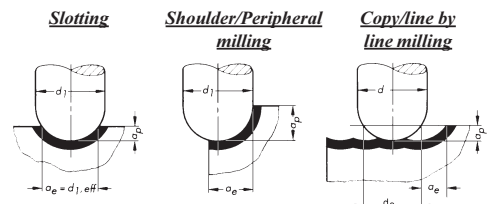


# CUTTING DATA - BALL NOSE MILLS

CUTTING DATA FOR BALL NOSE CUTTERS					Coated			Cermet			Uncoated						
MILLING CUTTER / MATERIAL					TN7535/TN450			TTI-25			TTM			TTR			
Cutter		Nominal diameter (d <sup>1</sup> )			Feed fz inches per tooth												
P	TBNF Finishing a <sub>e</sub> ≈ 10% of d <sup>1</sup> (cutter diameter) Effective # of teeth z = 2	3/8" & 1/2"			---	---	---	.003	.005	.006	.004	.005	.006	---	---	---	
		5/8"						.004	.006	.007	.005	.007	.009				
		3/4" & 1"						.006	.008	.010	.007	.009	.011				
		1 1/4"						.007	.010	.012	.009	.012	.014				
P	TBNR Roughing a <sub>e</sub> ≥ 40% of d <sup>1</sup> (cutter diameter) Effective # of teeth z = 1	5/8" & 3/4"			.004	.005	.006	.003	.005	.006	.004	.005	.006				
		1", 1 1/4" & 1 1/2"			.005	.007	.009	---	---	---	.004	.006	.008	.005	.007	.009	
		2"			.006	.009	.011	---	---	---	.005	.008	.010	.006	.009	.011	
ISO 513	Work Material	Condition	Hardness HB	Mat. Gr.	Cutting Speeds in SFPM												
P	Carbon steel, < 0.25% C	annealed	125	1	815	700	650	1465	1120	975	715	635	585	585	455	390	
	Unalloyed steel, cast steel and free cutting steel	≥ 0.25% C	annealed	190	2	585	490	455	1235	910	780	520	425	390	425	325	295
		< 0.55% C	heat-treated	250	3	490	425	390	1010	765	650	425	325	295	360	260	230
	Low alloy steel and cast steel	≥ 0.55% C	annealed	220	4	520	455	425	1140	845	715	455	360	325	390	295	260
			heat-treated	300	5	425	360	325	---	---	---	360	295	260	295	230	195
			annealed	200	6	585	490	455	1235	910	780	520	425	390	425	325	295
			heat-treated	275	7	455	390	360	---	---	---	390	325	295	325	260	230
		heat-treated	300	8	390	325	295	---	---	---	325	260	230	260	205	180	
		heat-treated	350	9	325	230	---	---	---	---	295	195	---	230	165	---	
	High alloy steel, cast steel & tool steel	annealed	200	10	520	440	390	1170	860	715	455	360	325	390	295	260	
	heat-treated	325	11	325	230	---	---	---	---	295	195	---	230	165	---		
M	400 series Stainless & cast steel	ferrit./mart.	200	12	555	490	455	1140	845	715	490	390	360	425	310	260	
		martensitic	240	13	455	390	360	975	750	650	425	325	295	360	260	230	
	300 series Stainless & cast steel	austenitic	180	14	490	295	---	---	---	---	325	260	---	---	---	---	

CUTTING DATA FOR BALL NOSE CUTTERS					Uncoated		
MILLING CUTTER / MATERIAL					THM		
Cutter		Nominal diameter (d <sup>1</sup> )			Feed fz inches per tooth		
P	TBNF Finishing a <sub>e</sub> ≈ 10% of d <sup>1</sup> (cutter diameter) Effective # of teeth z = 2	3/8" & 1/2"			.004	.005	.006
		5/8"			.005	.008	.009
		3/4" & 1"			.007	.010	.012
		1 1/4"			.009	.012	.015
P	TBNR Roughing a <sub>e</sub> ≥ 40% of d <sup>1</sup> (cutter diameter) Effective # of teeth z = 1	5/8" & 3/4"			.004	.006	.007
		1", 1 1/4" & 1 1/2"			.005	.007	.009
		2"			.006	.010	.012
ISO 513	Work Material	Condition	Hardness HB	Mat. Gr.	Cutting Speeds in SFPM		
K	Grey cast iron	ferrit./pearl.	180	15	520	390	325
		pearlitic	260	16	390	295	260
	Nodular cast iron	ferritic	160	17	455	340	295
		pearlitic	250	18	325	230	---
	Malleable cast iron	ferritic	130	19	455	295	---
		pearlitic	230	20	360	230	---
N	Cast aluminium alloys	≤ 12% Si	75	23	3250	2340	1950
		age-hardened	90	24	2600	1920	1625
	Copper & copper alloys	Red Brass, brass	90	27	1300	815	---
		Bronze	100	28	975	585	---
Cutter		Nominal diameter (d <sup>1</sup> )			Feed fz inches per tooth		
P	TBNF Finishing a <sub>e</sub> ≈ 10% of d <sup>1</sup> (cutter diameter) Effective # of teeth z = 2	3/8" & 1/2"			.004	.005	.006
		5/8"			.005	.006	.008
		3/4" & 1"			.005	.008	.009
		1 1/4"			.006	.009	.011
P	TBNR Roughing a <sub>e</sub> ≥ 40% of d <sup>1</sup> (cutter diameter) Effective # of teeth z = 1	5/8" & 3/4"			.003	.005	.006
		1", 1 1/4" & 1 1/2"			.004	.006	.007
		2"			.005	.007	.009
ISO 513	Work Material	Condition	Hardness HB	Mat. Gr.	Cutting Speeds in SFPM		
S	High-temperature alloys	annealed	250	33	80	60	50
	Ni- or Co-based	age-hardened	350	34	65	50	40
	Titanium alloys	age-hardened	310	37	230	150	115
H	Hardened steel	hardened	55 HRC	38	80	60	50
		hardened	60 HRC	39	---	---	---



**Depth of cut TBNR:**  
 max. ap ≈ 35% of d<sup>1</sup> in slotting  
 ≈ 90% of d<sup>1</sup> in shoulder & copy milling

**Spindle speed: RPM = SFPM \* 3.82 / d<sup>1eff</sup>**

**Cutter diameter:** In the case of depths of cut ap < 50% of d<sup>1</sup>, the cutting diameter to be used when calculating spindle speed and feed is smaller than the cutter diameter d<sup>1</sup>.

The effective cutting diameter can be read from the table below:

Depth of cut ap	EFFECTIVE CUTTER DIAMETERS							
	Effective cutter diameter d <sup>1eff</sup> for cutter nominal diameter d <sup>1</sup>							
	.375"	.500"	.625"	.750"	1.00"	1.25"	1.50"	2.00"
.010"	.121	.140	.157	.172	.199	.223	.244	.282
.020"	.169	.196	.220	.242	.280	.314	.344	.398
.030"	.203	.237	.267	.294	.341	.383	.420	.486
.040"	.232	.271	.306	.337	.392	.440	.483	.560
.050"	.255	.300	.339	.374	.436	.490	.539	.624
.075"	.300	.357	.406	.450	.527	.594	.654	.760
.100"	.332	.400	.458	.510	.600	.678	.748	.872
.125"	.354	.433	.500	.559	.661	.750	.829	.968
.250"	---	.500	.612	.707	.866	1.000	1.118	1.323
.375"	---	---	---	.750	.968	1.146	1.299	1.561
.500"	---	---	---	---	1.000	1.225	1.414	1.732
.625"	---	---	---	---	---	1.250	1.479	1.854
.750"	---	---	---	---	---	---	1.500	1.936
1.00"	---	---	---	---	---	---	---	2.000

CORRECTION FACTORS				
For stepovers of ≤ 40%, the cutting data should be corrected as follows				
Ratio ae : d <sup>1</sup>	5%	10%	20%	40%
Feed factor	3	2	1.5	1
SFPM factor	1.5	1.4	1.3	1.2

**Notes:** \* When using short M28 cutters, select feed approximately 20% higher (factor 1.2). In copy or line by line milling with smaller widths of cut, higher cutting data are possible. (see correction factors)