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.

ENHANCING YOUR COMPETITIVENESS

DELIVERING EXCELLENCE AND INNOVATION FOR TURBINE MANUFACTURERS

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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 CO₂ 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

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.

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.

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 machining processes, including grinding and precision grinding. Considered replaceable components, these shafts require the holding of tolerances to ensure smooth operation.

BLADE AND BLADE ROOT
The design and quality of turbine blades determine the overall efficiency of the 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 to maintain efficient operation.

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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

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.

MACHINING TURBINE POWER COMPONENTS: ROTOR SHAFT AND DISC

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.

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.
MACHINING TURBINE POWER COMPONENTS: CASING

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.

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.

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.

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.

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

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:
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.

MINIMASTER® PLUS

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.

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.

MACHINING TURBINE POWER COMPONENTS: IMPELLER
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

CUSTOM HEAVY GROOVING

YOUR CHALLENGE:
Safely achieving maximum performance during roughing 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.

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.

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.

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.

PERFOMAX® 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

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 productive and stable machining, 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 fin tree shape foot
- Maximising roughing and semi-finish milling with high security and tight tolerances
- Finishing milling with high security and tight tolerances
- Increasing productivity in airfoil finishing applications
- Accurately semi-finish milling and finishing blades
- Increasing productivity when roughing blade forged

CUSTOM INDEXABLE FIR TREE MILLING CUTTER

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

OUR SOLUTION:
Featuring a helical design to promote a free cutting action, the custom indexable fin 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 stability of your application.

R218.24 TAPERED BALL NOSE MILLING CUTTER

YOUR CHALLENGE:
Maximising roughing and semi-finish milling with high security and tight tolerances.

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:
Fin tree finishing milling with high security and tight tolerances.

OUR SOLUTION:
Counted among our most accurate and high-tolerance cutters, Jabro solid carbide fin 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-finish milling and finishing blades.

OUR SOLUTION:
With edges and a helix that provide a light cutting action, MinimasterPlus offers an ideal means of semi-fini-ishing 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.

MACHINING TURBINE POWER COMPONENTS: BLADE
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: X18CrNiMo4-4
Coolant: No
Operation: Heavy Grooving
Criterion: Wear \( v_b = 0.4 \) mm (0.016”)
Fixturing: Special
Tool: Big diameter custom disc milling
Insert 1: Various

<table>
<thead>
<tr>
<th>Cutting data</th>
<th>Metric</th>
<th>Inch</th>
<th>( v_c )</th>
<th>( f )</th>
<th>( z )</th>
<th>( a_p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>3.50”</td>
<td>1 mm/rev</td>
<td>0.039”/face</td>
<td>50 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results:** Increased chip removal rate with heavy grooving.

**ROTOR SHAFT – JABRO™ FIR TREE SLOT MILLING**

Material: X18CrNiMo4-4
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

<table>
<thead>
<tr>
<th>Cutting data</th>
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<th>( v_c )</th>
<th>( f )</th>
<th>( z )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1300</td>
<td>51”</td>
<td>0.058 mm/revolution</td>
<td>0.023”/tooth</td>
<td>0.024”</td>
<td></td>
</tr>
</tbody>
</table>

**Results:** Substantial improvements to productivity and tool life compared to the existing HSS solution.

**DISC – BROCACHING 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

<table>
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<tr>
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<tbody>
<tr>
<td>1300 rpm</td>
<td>51”</td>
<td>0.058 mm/revolution</td>
<td>0.023”/tooth</td>
<td>0.024”</td>
<td></td>
</tr>
</tbody>
</table>

**Results:** Dramatic reduction in machining time compared to the existing traditional method.

**CASING – PERFOMAX® SD600 MODULAR DRILL**

Material: GS-40
Coolant: Internal (10 bar)
Operation: Drilling
Criterion: Wear \( v_b = 0.3 \) mm (0.02”)
Fixturing: Clamped
Tool: SD612-71-50RG
Insert 1: SCGX120408-P2, T3000D

<table>
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<tr>
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<th>( f )</th>
<th>( z )</th>
<th>( a_p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>3.94”</td>
<td>0.2 mm/revolution</td>
<td>0.008”/tooth</td>
<td>1.18”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results:** Reduced cutting forces due to strong chip groove inserts.

**CASING – DISC MILLING SOLUTIONS**

Material: GG-40
Coolant: Internal (10 bar)
Operation: Heavy Grooving
Criterion: Wear \( v_b = 0.4 \) mm (0.016”)
Fixturing: Special
Tool: Special
Insert 1: NI-LN40-11770, S25M

<table>
<thead>
<tr>
<th>Cutting data</th>
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**Results:** Increased reliability of machining process, while maintaining high productivity.

**IMPPELLERS – EPB® MODULAR SYSTEM FOR PLUNGING**

Material: 17-4-PH stainless steel
Coolant: Emulsion - internal
Operation: Roughing plunge milling strategy
Criterion: Wear \( v_b = 0.0 \) mm (0.00”) (HSS)
Fixturing: Special
Tool: Modular tool holder - plunge milling cutter
Insert 1: Turbo

<table>
<thead>
<tr>
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<th>( z )</th>
<th>( a_p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>4.72”</td>
<td>0.08 mm/revolution</td>
<td>0.003”/tooth</td>
<td>CAM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results:** Dramatic improvement in productivity and tool life compared to the existing HSS solution.

**DISC – BROACHING TOOLS**

Material: Steel
Coolant: Pure oil
Operation: Dovetail clamping slot - roughing, by broaching
Criterion: Productivity
Fixturing: Special
Tool: Custom solid carbide fir tree shape cutter
Insert 1: Various - standard + special

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<td>0.024”</td>
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</tr>
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</table>

**Results:** Superior surface finish, with major reductions in cost and process time by machining each stage with one set-up and cutter.

**Casing – Perfomax® SD600 Modular Drill**

Material: GS-40
Coolant: Internal (10 bar)
Operation: Drilling
Criterion: Wear \( v_b = 0.3 \) mm (0.02”)
Fixturing: Clamped
Tool: SD612-71-50RG
Insert 1: SCGX120408-P2, T3000D

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</tbody>
</table>

**Results:** Increased reliability of machining process, while maintaining high productivity.

**Casing – Disc Milling Solutions**

Material: GG-40
Coolant: Internal (10 bar)
Operation: Heavy Grooving
Criterion: Wear \( v_b = 0.4 \) mm (0.016”)
Fixturing: Special
Tool: Special
Insert 1: NI-LN40-11770, S25M

<table>
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</table>

**Results:** Increased chip removal rate with heavy grooving.

**Impellers – Epb® Modular System for Plunging**

Material: 17-4-PH stainless steel
Coolant: Emulsion - internal
Operation: Roughing plunge milling strategy
Criterion: Wear \( v_b = 0.0 \) mm (0.00”) (HSS)
Fixturing: Special
Tool: Modular tool holder - plunge milling cutter
Insert 1: Turbo

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<td></td>
</tr>
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</table>

**Results:** Dramatic improvement in productivity and tool life compared to the existing HSS solution.
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
<table>
<thead>
<tr>
<th>Metric</th>
<th>vc</th>
<th>fz</th>
<th>ap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>350</td>
<td>0.4</td>
<td>3 mm</td>
</tr>
<tr>
<td>Metric</td>
<td>3150</td>
<td>0.016&quot;/tooth</td>
<td>0.118&quot;</td>
</tr>
<tr>
<td>Inch</td>
<td>317</td>
<td>0.44000</td>
<td>0.225</td>
</tr>
</tbody>
</table>
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
<table>
<thead>
<tr>
<th>Metric</th>
<th>vc</th>
<th>fz</th>
<th>ap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>420</td>
<td>0.2</td>
<td>1.15 mm</td>
</tr>
<tr>
<td>Metric</td>
<td>1378</td>
<td>0.008&quot;/tooth</td>
<td>0.04-0.6&quot;</td>
</tr>
<tr>
<td>Inch</td>
<td>137</td>
<td>5000</td>
<td>0.015</td>
</tr>
<tr>
<td>Metric</td>
<td>137</td>
<td>197</td>
<td>0.015</td>
</tr>
</tbody>
</table>
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: X12CrNiMoV12-3
Coolant: Emulsion
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
<table>
<thead>
<tr>
<th>Metric</th>
<th>vc</th>
<th>fz</th>
<th>ap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>270</td>
<td>0.233</td>
<td>1.30 mm</td>
</tr>
<tr>
<td>Metric</td>
<td>885</td>
<td>0.0092&quot;/tooth</td>
<td>0.04-1.8&quot;</td>
</tr>
<tr>
<td>Inch</td>
<td>885</td>
<td>2.000</td>
<td>0.02</td>
</tr>
<tr>
<td>Metric</td>
<td>885</td>
<td>797</td>
<td>0.015</td>
</tr>
</tbody>
</table>
Results: Extended tool life, reduced tool cost and eliminated regrounding operations compared to existing solid carbide cutter solutions.

BLADE – CUSTOM INDEXABLE
FIR TREE MILLING CUTTER
Material: X20Cr13
Coolant: Emulsion
Operation: Finishing and semi-finishing peel milling
Criterion: Wear vb = 0.2 mm (0.008")
Fixturing: Special
Tool: Customised fir tree shape cutter
Insert 1: Special | Special
Cutting data
<table>
<thead>
<tr>
<th>Metric</th>
<th>vc</th>
<th>fz</th>
<th>ap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>560</td>
<td>0.27</td>
<td>1-15 mm</td>
</tr>
<tr>
<td>Metric</td>
<td>1378</td>
<td>0.008&quot;/tooth</td>
<td>0.04-1.8&quot;</td>
</tr>
<tr>
<td>Inch</td>
<td>137</td>
<td>5000</td>
<td>0.015</td>
</tr>
<tr>
<td>Metric</td>
<td>137</td>
<td>197</td>
<td>0.015</td>
</tr>
</tbody>
</table>
Results: Dramatic reduction in machining time compared to existing solution.

BLADE – JABRO™ SOLID CARBIDE FIR TREE TOOLS AND ACCUFIT™ SHELL MILL HOLDER
Material: X22CrMoV12-1
Coolant: Emulsion
Operation: Finishing and semi-finishing peel milling
Criterion: Tool life must reach the end of component
Fixturing: Special
Tool holder: Accu-Fit™
Tool: Customised solid carbide fir tree shape cutter
Cutting data
<table>
<thead>
<tr>
<th>Metric</th>
<th>vc</th>
<th>fz</th>
<th>ap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>190</td>
<td>0.88</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Metric</td>
<td>560</td>
<td>0.00314&quot;/tooth</td>
<td>0.0118&quot;</td>
</tr>
<tr>
<td>Inch</td>
<td>560</td>
<td>197</td>
<td>0.015</td>
</tr>
</tbody>
</table>
Results: Increase in tool life of over 15%.
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.
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 work-piece 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 information on 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.

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.

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