A New World for Energy Parts Manufacturing

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Concerns about climate change and global carbon dioxide levels have put green energy closer to the driver's seat in recent years. According to the International Energy Agency's (IEA) Global Energy Review, most experts expect renewables to produce nearly 30 percent of all electricity in 2021, with wind and solar generation rising by 17 percent and 18 percent, respectively.

Despite this impressive growth, fossil fuels continue to dominate the market, with the IEA predicting that coal demand alone will account for 60 percent more than all renewables combined. As a result, energy-related CO_2 emissions are poised to reach their second largest annual rise ever, wiping out any pandemic-driven reductions in greenhouse gas concentrations.

It's a dynamic industry, to be sure, but one thing is certain: Global energy consumption—whatever its form—will continue to create new opportunities for machine shops and other discrete manufacturers. Pump and turbine housings, gearboxes, windmill root sections, wellhead and drilling components—these are just a few of the parts produced every day by energy OEMs and their Tier suppliers, many of them quite large, heavy and made of challenging materials like Inconel and Duplex steel.

Go Big or Go Home

Big parts require big machines, big workholding and big cutting tools—all of which demand a big investment. Klaus Miller, vice president of sales for Absolute Machine Tools Inc., Lorain, Ohio, is happy to help with the first of these. He noted that the energy and aerospace markets have been slow over the past two years, although both appear to be picking up now that the worst of the pandemic is hopefully behind us.

Remove the safety guarding, chip pans and controller from an OKK HM1600 horizontal machining center and you're left with the metal skeleton shown here. (Provided by Methods Machine Tool)

"We're an importer of You Ji and other brands of CNC machinery," said Miller. "You Ji equips some of their larger equipment with hydrostatic table bearings, making them quite popular with energy part manufacturers. That's because these machine tools can handle the extremely heavy loads encountered in this and other machining sectors, and offer excellent long-term accuracy due to this feature."

In one recent example, Absolute installed a You Ji vertical turret lathe (VTL) with a 4-m table. The company that purchased it machines large energy workpieces, which Miller said came on strong following the rise in clean energy investments during the 2006 timeframe but began to taper off roughly a decade later as manufacturing moved offshore to China, Romania and other low-cost suppliers. This new installation might indicate a reversal of what has long been a trend.

Absolute also installed a large-capacity boring mill for a local customer earlier this year. Although shop management did not disclose the specific application, they did tell Miller it was intended for energy work and that it must have a load capacity of 35,000 lbf (155.7 kN). "They already had a Johnford bridge mill but needed something larger," he said. "Here again, between the hydrostatic bearings and the sheer mass of the machine—130,000 lb (58,967 kg)—it proved to be the right solution."

Machine mass is clearly important when taking heavy cuts and striving for accuracy in parts larger than a pickup truck. Miller and others suggested that few machine tool builders today "make 'em like they used to" and that many machine shops have therefore opted to retrofit their Lucas, Giddings & Lewis and other old iron with CNC controls. And while this is an excellent way to extend the life of what was surely a substantial investment, there comes a time when even the best equipment falls short compared to its modern equivalent, no matter how many times it's been updated.

Another way for shops to maximize these investments is by using their large part machining capabilities to expand beyond the energy market. For example, the defense industry is a significant user of supersized parts, as are the mining, agricultural and construction industries. Tackling such work, however, means that shops must invest in flexible machine tools that can easily be adapted to a variety of parts and boast features that minimize downtime.

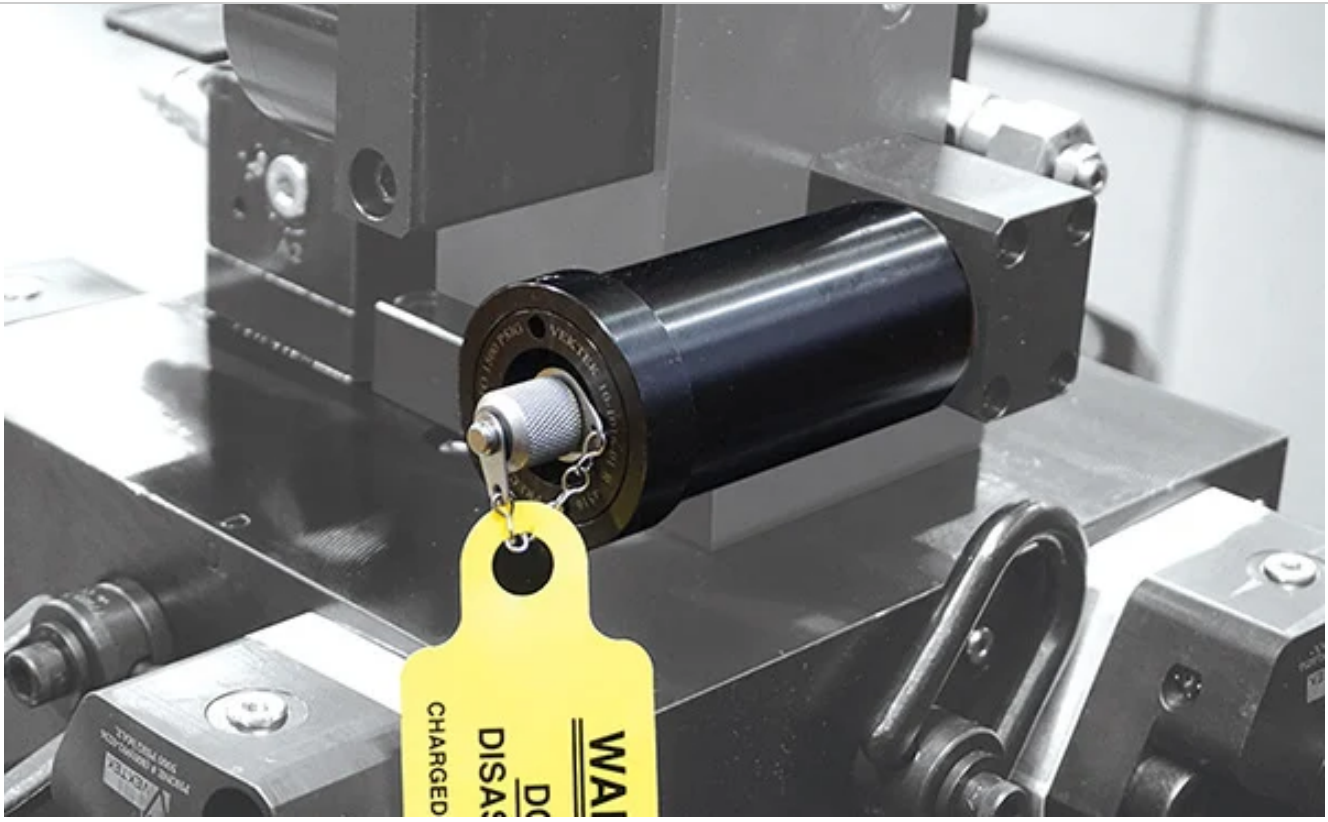
Bernard Otto, director of technical support and product manager for Kiwa Japan and OKK Japan products at Methods Machine Tools Inc., Sudbury, Mass., has several recommendations on how to achieve that. He noted that numerous Methods' customers support the fracking industry, producing pumps, housings and similarly large components. Being competitive here not only means removing large amounts of material from steel castings and forgings efficiently, but also keeping the spindle turning at all times.

"High spindle utilization requires that the person operating the machine can get 17,000 lb (7,711 kg) parts into and out of the machine quickly, accurately, and above all, safely," he said. "In the majority of cases, this is best accomplished with a pallet changer."

Going Deep

Otto also pointed out that having a broad range of spindle speeds lends similar flexibility. He said many of the machining centers in this arena boast 50-taper geared headstocks with only two ranges, high-speed and low-speed, and max out at 3,600 rpm. This limits their owners' ability to use small drills and milling cutters or machine aluminum alloys.

"OKK is one of the few builders to offer three gear ranges and up to 6,000 rpm, allowing its customers to cut very aggressively with big face mills, for instance, and also use smaller cutting tools when needed," said Otto. "This makes them much more versatile for shops that have to produce a variety of workpieces."



The Vektek Accumulator will maintain circuit pressure when the fixture is disconnected from the pump via a decoupler. (Provided by Vektek)

Other features to look for include high Z-axis thrust for heavy drilling operations, integrated plumbing for automated hydraulic workholding, and, on boring mills, the ability to lock the quill (the W axis) in place, greatly increasing rigidity when roughing out deep pockets. It's for these and other reasons that Otto agrees with Absolute's Miller that keeping up with current machine tool technology is the clear path forward for shops that wish to remain as competitive as possible.

But perhaps the most important recommendation for energy manufacturers and others with fluctuating demands is to keep their machines turned on and fully operational. This is especially true for the oil and gas sector, which can be very cyclical, and for companies with machinery assets that have long since been paid for and tend to sit idle between jobs.

Said Otto, "In these situations, our service department will often field calls from customers attempting to fire up a machine that hasn't been used for months and sometimes years, only to find that an axis is frozen or an electronic component has gone dead. That's why we tell shops to cycle their machines periodically, and, better yet, put them on a preventative maintenance schedule with an authorized distributor. Doing so helps avoid some unpleasant surprises, regardless of the machine brand, its size or the type of work."

Braden Damman seconded the need for hydraulic workholding, although he was quick to point out that the integrated plumbing mentioned earlier isn't a prerequisite. An applications engineer at workholding component supplier Vektek LLC, Emporia, Kan., Damman noted that several additional configuration options are available, including ones where the workholding fixture itself is plumbed for hydraulics and powered by an external "accumulator," a device that maintains pressure on the system during machining.

Regardless of the approach, hydraulic workholding is the clear winner in terms of consistency and reliability, if not in price. "In most applications, hydraulic is the most expensive solution, although the initial cost is quickly offset by productivity improvements," Damman said. "It eliminates the variation seen with manual clamping methods and is a must for automated processes."

Ironically, much of the large energy part workholding that Damman is called to assist with is for secondary operations. "We see a fair number of gas turbine components that have some sort of fine detail with very tight tolerances," he said. "In these applications, the customer often wants to mount the part on a CNC grinding machine for finishing and needs it to be automated besides. Hydraulic workholding is almost always the preferred method due to its high repeatability."

Larry Robbins, president of workholding specialist SMW Autoblok Corp., Wheeling, Illinois, is a big fan of repeatable clamping but noted that it's frequently necessary to reposition large parts due to their variability. "Whether it's a forging or casting, anytime you get above a meter or so in diameter, you almost always need a way to adjust its location within the chuck," he said. "We've offered independent jaw adjustment with our manual and hydraulic chucks for probably 25 years now but have extended that capability over the past few years to our electrically activated line of workholding products."

Energetic Workholding

Robbins explained that the company's MM e-motion chucks have a patented linear positioning system (LPS) that allows the operator—automatically or otherwise—to measure the part's location in the machine via a touch probe, send the positional information to the controller and have the chuck center the part accordingly. Each jaw is powered and controlled by its own "e-motor" that is in turn driven by an inductive coupler, allowing the system to be used on stationary or rotary applications. Parts of all shapes and sizes up to 1,250 mm are accommodated, as is modification of the gripping force, even while the part is being machined.

As several others here have stated, Robbins and SMW Autoblok have experienced slowdowns in the energy and aerospace sectors over the past two years, although both have enjoyed an uptick of late. Interestingly, he's begun seeing demand from the oil and gas industry for chucks able to grip ever larger pipes, a request that is challenging from the workholding and machine tool perspectives alike.

"In the past, we've redesigned the master jaws to increase capacity in existing chucks, but we're now faced with completely new product designs given the request for through-holes of 24" (610 mm)," he said. "Such large diameters also place a heavy load on a lathe's spindle bearings. This is something we can alleviate somewhat through the use of steady rests, but here again, we're approaching the limits of existing workholding technology. Energy providers are on the verge of creating an entirely new marketplace."

Agreeing on Automation

Automation system provider Fastems LLC USA, West Chester, Ohio, is seeing similar demands for new technology. Regional Sales Manager Loy McEldowney said the energy sector has traditionally been slow to adopt automated part handling, although that mindset

This requires several things. One of the pallet-changing machining centers described previously is a good place to start, followed closely by some form of automated workholding. Aside from the hydraulic and electronic fixturing already discussed, air or mechanically activated zero-point locating systems are also available. McEldowney said the retention knobs for such systems are often mounted directly to large workpieces, with the mating receiver attached to the pallet.

Perhaps most important of all is the development of stable, predictable processes. This task can be challenging on any machined part, but especially so for the low-volume, high-mix work common to energy manufacturing. Even so, an increasing number of oil and gas component suppliers are doing just that.

“Justifying the investment in automation and subsequent process development doesn’t require high volumes as much as it does fairly repeatable orders,” said McEldowney. “For companies that have long-term agreements with their customers and can see what’s coming over the next 18 to 24 months, it’s a lot less scary to spend money on dedicated fixtures, pallets to put them on, and an automated or even semi-automated storage system. When an order comes along, all they have to do is load the pallet, call up the program and run the part. And for those with our MMS (manufacturing management software) system and integrated cell controller, they can do it lights-out. Either way, it makes even lower volume manufacturing very efficient.”

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