2018-2019

TOOLING today

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2018-2019

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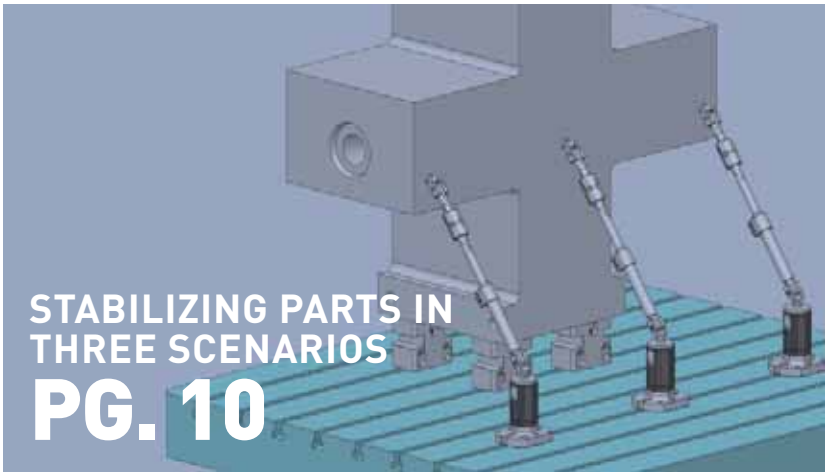

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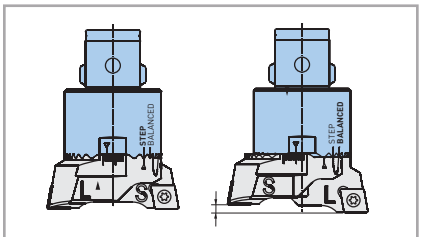
COVER

The MEGA SYNCHRO Tapping system is perfect for high-performance rigid tapping on CNC machines. Thread quality and tool life are improved by reducing thrust loads caused by synchronization errors during rigid tapping.

Productive Alternative to Helical Interpolation for High-Volume Holemaking

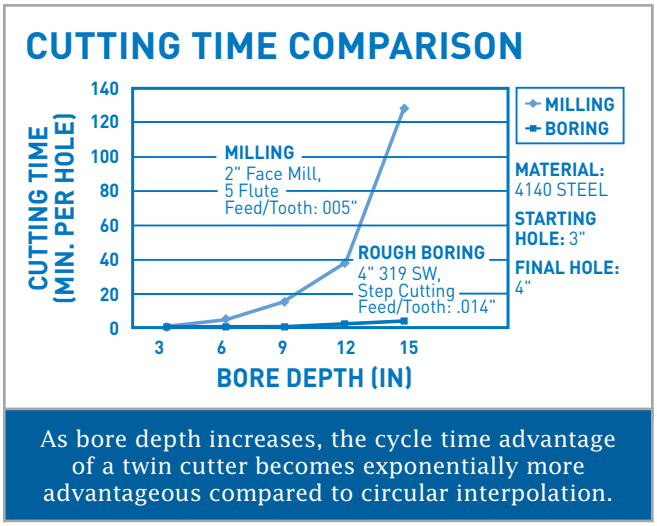
Matt Tegelman

The limitations of using milling tools to prepare holes for finishing become apparent as hole depth and volume increase. Enter the relatively simple and affordable twin cutter, which can solve this and virtually any other holemaking problem.



To adjust insert height, simply reverse the insert holders to switch between balanced and stepped cutting.

Helical interpolation using milling tools is a useful, tried-and-true method of preparing holes for finishing. Simultaneously rotating the cutter and moving it axially at a defined pitch makes a range of diameters and profiles – such as wide shoulders – possible with one tool by simply making more expanding sweeps. As hole depth and volume increase, however, limitations in this approach reveal themselves. A sufficiently rigid end mill can only be so long, requiring more and more time-consuming steps as depth increases – and the depth of the hole itself is limited. As the end mill lengthens, deflection becomes harder and harder to avoid because of the dynamic radial load. An operator could always make extremely light cuts as the mill moves through the hole, but that is a drag on cycle time that's not viable in production. Another variation is to use a helical milling cutter to perform heavy-duty cutting in the same circular pattern, but it's only possible at very high horsepower – the kind of horsepower that's not available to every shop. What's more, in all of



As bore depth increases, the cycle time advantage of a twin cutter becomes exponentially more advantageous compared to circular interpolation.

these scenarios there's a constant single-side load on the tooling and spindle as the axes are changing and the tool is fed in – a potentially harmful force for even the most robust machine tool and its bearings.

That brings us to boring as an option. Most often, this involves a starter hole created by a drill and a series of boring bars set to increasing diameters for stock removal one pass at a time. This will yield a straight and accurate hole, but it's a pricey and relatively expensive cycle with so much tooling and time involved. All of these aforementioned approaches may be suitable for one-offs or small batches, but it would be difficult for a shop to rely on any of them for consistency and efficiency in a production environment. Fortunately, another technique comes to us from the boring world that I firmly believe is best for holemaking production. It doesn't require elaborate setups or creative cycles, but rather a relatively simple and affordable tool that can be used on most any machine, CNC or not.

The addition of a twin cutter boring head to a shop's tooling arsenal opens the door to multiple holemaking options. Once thought of only as light-duty, semi-finishing tools, today's high-performance twin cutter boring heads have proven they can deliver in holemaking operations. Quite simply, once a starter hole is established with a drill, a twin cutter is plunged axially to remove the rest of the stock. This offers several natural advantages over helical interpolation and other similar processes:

- The plunging motion results in axial load as opposed to radial, preserving the machine and spindle components.
- Superior load balance in the cut makes for reliable and consistent performance, especially noticeable in long-reach applications.
- Milling tools can have multiple inserts per flute which is costly, while the aptly named twin cutter only requires two.
- A consistent inline feed requires less programming than the stepped removal required of an end mill or multiple boring bars.
- The two-edge effective tool enables faster feed rates and reduces cycle time.
- Perfect roundness is easier to achieve more consistently in preparation for finish boring.

Twin cutters are most often used for rotationally symmetric roughing where the edges are balanced in both height and diameter. This is an ideal arrangement for light to medium cuts, because the strength and rigidity of the direct balance makes very high spindle speed and feed rates possible.

Sounds good, right? It gets better.

The real power of twin cutter is realized when it's used outside of its balanced applications, most notably in stepped cutting. Also known as double offset roughing, this is when the insert holders are not balanced in height and/or diameter – a lead insert is set to one diameter and the other is set slightly back, to the wider, desired final diameter. Stepped cutting effectively cuts two larger diameters with two different inserts in one operation. This does affect feed rate, but time is made up in the increased material removal, elimination of tool changes, presetting and programming. When it comes to depth of cut, stepped cutting offers a 60 percent to 100 percent increase in the stock allowance of the twin cutter in its balanced configuration. The setup is best for through-bores, where a stepped profile is no concern.

A twin cutter boring head took a Ø5.38" bored hole to Ø6.23" on one pass and reduced the cycle time to less than 40 min. compared to the previous interpolation method, which took four hours.

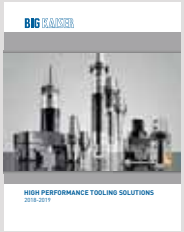
Stepped cutting is especially effective for long-chipping materials because the staggered cutting reduces chip length. With such a high volume of stock being removed, regardless of material type, chip removal is a key consideration in stepped cutting; high pressure coolant may be necessary. It's also important

to note that a disc will be created at the end of the bore; you'll have to account for fixturing and you don't want to run the operation on stacked plates.

Sure, helical interpolation allows for multiple diameters with one tool, but our lineup of twin cutters, for instance, ranges from .787 in to 8.000 in diameter with only eight different heads. For those with even larger jobs, pre-designed solutions are available up to 118 in. As we continue to gain more experience with shop applications over the years, we are more convinced than ever that there isn't one holemaking challenge that twin cutters can't answer, especially in production.

CONTRIBUTOR

Matt Tegelman is the Applications Manager & Product Manager Kaiser at BIG KAISER
Email: matt.tegelman@us.bigkaiser.com



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TIPS & TRICKS

Load up on Twin Cutters to Stabilize Applications

Some customers utilize twin cutter boring heads only as semi-finish tools. They are certainly capable in this role, but 'semi-finish' should not imply that the same stock allowance be taken with these tools as with single-point finish boring tools. Keep in mind that the nose radius of the inserts being used must be completely covered in order to make the cutting action stable.
Another common issue is feed rate. While a single point tool is typically run around .002"-.004" IPR, twin boring tools can be run at 4 to 5 times this feed rate.

Is BIG-PLUS An International Standard?

Jack Burley

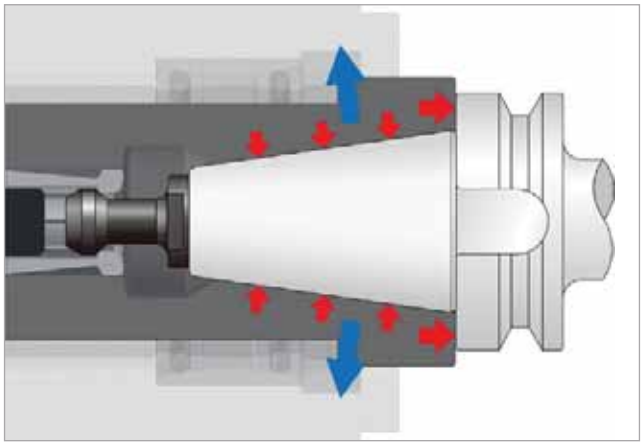
BIG-PLUS® SPINDLE SYSTEM DUAL CONTACT

Buyer Beware: This system has not been standardized by any governing body. If you purchase cheap dual contact tooling after being told by a supplier that it will work just as good as the original for half the price, you risk unsatisfactory performance and/or damage to very expensive spindles. Here's why.

More and more, we are asked this fairly simple question from shops who want to purchase BIG-PLUS dual contact tooling from sources other than us. One would certainly think that this must be the situation, given that more than 100 of the world's top-selling machine tool builders have adopted the BIG-PLUS spindle system as their own standard. The truthful answer to anyone who asks is that this system has not been standardized by any governing body such as ISO, DIN, JIS, or ASME.

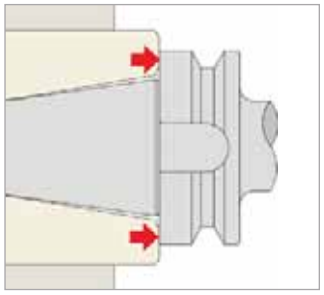
BIG Daishowa, the original developer of this system and a major reason that it has been so widely accepted throughout the world, still holds all of the proprietary information and, more importantly, the grand master gages that are used for reproducing spindles and tooling. Access to this information and gaging is well protected by BIG and is only provided to those companies who acquire a license agreement, mostly to protect the integrity of the system, which uses very close tolerances in order to function at its designed performance level.

The popularity of BIG-PLUS has surged over the past 10 years as many shops have tried the system and have witnessed for themselves the huge benefits in higher performance and accuracy over standardized taper contact tooling systems, such as CAT or



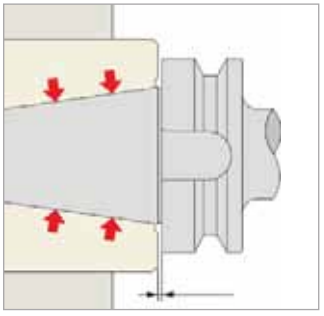
PROPER FIT

- Dual contact of taper and flange face after clamping



FLANGE CONTACT ONLY
Limited or No Taper Contact

- Poor runout accuracy
- Severe chatter and vibration
- Spindle damage



TAPER CONTACT ONLY
No Flange Contact

- Features of BIG-PLUS are voided
- Works same as taper-only contact tooling

BT. Other dual contact systems, such as HSK, have also seen a rise in popularity for similar reasons, but perhaps not with all of the same benefits of BIG-PLUS. Unfortunately, all of this increased popularity and demand has been accompanied by a surge in unlicensed copies to the market that offer all kinds of promises and prices never seen before.

Buyer Beware

I cannot fault a shop for purchasing cheap dual contact tooling after being told by their supplier that it will work just as good as the originals for half the price. After all, human nature wants to find the best offer at the best price – that sort of deal is capitalism at its best. As consumers, we are all confronted with choices every day about buying similar products that do similar functions from a wide range of suppliers and costs. For me personally, I usually decide to buy cheap only when I know the product will be used one time and then thrown away. On all other purchases, I'm in it for the long haul and willing to pay higher prices. At the end of the day, I want to be confident I made the right choice for the long term, and I'm willing to pay more for my peace of mind.

Master gages for tooling are quite common. Generally all of them are traceable to a known master to compare the accuracy for rate of taper for production of tool holders, such as CAT or BT. ISO dual contact systems such as HSK rely on the use of a grand master gage that all other master gages are produced to, thereby guaranteeing that all HSK tool holders are the same everywhere in the world. Our company decided to find out how the world's leading suppliers of HSK tool holders compared to the tolerances of the ISO standard. After acquiring more than 30 HSK-A63 taper tools from our competitors from all over the world and making a detailed quality inspection of the taper itself, we found that 50 percent of the samples were not in tolerance.

Perhaps the developers of HSK were overly critical of the functional limits and tolerances for the standard, given that 50 percent of most tools in use today are out of tolerance. In my opinion, this could be possible based on the very thin cross section of HSK tapers that allows for tool holders to expand elastically more than it was designed for. On the opposite side however, we have BIG-PLUS that relies on elastic deformation of the spindle, not the tool holder, therefore requiring a much stricter control of tolerances, even in comparison to HSK. This means anyone who is in the market for BIG-PLUS 'dual contact tooling' should also consider this simple statement: Only a licensed supplier of BIG-PLUS has master gages that are traceable to the BIG grand master gages and have the dimensions and tolerances provided to do it right. Everyone else is guessing and using a sample BIG-PLUS tool holder as their own master gage – a practice that any quality expert will advise against.

What are the consequences to a poorly researched choice in BIG-PLUS tooling? Unless all of the tools are marked "BIG-PLUS Spindle System-License BIG DAISHOWA SEIKI," the use of tooling not made by BIG Daishowa or its licensees may result in unsatisfactory performance and/or damage to very expensive spindles. Conditions producing such unsatisfactory performance include:

Distance between flange face and gage line diameter more than specification-little or no face contact occurs; tool holders provide only taper contact and no benefit of BIG-PLUS.

Distance between flange face and gage line diameter less than specification-face contact only; tool holders "float" in spindle taper with no positive radial location. Large cutter runout and fretting corrosion on spindle face occurs immediately. Severe spindle damage will occur.

Gage line diameter less than specification; face contact only with minimal or no taper contact. Severe spindle damage can occur. Gage line diameter more than specification; taper contact only and no benefits of BIG-PLUS.

BIG Daishowa Seiki and its North American subsidiary, BIG KAISER, are manufacturers and distributors of original, licensed BIG-PLUS tooling. For a complete

Gages for Machine Spindle

Master Gage

Measuring Device

Master Arbor

STRICT GAGE CONTROL

BIG-PLUS® spindles produced by licensed machine tool or spindle builders are strictly controlled in dimensions by the BIG original Master Gage. Only BIG-PLUS® trademarked tool holders can achieve the optimal performance fully and safely.

list of all licensed spindle and tool holder companies authorized for the production of BIG-PLUS, please contact us and remember: accept no substitutes.

CONTRIBUTOR

Jack Burley is the Vice President Sales & Engineering at BIG KAISER

Email: jack.burley@us.bigkaiser.com

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BIG DAISHOWA BIG-PLUS DUAL CONTACT

bigkaiser.com/big-plus

TIPS & TRICKS

Remember to Replace Your Spindle Cleaners Regularly

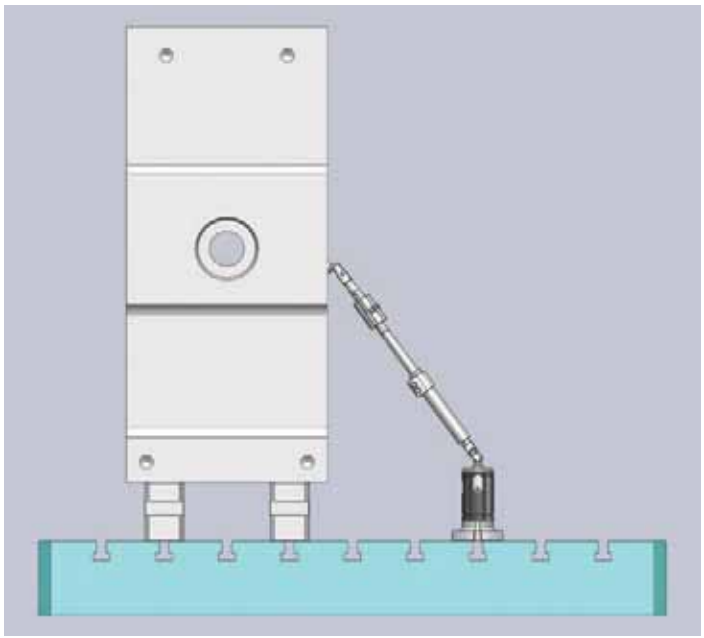
Remember to replace your spindle cleaners on a regular basis so that you aren't using worn out cleaners. What you think is helping to preserve your valuable Machine Tool/Presetter might actually be hurting it. When replaced regularly, spindle cleaners can prolong the life of your machine, tools and holders, and tool cleaners enhance the repeatability to the machine spindle. This is a perfect example of how a small investment can make a big impact.

NEW PRODUCT

SLIMMED-DOWN MILLING CHUCK FOR PRECISE, POWERFUL CUTTING WITH Ø1/2" END MILLS

the HMCJ, a super-slim milling chuck with peripheral coolant supply, is designed support heavy-duty and finish end milling tasks with power and precision. The slim yet rigid design of this new chuck brings the nut diameter down to an impressive 1.260" (32mm), the smallest in its class. The HMCJ applies the highest gripping force to the cutting tool shank of any comparable milling chuck in its class, and five to six times greater compared to collet chucks.

Stabilizing Parts in



Stabilizer systems that adjust quickly, adapt and stack easily, and quickly integrate into existing setups can really pay off by removing the difficult-to-diagnose part movement that makes fine finishes, tight tolerances and clean welds unattainable.

When instability rears its ugly head in a metalworking process, an operator's mind almost invariably starts thinking . . . "It can't be the machine or the table – this machine costs thousands of dollars and I haven't changed anything there. It can't be the part itself or the fixture, those are naturally rigid. It must be the easily replaced, not-budget-busting tooling or holder." But what if the tool assembly doesn't reveal any imperfections? Especially in the case of top heavy, tall parts, or complex weldments, the most rigid table and fixturing may not be able to prevent a large part from vibrating or bending while being worked on, even if you're performing a finishing process near the base. This kind of part movement is difficult to diagnose, but it has the potential to make fine finishes, tight tolerances and clean welds unattainable. This is where stabilizing the top of a part or an oddly-shaped weldment becomes necessary.

Machining

When machining, one of the big indicators that your large part might not be completely stable is if you're having to back off feeds and speeds to achieve the finishes and tolerances you need. Another indicator is poor tool life. Not only can stabilizing the top of the part improve quality, but if it allows you to accelerate your speeds and feeds, you'll obviously be more efficient producing your parts. Part variety and production levels influence this decision-making and troubleshooting process. Often, when production levels are high enough, adding a dedicated fixture is justified. However, large parts usually fall into lower production levels and the ability to reuse and reconfigure fixture systems is very beneficial to maintaining profitability. And since large parts often involve expensive material and time investments, it makes it all the more critical to identify the instability problem (or potential problems, before they occur) and find the right solution.

With a costly part, a temporary locating feature or weld tabs and brackets for an extra point of contact to grab onto is an option, but another alternative is gaining popularity: the modularity of stabilizer systems, in terms of both angles/reach and gripping style, is very appealing. In place of modifying parts by moving them from machine to machine – and introducing the chance for error – a stabilizer kit can easily adjust to each new part. Fixed directly to the table via a vice or, even better, a modular fixturing system like the UNILOCK zero-point system, stabilizer

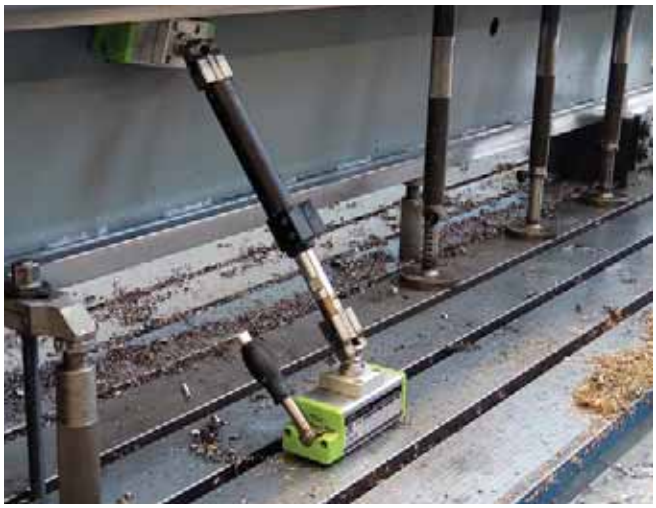
Three Scenarios

John Zaya

kits adapt to the part or weldment, as opposed to the other way around.

Welding

Stability is also of the utmost importance in preparing efficient welding processes. When tall parts are welded they are usually laid down on their sides for accessibility and for safety. However, not every part can be easily moved and, as a result, must be welded in place. The welding process itself may not impart much in the way of forces onto the part, but if they are not stable, then their positions relative to one another can be a problem for subsequent operations. This newer stabilizer kit offering is gaining momentum as a solution for this as well. The flexible arm design is capable of adjusting to immobile weldments or frames and securing them throughout multiple processes. Stabilizer systems also make sense for more mobile parts of odd shapes and sizes. No matter the part, these systems are easy to adjust within one job, or in the case that jobs are changing in and out rapidly.



Assembly

Added stability is beneficial during assembly work as well. Most large part assemblies are handled by overhead cranes that lift parts onto other parts. In some cases, parts are set up next to one another and, if they are tall enough, a falling or tipping hazard may exist. A stabilizer system dramatically improves safety in this setting. In terms of the final position of parts for further work, they can be controlled or fine-tuned by using various methods, from chain come-alongs, hydraulic pushers and pullers, and turnbuckles. A stabilizer system works hand-in-hand with these positioning tactics thanks to fine-adjustment extensions that can be adjusted by rotating the center section or either end piece.

The importance of stability across metalworking applications cannot be overstated. It impacts everything from profitability to employee safety. Stabilizer systems that can adjust quickly and adapt easily go a long way. What's more, integrating them into existing setups is quick. They stack easily and use a wide variety of gripping forms.

CONTRIBUTOR

John Zaya is the Product Manager Workholding at BIG KAISER

Email: john.zaya@us.bigkaiser.com

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UNILOCK MODULAR WORKHOLDING SYSTEM STABILIZER SYSTEM 2018

bigkaiser.com/stabilizer

NEW PRODUCT

UNILOCK STABILIZER SYSTEM FOR UILFEX BALL SYSTEM (Ø25.4)

Provides lateral support for tall parts during machining, welding or assembly processes. Allowing the transfer of loads down to the table or base.

- Fine adjustment allows for adjusting the position of parts
- Magnetic base option
- 5 fixed length extensions
- 2 adjustable length bases

Affordable Ways to Prevent Vibration

While the latest machine tool technology may go a long way toward eliminating vibration and chatter, adding a new one may not be realistic. Luckily, there are less disruptive options that can make positive impacts on vibration without breaking the bank.

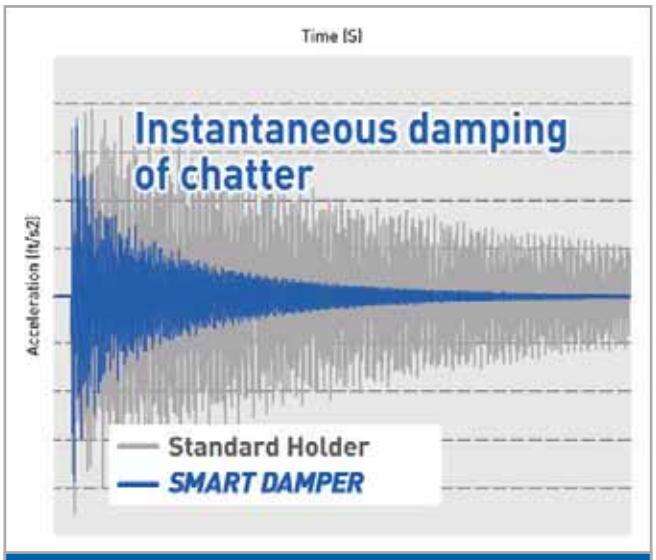
Vibration is a sworn enemy of high-quality, efficient metalworking operations. It hinders speeds and feeds, reduces tool life and makes achieving the fine finishes often required today nearly impossible. There are three typical causes of vibration during machining:

1. Quick changes in direction, stops and starts (either of the table or the cutting tool) cause deflection that impacts the initiating moments of a cut.
2. Inconsistent forces during a cut, such as unbalanced tools or workpieces, as well as the state of engagement of multi-tooth cutters naturally cause some resonance.
3. Because of some instability in the cutting process, chatter, or the buildup of oscillations in the machine tool structure and cutting process, that limit metal removal rates.

Machine tool builders are employing high technology in the newest machinery to monitor and manage these challenges. For one, accelerometers can endure the work area's rough environment while providing accurate and actionable readings.

Other technologies even go as far as gathering data from inside the cut and sending that information to the control, where spindle speed is adjusted when detrimental vibration is imminent. Today's machine tool construction options also attempt to tackle this age-old challenge, including turcite-lined box ways that resist vibration better than linear guides and machine beds made of cast iron, which is a better damping material than traditional steel. The list goes on and on: shorter, more compact spindles; precision, hybrid bearings; and dynamically balanced spindles.

Another one that we work with on a daily basis is a more rigid spindle/tooling interface known as dual contact. Over the past 20 years more than 100 machine tool builders have adopted this configuration, which allows for simultaneous taper and flange contact.



A modular system in both milling and boring setups allows for optimal projections while keeping the damper as close to the cutting edge as possible.

Jack Burley

Finish Boring of Ductile Cast Iron (FCD500)

Tool Holder	Cutting Speed (SFM)				Result
	80	165	325	500	
Competitor (w/o damping system)	○	×	×	×	**Outperforms competitor's holder by 6X higher productivity.**
SMART DAMPER **Built-in damping mechanism**	○	○	○	◎	**Superior surface finish and better tool life due to the increased cutting speed.**

× = Vibration ○ = Acceptable ◎ = Excellent Surface Finish

Cutting Conditions

Machine: HMC (BBT50) BIG-PLUS®
Boring Dia: ø2.677"
Depth of Hole: 16" (L/D=6:1)
Insert Nose Radius: R .016"
Feed Rate: .008"/rev.
Depth of Cut: .012"/ø

Since its added rigidity provides several other advantages in addition to vibration reduction, dual contact has also proliferated across tooling companies' product lines as well. A word of caution, however: not all dual contact systems are created equal. BIG-PLUS is the only true dual contact system for 7:24 taper systems. Tolerance testing has repeatedly shown that unlicensed 7:24 taper tooling billed as "dual contact" does not hold up when compared to authentic BIG-PLUS equipment.

Only our parent company, BIG Daishowa Seiki (Osaka, Japan), owns the master gages that ensure the proper relationship between the taper gage line and tool flange. And only licensed and properly trained tooling suppliers can produce and sell these tools with the BIG-PLUS trademark. We advise that you choose wisely and don't discount the value of this technology if you've been unimpressed or, worse yet, burned by a knock-off system.

Another area we specialize in where measures can be taken to combat vibration is how the part is held. No sandbags allowed. Our recommended weapon of choice is a mineral cast workholding solution. The advanced materials and methods used to produce this type of fixturing remove weight and introduce damping qualities into the foundation that exists between the machine table and part. The result is attenuation rates that are six to 10 times better than standard gray cast iron. How is this accomplished? The assemblies are precision machined and filled with ground positioning components and fasteners, then filled with a composite structure of mineral particles and epoxy resin. Also notable is how the finished composite structure is produced without heat to better preserve the integrity of the precision machined surfaces and clamping components.

Mineral particles make up about 90 percent of the added weight, with the remaining being resin and curing agents. The added composite structure has an excellent density-to-weight ratio of 2.3 kg/dm3, translating to application solutions that are about 50 percent lighter than alternatives and allow for higher output and better quality. That brings us to a tooling-specific solution: When it comes to vibration and tooling, the buzzword you'll often hear is "overhang," a condition that is also

Lightweight, stable and dampened fixturing system.

known as the "length-to-diameter ratio" because as the overhang grows, it more decidedly becomes the most fragile element in the machining process and increases the chance of detrimental vibration. This is an especially common issue for die and mold, aerospace, automobile, and oil and gas manufacturers.

It's always advised to use the largest possible diameter at the minimum possible length, the lightest weight tooling possible and the smallest possible insert points. But in the demanding settings that have been mentioned, ideal setups aren't always feasible. For instance, once tools extend beyond about 4xD in these scenarios, deflection begins to multiply at remarkable rates – even at constant cutting forces. That said, upgrading to tooling with damping characteristics is often a reasonable option.

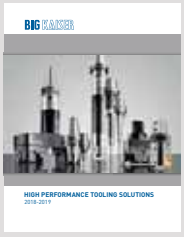
For example, we offer the SMART DAMPER system that provides specific solutions for rough and finish boring, plus milling operations. It incorporates a passive damping mechanism that functions as a counter action by way of high resonance friction action. This patent-pending system's damping capability minimizes the effects of high frequency oscillations, absorbing vibration effectively and allowing higher machining accuracy. Knowing that it's also critical to have the damping elements as close to the cut as possible, most SMART DAMPER offerings are modular in design. This allows for an array of standard shanks to be adapted to create custom tools that extend over 16 in to maintain damping nearer the tool and manage vibration in long-overhang setups.

While the latest machine tool technology may go a long way toward eliminating vibration and chatter, adding a new one may not be realistic. Luckily, there are less disruptive options that can make positive impacts on vibration without breaking the bank.

CONTRIBUTOR

Jack Burley is the Vice President Sales & Engineering at BIG KAISER

Email: jack.burley@us.bigkaiser.com



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TIPS & TRICKS

Have a Question on How to Run Your BIG KAISER Boring Tools?

Next time you have a question on how to run your BIG KAISER boring tools, just pick up your phone—not to call, but to use the BIG KAISER App.

Take advantage of this great resource. It provides optimal cutting parameters, cutting data for rough and fine boring heads and it's completely free. In total the app contains data for 61 BIG KAISER boring heads ranging from Ø.01575" (0.4 mm) to Ø 24.41" (620 mm).

Download on the App Store | GET IT ON Google Play

NEW PRODUCT

EASILY INSPECT MACHINE SPINDLE TAPERS WITH DYNA CONTACT

The ceramic taper gage allows inspection of machine spindle tapers at a glance.

Dyna Contact is a precise gage used to check the geometric accuracy of a machine spindle taper by visually comparing the contact of the gage to the spindle. A layout dye is applied to the Dyna Contact before inserting into the machine spindle. Upon removal, an operator can easily check for taper contact and determine if the machine spindle will have proper contact with tool holders.

The ceramic material of the Dyna Contact makes it more thermally stable than steel. This taper gage is also rustproof, 10x more wear resistant than steel and not subject to age deterioration.

TIPS & TRICKS

Removing Collets from MEGA NUTS

It is sometimes difficult for users to remove collets from our MEGA nuts. Luckily we have markings on the nuts to make it easier. Just line up the "BIG" logo on the nut and collet to align the slits for easy removal.

We also offer a couple of tools to make it even easier. The NBJ stick is designed to push the collet without damage when aligned properly or the CE collet ejectors for the smaller sizes that compress the collet from behind for one-handed removal.

5 Questions
with Jose Fenollosa

1. Why should tooling manufacturers implement Industry 4.0 technology now?

JF: Industry 4.0, Smart Factory, and Internet of Things (IoT) technologies result in a flexible, fully connected system that uses data flows and operational inputs across the shop floor for transparent monitoring and optimal decision making throughout the value chain. Technological improvements sparking this phenomenon include:

- Exponential increase in data volumes transmitted and stored, and the computational power required to handle these volumes
- Emergence of data analytics, artificial intelligence, machine learning
- New forms of human-machine interaction (HMI)
- Improvements in transferring digital data into the physical world and from physical to digital
- Use of time-sensitive networks in industrial environments

2. What are the biggest hurdles in creating Industry 4.0 compliant tooling?

JF: Smart technologies are limited by the lack of standards at sensor, control, plant management and enterprise resource planning (ERP) levels. Most systems are proprietary or lack consistent data formats, resulting in poor layer-to-layer interoperability, particularly in legacy systems. Machine controls use different internal communication protocols and different interfaces. There are many wired and wireless communication systems for sensor reading and actuator control, and data from different ERP systems is not easily interchangeable.

3. Is there data security for Industry 4.0 tooling?

JF: A large portion of a company's knowledge is susceptible to hacking, however, the problem is more critical at an ERP and IT level than at a tooling level. We use Bluetooth Low Energy (BLE) as a standard for several reasons. A small battery-operated, fine boring tool equipped with BLE can only communicate within a few meters. So, a hacking device needs to be placed near the machine tool, work undetected and send information outside the factory. Recent Bluetooth versions have added security features that would further deter hackers.

4. How does BIG KAISER plan to close the loop for automatic tool adjustments?

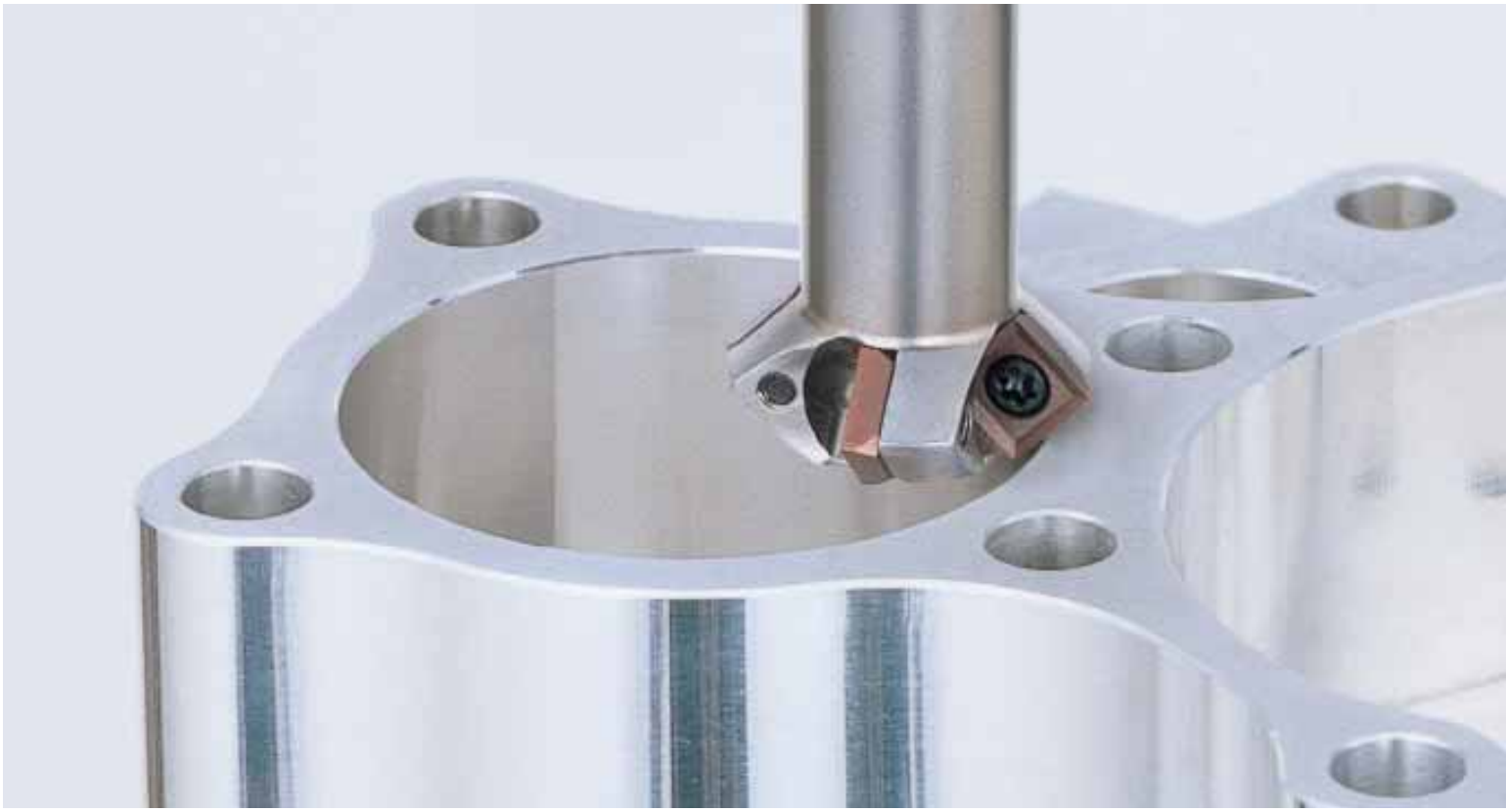
JF: We aim to provide the simplest possible automatic system to install and use. For customers who don't need a closed loop, the tool can be adjusted via a smartphone or tablet app. A handheld device is under development if such devices are not allowed in the shop. In legacy machines, the closed-loop system uses an industrial PC to interface the machine control (via Ethernet) and tool (via Bluetooth). In a third envisioned scenario, machine tool builders could equip their units with hardware, software, and HMI functions for direct communication to our devices without external hardware.

5. What other information might tools send or receive in the future?

JF: BIG KAISER boring heads are much closer to the cutting point than any other element of the machine tool, and this is where the "real stuff" affecting production quality and performance takes place. Our R&D department is developing wireless communications strategies, sensing capabilities, and signal pre-processing to offer vibration analysis, chatter detection, cutting forces, monitoring and impact analysis.

CONTRIBUTOR

Jose Fenollosa is the Senior Manager for Innovation & Digital Tool Development at BIG KAISER
Email: jose.fenollosa@ch.bigkaiser.com



The Chamfer that Changed the World

Cory Cetkovic

It all began with "Scuffgate," a small chamfered edge that became a critical priority and evolved into a growing demand for fine finishes and feel in a world of myriad applications that only precision chamfering can deliver.

Chances are you've heard of DC's "Watergate," the NFL's "Deflategate" or New Jersey's "Bridgegate," but what about "Scuffgate"? When Apple introduced the iPhone 5 it was a breakthrough in smartphone technology, but as the device started to make its way into the hands of users, some were finding scuffs on the phone exterior fresh out of the box, largely on the chamfered edges. The situation caused quite a stir, with the Internet and those in the press dubbing it "Scuffgate." Built with lighter aluminum for the first time, technology experts posited that the natural softness of the metal was to blame, but it was hard to believe such widespread issues happened during packaging or shipping. This led others to point to potential deficiencies in the machining process.

It was maybe the most talked-about chamfered edge ever. In fact, the issue made its way to the very top of the Apple chain of command . . . somewhat amazingly, a small chamfered edge had become a critical priority

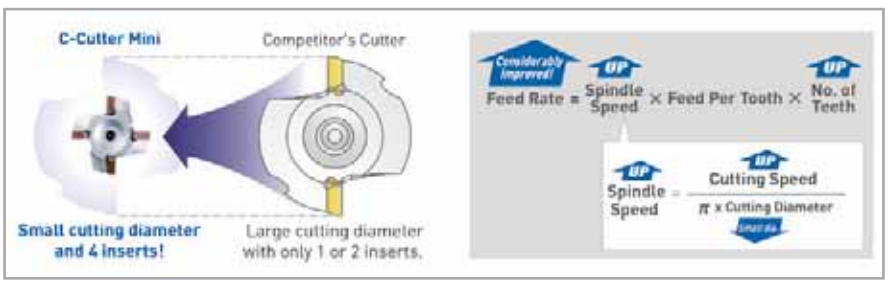
for one of the biggest companies in the world. Most machinists likely think of chamfering as just another finishing step to get through before moving a part out the door. However, this episode in consumer electronics history is the perfect illustration of the importance of consistently angled or rounded edges. As an operation that's performed on nearly every workpiece, there is (of course) the safety concern of sharp edges, but there's a growing demand for fine finishes and feel in a myriad of applications that only precision chamfering can deliver.

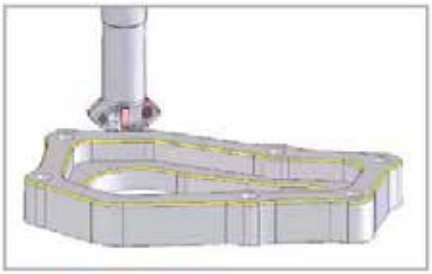
There's no doubt that I see shops dedicating more thought and time to this process. But when it comes to the tooling being used, they're often still trying to fit a square peg into a round hole, relying heavily on the accuracy of the machine instead of using a setup meant for the job. As we know, each component – from the cutting edge all the way back to the spindle housing – introduces variables and opportunity for error. While it may be light cutting, not using tooling that is tailored for the job can have consequences. For example, I often find chamfering performed with 90 deg-tipped drills or standard end mills with a tilted axis. That's a demanding ask for a tooling assembly that isn't designed to efficiently strike an edge in that way: it requires slower cutting speeds that extend cycle times and make fine finishes difficult, it strains tool life and increases consumable costs, and it requires more cutting and thrust force that translate into more energy consumption and machine wear.

So just how can a simple tooling change make for better performing and more economical chamfering operations? Let's start with feed rate, because higher feed rates not only reduce cycle time, but subsequently address some of the other issues as well. Increasing cutting speed capability and the number of teeth are two ways that a tool's design can increase feed rate. For example, our C-Cutter Mini uses up to four inserts. The diameter of its tool body is built to the lowest limits to optimize chipload and spindle speeds in chamfering small and large features. This allows for very fast cycles. The inserts themselves also play a key role, so much so that they are among the only inserts we design in-house: extremely sharp edges with three types of coating reduce cutting resistance to help address speed, finish and force concerns that can arise, even on chamfers that require the tool's maximum size capabilities.

In testing, this tool measured feed rates that were three times faster and a machining time that was less than 1/6 of a two-tooth alternative product. The versatility of chamfering tools can be impactful in key areas, too. Their capability to perform different types of processes, or even consolidate them, pays significant dividends. In this case, the C-Cutter Mini's unique design and proprietary four-edged inserts allow users to back or front chamfer without dramatic setup changes.

In another scenario where the proper tool selection pays off, let's say you have a part with 10,000 holes that all need to be chamfered. I see shops who think they are saving time by using a 90 deg chamfer to pilot. But when a deep hole drill with an angle of 140 deg has to enter a 90 deg hole, that's not really piloting. The corners want to rip off. The sporadic life of high-performance drills can often be attributed to this. A better tooling choice would be something like our double-degree Sphinx spot drill with a 142 deg angle that blends into a 90 deg angle up top. You're giving that drill somewhere to enter without running it into a 90 deg angle. Not only does it combine and accelerate processes, but you're





Cutting Conditions

Material: Aluminum
Chamfer: .020 x 45°
Feed Rate: .004 IPT

Front Chamfering for Aluminum

	Competitor's Cutter (Non-Coated Carbide Insert)	C-Cutter Mini Model ST12-C1116-45B-25
Chamfering Dia.	ø1.575	ø.472
Number of Inserts	3	4
Cutting Speed	660 SFM	1,980 SFM
Spindle Speed	1,590 RPM	15,920 RPM
Feed Rate	18.78 IPM	250.79 IPM
Result	**13 Times Better Cutting Efficiency**	

stabilizing consumable expenditures along the way.

Speaking of consumables, if that's your shop's primary concern when it comes to chamfering operations, I'd be remiss if I didn't mention how the indexable inserts on the C-Cutter Mini work. The four-sided design means you can turn the insert three times (assuming you're performing only front or back chamfering) before they have to be scrapped. On the other hand, with a solid carbide chamfering tool, once it's worn away the whole tool has to be replaced.

The bottom line is this: Taking a little extra time to explore the chamfering tool options out there can save you a lot in the end, in terms of both time and money. It's a process that may seem trivial, but there is a lot of opportunity to speed up cycles – even consolidate them – and save on consumable and energy costs, while delivering part quality that your customers are looking for more and more.

CONTRIBUTOR

Cory Cetkovic is the Product Manager Sphinx at BIG KAISER
Email: cory.cetkovic@us.bigkaiser.com

BIG KAISER PRECISION TOOLING SWITZERLAND CELEBRATES 70-YEAR ANNIVERSARY

In 1948, the 25-year-old Heinz Kaiser decided to give up his permanent job and start his own business near Zurich, Switzerland. His vision was to advance the development of high-quality tools needed to keep pace with the increasing productivity of machine tool technology at that time.

Heinz Kaiser had clear goals in mind: modern tools, manufactured in his own workshop, meeting high requirements. That meant designing tools which were strong, well-balanced and capable of boring precise holes with high accuracy and surface quality. Over time, this commitment to ongoing research and development was enriched by decades of experience in the design, manufacture and application of efficient cutting solutions. The result was a complete range of CKB (KAB) tool and clamping systems for boring, milling, drilling, and external turning which are still widely used in industries around the world today.

Now a member of the BIG Daishowa Group of companies, BIG KAISER Precision Tooling continues to have an integral role in the company's worldwide R & D and manufacturing strategy. The next generation of products developed in Switzerland delivers connectivity essential to today's smart manufacturing environments. For example, the EWE Digital Boring Heads enable repeatable and highly precise cutting parameters (.0001" and finer) and connect to a smartphone or tablet app to configure, monitor and track historical adjustments for multiple tools.

It has been 70 years since Heinz Kaiser started his success story with strong will, much faith and a little bit of luck. Many things have changed in the world of manufacturing and technology, but the quality standards of BIG KAISER Precision Tooling are unchanged. We want to say thank you to our customers, friends and supporters over these 70 years.

In-Machine Tool Measurement

In-machine laser technology is touted by machine tool builders and distributors as the way of the future and an indispensable tool for machinists. Do you really need an offline presetter if you have in-machine lasers? Yes, you do, and here's why.

In-machine tool measurement has become a standard feature on many of today's metalworking machines that use lasers to measure key setup parameters. This enables the machine to diagnose and, in some cases, automatically adjust the cutting tool to correct for cutter or spindle runout. This type of in-machine laser technology is being touted by machine tool builders and distributors as the way of the future and an indispensable tool for machinists. So now, needless to say perhaps, I'm being asked all of the time, "Do I really need an offline presetter if I have in-machine lasers?" And my answer is very often a resounding "Yes!" Here's why:

Presetters provide extremely valuable supplemental setup capabilities that in-machine functionalities cannot. This is particularly true in high stakes, high-precision applications; in large capacity shops that operate, for example, 20 to 100 machining centers; and even in small mom-and-pop shops that have to maximize output from just one or two spindles. So as we compare and contrast the capabilities of in-machine tool measurement with those of offline or standalone presetters, the hope is that we might alter the way most folks think about the entire laser vs. preset debate. In the end, it's less about choosing which one system is best and more about discovering the many benefits of using both systems in conjunction.

Offline Presetters vs. In-Machine Laser Tools

In addition to the ways listed nearby that these two types of systems may help complement one another and overcome known shortfalls, there are also critical factors that help illustrate the value of offline presetters working alone and particularly in complement with laser technologies to improve manufacturing efficiency, save costs, and maximize profit.

Adjustment & Cutting Time: Adjustments that could take up to 15 minutes when made in-machine can be made offline in less than one minute using a presetter, with your machine cutting – and earning revenue – that entire time.

> In fact, one aerospace customer of ours recently reported how having offline presetters actually makes their in-machine lasers measure faster.

But reduced tool-changeover time isn't the only time saver . . . By measuring their tools offline first, key setup data can be pre-loaded into the machine's tool table via RFID. From there the laser acts as a final check before starting production.

But here's the difference, and it's a great example of how presetter and in-machine technologies work together for optimal manufacturing results: Because the preset lengths were

vs. Offline Presetting

Doug Sumner

already loaded into the machine's tool table, the cutting tool will travel rapidly in approach speed only until it contacts the laser, effectively marking the final check and the beginning of production. If no preset values were in the tool table, however, that same cutter would move slowly and in repeated approach until it contacts the laser three to five times. So by combining offline and in-machine measurements, the client is now calibrating tools in a fraction of the time, making more chips, and using fewer machine passes with both technologies than would otherwise be possible by using only one.

Ease of Use: Operators can preset offline tools in preparation for the next job or reset tools after changing inserts while the machine continues to run,

Presetter image processing and control software can be used to create a tool database that helps guide the operator through the measuring process to ensure correctness and repeatability of the measurement.

instead of wasting valuable spindle time touching off tooling or making trial cuts.

Accuracy: Presetters are simply better at measuring than machine tools, which often fail to measure and store real values for runout and/or length. This, coupled with expected inaccuracies resulting from laser refraction off of diamond and other impregnated cutting tools, and many scenarios can arise with in-machine measuring tools that will still require test cuts, wasted machine time, and scrap parts. As such, it's only when adding in the precision and functional advantages brought on by an offline presetter that machinists improve their ability to produce a good part on the first try, saving time in the process and reducing consumables costs as well.

Equipment Cost: It's yet another popular misconception that in-machine lasers are standard or included options that come with machine tools straight from the factory. Closer investigation will reveal that you're still buying the lasers, typically at a cost of around $13,000 per machine. So when you look at the variety of presetters that are available today, cost-effective options may be available that can be used to better monetize and more efficiently operate not just one, but multiple machine centers shop-wide.

Return on Investment (ROI): The best answer to the infamous question "How can we make more chips?" is really a simple one. It's by doing more set-up operations outside of the machine while the spindle is still running and earning you revenue. By setting up tools outside the machine, a shop can increase production without purchasing another machining center that can cost hundreds of thousands of dollars and ultimately won't increase production any more than what could be accomplished at a fraction of the cost by investing in one or more presetters.

Most of our customers report that their presetter pays for itself within 30 days of implementation, which is a degree of return on investment that you simply won't achieve when opting for in-machine technology alone. Here's the bottom line: I've said openly before that if you absolutely have to pick only one, I would definitely recommend going with an offline presetter(s) every time. But for customers who are apt to use both lasers and presetters – and we're seeing more and more customers go this route – the cooperation between the two systems makes for superior manufacturing when compared to what often results when using one over the other.

CONTRIBUTOR

Doug Sumner is the Product Manager TMS at BIG KAISER

Email: doug.sumner@us.bigkaiser.com

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Time to Reconsider Holding Taps with Collet Chucks

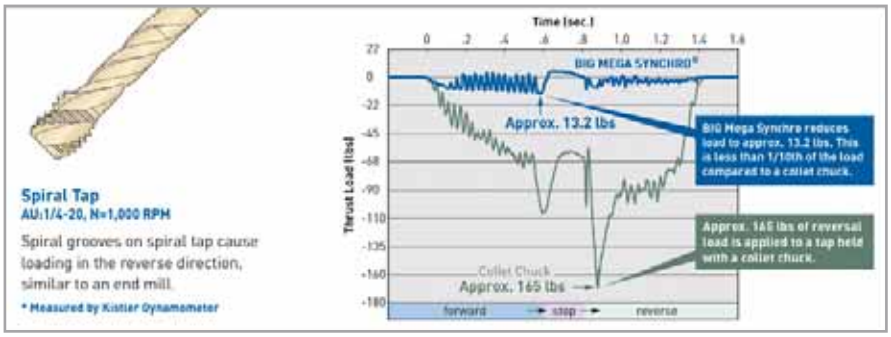
Alan Miller

The next time you think about setting up a tapping operation with a collet chuck the same old way you always have, you may want to think again.

There are now tap holders designed specifically to mitigate the load imposed on the tap by essentially absorbing synchronization error.

Tapping holes strikes fear in the hearts of machinists everywhere. Ok, that may be a bit of an exaggeration, but it is undoubtedly one of the more challenging metalworking processes to execute with precision in volume. Generations of machinists that came before, however, likely wouldn't be too sympathetic. As recently as the 1980s, tension-compression tapping was widespread. This involved underfeeding tapping holders with springs, allowing the tap to travel independently on the way in and out – a painstaking process that could only be performed at rpm levels in the hundreds. In the years since, machine builders have done their part to help spare machinists the pain sometimes associated with the process.

Thankfully, most machine tools now come with canned cycles allowing for M-code and G-code pairings that precisely synchronize the spindle and feed axis for repeatable harmony with the workpiece . . . rigid and synchronous tapping. Built-in encoders can even monitor these activities and adjust the machine to maintain the proper relationship between feed and speed. Thanks to these advances, machines can now perform tapping with spindle speeds exceeding 4,000 rpm. Still, in the wake of these dramatic advances, limited tap life, poor thread pitch or tolerance and, most impactful, broken taps can keep machinists up at night and cost shops efficiency. Regardless of programming enhancements,



it's still a challenge to synchronize depth (especially in blind hole scenarios) and thread pitch with the relatively violent stop/reverse. This brings the quest for more reliable tapping to a key variable outside of the machine itself: tooling.

When it comes specifically to holding taps, the majority of shops opt for collet chucks. They're easy to understand and set up, and they are generally well balanced, with strong runout characteristics. What many shops don't realize is that another perceived strength of collet chucks, their rigidity, can actually be detrimental in tapping. Rigidity does very little to counteract the dramatic thrust loads imposed on the tap and part, exacerbating the already difficult challenge of weathering the stop/reverse and maintaining synchronization.

Using a dynamometer, we measured the load on a spiral tap held with a collet chuck in aluminum with metrics of 20 m/minute, 1,050 rpm and a depth of 12 mm. At the start of the reversal, the load was approximately 165 lb. It's the resulting axial pressure that leads directly to breakage, poor tap life and inaccurate threads. If you've had to EDM a tap out of a hole, or even scrap a part, you understand the disruption breakage cause. While continuing difficulties with tap life or poor thread quality add up quickly in terms of real cost, you're still not going to guarantee results or maximize the floor's capacity if slowing down spindle speed is your solution.

Just like machine builders have done their part, I'm here to tell you that we tooling suppliers are doing ours too. There are now tap holders designed specifically to mitigate the load imposed on the tap by essentially absorbing synchronization error.

For example, the MEGA SYNCHRO tapping holder is held into the main taper adapter with a cross bolt. The bolt goes through the outside of the cave and through the adapter, locking it in place. The hole in the adapter that houses the bolt has what we call a synchro adapter, an elastomer bushing that cushions the bolt. It's this relationship between the cushioning and the bolt that allows for the right amount of float. This cushioning is enacted not only at the bottom of the hole during reversal, where rigidity and peak forces lead to breakage, but throughout the entire cutting process. This means more consistent control of thread pitch and tolerance while eliminating re-cutting on exit, even on machines capable of high-speed retractions. The reduction of force also results in significantly less tap chipping that extends tool life, regardless of spiral angle – by a factor of more than two in most cases.

Just how much force can a little cushioning in the tapping holder reduce? Using the dynamometer to measure force under the same parameters as detailed previously in our test, but replacing the collet chuck with the MEGA SYNCHRO, the load maxed out at about 13 lb, or more than 10 times less.

Today's shops are fortunate to have machines with specialized coding for this difficult process. Coding is not a cure-all, however. Using the proper holding equipment for tapping operations is the only way to maximize machine tool capabilities and compensate for synchronization errors that are still unavoidable. The next time you think about setting up a tapping operation with a collet chuck the same old way you always have, you may want to think again.

CONTRIBUTOR

Alan Miller is the Engineering Manager & Product Manager BIG at BIG KAISER

Email: alan.miller@us.bigkaiser.com

High-Precision Hydrochuck Overview

Masayuki Doi

For years hydrochucks have been used in reaming and finish end milling due to stable runout, accuracy and good operability. Recently, as machine tools have seen an increased use in 5-axis machining centers, as well as multi-task and high-speed machines, tool holders have been in demand for a variety of operations. As machining applications continue to expand, hydrochucks have been developed with higher precision, miniaturization, higher speed and multi-functionalization, as well as part accessibility, in mind.

Hydrochucks have been developed with higher precision, miniaturization, higher speed and multi-functionalization, as well as part accessibility, in mind.

Easy Operability

Due to good operability, hydrochucks are used in a variety of industries. Operation is simple and straightforward and not dependent on the skill of the worker.

The hydraulic clamping screw is tightened with the included wrench and is complete when the screw reaches the bottom. With its ease of use, manufacturers looking for consistent, high-level product quality and stability from multiple operators, no matter their skill level, can benefit from the hydrochuck.

Stable, Repeatable Runout Accuracy

Our hydrochuck guarantees runout accuracy of 4xD within 3 µm or less at the tip. Furthermore, with repeatable high-accuracy operations, hydrochucks are ideal for precision processing, including reaming and finish-end milling.

The HSK-E25, E32 series is available for fine finishing processes that require even more accurate precision. The Hydrochuck Ultra Precision has runout accuracy of 4xD within 1 µm at the tip. As in the case in microfabrication, with tool diameters between 0.1 mm and 0.05 mm, tools may break during tool changes. When handling a fragile tool, the hydrochuck can be attached and detached with a single wrench. Also, because it corresponds to shank diameter h6 tolerance, a range of tools can be used.

Effect Of Suppressing Chatter

Various factors affect chatter during processing, however, it may be difficult to determine the cause. In some cases, if the vibration is absorbed in the tooling, chatter may be felt. In one instance, chipping of the cutting edge occurred during ball end milling while using a shrink fit chuck, however, the chipping was eliminated by switching to a hydrochuck. In this case, the hydraulic chamber of the hydraulic chuck helped suppress the vibration.

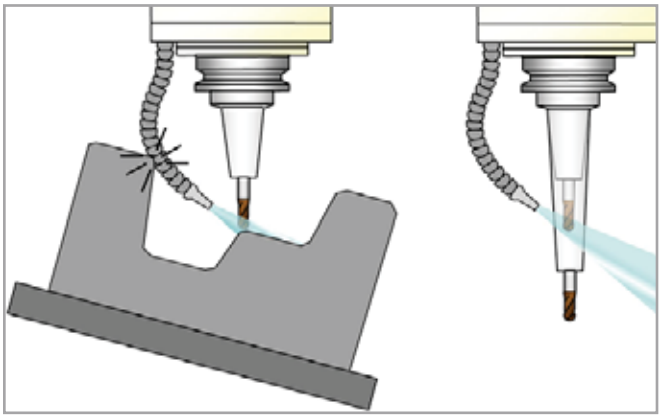
Super Slim Design

For more than 20 years a slim outer diameter has been an integral part of our hydrochuck's design. However, with the increase of 5-axis control machining centers and multi-axis machining centers, a slender design is required to avoid complex work designs, jig interference, chuck interference, etc. The super slim model further reduces the outer diameter opening, adopts a tapered shape, provides excellent accessibility to the workpiece, and is easy to use in 5-axis control machining centers, multi-axis processing machines and microfabrication machines. Furthermore, if used for ball end mill processing, the hydrochuck needs to stand up to high-speed rotation. Our hydraulic chuck adopts a unique balanced hydraulic mechanism and further evolves in a super slim design, up to 30,000 revolutions for BBT 40 and HSK-A63 type, and up to 45,000 rpm for HSK-E32 type, highest for HSK-E.

Jet-Through Type

In modern machine tools, it is increasingly common to use through-spindle coolant delivery systems. Even with the increase in the number of cutting tools with oil holes, there are many requests to supply the coolant from the tip of the tool holder. The reason: it is difficult for the external coolant nozzle at the end of the machine spindle to accurately supply coolant to the cutting edge when a multitude of tools with varying lengths are changed by an automatic tool changer.

In addition, when using a complicated workpiece design or a 5-axis control machining center, the workpiece may prohibit the nozzles of the external coolant to be in close proximity. If there is a coolant hole at the tip of the tool holder, the coolant can always be supplied near the cutting edge of the tool.



Since the main body of the hydrochuck incorporates an internal hydraulic mechanism, it was difficult to place the coolant hole in the limited space of the tooling tip. However, we succeeded in establishing the world's first jet-through coolant hole in a monolithic hydrochuck. Even when processing a mold with a ball end mill, coolant and oil mist are often supplied from the tip of the tooling to improve the tool life. The hydrochuck jet-through type is designed to be thinner than the previous hydraulic chuck, so it is easier to use even during mold processing where there tends to be holder interference.

Hydrochucks have responded to a variety of needs for various machine tools as 5-axis control machining centers, multi-task machines and high-speed machines have become widespread. Hydrochucks are available in various designs for a range of applications, such as the super slim type for reduced interference, jet-through type to supply coolant from the tip of tooling, and the ultra-high precision model with runout accuracy of 1 µm for high-speed micro-machining.

CONTRIBUTOR

Masayuki Doi — BIG DAISHOWA SEIKI CO., LTD., Technical Headquarters
Email: aw_tec@big-net.ne.jp

BIG KAISER Precision Tooling Inc.
A Member of the BIG DAISHOWA Group

2600 Huntington Blvd | Hoffman Estates, IL 60192 | P: (224) 770-2999 | F: (224) 770-2997 | bigkaiser@us.bigkaiser.com | www.bigkaiser.com