Tyson infoTECH™

Issue 27

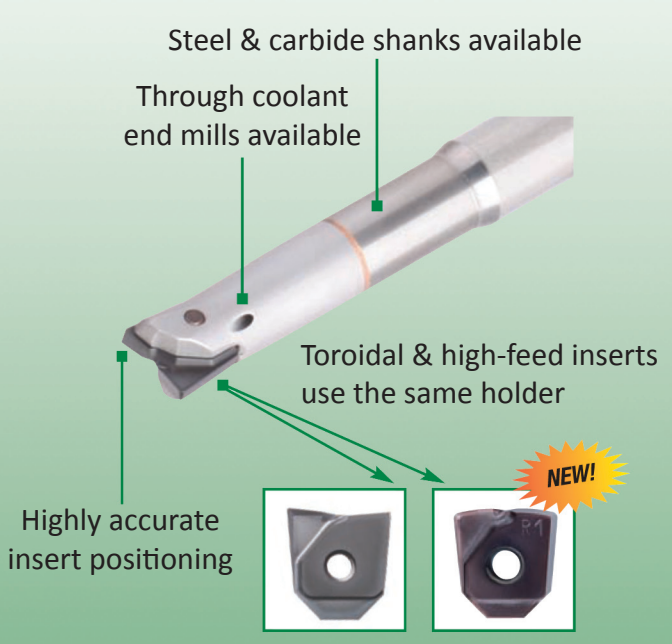
WIDIA

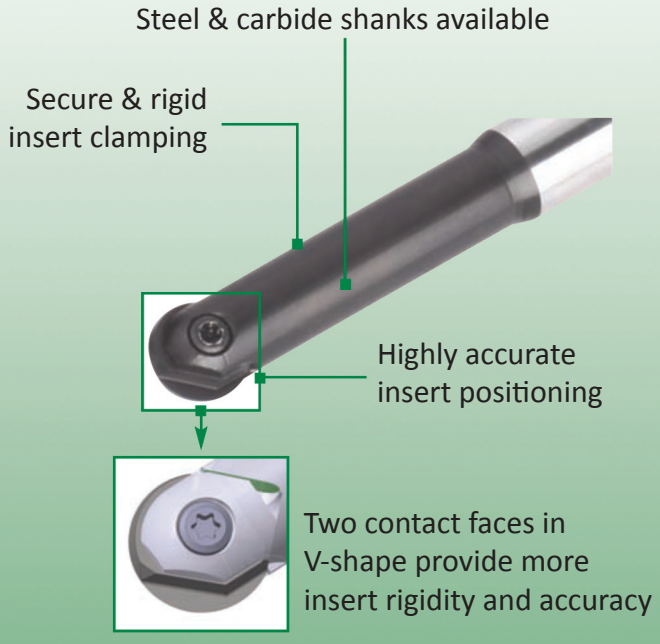
M270 Series • *For Secure and Rigid Insert Clamping*

With precision-engineered ball nose, toroidal, and new high-feed inserts, the M270 Series provides the highest accuracy and insert stability for exceptional reliability and performance.

- Ball nose and toroidal tools for semi-finishing through finishing
- NEW performance-boosting High-Feed (HF) inserts offered standard
- V-shaped contact faces enable maximum stability and accuracy

M270

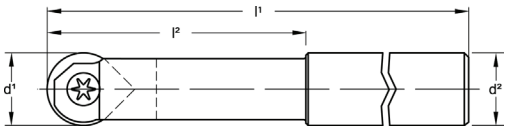




- Rough, semi-finish, and finish with one system
- Secure and rigid insert clamping system

-BR Roughing and semi-finishing geometry for contouring in a variety of workpiece materials.

-BF Precision ground finishing and semi-finishing for contouring in a variety of workpiece materials.



Extended Length Steel Shank End Mill with Cylindrical Shank

Designation	Ø d¹	d²	l¹	l²	Insert	Insert Screw	Wrench
M270B-D037C050-L550	.375	.500	5.550	1.800	M270BR/BF-0375/10MM	274.86.105	274.97.262
M270B-D050C050-L575	.500	.500	5.750	2.000	M270BR/BF-0500/12MM	274.86.106	274.97.262
M270B-DC062C062-L600	.625	.625	6.000	2.300	M270BR/BF-0625/16MM	274.86.107	274.97.993
M270B-D075C075-L700	.750	.750	7.000	2.800	M270BR/BF-0750/20MM	274.86.108	274.97.993
M270B-D100C100-L800	1.000	1.000	8.000	3.500	M270BR/BF-1000/25MM	274.86.109	274.97.898

Remember to use COPASLIP® anti-seize compound on all insert screws

Extended Length Carbide Shank End Mill with Cylindrical Shank

Designation	Ø d¹	d²	l¹	l²	Insert	Insert Screw	Wrench
M270B-D037C050-L550C	.375	.500	5.550	1.800	M270BR/BF-0375/10MM	274.86.105	274.97.262
M270B-D050C050-L575C	.500	.500	5.750	2.000	M270BR/BF-0500/12MM	274.86.106	274.97.262
M270B-DC062C062-L600C	.625	.625	6.000	2.300	M270BR/BF-0625/16MM	274.86.107	274.97.993
M270B-D075C075-L700C	.750	.750	7.000	2.800	M270BR/BF-0750/20MM	274.86.108	274.97.993
M270B-D100C100-L800C	1.000	1.000	8.000	3.500	M270BR/BF-1000/25MM	274.86.109	274.97.898

Remember to use COPASLIP® anti-seize compound on all insert screws

Calculating the correct insert & cutting conditions for your application

Insert Style: Considerations for selecting the correct insert

Best choices for insert & grade selection ● 1st Choice ○ 2nd Choice	BR Geometry		BF Geometry
			
Grade	TN7535	TN2510	TN2505
Roughing operation	●	○	
Finishing operation		○	●
Low RPM machine	●	○	
Flat Areas or Face Milling (less than 10° inclination)	●	○	
Hard Machining		○	●
Unstable and/or Long Overhangs	●	○	
HSM or 5-axis Machining (smaller ap/ae values)		○	●

Use only carbide shanks for semi-finishing and finishing operations.
Use only steel shanks for semi-roughing operations.

Effective Cutting Diameters

Depth of Cut ap	Effective cutter diameter d¹ eff for cutter nominal diameter d¹				
	.375	.500	.625	.750	1.000
.010"	.121	.140	.157	.172	.199
.020"	.169	.196	.220	.242	.280
.035"	.218	.255	.287	.316	.368
.050"	.255	.300	.339	.374	.436
.075"	.300	.357	.406	.450	.527
.100"	.332	.400	.458	.510	.600
.125"	.354	.433	.500	.559	.661
.156"	.370	.464	.541	.609	.726
.188"	.375	.484	.573	.650	.781
.250"	--	.500	.612	.707	.556
.312"	--	--	.625	.734	.927
.375"	--	--	--	.750	.968
.500"	--	--	--	--	1.000
.625"	--	--	--	--	--

Feed Rate Adjustment Factor

Depth of Cut ap	for cutter nominal diameter d¹				
	.375	.500	.625	.750	1.000
.010"	3.10	3.60	4.00	4.40	5.00
.020"	2.22	2.56	2.86	3.13	3.57
.035"	1.85	2.11	2.36	2.57	2.92
.050"	1.47	1.66	1.85	2.00	2.27
.075"	1.25	1.41	1.54	1.66	1.86
.100"	1.14	1.25	1.37	1.47	1.66
.125"	1.06	1.15	1.25	1.33	1.52
.156"	1.01	1.08	1.15	1.23	1.37
.188"	1.00	1.03	1.09	1.15	1.28
.250"	--	1.00	1.02	1.06	1.15
.312"	--	--	1.00	1.01	1.08
.375"	--	--	--	1.00	1.03
.500"	--	--	--	--	1.00

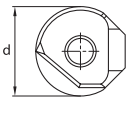
Performance Features:

The indexable insert has two flutes covering an arc of 230° to give a wider range of applications when compared with tools having semicircular inserts.

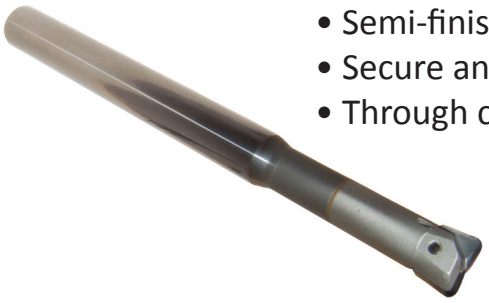
Outstanding cutting performance is guaranteed by exact insert positioning and secure screw locking. The positive cutting edge geometry results in superior surface finishes, especially on inclined work surfaces. All inserts are precision ground to ensure precise milling of workpiece contours.

-BR Roughing and semi-finishing geometry for contouring in a variety of workpiece materials.

-BF Precision ground finishing and semi-finishing for contouring in a variety of workpiece materials.



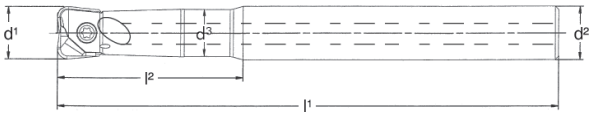
Designation	l	s	r	d	d¹	m	TN7525	TN6525	TN7535	TN6540	TN450	TN5515	TN2505	TN2510	TN2525	TTM	TTR	THM	THR	THM-U	TTI-25
							Coated									Uncoated					Cermet
INCH INSERTS																					
Precision ground finishing and semi-finishing																					
M270BF-0375	--	.094	--	.375	.138	--							●			●					
M270BF-0500	--	.125	--	.500	.138	--							●			●					
M270BF-0625	--	.187	--	.625	.181	--							●								
M270BF-0750	--	.187	--	.750	.181	--							●			●		●			
M270BF-1000	--	.187	--	1.000	.220	--							●								
Roughing and semi-finishing																					
M270BR-0375	--	.094	--	.375	.138	--			●					●							
M270BR-0500	--	.125	--	.500	.138	--			●					●							
M270BR-0625	--	.187	--	.625	.181	--			●					●							
M270BR-0750	--	.187	--	.750	.181	--			●					●		●					
M270BR-1000	--	.187	--	1.000	.220	--			●					●							
METRIC INSERTS																					
Precision ground finishing and semi-finishing																					
M270BF-10MM	--	.094	--	.394	.138	--							●	●				●			
M270BF-12MM	--	.125	--	.472	.138	--		●					●	●				●			
M270BF-16MM	--	.187	--	.630	.181	--		●					●	●		●		●			●
M270BF-20MM	--	.187	--	.787	.181	--		●					●	●		●		●			
M270BF-25MM	--	.187	--	.984	.220	--							●	●		●		●			●
M270BF-32MM	--	.187	--	1.260	.260	--							●	●				●			
Roughing and semi-finishing																					
M270BR-10MM	--	.094	--	.394	.138	--	●		●					●		●		●			
M270BR-12MM	--	.125	--	.472	.138	--	●		●	●				●		●					
M270BR-16MM	--	.187	--	.630	.181	--	●		●	●				●		●		●			
M270BR-20MM	--	.187	--	.787	.181	--	●		●	●				●		●		●			
M270BR-25MM	--	.187	--	.984	.220	--	●		●					●		●		●			
M270BR-32MM	--	.187	--	1.260	.260	--	●		●					●		●		●			



- Semi-finishing, and finishing applications
- Secure and rigid insert clamping system
- Through coolant

-TF Precision ground with corner radius and back taper for helical and pocket milling of pre-hardened and hardened materials.

-HF The design of this insert allows for high speeds and high feed rates with shallow depth of cut. Forces are directed upwards towards the spindle helping to eliminate vibration and deflection allowing for heavy chip loads.



Corner Radius End Mill with Straight Shank Backdraft

Designation	Ø d¹	d²	d³	l¹	l²	Insert	Insert Screw	Wrench
M270T-D037C037-L555	.375	.375	.345	5.550	1.800	M270TF-0375R0031 M270TF-10R__ M270HF-0375	274.86.105	274.97.262
M270T-D050C050-L575	.500	.500	.417	5.750	2.000	M270TF-0500R0063 M270TF-12R__ M270HF-0500	274.86.106	274.97.262
M270T-D062C062-L600	.625	.625	.559	6.000	2.300	M270TF-0625R0126 M270TF-16R__ M270HF-0625	274.86.107	274.97.993
M270T-D075C075-L700	.750	.750	.707	7.000	2.800	M270TF-0750R0126 M270TF-20R__ M270HF-0750	274.86.108	274.97.993

Remember to use COPASLIP® anti-seize compound on all insert screws

Corner Radius End Mill with Straight Carbide Shank Backdraft

Designation	Ø d¹	d²	d³	l¹	l²	Insert	Insert Screw	Wrench
M270T-D037C050-L555C	.375	.500	.345	5.550	1.800	M270TF-0375R0031 M270TF-10R__ M270HF-0375	274.86.105	274.97.262
M270T-D050C050-L575C	.500	.500	.417	5.750	2.000	M270TF-0500R0063 M270TF-12R__ M270HF-0500	274.86.106	274.97.262
M270T-D062C062-L600C	.625	.625	.559	6.000	2.300	M270TF-0625R0126 M270TF-16R__ M270HF-0625	274.86.107	274.97.993
M270T-D075C075-L700C	.750	.750	.707	7.000	2.800	M270TF-0750R0126 M270TF-20R__ M270HF-0750	274.86.108	274.97.993

Remember to use COPASLIP® anti-seize compound on all insert screws

Applying high-feed tools

The High-Feed concept bases its strategy in small depth of cut and high fz values, which results in a higher MRR and productivity with low radial forces.

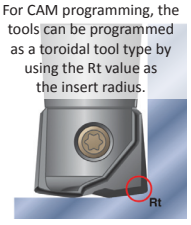
General programming information for applying M270 High-Feed

tool diameter	.375"	.500"	.625"	.750"
recommended starting Ap1 (inch)	.016	.016	.023	.030
Rt CAM programming	.044	.057	.070	.090
fz recommended for general purpose	.020	.022	.024	.030
fz recommended for 45 HRC (approx.)	.015	.018	.022	.026
fz recommended for 55 HRC (approx.)	.012	.014	.018	.020

Recommended max to 55% of cutting diameter. While centre cutting is possible, we recommend using a ramp angle of 0.5° - 1.0° to ensure smooth operation

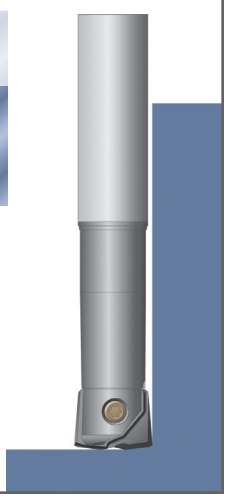
Small Ap1 values and higher feed rate generate lower cutting forces versus traditional milling strategies.

For CAM programming, the tools can be programmed as a toroidal tool type by using the Rt value as the insert radius.

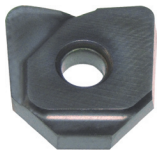


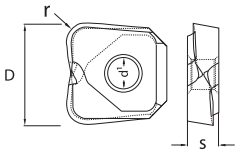
Recommended when long overhang is necessary due to lower radial forces. Maximum L/D ratio of 10 x D.

L/D Ratio	% of Ap1 max to reduce	% of vc to reduce
<4	0%	0%
4<L/D<7	55–65%	10–15%
>8	65–75%	20–30%



WIDIA M270 Inserts • *for M270 Toroidal Cutters*



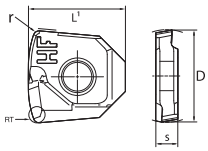


-TF Precision ground with corner radius and back taper for helical and pocket milling of pre-hardened and hardened materials.

Designation	D	s	r	d¹	D.O.C.	TN7525	TN6525	TN7535	TN6540	TN450	TN5515	TN2505	TN2510	TN2525	TTM	TTR	THM	THR	THM-U	TTI-25
						Coated									Uncoated					Cermet
INCH INSERTS																				
M270TF-0375R0031	.375	.094	.031	.138	.031							●		●						
M270TF-0500R0063	.500	.125	.063	.138	.063							●		●						
M270TF-0625R0095	.625	.187	.095	.181	.095							●		●						
M270TF-0750R0126	.750	.187	.126	.181	.126							●		●						
METRIC INSERTS																				
M270TF-10R03	10mm	.094	.012	.138	.012								●							
M270TF-10R05			.020		.020								●	●						
M270TF-10R1			.040		.040							●		●						
M270TF-12R03	12mm	.125	.012	.138	.012								●	●						
M270TF-12R05			.020		.020								●	●						
M270TF-12R1			.040		.040								●	●						
M270TF-12R2			.079		.079							●		●						
M270TF-16R03	16mm	.187	.012	.181	.012								●	●						
M270TF-16R05			.020		.020								●	●						
M270TF-16R1			.040		.040								●	●						
M270TF-16R2			.079		.079								●	●						
M270TF-16R3			.118		.118							●		●						
M270TF-20R03	20mm	.187	.012	.181	.012								●	●						
M270TF-20R05			.020		.020								●	●						
M270TF-20R1			.040		.040								●	●						
M270TF-20R2			.079		.079								●	●						
M270TF-20R3			.118		.118							●		●						

WIDIA M270 'HF' Inserts • *for M270 Toroidal Cutters*

High Feed Inserts



-HF The design of this insert allows for high speeds and high feed rates with shallow depth of cut. Forces are directed upwards towards the spindle helping to eliminate vibration and deflection allowing for heavy chip loads.

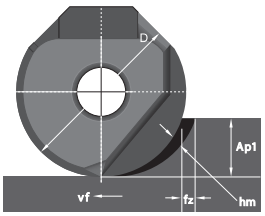
Designation	D	S	R	RT	D.O.C. max	d¹	TN7525	TN6525	TN7535	TN6540	TN450	TN5515	TN2505	TN2510	TN2525	TTM	TTR	THM	THR	THM-U	TTI-25
							Coated									Uncoated					Cermet
INCH INSERTS																					
M270HF-0375	.375	.094	.023	.044	.024	.138				●			●								
M270HF-0500	.500	.125	.031	.057	.024	.138				●			●								
M270HF-0625	.625	.187	.039	.070	.035	.181				●			●								
M270HF-0750	.750	.187	.047	.090	.043	.181				●			●								

"RT" = Programming Radius

ANSI ISO 513	Cutting Data for M270 Milling Cutters					COATED												UNCOATED		
	Cutter		Carbide Insert			TN2505			TN2510			TN2525			TN7535			THM		
						feed per tooth *(inch)														
	M270 Ball Nose M270 Toroidal		.375			.0024	**.0031**	.0039	.0024	**.0031**	.0047	.0024	**.0031**	.0047	.0043	**.0065**	.0078	.0039	**.0055**	.0063
			.500			.0024	**.0031**	.0039	.0028	**.0039**	.0059	.0028	**.0039**	.0059	.0052	**.0069**	.0087	.0055	**.0079**	.0094
			.625			.0028	**.0039**	.0051	.0031	**.0047**	.0071	.0031	**.0047**	.0071	.0065	**.0087**	.0108	.0071	**.0098**	.0118
			.750			.0031	**.0047**	.0059	.0039	**.0055**	.0087	.0039	**.0055**	.0087	-	-	-	.0091	**.0126**	.0150
	Work Material			Condition	Hardness HB	Mat. Gr.	vc *(sfm)														
P	Carbon steel, Unalloyed steel, cast steel and free cutting steel	< 0.25% C		annealed	125	1	-	-	-	-	-	-	950	**740**	620	1180	**920**	790	-	-	-
		≥ 0.25% C		annealed	190	2	-	-	-	-	-	-	660	**490**	430	820	**620**	540	-	-	-
		< 0.55% C		heat-treated	250	3	-	-	-	-	-	-	560	**430**	360	690	**520**	460	-	-	-
		≥ 0.55% C		annealed	220	4	-	-	-	-	-	-	560	**430**	360	710	**540**	460	-	-	-
				heat-treated	300	5	-	-	-	-	-	-	480	**340**	300	590	**430**	360	-	-	-
	Low alloy steel and cast steel			annealed	200	6	-	-	-	-	-	-	620	**480**	390	790	**590**	490	-	-	-
				heat-treated	275	7	-	-	-	-	-	-	480	**360**	310	590	**460**	390	-	-	-
				heat-treated	300	8	-	-	-	-	-	-	430	**310**	260	520	**390**	330	-	-	-
				heat-treated	350	9	-	-	-	-	-	-	360	**260**	210	460	**330**	260	-	-	-
	High alloy steel, cast steel & tool steel			annealed	200	10	750	**590**	560	620	**490**	460	480	**380**	340	590	**480**	430	-	-	-
				heat-treated	325	11	520	**390**	330	430	**330**	260	310	**230**	180	390	**300**	230	-	-	-
	400 series stainless			FE / MA	200	12	950	**750**	590	790	**620**	490	610	**460**	390	750	**570**	490	-	-	-
				MA	240	13.1	820	**590**	520	690	**490**	430	520	**380**	310	660	**480**	390	-	-	-
				MA / PH	330	13.2	430	**330**	260	360	**260**	230	260	**200**	160	330	**250**	200	-	-	-
M	300 Series			AU	180	14.1	-	-	-	-	-	-	520	**310**	230	660	**390**	300	-	-	-
	Stainless			DU	230	14.2	-	-	-	-	-	-	430	**250**	180	520	**310**	230	-	-	-
	Duplex			S-AU	200	14.3	-	-	-	-	-	-	310	**180**	150	390	**230**	180	-	-	-
	Stainless			AU-PH	330	14.4	-	-	-	-	-	-	260	**160**	110	330	**200**	150	-	-	-
K	Grey cast iron			ferrit./pearl.	180	15	-	-	-	2260	**1640**	1100	-	-	-	-	-	-	-	-	-
				pearlitic	260	16	-	-	-	1740	**1310**	980	-	-	-	-	-	-	-	-	-
	Nodular cast iron			ferritic	160	17	2400	**1570**	1180	2000	**1310**	980	660	**490**	430	820	**620**	540	750	**560**	490
				pearlitic	250	18	1540	**1150**	850	1280	**950**	720	560	**430**	630	690	**520**	460	620	**460**	430
	Malleable cast iron			ferritic	130	19	-	-	-	1460	**1210**	950	-	-	-	-	-	-	-	-	-
				pearlitic	230	20	-	-	-	1310	**980**	710	-	-	-	-	-	-	-	-	-
N	Wrought			Non AG	60	21	-	-	-	-	-	-	-	-	-	-	-	-	3280	**2460**	1970
				AG	100	22	-	-	-	-	-	-	-	-	-	-	-	-	1640	**1180**	980
	Cast aluminum alloys			Non Ag	75	23	-	-	-	-	-	-	-	-	-	-	-	-	3280	**2460**	1970
		Si ≤ 12%		AG	90	24	-	-	-	-	-	-	-	-	-	-	-	-	2620	**1970**	1640
		Si ≥ 12%			130	25	-	-	-	-	-	-	-	-	-	-	-	-	1640	**1150**	820
S	High Temp			G	200	31	-	-	-	-	-	-	-	-	-	-	-	-	120	**80**	-
	Alloy FE			AG	280	32	-	-	-	-	-	-	-	-	-	-	-	-	100	**70**	-
	High Temp			G	250	33	-	-	-	-	-	-	-	-	-	-	-	-	80	**50**	-
	Alloy			AG	350	34	-	-	-	-	-	-	-	-	-	-	-	-	70	**40**	-
	Ni / Co			GO	320	35	-	-	-	-	-	-	-	-	-	-	-	-	70	**40**	-
	Titanium alloys					36	-	-	-	-	-	-	-	-	-	-	-	-	260	**130**	-
	TiAL6V4			AG		37	-	-	-	-	-	-	-	-	-	-	-	-	230	**110**	-
H	Hardened steel			H	45	38.1	520	**390**	260	430	**340**	260	-	-	-	-	-	-	-	-	-
				H	55	38.2	520	**390**	260	430	**340**	260	-	-	-	-	-	-	-	-	-
				H	60	39.1	390	**330**	200	360	**280**	210	-	-	-	-	-	-	-	-	-
				H	> 62	39.2	390	**330**	200	360	**280**	210	-	-	-	-	-	-	-	-	-

ANSI ISO 513	Cutting Data for M270 Milling Cutters					COATED					
	Cutter		Carbide Insert			TN2505			TN6540		
						feed per tooth *(inch)					
	M270 High Feed		.375			.0059	**.0098**	.0110	.0059	**.0118**	.0197
			.500			.0059	**.0118**	.0138	.0059	**.0157**	.0197
			.625			.0059	**.0157**	.0177	.0059	**.0197**	.0236
			.750			.0059	**.0197**	.0217	.0059	**.0236**	.0276
	Work Material		Condition	Hardness HB	Mat. Gr.	vc *(sfm)					
P	Carbon steel, Unalloyed steel, cast steel and free cutting steel	< 0.25% C	annealed	125	1	-	-	-	950	**740**	620
		≥ 0.25% C	annealed	190	2	-	-	-	660	**490**	430
		< 0.55% C	heat-treated	250	3	-	-	-	560	**430**	360
		≥ 0.55% C	annealed	220	4	-	-	-	560	**430**	360
			heat-treated	300	5	-	-	-	480	**340**	300
	Low alloy steel and cast steel		annealed	200	6	-	-	-	620	**480**	390
			heat-treated	275	7	-	-	-	480	**360**	310
			heat-treated	300	8	-	-	-	430	**310**	260
			heat-treated	350	9	-	-	-	360	**260**	210
	High alloy steel, cast steel & tool steel		annealed	200	10	560	**460**	430	480	**380**	340
			heat-treated	325	11	360	**260**	230	310	**230**	180
	400 series stainless		FE / MA	200	12	720	**560**	460	610	**460**	390
			MA	240	13.1	620	**460**	360	520	**380**	310
			MA / PH	330	13.2	330	**230**	200	260	**200**	160
M	300 Series		AU	180	14.1	-	-	-	520	**310**	230
	Stainless		DU	230	14.2	-	-	-	430	**250**	180
	Duplex		S-AU	200	14.3	-	-	-	310	**180**	150
	Stainless		AU-PH	330	14.4	-	-	-	260	**160**	110
K	Grey cast iron		ferrit./pearl.	180	15	-	-	-	-	-	-
			pearlitic	260	16	-	-	-	-	-	-
	Nodular cast iron		ferritic	160	17	790	**590**	520	660	**490**	430
			pearlitic	250	18	660	**520**	430	560	**430**	360
	Malleable cast iron		ferritic	130	19	-	-	-	-	-	-
			pearlitic	230	20	-	-	-	-	-	-
N	Wrought		Non AG	60	21	-	-	-	-	-	-
			AG	100	22	-	-	-	-	-	-
	Cast aluminum alloys		Non Ag	75	23	-	-	-	-	-	-
		Si ≤ 12%	AG	90	24	-	-	-	-	-	-
		Si ≥ 12%		130	25	-	-	-	-	-	-
S	High Temp		G	200	31	-	-	-	200	**160**	150
	Alloy FE		AG	280	32	-	-	-	160	**130**	110
	High Temp		G	250	33	-	-	-	110	**80**	70
	Alloy		AG	350	34	-	-	-	100	**70**	50
	Ni / Co		GO	320	35	-	-	-	100	**70**	50
	Titanium alloys				36	-	-	-	260	**160**	130
	TiAL6V4		AG		37	-	-	-	230	**150**	110
H	Hardened steel		H	45	38.1	520	**390**	260	-	-	-
			H	55	38.2	520	**390**	260	-	-	-
			H	60	39.1	390	**330**	200	-	-	-
			H	> 62	39.2	390	**330**	200	-	-	-

Factors for M270 Ball Nose & Toroidal Milling Cutters:



First choice starting speed (vc) are in bold type. Use corresponding feed (fz).

Given fz is valid for face milling with width of cut (ae) ≥ 0.4 D1 and Ap1 max.

For smaller ae and ap, use the given correction factors (D = dia. of insert, D1 = cutter dia.).

M270 Ball Nose

fz-factor for ratio ae:d[1]				
ap1	0.05	0.1	0.2	0.4
5% of d	9	6.3	4.3	3.2
10% of d	6.3	4.3	3.2	2.2
20% of d	4.3	3.2	2.2	1.6
40% of d	3.2	4.2	1.6	1.1

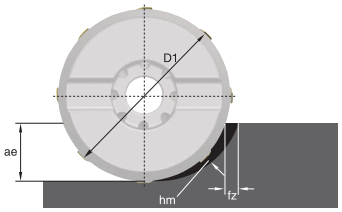
vc-factor at fz-factor							
fz - Factor	9	6.3	4.3	3.2	2.2	1.6	1.1
fc - Factor	1.6	1.5	1.4	1.3	1.2	1.1	1

Example: ae : D1 = 0.1 = 0.2 x D
fznom = .0080" fz eff=.0080" x 3.2 = .0256"
vcnom = 525 vc eff = 525 x 1.3 = 683 sfm

M270 Toroidal

ae / D1	0.02	0.05	0.1	0.2	0.4
fz - Factor	3.5	3	2	1.5	1
fc - Factor	1.6	1.5	1.4	1.3	1.1

Factors for M270 High Feed Milling Cutters:



$$hm = fz \cdot \sqrt{\frac{ae}{D1}} \qquad fz = hm \cdot \sqrt{\frac{D1}{ae}}$$

First choice starting speed (vc) are in bold type. Use corresponding feed (fz).

fz and vc are valid for ae ≥ 0.4 D1.

For smaller ae, fz and vc should be multiplied by the factor given below.

M270 High Feed

ae / D1	0.1	0.2	0.3	0.4
fz - Factor	2	1.5	1.3	1
fc - Factor	1.4	1.3	1.2	1.1

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