Cylkro Face Gears:

DUTCH DESIGN AND SWISS INGENUITY CAUSE TRANSMISSION BREAKTHROUGH

When the Cylkro face gear transmission was first introduced by a Dutch company, it was met with years of skeptical disbelief and resistance from the traditional transmission establishment. Nevertheless, perseverance and a takeover in 2003 by Swiss-based ASSAG paved the way for growth and success in various industries and in many countries. This article describes the start and breakthrough of the Cylkro face gear transmission.

Origin. It was not until the early 1990s that face gears found some acceptance among the established transmission systems. Although face gears have been seen through history—for instance in the Chinese south-pointing chariot or in several Leonardo da Vinci designs—these examples more often ended up as museum pieces, not fit for industrial use. Then, some 20 years ago, the University of Eindhoven (Netherlands) began researching the possibilities of calculating and manufacturing face gears in such a way that these could be used in high-end, high-torque applications.

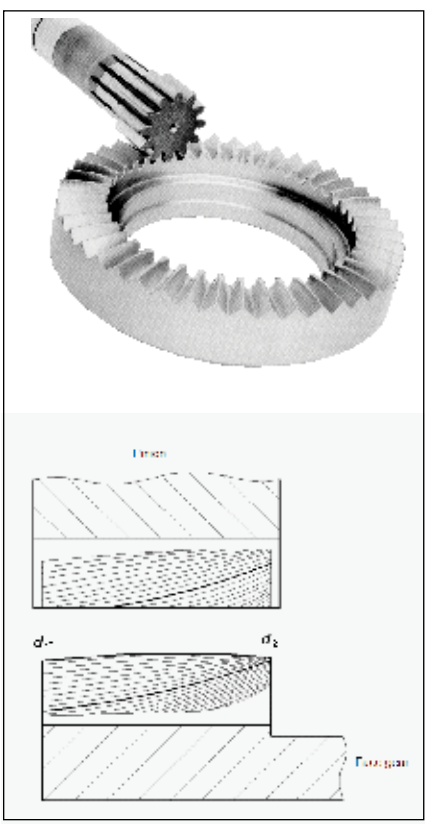

Figure 1—Face gear set (above) and helical contact lines on pinion and face gear.

Design. Derived from the Dutch words for cylindrical pinion and face gear, this new type of face gear transmission was named the Cylkro face gear. The first aim was to develop software to calculate the geometry and strength of the Cylkro transmission. A basic face gear set consists of one involute cylindrical pinion and one face gear, mostly at a 90° axis angle. It is the pinion's geometry, axial position and transmission ratio that determine Cylkro face gear geometry.

The shape of a Cylkro tooth or, more accurately, a tooth fillet, varies over its width. At the inner diameter, the fillet is relatively large as compared to the outer diameter. As a result, the point-of-contact of the Cylkro flank at the inner diameter is on a smaller radius of the pinion than at the outer diameter. Therefore, the lines of contact are inclined, even with a spur pinion. With a driving pinion, the meshing starts at the tip of the Cylkro tooth at the outer diameter (Fig. 1).

The pressure angle also varies over the tooth width, caused by higher velocity at the outer than at the inner diameter. The load capacity calculations for bending strength and pitting resistance are based upon the German standard DIN 3990 and ISO/DIS 6336, which apply to parallel gears. These include factors for geometry, meshing conditions, material properties, etc. The characteristics of the Cylkro transmission were translated into these factors with the help of FEM calculations. In order to avoid edge contact, the teeth of the pinion and/or Cylkro gear have to be crowned. Specific Cylkro software programs allow calculating the load distribution over meshing teeth and along the lines of contact, as well as tooth root bending stress and contact stress (pitting resistance) of a Cylkro face gear transmission.

Manufacturing. The Cylkro face gear production method was continuously improved and is described in a large number of patents. The processes include continuous hobbing, hard-cutting and several options for surface treatments (Fig. 2).

The geometry of the hob is based on the geometry of the pinion. Because one pinion can mesh with various face gears with different numbers of teeth and axis angles, it is possible to manufacture all these types of gears with one single hob.

Features. The wide range of gear ratios—from 1:1 up to 20:1, and more—is only one of the Cylkro face gear's specific characteristics. Other features are:

- Axial freedom of the pinion
- Free choice of axis angle from 0° to 135°
- The possibility of helical teeth or axis offset
- Multiple power transmissions; i.e.—two or more pinions mesh with one or between two face gears

Customer-specific applications. Almost all Cylkro face gear transmissions benefit from the advantage of axial freedom of the pinion at the mounting of the gear set (Fig. 3).

Compared to traditional angular transmissions such as bevel gear sets and worm gear sets, in which both gears have to be adjusted very precisely and even in pairs, the spur Cylkro face gear set only requires adjusting of the face gear. Thanks to the axial freedom of the cylindrical pinion, the axial position of the pinion does not affect the contact pattern.

Pinions can be exchanged easily and do not require meshing in pairs with the Cylkro face gear. This is of great benefit when there is expansion in the pinion axis due to heat generation. Or, the feature can also be utilized when the axial freedom becomes part of the application's function. For example, Saueressig embossing machines use the feature to slide one embossing cylinder closer to the second embossing cylinder. Another example is the starter gear in the Porsche Carrera GT, of which only an exclusive 1,200 cars were built and in which the pinion is axially pushed into the face gear at the moment of starting the engine.

It is possible to choose any axis angle between 0° and 135°, of which 90° is the most common. Smaller axis angles, such as 17°, are used in mixing equipment or driven tools with 45° angles from Sauter Feinmechanik GmbH (Fig. 4) and Benz-driven tools for the metal working industry.

Face gear sets with a helix angle are used, for instance, in automatic door systems. In this example (Fig. 5), the pinion only has three teeth and is shaped almost like a worm. However, the helical Cylkro transmission's efficiency remains very high as compared to the loss of efficiency in worm gear sets. Another advantage, specifically for the door system application, is the lack of self-braking factor. This means that in case of power failure and emergency, the doors can be opened easily by hand.

Gear ratios in the range of 1:1 to 1:5 are the typical choice for power applications. Larger gear ratios are more often used in hand-driven applications or in precision solutions such as printing machines or optical machinery from Zeiss. U.S.-based Danaher Motion has a full range of angle gear heads in which a total of 29 different Cylkro face gear sets are used. The gear head range is divided into five sizes, each size covering a gear ratio range of 1:1 to 1:5.

Finally, the multiple-power transmission—in which one or more pinions mesh with one wheel or between two Cylkro face gears—has been realized, for instance, in Hydrosta BV bow thrusters (Fig. 6) and Index Traub turning machines (Fig. 7).

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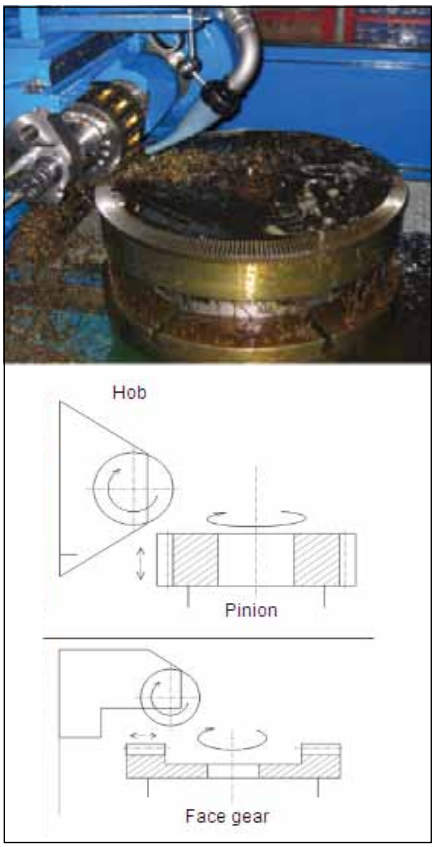

Figure 2—Manufacturing of Cylkro face gears by a six-axis CNC spur gear hobbing machine.

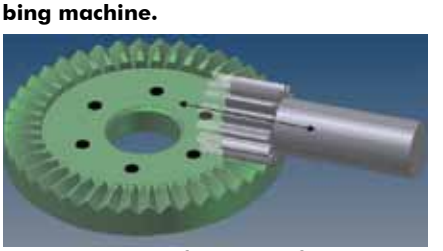

Figure 3—Axial freedom of the pinion in face gear transmissions.

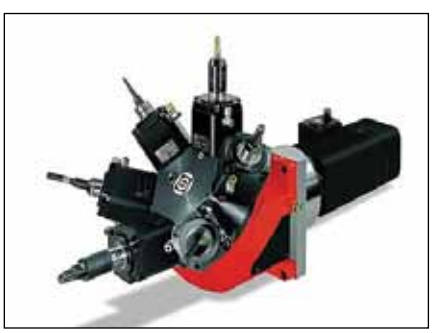

Figure 4—Compact tool exchanger based on face gear transmission.

Figure 5—Automatic door moving system with Cylkro transmission.

Figure 6—Cylkro face gears in counter-rotating bow thrusters achieve higher efficiency.

Figure 7—Multimodal Index Traub turning machine with inner and outer face gear rings.

Center Differential of the New Audi Quattro with Cylkro Face Gear Technology

An enormous breakthrough for the multiple-power Cylkro face gear transmission in the field of automotive applications was the introduction at the Geneva Autosalon earlier this year of the new Audi Quattro RS 5 with a self-locking crown gear differential in the Quattro drive train, which regulates the power distribution between the front and rear axles.

Two Cylkro face gears with different tooth geometries, resulting in a 40:60% torque split, are built into this lightweight differential (4.8 kg). ASSAG was given the responsibility of developing the tooth geometry of the face gears and pinions that are used in the heart of the Quattro drivetrain. Finally the successful cooperation resulted in a common patent application and ASSAG granted a license for serial production of the Cylkro face gears. Using the Cylkro face gear technology, Audi could realize a weight reduction of 2 kg compared to the conventional differential. Furthermore, the package of plates of the differential could be considerably reduced.

How it works. The Cylkro face gear with the largest number of teeth (Fig. 8, left side) is connected with the cardan shaft to the rear axle. The second face gear takes care of the power take-off to the front axle. In between the face gears, four planetary pinions are equally spaced at 90° in a planet carrier that is driven by the outgoing axis of the S-tronic 7-speed gearbox with double clutch.

The self-locking crown gear center differential attains a high efficiency ratio. This standard rear-biased configuration ensures sporty handling of the vehicle. In the basic situation, there is no difference in rotational speeds of the face gears and the planet carrier. If one of the axles starts to spin, for example, while it is on ice or snow, the self-locking face gear center differential will immediately engage. By a package of plates, the differential can widely vary the torque distribution between the front and rear axles. Up to 70% of the drive force can be fed to the front, and as much as 85% toward the tail-end (Fig. 9).

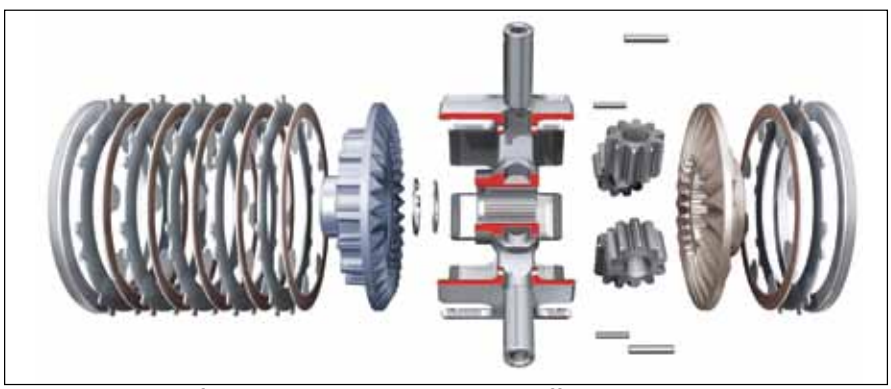

Figure 8—Detail of the Audi Quattro RS 5 center differential.

Figure 9—Embedded face gear center differential.

ASSAG could realize this wide variation by exactly locating and tolerating the contact patterns between the pinions and face gears. These contact patterns have been pre-defined by ASSAG within specified limitations. This leads to certain axial forces on the face gears and on the package of plates, finally resulting in a variation of the torque distribution in such a way that ASSAG could fulfill all Audi specifications.

In the crown gear differential, the gears are mounted without backlash. The result is a homogeneous conversion of the torque distribution without any delay. In conjunction with intelligent software in the braking system, the Quattro system assigns optimal torque to every driven wheel. Interventions of the ESP system will be reduced to a minimum. This increases the drivability of the Audi RS 5 in every situation. (After the release of the RS 5, Audi will equip future Quattro series with the face gear differential.)

Catalog products. The earlier mentioned Danaher's gear range was the instigator for ASSAG to look at its own standard range of catalog Cylkro face gear sets. This way, Cylkro face gear sets would also become available as a standard program allowing short delivery times and competitive prices. The program covers torques from 0.7 to 518 Nm at ratios up to 1:10. More information on the standard program is available in the Cylkro catalog or

online on the ASSAG homepage.

Evolvere solutions. With the takeover by ASSAG Switzerland, new engineering knowledge and experience became available for the Cylkro technology. It found its way to the market not only as a face gear set, but, thanks to ASSAG's "Evolvere" concept, it is now also available as a complete angular gearbox. Evolvere is Latin for "to evolve" and so the Evolvere trademark stands for the optimal added value of Swiss transmission technology. It includes support in evaluating the best solution, considering cost-effective components and easy mounting and maintenance. ASSAG engineers construct transmissions of all types, for all kinds of industries and design animated 3-D models.

ASSAG provides three types of standard Evolvere gearboxes:

- Block-shaped gearboxes for 90° transmission ratios 1:1 to 1:4 (Fig. 10)
- Compact, flat gearbox for 90° transmissions with ratios 1:5 to 1:10 (Fig. 11)
- Octagonal gearboxes (Octodrive) for different angles and multiple inputs/outputs with ratios 1:3 and higher (Fig. 12).

All of them use the standard Cylkro face gear sets from the Cylkro catalog as described earlier.

Octodrive Transmission Offers Customer-Driven Choices

ASSAG's angular gearbox program—Octodrive—affords customers the freedom of choosing the number of inputs, outputs, angles, ratios and other options. The customer has the possibility to design the gearbox according to his needs by choosing the relevant components in a dialog window. This allows for generation of multifunctional and high-quality angular gears quickly, with the resulting octagonal gearbox available from ASSAG partners or via the internet.

Octodrive face gear drives are

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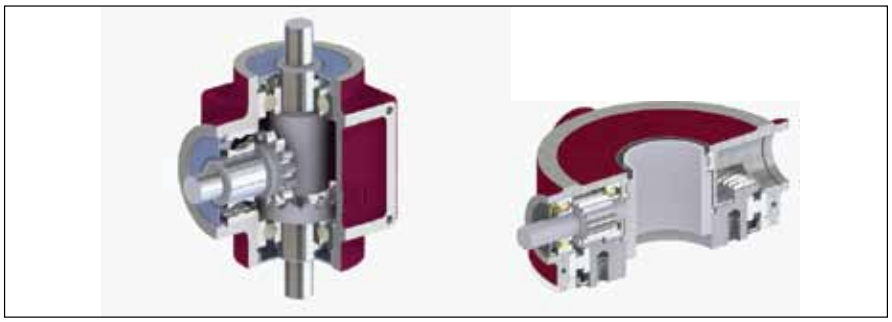

Figure 10—Block-shaped 1:1 and flat 1:5 versions of the Evolvere angular gearbox family.

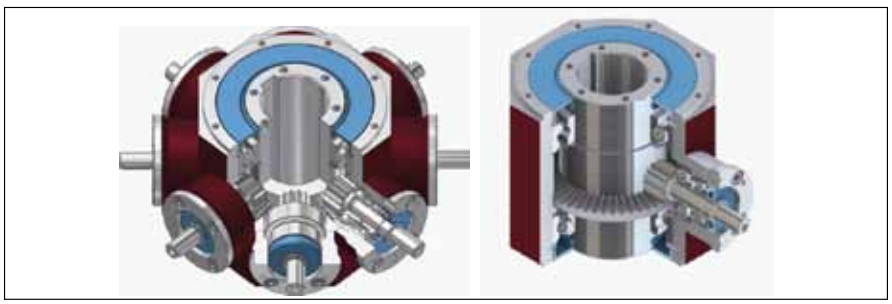

Figure 11—Octodrive gearbox (sectional view) in different configurations.

Figure 12—Up to eight pinion shafts on one layer can be mounted (left). Depending on the application, only one output may be needed. If required, it can be combined with a second face gear.

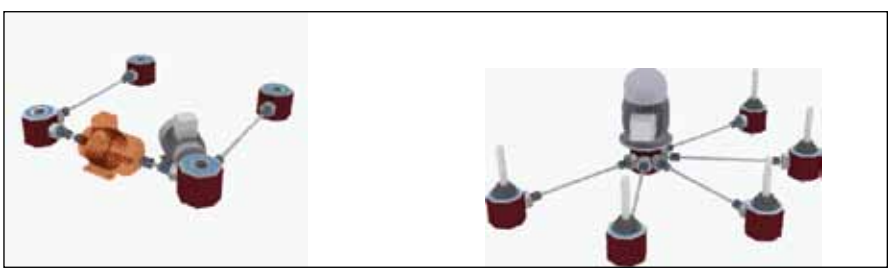

Figure 13—Application examples of Octodrive face gear transmissions: table-adjustment and multiple-lift drive combination.

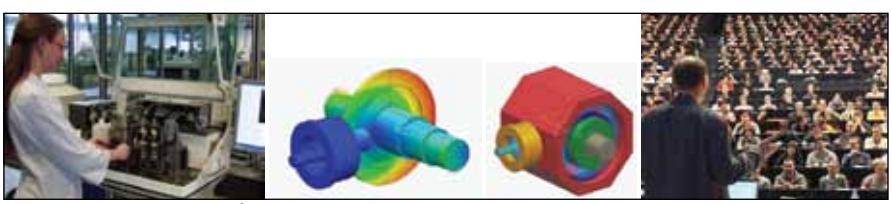

Figure 14—As a tool for researchers and educational purposes, Octodrive allows for the understanding, advancement and teaching of gear and transmission technologies under many aspects.

delivered with output torques from 29 to 255 Nm and modules 0.7 to 3.5 with ratios 1:3 up to 1:10 (Table 1). This spectrum enables Octodrive to be applied in a large variety of applications. Hollow- or solid-shaft, as well as different options for motor adaptations, can be chosen (Fig. 12).

Clean technology. Friction-minimized angular ball bearings and optimized geometry and topology of the teeth out of hardened steel result in an efficiency factor of the gear transmission > 95%. High load capacity and long durability are realized despite a moderately light construction principle. It is grease-lubricated for life.

Based on self-oscillation analyses as well as optimization of tooth geometry and topology, the Octodrive transmission is designed for minimal noise generation with focus on the expected driving speed and load distributions.

Easy application. Octodrive is delivered along with a final testing certificate. Based on its octagonal form and self-centering of norm flanges, the gearbox fits practically anywhere and is implemented in a short time by the customer.

Large field of applications. Whether as a lifting unit, tool exchanger, in a robot, as part of a packaging line or as an angular gearbox of a robot, Octodrive fulfils the expected flexibility, bifurcation or inversion of the movement (Fig. 13). It enables the development of prototypes of complex machines in a timely fashion.

Synergies. The use of face gear sets based on the official Cylkro pro-

Table 1—Scale of the Octodrive program. M1 refers to the maximal constant torque at the pinion shaft.

Diameter (mm)	MI (Nm)	Ratio	Modul
95	18	3	1.25
95	12	4	1
95	9	5	0.9
95	5	6	0.7
115	30	3	1.5
115	22	4	1.25
115	14	5	1
115	10	6	0.9
115	5	8	0.7
140	50	3	1.75
140	39	4	1.5
140	27	5	1.25
140	15	6	1
140	10	8	0.9
140	5	10	0.7
160	64	4	1.75
160	47	5	1.5
160	29	6	1.25
160	16	8	1
160	10	10	0.9

gram allows the customer to order angular gearboxes with leading gearing technology and Swiss quality directly from the catalog at ASSAG's distribution partners or via Internet.

Summary and Forecast

During the past 20 years, the concept of a face gear transmission has developed into a well-defined, practice-proven and widely applied transmission, with the latest Cylkro success being the breakthrough in the automotive industry. Now available as a catalog product and as part of Evolvere and Octodrive gearboxes, the technology has become available to the standard gear market as well. ASSAG engineers continue to explore the possibilities of the Cylkro technology, both in the fields of application and in production techniques.

Cylkro and Evolvere are registered trademarks of ASSAG.

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Zeiss

OFFERS NEW MEASURING CAPABILITIES

With DuraMax, Carl Zeiss offers a compact 3-D coordinate measuring machine. DuraMax Gear transitions DuraMax into a shop floor gear measuring machine. "This enables us to fulfill the requests of many customers and introduce gear wheel measuring technology with small machines that can be used as close to production as possible," says Alexander Dollansky, product manager at Carl Zeiss Industrial Metrology.

The key features of DuraMax Gear are its suitability for a rough production environment and high permissible temperature fluctuations. DuraMax is suited for process control on the production floor, for quick in-between inspections of small workpieces and for testing volume parts directly in production. Because of its accuracy, DuraMax can also be utilized for many requirements in gear measuring tech-

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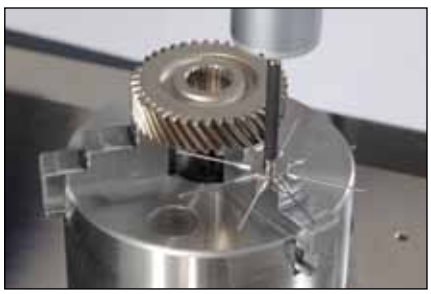
nology. DuraMax Gear comes with the required software and hardware, including stylus material for a broad range of applications. If the product being tested changes, standard inspection procedures often require new, expensive modifications. DuraMax Gear, however, when combined with CAD-based *Calypso* and *Gear Pro* involute measuring software, quickly, easily and reproducibly measures all changes. DuraMax Gear is available as a tabletop machine or with an optional base. Its design enables part loading from four sides. With *Calypso* measuring software and *Gear Pro* involute, which was specially developed to measure spur gears, it is now possible to complete all jobs in daily gear measurement for spur and helical gears, and splines in accordance with the applicable standards. With the *Calypso* Qs-Stat Out log output option included with delivery, customers are well-equipped to assess processes using a comprehensive, statistical evaluation of quality information relevant to production.

Carl Zeiss also recently introduced the new ACCURA CMM, a multi-sensor-capable measuring system that



permits fast, economical, precise and flexible measurements. As with any versatile modular system, customers can configure the ACCURA to fit their requirements. Based on their current tasks, they select the suitable configuration, i.e. sensors. Special software, such as *Gear Pro* for gears and *Holos Nt* for freeform surface measurements, is integrated along with *Calypso*, the standard CAD-based measuring software from Carl Zeiss. Subsequent modifications can be made very easily. If requirements change, different sensors and software can be easily added. Whether cut, shaped or molded parts, plastic or steel—all options of coordinate measuring technology are available. The ACCURA also permits the integration of Mass technology from Carl Zeiss. Combined with an RDS articulating probe holder, Mass permits the fast measuring program-guided change between contact sensors and the ViScan and LineScan optical sensors during a CNC run. The contact measuring sensors of the Vast family and the DT single-point sensor can also be used in various configurations.

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Mitsui Seiki

INTRODUCES MACHINING CENTERS TO NORTH AMERICA

Mitsui Seiki recently introduced its line of large-capacity, heavy-duty and configurable machining centers to North America. The new HU100 series is the first range of configurable machining centers aimed at a variety of manufacturing industries interested in versatile equipment for heavier applications. The concept of configurable machines has been a part of Mitsui Seiki philosophy for many years, but only recently has the concept been standardized for the marketplace. Configurable machines are those that are based on a set of standard modular components that can be arranged to suit specific customers' needs easily and affordably.

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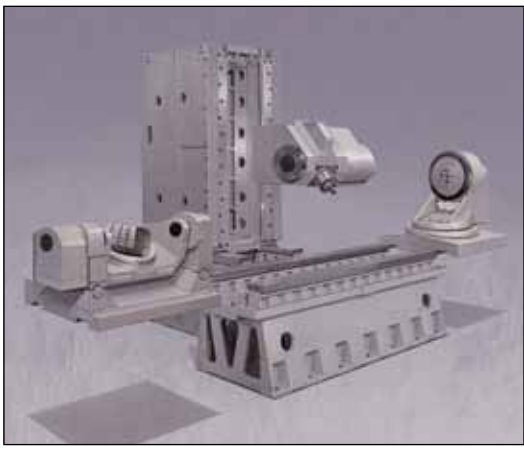
Mitsui Seiki's customers can choose axis travels from 1,300 mm to 2,500 mm, four, five, or six axes of continuous motion with a choice of a rotary table, trunnion table, or table on table. There's also a variety of spindle choices, including fixed spindles from 6,000 rpm (50 hp, 2,000 ft./lbs. torque) for heavy milling up to 25,000 rpm for high-speed applications. Tilt or swivel spindle choices are available from 6,000 rpm (800 ft./lbs. torque) for heavy milling up to 12,000 rpm for high-speed machining. Mitsui Seiki also offers quill type spindles for precision boring with shorter tools. Mitsui Seiki applications engineers will assist customers in selecting the optimum component choices to meet their needs and objectives.



The HU100 series is suitable for larger aerospace and power generation parts with a work zone capacity of up to 2,500 mm dia. x 2,000 mm height. The machines accommodate weights from 4,400 lbs. (2,000 kg) to 17,500 lbs. (8,000 kg). These machines can be equipped with simple pallet changers to fully integrated FMS systems for work and raw material handling. Likewise, tool handling systems range from on-board magazines to central systems for more than 2,500 tools.

Launched earlier this year, the HU100 line has been sold to industries as diverse as aerospace, refrigeration compressor, mold & die, heavy equipment and energy. All of these industries have fundamental common requirements: machine rigidity/stiffness and high accuracy.

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Arrow Gear and Motoman Robotics

Offer Chamfering/ Deburring Solutions

PerfectEdge, a complete, full function robotic solution, meets the challenges of tight tolerance chamfering, deburring or finishing processes, while offering a non-touch teach method of programming. Designed in collaboration with Arrow Gear, it includes a six-axis Motoman DX1350D industrial robot and a precision indexer with hollow chuck controlled by a Yaskawa America Sigma-5 servo motor for fixturing shafted gears. The cell has an eight-slot protected tool holder, and an Alfred Jaeger spindle that provides the muscle, speed control and holding torque to perform the most demanding tasks.

PerfectEdge has the capacity to process 20 inch diameter by 10 inch cylindrical parts. Designed on a common base with fork pockets, PerfectEdge can easily be deployed or relocated. Programming is easy with menu-driven material removal software. Motoman Robotics' powerful *G-Code/Points Importer* off-line programming software drives the robot from your part data. *G-Code* converter translates the CAM file into programs that are downloaded to the robot controller. PerfectEdge then provides consistent, predictable results, part after part. The

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PerfectEdge cell features a polycarbonate and aluminum full-safety enclosure with electrically interlocked access doors. A particle and fume extraction system is included, making PerfectEdge easy to connect to an air handling system. Repetitive stress injuries and operator fatigue are eliminated, reducing scrap rates and improving safety. It is compliant with ANSI/RIA R15.06-1999 and other relevant ISO and CSA safety standards. A CE compliant version is available upon request.

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Mazak's 430A

OFFERS OPERATOR EFFICIENCY

Mazak's new Vertical Center Smart (VCS) 430A offers value across a variety of applications, ranging from heavy-duty machining to high-speed machining. Able to utilize both EIA/ISO programs and conversational programming, the machine integrates Mazak SMART CNC to maximize ease-of-use and operator efficiency.

The VCS 430A features a 25 hp, 12,000 rpm No. 40 taper spindle that provides a maximum torque of 70.2 ft/

lbs. A tool-to-tool change time of just 1.3 seconds helps optimize productivity while the 35.43" x 16.93" table provides the largest machining area available for this machine class.

A variety of intelligent machine functions further simplify operation and boost reliability and productivity. Active Vibration Control (AVC) increases accuracy and tool life by minimizing machine vibration. Intelligent Thermal Shield (ITS) further ensures accuracy by actively managing heat displacement. Intelligent Maintenance Support (IMS) aids with preventive maintenance by tracking and reporting the status of the machine's perishable items, such as filters and cover wipers.

Ergonomics received special attention throughout the design of the VCS 430A. The machine provides convenient loading and unloading of parts by offering a large front-door opening of 36.22" and a tool clamp/unclamp switch located next to the spindle. Additionally, the operator door includes a top cover opening to facilitate use of a crane for materials handling.

The new Mazak MX Hybrid Roller Guide System is integrated into the VCS 430A to deliver levels of durability and reliability that result in long-term accuracy. The Mazak MX Hybrid Roller Guide System increases vibration damping to extend tool life, handles higher load capacities, accelerates and decelerates quicker to shorten cycle times, consumes less oil for "greener" operations and lasts longer with less required maintenance. The SMART CNC control keeps operation easy by offering conversational programming and simplified set-up, allowing for the fastest possible completion of a first part. The SMART CNC control also tracks and provides detailed tool information and offers the ability to perform time study analysis of operations.

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Sandvik

RELEASES FREE APP FOR CUTTING DATA

Sandvik Coromant has released a free app designed to provide engineers and machinists with a convenient resource for calculating cutting data. Once downloaded and installed, the app helps users optimize performance of their turning, milling and drilling applications by calculating optimal settings based on a job's unique parameters. "We're always looking for exciting new ways to meet the ever-changing needs of our customers," says Lennart Lindgren, global vice president marketing and sales. "We developed this app to provide customers with a convenient resource that can be accessed anywhere they take their phone."

The Machining Calculator app features a help button that provides additional information on the calculation being executed and the input needed to generate results. Sandvik Coromant's app also contains a process cost comparison that determines how tool optimization can provide cost and time savings. The app works with both metric and inch measurements and is available for both iPhone and Android phones.

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LMC

RELEASES NEW FACE DRIVERS

LMC Workholding introduces new Neidlein FFBHZ face drivers for gear grinding, gear hobbing and gear milling, suited for high run out result operations with zero backlash. The Neidlein FFBHZ face drivers design offers less downtime when changing drive diameter ranges within one face driver size. Hydraulic compensating drive pins guarantee shear force-free clamping of workpieces with badly machined surfaces at clamping areas. The built-in hydraulic cartridge is easy to change and maintain. Neidlein face drivers quickly grip and turn a workpiece from its end, allowing the entire part to be machined in just one operation, including cutting off the ends and eliminating the need to flip the part. Face drivers allow turning applications to have increased flexibility to lower cycle times and allow large interrupted and heavy cuts. Neidlein face drivers offer fast set-up, quick changeovers, improved part quality, reduced cost and lower maintenance.

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ADCOLE

RELEASES LED MICROMETER

A low-cost LED micrometer for their Model 1200 Crankshaft Gage that validates parts that have been rolled to the proper depth and stress-relieved is now available from Adcole Corporation of Marlborough, Massachusetts. The sensor provides ± 3 µm accuracy, ± 1 µm repeatability, and 0.25 µm resolution to validate that parts have been rolled to the proper depth. Capable of measuring fillet undercut depth (before and after rolling) at a 35 degree roll angle, journal straightness, and radial distance or journal shoulder to journal, this gage creates chart reports depicting any problem areas. Providing 3x higher accuracy and resolution than a laser micrometer, the Adcole LED Micrometer Sensor is attached to the follower carriage, and the Z-axis location is known by the standard gage for start/stop measurement. Supplied standard on the Model 1200 Crankshaft gage, it is also offered for retrofit. The Model 1200 features a menu-driven sequence builder utility for developing measurement sequences for new crankshafts and camshafts.

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CUT 1000

OFFERS ALTERNATIVE CUTTING PROCESS

GF AgieCharmilles' CUT 1000 OilTech is designed specifically for micromachining and ultra precision applications. The CUT 1000 OilTech

uses wires as small as .02 mm diameter to achieve surface finishes down to Ra 0.05 µm in continuous operation with suitable corner quality. CUT 1000 OilTech uses oil as an inert dielectric. The oil eliminates the effects of corrosion due to long periods of immersion in the workpiece. As a result, multiple workpieces can remain immersed in the dielectric for overnight or weekend machining needs. The oil also enables smaller distances between the wire and workpiece to produce smaller internal radii when compared to water-based machining. Equipped with a high-performance generator and the AC Duo wire system, the machine is able to work with two wire spools, each with a different wire type, and switch between wires of different diameters automatically. Programmable via the machine control, the forward feed of the wires, just like the threading, takes place automatically and is monitored by patented sensors. GF AgieCharmilles constructed the CUT 1000 OilTech with a table design that separates the X and Y-axes on a patented monobloc, eliminating mutual interference and tripping errors. A traveling table on the machine bed carries the work tank and moves the workpiece in the X direction exclusively. A second axis slide, also movable in the horizontal plane on the machine frame, accommodates the upper part of the C-frame and moves the wire in the Y direction. This configuration delivers ideal travels, positioning accu-

continued

racy and taper cutting capability for machining complex, high-precision parts. Cut 1000 OilTech accommodates workpieces up to 77 lbs. and has X-, Y- and Z-axis travels of 8.66" x 6.29" x 3.93"Additionally, CUT 1000 OilTech is equipped with Vision 5, a control system developed specifically for wire cut EDM that enables flexible data input in accordance with a workshop environment.

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Mahr

INTRODUCES NEW GENERATION OF DIGITAL CALIPERS

Mahr Federal has introduced a new generation of its popular line of MarCal digital calipers. Included are a number of innovations, such as lapped guideways, a new reference system that retains the zero position setting and an increased number of product options and accessories. MarCal digital calipers are available with protection against dust and immersion to class IP67, provide increased battery life, offer a range of data output options and are available in a wide range of sizes and blade and anvil configurations. The design recently won a German award for excellence in innovation and quality.

The new reference system available on MarCal R-designated digital calipers is designed to be a significant time-saver for operators. Unlike older models, which require the zero position to be

reset whenever the caliper is switched on, the MarCal reference system retains the zero setting, so that the unit is ready to measure whenever it is turned on or the jaws are moved. A convenient reference lock protects the setting from operator error, and the new reference system is also much more energy efficient, providing up to 50 percent longer battery life.

Mechanically, the new MarCal digital calipers are the only line to provide lapped guideway surfaces. Compared to ground guideways, this improvement not only smoothes slide operation and sensitivity, but significantly increases the service life of the instruments. Ergonomic improvements, including a thumb support and large LCD with 8.5 mm digits, facilitate operation. W-designated MarCal units include protection against dust, water, coolant, and lubricants to IP67, making them suitable for service in even the most difficult shop conditions.

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