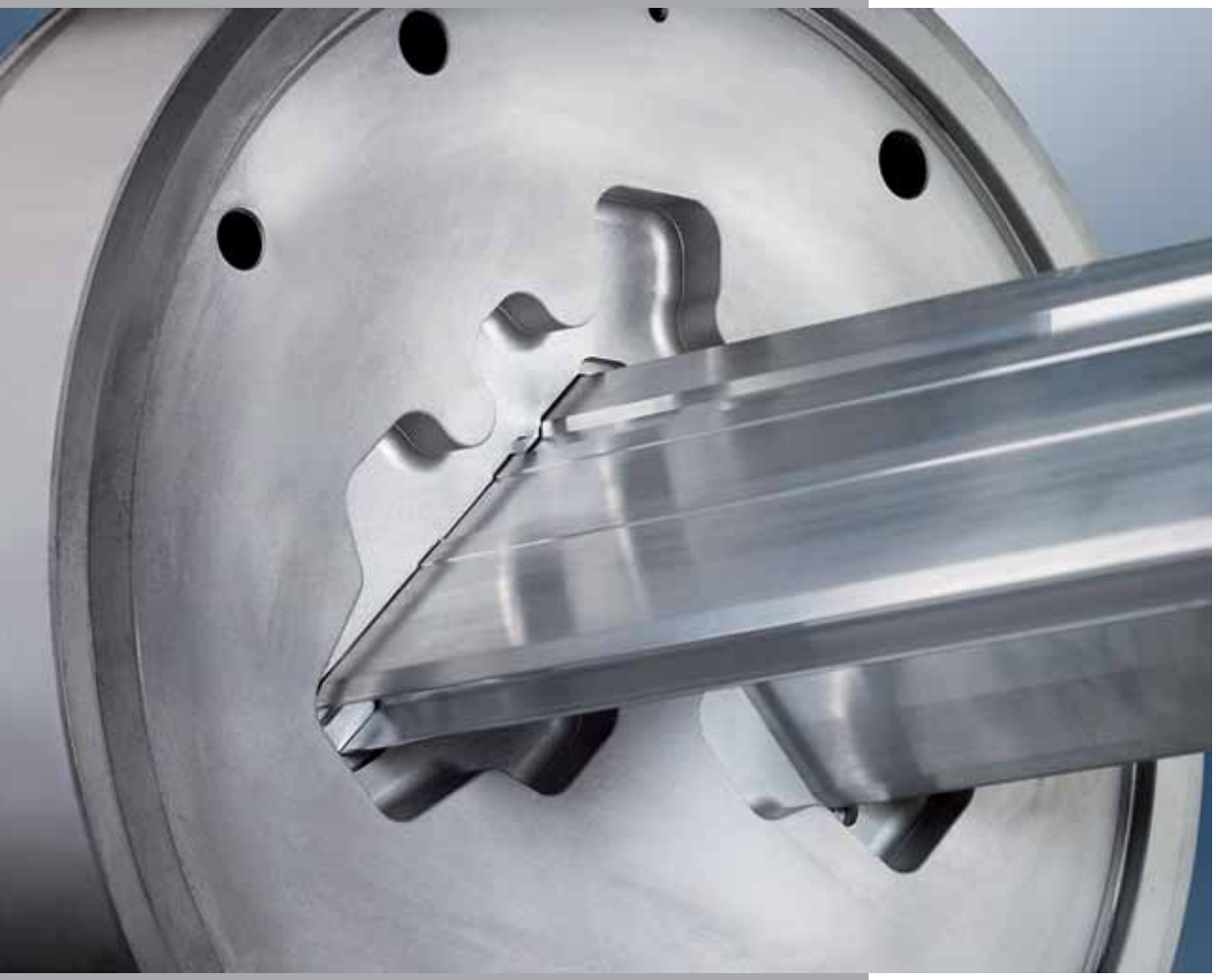
Technical Information

Extrusion Process

Aluminium, Copper and Magnesium Alloys



FUCHS

OTTO FUCHS KG

High performance materials in form and function

OTTO FUCHS KG

Your specialist when it comes to customized solutions

For over hundred years, the OTTO FUCHS Group has been shaped by the will to perfect the established and to create the new. What began in 1910 as a small brass foundry evolved over the years into a global player with ideas, solutions, and products for the aerospace, automotive, construction and general engineering industries. The core competence of this family enterprise lies in the hot forming of non-ferrous metals through forging, extrusion, and ring rolling. Together with its subsidiaries at home and abroad, OTTO FUCHS develops its own aluminium, magnesium, copper, titanium and nickel alloys for the production of high quality semifinished products, ready to fit components, finished products, and complete systems – for applications prioritising safety, weight, and service life. Our objective is the order related manufacture of customised products that are developed as early as the project phase with support from our technical advisory and development services.

OTTO FUCHS KG, Meinerzhagen

Employing over 2500 staff, the headquarter focuses on extru-sion, forged, and ring rolled parts and components of aluminium, magnesium, titanium, and nickel alloys. We manufacture products for the aerospace, automotive, construction and general engineering industries. Aided by our materials know-how coupled with our wide range of manufacturing methods, we develop the ideal component for specific customer wishes. We are the only company throughout Germany to process magnesium alloys in extrusion presses.

OTTO FUCHS Dülken GmbH & Co. KG, Viersen

Employing over 400 staff, our subsidiary specialises in the manufacture of extruded and forged semifinished products and finished parts of copper alloys. Our main line manufactures products for the automotive, general engineering and sanitary industries. This product range is rounded off with customised applications for special industrial segments.

The company is acclaimed for its high level of flexibility in complying with customer wishes and for its series and small batch production of forged parts and extruded products of high quality alloys.

Aluminium foundry in Meinerzhagen

Material competence and material supply

Development competence

Our unique material competence is a cornerstone of our success. A long time ago we discovered that it is not enough just to plan the shape of a component - the material must also be individually configured and if necessary optimised to each and every application. Through our targeted, inhouse research work, we can continue to refine the know-how we have been gaining over the decades. This focuses on the development of new and optimised materials that must be both light and high strength. These help to throttle energy consumption, reduce the material amount, weight, and volume of components and enhance friction and wearing properties. They compete with alternative materials and are to prove their superiority when used in new technologies. For instance, super high strength materials must be developed for the aerospace industries, or optimised automotive alloys with greater strength but equal crash properties.

Material diversity

OTTO FUCHS processes a total of nearly seventy different aluminium alloys, sixty copper alloys, and twelve different magnesium materials. This wide range is a unique source of materials tailored to the optimal effect for customer requirements. A team of experienced material specialists support our customers in the choice of the material best suited to their applications. Our own foundries also allow us to develop and manufacture new, optimised material variants.

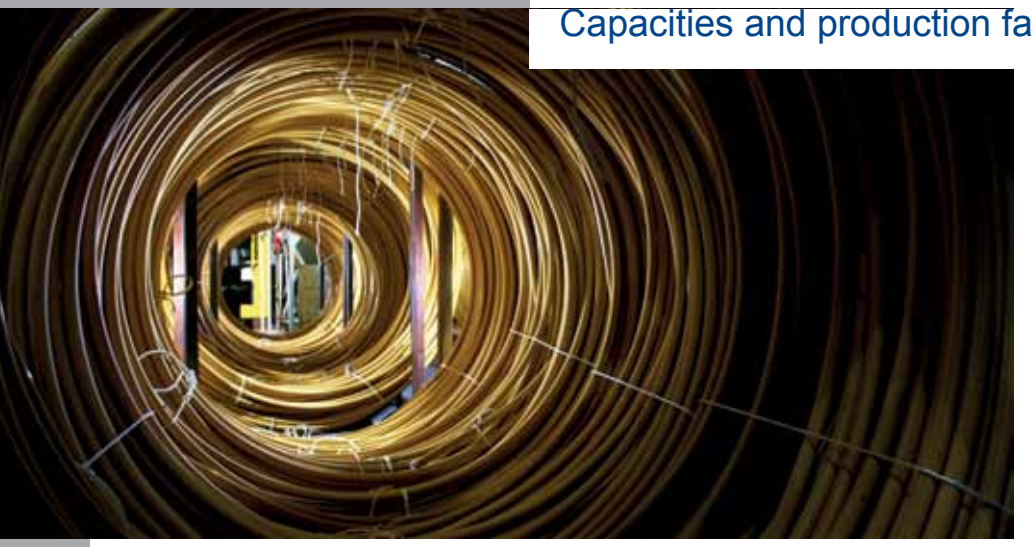
Material production

OTTO FUCHS operates its own aluminium, magnesium and copper foundry. Complying with all aspects of environmental protection, these modern continuous foundries can process a total annual capacity of about 150,000 tons. By operating its own foundry, OTTO FUCHS can provide its production processes with the most diverse geometries and the highest quality of input stock, in the right quantities at the right time, without having to rely on external suppliers. The alloy constituents are specified within tighter limits than prescribed under the national and international standards, a measure that safeguards the reproducibility of properties in series production. This suppresses the effects of individual batches and raises the level of quality. The result is a minimised spread of properties from the extruded blank to the finished component. In a closed material cycle, all production returns are reintroduced to the manufacturing process, for the optimal economic and ecological benefits.

Crash alloys by OTTO FUCHS

For their occupant crash protection programmes, the automotive industries use a variety of materials including aluminium sections. In the event of a collision, the configured geometries and materials of these sections deform over precisely defined sections that crumple evenly and without fracturing, absorbing the impact energy in the process. The image shows a section before and after a simulated crash. Not only the alloy itself, also its grain structure helps to direct this predefined deformation. These sections are used primarily in space frames.

Capacities and production facilities



Nonstop quality

Supported by its entire range of manufacturing technologies, OTTO FUCHS processes up to 115,000 tons of aluminium, magnesium, and copper alloys each year for its production of solid and porthole hollow sections. At its Meinerzhagen and Dülken locations, OTTO FUCHS operates a total of twelve extrusion presses with capacities ranging from 710 to 7,500 tons.

	OTTO FUCHS KG, Meinerzhagen	OTTO FUCHS Dülken GmbH & Co. KG, Viersen
press	1,500 t 1,900 t 2,000 t 2,000 t 2,800 t 3,000 t 3,500 t 5,500 t 7,500 t	710 t 1,600 t 2,500 t
weight per meter	aluminium: 100 g/m to 50,000 g/m* magnesium: 700 g/m to 6,000 g/m*	copper: 170 g/m bis 140,000 g/m*
circumscribing circle	aluminium: to 390 mm* magnesium: to 220 mm*	copper: 10 mm to 180 mm*
applied extrusion methods	aluminium: direct, indirect, over a mandrel magnesium: direct, indirect, over a mandrel	copper: direct, indirect, over a mandrel
annual capacity	sum aluminium and magnesium: 75,000 t	copper: 40,000 t
* Owing to the use of different alloys and section wall thickness, natural size and weight restrictions become unavoidable.		

Table of capacities and production facilities at the Meinerzhagen and Viersen locations

Meinerzhagen

Presses with capacities ranging from 1,500 to 7,500 tons produce cross sections of aluminium alloys with an outer diameter of 10 - 390 mm. The maximum extruded length is 50 m. The extruded length of magnesium alloys is limited to 13 m, and the maximum outer diameter to 220 mm.

Viersen

OTTO FUCHS Dülken GmbH & Co. KG operates three extrusion presses with capacities ranging from 710 to 2,500 tons and an annual total output of about 40,000 tons for the production of customised products. Here too, we apply the entire range of our manufacturing technologies. Cross sections can be manufactured with a diameter of 10 - 180 mm and a weight of 170 g to 140 kg per metre. The maximum extruded length is 45 m.

Applied extrusion methods

Direct extrusion

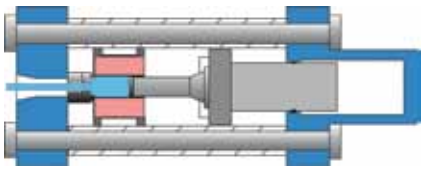


Fig. 1

This is the standard extrusion method. Here, the block is loaded into the container where the platen forces it through the die installed in the backstop (Fig 1). At the end of extrusion, the remaining input stock is shorn off, and the next block loaded. This direct method can produce both solid and hollow sections as well as seamless pipes over a mandrel. This advantage of maximised productivity is, however, offset by the drawback that the press stroke must overcome not only the material's forming resistance, but also the friction between the block and the container wall. This method is therefore preferred for materials that extrude under light to medium forces.

Indirect extrusion

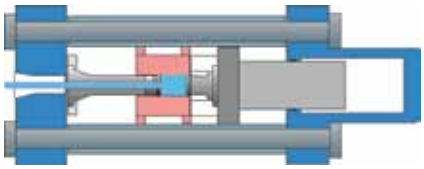


Fig. 2

In the indirect extrusion the press forces the material block in the container against a hollow punch to which the die is attached (Fig 2). This method can produce both solid and hollow sections. The extruded section then flows through the hollow punch. Its measurements, however, are subjected to tighter limits than in direct extrusion. At the end of extrusion, the remaining input stock is shorn off. The next block can be clamped between the die and platen and introduced to the container. The advantage of this measure is that there is no friction between the block and container. The whole extrusion force is therefore available for forming the material. Hence, indirect extrusion is suitable for high resistance materials that deform only under particularly high forces.

Extrusion over a mandrel

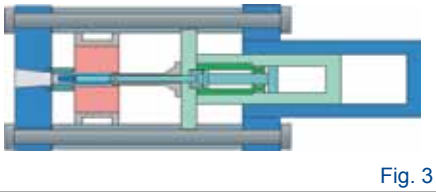
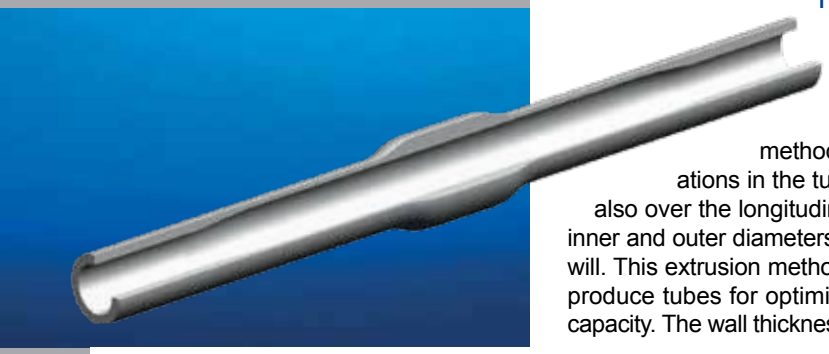


Fig. 3

This method is used to manufacture seamless pipes and single-chamber hollow sections for applications that forbid moulding seams usual in porthole and composite dies. This is a variant of direct extrusion where a piercing mandrel in the platen first drives an initial hole through the material block loaded in the container (Fig 3). For the whole duration of extrusion, this piercing mandrel, whose geometry corresponds to the section's internal contours, remains in the die and with this provides the geometry for the required hollow section. This method is suitable for all aluminium materials.

Special processes



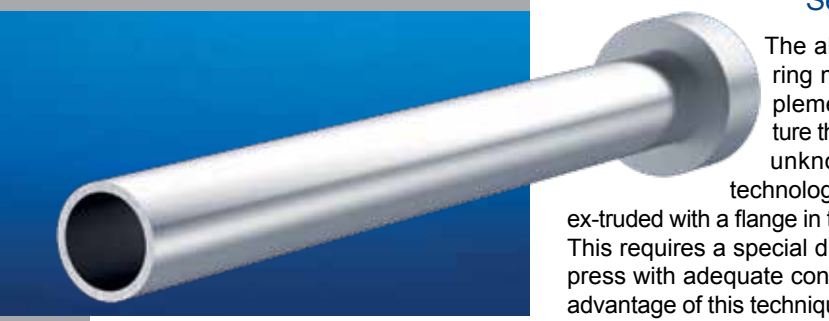
Tailored aluminium tubes

Tubes with varying wall thicknesses

For seamless extruded tubes, OTTO FUCHS has developed a method that allows variations in the tube cross section, also over the longitudinal axis. Both the inner and outer diameters can be varied at will. This extrusion method can be used to produce tubes for optimised load bearing capacity. The wall thickness or outer diameter is then adjusted to the local loads acting on this point. These changes to diameter and the resulting wall thicknesses help to optimise the mechanical strength of components and to model tube sections with varying wall thicknesses that can then be introduced to subsequent machining or forming processes. The actual customer benefit is the optimised component weight and fewer subsequent operations, for example turning inside diameters or additional joining work.

Example application: aluminium drill pipes

Owing to the dwindling supply of resources, raw materials must be extracted from ever greater depths in the earth's crust. Drilling lines soon come up against their weight limits when they use steel pipes. Here, the future lies in wrought aluminium alloys. The density of aluminium is a third that of steel, yet aluminium exhibits a comparable mechanical strength. Deeper wells can therefore be drilled with the same equipment. This low weight also makes handling the drill pipe considerably easier, a significant advantage above all in geothermals. In addition, aluminium exhibits a considerably higher flexibility than steel, and wells can be aligned with far greater ease.
However, connecting tool joints to the usual conical threads at the end of the drill pipe requires a pipe wall thickness that far exceeds the value needed for adequate mechanical strength. Extruded pipes with the corresponding thicknesses at their ends present here a practicable solution in both engineering and economic terms.



Tube with flange

Seamless extruded tubes with coextruded flange

The above manufacturing methods are supplemented with a feature that was previously unknown in extruding technology: the tube is co-extruded with a flange in the one operation. This requires a special die in addition to a press with adequate control facilities. The advantage of this technique over welded or bolted flanges lies in its elimination of reduced strength and tightness problems in the connecting zone between the flange and the tube. Both the tube and flange consist of a homogeneous material with absolutely identical properties and a dense grain structure. This new variant now provides completely new potential for tubular components that before could not have been realised, or realised only with considerably greater material quantities and processing work.

Nonslip surfaces

Subsequent processing

The subsequent processing of manufactured sections with minimised tolerances and integrated process and quality control is a strategic target of OTTO FUCHS. We have complied with the customer's wish for an end to end provider of innovative components and systems and can now offer the know-how needed for subsequent processing in addition to a basis for competitive semifinished products. We have the development and production resources needed to realise these projects.
Mechanical equipment for milling, punching, bending, and welding work provide the basis for subsequent processing prior to high end products. The series production of these components runs on highly automated systems, some of which are fully integrated solutions.

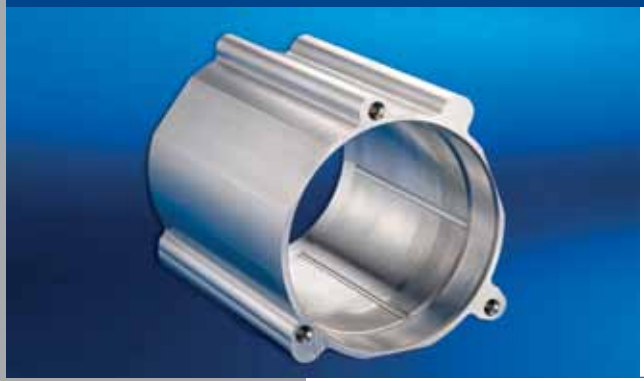
Meinerzhagen

For instance, we part off lengths of aluminium sections in ABS housings on a fully automated sawing unit with inline measuring station. This inline measuring station monitors the extremely tight length and form tolerances before the parted sections are cleaned, marked, and packaged for storage.

Viersen

The Viersen location also operates fully automated installations for the production of piston pin bushings of high strength brass. The products can be processed, cleaned, tested, and packaged to optimal effect in series production.

Example application at Meinerzhagen: steering box section for passenger cars



We manufacture this section to very tight tolerances on our extruding press. Subsequent precision machining is inte-grated in the upstream sawing process and the downstream washing installation. Before final order picking, we scrutinise all of the sections' critical dimensions for 100% compliance. This combination of extruded manufacture and finishing from the one source and the experience and infrastructure needed for quality assurance in series production have made OTTO FUCHS the competent partner for the development and series supply of ready to fit extruded components.

Example application at Viersen: shift stones for selector forks

We produce these sections from a high strength brass alloy on our extruding press. Even at this early stage, the sections are produced within such tight tolerances and with such a good surface quality that they afterwards need "only be sawn off". The next step involves turning a seat on the slide blocks. Each selector fork can then be fitted with two shift stones in their rotating bearings. Afterwards, the blocks are packaged to customer specifications for safe transport.

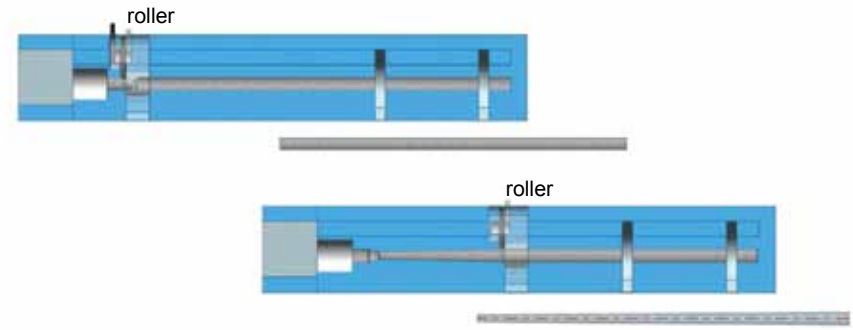
Tapered flagpoles of aluminium

Special processing methods

Flow forming

The flow forming method we apply without an internal mandrel allows us to manufacture pipes with varying cross sections. This involves rotating the extruded pipe and forming it to the required geometry through a CNC roller. We can produce pipes with a maximum outer diameter of 150 mm and a maximum length of 14 m. The forming zone is maximum 7 m. Tapered pipes are used above all by the construction industries, for example as lighting pylons or flagpoles, but also in electrical installations as for example trolley pole contact rods for electric buses. The hallmarks of these tapered pipes are their low weight, high corrosion resistance, not to mention their aesthetic surfaces. Moreover, the tapered form reduces the wind loads on these pipes for greater stability.

Flow forming

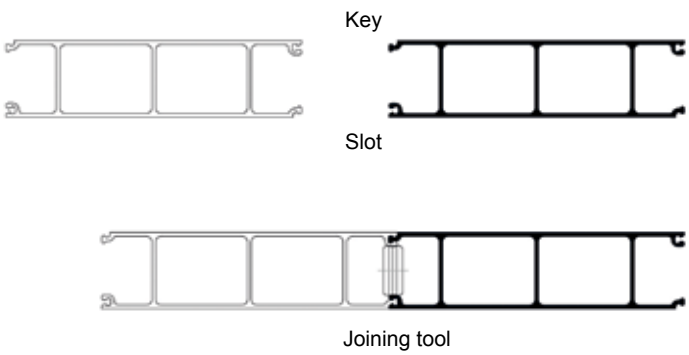


Cold joining

The cold joining method (OFCJM) we have developed and patented provides a unique opportunity for the firm and permanent connection of sections. The result is a thin walled, lightweight compound of extrusion that can be adapted individually and flexibly to the onsite structural requirements. Every day these compound sections prove their extraordinary stability under static and dynamic loads, for example as tail lift platforms or as base structures for modern bridges.

Cold joining

OFCJM is a powerful and cost effective joining technology. All it needs are sections that each feature a compatible key and slot system on their edges. The actual joining process involves engaging the sections, clamping their parts, and compressing the whole. The engaged key and slot systems are then forced together.



Noise barrier elements of aluminium

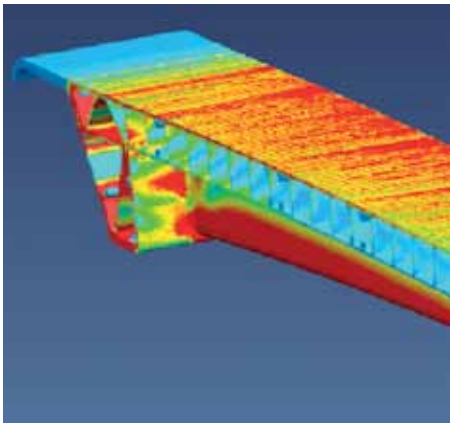
Product development

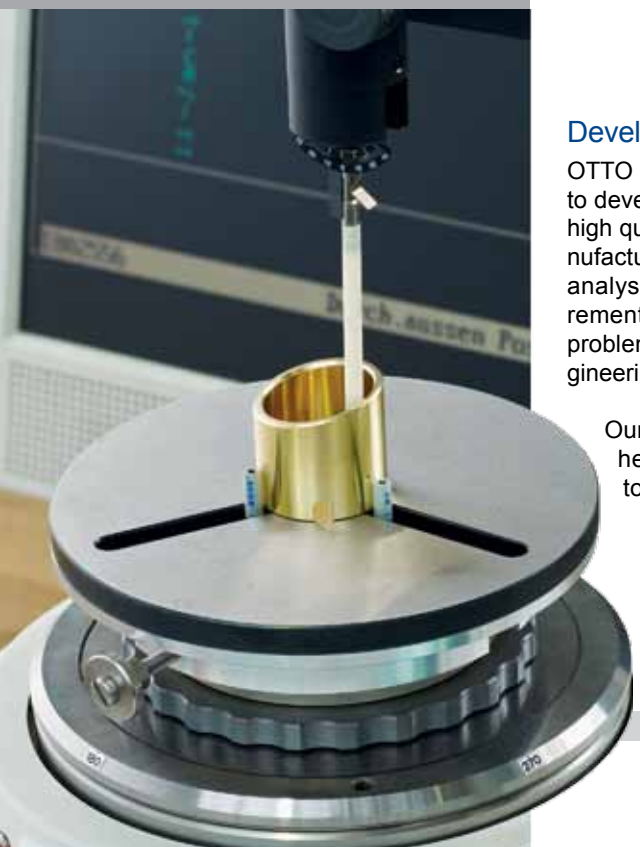
Progress through engineering

There are many steps to be taken from the idea for a product and the finished component. OTTO FUCHS is a problem solver and development partner in one. We assist our customers with competent advice from a very early phase of product development. With a wide range of ultra modern development tools, we provide the customer with our support over all stages, from the component draft to the production aligned design to the optimisation of material properties. The final design is validated against the customer's specifications in the materials laboratory and on our own test rigs.

Example FEM analysis on a tail lift

Tail lift platforms are subjected to a wide range of loads when in use. Besides the recurrent loads exerted on them during lifting and lowering, they are also subjected to sporadic static overloads when they are not used properly. These may not cause the platform to fail abruptly. The tailgate is an assembly of sections made up of the composite platform and its substructure. Hence the entire assembly must be modelled by FEM analysis. Local extreme deflections and stresses can therefore be identified as critical details on the designed sections, and the entire structure upgraded with suitable optimisations for a long service life.





Developing methods for individual series production projects

OTTO FUCHS has the experience needed to develop series production processes of high quality and reproducibility and to manufacture the corresponding products. By analysing our customers' specific requirements, we can therefore find for every problem a convincing solution in both engineering and economic terms.

Our family enterprise is founded on a healthy financial basis, allowing us to invest the sums needed in series production projects. When developing production processes, we make sure that all of the customer's specifications are fulfilled and if necessary documented. At the same time, our quality policy focuses on the continuous monitoring of all process parameters. Statistical analyses for inline quality assurance provide verification of consistent product quality and process control. This safeguards the documentation and traceability required for all processes and the constant process optimisation.

Optimal quality with high reproducibility: bushings on the 3D measuring rig

References

The following reference products from our extrusion lines illustrate the individuality and precision of OTTO FUCHS products. The optimal combination of materials and methods provides the right solution for every customer requirement.

We give form and function to high performance materials.

Aerospace industry

Seat rail extrusion

Material	Aluminium 7349
Area of app.	fuselage/floor

Stringer profile

Material	Aluminium 7349
Area of app.	fuselage/outer skin

Cross beam

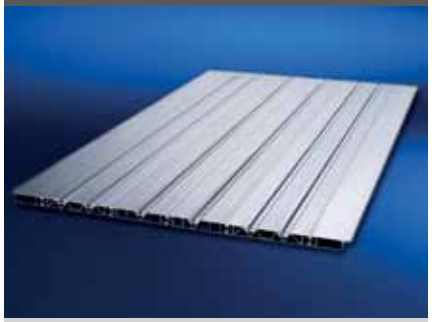
Material	Aluminium 7349
Area of app.	fuselage/floor

Automotive and transport

Bushing

Material	copper various alloys depending on the app.
Area of app.	engine and drive

Trailer flooring



Material	aluminium EN AW 6060/6063
Area of app.	as floor of a truck

Structure profile

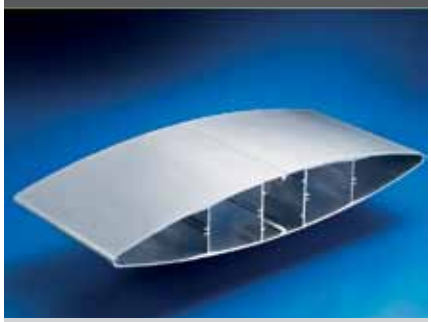
Material	aluminium EN AW 6063
Area of app.	body

Construction industry

Flagpole

Material	aluminium EN AW 6063
Area of app.	outdoor area

Sun protection / Sun barrier



Material	aluminium EN AW 6063
Area of app.	building envelope

Door treshold rofile

Material	copper DIN EN CW 622 N
Area of app.	winter garden

General engineering

Quiding profile of a chain

Material	copper DIN EN CW 721R
Area of app.	engineering

Profile for textile machines

Material	magnesium 3.5312 nach DIN 1729
Area of app.	textile machinery

Housing

Material	aluminium EN AW 6063
Area of app.	engine case

To learn more about OTTO FUCHS, our products, the materials and the methods we apply, please visit www.otto-fuchs.com.

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FUCHS

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