



Courtesy: Royal Machine Tools

WORKHOLDING EQUIPMENT

Securing the right grip

With increasing usage of CNC machines and arrival of advanced tooling systems, there has been a significant change in the design of workholding tools, which are crucial to the support environment of these high-performance machines. **Rachita Jha** explores the latest trends in workholding that are speeding set-ups and promising accurate repeatability in tooling systems.

When a workpiece gets ready for job work, the sole function of the workholding device is to offer a secure and fast machining set up that is built to withstand high speed and strong forces during the machining operation. If the workholding device becomes loose at any point, it can directly result in losses during machining and damage to the workpiece. As compared to the pace of the development of machining centres,

parallel technology advancements have been relatively slow-paced in the workholding applications.

The recent spurt in manufacturing activities and its impact on the productivity of machining centres, has precision engineers consider the crucial role of workholding equipment. Today, the need to deliver accuracy on a consistent basis demands workholders to be designed for quick set-up and changeover from one job to the next in the shortest possible time and at minimum cost.

Evolving with machines

Several changes have taken place on the job floor over the last decade - machines, materials, scale of operations, precision parameters and productivity benchmarks, to name a few. Companies that machine from the hardest grades of steel to the most fragile aluminium job work are finding many novel applications in emerging sectors of engineering. This has led to the arrival of high-performance CNC machines that offer multiple functions using different workpieces and tooling systems.

The technology leap has forced workholding systems to match the power and accuracy of these new machines. The ability to manoeuvre and customise operations gained greater importance during and post-economic slowdown period. So, as machines become more multi-functional, the same is demanded from the workholding and tool-holding equipment to ensure optimum productivity levels.

Says Satish Sadasivan, Managing Director, SCHUNK Intec India Pvt Ltd, "In the wider perspective, workholding is understood to be important and is treated with reasonable seriousness but is yet to be given its due priority. Every application in machining needs an efficient workholding, and therefore, the growth in this product is as vibrant as the machining itself."

The latest generations of workholding devices are a boon for engineers working on CNC machines, as they come with advanced part-holding rigidity and long-term accuracy, while absorbing machining vibration effectively. Moreover, their ability to adapt to a variety of workpieces makes them an important investment for any manufacturer.

Current trends

In-built with greater capability, flexibility and precision machines, the concept of workholding is set to make a paradigm shift. Reflecting on the current market scenario, Joseph



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Killukan, Managing Director, Jergens India Pvt Ltd, says, "The global market research says that the machine tool market worldwide is around \$ 70 billion. We would expect the workholding solutions market to be around \$ 4-5 billion. As CNC machines involve a much high investment, users today are more eager than ever before to use innovative value-adding solutions. The global trend indicates a shift away from expensive, dedicated and highly customised transfer lines in

6 key factors for workholding selection

- Reliable precision and repeatability
- Simple in design and highly flexible
- Optimal clamping forces
- Quick set-up time and automation ready
- Cost to performance ratio
- Ease of operations and maintenance

favour of standard CNC machines - creating the need for standard and flexible workholding solutions that are quick changeable, practical and repeatable to meet the needs of the applications."

A case in example is the growing popularity of changeable collet chucks that have undergone a rigorous innovation cycle in the workholding devices market and are designed to leapfrog the traditional collet chuck versions. "So far, customised workholding dominate the industry in India, and with the onset of flexi-machines & high-speed machines, it is becoming imperative that the workholding is well-thought of in advance. Dynamics in the design

upgradation demand that workholding is relevant despite changes in workpieces. For this reason, the workholding investment today demands greater time validity than it was earlier," observes Sadasivan. The next version of the workholding will surely be products that can be customised & precise, and ready & quick for multi-purpose machining.

Designed to perform

To make the right choice of workholding, customers prefer tools that are simple in design and highly flexible. The variations in shape and sizes of workpiece demand a unique set of machining force that should be applied on it for best results. The workholding system must therefore have a variable force regulation to be effective for variants in workpieces.

"More access to the workpiece enables faster machining. Therefore, it is essential to simplify the design of workholding to meet the demands. Also, the most efficient workholding are those with a standard drive unit and with minimal customised peripherals. The change of peripherals must enable flexibility to hold a variety of workpieces," says Sadasivan.

There also exist technologies like magnetic, vacuum, etc that have the ability to regulate clamping forces. Thus, the future of workholding design is governed by building them on the foundation of optimal clamping forces. "The new-age machining behaviour demands not just a clamping arrangement but more. With new technologies like magnetic clamping having electro-permanent magnetic system and vacuum technology, workholding has achieved a quantum



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leap in terms of flexibility, workpiece access, reliability, speed and optimum rigidity. Also, the future could witness less dedicated and totally customised workholding compared to the standard workholding devices having flexible end-elements like jaws or clamps," adds Sadasivan.

Versatile vises

Machining centres depend on vises and workholding for accurate parts. Over the years, the technology landscape for vises has changed from the manual to power vises that are designed specifically to match the performance parameters of CNC machines. As the job work on CNC machines is designed for precision and large-scale operations, the latest range of power vises come with the built-in feature of self-centring. This improves productivity by positioning and clamping workpieces precisely and quickly on a defined symmetrical axis.

Available in a broad range of sizes, they offer a large clamping range for odd-sized workpieces. Their nature to easily and quickly align themselves on a machine worktable functions as a catalyst to maximise productivity of the jobbing activity. "Five-axis workholding is designed for multi-face machining with a single clamping operation. It is ideal for machining complicated workpieces in a single clamping operation such as in mould making. These vises are small but have a large holding capacity. A variety of jaws options increase the range of applications. Free axes to the workpiece allow utilisation of short standard tools," avers Killukan.

The latest features in these tools include constant zero position, adjustable clamping pressure,

modular fixturing and maintenance-free hydraulics, among others. The versatility of workholding has opened new applications corresponding to the industry demands for precision in tooling systems.

Zero-point clamping system

A state-of-the-art CNC machine or the latest drilling tool is not sufficient to promise the best of performance standards unless it has the right workholding tool. A zero-point clamping system has become a popular technology for workholding users, as it provides fast and highly accurate location and clamping technique to speed up production in the manufacturing processes.

Sadasivan says that the zero-point clamping system is categorically a machine downtime killer in terms of fixture or workholding interchange. "In a matter of seconds, workholding (or pallet) can be precisely exchanged so that there is no evident downtime in terms of fixture exchange. The system provides a repeatability of position within 5 micron and has enormous retention force to accept any kind of machining application. The system is mechanically locked and ensures 100 per cent security at all times during machining with a retention force of upto 75 kN per sub-unit," he adds.

Variants of the zero-point system used in most of the latest workholders

ensure a suitable product for every machine and application. With its high lifetime, the zero-point clamping contributes maximum flexibility in every machine with unparalleled rigidity, precision and longevity.

"For applications where quick changeover and precision locating are critical, we have observed that zero-point system (ZPS) can cut set up times by 90 per cent with repeatability within ± 0.0002 " (0.005 mm). This ZPS technology allows one to fix position and clamp in a single step and is an ideal solution for a wide range of applications, including those where corrosion-resistance is needed," states Killukan. Available with either pneumatic or hydraulic release, these positive locking locating modules allow operators to quickly change large and small fixtures accurately and with minimal effort.

Lathe toolholding

The main constraint while machining on CNC lathes is chip-breaking. Super alloys, stainless steels, mild steels, etc tend to produce long chips while turning. According to Sashi Menon, Deputy General Manager - Technical Support, Seco Tools India, "The long chips do hamper productivity, tool life, surface integrity & cutting parameters. Hence, the basic necessity in turning is to break the chips. One of the latest developments in turning is the *Jetstream* concept. With the help of *Jetstream* tool holder, the coolant can be directed towards the cutting edge, and is controlled so that it falls below the area where the chips are forming. The high-pressure coolant, directed by *Jetstream* tool-holder, falls below the curling chips, lift and break them into small manageable segments."



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A smaller tool means high-cutting speeds, and most of the time, high-cutting speed leads to high revolutions of the spindle. To ensure the overall performance of the machine at high revolution per minute, the tool and the adaptor should be well-balanced to ensure better tool life and longer spindle life. "Shrink-fit adaptors are the best desirable holding system for high-speed machining, especially while using solid carbide end-mills. Shrink-fit adaptors are naturally balanced as per DIN 69888 Standard. After a tool is shrink-fitted, both the tool and the adaptor behave like a single piece, thereby increasing rigidity and reduce the run-out as low as 3 micron," informs Menon.

A tool holder that offers reduced run-out and increased rigidity invariably leads to high-cutting parameters, better tool life, and of course longer spindle life. Speaking on the future growth prospects, B S Venkatesh, General Manager-Business Development, Seenu Precision Tooling Systems Pvt Ltd says, "Current market for tool holding solutions is continuously growing and India is gaining increasing importance as a global sourcing hub for automobile and other industries worldwide. With this in mind, there is a large capacity expansion taking place in



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Making the right choice

Reliable precision and repeatability is crucial to avoid dissatisfied performance and huge time loss. As the machines incorporate more functions, it is essential to assist optimum performance with suitable workholding. Many factors play a role in ensuring a high level of performance of the machine. Importance needs to be paid to the cutting strategy.

"In the recent times, we have seen that workholding systems have kept pace with the advancement in cutting/machining technology. And, the thrust has been to keep the spindle cutting or as some would say, keep the machine engaged in doing its job instead of idling for whatever reason. New designs in quick change fixturing, clamping are now available to the discerning user," says Killukan.

An important aspect that needs to be considered while making a choice of a suitable workholding device is to analyse the cost-to-performance benefits. "With all above features, the cost-to-performance still must be justified to succeed in such high-quality and upgraded workholding. A standard basic drive unit with flexible customised peripherals would add value to investment, and this with longevity of the performance of the workholding, will comfortably justify the investment in the next generation of workholding," says Sadasivan.

The future definitely belongs to automation-embedded tools. Reflecting his views on the role of automation, he adds, "Future

workholding must be automation-ready, as low cycle times make manual interference more challenging. To have an automated load and unload of workpiece, the workholding must be ready, and this is surely a pre-requisite in the future. Speed is a key factor in such cases."

Future performance

The advent of high-performing CNC machines and cutting tools necessitates a good quality adaptor - the key link, which adheres to the latest industrial norms. The year 2010 had India investing heavily in state-of-the-art CNC machines. This trend definitely means that the need of the state-of-the-art tool holders/adaptors and workpiece holders has also witnessed a concurrent increase in demand.

According to Menon, adaptor is the key link between the machine spindle and cutting edge. "For a trouble-free and predictable machining at high speeds on modern CNC machines, this link should work in sync with the spindle and cutting tool. Any defect in this key link will lead to poor tool-life, bad surface finish, low-cutting parameters, and the worst, bad spindle life. The key features for a new-age product will remain rigidity, reliability and minimum run-out," he adds.

The current demand is for machines that feature multi-functionality and accuracy, which has infused a renewed vigour in the R&D and product design departments of leading manufacturers of workpiece holders, prompting them to launch products that offer a stronghold to match the machine performance. The coming years will witness a technology revolution in workholding that are slender, flexible and automation ready. ➤



Courtesy: CO-OP TOOL Workholding System

Advance chucks for workholding