

Lightweight Solutions made from

**Carbon-fibre Reinforced Plastic (CRP)**



**LIEBHERR**



# New Dimensions with CRP Solutions by Liebherr

Robust and durable components are not in contradiction with optimisation and efficiency. In pursuing this task Liebherr offers solutions made from carbon-fibre reinforced plastic.

As a traditional engineering company, Liebherr shapes technological progress with the implementation of new materials and the creation of innovative processes.

For Liebherr this means ...

## **Taking advantages of CRP benefits**

The fibre composite has characteristic properties that can provide considerable benefits in the application with an optimal product design.

## **Demonstrate the opportunities**

In various application areas and branches, CRP components are utilized in a proven and targeted manner.

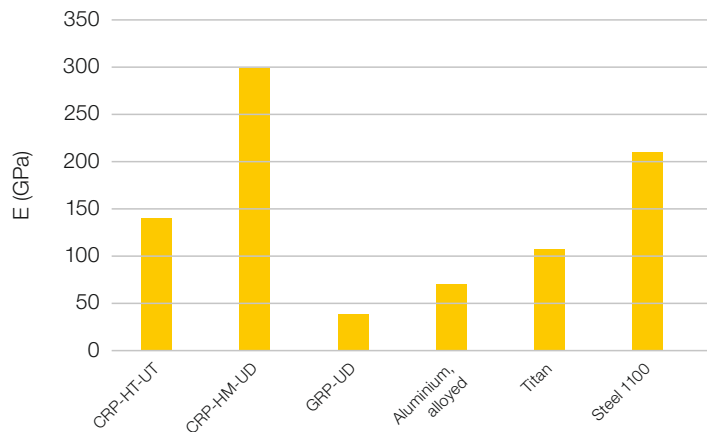
## **Be the development partner**

Challenges that arise throughout the entire product life cycle are tackled together with the customer.

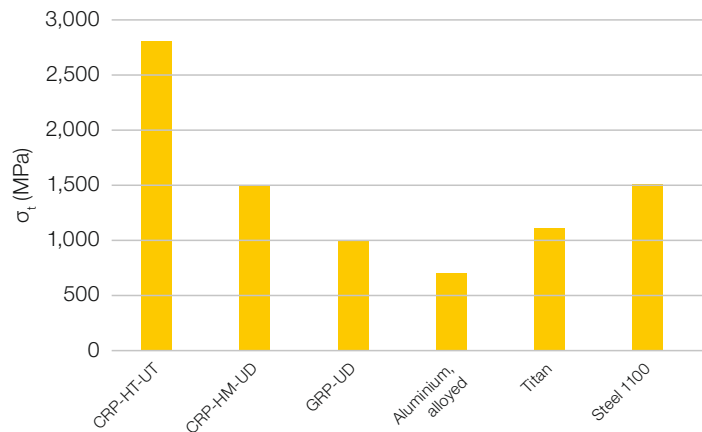
## **Have in-house expertise and know-how**

To fulfil the quality promise, Liebherr develops and manufacture completely in-house.

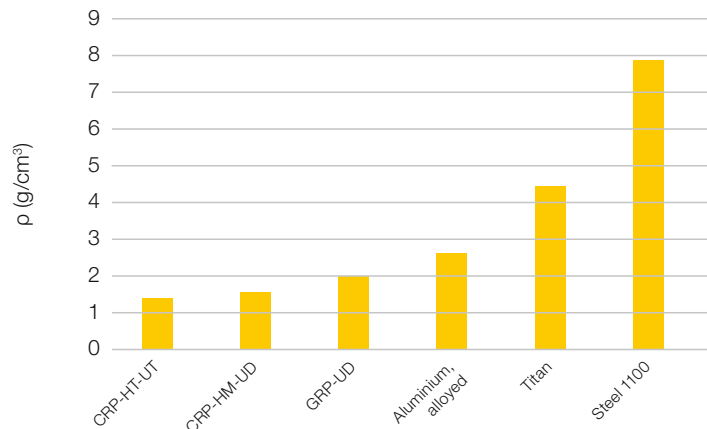
### High stiffness for a lower deformation



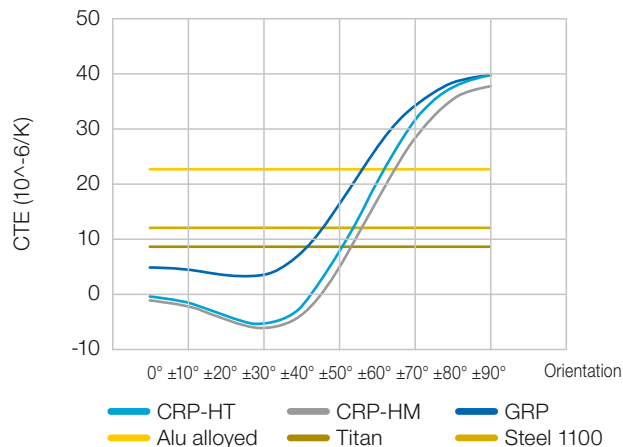
### High tensile strength for heavy loads



### Low density for optimal weight reduction



### Adjustable thermal expansion for temperature independent accuracy



CRP=carbon-fiber-reinforced plastic, GRP=glass-fiber-reinforced plastic, HT=high tenacity carbon-fiber, HM=high modulus carbon-fiber, UD=unidirectional orientation of fibers, CTE=coefficient of thermal expansion

# Taking Advantages of CRP Benefits

## **Tailore-made profile of properties explore new horizons**

Carbon-fibre reinforced plastic (CRP) allows freedom of design. For instance, various raw materials and the orientation of the reinforcement fibres allow the composite material to be designed in itself. Thanks to the customisation of stiffness, strength and density, the material can be individually adapted to diverse profiles of requirements.

Liebherr understands the challenging requirements of customers.

With the expertise in composites technology the implemented solutions improve the performance of the individual components and the entire system to reach higher dimensions.

Through the selective substitution of conventional materials Liebherr optimises the weight and performance of individual components across assemblies through to complete systems. Apart from static and dynamic efficiencies, further added-value is generated. Positive corrosion behaviour, special damping characteristics or adjustable thermal expansion are of use here.

**“As a strong development partner, we consider it as our mission to realise innovation and ideas in the area of CRP together with our customers - in that way we overcome the challenges in the market environment of our partners.”**



# Demonstrate the Opportunities

Liebherr Components identifies trends and potentials in lightweight design at an early stage due to a high level of understanding for customers and their applications. Marketable solutions of today meet customer requirements of tomorrow - to ensure a common global competitiveness.



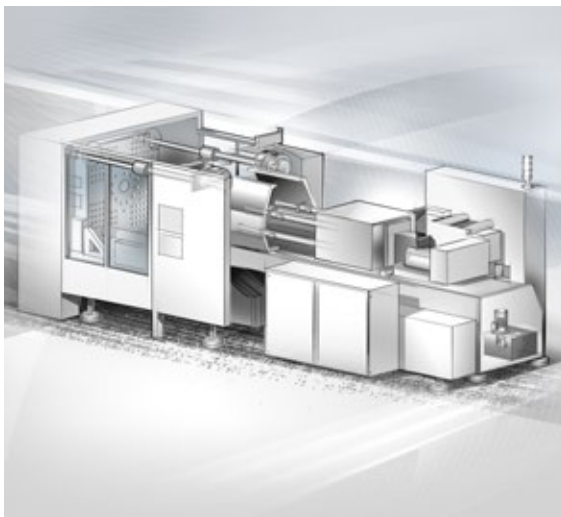
## New dimensions

In the crane and construction machinery sector, tailor-made lightweight design is applied where conventional materials reach their limits statically and dynamically. This increases payloads, operating heights and working speeds.



## New potentials

Fiber-reinforced materials have already been put through their paces in the aerospace industry. Today they reduce fuel consumption and emissions in motor vehicles and commercial vehicles. This increases range and load capacities. By doing so Liebherr actively shapes the mobility of tomorrow, together with its customers.



### **New benchmarks**

The characteristic material properties of fibre composites can be found in a wide range of industrial applications. Low moving masses and temperature independence revolutionise the world of measuring and testing technology. CRP also sets the benchmark for performance in the consumer goods industry.



### **New energy**

Powerful material combinations play an important role in production and storage of energy as well as in electrical machines. This significantly increases efficiency while reducing maintenance costs at the same time. Composite materials ensure the competitiveness of alternative energy and drive concepts and thus provide an important part for sustainability.

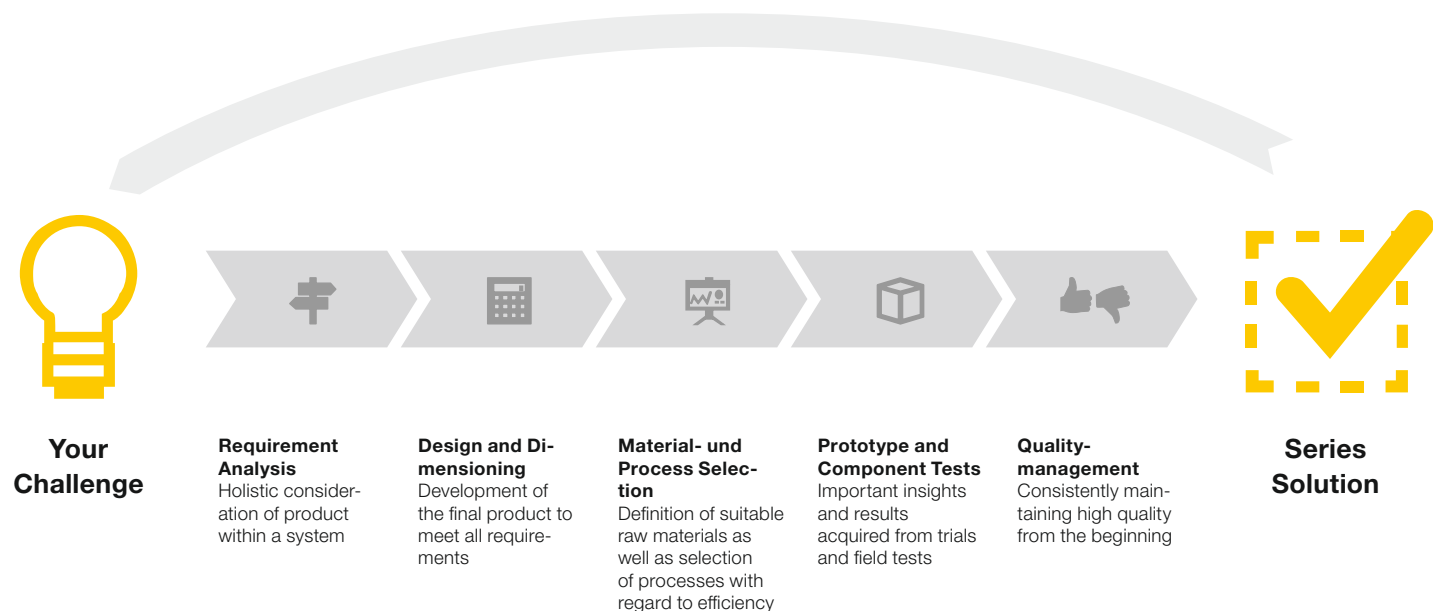




# Being the Development Partner

To implement a reasonable solution, Liebherr is a strong development partner who assists from the outset. Experienced employees take all necessary actions from the requirements analysis to production-ready solutions with a view to customer needs.

Liebherr overcomes challenges that arise throughout the entire product life cycle together with the customer. In doing so solutions are adjusted if necessary and adapted to new requirements.





# Have In-house Expertise and Know-how

## **Requirement analysis**

An comprehensive analysis of the customer application is the basis of every development process. Apart from determining the static and dynamic loads, this also includes the consideration of the complete system as well as its environment.

## **Design and dimensioning**

From rough dimensioning to a fibre-specific design, Liebherr offers a very detailed component analysis for the optimisation of the fibre composite laminate using FEA. Guidelines such as VDI2014 or DNV-GL can also be utilized.

## **Material and process selection**

Meanwhile market and technology offer a variety of fibre materials, matrix systems and manufacturing processes. With respect to cost, performance and quantity the optimum composition is chosen.

## **Production**

CRP products are manufactured in-house. In production Liebherr focuses on automated processes and state-of-the-art facilities, which allow efficient and considerate processing of the raw materials. The focus here is on safety for human beings and the product.

## **Quality management**

Liebherr offers highest quality standards in the area of fibre composites. This requirement is met with the integration in the innovative Quality Management system of the company group. Destructive and non-destructive testing is carried out throughout the entire process chain. The documentation of all production parameters and continuous process improvement are regarded as a matter of course.



# Liebherr Components



Gas engines



Diesel engines



Fuel injection systems



Axial piston hydraulics



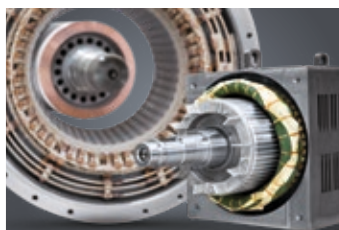
Hydraulic cylinders



Slewing bearings



Gearboxes and winches



Electric machines



Remanufacturing



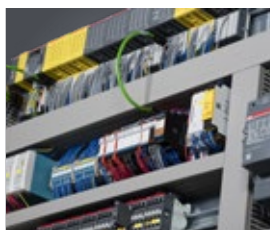
Human-machine interfaces and gateways



Control electronics and sensor technology



Power electronics



Control cabinets



Software

From A to Z – the components division of the Liebherr Group offers a broad range of solutions in the area of mechanical, hydraulic, electric and electronic drive system and control technology. The efficient components and systems are produced at a total of ten production sites around the world to the highest standards of quality. Central contact persons for all product lines are available to our customers at Liebherr-Components AG and the regional sales and distribution branches.

Liebherr is your partner for joint success: from the product idea to development, manufacture and commissioning right through to customer service solutions like remanufacturing.

**[components.liebherr.com](http://components.liebherr.com)**

## Liebherr-Components AG

Post box 222, CH-5415 Nussbaumen / AG

☎ +41 56 296 43 00

✉ [components@liebherr.com](mailto:components@liebherr.com)

## Liebherr USA, CO.

1465 Woodland Drive, Saline, MI 48176, USA

☎ +1 734 944 63 34

✉ [components.usa@liebherr.com](mailto:components.usa@liebherr.com)