



CAST AND FORGED PARTS

ROBOT CELLS FOR

fettling | deburring | milling | grinding



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THE BERGER GRUPPE

CNC AND ROBOT TECHNOLOGY

The Berger Gruppe is a family-run business based in Wuppertal. The company has grown steadily since its foundation in 1957.

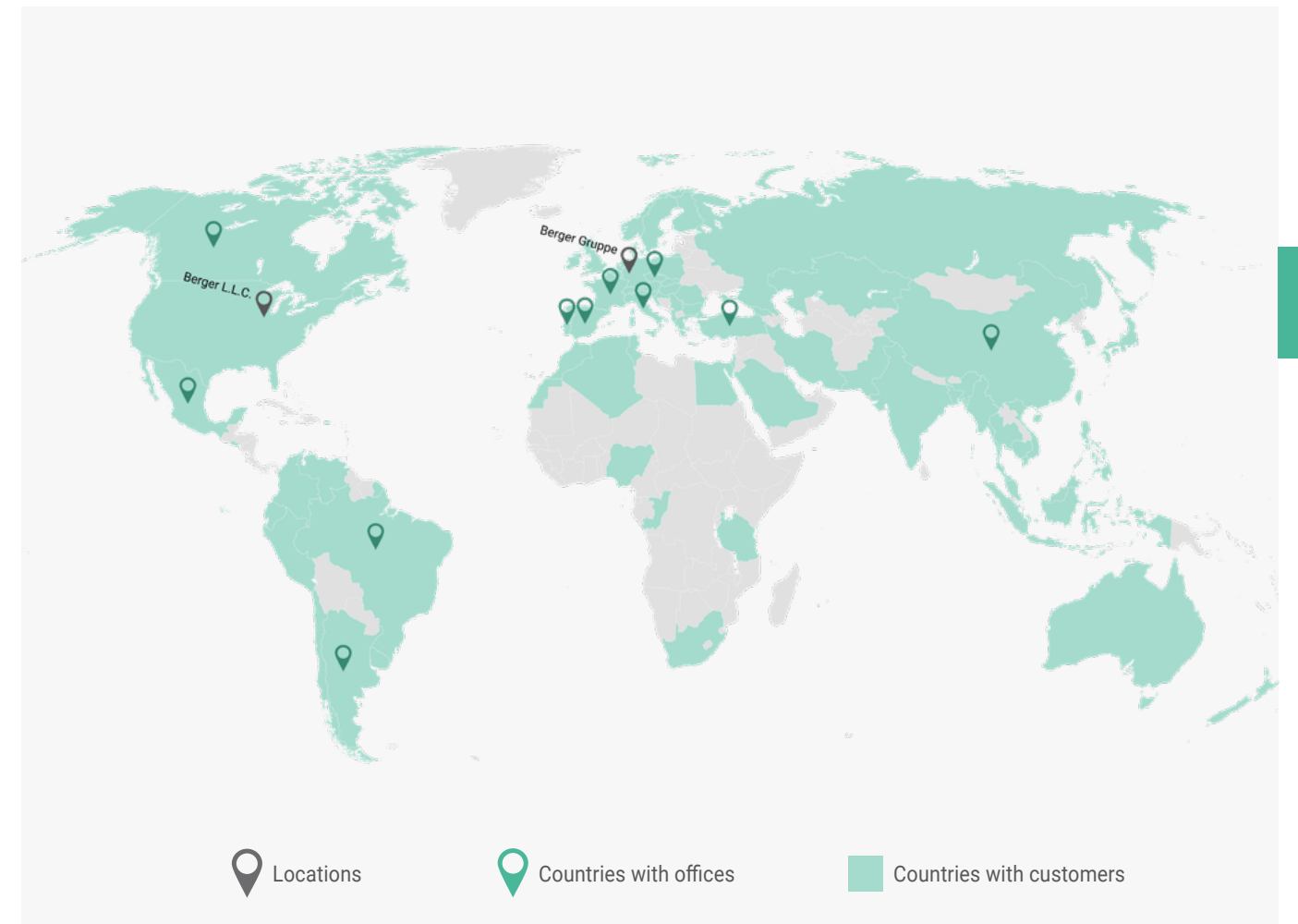


Across 9000 m² of production and of-
fice space, just under 200 employees
now design and build 250 machine types and
over 1100 robotic applications, which are used in
various industries.



MACHINES AUTOMATION ROBOTICS

With 11 representative offices and a
subsidiary in the USA and in Mexico,
the Berger Gruppe supplies machines and systems
to over 70 countries worldwide.



Product range

• Machines for individual workpieces

- Grinding
- Machining



• Robotic systems

- Workpiece processing:
Fettling, deburring, milling
grinding, polishing
- Automation
- Robot process technology



• Machines for steel strip

- Grinding
- Machining by metal-cutting



• After-sales

- Service
- Tools/spare parts



FETTLING

KEY FACTORS

MACHINING OF CASTINGS WEIGHING BETWEEN 100 G AND 100 T

Process reliability

Manual deburring and cleaning, as a non-value-adding activity, accounts for a significant proportion of time even in the highly automated production of cast and forged parts; due to a lack of process reliability, it leads to a high risk of rework and scrap, often only becoming apparent at the end of the production line.



The workpiece

The nature of the workpiece and the complexity of the machining process determine the configuration of the robot cell.



- **Weight:** from 100 g to 100 t
- **Material:**
 - Cast steel
 - Die-cast
 - Grey cast iron
 - Permanent mould casting
 - Ductile cast iron ...
- **Machining:**
 - Deburring
 - Grinding
 - Milling
 - Fettling

The solution

The Berger Gruppe develops and builds solutions for deburring and fettling of cast and forged parts with robot technology.



- **Tool-changing system equipped with:**
 - Grinding wheels
 - Grinding belts
 - Milling tools ...
- **Multi-tool head**
 - Tool change times between 0,5 and 1 s
- **Specialised tools for deburring undefined contours**
 - Compensating for raw part tolerances
 - Achieving defined chamfers/radii
 - Seamless, proces-reliable and with high feed rates
- **Force-torque sensor**
 - Seamless machining of moulded parts and contour profiles (e. g. in the case of crack formation ...)



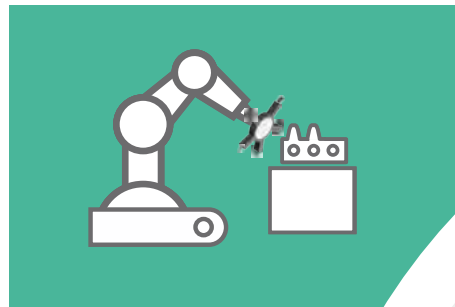
SOLUTIONS

WITH ROBOT TECHNOLOGY

CONCEPT 1

Machining with multi-tool head

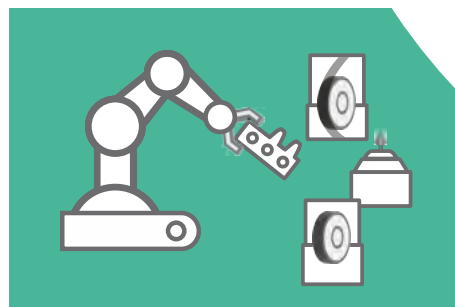
- machining with five tools
- machining robot with quick-change system with change time < 1s
- workpiece measurement integrated in the system
- path-optimized machining
- CNC rotary table for holding the workpiece



CONCEPT 2

Machining with robot-guided workpiece

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



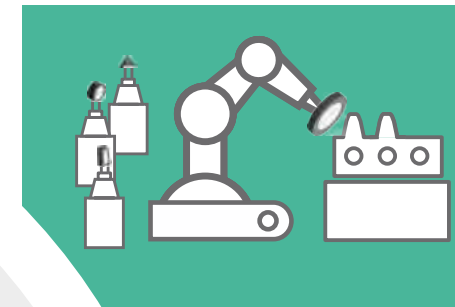
CONCEPTS FOR THE MACHINING OF CASTINGS AND FORGINGS

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 3:

Machining with robot-guided tool

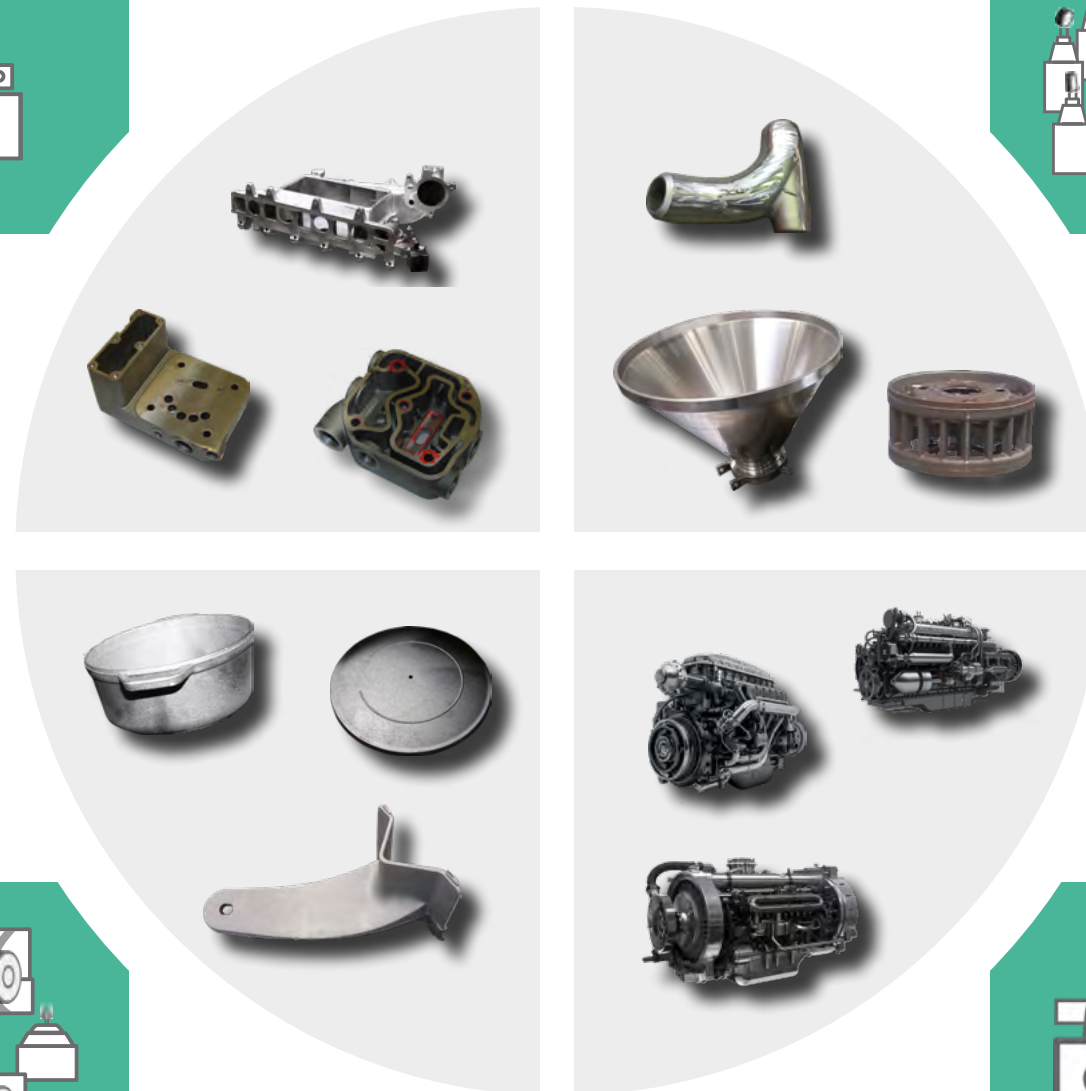
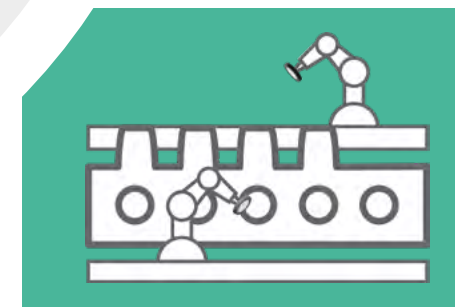
- machining with robot guided tool
- machining of workpieces with a maximum weight of 1.5 t
- feeding of the workpiece via CNC rotary table
- machining with robot-guided workpiece, e. g. grinding wheel or milling cutter

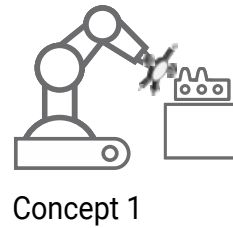


CONCEPT 4

Machining with robots on guide rails

- machining of large-volume workpieces weighing between 30 and 107 tonnes
- robot-guided tool
- machining with cutting discs, diamond grinding wheels, grinding pins and similar tools
- two robots capable of travelling along guide rails
- two linear axes: 6000 x 80 x 80 mm



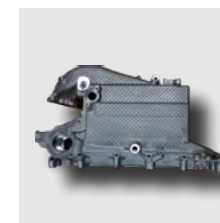
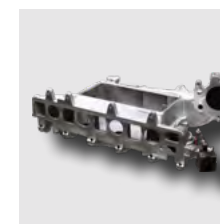
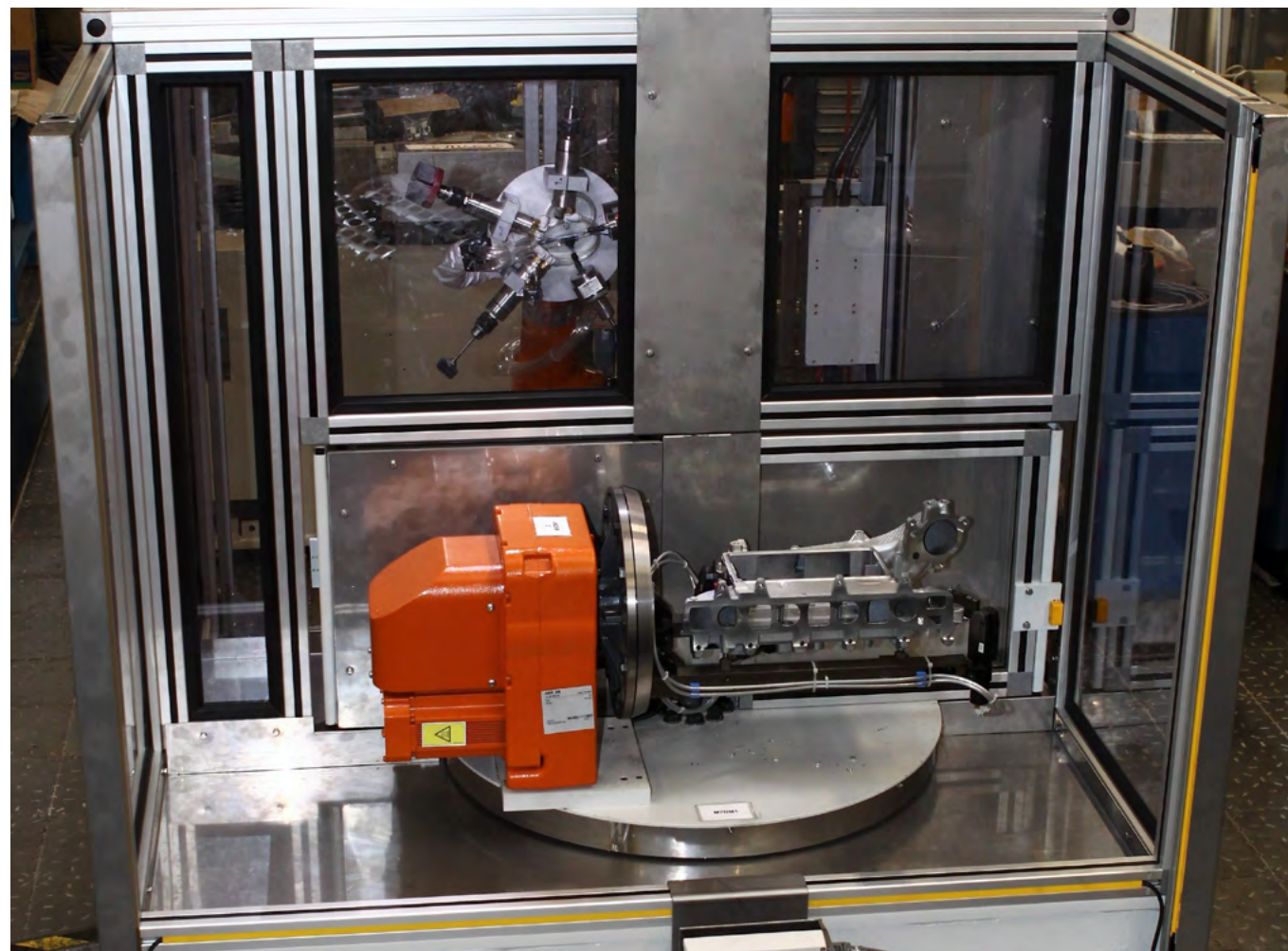


ROBOT CELLS

PROCESSING WITH MULTI-TOOL-HEAD

PROCESSING WITH FIVE TOOLS IN ONE PRODUCTION PROCESS

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

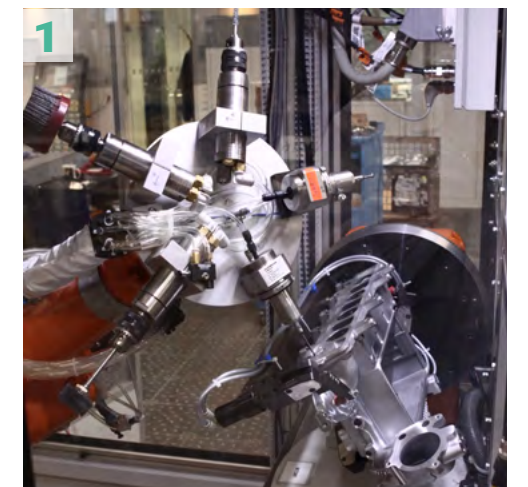
The standard robot cell shown here is designed for the machining of gravity die castings.

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).

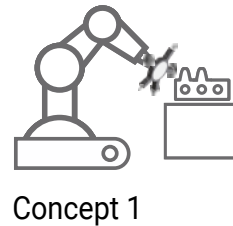
Five tools are mounted on a multi-tool head and are selected depending on the machining operation.

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



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

- robot 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)



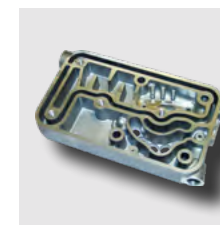
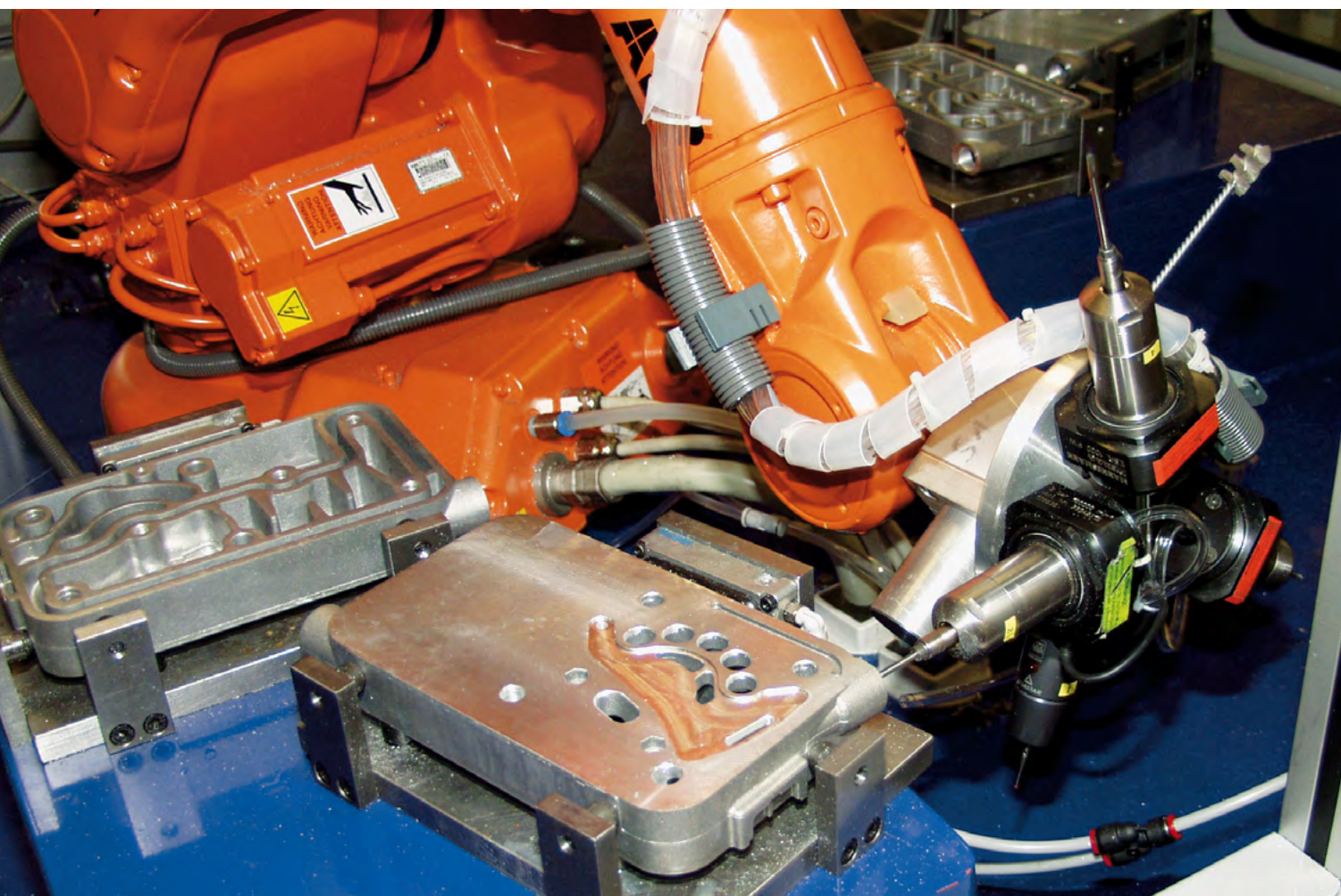
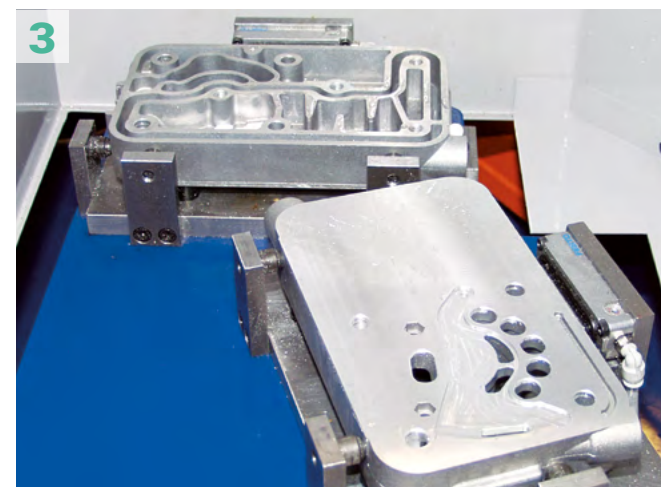
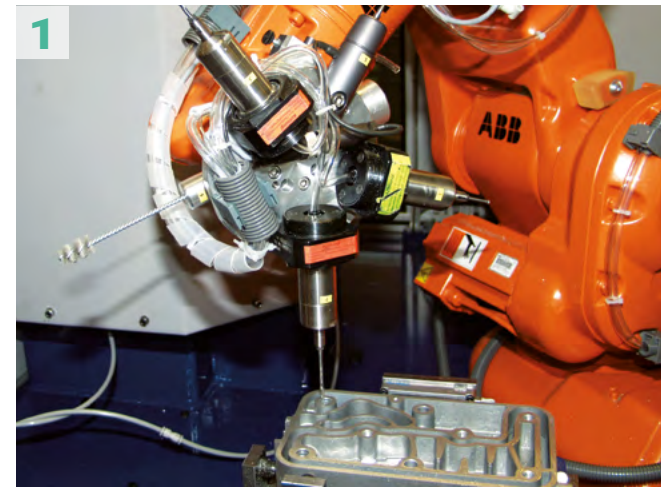
ROBOT CELL PROCESSING WITH MULTI-TOOL-HEAD

Robot processing with three tools in a single process

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
- 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



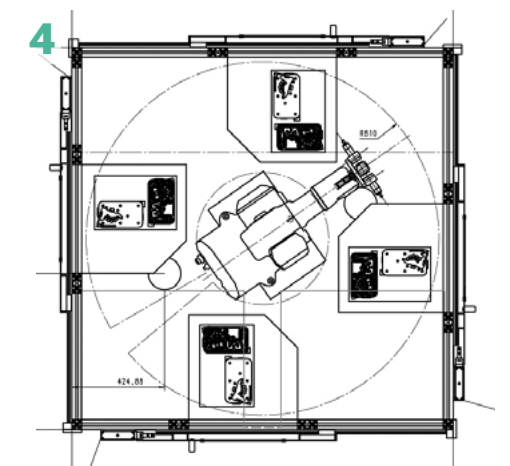
When machining die-cast cylinder heads, for example, precise, defined and secondary burr-free deburring is crucial.

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

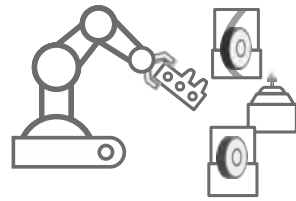
Special milling tools have been developed to reliably produce these uniform and narrow deburring edges for aluminium. The milling tools guarantee a long service life and are designed to limit penetration into the workpiece.

RobotStudio is used to program the robot. The drawing data is retrieved, 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)
- tool change time: 0.4 s
- increased tool life and improved surface finish during deburring by wetting with liquid from a spray attachable at the tool turret



- machining of die cast parts with tool turret (picture 1)
- RSP/3F/1T 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/3F/1T (drawing 4)



Concept 2

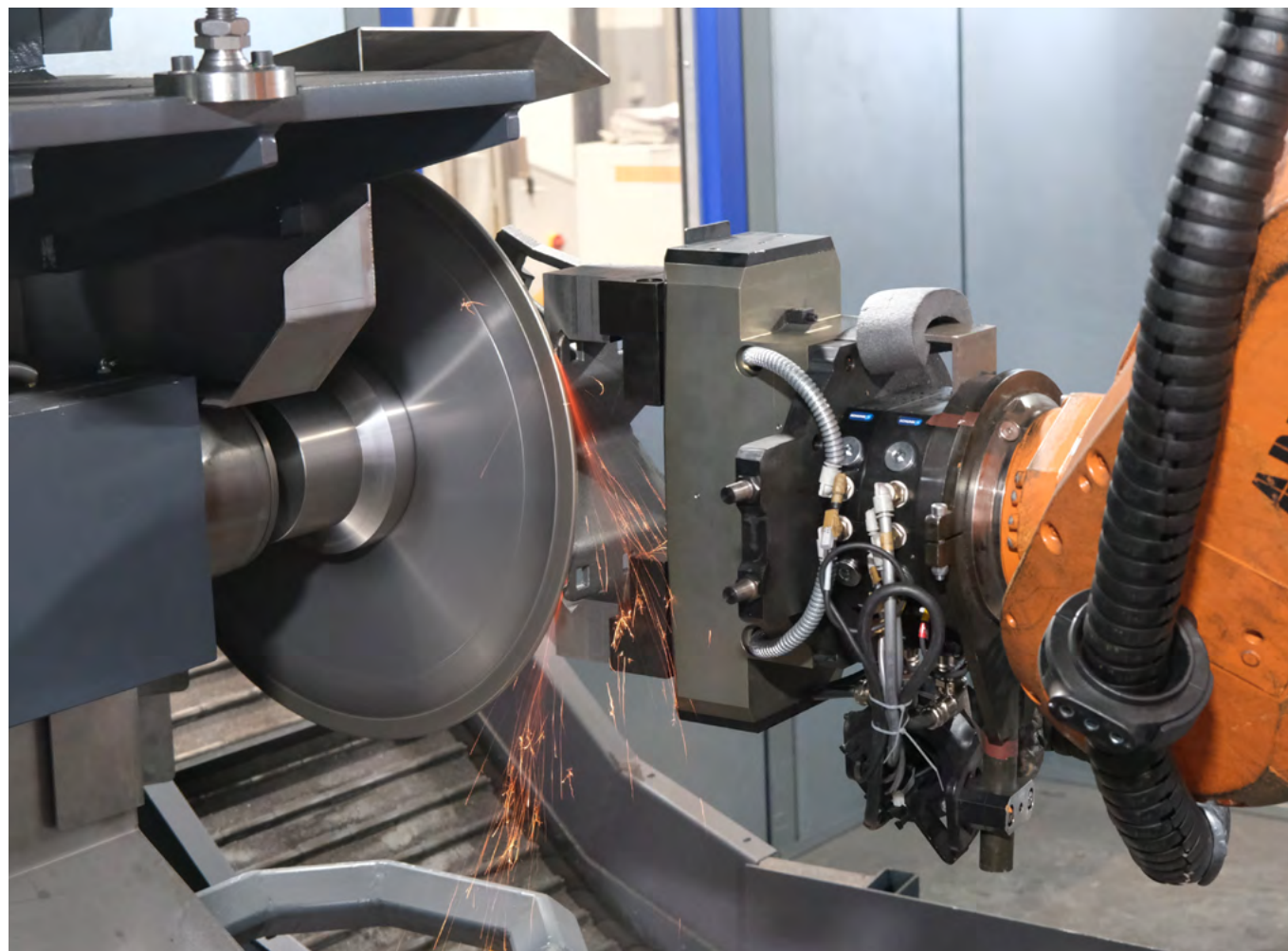
ROBOT CELLS

WITH ROBOT-GUIDED WORKPIECE

ROBOT MACHINING WITH FIXED PROCESSING STATIONS

Robotic machining with a milling/deburring station

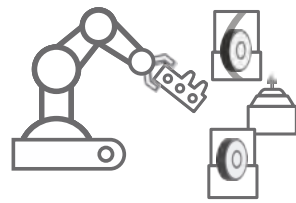
The RSP/2S/1T/1F robotic cell shown here, equipped with four machining stations, processes castings weighing between 15 and 120 kg.



The robot cell consists of:

- SS1 single-sided grinding station with cup wheel, grinding wheel Ø 600 mm
- milling spindle with finger cutter, Ø 20 mm
- SS1 machining station with cutting disc, Ø 600 mm
- CNC rotary table for mounting the SS1 cutting disc
- single-sided grinding station P/T with peripheral grinding wheel, Ø 80–100 mm
- machining robot with gripper changeover system

- feeding system for loading and unloading workpieces
- enclosed housing
- 3D measuring station integrated into the loading position for detecting the position of workpieces on the feed conveyor
- laser distance sensor for aligning workpieces in the robot gripper prior to machining
- swarf conveyor

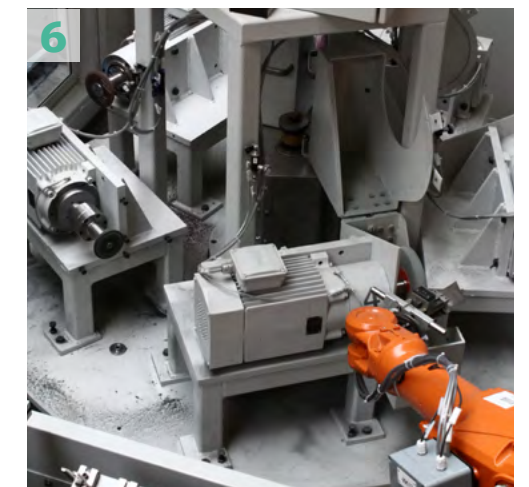
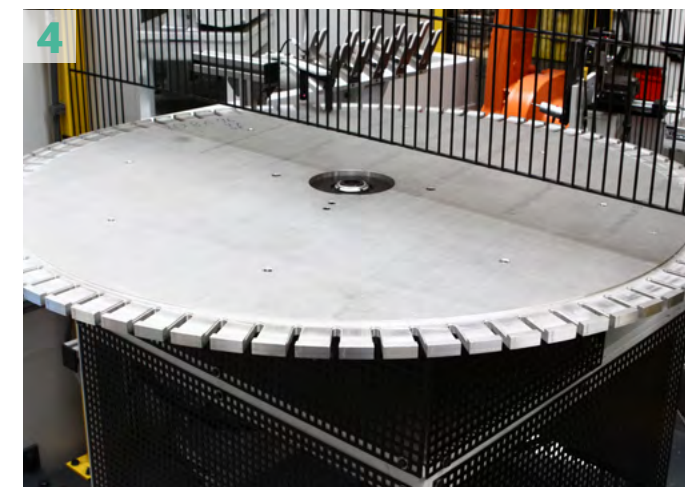
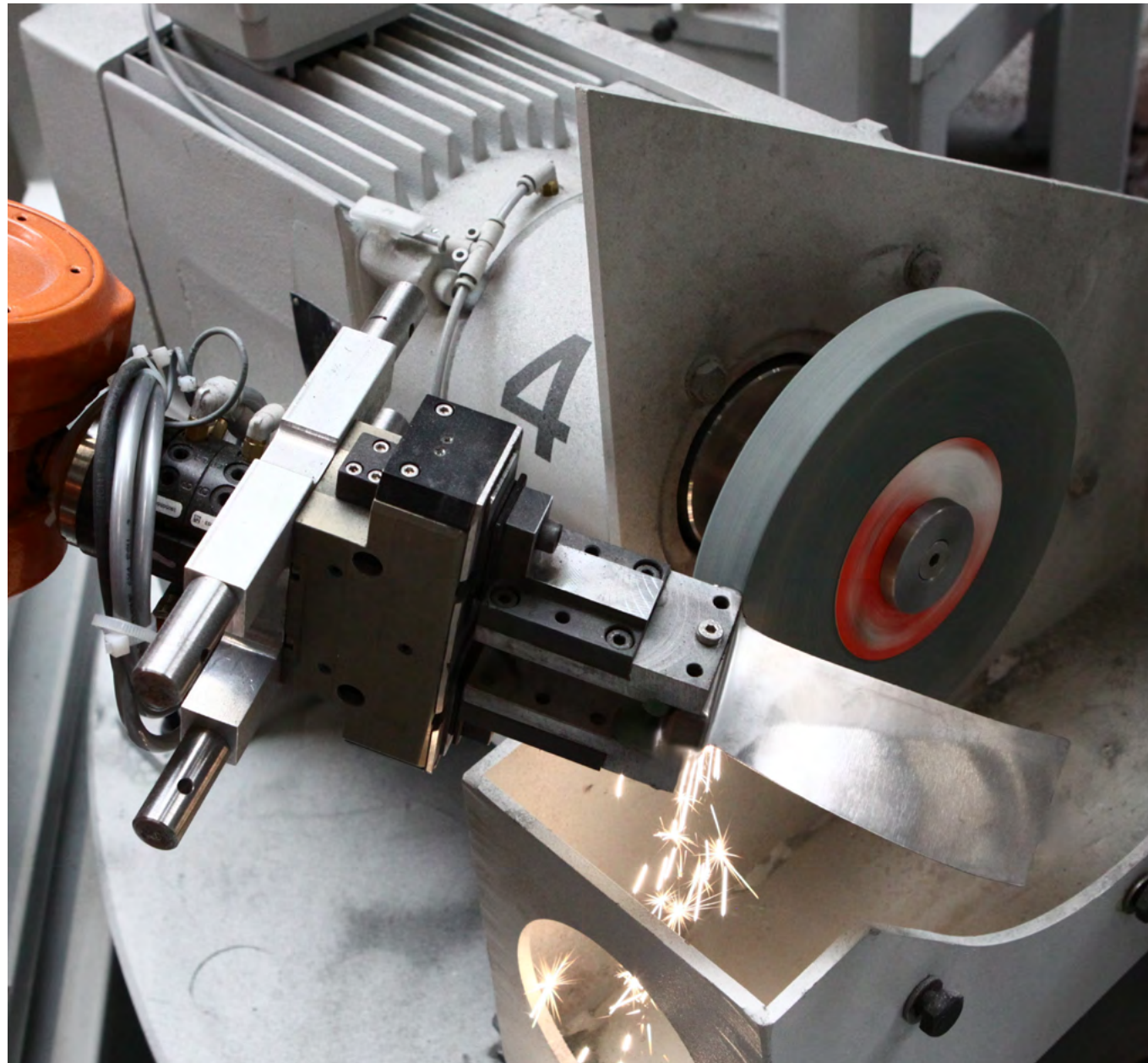


Concept 2

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.

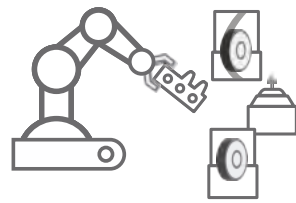


The machining cell is designed for all-round machining of workpieces such as turbine blades (picture left).

- CNC rotary table for 5 processing stations (pictures 1, 5, 6)
- 5 single-sided grinding machines of the P3 series, equipped for wet grinding with nozzles for intensive cooling
- 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



Concept 2

ROBOT CELLS WITH ROBOT-GUIDED WORKPIECE

Robot processing with fixed procession station

The robot cell shown here is designed for de-burring and milling cast or forged parts—in this case, cast steel.



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.

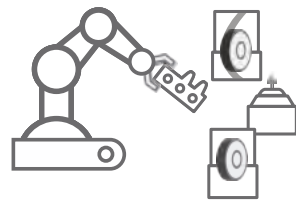


After that, the workpiece is machined at a milling station with a fixed milling spindle.

(For machining with a fixed milling spindle see also page 21)

The robot cell consists of:

- rotary table for loading and unloading workpieces with a diameter of 2000 mm, holding up to 30 workpieces
- milling station with pneumatic spindles for the use of burs (picture on the left side)
- camera measuring system with illumination and lens
- 3D probe



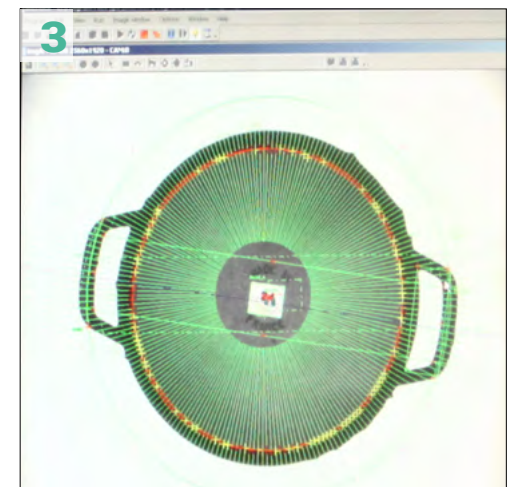
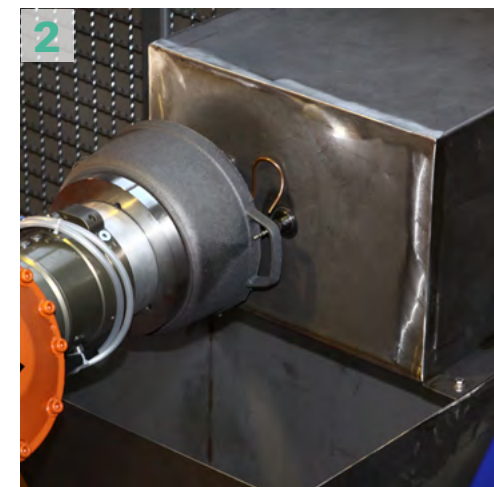
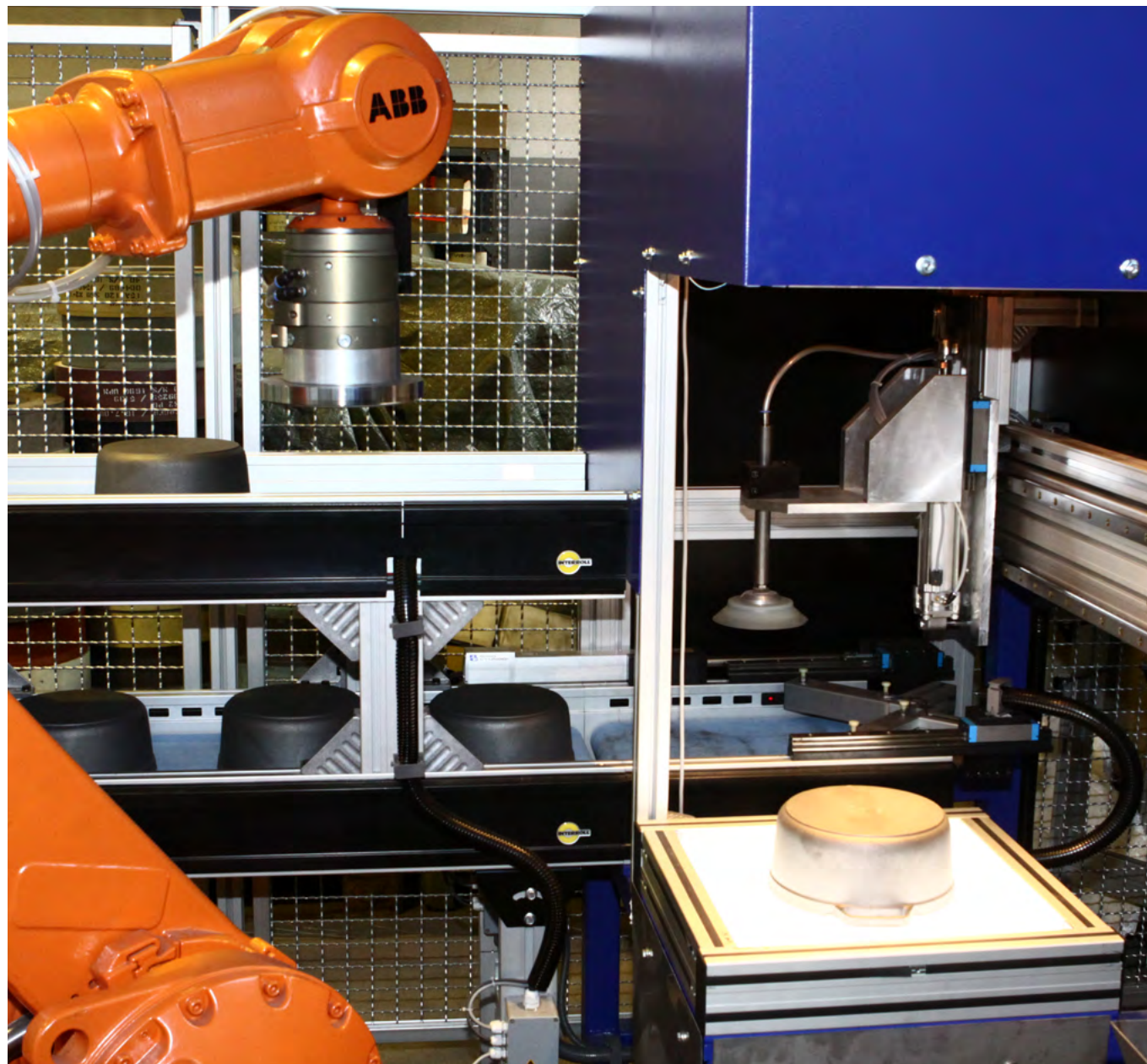
Concept 2

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.

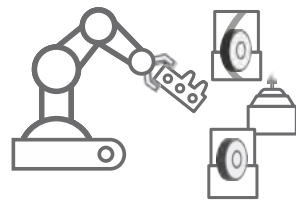
The workpieces are picked up by adapted grippers and guided by robots.



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)

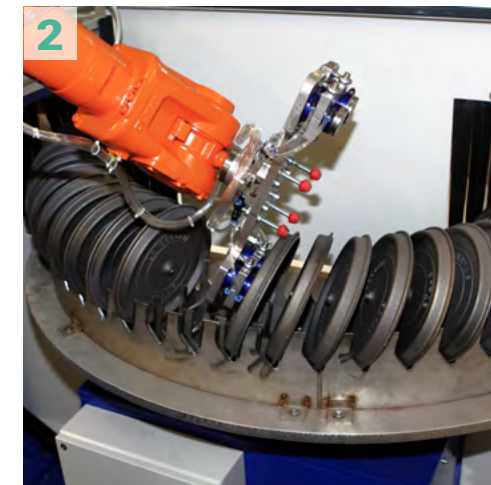
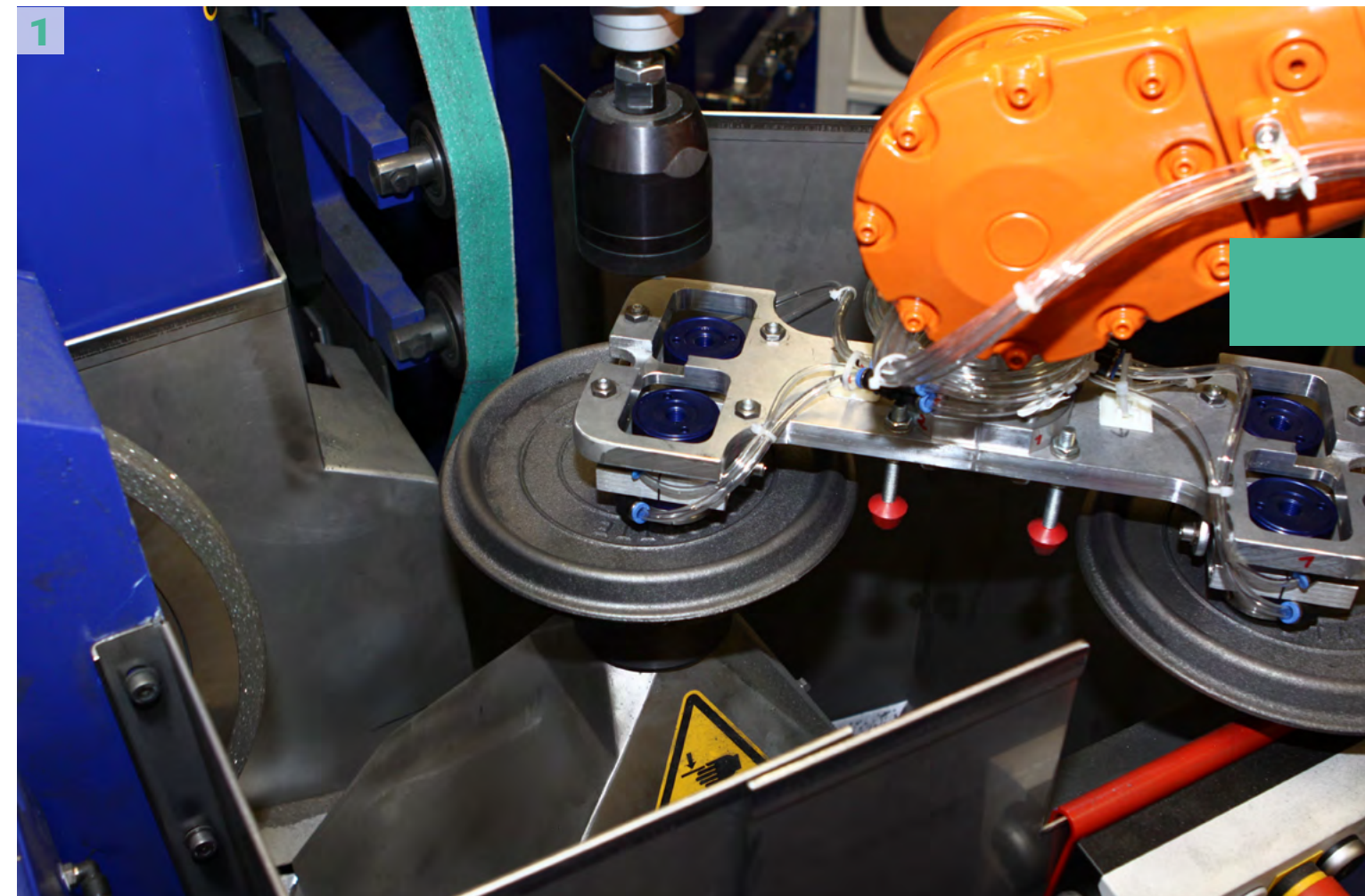


Concept 2

ROBOT CELLS WITH ROBOTIC WORKPIECE FEEDING

Deburring of spheroidal graphite cast iron

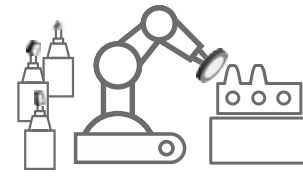
The modular robot cell shown here is designed for machining cast lids and similar workpieces.



- 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)



Concept 3

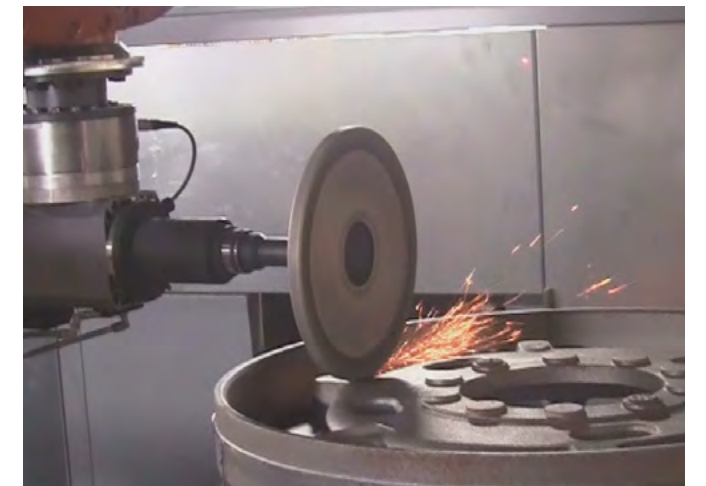
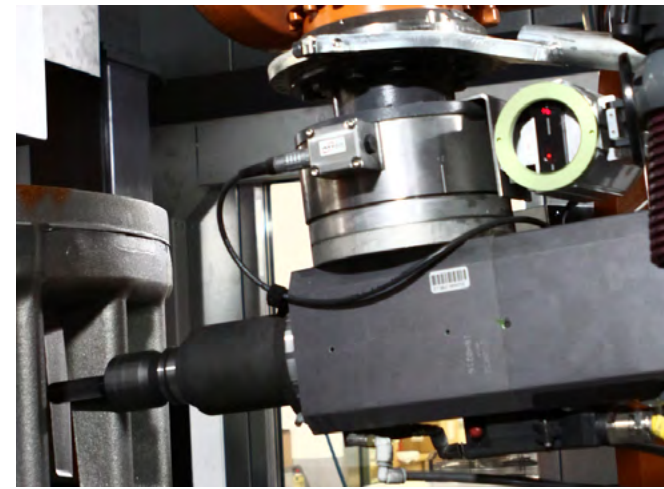
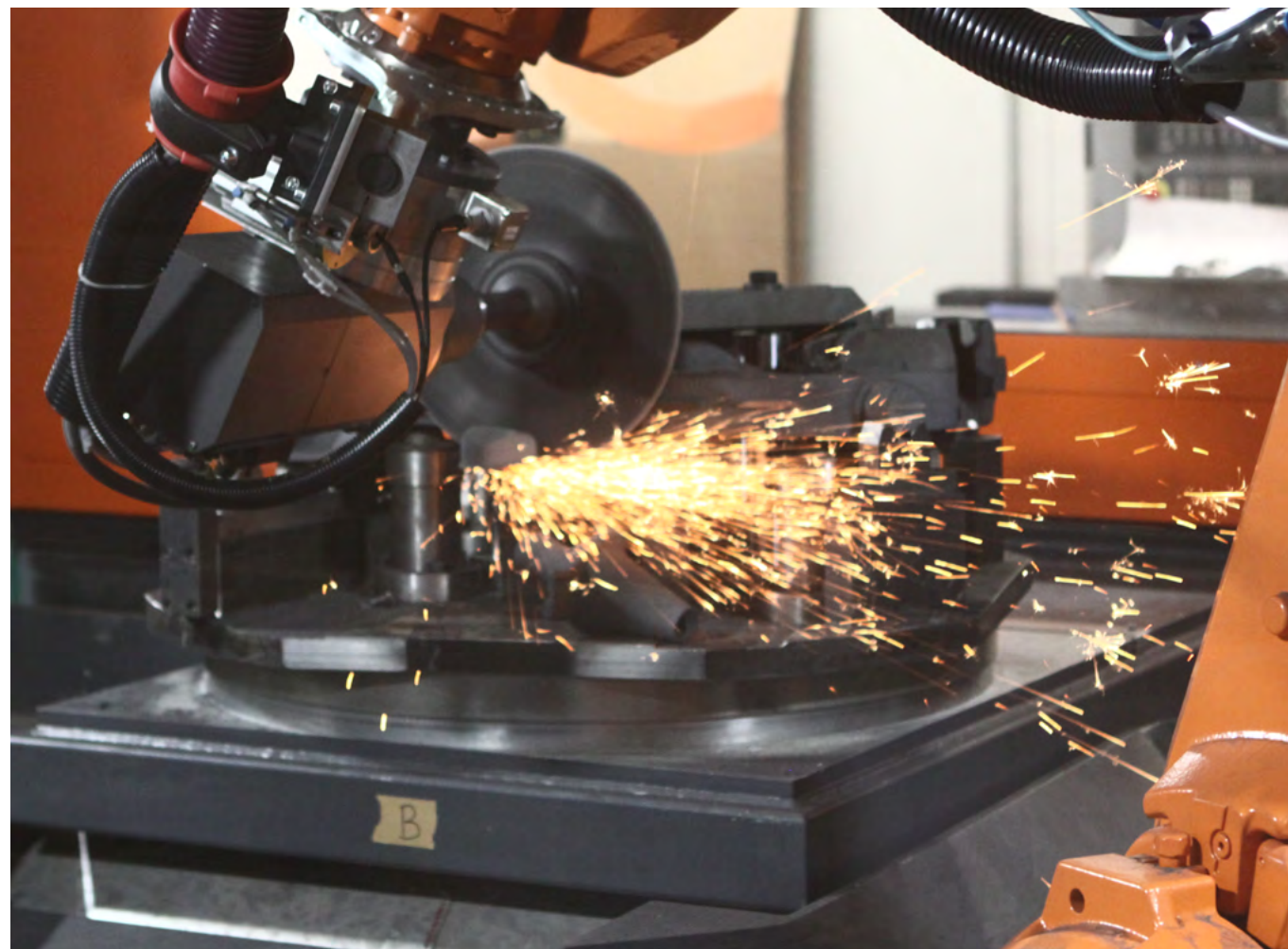
ROBOT CELL

WITH ROBOT-GUIDED TOOL

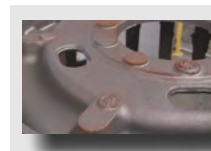
DEBURRING OF LARGE-VOLUME WORKPIECES

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.



Before processing



After processing

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.

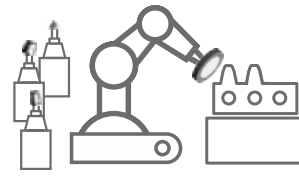
The workpiece is machined with various rotating tools such as grinding wheels or milling cutters.

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.



Concept 3

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



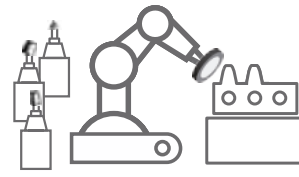
after machining



- 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



Concept 3

ROBOT CELLS WITH ROBOT-GUIDED TOOL

Robotic grinding and polishing system for large hoppers

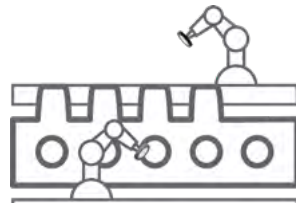
The Berger Gruppe has developed a new robotic grinding and polishing system for large hoppers and large-surface-area containers up to 2 m in size/diameter.

With this new robotic grinding and polishing system, the Berger Gruppe is replacing various manual manufacturing processes that previously had to be carried out by people in unhealthy environments and under considerable physical strain.



- max. workpiece diameter 2000 mm
- grinding belt change system with 18 kW drive
- automated use of different grinding belt grades and grit sizes
- use of additional grinding tools via HSK change system
- offline generation of machining steps via CAM system
- additional CNC axis via rotary table for collision-free execution of machining steps
- CNC axis fully integrated into the robot control system as a simultaneously moving axis
- integration of a laser measurement system for tool compensation
- force-torque sensor integrated into the robot arm for carrying out grinding and polishing tasks on the outer and inner surfaces of the container
- automatic belt change





Concept 4

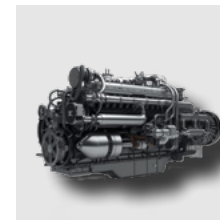
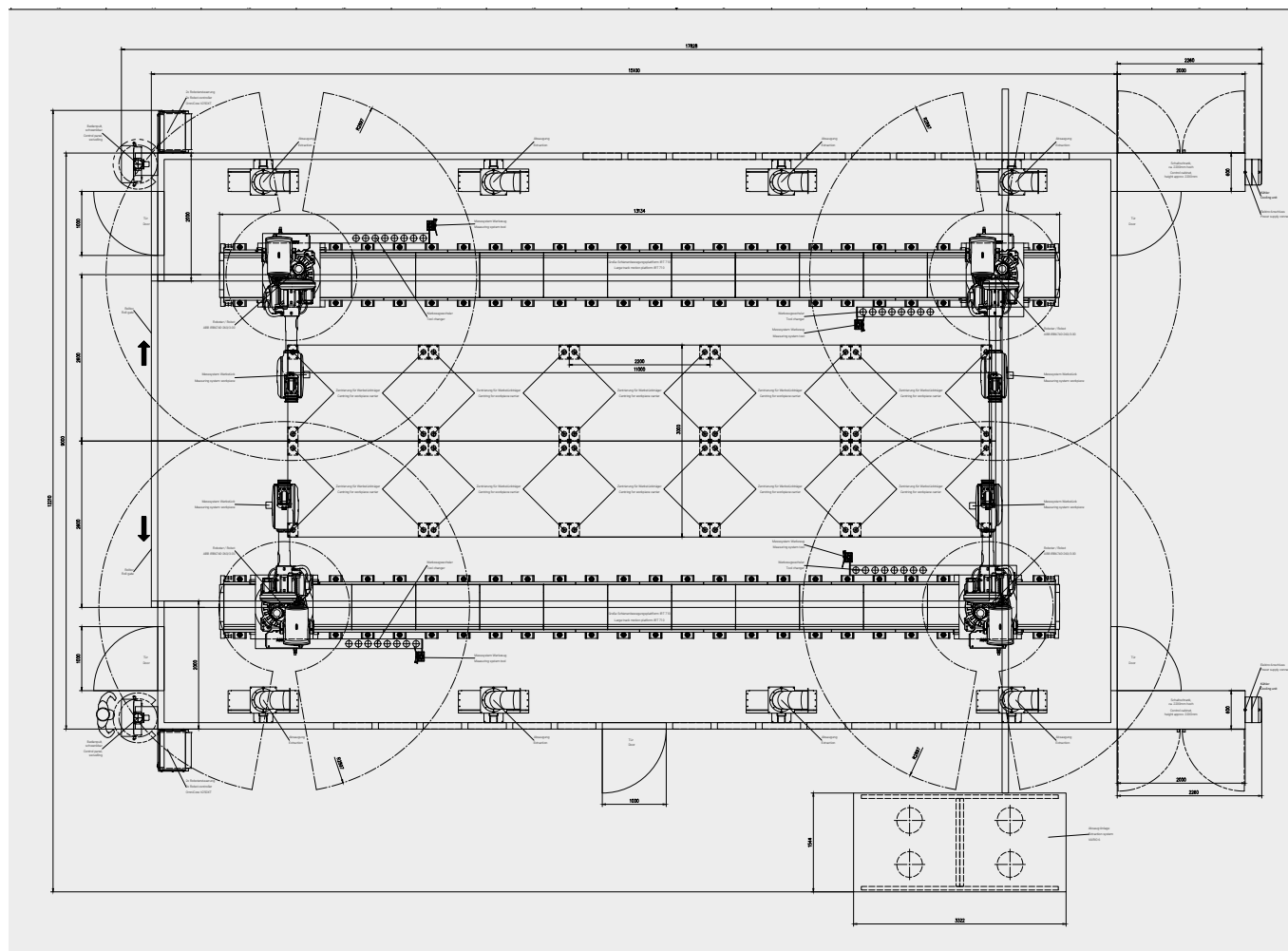
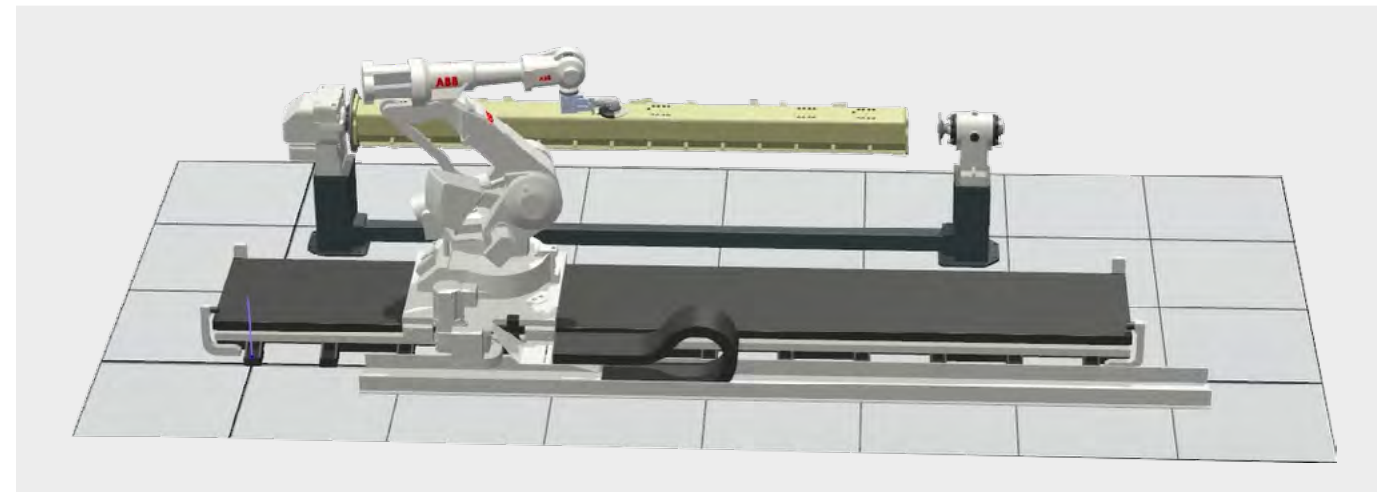
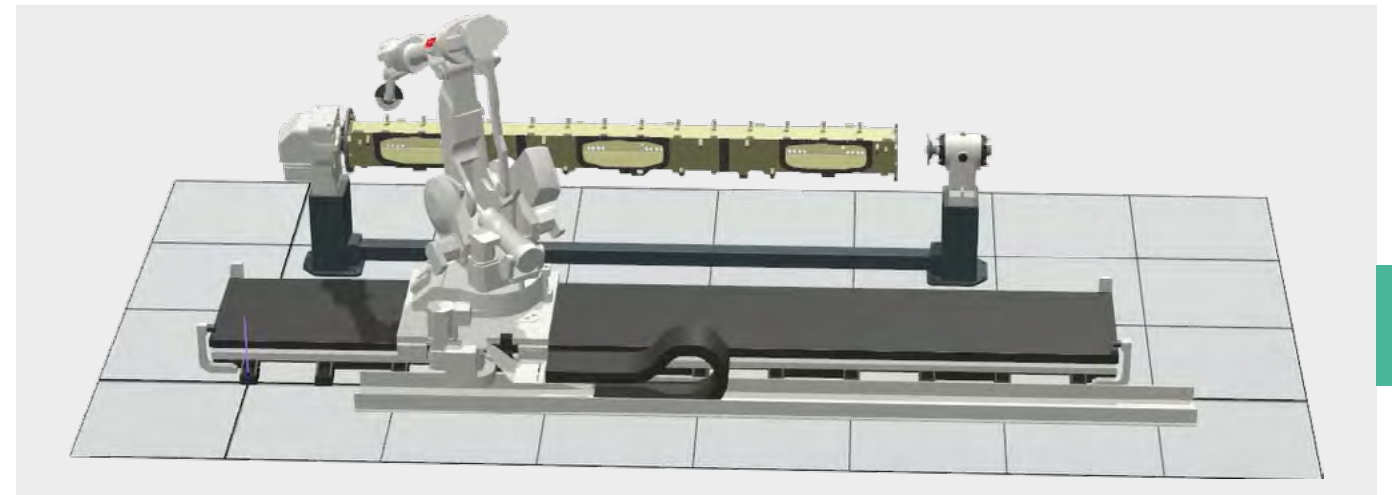
ROBOT CELLS

USING ROBOTS ON GUIDE RAILS

ROBOTIC MACHINING OF LARGE-VOLUME CAST PARTS WEIGHING UP TO 107 T

Robotic cell for grinding and fettling of cast parts weighing between 30 and 107 tonnes

The RSP/2S/1T/1F robot cell shown here, with its four processing stations, processes castings weighing between 30 and 107 kg.



The robot cell consists of:

- rotary table tool-changing system
- base plates with base stamps to support the motor blocks
- filter system for dust extraction
- enclosed cabin
- two or four ABB robots with tools:
 - cutting disc, Ø 360 mm
 - diamond grinding wheel Ø 300 mm
 - grinding mandrel
 - diamond grinding wheel Ø 80 mm
- two linear axes, 6000 × 80 × 80 mm

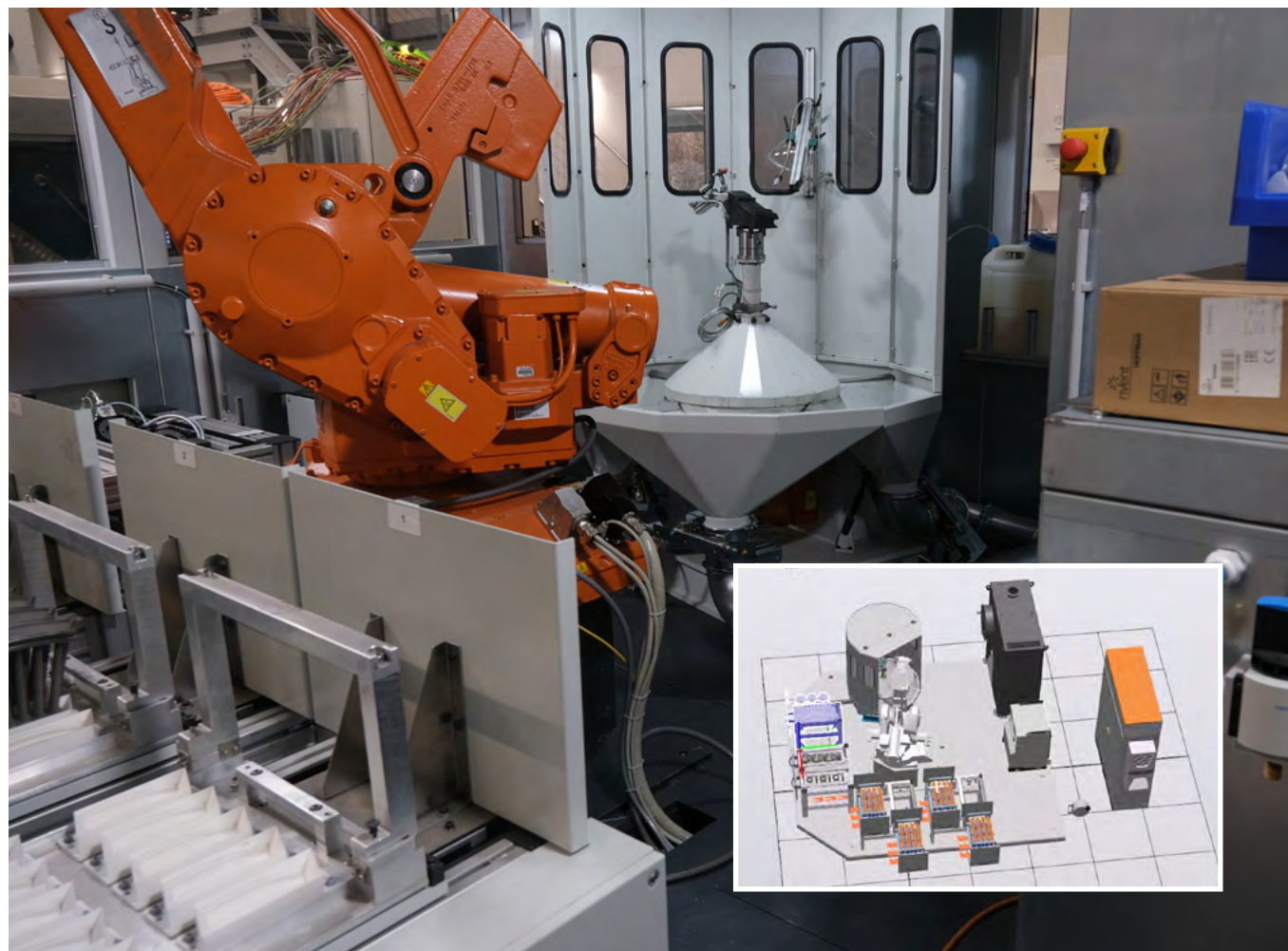
PROGRAMMING FOR ROBOT CELLS

PROGRAMMING IN A VIRTUAL ENVIRONMENT

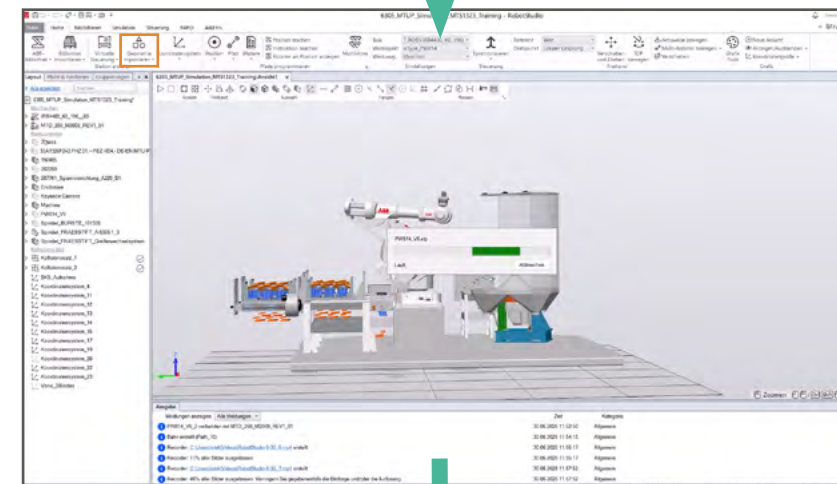
Programming with RobotStudio

Programmes can be created offline using suitable software – for example, as shown here with RobotStudio.

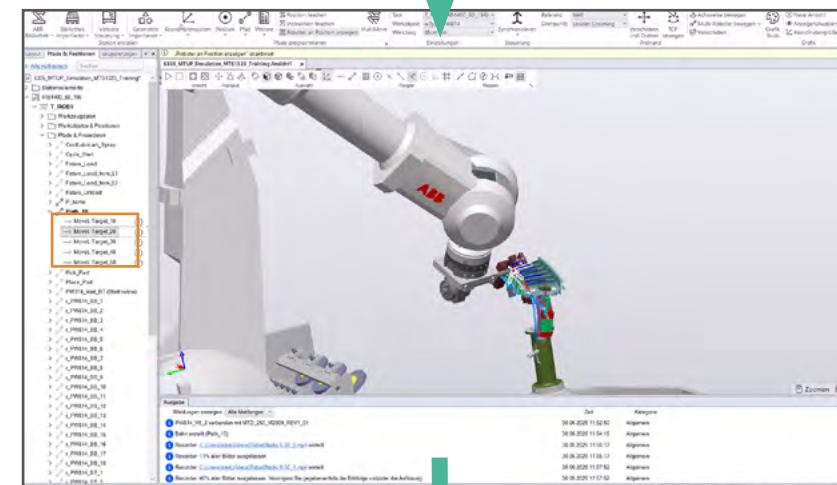
- creating the robot program using RobotStudio in four steps, as shown in the figures on the right
- transferring the program to the ABB robot in a “live environment”



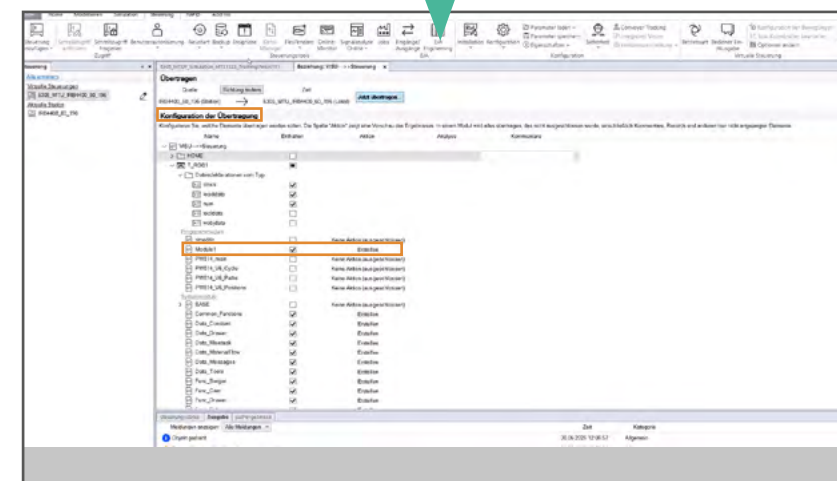
- 1 Virtual workpiece positioning using a 3D file



- 2 RobotStudio user interface: Loading a new workpiece



- 3 Simulation, shown here during rotation of the 7th axis



- 4 Determining trajectories, path planning and alignment using sensors

PROGRAMMING FOR ROBOT CELLS

Position Detection and Correction

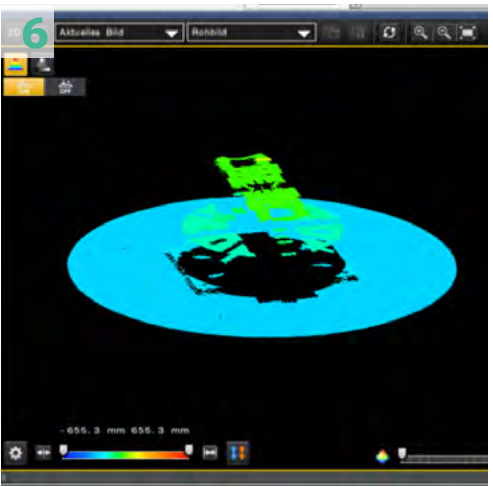
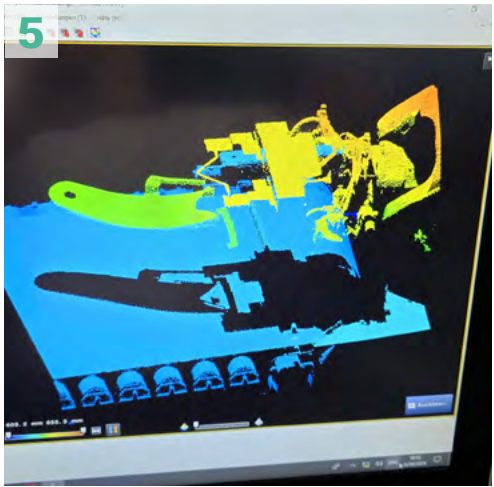
The position of the workpiece is measured using a 3D camera or a distance laser mounted on the robot:

- For robot cells with a robot-guided workpiece (Concept 2): Here, the workpiece is guided by the robot and measured using a 3D camera.
- For robot cells with a robot-guided tool (Concept 3): The clamped workpiece is measured, and the data is transmitted in a closed-loop control system to the real-world environment to adjust the robot program.

- For robot cells with a robot-guided workpiece (Concept 3), a distance laser can be integrated into the robot arm to measure the position of the stationary workpiece.

Pictures

1. + 2. Measuring the clamped workpiece using a distance laser during machining with force-torque sensors (Pictures 1 + 2)



Pictures

3. + 5. Position detection of the workpiece in the robot using a 3D camera, followed by correction of the workpiece's position in the gripper; used in robot cells with robot-guided workpieces (Concept 2) (Pictures 3 + 5)

4. + 6. Detection of the clamped workpiece using a 3D camera and transmission of the position to the robot controller; used in robot cells with robot-guided tools (Concept 3) (Pictures 4 + 6)

STRONG PARTNERS

UNDER ONE ROOF ...

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.



OUR PRODUCT CATEGORIES



Grinding machines
for single workpieces



Grinding machines
for steel strip



Polishing machines
for single workpieces



Robotic process
technology/automation



Robotic grinding and
polishing systems



Strip processing machines
by metal-cutting



Metal cutting
machines