Operating Guidelines - 5xD

Materials				Condition	Tensile Strength (N/mm2)	HB Hardness	Vc Cutting Speed SFM	IPR Cutting Diameter (in/rev)					
ISO	Mtl Group No.	Type						3.0-6.0 mm (.118-.235")	6.0-9.0 mm (.236-.353")	9.0-12.0 mm (.354-.471")	12.0-16.0 mm (.472-.629")	16.0-19.05 mm (.630-.749")	19.05-20.0 mm (.750-.787")
P	1	Non alloy steel and cast steel free cutting steel	< 0.25 %C	Annealed	420	125	375	.0030 - .0050	.0050 - .0075	.0075 - .0100	.0100 - .0130	.0130 - .0153	.0153 - .0160
	2		>= 0.25 %C	Annealed	650	190							
	3		< 0.55 %C	Quenched and Tempered	850	250							
	4		>= 0.55 %C	Annealed	750	220							
	5		> 0.55 %C	Quenched and Tempered	1000	300							
	6	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200							
	7			Quenched and Tempered	930	275							
	8				1000	300							
	9				1200	350							
	10	High alloyed steel, cast steel, and tool steel		Annealed	680	200	275	.0030 - .0050	.0050 - .0075	.0075 - .0100	.0100 - .0130	.0130 - .0153	.0153 - .0160
	11			Quenched and Tempered	1100	325							
M	12	Stainless steel (410, 416, 420, 440)		Ferritic/ Martensitic	680	200	230	.0023 - .0047	.0047 - .0070	.0070 - .0094	.0094 - .0126	.0126 - .0138	.0138 - .0140
	13	Stainless steel (15-5, 17-4)		Martensitic	820	240							
	14	Stainless steel (302, 303, 304)		Austenitic	600	180							
		Stainless steel (310, 316, 321)					180	.0020 - .0040	.0040 - .0060	.0060 - .0080	.0080 - .0110	.0110 - .0121	.0121 - .0125
	14	Stainless steel (323, 329, F55, 2205)		Austenitic/ Ferritic	820	240	150	.0020 - .0035	.0035 - .0045	.0045 - .0050	.0050 - .0055	.0055 - .0059	.0059 - .0060
N	21	Aluminum Alloy Forging		<12% Si 1000 - 8000 series			820	.0120 - .0140	.0140 - .0200	.0200 - .0250	.0250 - .0260	.0260 - .0268	.0268 - .0270
	22												
	23	Aluminum Alloy Casting		>12% Si 4000 series & Castings			820	.0110 - .0150	.0150 - .0190	.0190 - .0230	.0230 - .0240	.0240 - .0248	.0248 - .0250
	24												
	25												
S	36	Titanium Ti alloys TI1100, TI6AL4V			Rm 400		150	.0020 - .0030	.0030 - .0040	.0040 - .0050	.0050 - .0065	.0065 - .0084	.0080 - .0084
	37			Alpha + Beta alloys cured	Rm1050								

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.

Operating Guidelines - 16xD

Materials				Condition	Tensile Strength (N/mm2)	HB Hardness	Vc Cutting Speed SFM	IPR Cutting Diameter (in/rev)				
ISO	Mtl Group No.	Type						3.0-5.9 mm (.118-.235")	6.0-8.9 mm (.236-.353")	9.0-11.9 mm (.354-.471")	12.0-15.9 mm (.472-.629")	16.0+ mm (.630+")
P	1	Non alloy steel and cast steel free cutting steel	< 0.25 %C	Annealed	420	125	375	.0058 - .0094	.0094 - .0120	.0120 - .0130	.0130 - .0140	.0140
	2		>= 0.25 %C	Annealed	650	190						
	3		< 0.55 %C	Quenched and Tempered	850	250						
	4		>= 0.55 %C	Annealed	750	220						
	5		> 0.55 %C	Quenched and Tempered	1000	300						
	6	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200	260	.0058 - .0094	.0094 - .0120	0.012 - .0130	.0130 - .0140	.0140
	7			Quenched and Tempered	930	275						
	8				1000	300						
	9				1200	350						
	10	High alloyed steel, cast steel, and tool steel		Annealed	680	200	230	.0043 - .0069	.0069 - .0088	.0088 - .0095	.0095 - .0102	.0102
	11			Quenched and Tempered	1100	325						
M	12	Stainless steel (410, 416, 420, 440)		Ferritic/ Martensitic	680	200	230	.0043 - .0069	.0069 - .0088	.0088 - .0095	.0095 - .0102	.0102
	13	Stainless steel (15-5, 17-4)		Martensitic	820	240						
	14	Stainless steel (302, 303, 304)		Austenitic	600	180	220	.0023 - .0047	.0047 - .0070	.0070 - .0094	.0094 - .0122	.0122
		Stainless steel (310, 316, 321)					180	.0018 - .0035	.0035 - .0053	.0053 - .0070	.0070 - .0093	.0093
	14	Stainless steel (323, 329, F55, 2205)		Austenitic/ Ferritic	820	240	125	0.001 - .0024	.0024 - .0029	.0029 - .0033	.0033 - .0036	.0036
S	36	Titanium Ti alloys TI1100, TI6AL4V			Rm 400		125	.0014 - .0025	.0025 - .0030	.0030 - .0035	.0035 - .0040	.0040
	37			Alpha + Beta alloys cured	Rm1050							

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.

Operating Guidelines - 20xD

Materials				Condition	Tensile Strength (N/mm2)	HB Hardness	Vc Cutting Speed SFM	IPR Cutting Diameter (in/rev)			
ISO	Mtl Group No.	Type						3.0-5.9 mm (.118-.235")	6.0-8.9 mm (.236-.353")	9.0-11.9 mm (.354-.471")	12.0-16.0 mm (.472+")
P	1	Non alloy steel and cast steel free cutting steel	< 0.25 %C	Annealed	420	125	360	.0058 - .0094	.0094 - .0120	.0120 - .0130	.0130
	2		>= 0.25 %C	Annealed	650	190					
	3		< 0.55 %C	Quenched and Tempered	850	250					
	4		>= 0.55 %C	Annealed	750	220					
	5		> 0.55 %C	Quenched and Tempered	1000	300					
	6	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200	245	.0058 - .0094	.0094 - .0120	.012 - .0130	.0130
	7			Quenched and Tempered	930	275					
	8				1000	300					
	9				1200	350					
	10	High alloyed steel, cast steel, and tool steel		Annealed	680	200	220	.0043 - .0069	.0069 - .0088	.0088 - .0094	.0094 - .0102
	11			Quenched and Tempered	1100	325					
M	12	Stainless steel (410, 416, 420, 440)		Ferritic/ Martensitic	680	200	220	.0043 - .0069	.0069 - .088	.0088 - .0094	.0094 - .0102
	13	Stainless steel (15-5, 17-4)		Martensitic	820	240					
	14	Stainless steel (302, 303, 304)		Austenitic	600	180	220	.0023 - .0047	.0047 - .0070	.0070 - .0094	.0094 - .0122
		Stainless steel (310, 316, 321)					165	.0018 - .0035	.0035 - .0053	.0053 - .0070	.0070 - .0093
	14	Stainless steel (323, 329, F55, 2205)		Austenitic/ Ferritic	820	240	120	.0010 - .0024	.0024 - .0029	.0029 - .0033	.0033 - .0036
S	36	Titanium Ti alloys TI1100, TI6AL4V			Rm 400		120	.0010 - .0023	.0023 - .0028	.0028 - .0032	.0032 - .0037
	37			Alpha + Beta alloys cured	Rm1050						

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.

Operating Guidelines - 25xD

Materials				Condition	Tensile Strength (N/mm2)	HB Hardness	Vc Cutting Speed SFM	IPR Cutting Diameter (in/rev)			
ISO	Mtl Group No.	Type						3.0-5.9 mm (.118-.235")	6.0-8.9 mm (.236-.353")	9.0-11.9 mm (.354-.471")	12.0-16.0 mm (.472+")
P	1	Non alloy steel and cast steel free cutting steel	< 0.25 %C	Annealed	420	125	360	.0058 - .0094	.0094 - .011	.0110 - .0130	.0130
	2		>= 0.25 %C	Annealed	650	190					
	3		< 0.55 %C	Quenched and Tempered	850	250					
	4		>= 0.55 %C	Annealed	750	220					
	5		> 0.55 %C	Quenched and Tempered	1000	300					
	6	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200	230	.0058 - .0094	.0094 - .0110	.0110 - .0130	.0130
	7			Quenched and Tempered	930	275					
	8				1000	300					
	9				1200	350					
	10	High alloyed steel, cast steel, and tool steel		Annealed	680	200	210	.0043 - .0069	.0069 - .0081	.0081 - .0095	.0095
	11			Quenched and Tempered	1100	325					
M	12	Stainless steel (410, 416, 420, 440)		Ferritic/ Martensitic	680	200	210	.0043 - .0069	.0069 - .0081	.0081 - .0095	.0095
	13	Stainless steel (15-5, 17-4)		Martensitic	820	240					
	14	Stainless steel (302, 303, 304)		Austenitic	600	180	210	.0023 - .0047	.0047 - .0070	.0070 - .0094	.0094
		Stainless steel (310, 316, 321)					165	.0016 - .0032	.0032 - .0050	.0050 - .0065	.0065
	14	Stainless steel (323, 329, F55, 2205)		Austenitic/ Ferritic	820	240	120	.0011 - .0019	.0019 -.0023	.0023 - .0027	.0027
S	36	Titanium Ti alloys TI1100, TI6AL4V			Rm 400		115	.0010 - .0020	.0020 - .0027	.0027 - .0032	.0032
	37			Alpha + Beta alloys cured	Rm1050						

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.

Operating Guidelines - 30xD

Materials				Condition	Tensile Strength (N/mm2)	HB Hardness	Vc Cutting Speed SFM	IPR Cutting Diameter (in/rev)		
ISO	Mtl Group No.	Type						3.0-5.9 mm (.118-.235")	6.0-8.9 mm (.236-.353")	9.0-11.9 mm (.354+")
P	1	Non alloy steel and cast steel free cutting steel	< 0.25 %C	Annealed	420	125	345	.0058 - .0094	.0094 - .0120	.0120
	2		>= 0.25 %C	Annealed	650	190				
	3		< 0.55 %C	Quenched and Tempered	850	250				
	4		>= 0.55 %C	Annealed	750	220				
	5		> 0.55 %C	Quenched and Tempered	1000	300				
	6	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200	215	.0058 - .0094	.0094 - .0120	.0120
	7			Quenched and Tempered	930	275				
	8				1000	300				
	9				1200	350				
	10	High alloyed steel, cast steel, and tool steel		Annealed	680	200	200	.0043 - .0069	.0069 - .0088	.0088
	11			Quenched and Tempered	1100	325				
M	12	Stainless steel (410, 416, 420, 440)		Ferritic/ Martensitic	680	200	200	.0043 - .0069	.0069 - .0088	.0088
	13	Stainless steel (15-5, 17-4)		Martensitic	820	240				
	14	Stainless steel (302, 303, 304)		Austenitic	600	180	195	.0023 - .0047	.0047 - .007	.0070
		Stainless steel (310, 316, 321)					150	.0016 - .0032	.0032 - .0050	.0050
	14	Stainless steel (323, 329, F55, 2205)		Austenitic/ Ferritic	820	240	120	.0011 - .0019	.0019 - .0023	.0023
S	36	Titanium Ti alloys TI1100, TI6AL4V			Rm 400		110	.0010 - .0020	.0020 - .0026	.0026
	37			Alpha + Beta alloys cured	Rm1050					

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.

Operating Guidelines - 40xD

Materials				Condition	Tensile Strength (N/mm2)	HB Hardness	Vc Cutting Speed SFM	IPR Cutting Diameter (in/rev)		
ISO	Mtl Group No.	Type						3.0-5.99 mm (.118-.235")	6.0-7.99 mm (.236-.314")	8.0 mm (.312+")
P	1	Non alloy steel and cast steel free cutting steel	< 0.25 %C	Annealed	420	125	330	.0050 - .0094	.0094 - .0105	.0105
	2		>= 0.25 %C	Annealed	650	190				
	3		< 0.55 %C	Quenched and Tempered	850	250				
	4		>= 0.55 %C	Annealed	750	220				
	5		> 0.55 %C	Quenched and Tempered	1000	300				
	6	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200	215	.0050 - .0094	.0094 - .0105	.0105
	7			Quenched and Tempered	930	275				
	8				1000	300				
	9				1200	350				
	10	High alloyed steel, cast steel, and tool steel		Annealed	680	200	200	.0037 - .0069	.0069 - .0077	.0077
	11			Quenched and Tempered	1100	325				
M	12	Stainless steel (410, 416, 420, 440)		Ferritic/ Martensitic	680	200	200	.0037 - .0069	.0069 - .0077	.0077
	13	Stainless steel (15-5, 17-4)		Martensitic	820	240				
	14	Stainless steel (302, 303, 304)		Austenitic	600	180	195	.0020 - .0040	.0040 - .0055	.0055
		Stainless steel (310, 316, 321)					145	.0016 - .0032	.0032 - .0045	.0045
	14	Stainless steel (323, 329, F55, 2205)		Austenitic/ Ferritic	820	240	115	.0010 - .0019	.0019 - .0021	.0021
S	36	Titanium Ti alloys TI1100, TI6AL4V			Rm 400		100	.0010 - .0020	.0020 - .0030	.0030
	37			Alpha + Beta alloys cured	Rm1050					

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.

Operating Guidelines - 50xD

Materials				Condition	Tensile Strength (N/mm2)	HB Hardness	Vc Cutting Speed SFM	IPR Cutting Diameter (in/rev)		
ISO	Mtl Group No.	Type						4.0-4.99 mm (.157-.196")	5.0-5.99 mm (.197-.235")	6.0 mm (.250+")
P	1	Non alloy steel and cast steel free cutting steel	< 0.25 %C	Annealed	420	125	330	.0060 - .0075	.0075 - .0094	.0094
	2		>= 0.25 %C	Annealed	650	190				
	3		< 0.55 %C	Quenched and Tempered	850	250				
	4		>= 0.55 %C	Annealed	750	220				
	5		> 0.55 %C	Quenched and Tempered	1000	300				
	6	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200	215	.0060 - .0075	.0075 - .0094	.0094
	7			Quenched and Tempered	930	275				
	8				1000	300				
	9				1200	350				
	10	High alloyed steel, cast steel, and tool steel		Annealed	680	200	190	.0040 - .0052	.0052 - .0065	.0065
	11			Quenched and Tempered	1100	325				
M	12	Stainless steel (410, 416, 420, 440)		Ferritic/ Martensitic	680	200	190	.0040 - .0052	.0052 - .0065	.0065
	13	Stainless steel (15-5, 17-4)		Martensitic	820	240				
	14	Stainless steel (302, 303, 304)		Austenitic	600	180	195	.0025 - .0032	.0032 - .0040	.0040
		Stainless steel (310, 316, 321)					145	.0018 - .0026	.0026 - .0032	.0032
	14	Stainless steel (323, 329, F55, 2205)		Austenitic/ Ferritic	820	240	115	.0010 - .0015	.0015 - .0019	.0019
S	36	Titanium Ti alloys TI1100, TI6AL4V			Rm 400		100	.0010 - .0015	.0015 - .0020	.0020
	37			Alpha + Beta alloys cured	Rm1050					

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.