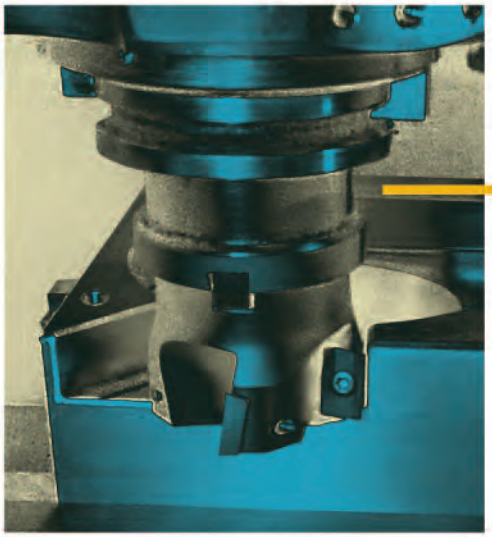
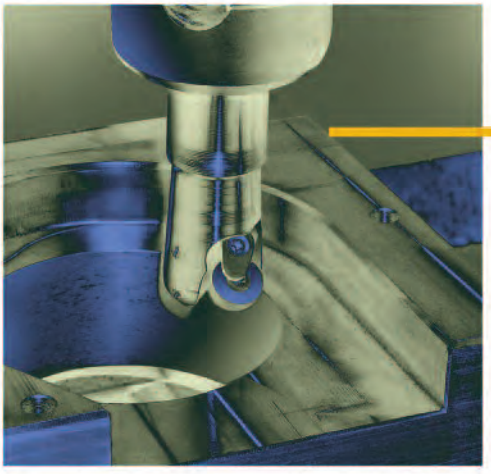
DAPRA®

METRIC

High-Performance Ball Nose Finishing Mills and Inserts



90° Square Shoulder Precision Mills and Inserts



High-Performance Toroid Cutters and Inserts

Dapra Corporation
www.dapra.com

DAPRA® CORPORATION

METRIC SERIES

BALL NOSE — Pages 3-8

SQUARE SHOULDER — Pages 9-13

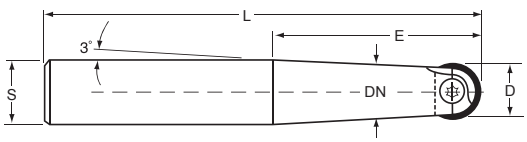
TOROID — Pages 14-18

Achieve Superior Finishes... with Dapra's Ball Nose Finishing Mills!

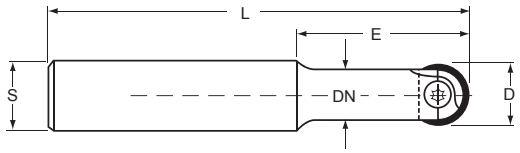
- Geometry and coatings produce superior surface finishes
- Excellent tool life reduces or eliminates costly bench work
- Ideal for unattended contour finishing applications
- High-speed runs reduce cycle time by 50%
- Precision-ground inserts achieve closer tolerances and longer life
- Hardened steel cutter bodies ensure close tolerance finishing
- Screw-on modular heads and heavy metal extensions fit industry standard cutting systems

Steel Holder Ordering Information

D Ø Diameter	Holder	E Effective Length	L Overall Length	S Shank Diameter	DN Neck Diameter	Insert Screw
TAPERED SOLID METRIC						
8 mm	GWR08-100-10-RZK	25mm	100mm	10mm	7mm	GWS 08
STRAIGHT SOLID METRIC						
10mm	GWR10-130-10-RZ	25mm	130mm	10mm	9mm	GWS 10
12mm	GWR12-150-12-RZ	47mm	150mm	12mm	10.5mm	GWS 12
12mm	SC-GWR-12-180-12MM-RZ	38mm	180mm	12mm (CARBIDE)	10.5mm	GWS 12
16mm	GWR16-180-16-RZ	52mm	180mm	16mm	14.5mm	GWS 16
20mm	SC-GWR-20-250-18MM-RZ	57mm	250mm	18mm (CARBIDE)	17mm	GWS 18
20mm	GWR20-230-20-RZ	65mm	230mm	20mm	18mm	GWS 20
25mm	GWR25-250-25-RZ	70mm	250mm	25mm	22.5mm	GWS 25
25mm	SC-GWR-25-250-25MM-RZ	76mm	250mm	25mm (CARBIDE)	22mm	GWS 25
32mm	GWR32-250-32-RZ	70mm	250mm	32mm	27.5mm	GWS 32
UNDERSIZED SHANK GWR CUTTERS						
12mm	US-GWR12-150-11MM-RZ	25mm	150mm	11mm	10.5mm	GWS 12
16mm	US-GWR16-180-15MM-RZ	52mm	180mm	15mm	14.5mm	GWS 16
20mm	US-GWR20-230-18MM-RZ	65mm	230mm	18mm	18mm	GWS 20
25mm	US-GWR25-250-24MM-RZ	70mm	250mm	24mm	22.5mm	GWS 25



Tapered Holder



Straight Holder

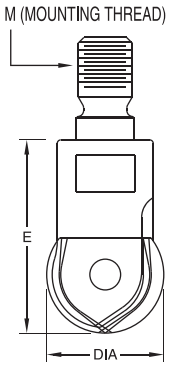
Modular Head Ordering Information

Screw-On Modular Heads and Modular Extensions Fit Industry Standard Cutting Systems

- Compatible with ISO standard modular systems
- Greater effective reach than solid end mills
- Close-tolerance mounting minimizes runout
- Wrench flats accept adjustable wrenches - no special wrenches needed

Ball Nose Screw-On Heads

Dia.	Holder	M	E	Flutes
12mm	GWR12-MOD	M8	27mm	2
16mm	GWR16-MOD	M8	28mm	2
20mm	GWR20-MOD	M10	32.5mm	2
25mm	GWR25-MOD	M12	42mm	2
32mm	GWR32-MOD	M16	45mm	2



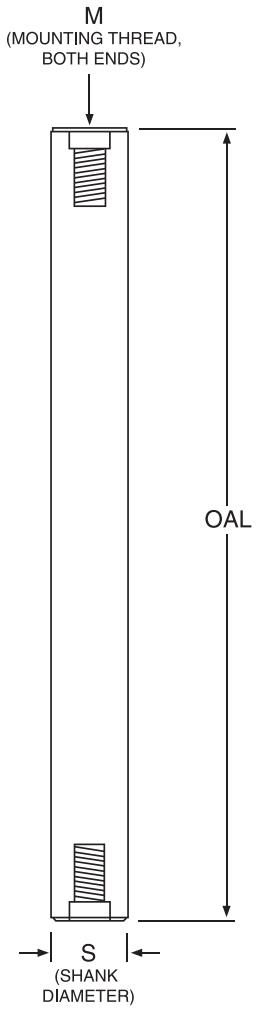
Modular Head

Dapra's Modular Extensions Provide Even More Cutting Options

- Made of high-density tungsten, providing extra resistance to vibration and deflection
- Machined on both ends; can be cut in half and used with two different modular heads
- Shank diameters either match or are undersize compared to cutting diameters

Heavy Metal Modular Extensions

Modular Head Dia.	Part No.	OAL	M	S
20mm	ME-0750-18MM-900	230mm	M10	18mm
25mm	ME-1000-25MM-1100	280mm	M12	25mm
32mm	ME-125/150-25MM-1200	305mm	M16	25mm



Modular Extension

Spare Parts & Tools

Insert Screw	Metric Insert Size	Wrenches TORX®	Torque N/m	Miscellaneous Description	Miscellaneous Catalog No.
GWS 08	8	T-8F	Manual	Special Anti-Seize Grease	ASG-120
GWS 10	10	T-10F	Manual		
GWS 12	12	T-15F	6.0		
GWS 16	16	T-15F	6.2		
GWS 20	20	T-20F	6.2		
GWS 25	25	T-30L	6.5		
GWS 32	30 / 32	T-30L	6.5		

TORX® is a registered trademark of Camcar/Textron.

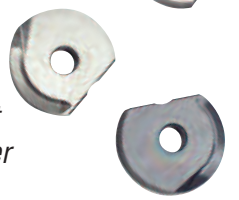
Inserts and Insert Grade Selection

Metric Ball Nose Inserts*

HBN
Helical Cutting Edge Ball Nose Inserts

- **Smoother cutting action**
- **Increased metal removal**
- **Cleaner surface finish**
- **Longer tool life**

BNR-N
Ball Nose Insert without Chipbreaker



BNR-CB
Ball Nose Insert with Chipbreaker

D Ø Diameter	Helical (HBN)
10mm	HBN-10MM
12mm	HBN-12MM
16mm	HBN-16MM
20mm	HBN-20MM
25mm	HBN-25MM
30mm	HBN-30MM
32mm	HBN-32MM

D Ø Diameter	Without Chipbreaker
10mm	BNR-10MM-N
12mm	BNR-12MM-N
16mm	BNR-16MM-N
20mm	BNR-20MM-N
25mm	BNR-25MM-N
30mm	BNR-30MM-N†
32mm	BNR-32MM-N

D Ø Diameter	Chipbreaker
8mm	BNR-08MM-CB
10mm	BNR-10MM-CB
12mm	BNR-12MM-CB
16mm	BNR-16MM-CB
20mm	BNR-20MM-CB
25mm	BNR-25MM-CB
32mm	BNR-32MM-CB

**For insert grades and coatings, see chart below. Other coatings are available upon request. Contact Dapra for more information.*

†Use size 32 insert screws for 30mm inserts.

Ball Nose Insert Grades

Base Grade	with Coating	Description	Specifications
F1		Micro-grain tungsten carbide with high edge strength and good toughness. Good for machining steels, high-temperature alloys, cast iron and nonferrous materials.	(C-2), (K10)
	FPX	Titanium carbon nitride (TiCN) is a functional hard coating offering an optimal combination of hardness, toughness and antifriction characteristics. TiCN is recommended for high shock resistance.	3000 HV, 400° C, .4 Co
	FPO	Premium grade for high-performance milling of steels up to 54 HRC. High-temperature PVD coating provides the ultimate in heat resistance and tool life.	3200 HV, 1100° C, .4 Co
	FPA	Aluminum titanium nitride (AlTiN) is recommended when extra hardness and heat resistance are required. AlTiN makes both machining at higher speeds and dry machining possible.	3600 HV, 1100° C, .4 Co
	FP-GLH	Premium high-temperature grade. Unbeatable performance and wear resistance in high-heat applications such as harder steels, tough stainless steels and high-temperature alloys.	3600 HV, 2000° F, .2 Co

- **Match coating to material being cut and available speed/RPM (see chart on page 8).**
- **FPA and FP-GLH coatings are best suited for higher operating speeds (temperatures) and harder materials.**
- **FPX and FPO coatings are best suited for low to medium operating speeds (temperatures) and softer materials.**
- **Other coatings available on request. Contact factory for details.**

Application Information

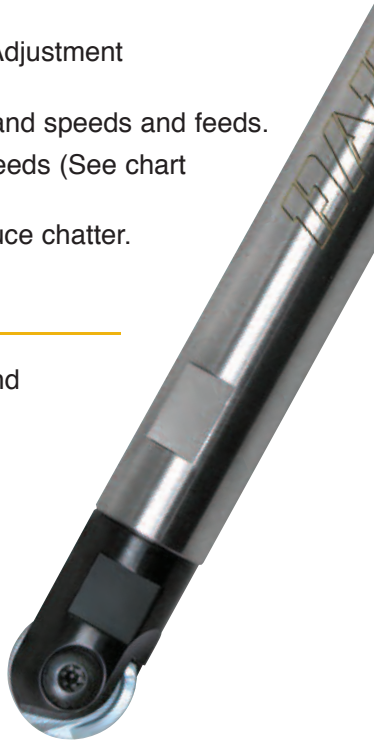
Recommendations

- Maximum Depth of Cut (DOC) for finishing should be less than or equal to 10% of ball diameter.
- Stepover should be greater than or equal to DOC.
- For roughing operations, maximum recommended Width of Cut (WOC) and DOC are 30% of ball diameter.

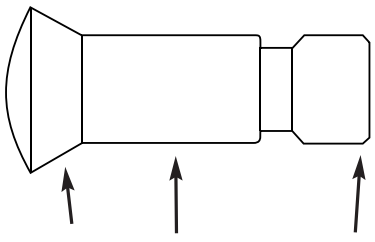
- Starting Feed per Revolution (FPR) should be 1% of ball diameter. Example: 20mm diameter x .01 = .20mm FPR
- Climb milling is preferred.
- When plunging with Ball Nose, use pecking cycle with a maximum of .05mm FPR; maximum recommended depth is 30% of ball diameter.
- Compensate for Effective Cutting Diameter (see Table 1 and Fig. 1 on page 7).
- Compensate for chip thinning with Feed Rate Adjustment (see Table 2 on page 7).
- Surface finish (RMS) is a function of stepover and speeds and feeds.
- Try to work within recommended speeds and feeds (See chart on page 8).
- Decrease feed rate coming into corners to reduce chatter.

Technical Considerations

- Always use anti-seize compound on threads and screw body.
- Thoroughly clean pocket and screw at each insert change.
- Change insert screw every 10 inserts.
- Use high-quality tool holders: power chucks and ER collets ***are*** recommended; end mill holders ***are not*** recommended.
- Cutter bodies will wear and fatigue over time; inspect tool before each use.



How to Apply Anti-Seize to Ball Nose Insert Screws



Generously apply anti-seize to these surfaces with each insert change.

CAUTION: Grinding produces hazardous dust. To avoid adverse health effects, use adequate ventilation and read material safety data sheet first. Cutting tools can break during use. To avoid injury, use safety precautions such as shields, guards and an approved form of eye protection.

1. Anti-seize must be applied before using tool for first time.
2. Remove screw from cutter body.
3. Generously apply anti-seize to entire length of screw body, not to just the threads (see diagram).
4. Clean out insert pocket before assembly of insert/screw combination.
5. Place insert into cutter body pocket.
6. Place screw with applied anti-seize into position in cutter body.
7. While gently pushing on the end of the TORX® screwdriver/wrench, begin tightening the screw (may turn with slight resistance in order to pull insert tight into the pocket).
8. Tighten screw to snug fit, taking care not to over tighten. Follow torque specifications shown on page 4.
9. Repeat steps 2-8 for each insert change.
10. Replace screw with each new box of inserts to assure maximum performance.

Optimizing Performance

Feed, Speed & Diameter Compensation

Table 1: Effective Cutting Diameter (ECD)

Depth of Cut (DOC)

Insert Diameter	.10	.25	.40	.50	.75	1.00	1.25	1.50	2.00	3.00	4.00
10mm	1.99	3.12	3.92	4.36	5.27	6.00	6.60	7.14	8.00	9.17	9.80
12mm	2.18	3.43	4.31	4.80	5.81	6.63	7.33	7.94	8.94	10.39	11.31
16mm	2.52	3.97	5.00	5.57	6.75	7.75	8.59	9.33	10.58	12.49	13.87
20mm	2.82	4.44	5.60	6.25	7.60	8.72	9.68	10.54	12.00	14.28	16.00
25mm	3.16	4.98	6.27	7.00	8.53	9.80	10.90	11.87	13.57	16.25	18.33
32mm	3.57	5.64	7.11	7.94	9.68	11.14	12.40	13.53	15.49	18.66	21.17

Table 2: Feed Rate Adjustment (FRA)

Insert Diameter

Depth of Cut (DOC)	6mm	8mm	10mm	12mm	16mm	20mm	25mm	32mm
.10	3.6	4.0	4.4	5.0	5.6	6.1	7.1	7.9
.25	2.6	2.8	3.1	3.6	4.0	4.4	5.0	5.6
.40	2.1	2.3	2.6	2.9	3.3	3.6	4.1	4.6
.50	1.8	2.0	2.2	2.6	2.8	3.1	3.6	4.0
.65	1.7	1.8	2.0	2.3	2.6	2.8	3.2	3.6
1.30	1.2	1.4	1.5	1.7	1.8	2.0	2.3	2.6
2.00	1.1	1.2	1.2	1.4	1.5	1.7	1.9	2.1
2.50		1.1	1.1	1.2	1.4	1.5	1.7	1.8
3.00			1.1	1.2	1.3	1.3	1.5	1.7
4.00				1.1	1.2	1.3	1.4	1.5
4.50					1.1	1.2	1.3	1.4
5.00						1.1	1.3	1.4
6.35							1.2	1.2
7.50							1.1	1.2
10.00								1.1

Use multiple above to calculate adjusted feed rate.

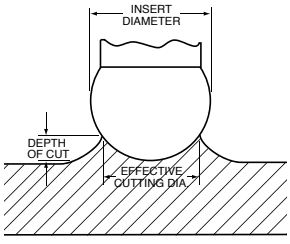


Figure 1

1. Select diameter of tool to be used.
2. Determine Depth of Cut (DOC) to be used.
3. Refer to Figure 1 and Table 1 to find the Effective Cutting Diameter (ECD).
4. Refer to Feed and Speed chart on page 8 to select the Vc to be used (m/min).
5. Calculate RPM using the ECD and Vc. (Vc x 318.5 / ECD = RPM)
6. Refer to Table 2 to determine Feed Rate Adjustment (FRA).
7. Refer to chart on page 8 to select Feed per Revolution (FPR).
8. Calculate feedrate in mm per Minute (mmpm). (RPM x FPR x FRA = mmpm)

Troubleshooting

Concern	Possible Cause	Solutions
Insert wear at tip	-Not enough chip load	-Verify correct speed and feed -Increase feed rate -Decrease RPM -Increase DOC
Insert wear appears high (flank wear)	-Not enough chip load -Surface footage is high -Incorrect grade or coating	-Verify correct speed and feed -Increase feed rate -Decrease RPM -Consider different insert
Insert chipping	-Surface footage is low -Incorrect grade or coating -Using CB style insert incorrectly -Feed too high	-Verify correct speed and feed -Increase spindle speed -Decrease feed rate -Change insert selection -Decrease DOC -Use N style insert
Built-up edge on insert	-Low surface footage -Light chip load (feed per tooth) -Incorrect coating	-Verify correct speed and feed -Increase cutting speed -Increase feed rate -Select different coating
Poor finish/chatter	-Cutter hung out too far -Excessive runout	-Reduce tool gage length -Check tool holder wear
Tool shank breaks	-Tool pressure too great -Fatigued cutter body	-Decrease DOC -Reduce tool gage length -Decrease feed rate

Recommended Cutting Speeds and Feeds

ISO	Material Group		Vc in mpm (Uncoated) F1	Vc in mpm (Coated) FPX	FPO	FPA and FP-GLH	Chip-breaker	FPR*(mm)
P	Plain Steels	< 3%C	90-180	120-300	180-390	240-490	N CB HBN	.08-.25
		3%-6%C						
		5%-1.5%C						
	Alloy Steels	Mo		90-275	135-395	210-420		
		Cr						
		NiCrMo						
	Tool & Die Steels							
M	Stainless Steels	Ferritic/ Martensitic	45-90	75-240	110-300	100-360	N, CB HBN	.08-.25
		Austenitic		45-200	65-265	90-330	CB HBN	
		Precipitation Hardening (PH)		45-150	65-210	90-270		
K	Cast Iron	Gray	100-180	90-275	135-320	150-360	N HBN	.08-.38
		Malleable			135-300	120-330		
		Ductile						
N	Aluminum Alloys		300+	300+	300+	300+	CB HBN	.13-.64
	Copper Alloys	CuNi: refer to High-Temp. Alloys below	120-180	120-240	150-270	150-300		
S	High-Temp. Alloys		15-40	15-60	15-100	30-140	CB HBN	.05-.20
	Titanium Alloys		15-40	15-60	15-120	45-200		.05-.20

**For tools below 20mm diameter, use the lower half of the range. For tools above 20mm diameter, use the higher end of the range.*

FPX and FPO coatings are best suited for low to medium operating speeds (temperatures) and softer materials.

FPA and FP-GLH coatings are best suited for higher operating speeds (temperatures) and harder materials.

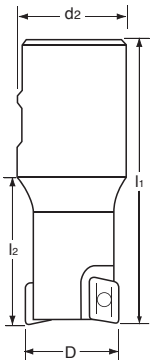
The parameters provided are suggested operating parameters. Actual speeds and feeds will depend on many variables, such as rigidity, workpiece hardness, tool extension, machine accuracy, Depth of Cut, etc. Start at the middle of the Vc range and the low end of the FPR range. Next, increase FPR to optimize productivity and tool life. Higher Vc will provide higher output but will reduce tool life. Try different combinations to find the parameters that best suit your needs.

Experience True 90˚ Precision and Extreme Metal Removal with Dapra Square Shoulder Precision Mills

- **Cut to a true 90˚, generating smoother finishes**
- **Perfect for ramping, slotting, profiling, pocketing, step milling, face milling, shoulder milling and helical interpolation**
- **Positive axial and radial insert geometry, providing maximum metal removal capabilities with minimum horsepower consumption**
- **Hardened steel cutter bodies minimize runout and create excellent surface finishes at high feed rates**

Metric End Mills

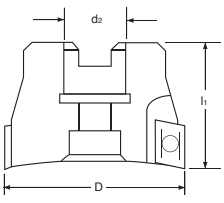
d_2 = shank diameter; l_1 = overall length; l_2 = effective length



Cutting Dia. (D)	Holder	Insert Length	Flutes	d_2	l_1	l_2	Inserts
16mm	SSEM16-16-R35-2	10mm	2	16mm	80mm	31mm	*APET1003.. / XPET1003..*
20mm	SSEM20-20-R35-2	10mm	2	20mm	90mm	39mm	
25mm	SSEM25-20-R35-4	10mm	4	20mm	90mm	39mm	
25mm	SSEM25-25-R55-2	16mm	2	25mm	100mm	44mm	*APET1604.. / XPET1604..*
32mm	SSEM32-32-R35-5	10mm	5	32mm	100mm	44mm	*APET1003.. / XPET1003..*
32mm	SSEM32-32-R55-3	16mm	3	32mm	100mm	44mm	*APET1604.. / XPET1604..*
40mm	SSEM40-32-R55-4	16mm	4	32mm	115mm	55mm	

Standard Pitch Metric Shell Mills

d_2 = arbor diameter; l_1 = overall height



Cutting Dia. (D)	Holder	Insert Length	Flutes	d_2	l_1	Mounting Screw	Inserts
50mm	SSSM50-22-R55-4	16mm	4	22mm	38mm	M10	*APET1604.. / XPET1604..*
50mm	SSSM50-22-R55-5	16mm	5	22mm	38mm	M10	
63mm	SSSM63-27-R55-5	16mm	5	27mm	38mm	M12	
80mm	SSSM80-27-R55-6	16mm	6	27mm	50mm	M12	

Inserts and Grade Selection

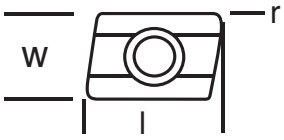
APET & XPET CNC Pressed Inserts

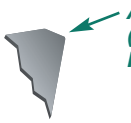
The most economical high-performance inserts available! ***APET and XPET*** inserts:

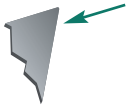
- provide good repeatability and accuracy due to CNC pressing technology.
- feature a high positive pressed cutting geometry for aggressive material removal rates and low horsepower consumption.
- have a strong edge preparation for heavy chiploads.
- are available in a large variety of corner radii with a true tangential blend.
- provide excellent surface finishes due to computer-designed wiper geometry.
- are economical and offer high-performance cutting capabilities.

- ***APET inserts feature a high-strength cutting edge and are ideal for high-performance milling of most steels and cast irons.***
- ***XPET inserts are ideal for high-performance milling of stainless steels and nonferrous materials such as copper alloys and aluminum. Also good for gummy, free-machining steels.***

APET & XPET Insert Sizes and Available Grades







• ***Stocked standard***

Insert	l	w	r	Uncoated	Coated			
				DMP35 DMK30† DMP30 DMK25	DMP353 DMK303† DMP303 DMK253	DMP35-HP DMK30-HP† DMP30-HP DMK25-HP	DMP357 DMK307† DMP307 DMK257	DMP35-GLH DMK30-GLH† DMP30-GLH DMK25-GLH
Pressed to Size								
APET – feature a high-strength cutting edge and are ideal for high-performance milling of most steels and cast irons.								
APET100308	10.0mm	6.4mm	0.8mm	•	•	•	•	•
APET100316	10.0mm	6.4mm	1.6mm	•	•	•	•	•
APET160408	16.0mm	9.5mm	0.8mm	•	•	•	•	•
APET160412	16.0mm	9.5mm	1.2mm	•	•	•	•	•
APET160416	16.0mm	9.5mm	1.6mm	•	•	•	•	•
APET160431	16.0mm	9.5mm	3.0mm	•	•	•	•	•
XPET – ideal for high-performance milling of stainless steels and nonferrous materials such as copper alloys and aluminum. Also good for gummy, softer, free-machining steels.								
XPET100308	10.0mm	6.4mm	0.8mm	•	•	•	•	•
XPET100316	10.0mm	6.4mm	1.6mm	•	•	•	•	•
XPET160404	16.0mm	9.5mm	0.4mm	•	•	•	•	•
XPET160408	16.0mm	9.5mm	0.8mm	•	•	•	•	•
XPET160412	16.0mm	9.5mm	1.2mm	•	•	•	•	•
XPET160416	16.0mm	9.5mm	1.6mm	•	•	•	•	•
XPET160431	16.0mm	9.5mm	3.0mm	•	•	•	•	•

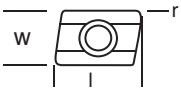
† ***Available for XPET only.***

Inserts and Grade Selection

XPET Lapped, Aluminum-Cutting Inserts

- feature precision-ground and lapped rake face, ideally suited for machining aluminum and copper alloys, bronze, brass, etc. Built-up edge is virtually eliminated.
- have higher positive rake angle than standard inserts, providing highest shear possible.
- offer sharp cutting edge configured specifically for cutting nonferrous materials, yielding the ultimate in low-torque material removal.
- feature a variety of corner radii with a true tangential blend.

• ***Stocked standard***



XPET..

Insert	l	w	r	Uncoated	Coated	
Al, Ti, SS				**DMK25**	**DMK253**	**DMK257**
XPET100308-ALU	10.0mm	6.4mm	0.8mm	•	•	•
XPET100316-ALU	10.0mm	6.4mm	1.6mm	•	•	•
XPET160404-ALU	16.0mm	9.5mm	0.4mm	•	•	•
XPET160408-ALU	16.0mm	9.5mm	0.8mm	•	•	•
XPET160412-ALU	16.0mm	9.5mm	1.2mm	•	•	•
XPET160416-ALU	16.0mm	9.5mm	1.6mm	•	•	•
XPET160431-ALU**	16.0mm	9.5mm	3.0mm	•	•	•

***** This insert is designed for heavy roughing and has a corner radius that actually measures closer to 2.9mm than 3.2mm (.25mm difference) due to distortion by the positive radial insert angle.***

Coated versions available upon request. Contact Dapra for details.

Shock & Wear Resistance	Uncoated (Base Grade)	with Coating	Description	Specifications
TOUGHEST Shock Resistance	DMP35		Moderate wear resistance/high shock resistance. Recommended for interrupted or unstable steel, most 300 series stainless steel, high-temperature alloys and cast iron applications.	ANSI C1-C2 ISO K25-K40, M25-M35
		DMP353	PVD TiCN coating. Excellent wear resistance for low-to-medium operating temperatures.	
		DMP35-HP	High-performance medium-temperature grade. Optimum performance and wear resistance in most soft steels, soft stainless steels and cast irons.	
		DMP357	PVD AlTiN coating. For higher-temp. applications including tougher stainless steels, high-temperature alloys and higher-speed machining.	
		DMP35-GLH	Premium high-temperature coating. Best resistance to heat for high-shock applications. Excellent for tough stainless steels, high-temperature alloys and many tool steels.	
MEDIUM Shock and Wear	DMK30†		Micro-grain carbide providing higher wear resistance and good shock resistance for applications in tough stainless steels, high-temperature alloys, irons and many tool steels.	ANSI C2-C3 ISO K15-K30 M15-M30
		DMK303	PVD TiCN coating. Excellent wear resistance for low-to-medium operating temperatures.	
		DMK30-HP	High-performance medium-temperature grade. Optimum performance and wear resistance in most soft steels, soft stainless steels and cast irons.	
		DMK307	PVD AlTiN coating. For higher-temperature applications including high-speed machining and heat-treated materials < 44 Rc.	
		DMK30-GLH	Premium high-temperature coating. Outstanding performance and wear resistance in high-heat applications involving tough stainless steels, high-temperature alloys and many tool steels.	
MEDIUM Shock and Wear	DMP30		High wear resistance/moderate shock resistance, recommended for most steel and 400 series stainless steel applications.	ANSI C5-C6 ISO P25-P40
		DMP303	PVD TiCN coating. Excellent wear resistance for low-to-medium operating temperatures.	
		DMP30-HP	High-performance medium-temperature grade. Optimum performance and wear resistance in most soft steels, soft stainless steels and cast irons.	
		DMP307	PVD AlTiN coating. For higher-temperature applications including high-speed machining and heat-treated materials < 44 Rc.	
		DMP30-GLH	Premium high-temperature grade. Unbeatable performance and wear resistance in high-heat applications such as higher speed machining in steels (< 44 Rc) and ductile irons.	
HARDEST Wear Resistance	DMK25		Highest wear resistance with reduced shock absorption capabilities. Micro- grain carbide provides excellent edge strength for abrasive applications in nonferrous materials. Suitable for castings, aluminum and smoother cuts in tough stainless steels, high-temperature alloys and hardened steel.	ANSI C2-C3 ISO K15-K25, M15-M25
		DMK253	PVD TiCN coating. Excellent wear resistance for low-to-medium operating temperatures. Good resistance to built-up edge for aluminum machining.	
		DMK25-HP	High-performance medium-temperature grade. Optimum performance and wear resistance in most soft steels, soft stainless steels and cast irons.	
		DMK257	PVD AlTiN coating. Appropriate for higher-temperature applications such as high-velocity cast iron machining, tough stainless steels, high-temperature alloys and hardened steel.	
		DMK25-GLH	Premium high-temperature grade. Unbeatable performance and wear resistance in high-heat applications such as harder steels, tough stainless steels and high- temperature alloys.	

† DMK30 grades are available in XPET only.

Recommendations

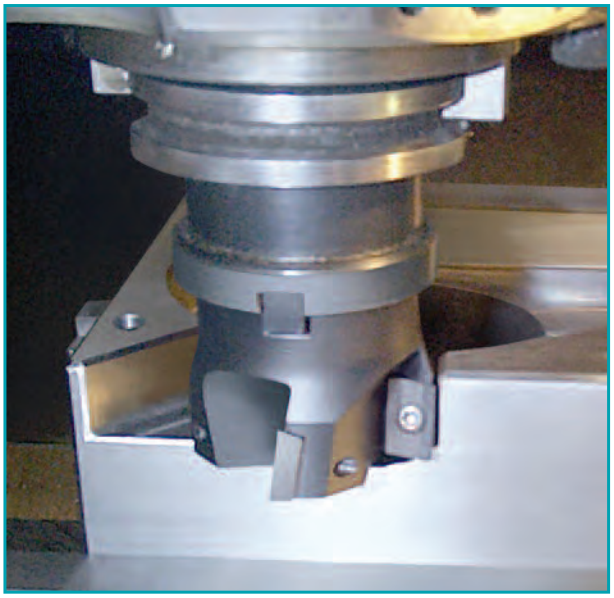


Photo courtesy of Denny Hallman, EWT, Inc.

- Square Shoulder milling allows heavier Depths of Cut (DOC), but Dapra recommends that no more than 2/3 of the insert length should be engaged to reduce the chance for screw breakage.
- Utilize as much of the cutting edge per pass (DOC) as possible, to get the most metal removal within the insert's tool life.
- Use the larger corner radii for the strongest cutting edge during roughing applications.
- Climb milling is recommended whenever possible.
- Square Shoulder tools can not plunge; instead, use 1/2 - 2° ramp angle for full diameter cut. Greater ramp angles possible with partial width cut.
- Although the cutter is capable of the heavier cut, take care to allow for the machine tool's capabilities in horsepower and rigidity.
- Compensate for radial chip thinning when Width of Cut (WOC) is less than 50% of the cutter diameter.
- Feed rates should not go significantly below or above the recommended ranges (see page 13), or premature failure can occur.
- Because our Square Shoulder tools cut a true 90°, they are a good choice for a wide range of finishing applications.
- Most of Dapra's high-performance grades run best without coolant. Coolant in most milling applications creates a high potential for thermal shock, which can produce premature, and sometimes catastrophic, failure. Use air pressure to provide adequate cooling and chip evacuation.

Technical Considerations

- Always use anti-seize compound on screws.
- Change insert screw every 10 inserts.
- Use tool holders appropriate for roughing operations: end mill holders and power chucks ***are*** recommended; collets ***are not*** recommended.
- Use the shortest-length tool holder (end mill holder) for maximum rigidity: the shank of the cutting tool should be up inside the machine spindle taper whenever possible.
- Thoroughly clean pocket at each insert change.

Spare Parts & Tools

Part Description	Order Number	
	for all ..1003.. Inserts	for all ..1604.. Inserts
Clamping Screw	SSTX08-S	SSTX15-S
Wrench	T-8F	T-15F
Tightening Torque	1.0 N/m	3.5 N/m

Troubleshooting

Concern	Possible Cause	Solutions
Insert wear appears high (flank wear)	-Not enough chip load -Surface footage is high -Incorrect grade or coating	-Verify correct speed and feed -Increase feed rate -Decrease RPM -Consider different insert
Insert chipping	-Surface footage is low -Incorrect grade or coating -Using sharp edge insert incorrectly -Feed too high	-Verify correct speed and feed -Increase spindle speed -Decrease feed rate -Change insert selection -Decrease DOC
Built-up edge on insert	-Low surface footage -Light chip load (feed per tooth) -Incorrect coating	-Verify correct speed and feed -Increase cutting speed -Increase feed rate -Select different coating
Poor finish/ chatter	-Cutter hung out too far -Excessive runout -Inadequate tool holding	-Reduce tool gage length -Check tool holder wear -Use high-rigidity tool holder
Tool shank breaks	-Tool pressure too great -Fatigued cutter body	-Decrease DOC -Reduce tool gage length -Decrease feed rate

Recommended Cutting Speeds and Feeds

			1018, 12L14, 1041, 1045	4140, 4150 4340, H13, P20, A2, D2	4140, 4150 4340, H13, P20, A2, D2	303, 304 LOW 400 SERIES	316, 347, PH STAINLESS	GRAY, MALLEABLE, DUCTILE	6061, 7075	AMPCO, WEARITE	INCONEL, WASPALOY, MONEL	
			LOW-TO-MEDIUM CARBON STEELS	TOOL STEELS, HIGH-ALLOY STEELS (SOFT)	TOOL STEELS, HIGH-ALLOY STEELS (HARDENED)	FREE MACHINING STAINLESS	TOUGHER STAINLESS	CAST IRONS	ALUMINUM ALLOYS	COPPER ALLOYS	HIGH-TEMP. ALLOYS/ TITANIUM	PLASTICS, NON-FERROUS
TOUGHEST Shock Resistance	LOWER TEMPS ▲ HIGHER TEMPS ▼	DMP30	98-148	82-131		**49-98**	**41-82**	98-148	328+	66-197	16-49 ROUGHING	328+
		DMP353	131-230	98-197		**98-197**	**49-131**				16-49 ROUGHING	328+
		DMP35-HP	164-262	131-230		**164-262**	**82-164**	164-262		131-393		328+
		DMP357	197-295	164-262		**197-295**	**98-197**	197-295			**25-98 ROUGHING**	328+
		DMK35-GLH	230-328	164-295		**197-361**	**98-262**	197-393			**25-148 ROUGHING**	328+
MEDIUM Shock & Wear	LOWER TEMPS ▲ HIGHER TEMPS ▼	DMK30	148-262	123-230		82-131	**46-90**	**115-180**			**18-54**	
		DMK303	164-279	131-262		131-230	**54-144**				**18-54**	
		DMK30-HP	197-328	164-295		164-295	**90-180**	**164-295**				
		DMK307	230-393	197-328	82-164	197-328	**108-216**	**164-361**			**30-108**	
		DMK30-GLH	262-525	197-393	82-230	197-393	**108-289**	**164-426**			**30-162**	
MEDIUM Shock & Wear	LOWER TEMPS ▲ HIGHER TEMPS ▼	DMP30	**148-262**	**123-230**		82-131		**115-180 DUCTILE**	328+	66-197		328+
		DMP303	**164-279**	**131-262**		131-230				131-393		328+
		DMP30-HP	**197-328**	**164-295**		164-295		**164-295 DUCTILE**			16-49 FINISHING	328+
		DMP307	**230-393**	**197-328**	82-164	197-328		**164-361 DUCTILE**			16-66 FINISHING	328+
		DMP30-GLH	**262-525**	**197-393**	82-230	197-393		**164-426 DUCTILE**			16-82 FINISHING	328+
HARDEST Wear Resistance	LOWER TEMPS ▲ HIGHER TEMPS ▼	DMK25				82-131	**41-82 FINISHING**	**115-197 GRAY**	**328+**	**66-197**	16-49 FINISHING	**328+**
		DMK253				131-230	**49-131 FINISHING**		**328+**	**131-262**	16-82 FINISHING	328+
		DMK25-HP	197-328	164-295		164-295	**82-164 FINISHING**	**197-295 GRAY**		**131-295**	16-82 FINISHING	328+
		DMK257	230-393	197-328	**82-230**	197-328	**98-197 FINISHING**	**230-361 GRAY**			**25-82 FINISHING**	328+
		DMK25-GLH	262-525	197-393	**98-262**	197-393	**98-262 FINISHING**	**262-426 GRAY**		**131-393**	**25-115 FINISHING**	328+
		PCD							**656+**			
RECOMMENDED GEOMETRY			XPET / APET	APET	APET	XPET / APET	XPET	APET	XPET / ALU	XPET	XPET	XPET/ALU
RECOMMENDED FPT - 10mm			.076-0.25	.076-0.20	.076-0.13	.076-0.20	.076-0.18	.076-0.25	.076-0.51	.076-0.38	.076-0.15	.076-0.64
RECOMMENDED FPT - 16mm			0.15-0.38	0.15-0.30	0.10-0.20	0.13-0.30	0.10-0.25	0.15-0.38	.076-0.64	.076-0.64	.076-0.20	.076-0.64

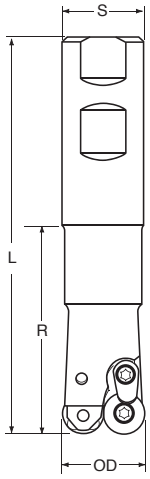
• First choice grade shown in bold text. • For heavy WOC and/or DOC, use the lower end of the FPT range. • For light WOC and DOC, the higher end of the FPT range may be possible.

The parameters provided are suggested operating parameters. Actual speeds and feeds will depend on many variables, such as rigidity, workpiece hardness, tool extension, machine accuracy, Depth of Cut, etc. Start at the middle of the SFM range and the low end of the IPT range. Next, increase IPT to optimize productivity and tool life. Higher SFM will provide higher output but will reduce tool life. Try different combinations to find the parameters that best suit your needs.

Dapra Toroid: High-Performance Roughing and Semifinishing

- **New Premium GLH Premium Coating provides the smoothest surface finishes at the highest operating temperatures**
- **Screw-on modular heads and heavy metal extensions fit industry standard cutting systems**
- **High-performance button inserts are ideal for roughing, semifinishing, helical interpolation and face milling.**

32mm shank dia. cutters and smaller are available in limited supply without Weldon Flats. Add WOF to the end of the part number when ordering.

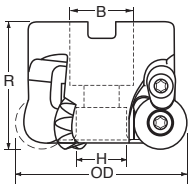


End Mill

Metric End Mills

OD Diameter	Holder	R Effective Length	L Overall Length	S Shank Dia.	Flutes	Insert
20mm	TREM20-50-R5-2†	50mm	103mm	20mm	2	RDCH10
20mm	TREM20-75-R5-2C†	75mm	128mm	20mm	2	RDCH10
25mm	TREM25-65-R5-2C†	65mm	121mm	25mm	2	RDCH10
25mm	TREM25-65-R5-3†	65mm	121mm	25mm	3	RDCH10
25mm	TREM25-115-R5-3†	115mm	171mm	25mm	3	RDCH10
25mm	TREM25-65-R6-2	65mm	121mm	25mm	2	RDCH12
25mm	TREM25-115-R6-2	115mm	171mm	25mm	2	RDCH12
32mm	TREM32-75-R6-2	75mm	133mm	32mm	2	RDCH12
32mm	TREM32-130-R6-2	130mm	184mm	32mm	2	RDCH12

† ***Does not come with top clamps.***



Shell Mill

Metric Shell Mills

OD Diameter	Holder	R Effective Length	B Arbor Dia.	H Counter Bore Dia.	Flutes	Mounting Screw	Insert
50mm	TRSM50-22-R6-4	38mm	22mm	10.4mm	4	M10	RDCH12
63mm	TRSM63-27-R6-5	50mm	27mm	12.4mm	5	M12	RDCH12
80mm	TRSM80-27-R6-6	50mm	27mm	12.4mm	6	M12	RDCH12

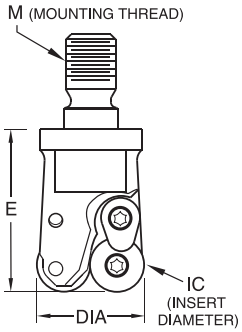
T = T-Land Edge Geometry

D = Honed Edge Only

Toroid Inserts – *CNC-Pressed*

Insert	Insert Diameter	Insert Grades: DMK30 DMP25 DMK15	DMK30-HP DMP25-HP DMK15-HP	DMK307 DMP257 DMK157	DMK30-GLH DMP25-GLH DMK15-GLH
RDCH10T	10mm	•	•	•	•
RDCH10D	10mm	•	•	•	•
RDCH12T	12mm	•	•	•	•
RDCH12D	12mm	•	•	•	•

Screw-On Modular Heads and Modular Extensions Fit Industry Standard Cutting Systems

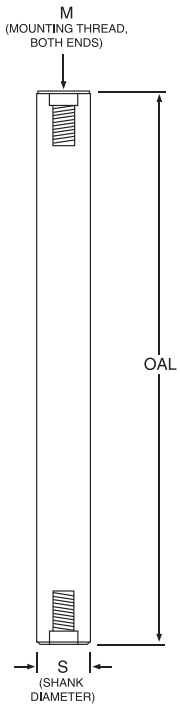


- Compatible with ISO standard modular systems
- Greater effective reach than solid end mills
- Close-tolerance mounting minimizes runout
- Wrench flats accept adjustable wrenches - no special wrenches needed

Metric Screw-On Modular Heads

Dia.	Holder	M	E	IC	Flutes	Insert
20mm	TREM20-MOD-R5-2C†	M10	38mm	10mm	2	RDCH10
25mm	TREM25-MOD-R5-2C†	M12	38mm	10mm	2	RDCH10

† ***Does not come with top clamps.***



Dapra's Modular Extensions Provide Even More Cutting Options

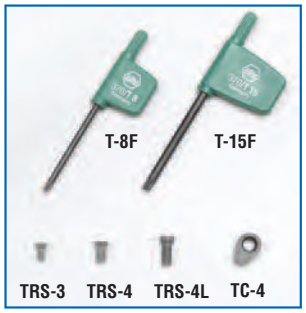
- Made of high-density tungsten, providing extra resistance to vibration and deflection
- Machined on both ends; can be cut in half and used with two different modular heads
- Shank diameters either match or are undersize compared to cutting diameters

Modular Extensions

Modular Head Dia.	Part No.	OAL	M	Shank Dia.
20mm	ME-0750-18MM-900	230mm	M10	18mm
25mm	ME-1000-25MM-1100	280mm	M12	25mm

Spare Parts & Tools

Metric Toroid Mill	Insert Screw	Top Clamp Screw	Top Clamps	Wrench	Anti-Seize Grease
TREM20…	TRS-3	N/A	N/A	T-8F	ASG-120
TREM25…R5	TRS-3	N/A	N/A	T-8F	ASG-120
TREM25…R6	TRS-4	TRS-4L	TC-4	T-15F	ASG-120
TREM32…	TRS-4	TRS-4L	TC-4	T-15F	ASG-120
TRSM50-22-R6-4	TRS-4	TRS-4L	TC-4	T-15F	ASG-120
TRSM63-27-R6-5	TRS-4	TRS-4L	TC-4	T-15F	ASG-120
TRSM80-27-R6-6	TRS-4	TRS-4L	TC-4	T-15F	ASG-120



Toroid Insert Grades

Shock & Wear Resistance	Uncoated (Base grade)	with Coating	Description	Specifications
TOUGHEST Shock Resistance	DMK30		Moderate wear resistance/high shock resistance. Recommended for interrupted or unstable steel, most 300 series stainless steel, high-temperature alloys and cast iron applications.	ISO K25-K40, M25-M35
		DMK303	PVD TiCN coating. Excellent wear resistance for low-to-medium operating temperatures.	
		DMK30-HP	High-performance medium-temperature grade. Optimum performance and wear resistance in most soft steels, soft stainless steels and cast irons.	
		DMK307	PVD AlTiN coating. For higher-temperature applications including tougher stainless steels, high-temperature alloys, high-speed machining and heat-treated materials.	
		DMK30-GLH	Premium high-temperature grade. Unbeatable performance and wear resistance in high-heat applications such as harder steels, tough stainless steels and high- temperature alloys.	
MEDIUM Shock and Wear	DMP25		High wear resistance/moderate shock resistance, recommended for most steel and 400 series stainless steel applications.	ISO P25-P40
		DMP253	PVD TiCN coating. Excellent wear resistance for low-to-medium operating temperatures.	
		DMP25-HP	High-performance medium-temperature grade. Optimum performance and wear resistance in most soft steels, soft stainless steels and cast irons.	
		DMP257	PVD AlTiN coating. For higher-temperature applications including high-speed machining and heat-treated materials.	
		DMP25-GLH	Premium high-temperature grade. Unbeatable performance and wear resistance in high-heat applications such as harder steels, tough stainless steels and high- temperature alloys.	
HARDEST Wear Resistance	DMK15		Highest wear resistance with reduced shock absorption capabilities. Micro- grain carbide provides excellent edge strength for abrasive applications in nonferrous materials. Suitable for castings, aluminum and smoother cuts in tough stainless steels, high-temperature alloys and hardened steel.	ISO K15-K25, M15-M25
		DMK153	PVD TiCN coating. Excellent wear resistance for low-to-medium operating temperatures. Good resistance to built-up edge for aluminum machining.	
		DMK15-HP	High-performance medium-temperature grade. Optimum performance and wear resistance in most soft steels, soft stainless steels and cast irons.	
		DMK157	PVD AlTiN coating. Appropriate for higher-temperature applications such as high-velocity cast iron machining, tough stainless steels, high-temperature alloys and hardened steel.	
		DMK15-GLH	Premium high-temperature grade. Unbeatable performance and wear resistance in high-heat applications such as harder steels, tough stainless steels and high-temperature alloys. Excellent for hard milling.	

DMP25-HP is a good first choice for most applications. ***Other coatings available on request. Contact Dapra for details.***

Technical Considerations

- Always use anti-seize compound on screws.
- Thoroughly clean pocket and screw at each insert change.
- Change insert screw every 10 inserts.
- Use the shortest length tool holder (end mill holder) for maximum rigidity; the shank of the cutting tool should be up inside the machine spindle taper whenever possible.
- Use tool holders appropriate for roughing operations: End mill holders and powerchucks ***are*** recommended; Collets ***are not*** recommended.

Recommendations

- Tool is most appropriate for "Z-level" roughing; plunge to Depth of Cut (DOC) and clear entire level.
- End Mills – plunge rate should not exceed .50mm per revolution (.25mm per tooth).
  Shell Mills – ramping is recommended (less than 3˚). Ramping feed recommended 50% of X-Y axis feed.
- Minimum diametric plunging engagement is 75% of cutter diameter.
- Width of Cut (WOC) should be 60-75% of cutter diameter whenever possible, creating a "scalloping" effect (end mills only) between passes, especially with longer length tools.
- Plunging creates a long, continuous chip; use a peck cycle with full withdrawal to break and evacuate this chip when plunging to depths greater than 3.8mm.
- The round inserts provide a very strong cutting edge and the ability to machine much closer to finish size. Utilize high speeds and feeds with light DOC to take advantage of these benefits. High metal removal rates will be achieved without high horsepower consumption.
- Use the Feed Rate Compensation chart on page 17 to compensate for chip thinning that occurs with round inserts; this will provide for optimum metal removal rates and tool life; the lighter the DOC, the more critical feed compensation becomes.
- Precision-ground inserts are accurate to within .0127mm, making this cutter excellent for semifinishing, using profiling or raster-type cutter paths.

Troubleshooting

Concern	Possible Cause	Solutions
Insert wear appears high (flank wear)	-Not enough chip load -Surface footage is high -Incorrect grade or coating	-Verify correct speed and feed -Increase feed rate -Decrease RPM -Increase DOC -Use harder grade
Insert chipping	-Surface footage is low -Incorrect grade or coating -Using honed insert incorrectly -Feed too high	-Verify correct speed and feed -Increase spindle speed -Decrease feed rate -Decrease DOC -Use T-Land insert -Use tougher grade
Built-up edge on insert	-Low surface footage -Light chip load (feed per tooth) -Incorrect coating	-Verify correct speed and feed -Increase cutting speed -Increase feed rate -Select different coating
Poor finish/ chatter	-Cutter hung out too far -Excessive runout -Inadequate tool holding	-Reduce tool gage length -Check tool holder wear -Use high-rigidity tool holder
Tool shank breaks	-Tool pressure too great -Fatigued cutter body	-Decrease DOC -Reduce tool gage length -Decrease feed rate

Feed Rate Compensation

After determining the desired chip thickness (MMPT - see chart on page 18), find the insert diameter and depth of cut intersection in the chart at right. Multiply the desired chip thickness by the factor shown in the chart. This will be the Adjusted Feed per Tooth (AFPT), resulting in a true chip thickness of the desired amount.

Example:

If using a 25mm Toroid End Mill with the 12mm inserts @ .75mm Depth of Cut (DOC), the factor for the chip thickness = 2.1.
So, if a chip thickness of .13mm is desired, a feed rate of .27mm (.13mm x 2.1) needs to be programmed into the machine tool.

or

Adjusted Feed per Tooth (AFPT) = chip thickness x chip thinning factor (from chart)

Insert Diameter

Depth of Cut (DOC)	10mm	12mm
.13	4.4	5
.25	3.1	3.6
.38	2.6	2.9
.50	2.2	2.6
.63	2	2.3
.75	1.8	2.1
.90	1.7	2
1.02	1.6	1.8
1.27	1.5	1.7
1.52	1.4	1.5
1.90	1.3	1.4
2.16	1.2	1.3
2.54	1.1	1.3
3.18	1.1	1.2
3.81	NR	1.1

Hole Diameter Calculation

Shell Mill Part Number	Minimum Hole Dia.	Maximum Hole Dia.*
TRSM50-022-R6-4	82.5mm	101.6mm
TRSM63-100-R5-4	103.1mm	127.0mm
TRSM80-100-R4-6	133.3mm	152.4mm

Formulas:

Minimum Hole Dia.:
(Tool Dia. x 2) - (1.5 x Insert Dia.)

Maximum Hole Dia.*:
Tool Dia. x 2

** Not recommended. At this diameter, the center tip is at its maximum. It is suggested that you stay slightly under this number.*

For more information on how Helical Interpolation can improve your manufacturing efficiency, contact your Dapra Applications Specialist.

Helical Interpolation for Larger Diameter Hole Making

Larger diameter hole making can be quick and easy when a Toroid Cutter is used in combination with Helical Interpolation. This technique resembles thread milling in that all three axes (X, Y and Z) are in motion simultaneously. It differs from thread milling in that the tool is introduced into the material without a start hole of any kind. The tool simply is positioned at the inside diameter of the hole to begin its helix from there, achieving complete material removal from the hole by ramping down to the final depth. This smooth operation tends to avoid the high horsepower consumption characteristic of large diameter hole making. And with the high clearance angles of Toroid Cutting Tools, ramp angles during Helical Interpolation can be aggressive, without concern for rubbing the bottom of the cutting edge. The quick and easy process offers the added advantage of allowing many different hole sizes to be generated with the same diameter tool. Hole size variation is all in the programming.

METRIC TOROID Recommended Cutting Speeds

Speeds and Feeds for Dapra Metric Toroid Cutters		LOW-TO-MEDIUM CARBON STEELS	TOOL STEELS, HIGH-ALLOY STEELS (SOFT)	TOOL STEELS, HIGH-ALLOY STEELS (HARDENED)	FREE MACHINING STAINLESS	TOUGHER STAINLESS	CAST IRONS	ALUMINUM ALLOYS	COPPER ALLOYS	HIGH-TEMP. ALLOYS/ TITANIUM	PLASTICS, NON-FERROUS
TOUGHEST Shock Resistance	DMK30				**45-90**	**45-90**				**20-45 ROUGHING**	
	DMK30-HP	**144-292**	**120-268**		**120-244**	**96-192**				**36-108 ROUGHING**	
	DMK307/ DMK30-GLH	**180-365**	**150-335**		**150-305**	**120-240**				**45-135 ROUGHING**	
MEDIUM Shock & Wear	DMP25	90-125	**60-150**		45-90		**75-150 DUCTILE**				
	DMP25-HP	192-340	**144-292**	48-120	120-244		**120-268 DUCTILE**				
	DMP257/ DMP25-GLH	240-425	**180-365**	60-150	150-305		**150-335 DUCTILE**				
HARDEST Wear Resistance	DMK15				45-90	45-90	**75-150 GRAY**	**305+**	**90-150**	**20-45 FINISHING**	**305+**
	DMK15-HP	144-292	120-268	60-176	120-244	96-192	**120-268 GRAY**	**244+**	**192-416**	**36-108 FINISHING**	**244+**
	DMK157/ DMK15-GLH	180-365	150-335	**75-220**	150-305	120-240	**150-335 GRAY**	**305+**	**240-520**	**45-135 FINISHING**	**305+**
RECOMMENDED GEOMETRY		T-Land	T-Land	T-Land	Dished	Dished	T-Land	Dished	Dished	Dished	Dished
RECOMMENDED MMPT		.10-.25	.10-.25	.10-.25	.10-.25	.10-.20	.10-.38	.25-.65	.25-.65	.08-.18	.25+

The parameters provided above are suggested operating parameters. Actual speeds and feeds will depend on many variables, such as rigidity, workpiece hardness, tool extension, machine accuracy, Depth of Cut, etc. Start at the middle of the SFM range and the low end of the FPT range. Next, increase FPT to optimize productivity and tool life. Higher SFM will provide higher output but may reduce tool life. Try different combinations to find the parameters that best suit your needs.

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