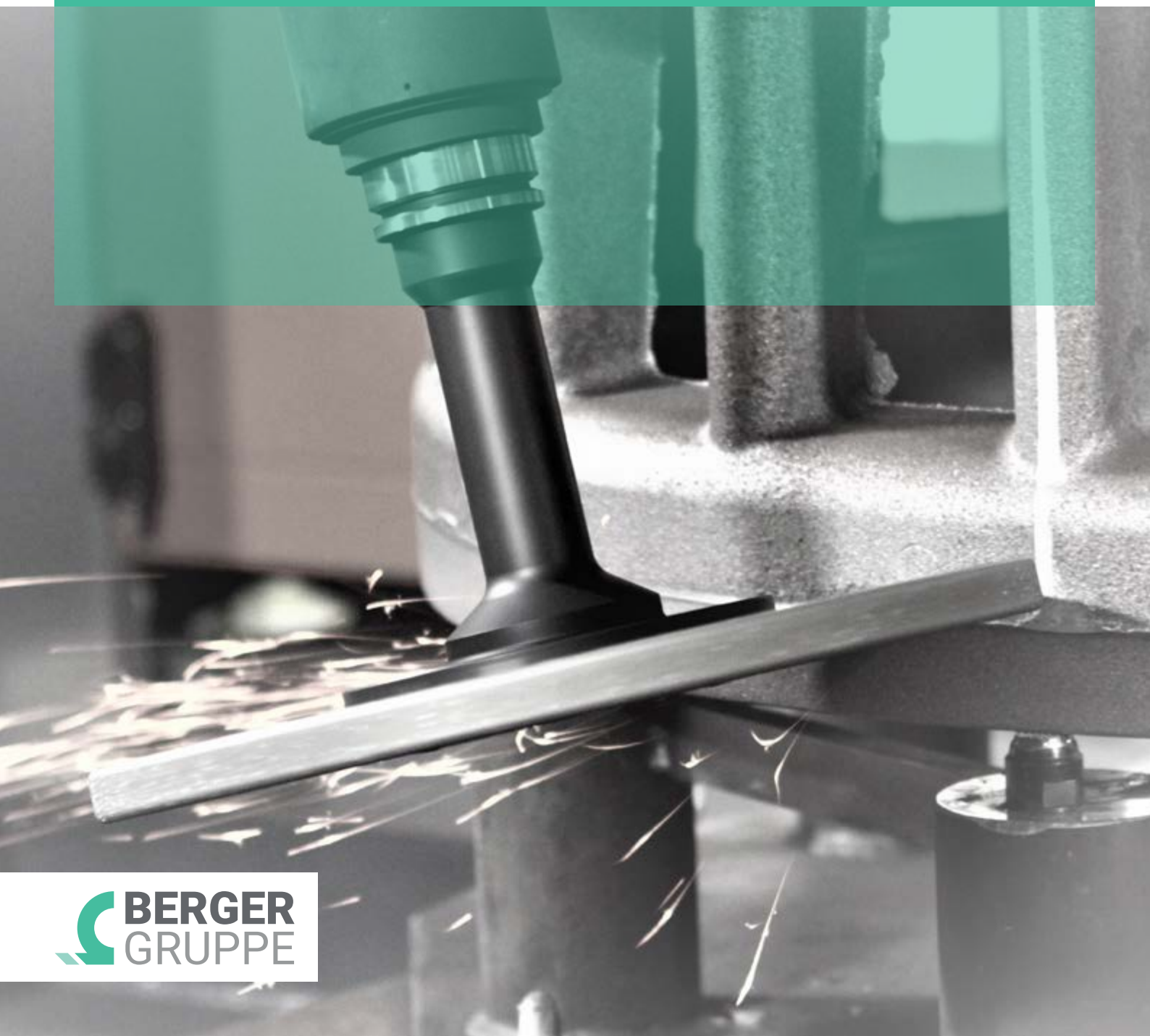
CAST AND FORGED PARTS

ROBOT CELLS FOR

fettling | deburring | milling | grinding



BERGER GRUPPE

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ROBOT CELLS

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FETTLING

WITH ROBOTIC DEBURRING TECHNOLOGY

GRINDING AND DEBURRING WITH ROBOTIC TECHNIQUE

Process reliability

Manual deburring and fettling as a non-value-adding activity represents a large amount of time, even in a highly automated production of castings and forgings, and leads to a high risk of reworking and rejects due to a lack of process reliability, often only at the end of the process chain.

The Berger Gruppe presents solutions for robotic deburring and fettling of castings and forgings. The focus is on partly standardized robot deburring cells with different conceptual approaches.

Depending on the nature of the cast or forged part, the robotic cell is equipped with different processing stations. Either the workpiece or the tool is guided by the robot.

Robot-guided tool

If the tool is robot-guided, the workpiece can be aligned via CNC axes so that all-round machining is possible without additional changeover time.

The deburring robot is equipped with a tool changing system so that it can be equipped with various tools such as grinding wheels, grinding belts, milling tools, files, brushes or polishing wheels.

Berger multi-tool-head

The Berger multi-tool-head as a tool changing system enables tool changing times between 0.5 and 1 s.

A 3D measuring system integrated in the tool head measures complete workpieces or individual contour elements for programming and checking the workpiece position in the process.

Deburring of contours with large dimensional variation

By using tools specially developed for robot deburring of undefined contours, blank tolerances can be compensated and defined chamfers or radii can be applied seamlessly, reliably and at very high feed rates.

Force-torque sensors

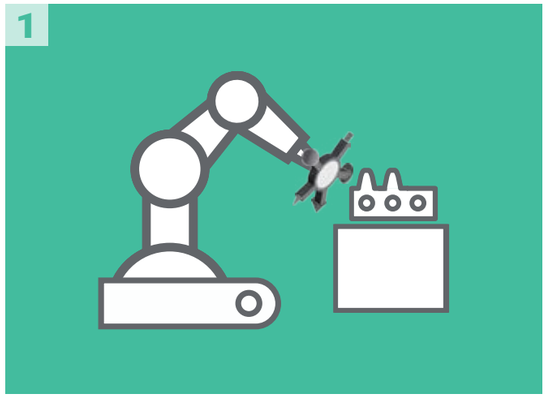
When fettling raw parts, the Berger Gruppe relies on force-torque sensor technology, which enables almost seamless machining of mould divisions and contour progressions (for fire cracks, etc.) and thus replaces time-consuming manual fettling operations.

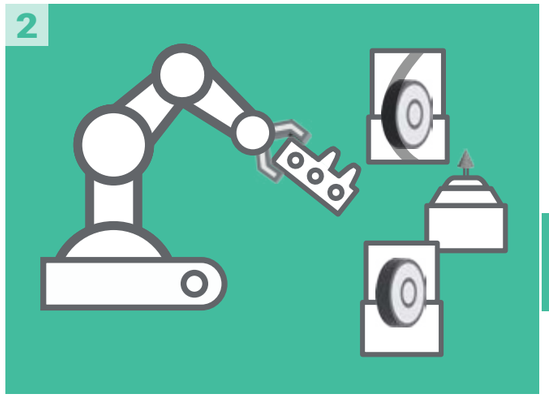
ROBOT CELLS

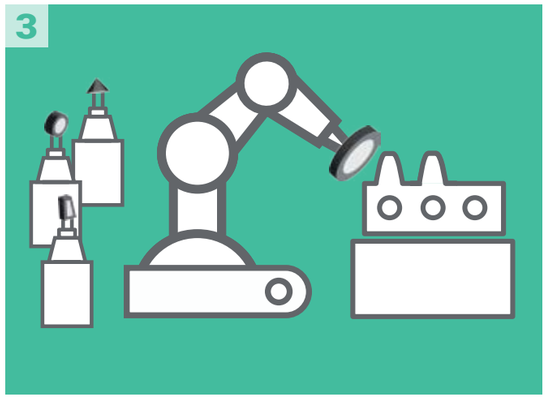
SOLUTIONS

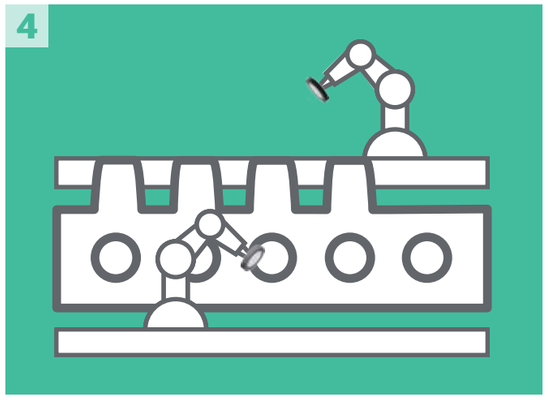
CONCEPTS FOR THE MACHINING OF CASTINGS AND FORGINGS

Depending on the workpiece size/weight and machining accuracy, the Berger Gruppe offers robot cells with four different concepts for the machining of castings and forgings.









Concept 1: Machining with multi-tool-head

- machining with five tools
- machining robot with quick-change system
- workpiece measurement integrated in the system
- path-optimized machining
- CNC rotary table for holding the workpiece

→ more information on p. 8–11

Concept 2: Machining with robot-guided workpiece

- machining of workpieces with part weight from 15–120 kg
- workpiece guided by robot
- machining at fixed machining stations (e. g. grinding or milling station)
- storage via conveyor belt
- chip conveyor integrated

→ more information on p. 16–23

Concept 3: Machining with robot-guided tool

- machining with robot guided tool
- machining of workpieces with a maximum weight of 1.5 t
- feeding of the workpiece via CNC rotary table
- machining with robot-guided workpiece, e. g. grinding wheel or milling cutter

→ more information on p. 12–15

Concept 4: Machining with robots on guide rails

- machining of large-volume workpieces with part weights of 30–107 t
- tool robot-guided
- two robots can be moved on guide rails

ROBOT CELLS

WITH ROBOT-GUIDED TOOL

ROBOT PROCESSING WITH MULTI-TOOL-HEAD

If the workpiece is too large or difficult to move, the robot cells are designed so that the workpiece is clamped or fixed on a rotary table with CNC axis and machined with one or more robot-guided tools.

Deburring and milling of aluminium gravity die casting

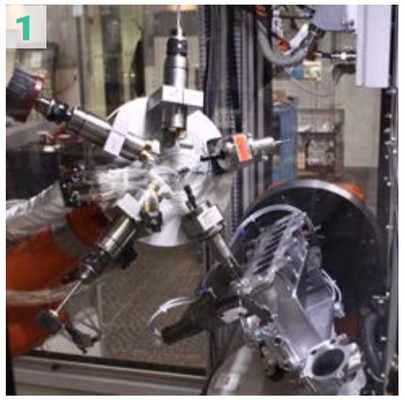
The standard robot cell shown here is designed for the machining of gravity die castings.

The workpieces supplied by the customer are picked up via a CNC rotary table with a machining position and a loading and unloading position. Loading, unloading and machining can thus be carried out in parallel.

An additional rotary axis integrated into the robot control repositions the workpiece during machining (picture on the left side.

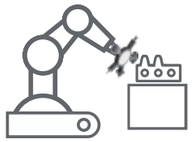
Five tools are mounted on a multi-tool head and are selected depending on the machining operation.

Programming is done offline, e.g. using RobotStudio. Measurement of the workpiece is integrated into the system.



The robotic cell of the series RSP/5F/3R shown here is composed of:

- 2 robots for loading and unloading
- positioning of the workpieces by a processing robot via CNC rotary table
- multi-tool head for holding five tools equipped with five pneumatically driven precision spindles (picture 1)



ROBOT CELL
WITH ROBOT-GUIDED TOOL

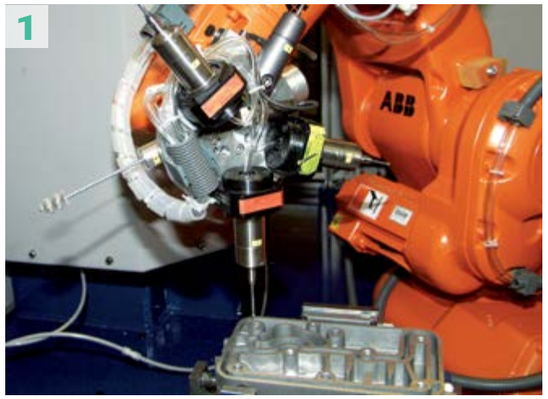
Robot processing with multi-tool-head

The robot deburring of aluminium castings can be realized with the help of various tools. The main tools used are rotationally driven tools such as milling and grinding pins, abrasive flap discs or brushes.

The selection of the tools depends on the accuracy requirements, the material, the surface and the amount of material to be removed.

- mounting of different tools in three pneumatically driven milling spindles and one brushing spindle via tool turret head
- tool changing time: 0,4 s
- execution of programmed curves in geometric order
- shortest machining paths
- integration of up to four tools
- calibration of complete workpieces or individual contour elements for programming and checking the workpiece position in the process via integrated 3D measuring probes
- increased tool life and improved surface finish during deburring by wetting with liquid from a spray attachable at the tool turret

1



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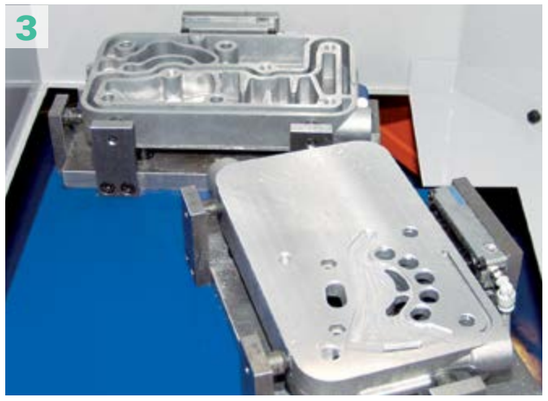


When machining die-cast cylinder heads, for example, precise, defined and secondary burr-free deburring is crucial.

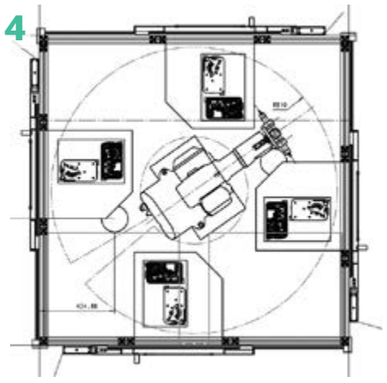
The deburred edges should be 0.2 to 0.4 mm wide to ensure maximum size of the sealing surfaces.

Special milling tools have been developed to reliably produce these uniform and narrow deburring edges for aluminium. The milling tools guarantee a long service life and are designed to limit penetration into the workpiece.

Offline software is supplied for programming the robot, with which drawing data is tapped and the curves to be deburred are assembled as radius and line elements.

- tool turret head with 3 pneumatically driven milling spindles, pneumatically driven brush spindle and 3D measuring probe (picture on the left side)

4



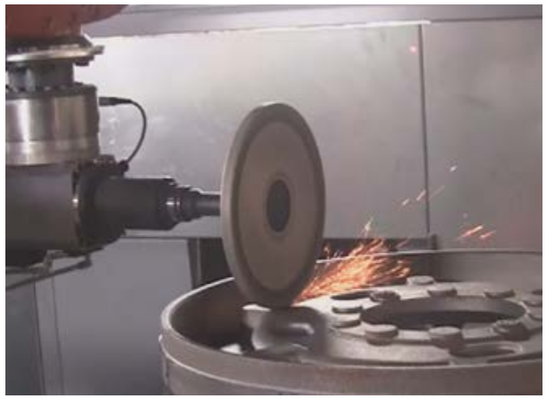
- machining of die cast parts with tool turret (picture 1)
- RSP/5F robotic cell for processing die-cast parts (picture 2)
- interchangeable workpiece holder (fixture) with defined reference points (picture 3)
- layout plan of the robotic cell RSP/5F (drawing 4)

ROBOT CELL
WITH ROBOT-GUIDED TOOL

Deburring of large-volume workpieces

The fully automated robot cell is designed for deburring large-volume workpieces – e. g. made of grey cast.

The feeding is carried out by the customer via a loading and unloading position. From then on, the workpiece is machined fully automatically.



The workpiece is positioned on a CNC rotary table for machining within the production center. The rotary table axis is fully integrated into the robot control system.

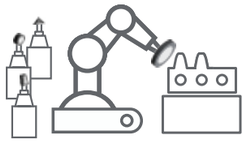
The workpiece is machined with various rotating tools such as grinding wheels or milling cutters.

Depending on the machining task, a tool change is carried out and takes place from a change magazine.

The machining is prepared by means of offline programming – e. g. via RobotStudio.

The robot is equipped with a force-torque sensor, so that an almost seamless machining of contours is possible.

Thanks to additional measurement technology, this robot cell can be offered as a turn-key solution.



ROBOT CELL
WITH ROBOT-GUIDED TOOL

Fully automated all-round machining of complex geometries

The newly developed, highly universal robot cell is designed for fettling castings and machining the surfaces of workpieces weighing up to 100 kg with complex geometries.

The aim of the machining is the uniform removal of at least 1 mm of material thickness from the total surface of the workpiece to be machined.

The innovative content of the process presented here lies in the combination of force-torque sensor technology with the machining of complex 3D-defined surfaces and a constant force control orthogonal to the surface with simultaneous tool wear compensation.

The 3D design drawings of the workpieces are read in via CAM software and necessary robot paths are programmed offline, with tool paths calculated in six- or multi-axis codes.

The challenge of this innovation lay in the use of abrasive tools, as not only the workpiece circumference but also the diameter of the grinding wheel changes during machining.

before machining

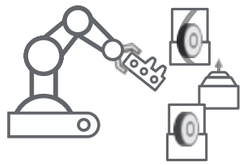
after machining

- fixing the workpiece with pallet clamping system on rotary table
- rotary table with two pallets arranged at 180°.
- clamping of the next workpiece during machining of the first workpiece
- positioning of the pallet in the correct position with a zero-point clamping system on a second rotary table within the robot cell
- rotary table controlled by 6-axis industrial robot as seventh axis, freely programmable
- robot equipped with water-cooled high-performance spindle, which ensures optimum workpiece accessibility
- precise control of the tool's contact force on the workpiece via force-torque sensor integrated in robot gripper

  → force-sensitive machining of the workpiece also possible

  → fully automated all-round machining of complex geometries possible

- grinding/milling spindle equipped with a tool changing system with up to 132 tools
- worn tools replaceable by sister tools



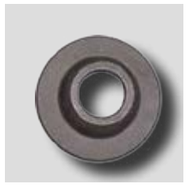
ROBOT CELLS

WITH ROBOT-GUIDED WORKPIECE

ROBOT MACHINING WITH FIXED PROCESSING STATIONS

Robot processing with one milling/deburring station

The robot cell of the RSP/5F series shown here is designed for deburring and milling cast and forged parts.



The workpiece positioned on the loading table is gripped by the robot.

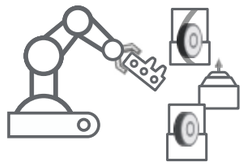
The workpiece is aligned and measured with the aid of a camera measuring station and demo 3D measuring probe.

After that, the workpiece is machined at a milling station with a fixed milling spindle.

(For machining with a fixed milling spindle see also page 19)

The robot cell consists of:

- rotary table for loading and unloading workpieces with a diameter of 2,000 mm, holding up to 30 workpieces
- milling station with pneumatic spindles for the use of burrs (picture on the left side)
- camera measuring system with illumination and lens (pictures 1 and 2)
- 3D probe (picture 3)

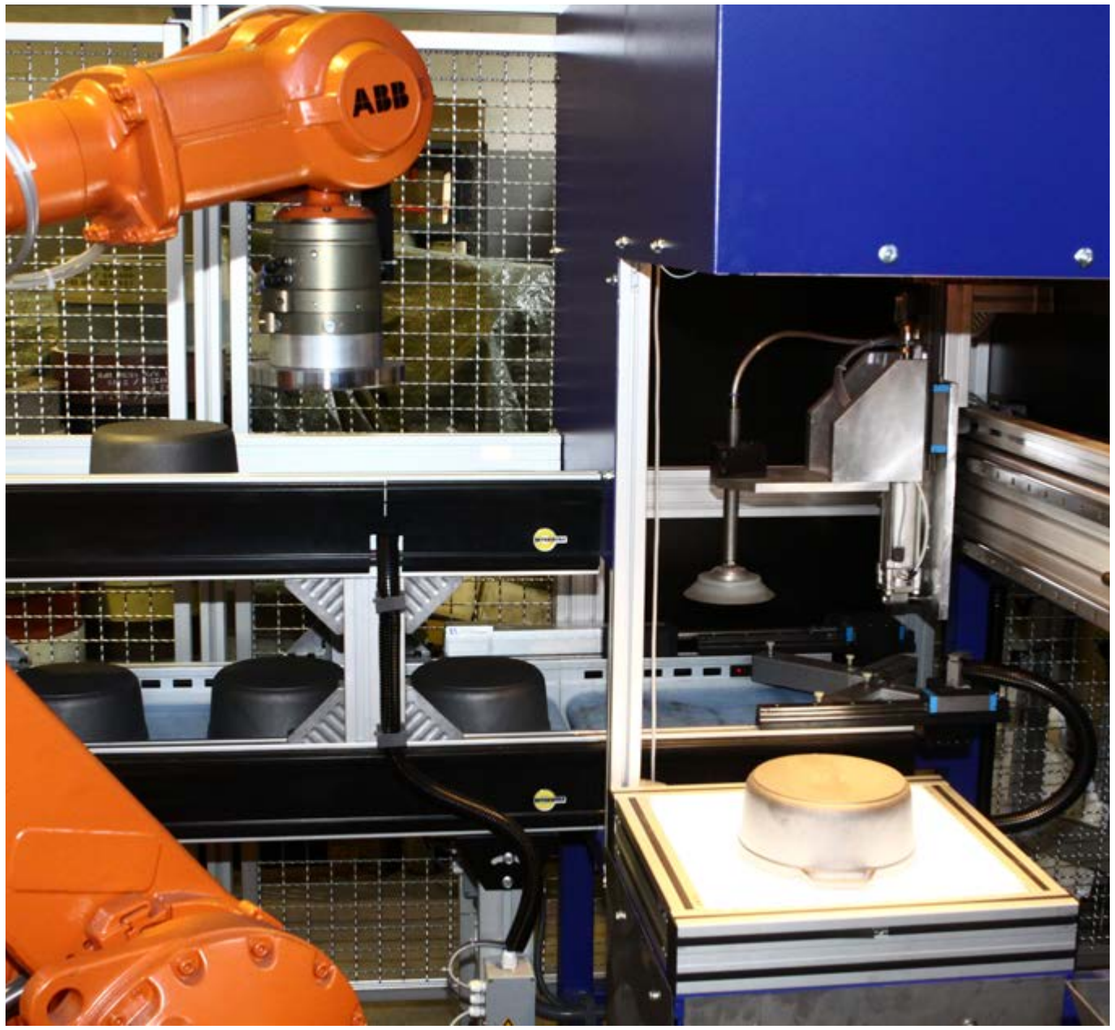


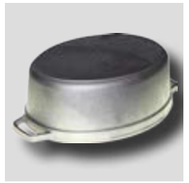
ROBOT CELLS
WITH ROBOT-GUIDED WORKPIECE

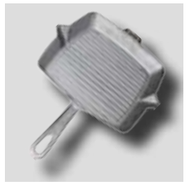
Robot processing with two grinding and one milling station

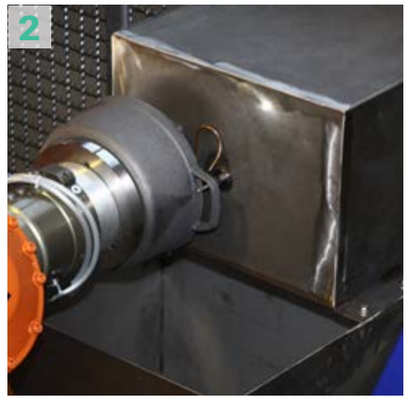
The modular robot cell of the RSP/1B/1S/1F series shown here is designed for machining cast parts – in this case spheroidal graphite cast iron.

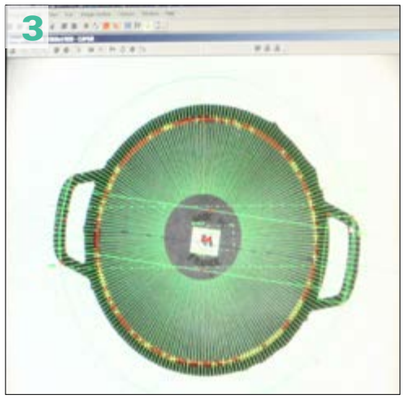
The workpieces are picked up by adapted grippers and guided by robots.





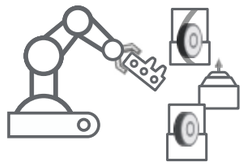






The robot cell is composed of:

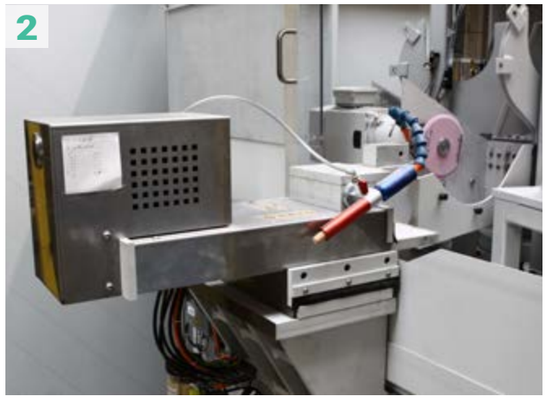
- feeding via conveyor belt with preparation on camera measuring table (picture on the left side)
- compensation of workpiece tolerances by camera measuring system (picture 3)
- deburring of the inside of the handle with high-frequency motor spindle (picture 2)
- outside cleaning with two belt grinding stations type BSS14 (picture 1)

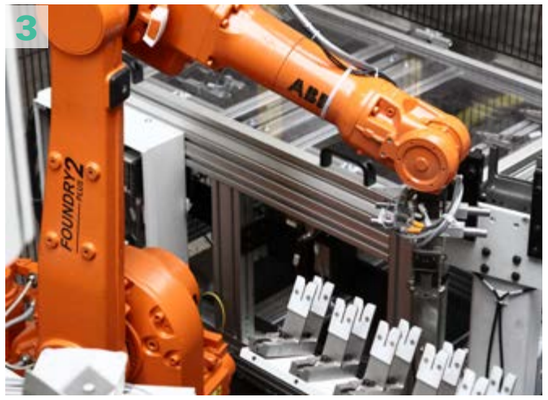


ROBOT CELLS
WITH ROBOT-GUIDED WORKPIECE

All-around processing with CNC rotary table with five processing stations

The robot cell is equipped with five processing stations mounted on a rotary table. The workpiece – in this case cast steel – is guided by the robot.





The machining cell is designed for all-round machining of workpieces.

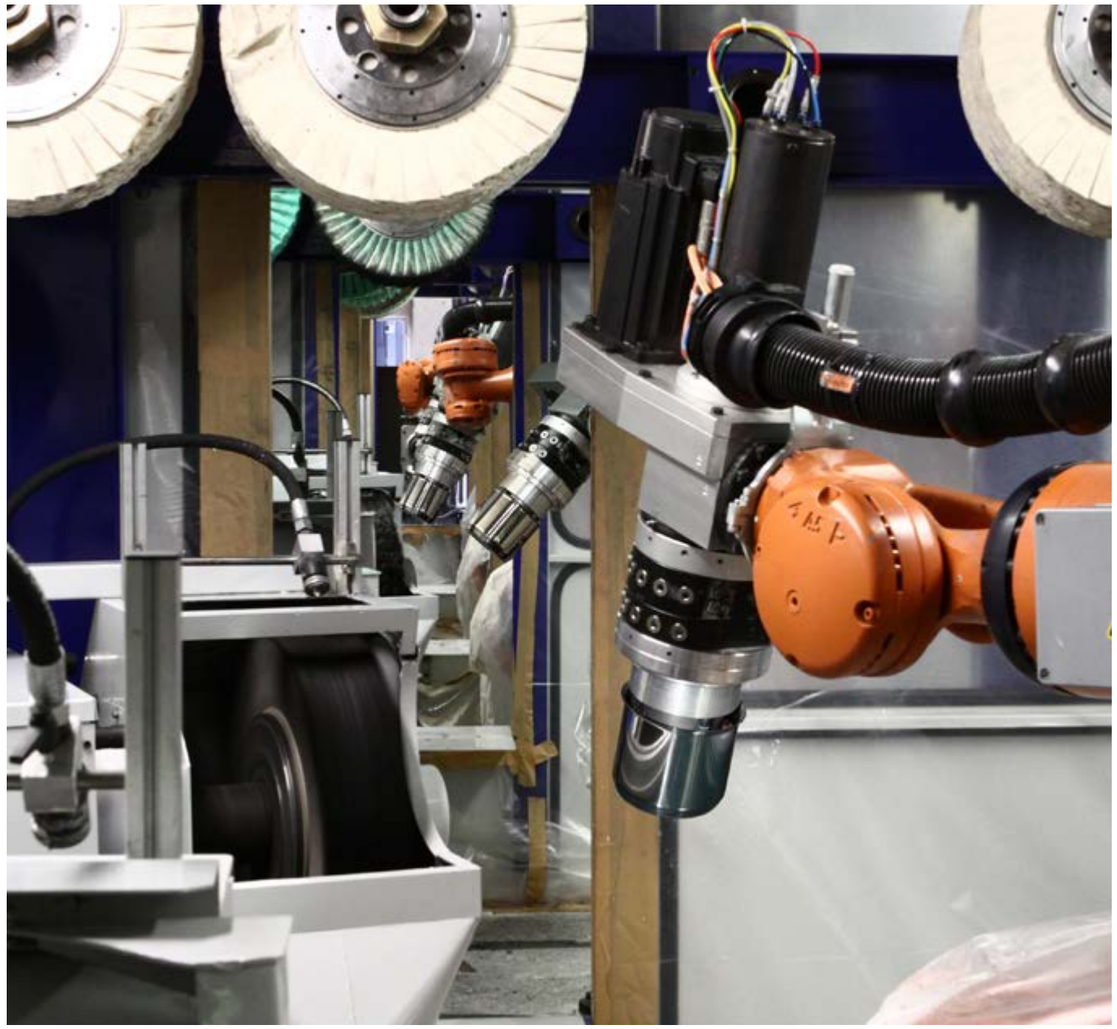
- CNC rotary table for 5 processing stations (pictures 5, 6 and p. 20)
- 5 single-sided grinding machines of the P3 series, equipped for wet grinding with nozzles for intensive cooling (picture 1)
- CNC dresser with two CNC axes
- measuring station for measuring the workpiece, consisting of two stirrup lasers, a double laser distance sensor and a tactile Tesa measuring probe (picture 2)
- turning and centering station (picture 3)
- 180° loading table (picture 4)
- robot with gripper changing system
- interchangeable gripper for machining the other side of the workpiece

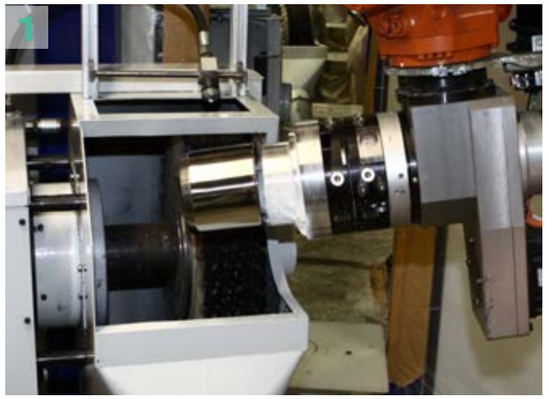
ROBOT CELLS
WITH ROBOT-GUIDED WORKPIECE

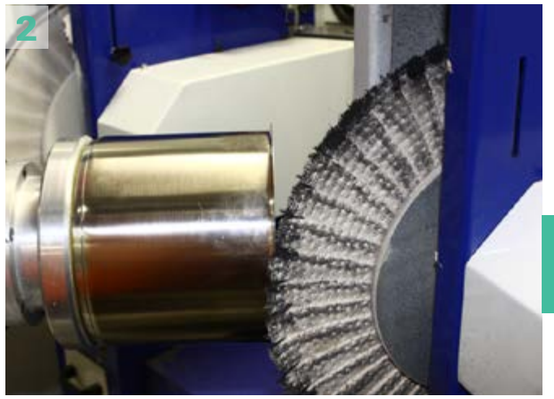
Fully automated robotic system with 33 interacting robot cells

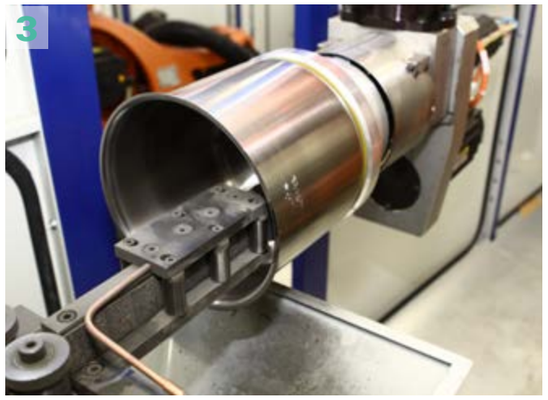
Fully automated robotic system for polishing the inside and the outer surface and deburring the rim of hollow goods

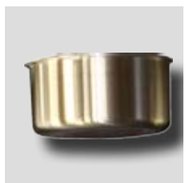
ROBOTICS AWARD 2018











Fully automated robotic system for polishing the inside and the outer surface of hollow goods.

Decentralized, intelligent systems decide on the basis of input signals and sensor technology what kind of actions are to be carried out.

This is achieved both in the area of networked control technology and in the area of intelligent spare parts supply.

The robot system is equipped with 33 interacting robots. The robots communicate with each other, request raw materials or display consumables – each as an independent, intelligent unit.

For spare parts supply and preventive maintenance, the machines communicate worldwide as an independent system with the control center to display the current machine status and the required wear parts.

The robot cell is equipped as follows:

- feeding via conveyor belt system
- modular design of the system
- separate lines for the inside and the outside machining
- automatic gripper changing system
- tool changing system
- control station monitoring the entire plant
- CNC adjustment of the paste gun
- high-gloss polishing of the outer jacket (picture. 1)
- polishing the pot rim (picture 2)
- grinding of the inner jacket, the robot holding the pot by vacuum system (picture 3).
- fully automatic change of polishing discs (picture 4)

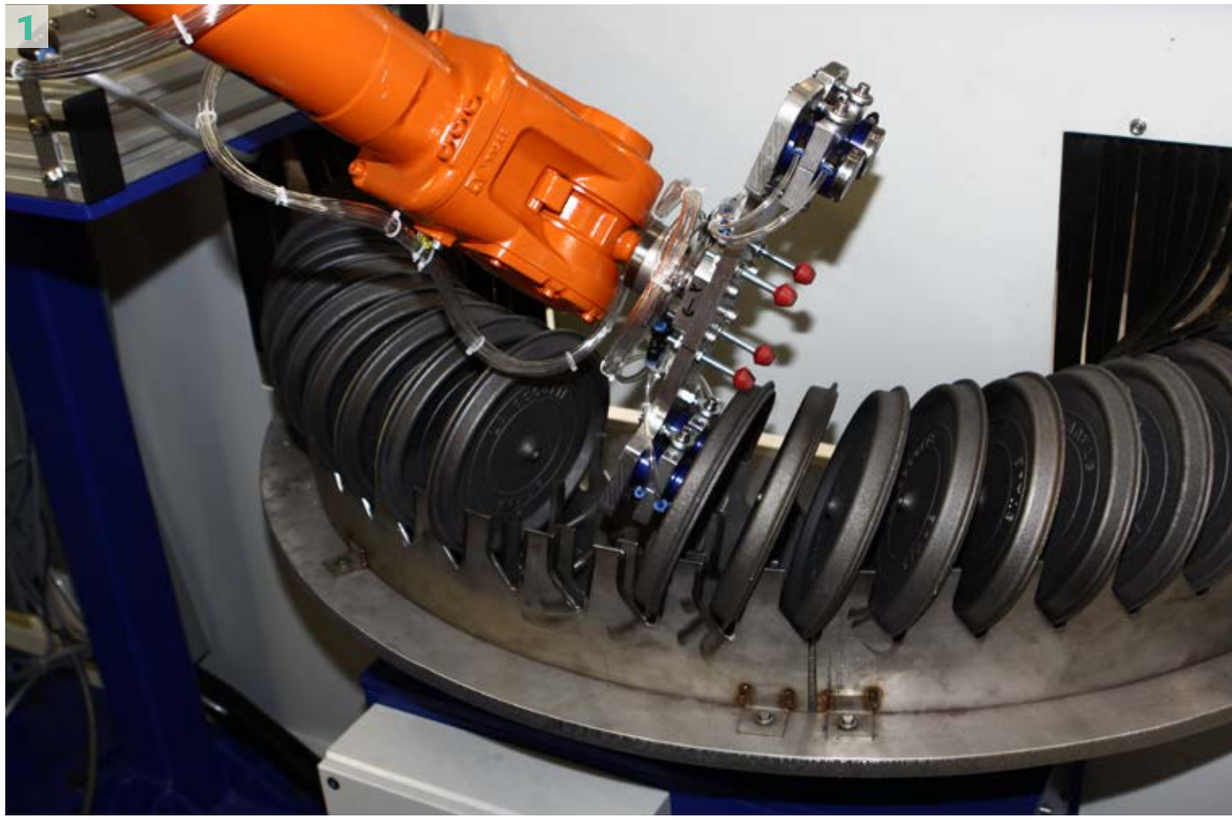
CNC-DEBURRING MACHINES

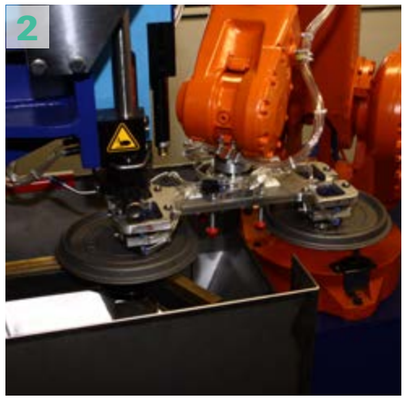
WITH ROBOTIC FEEDING OF THE WORKPIECE

PROCESSING WITH CNC TECHNIQUE

Deburring of spheroidal graphite cast iron

The modular robot cell shown here is designed for machining cast lids and similar workpieces.





- robot gripper designed as double gripper for handling two lids including change parts for one pot family (picture 2)
- belt grinding station BSS10 with pneumatic belt tensioning and belt breakage control
- polishing station P3 with CNC axis for grooving the grinding belt against the pot lid; design with ball screw, AC servo motor and SERCOS interface
- frequency converter for infinitely variable regulation of the spindle speed of the station BSS10/P3
- encapsulation of the grinding machine (picture 3)
- belt grinding station BSS14 for processing pot lids (picture on the left side)
- rotary table holding up to 60 workpieces (picture 1)

ACCESSORIES

FOR ROBOT CELLS

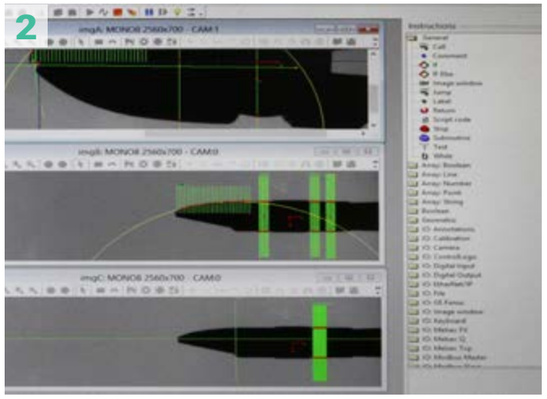
MEASURING TECHNIQUE
PROGRAMMING
SYSTEM MONITORING

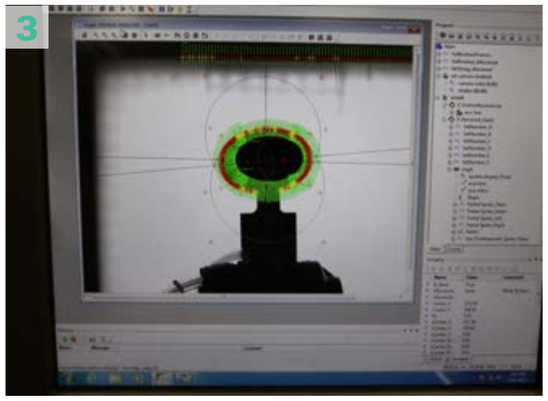
Measuring technique

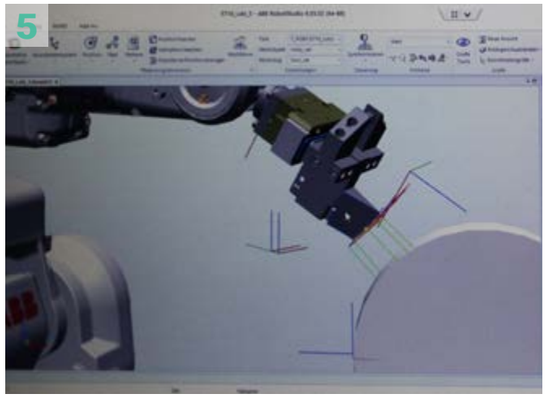
With the help of cameras or mechanical probes, the workpieces can be measured before or after machining and thus the machining program can be influenced.

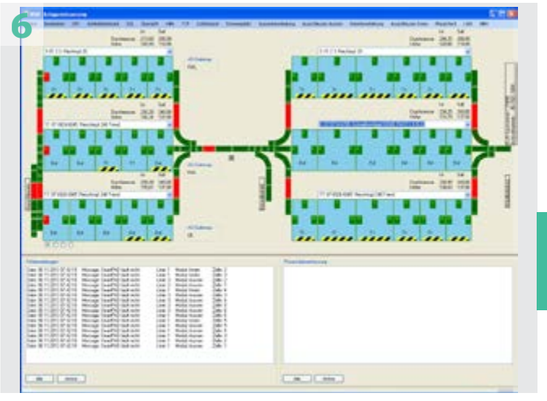
Examples of application:

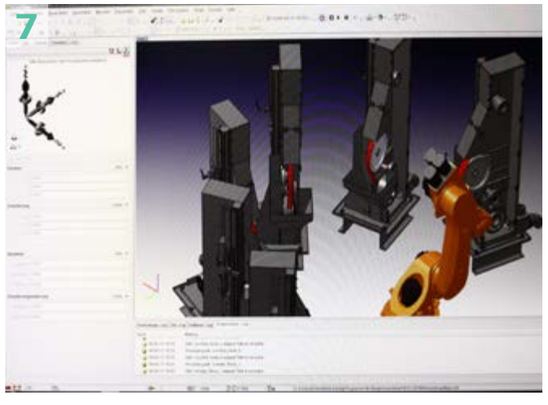
- 3D measuring with probe (picture 1)
- 3D measuring with camera system (picture 2)
- compensation of workpiece tolerances by camera measuring system (picture 3)
- camera measuring system with graphic interface for part measurement (picture 4)











Programming

The program can be created offline with corresponding software – e. g. with RobotStudio (pictures 9 and 10).

The processes can also be simulated and the machining times determined.

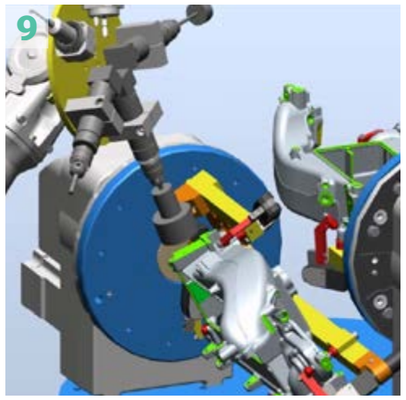
Examples of application:

- robot program in conjunction with RobotStudio: guiding of the workpiece (picture 5)
- 3D offline programming in conjunction with KUKA robots (picture 7)

System monitoring

The system states can be monitored by means of an app with email notification (picture 8) or in connection with a central PC (picture 6).

Warnings are shown on the display or sent by email.



BERGER GRUPPE | MACHINES AUTOMATION ROBOTICS

STRONG PARTNERS

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The Berger Gruppe develops and builds CNC-controlled grinding machines for various industries such as the cutlery, tool, surgical and automotive industries.

Every year 10–12 new types of machines or new production processes are completed from a total of 80–110 new plants. As a robot system house from ABB and KUKA, the company mainly uses robots to automate its machines.

The robots are used both for handling and for workpiece or tool guidance. The feeding technology of the components to be machined is decisive for the use of automation

The development of workpiece provision and interfaces for other production steps is an important area of work for the company.

Newest technologies of broadband connectivity and digitalization of production purposes set the stage for Berger developments of interfaces for Industry 4.0 applications with linked sensor technology, signal analysis and integration of Automated Guided Vehicles (AGV) for the machines.

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