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Fraunhofer Institute for Large Structures in Production Engineering IGP

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Overview of services

Joining and Forming by Plastic Deformation



Joining and Forming by Plastic Deformation

In the field of **forming-based joining**, we are dedicated to the development and analysis of modern joining technologies for lightweight materials. The emphasis is on fiber-reinforced composites and wrought aluminum alloys, which are joined efficiently and, in a material-friendly way using purely forming-based joining processes. These technologies play a central role in the mobility industry, for example in aircraft, rail vehicle and automotive manufacturing.

A key part of our work is ensuring the practical suitability of forming and setting processes. We therefore systematically evaluate whether the joints produced meet our customers' demanding requirements. Beyond assessing load-bearing capacity under static and cyclic loads and evaluating crack initiation, crack propagation, and joint failure from a fracture-mechanics perspective, functional properties such as leak tightness and electrical conductivity are tested, and the suitability of nondestructive testing methods is explored.

The research focus in the field of **forming by plastic deformation** centers on fundamental questions regarding the shaping of component structures. To this end, we develop predictive models

and derive process control concepts for cold plastic forming, primarily for large sheet metal panels thicker than 5 millimeters. These concepts are then evaluated and optimized for real-time capability to enable integration into machine control systems.

Our Services

- Application-specific development and optimization of forming-based joining processes for lightweight construction materials
- Process integration of joining technologies through joint sampling, innovative tool concepts and ergonomic workstation design
- Establishment of quality assurance procedures, e.g., monitoring installation process or applying NDT methods
- Material and joint tests (quasi-static, fatigue, fracture mechanics)
- Simulation of joining and forming processes using numerical FEM (ANSYS, LS Dyna, etc.)
- Forming of thick sheet metal and development of simplified prediction models for control system integration
- Development of self-learning (AI) systems for forming and joining processes
- Analytical methods for sensitivity and damage analysis in forming-based joining and shaping processes (metallography)