

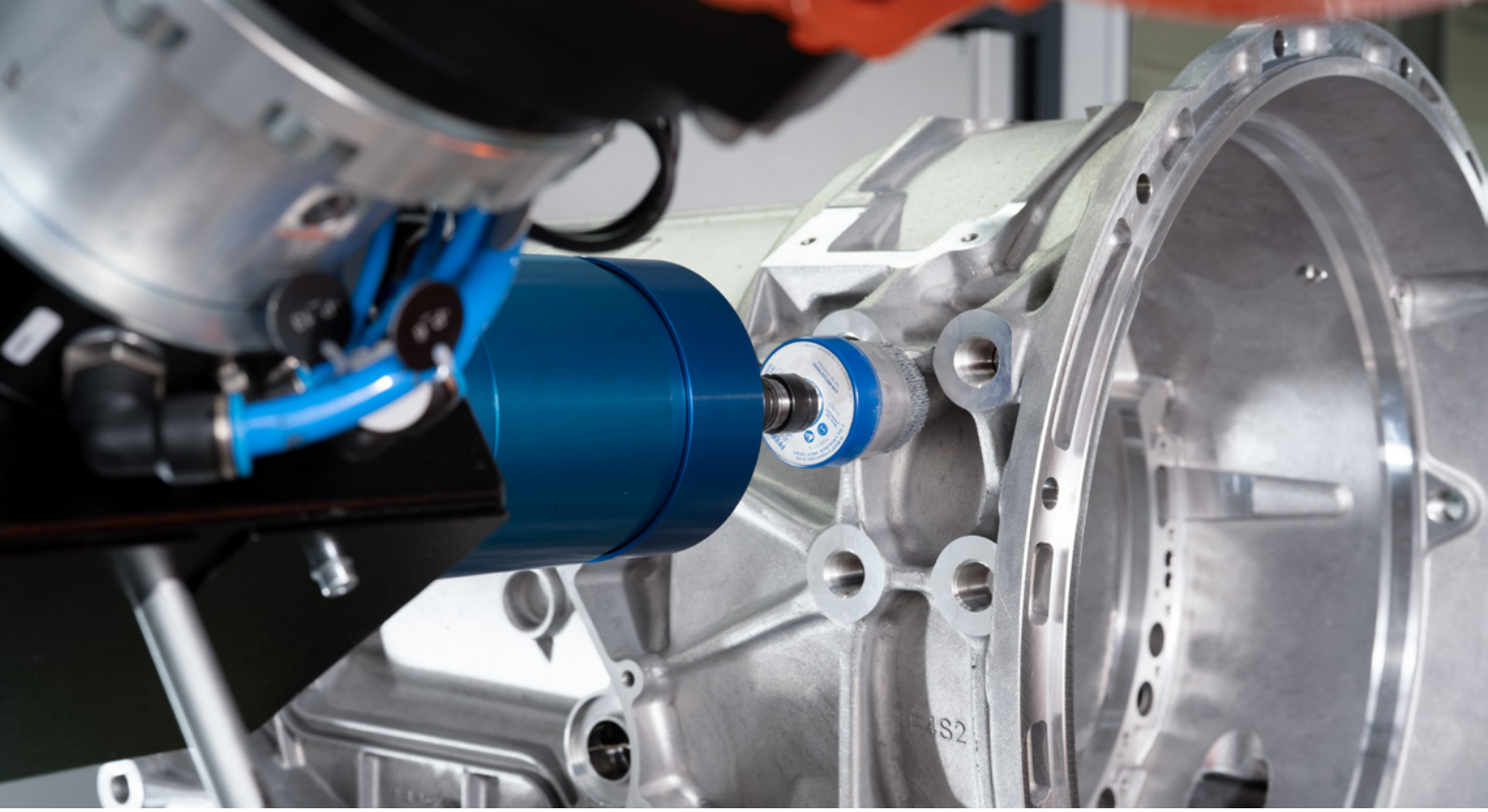
FOCUS

PFERD TOOLS

TOOL. DRIVE. PROCESS.

Robotics

Automation starts with the tool



Automation in production environments

Industrial processes are under mounting pressure from more stringent quality requirements, the skills shortage, rising costs, and the greater diversity in product variants. Manual processes are increasingly reaching their limits here. This is where automation comes in, as it opens up new possibilities. It is a key factor in ensuring quality, efficiency, and a company's competitive edge.

The benefits at a glance

Consistent quality
Consistent results regardless of capacity utilization or how your team is performing on the day.

Greater efficiency
Faster processes and better capacity utilization.

Reduced employee workload
Fewer monotonous or physically demanding tasks.

Sharper competitive edge
Respond faster to market requirements.

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This is how stable robotic processes are created

More and more companies are automating machining processes in order to improve quality, productivity and reproducibility. However, success does not come about simply through the use of a robot. The key factor is whether the process is understood in terms of its influencing factors, properly designed and mastered under real-world conditions.

Whether you are optimizing existing robotic processes or planning to start using automation: find out in this brochure how grinding, milling and brushing processes are structurally prepared, designed and validated.

Your guide to this brochure:

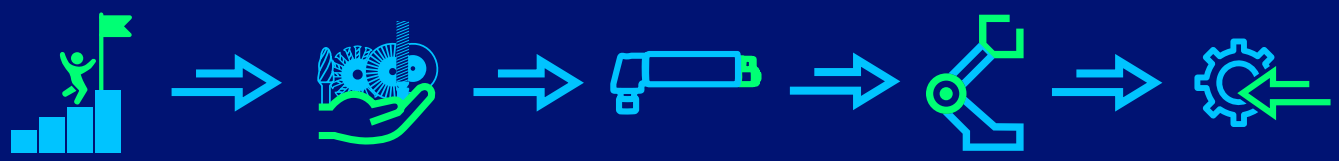
1. Find your way around **Pages 4–8**
Understand the basics, clarify responsibilities and contextualize the robotics solution.

2. Layout **Pages 9–14**
Adapt the tool, drive and robot system to the machining objective.

3. Application **Pages 15–17**
Find out about suitable tool solutions and typical applications.

4. Implementation **Pages 18–21**
Ensuring processes are validated during trials and successfully transferred to series production.

The learning pathway



Clarify the objective of the task | **Select a tool** | **Design the drive** | **Derive robot** | **Validate in a trial**

Three partners – one responsibility

A successful robotic process is the result of collaboration between the user, the integrator and PFERD TOOLS. Each party contributes different areas of expertize to work together in creating a robust process.

The shared goal:
To create a stable, economical machining process.







Users
- Defines the quality required, cycle time and framework.
- Provides components, material data and tolerances.
- Takes responsibility for series production.

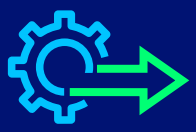
PFERD TOOLS
- Analyses the task and process.
- Coordinates the tool and drive – using custom tools if required.
- Validates the process window.

Integrator
- Plans the robot, jig and sensor system.
- Programmes paths and interfaces.
- Takes responsibility for safety and overall integration.

Analysing the initial situation

Whether you're still carrying out manual work, looking to optimize an existing robotic process, or planning a new automation project: we'll support you right from the start of your current challenge. PFERD TOOLS considers the tool, the drive and the process parameters as an integrated whole.

Which role suits you best?



Change a manual process into an automated workflow

The task and quality requirements are known and staff have the practical knowledge, but the technical framework is still unclear.

→ **PFERD TOOLS shows which parameters are effective and determines the requirements for the tool and drive.**



Use existing robots in a targeted way

The robot, spindle and/or tool have already been defined.

→ **PFERD TOOLS reviews the existing set-up, looking at the desired machining outcome, forces in the processand permitted work areas.**



Improve unstable series processes

The cycle time, surface quality or tool life vary during operation.

→ **PFERD TOOLS narrows down the causes and validates improvements using trials and clear changeover criteria.**



Successful automation starts with the machining process

A robot can repeat movements with precision. However, this alone is not sufficient to ensure reproducible results. Experienced employees react to wear, tolerances, temperature and changes in contact whilst carrying out the work. In automated processes, these factors must be controlled by means of defined parameters, process limits and inspection criteria.

That is why successful automation does not begin with the robot, but with the machining task. Starting from the desired machining result, the tool, drive and robot system are gradually coordinated with one another. This results in a stable and repeatable overall process.



Processing objective
Specify the material, contour, quality and cycle time.

Tool
Determine the geometry, contact shape, diameter and rotational speed range.

Drive
Tune the rotational speed, torque, power and deflection.

Robots
Derive the load capacity, centre of gravity, moment of inertia, range and dynamics.

Integration
Implementing cells, devices, lines, safety and interfaces.

Are there any robots?
Then check backwards: What loads and dynamic conditions does it allow? Which tool-drive package fits within these limits?

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From the processing objective to the appropriate tool group

The choice of tool should always be based on the desired result. The overview shown here serves as an initial guide. The final selection is validated in practical testing, taking into account the material, geometry, accessibility and quality requirements.

Processing objective	Suitable tools	Advantages
■ High stock removal rate ■ Work on weld seams	■ CC-GRIND grinding discs with VICTOGRAIN abrasive grain ■ POLIFAN flap discs	■ High-performance. ■ Available for various types of contact.
■ Precise deburring ■ Chamfering	■ Tungsten carbide burrs with HICOAT coating	■ Defined geometry. ■ High contour accuracy.
■ Hard cast materials edit	■ Diamond tools	■ Long tool life when machining hard materials. ■ Defined geometries.
■ Fine grinding ■ Finish	■ POLINOX grinding tools ■ PNER non-woven tools ■ Polishing tools	■ Gradual fine grinding through to polishing.
■ Rounding corners ■ Cleaning	■ Composite brushes ■ Industrial brushes	■ Flexible contour adjustment. ■ A reproducible brushing effect.

Milling tools: Precise stock removal with high contour accuracy

Tools:
- Tungsten carbide burrs.
- Milling tools for use with robotic systems.
- Milling tools with tungsten carbide cutting inserts.

Typical tasks:
- Deburring and chamfering.
- Finishing castings.
- Trimming of FVK components.

Why PFERD TOOLS?
- Special geometries for robotic processes.
- Several machining operations with a single tool.
- HICOAT coating: longer tool life and consistently high stock removal rate.
- Precise concentricity for reproducible contours.
- Cutting edges that retain their shape throughout their entire tool life.
- Chips instead of grinding dust in metalworking.

Process anchors:
- Clamp with no play and a short shaft protrusion.
- Use the recommended upper rotational speed range.
- Limit tool engagement and contact forces.



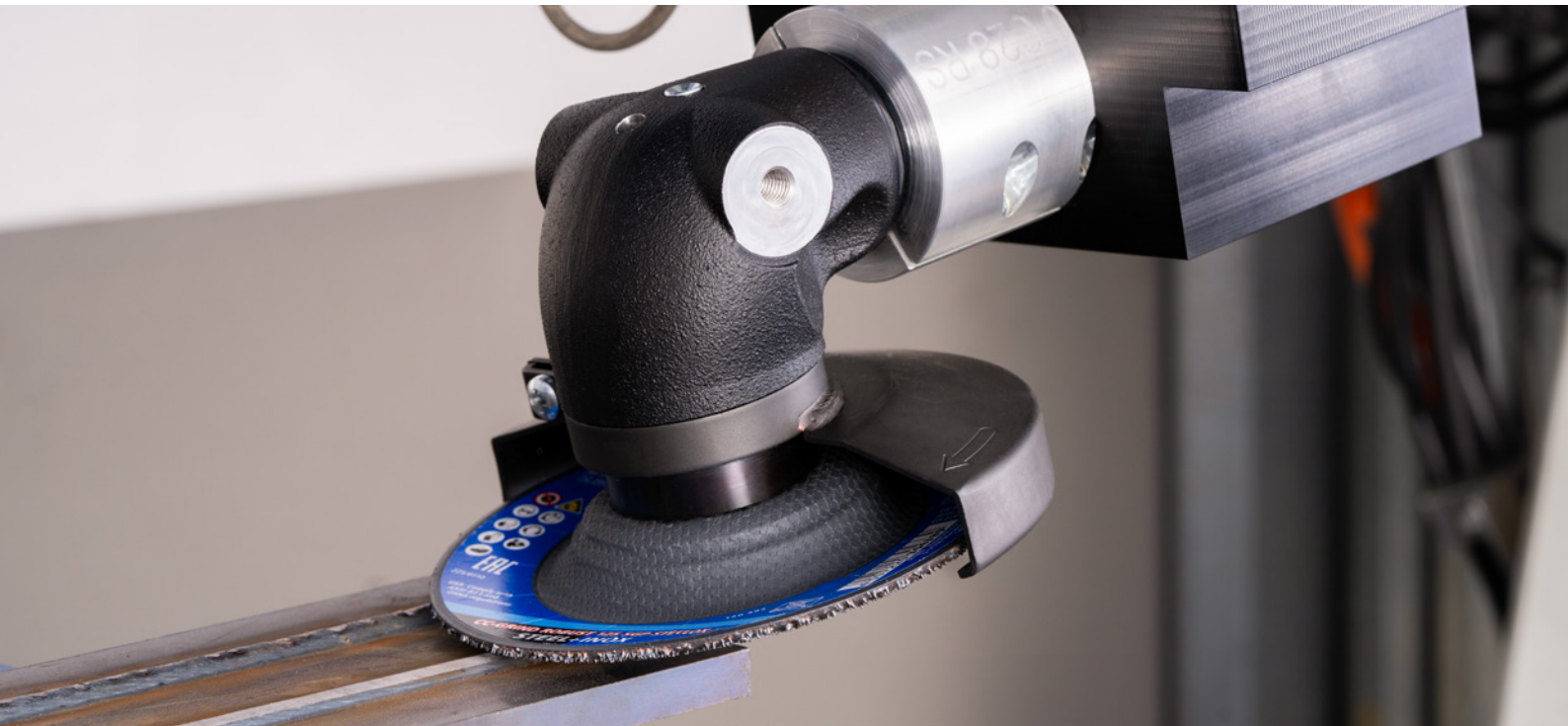
Grinding tools:
Flexible on varying contours

Tools:
- COMBICLICK system.
- Non-woven and fine grinding tools.
- Polishing tools.
- CC-GRIND ROBUST and CC-GRIND VIEW grinding discs.
- POLIFAN flap discs.
- Diamond and CBN grinding tools.

Typical tasks:
- Deburring.
- Grinding surfaces and contours.
- Machining weld seams.

Why PFERD TOOLS?
- Flexible tools adapt to contours.
- Dimensionally stable tools reduce the need for path corrections.
- The CC-GRIND ROBUST grinding disc, patented in many countries around the world, is designed for high stock removal and dimensional stability.
- A long tool life reduces the need for tool changes.

Process anchors:
- Flexible for contour adaptation.
- Dimensionally stable for reproducible geometries.



Industrial brushes:
Consistent results on complex contours

Tools:
- Composite brushes with plastic filaments.
- Virtually the entire range of brushes, e.g. COMBITWIST.

Typical tasks:
- Deburring and rounding off edges.
- Machining holes and female threads.
- Cleaning and surface treatment.

Why PFERD TOOLS?
- Evenly distributed and securely anchored filaments.
- High concentricity and dimensional stability.
- Flexible adaptation to complex contours.
- Consistent results throughout the entire tool life.
- Long tool life and few tool changes.

Process anchors:
- Tension the string briefly and without any slack.
- Use the recommended peripheral speed.
- Limit feed and tool engagement.



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Which drives are suitable for robotic applications?

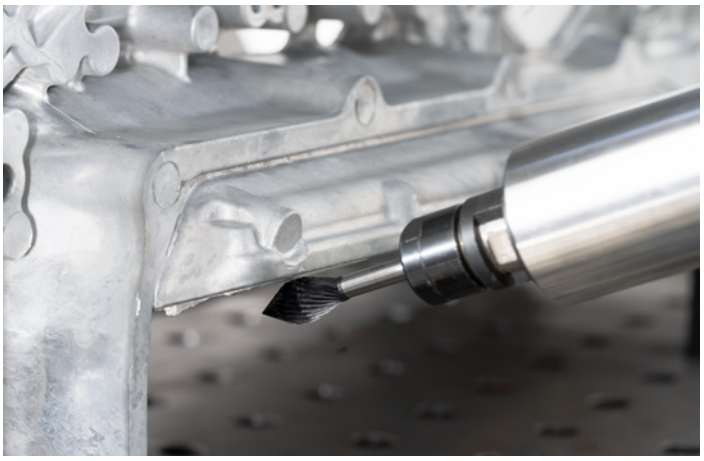
Before making your choice, clarify the following:

- Permissible tool speed.
- Torque and power.
- Rigid or flexible guidance.
- Automatic tool change?

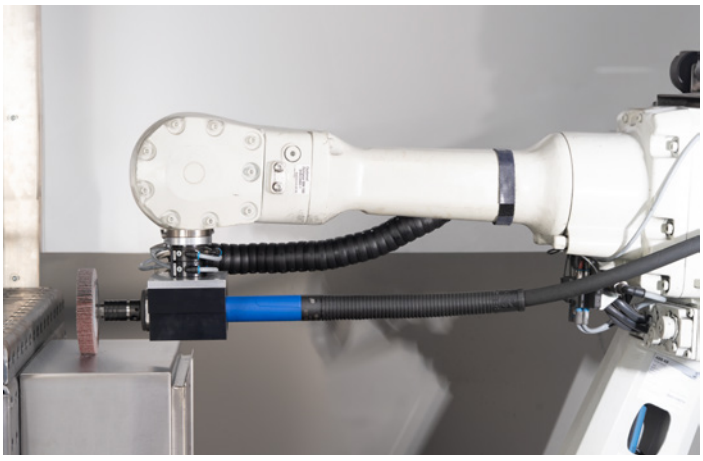
Special features	Pneumatic	Electric		
	Air grinders	Asynchronous motors	Flexible shafts	High-frequency-spindles
Constant rotational speed during operation	-	●	●	●
Adjustable rotational speed	○	●	●	●
Broad rotational speed range	-	○	●	●
Power	○	●	●	●
Automatic tool changes	○	○	-*	●
Deflection	●	-	-*	-
Ease to service	●	●	●	○
Investment costs	low	medium	medium	high

● = highly suitable <○ = sutiable - not available

*Tool changes and deflection are only possible with flexible shafts from PFERD TOOLS.



Example: Robot spindle



Example: Flexible shaft

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Industrial robots and cobots: An overview

Many companies wonder whether a cobot or a traditional industrial robot is the better choice. The answer does not depend on the type of robot alone. The decisive factors are the machining task, the tool, the drive system, the process forces required and the application's safety concept.

Industrial robots

Programmable system
An automatically controlled, reprogrammable system for industrial tasks. It is designed for high performance, precision and repeatable processes, and usually operates in a secured area. Movement can be programmed along at least three axes.

- Typical configurations: articulated arm, SCARA, gantry and Delta.
- Designed according to load capacity, reach, dynamic performance, rigidity and operating environment.



Cobot

Designed for collaboration
An industrial robot designed to collaborate with humans. In many cases it can be guided by hand and is simple to set up.

- Can make it easier to work closely with operators and carry out flexible tasks.
- This remains part of the risk assessment for the full application.



Important:
To create a collaborative application, you need more than just the robot. The application is not considered safe until the entire set-up with the robot, tool, component and workplace is analyzed.



Note: The term 'cobot' refers to a type of industrial robot designed for collaborative applications – it is not a standalone robot category.

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Industrial robots and cobots: A quick comparison

	Cobot	Industrial robots
Focus:	Flexible tasks, often changing conditions, close to the operator	High cycle rates, high forces, robust mass-production processes
Typical strength:	Compact design, hand-guided operation, teach-in function often available	Stiffness, dynamics, range, power reserves
Typical limit:	Safety limits can restrict speed, force and cycle time	Often involves greater effort in terms of shelter and integration
Well suited for:	Moderate loads, varied tasks, often changing changeovers	High stock removal, heavy-duty drives, large workpieces, short cycles
Mnemonic:	Not automatic without an enclosure	Not necessarily inflexible



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Industrial robots and cobots: Criteria for making the right choice

A robot's payload alone says little about its suitability. The decisive factors are the task, the tool and drive system, the cycle time and the safety concept.

To ensure a safe design, the following issues should always be clarified:

1. **Forces & stiffness**
   What contact and reaction forces are involved?
   How much stiffness does the result require?

2. **Moving load**
   What are the total mass, centre of gravity and inertia of the tool, drive, adapter, sensors and media?

3. **Reach & Access**
   Can all machining areas be accessed without the risk of collision and whilst maintaining a stable wristposition?

4. **Cycle time & duty cycle**
   How should speed, acceleration, operating time, cooling and maintenance windows be assessed in conjunction with one another?

5. **A people-centred approach**
   Is proximity to the operator required during automatic operation, or only during set-up, testing and changeovers?

6. **Safety & Environment**
   How are rotating tools, breakage, sparks, dust, noise, media and safe access taken into account?

As a guide, but not as a hard and fast rule, the following applies:
Cobots for moderate loads and flexible tool changes.
Traditional industrial robots for high forces, dynamics and cycle rates.
The specific choice of robot is based on the machining objective, tool, drive system and the resulting process requirements.



Practical applications:
Levelling a weld seam on steel

Grinding disc
CC-GRIND ROBUST 125 SGP STEELOX



Robot spindle PWA 11/120 RS



Task & Context:

Component/Material

- Steel construction; flat or slightly curved surfaces.

Objective

- To level the weld seam and achieve a defined surface finish.

Why this combination?

- High stock removal rate during work on weld seams.
- A robust disc with a long tool life.
- Robot spindle for stationary use and constant power delivery.

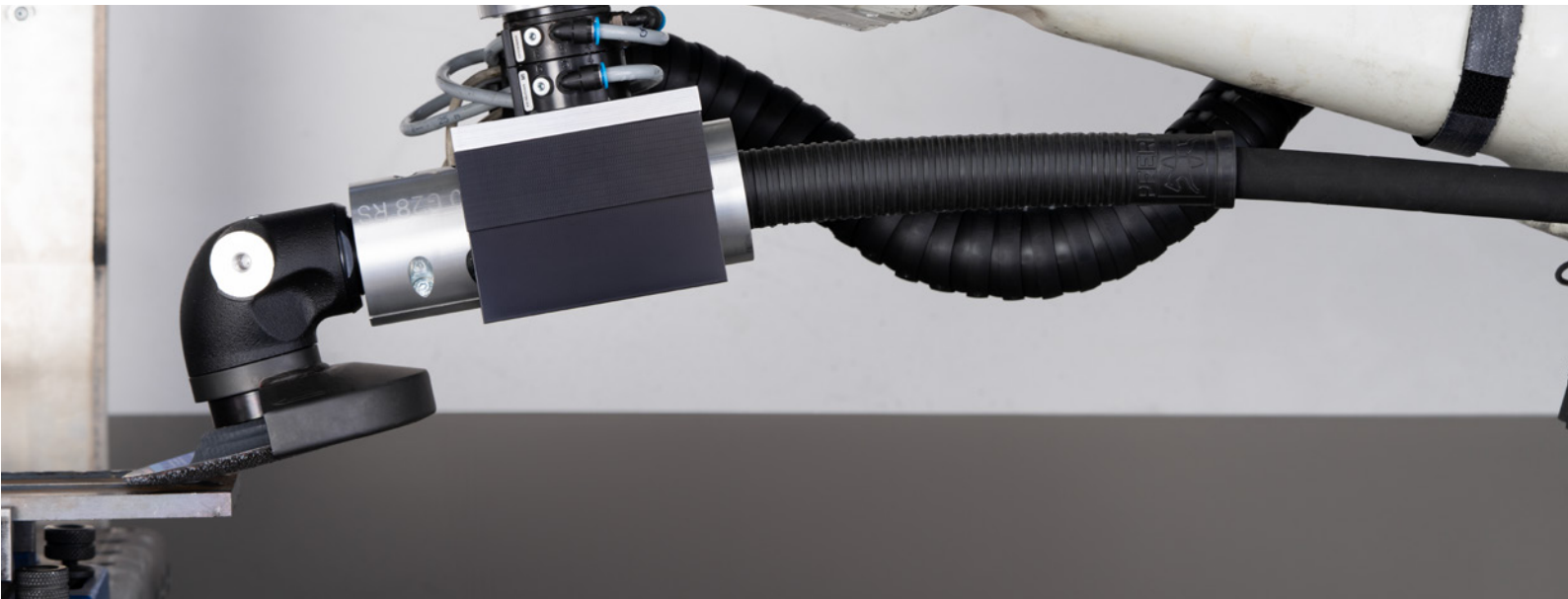
Specify in the trial:

- Rotational speed.
- Contact angle.
- Contact force.
- Track overlap.
- Change criterion.

Validate:

Always validate specific parameters on a component- and cell-by-cell basis.

- Stock removal.
- Cycle time.
- Tool life.
- Surface.
- Dispersion.



Practical applications: Deburring and precision chamfering of edges

TC burr
KZW 1225/6 MICRO HC RS



Robot spindle PGAS 4/280 RS



Task & Context:

Component/Material

- A complex metal component with fine contours and hard-to-reach edges.

Objective

- Carefully remove the burr and create a defined chamfer.

Why this combination?

- HICOAT coating: longer tool life and consistently high stock removal rate.
- Defined geometry supports the contour.
- Spindle with high concentricity in continuous operation.

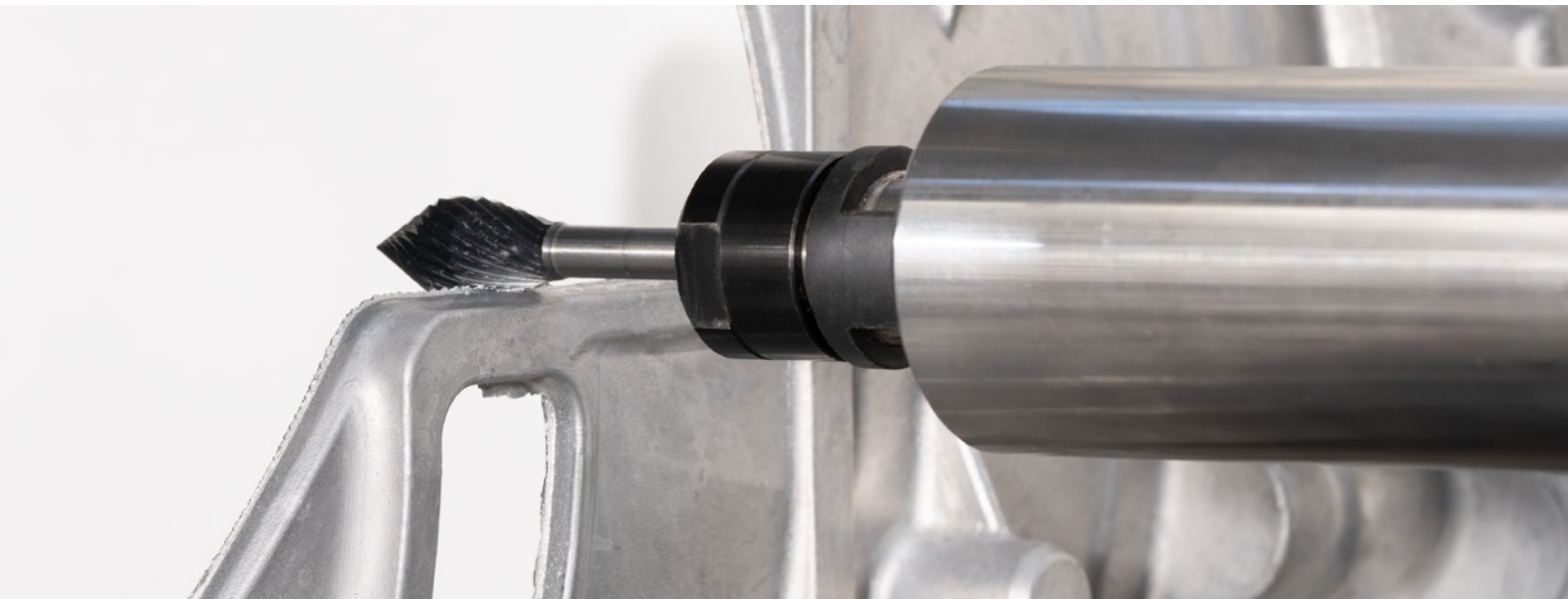
Specify in the trial:

- Rotational speed/cutting speed.
- Intervention.
- Feed.
- Direction of installation.
- Change criterion.

Validate:

Always validate specific parameters on a component- and cell-by-cell basis.

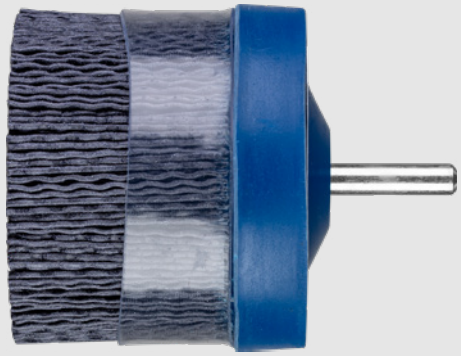
- Burr-free.
- Chamfer dimension.
- Surface.
- Cycle time.
- Tool life.



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Practical applications: Reproducible deburring and rounding of edges

Composite disc brush
DBUR 63/6 CO 120 1.10



Robot spindle PGAS 4/24 RS



Task & Context:

Component/Material

- Machined metal component with outer edges and slight burrs.

Objective

- Consistently perform deburring and rounding of edges without damaging the contour.

Why this combination?

- High filament density for an aggressive, even brushing effect.
- Long tool life and consistent brush performance.
- Spindle with concentricity and double bearings.

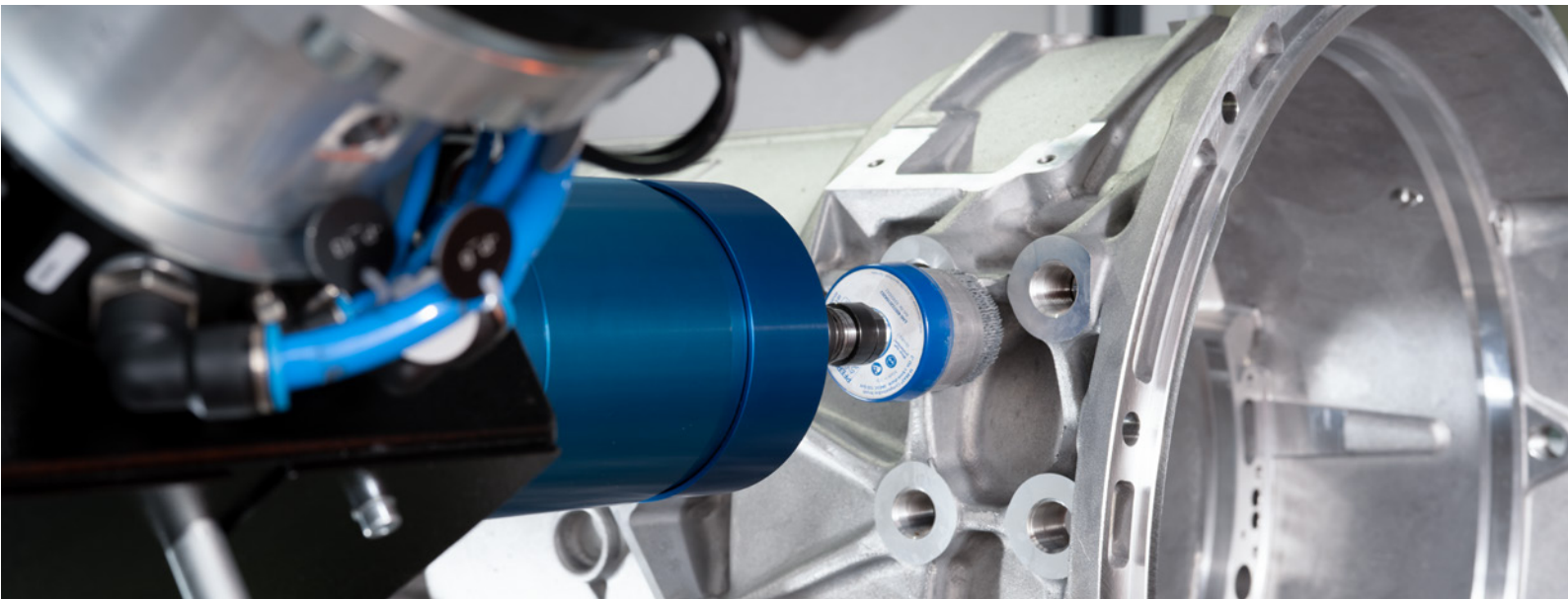
Specify in the trial:

- Peripheral speed.
- Delivery.
- Working position.
- Direction of travel.
- Change criterion.

Validate:

Always validate specific parameters on a component- and cell-specific basis.

- Burr-free.
- Edge radius.
- Surface.
- Cycle time.
- Tool life.



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Five factors determine process stability

A stable machining process is the result of the interplay of several factors:

Tool geometry and condition
Which geometry, binding and wear characteristics support the objective?

1. **Process forces and contact conditions**
What force, what angle and what contact area can still be controlled?

2. **Material properties**
What variations in materials, components and tolerances affect the result?

3. **Drive and control**
What rotational speed, power, rigidity or flexibility is required?

4. **Process parameters**
What rotational speed, feed rate, web speed, overlap and web strategy produce consistent results?

→ Wear, temperature and tolerances shift the stable range. Only when the factors mentioned above are considered together can a robust and controllable process be achieved.



Seven rules for stable robotic processes

Many process problems are not caused by the robot itself, but by unsuitable tool settings or a lack of process standards.

The following basic rules are no substitute for component testing, but they do significantly improve the conditions for reproducible results:

1. **Ensure concentricity**
   Clamp the tool so that it is not in contact with the workpiece and with a short shaft protrusion.
   Avoid impact and chatter.

2. **Use suitable rotational speed ranges**
   Start within the recommended range and monitor stock removal, heat build-up and tool life together.

3. **Limit tool engagement in a targeted manner**
   With burrs, the contact area should generally be limited to no more than one third.

4. **Keep the feed rate steady**
   Smooth feeding prevents localised overloading and uneven surfaces.

5. **Let the brush tips do the work**
   Adjust the feed so that the filament or wire tips remain effective.

6. **Clearly define the wear limit**
   Change the tool before it fails. Use geometry, performance or results as a limit.

7. **Document all process parameters in full**
   Record the rotational speed, force, angle, feed rate, overlap and condition of the component.



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From trial to production-ready robotic process

A successful robotic process does not come about by chance. It is based on systematic testing under realistic conditions. The more precise the initial data, the more quickly feasibility, cost-effectiveness and process reliability can be assessed. The aim of the trial is to establish a verifiably validated process with clearly defined parameters, responsibilities and response limits. This transforms a good idea into a robust production process.

1. Analyse the initial situation

- Record the workpiece, material and tolerances.
- Define quality requirements.
- Assess existing technology and peripherals.
- Set production targets and financial targets.

2. Carry out experiments

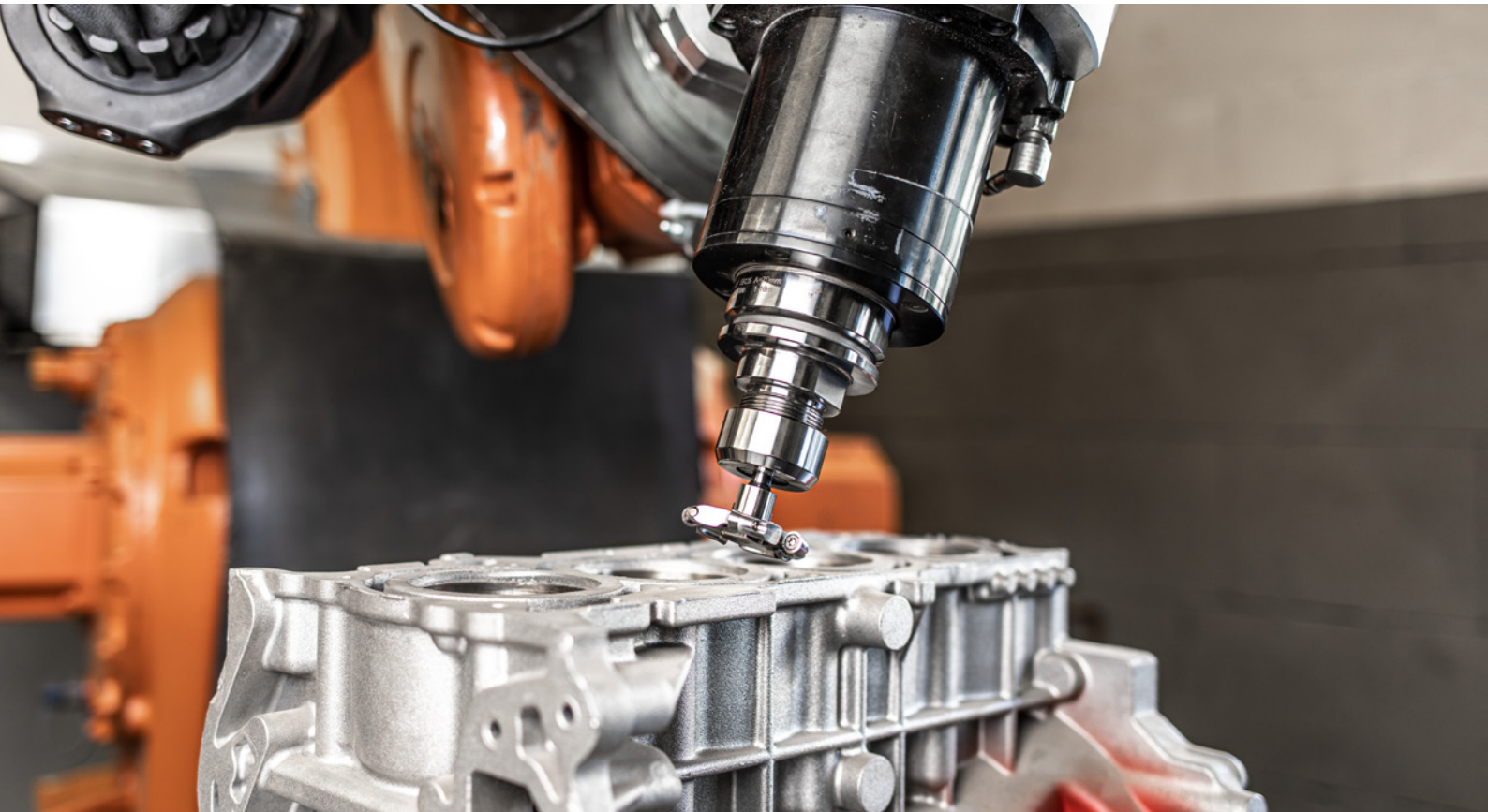
- Set the machining parameters.
- Test the rotational speed, feed rate, clamping force and tool.
- Systematically vary the influencing factors.
- Specify the process window.

3. Evaluate the results

- Check quality and repeatability.
- Analyse processing time and cost-effectiveness.
- Identifying and minimizing variations.

4. Ensure the production process runs smoothly

- Document the parameters that have been released.
- Define responsibilities.
- Establish response plans for deviations.
- Handover to production and operations.





Process intelligence requires experience

PFERD TOOLS combines decades of experience in manual processes with an in-depth understanding of automated applications.
This expertie is applied to:

- The development of tools and drives suitable for use with robots.
- The analysis of real process conditions.
- Structured support for automation projects.

PFERD TOOLS helps you to analyse manual machining processes, identify opportunities for automation and develop reliable solutions for series production.
In this way, experience is transformed into a reproducible process.

Scan the QR code to request a consultation.



First Step Robotics: Robotics needs process intelligence
Robots repeat tasks and processes perfectly. However, that also means they repeat the associated mistakes. This white paper explains how to design stable processes and successfully overcome organizational and structural challenges.

Scan the QR code to request your free white paper, including a checklist.

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Innovative by Tradition

Automation requires process expertise and stable process parameters. As a result, the way in which the integrator and tool manufacturer work together is vital to the success of robot applications.



Stephan von Schneyder
Managing Director at
WMS-engineering GmbH

pferd.com

Innovative by tradition

PFERD TOOLS has been a **pioneer in innovative tool solutions** for work on surfaces and for cutting and machining of materials **for over 225 years**. We offer you **premium products, consistent quality together with reliable delivery, comprehensive advice** and **first-class service**. As an internationally oriented family business, we are active wherever you need us – with personal and digital support.

Premium quality without compromises

We use **state-of-the-art production and measuring equipment** to ensure accurate tolerances down to the last micrometer, which enables us to meet and exceed the highest demands for process reliability, productivity and precision.

Global presence

We are always there for you – worldwide, in person and digitally. PFERD TOOLS is globally present and locally committed, with a thorough understanding of your individual requirements.



You can find all contact persons, subsidiaries, distribution companies and national and international representative offices here.

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