

Technology Chases Production

Productivity flows from CNC machining

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Automation provided by Okuma's Oil Coupling Cell removes the most troubling aspect of coupling manufacturing—the need for human intervention.

Partsmakers and machine tool builders alike are being challenged to provide the advanced technology and equipment required by the oil companies and their energy service suppliers to seek for, find, and successfully recover oil and gas resources needed to fuel the world's economies.

The oil companies have to drill farther afield and deeper in the earth and in deep water in their explorations. To the already ubiquitous land-based drilling rigs, more oil platforms are being added for drilling on and, increasingly, off the continental shelf, in waters from 1500 to 8000' (457–2438-m) deep before the ocean floor is even reached and penetrated.

Operating environments are much tougher, requiring metals that are more corrosion-resistant and more able to withstand crushing pressures without failure. Strings of 30' (9.1-m) pipe hang, screwed together by their secure threads, penetrate several miles deep into holes created by rock bits of every imaginable size, and often intimidating shapes. Mud is pumped via miles of tubing

through the bits to remove rock debris from the newly formed hole. Casings must be built up to prevent the hole from collapsing on itself.

“Durability is a critical factor for pipe with heavier wall thicknesses to withstand the pressures of deeper wells.”

For their part, machine tool builders and tooling suppliers are designing their products to adjust to these trends:

- CNC turning with precision threading capability, especially in larger diam through-bore sizes, is being offered.

- Use of multitasking machines and five-axis machining centers with the capability to handle difficult-to-machine metals to reduce or totally eliminate the number of setups for machining complex workpieces is increasing.
- Automation can effectively reduce cycle times and increase throughput, improving productivity even in a job-shop environment.
- Metals that must withstand more severe operating environments pose their own special machining challenges to machine tool and cutting tool manufacturers alike.

Products for the oil field include the usual wide array of machined, welded, and fabricated parts and

Gage Measures Large Oil Field Parts

Measuring and documenting critical dimensions of machined parts is an issue facing many plants and shops, regardless of the size of parts to be gaged. That task is further complicated when parts of the type found in the energy industry, such as large-bore pipe, are involved.

“Once you get above 12” (304.8-mm) diam, a bore gage with a nose piece that is machined from solid steel material becomes quite heavy and difficult to maneuver,” explains Bob Harman, Testar product manager at Marposs Corp., Auburn Hills, MI.

For measuring large-size bores up to 20” (508-mm) diam, Marposs designed a fabricated gage nose piece carrying measuring contacts, into which a handle containing the measuring apparatus is mounted.

The part-touching fabrication resembles a cross within a circle where



For measuring large-size bores up to 20” (508-mm) diam, Marposs designed a fabricated gage nose piece carrying measuring contacts, into which a handle containing the measuring apparatus is mounted.

the space surrounding the cross pieces is open. Thus, the weight of the gage is significantly reduced,

making it practical to use the gage for measuring any large-bore pipe or other component. Two handles fixed to the nosepiece make it easy to move the gage. The gage contacts, which are guided to avoid bending errors, can be provided in tungsten carbide, DLC coating, or diamond.

One of the dedicated solutions available from the M1 Star line of manual bore gages, the Marposs large-diameter gage produces measurements with repeatability to 0.5 μm . Measurements can be displayed on a digital or dial indicator mounted on the handle or via a transducer connected to an electronic unit that can capture data for SPC reporting. The gage can be equipped with Bluetooth wireless technology to eliminate cables and provide real-time measurements inside deep bores. ■



Oil pipe is being honed on a Mazak QTN 450.

equipment used in a complex network of rigs, pipelines, and facilities for upstream drilling and completion.

“We identify three categories of products that our machining processes must handle,” explains Dana Scott, southwestern general manager, Mazak Corp. (Florence, KY). “They include tubular goods for casings and the drill string; wellhead valves including blowout preventers, and the so-called Christmas tree valves; also accessories including chokes and mandrels, the kinds of products that are needed to drill and complete a well,” Scott says.

“For tubular products, we provide turning centers with large bores; the Slant Turn 60 with the 14.75" [374.6-mm] bore is the most popular model, as well as the Slant turn 80 with the 21" [533-mm] bore,” Scott says. “Durability is a critical factor, particularly because we are seeing pipe with heavier wall thicknesses to withstand the pressures of deeper wells. As an example, traditional drill pipe might have 3/8" [9.5-mm] wall thickness; now you

are seeing wall thickness closer to 1" [25.4 mm].”

Scott points to Mazak’s Integrex multitasking machines and e-series models, which provide contract manufacturers with the capacity for build-to-order machining of complex parts, elimination of work in process, and reduction of inventory. “Valves, for example, can be done in a two-operation mode with the first op done on head one, followed by automatic transfer to head two for completion,” he points out.

Energy resources go far beyond just oil and gas drilling.

Recent expansion of the Mazak Technology Center in Houston represents the company’s continuing commitment to testing out machining of workpieces, both in its own facility and in the R&D facilities of the energy service-industry providers.

“Everyone perceives the oil industry as just big lathes cutting pipe, which, of course, is not true,” says Gerald Owen, team leader-Dallas, Mori Seiki USA Inc. (Rolling Meadows, IL). Owen points out that the demand for multitasking machines and five-axis machining centers is growing to meet the demands for single setup machining of complicated workpieces in small lots.

“Our new vertical NMV 5000 VMC is a full five-axis machining center with direct-drive motors. And the NT series lathes are multitasking machines that can be used as a lathe, but we have some customers who are employing them as five-axis machining centers, using the chuck as a rotary table.”

The NMV5000 DCG minimizes vibration by pushing moving structural parts along their simulated centers of gravity, improving accuracy, reducing machining times, and extending tool life. Box-in-box construction achieves a structure with zero overhang, so that guide-ways and drives are well balanced for stable feeds, even at high speeds. Direct drive motors are used on the B and C axes. Turning is also possible with a C-axis rapid traverse rate of 120 rpm.

Mori Seiki’s NT Series of integrated mill-turn center is available in the NT5400 DCG/1800S configuration featuring a sub-spindle. The machine’s maximum turning length is 70.8" (1798 mm). The mill-turn center is in the 15" (381-mm) chuck size class, and can handle a maximum bar work diam of 4.1" (104 mm).

“Depending on the type of drill bit being produced, five-axis ma-



Romi's M43 CNC combination lathe has been chosen by National Oilwell Varco for threading new pipe and rethreading old pipe for downhole oilwell tooling in Dubai.

chining is being used to machine graphite molds for forging or casting drill bits. Materials being used include high-nickel-content metals such as Inconel, high chrome, a lot of 4340 modified steel, Hastelloy, and Monel for the gas industry," says Owen.

Romi Machine Tools Ltd. (Erlanger, KY) is supplying its M33 and M43 CNC combination lathes to National Oilwell Varco for its downhole oilwell tooling for both

threading new pipe and rethreading old pipe. Downhole tools are used for drilling, well intervention, reentry, and well-completion applications. National Oilwell has offices in Houston, Edmonton, and a new facility in Dubai (UAE).

Romi has provided the company with a M43 × 140" (3.5-m) model in Houston and two M33 × 140" and an M27 × 120" (3 m) for its new facility in Dubai. Two more machines, an M33 and an M43, are on order

for Dubai. The M33 model features a 33.4" (848-mm) swing over bed, through-hole of 5.4/9.9" (137/251 mm) and a 50-hp (37-kW) spindle motor. The M43 features a 43.3" (1099-mm) swing over bed, through hole of 6.9/14.7" (175/373 mm), and a 60-hp (44.7-kW) spindle motor.

Fanuc 21I-T controls on the Romi machines feature a thread repair module that facilitates reclamation of used pipe and rework of oversize (OD) and undersize (ID)



threads. The integrity of threads is particularly important because a thread failure can result in staggering losses if the string is stranded deep in the hole.

When Hartwig Inc. and Okuma America Corp. (Charlotte, NC) celebrated the grand opening of Hartwig's new Dallas facility in mid-December, seminars highlighted creative machining opportunities, particularly in the oil and gas industry, available through Okuma, Partners in THINC, and their collaborative R&D efforts, which also produced the automated Okuma Oil Coupling Cell.

Seminars focused on the benefits of high-pressure coolant (ChipBlas-

ter; Meadville, PA), adaptive logic (Caron Engineering Inc.; Wells, ME), lean manufacturing (Okuma and Hartwig), enterprise requirements planning (ERP), the THINC control from the customer's perspective (MetalQuest Unlimited; Hebron, NE), and Oil Coupling Technology (Okuma America). Exhibits included the fifteen Okuma machines and many Partners in THINC demonstrations.

Automating oil industry machining was the primary goal of the Okuma Oil Coupling Cell presented by P.S. Reddy, Okuma production specialist. "I think as oil prices continue to go up, oil producers need premium couplings

for deep wells at competitive pricing. Okuma Coupling Automation will help to improve quality, increase throughput, and decrease production costs at a price much lower than you might expect."

The cell addresses one of the most troubling, time-consuming, and even dangerous aspects of coupling manufacturing—the need for human intervention in load/unload, machining, and clearing the work envelope of chips without damaging the workpiece, workpiece threads, and the cutters themselves.

The solution resulted from the cooperation between Okuma and Partners in THINC. An automated cell has been created around

Positioned for All Energy Markets

Energy resources go far beyond just oil and gas drilling. The sun, the wind, and even the wave action of the seas are all regarded as having some potential to meet the world's growing thirst for power. MAG Cincinnati (Cincinnati) has a ready portfolio of machining centers to meet the machining needs of the various energy markets.

Two machining centers, the MAG Cincinnati U5 and the H5 platforms with variations that include vertical, horizontal, and five-axis contouring heads, automatic head changers, and extended travels have emerged as key players for energy-related applications.

The MAG Cincinnati U5 universal machining center is capable of five-sided machining and five-axis contouring of transmission cases for the wind power industry, as well as applications in the oil and gas industry that require heavy metal removal.

The U5 is available as bridge-style, rail, or in the new U5 1500 version for extra large parts. The U5



The U5 1500 universal machining center features an extended Z-axis travel for machining large housings in wind power and ship engine production applications.

1500 is capable of heavy metal removal with a special high-torque head and 75% larger ram and 75% larger cross rail. This machine is

particularly well-suited for machining extremely large housings used in wind power and ship engine production applications.

For turbine components, the MAG Cincinnati H5 five-axis machining center can machine cases, blades, blisks, from difficult-to-machine metals such as titanium and hardened steels. The H5 GEMINEX multi-tasking machining center is capable of milling and turning operations utilizing a direct-drive motor rotary table.

The H5 is also being used for four and five-axis machining of diesel engine products for the pollution control, marine, and back-up capacity generator applications. An application that could benefit from another of MAG Cincinnati's technologies, its fiber placement system, is the manufacture of blades for wind turbines that can reach to more than 100' (30.5-m) long. ■

an Okuma Oil Country Lathe (LOC650), an Okuma V80R VTL, ChipBLASTER high-pressure coolant, and an overhead Fanuc gantry robot. Collaborative Partners also included in the R&D project are Schunk, Kennametal, Sandvik, LNS, Big Fix, Symantec, Trend Micro, Webex, Hexagon Metrology, Tool-Boss, Marposs, and Iscar Metals.

The LOC is a four-axis machine capable of reducing cycle time by about 30% compared with a two-axis lathe, especially in roughing. Currently operating with a 14.75" (374.6-mm) diam spindle bore, the V80R is capable of running at extremely low speed and high torque for larger parts, or faster to a top speed of 1250 rpm. Bore sizes of 7.87" (200 mm) and 22.05" (569 mm) are available. The cell is divided into two zones, one with the LOC650 and the second with the V80R, allowing entry into either side for maintenance while the other continues production.

The Variable Spindle Speed Threading (VSST), a process developed by Okuma, was also demonstrated at the open house event on the Captain L470, the LOC650, and LU45 lathes. VSST eliminates vibration and presents

pitch errors with a slow, smooth spindle transition.

Harlow Sammons Inc. (Odessa, TX) has transitioned its hydraulic business from rebuilding well-servicing pumps, or mud pumps, to machining new pump parts, explains Chris McGaha, president. The company, which began as an industrial engine rebuilding shop, has pinned its growth on several Johnford machining centers from Absolute Machine Tools Inc. (Lorain, OH), supplied by distributor North Texas Machine Tool & Group (Carrollton, TX).

The integrity of threads is particularly important because a thread failure can result in staggering losses.

"We manufacture three main fluid ends in two sizes for Gardner Denver pumps. The smaller one can be completed on the DMC-1500H from start to finish on one machine in four setups. The larger pump is done on two machines. We do all the milling, facing, and

squaring on the DMC-1500H or the DMC-2100H. Then we move it back to the St-60B to bore out the holes," McGaha explains.

"The third pump is done on the 2100H, which we had custom-made for the job. North Texas put risers on the bridge to raise it up. We tell everyone who comes here trying to sell us an HMC that the horizontal here is standing on end. In a sense, that's what we did. We had them raise the bridge enough. And it has a 24" (610-mm) rotary table on it, which makes it like a horizontal standing on end. The third fluid end is much larger than the other two, and we can do it in three setups from start to finish. The other two are individual modules. It takes three modules per pump and these are individual modules. On the third, it's all three built on one."

McGaha likes the rigidity of a bridge machine. "All we cut is 4140 steel. That's 75% of what we machine. These fluid ends have a hole in front that's 4.25" [108 mm] in diam. Our machine can put the hole in there in two processes without batting an eye. In less than 8 min, it puts a 4.25" [108-mm] hole, 9" [228.6-mm] long in a piece of 4140 steel," McGaha concludes. ■