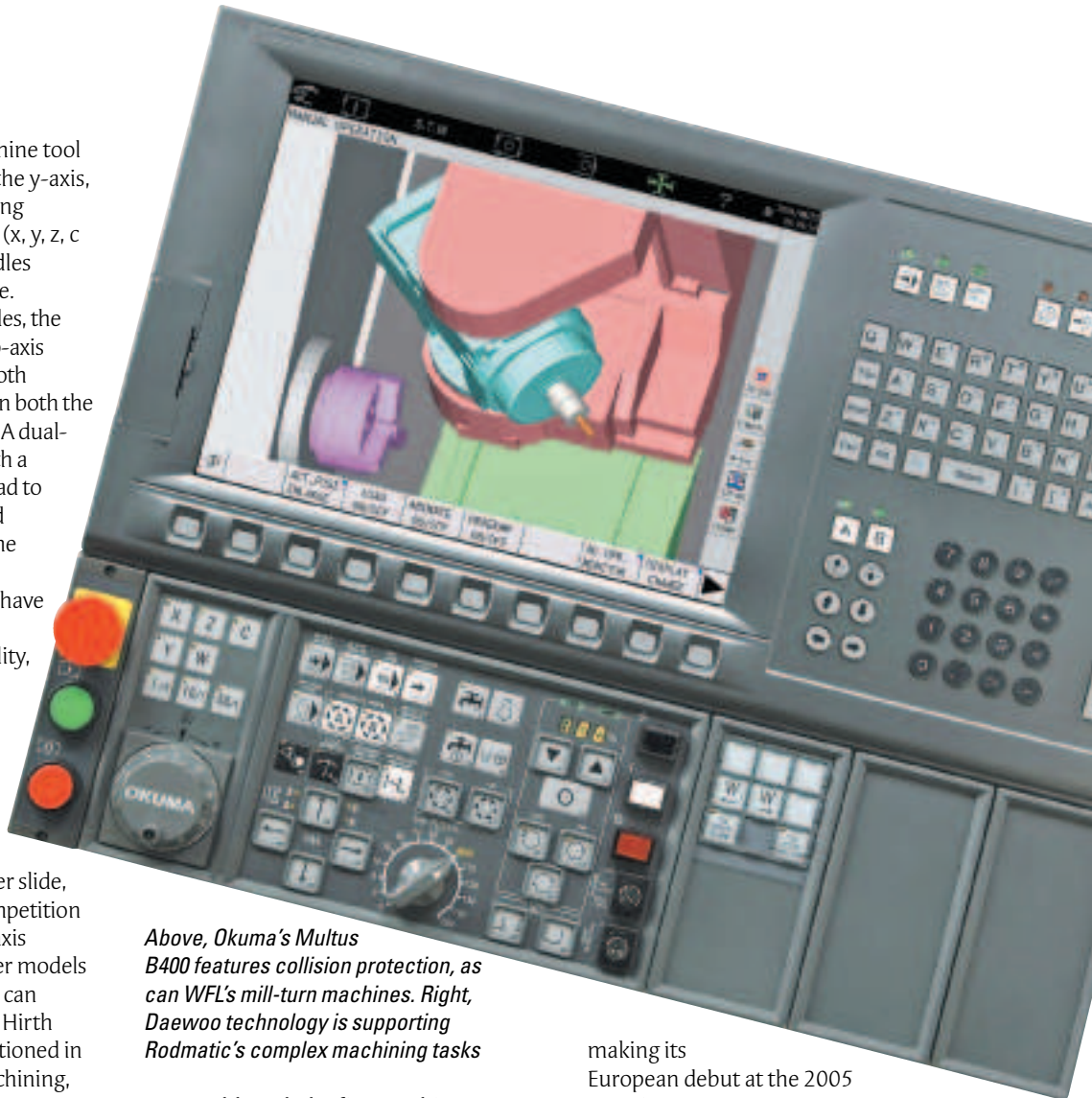
To 'b' or not to 'b'?

Multifunction mill-turn machines with b-axis capability have brought a whole new meaning to 'one-hit' machining. Steed Webzell reveals who offers the technology and its benefits

The b-axis on a mill-turn machine tool is defined as rotation about the y-axis, and in effect grants 5-axis milling capability to a turning machine (x, y, z, c and b). B-axis turrets/tool spindles typically sit above the centre line.

When fitted with dual spindles, the extended machining range of a b-axis machine enables it to perform both milling and turning operations on both the front and back of the workpiece. A dual-spindle b-axis machine fitted with a lower turret allows the b-axis head to operate when other turret-based cutting tools are being used on the spindle from below centre line.

Many machine tool makers have introduced models offering a variety of levels of b-axis capability, such as WFL for instance, represented in the UK by Kyal Machine Tools. WFL is a mill-turn only machine tool builder with a long history in this technology area. Its medium-to-large machines go from 420 mm to 1,500 mm swing over slide, taking it into a realm where competition is limited. All models sport a b-axis spindle (+110°/-110° for smaller models and +110°/-90° for larger) that can either be indexed by means of a Hirth coupling in steps of 2.5° or positioned in steps of 0.001°. Apart from machining, b-axis is also used to achieve easy access while part probing. In addition, the b-axis is a full NC-axis suitable for the 5-axis machining of components such as turbine blades (see also news item page 6). A lower turret complements the upper b-axis turret. Kyal's customers include Rolls-Royce and many other large OEMs, although the first machine, an M35, is to be installed at a UK sub-contractor soon.



Above, Okuma's Multus B400 features collision protection, as can WFL's mill-turn machines. Right, Daewoo technology is supporting Rodmatic's complex machining tasks

Mazak has some 27 models across its Integrex Series IV and Integrex e Series II ranges offering this b-axis. 'Done in one' is how Mazak describes this concept, with the Integrex e-1550V10 Series II making its European debut at the 2005 EMO in Hanover.

Defined as the fusion of a vertical turning lathe with a 5-axis machining centre, the machine has been designed for the turning of large diameter workpieces such as turbine casings.

A 37 kW, 10,000 rpm tilting (b-axis) spindle with 150° of movement

(+120°/-30°) caters for both horizontal and vertical machining operations as well as angle boring and milling, and combines with a 37 kW, 300 rpm turning spindle for significant throughput gains.

Two recent orders received by Yamazaki Mazak UK, from machine tool builder Mollart for an Integrex e-500H and from Lymington Precision for an Integrex e-650H, confirm that the integrated approach appeals to OEMs and sub-contractors alike.

Also launched at EMO 2005 was the new eight-machine Mori Seiki NT Series, pitched at the aerospace and power industries, as well as for prototype automotive parts and mould inserts.

It is claimed that the new NTs combine turning and milling on an equal footing, with a major productivity gain attributed to the machines' direct drive b-axis which swivels through ±120° at a maximum speed of 100 rpm. This benefits machining on freeform surfaces, yet also facilitates fast re-tooling (re-tooling time 1 sec; chip-

Gripping stories

All mill-turn centres are ultimately a combination of lathe and milling machine. As such they present tooling challenges, such as rigidity. Tooling and spindle couplings must provide enough rigidity to handle b-axis-spindle work.

Today's tooling companies approach the rigidity challenge in different ways, but most agree that rigid turn-mill tooling starts with the adapter/spindle coupling. For instance, Walter's Xtratec and Screwfit lines, Sandvik Coromant's Capto system and Kennametal's KM system all provide rigidity through special coupling designs.

Walter's Screwfit adaptor combines taper locating with a simultaneous flange fit for easy tool changes, precision and rigidity. This two-point locating system accommodates several different Xtratec tools and adapts to NCT modular-type systems without loss of rigidity. The company also meets the rigidity challenge using special cutter geometries.

Sandvik's Capto system on the other hand, is a face-contact adapter that locates tools via a self-centring tapered polygon. Designed for toolchanging along with static turning and rotational milling operations, the system delivers good torque transmission, stability and balance. Its toolchanging repeatability (tool in and out repositioning) is within 0.002 mm. Like Walter, Sandvik also manufactures special tooling for rigid b-axis machining. These products include 45° turning tools, solid carbide milling cutters and wiper inserts.

As with Sandvik's Capto system, Kennametal's KM system is well suited for both rotating and static machining on a mill-turn machine. The KM uses three surface contacts for rigidity in both turning and milling operations. It has a short taper and makes contact at the face, the front portion of the taper and the back of the taper.

Mazak's Integrex series range now takes in some 27 models, all with b-axis

to-chip 3.4 sec).

One of the traditional arguments against the adoption of b-axis mill-turn machines has been that they are unnecessarily complex to program and operate. Tackling this head on is DMG's new GMX 200S linear model (b-axis = ±120°) that introduces the new Siemens SolutionLine controller with integrated ShopTurn programming, a move that DMG says makes the machine as simple to use as a universal lathe.

This control provides a simple choice of cycles and 3D workpiece simulation for all turning and milling operations, this extending to the b-axis.

Both DMG's GMX and Twin series machines offer b-axis capability. In total there are now over 150 installations worldwide. In the UK, users include the Renault F1 Team based at Enstone, Oxfordshire which puts its GMX200 linear to work producing a wide variety of parts for its championship-winning Formula One racing cars.

EXPANDING CHOICE

New entrants to the b-axis turning market are appearing constantly. Okuma, for instance, has launched a new mill-turn centre for one-hit machining of components up to 710 mm in diameter by over 1,500 mm long. Called the Multus B400, this 5-axis machine features advanced collision avoidance in real time during an automatic machining cycle or, unusually, in manual mode as well (thus preventing the axes from being wound by hand into a collision situation). Incidentally, WFL also sports a similar feature, Crash Guard.

In place of a turning tool, the Okuma's swivelling b-axis spindle accepts HSK-A63 (Capto C6) tools, exchanged from a 20-station (or 40 or 80) magazine, for undertaking heavy prismatic machining operations using 10 kW (optionally 14 kW) of power. The milling spindle of the Multus B400 (available in the UK from NCMT) swivels from -30 to +195° in 0.001° increments.

The Italian lathe manufacturer Biglia (Whitehouse Machine Tools) has introduced its first b-axis mill-turn machine, called SmartTurn 1200. The torque delivered by the HSK-63 milling spindle is particularly high at 86 Nm, provided by a 9 kW motor with a maximum speed of 6,000 rpm. Pivoting of the b-axis above the spindle centreline is through ±105°, with through-spindle coolant and locking by Hirth coupling.

The first SmartTurn customer in the UK will be punch and die manufacturer AW Precision of Rugby, whose works director Graham Tranter needs to rough out large volumes of high speed and tool steels quickly. The pre-milling process is designed to replace slower and more costly grinding operations on site.

"Of the three b-axis lathes we shortlisted," explains Mr Tranter, "the twin-spindle SmartTurn 1200 offered by far the highest torque for milling, which was important to us as the parts we intend to put on to the machine have a lot of prismatic machining content."

At Reading-based Rodmatic, a special department (called Hytec) has been established as a fast response, single cycle specialist sub-contract operation for producing higher value and complex parts in batch sizes between 20 and 500.

The company has recently installed a 9-axis Doosan Daewoo Puma MX2000ST mill-turn centre. Typical of the projects undertaken at Rodmatic Hytec is a family of some 20 different shuttle valve bodies produced in batches of between 25 and 50 parts directly from a 200 mm sawn billet in a single operation. The components involve considerably more milling and drilling than turning, with the presence of more than 30 different holes, some set at compound angles with various critical intersections and breakthroughs to other holes and features. Further operations also include turning, extensive milling, boring and threading carried out using both main and sub-spindle, b-axis with 240° of movement and 5-axis positioning.

Promoting the Doosan Daewoo MX-ST range in the UK is Mills Manufacturing Technology, which says it has also been a success at other UK sub-contract machining companies, such as Chard-based Metaltech Precision and Jigs & Fixtures of Ayrshire.

Metaltech supplies high accuracy pump and valve parts to the petrochemical and oil industries in batches of around 100. "Even though we have only had the MX2500ST a few months, it is already an indispensable part of our operation," says director Steve Hill.

Oil and gas represents over 60 per cent of Jigs & Fixtures' business. It owns three MX2500ST models: "We can afford to be more selective with the work we take on thanks to the investments we have made," says company partner William Hyslop.

RISING FROM THE FLAMES

Hemel Hempstead-based Colbree Precision had the misfortune to be within 200 yards of the Buncefield oil depot blast last December (see *Machinery* June 2006, page 32). The company has subsequently installed a Nakamura-Tome Super NTJ twin spindle, twin turret mill-turn machine with a ±90° b-axis.

"With the b-axis we can actually swivel the turret round and do features such as angled holes," explains director Steve Bree. "The only way we could do this before was as another operation on a milling machine. We used to have three milling machines and now we have cut that down to one – the more work we can do while we are turning the better."□

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