SHAPE IT

OSG Global Tooling Magazine | WINTER 2021

Productivity of the Highest Level

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Leading Businesses in the New Normal

A Message from the President

2020 has become one of the most challenging years in the 21st century, where businesses are forced to operate in a rapidly changing environment. The coronavirus pandemic did more damage to the world economy than the Lehman financial crisis over a decade ago. With the pressure of lockdown and ongoing uncertainty in all factors of life, impacts are felt across the globe. On both corporate level and individual level, activities that were once considered 'normal' can no longer be carried out with ease. When a coronavirus vaccine is developed with treatment method established, 'normal activities' can be resumed. However, the transformed business models and practices will continue to take root in what is now known as the 'new normal.'

Even after we have entered into the post-crisis period, this 'new normal' will likely remain to become the new standard across business sectors. However, products and services must not be driven into a uniform approach that lack attention to individual differences. Sustainable growth can only be achieved through innovation and by responding effectively to change. Under the new norm, we must continue to implement greater differentiation and deliver new values to our clients.

In 2021, OSG will strive to create values that go beyond the 'new norm,' building resilience to help the company and manufacturers around the world to thrive in this new reality.

Norio Ishikawa
President & CEO of OSG Corporation

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From left, Kentaro Masutani from Primetals Technologies Japan, Masaru Fujinaga, Osamu Nakano, Yusuke Kamio, Ayakatsu Eki, Takanori Terasako, Hirokazu Unno, Noriaki Sugihara and Masaki Murakami from MHI.

Members of the 777X project pose for a photograph in front of the Makino A6 high-speed and high power 5-axis horizontal machining center at MHI's Eba Factory in Hiroshima, Japan.

Productivity of the Highest Level

AERO milling cutter and Safe-Lock™ system enable ultra-high-speed machining of large aluminum aircraft parts

Kanako Mizutani
OSG Corporation

Aluminum in general is a material with good machinability and is often processed under more aggressive cutting conditions than steel. In recent years, there is a growing demand for ultra-high-speed machining of large-sized aluminum parts using high-power milling machines exceeding 80 kW especially in the aerospace industry. In order to meet the demand of heavy duty machining that maximizes the capabilities of advanced machining centers, however, a number of challenges with regard to cutting tools and tool holders must be overcome.

Tool Damage and Breakage

Especially notable under aggressive cutting conditions, as the machine's spindle speed increases, the centrifugal force on the tool mounted at the end of the spindle will also increase. Therefore, even if the runout accuracy of the tool cutting edge is initially controlled, runout may occur during rotation. This would result in a shorter tool life and may cause chipping or sudden tool breakage in some cases.

Reduced Machining Accuracy

Ultra-high-speed machining requires a larger cutting load than usual. If the rigidity of the tool or tool holder is insufficient, deflection or chattering may occur during machining. In addition, runout of the cutting edge will increase due to the centrifugal force, which may result in undesirable machined surface quality and dimensional accuracy.

A photograph of the Boeing 777X.
Photo courtesy of The Boeing Company.

With the launch of the Boeing passenger aircraft 777X project, MHI decided to introduce a 120 kW high-speed and high power 5-axis horizontal machining center, the Makino A6, with a maximum spindle speed of 33,000 min^{-1} to improve productivity substantially.

Tool Pull Out

When the cutting load increases, a large force is applied to the tool in the direction away from the spindle. The axial and rotational forces can cause the cutting tool to rotate in the tool holder. In the worst case, the cutter is pulled out of the chuck. Under such a scenario, not only is the tool damaged, the machined workpiece may also suffer defects. Conventional side lock mechanism for tool pull out may deteriorate runout accuracy.

Reduced Spindle Life

When the tool holder and cutter receive a large centrifugal force due to high-speed rotation, a large load is also applied to the spindle. This reduces the life of the spindle and necessitates frequent replacement.

In order to solve the above problems, a tooling system with high rigidity and ability to minimize centrifugal force is necessary. In addition, heat and a large amount of cutting chips are generated during machining, so the cutter must be equipped with welding resistance, lubricity, and excellent chip evacuation capabilities.

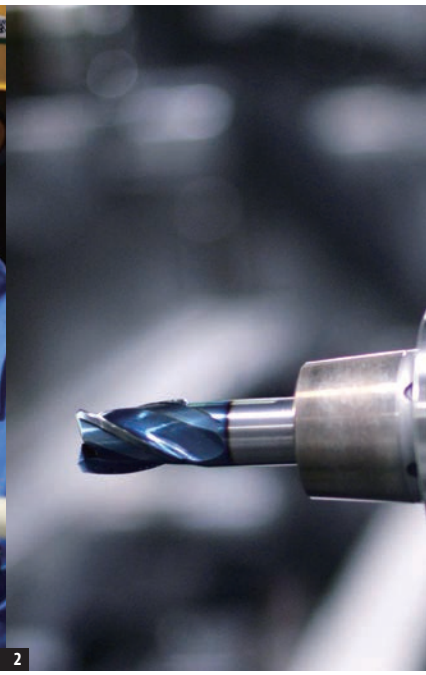
MHI 777X Project Member Spotlight

Jun Eto

Eto is an MHI engineer with 10 years of experience in aircraft parts machining. He belongs to the Manufacturing Engineering Department's Tool Design Team in Nagoya and is a key member of the 777X project. After launching the 777X project, Eto joins the Mitsubishi SpaceJet development team and has been in charge of technical development of parts machining since July 2020.

Hirokazu Unno

Unno is an MHI engineer with more than 20 years of experience in aircraft parts machining, cutting tools and jig design. He belongs to the Manufacturing Engineering Department's Tool Design Team in Nagoya and is a key member of the 777X project. Even now, Unno visits the Eba Factory in Hiroshima regularly to continue to support machining process improvement of the 777X project.



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1. From left, Primetals Technologies Japan Technician Kentaro Masutani and MHI technician Takanori Terasako discuss details of the application for the 777X project.

2. Based on cutting trial results, MHI selected OSG's AERO end mill series for the cutter.

Mitsubishi Heavy Industries, Ltd.

Founded in 1884, Mitsubishi Heavy Industries, Ltd. (MHI) is a multinational company headquartered in Tokyo, Japan. MHI has a proven track record in a wide range of industries, from shipbuilding, transportation systems, civil aircraft, infrastructure such as power generation systems, to space systems.

In the aircraft field, MHI's Oe Factory in Nagoya and Eba Factory in Hiroshima manufacture large parts such as the main wings of the Boeing 787 and sections of the fuselage of the Boeing 777. The Oe Factory and Eba Factory have a site area of 387,700-square-meter and 669,908-square-meter respectively.

Currently, MHI is actively involved in the manufacturing of the Boeing passenger aircraft 777X. MHI is responsible for producing sections of the rear and tail fuselage as well as the passenger entry doors. Among them, OSG cutting tools are used for the roughing and finishing of large aluminum structural parts (about 4 meters in size) of the rear fuselage panels.

"For the 777X, there are approximately 100 new large components required to be made," said Hirokazu Unno, an MHI lead engineer with more than 20 years of experience at the Manufacturing Engineering Department's Tool Design Team.

"Traditional method would have been to start with a large number of machines and suppliers," Unno explains. "However, to reduce costs, we shifted focus to increasing productivity per machine and start up with as few facilities as possible."

MHI's 777X project team and two applications engineers from Makino pose for a photograph with a prototype part at the 777X 1st Part Completion Ceremony at the Eba Factory in Hiroshima on October 31, 2016. Photo courtesy of MHI.

The AERO-O-ETS end mill is a part of OSG's AERO end mill series, which is designed to maximize the full potential of high-performance equipment over 80 kW. The AERO series is most ideal for high-efficiency machining of large aluminum aircraft components.

3. From left, HAIMER Area Sales Manager Tom Yamashita explains features of the HAIMER Power Clamp shrink fit machine to MHI's Osamu Nakano.

Like Unno, Jun Eto is also a key member of the 777X project from the start and belongs to the same department with 10 years of experience in aircraft parts machining.

"Speed is an important factor when we are required to produce large numbers of new parts," Eto adds. "We opted for a new machining process in order to further improve precision and reduce machining time."

According to Eto, when working with new parts and machining processes, troubles relating to the workpiece often occur at startup. "So, we have to eliminate all potential troubles on the tool side," said Eto.

In the past, MHI had introduced a horizontal machining center with up to 30,000 min^{-1} spindle speed for heavy duty machining. However, full benefits of high-speed machining could not be obtained with the machine, conventional tool and tool holder at the time. Thus, the company mainly used vertical machining centers with less than 20,000 min^{-1} spindle speed for the machining of aluminum parts.

With the launch of the Boeing passenger aircraft 777X project, MHI decided to introduce a 120 kW high-speed and high power 5-axis horizontal machining center, the Makino A6, with a maximum speed of 33,000 min^{-1} to improve productivity substantially.

"We felt that the 777X project was a great opportunity to introduce some of the best equipment in the world," said Eto.

Based on preliminary research in Japan and overseas, the project team knew for a fact that the machining center is highly reliable. The challenge was how to operate it.

MHI installed the HAIMER Tool Management system at its Eba Factory – a working area specifically designed for tool storage, assembly, presetting and administration. Preset areas have an image of being dark and are typically situated at the corner of a factory. To eliminate this common perception, MHI purposely installed the Tool Management system as a bright, clean and open area at the factory entrance to symbolize the company's attitude toward tool management and commitment to quality.

Takanori Terasako, MHI technician and a member of the 777X project, uses the HAIMER Tool Dynamic balancing machine at the Eba Factory in Hiroshima.

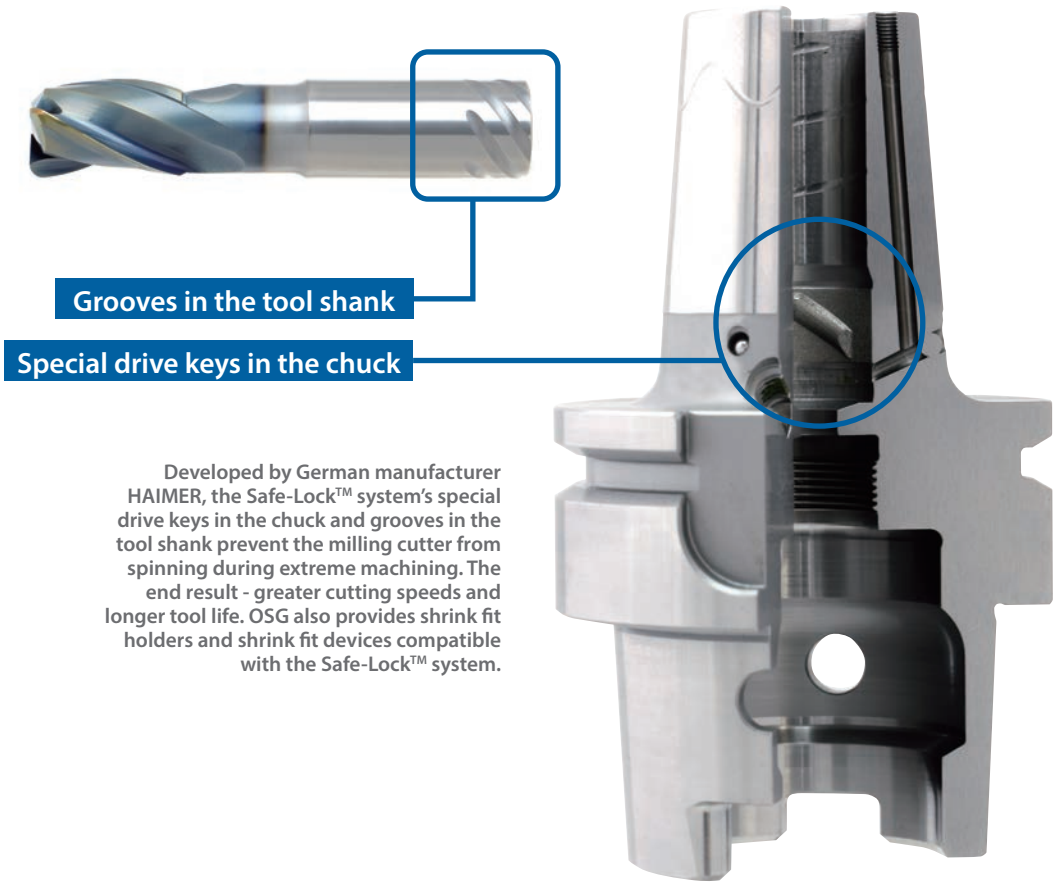
"High-speed milling machines offer high performance, but it is essential to pay close attention to the operating cost including the spindle unit," said Eto. "In order to increase productivity and reduce operating costs, it is necessary to control not only the machine, but the total performance from the spindle to the tool tip."

For the tooling, MHI conducted in-house research and cutting trials in advance to select the most appropriate cutter and tool holder. In order to achieve stable production at ultra-high-speed machining of over 30,000 min^{-1}, it is utmost critical to minimize the variation in performance of the cutting tool and tool holder. Specifically, it is crucial to control the variation when the tool is preset in the tool holder.

The start of production was under a tight schedule at the time. It was important that the tooling used have minimal difference between the process simulation and the actual performance. The more consistent the performance, the sooner MHI would be able to start up the actual machine without the need to conduct more tests for cutting condition settings. Among the tools that MHI have tested was OSG's AERO end mill series, which the company has been using for a long period of time. The tools from this series have also demonstrated good productivity and minimal difference from the simulation in field trials by machine tool manufacturers. Based on the results of the cutting trials, MHI selected OSG's AERO end mill series for the cutter.

OSG's AERO end mill series is designed to maximize the full potential of high-performance equipment over 80 kW. The AERO series is most ideal for high-efficiency machining of large aluminum aircraft components. The AERO-O-ETS 3-flute short type carbide end mill with internal coolant hole can be used for roughing up to finishing. It features a sharp cutting edge specification to enable excellent cutting, and an optimal flute geometry to facilitate trouble-free chip evacuation. Furthermore, its DLC coating provides a shiny surface with optimized end mill performance particularly in aluminum alloys that require welding resistance and lubricity. Its thin coating layer enables a sharp cutting edge, which contributes to smooth and superb surface finish, even in high-feed milling.

For the tool holder, MHI selected a high rigidity and precision shrink fit holder developed by German manufacturer HAIMER, as well as their Safe-Lock™ system for pull out protection of shank tools, which is a unique innovation of the company. The system's



Developed by German manufacturer HAIMER, the Safe-Lock™ system's special drive keys in the chuck and grooves in the tool shank prevent the milling cutter from spinning during extreme machining. The end result - greater cutting speeds and longer tool life. OSG also provides shrink fit holders and shrink fit devices compatible with the Safe-Lock™ system.

special drive keys in the chuck and grooves in the tool shank prevent the milling cutter from spinning during extreme machining to enable greater cutting speeds, longer tool life and a safer machining environment.

"Although it is rare for a cutter to completely come off during the machining of aluminum, the tool has slipped at the corner during roughing," said Eto.

"If slippage occurs during high-speed milling at 120 kW, the tool will chip. In the worst case scenario, the cutter will eventually become a round bar that cannot perform any cutting and will collide with the workpiece, which damages the spindle," Eto explains. "This scenario must be avoided at all costs, so we decided to install the Safe-Lock™ system."

Furthermore, in order to suppress variations in the overall tooling, HAIMER's Tool Dynamic Comfort Plus balancing machine is used to better control the influence of centrifugal force under high rotation. In order to manage preset errors, an automatic tool measuring device is also deployed.

MHI's new 5-axis horizontal machining center and the corresponding equipment are installed at the Eba Factory, where the 777X fuselage assembly plant is located, in order to streamline the production process.

The project is being tackled by a team of young technicians including Takanori Terasako, who are enthusiastic about the opportunity to manufacture aircraft parts using a new machining center, tooling system, and machining method. Since the schedule for the new model development project is relatively tight, lead engineers Eto and Unno from the Oe Factory joined the Eba project team at the time of startup. In addition, Kentaro Masutani, a technician who is highly experienced in machining large-scale machine parts also participated as a supporting member from steel-plant builder Primetals Technologies Japan Co., Ltd., a subsidiary of MHI.

"In the simulation, we set the cutting conditions while also looking at the load on the bearings," said Eto. "In order to reduce the difference between the actual cutting and the simulation, high quality of the tool cutting edge, preset accuracy, and vibration characteristics from the machine to the tool tip must be achieved," Eto elaborates. So, the machine operators were requested to realize very high accuracy in preset operations.

A section of MHI's Eba Factory in Hiroshima that is currently designated for the production of the Boeing passenger aircraft 777X.

"Unlike before, it was difficult at first to satisfy the automatically measured balance value and preset accuracy," said Terasako. "However, OSG's AERO end mill has a high shank accuracy and we are able to preset relatively smoothly."

"In terms of cutting conditions, steel and aluminum are very different," said Masutani. "But I think that the technology introduced for high-speed machining of aluminum can be applied to the machining of steel as well."

According to Unno, various problems arose during startup due to the adoption of a new machining process. "But thanks to the stable performance of the tooling, we were able to concentrate resources to trouble-shoot quickly," said Unno.

Eto adds that the AERO end mill is able to operate smoothly under identical conditions set during the simulation. "It is the stable quality of the tooling side that makes this replication possible," said Eto.

Although it was the first time for MHI to introduce a 33,000 min^{-1} spindle speed machine, its project team was able to overcome various challenges. Despite having to create a newly designed part using a new machining method, the team successfully completed the setup of the equipment in a short period of three weeks to complete the first product.

With the perfect combination of machine tool, cutter and holder, stable slotting and pocketing at a speed of 33,000 min^{-1} and a feed rate of 25,000 mm/min can be achieved.

Inside a section of MHI's Eba Factory in Hiroshima that is currently designated for the production of the Boeing passenger aircraft 777X. MHI is responsible for producing sections of the rear and tail fuselage as well as the passenger entry doors of the Boeing passenger aircraft 777X.

From left, Jun Eto and Hirokazu Unno, MHI lead engineers from the Manufacturing Engineering Department's Tool Design Team. Since the schedule for the new model development of the 777X project was relatively tight, the pair joined the Eba project team in Hiroshima at the time of startup to provide support.

With the OSG AERO end mill, metal removal rate reaches 6,200 cc/min at its maximum. Machining time is reduced by approximately 75 percent versus conventional machines.

MHI is currently producing several dozens of these aluminum parts every month. The cutter and tool holder from OSG and HAIMER are continuing to demonstrate consistent performance. Also, machine spindles in general are replaced in roughly a year. In MHI's case, its machine spindle is still in good shape after more than three years and can be used under identical cutting condition.

Osamu Nakano, who is in charge of introducing and managing milling machines and their associated equipment adds that "compared to previous machines, I am surprised that there are few failures around the spindle and made me recognize the importance of tooling quality."

Unno joins in and adds that by selecting the most optimum tool and tool holder, the required machining time has been reduced to 25 percent versus conventional method, and the life of the machine spindle has more than tripled. "In addition, by utilizing the Safe-Lock™ system, work defects caused by tool pull out can be prevented and results have demonstrated its effectiveness," said Unno.

According to Eto, mass production of the 777X began a couple of years ago and production rates are planned to increase. It is necessary to further enhance machining efficiency. At MHI, the company always strives to channel new ideas into solutions that move the world forward. "We are not satisfied with the status quo as growth does not stop," said Eto. "We will continue to gather information from all over the world and pursue the latest technology to move aircraft manufacturing forward."

Scan to learn more about MHI.

Scan to learn more about OSG's AERO end mill series.

Scan to learn more about the OSG-HAIMER Safe-Lock™ system and corresponding products.

ADO-40D and 50D Coolant-Through Carbide

Ultra-efficiency in deep-hole drilling applications

Takahiro Yamamoto
OSG Corporation Applications Engineer (Drill Development Division)

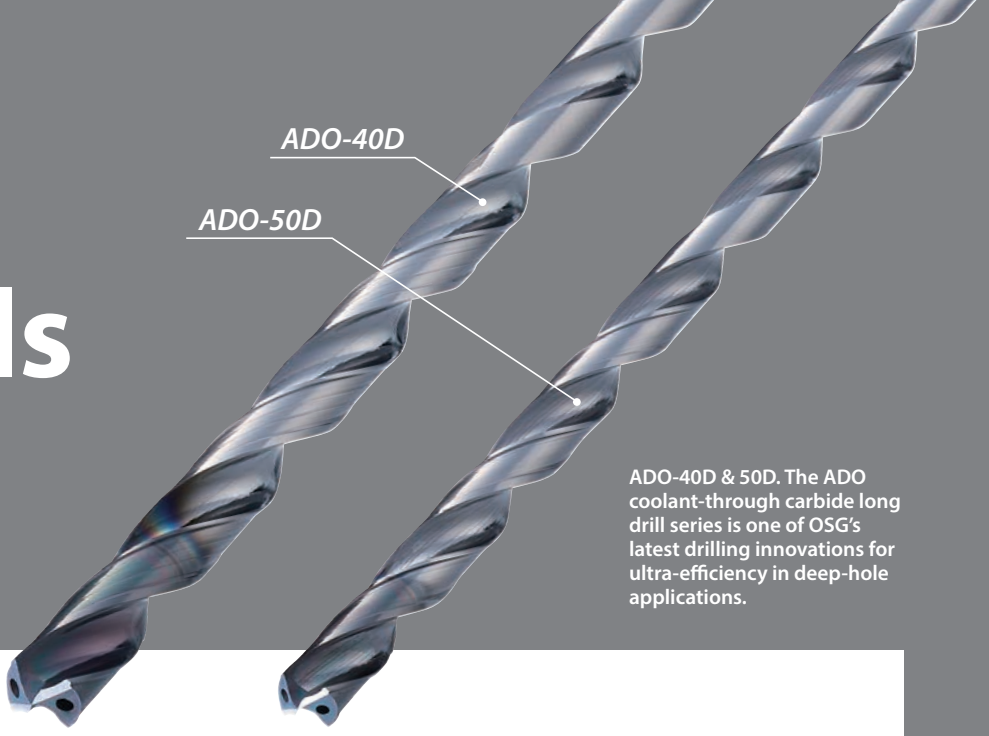
For many years, gun drills and HSS long drills have been the tooling of choice for deep-hole applications. For drilling depth of 30xD or less, carbide twist drills capable of high-efficiency performance have become more and more widespread in recent times. However, for deep-hole applications exceeding 30xD, it is still a great challenge for carbide twist drills to achieve stable high-efficiency performance. Thus, gun drills continue to be commonly chosen for ultra-deep-hole scenarios.

OSG Corporation is pleased to introduce one of its latest drilling innovations for deep-hole applications – the ADO-40D and 50D coolant-through carbide long drills – engineered for ultra-efficiency and superior stability with performance equivalent to drilling 30xD or lower depth.

Features of ADO-40D and 50D

There are three key features of the ADO-40D and 50D that contribute to high-efficiency and stable machining of deep holes exceeding 30xD. The most important feature is its newly developed R gash geometry.

Long Drills



ADO-40D & 50D. The ADO coolant-through carbide long drill series is one of OSG's latest drilling innovations for ultra-efficiency in deep-hole applications.

Although conventional carbide twist drills are capable of producing finely divided chips, when machining steel materials such as carbon steel, alloy steel and stainless steel, elongation of chips can easily occur. The unstable chip shape interferes with chip evacuation, which is especially problematic in deep-hole drilling, and may lead to sudden tool breakage.

The ADO's newly developed R gash geometry expands the chip room at the center of the tool where chips are difficult to be discharged. With the optimized R shape to guide the direction of chip flow, chips can be evacuated smoothly. Moreover, with this new feature, the curling of chips is controlled, and the consistency of chip shape has significantly improved to allow superior chip separation versus the conventional design. In addition, the cutting force (thrust resistance) is reduced by approximately 30 percent compared to the conventional design, thereby enabling the suppression of machining vibration in high-feed machining and improves straightness during drilling.

Figure 1. Newly developed R gash geometry. The newly developed R gash geometry enables a cutting force reduction of 30 percent or more compared to the conventional design with exceptional chip shape stability.

The second key feature of the ADO long drill is its new flute specification that enables smooth evacuation of the compact chips created by the R gash geometry, while maintaining high tool rigidity of the long tool body necessary for 40xD and 50xD applications. Chip evacuation capability has been greatly amplified by expanding the width of the flute, which functions as chip room. A 25-degree helical flute geometry is applied to enhance rigidity without interfering chip evacuation capability.

Last but not least, just as important as the previous two key features is the adoption of OSG's original EgiAs coating for high durability. The EgiAs coating is consist of overlapping nano-periodical layers and wear-resistance layers, engineered to suppress the propagation of cracks that are likely to occur during drilling. The wear-resistance layer is composed of multiple hard layers; while the nano-periodical is a combination of hard and soft layers. With a mixture of hard and soft layers, internal stress can be relieved, allowing the EgiAs coating to achieve both high wear resistance and extreme toughness to ensure stable and consistent tool life under aggressive cutting conditions.

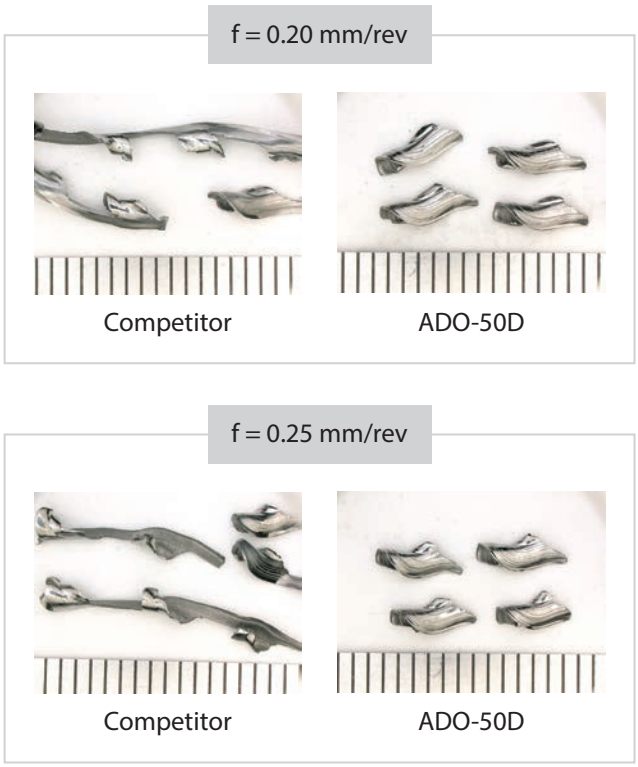
Cutting Data

As mentioned previously, the most notable advantages of the ADO long drill are its consistent chip separation ability, low cutting resistance, and capability to achieve a fine balance between tool rigidity and trouble-free chip evacuation regardless of the long cutting depth to allow stable and efficiency processing.

1. Consistent Chip Separation Ability

Figure 2. Chip shapes in alloy steel SCM420H, which is highly viscous among steel materials.

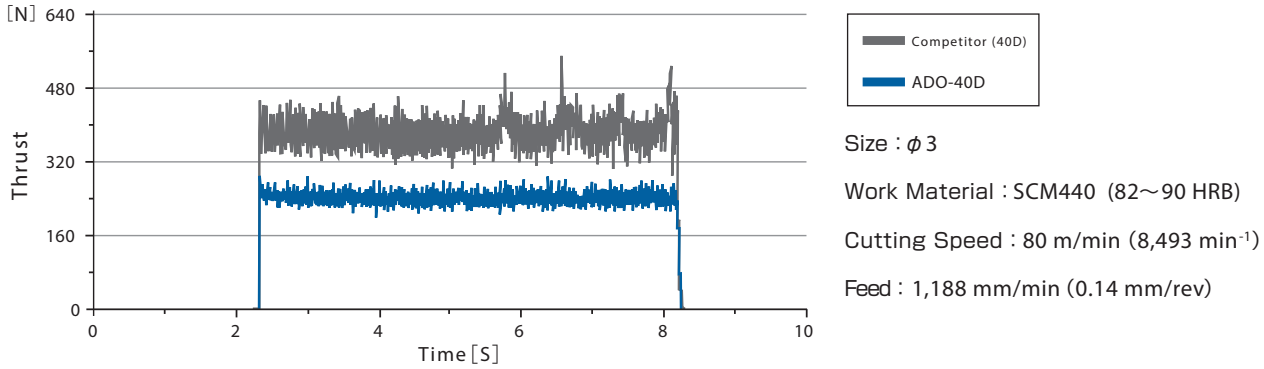
Benefit of R Gash Geometry	
Work Material	SCM420H
Tool Diameter	Ø 5 mm
Hole Depth	250 mm (blind)
Cutting Speed	60 m/min
Feed	0.20 – 0.25 mm/rev
Processing Method	Non-step
Coolant	Water-soluble (dilution concentration 5%)
Coolant Pressure	7 MPa
Machine	Multifunction Lathe
Pilot Hole Diameter / Depth	Ø 5 / 25 mm
Pilot Hole Processing Condition	Vc = 60 m/min f = 0.15 mm/rev



As depicted in figure 2, the competitor carbide twist drill is unable to separate the chips effectively and ended up with elongated chips. The ADO-50D, on the other hand, demonstrates finely divided chips that are consistent in shape. The stability of cutting chips is one of the most important factors for achieving stable machining in deep-hole applications. As will be depicted later on in the article, this factor is the key to stable and extremely long tool life.

2. Low Resistance Processing

Figure 3. Cutting force resistance comparison when machining SCM440.

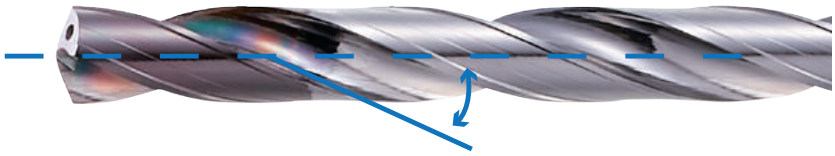


As shown in figure 3, the thrust resistance generated by the ADO-40D has been reduced by approximately 30 percent compared to the competitor drill (conventional design). The recorded waveform is calm and consistent, contributed by the ADO-40D's smooth chip evacuation capability for stable performance.

3. High Tool Rigidity with Excellent Chip Evacuation for Achieving Stable Machining

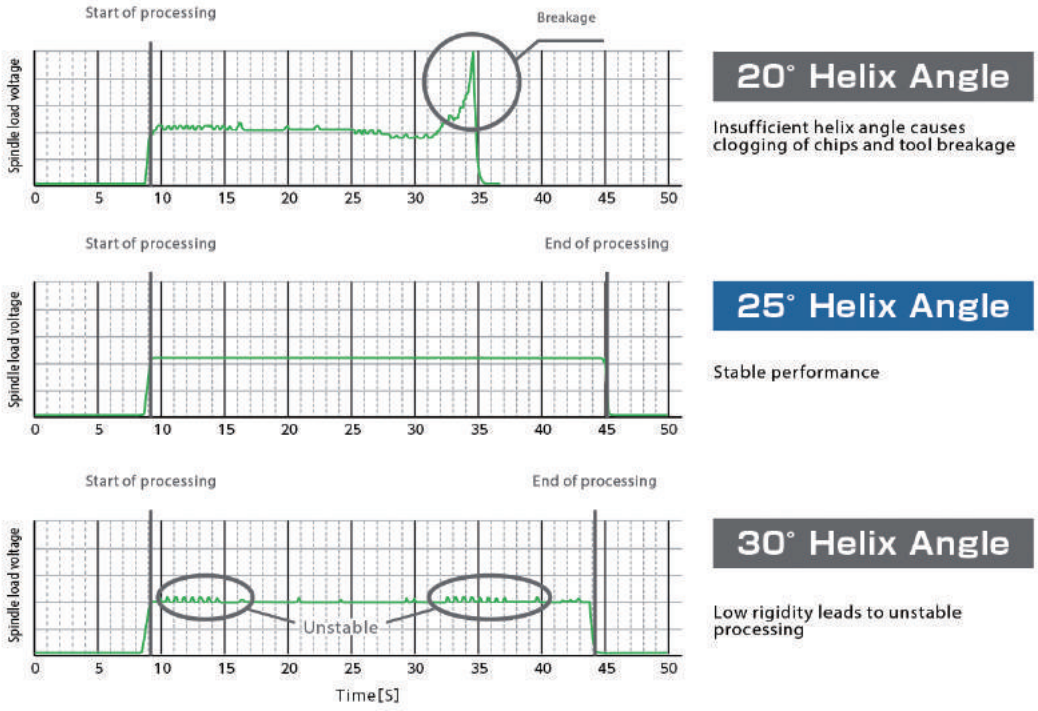
For long drill lengths such as 30xD, 40xD and 50xD, the tool rigidity is reduced by nature due to the long overhang length. By increasing the bottom flute diameter or by reducing the helix angle can enhance tool rigidity. However, since the machining depth is deep, the path required for chip discharge is also lengthy. If too much emphasis is placed on the tool rigidity, chips cannot be evacuated smoothly. To resolve this challenge, the ADO-40D and 50D carbide long drills have employed a 25-degree helix angle versus the 30-degree helix angle commonly found in coolant-through carbide drills. This design ensures tool rigidity without impairing chip evacuation.

Figure 4. Helix angle's effect on machining



Benefit of 25° Helix Angle	
Work Material	SCM440 (82-90 HRB)
Tool Diameter	Ø 6 mm
Hole Depth	300 mm (blind)
Cutting Speed	60 m/min
Feed	0.30 mm/rev
Processing Method	Non-step

Benefit of 25° Helix Angle	
Coolant	MQL (50 cc/h)
Coolant Pressure	0.8 MPa
Machine	Horizontal Machining Center
Pilot Hole Diameter / Depth	Ø 6 / 30 mm
Pilot Hole Processing Condition	Vc = 60 m/min f = 0.12 mm/rev



As depicted in figure 4, vibration due to insufficient tool rigidity is observed during machining with the conventional 30-degree helix angle. While the 20-degree helix angle configuration has difficulty discharging cutting chips. The 25-degree helix angle demonstrates excellent stability and smooth chip evacuation.

With the previously mentioned key features of the ADO carbide long drill and the effect of OSG's newly developed EgiAs coating, long tool life and stable machining is made possible in deep-hole applications. Figures 5 and 6 highlight the superior performance of the ADO long drills that far surpass gun drills and other competitor products.

Figure 5. Performance versus gun drill (Hole size: dia.8 mm)

Roller Shaft Processing in SCM440 (performance comparison against gun drill + twist drill)				
Process	**Item**	**First Step**	**Second Step**	**Third Step**
Conventional Method	Tool	Competitor carbide drill (5D type)	Competitor carbide long drill (30D type)	Competitor gun drill
	Hole Depth	40 mm	215 mm	391 mm
	Cutting Condition	Vc = 60 m/min, f = 0.16 mm/rev	Vc = 50 m/min, f = 0.12 mm/rev	Vc = 60 m/min, f = 0.06 mm/rev
	Tool Life	1,250 holes Wear and replacement	200 holes (35 m) Wear and replacement	150 holes (26 m)
Competitor (50D Type)	Tool	Competitor carbide drill (5D type)	Competitor carbide long drill (50D type)	Unstable processing; unable to reduce tool used and steps
	Hole Depth	40 mm	391 mm	
	Cutting Condition	Vc = 60 m/min, f = 0.16 mm/rev	Vc = 70 m/min, f = 0.15 mm/rev	
	Tool Life	1,250 holes Wear and replacement	Less than 60 holes (< 21 m) Breakage and clogging of chips	
ADO-50D	Hole Depth	40 mm	391 mm	Reduction in tool used and steps
	Cutting Condition	Vc = 70 m/min, f = 0.24 mm/rev	Vc = 62.8 m/min, f = 0.3 mm/rev (3.7% x D)	
	Versus Conventional (Efficiency)	175%	Vs. competitor 30D: 314% Vs. gun drill: 523%	
	Tool Life	1,750 holes Wear and replacement	256 holes (90 m) Can continue to be used	
	Versus Conventional (Tool Life)	140%	Vs. competitor 30D: 257% Vs. gun drill: 346%	

Cutting edge condition of ADO-50D after drilling 256 holes

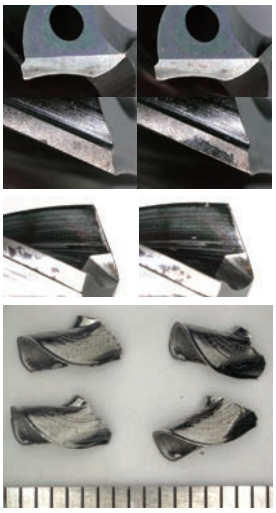
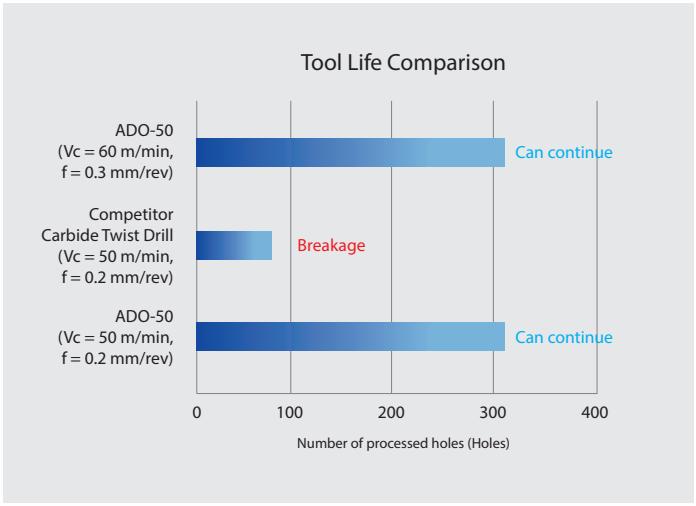


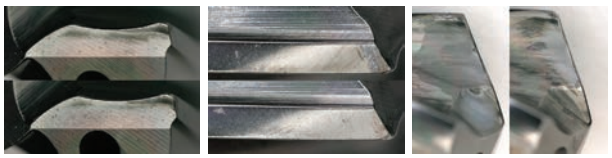
Figure 5 introduces an example of using the ADO-50D to reduce the number of steps required for deep-hole drilling to improve higher processing efficiency while extending tool life.

Conventionally, deep-hole applications require the use of three tools – pilot hole drill, carbide twist drill (up to 27xD) and gun drill. However, in the cutting example illustrated in figure 5, the process is carried out in two steps, where only two tools – pilot hole drill and carbide long drill (50xD) are used to reduce the number of processes, increase efficiency and extend tool life. With the competitor long drill, machining is highly unstable and tool life is short. Thus, it is not possible to perform the operation in two steps. By employing the ADO-50D, on the other hand, significant processing time reduction and long tool life can be achieved. The long drilling process after the pilot hole can be completed with a single tool. Moreover, tool life is estimated to be 1.3 times longer with more than 2.5 times the drilling distance being machined. In this cutting trial, the ADO-50D is able to perform at more than 3 times the processing efficiency stably versus the conventional method.

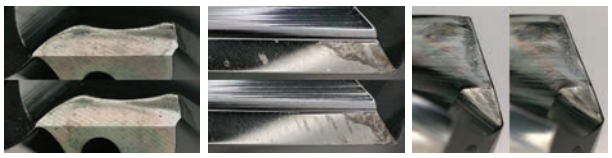
Figure 6. Performance versus the competitor

Transmission Shaft Processing (performance vs. competitor twist drill)	
Tool	ADO-50D Ø 5 mm
Work Material	SCM420H
Processing Method	Non-step
Cutting Speed	50 - 60 m/min
Feed	0.2 – 0.3 mm/rev
Hole Depth	250 mm (blind)
Coolant	Water-soluble (dilution concentration 10%)
Coolant Pressure	7 MPa
Machine	Horizontal Machining Center (BT40)
Pilot Hole Diameter / Depth	Ø 5 / 25 mm
Pilot Hole Processing Condition	Vc = 60 m/min f = 0.15 mm/rev





Vc = 50 m/min, f = 0.2 mm/rev, cutting edge wear condition after drilling 322 holes



Vc = 60 m/min, f = 0.3 mm/rev, cutting edge wear condition after drilling 322 holes

As depicted in figure 6, the competitor carbide twist drill encountered sudden breakage due to unstable chip shape and chip evacuation, which can commonly occur at 100 holes or less. The ADO-50D, on the other hand, is able to machine under identical cutting condition as the competitor, but with 1.8 times the machining efficiency and more than 3 times the tool life consistently.

The ADO-40D and 50D are able to demonstrate their superior capability to eliminate machining troubles such as abrupt tool breakage, short tool life, long processing time and unstable performance commonly found in deep-hole applications.

The newly developed R gash geometry applied in the ADO long drill is also used in OSG's ADO-TRS 3-flute carbide drill for ultra-machining efficiency and stability in steel applications. In the future, OSG will look to apply this unique specification to other products and evolve the company's A-Drill series to better meet today's demand of higher stability, efficiency, longer tool life, and greater precision machining.

For manufacturers who are struggling with deep-hole drilling, look to the ADO-40D and 50D to experience ultra-processing efficiency and stability.

The ADO-40D is available from diameter 3 mm up to 10 mm. The ADO-50D is available from diameter 3 mm up to 8 mm. Custom sizes are also available upon request. The manufacturable range of special sizes is indicated in figure 7.

Figure 7. Manufacturable range of special sizes

Unit:mm

Diameter range	Maximum overall length	Maximum flute length	Maximum drilling depth of hole								
			50	100	150	200	250	300	350	400	450
3	209	159			150						
~4	262	212				200					
~5	315	265					250				
~6	428	378							360		
~7	456	406								380	
~8	500	450									430
~9	500	450									420
~10	500	450									420
~11	500	450									420
~12	500	450									420
~13	500	450								410	
~14	500	450								410	
~15	500	450								410	
~16	500	450								400	

Manufacturable range

Scan for details

From left to right, OSG Sulamericana Product Designer James Reis, ZF Engineer Guilherme Gonçalves, ZF Engineer Éldio Pinto, ZF Tool Presset Matheus Ribeiro and OSG Sulamericana Sales Technician Bruno Dias pose for a photograph at ZF's manufacturing plant in Limeira, São Paulo, Brazil.

Tailored Solution

OSG custom carbide tap eliminates chip evacuation issues in automotive pipe production

Marcela Rattin Bombini
OSG Sulamericana

Founded in August 1958, ZF do Brasil Ltda. is an automotive company, with one of the eight facilities located in the city of Limeira, São Paulo, Brazil, with an estimate plant area of 50,000-square-meter. ZF do Brasil is a part of the ZF Group, which was established in 1915. Headquartered in Friedrichshafen, Baden-Württemberg, Germany, the ZF Group is a global technology company that supplies systems for passenger cars, commercial vehicles and industrial technology, enabling the next generation of mobility. As of today, the ZF Group is available in approximately 230 locations in 40 countries.

Recently, ZF was looking to improve tool performance on its automotive pipe production, which is used in car steering mechanism for the automotive segment. Made of SAE 1045 forged steel, ZF produces approximately 900,000 pieces of pipes per year, and it is one of the largest productions of the company. ZF has been manufacturing this part for about four years. Eight pieces of pipes are produced per machine cycle. Each part requires vertical threading of one blind hole using an M14 tap. The hole is 46 mm in length, 38 mm in depth, and with a tap tolerance of 7H. The thread finish should be polished and without burrs.

OSG Sulamericana Sales Technician Bruno Dias inspects a finished thread made by OSG's custom carbide tap at ZF's manufacturing plant in Limeira, São Paulo, Brazil.

1. From left, OSG Sulamericana Product Designer James Reis, ZF Engineer Guilherme Gonçalves, ZF Engineer Éldio Pinto and OSG Sulamericana Sales Technician Bruno Dias, inspect OSG's custom carbide tap.

2. A custom carbide tap M14 x 1.5 7HX with AlTiN coating was developed specifically for ZF's automotive pipe production to eliminate tapping issues.

3. Made of SAE 1045 forged steel, ZF produces approximately 900,000 pieces of automotive pipes per year, and it is one of the largest productions of the company.

4. In addition to standard items, OSG also offers custom tooling as well as modification and coating services to help manufacturers maximize productivity and quality.

ZF was originally using a carbide tap M14 for the application. However, the company was experiencing great difficulty with irregular chip formation, bird nesting, and elongated chips that cause chipping of the fillets. Furthermore, with cutting chips clogged up in the bottom of the hole unable to be evacuated, issues such as chipping and tool breakage were also a great headache for the company. OSG Sulamericana was an existing tooling supplier for ZF in other applications. When the opportunity arose to compete within this process, OSG entered and won the order with superior result.

Upon a detail evaluation of the manufacturing process, OSG Sulamericana Sales Technician Bruno Dias proposed a custom carbide tap M14 x 1.5 7HX with AlTiN coating developed specifically for the application. OSG's custom carbide tap was put into a Doosan MV3016LS vertical machining center, running at a cutting speed of 30 m/min with soluble oil. ZF's previous tooling choice was able to complete 1,200 pieces. OSG's custom tool, on the other hand, was able to complete 2,880 pieces, which more than doubled the efficiency. Immediately, ZF was able to obtain an improvement in the threading process, a gain in tool life, as well as setup time.

ZF's machine operator prepares for the machining of automotive pipes using a Doosan MV3016LS vertical machining center.

"We cannot be more pleased with OSG's service," said ZF Engineer Guilherme Gonçalves. "Bruno is always present when help is needed. ZF looks for reliable partners to help during time of troubles, and OSG is always there, which contributes to a long-lasting partnership."

From left, Lifetime CNC Programmer Randy Macari and OSG USA District Manager Steve Lauman pose for a photograph at Lifetime's manufacturing facility in Clearfield, Utah, USA.

High Speed Machining

The perfect combination of cutting tool, tool holder and machine tool takes mold manufacturer to a new level of productivity

Steve Lauman
OSG USA

For the past 20 years, Lifetime Products Incorporated's mold shop has been producing aluminum blow molds to support the company's production of plastic tables, chairs, coolers, kayaks, outdoor sheds, and much more. Lifetime first started its legacy in the sporting goods industry in 1986, introducing a breakthrough basketball system that can be adjusted in seconds. It was the first system that allows basketball hoop homeowners to easily raise and lower the height quickly. Since then, Lifetime has become the world's largest manufacturer of residential basketball hoops as well as folding tables and chairs, selling products in 58 countries around the globe. Today, the company has grown from 15 employees in a partial warehouse to over 1,500 employees around the world, serving the sporting goods, folding furniture, lawns and garden, playground and the watersports markets.

Lifetime's global business and manufacturing headquarters is located in Clearfield, Utah, USA. Lifetime's mold division, which was established in 1999, currently employs 23 staff and has an estimate production area of 16,000-square-feet. As an organization that is committed to innovation and quality, Lifetime is constantly looking for ways to improve their manufacturing process.

For some time, Lifetime has been searching for new solutions to enhance efficiency in their mold production primarily made of aluminum materials such as 6061, 7075 and QC10. In terms of production volume, Lifetime on average produces 20 to 30 molds per year. Lifetime Mold Engineer Dennis Norman and Lifetime Head CNC Programmer Randy Macari are well versed on high speed machining and how it can help them attain much higher productivity. They also understood the required three essential components in order to maximize the benefit of high speed machining – high performance tooling capable of running high speed machining programs, precision holders to secure tool engagement at high rpms, and a machine tool with features such as look ahead software and the ability to run at high speeds.

1. Combined with Lifetime's new Mazak vertical machining center, OSG's 3/8" 3-flute Blizzard end mill is able to reach its full potential, with parameters as high as 15,000 rpm and 220 ipm to generate unparalleled results in productivity.

2. Lifetime's mold production is primarily made of aluminum materials such as 6061, 7075 and QC10.

3. For the past 20 years, Lifetime Products Incorporated's mold shop has been producing aluminum blow molds to support the company's production of plastic tables, chairs, coolers, kayaks, outdoor sheds, and much more.

The first requirement of high-performance tooling was met when Lifetime began utilizing OSG end mills. Lifetime's previous tooling choice was a 3/8" 3-flute end mill that was used at 6,000 rpm and 60 ipm. The second requirement was met with OSG's HY-PRO shrink fit holder and shrink fit technology. OSG's balanced holder gave Lifetime the ability to mill in excess of 20,000 rpm. The fulfillment of the first two requirements has greatly improved tool life and performance at Lifetime. However, further progress was held back because Lifetime's older machine tools are incapable of running high speed machining programs. It all changed when this past year, a new Mazak FJV-60/120 vertical mill arrived with look ahead controls designed for high speed machining along with a high-pressure coolant through spindle. With the equipment update, Lifetime is now able to fully leverage OSG's Exocarb Aero Blizzard high performance carbide end mill.

The Exocarb Aero Blizzard series is a part of the OSG premium line of carbide high performance end mills specifically designed for aluminum and copper alloys. The series' special end cut gashing and offset teeth permit large depths of cut and maximum feed per tooth. Made with polished flutes to enhance tool life and reduce built up edges, the Blizzard end mill series is engineered to yield high metal removal rates in roughing applications while providing a superior finishing.

Combined with the new Mazak vertical machining center, OSG's 3/8" 3-flute Blizzard end mill is now able to reach its full potential, with parameters as high as 15,000 rpm and 220 ipm to generate unparalleled results in productivity. These improvements across all the different milling operations at Lifetime have created an average of 25 percent cycle time reduction. A typical mold is now machined and built in less than 12 weeks, down from an average of 16 weeks. In addition to increased speeds and metal removal rates, Lifetime also saw much improved surface finish, which lowered labor costs by reducing the amount of labor time needed to polish the cavity components of each mold. The combination of a quality tool with precision tool holder engages the workpiece in a more rigid and stable environment, thus resulting in a better surface finish. The overall polishing time was reduced by more than 75 percent. Mold polishing in general added 40 hours to the mold build time, which has now been reduced to eight hours.

"OSG's Blizzard end mill's performance helped exceed our objectives needed to deliver our molds faster and better," said Lifetime Products CNC Programmer Randy Macari.

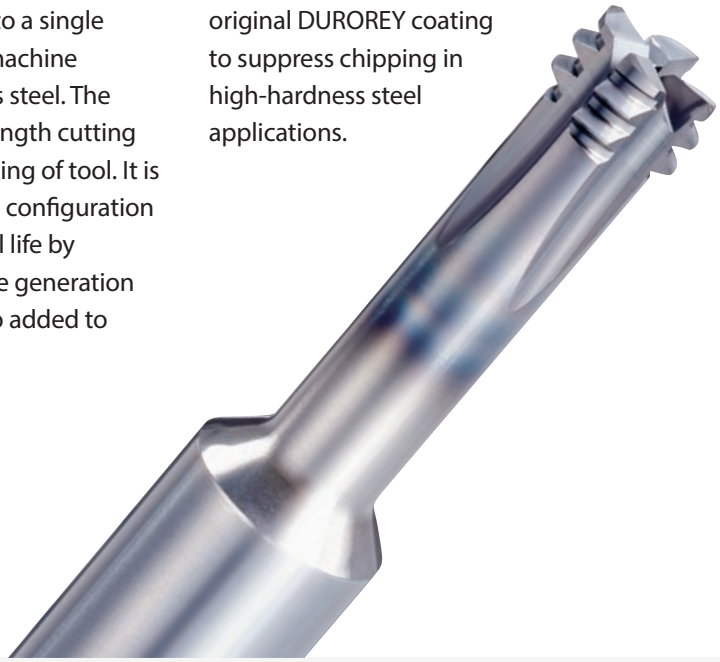
High productivity can only be achieved with the perfect combination of cutting tool, tool holder and machine tool. By constantly improving, innovating and leveraging the latest manufacturing technologies, Lifetime will continue its journey in creating affordable and lasting products for consumers and their families.

The Exocarb Aero Blizzard series is a part of the OSG premium line of carbide high performance end mills specifically designed for aluminum and copper alloys. The Exocarb Aero Blizzard end mill series is available in various end styles, such as square, corner radius and ball.

AT-2

Helical Drilling and Threading Combo Tool for High-Hardness Steels

OSG's latest AT-2 carbide thread mill is developed specifically to combine the drilling of a pilot hole and threading into a single procedure even in difficult-to-machine materials such as high-hardness steel. The AT-2 features a unique high strength cutting edge shape to control the bending of tool. It is engineered with a left-hand cut configuration for climb milling to prolong tool life by reducing tool deflection and the generation of heat. Roughing teeth are also added to distribute tool load. Furthermore, the AT-2 is coated with OSG's original DUROREY coating to suppress chipping in high-hardness steel applications.



AM-EBT and AM-CRE

Carbide End Mills for Additive Manufacturing Applications

The AM-EBT ball type carbide end mill features a robust 3-dimensional negative geometry optimized for large depth of cut. The AM-CRE radius type carbide end mill is available in 6-flute or 8-flute configuration. The AM-EBT and AM-CRE end mills are recommended for hardened steel, pre-hardened steel, stainless steel, heat-resistant alloy additive manufacturing applications and built-up welding parts.

Phoenix PSTW

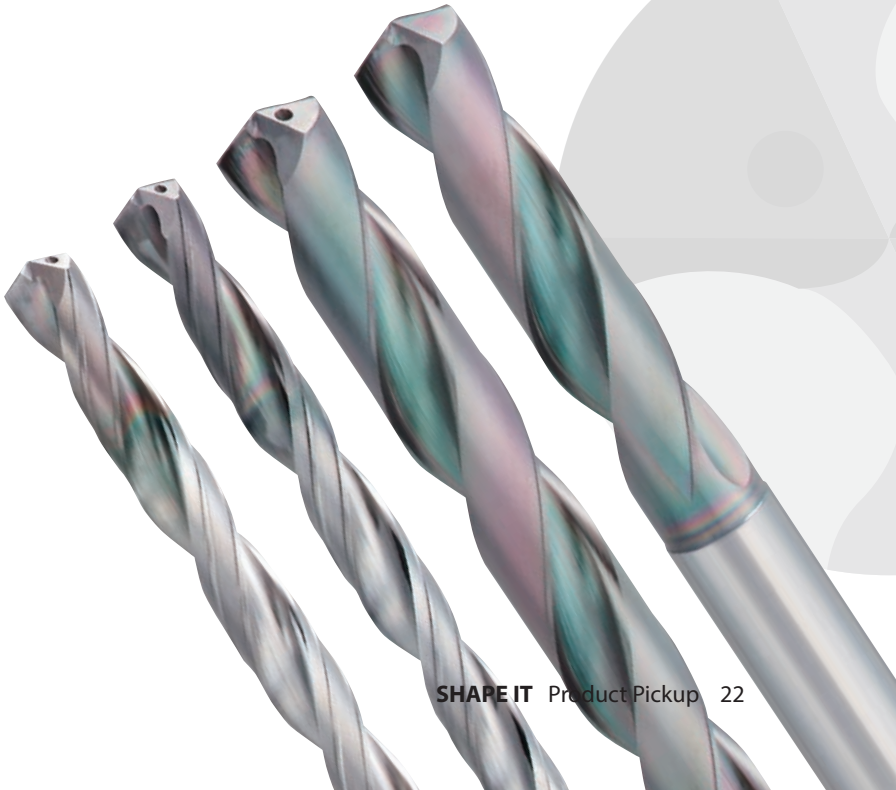
6-Corner Shoulder Milling Cutter

The OSG Phoenix PSTW 6-corner shoulder milling cutter is designed for high efficiency heaving milling. The PSTW series is engineered to effectively process long overhang length applications with strong chattering resistance with its high rigidity and positive rake angle geometry.

AD and ADO

Solid and Coolant-Through Carbide Drill Series

The AD and ADO are OSG's next generation high performance solid and coolant-through carbide drill series designed for every drilling application. Low thrust, enhanced durability and stable drilling is made possible with the adoption of a unique point form. With the addition of OSG's original EgiAs coating, high wear resistance can be achieved to further prolong tool life. The AD solid carbide drill is available in 2xD and 4xD. The ADO coolant-through carbide drill is available from 3xD up to 50xD.



OSG Corporation launches Web Showroom to manufacturers in a new exhibition style

OSG Corporation has recently launched a new online exhibition website – the OSG Web Showroom. Many exhibitions have been canceled or postponed due to the spread of the coronavirus. Moreover, due to the postponement of the Tokyo Olympics, it has become a challenge to secure venues for exhibitions domestically. As sales and services must continue to accommodate new attitudes and behaviors in the era of COVID-19, the company has looked beyond tradition exhibitions and opted for a digital experience that is not tied to time or place.

Incorporation of various functions that emphasize customer communication

OSG considers an exhibition to be a place for communication with its customers. It is the core value of exhibiting at a trade show that the company interacts with customers who visit the booth, rather than unilaterally promoting products. The new OSG Web Showroom is no different. OSG offers a live chat feature (currently available in Japanese only) that allows its representatives to communicate with customers seamlessly. Visitors can discuss about tools and machining with ease just like they would physically at an exhibition booth. Live chat support is handled by OSG's technical staff who are experts in the field. In addition to tool selection and calculation of cutting conditions, OSG also has a system in place to respond to a wide range of inquiries regarding machining methods and machine setup. With the addition of the chatbot feature, information such as product brochures and application videos can be easily and quickly accessed.

connect with

Although the global outbreak of COVID-19 presents a significant challenge for physical interaction, it is also driving organizations to reinvent and evolve through the use of digital technology. With the new OSG Web Showroom platform, OSG will strive to meet customer expectations with even greater creativity and innovation.

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Access the OSG Web Showroom

OSG Around the World

Employee Interview with

Jason Kennedy

Jason Kennedy
Location: Canada
Position: Western Regional Manager
Joined OSG: 2010
Motto: "Opportunities don't happen. You create them."

Tell us about your work and experience at OSG.
From the start of my career, I have always been involved in the manufacturing industry. I began my machining apprenticeship in the United Kingdom two days after my 16th birthday in 1991. Upon completing my apprenticeship early, just under three years, I started working in a couple of machining cells, manufacturing various components for steam turbine generators. In 2000, I had the opportunity to manufacture racing engines for various motorsports, such as Formula 1, World Rally Championship, Grand Prix motorcycle racing, IndyCar, etc. In 2005, I changed employers where I held the position of an electromechanical maintenance engineer. In 2006, my family made a life-changing decision and we decided to immigrate to Canada. We immigrated directly to Calgary, Alberta where I worked in the oil and gas sector for four years, before joining OSG Canada in August 2010. My original position was sales engineer for the provinces of Alberta and Saskatchewan. In 2014, I was promoted to my current position as western regional manager.

Kennedy's family immigrated to Canada from the United Kingdom in 2006 and recently became fully fledged Canadian citizens.

Tell us about your daily routine.
Being in sales, I cannot sit back and wait for the sales to come to me. I have to plan and strategize in order to grow sales for my territory. One of the most interesting challenges for my work is how my workday varies from day to day. Depending on the day of the week, I could be stepping on a plane at 6 a.m., joining the highway for a several hour drive, meeting with a customer to discuss an application, or my favorite part of all – testing an OSG tool on the customer spindle.

What is most challenging about your work?
Like a lot of careers, time management can be one of the main challenges, and this is no different for me. OSG has many customers – both distributors and end users. I sometimes find it a challenge to meet with everyone locally, while also communicating with customers who are reaching out to me from other cities in my territory. Although managing this juggling act can be time consuming, it is also very rewarding when things fall into place.

What is unique about OSG Canada?

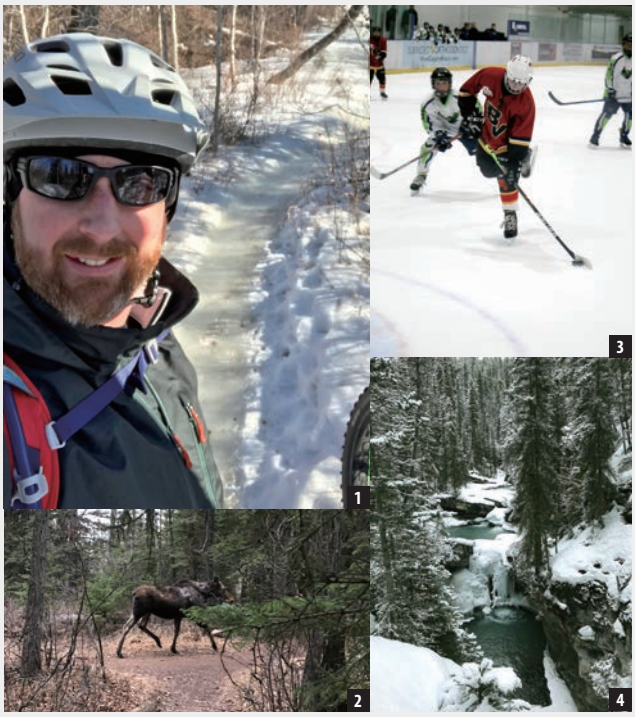
OSG Canada has terrific teamwork. Our employees are our strengths, who are always providing teams out in the field with exceptional support behind the scenes. Having a reliable network of support enables us to have the confidence to provide the best possible products and services to our clients in Canada.

What is your favorite OSG tool?

My favorite OSG tool is the AE-VML long flute carbide end mill, which is a part of the A Brand AE-VM anti-vibration carbide end mill series. In my main territory, there is a lot of solid carbide end mill applications. In the past, I have found that our competitors are able to offer some very competitive products. However, OSG's A Brand end mills are very well received and have demonstrated consistent positive results. When running the AE-VML end mill in particular, this tool is able to stand head and shoulders above other similar competitive products in the market.

The AE-VML long flute carbide end mill is a part of the AE-VM anti-vibration carbide end mill series designed to attain an all new level of milling efficiency coupled with superb finish quality suitable for a variety of milling applications. High-speed side milling is made possible by the AE-VML's large thick core design. Its unique flute form with high tool rigidity and excellent chip evacuation properties enables stable milling performance and the suppression of burrs. With the addition of OSG's original DUARISE coating, tool life can be enhanced by its excellent lubricity, superior friction-resistance and high oxidation temperature qualities.

Kennedy's family enjoys spending time outdoor and would often camp near the Canadian Rockies.



1. During time off work, Kennedy enjoys mountain biking on the trails.

2. A photograph of a moose calf taken from the Fish Creek Provincial Park in the southern part of Calgary, Alberta, Canada. According to Kennedy, wildlife sometimes would wander into the city from the mountains.

3. Kennedy watches his 13-year-old son Bill plays competitive ice hockey.

4. A photograph from the Johnston Canyon in Banff National Park. There are several hiking trails that are open all year round.

How do you spend time on your day off?

I have two children, Keira, who is 15 years old, and William, who also goes by Bill, is 13 years old. Bill plays competitive ice hockey and basketball. As any sports parent knows, this can be a full-time commitment, with the team members being like a temporary family for the sports season.

I live in Calgary, Alberta, which is approximately 1-hour east of the Canadian Rockies. So, my family always tries to spend as much time outdoors as we can, all year round. Whenever we get a chance, we will head out camping in the mountains. Canada is the home to a large population of wildlife, such as bears, cougars, wolves, moose, etc. The close proximity is phenomenal. At the same time, however, we have to be cautious and respectful of the wildlife.

I also like to get away from the hustle and bustle of the city and will head out on my own or with some friends mountain biking on the trails. When the weather is nice, the trip will often end with a BBQ when we return to the vehicle.

shaping your dreams

Superior performance in high-hardness steel applications

AE-BM-H • AE-BD-H • AE-LNBD-H

Carbide Ball End Mills

scan for details

The A Brand