



Gear generating

Revisions to the hard-finishing process to meet Industry 4.0 requirements are enabling improved gear grinding performance as well as greater workpiece traceability and data processing

More than 1,000 RZ x60 generation grinding machines have now entered the global market, proving the technology as a successful concept. Building on this experience, Reishauer has heavily revised its machine and adapted it to the requirements of Industry 4.0 applications.

The RZ x60 4.0 series still features proven double spindle technology. However, it has been complemented with updated control technology and the company's Argus process monitoring system. Furthermore, the RZ 160 KWS enables the user to grind gears with interference contours.

GENERATING SKIVING

The basic principles of skiving have been known for over 100 years, given the first patent for the manufacturing method was filed by the inventor Julius Wilhelm von Pittler in 1910. However, skiving initially lived in the shadows of other processes as the machines were not up to the task. Furthermore, for hard-finishing, the tooling – mostly made of tungsten carbide – offered insufficient tool life.

The automatic transmission features several planetary gearsets with internal gearing that would benefit significantly from hard finishing if an adequate process were available. For this reason, Reishauer designed a very stiff generating skiving machine and concurrently developed cutting tools that use cutting edges made from a superhard material. This combination enables economical and successful generating skiving for the hard finishing of internal gear components.

1. Generating gear RZ 160 KWS grinder with loader
2. The Reishauer small diameter grinding wheel

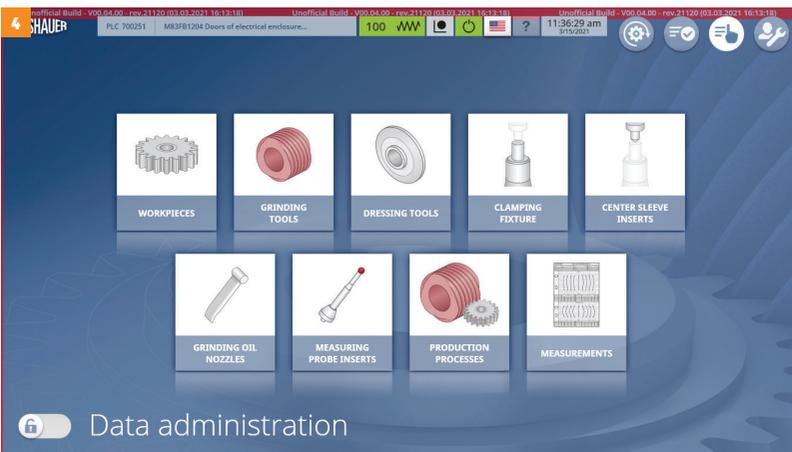
CONTROL SYSTEM

The scarcity of skilled operators demanded a rethink of the machine's operating system, the RZControl. Hence, a key design area was user-friendliness. Easily understandable icons guide the user through the setup process. These visual aids apply both to generating skiving and generating grinding. The RSP software

platform simplifies operation and process design considerably, reduces potential errors, and increases efficiency with modern database technologies encompassing tooling, workpieces and processes. During data input, the control system automatically generates machining proposals based on highly sophisticated calculation models that reflect decades of experience in generating grinding.

The RZDesk option enables the user to build grinding programs on the PC, which can be transferred to the machine even during a running operation. While setting up the grinding process, the grinding time and number of parts per grinding wheel width are calculated, including for low-noise and optimized shifting. Operating equipment needs to be recorded only once and is permanently available on a database, both on the machine control and on RZDesk.





PROCESS MONITORING

The Argus process monitoring system controls the dressing and grinding intensities by applying real-time data processing and tested algorithms. Grinding and dressing intensities are process-based force models that enable calibration of the grinding and dressing forces as well as process interpretation and control. The force models encompass the characteristics of the cutting zone, the cutting kinematics over the changing grinding wheel diameter, the variation of the wheel's RPM, and the variable lever ratios depending on the wheel's position to the axial location of the bearing.

The force calibration enables the user to set narrow evaluation limits for the grinding process, which, in turn, offers a detailed error

3. Reishauer designed a very stiff generating skiving machine and superhard cutting tools to notably improve the gear skiving process

4. The RSP interface simplifies operation of the machine, cutting down on user errors

5. Improved data flow allows insight into key process performance



evaluation. Any faulty pre-work workpieces, for example, can be automatically removed from the machine, based on this evaluation and the set boundaries.

Furthermore, the Argus system is able to demonstrate a direct correlation between grinding intensities and measurement data from the coordinate-measuring machine (CMM). The gear grinding machine can produce far more parts per unit of time than a CMM machine can measure. Hence, to date, users have had to rely on sample measurements. However, once a few samples are approved, the Argus monitoring system allows 100% in-process measurement, which ensures zero-error production.

As the system offers traceability of each ground workpiece and off-machine data storage options, this enables new insights into the machine capability and key performance indicators of the processes. For grinding and dressing, this system uses adaptive strategies, enables better usage of potential process parameters, and improves tool life, all of which carry economic benefits. ©

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