Special Installations

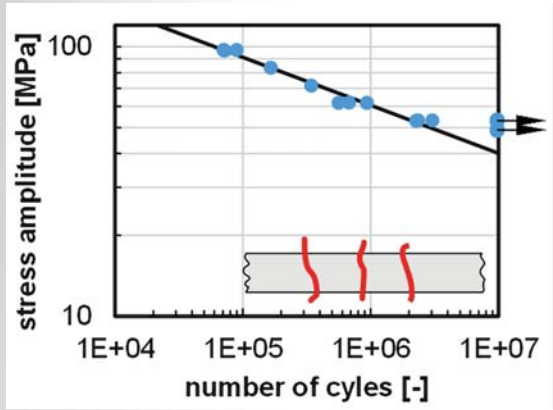
- Friction Stir Welding machine
- Resistance welding machines (spot welding and projection welding)
- Ultrasonic welding machines
- Thermomechanical testing system Gleeble
- Thermal imaging/infrared camera (-25°C to 2000°C, 50 images/s)
- Universal testing machines
- Test facilities to measure contact and material resistance
- Furnaces for heat treatment

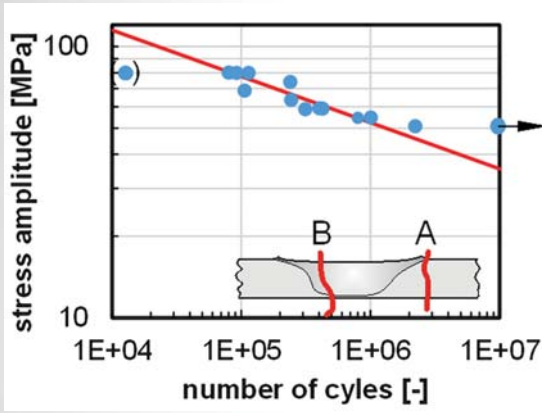
Expertise

- Sample welding
- Numerical process simulation (FEM) in the field of joining and welding technology
- Investigation of material and process-related occurrences during welding as well as development of innovative joining technologies for new materials
- Process development for innovative fields of welding technology (e.g. Friction Stir Welding)
- Numerical simulations to optimize the residual stress condition of welded joints and to determine microstructure development and hardness
- Linked with the High-Performance Computing Center Stuttgart
- (HLRS)
- Examinations of welded samples (non-destructive testing, strength, metallography)

Unit:
Joining Technology

https://www.mpa.uni-stuttgart.de/en/institute/departments/joining-technology-and-additive-manufacturing/





Comparing the Wöhler curves, it shows the excellent fatigue strength of a friction stir welding connection relating to base material EN AW 6016 T4.

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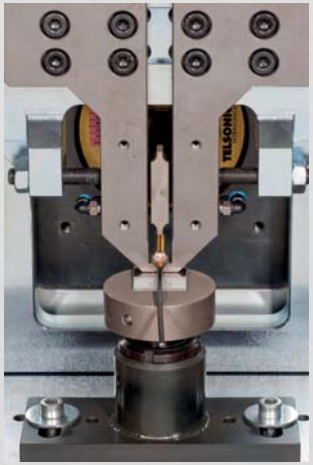
The Joining Technology unit does research concerning issues in process technology and metallurgy of welding. The focus is currently on resistance spot welding and friction stir welding. Additionally, projection welding and ultrasonic welding as well as fusion welding processes can be tested in our laboratories.

Our portfolio includes experimental work such as parameter studies, process optimizations, heat treatment investigations including the determination of the developing microstructure and the resulting static and cyclic strength properties. In addition, we are working on current research projects to develop and improve numerical process simulations to predict process temperatures, resulting microstructures and their properties.

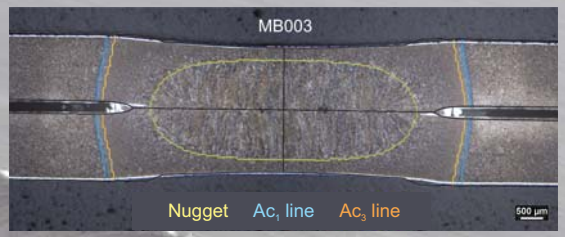
Due to the combination of numerical process simulation, experimental investigations and a deep understanding of the process, we are able to develop optimal and application-oriented solutions for various welding processes. Recently we have developed new joint configurations for friction stir welding with which aluminum and steel sheets of different thicknesses can be joined as butt joint.

Ultrasonic Welding

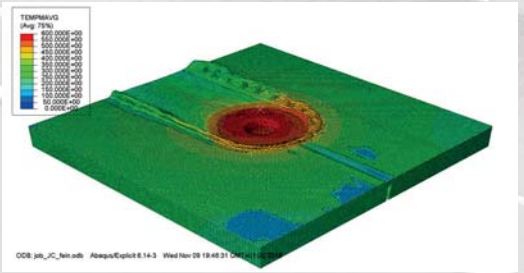


Resistance Spot Welding

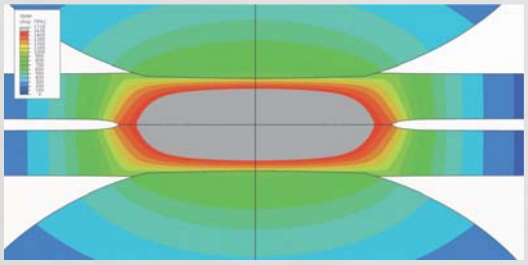
Current research analyses numerically and experimentally the influence of process parameters of resistance spot welding on the formation of softening zones in high-strength steels, which could endanger component integrity through the formation and expansion of cracks. For this purpose, an FE model is used to calculate the resulting hardness in the heat-affected zone, the microstructure and the nugget diameter after the welding process.



Welding Process Simulation



Calculated temperature fields for friction stir welding (above) and resistance spot welding (below)



Friction Stir Welding

At the MPA, innovative weld configurations are being developed and experimentally tested for high-strength joining of aluminum and steel plates by means of friction stir welding. Additional experimental works are thermomechanically coupled, continuum mechanical simulations using specifically developed material models.

Friction Stir Welding (FSW)-machine ESAB Legio-3ST