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Resume
Online Portfolio

BIO

Lee Kolinsky is an award-winning writer with a foundation in journalism. His knowledge covers an array of subjects including health care, industrial supply, finance, retail, entertainment, and lifestyle.

Lee has provided content for Kennametal, Inc., MSC Industrial Supply, Doubleday Entertainment, Columbia House DVD, BMG, PR Newswire, yourmusic.com, and the Nassau Herald Community Newspapers. His career also includes writing screenplays for independent films Send No Flowers, Junkie Heaven, Bullified, and Generation Change.

Highlights

Support sales globally with customer-focused content

Craft articles, brochures, emails, landing pages and product information

Edit and normalize data across catalogs and websites

Document procedures to streamline website content workflows

Collaborate across departments to align content timelines

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Machining strategies for solid end milling aerospace components

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cover story

Machining strategies for solid end milling aerospace components

Kennametal's
experts explain
the best ways to
machine high-
temperature alloys.

Edited by Eric Brothers

HARVI III AERO (KCSM15A)

Inconel and titanium alloys are ideal for turbine blades, exhaust ducts, landing gear, and other high-stress aerospace components due to their strength and heat resistance. However, their high strength and low thermal conductivity make for poor machinability. Achieving optimal tool life, surface finish, and cutting efficiency requires a comprehensive strategy to avoid problems hindering solid end milling.

Effective strategies include optimizing cutting parameters, using advanced tool materials and coatings, and employing efficient cooling and lubrication techniques. Additionally, implementing precise toolpath planning and chip evacuation methods can significantly enhance machining performance.

"The biggest issue when machining high-temp alloys is going

to be heat," says Danny Davis, senior staff engineer, solutions at Kennametal. "We need to take special care in managing the heat, and we do that by using the correct speeds, coolants, coatings, and substrates."

What creates the heat?

Heat generated by the cutting process doesn't dissipate as easily into the workpiece or chips for high-temp alloys compared to other materials, leaving the tool and sometimes the part carrying the thermal burden. Every machining operation is essentially a thermal system. Electrical energy entering the spindle is converted into kinetic energy (tool rotation and movement) and heat (due to friction and plastic deformation), affecting chip momentum

PHOTOS COURTESY KENNAMETAL INC.

(material removal).

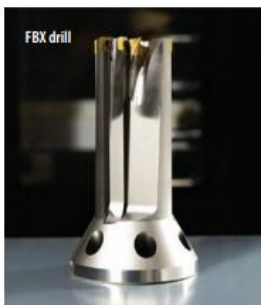
Chip formation has three distinct phases:

- Rubbing (friction) converts nearly 100% of the energy into heat
- Plowing (plastic deformation) turns approximately 90% of the energy into heat
- Shearing (actual chip separation) generates significant heat

"We know thermal energy is the biggest factor damaging the cutting edge, leading to poor tool life and performance," says Steve George, senior manager, product design engineering at Kennametal. "It also affects structural concerns like the formation of a white layer from phase changes due to heat. We need to figure out how to lower it, and there are ways we can go about it."

Managing heat in high-temp alloys

- Use tools designed to cut more efficiently by reducing the specific cutting energy, which measures how much energy is required to remove a unit volume of material. The **HARVI I** or **HARVI II** tools are engineered to reduce cutting energy through optimized geometries and coatings. Lower energy equals less thermal stress on the tool.
- With advanced coatings such as Kennametal's **KCSM15A** grade engineered specifically for high-temp alloys. With its smoother, thinner layer, it retains a sharper cutting edge, and its enhanced abrasion resistance mitigates the aggressive conditions found in nickel-based alloys. Combined with the right coolant strategy – one with high lubricity – these coatings can significantly extend tool life by reducing material adhesion and heat generation.
- Increasing lubrication with high-pressure coolant systems or minimum quantity lubrication (MQL) can significantly reduce thermal loads, particularly with high cutting speeds. Lubrication doesn't just cool, it separates contact surfaces, directly reducing energy converted into heat during rubbing and plowing stages.
- In a perfect situation, most heat would exit with the chip. But high-temp alloys have poor thermal conductivity, keeping the heat near the tool. If the cutting tool conducts heat better than the workpiece or chip, it ends up absorbing more of it and wears out faster. By using tools made of materials that insulate rather than conduct, such as ceramics or certain coated carbide, more heat is forced into the chip rather than the tool.



- Time is crucial in heat transfer during chip formation. The longer the tool remains in contact with the material, the more heat can transfer into it. Traditional milling, which involves longer engagement and constant contact, tends to increase heat due to the extended machining time. In contrast, dynamic milling uses smaller radial engagement and keeps the cutter in motion with less surface contact, reducing heat buildup and improving chip evacuation. Adjusting feeds and speeds also plays a significant role. Lower cutting speeds can reduce heat generation, while higher feed rates prevent rubbing and encourage clean shearing, moving the process away from the plowing zone.

Coolant and lubrication best practices

High-temp alloys generate significant heat during cutting, requiring clever coolant strategies:

- Water offers excellent heat transfer but poor lubrication. Use a coolant with a rich concentration of extreme pressure (EP) additives to fight abrasion.
- Air can help with chip evacuation when coolant isn't an option. Neat

oils offer top-tier lubrication but are typically reserved for extreme cases due to mess and maintenance.

It's not just about volume, it's also about placement. Ensure the coolant hits the cutting zone directly. Unsuccessfully aimed

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nozzles waste coolant and leave tools vulnerable. Tools like the **HARVI IV** series offer through-tool coolant delivery, flushing chips directly from tight pockets or corners while reducing thermal load on the tool.

"Using higher concentrations of coolant helps reduce abrasive wear and manage heat when machining high-temp alloys," says Katie Myers, product manager, marketing at Kennametal. "High-pressure through-tool coolant ensures effective heat removal and chip evacuation, which is crucial for tool life and part quality."

Using ceramic tools in a dry-cutting environment

Ceramic tools offer unique advantages when machining high-temp aerospace alloys. Their ability to withstand extreme temperatures makes them well-suited for dry cutting environments where traditional carbide tools would struggle.

"When we talk about ceramic tools, we're almost always talking about a dry cutting environment," George explains. "You need to be very careful with your setup because ceramic tools are much more sensitive to tool path and workpiece geometry."

PHOTOS COURTESY KENNAMETAL INC.



A key strategy with ceramics is managing heat without using coolant. George notes, "When we're machining high-temp alloys, heat is a big concern. But ceramic likes heat. So, we want to generate the heat and get rid of it quickly."

George advises avoiding re-cutting and ensuring good chip evacuation to prevent premature wear or tool failure. He also suggests specific motion strategies: "Step the walls of the pockets. As you step down, move away from the wall with each pass. That keeps the tool away from the heat zone and helps prevent excessive burr formation."

These careful toolpath decisions are vital when coolant can't be used. By managing heat through cutting strategy rather than fluid application, machinists can maximize tool life and avoid sudden ceramic failure.

Effective approaches for solid end milling aerospace components
Pocketing techniques and methods of entry:
Many aerospace parts are designed with deep, complex pockets. Proper entry strategy and cutter selection make a difference,

especially in materials prone to work-hardening and thermal stress. Optimizing pocketing for high-temp alloys is crucial. Plunging is often the most direct method of entering a pocket. This strategy involves dropping the tool straight into the materi-

al like a drill. It requires a tool capable of withstanding the axial loads and offering stability during the initial entry. "Pocketing is one of the most common operations in aerospace, but it can be tricky when you're dealing with high-temp

alloys," George says. "Choosing the right strategy can make all the difference in reducing cycle time and preserving tool life."
• Plunge entry works best for small pockets with limited space. HARVI I TE or HARVI II TE solid end mills

are designed to plunge directly into the material, offering high flexibility for tight spaces. However, it's important to ensure the cutting forces don't exceed the machine's capabilities.
• Ramp entry is great for deeper pockets

and allows for more aggressive cutting. Straight-angle ramping can significantly reduce cycle times but requires a machine with the rigidity to withstand higher forces.

• Helical interpolation is the most stable and efficient pocketing strategy due to lighter depth of cuts. Corner geometry is another major consideration. Oversized tools can cause excessive radial engagement in tight corners, increasing wear and chatter.

"If you have a 1/2" radius in the corner, then I'd use a 3/4" diameter tool, maybe even 5/8". You need to use a small enough tool to follow the arc of the corner without gouging or over-engagement," George adds.

Tool selection, depth, and the required rigidity must be balanced carefully. In large pockets with tight corners, a smart method is to start roughing with a larger, more rigid tool, then switch to a smaller tool to finish detailed areas.

Minimizing chatter and maintaining rigidity: Chatter often comes from the machine-tool interface with high-temp alloys. Even the best tool can fail if the spindle or machine lacks the rigidity to absorb cutting forces.

"Chatter occurs when there's too much movement between the tool and the part, which leads to inconsistent cuts and tool wear," Myers explains. "The best way to reduce chatter is by ensuring your machine has enough rigidity."

Chatter can stem from excessive tool stick-out, weak spindles, or incorrect chip thickness. Reducing axial or radial depth of cut, rather than slowing down the entire process, can help with machining. Additionally, selecting the right tool and tool holder will help reduce vibration and prevent chatter. Make sure your tool selection matches the pocket size you're machining. Using a strong spindle with a good connection to the tool holder can help reduce vibrations. The key is balancing rigidity with the feed and speed to minimize cutting forces.

If chatter persists despite adjusting stick-out and tool selection, reduce the depth of cut to lessen cutting forces instead of slowing down feeds and speeds. This will keep vibrations in check without impacting overall cycle time.

"Even if you have a robust machine, the combination of a long stick-out and a weak spindle can lead to chatter," George says. "It's all about balancing tool size, rigidity, and cutting force."

Cutting parameters and tool life: Tool longevity is directly tied to cutting parameters. Running tools at the right speeds, feeds, and chip loads ensures maximum tool life while preventing premature wear. Speed is crucial when machining high-temp alloys. A speed too fast will burn through a tool much quicker. It's about finding that sweet spot.

Just as important is chip thickness. Too light a radial engagement without proper feed compensation leads to rubbing, not cutting, generating excess heat and accelerating wear. Always account for chip thinning in your calculations, especially during dynamic toolpaths or finishing passes.

Wall stiffness and support geometry: When machining features like blisks, iso-grids, or blades, geometry plays a critical role in maintaining part stability and minimizing deflection. In many cases, adjacent or curved walls help reinforce a feature, offering opportunities to push past standard roughing rules.

"The curvature of the blade actually adds more stiffness into that part," Davis says. "So, these rules can be a guideline. If the wall has a curvature, or if it has an adjacent wall or a corner or radiuses down at the bottom — all that adds more stiffness."

The classic 13:1 height-to-width rule for machining high-temp alloys such as Inconel still applies, but features like adjacent walls and internal radii can safely stretch those limits during roughing — especially before the final finishing passes.

Conclusion

Machining aerospace components from high-temp alloys demands more than just the right tools, it requires a comprehensive strategy that addresses heat, rigidity, tool-path planning, and part geometry. By using

the right strategies, you can stay ahead of the solid end milling curve in machining complex aerospace parts. **A**

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NAVIGATING THE REGULATORY LANDSCAPE: Compliance and challenges for U.S. underground mining

Kennametal has a consistent focus on customer's sites and their operations-particularly changing underground regulations and how the costs of doing business changes in parallel.

Underground mining procedures in the United States are filled with federal and state regulations to ensure safety, environmental protection, and fair labor practices. These highly complex regulations build a framework governing underground mining operations and significantly impact the industry. Here are a few key regulations, some of the challenges companies face in achieving compliance, and best practices for managing the costs and regulatory requirements that can incur on your business.

REGULATORY OVERVIEW

Major federal and state regulations affect underground mining in the USA. The Mine Safety and Health Administration (MSHA) and Environmental Protection Agency (EPA) guidelines are two primary regulatory bodies overseeing underground mining.

Key regulations for underground mining include:

The Federal Mine Safety and Health Act of 1977 (Mine Act)

This act establishes mandatory safety and health standards for mines to prevent death, disease, and injury from mining

and to promote safe and healthful workplaces for miners.

Implementation of the Mine Act includes regulations and standards in 30 CFR Parts 1-199; rulemaking documents, including proposed and final rules; technical amendments to existing regulations and standards; and notice documents that include petitions for modification of existing standards, Information Collections (ICs), and public meetings.

The Coal Mine Health and Safety Act (CMHSA)

This act specifically targets coal mining, setting forth comprehensive safety standards for the protection of life, health, and property in coal mines. CMHSA discusses mandatory safety standards such as:

- Proper ventilation systems must be installed and maintained to control the accumulation of harmful gases, such as methane, and to ensure a supply of breathable air.
- Standards for roof control systems to prevent cave-ins and collapses, ensuring structural stability in underground mines.
- Regulations on the use, handling, and storage of explosives to minimize the risk of accidental detonations.

- Measures to control coal dust and silica dust levels to prevent respiratory diseases such as black lung (coal workers' pneumoconiosis) and silicosis.
- Implementation of noise control measures to protect miners from hearing loss and other noise-induced health issues.

The Clean Water Act (CWA)

This act regulates the discharge of pollutants into the waters of the United States and sets quality standards for surface waters.

Federal facilities have regulatory responsibilities under the Clean Water Act, which includes preventing water pollution; obtaining discharge permits; meeting applicable water quality standards; developing risk management plans; and maintaining records.

COMPLIANCE CHALLENGES, COSTS AND BEST PRACTICES

There are many hurdles mining companies encounter in meeting with compliance regulations. This includes health and safety compliance, environmental protection, and reporting requirements. Here, we delve into some common problems and provide some best practices.

Common challenges

Regulations are complex and require specialized knowledge to understand and implement. Standards can change frequently and keeping up with these changes can be difficult. This can be particularly challenging for smaller

mining operations that may lack the necessary resources.

Technological advancements in mining techniques can outpace regulatory changes, leading to a gap between practice and regulation. By staying on top of technology, your business can potentially reduce costs in the long run.

Balancing the need for mining with environmental conservation is a significant challenge. Mining operations must comply with environmental regulations, which can be stringent and vary across states.

Cost of compliance

Non-compliance with mining regulations can result in hefty fines and penalties. The cost of these fines can be substantial, potentially running into millions of dollars for serious violations. Compliance often requires mining companies to make operational adjustments. This could include investing in new safety equipment, implementing more rigorous training programs, or modifying mining processes to reduce environmental impact.

Regulatory compliance also involves ongoing monitoring and reporting. This requires investment in monitoring equipment and personnel and the administrative costs of preparing and submitting reports. Mining operations are often required to remediate any environmental damage they cause and to reclaim mined land after operations are complete. This can involve soil restoration, water treatment, and re-vegetation, all of which can be costly.

The costs of compliance can also impact a mining company's long-term financial planning. The potential for future regulatory changes adds an element of uncertainty

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and the potential for future fines or penalties. Non-compliance can lead to reputational damage and have indirect financial impact. A poor compliance record can make it more difficult for a mining company to secure financing, attract partners, or gain social license to operate in communities.

Best practices

Familiarize yourself with all relevant federal, state, and local regulations. Regularly review these regulations to stay updated as they can change over time. Also, conduct regular safety inspections and environmental audits. This can help identify potential issues before they become serious problems.

Provide comprehensive training to all employees on safety procedures, environmental regulations, and emergency response plans. This not only ensures compliance but also promotes a culture of safety within the organization. Maintain open lines of communication with regulatory agencies. If you're unsure about a certain regulation or requirement, don't hesitate to ask for clarification.

Invest in technology to improve safety and compliance. This could include equipment for monitoring air quality, software for tracking compliance tasks, or machinery that reduces environmental impact.

State regulations

State regulations can complement or exceed federal standards, often focusing on specific regional concerns. Changes are made to state legislation all the time, so keep up with your current state's laws.

Some examples include:

California

California Environmental Quality Act (CEQA): Requires environmental impact assessments for mining projects to identify and mitigate potential environmental damage.

California Surface Mining and Reclamation Act (SMARA): Mandates that mining operations develop and implement reclamation plans to restore mined land to a beneficial use.

Nevada

Nevada Division of Environmental Protection (NDEP): Enforces state-specific regulations for mine permitting, environmental monitoring, and land reclamation.

Nevada Revised Statutes (NRS): Contains laws governing mining operations, including safety, environmental protection, and reclamation requirements.

Colorado

Colorado Mined Land Reclamation Act: Regulates the reclamation of mined lands to ensure they are returned to beneficial use, including requirements for revegetation and erosion control.

Colorado Department of Public Health and Environment (CDPHE): Oversees environmental regulations related to air and water quality, hazardous waste, and radiation control in mining operations.

Federal and state regulations governing underground mining in the U.S. are comprehensive and continually evolving. By understanding these regulations and implementing effective compliance and risk management strategies, mining companies can ensure they operate within legal frameworks, protect their workers, and minimize their environmental impact.



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When you strive for innovation, it doesn't get much more advanced—or cooler—than our partnership with [Kraus Motor Company](#). High-performance tooling and sleek surface finishes make the perfect combination for unmatched craftsmanship. Owner Satya Kraus shares what makes this collaboration truly exceptional: <https://heyor.ca/msxRjd>



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Kennametal and Kraus Motor Innovate Together

June 12, 2025

When you strive for innovation, you can't get much more advanced or even cooler than the partnership between Kennametal and [Kraus Motor](#). High-performance tooling and sleek surface finishes make the perfect combination for unequalled craftsmanship.

Kraus Motor is a custom CNC shop that designs and manufactures ergonomics, suspensions and braking systems for motorcycles. Their focus is on consumer products based in an industry that is all about aesthetics and quality of finish. And that is super important to them because each product is front and center for the customer to see.

When Kennametal learned that Kraus Motor had been fighting with different tooling for their aluminum and stainless steel products to obtain the right finish quality they needed, our representatives stepped in and presented solutions to solve their machining challenges.

"The quality of the tooling has been great. The support and being able to speak with people who know what you're talking about -- and are machinists and have done machining makes a big difference when you have a technical question. There's somebody there who understands what you're talking about and has some experience with it. I've found we get that with Kennametal!" – Satya Kraus, Owner of Kraus Motor Co.

Kraus Motor runs a ton of tooling through their shop and is making a big push to transform a majority of their drilling and milling solutions to Kennametal. Satya highlights that his machinists and programmers appreciate the Kennametal systems, tooling, and catalogs. A key benefit is the ability to load tooling models into their CAM systems directly.

As a leader in their industry, Kraus Motor designs and fabricates their products using lathes, 5-axis machines and horizontal and vertical machines. Some of their complex tooling includes the use of 3D machining for their ball-end finishes. With so many machines and the need for several types of tools including [Beyond™ Evolution cut-off inserts](#), Kennametal provides innovative options at every stage of product development.

"[Kennametal is] creating product sets across the board. They do drills well. They do inserts well. We're getting really good finishes out of the mills. You want to work with companies that are continuing to develop," said Satya.

As the industry continues to shift towards performance, ergonomics has become Kraus Motor's primary focus. Their research and development team, composed of experienced riders, understands what customers seek to experience.

"Ergonomics is the first thing we attack. We set that bike up for the individual. If they are comfortable on that bike, they are confident on that bike. Then they are going to be able to use the OEM performance to its extent before they start adding some really high-grade suspension and braking technologies," – Kraus said.

Kraus Motor is dedicated to producing products that require multiple operations and have features that must be precisely aligned with each other. With Kennametal's precision tooling solutions and Kraus Motor's dedication to creating a new functional experience for the rider, their partnership is set to push the boundaries of motorcycle design and manufacturing.



TURNING METAL INTO INNOVATION SINCE 1938



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1980	KC850 Coated Co. Enriched Grade (TiC/TiCN/TiN)	1983	KC950 Al ₂ O ₃ Coated Enriched Grade	1994	KC9010 Enhanced Al ₂ O ₃ Coated Grade	1999-2005	KENNA PERFECT™ KCB Series Enhanced MT-TiCN/Al ₂ O ₃ Coated Grades	2012	Beyond™ Drive™ B Series KCP, KCK, KCM Bronze TiCN Top Layer for Improved Wear Identification		

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1990	HT First Generation Cement Grades (HT2, HT5, HTX)	1998	KC7310 First PVD TiAlN Coated Carbide Grade	2005	KC5410 TiB ₂ Coated Grade Non-Ferrous Alloys	2011	KCU10/KCU25 Universal Turning Grade with Nano- composite Layer	2019	KCS10B AlTiN Coating made by High PMS Technology	2023	KCU10B/ KC025B KENGOLD PVD, Universal Turning Grade

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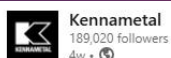
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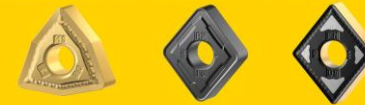


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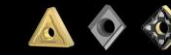


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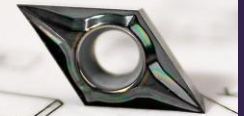


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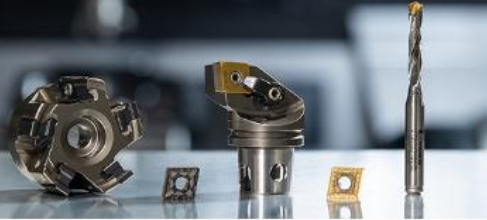
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- Dual coolant delivery system for reduced heat and enhanced chip control at the cutting-edge
- KM Micro three-point contact (1 face and 2 tapers) provides a stronger clamping connection
- Easy insert replacement with front clamp design for reaching tight spaces
- Flexible quick-change capabilities with A4™, Beyond Evolution™ and existing cutting-head styles
- Shanks available in 12mm, 16mm and 5/8" and 1/2" sizes

Beyond Evolution™ Bolt-On Heads

Modular Grooving and Turning



- Serrated connection secures attachment to boring bar for better dynamic performance
- Short overhang provides high stability and consistent repeatability for better accuracy
- Through coolant technology reduces heat on inserts and provides better chip flow, extending tool life

MQL Shrink Fit and Hydraulic Tool Holders

Leading-Edge Tools for Environmentally Friendly Machining

Contact an Expert



Unlock the Full Potential of MQL with DIN-Standard Tool Holders

Boost machining efficiency and optimize coolant use with DIN-standard Minimum Quantity Lubrication (MQL) tool holders—designed for machines equipped with MQL capability. Our hydraulic and shrink fit holders support MQL1 and MQL2 systems, helping you realize the full benefits of MQL in aluminum machining, with suitability for select cast iron and steel applications. Available in HSK83A and HSK100A connections, these holders reduce lubricant waste, lower operational costs and minimize environmental impact.

These tool holders are designed for MQL-ready systems and are available in:



- MQL1 – Cost-effective single-channel system for general machining
- MQL2 – Extra-efficiency dual-channel system ensuring better lubrication for complex machining and critical applications
- Hydraulic holders offer effortless handling and ultimate precision
- Shrink fit holders provide low runout and narrow envelope for high-performance machining
- Available shrink fit configurations include short and long gauge lengths with fine balancing screws

NEW! KM™ Micro HPCR: Precision Cooling at Every Turn!

KM Micro HPCR clamping units are the latest addition to the KM Micro platform. The through coolant clamping units for smaller toolholders feature a flexible modular design including a riser and nozzle that provides optimal cooling to the turning insert's cutting edge. Additionally, an internal port channels coolant directly into the cutting heads of grooving and cut-off tools.



- Optional dual coolant delivery system for reduced heat and enhanced chip control at the cutting edge
- Easy insert replacement with front clamp designed heads for Swiss-type lathes
- Flexible quick-change capabilities with new A4™ and Beyond Evolution™ heads for cut-off and grooving
- Shanks available in 12mm, 16mm, 1/2" and 5/8" shank sizes
- Primarily for Swiss-type lathes, but compatible with a wide range of machines