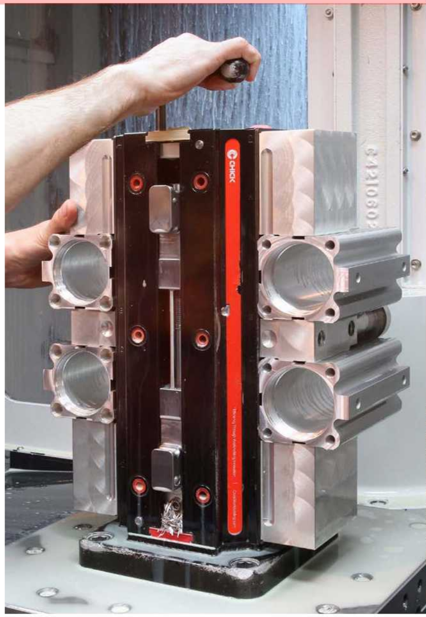
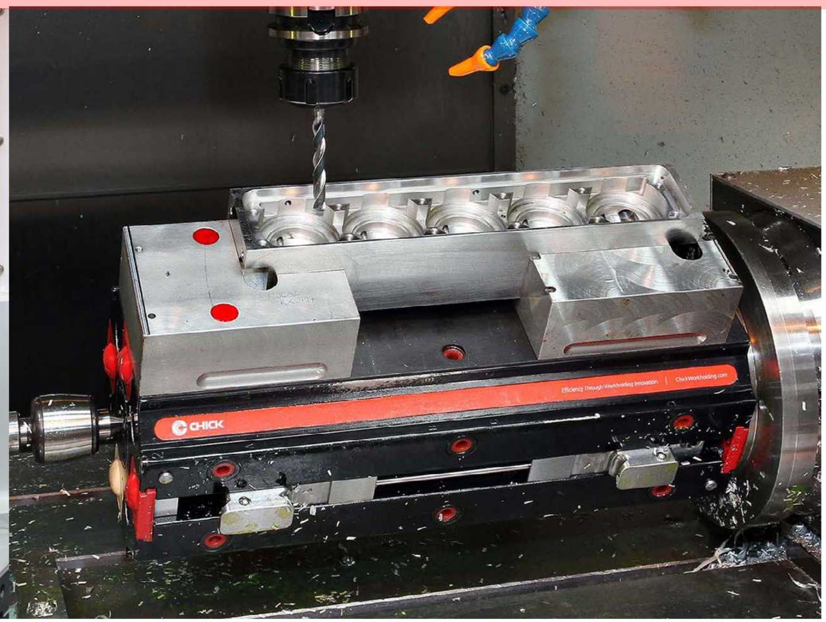
WORKHOLDING





Whether components need to be secured for prismatic metalcutting on a machining centre, for turning on a lathe or for undergoing a different machining operation, quick and reliable workholding is essential. Speed of loading and unloading during a batch run maximises production output and lowers unit manufacturing costs, while rigidity of clamping minimises vibration, leading to high machining accuracy and long tool life.

Prismatic machining applications

The first prerequisite of any workholding solution is to provide secure and consistent location for the workpiece.

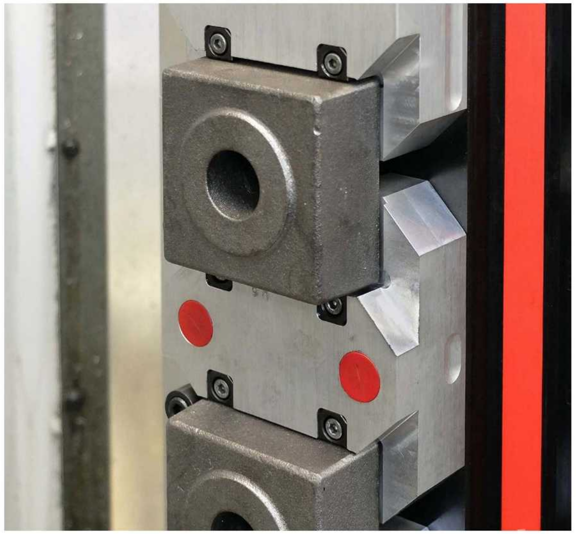
Using a traditional machine vice, a single workpiece is typically clamped by a moveable jaw against a fixed jaw, which normally deflects as clamping pressure is applied, making it difficult to achieve repeatable results.

In contrast, a modern workholding system squeezes two moveable jaws against a central fixed jaw, cancelling the opposing forces to provide a reliable reference point. Moreover, the units enable two components to be machined in a single cycle, rather than just one, immediately increasing productivity.

To improve workpiece retention when machining castings rather than billets, gripper inserts tilted to match the draft angle of the casting ensure maximum grip. These combination systems allow a modular approach to workholding, enabling productivity to be raised progressively.

Instead of such clamping systems holding components directly, an aluminium faceplate with two machined recesses on the underside can snap onto the slide assembly in the base, after removal of the jaws.

It allows the faceplate to be secured in seconds to a repeatability measured in microns, as during zero-point pallet change. The faceplate can then be used in conjunction with other workholding



devices, such as machinable clamps, to secure dozens of components quickly.

To take better advantage of the available vertical space in a machining centre, components can be mounted on an indexing sub-system. Each comprises a four- or six-sided tombstone mounted between a 4th axis indexer and tailstock on the table of a machining centre to present four (or six) components or sets of components to the spindle. Throughput and operator walk-away time are increased dramatically, the more so if several such units are mounted side by side.

Other clamping system are particularly well suited to 5-axis machining, such as low-profile, centric (self-centring) vices with high clamping forces up to typically 100 kN.

Notable qualities of some products are an ability to clamp on only 3 mm of material; and ± 0.01 mm centring accuracy with five microns repeatability for manual and pneumatic vices, or one micron repeatability for hydraulic types.

Highly repeatable zero-point clamping systems for machining centres are also widely used. Some pneumatic quick-change systems feature powerful retraction of the clamping pin in each receiver and a positioning accuracy of better than 5 microns.

Recent development have seen the introduction of systems for checking how tightly a component has been clamped. During automated machining in particular, verifying holding force is always a challenge.

One approach is to integrate measurement directly into a modular fixturing rail. An on-screen digital readout of clamping pressure from a device enables an operator to verify that a hydraulically secured component is held correctly. A second system uses a coloured dot that changes hue, allowing the holding force of a manually secured workpiece to be checked.

Most workholding solutions are compatible with rotary tables, which add 4th and 5th CNC axes to a 3-axis machining centre. They reduce the number of separate machining operations and increase the complexity of parts that can be produced.

Many options are available to complement rotary tables, such as manual, pneumatic or hydraulic tailstocks, tail spindles with built-in clamping system, trunnion assemblies, rotary joints, air/hydraulic intensifiers, and manual, pneumatic and hydraulic chuck systems.

Finally, permanent-electromagnetic clamps can often provide an efficient workholding solution when fixturing ferrous materials. The low-profile equipment provides excellent access for tools and consumes a minimum of Z-axis travel.

Meanwhile, a double magnetic circuit allows uniform clamping between the workpiece and the magnetic surface and at the same time between the magnetic system and the machine table.

Turning applications

In the area of rotational machining, workholding solutions include jaw chucks including quick-change varieties and collet chucks. A vast range of standard options is available.

Alternatively, a bespoke problem-solving approach to workholding can be taken. To cite a typical example, an irregularly shaped automotive pump housing needed to be clamped in a jaw chuck for machining. The component had through-holes in a flange specified

to extremely close tolerances in relation to a bore. In addition, the taper of the cast body called for a chuck capable of providing substantial pull back characteristics.

The optimal solution was identified as being a purpose-designed back stop and two jaws with a custom profile mounted in a power wing chuck with draw-down action.

The arrangement was subsequently confirmed successful through a series of tests and the component is now in volume production at a leading component supplier to the motor industry.

Collet chucks have the advantage of applying clamping pressure evenly around the circumference of a part, leading to tight concentricity during turning. They also open and close rapidly, boosting productivity for both long and short runs.

For example, a collet chuck supplied with requisite adapter plate is used on a twin-spindle Colchester lathe at a hydraulic equipment manufacturer in the West Country. A collet design is preferred, as it allows higher accuracy of machined components and the inconvenience of having to set and bore out chuck jaws is avoided.

Another useful product in the arsenal of workholding equipment is the expanding mandrel for ID clamping, which allows full access to the outside profile of a component for machining.

The number of operations can be reduced and the Takt time shortened, leading to more economical production and better accuracy.

An example of a special workholding arrangement using this equipment is a dual sleeve expanding mandrel system mounted on a lathe for internally gripping thin-walled tube.

Parallel expansion offers optimum accuracy and grip force and the sleeves are sealed for complete protection.

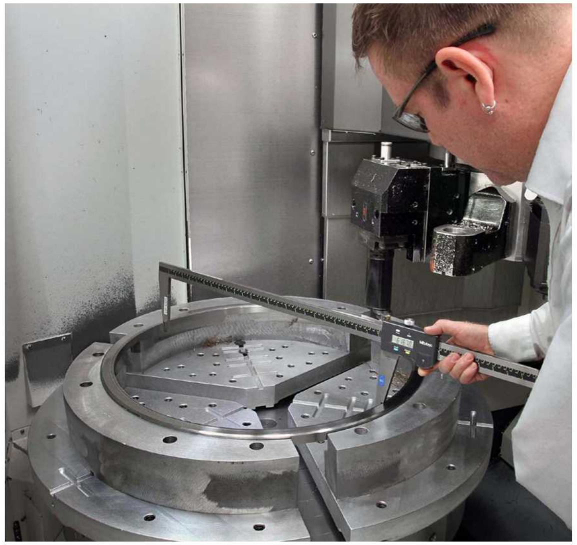
An ingenious workholding configuration was adopted at a Birmingham engineering company following the arrival of a vertical turning lathe (VTL).

The machine allowed the subcontractor to take on extra work turning larger aero engine rings from Jethete, aircraft grade stainless steel and nickel-based alloy castings or forgings. However, the machine's three-jaw chuck was unable to hold the thin-wall components without introducing distortion, out-of-roundness and eccentricity.

So a master plate was sourced from the US, which was pre-drilled and keyed to accommodate three standard, curved segments that spread the clamping pressure evenly around the circumference of the aero rings, either by holding on the inside or the outside.

The workholding system allows the required 0.15 mm circularity and ± 0.1 mm dimensional accuracy of the components to be held, while the cost was well under half that of a multi-jaw compensating chuck.

1st MTA operates a consultancy service to identify the optimum workholding solution for any given application. It offers to UK and Irish manufacturers the largest variety of clamping products from a single source for securing round and prismatically shaped components.



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