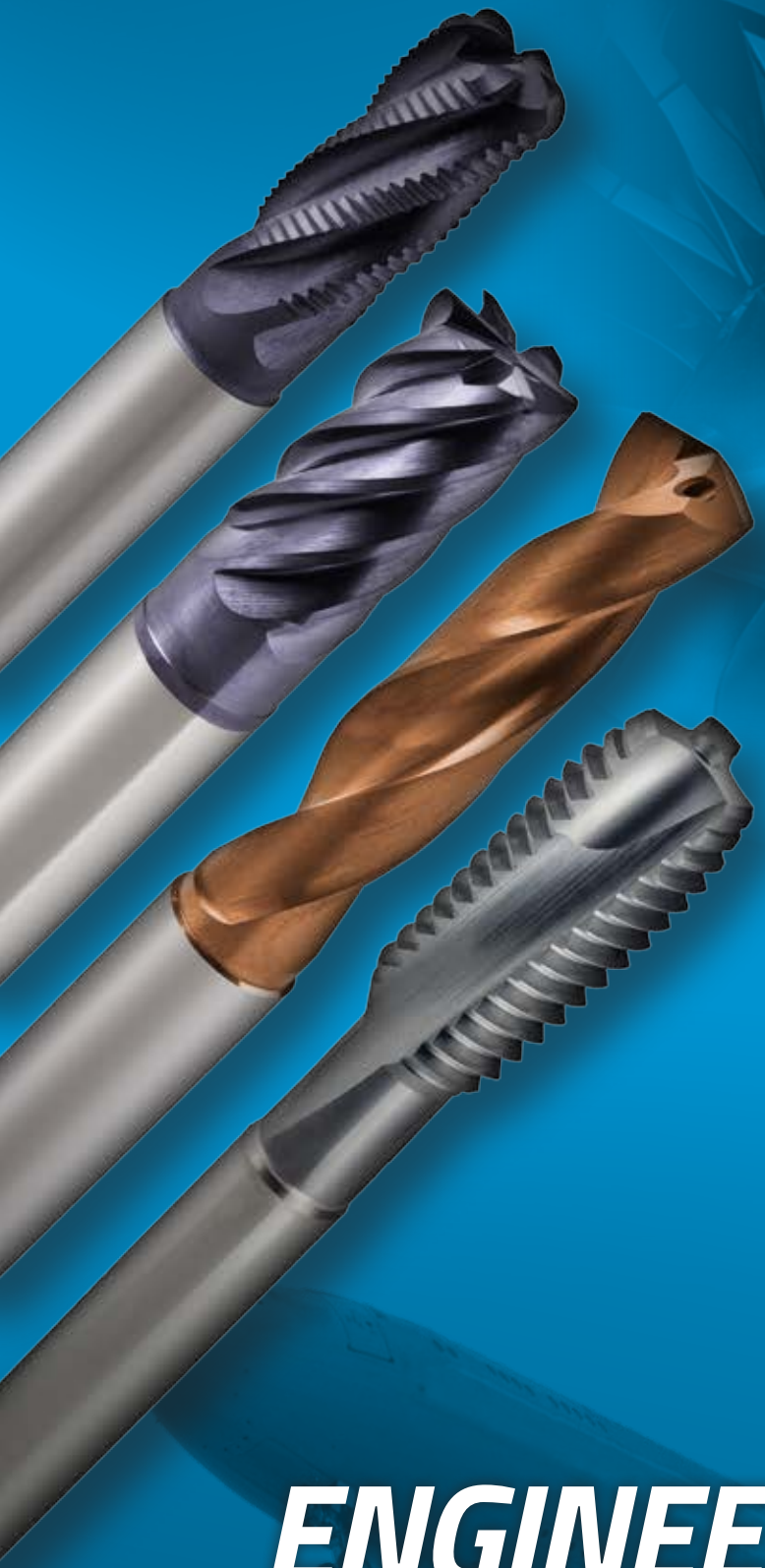
suttontools
world class cutting tools



SUPER ALLOYS & STAINLESS STEEL

ENGINEERED SOLUTIONS

Cutting tools in industries such as aerospace, medical, oil & gas, are being used on materials such as titanium's, nickel alloys and stainless steels, which are known as difficult-to-machine materials. The properties that make these materials so sought after, is the high toughness, high strength to weight ratio and low thermal conductivity, which is exactly why they are difficult-to-machine and form into complex shapes.

These super alloys inherit very poor machinability (refer table below), since most of the heat is absorbed by the cutting edge.

This creates quite a challenge for the cutting tool producers. Sutton Tools provides the solution through extra attention to the tools attributes to withstand the heat build-up, such as specially selected carbide grades, optimised geometries and the ideal PVD coatings.

ISO	Material group	Material Type	Machinability
P	Steels	Free Cutting	100%
		Low Carbon	70-80%
		Medium Carbon	55-65%
		High Carbon	50-60%
M	Stainless Steels	**Austenitic**	**40-50%**
		Duplex	**40-55%**
		Precipitation Hardening	**50-65%**
S	Titaniums & Super Alloys	**Titanium Alloy**	**30%**
		Fe Based	25%
		Nickel Based	**10%**
		Cobalt Based	5-10%

TOOL FINDER

suttontools

	Page	Tool	Application	Tool Material	Recommendation	S – Ti: Ti based alloys	S – Ni: Ni based alloys	M – VA: Stainless Steels (precipitating)
MILLING	4		Universal	VHM 5 Flute	R40/42 Ti	●	○	○
	4			VHM 6 Flute	R40/42 Ti	●	○	○
	4			VHM 5 Flute	R40/42 Ni	○	●	●
	6		Roughing	HSSE-PM	R30-VA HR	●	○	●
	10		Universal	Harmony VHM	R40/42 VA	○	○	●
	10		Roughing	VHM	R35/36/36 HR	○	○	●
	10		Slotting		R55/54/56 VA	○	○	●
DRILLING	12		3xd	VHM	R30 VA-IK	●	○	●
	12		5xd			●	○	●
	13		3 & 5xd	HSS-Co	R40 VA	○		●
TAPPING	7		Blind	PM-HSSE	R15 Ti	●		○
	7		Through		L12 Ti	●		○
	9		Blind/ Through		R10 Ni		●	○
	14		Blind	HSSE/PM	R40 VA R45 VA R50 VA	○		○
	14		Through		VA GUN	○		○
	14		Blind/ Through	PM-HSSE	Former			●

● Optimal ○ Effective

Common Grade - Titanium Alloy, TiAl6V4 (T-A6V), Grade 5

Applications - compressor blades, discs, and rings for jet engines; airframe and space capsule components, pressure vessels, rocket engine cases, helicopter rotor hubs, fasteners, critical forgings requiring high strength-to-weight ratios.

Machining - often a similar practice to austenitic stainless steels. Best results are usually achieved with slower speeds, heavy feeds, rigid tooling, and large amounts of non-chlorinated cutting fluid. The chip thickness is paramount when machining titanium, getting this right, will have the biggest effect on your productivity. A relatively increased fz (mm/tooth) and moderately slower Vc (m/min) when compared to machining general steels, provides the best MRR.

Sutton Tools Ti Series provides the following ranges with the above in mind, to ensure the highest productivity and process reliability is achieved.

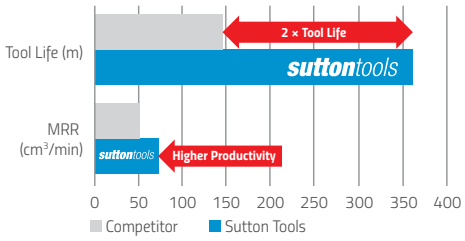
	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Shank Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
MILLING	Universal/ Trochoidal	E464		12mm - 20mm	Square End	DIN6535 HA	5	R40/42 Ti	VHM-Ultra	AlNova	DIN6527 L
		E465				DIN6535 HB					
		E466			Corner Radius	DIN6535 HA					
		E467				DIN6535 HB					
	3XL	E476			Square End & Corner Radius	DIN6535 HA					Sutton Standard
	4XL	E477				DIN6535 HB					

R40/42 5-Flute Ti Carbide Endmill
E466 Series

Test Data

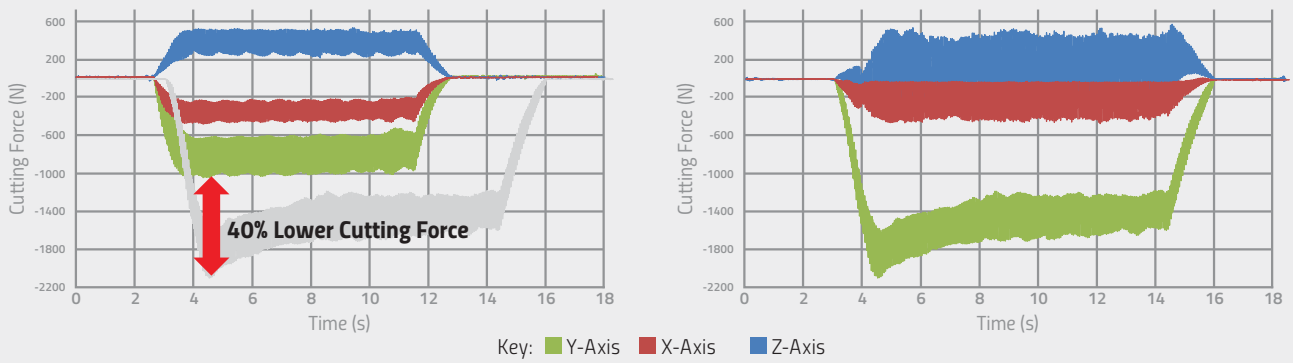
Material	TiAl6V4
Tool	E466 1640
Tool Holder	Collet Chuck (Big Dashowa)
Size	ø16 x 4 Corner Radius
Cutting Speed Vc (m/min)	90
RPM	1430
Feed Rate Vf (mm/min)	572
Feed fz (mm/tooth)	0.08
ae (mm)	4
ap (mm)	30

Results



Comparison

Sutton Tools **Competitor**



	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Shank Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
MILLING	High Productivity	E468		12mm - 20mm	Square End	DIN6535 HA	6	R40/42 Ti	VHM-Ultra	AlNova	DIN6527 L
		E469				DIN6535 HB					
		E470			Corner Radius	DIN6535 HA					
		E471				DIN6535 HB					

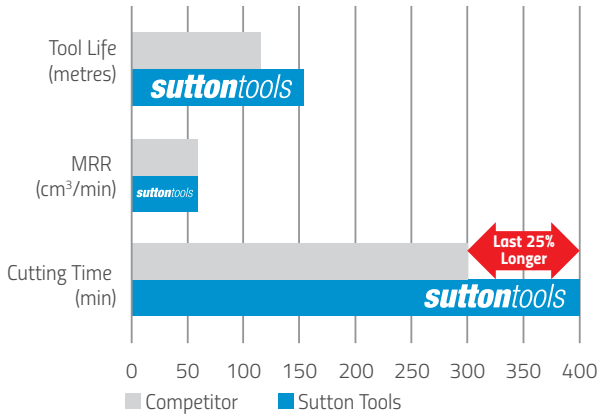
R40/42 6-Flute Ti Carbide Endmill
E470 Series

Test Data

Material	TiAl6V4
Tool Holder	HSK63 Shrink Fit (HAIMER)
Size	ø20 x R1
ae (mm)	6
ap (mm)	26

	Sutton Tools	Competitor A
Tool	E470 2010	6 Flute, Variable Helix
Cutting Speed Vc (m/min)	80	80
RPM	1272	1272
Feed Rate Vf (mm/min)	382	382
Feed fz (mm/tooth)	0.06	0.06

Comparison



Edge Condition after 400 mins.

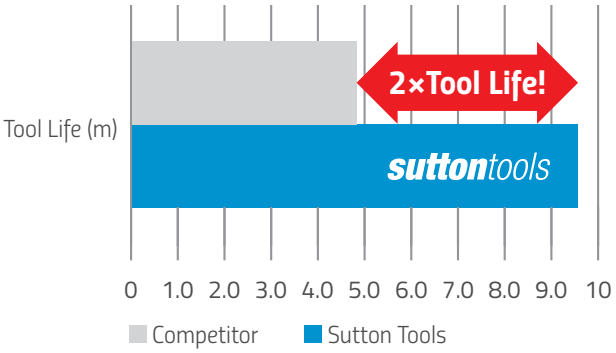
	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Shank Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
MILLING	Roughing	E251		6mm - 32mm	Square End	DIN1835 B	4/5/6	R30 VA-R	SPM	AlCrN	DIN844K
	Roughing (LONG)	E252									DIN844L
	Roughing	E255		10mm - 32mm	Corner Radius						DIN844K

R30VA-R 5 Flute SPM Roughing Endmill
E255 Series

Comparison 1 Test Data

Material	TiAl6V4
Tool	E255 1640
Tool Holder	Collet Chuck (Big Dashowa)
Size	ø16 x R4
Cutting Speed Vc (m/min)	20
RPM	398
Feed Rate Vf (mm/min)	119
Feed fz (mm/tooth)	0.06
ae (mm)	10
ap (mm)	20

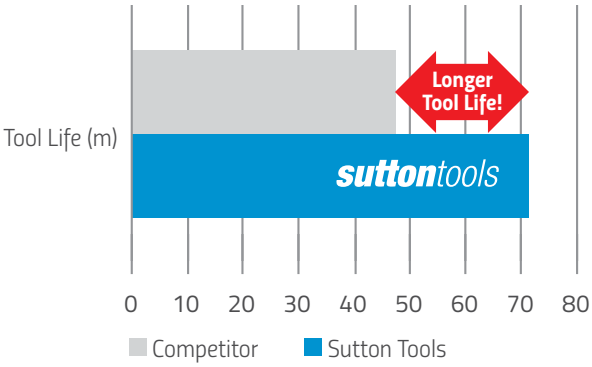
Results



Comparison 2 Test Data

Material	TiAl6V4
Tool	Special Custom Make
Tool Holder	Collet Chuck
Size	31.75mm (1-1/4")
Cutting Speed Vc (m/min)	23
RPM	230
Feed Rate Vf (mm/min)	79
Feed fz (mm/tooth)	0.057
ae (mm)	16
ap (mm)	48

Results

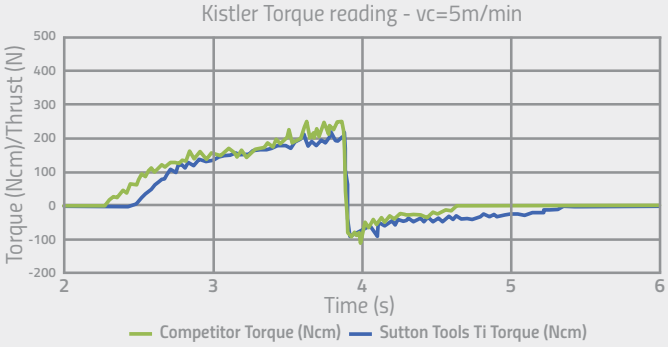


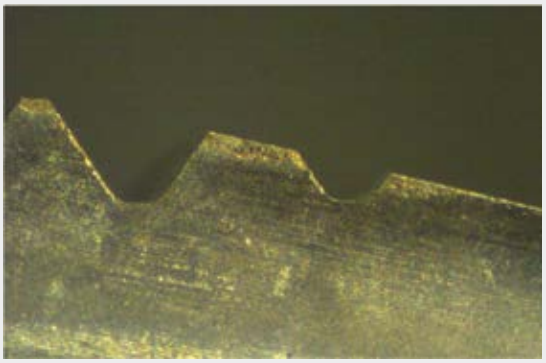
TAPPING

Application	Sutton Tools Item Code	Tool	Diameter range	Type	Chamfer Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
Blind holes	T215		M3 - M10	6HX	C	3	R15 Ti	PM-HSSCo	TiCN	DIN371
	T216		M12 - M20			3/4				DIN376
	T788		MJ3 - MJ10	4HX		3				DIN371
	T789		MJ12 - MJ20			3/4				DIN376
	T790		#4 to 1/2" UNJC	3BX		3				DIN2184-1
	T791		#10 to 1/2" UNJF							
Through holes	T152		M3 - M10	6HX	B	3	L12 Ti	PM-HSSCo	TiCN	DIN371
	T153		M12 - M20			3/4				DIN376
	T784		MJ3 - MJ10	4HX		3				DIN371
	T785									
	T786		1/4" to 3/8" UNJC	3BX						DIN2184-1
	T787		1/4" to 3/8" UNJF							

R15 Ti HSSE-PM Tap - T215 Series

Designed for optimal performance in titanium alloys, which are generally difficult to cut due to the work hardening, low heat conductivity and strong alloying characteristics. Sutton Tools' Ti range of taps offers high process reliability due to the optimised micro-finish coating, its specific grade of powder metal HSS tool material, and the unique cutting geometry that enables highly efficient swarf ejection that provides consistent thread quality.





Common Grade - Inconels, such as 625 & 718 are heat resistant/high temperature alloys, which has the highest resistance to temperature, corrosion, oxidation and creep than any other alloy system.

Applications - aircraft engine/exhaust systems, gas turbine & biomedical components.

Machining
- It is extremely heat resistant, higher than titanium. It is not only the high temperature resistance that makes them difficult-to-machine, but the high strength causes high cutting forces, generating greater heat, limiting the speeds, hence limiting the productivity available.
- In addition to this, reduced tool life can result from the excessive tool wear caused from the low thermal conductivity characteristics on Inconels. The challenge to control the swarf/chips is vital since they are generally tough/work harden chips and can lead to burr formation or poor surface finish on the workpiece. For best results, much slower cutting parameters are preferred when compare to machining titaniums.

Sutton Tools' Ni range encompasses a geometry set, that looks to offer reinforced cutting edges and carefully selected coatings to resist the high cutting forces encountered.

	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Shank Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
MILLING	Universal/ Tro choidal	E472		12mm - 20mm	Square End	DIN6535 HA	5	R40/42 Ti	VHM-Ultra	X.Ceed	DIN6527 L
		E473				DIN6535 HB					
		E474			Corner Radius	DIN6535 HA					
		E475				DIN6535 HB					

R40/42 5-Flute Ni Carbide Endmill E474 Series

Excellent solution for shoulder and finish milling application, particularly for fine surface finish requirements, due to the multi-flute design the cutting forces and loads are distributed over more cutting edges than the conventional 4 flute endmills, resulting longer tool life.

Coming Soon!

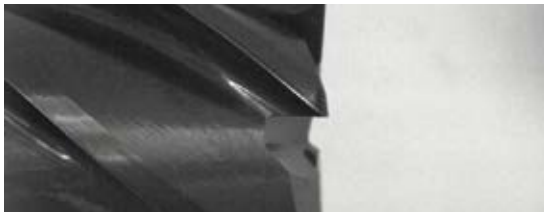
Test Data

Material	Inconel 718 (45 HRC)
Tool Holder	ER Collet Chuck
Size	ø16 x R1
ae (mm)	3
ap (mm)	28

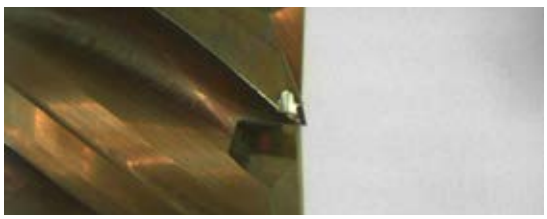
	Sutton Tools	Competitor
Tool	E474 1610	VA Tool 4 Flute
Cutting Speed Vc (m/min)	28	25
RPM	557	557
Feed Rate Vf (mm/min)	195	156
Feed fz (mm/tooth)	0.07	0.07

Wear Comparison

Sutton Tools 5 Flute Ni



Competitor 4 Flute VA Tool

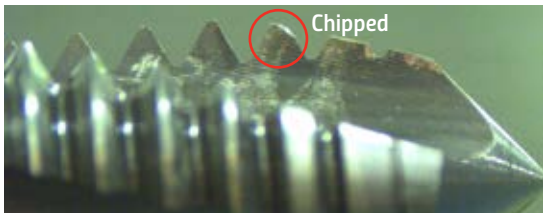


	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Chamfer Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
TAPPING	Blind & Through holes	T217		M3 - M10	6HX	C	3	R10 Ni	PM-HSSCo	TiCN	DIN371
		T218		M12 - M20			3/4				DIN376
		T792		MJ3 - MJ10	4HX		3				DIN371
		T793		J12 - MJ20			3/4				DIN376
		T794		1/4" to 3/8" UNJC	3BX		3				DIN2184-1
		T795		1/4" to 3/8" UNJF							

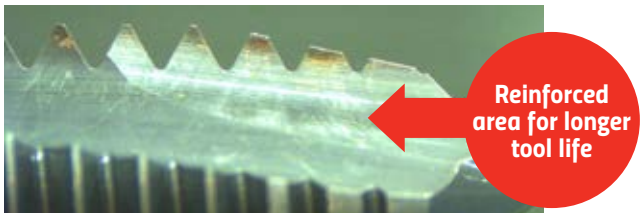
R10 Ni HSSE-PM Tap
T794 Series

For nickel base alloys such as Inconel 718 & 725, rapid tool wear has always been the problem, due to the materials extremely difficult machinability characteristics. Sutton Tools now offers a Ni range that overcomes these issues, due to its reinforced cutting geometry that efficiently deals with the short chips produced when tapping this material group, providing longer tap life and process reliability in nickel based alloys.

Competitor edge condition after 10 holes - Edge Worn



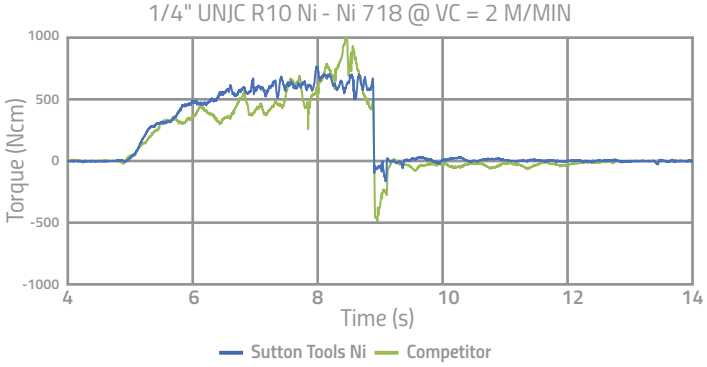
Sutton Tools Ni edge condition after 10 holes - protected design



Test Data

Material	Inconel 718	
Tool Holder	ER Collet Chuck	
Size	1/4"-20 UNJC 3B	
ap (mm)	10	
	Sutton Tools Ni	**Competitor**
Cutting Speed Vc (m/min)	2	2
RPM	100	100
Feed Rate Vf (mm/min)	127	127

Comparison



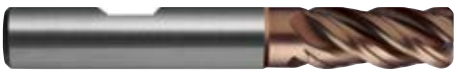
MILLING
STAINLESS STEEL

Applications - Stainless steel is notable for its corrosion resistance, and it is widely used in aerospace, medical, automotive and the food processing industries, among many other applications.

Stainless steel can be used for almost any part of an aircraft, however, its use in mainstream aircraft is hindered by its excessive weight compared to other materials, such as aluminium. Some of its common applications are in the fabrication of exhaust collectors, stacks and manifolds, structural and machined parts, springs, castings, tie rods and control cables.

Machining - The machining of this material has been somewhat difficult due to its toughness and high work hardening properties. Specific geometry and cutting parameters optimised for stainless steels are essential & will make light work for machining processes.

Sutton Tools has developed a large range of solutions for stainless steels over many years, with its product offer summarised in the following.

	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Shank Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
MILLING	Universal/ Trochoidal	E459		3mm - 20mm	Square End	DIN6535 HA	4	R40/42 VA	VHM-Ultra	Helica	DIN6527 L
		E460				DIN6535 HB					
		E462		6mm - 20mm	Corner Radius	DIN6535 HA	4	R40/42 VA	VHM-Ultra	Helica	DIN6527 L
		E463				DIN6535 HB					
	Slotting	E410		3mm - 20mm	Square End	DIN6535 HA	3	R55/54/56	VHM-Ultra	Helica	DIN6527 L
		E411				DIN6535 HB					
	Roughing	E416		6mm - 16mm	Square End	DIN6535 HA	3	R35/36/36 HR	VHM-Ultra	Helica	DIN6527 L
		E417				DIN6535 HB	3				

R40/42 VA Carbide Endmill
E462 Series

(with multiple corner radius sizes available per diameter!)

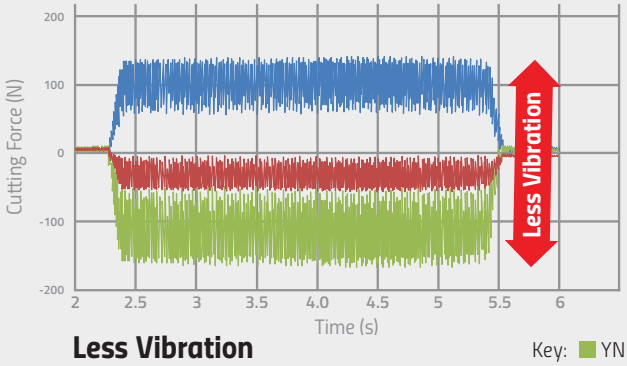
These high performance range of endmills are designed with variable helix geometry that suppresses chatter. With built in corner protection feature as standard, allows outstanding performance in trochoidal and universal milling of difficult to machine applications. If helical plunging/ramping and side milling is required with one tool, then this is the ideal design. The endteeth geometry has high relief and chip space to enable an efficient process, without the need to drill a hole when milling cavities.

Test Data

Material	AISI 304 / 1.4301 / AS 304
Tool	E462 1640
Tool Holder	Collet Chuck
Size	ø16 x 4 Corner Radius
Cutting Speed Vc (m/min)	120
RPM	3185
Feed Rate Vf (mm/min)	828
Feed fz (mm/tooth)	0.065
ae (mm)	2.4
ap (mm)	18

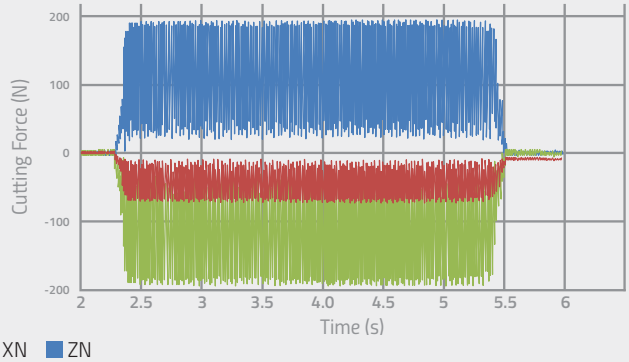
Comparison

Sutton Tools



Less Vibration

Competitor



Key: YN XN ZN

	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Shank Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
DRILLING	3xD	D356		3mm - 20mm	IK	DIN6535 HA	2	R30 VA	VHM-Ultra	Helica	DIN6537
		D357				DIN6535 HE					
	5xD	D358		3mm - 20mm	IK	DIN6535 HA	2	R30 VA	VHM-Ultra	Helica	DIN6537
		D359				DIN6535 HE					

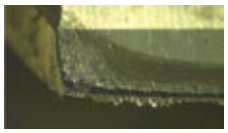
R30 VA-IK 'Black Magic' Carbide Drill
D356 Series

The ideal solution for high-quality/high-volume drilling of the latest materials found in the aerospace and oil & gas industries. Aimed specifically at stainless steels and titaniums, the Black Magic range features a Balzers Oerlikon Helica multi-layer AlCr-based PVD coating, optimised for high temperature materials. This performance study compares the tool wear between the Sutton Tools Carbide VA Black Magic Drills and three leading European brand drills. The results clearly indicate the longer tool life of the Sutton Tools drill.

Test Data

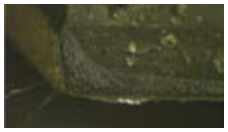
Machine	Haas VF2-SS Vertical Machining Centre
Holder	Hydraulic Chuck
Size (mm)	6.8
Material	AISI 55304/1.4301/V2A/ x5CrNi17-10
Cutting Speed Vc (m/min)	70
Feed f (mm/rev)	0.18
ap (mm)	34

Sutton Tools
Hole 600 Wear = 0.015mm



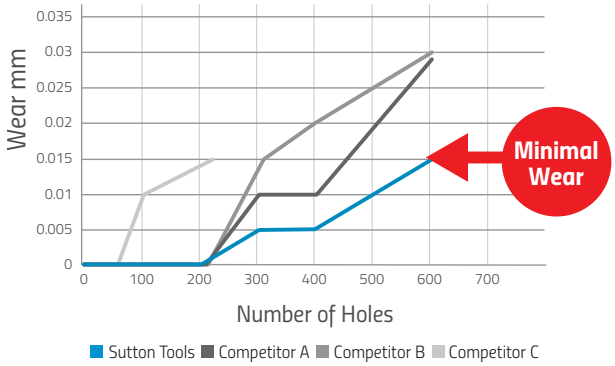
Competitor A
Hole 600 Wear = 0.03mm

Competitor B
Hole 300 Wear = 0.03mm

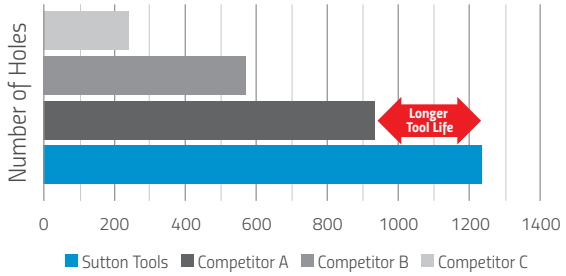


Competitor C
Hole 200 Wear = 0.015mm

Tool Wear



Tool Life



	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Shank Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
DRILLING	Stub	D153		0.5mm - 20mm		DIN1835 A	2	R40 VA	HSSCo	TiAlN	~DIN1897
	Jobber	D169		2mm - 20mm			2				~DIN338

R40 VA HSS-Co Drill
D153 Series

With its excellent resistance to corrosion, stainless steels are a popular material used in various industries namely aerospace, medical, automotive and food processing industries. Drilling stainless steels has been somewhat difficult due to its toughness and high work hardening properties. Specific geometry and cutting parameters optimised for stainless steels will make light work for producing holes, however, often carbide drill options are not ideal if relatively low batch size of components are required and perhaps the clamping or machine rigidity is less than ideal. This is where the R40 VA drills have been specifically designed to meet the requirements and demands in this area of application, the R40 VA offers precise hole quality at a much lower cost than carbide drills.

High Helix & Unique Flute Form

40° flute helix with unique radius flute form. Produces short chips, even in stainless steel and copper alloys, allowing for non-step drilling of 3 to 4xd hole depths possible. Resulting in superior drill life and hole condition.

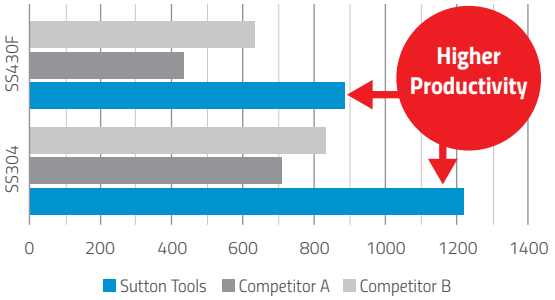
Material: SS304
Ø8mm / depth 16mm
Vc = 20m/min
f = 0.15mm/rev

Material: Cu
Ø8mm / depth 5mm
Vc = 40m/min
f = 0.15mm/rev

Test Data

Material	SS304	SS430F
Cutting Speed Vc (m/min)	20	30
Feed f (mm/rev)	0.11	0.135
Lubrication	7% water soluble	7% water soluble

Tool life comparison between Sutton Tools R40 VA Drill and competitors drill, 5mm diameter & 15mm deep



TAPPING
STAINLESS STEEL

suttontools

TAPPING

Application	Sutton Tools Item Code	Tool	Diameter range	Type	Chamfer Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
Blind/ Through holes	T325		M3 - M10	6H	C	3	Former	SPM	TiAlN	DIN2174
	T326		M12 - M16							
Blind holes	T201		M3 - M10	6H	C	3	R45 VA DH Spiral Flute	HSSE	TiCN	DIN371
	T202		M6 - M36			3/4				DIN376
	T251		MF6 - MF14			3				DIN374
	T262		#2 to 1" UNC	2B		3/4	R45 VA DH Spiral Flute	HSSE	TiCN	DIN2184-1
	T264		8 UN Series			4				
	T277		1/4" to 1" UNF			3/4				
	T285		G1/8 to G1 (BPSF)	ISO228		3/4				DIN5156
Through holes	T112		M3 - M10	6H	B	3	VA GUN Spiral Point	HSSE	TiCN	DIN371
	T113		M6 - M30			3/4				DIN376
	T161		MF6 - MF14			3				DIN374
	T171		#6 to 1" UNC	2B		3/4				DIN2184-1
	T177		#10 to 1" UNF	2B		3/4				
	T182		G1/8 to G1 (BPSF)	ISO228		3/4				DIN5156
Blind holes	T205		M1.6 - M10	6HX	C	3	R50 VA Spiral Flute	PM-HSSE	TiCN	DIN371
	T206		M12 - M30			3/4				DIN376
	T252		MF6 - MF20							DIN374
	T695		#2 to 5/8" UNC	2BX						DIN2184-1
	T696		#4 to 5/8" UNF							
	T352		G1/8 to G1 (BPSF)	ISO228						DIN5156

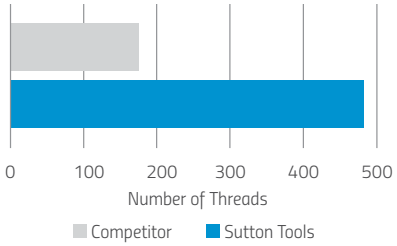
	Application	Sutton Tools Item Code	Tool	Diameter range	Type	Chamfer Type	No. of Flutes	Geometry	Tool Material	Coating	Standard
TAPPING	Through holes	T116		M2 - M10		B	3	VAPM GUN Spiral Point	PM-HSSE	TiCN	DIN371
		T117		M12 - M20			3/4				DIN376
		T160		MF6 - MF20							DIN374
		T697		#2 to 5/8" UNC							DIN2184-1
		T698		#4 to 5/8" UNF							DIN2184-1
		T350		G1/8 to G1 (BPSF)							DIN5156

R50 VA PM-HSS Spiral Flute Tap T205 Series

Test Data

Material	SS316
Tool	T205 0600
Size	M6
Cutting Speed Vc (m/min)	10
RPM	530
ap (mm)	12

Results



*Other sizes available to order on request

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All Thread Forms
M, MJ, UNJC, UNJF, Screw Thread Insert (STI)

Sizes
M2-M30, #2-1"

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