



Photo courtesy Southwestern Industries

## Machining Centers

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# INNOVATIVE TECHNOLOGY CHOICES

*Match machine selection  
to shop needs, toughest jobs*

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There's a lot of agreement that finding the right technology solution involves more than just selecting the right horizontal, vertical, universal, five-axis, high-speed, or multitasking machining center. Obviously, choices are made based on the job at hand. Best cost per piece, however, means very different things in a mold shop or a production facility, a job shop or an aerospace OEM. Each application has its own set of requirements with machine tool builders offering new technology and new machining center lines aimed at specific targeted applications, markets, and industries. Here's a sampling of recent innovative introductions:

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TRAK LPM from Southwestern Industries Inc. (Rancho Dominguez, CA) is a vertical machining center (VMC) system that places the skilled machinist in the position to reduce setups for short-run production with minimal help from shop specialists. It combines machining center technology with the simplicity and flexibility of the ProtoTRAK PMX CNC, which doesn't require the operator to have G and M code knowledge for programming, either at the machine or off line.

The PMX CNC integrates programming, workholding, tooling, and job management in a system that includes a table with locating bushings at precise locations known to the PMX. The locating holes in the table contain receivers for the Jergens Ball Lock system. Fixture plates can be prepared off machine, positioned at one of the preset locations, and locked down in seconds. Fixture offsets don't have to be measured with the machine idle, and the flexible Ball Lock locating guides allow using existing tooling in the LPM system. A mobile tool-setting system is standard with the TRAK LPM, which includes a cart equipped with a simple presetting methods and tooling organization that fits the guided tool-setting procedure of the ProtoTRAK PMX CNC.



***JapanTek 5X-410 features a tilting spindle head and CNC-controlled rotary table that allows unrestricted five-sided machining of relatively large workpieces equal to the size of the 16" (406-mm) square table.***

Job management objectives possible with the TRAK LPM include allowing operators to prepare future jobs while tending a current job, enabling a skilled machinist to control all aspects of a small-volume production job, and reducing planning and thinking required for repeat jobs. A great help in this regard is available by capturing information about job setups with photos

and notes that are annotated and saved along with each program for future call-up.

### Multiple Models Offer Diverse Solutions

For machining complex parts, SB Machine Tools (Schaumburg, IL) is introducing the JapanTek 5X-410 machining center with five axes/five faces machining capability. According to Tak Yamamoto, vice president, "The 5X-410 offers four machining capabilities in one machine due to its unique design for aviation, aerospace, medical, automotive, and die and mold applications." The four capabilities are five-axis machining center with automatic two-pallet changer (APC), five-face machining center with APC, horizontal machining center (HMC) with APC, and VMC with APC. "Milling, drilling, and tapping can be seamlessly done on even the most intricate shapes," says Yamamoto.

The machine's design features a 120° (90° ± 15°) tilting spindle head, a fully CNC-controlled, double-wormgear-driven pallet, and extended linear X-Y-Z strokes which facilitate simultaneous multi-axis machining. The 16" (406-mm) square pallet allows for full four sides and top surface machining on any 16 × 16 × 16" (406 × 406 × 406-mm) workpiece. From any angle the X-axis travel is 650 mm. At spindle vertical, the Y-axis travel is 400 mm, and the Z-axis (table surface to spindle nose) travel is 550 mm. At spindle horizontal, the Y-axis (table center to spindle nose) travel ranges from 70 to 650 mm, and the Z-axis (table surface to spindle nose) travel ranges from 0 to 610 mm.

MC Machinery Systems Inc. (Wood Dale, IL) has expanded their machining center business with the introduction of its MC Milling line, which effectively complements Mitsubishi's high-end Roku-Roku line of VMCs, EDM, waterjet, laser, press brake, and consumable products. The Diamond Cut general milling line comprises five series of VMCs and drilling and tapping machines. The MC Milling line covers a broad cross section of machining operations including general engineering, mold and die, drill/tap, and heavy-duty machining.

The MCV Series general-purpose machining centers feature two spindle/tooling systems, CAT-40 8000-rpm and CAP-50 6000-rpm motor, for applications like fixtures, mold base, and secondary operations. The DV Series general-purpose machine features a 15,000-rpm direct-drive spindle and CAT-40 tooling for intricate milling work in job shops. The DM Series features a 20,000-rpm HSK-A63 spindle for mold and die work. The SV Series features heavy-duty box-way construction for large-part machining with a CAT-50 spindle and hand-scraped box way guides. The TV Series drill/tap machines feature 24,000-rpm

high-speed spindles driven by a 5-hp (3.7-kW) motor. “We’ve tried to make the machine selection as simple as possible and included all the important features as standard on the machines,” says Danny Haight, national milling product sales manager.

### **Innovative Design Leads to Better Quality**

The latest Mikron HSM machines from GF AgieCharmilles (Lincolnshire, IL), like the HSM 400U LP and HSM 600U LP, are well-suited for machining medical devices and dental implants, turbomachinery components, aerospace, mold and die, and new applications like LED and fuel-cell manufacturing. Technology advances include linear motors for all three linear axes and direct-drive torque motors for the rotary and tilt axes on its five-axis machining centers. Axis accelerations of 2.5 g in three axes and rapid traverse rates to 100 m/min enable the machine to achieve higher dynamic performance on a polymer concrete base structure. A typical circularity test with a grid encoder at a feed rate of 5 m/min shows a deviation of less than 2  $\mu\text{m}$  over the entire circumference of a 150-mm circle. Surface finishes down to  $R_a$  0.05  $\mu\text{m}$  are being achieved.

The Mikron HSM 400U LP has a 42,000-rpm coolant-through spindle and modular tool tower that can accommodate 308 tools. Mikron HSM machines are designed for automation with built-in table chucks for pallet changer or robot palletization. Smart features for untended operation include built-in vibration monitor in the spindle to stop the machine, broken tool detection with a laser measurement system, power-failure protection, and a remote notification system.

The R300 turning/milling center from INDEX Corp. (Noblesville, IN) is intended for applications where larger chuck parts require a large amount of milling and drilling work, such as machine and farm machinery construction, in tool and mold making, or in the aerospace industry. The R300, the most recent addition to the RatioLine series, is designed to be highly productive in machining short bars up to 102 mm and chuck parts up to 315 mm in diameter. From very simple to highly complex components, complex machining operations are possible simultaneously on the front and rear side with two motorized milling spindles. The use of HSK tools instead of live toolholders on turrets reduces tool costs.

For high-end mold machining, OKK USA Corp. (Glendale Hts., IL) has introduced the VB53 high-speed VMC, with design features intended to achieve superior surface finish and precision. The VB53 is standard with 20,000-rpm Big Plus double-contact spindle connection and  $X$ - $Y$ - $Z$  travels of  $41.34 \times 20.87 \times 20.08$ " ( $1050 \times 530 \times 510$  mm). Technological innovations

include the VB53’s superior surface finishing capability, fewer vibration stripes by accel/decel, and less quadrant projections. OKK’s fine-pitch ballscrew reduces the maximum rapid speed, but increases the overall precision of the entire system. In addition, the VB53 employs an external, isolated oil cooler, which removes a common source of vibration from the machine, resulting in superior die quality. Thermal control protects castings from being exposed to either cutting chips or coolant that can affect thermal displacement during machining.

The VB53’s workspace has been redesigned to reduce operator fatigue and is 15–50% more accessible than conventional machines. Coil-type conveyers clear chips efficiently, moving stray chips outside the machine quickly. The VB53 also comes with an automatic grease lubrication system standard; this means no waste oil contamination of the coolant, and the cartridge-based design makes it easy for the operator to replace. Standard equipment like the 0.05- $\mu\text{m}$  scale feedback linear scale enhances the positioning accuracy through all possible applications.

### **Pick Your Level of Machine Capability**

Mazak Corp. (Florence, KY) continues to build out its Five Levels of Multi-Tasking with new machine additions. The Integrex j-300 is a Level 3 machine, which features independent milling spindle headstocks with  $B$ -axis indexing, as well as full  $Y$ -axis travels and tool storage magazines. The j-300 provides milling, turning, and drilling operations for quick and accurate processing of simple to complex workpieces in fewer setups.

The j-300’s main turning spindle with  $C$ -axis control and 10" (254-mm) chuck capability delivers 25 hp (18 kW), 4000 rpm for demanding metal removal applications. A 30-hp (22-kW), 12,000-rpm milling spindle allows for four-axis simultaneous machining plus five-axis tool tip positioning indexed in 5° (or optional 1°) increments from -30 to 190° ( $B$ -axis control). This capability makes it possible to perform OD machining, as well as turning, facing, grooving, and threading with the same flash tool. The milling spindle can be radially indexed and clamped, enabling the same tool to be used for turning in both forward and reverse directions. The MX Hybrid Roller Guide System dampens vibration to extend tool life, handles higher load capacities, and accelerates and decelerates quicker to shorten cycle times.

The compact G350 and G550 horizontal machining centers from Grob Systems Inc. (Bluffton, OH) are designed for machining materials ranging from plastics to stainless steel in small to medium series production. Based on the modular G

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series modules, the machines are capable of five-sided machining and five-axis profiling, wet or dry. The machines have a 240° *A* axis and 360° *B* axis. The latest development for the machining centers is an electromechanical pallet changer. The pallet is mechanically clamped and secured on the setup and working area sides, allowing the operating cycle for loading to be shortened and sped up.

As an option at the setup station, an electrical central drive can be selected for tensioning and releasing workpieces on the pallet. With the central drive clamping of the part can be carried out by means of an electromechanical vise, chuck, or zero-point clamping. Another new Grob development is the G550T, milling/turning machine based on the G550.

### Machines Designed for Large Parts

Large-part machining poses its own set of special challenges, which have been met by a new generation of Speedmat boring and milling centers and Speedcenter HMCs from PAMA Inc. (Elgin, IL). There are a total eight different models with pallet sizes ranging from 1250 × 1250 to 2000 × 2500 mm. Efforts to increase dimensional capacities have succeeded in producing models of both ranges that can machine parts up to 4600 mm in diameter and weighing 25 t.

PAMA's new Speedcenter machining center models feature sturdy and precise machines with superior dynamic performance. Typical workpieces processed on them include power generation, earthmoving, large diesel engines, heavy mechanical engineering, molds, automotive, aerospace, and contract manufacturers. Speedcenter machines have the power, torque, speed, and acceleration characteristics to machine the most diversified materials from steel and cast iron and from aluminum alloys to titanium alloys.

Speedcenter machines maintain the "T" structure with the table moving on the *X* axis and the column on the *Z* axis. Three models are available starting from the 1250 × 1250 mm pallet with *X-Y-Z* travels of 3000, 2000, and 2300 mm up to 2000 × 2500-mm pallet with 4600, 3000, and 3200 *X-Y-Z* travels. The rotating table features hydrostatic support and the rotating *Z* axis is driven by a preloaded double rack-and-pinion system to ensure backlash-free positioning. Choice of CNC control includes Siemens 840D sl, Fanuc 30i-A, or Heidenhain iTNC 530 NC.

### Titanium Challenges Machine Stiffness

Difficult-to-machine workpieces, typically the newest titaniums, Inconels, high-strength stainless alloys, and other alloys



***MC Machinery's Diamond Cut VMC series covers a wide range of likely shop applications ranging from general purpose, mold and die to drilling and tapping operations.***

have forced an even greater design discipline on machine builders and suppliers of cutting tools, toolholders, coolant systems, and CNCs. All of them taken together are necessary for successful machining results. "The crux of the matter for optimum heavy-metal machining lies in the ability of the machining system to perform low-frequency machining without chatter, hold tools tightly with heavy-duty tool tapers, increase machine stiffness construction, and deliver the power necessary," says Scott Walker, president, Mitsui Seiki (USA) Inc. (Franklin Lakes, NJ).

According to Walker, the volume of titanium to be used in aircraft in 2012 is projected to be 100 million lb (45,359 t). Remarkably, this represents only 35% of total titanium consumption, and demand is growing, says Walker. Mitsui Seiki's HS6A-5X five-axis HMC with 1300 × 1200 × 1200 *X-Y-Z* and two 1000-mm square pallet tables has demonstrated its effectiveness in machining moderately complex titanium workpieces up to 1000-mm long.

"Machining moderately complex titanium parts up to 1 m in length, for example, where primarily three and positional four-axis cuts are required, requires machine tools with structural design to machine at low amplitude ranges in less than 350 Hz—especially at the 20, 90, and 320 Hz ranges," Walker explains. "In heavy metal machining, all of the materials in the machine tool structure must stay within a specific range of stiffness and resiliency so that when cutting, the spring memory of the machine is very repeatable. This repeatability is paramount for tightly controlling the cutting edge machining parameters as they pass throughout materials. To cut heavy metals, the machine needs ample torque. The spindles should produce 2000 ft-lb (2711 N•m) of torque at 100 rpm and large servomotor drives on fine-pitch lead ballscrews." **ME**