



***) experts for experts.
Technology for Individual
Product Solutions**

***) experts for experts:
Let's talk about technological expertise.**

Decades of experience and technological skill have
turned us into a specialist in tube forming.



The voestalpine Rotec Group

We produce high-quality and technically demanding tubular components for the most diverse industries (such as the automotive, general mechanical engineering, domestic and office equipment industries) at international sites in North America, Europe and China. To do this we use innovative technologies and develop economically and technically optimised processes and machine concepts. Our technological skills have been developed with in-house training and professional development of our employees and utilising the knowledge amassed in our technology skills centre. Beyond this, close cooperation with our customers and long-term cooperation with experts in the construction of special machinery and finishing enable us to develop our product range on an ongoing basis.

Our knowledge and commitment begins with technical advice for our customers during the product development stage and covers material, tool and plant design. We implement the jointly developed design concepts from prototype construction to series supply.

The technology, material, assembly and surface treatment used must meet the highest requirements.

Our Group offers both high-quality technologies developed internally and also those of long-term partners.

For new or existing products, processes and machine concepts are adapted individually and efficiently to new requirements thanks



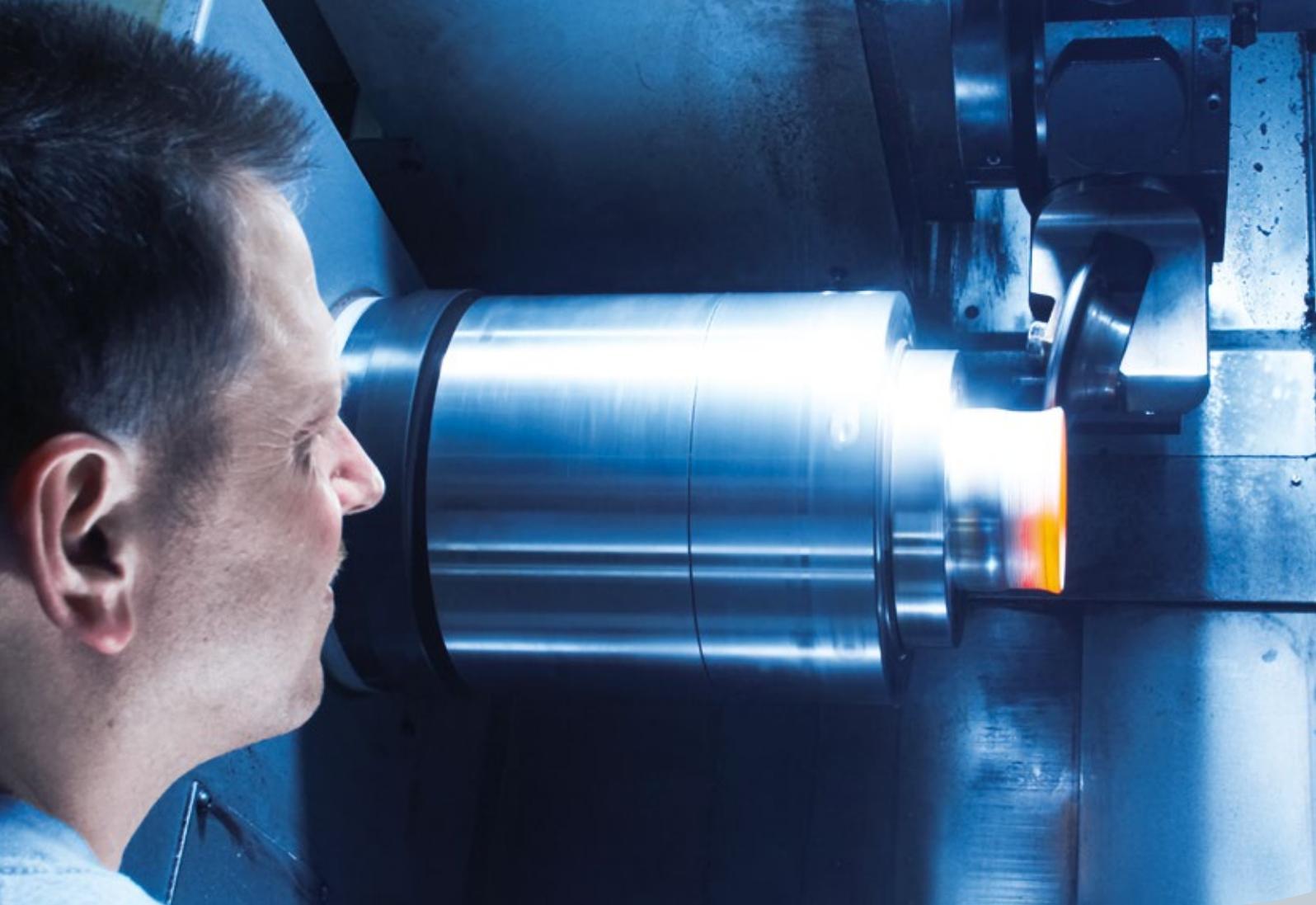
to our flexibility, our technical knowledge and a wide range of systems. We offer a wealth of production technologies, individually or interlinked:

- **Laser cutting**
- **Tube cutting and end finishing**
- **Bending, stamping, punching**
- **Reducing and expanding**
- **Thread cutting, forming, rolling**
- **TIG, MIG, spot welding**
- **Grinding, turning, milling**
- **Rotational forming**
- **Radial forging**
- **Surface and joining technologies.**

As a technological and logistical service provider, we focus on customer-oriented solutions

along the entire process chain. Our network, technological skill and knowledge make us what we are - **experts for experts.**





Rotational Forming

The Technology

The rotational forming process developed internally offers a wide range of applications for rotationally symmetrical forming of components. We process thin- and thick-walled tubes and tubular components made from virtually all metals. During this process, forming, cutting and heat treatment are carried out in a single operation. Internal mandrels are not required as the component is only formed from the outside against the material's inherent forces. It is also possible to create undercut geometries. The speed and efficiencies of the chipless forming process are combined here with the accuracy of precision machining.



Advantages

The process is suitable for small, medium and large volume production due to short tooling times and low tool costs. Optimum utilisation of material and short cycle times increase the process efficiency. This creates new potential for cost-saving and faster availability of prototypes. Technical advantages over conventional production on CNC machines are achieved with a clamping arrangement that enables compliance with close shape and positional tolerances, while high-strength materials can be formed by means of the process-integrated heat treatment. The product range we produce using the rotational forming process currently includes



- Pressure vessels
- High-precision bearings
- Chassis components for the automotive sector
- Airbag components for passenger airbag or side airbag systems.
- Air Suspension

The Products

Air Suspension Components

Production Stages: Forming + machining

The most varied components of steel or aluminium are produced for pneumatic automotive air suspension systems. These control the precision adjustment of a car's suspension system and must therefore be produced in a very close tolerance range. Unlike tool-bound processes, the rotational forming process has the advantage of contour adjustment without time and cost expenditure until just before the start of series production.

Pressure Vessels

Production Stages: Forming + machining

A pressure vessel is produced from one piece of tube. By the roll forming process vessels are sealed without the need for welding and have an extremely even wall thickness. Leakage tests can thus be reduced to a minimum and the pressure vessel produced very cost-effectively. The pressure accumulators made from

high-grade steel, aluminium or steel are used for pneumatic applications in the automotive industry, in the medical/technical sector and in general machine construction.

Airbag Components

Production Stages: Forming, turning, stamping, resistance welding. Cold gas tanks used in passenger airbags and side airbags are made by means of the rotational forming process from a high-strength tube ($R_p > 900 \text{ MPa}$).

Comprehensive material tempering in respect of hardness, material structure and grain boundaries (homogeneity) is ensured at the same time. This leads to the desired bursting behaviour and amongst other things enable smooth performance of the strict airbag testing procedures in the automotive industry.

Rotational Forming
Close shape and positional tolerances due to forming and machining in one clamping arrangement
Complex undercut geometries possible
Fast prototype production and adaptation
CNC-controlled process enables rapid modifications without high tool costs



Radial Forging

The Technology

The radial forging technology that we have used successfully for many years enables the performance of cold and hot forming processes in a dimensional range of up to 120 mm external diameter. In this case the technology combines axial and radial forming.

In hot forming, the workpiece to be processed is heated up inductively and swaged in the longitudinal direction before being radially formed via four oscillating rotary swaging dies in the actual forging plant. At the same time, the internal contour is defined by way of a forging mandrel. This simultaneous internal and external production achieved by shaping over mandrel thus makes it possible to save on production stages. This forging over mandrel process also ensures a variable component wall thickness and thus meets the market requirements for weight-saving with a simultaneous increase in the material loading capacities. The material- and cost efficient tube components produced by means of this technology may be used in many areas of the automotive industry such as the powertrain, chassis, transmission and steering.

The Advantages of the Forging Process

The advantages of radial forging, in addition to the weight reduction achieved, are the close tolerances of the internal and external contours

(cold forming), the optimum grain direction

and high surface quality. Simultaneous fabrication of the inside and outside as well as low setting up, development and tool costs also increase the productivity and profitability of this technology.

The Product

The production of forged parts for the rear axle area in the commercial vehicles segment is carried out at our plant in a closed process chain: we cold-draw the tube material and cut it to size on cutting systems before it is processed further in the forging centre.

At the customer's request, further processing stages, such as descaling (hot forming) and turning, are carried out on the forged part. For this we offer state of the art production facilities.

Radial Forging
Cost- and material-efficient cold, semi-hot and hot forming
Close tolerances for internal and external contours (cold forming: H7/h9)
High level of efficiency due to low development and tool costs in addition to weight reduction
Production of diverse geometries for tubular workpieces
Short production cycles

Interlinked Process Concepts

The Technology

Decades of experience mark us out as a Specialist in the development and implementation of system designs and interlinked production processes. On our own or jointly with experienced partners from the field of special machine construction, we develop customised cost-effective machine concepts which link together a large number of production steps in a cost-optimised and fully-automated manner. For the production of complex tube components for seat belt systems for example, operations such as cutting, end finishing, chamfering, bending, flaring, stamping, embossing, marking and testing are linked together in a fully automated production line in such a way that they guarantee high product quality and very good reproducibility in a short cycle time. At the end of the process is a finished seat belt component tested according to the standards of the automotive industry. Various components for belt pretensioner systems with the most diverse technical requirements are already produced using our process designs - such as components for the chest belt pretensioner or pretensioning of the lap belt.

The Advantages

The advantages of our systems and processes lie in low production costs due to the high level of automation and in the opportunities for tool changes. As a result, the systems can be used not just for one product but for whole product families. So that the condition and also the appropriate coating of tube components meets the strict requirements of the automotive industry, it is necessary to achieve the highest requirements not only in production but also in the semi-finished material we use. In this case, continuous optimisation of materials contributes significantly to ensuring compliance with product requirements and is a major advantage of our extended process chain.

The interaction between this material competence and our process experience, our technological knowledge and the close cooperation with our customers represents the best possible implementation of these requirements in the form of innovative and individual production solutions.

Process Concepts
A large number of interlinked, fully-automated production steps in one system
Integrated test and examination steps
Reduction of production costs
Production of diverse products on only one system due to the possible use of the most varied tools.





Conventional Process Concepts

In addition to the development of highly complex machine concepts, we also specialise in conventional production processes and systems which are used individually according to the requirements of our customers and products. The optimisation of a multi-stage production sequence by means of a manufacturing cell is as much a part of our expertise as the continuous process optimisation of individual systems.

For years we have been carrying out more complex processing activities for the production of automotive steering components in optimised product cells, for example:

- Cutting to precise length with subsequent end finishing
- Expansion or reduction of the tube diameter with subsequent end finishing
- Centreless grinding of external diameters
- Punching, stamping, drilling, milling of strips, slots and holes
- Coatings

Products and Advantages

The voestalpine Rotec Group has many years of experience in the development and production of steering components.

We stand out in this case due to our skilled advice and the best possible combination of the technical and economic processes and machines required. Thanks to our flexibility, our technical competence and the technologies available, we can adjust production and process sequences perfectly to the product requirements of our customers in respect of design, test methods and material.

Be it components for steering columns, for steering shafts or steering column locks, we offer cost-effective and technically mature production solutions - also using our own semi-finished products from our associated Group companies.

Production of Steering Components in Product Islands

Semi-finished products: directly welded, welded or seamless drawn precision steel tubes with smaller diameters and higher wall thicknesses

Production in optimised product cells to increase productivity, quality and cost reduction for complex processing activities

Performance of pressing, milling, drilling, stamping, grinding and coating operations

Production of the most diverse stampings and the most varied diameters

Professional Prototype Construction



Joining Technology

Alongside our expertise in the areas of materials, tube forming and process development, we also possess extensive knowledge in the field of joining technology. "Tube to tube" and "tube to plate" component joints are implemented in-house in the most varied geometries using a variety of joining technologies such as

- Resistance welding
- Riveting/Clinching
- Bonding

technology generated or implemented jointly with long-term cooperation partners.

The Technologies

Resistance Welding

We have been using resistance welding successfully for many years for joining airbag components to additional components defined by the customer (example: joining of a centring ring to an airbag sleeve).

Riveting/Clinching

Riveting/clinching is used for the joining of coated, temperature-sensitive components or non-weldable material combinations.

In-house, we have developed state-of-the-art processes with integrated 100% force/displacement monitoring for the quality assurance of these techniques.

A typical application example would be a steering column for passenger car steering systems, where an organically coated energy absorber is riveted onto a tubular casing.

Bonding Technology

In addition to welding technologies we are always looking for or developing further technically and economically feasible joining alternatives such as bonding technology. It is used for the assembly of a pressure vessel mounting. For this purpose, a specially developed holding clamp is joined to the pressure vessel with a special adhesive in such a way that axial slipping is impossible. It is possible to save on an additional, considerably more expensive welding process by using this joining technology.

The supplementation of our forming technologies by these joining technologies completes the range of processes we offer and guarantees our customers an additional quality and cost benefit.

Surface Technology

As a full-service provider and competent partner to our customers, we also offer coating and finishing of our products. We guarantee high-quality surface treatment and completion of the product using both external experts as well as our own surface processes developed in-house. Among other things, we offer KTL/e-coating (cataphoretic dip painting), powder coating and even ACC (autophoretic) coating, wet painting and also galvanizing based on our long-term cooperation with first-class partners. We develop special custom-designed coatings, such as ceramic coatings, that are not available on the market.

The Process - Special Surface Technology

It is possible, using a surface technology specially developed and employed by us, to apply high-quality enamelling or ceramic coatings to high-grade steel. In this case, we mix the enamel in-house from the most varied raw materials as it is not available commercially in the composition and consistency required. Application of the enamel to the previously formed high-grade steel sections is fully automated. The coating is subsequently dried in a continuous flow dryer and fired in annealing furnaces. These special functional coatings may be produced individually to customers' wishes in respect of their technical properties. Some-

times several coating and firing processes with differently blended enamel compositions are required in order to achieve the desired technical function.

This surface technology offers numerous advantages:

- Outstanding concentricity due to precise control of the coating application
- Highly wear-resistant surfaces with chemical stability
- One hundred percent pore-free, high-voltage resistant enamelling
- Adhesive or cohesive ceramic-based surfaces
- Decorative coatings

We are a competent partner for our customers due to our many years of experience in surface technology and our successful collaboration with external coating specialists.



Advantages of our subsequent processing skills:

- Closed added-value chain: from liquid steel to ready to install tube component
- Long-standing process and materials skills
- Extensive knowledge in the field of tool development
- Wide range of process technologies
- Development of innovative system designs
- Constant optimisation of production sequences and processes
- Competence in joining and surface technology
- Development partnership with our customers and external service providers
- Own plant engineering and tool manufacturing



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