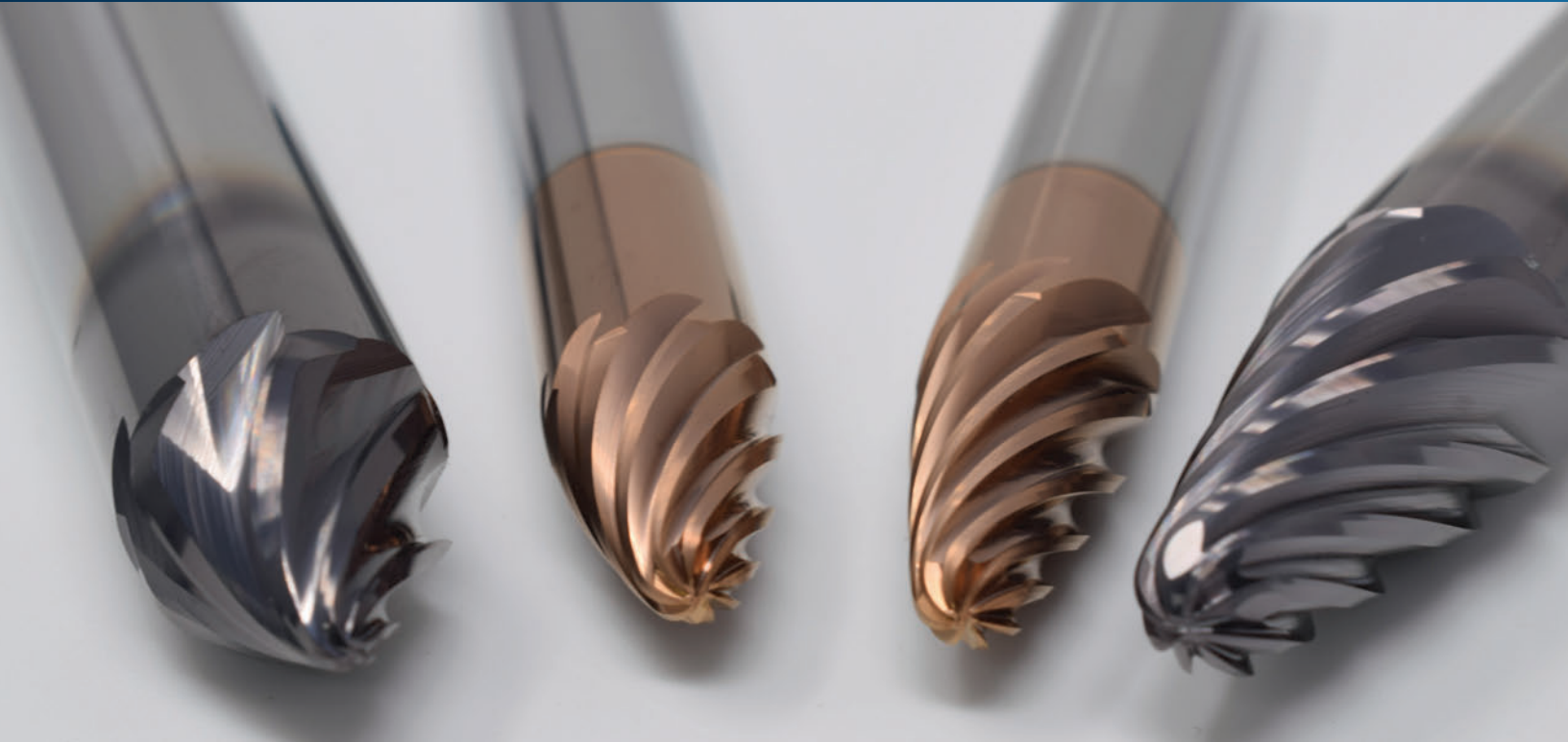




Tapered Circle Segment Barrel Endmills



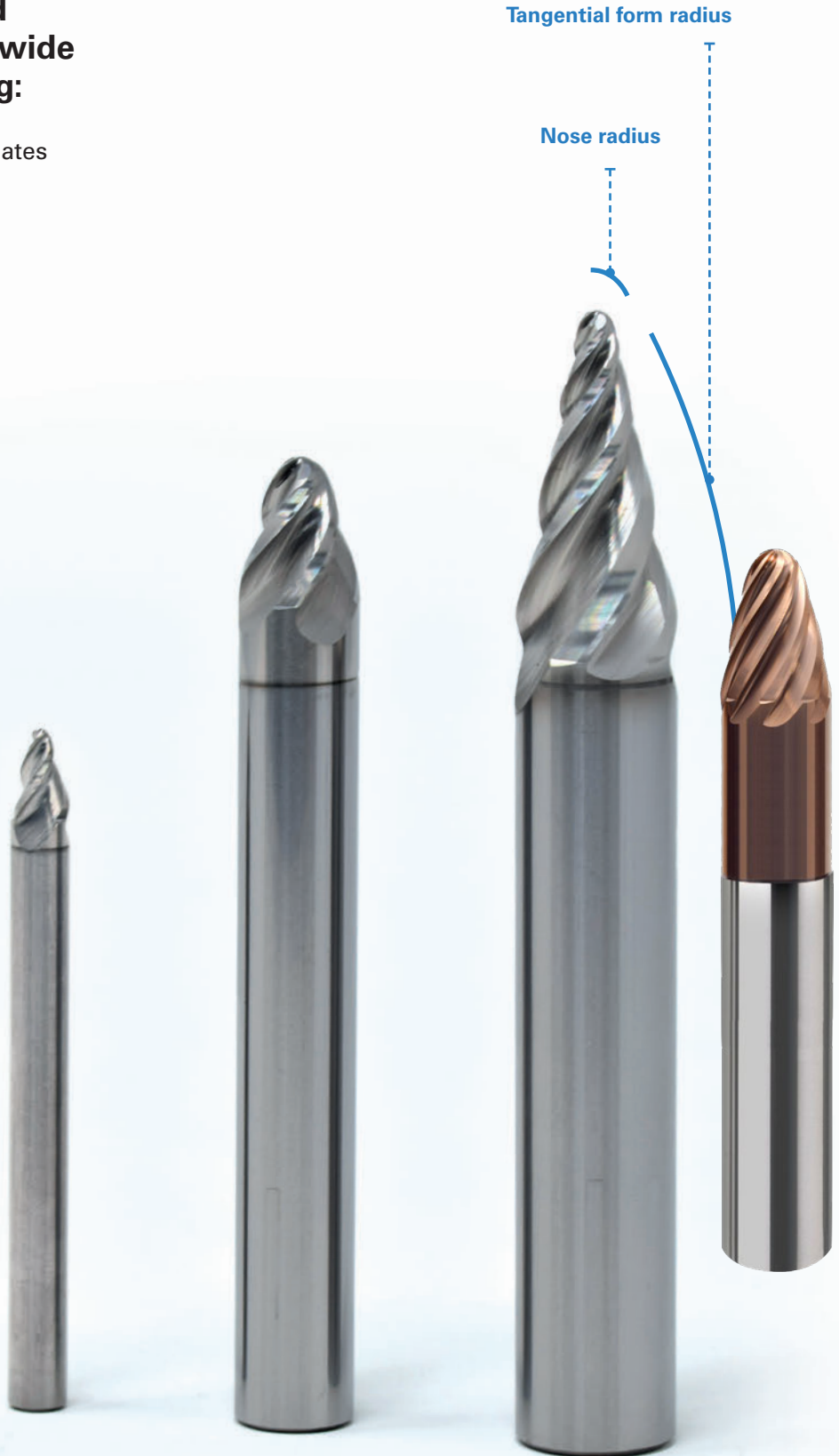
Introducing a New Range of Tapered Circle Segment Barrel Endmills

For revolutionary finishing and semi-finishing strategies on a wide range of components including:

- **Medical** | Femoral knees and trauma plates
- **Aerospace** | Blisks, discs and blades
- **Power Generation** | Turbine blades
- **Mold and Die** | Deep cavities
- **Automotive** | Complex shapes

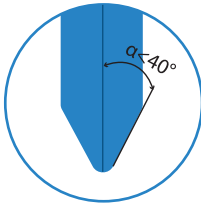
Applications

- Designed to significantly improve traditional ball end applications
- Highly efficient at finishing and semi-finishing profiling
- Main application areas include profiling and pocket milling
- Especially suited to machining deep pockets and hard-to-reach areas without using long-reach tools
- Their versatility also allows for machining profiles and blends with one tool



Tapered Circle Segment Barrel Endmills Design

- Tapered circle segment barrel endmills are a variation of a taper ball end tool where the straight taper is replaced with a large tangential radius ($\varnothing 50$ mm to $\varnothing 1500$ mm)



Tapered circle segment barrel endmills with a tapered angle less than 40° are excellent for machining steep profiles

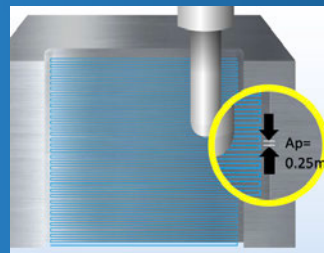
Features

- Variable geometry for chatter reduction leading to extended tool life
- Patent pending geometry allowing multiple regrinds
- Extreme wear resistance due to hard micro-grain substrates and proprietary coatings developed for optimized tool life
- 3-8 flute design to suit application & material
- Precise form tolerance for dimensional accuracy
- Standard range from $\varnothing 6$ mm to $\varnothing 16$ mm
- 36 standard items available for ferrous and non-ferrous applications
- Specials available on request

Benefits of Tapered Circle Segment Barrel Endmills

- Enables a greater ap step-over maintaining the same theoretical scallop height
- Improved efficiency with enhanced surface quality
- Increased tool life while simultaneously reducing the number of tools required
- Spindle growth, machine position and thermal properties allow for a large tool radius
- Lower set-up costs
- Excellent process reliability
- Reduces / eliminates the need for post-milling processes such as finishing and polishing
- Reduces heat transfer effects which can lead to thermal deformation of the component
- Flexibility with face machining and ball end cutting

Capabilities

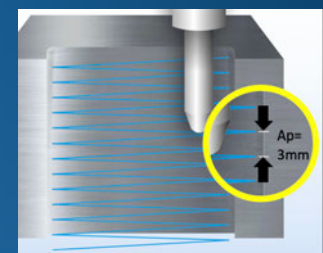


Typical Ball End

Small step-over

- Many cuts
- Long machining time

To achieve the desired cusp height with a ball end requires a step-over of **0,25 mm**



Tapered Circle Segment Barrel Endmills Tooling

Larger step-over

- Fewer cuts
- Shorter machining time

To achieve the desired cusp height with a tapered circle segment barrel endmill requires a step-over of **3 mm**

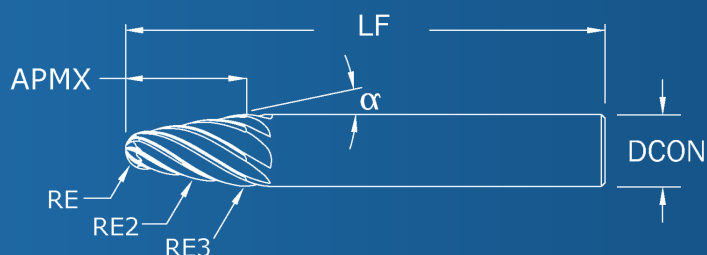
Pocket Machining

Ball End	VS.	Tapered Circle Segment Barrel Endmills
18 mins 40 secs	CYCLE TIME	2 mins 31 secs
0,25 mm	STEP DOWN	3 mm
18,667 mm	LINEAR DISTANCE	4,045 mm
1,000 mm/min	FEED RATES	1,000 mm/min

87%
cycle time
savings

Product Range

For patent information visit
www.ksptpatents.com



TOLERANCES (mm)		
FORM	DCON	RE
+/- 0,010 (0.0004")	h6	+/- 0,01 (0.0004")

Ball	Common	Regular & Long	Flute Spacing Unequal	Positive Rake Angle	Flutes	Flutes	Flutes	Flutes

Hard Metals - Range Ø6-Ø16 mm

SHANK DIAMETER DCON	LENGTH OF CUT APMX	OVERALL LENGTH LF	CENTERLINE ANGLE α	RE	RE2	RE3	NO. OF FLUTES	TI-NAMITE®-H EDP NO.
6	9,5	58	17,5	1	250	3	4	45700
6	8	58	17,5	1,5	250	3	4	45701
8	10,5	80	20	1,5	250	4	4	45702
8	9,5	80	20	2	250	4	4	45703
10	12,5	89	20	2	250	5	6	45704
10	11,5	89	20	2,5	250	5	6	45705
12	13,5	100	20	3	250	6	8	45706
12	14,4	100	20	2,5	250	6	8	45707
12	20	100	14	2	60	6	6	45708
16	31	109	12,5	2	1000	5	6	45709
16	27,5	109	12,5	3	1000	5	8	45710
16	24	109	12,5	4	1000	5	8	45711
16	21	109	15	4	1000	5	8	45712
16	18,5	109	20	4	1500	8	8	45713
16	28,5	109	10	4	1000	5	8	45714
16	19	109	20	3	750	5	8	45715
16	15	109	30	2	750	3	6	45716
16	18,5	109	20	3	60	5	8	45717



Soft Metals - Range Ø6-Ø16 mm

SHANK DIAMETER DCON	LENGTH OF CUT APMX	OVERALL LENGTH LF	CENTERLINE ANGLE α	RE	RE2	RE3	NO. OF FLUTES	TI-NAMITE®-B EDP NO.
6	9,5	58	17,5	1	250	3	3	45718
6	8	58	17,5	1,5	250	3	3	45719
8	10,5	80	20	1,5	250	4	3	45720
8	9,5	80	20	2	250	4	3	45721
10	12,5	89	20	2	250	5	3	45722
10	11,5	89	20	2,5	250	5	3	45723
12	13,5	100	20	3	250	6	4	45724
12	14,4	100	20	2,5	250	6	4	45725
12	20	100	14	2	60	6	4	45726
16	31	109	12,5	2	1000	5	4	45727
16	27,5	109	12,5	3	1000	5	4	45728
16	24	109	12,5	4	1000	5	4	45729
16	21	109	15	4	1000	5	4	45730
16	18,5	109	20	4	1500	8	4	45731
16	28,5	109	10	4	1000	5	4	45732
16	19	109	20	3	750	5	4	45733
16	15	109	30	2	750	3	4	45734
16	18,5	109	20	3	60	5	4	45735



Tapered Circle Segment Barrel Endmills

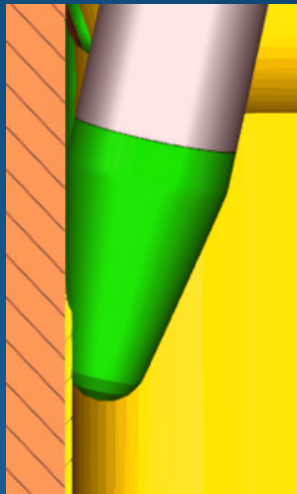
Milling Strategies

Machining strategies play an important function in the performance of the tool as well as extending tool life.

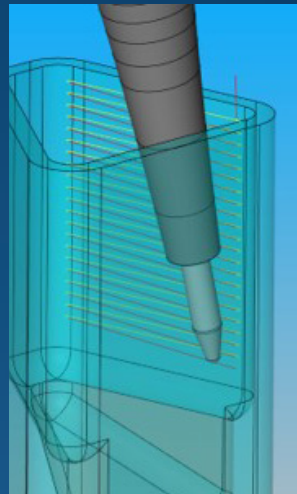
For large surfaces always use the main barrel radius.

Use the largest diameter possible to utilize surface speed and chip space.

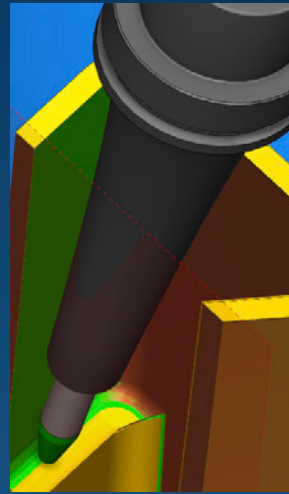
Change the contact point along the cutting edge as often as possible to spread wear and prolong tool life.



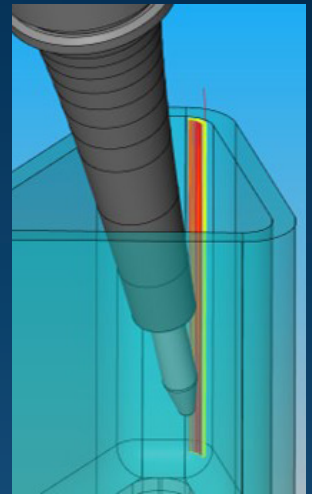
Use a combination of passes to clean ridges.



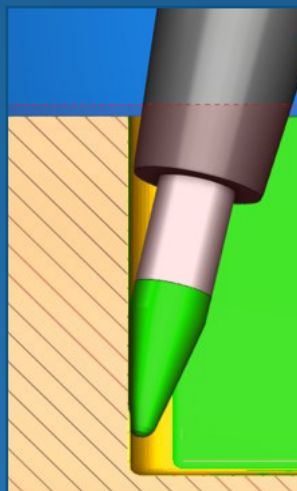
Climb milling is advised to ensure optimal tool life and surface finish.



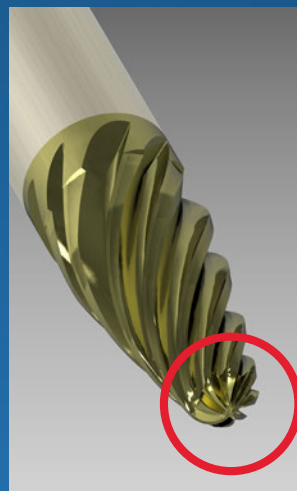
Small corner features can be finished with the radius tip of the barrel.



For larger corner radii use the barrel radius.



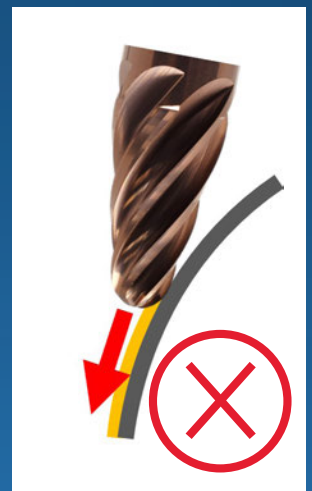
Always consider the tool and tool-holder combination when programming and aim for the shortest possible protrusion.



Try and avoid using the tip of the tool where chip space is smallest, thus limiting size of cut. Consider lowering the surface speed and feed in this area of the tool.



Apply an upward machining strategy where possible instead of feeding the tool nose down a profile.



Cutting Data

			Ae										
			0,20 0,45 0,25 0,55 0,30 0,60 0,35 0,65 0,40 0,70										
													
Metric	Hardness (HRC)	Vc (m/min)	Diameter	Tip-6	6	Tip-8	8	Tip-10	10	Tip-12	12	Tip-16	16
P Alloy Steels	≤28 (155-232)	194	RPM	14408	10292	10806	7719	8645	6175	7204	5146	5403	3859
			Fz	0,019	0,030	0,025	0,040	0,031	0,050	0,038	0,060	0,057	0,080
			Feed (mm/min)	1081	1235	1081	1235	1621	1853	1621	1853	1853	1853
	≤40 (88-132)	110	RPM	8170	5836	6127	4377	4902	3501	4085	2918	3064	2188
			Fz	0,013	0,020	0,019	0,030	0,025	0,040	0,031	0,050	0,044	0,070
			Feed (mm/min)	408	467	460	525	735	840	766	875	804	919
P Hardened Steels	≤35 (69-118)	93	RPM	6907	4934	5180	3700	4144	2960	3454	2467	2590	1850
			Fz	0,019	0,030	0,025	0,040	0,080	0,050	0,038	0,060	0,050	0,080
			Feed (mm/min)	518	592	518	592	1989	888	777	888	777	888
	≤45 (51-77)	64	RPM	4753	3395	3565	2546	2852	2037	2377	1698	1782	1273
			Fz	0,013	0,020	0,019	0,030	0,025	0,040	0,031	0,050	0,038	0,060
			Feed (mm/min)	238	272	267	306	428	489	446	509	401	458
M Stainless Steels	≤28 (94-141)	117	RPM	8690	6207	6517	4655	5214	3724	4345	3103	3259	2328
			Fz	0,019	0,030	0,025	0,040	0,031	0,050	0,038	0,060	0,044	0,070
			Feed (mm/min)	652	745	652	745	978	1117	978	1117	855	978
	≤35 (87-130)	108	RPM	8021	5729	6016	4297	4813	3438	4011	2865	3008	2149
			Fz	0,013	0,020	0,019	0,030	0,025	0,040	0,031	0,050	0,038	0,060
			Feed (mm/min)	401	458	451	516	722	825	752	859	677	773

NOTE:

- $rpm = (Vc \times 1000 / DC \times 3.142)$
- $Feed = Fz \times \text{No. of flutes} \times rpm$
- Adjust speed and feed cutting
- Adjust rates according to cutting area of tool being used
- Avoid using tip of the tool where possible due to reduced chip space
- Be aware of max cut Ae, especially on the lower portion of the tool
- Medical applications:
 - Titanium can be cut dry while keeping cut size to a minimum and providing good chip evacuation (air blast)
 - For cobalt chrome applications, a surface speed of 45m/min is a guide (can also be cut dry as per titanium)
- Refer to the SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)



			Ae	0,20	0,45	0,25	0,55	0,30	0,60	0,35	0,65	0,40	0,70
													
Metric	Hardness (HRC)	Vc (m/min)	Diameter	Tip-6	6	Tip-8	8	Tip-10	10	Tip-12	12	Tip-16	16
S High Temperature Alloys	≤32	32	RPM	2377	1698	1782	1273	1426	1019	1188	849	891	637
		(32-38)	Fz	0,013	0,020	0,019	0,030	0,025	0,040	0,031	0,050	0,038	0,06
			Feed (mm/min)	119	136	134	153	214	244	223	255	201	229
	≤43	26	RPM	1931	1379	1448	1034	1159	828	966	690	724	517
		(21-31)	Fz	0,006	0,010	0,013	0,020	0,019	0,030	0,025	0,040	0,031	0,050
			Feed (mm/min)	48	55	72	83	130	149	145	166	136	155
S Titanium Alloys	≤35	109	RPM	8095	5782	6072	4337	4857	3469	4048	2891	3036	2168
		(85-133)	Fz	0,019	0,030	0,025	0,040	0,031	0,050	0,038	0,060	0,050	0,080
			Feed (mm/min)	607	694	607	694	911	1041	911	1041	911	1041
	≤45	53	RPM	3936	2812	2952	2109	2362	1687	1968	1406	1476	1054
		(44-61)	Fz	0,013	0,020	0,019	0,030	0,025	0,040	0,031	0,050	0,044	0,070
			Feed (mm/min)	197	225	221	253	354	405	369	422	387	443
			Ae	0,20	0,45	0,25	0,55	0,30	0,60	0,35	0,65	0,40	0,70
													
Metric	Hardness (HRC)	Vc (m/min)	Diameter	Tip-6	6	Tip-8	8	Tip-10	10	Tip-12	12	Tip-16	16
N Aluminium	≤7	610	RPM	37878	27056	28408	20292	22727	16233	18939	13528	14204	10146
		(488-732)	Fz	0,025	0,040	0,031	0,050	0,038	0,060	0,050	0,080	0,063	0,100
			Feed (mm/min)	2841	3247	2663	3044	2557	2922	2841	3247	2663	3044
	≥7	610	RPM	24509	17507	18382	13130	14705	10504	12255	8753	9191	6565
		(488-372)	Fz	0,019	0,030	0,025	0,040	0,031	0,050	0,038	0,060	0,050	0,080
			Feed (mm/min)	1379	1576	1379	1576	1379	1576	1379	1576	1838	2101

Ti-NAMITE®-H

This coating demonstrates a superior combination of hardness and adhesion in hard machining of molds and dies and machining high-alloy stainless steels for high temperature applications such as turbines. The smooth surface ensures optimum surface quality and decreases the temperature in the cutting zone by reducing friction.

Hardness (HV): 3800

Oxidation Temperature: 1100°C / 2010°F

Coefficient of Friction: 0.30

Thickness: 1–5 Microns (based on tool diameter)

Ti-NAMITE®-B

This ceramic-based coating ensures a smooth surface and a low affinity to cold welding or edge build up, which makes it optimal for aluminium and copper applications. It has a high toughness and high hardness.

Hardness (HV): 4000

Oxidation Temperature: 850°C / 1562°F

Coefficient of Friction: 0.10–0.20

Thickness: 1–2 Microns (based on tool diameter)

Tapered Circle Segment Barrel Endmill Applications – Medical Femoral Knee Solutions



Milling Condyle Surfaces – Tapered Circle Segment Barrel Endmills

The condyle surfaces represent the largest portion of cycle time when machining femoral components. These surfaces are milled with ball end tools using a scanning strategy.

The SGS range of tapered circle segment barrel endmills achieve step overs up to 3,0 mm and feed rate over 1,500 mm/min while still delivering surface finishes within tolerance.



Condyle Surface Machining

Application Details		Cutting Data Ø12 mm / R200 mm	
Operation	Finishing condyle surface	Speed	40-50 m/min
Requirement	Cycle time reduction and dimensional accuracy	Feed	800 mm/min
Tool	SGS Tapered Circle Segment Barrel Endmills Ø12 mm / R200 mm	Radial (ae)	2,0 mm
Material	Cobalt chrome	Depth (ap)	0,5 mm
Coolant	Emulsion - Flood	Tool life	60 parts

Solution Advantages

- ✓ Reduction in scrap
- ✓ Extended tool life (3h recorded)
- ✓ Reduction in post milling finishing

Result: Cycle time reduction of 40% and dimensional accuracy improvement



Blisk Applications – Aerospace Blade Applications



Wall Machining – Tapered Circle Segment Barrel Endmills

The blade wall surfaces represent the largest portion of cycle time when machining solid blisk components with ball end tools.

The SGS range of tapered circle segment barrel endmills have achieved lower cusp height and increased surface quality while increasing the step-over from 0,3 mm to 3,0mm. The feed rate reduced cycle time decreased from 25 minutes to under 3 minutes.



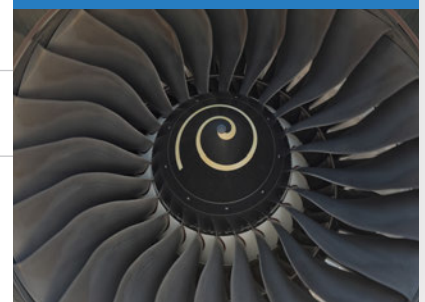
Titanium Blade – Wall Machining

Application Details		Cutting Data Ø12 mm	
Operation	Finishing blade wall	Speed	90 m/min
Requirement	Cycle time reduction and dimensional accuracy	Feed	1000 mm/min
Tool	SGS Tapered Circle Segment Barrel Endmills Ø12 mm	Radial (ae)	0,2 mm
Material	Titanium	Depth (ap)	3,0 mm
Coolant	Emulsion - Flood	Tool life	+60 blades

Result: Cycle time reduction of 90% and dimensional accuracy improvement

Solution Advantages

- ✓ Extended tool life
- ✓ Reduced contact time
- ✓ Increased surface finish quality (Ra)
- ✓ Reduction in cusp height

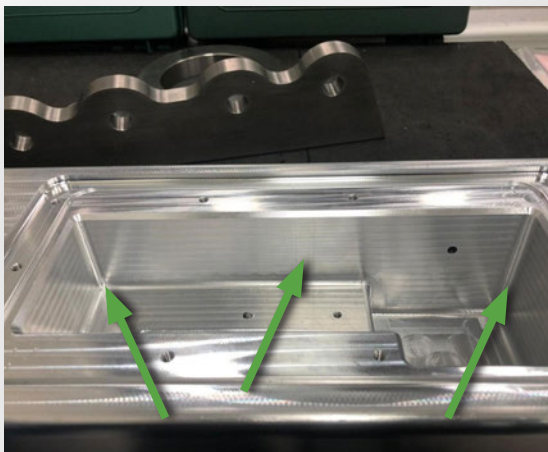


Lab Results – Aluminum Machining



Aluminum-Aero Structure Superior Finish vs. Competition

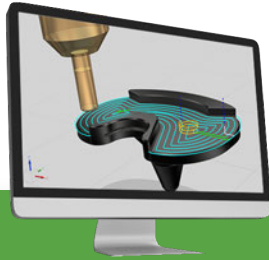
	Competitor-F	SGS
Finish Value	1.88	0.48
Mismatch	Poor	Good
Surface Quality	Poor	Good



Aluminum-Pocket Superior Finish vs. Competition

	Competitor-B	SGS
Finish Value	1.78	0.55
Mismatch	Poor	Good
Surface Quality	Poor	Good
Cycle Time	10.5 Mins	7.8 Mins
Cycle Time Reduction		26%

OUR SERVICES

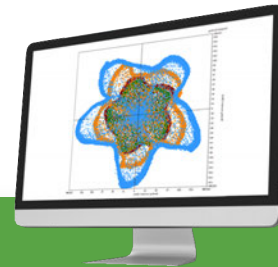


PROCESS DEVELOPMENT

KYOCERA SGS technical centers help obtain the best tooling solutions utilizing the high-performance range of tooling and optimum strategies.

The technical centers use in-house Multi-Axis CNC milling machines and work in conjunction with their partners to create a successful process.

Whether it be machine tools, tool holding, work holding or using the latest CAD-CAM software, KYOCERA SGS technical centers are committed to engineering the best solution.



CUSTOM TOOLING SOLUTIONS

The KYOCERA SGS R&D team's extensive knowledge and creative thinking along with utilizing the latest technology develop specific tooling unique to your application and material requirements.

Before

Re-manufactured to original geometry



REGRIND, RECOAT AND ALTERATION SERVICES



Ask about the custom tapered circle segment barrel endmills designed to suit specific applications.

SOLUTIONS AROUND THE GLOBE

KYOCERA SGS Precision Tools is an ISO 9001:2015 Certified leader of round solid carbide cutting tool technology for the aerospace, metalworking, and automotive industries with manufacturing sites in the United States and United Kingdom. Our global network of Sales Representatives, Industrial Distributors, and Agents blanket the world selling into more than 60 countries.

LEADERS IN SOLID CARBIDE TOOL TECHNOLOGY

Brand names such as Z-Carb®, S-Carb®, V-Carb, Hi-PerCarb®, Multi-Carb have become synonymous with high performance tooling in the machining and metalworking industry.

We're proud to have pioneered some of the world's most advanced cutting technology right here on our Northeast Ohio manufacturing campus. KSPT high performance end mills, drills and routers are increasing productivity and reducing cost around the world.

EXCEEDING CUSTOMER EXPECTATIONS

As the world's manufacturing needs change, so does KSPT. It's all about the science, starting with our lab inspected substrate materials to our tool designs and coatings. Our exceptional team of researchers, engineers, and machinists are dedicated to developing the absolute best and delivering the ultimate Value at the Spindle®.

- Incredible batch-to-batch consistency
- Metallurgical lab dedicated to testing and rigorous quality control
- ISO 9001:2015 Certified quality procedures
- Patented geometries that extend tool life, reduce chatter, cut cycle times, and improve part quality—even at extreme parameters
- Specialists in extreme and demanding product applications
- Comprehensive tooling services
- Experienced Field Sales Engineers who work to optimize a tool for your particular application
- Dedicated multi-lingual customer service representatives

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UNITED STATES OF AMERICA

KYOCERA SGS Precision Tools
150 Marc Drive
Cuyahoga Falls, Ohio 44223 U.S.A.
customer service -
US and Canada: (330) 686-5700
fax - US & Canada: (800) 447-4017
international fax: (330) 686-2146
orders: sales@kyocera-sgstool.com
web: www.kyocera-sgstool.com

KYOCERA SGS Tech Hub LLC

149 Slayton Avenue
Danville, Virginia 24540 U.S.A.
customer service -
US and Canada: (434) 791-2020
fax - US & Canada: (434) 791-2044
web: www.kyocera-techhub.com

UNITED KINGDOM

KYOCERA SGS Precision Tools Europe Ltd.
10 Ashville Way
Wokingham, Berkshire
RG41 2PL England
phone: (44) 1189-795-200
fax: (44) 1189-795-295
e-mail: SalesEU@kyocera-sgstool.com
web: www.kyocera-sgstool.co.uk

JAPAN

KYOCERA Corporation
International Sales Dept.
6 Takeda Tobadono-cho,
Fushimi-ku, Kyoto 612-8501, Japan
phone: +81-75-604-3473
fax: +81-75-604-3472
web: global.kyocera.com/prdct/tool/index.html

COMMERCIAL OFFICES

EASTERN EUROPE

SINTCOM
Sintcom Tools
95 Arsenalski Blvd.
1421 Sofia, Bulgaria
phone: (359) 283-64421
fax: (359) 286-52493
e-mail: sintcom@sintcomtools.com

FRANCE

DOGA USINAGE
8, Avenue Gutenberg CS 50510
78317 Maurepas Cedex, France
phone: +33 1 30 66 4141
e-mail: usinage-outils@doga.fr
web: www.doga.fr

GERMANY

KADIGO Tool Systems GmbH
Walramster. 27
65510 Idstein, Germany
phone: +49-212-645573-0
fax: +49-212-38089693
e-mail: info@kadigo-ts.com

INDIA

KYOCERA Asia Pacific India Pvt. Ltd
Plot No.51, Phase-I,
Udyog Vihar Gurgaon 122016,
Haryana, India
phone: +91-124-4025022
fax: +91-124-4025001

KOREA

KYOCERA Precision Tools Korea Co., Ltd.
2LT 69BL, Namdong Industrial Estate,
638-1, Kozan-Dong, Namdong Incheon,
Korea
phone: +82-32-821-8365
fax: +82-32-821-8369
web: www.kptk.co.kr/

POLAND

KYOCERA SGS Precision Tools
phone: +48 530 432 002
e-mail: SalesEU@kyocera-sgstool.com

RUSSIA

HALTEC
phone: (7) 495-252-05-00
e-mail: info@haltec.ru
web: www.haltec.ru

SPAIN

KYOCERA SGS Precision Tools IBERICA
e-mail: SalesEU@kyocera-sgstool.com

THAILAND

KYOCERA Asia Pacific (Thailand) Co., Ltd.
1 Capital Work Place Building
7th Floor, Soi Chamchan, Sukhumvit
55 Road, Klongton Nua, Wattana,
Bangkok 10110, Thailand
phone: +66-2-030-6688
fax: +66-2-030-6600

SINGAPORE

KYOCERA Asia Pacific Pte. Ltd.
298 Tiong Bahru Road, #13-03/05 Central Plaza,
Singapore 168730
phone: +65-6373-6700
fax: +65-6271-0600
web: asia.kyocera.com/products/cuttingtools/index.html

CHINA

KYOCERA (China) Sales & Trading Corporation
Room 140, Building A3, Daning Central Square,
No. 700 Warrong Road,
Zhabei District, Shanghai, 200072,
P.R. China
phone: +86-21-3660-7711
fax: +86-21-568-6200
web: www.kyocera.com.cn/prdct/cuttingtool

