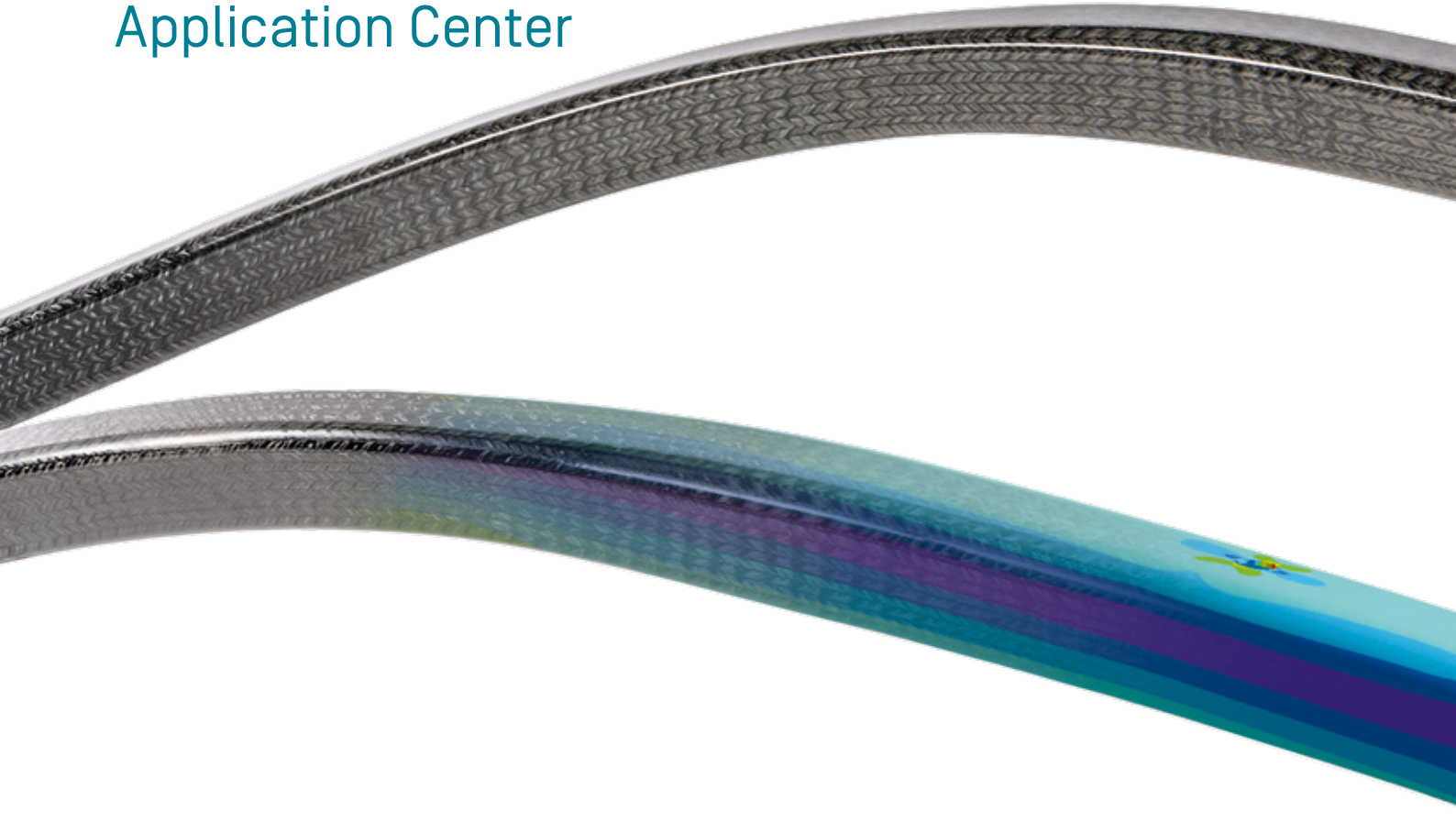
sgl carbon

The Solution Developers

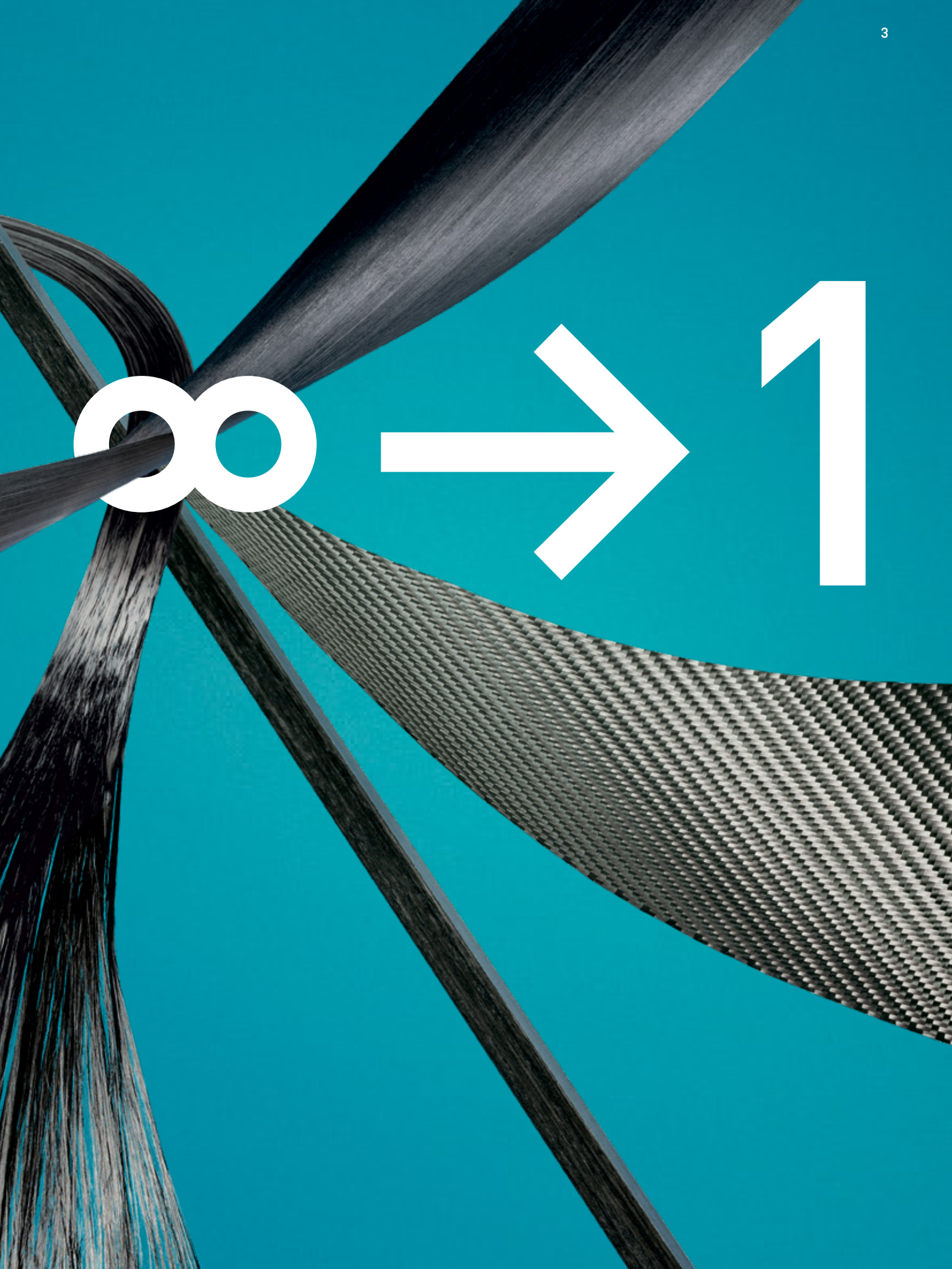
Our Lightweight and Application Center



Composite Solutions

Lightweight and Application Center
The lightweight construction experts for your application

You have a vision, an idea, a goal. We are the experts in lightweight construction with fiber-reinforced composites, and stand by your project from planning to start of production. With unrivaled material, design, production and application know-how. With the best construction and simulation tools for design and engineering. With cutting-edge equipment for all composite processes. Whether intelligent material concepts or ready-to-use components: From the endless possibilities, we select and develop with you, the best solution at our Lightweight and Application Center (LAC). The most lightweight, most rigid, most cost-effective – depending on your objective. The LAC from SGL Carbon – a real solution developer.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Our Lightweight and Application Center

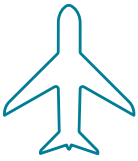
As a manufacturer of top quality high-tech materials for lightweight components, we are known around the world for supplying demanding customers in different industries. With the new Lightweight and Application Center (LAC), we have taken another leap as a solutions provider by supporting our customers in the development of parts and components, from the initial idea to series production.

Market segments of our Business Unit Composite Solutions	Automotive	Industrial Applications
Typical applications and products	• Body-in-white components: A, B, C pillars, side members, windshield cowls, etc. • Leaf springs, wishbones • Battery case • Structural reinforcements: Struts, floor shear webs	• Machine trusses • Lightweight solutions for precise and fast-moving system parts
Processes and equipment at the LAC	• Automated Fiber Placement (AFP) with 2D lay-up • 3D Winding • Braiding • Wet compression molding, RTM • Thermoforming • Injection molding with continuous fiber-reinforcements • Hot-pressing for prepregs	• Wet compression molding, RTM • Prepreg-autoclave process • Hot-pressing for prepregs
Materials used from SGL Carbon	• SIGRATEX® non-crimp fabrics • SIGRATEX® woven fabrics • SIGRATEX® non-wovens • SIGRAPREG® prepregs • SIGRAPREG® TowPregs	• SIGRATEX® non-crimp fabrics • SIGRATEX® woven fabrics • SIGRATEX® non-wovens • SIGRAPREG® prepregs

Lightweight construction solutions – from concept to serial production

Fiber composite materials have long been established in the cost-efficient production of lightweight components in large numbers. The key to success is finding the best technical and economic solution from the countless possibilities using different materials and molding processes. At the LAC, we bundle our far-reaching material, process and application know-how to provide our customers with optimum support, from concept development to a serial production solution.

With cutting-edge machinery on more than 2,000 m², we have created the ideal prerequisites in the LAC at our site in Meitingen. Always open to new ideas, we work with an interdisciplinary team of experts consisting of simulation and process engineers, as well as production and automation specialists. We sucessfully develop customer-specific light-weight construction solutions – for example for companies in the automotive and aerospace industries, the energy sector and other industrial applications.



Aerospace

- Interior components, e.g. floor elements, seats, etc.
- Structural components for ultra-light aircrafts

- Automated fiber placement with 2D and 3D lay-up
- Prepreg autoclave process

- SIGRATEX® non-crimp fabrics
- SIGRATEX® woven fabrics
- SIGRATEX® non-wovens
- SIGRAPREG® prepregs
- SIGRAPREG® TowPregs

Energy

- Structures for wind energy plants, e.g. rotor blades
- Structures for hydro installations
- Supporting structures for solar installations

- Pultrusion
- Vacuum infusion process

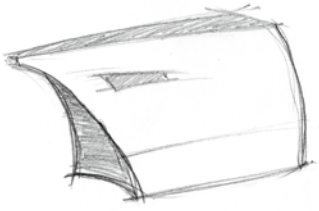
- SIGRAFIL® continuous carbon fiber tows
- SIGRATEX® non-crimp fabrics
- SIGRATEX® woven fabrics
- SIGRATEX® non-wovens

Many options, one result: Your best lightweight construction solution

Which skills, tools, equipment are most expedient for you? What are the development steps on the way to your individually optimized lightweight solution? That depends but we have the experience in every case.

Our LAC procedures for your lightweight construction success

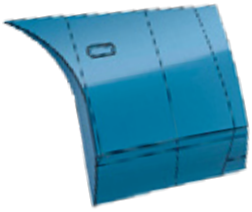
Concept development



We develop different and cost-efficient fiber-composite solutions for your applications, based on

- our material expertise
- our process know-how
- your requirements

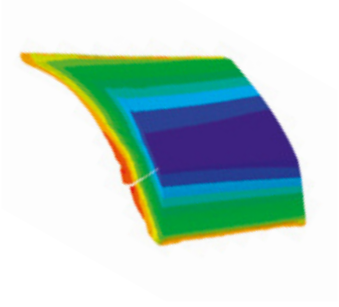
Product design



Our experienced design team creates detailed CAD models focusing on

- process and material specifications
- lay-up and laminate specifications
- tool construction

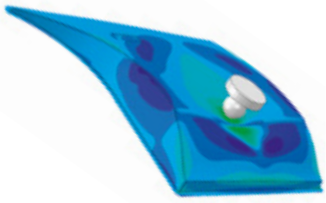
Process simulation



Depending on your composite manufacturing process, we determine the technological capabilites:

- Determination of material and process parameters
- Draping and filling simulations
- Impregnation and curing analyses

Structural analysis



We check and optimize your composite construction based on structural require-ments focusing on

- rigidity and strength
- vibration and frequency analysis
- crash and fatigue behavior
- optimized use of material

Think tank, lab, workbench – all under one roof
What we offer you at the Lightweight and Application Center: Reliable, quick and cost-effective solutions ready for serial production.

The Lightweight and Application Center leaves no stone unturned in precisely identifying all individual requirements. This is not specific to your particular usage. So let's just say: At the beginning, you present the LAC with your requirements. At the end you take the best solution into serial production.

Virtual prototyping

We optimize your manufacturing process by aiming for a first-time-right prototype which combines

- geometric specifications
- process parameters
- functional requirements

Prototyping

Your prototype is produced on equipment at the cutting-edge of technology, employing our entire product range on lab space of more than 2,000 m².

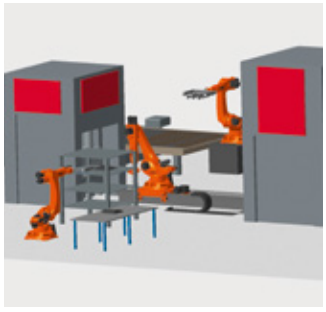
- Preforming and impregnation
- Prepreg processes
- Thermoplastic technologies

Product testing

We test finished components in our internal test lab, results feed back into the product development process. Our testing methods include

- material analysis at the coupon level
- non-destructive tests
- component testing

Factory simulation



During product development, we analyze and visualize the production process and facilitate large series planning of material flow with a focus on

- the scaling of manufacturing processes
- factory layout
- cycle times and capacity utilization

Higher, faster, farther: LAC Design & Engineering

Enhance the quality of your products. Get your ideas ready for production. Cut your development costs. This is why we have set up the LAC and perfectly equipped it. Our experts know what matters when it comes to composite materials. They have powerful design and simulation tools to optimize your products at all development steps: from CAD and CAE to CAM.

FEM simulations for faster development of better products

CAD – Optimization from the start

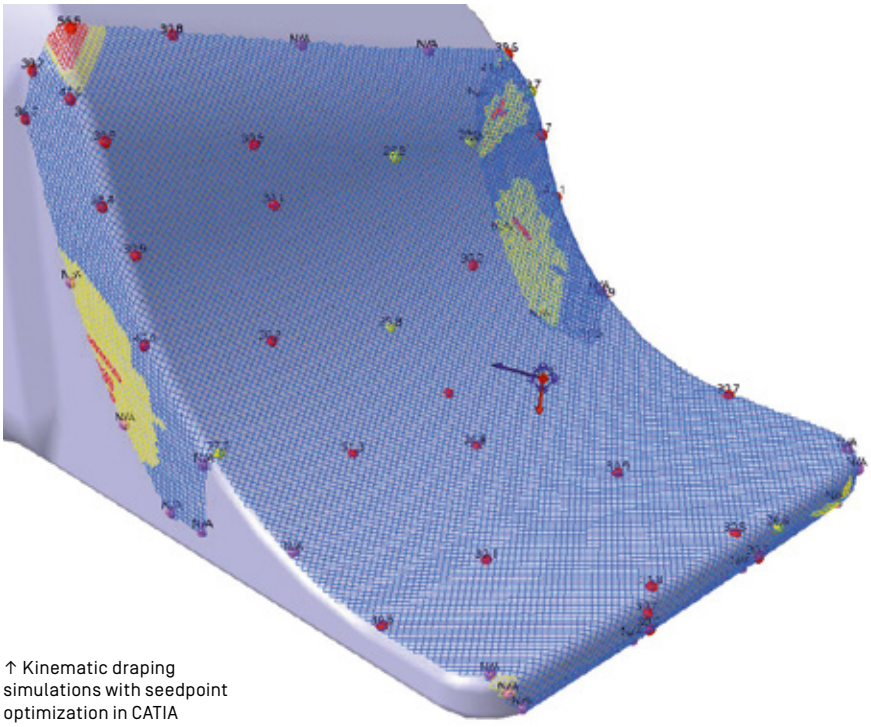
At the beginning of a new CFRP component, there is often only a vague idea of its design. From initial sketches to highly engineered 3D models, the idea takes shape in the design process.

We utilize the advantages provided by modern design and simulation technologies early on in product design. This allows us to calculate many variants in very little time, and to selectively conduct real tests only where they are needed for validation. The results feed back directly into further developing the component.

Product optimization thus begins in the LAC when the time and effort for changes is still minimal. Our customers reap the benefits of components with optimized properties, and ultimately of significant cost and time advantages in the development process.

Construction of CFRP components

- Definition of lay-ups
- Draping simulations
- Generation of 2D and 3D cutting contours
- 3D-laser projection contours
- Design of preform, lamination and consolidation tools



↑ Kinematic draping simulations with seedpoint optimization in CATIA

CAE – Using simulation for the best solution

We simulate to achieve the best solution

Static simulation
- Deformation/stiffness
- Strength

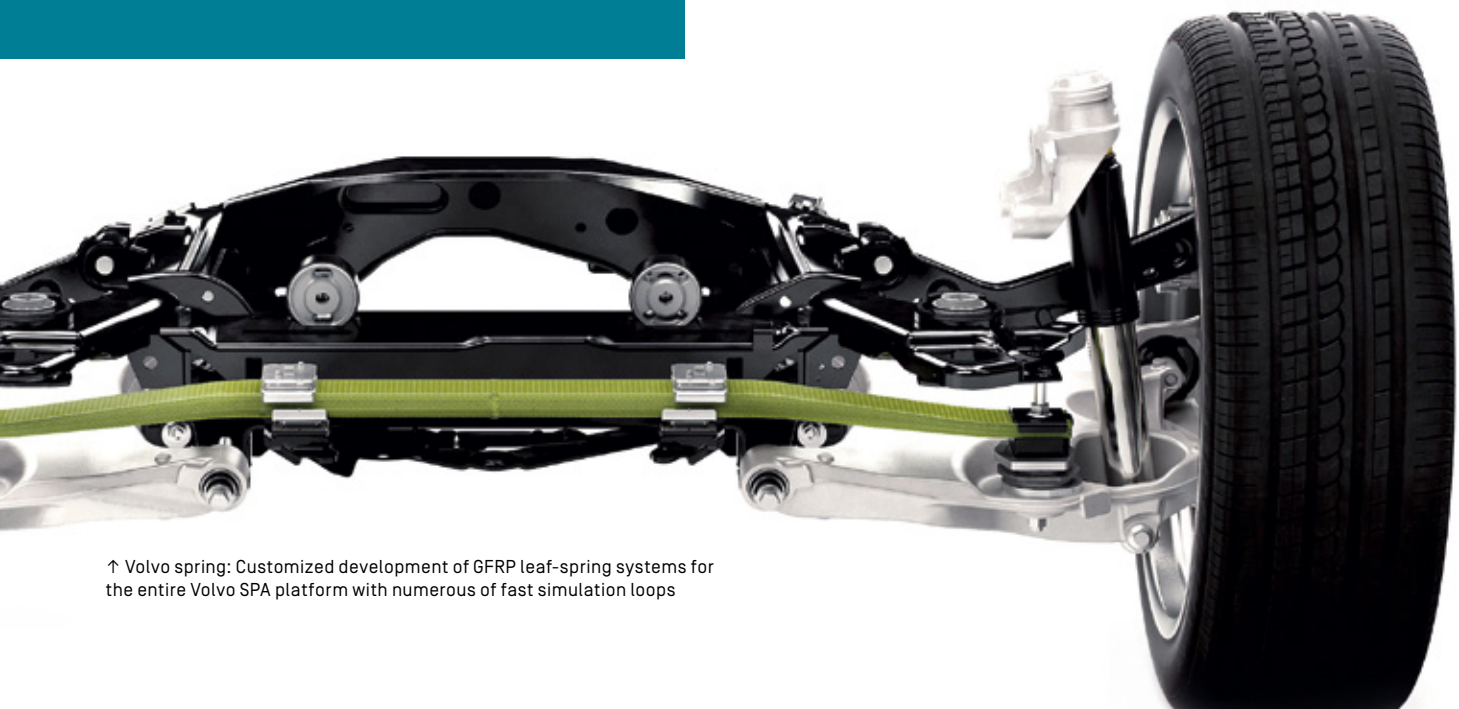
Dynamic simulation
- Crash behavior
- Noise vibration harshness
- Durability analysis

Process simulations
- Draping and forming simulation
- Filling simulation (RTM, injection-molding)
- Distortion simulation

How is the required stiffness of a component reached with minimal use of material? What happens in the event of a crash? How can filling behavior be optimized in an injection-molding process? When developing CFRP components, a large number of specific issues need to be addressed.

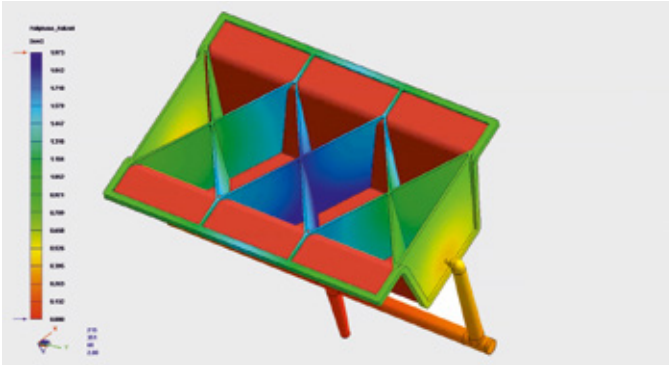
Modern simulation technologies deliver important insights. For instance, in order to make products simpler, more resilient and safer, to realize process-optimized design, to increase the durability of a component, to decrease noise emissions and much more.

Exact material data for valid simulation results
A prerequisite for reliable simulation results is that the software is individually fed with the correct material data for each project. While approximate values are often used for this, we as material manufacturers have a first-class database at hand, essential to precise calculations.



↑ Volvo spring: Customized development of GFRP leaf-spring systems for the entire Volvo SPA platform with numerous of fast simulation loops

Powerful software tools for all types of simulation
The best tool is just good enough for our simulation engineers. After all, it is their job to find not just any, but rather the best individual solution for our customers. We therefore use the most powerful software package for each type of simulation.



↑ Injection-molding simulation of reinforcing ribs in a thermoformed hat profile in Moldex3D

We use the best CAx tools

- CAD: Catia and Solid Edge
- CAE: Abaqus, LSdyna, ANSYS, ANSA/Metapost, PAM composites and Moldex3D
- CAM: KUKA.Sim and CADWind

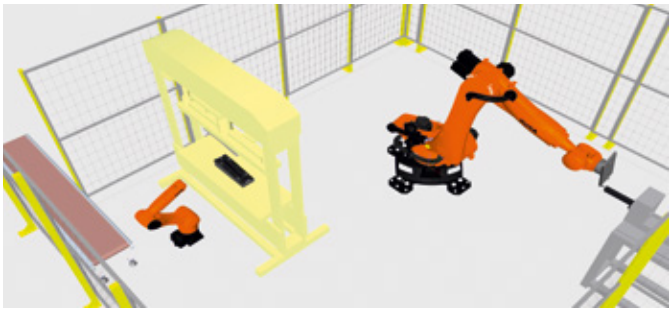
CAM – Planning your production processes

We always keep an eye on production processes when we develop a component. Manufacturing methods have a major impact on component properties. A further concern, of course, is optimization of the reliability and cost-efficiency of the manufacturing itself.

Our comprehensive process knowledge affects production planning. We not only know our materials and their properties down to the tiniest detail, we also know how they are best processed – from single prototypes and small quantities to large-scale serial production.

Using virtual factories, we test complete equipment configurations with regard to the specific circumstances of processes, production numbers and cycle times. Moreover, machine operation can be programmed prior to assembly and virtually checked with specific software solutions – for instance the complex motion processes of robots.

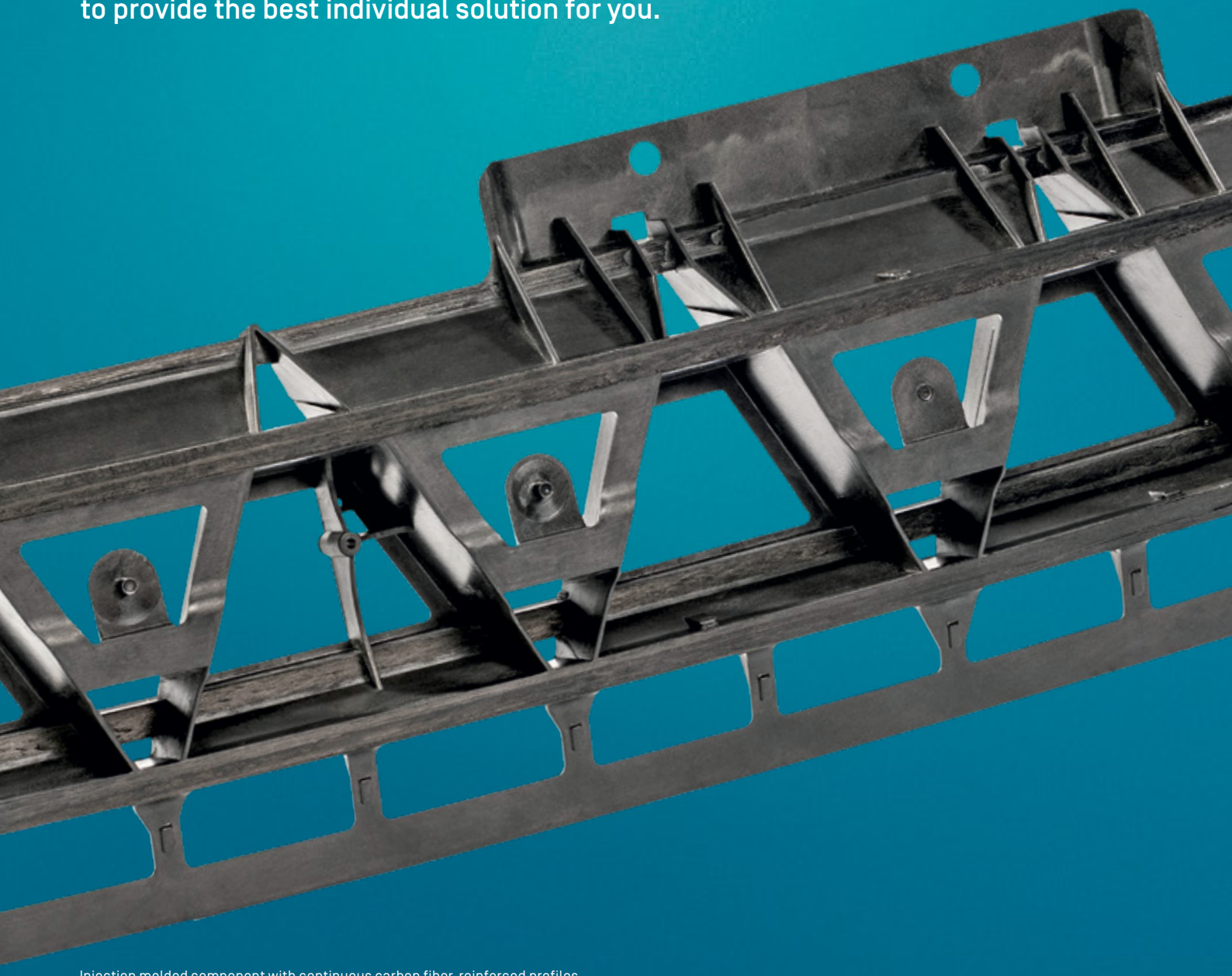
This is considerably more efficient than programming with actual operational tests after start-up. Simulation also helps save time and costs in the arrangement of machines and systems.



↑ Robot programming and visualization of a 3D winding process in KUKA.Sim

Fully equipped for your manufacturing solution

In the LAC we draw on wide ranging resources to find a custom-tailored manufacturing solution for your composite product. We have everything available for an optimum production of different CFRP components: all materials, all common processes, and all the required machines and systems. We utilize these resources like a construction kit to provide the best individual solution for you.



Injection molded component with continuous carbon fiber-reinforced profiles

State-of-the-art production routes for dry materials, prepregs and thermoplastics

Every CFRP project is based on a unique line-up of requirements which exert considerable influence on the planning of an optimized manufacturing solution. The challenge consists of reaching the exact performance required, such as mechanical and thermal stability, resistance to corrosion, dimensional accuracy, and much more, just as for the goal of lightweight and low costs. Of course, the production numbers and cycle times play a decisive role as well.

We consider all these parameters to develop a tailored manufacturing concept for your application. The basis is our special material kits and state-of-the-art production routes for processing dry materials, pre-impregnated materials and thermoplastic fiber composites.

Our focus at the LAC

- Large volume production
- Short cycle times
- Low material waste
- High degree of automation
- Robust processes
- Load-optimized use of fiber
- Hybrid component design

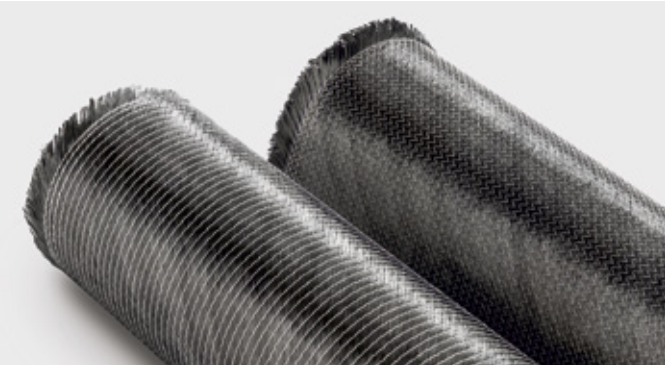
Our systems for processing

Systems	Material class	Component geometry	Component size (m)	Systems parameters
AFP systems	dry materials, prepregs, thermoplastics	2D, 3D	Ø 3 x 7	tape widths: 1/8" – 4"
Pultrusion line	prepregs, thermoplastics	2.5D		
Braiding machine	dry materials	3D	Ø 0.2 x 3	128 braiding bobbins
Injection-molding system with pre-heating station for continuous fiber-reinforcements	thermoplastics	3D	0.6 x 0.4	400 °C, 2000 kN
Wet compression molding cell	dry materials	3D	0.8 x 0.8	200 °C, 290 kN
Thermoforming cell	thermoplastics	3D	0.6 x 0.4	400 °C, 290 kN
Winding cell	prepregs	2D, 3D	1.5 x 1.5 Ø 0.5 x 1.5	
Different hot presses	prepregs, thermoplastics	3D	0.8 x 0.6	400 °C, 1000 kN

Our toolbox for dry materials

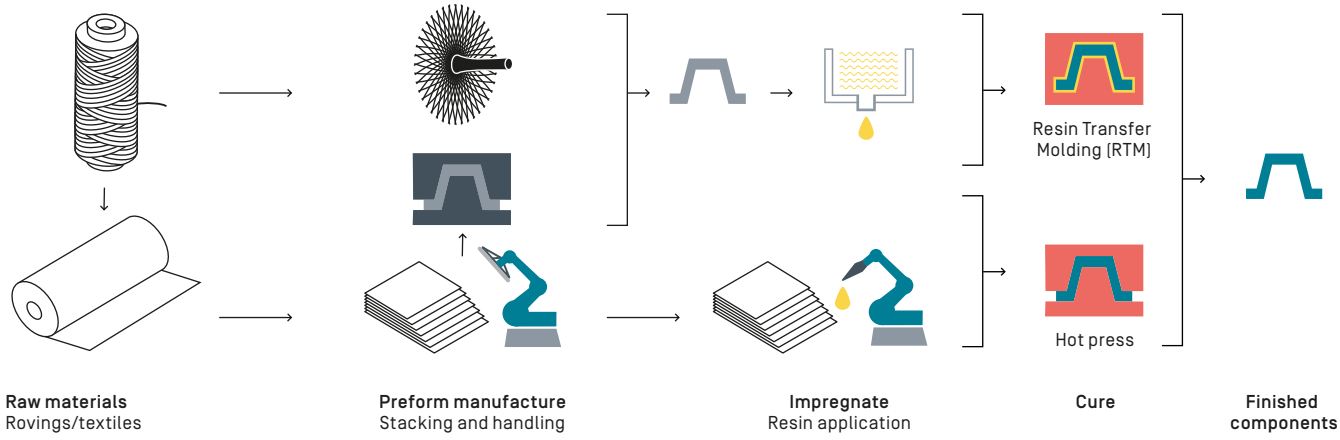
Reinforcement fibers can be brought directly into shape, e.g. in a braiding process, or they can be used to manufacture textiles, which are then cut to size, stacked and draped into a laminate. The net shape dry fiber structure, called preform, is infiltrated with a thermoset resin in a closed mold. Another option is wet compression molding. In this process the resin is applied on top of a flat textile lay-up. This stack is subsequently transferred to a press that simulatinously impregnates and drapes it into the final shape of the component. Under pressure and temperature, the resin subsequently cures in the tool and, after demolding, the component must only be mechanically trimmed to final contour.

↑ SIGRAFIL continuous carbon fiber tows with 50,000 filaments



↑ SIGRATEX biaxial carbon fiber fabric

Process route of our toolbox for dry materials



Economical textiles and short cycle times
The high throughput of textile machines allows there to be very efficient production of fabrics and non-woven textiles as semi-finished products. Fiber placement processes help reduce cutting waste by net-shape manufacture of the stack. Direct preforming processes such as braiding also minimize waste. Due to their low viscosity, thermoset resins impregnate the preforms in very little time. Specifically with wet compression molding, cycle times of just a few minutes can be realized. Thanks to good mechanical properties, moderate process and low material costs, these processes are commonly used in volume manufacturing.

Typical areas of application
- Automotive production: Standard process for many components
- Wind power: Especially rotor blades
- Industrial applications: Large components
- Marine applications: Hulls

Systems and processes in LAC

- Cutter for textiles
- Braiding machine
- AFP systems for fiber tapes and FixTow
- Wet compression molding cell
- RTM (Resin Transfer Molding)

↑ Robot-based AFP system for 3D lay-up of tapes

↑ Radial braiding machine with 128 bobbins and handling robot for manufacturing three-dimensional hollow profiles

↑ Inserting textile pre-cuts into wet compression molding cell for resin application

Our toolbox for prepregs

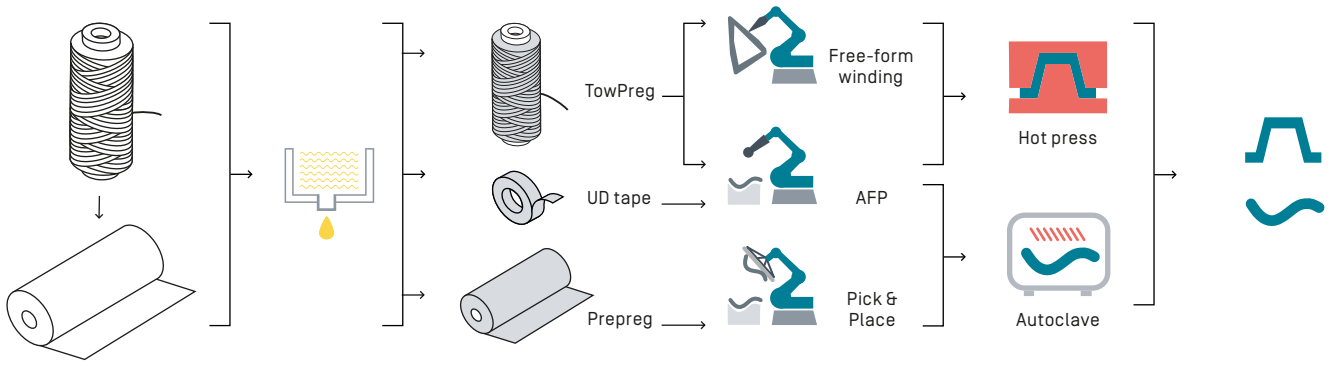
The prepreg-based manufacturing route: the reinforcement fibers are firstly impregnated with an uncured thermoset resin. In fact, this happens at roving, UD layer or textile levels. The semi-finished products (TowPreg, tape, textile-based prepreg) are then cut, either manually or automatically, and laminated. In the AFP process, multiple tapes are placed either directly into the mold or as a flat stack by a robot-assisted laying head.

Curing is typically done in an autoclave or hot press, which combines shaping and curing. Robot-assisted freeform winding creates a load-optimized three-dimensional network of TowPreg that is subsequently pressed into a finished component. This process enables the integration of metallic load added and allows for producing components directly in their final shape. Thus, no further machining step is required.

↑SIGRAPREG woven carbon fiber fabric prepreg

↑ SIGRAPREG TowPreg

Process route of our toolbox for prepregs



Systems and processes in LAC

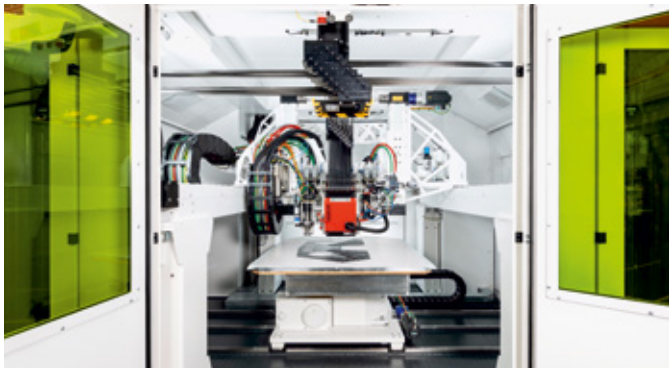
- TowPreg and prepreg lines
- Laying and winding machines
- Pick & Place
- AFP systems
- Autoclave and hot-pressing

Superb laminate quality: high fiber content, low porosity
Precisely controlled resin distribution within the components results in high quality laminate with high fiber content and low porosity. Processes with near net-shape lay-up capability, such as AFP, help to significantly reduce cutting waste. With free-form winding, the material is even processed without any off-cuts. Our snap-cure resin systems enable cycle times of less than 3 minutes.

Examples of current areas of use and trends:

- Aerospace: Ribs, stiffening profiles, wing and fuselage shells
- Sporting goods: Bicycle frames and parts, tennis rackets and golf clubs
- Medical technology: Parts with complex geometries in small lots
- Automotive trend: Innovative components through direct molding with fast resins

↑ Hot-press for curing prepreg components



↑ Gantry-based 2D-AFP system for processing TowPreg

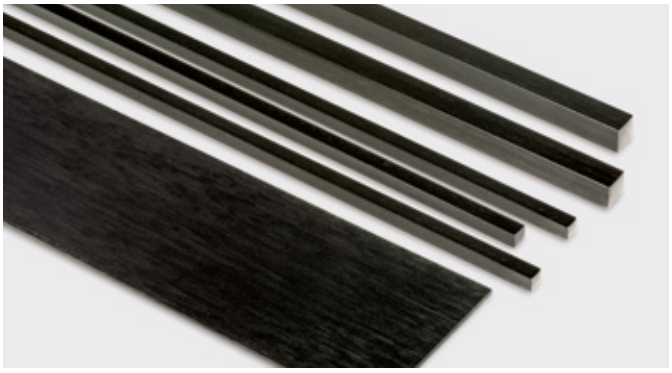
↑ Multifunctional robot winding cell for 3D placement of TowPregs

Our toolbox for thermoplastics

As the viscosity of thermoplastic polymers at their processing temperature is significantly higher than that of reactive resin systems, fiber structures can only be impregnated comparatively slowly, under pressure, and temperature. Pre-impregnated semi-finished products are therefore usually produced in a first step. Time consuming impregnation is thus decoupled from component production.

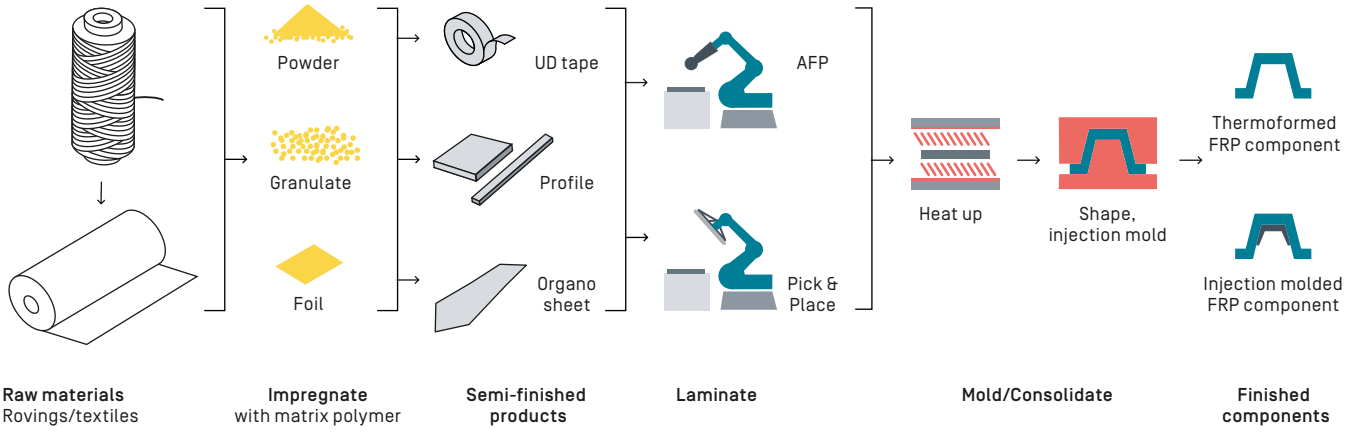
UD tapes are placed into load-optimized stacks or laminates using AFP processes; profiles are preformed by heating or pressing, and organo sheets are cut to contour and stacked. The thermoplastic matrix is then brought to melting temperature in an infrared field or oven and the structure is reshaped in a press. An injection molding machine can be used to integrate additional complex functional surfaces made of pure or fiber-reinforced plastics. The component cools down in the mold and is then often ready for use without further machining.

↑ Thermoformed fabric organo sheet with injection-molded ribs



↑ Carbon fiber-reinforced thermoplastic profiles

Process route of our toolbox for thermoplastics



High-speed production with cycle times of less than one minute

Thermoplastics enable production cycles of less than one minute. Furthermore, thermoplastic-matrix composites can be remelted, which allows for post-forming and even welding, thus opening up new possibilities in joining technology. For instance, joints can be easily dismantled in order to simplify repair and recycling. Thermoplastics are also more impact-resistant than thermoset matrix materials. By using thermoplastic composites as inserts in the injection-molding process, off-the-mold composite components can be manufactured by back injection molding.

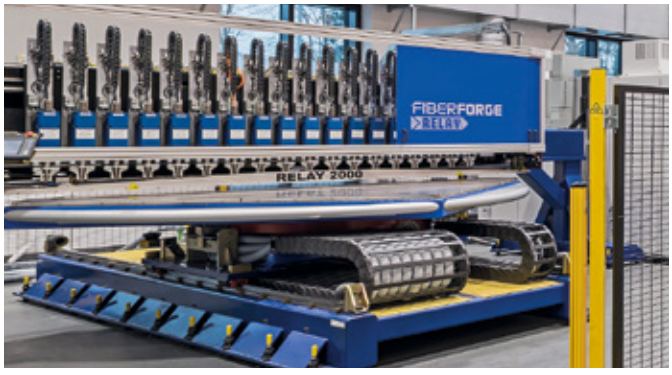
Examples of current usage and trends:

- Automotive: Extruded organo sheets in many applications
- Automotive trend: Skeleton design as a pioneering and material-efficient option for large-scale production
- Aerospace: Leading edges and brackets for fuselage assembly
- Aerospace trend: Applications for large structural elements

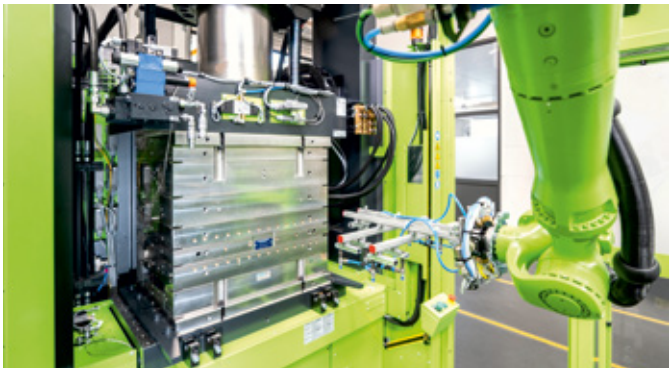
Systems and processes in LAC

- Systems for profile and tape manufacture
- AFP systems
- Injection-molding system with pre-heater
- Thermoforming cell
- Hot-pressing for organo sheets

↑ Thermoforming cell with infrared heating field and handling robot



↑ 2D lay-up station for thermoplastic tapes up to 100 mm width



↑ Injection-molding system with 6-axis handling robot and pre-heater

Successful together

Joining forces for success. This is our goal and our promise at the Lightweight and Application Center of SGL Carbon. We are, of course, technicians and engineers with one-of-a-kind lightweight construction expertise. We work with the latest design and engineering technologies, and have the latest equipment for all manufacturing processes at our disposal.

But we are also convinced that something decisive must be added to enable the best solution for you: collaboration based on partnership throughout all phases of development. We are there for you from the beginning, involving you in to all processes and accompanying you step by step.

Virtual reality for your very real solution

Lightweight construction can make many things lighter. And this is precisely why we team up with our customers to develop new solutions every day at the LAC. Not just any, but the best for your specific requirements. So we can proudly claim that we don't use yesterday's tools. On the contrary: we are often a step ahead of current development work.

We put on augmented-reality glasses to observe the development of innovative lightweight construction parts from an entirely new perspective. And that's just one of many examples. Linking the virtual to the real world of development provides us with many options for continuously developing better products far quicker.

What is your lightweight construction idea? Let's talk about it. Together we can put it into practice.

Smart Solutions

Be it materials, components or production processes, we focus our thinking and actions on the customer and keep an eye on the big picture. Our solutions already anticipate the future today.

The following examples show a selection of our unique product range.

Mobility

- Lightweight components and structural parts based on fiber-reinforced composites for automotive and aerospace manufacture
- Graphite anode material for lithium-ion batteries in electric vehicles
- Carbon-ceramic brake disks for sports cars and luxury sedans

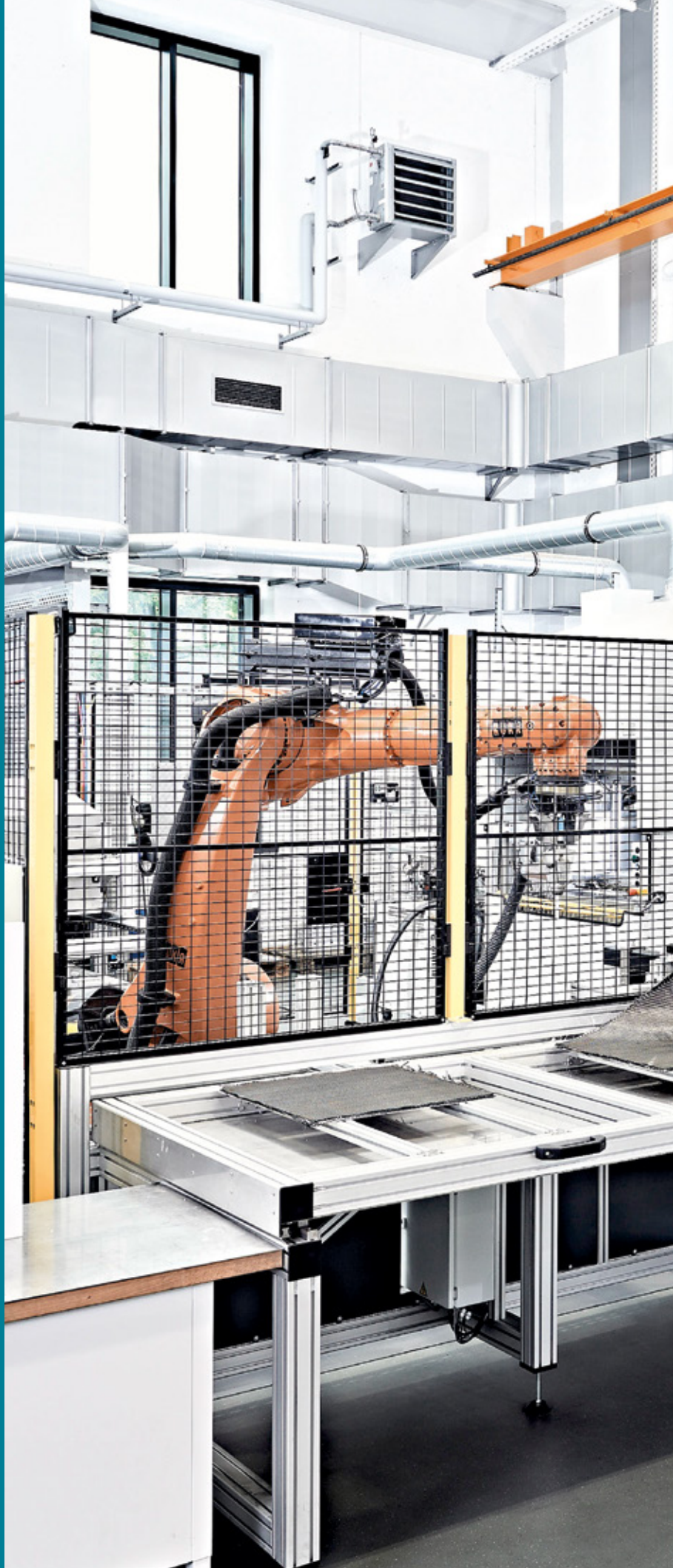
Energy

- High-temperature solutions based on specialty graphites and fiber materials for the photovoltaic industry
- Carbon fiber materials for rotor blades
- Gas diffusion layers for fuel cells
- Systems for more efficient heat exchange and heat recovery
- Carbon fibers for pressurized gas containers

Digitization

- Carbon, graphite, and CFC components for polysilicon and monocrystal pulling in the semiconductor industry
- High precision, coated graphite carriers for the production of LEDs

→ Wet pressing process for CFRP component production in the Lightweight and Application Center



SGL Carbon

We are leaders in the development and manufacture of products based on carbon, graphite, carbon fibers, and fiber-reinforced composites. In partnership with our customers, we develop intelligent, trendsetting, and sustainable solutions that deliver a clear benefit.

With our in-depth material, engineering, and application know-how, we make a substantial contribution to the major future topics mobility, energy, and digitization.

Contact

Contact our Lightweight and Application Center in Meitingen/Germany for individual consultation:
cs@sglcarbon.com
Phone +49 8271 83-1000

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Composite Solutions
SGL TECHNOLOGIES GmbH
Werner-von-Siemens-Strasse 18
86405 Meitingen/Germany
www.sglcarbon.com/company