions	Check for excessive speed and feed and depth of cut
	Part	Check the entry hole size
	Tool	Select a tool with a corner radius.
Chatter	Boring Bar	Select the largest bar possible
	Setup	Position the tool above center. Reduce the overhang ratio. Clamping length should be 3x the boring bar diameter. Change the speed to break up harmonics and reduce chatter.
Rough Finish	Built up Edge	See Solution for Built Up Edge.
	Cutting Conditions	Check (IPR) for excessive feed rate
Excessive Flank Wear	Cutting Conditions	Check for excessive speed and feed
	Part	Make sure workhardening did not occur from prior operation
	Tool	Use a coated tool
Smaller Taper in Back	Chip Packing	Boring Bar may be too large which will not allow chips to evacuate. This causes the bar to deflect away from bore.
	Program	If taper is consistant, change program to compensate for the taper
Larger Taper in Back	Built Up Edge	A built up edge will cause the hole to become larger until the edge breaks off then the hole will become smaller.
	Cutting Forces	Reduce Forces. Deflecting bar below center causes the hole to become larger.
	Program	If taper is consistant, change program to compensate for the taper

Grooving Tools Speeds & Feeds

Material	Grades	Speed		Tool Diameter (Max FPR)				
		Uncoated	AltiN Coated	.060-.080	.090-.125	.180-.220	.250-.312	.375 +
		SFM	SFM	Max FPR	Max FPR	Max FPR	Max FPR	Max FPR
P - Steels								
High Strength Tool Steel	A2, D2, P20, H11, H13, S2, 01	75-175	175-300	.0005	.0006	.0008	.0015	.0022
Low Carbon	A36, 12L14, 12L15, 1005, 1018, 1020, 1108-1119, 1213-1215, 1513-1518, 4012, 5015, 9310	75-200	200-450	.0007	.0008	.0011	.0022	.0030
Medium Carbon	1040-1095, 1140-1151, 1330-1345, 1520-1572, 4023-4063, 4120-4161, 4330-4340, 4620-4640, 8620-8660, 8740-8750, 6150, 51000, 52100	75-200	200-425	.0006	.0007	.0010	.0019	.0026
M - Stainless Steels								
Austenitic	301-304L, 310, 316L, 321, 347	75-175	75-350	.0006	.0007	.0010	.0019	.0026
Martensitic	403, 410, 416, 420, 430, 431, 440	75-210	130-420	.0005	.0006	.0008	.0016	.0023
Precipitation Hardening	12/8, 15/5, 17/4, AM-350/355/363, PH13-8MO, PH14-8/MO	75-230	130-600	.0005	.0006	.0008	.0016	.0023
K - Cast Irons								
Ductile	A536, J434, 60-40-18	120-350	200-550	.0010	.0012	.0017	.0031	.0044
Gray	A48, A436, A319, Class 20, G4000	120-350	200-550	.0010	.0012	.0017	.0031	.0044
Malleable	A220, A602, J158	120-350	200-550	.0010	.0012	.0017	.0031	.0044
N - Non-Ferrous								
Aluminum Alloys	2014, 2024, 6061, 7075	75-250	250-750	.0022	.0026	.0037	.0065	.0085
Aluminum High Silicon	A380, A390	75-250	250-750	.0022	.0026	.0037	.0065	.0085
Brass/Bronze	Aluminum Bronze, Low Silicon Bronze	250-300	250-650	.0018	.0021	.0030	.0053	.0079
Composites	G-10, Fiberglass, Graphite, Graphite Epoxy, Plastics	250-300	250-650	.0018	.0021	.0030	.0053	.0079
Copper	101-707, 834-97	75-250	250-750	.0022	.0026	.0037	.0065	.0085
Magnesium		75-250	250-750	.0022	.0026	.0037	.0065	.0085
S - High Temp Alloys								
Cobalt Base	Stellite, HS-21, Haynes 25/188, X40, L605	50-130	130-300	.0004	.0005	.0007	.0013	.0017
Iron Base	Incoloy 800-802, Multmet N-155, Timkin 16-25-6, Carpenter 22-b3	50-100	100-200	.0004	.0004	.0006	.0011	.0016
Nickel Base	Inconel 625/718, Inco 700, 713C, 718, Monel 400-401, 404, K401, Rene, Rene 41 & 95 Hastel-loy, Waspoloy, Udimet 500 & 700	50-130	130-300	.0004	.0005	.0007	.0013	.0017
Titanium	Commercially Pure, 6Al-4V, ASTM 1/2/3, 6Al-25N-4Zr-2Mo-Si, Ti-8Al-1Mo, Ti-8Al-4Mo	50-120	120-275	.0005	.0006	.0008	.0016	.0022

NOTE: Speeds and Feeds listed are estimated and will vary by application.

These tools can be found on pages 502, 503, 518-532.

Grooving Tools Troubleshooting

Problems	Causes	Solutions
Built Up Edge	Cutting Forces	Check (IPR) for excessive feed rate
	Heat	Use coolant or air blast and a coated tool
	Tool	Use a coated tool
Tool Breakage	Cutting Conditions	Check (IPR) for excessive feed rate
	Chip Packing	Stagger - Peck Grooving
Chatter	Clamping	Clamping length should be 3x the grooving bar diameter. Check the tool-holder for rigidity.
	Cutting Conditions	Reduce RPM and Increase Feed Rates
	Tool	Add a (.0001-.0003) hone to the cutting edge to keep forces consistent.
Excessive Flank Wear	Cutting Conditions	Check for excessive speed
	Part	Make sure workhardening did not occur from prior operation
	Tool	Use a coated tool

Threading Tools Speeds & Feeds

Material	Grades	SFM	Feed Infeed Per Pass 1st Pass	Feed Infeed Per Pass Last Pass
P - Steels				
High Strength Tool Steel	A2, D2, P20, H11, H13, S2, 01	50-150	.0150	.0010
Low Carbon	A36, 12L14, 12L15, 1005, 1018, 1020,1108-1119, 1213-1215, 1513-1518, 4012, 5015, 9310	50-150	.0150	.0010
Medium Carbon	1040-1095, 1140-1151, 1330-1345, 1520-1572, 4023-4063, 4120-4161, 4330-4340, 4620-4640, 8620-8660, 8740-8750, 6150, 51000, 52100	50-150	.0150	.0010
M - Stainless Steels				
Austenitic	301-304L, 310, 316L, 321, 347	65-100	.0150	.0010
Martensitic	403, 410, 416, 420, 430, 431, 440	65-100	.0150	.0010
Precipitation Hardening	12/8, 15/5, 17/4, AM-350/355/363, PH13-8MO, PH14-8/MO	65-100	.0150	.0010
K - Cast Irons				
Ductile	A536, J434, 60-40-18	85-180	.0150	.0005
Gray	A48, A436, A319, Class 20, G4000	85-140	.0150	.0005
Malleable	A220, A602, J158	85-100	.0150	.0005
N - Non-Ferrous				
Aluminum Alloys	2014, 2024, 6061, 7075	100-200	.0200	.0010
Aluminum High Silicon	A380, A390	100-200	.0200	.0010
Brass/Bronze	Aluminum Bronze, Low Silicon Bronze	200-300	.0100	.0010
Composites	G-10, Fiberglass, Graphite, Graphite Epoxy, Plastics	250-400	.0150	.0010
Copper		100-200	.0100	.0010
Magnesium		100-200	.0200	.0010
S - High Temp Alloys				
Cobalt Base	Stellite, HS-21, Haynes 25/188, X40, L605	40-65	.0200	.0005
Iron Base	Incoloy 800-802, Multmet N-155, Timkin 16-25-6, Carpenter 22-b3	40-65	.0200	.0005
Nickel Base	Inconel 625/718, Inco 700, 713C, 718 Monel 400-401, 404, K401, Rene, Rene 41 & 95 Hastelloy, Waspoloy, Udimet 500 & 700	40-100	.0150	.0001
Titanium	Commercially Pure, 6Al-4V, ASTM 1/2/3, 6Al-25N-4Zr-2Mo-Si, Ti-8Al-1Mo, Ti-8Al-4Mo	40-65	.0200	.0005

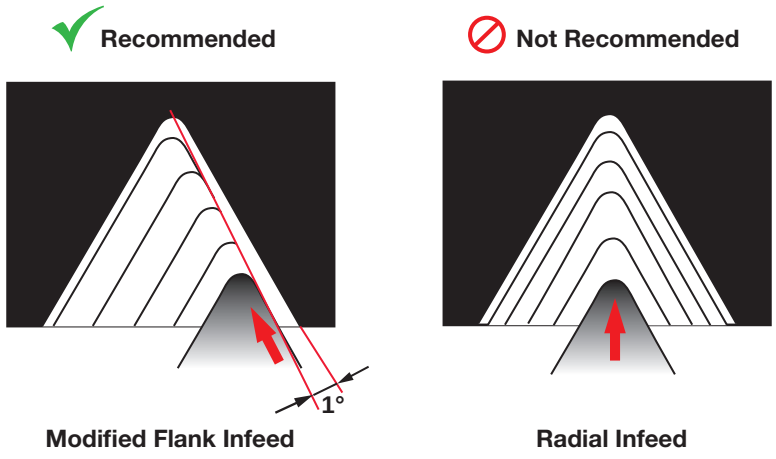
NOTE: Speeds and Feeds listed are estimated and will vary by application. These tools can be found on pages 505, 533-536.

Single Point Threading Roughing Infeed Depth per Pass

Pass	Threads Per Inch 8	10	11	12	13	14	16	18	20	24	28	32	36	40
Pass 1	.0171	.0148	.0148	.0134	.0124	.0114	.0110	.0110	.0099	.0094	.0079	.0083	.0072	.0083
Pass 2	.0283	.0243	.0243	.0219	.0202	.0189	.0179	.0178	.0159	.0150	.0126	.0130	.0113	.0128
Pass 3	.0372	.0318	.0318	.0287	.0264	.0244	.0233	.0231	.0206	.0194	.0163	.0167	.0145	
Pass 4	.0449	.0383	.0383	.0345	.0317	.0293	.0279	.0276	.0246	.0231	.0194			
Pass 5	.0517	.0441	.0441	.0396	.0364	.0337	.0321	.0316	.0282					
Pass 6	.0580	.0494	.0494	.0443	.0407	.0376	.0358							
Pass 7	.0637	.0543	.0543	.0486	.0447	.0413								
Pass 8	.0691	.0588	.0588											
Pass 9	.0742													

Threading Tools Troubleshooting

Problems	Causes	Solutions
Built Up Edge	Cutting Forces	Increase the number of passes
	Heat	Use coolant or air blast and a coated tool
	Tool	Use a coated tool
Corner Breakage	Cutting Conditions	Reduce first pass Depth of Cut
	Program	If there is not thread relief, withdraw tool on an angle.
	Part	End in Thread Relief
Chip Wrapping	Tool	The tools should be at least 30% smaller than the hole diameter.
Excessive Flank Wear	Cutting Conditions	Check for excessive speed
	Part	Make sure workhardening did not occur from prior operation
	Tool	Use a coated tool



Modified Flank Infeed

Radial Infeed

Notes:
- **A radial infeed is not recommended, a modified flank at 1 degree is recommended.**
- **For increased length to diameter ratios or difficult to machine materials increase the number of passes by 40%.**
- **Depth of cut per pass should not be less than .0003 inch.**