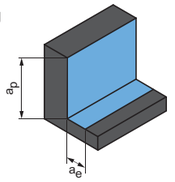
Cutting data recommendations for ball nose milling cutters

Feed and cutting speed

Roughing



Plunge angle
1.0° - 3.0°

Next page:
Finishing

OptiMill-3D-BN-Hardened | MBN106, 107, 108, 109

MMG*		Workpiece material	Strength/hardness [N/mm²] [HRC]	Cooling			a_p [mm]	a_e [mm]	v_c [m/min]	f_z [mm] Diameter of milling cutter [mm]																					
				Dry	Air/MQL	KSS				0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.50	1.80	2.00	2.50	3.00	4.00	5.00	6.00	8.00	10.00	12.00	16.00
P	P1.1	Structural, machining, case hardened and tempering steels, unalloyed	< 700	✓	✓	✓	0.05xD	< 0.25xD	**250-300**	0.003	0.004	0.006	0.008	0.010	0.012	0.016	0.020	0.028	0.035	0.040	0.050	0.061	0.084	0.107	0.125	0.165	0.200	0.235	0.300
	P1	P1.2	Structural, machining, case hardened and tempering steels, unalloyed	< 1,200	✓	✓	✓	0.045xD	< 0.25xD	**240-280**	0.003	0.004	0.005	0.007	0.009	0.011	0.014	0.018	0.025	0.031	0.035	0.044	0.054	0.074	0.094	0.110	0.145	0.176	0.207	0.264
	P2	P2.1	Nitriding, hardening and tempering steels, alloyed	< 900	✓	✓	✓	0.05xD	< 0.25xD	**250-300**	0.003	0.004	0.006	0.008	0.010	0.012	0.016	0.020	0.028	0.035	0.040	0.050	0.061	0.084	0.107	0.125	0.165	0.200	0.235	0.300
		P2.2	Nitriding, hardening and tempering steels, alloyed	< 1,400	✓	✓	✓	0.045xD	< 0.25xD	**240-280**	0.003	0.004	0.005	0.007	0.009	0.011	0.014	0.018	0.025	0.031	0.035	0.044	0.054	0.074	0.094	0.110	0.145	0.176	0.207	0.264
	P3	P3.1	Tool, bearing, spring and high-speed steels**	< 800	✓	✓	✓	0.05xD	< 0.25xD	**250-300**	0.003	0.004	0.006	0.008	0.010	0.011	0.015	0.019	0.027	0.033	0.038	0.048	0.058	0.080	0.102	0.119	0.157	0.190	0.223	0.285
		P3.2	Tool, bearing, spring and high-speed steels**	< 1,000	✓	✓	✓	0.045xD	< 0.2xD	**240-280**	0.003	0.004	0.005	0.007	0.009	0.011	0.014	0.018	0.025	0.031	0.035	0.044	0.054	0.074	0.094	0.110	0.145	0.176	0.207	0.264
		P3.3	Tool, bearing, spring and high-speed steels**	< 1,500	✓	✓	✓	0.04xD	< 0.2xD	**220-260**	0.002	0.003	0.004	0.006	0.007	0.009	0.012	0.015	0.020	0.026	0.029	0.037	0.045	0.061	0.078	0.091	0.120	0.146	0.172	0.219
	P4	P4.1	Stainless steels, ferritic and martensitic			✓	✓	0.05xD	< 0.25xD	**240-280**	0.003	0.004	0.006	0.008	0.010	0.012	0.016	0.020	0.028	0.035	0.040	0.050	0.061	0.084	0.107	0.125	0.165	0.200	0.235	0.300
	P5	P5.1	Cast steel			✓	✓	0.05xD	< 0.25xD	**240-280**	0.003	0.004	0.005	0.007	0.009	0.011	0.014	0.018	0.025	0.031	0.035	0.044	0.054	0.074	0.094	0.110	0.145	0.176	0.207	0.264
	P6	P6.1	Stainless cast steels, ferritic and martensitic			✓	✓	0.045xD	< 0.25xD	**200-250**	0.002	0.003	0.004	0.006	0.007	0.009	0.012	0.015	0.020	0.026	0.029	0.037	0.045	0.061	0.078	0.091	0.120	0.146	0.172	0.219
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), GJL	< 300	✓	✓	✓	0.06xD	< 0.3xD	**250-300**	0.004	0.005	0.007	0.010	0.012	0.014	0.019	0.024	0.034	0.042	0.048	0.060	0.073	0.101	0.128	0.150	0.198	0.240	0.282	0.360
	K2	K2.1	Cast iron with spheroidal graphite, GJS	< 500	✓	✓	✓	0.06xD	< 0.3xD	**250-300**	0.003	0.004	0.006	0.008	0.010	0.012	0.016	0.020	0.028	0.035	0.040	0.050	0.061	0.084	0.107	0.125	0.165	0.200	0.235	0.300
		K2.2	Cast iron with spheroidal graphite, GJS	≤ 800	✓	✓	✓	0.06xD	< 0.3xD	**240-280**	0.003	0.004	0.006	0.008	0.010	0.012	0.016	0.020	0.028	0.035	0.040	0.050	0.061	0.084	0.107	0.125	0.165	0.200	0.235	0.300
		K2.3	Cast iron with spheroidal graphite, GJS	> 800	✓	✓	✓	0.06xD	< 0.3xD	**240-280**	0.003	0.004	0.005	0.007	0.009	0.011	0.014	0.018	0.025	0.031	0.035	0.044	0.054	0.074	0.094	0.110	0.145	0.176	0.207	0.264
	K3	K3.1	Cast iron with vermicular graphite, GJV; malleable cast iron, GJM	< 500	✓	✓	✓	0.06xD	< 0.3xD	**250-300**	0.002	0.003	0.004	0.006	0.007	0.009	0.012	0.015	0.020	0.026	0.029	0.037	0.045	0.061	0.078	0.091	0.120	0.146	0.172	0.219
		K3.2	Cast iron with vermicular graphite, GJV; malleable cast iron, GJM	> 500	✓	✓	✓	0.06xD	< 0.3xD	**240-280**	0.002	0.002	0.004	0.005	0.006	0.007	0.010	0.012	0.017	0.022	0.025	0.031	0.038	0.052	0.066	0.078	0.102	0.124	0.146	0.186
H	H1	H1.1	Hardened steel / cast steel	< 44 HRC	✓	✓		0.04xD	< 0.18xD	**220-280**	0.002	0.003	0.004	0.006	0.007	0.009	0.012	0.015	0.020	0.026	0.029	0.037	0.045	0.061	0.078	0.091	0.120	0.146	0.172	0.219
		H1.2	Hardened steel / cast steel	< 55 HRC	✓	✓		0.03xD	< 0.12xD	**160-220**	0.002	0.002	0.004	0.005	0.006	0.007	0.010	0.012	0.017	0.021	0.024	0.030	0.037	0.050	0.064	0.075	0.099	0.120	0.141	0.180
	H2	H2.1	Hardened steel / cast steel	< 60 HRC		✓		0.015xD	< 0.03xD	**100-160**	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.008	0.011	0.014	0.016	0.020	0.024	0.034	0.043	0.050	0.066	0.080	0.094	0.120
		H2.2	Hardened steel / cast steel	< 65 HRC		✓		0.008xD	< 0.018xD	**60-100**	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.008	0.011	0.012	0.015	0.018	0.025	0.032	0.038	0.050	0.060	0.071	0.090
		H2.3	Hardened steel / cast steel	< 68 HRC		✓		0.005xD	< 0.015xD	**40-80**	0.001	0.001	0.001	0.002	0.002	0.003	0.004	0.004	0.006	0.008	0.009	0.011	0.013	0.019	0.024	0.028	0.036	0.044	0.052	0.066
	H3	H3.1	Wear-resistant cast / chill casting, GJN		✓	✓		0.015xD	< 0.03xD	**100-160**	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.008	0.011	0.014	0.016	0.020	0.024	0.034	0.043	0.050	0.066	0.080	0.094	0.120

Working depth correction factor – k_{AT}

AT	k_{AT}		
	a_p	n	v_f
≤ 3xD	1,00	1,00	1,00
≤ 5xD	0,80	0,90	0,90
≤ 6xD	0,70	0,85	0,85
≤ 8xD	0,60	0,75	0,75
≤ 10xD	0,50	0,70	0,70
≤ 12xD	0,45***	0,65	0,65
≤ 15xD	0,40***	0,60	0,60
≤ 20xD	0,35***	0,60	0,60
≤ 25xD	0,35***	0,50	0,50
≤ 30xD	0,30***	0,50	0,50
≤ 35xD	0,30***	0,50	0,50

Cone angle correction factor – k_{KW}

φ [°]	k_{KW}		
	a_p	n	v_f
0	1,00	1,00	1,00
0,5	1,01	1,01	1,01
1	1,02	1,02	1,02
1,5	1,03	1,03	1,03
3	1,06	1,06	1,06

Note:
To determine cutting data, please observe the notes on page 548-551.

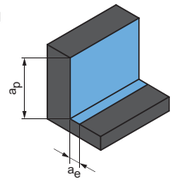
* MAPAL machining groups
** If the alloy parts Cr, Mo, Ni, V, W in total > 8%, then select the next highest MAPAL machining group.
*** Consultation with a MAPAL application engineer.

The specified machining values are guide values.
The optimum data for the respective machining task should be determined during the test or machining.

Cutting data recommendations for ball nose milling cutters

Feed and cutting speed

Finishing



Plunge angle
0.5° - 1.0°

OptiMill-3D-BN-Hardened | MBN106, 107, 108, 109

MMG*		Workpiece material	Strength/hardness [N/mm²] [HRC]	Cooling			a_p [mm]	a_e [mm]	v_c [m/min]	f_z [mm] Diameter of milling cutter [mm]																				
				Dry	Air/MQL	KSS				0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.50	1.80	2.00	2.50	3.00	4.00	5.00	6.00	8.00	10.00	12.00	16.00
P	P1	P1.1	Structural, machining, case hardened and tempering steels, unalloyed	< 700	✓	✓	✓	0.015xD	0.025xD	**280-340**	0.003	0.004	0.006	0.008	0.010	0.011	0.015	0.019	0.027	0.033	0.038	0.048	0.058	0.080	0.102	0.119	0.157	0.190	0.223	0.285
		P1.2	Structural, machining, case hardened and tempering steels, unalloyed	< 1,200	✓	✓	✓	0.014xD	0.024xD	**280-320**	0.003	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.042	0.051	0.070	0.089	0.105	0.138	0.167	0.196	0.251
	P2	P2.1	Nitriding, hardening and tempering steels, alloyed	< 900	✓	✓	✓	0.014xD	0.024xD	**270-320**	0.003	0.004	0.006	0.008	0.010	0.011	0.015	0.019	0.027	0.033	0.038	0.048	0.058	0.080	0.102	0.119	0.157	0.190	0.223	0.285
		P2.2	Nitriding, hardening and tempering steels, alloyed	< 1,400	✓	✓	✓	0.013xD	0.023xD	**260-300**	0.003	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.042	0.051	0.070	0.089	0.105	0.138	0.167	0.196	0.251
	P3	P3.1	Tool, bearing, spring and high-speed steels**	< 800	✓	✓	✓	0.013xD	0.023xD	**280-320**	0.003	0.004	0.005	0.007	0.009	0.011	0.014	0.018	0.025	0.032	0.036	0.045	0.055	0.076	0.097	0.113	0.149	0.181	0.212	0.271
		P3.2	Tool, bearing, spring and high-speed steels**	< 1,000	✓	✓	✓	0.012xD	0.022xD	**260-300**	0.003	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.042	0.051	0.070	0.089	0.105	0.138	0.167	0.196	0.251
		P3.3	Tool, bearing, spring and high-speed steels**	< 1,500	✓	✓	✓	0.01xD	0.02xD	**240-280**	0.002	0.003	0.004	0.006	0.007	0.008	0.011	0.014	0.019	0.024	0.028	0.035	0.042	0.058	0.074	0.087	0.114	0.139	0.163	0.208
	P4	P4.1	Stainless steels, ferritic and martensitic			✓	✓	0.013xD	0.023xD	**260-300**	0.003	0.004	0.006	0.008	0.010	0.011	0.015	0.019	0.027	0.033	0.038	0.048	0.058	0.080	0.102	0.119	0.157	0.190	0.223	0.285
	P5	P5.1	Cast steel			✓	✓	0.013xD	0.023xD	**260-300**	0.003	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.042	0.051	0.070	0.089	0.105	0.138	0.167	0.196	0.251
	P6	P6.1	Stainless cast steels, ferritic and martensitic			✓	✓	0.012xD	0.022xD	**220-270**	0.002	0.003	0.004	0.006	0.007	0.008	0.011	0.014	0.019	0.024	0.028	0.035	0.042	0.058	0.074	0.087	0.114	0.139	0.163	0.208
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), GJL	< 300	✓	✓	✓	0.015xD	0.025xD	**280-340**	0.003	0.004	0.006	0.008	0.010	0.011	0.015	0.019	0.027	0.033	0.038	0.048	0.058	0.080	0.102	0.119	0.157	0.190	0.223	0.285
	K2	K2.1	Cast iron with spheroidal graphite, GJS	< 500	✓	✓	✓	0.014xD	0.024xD	**280-320**	0.003	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.042	0.051	0.070	0.089	0.105	0.138	0.167	0.196	0.251
		K2.2	Cast iron with spheroidal graphite, GJS	≤ 800	✓	✓	✓	0.013xD	0.023xD	**270-320**	0.003	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.042	0.051	0.070	0.089	0.105	0.138	0.167	0.196	0.251
		K2.3	Cast iron with spheroidal graphite, GJS	> 800	✓	✓	✓	0.012xD	0.022xD	**260-300**	0.003	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.042	0.051	0.070	0.089	0.105	0.138	0.167	0.196	0.251
	K3	K3.1	Cast iron with vermicular graphite, GJV; malleable cast iron, GJM	< 500	✓	✓	✓	0.014xD	0.024xD	**280-320**	0.002	0.003	0.004	0.006	0.007	0.008	0.011	0.014	0.019	0.024	0.028	0.035	0.042	0.058	0.074	0.087	0.114	0.139	0.163	0.208
		K3.2	Cast iron with vermicular graphite, GJV; malleable cast iron, GJM	> 500	✓	✓	✓	0.013xD	0.023xD	**260-300**	0.002	0.002	0.004	0.005	0.006	0.007	0.009	0.012	0.017	0.021	0.024	0.029	0.036	0.050	0.063	0.074	0.097	0.118	0.139	0.177
H	H1	H1.1	Hardened steel / cast steel	< 44 HRC	✓	✓		0.012xD	0.022xD	**250-300**	0.003	0.004	0.005	0.007	0.009	0.011	0.015	0.018	0.026	0.032	0.037	0.046	0.056	0.077	0.098	0.114	0.151	0.183	0.215	0.274
		H1.2	Hardened steel / cast steel	< 55 HRC	✓	✓		0.01xD	0.02xD	**200-250**	0.002	0.003	0.005	0.007	0.008	0.010	0.013	0.017	0.023	0.029	0.033	0.041	0.051	0.070	0.089	0.104	0.137	0.166	0.195	0.249
	H2	H2.1	Hardened steel / cast steel	< 60 HRC		✓		0.008xD	0.018xD	**130-200**	0.002	0.003	0.005	0.006	0.008	0.009	0.012	0.015	0.021	0.026	0.030	0.038	0.046	0.063	0.081	0.094	0.124	0.151	0.177	0.226
		H2.2	Hardened steel / cast steel	< 65 HRC		✓		0.006xD	0.016xD	**100-150**	0.002	0.003	0.004	0.005	0.007	0.008	0.011	0.014	0.019	0.024	0.027	0.034	0.042	0.058	0.073	0.086	0.113	0.137	0.161	0.206
		H2.3	Hardened steel / cast steel	< 68 HRC		✓		0.005xD	0.015xD	**70-120**	0.001	0.002	0.003	0.004	0.005	0.006	0.008	0.010	0.013	0.017	0.019	0.024	0.029	0.040	0.051	0.060	0.079	0.096	0.113	0.144
	H3	H3.1	Wear-resistant cast / chill casting, GJN		✓	✓		0.008xD	0.018xD	**130-200**	0.002	0.003	0.005	0.006	0.008	0.009	0.012	0.015	0.021	0.026	0.030	0.038	0.046	0.063	0.081	0.094	0.124	0.151	0.177	0.226

Working depth correction factor – k_{AT}

AT	k_{AT}		
	a_p	n	v_f
≤ 3xD	1,00	1,00	1,00
≤ 5xD	0,80	0,90	0,90
≤ 6xD	0,70	0,85	0,85
≤ 8xD	0,60	0,75	0,75
≤ 10xD	0,50	0,70	0,70
≤ 12xD	0,45***	0,65	0,65
≤ 15xD	0,40***	0,60	0,60
≤ 20xD	0,35***	0,60	0,60
≤ 25xD	0,35***	0,50	0,50
≤ 30xD	0,30***	0,50	0,50
≤ 35xD	0,30***	0,50	0,50

Cone angle correction factor – k_{KW}

φ [°]	k_{KW}		
	a_p	n	v_f
0	1,00	1,00	1,00
0,5	1,01	1,01	1,01
1	1,02	1,02	1,02
1,5	1,03	1,03	1,03
3	1,06	1,06	1,06

Note:
To determine cutting data, please observe the notes on page 548-551.

* MAPAL machining groups
** If the alloy parts Cr, Mo, Ni, V, W in total > 8%, then select the next highest MAPAL machining group.
*** Consultation with a MAPAL application engineer.

The specified machining values are guide values.
The optimum data for the respective machining task should be determined during the test or machining.