Precision machining

Honing in on the physical limits

High-precision honing has traditionally been the domain of high-volume producers with highly trained personnel. Using B&R technology, KADIA has made groundbreaking improvements to honing machine usability. These machines are now more efficient to use and begin to pay off for smaller batch sizes.

Source: KADIA

The rise of direct fuel injection is good news for Formula 1 drivers and fans – and great news for KADIA. The company's highly specialized honing equipment is what gives the cylinder bores in the interior of the fuel injection system the final polish, helping the pistons and cylinders meet the extreme levels of surface quality and trueness to shape needed to achieve operating pressures of up to 500 bar.

"We're talking about sub-micrometer precision – approaching the limits of what is physically possible to do with mechanical machining," notes KADIA's managing director, Henning Klein. "Many manufacturers require a defined clearance between the piston and the inside wall of the cylinder – for example 10 micrometers with a tolerance of less than 1 micrometer." To meet such tight tolerances requires the use of statistical measures of process capability and ultimately demands precision to within only a few hundred nanometers.

The ultimate challenge: match honing

The key to getting parts to fit together as perfectly as needed for fuel injection pumps is a machining process called match honing. This process involves measuring the outer diameter of the finished

Honed fuel injection pumps significantly reduce fuel consumption and CO_2 emissions.

Roland Regler
Chief Designer, KADIA

"The SPT functions and POWERLINK cross-communication have been key to the performance of the new HMC100 controller. These mechanisms allow the B&R drives to handle control functions remotely and to communicate directly with one another without going through the controller." (Source: F. Rossmann)

piston and passing it on to the honing controller along with the workpiece identification data. The honing controller then calculates the final dimensions of the bore to be honed, taking the desired clearance into account. Then the housing bore passes through up to six honing stations, each preceded by in-process gaging, until the final dimensions are achieved. Finally, the workpiece is clearly marked and permanently assigned to the corresponding piston.

Previous solutions with severe restrictions

Until recently, KADIA had been operating its ultra-precise machines with a controller tailored to standard machine tool requirements. "There are some significant differences compared to traditional machining processes like milling and turning, such as the number of spindles and the volumes of data being exchanged between the honing and measurement stations," notes Klein. "We had to make extensive modifications to the controller before we could use it in our honing machines." KADIA faced similar difficulties adapting the HMI application that came with the controller. "Despite our best efforts, the limitations of the HMI system left us with an unintuitive user interface that took operators some time to get used to," says Klein.

Intuitive operation for an efficient workflow

The switch to a new automation partner and the complete redesign of the control and HMI solutions have brought substantial improvements. "Based on B&R technology, the terminal's new smartphone-inspired user interface is especially intuitive to operate," says Klein. The juries of the Red Dot and IF Design awards agreed, honoring KADIA with multiple distinctions. Under the terminal's custom-tailored aluminum housing there is an industry-grade HMI device with a scratch-resistant, oil-resistant 19" touch screen. It communicates with the B&R Automation PC 910 that serves as the platform for both machine control and the HMI application.

POWERLINK cross-communication frees up resources

With its Intel Core i5 processor, the Automation PC 910 has plenty of capacity to handle the huge volumes of data generated by the constant measurement and readjustment of the honing process. "The B&R solution offers numerous technical details that really work to the advantage of the new HMC100 controller," says KADIA's chief designer, Roland Regler. "POWERLINK cross-communication has been key. It allows B&R drives to handle control functions remotely and to communicate directly with one another without going through the controller."

Source: KADIA

Winner of multiple design awards: the new R-series rotary honing machine from KADIA features cutting-edge control technology and a swing arm mounted control panel from B&R.

Inspired by smartphone design, the elegant styling and ergonomic handling of the HMC100 operator terminal make controlling KADIA's new honing machines exceptionally easy and intuitive.

Depending on the configuration a given machine, the R-series is equipped with a POWERLINK network of up to 28 liquid-cooled ACOPOSmulti servo drives. As many as five of them control the stroke movement of the LH2 / LH3 honing tools KADIA developed along with the new control system. Equipped with B&R's safe motion control solution, the drives ensure that operators are safeguarded during setup. Operating on a common DC bus, the drives are able to share excess kinetic energy that would otherwise go unused, offering clear benefits for the machines' thermal economy, energy consumption and operating costs.

Mastering machine options in Automation Studio

To future-proof its HMC100 solution and allow new systems to be added down the road, KADIA designed it to accommodate up to 40 axes. Since the number and type of honing and measurement stations also varies from machine to machine, the KADIA team has a whole spectrum of variants that it needs to cover with the control software.

"This is where another highlight of the B&R solution comes into play. Their integrated development environment, Automation Studio, allows you to create custom-tailored control and HMI applications using configuration files," explains the chief designer. "This way, we're able to represent countless potential machine configurations in a single software project with no extra programming." Later on, there's no need for commissioning technicians to use a software development tool or do any programming on site. KADIA's efforts to future-proof the HMC100 are additionally supported by the CNC and robotics functions provided in Automation Studio.

Full support from B&R

KADIA will only be able to enjoy all the potential that it has designed into the HMC100 for as long as it has access to the corresponding hardware. "That's why, beyond all the technical requirements, long-term availability was one of the key criteria in our selection of an automation partner," reports Klein. "B&R met this requirement and gave us full support throughout the entire project."

The collaborative efforts have certainly paid off. All the leading producers of fuel injector pumps have since been convinced of the advantages of the new controller, and the HMC100 has established itself as KADIA's most popular control solution. Concludes Regler enthusiastically: "What we've achieved here is absolutely revolutionary in the field of honing equipment." ←

Henning Klein
Managing Director, KADIA

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