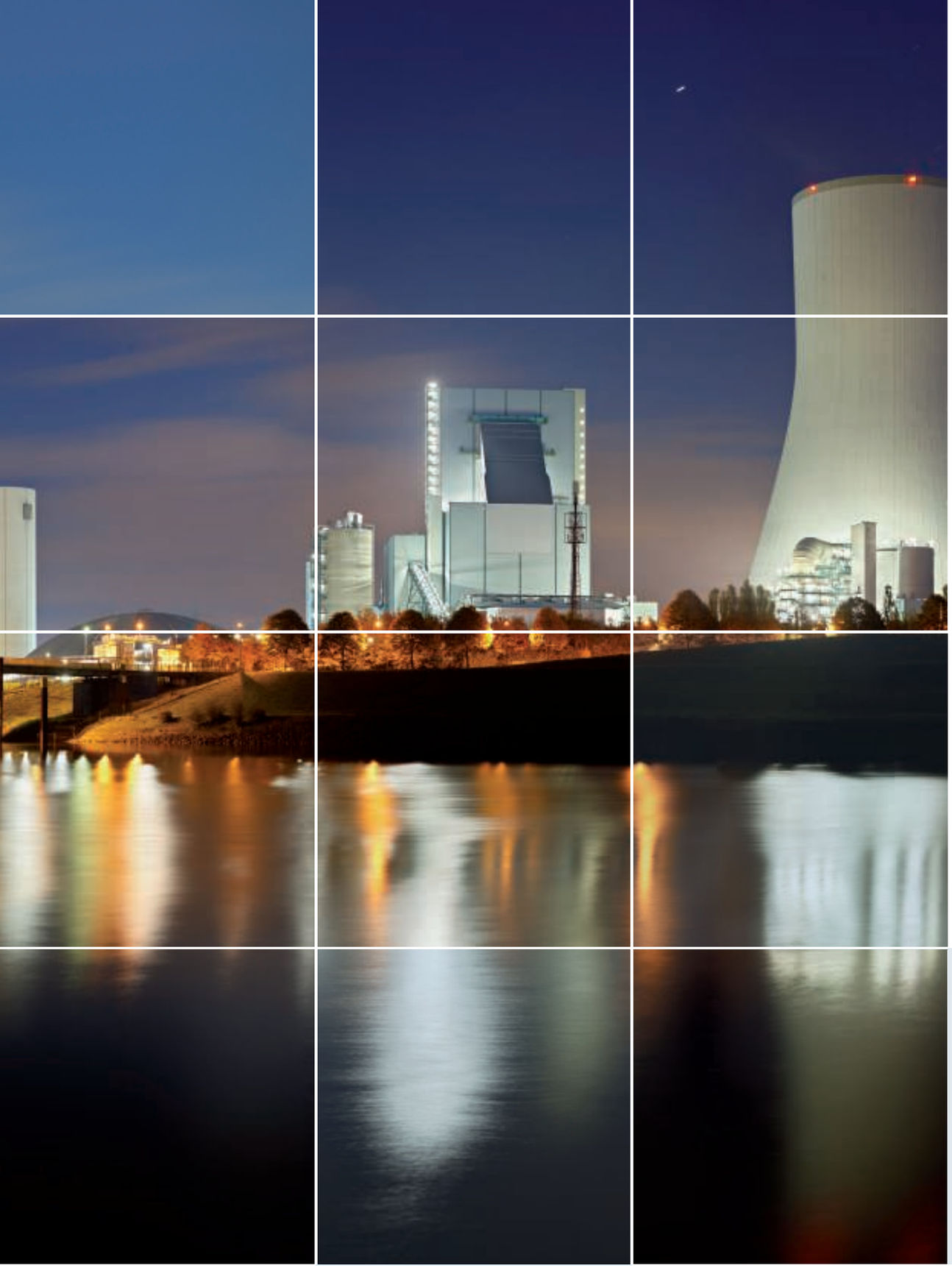
POWER GENERATION

INNOVATIVE TOOLING SOLUTIONS

SECO



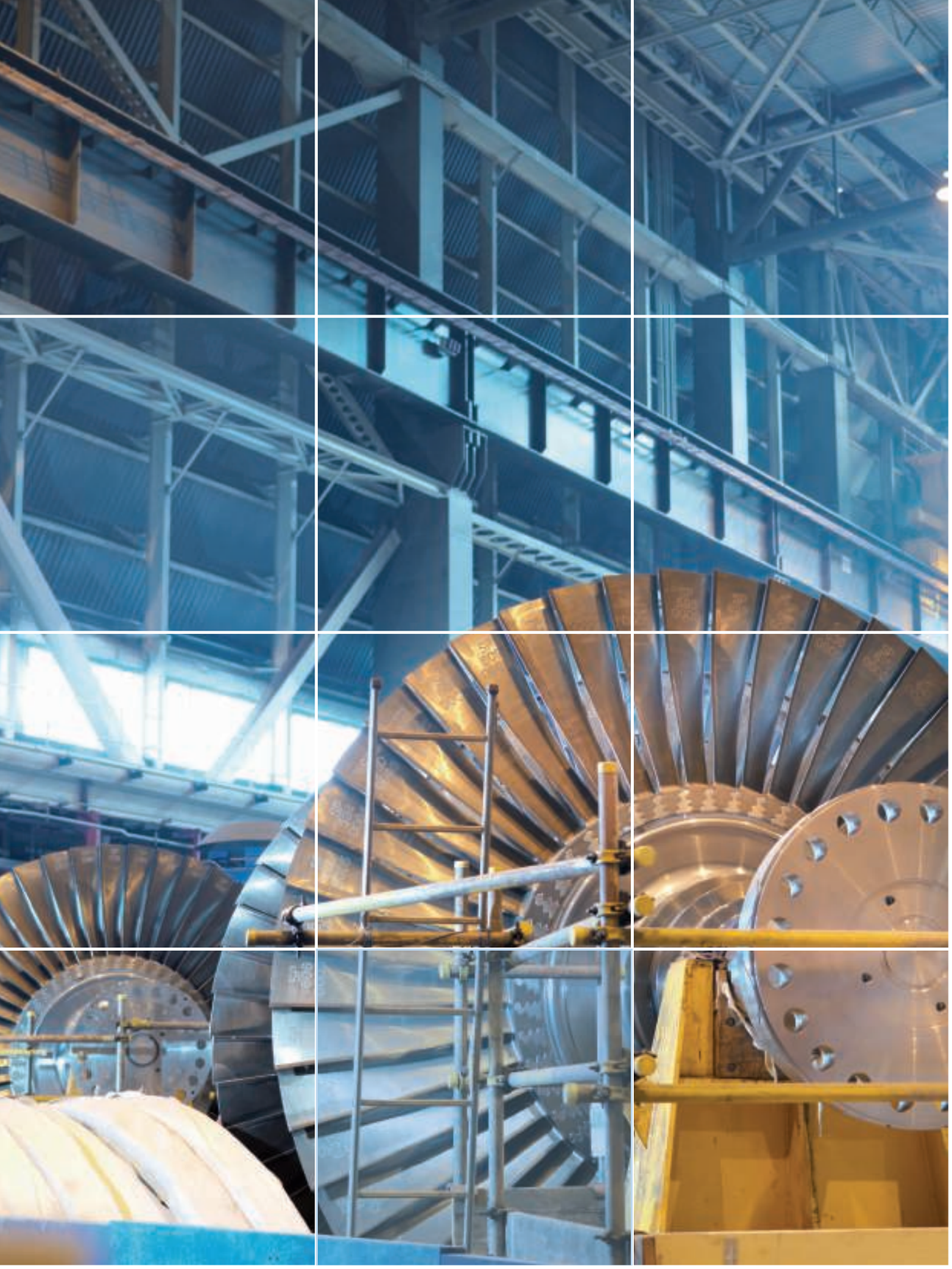
ENHANCING YOUR COMPETITIVENESS

DELIVERING EXCELLENCE AND INNOVATION FOR TURBINE MANUFACTURERS

Seco works closely with power generation manufacturers to create and provide solutions that increase productivity and bolster profitability. With 5,000 team members in over 45 countries, we offer a globally networked resource dedicated to solving your challenges and supporting your operations. Through cooperative partnerships with turbine manufacturers and entities around the world, we monitor trends, identify challenges and develop solutions that overcome the industry's most demanding applications.

When you work with Seco, you experience a true partnership based on trust, respect and communication. Our solutions exceed milling, holemaking, turning and tool holding products, as we work closely with your team to address and improve every aspect of production. For over 80 years, Seco has developed the tools, processes and services that leading manufacturers turn to for maximum performance. Whatever challenges you encounter, our team is always nearby to help you overcome them through extensive expertise and high quality products.

Seco customers can also access the latest information regarding new products, machining data, manufacturing techniques and other developments by visiting our power generation web site at **www.secotools.com/energy**.



SUPPLYING POWER GENERATION

RISING TO THE CHALLENGE

Driven by population, economic and political considerations, the energy production industry continues to experience rapid growth and change, which is expected to continue into the foreseeable future despite continued instability in much of the world. This trend makes the industry an ideal focal point for many manufacturers, though only those able to adapt to constant change are able to maximise their success.

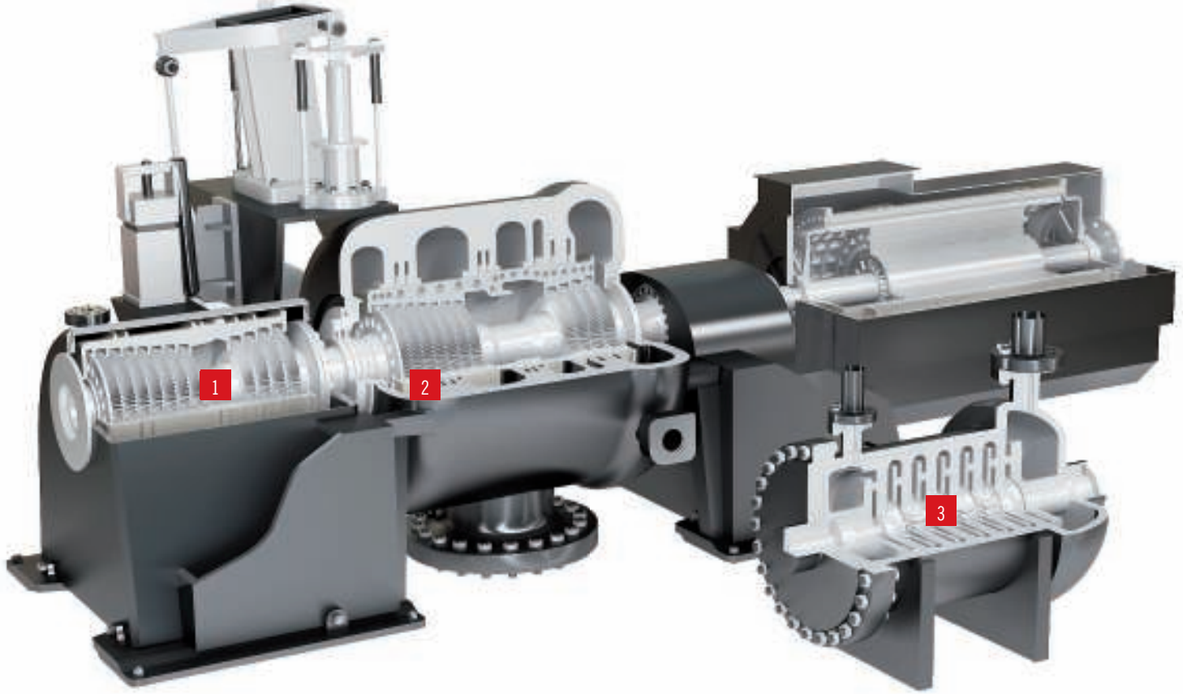
The world's population continues to explode, with the UN estimating that it will exceed 7.6 billion by 2020. By 2025, projections indicate there will be 27 megalopolises, each populated by more than 10 million inhabitants. Coupled with increasing consumption rates in developed and emerging markets, this growth will correspond with tremendous increases in demand for electricity. Some estimates place aggregate demand at doubling by the year 2050.

Coal, oil and gas account for approximately 90% of global power production. As such, environmental concerns and regulations create a need for substantial increases in the efficiency of energy production machinery, along with reductions in CO_2 emissions. Those working towards these goals are concentrating on areas such as new materials and innovative approaches to component design. In turn, manufacturers are consistently faced with new challenges when it comes to machining components for the energy industry.

At Seco, we partner with customers, research institutes, universities and other energy organisations to stay abreast of the changes our customers will face in the near and long-term future. We invest significantly in R&D to develop innovative products and processes that will boost your productivity, increase process stability and reliability, and allow you to produce even more complex and demanding components.

The energy industry faces decades of expected growth and provides a keen opportunity for manufacturers looking to plan for the future of their company. As you face the challenges the industry presents, Seco will be there as a partner to help maximise your success.

TURBINE POWER COMPONENTS



ROTOR SHAFT AND DISC

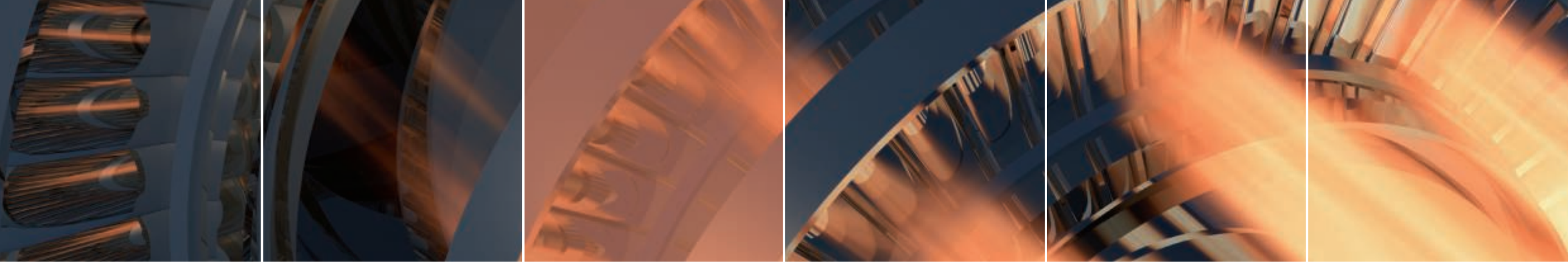
Responsible for transferring gas or steam energy into the generator, the rotor shaft and discs can take the form of a single component or an assembly. Steam systems typically incorporate a monolithic component made of carbon steel, while gas turbines usually demand an assembly with both carbon steel and heat resistant superalloy components. In either instance, manufacturers face challenging features to machine and heavy duty metal cutting.

CASING

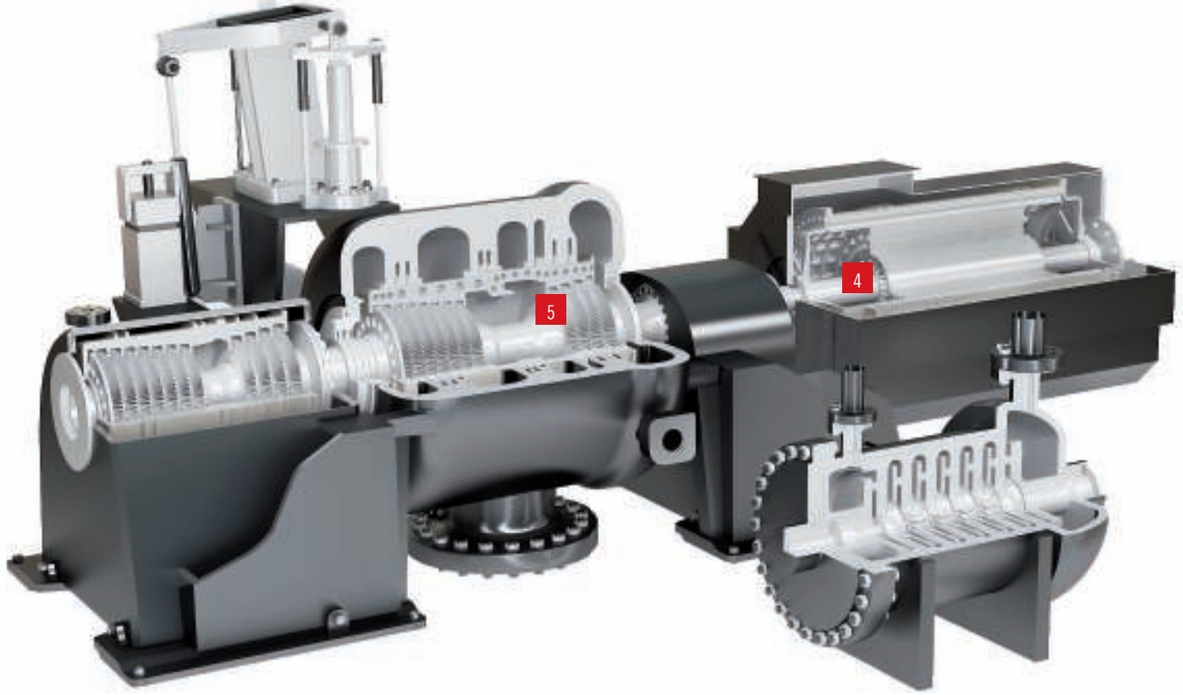
While the variety of turbine types result in different shapes and designs of casings, these components always provide a shell that contains and controls the working gas. Typically produced from castings of nodular cast iron or low alloy steel, turbine generator casings usually require substantial material removal, offering high potential for time and cost savings through process improvement.

IMPELLER

Typically made from low-alloy or stainless steels, impellers play a central role in the centrifugal compressors in gas turbines. An impeller's design typically comprises a short cylinder with an inlet to accept incoming fluid, vanes to push the fluid radially and a splined, keyed or threaded bore to accept a drive shaft. The components incorporate thin walls and require use of very long tool overhangs, making them especially challenging to machine effectively.

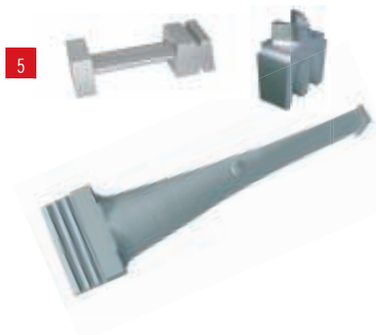


TURBINE POWER COMPONENTS



GENERATOR SHAFT

Forming the mechanical core of a turbine generator, the generator shaft typically is machined from a carbon steel alloy and produced from a forged shaft. The component requires heavy duty turning, as well as substantial milling processes, including disc milling of long deep slots. Advances pertaining to material removal rates and the life, security and reliability of tools have created opportunities for improving the productivity of machining these components.

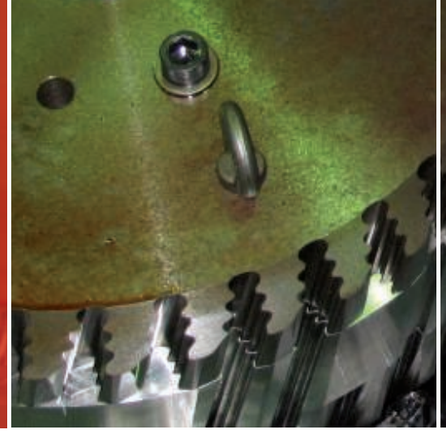


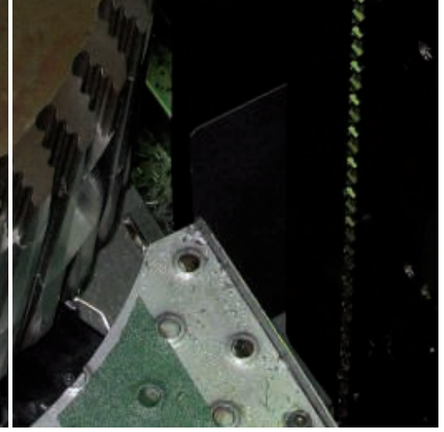
BLADE AND BLADE ROOT

The design and quality of turbine blades determine the overall efficiency of a turbine machinery. Machined from solid bar or forged blanks, blades are typically made from martensitic or duplex stainless steel or heat resistant superalloys. The exact material used depends on where the blade will be positioned within the turbine and whether it is to be used in a gas or steam turbine. Considered replaceable components, blades require the holding of tolerances across roughness and shape geometry.

YOUR MANUFACTURING CHALLENGES:

- Fir tree milling with high security keeping tight tolerances
- Safely achieving maximum performance during rough grooving and turning
- Efficiently roughing fir tree or dovetail forms





MACHINING TURBINE POWER COMPONENTS: ROTOR SHAFT AND DISC

1

JABRO™ SOLID CARBIDE FIRE TREE TOOLS

YOUR CHALLENGE:
Fir tree milling with high security keeping tight tolerances.

OUR SOLUTION:
Counted among our most accurate and high-tolerance cutters, Jabro solid carbide fir tree tools provide extreme precision in machining one of the most challenging features found in a turbine rotor. A helical design with spiral flute improves surface finish and tool life, while the high dimensional accuracy of the cutters is verified with a tool quality certification. Your benefits include complete confidence in your process while maximising productivity.

2

CUSTOM HEAVY GROOVING

YOUR CHALLENGE:
Safely achieving maximum performance during rough grooving and turning.

OUR SOLUTION:
To handle the heavy machining of groove roughing, this custom system adds rigid clamping, robust inserts and a unique insert geometry to Seco's standard products. The solution also provides the efficient and reliable performance of our standard MDT (multi-directional turning) system. Your benefits include reduced costs, increased performance and productive material removal in a demanding application.

3

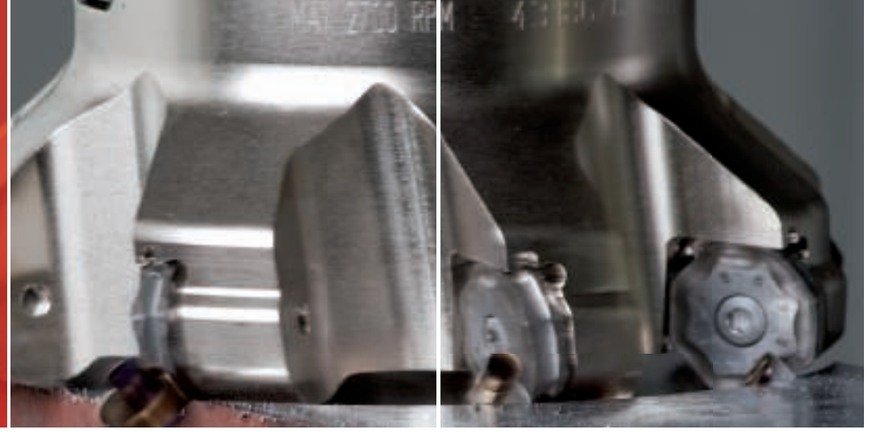
BROACHING TOOLS

YOUR CHALLENGE:
Efficiently roughing fir tree or dovetail forms.

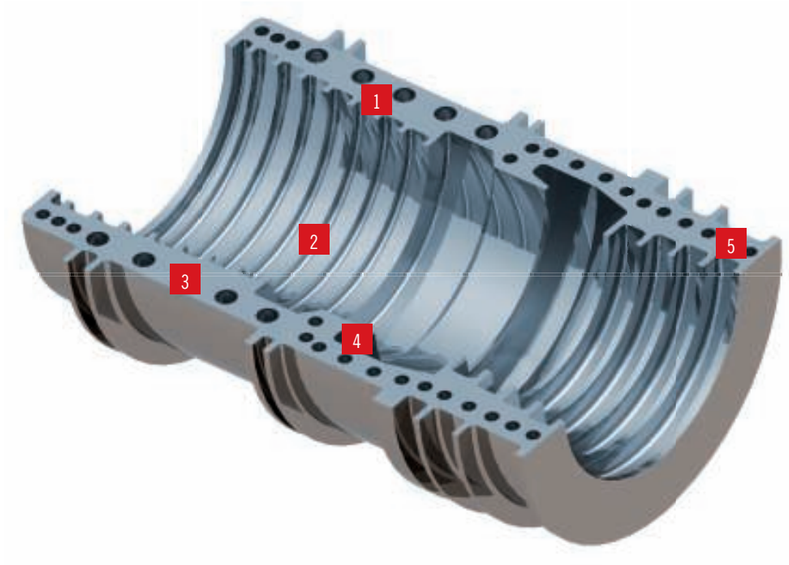
OUR SOLUTION:
The indexable carbide insert design of our unique, patented broaching tools provides incredible gains over traditional high-speed steel alternatives. With no need for regrinding and tremendous gains in cutting speeds, these cutters streamline tooling inventories and can reduce production times by up to 50%. Your benefits include immediate, dramatic cost and time savings.

YOUR MANUFACTURING CHALLENGES:

- Reliably machining casings with irregular stock, cast skin and impure surfaces
- Roughing radial grooves safely and productively
- Eliminating potential rework in large threads
- Semi-finishing and finishing profiled undercut grooves
- Ensuring adequate chip evacuation in large and deep holes



MACHINING TURBINE POWER COMPONENTS: CASING



1

HEAVY DUTY FACE MILLING CUTTERS

YOUR CHALLENGE:
Reliably machining casings with irregular stock, cast skin and impure surfaces.

OUR SOLUTION:
Seco offers a variety of face milling cutters designed to provide top performance in tough applications. From the Double Octomill™ (pin solution for stability and security) to R220.60 cutter, our family of tools feature robust bodies and thick inserts that address all of your needs for face milling casing castings. Your benefits include high metal removal rates with long tool life and reliable results.

2

DISC MILLING SOLUTIONS

YOUR CHALLENGE:
Roughing radial grooves safely and productively.

OUR SOLUTION:
In addition to the wide range of inserts, cutter bodies and attachments in our standard line, Seco provides an enormous range of customised disc mills to meet your needs. When designing a custom disc milling cutter, we incorporate a robust design insert and cutter geometries tailored to your application. Your benefits include versatility, productivity and security when machining radial grooves.

3

THREAD MILLING CUTTER

YOUR CHALLENGE:
Eliminating potential rework in large threads.

OUR SOLUTION:
Compared to traditional tapping, thread milling cutters increase thread quality and raise productivity, while reducing cost per part and minimising tool inventory. High rigidity and vibration resistance provide stable performance, high accuracy and strong tool life. Additionally, the cutters offer lower power consumption, less tool breakage and shorter chips than tapping. Your benefits include lower costs, better results and elimination of the possibility of threading rework.

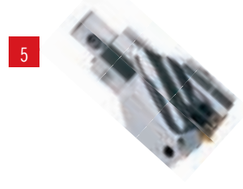
4

CUSTOM MDT GROOVING

YOUR CHALLENGE:
Semi-finishing and finishing profiled undercut grooves.

OUR SOLUTION:
The unique Secoloc™ insert clamping system makes it easy to combine custom and standard product in our MDT system. This flexibility allows optimum solutions for machining even the most difficult profiled grooves, while providing the standard benefits of MDT. Your benefits include increased performance and precision with challenging grooving operations.

5



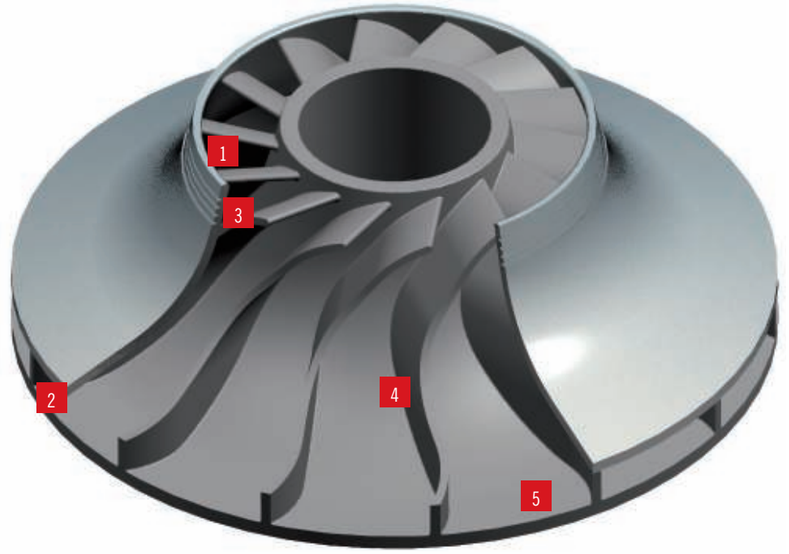
PERFORMAX® SD600

YOUR CHALLENGE:
Ensuring adequate chip evacuation in large and deep holes.

OUR SOLUTION:
Created to maximise productivity in large and deep holes, the Perfomax SD600 modular drill head system incorporates strong square inserts and a cartridge system to provide flexible high performance. This unique tool includes a strong pilot drill design and is ABS compatible, with a Graflex® connection. Your benefits include cost reduction via greater throughput and lowered tool cost.

YOUR MANUFACTURING CHALLENGES:

- Achieving stability with long tool overhang
- Semi-finishing with very long overhangs
- Chamber roughing with medium tool overhang
- Semi-finishing and finishing thin-walled blades of unshrouded impellers
- Roughing with very long overhangs



MACHINING TURBINE POWER COMPONENTS: IMPELLER

EPB® MODULAR SYSTEM

YOUR CHALLENGE:
Achieving stability with long tool overhang.

OUR SOLUTION:
The modular design of the EPB tool holding system allows it to be easily incorporated into applications across a wide range of tool overhangs. Vibration dampening ensures high performance when cutting hard-to-reach features and the system is available with Combimaster®, Easyshrink®, Graflex® and Seco-Capto™ connections. Your benefits include increased precision and stability when machining features that require a long reach.

CUSTOM PLUNGE MILLING CUTTERS

YOUR CHALLENGE:
Semi-finishing with very long overhangs.

OUR SOLUTION:
In addition to the benefits provided by our standard plunge milling cutters, Seco offers a custom tool that incorporates a unique geometry to further reduce cutting forces. CAM programming can further optimise performance by treating this cutter as a ball nose end mill. Your benefits include achieving productive semi-finishing in long-overhang applications.

SECO HIGH FEED MILLING (HFM) SOLUTIONS

YOUR CHALLENGE:
Chamber roughing with medium tool overhang.

OUR SOLUTION:
By taking shallow depths of cut and incorporating very high feed rates, HFM cutters can provide substantial productivity gains. They offer strong performance when working with medium tool overhang, as the lessened pressure on the tool minimises the risk of bending and vibration. Your benefits include aggressive material removal with stability in applications with medium tool overhang.

MINIMASTER® PLUS

YOUR CHALLENGE:
Semi-finishing and finishing thin-walled blades of unshrouded impellers.

OUR SOLUTION:
With edges and a helix that provide a light cutting action, MinimasterPlus offers an ideal means of semi-finishing and finishing thin-walled impeller blades. Additionally, incorporation of a unique head clamping system ensures high accuracy and performance while minimising cost and tool change times. Internal through-coolant channels increase productivity and facilitate chip evacuation. Your benefits include cost and time savings while getting the level of precision your application demands.

PLUNGE MILLING CUTTERS

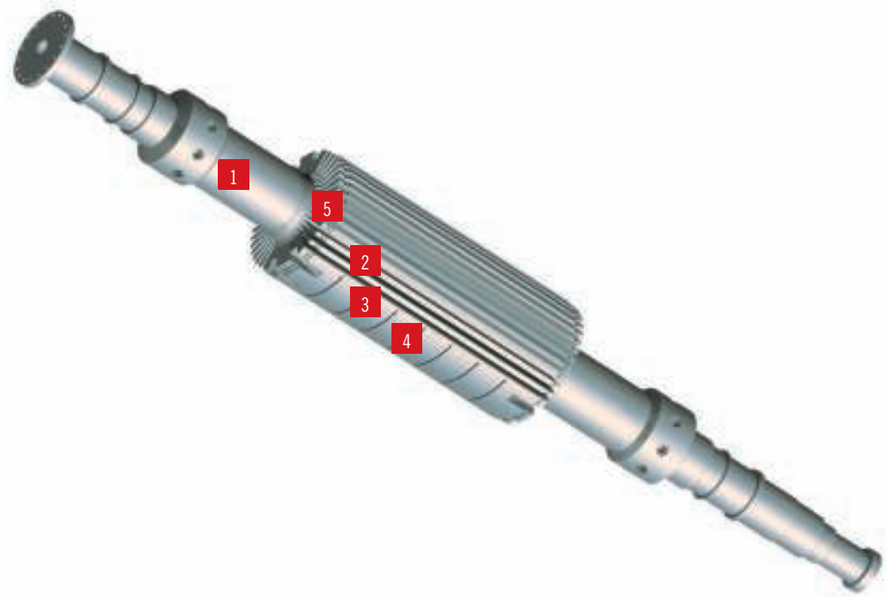
YOUR CHALLENGE:
Roughing with very long overhangs.

OUR SOLUTION:
Seco plunge milling cutters direct cutting forces axially into the spindle to optimise stability and allow high metal removal rates, even with long overhangs. These unique tools also enable access to surfaces that cannot be reached by conventional cutting processes and they minimise the wear and tear on your machine. Your benefits include increased flexibility, productivity and stability when working with long tool overhangs.

YOUR MANUFACTURING CHALLENGES:

- Safely achieving maximum performance during rough grooving and turning
- Productively roughing and finishing deep longitudinal slots
- Secure and productive heavy duty turning of castings
- Maintaining high precision when machining inertial slots
- Machining complex key slot geometries

MACHINING TURBINE POWER COMPONENTS: GENERATOR SHAFT



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CUSTOM HEAVY GROOVING

YOUR CHALLENGE:
Safely achieving maximum performance during roughing grooving and turning.

OUR SOLUTION:
To handle the heavy machining of groove roughing, this custom system adds rigid clamping, robust inserts and a unique insert geometry to Seco‘s standard products. The solution also provides the efficient and reliable performance of our standard MDT (multi-directional turning) system. Your benefits include reduced costs, increased performance and productive material removal in a demanding application.

2

SECO DISC MILLING POLAR SLOTS, WINDING SLOTS & VENTILATION SLOTS

YOUR CHALLENGE:
Productively roughing and finishing deep longitudinal slots.

OUR SOLUTION:
Seco offers a wide range of standard and custom inserts, cutter bodies and attachments for disc milling. Whether considering polar slots, winding slots or ventilation slots, our focus on providing a robust design and the correct insert and cutter geometries ensures a productive and accurate solution to your specific disc milling needs. Your benefits include achieving the precision you need with excellent chip evacuation and minimal cycle times.

3

HEAVY TURNING TOOLS

YOUR CHALLENGE:
Secure and productive turning of castings.

OUR SOLUTION:
Seco offers a wide variety of heavy turning tools with strong insert clamping and seating to provide effective and efficient roughing, semi-finishing and finishing of castings. Dedicated chipbreakers optimise material removal and our range of Duratomic® grades, which incorporate special coatings manipulated at the atomic level, provide tough and strong performance across all common workpiece materials. Your benefits include high process security and productivity.

4

CUSTOM MDT GROOVING

YOUR CHALLENGE:
Maintaining high precision when machining inertial slots.

OUR SOLUTION:
Inertial slots are one of the most critical features when machining generator shafts. Seco provides an enormous range of customised disc mills, applying our expertise to create robust solutions with the geometries appropriate for machining these thin and deep slots. Your benefits include reliably obtaining the high tolerances required by these demanding features.

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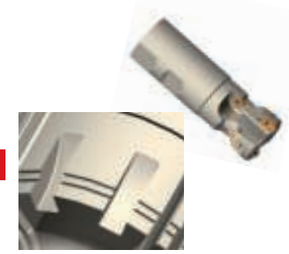


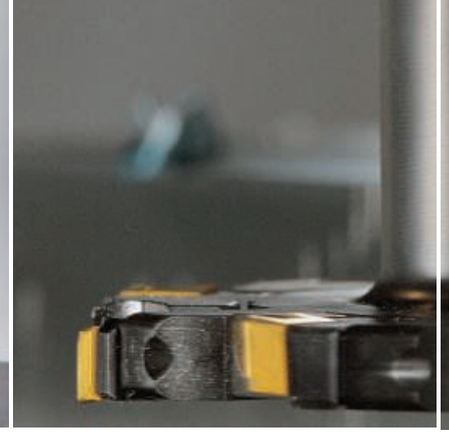
PERFORMAX® SD600

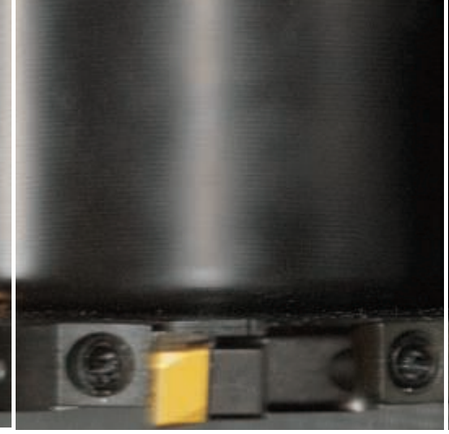
YOUR CHALLENGE:
Machining complex key slot geometries.

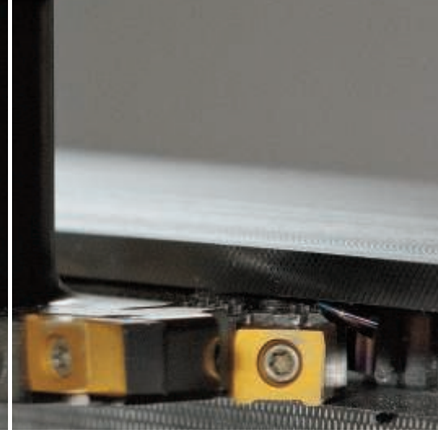
OUR SOLUTION:
Machining of key slots with complex geometries traditionally requires a variety of specialised, dedicated tools. Seco‘s custom key slot indexable milling cutters are created specifically for your applications, to ensure that you can fully cut these challenging features with a single tool. Your benefits include reduced inventory and a simpler machining process.

YOUR MANUFACTURING CHALLENGES:

- Obtaining high material removal rates with high security
- Maintaining high roughness, dimensional and geometrical tolerances on shrouded planes
- Roughing and finishing the fork shape on a blade root







MACHINING TURBINE POWER COMPONENTS: BLADE & BLADE ROOT

STANDARD SOLUTION **CUSTOMISED SOLUTION**

POWER 4™ COPY MILLING

YOUR CHALLENGE:
Obtaining high material removal rates with high security.

OUR SOLUTION:
Developed specifically for customers in the power generation industry, the Power 4 round insert cutter incorporates an anti-rotation insert system to maximise stability during aggressive cutting. A strong body design and fully hardened nickel coating further increase performance and tool life. Your benefits include a highly productive and stable process.

R230.19 FACE MILLING CUTTER

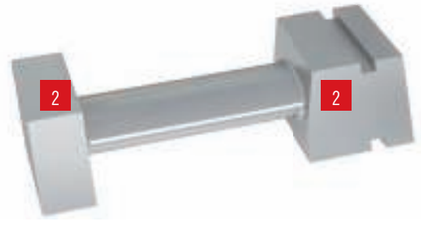
YOUR CHALLENGE:
Maintaining high roughness, dimensional and geometrical tolerances on shrouded planes.

OUR SOLUTION:
The R230.19 face milling cutter equipped with ground SNHQ inserts provides excellent flatness, roughness and dimensional accuracy. The high accuracy of the insert thickness and fixed pocket on the cutter body reduce set up times, and balanced cutting forces eliminate vibration to optimise performance. Your benefits include productively attaining the high levels of precision your applications demand.

DISC MILLING SOLUTIONS

YOUR CHALLENGE:
Roughing and finishing the fork shape on a blade root.

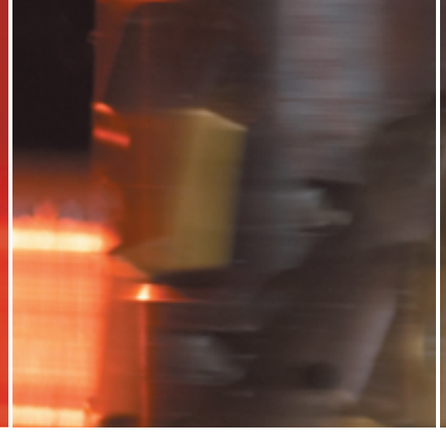
OUR SOLUTION:
In addition to the wide range of inserts, cutter bodies and attachments in our standard line, Seco provides an enormous range of customised disc mills to meet your needs. When designing a custom disc milling cutter, we incorporate a robust design and insert and cutter geometries tailored to your application. Your benefits include versatility, productivity and security when machining a blade root's fork interface.

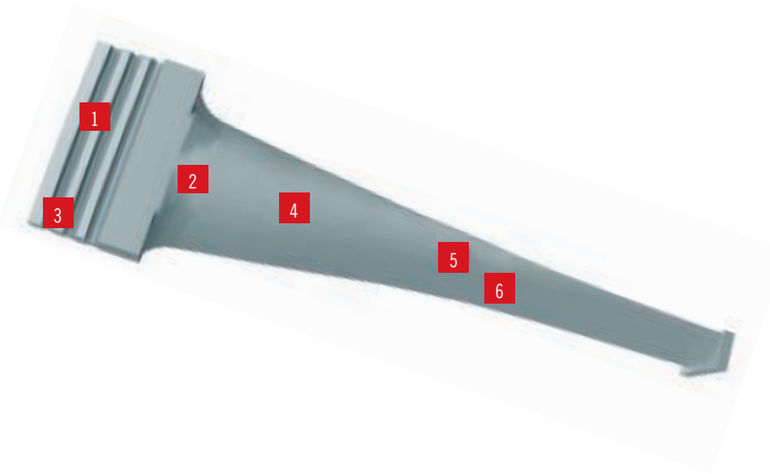


YOUR MANUFACTURING CHALLENGES:

- Maximising productivity on semi-finishing fir tree shape foot
- Maximising roughing and semifinishing of blade interface area
- Fir tree finishing milling with high security and tight tolerances

- Increasing productivity in airfoil finishing applications
- Accurately semi-finishing and finishing blades
- Increasing productivity when roughing blade forged





MACHINING TURBINE POWER COMPONENTS: BLADE

CUSTOM INDEXABLE FIR TREE MILLING CUTTER

YOUR CHALLENGE:
Maximising productivity on semi-finishing fir tree shape foot.

OUR SOLUTION:
Featuring a helical design to promote a free cutting action, the custom indexable fir tree milling cutter achieves highly reliable performance with long and predict-able tool life. The tool consumes minimal power for a large-diameter cutter and features through coolant channels to optimise chip evacuation and reduce temperature in the cut. Your benefits include reducing costs and highly stable performance.

R218.24 TAPERED BALL NOSE MILLING CUTTER

YOUR CHALLENGE:
Maximising roughing and semi-finishing of blade interface area.

OUR SOLUTION:
Highly efficient and productive, the R218.24 tapered ball nose milling cutter provides high levels of quality and process security. Available in diameters ranging from 12 mm – 25 mm, the cutter eliminates the need for regrinding that must be performed with solid carbide tools. Your benefits include elimination of a secondary process to increase efficiency.

JABRO™ SOLID CARBIDE FIR TREE TOOLS AND ACCUFIT™ SHELL MILL HOLDER

YOUR CHALLENGE:
Fir tree finishing milling with high security and tight tolerances.

OUR SOLUTION:
Counted among our most accurate and high-tolerance cutters, Jabro solid carbide fir tree tools provide extreme precision in machining one of the most challenging features found in an turbine. A helical design with spiral flute improves surface finish and tool life, further improvements are obtained thanks to the Accufit centering features, while the high dimensional accuracy of the cutters is verified with a tool quality certification. Your benefits include complete confidence in your process while maximising productivity.

TURBO SQUARE SHOULDER MILLS

YOUR CHALLENGE:
Increasing productivity in airfoil finishing applications.

OUR SOLUTION:
Turbo square shoulder mills incorporate hardened steel cutter bodies and strong, thick inserts to achieve incredibly reliable performance. These tools provide optimal performance in slotting, contour milling, ramping, plunging, pocket milling and helical interpolation operations that require process security, flexibility and high precision. Your benefits include increased confidence in the stability of your applications and substantial time savings.

MINIMASTER® PLUS

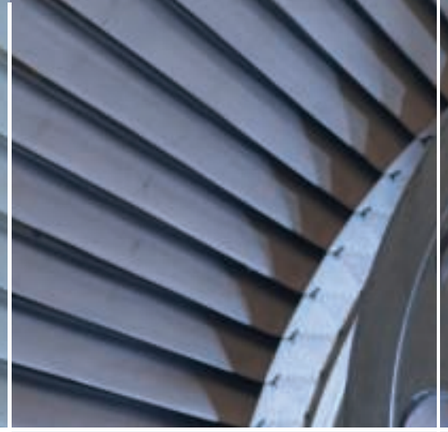
YOUR CHALLENGE:
Accurately semi-finishing and finishing blades.

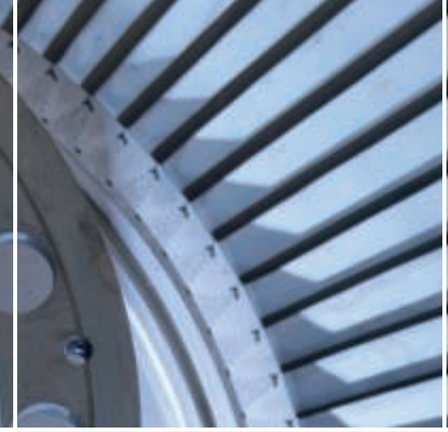
OUR SOLUTION:
With edges and a helix that provide a light cutting action, MinimasterPlus offers an ideal means of semi-finishing and finishing blades. Additionally, incorporation of a unique head clamping system ensures high accuracy and performance while minimising cost and tool change times. Internal through-coolant channels increase productivity and facilitate chip evacuation. Your benefits include cost and time savings while getting the level of precision your application demands.

HELICAL TURBO CUTTERS

YOUR CHALLENGE:
Increasing productivity when roughing blade forged.

OUR SOLUTION:
Available in a wide range of sizes, the high performance Helical Turbo cutters use thick inserts and nickel-coated steel bodies to provide robust, reliable performance. Optimised for high material removal rates, these tools feature the benefits of the standard Turbo cutters, but can take depths of cut of up to five times deeper. Your benefits include dramatically increased productivity in roughing applications.

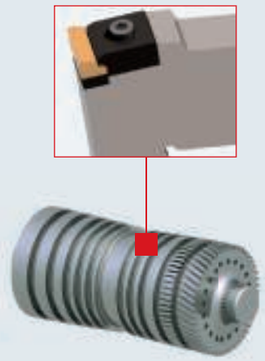




CASE STUDIES

The true test of a potential solution is its real world application. The following examples provide a sample of the documented results Seco products and processes have achieved.

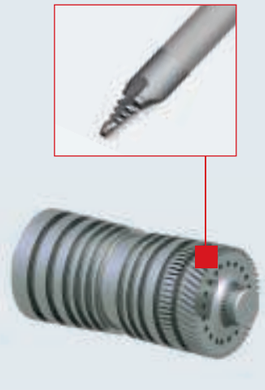
ROTOR SHAFT – CUSTOM HEAVY GROOVING

Material:	X38NiCrMo4			
Coolant:	No			
Operation:	Heavy Grooving			
Criterion:	Wear v_b = 0.4 mm (0.016“)			
Fixturing:	Special			
Tool:	Special			
Insert 1:	NI-LN40-11770, S25M			
Cutting data		v_c	f_z	a_p
	Metric	90 m/min	1 mm/rev	50 mm
	Inch	295 sf/min	0.039"/rev	1.97"
Results	**Increased chip removal rate with heavy grooving.**			



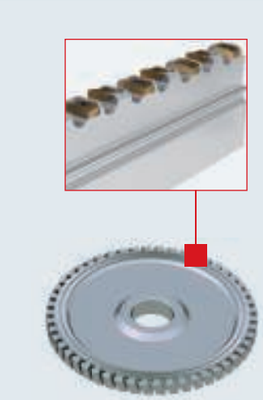
ROTOR SHAFT – JABRO™ FIR TREE SLOT MILLING

Material:	X38NiCrMo4			
Coolant:	Emulsion			
Operation:	Fir tree root slotting - full cycle			
Criterion:	Wear v_b = 0.2 mm (0.008“)			
Fixturing:	Special			
Tool:	Custom solid carbide fir tree shape cutter			
Cutting data		n	f_z	a_e
	Metric	1300 rpm	0.058 mm/tooth	0.61 mm
	Inch	1300 rpm	0.0023"/tooth	0.024"
Cutting data		a_p	v_f	
	Metric	total profile depth	226 mm/min	
	Inch	total profile depth	8.9“/min	
Results	**Superior surface finish, with major reductions in cost and process time by machining each stage with one set-up and cutter.**			



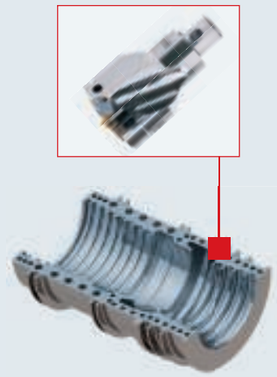
DISC – BROACHING TOOLS

Material:	Steel		
Coolant:	Pure oil		
Operation:	Dovetail clamping slot - roughing, by broaching		
Criterion:	Productivity		
Fixturing:	Special		
Tool:	Custom indexable insert broach rail		
Insert 1:	Various - standard + special		
Cutting data		v_c	a_p
	Metric	40 m/min	16-22 mm
	Inch	131 sf/min	0.63-0.86“
Results	**Substantial improvements to productivity and tool life compared to the existing HSS solution.**		



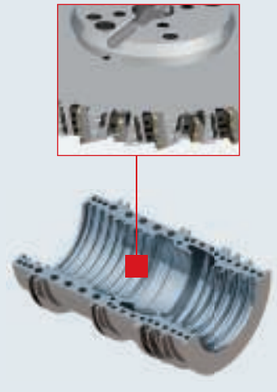
CASING – PERFOMAX® SD600 MODULAR DRILL

Material:	GG-40			
Coolant:	Internal (10 bar)			
Operation:	Drilling			
Criterion:	Wear v_b = 0.5 mm (0.02“)			
Fixturing:	Clamped			
Tool:	SD612-70-50RG			
Insert 1:	SCGX120408-P2, T3000D			
Insert 2:	SPGX11C3-C1, T400D			
Cutting data		v_c	f_z	v_f
	Metric	150 m/min	0.15 mm/rev	102 mm/min
	Inch	490 sf/min	0.006"/rev	4"/min
Results	**Increased reliability of machining process, while maintaining high productivity.**			



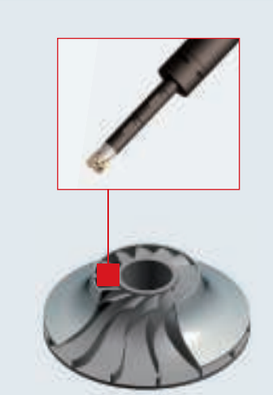
CASING – DISC MILLING SOLUTIONS

Material:	GG-40				
Coolant:	No				
Operation:	Rough slotting by custom disc milling				
Criterion:	Wear v_b = 0.5 mm (0.02“)				
Fixturing:	Special				
Tool:	Big diameter custom disc milling				
Insert 1:	Various				
Cutting data		v_c	f_z	a_p	a_e
	Metric	160 m/min	0.2 mm/tooth	30 mm	50 mm
	Inch	525 sf/min	0.008"/tooth	1.18"	1.97"
Results	**Reduced cutting forces due to strong chip groove inserts.**				



IMPELLERS – EPB® MODULAR SYSTEM FOR PLUNGING

Material:	17.4-PH stainless steel				
Coolant:	Emulsion - internal				
Operation:	Roughing plunge milling strategy				
Criterion:	Flank wear v_b = 0.2 mm (0.008“)				
Fixturing:	Special				
Tool:	Modular tool holder + plunge milling cutter				
Insert 1:	Turbo				
Note:	Long overhang				
Cutting data		v_c	f_z	a_p	a_e
	Metric	120 m/min	0.08 mm/tooth	CAM	CAM
	Inch	395 sf/min	0.003"/tooth	CAM	CAM
Results	**Dramatic reduction in machining time compared to the existing traditional method.**				








CASE STUDIES

BLADE – POWER 4™ COPY MILLING

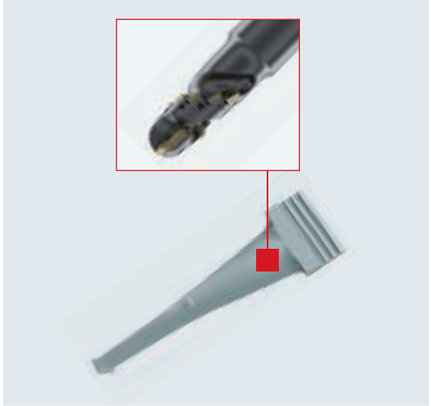
Material:	X12CrNiMoV12-3			
Coolant:	No			
Operation:	Blade airfoil roughing milling			
Criterion:	Tool life must reach the end of component			
Fixturing:	Special			
Tool:	R220.24-0052-12.5A			
Insert 1:	ROHT1204M0-M12, MS2500			
Cutting data		v_c	f_z	a_p
	Metric	350 m/min	0.4 mm/tooth	3 mm
	Inch	1150 sf/min	0.016"/tooth	0.118"
Cutting data		a_e	v_f	
	Metric	12 mm	4400 mm/min	
	Inch	0.472"	173"/min	
Results	**Higher chip removal rate.**			

BLADE – MINIMASTER®PLUS

Material:	X20Cr13			
Coolant:	Mist spray			
Operation:	Finishing and semi-finishing peel milling			
Criterion:	Roughness required			
Tool:	Standard shank			
Insert 1:	MP16-16019B90Z3 M05, MP3000			
Cutting data		v_c	f_z	a_p
	Metric	420 m/min	0.2 mm/tooth	1-15 mm
	Inch	1378 sf/min	0.008"/tooth	0.04-0.6"
Cutting data		a_e	v_f	
	Metric	0.8 mm	5000 mm/min	
	Inch	0.0315"	197"/min	
Results	**Semi-finishing and finishing combined into a single operation to achieve an enormous reduction in machining time.**			

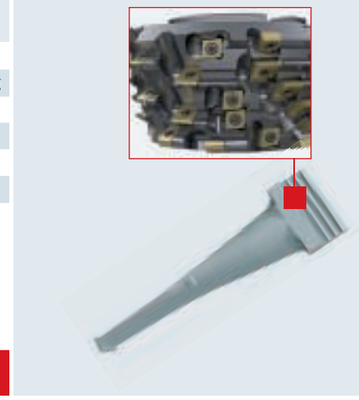
BLADE – TAPERED BALL NOSE MILLING CUTTER

Material:	X22CrMoV12-1		Coolant:	Emulsion
Operation:	Semi-finishing milling			
Criterion:	Wear v_b = 0.2 mm (0.008“)			
Fixturing:	Chuck - tailstock			
Tool:	R218-24-25R100.0-048-09.2A			
Insert 1/2:	R218.20-100ER-M05, F40M I XOMX090308TR-ME06, F40M			
Cutting data		v_c	f_z	a_p
	Metric	270 m/min	0.233 mm/tooth	1-30 mm
	Inch	885 sf/min	0.0092"/tooth	0.04-1.8"
Cutting data		a_e	v_f	
	Metric	0.5 mm	2000 mm/min	
	Inch	0.02"	79"/min	
Results	**Extended tool life, reduced tool cost and eliminated regrinding operations compared to existing solid carbide cutter solution.**			



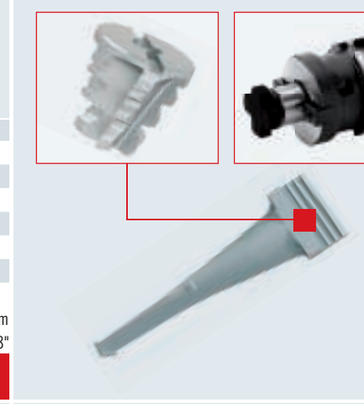
BLADE – CUSTOM INDEXABLE FIR TREE MILLING CUTTER

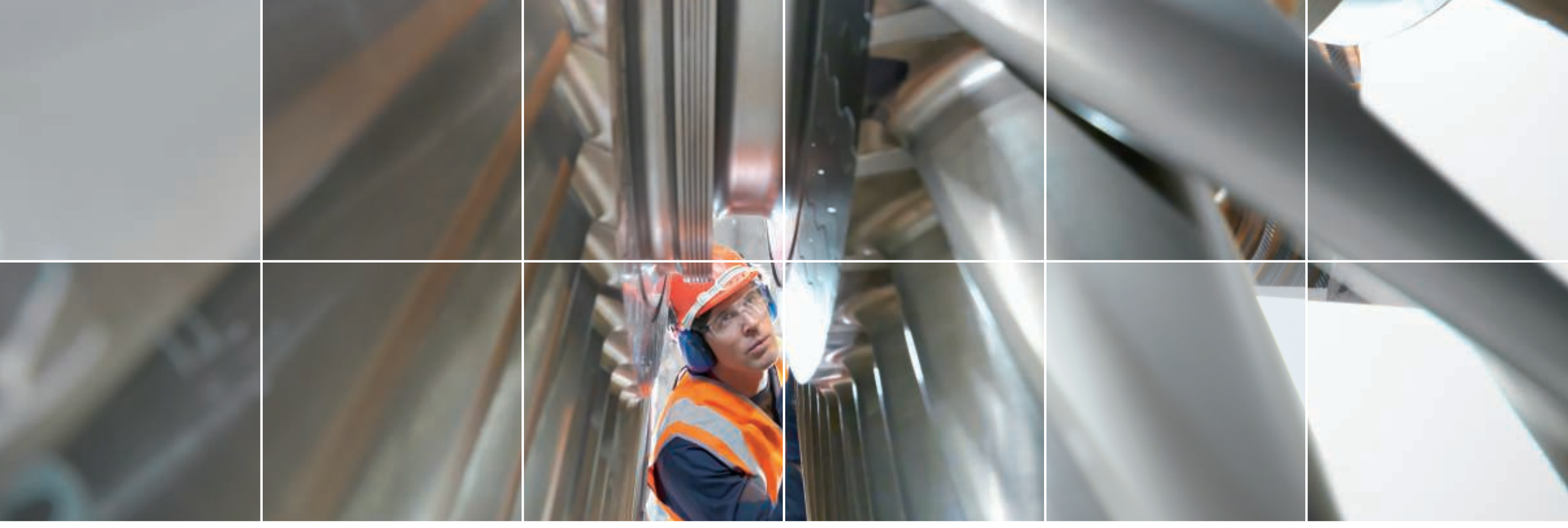
Material:	Jethete		Coolant:	Emulsion
Operation:	Fir tree shape turbine blade foot - semi-finishing milling			
Criterion:	Wear v_b = 0.5 mm (0.02“)			
Fixturing:	Special			
Tool:	Customised fir tree shape cutter			
Insert 1/2:	Special I Special			
Cutting data		v_c	f_z	
	Metric	160 m/min	0.27 mm/tooth	
	Inch	560 sf/min	0.010"/tooth	
Cutting data		a_p	a_e	
	Metric	h profile	h lobe profile	
	Inch	h profile	h lobe profile	
Results	**Dramatic reduction in machining time compared to existing solution.**			



BLADE – JABRO™ SOLID CARBIDE FIR TREE TOOLS AND ACCUFIT™ SHELL MILL HOLDER

Material:	Jethete				
Coolant:	Emulsion				
Operation:	Fir tree shape turbine blade foot - semi-finishing milling				
Criterion:	Wear v_b = 0.2 mm (0.008“)				
Fixturing:	Special				
Tool holder:	Accu-Fit™				
Tool:	Customised solid carbide fir tree shape cutter				
Cutting data		v_c	f_z	a_p	a_e
	Metric	190 m/min	0.08 mm/tooth	h profile	0.3 mm
	Inch	623 sf/min	0.00314"/tooth	h profile	0.0118"
Results	**Increase in tool life of over 100%.**				





SOLUTIONS MADE FOR YOU

SECO'S ENGINEERING SERVICES

When striving to perfect a manufacturing process, having the right tooling partner is critical. Seco provides an extensive unique engineering service, providing full applications support and the necessary expertise to understand your productivity requirement and deliver a winning solution.

NETWORK OF APPLICATION EXPERTS

Seco offers through their **Strategic Engineering Group** a global support network, consisting of international component specialists having an in-depth knowledge and understanding of the relevant industry segment. Together with locally based Seco application experts, this team ensures that you get the very best support to the component you are machining.

INTEGRATED ENGINEERING SUPPORT

Seco's **Component Engineered Tooling (CET)** offers a comprehensive approach to process design and optimisation that ensures you achieve the highest levels of productivity, efficiency and cost effectiveness. Specialising in project management from conception to completion, the globally networked CET teams work together with our customers, and can integrate relevant representatives from providers of complementary equipment, such as machine tools, work-holding and automation systems.

DOCUMENTED PROCESS OPTIMISATION

We can assist you with current process evaluation and optimisation using the Seco **Productivity and Cost Analysis software (PCA)**. This tool allows us to benchmark existing processes, documenting them against our proposal for potential improvements. PCA can be fully scaled to meet your unique needs, from assessing a single machining application to evaluating workflows throughout your facility.

TAILOR-MADE SOLUTIONS

Seco will ensure that you always get the ultimate tooling solution best suited to your individual requirement, whether it is for standard tooling products or tailor-made solutions. Seco **Custom Tooling** offers complete support to you in these situations, analysing your application and developing a unique solution around it. With 19 state-of-the-art production facilities worldwide, Seco Custom Tooling is always available to make your challenge our priority.

DELIVERING PERSONAL COMMITMENT

SECO'S BUSINESS SERVICES

100% RELIANCE

Seco is fully committed to constantly improving to set new standards in **Quality Assurance** as is evident in our global ISO 9001 certification. We rigorously evaluate our processes to ensure that every product we produce is capable of meeting and exceeding our customers' expectations.
Our total commitment to quality is evident in the level of documentation we provide which meets the vigorous requirements of traceability set by our customers. When you partner with Seco, quality becomes a constant you can count on.

LONG-TERM SUSTAINABILITY

Seco has established and maintains a used carbide **Recycling Programme**; with a commitment to minimising our environmental footprint and conserving non-renewable materials. All aspects of this programme operate within the principles of our ISO 14001 certification, and we make it easy for you to participate. When you recycle used carbide, you not only positively impact the environment, you also recoup a portion of your original expense and help us minimise the cost of tools in the future.

KEEPING THE CUTTING EDGE

Tool Reconditioning is critical to maintain the quality standards required on your workpiece but often, when a tool is removed from use as they show signs of wear, this means discarding an entire cutter when only a small portion of it has been worn. Seco's tool reconditioning service eliminates this potential waste by applying advanced regrinding and recoating processes to bring a tool's geometry, edge preparation and coating back to its original specifications.

INVENTORY MANAGEMENT

Using **Seco Point - Inventory Management** is made simple and efficient. This can be achieved through our user-friendly, point-of-use tool dispensers, tool consumption and inventory levels are tracked and monitored. Inventory replenishment can be automated and you receive reports that make it easy to identify where consumption can be reduced.

BUILDING EXPERTISE IN OUR

GLOBAL COMPETENCE CENTRES

SECO GLOBAL TECHNICAL CENTRES

Seco's Technical Centres are used to engage with our existing and potential customers to facilitate the transfer of expertise and knowledge, for product introduction, industry specific events and engineer customer specific solutions. In addition, Seco representatives from diverse nations gather to share information and discuss winning solutions developed in their home markets, working together to ensure that we understand and are prepared for the trends and challenges you face.

SECO TECHNICAL EDUCATION PROGRAMME (STEP)

Available at our global technical centres or on-site at your own facility, Seco STEP provides training courses on every aspect of metal cutting, at every level of expertise. Whether instructing your apprentices on the basics of cutting processes or helping your experts stay abreast of the latest technological innovations, Seco STEP is an invaluable resource in maximising workforce knowledge.

SECO POWER GENERATION WEBSITE

As part of our commitment to power generation manufacturers, Seco developed a comprehensive web resource dedicated to the industry. Featuring a wide variety of video and written content, the website provides informationon current trends, process innovations, tool data and documented application successes. The user-friendly site incorporates an interactive turbine model to easily obtain data relevant to machining specific components. To learn more, visit www.secotools.com/energy.

Scan this code to see more.
www.secotools.com/energy

SECO CUSTOMER ZONE & ONLINE STORE

To achieve an even greater level of personal interaction with turbine manufacturers, we provide you with access to the Seco Customer Zone - www.secotools.com/customerzone. This unique web tool provides a wealth of content tailored to your specific needs. From technical applications and product information to interactive training and online ordering.
At Seco, we believe that you should always be able to place and monitor the status of orders, regardless of your location or the date or time. The Seco Online Store allows you to research technical information, check product availability, purchase tooling and follow the status of your orders.

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