THE DIGITAL GRIND: HMIS AND SOFTWARE INCREASE PRODUCTIVITY

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An effective HMI/ operating system simplifies all aspects of cylindrical grinding, from training to part production.

INTRODUCTION

Truly productive cylindrical grinding operations depend on digital solutions – HMIs (human-machine interfaces, or operating systems) and software. The advent and continuous advancement of these solutions has allowed for exceptional performance and productivity, helping manufacturers use their state-of-the-art cylindrical grinding technology to its utmost potential.

An effective HMI/operating system simplifies all aspects of cylindrical grinding, from training to part production. Today's manufacturers demand solutions that are based on open software concepts and are user friendly as well as intuitive. It is for these demands that cylindrical grinding machine OEM STUDER developed its OS solutions StuderWIN and StuderSIM, which leverage a wide range of modules and functions to shorten machine setup, programming and grinding times, thus ensuring the highest machine utilization rates.

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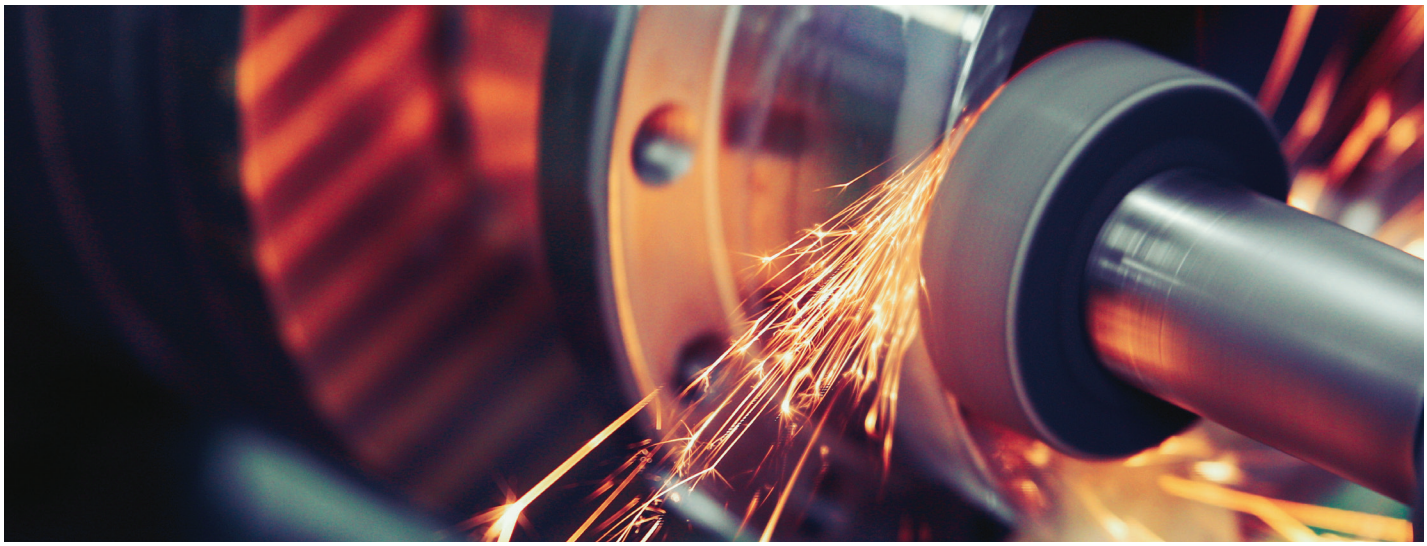

EARLY OPERATING SYSTEMS AND SOFTWARE SOLUTIONS

For hundreds of years, grinding has been a preferred way to shape and finish metals and other materials. Craftsmen used rotary grindstones as far back as the first century, but grinding machines in the modern sense came into being in the mid-19th century during the Industrial Revolution. Grinding then was truly an art; optimal results required a skilled operator who could manipulate every element of the grinding process. That effort included setting and adjusting speeds and feed rates with crude handwheels on machines of questionable rigidity.

As grinding machines grew more capable and precise, numerical control (NC) via punched tapes appeared in the 1950s and made grinding operations even more precise and repeatable. In the late 1970s and early 1980s, computer numerical controls (CNCs) accelerated the programming process. Nevertheless, programming a grinding operation required both thorough knowledge of the numerous factors affecting grinding results as well as familiarity with computer programming language and codes. Programming technology later advanced to providing preset "canned cycles" that could be packaged to produce the desired part. These programs, however, were not optimized for specific parts or materials and lacked error messages or other means to verify a program before it ran.

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Successful grinding, especially in job shop or high-mix/low-volume manufacturing scenarios, still requires careful analysis of multiple factors to achieve the best results. Consequently, grinding software is specialized and complex. In light of increasingly strict demands for part output and accuracy in the manufacturing industry, and recognizing the decreasing number of shop personnel with grinding experience, maximizing the efficiency and user friendliness of grinding software and operating systems has become a critical issue.

BENEFITS AND FUNCTIONALITY OF TODAY'S OPERATING SYSTEMS AND SOFTWARE

To extract maximum productivity from their equipment, grinding machine builders have developed their own operating systems and software packages. STUDER provides the StuderWIN and StuderSIM cylindrical grinding operating systems and software that fully exploit the advanced capabilities of the company's versatile grinding machines. StuderWIN is an external/universal workpiece-oriented programming solution with data storage and cycle-specific visualization of the grinding tool in relation to the workpiece. Multichannel StuderSIM software enables comprehensive programming of all basic cycles for grinding and dressing with emphasis on complex internal and radius applications.

StuderWIN

StuderWIN software streamlines the cylindrical grinding programming process. It permits an operator to set up the machine efficiently and achieve cost-effective production without having to repeatedly consult numerous option menus. With important information available at a glance, the software guides detailed and precise grinding tasks via a number of simple-to-operate functions. A focal point is reduced setup times. The Quick-Set function allows the machine to be reset in a very short time with the help of an electronic measuring probe. Workpiece and dressers are keyed to the grinding wheel and all relevant steps are registered using a teach-in procedure in a guided screen dialog.

A key feature of STUDER grinding software is the StuderPictogramming visual programming language. Pioneered by STUDER, Pictogramming enables the operator to program a machine by assembling graphic pictograms or subroutines based on the desired results. Each cycle has its own distinctive symbol or "Picto" that enables the process parameters to be queried in a simple dialog. The pictograms also provide access to STUDER's comprehensive workshop-based library of grinding applications.

The software executes the pictogramed cycles to accomplish setup, tool definition and management, corrections, creation of programs, and process visualization. It also facilitates diagnosis and analysis. Users can operate the software with or without a

touchscreen, and they can create programs with visual graphics on PC-based machine controls or on offline computers. Similarly, operators can perform troubleshooting via dry runs performed on the machine without actually grinding a part. The simulation capabilities enable operators to test programs confidently.

STUDER grinding software provides measuring capability for qualifying the part before and after grinding, but also permits in-process measurement that can initiate automated real-time parameter adjustments and eliminate the need for operator intervention. This frees an operator to program the next part, tend another machine or otherwise maximize their productiveness.

StuderSIM

Today's flexible, user-friendly StuderSIM software is suited for all cylindrical grinding operations, with emphasis on internal grinding and especially grinding of radii.

StuderSIM supports the multichannel operation and in-process recalculation required to produce complex simultaneous motion of the grinding wheel. Indexing the wheel while it simultaneously oscillates along the edge of the part produces smooth continuous radii. Wheel wear is uniform, maximizing tool life and reducing dressing cycles. In many cases, the extremely smooth ground surface that results reduces or eliminates the need for post-grinding polishing. And when multiple wheels are available, roughing, medium and finish cycles are accomplished in one fixturing, with the part emerging from the machine complete.

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Basic cycles such as plan, bore, cone and thread grinding, dressing, and measuring are defined by parameter input windows in StuderSIM. Dynamic help guides the operator in creating grinding data. After programming, the process can be simulated and optimized. This results in short programming times and an increase in cost effectiveness. With StuderSIM, operators can derive workpiece definitions from a drawing and generate all necessary geometric data for the grinding cycles. These users can check and visualize the grinding process by means of simulation on HMI StuderSIM or on an offline PC.

EXPANSION MODULES & INTEGRATED PACKAGES

The modular nature of STUDER grinding operating systems and software enables users to add capabilities and custom-tailor functions matched to their specific production needs via expansion modules and integrated function packages.

StuderTechnology Integrated enables users to benefit from STUDER's extensive shop floor experience and powerful software systems. Rather than rely on conservative standardized values that apply grinding machines and wheels well below their potential performance capabilities, the module determines optimal values from analysis of important process variables such as grinding wheel material, workpiece features and coolant conditions. The operator needs only to define specific production goals, and the software precisely calculates machining times and other parameters for maximum economic efficiency. Users can simulate and check programs for potential collisions in the machine's work envelope. Existing manually created grinding programs can be analyzed, compared with the suggested values and modified or overwritten if desired.

The role of software and operating systems has become critical as the generation of grinding machine operators who learned their trade on manual machines are replaced by newer (and fewer) operators who – born into a digital generation – lack a familiarity with the basic (manual) elements of precision grinding.

StuderDress Integrated utilizes an advanced strategy for profiling new and used grinding wheels, involving information acquired from a graphically defined workpiece. Users can drag the grinding wheel image onto the virtual workpiece using a "Drag and Cut" command. Existing draft points facilitate positioning of the wheel on desired reference points, and depending on the wheel's intended profile, an optimized number of cutting passes can enable it to be dressed 3 to 10 times faster than by conventional methods.

StuderContour Integrated is engineered for high-precision machining of longitudinal contours using a rough grinding method. The software performs peel grinding with automatic definition of cutting passes, convex/concave grinding applications and contour grinding. Divided toolpaths produce the shortest travel and maximize grinding wheel cutting performance. Users can import specific contours via a DXF and IGS interface.

STUDERForm and StuderFormHSM Integrated facilitate grinding of out-of-round part configurations. StuderForm universal form-grinding software enables machining of curves and polygons for standard applications in small production runs. Macros are provided for standard forms, and free forms can be ground using the DXF format. StuderFormHSM software is a more specialized technology, providing high-speed capability for out-of-round grinding and the machining of demanding forms and polygons in both individual component and large-batch production.

CONCLUSION

Grinding operations provide results that often are unobtainable with other forms of material removal or surface treatment. This has been the case for centuries, and grinding's long history has involved continual improvements in grinding machines and wheels. Along with those improvements, the amount of knowledge and experience required to operate the grinding equipment has grown and evolved as well. Unfailingly precise control of the process is essential for consistent results, and computer control assures error-free wheel movement. Now, new developments focus on maximizing the efficiency and ease of use of the software that guides the computer's commands. The role of software and operating systems has become critical as the generation of grinding machine operators who learned their trade on manual machines are replaced by newer (and fewer) operators who – born into a digital generation – lack a familiarity with the basic (manual) elements of precision grinding.