



Testing Equipment at FLB

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Preface

The Institute of Automotive Lightweight Design (FLB) University of Siegen was founded in 2010. The research at FLB deals with the development of lightweight design strategies and principles for car body and chassis structures.

In particular, the lightweight design development considers the whole development chain starting from material properties and manufacturing technology to the final design. The main goal of the research at FLB is to develop novel lightweight design methods and applications, which can be industrialized and realized in a cost efficient way.

Following this approach novel components and material applications based on innovative manufacturing techniques and design strategies are developed independently at FLB, but also in cooperation with industrial partners within the framework of research projects.

FLB University of Siegen is also founding member of the South Westphalia Automotive Center (ACS) and was part of the car body development of the electric vehicle *StreetScooter*.

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Drop tower



Figure 1: Drop tower (l.) and exemplary test setup of a component test (r.)

Application field:

- Dynamic testing of structural components, joining technologies and material behavior under various load conditions
- Enlarging of testing area due to modular drop tower assembly for testing of large components (e.g. longmembers, bonnet)

Technical specifications:

- Maximum test velocity: 34 kph
- Fall mass: 1 kg to 1000 kg
- Measurement of force, displacement and acceleration with 100 kHz sampling frequency
- Different Impactor geometries applicable (e.g. for 3-Point Bending, Axial Crash, etc.)

Sledge test system



Figure 2: RCAR bumper test barrier (l.) and sledge test setup with 10°RCAR structure test barrier (r.)

Application field:

- Dynamic testing of crash management systems (CMS) and various front or rear end vehicle structures
- Testing of restraint systems according to ECE / FMVSS
- Second sledge for car-2-car collision
- Most common barriers such as rigid wall, RCAR barrier, etc. applicable

Technical specifications:

- Sledge mass adjustable up to 2000 kg
- Maximum test velocity: 50 kph
- Evaluation of force, displacement, acceleration and energy absorption profile



Figure 3: High speed video of 10°-RCAR structure test

Multiaxial hydraulic test bench Instron



Figure 4: Modular test field for multiaxial component testing

Application field:

- Cyclic or quasi-static component tests for chassis and body applications
- Testing with 1 (uniaxial) or 2 (multiaxial) channels
- Durability and fatigue investigations
- Flexible clamping systems

Technical specifications:

- Test area size: 4,0 m x 5,0 m
- Hydraulic cylinder maximum forces: 1 x 25 kN, 3 x 40 kN
- Hydraulic cylinder travel: 100 mm
- Signals: cyclic (random, sine, etc.) up to 50 Hz or quasi-static

Tensile test bench Zwick Roell Z100 + Thermal chamber

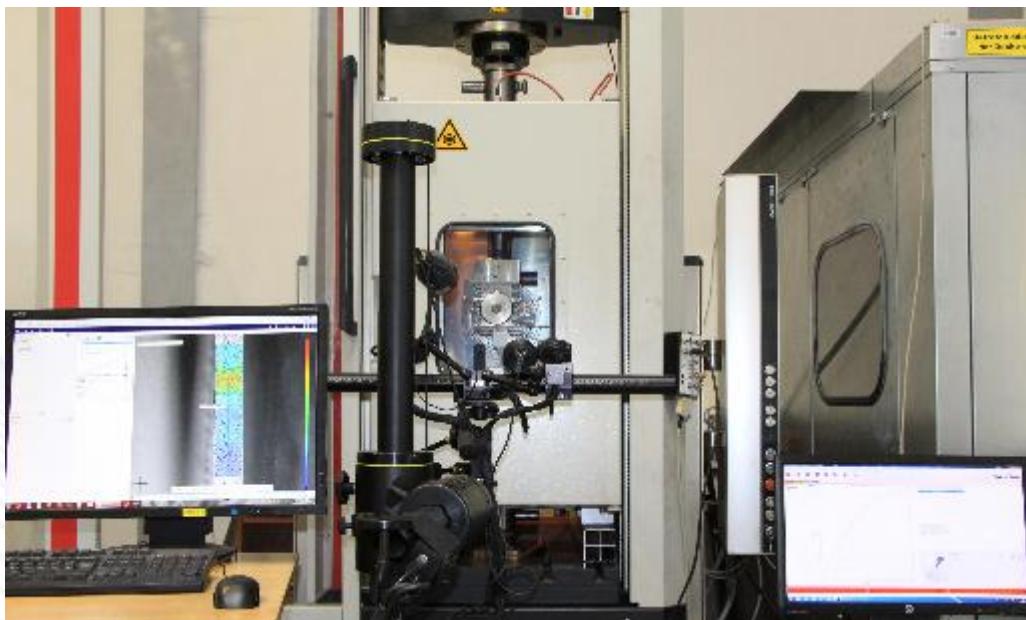


Figure 5: Tensile test with optical strain measurement under elevated temperatures

Application field:

- Velocity controlled low speed material testing with optical strain measurement (GOM Aramis)
- Testing of materials in tension, shear and compression
- Testing of joining technology (e.g. KS2 specimen)

Technical specifications:

- Maximum force: 100 kN
- Maximum test velocity: 400 mm/min
- Temperature range of thermal chamber: -40 to +280 °C

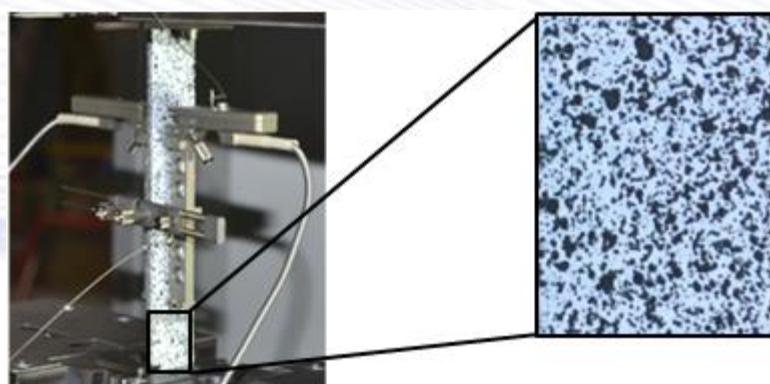


Figure 6: Optical strain measurement (GOM Aramis) using DIC

High speed tensile test machine Zwick Roell HTM 5020

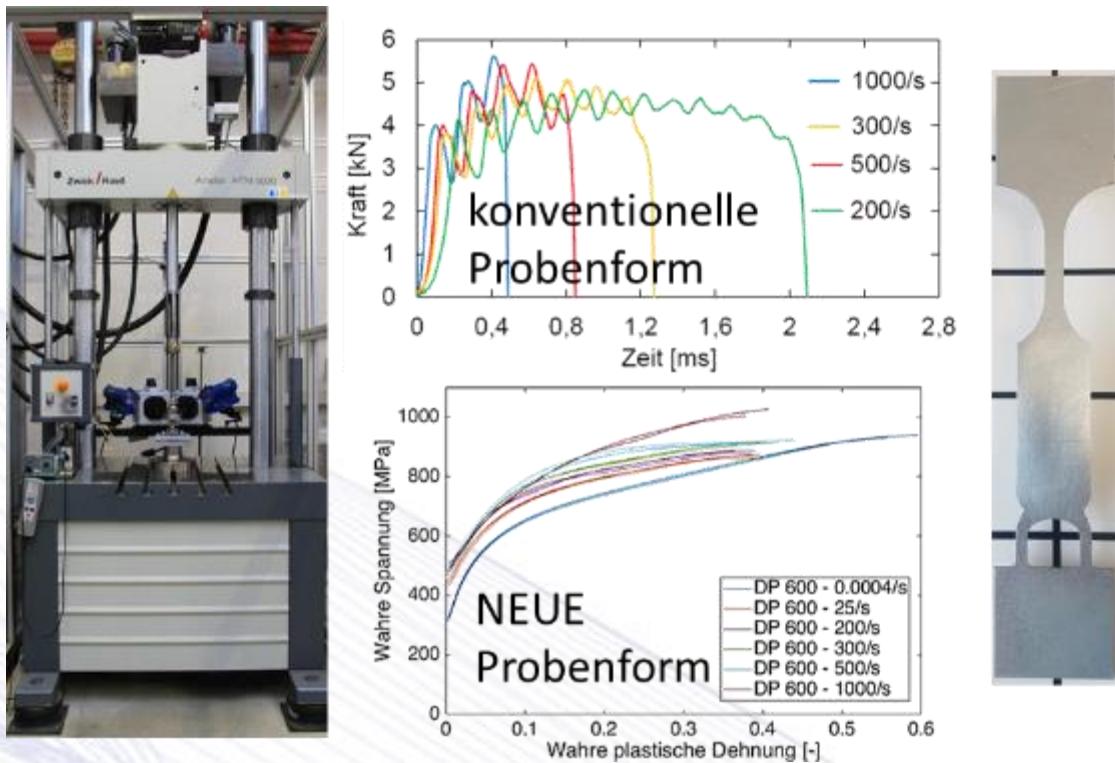


Figure 7: High speed tensile test machine HTM5020 (l.), oscillation free stress-strain curves obtained using novel „GEN. III specimen“ (r.)

Application field:

- Velocity controlled high speed material testing to measure strain rate dependent material properties with reduced oscillations in the force signal
- Material cards for crash simulation can be implemented
- Testing of material and joining technology (e.g. KS2 specimen)

Technical specifications:

- Maximum Force: 50 kN
- Test velocity range: 1.0 to 20 m/s
- Hydraulic drive with pressure tanks (\rightarrow jerk-free starting)
- Optical strain measurement (GOM Aramis) using DIC
- Optionally thermal chamber can be implemented

Electro-mechanic Creep test bench Testcom-50 + Climate Chamber



Figure 8: Creep test bench Testcom-50 (Ibertest)

Application field:

- Stress- or strain controlled creep test with FRPs or metals
- Accelerated creep testing for plastics using stepped isothermal method (SIM)
- Quasi-static testing under elevated temperatures with humidity

Technical specifications:

- Maximum force: 50 kN
- Velocity range: 0,001 mm/min to 500 mm/min
- Size of climate chamber: 680 x 220 x 300 mm³
- Temperatures of climate chamber: -40 °C to +150 °C
- Moisture of 30 % to 85 % (in temperature range 20-80°C)

Servo-pneumatic test bench Dynamess TP10 LCF

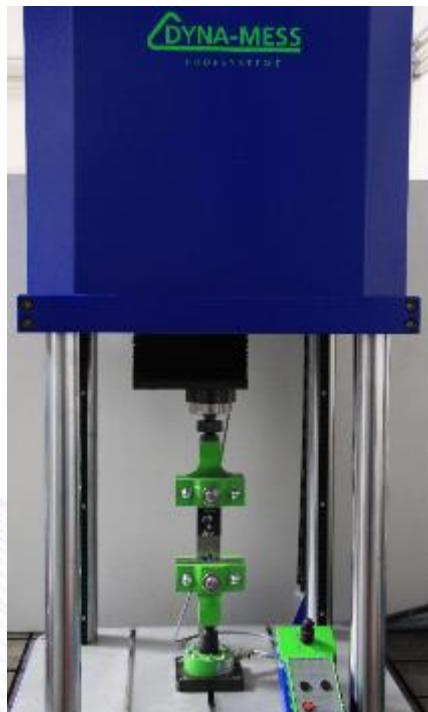


Figure 9: Fatigue test of joining technology

Application field:

- Fatigue tests for joining techniques, plastic or FRP specimen at low test frequency
- Generating SN-curves
- Quasi-static tests in tension or compression

Technical specification:

- Maximum force: 10 kN
- Maximum test frequency: 10 Hz
- Maximum travel: 300 mm
- Flexible clamping devices

Resonance test bench SincoTec Power Swing 100



Figure 10: Resonance test bench with test setup for flat specimen (l.) and H-specimen for cyclic testing of joining elements (re.)

Application field:

- High cycle fatigue test of materials and joining technology
- Electromagnetic excitation of specimen in the eigenfrequency of the test system
- Cost and time efficient generation of SN-curves

Technical specification:

- Load cells: 12.5 and 100 kN
- Frequency range: 30-300 Hz
- Maximum travel: ± 2 mm
- Force or displacement controlled tests possible
- Test area: 530 x 1050 mm
- Various clamping devices applicable (e.g. H-specimen, 3-Point-Bending, etc.)

High speed camera system Photron

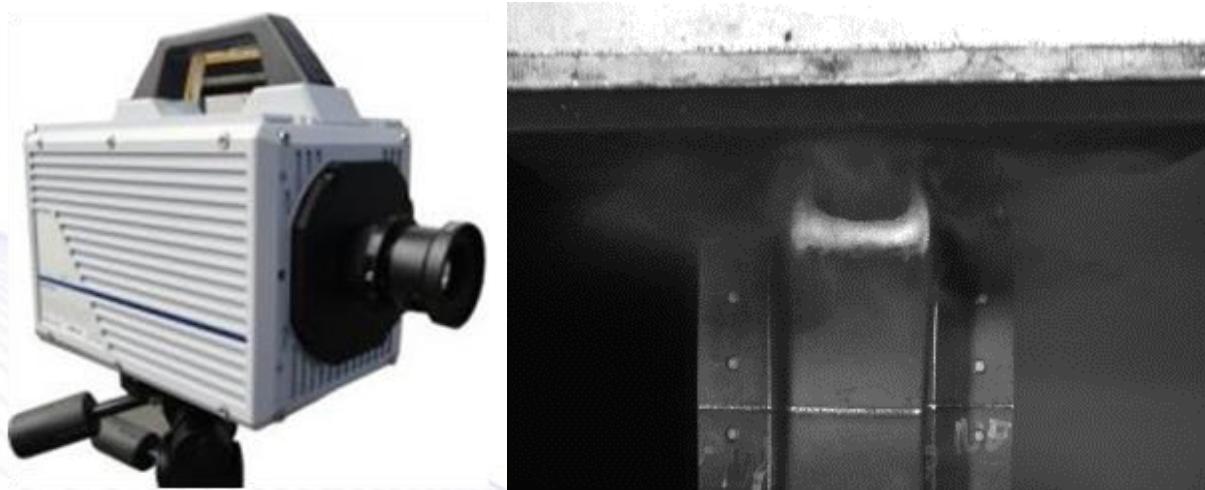


Figure 11: High speed camera Photron SA5 (l.), High speed video of drop tower test with 2.000 fps (re.)

Application field:

- Recording high speed material testing (e.g. Drop tower, sledge test)
- Monitor crack propagation during test in specimen and components
- Optical strain measurement at high speed test

Technical specification:

- 2 cameras available
- Free choice of recording window
- Maximum frame rate of 7.5 kHz at resolution 1024x1024 px, higher frame rate up to 1 MHz at lower resolution possible

High speed thermal camera FLIR

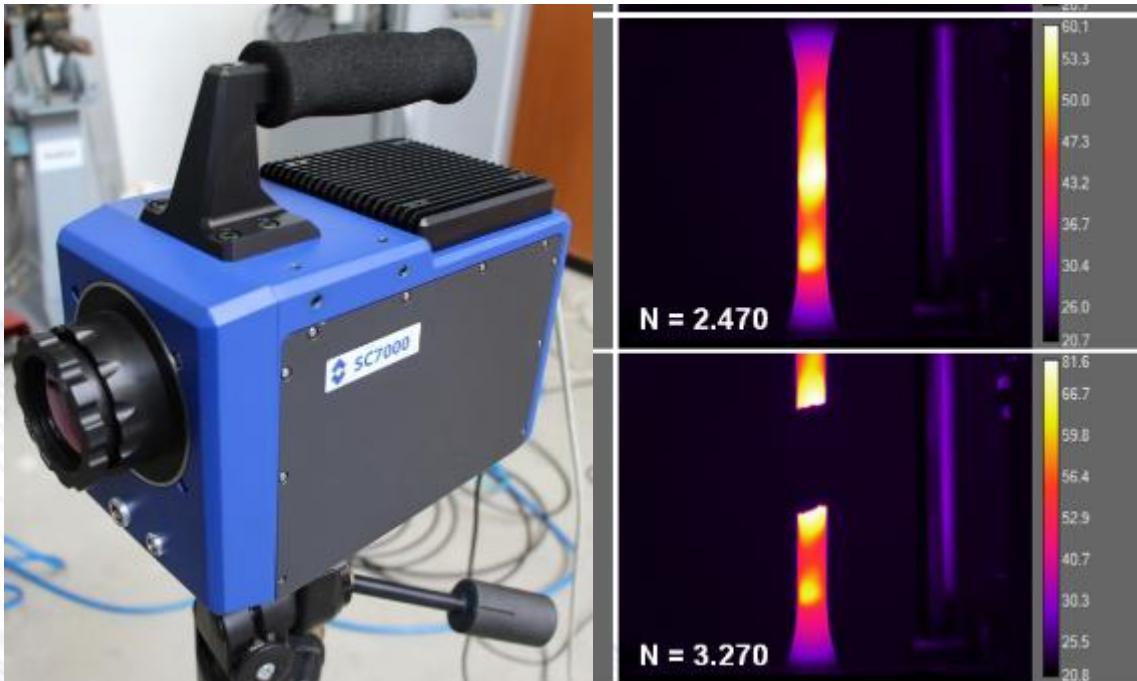


Figure 12: FLIR Thermal camera SC7000 (l.), Heat dissipation during fatigue test of plastic specimen (r.)

Application field:

- Optical temperature measurement (contact-free)
- Control of temperature sensitive material testing of production processes (e.g. measuring mold temperature field)

Technical specification:

- Max. Frame rate: 383 Hz at resolution of 320 x 256 px, higher frame rate up to 31 kHz at lower resolution possible
- Two temperature range calibrations: 5-300 °C and 300-1500 °C

Corrosion chamber



Figure 13:Corrosion chamber with tank (NaCl)

Application field:

- Accelerated corrosion test with specimen or components
- Salt spray test according to DIN EN ISO 9227
- Thermal shock resistance tests

Technical specifications:

- Temperature range: 25-75° C
- Chamber size: 900 x 1100 x 800 mm
- User defined test cycles can be implemented
- Can be combined with cyclic loading on hydraulic test bench

Spot welding machine Dalex



Figure 14: Spot welding system (l.) + novel joining element resistance rivet spot welding (RRSW) (r.)

Application field:

- Spot welding: steel up to 5 mm thickness, aluminum up to 3,5 mm
- Projection welding
- Welding of coated metals possible due to two stage transformer

Technical specification:

- Power: 180 kVA
- Maximum current: 40 kA
- Mid-frequency technology
- Maximum Travel: 100 mm
- Computer aided control of current- and voltage profiles

Hydraulic Press WKP 2000 S + Tempering Furnace



Figure 15: Tempering Furnace (l.) and Hydraulic Press WKP 2000 (r.)

Application field:

- Metal forming
- FRP compression molding
- Tempering Furnace for hot forming

Technical specifications:

- Maximum press force: 2250 kN
- Hydraulic drawing cushion: 50-500 kN / Travel: 200 mm
- Press table size: 1000 mm x 1000 mm
- Mold tempering units applicable

Technical specification furnace Kittec:

- Maximum temperature: 1280° C
- Inner size: 750 x 1100 x 500 mm³

Contact person for technical questions

Test bench / system	Contact person
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