Junker’s Lean Selection speed is an extremely efficient high-speed grinding machine, perfect for grinding small and medium-sized production series in single or multiple-shift operation with CBN and/or diamond wheels. When grinding shaft-type parts, including blanks for cutting tools, the Lean Selection speed is a cost-efficient and flexible solution with peripheral speed up to 140 m/s.

Machine Designs Win New Grinding Applications

Precision parts cover wide aerospace, automotive, medical, and tool grinding applications

Jim Lorincz
Senior Editor

In what shouldn’t be too much of a surprise, challenges for advanced grinding technology from high tech industries range from handling the most difficult-to-machine materials for aerospace jet engine turbines to series production on automotive drive train lines. “Common high-value aerospace engine parts are those located directly after the combustion phase area in the turbine hot section. These parts are typically made from superalloys with chemistry make-ups of nickel, cobalt and chromium as well as a variety of other difficult-to-machine materials,” said Larry Marchand, vice president-profile group, United Grinding North America Inc. (Miamisburg, OH).

For such high-value components, United Grinding technology ranges from three-axis creep feed grinding machines and four-axis continuous dress creep feed systems up to six-axis machines with tool changing capabilities for grinding complicated radial shapes. Also, these highly advanced solutions typically
combine multiple operations to complete complex turbine parts in single setups/clampings.

“The advantages of single-clamping part processing are numerous,” said Marchand. “Most importantly, it ensures extremely accurate dimensional relationships between part features, which is especially critical when IDs and ODs, for instance, must be perfectly concentric to one another. Multiple clampings, on the other hand, usually involve human intervention and thus an increased risk of error.”

Marchand added that grinding machines with tool changers provide even further benefits for processing high-value jet engine components. These machines give shops the option to use multiple abrasive types in one setup and on the same part. For instance, a combination of CBN, conventional or diamond wheels could create the various features of one part. Or a shop could use continuous dress creep feed grinding for fast heavy metal removal then change wheel type for lighter material removal at different parameters to achieve even finer finishes.

At IMTS, United Grinding exhibited the Mägerle MFP 50 continuous dress grinding and machining center, a five or six-axis machine that performs grinding, milling, and drilling in single-clamping operations. “With the addition of milling and drilling capability, the machine eliminates having to
move workpieces to multiple secondary machining process – each involving its own setup, clamping and risk of human error.

Grinding is a popular and productive choice for machining high-pressure turbine blades and turbine vanes, which are the two primary components in the gas path of a jet engine, according to Marchand. “Typically, grinding is much more productive in terms of time and generates better surface finishes than the EDM process.”

Today’s aerospace manufacturers face several challenges and look to grinding application experts such as United Grinding for help. “For our customers, advanced materials and tough to hold parts have been the common hurdles to overcome,” said Marchand. “Advanced materials—such as titanium aluminate, ceramic-coatings or ceramic-matrix composites—when subjected to heat, have very low coefficients of heat transfer/poor thermal conductivity. While this is most beneficial for jet engine performance, it creates a very dicey grinding situation. If grinding generates heat, it could then transfer into the part and cause a recast layer on the part or compromise the integrity of its base material.”

Especially for processing delicate or complex shaped parts, many aerospace manufacturers come to United Grinding for turnkey workholding solutions. “These are projects that they want us take ownership and responsibility for not only the grinding processes, but also all the associated workholding as well. A majority of such projects involve parts that are extremely difficult to clamp and hold due to thin walls or complex airfoil-type shapes. These parts are delicate, and workholding is a balancing act. The part has to be clamped rigidly enough so that it doesn’t move during grinding, but without overclamping to prevent any deflection or indentation in the part—all while trying to grind parts as quickly as possible. Often, we could easily double a customer’s process output, but the necessary workholding forces for more aggressive grinding would deflect or damage the part. The grinding process itself and the workholding are individual links in a chain, and the weakest of two will drive a process’s final results,” said Marchand.

**ID/OD Grinder for High-Precision Part Production**

Systems for automotive production are designed with the ability to grind geometrically related features in a single clamping like the Landis-Bryant RU2 ID/OD grinding system introduced at IMTS by Fives Landis (Hagerstown, MD). Typical product applications include a wide range of parts requiring ultra-precision capabilities including applications in the fuel systems, valve train, drive train, bearing, medical, and aerospace industries.

“A high-precision, multi-surface grinding system, the Landis-Bryant RU2 offers multi-slide possibilities in both the X and Z axes,” said Ron Wood, executive director business development at Fives Landis Corp. “With multiple work heads, wheel heads, and dressing systems, the machine provides flexibility to grind several geometrically related features in a single chucking. The machine is ideal for process operations such as bore, seat, and face of fuel injection nozzles, turbochargers, and shaft-type parts. With its standard and custom automation solutions, Landis-Bryant machines can be integrated into any production environment.”

“The grinder’s dual-slide arrangement in Z axis can accommodate up to six grinding spindles. It was specifically designed for the challenging requirements of fuel system components that require tight control over related features during grinding operations through a single handling,” said Wood. The Landis-Bryant RU2 ID/OD grinding system features granite epoxy bed that includes a thermal stability system to
monitor the temperature. Together with the adaptive thermal compensation option it provides ultimate thermal stability. A stiff hydrostatic round-bar guideway system, coupled with high-resolution Heidenhain glass scales and FANUC linear motors, enables precise location of all axes guaranteeing dimensional and geometric accuracy.

The modular design of the RU2 grinder enables flexibility and allows customers to choose from an extensive range of the machine configurations of work spindles, slides, tooling, and fixtures. The Landis-Bryant RU2 has the ability to handle parts up to 13" (330 mm) in diameter and 7" (177 mm) in length, and can be configured as chucker, shoe centerless and center-type systems for OD and ID grinding, universal grinding, form grinding, match grinding, and peel grinding applications.

“When dealing with higher value parts there is a noticeable advantage when clamping one time.”

A complete line of precision spindles with infinitely variable speeds up to 120,000 rpm is available. Landis-Bryant spindles contain super-precision bearings that permit operation at extremely high speeds, and are powered by in-house-designed induction motors to provide superior performance for efficient machining.

Other grinders in the Landis-Bryant lineup include the Landis-Bryant RU1, UL2 and UF2. The Landis-Bryant RU1 is a single-spindle machine for small precision part processing such as bearings, fuel systems, valve train, and medical applications. The Landis-Bryant UL2 is designed for high production/high precision grinding bores and faces in bearing rings, universal joint cups, valve lifters and gears, while the Landis-Bryant UF2 is engineered for high production/high precision grinding of external diameters, faces, and forms.
Pinch/Peel Grinding of Non-Round Punches, Parts

Rollomatic Inc. (Mundelein, IL) has introduced its ShapeSmart NP 5 five-axis grinder with a new pinch/peel grinding option for non-round grinding of punches and pins. The non-round process includes full pinch/peel grinding designed to ensure extremely high tolerances, form accuracy, and an exceptionally low TIR in grinding thin and long parts. Oblong punches, form punches, squares out of center, corner radiuses, and other shapes can be produced with this technology. The ShapeSmart NP 5 is designed and dedicated for cylindrical grinding of carbide, HSS, and stainless components with emphasis on achieving the highest surface finish and concentricity.

Rough and finish grinding are performed in one pass, eliminating a separate process and reducing cycle time. The machine utilizes two different grinding wheels running on separate spindles and positioned on independently controlled CNC linear slides. For example, Rollomatic has demonstrated pinch/peel grinding of a 0.2 x 0.5-mm oblong radius form punch over a length of 2” (51 mm) with extremely tight tolerances, perfect radius tangencies, and practically no TIR. Customer-specific tests have resulted in a shape accuracy of 0.002 mm and a surface finish of 2-2.5 μin. Non-round form punches up to 0.75” (19-mm) diameter/size can be processed with pinch/peel grinding. In addition to oblong punches form punches, squares out of center and corner radiuses are being cut. For every rotation of the tooling part, the X and V axis (roughing and finishing wheel) interpolation with the C axis (tool axis).

The ShapeSmart NP5 features a positioning camera for grinding coolant slots in blanks with coolant-through holes. Form grinding cutting tool blanks for the industrial, medical, and dental markets, as well as production grinding of die and mold components, and precision punches, including non-round punches is possible.

Grinders Cover Variety of Surface, Profile Applications

FSG-ADS series fully automatic three-axis grinders from Chevalier Machinery Inc. (Santa Fe Springs, CA) with a PLC controller provide a grind cycle with rough grinding, fine grinding, and spark-out passes. An automatic over-wheel dresser with compensation can be added to fully automate the grind process. After the cycle is finished, the table will park either left or right of the saddle and at the front to facilitate unloading and loading.

The FSG-ADS series is well-suited for mass production and is easy to set up, program, and operate with user-friendly conversational programming. The machine’s spindle can be set to “stop running” or “continue running.” The wheel head can also be set to return to the start position or to park at a reference point. Once the cycle is started, the wheel head moves rapidly to the start point and repeats the grind cycle. If material is required to be removed from both sides, “flip over” can be selected, leaving the wheel head position at the finish grind height, which then starts grinding immediately without touching off.

The fully automatic grind feature consists of rough and fine-grinding cycles, switching from rough-grinding down-feed increments to fine-grinding down-feed increments at preset points during the cycle. The crossfeed also switches from a rough to fine cross-feed increment, resulting in a finer surface finish and finer accuracy.
The new Chevalier FSG-ADIII three-axis grinder series is an automatic, precision, surface-grinding machine that offers improved accuracy, quality, and ease of operation. This series includes a new touch-screen control station adjustable to a comfortable position for the operator. Switches, buttons, LEDs, and indicating lamps are all combined in a touch display that is ergonomically positioned to provide the best user-friendly operation. Rough and finish grinding are performed in one pass, eliminating a separate process and reducing cycle time.

**Rough and finish grinding are performed in one pass, eliminating a separate process and reducing cycle time.**

The FSG-ADIII Series includes a new PLC controller that provides a grind cycle with rough grinding, fine grinding, spark-out passes and an automatic over-wheel dresser with compensation, which can be added to fully automate the grind process. After the cycle is finished, the table will “park” either left or right of the saddle and at the front to facilitate unloading and loading. The spindle can be set to “stop running” or “continue running.” The wheelhead can also be set to return to the start position or to park at a reference point. Once the cycle is started, the wheel head will move rapidly to the start point and repeat the grind cycle. If material is required to be removed from both sides, “flip over” can be selected, leaving the wheelhead position at the finish grind height, which will start grinding immediately without touching off.

**Five-Axis CNC Grinder for Micro Tools, Complex Geometries**

The 325linear five-axis CNC grinder from Schütte (Jackson, MI) is designed for precision grinding of micro tools, gun drills, hob cutters, and complex geometries. The 325linear features extended X and Y-axis movement plus two auxiliary slides for workpiece clamping and improved grinding wheel guidance over the entire machining envelope. The additional second auxiliary slide enables the 325linear to utilize tool guidance, part support, tailstock or workpiece pallets in operation. This new Schütte machine further expands the user’s automation possibilities, as it also offers significant advancements in wheel change and robotic workpiece handling.

For example, on the A axis, a user can install collet chucks, hydraulic expansion chucks or multirange chucks. With the automated collet changer on the machine, workpieces with different diameters can be clamped with high concentricity in the untended loader station. The Schütte A-axis configuration on this machine also permits position-oriented clamping of non-rotationally symmetrical workpieces. In this way, sequential workpieces with various roughing and finishing requirements can be preset on the machine for continuous processing.

The 325linear grinding system offers scalable automation, with a 140-position toolchanger, 5-24 grinding wheel magazine and a flexible robotic tool gripper for changing the smallest micro tools as available options. The same base machine can be utilized for continuous production of a single part in a workcell setup or used for sequential one-off work, as needed.

The 325linear is offered with the proprietary SIGSpro (Schütte Integrated Grinding Software) as the programming...
interface, allowing users to assign clamping options for each grinding operation being performed. When the support and tool guidance system are used, preset distances from the grinding wheel to the workpiece can be defined and held constant. In the 3D mode, all cycle steps can be simulated, controlled and optimized for exact estimating, collision avoidance and even external workstation integration with the other workpieces.

**Junker, SST Team Up to Extend CBN Grinding Solutions in US**

The distribution agreement between Single Source Technologies (SST; Auburn Hills, MI) and the Junker Group (Nordrach, Germany) will expand the presence of Junker’s precision high-speed CBN and non-CBN production grinding solutions in North American markets in the South, Southeast, and Midwest where SST will represent it. The agreement will provide SST, which is the North American distributor of Makino and premium machinery brands, automation, tooling and EDM supplies for prismatic parts, with a portfolio of machining solutions for round and non-round components including shaft and cylindrical workpieces.

Junker’s precision grinding solutions include double disk, profile, cylindrical, cutting tool and tool, centerless grinding, cylindrical grinding machines, and hardturning/grinding, as well as non-cylindrical grinding machines. “The collaboration with SST will enhance our market penetration and customer support for mid to high-volume applications, as well as small series production,” said Horst Zemp, president and CEO, Erwin Junker Machinery Inc. USA (Elgin, IL).

“Our precision grinding solutions are used to grind round components of all types, including shafts, camshafts, and crankshafts for automotive, aerospace, power generation, off highway and agricultural vehicle applications, among others. Shafts with 1.5” [37-mm] diameter that are 20” [508-mm] long can be centerless ground with center relation in 18–25 seconds,” said Zemp, “or we have large machines with swing diameters up to 470 mm that can grind large crankshafts up to 4.8’ [1.46-m] long in a single setup for power generation applications.”

**Schütte’s 325linear five-axis CNC grinder for precision grinding of micro tools, gundrills, hob cutters, and complex geometries can be equipped with optional robotic handling of workpieces.**

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