Joining and assembly technology
- Shape and positional correction
- Stress/load monitored assembly
- Automated joining and shimming
- Quality surfaces suitable for assembly | Flex® release film
- Adhesive bonding
- Combined adhesive bonding and riveting
- Surface pre-treatment
- Sealing of edges and rivet/bolt heads

Machining technology
- Milling
- Drilling
- Waterjet cutting
- Process benchmarks
- Sensor-controlled machining processes
- Mobile robot-based machining modules

Automation
- Integration of measuring technology
- Improvement of robot precision
- Offline programming
- Software development

Automation and Production Technology

In cooperation with the Institute for Production Management and Technology of Hamburg University of Technology:

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Lightweight design is vital for the future. New construction methods are allowing improved design, better performance, and weight-saving.

This is playing a decisive role in the transport industry, – e.g. for cars, rail vehicles, ships, and aircrafts – because it allows fuel consumption and CO2 emissions to be reduced and hence has benefits for resource usage and the environment. Fiber reinforced plastics (FRPs) are ideal for lightweight construction because of their low weight and simultaneous very high strength, high load limit, and excellent fatigue properties. In the area of renewable energy, and in particular wind energy, FRPs allow the use of energy-efficient construction methods and improve the profitability of wind turbines.

Once the use of glass fiber reinforced plastics (GFRPs) and carbon fiber reinforced plastics (CFRPs) has become established in industry, the number of large FRP structures is expected to grow substantially. This will require further development and increased automation of production processes. For the assembly of large structures, in particular, this brings many challenges.

**Expertise in joining and assembly technology**

How can large components, which in some cases differ significantly from the specified geometry as a result of the production processes, be joined to minimize material wastage and maximize profit? How can innovative materials and combinations of materials be effectively joined and assembled? Adhesive bonding technology provides the answer here. Besides their actual joining function, adhesives provide other useful properties such as complete filling and sealing of different gap geometries, planar force transfer, absorption of strain deformation by the adhesive so protecting the substrates, and electrical insulation. Fraunhofer IFAM has longstanding experience of adhesive bonding processes and develops partly or fully automated processes that allow highly effective bonded joints to be realized having good long-term stability. The Automation and Production Technology department utilizes adhesive bonding on large 1:1 structures for industrial applications. The department tackles topical challenges such as developing faster assembly processes with simultaneous cost-saving. Our technology portfolio also includes the award-winning FlexPLAS® release film. This film allows the facile demolding of components and creates high-quality “ready-to-paint” surfaces.

**Expertise in machining technology**

The machining of FRPs involves wholly different challenges to the machining of metallic materials. This is due to their different mechanical properties, the anisotropic structure of the materials, and their sensitivity to high process temperatures.

The machining of components at the end of a high value creation chain, where CFRPs typically represent ca. 80 percent of the final manufacturing costs, means that minor processing faults can result in major financial losses. Fault-free production is essential here and this can only be achieved by having total control of processes. An important tool here is fault prevention by monitoring key process parameters.

A further main activity is the realization of versatile plant design. The necessary process precision here is not achieved with heavy-duty foundations and heavy steel machinery but is rather achieved with mobile, precision-controlled processing modules made of lightweight components, such as industrial robots, which can be used simultaneously.

**Expertise in automation**

Automated production plants for the machining and assembly of large FRP structures need high-precision measurement and control systems. Many of the processes that are established for the mass production of smaller components have technological limitations when it comes to processing large structures. The latter must be treated as unique products due to their production-related geometrical differences. Under these boundary conditions, the “teaching” of robots does not lead to satisfactory results.

There is currently a need for intelligent systems which adapt individually to the relevant component geometry and production situation. Flexible components must be automatically positioned and their shape modified.

This is achieved via automated, precise 3D geometry measurement, for example using coupled laser-optic geometry measurement methods.

In addition, the absolute positioning accuracy of offline-programmed 6-axis industrial robots for large structure assembly can be improved to 0.1 mm by additional calibration. Sensor-aided CAD-CAM coupling allows adaptive web guidance in real time and increases the versatility of production plants.