

# Machining Data for roughing Face and Shoulder Mills

Material group	Breakdown of main material groupings and code letters		Brinell-hardness HB	Machining group <sup>5</sup>	Starting value for $v_c$ [ft/min]							
					HC = Coated Grades							
					WAP 25		WAP 35		WTP 35		WQM 45 WXP 45	
					$a_e/D_c^*$		$a_e/D_c^*$		$a_e/D_c^*$		$a_e/D_c^*$	
1/1 1/2		1/1 1/5		1/1 1/2		1/1 1/5		1/1 1/5				
P	Unalloyed steel <sup>1</sup>	approx. 0.15% C annealed	125	1	820	1050	720	920	560	720	620	790
		approx. 0.45% C annealed	190	2	720	920	620	790	480	620	520	690
		approx. 0.45% C tempered	250	3	660	820	540	690	390	490	430	540
		approx. 0.75% C annealed	270	4	620	820	510	620	360	430	390	460
		approx. 0.75% C tempered	300	5	590	720	460	520	330	360	360	390
	Low-alloyed steel <sup>1</sup>	annealed	180	6	750	950	640	800	480	610	520	660
		tempered	275	7	620	790	490	570	360	430	390	460
		tempered	300	8	590	720	460	510	330	360	360	390
		tempered	350	9	460	520	330	380	230	260	260	300
	High-alloyed steel and high-alloyed tool steel <sup>1</sup>	annealed	200	10	390	490	360	460	280	340	310	380
hardened by tempering		325	11	300	360	230	260	160	200	180	230	
Stainless steel <sup>1</sup>	ferritic / martensitic, annealed	200	12			390	460	390	460	430	510	
	martensitic, tempered	240	13			260	330	260	330	300	360	
M	Stainless steel <sup>1</sup>	austenitic <sup>2</sup> , retained	180	14					430	490		
K	Grey cast iron	pearlitic / ferritic	180	15	790	790	520	520	330	430		
		pearlitic (martensitic)	260	16	560	560	330	330	260	300		
	Cast iron with spheroidal graphite	ferritic	160	17	660	660	460	460	330	440		
		pearlitic	250	18	560	560	390	390	260	360		
	Malleable cast iron	ferritic	130	19	720	720	520	520	430	540		
		pearlitic	230	20	590	590	430	430	330	430		
N	Aluminum malleable alloys	non-age-hardenable	60	21					2300	2710		
		age-hardenable, age-hardened	100	22					1480	1840		
	Aluminum cast alloys	≤ 12% Si, non-age-hardenable	75	23					1800	2130		
		≤ 12% Si, age-hardenable, -hardened	90	24					1310	1310		
		> 12% Si, non-age-hardenable	130	25					820	970		
	Copper and copper alloys (Bronze/brass)	Free cutting alloys, Pb > 1%	110	26					1310	1310		
		Brass, red brass	90	27					820	970		
		Bronze unleaded copper and electrolytic copper	100	28								
	Non-metallic materials	Duroplasts, fiber-reinforced plastics		29								
Hard rubber			30									
S	Heat-resistant alloys	Fe basis annealed	200	31								
		Fe basis age-hardened	280	32								
		Ni or Co basis annealed	250	33			200		160		160	
		Ni or Co basis age-hardened	350	34			100		160		160	
		Ni or Co basis cast	320	35			130		110		110	
	Titanium alloys	Pure titanium	400 <sup>3</sup>	36								
	Alpha + Beta alloys, age-hardened	1050 <sup>3</sup>	37					150	160			
H	Hardened steel	hardened by tempering	55 <sup>4</sup>	38								
		hardened by tempering	60 <sup>4</sup>	39								
	Chill cast iron	cast	400	40								
	Hardened cast iron	hardened by tempering	55 <sup>4</sup>	41								

<sup>1</sup> and cast steel <sup>2</sup> and austenitic / ferritic <sup>3</sup> Rm: Tensile strength in MPa = N/mm<sup>2</sup> <sup>4</sup> HRC: Rockwell hardness C

<sup>5</sup> See page 712 etc. for the assignment of machining group.