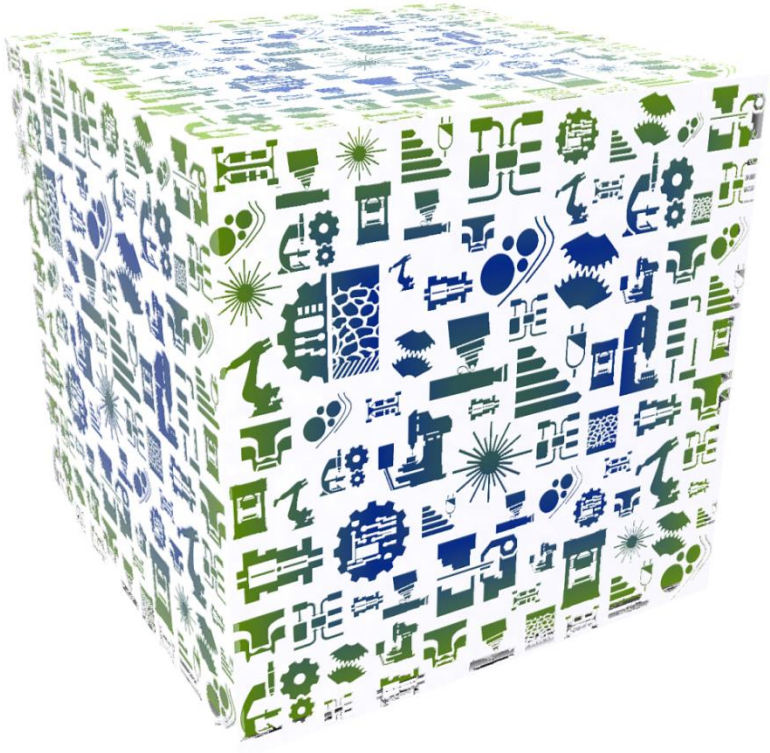
THE FRAUNHOFER IWU
PROFILE



Fraunhofer IWU

Profile of the Fraunhofer IWU

Research under the heading “Resource-Efficient Production“

- Founded Juli 1st 1991
- Currently approx. 530 employees
- Approx. € 40 million annual budget
- Locations: Chemnitz (headquarters) Dresden, Zittau, Wolfsburg, Leipzig
- 3 scientific fields:

Mechatronics and Lightweight Structures	Forming Technology	Machine Tools, Production Systems and Machining

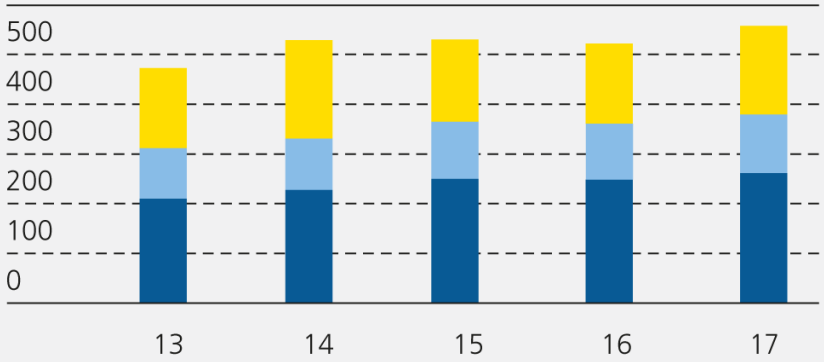
Fraunhofer IWU

Profile of the Fraunhofer IWU

Human resources

Mitarbeiterentwicklung 2013 – 2017

Employee development 2013-2017



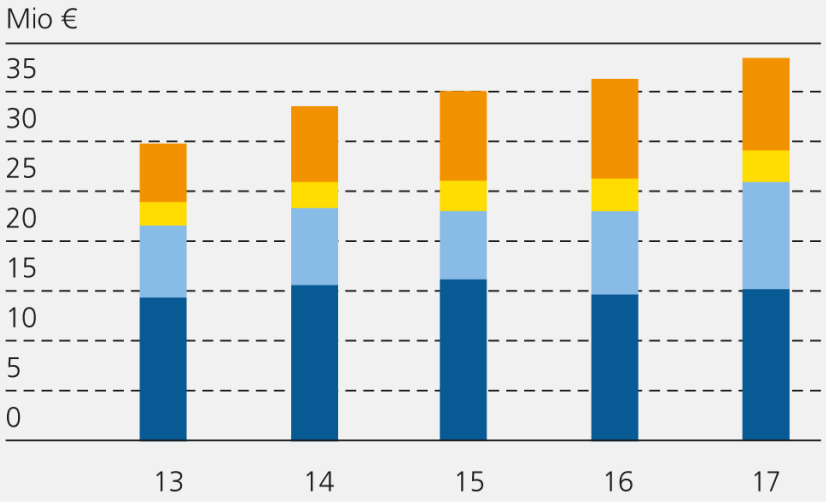
	2013	2014	2015	2016	2017
Scientists	211	228	251	248	264
Administration and technical staff	102	104	114	113	118
Student assistants	160	196	164	160	177
= Employees	**473**	**528**	**529**	**521**	**559**

Fraunhofer IWU

Profile of the Fraunhofer IWU
Finances

Betriebshaushalt 2013 – 2017

Operating budget 2013 - 2017



	2013	2014	2015	2016	2017
Industrial income	14,3	15,6	16,2	14,7	15,0
Public income (Federation and countries)	7,2	7,7	6,8	8,3	10,9
Research funding / other	2,4	2,7	3,1	3,3	3,1
Institutional funding	5,9	7,6	9,0	10,0	9,2
= Operating budget in million €	**29,8**	**33,6**	**35,1**	**36,3**	**38,2**

Fraunhofer IWU

Profile of the Fraunhofer IWU
Advisory Board

Chair
Prof. H. Waltl, AUDI AG

Members
- Prof. Reinhold Achatz, thyssenkrupp AG
- Dr. Stephan Arnold, Europäische Forschungsgesellschaft für Blechverarbeitung e.V.
- Bernhard Beck, VERITAS AG
- Walter Fust, StarragHeckert Holding AG, Schweiz
- Dr. Gunnar Grosse, DEROSSI Invest GmbH
- Prof. Jochem Heizmann, Volkswagen AG
- Wilfried Jakob
- Klaus Löffler, Trumpf GmbH & Co. KG
- Dr. Gyula de Meleghy, Meleghy Automotive GmbH & Co. KG
- Prof. Hans J. Naumann, NILES-SIMMONS Industrieanlagen GmbH
- Prof. Konrad Wegener, ETH Zürich, Schweiz
- MinRat Christoph Zimmer-Conrad, SMWA

Profile of the Fraunhofer IWU
Research locations

Chemnitz

Dresden

Zittau

Wolfsburg

- IWU Locations

- 72 institutes and research institutes at locations in Germany

Fraunhofer IWU

Profile of the Fraunhofer IWU
Location Chemnitz

Chemnitz

- Chemnitz is a traditional location for Mechanical Engineering
- Campus of the IWU includes more than 9500 m² area in the immediate proximity to the TU Chemnitz
- Research and development of materials and energy-efficient technologies and products
  - Testing fields for the areas Forming Technology, Machine Tools, Production Systems and Machining, Cutting and Micro-Technology, Mounting, Robotics, Lightweight Construction and Production Management
  - E³-Forschungsfabrik Resource-Efficient Production for the development of holistic solutions for the production of tomorrow
  - Virtual-Reality Technical Center for using virtual technologies in research and teaching

Profile of the Fraunhofer IWU
Location Dresden

Dresden

- Dresden is Germany's city with the greatest concentration of research facilities
- Institute location with 1000 m² technical equipment in the immediate proximity to the TU Dresden
- Research and development of materials and energy-efficient technologies and products
  - Main emphases are Adaptronics, Acoustics, Functionally Integrated Lightweight Construction, Additive Manufacturing, Mechanical Joining Technology, Medical Engineering as well as Cyber-Physical Production Systems
  - Anechoic room for acoustic studies on machines, vehicles and equipment

Profile of the Fraunhofer IWU
Fraunhofer Plastics Technology Center Oberlausitz

Zittau

- Region Zittau with a multitude of companies of the plastics processing industry
- Location in the immediate proximity to the Zittau / Görlitz College with modern technical center
- Development of innovative technologies and products for the plastics processing industry with focus on lightweight construction
  - Main research emphases are Additive Manufacturing of Plastic Components, Development of Functionally Integrated Plastic Components and Semi-Finished Products of Continuous Fiber-Reinforced Thermoplastics as well as Elastomer Processing
  - Knowledge and technology transfer into the region

Profile of the Fraunhofer IWU
Joint Labs

University of Naples
Federico II (Italy)
since 2010

Stellenbosch University
(South Africa)
since 2006

Fraunhofer IWU

Profile of the Fraunhofer IWU
Jobs and careers: discover your future with us!

WHO WE ARE LOOKING FOR:

- Experienced professionals, professional newcomers, students and managers
- Lateral thinkers with new ideas
- Motivation and self-initiative in the development of visionary technical solutions
- Studies in the field of Engineering, Technology or IT/Computer Sciences
- Good skills in German and English

WHAT WE OFFER:

- Practical approach and the possibility of obtaining the doctorate degree
- State-of-the-art technical equipment
- Exchange with professional colleagues
- Opportunities for personal development
- Targeted staff development and various offers for qualification
- Remuneration according to TVöD incl. variable remuneration components
- Work-life balance due to flexible working hours

Fraunhofer IWU

Profile of the Fraunhofer IWU
Scientific fields

Mechatronics and Lightweight Structures

Prof. Dr.-Ing. Welf-Guntram Drossel

Forming Technology

Prof. Dr.-Ing. Reinhard Mauermann

Machine Tools, Production Systems and Machining

Prof. Dr.-Ing. Matthias Putz

Profile of the Fraunhofer IWU
Organization

Fraunhofer Institute for Machine Tools and Forming Technology IWU

Board of Directors Prof. W.-G. Drossel (executive), Prof. R. Mauermann, Prof. M. Putz

Scientific Field Mechatronics and Lightweight Structures Prof. W.-G. Drossel	**Scientific Field Forming Technology** Prof. R. Mauermann	**Scientific Field Machine Tools, Production Systems and Machining** Prof. M. Putz
Division Mechatronics	Division Media-Based Forming & High-Velocity Technologies	Division Production Systems and Machines
Division Functional Integration / Lightweight Design	Division Sheet Metal Forming & Fundamentals	Division Smart Factory – Digitization and Automation
Division Textile Lightweight Design		Division Machining and Removal
Division Joining		
Division Cyber-Physical Production Systems		

Strategy and International Affairs	
Business Development	Public Relations

Services		
Technical Services	Research Technology	Administration

Fraunhofer IWU

Profile of the Fraunhofer IWU
Organization

Mechatronics and Lightweight Structures

Prof. Dr.-Ing. Welf-Guntram Drossel

Mechatronics	Functional Integration / Lightweight Design	Textile Lightweight Design	Joining	Cyber-Physical Production Systems
Adaptronics	Functionally Integrated Lightweight Construction	Systems and Technologies for Textile Structures	Thermal Joining	Technical Cybernetics
Medical Engineering	Additive Processes	Applied Plastics Technologies	Mechanical Joining	Data Chains and –analyses in Production
Project House smart³				
Acoustical Engineering				

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Profile of the Fraunhofer IWU
Organization

Forming Technology

Prof. Dr.-Ing. Reinhard Mauermann

Media-Based Forming and High-Velocity Technologies	Sheet Metal Forming and Fundamentals
Media-Based Forming	Fundamentals in Sheet Metal Forming
High-Velocity Technologies	Sheet Metal Forming

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Profile of the Fraunhofer IWU
Organization

Machine Tools, Production Systems and Machining

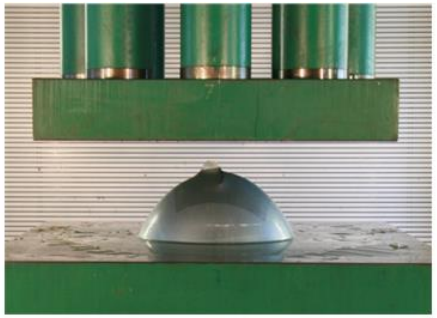
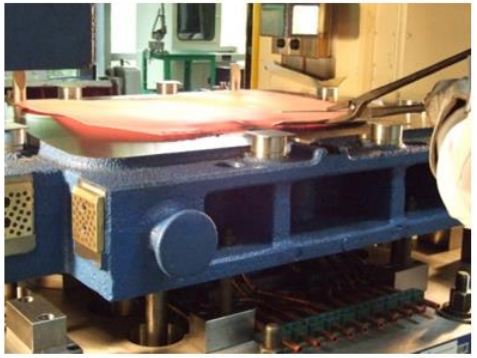
Prof. Dr.-Ing. Matthias Putz

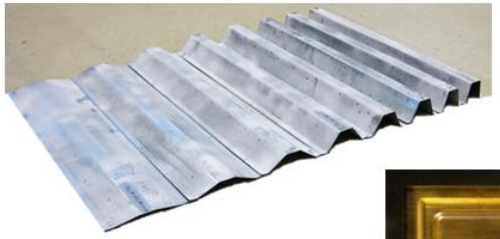
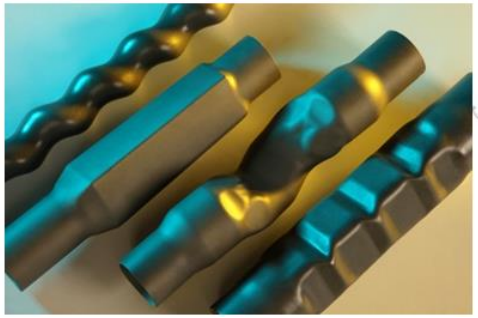
Production Systems and Machines	Smart Factory Digitisation & Automation	Machining and Removal
Machine Tools	Factory of the Future	Cutting Technology
Car Body Construction and Assembly	Digitization in Production	Functional Surfaces / Microsystems Manufacturing
Robotics	Automation and Monitoring	
	Project Center LIM (Labor, Innovation and Management)	

Fraunhofer IWU

Division Sheet Metal Forming

Frank Schieck

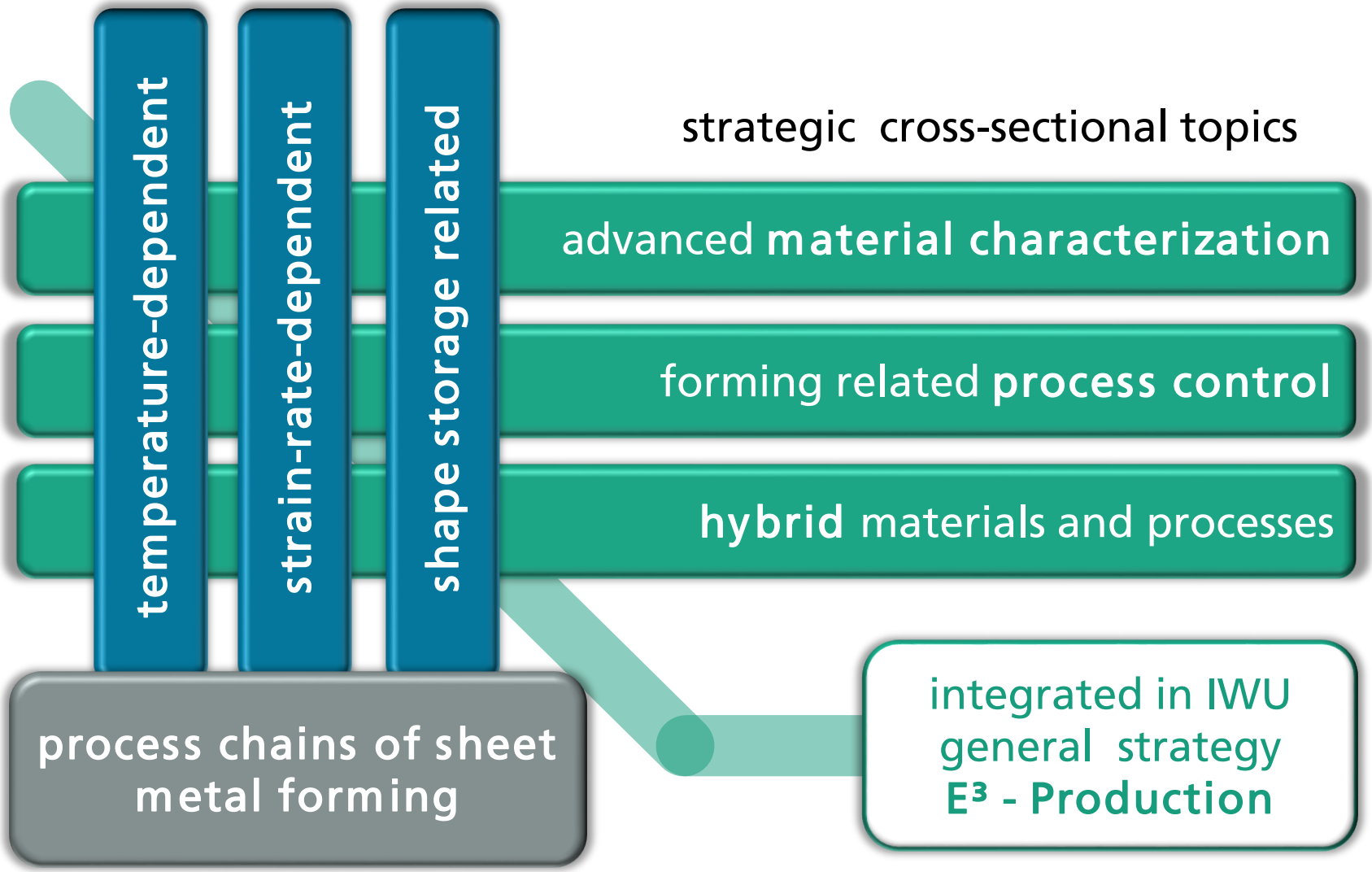




Fraunhofer IWU

Division Sheet Metal Forming

Strategic Orientation

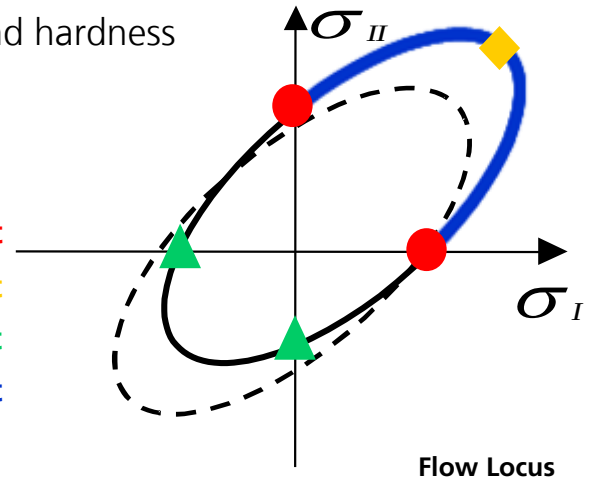


Material Characterization and Determination of Parameters

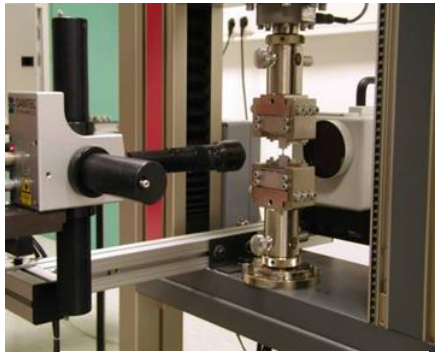
Our Expertise

- Determination of mechanical-physical material parameters
- Determination of thermal-physical material parameters
- Characterization of the material behavior of metal sheets
- Determination of technological material parameters
- Investigation of the tribological behavior and the frictional behavior
- Analysis of dimensional change in solid and sheet metal components
- Investigations by using radiography
- Metallographic investigations
- Measurement of roughness and hardness

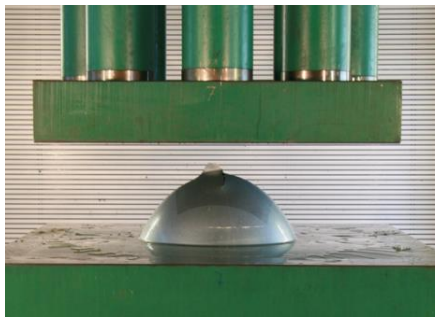
Uniaxial tensile test
Maxi bulge test
Tensile compression test
Biaxial tensile test



Flow Locus



Tensile compression test



Maxi bulge test

Biaxial tensile test

Fraunhofer IWU

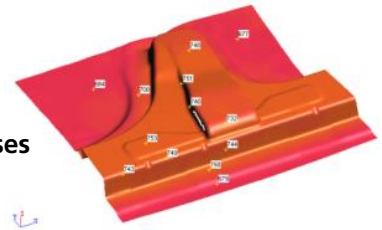
Simulation

Our Expertise

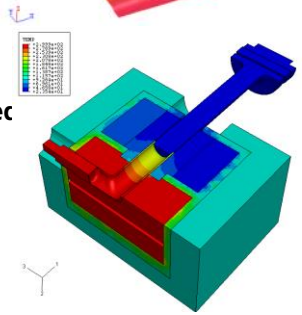
Simulation of

- Processes of sheet metal forming (e.g. deep drawing, bending, embossing)
- Hydro forming processes (e.g. hydroforming of blanks and profiles, gas forming)
- Tempered forming processes (e.g. hydroforming, press hardening)
- Cutting technologies (e.g. shearing, fine blanking, precision cutting)

technology design for press hardening processes



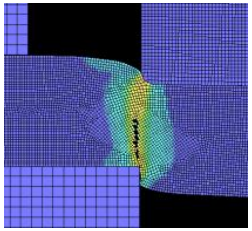
tool design for tempered forming processes



Consideration of Phenomena

- Springback
- Thermal effects
- High velocity effects
- Occurrence of failure

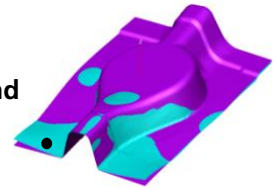
process simulation of cutting



process design of hydroforming component (bending, preforming, hydroforming)

Utilization of software

springback analysis and tool compensation



Deep Drawing & Stretch Forming of Blanks

Our Expertise

- **Methods planning** and simulation based **process layout** for different blank materials:
  - Steel
  - Aluminum
  - Magnesium
  - Titanium
  - Hybrid Metal-Polymer Compounds
  - Organic Blanks
  - Tailored Blanks
- **Tool layout** and **Design**
- **Experimental Investigations** and **Tryout**
- **Manufacturing** of **Prototypes** and **Pre Series**
- **Controlled (intelligent) Forming processes**
- **Analysis** of **Process Chains** and **Technology Optimization**

Street light housing Aluminum (6000er)

Inner door Magnesium Tailored Blank (AZ 31)

16 000 kN hydraulic Tryoutpress

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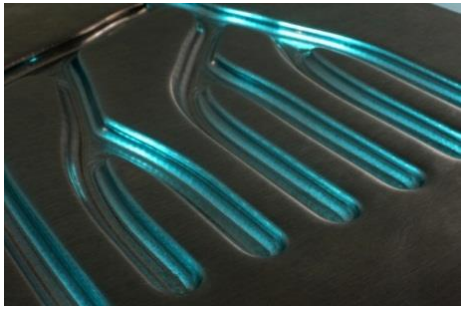
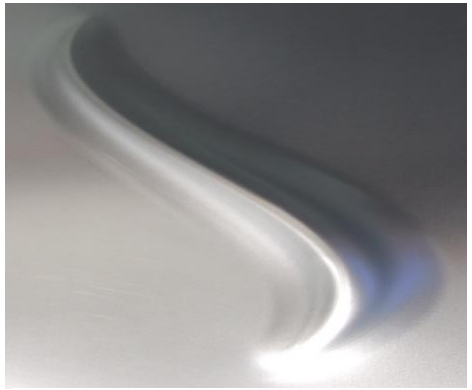
Incremental Sheet Metal Forming

Our Expertise

- Part dimensions up to
  - **4,000 x 3,000 x 500 mm³ (cold)**
  - **2,000 x 1,000 x 500 mm³ (up to 250°C)**
- **Sheet thicknesses of up to 2.5/5 mm (St/Al)**
- Machine tool "Dynapod" for mandrel movement
- Rolling of or rotating mandrels
- Utilization of variable clamping frames
- Investigation **of various sheet metal materials**
  - Steel alloys
  - Aluminum alloys
  - Magnesium alloys
  - Composite sheet metal
  - Copper alloys
  - …
- Utilization of partial or full male molds



incrementally produced canal structure



incrementally produced bead

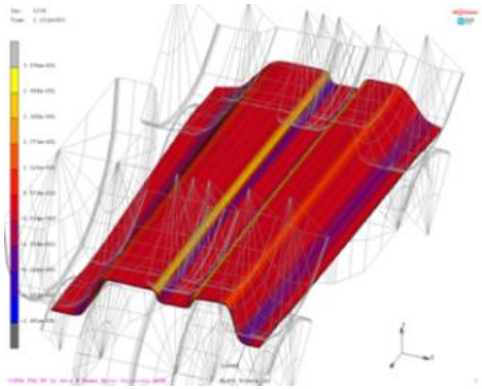
stylus in forming

Roll Forming

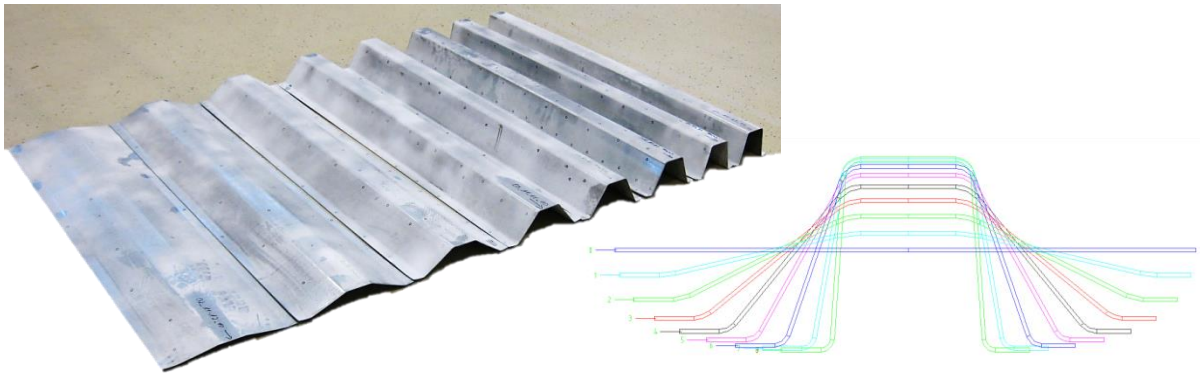
Our Expertise

- Design of roll forming processes (flower design, process parameters)
- Protection of process stability by using FE methods
- Experimental investigations on testing facility
  (manufacturer Schuler, 9 forming stands, modular setup)
- Optical detection of geometry and validation of the simulation results
- Local or global tempering for extending the forming limits
- Controlled temperature guide

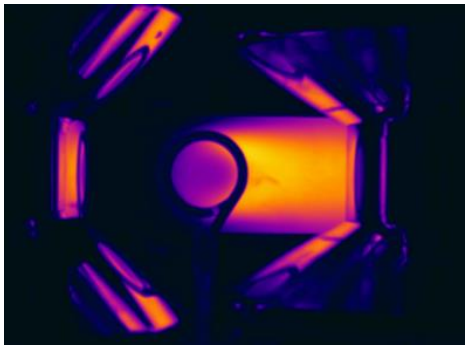
Roll forming machine at the IWU



Process developement using FEM

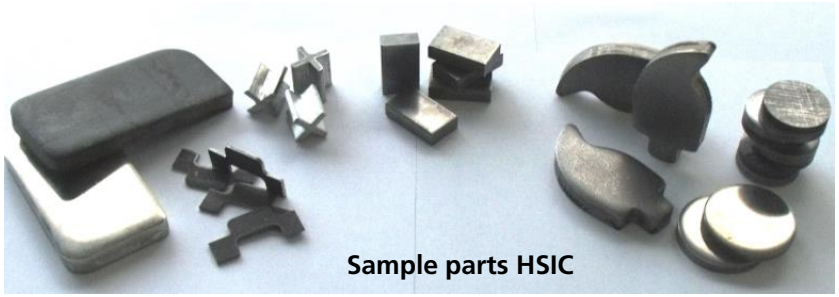


process design (flower diagram)



Temperature support

Cutting Technologies


Sample parts HSIC

Our Expertise

Simulation

- Cutting simulation by using DEFORM, Abaqus and LS-Dyna

Technology

- Shearing
- Fine blanking and precision cutting
- High speed shearing (HSIC)

system for HSIC ADIA7®

Tools

- Design of cutting tools
- Alternative tool materials and coatings

Process monitoring

- Development, testing and optimization of sensors based on force sensor coatings
- Online process monitoring in cutting processes


process monitoring technology by thin layer sensors

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Process Monitoring

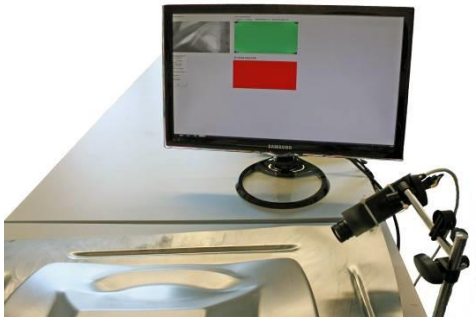
Our Expertise

Combinable 100% - Strategies

- Permanent **material control** by tool-integrated mini-bulge test
  - Every blank is checked for characteristic parameters (according to DIN or own requirements)
- **Monitoring of the tool** by sensors
  - Using of piezo sensors and sensors for structure-born noise
  - Determination of failures of tool and components during every strok
- **Optical InLine control of finished parts**
  - Checking for necking, cracks, impressions, etc. for every component on the output conveyor
  - Geometry monitoring (control of holes, target geometry…) implementable by CAD models
- **Central database** for storing all production data

material-InLine Test

piezo sensors and sensors for structure-born noise



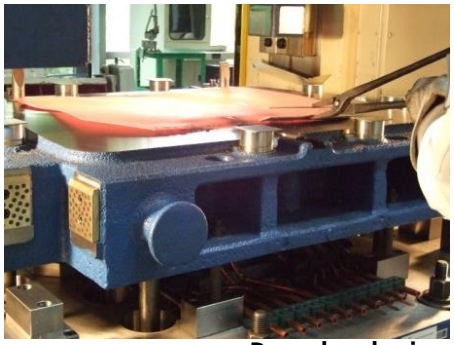
optical InLine control of finished parts

Hot Sheet Metal Forming– Press Hardening

Our Expertise

- Manufacturing strategies for components with **customized properties**
- **Physical investigations of the materials**
- Analysis of **technological material parameters**
- Tribological investigations
- **Simulation** of the forming process
  - Thermo-mechanically coupled forming simulation
  - Structure simulation
  - Flow simulation
- Planning of process chains and **methods** for hot sheet metal forming
  - Determination of optimal process parameters
  - Feasibility analysis
- Development of **tool concepts** and implementation into the design
- Evaluation of **energy and resource efficiency** of processes and process chains

Temperature supported tensile test

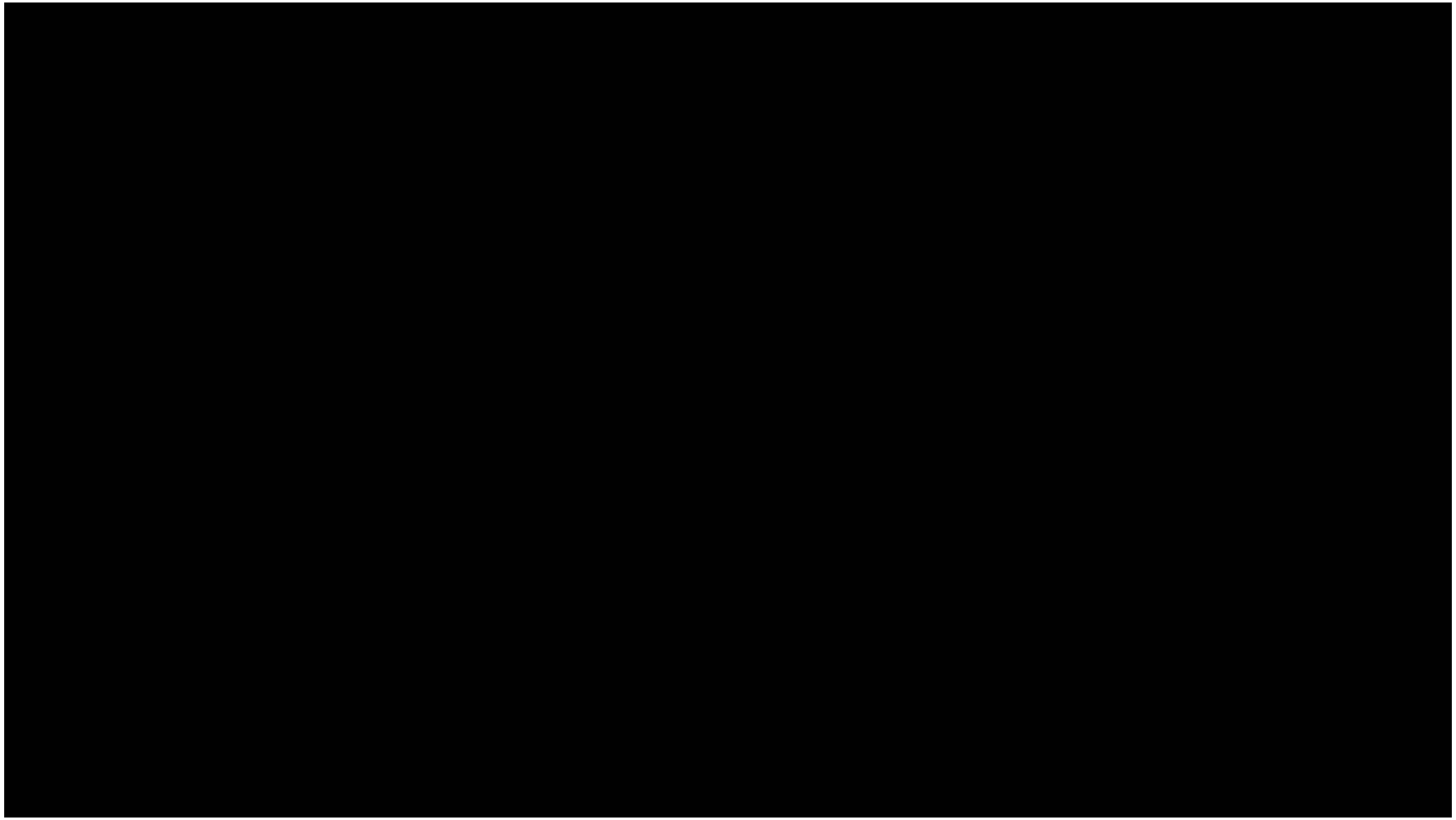


Press hardening

Prototyping B-pillar base

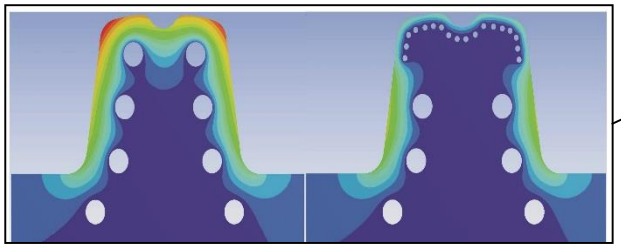
Fraunhofer IWU

Fully automated test set up for press hardening of car body parts

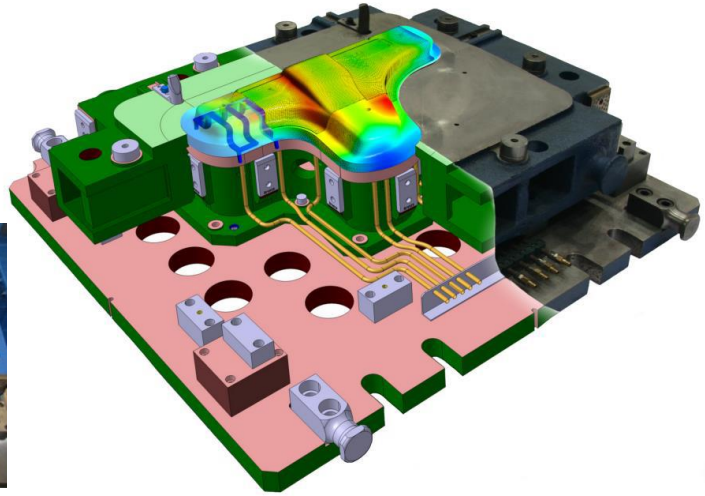


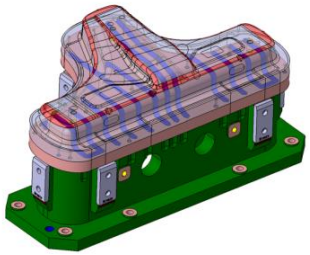
Tool Concepts – Forming / Cutting Tools

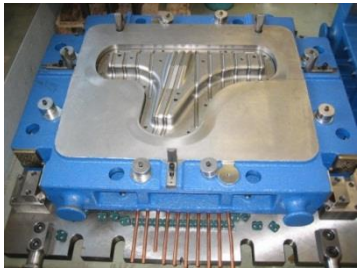
Our Expertise



- Method planning and tool design for forming and cutting tools
- FE calculation of forming and cutting processes
- Design of forming tools for tempered sheet metal forming (warm forming and hot forming)
- Design of warm cutting tools
- FE calculation and optimization of the required tool cooling in tempered sheet metal forming (forming and cutting processes)
- Design of active components using hybrid construction with cooling adapted to the contour for hot forming tools (manufacturing of active components using laser melting)
- Design of active components appropriate for load of cutting dies for tempered steel



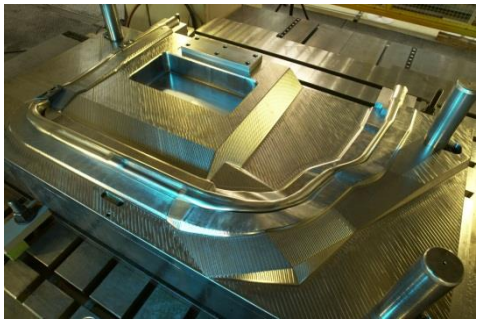




Media based Forming technologies

Our Expertise

- Design of component and process for:
  - Conventional hydroforming and IHB
  - Hydrothermal forming
  - Hot-Metal-Gas-Forming
- Development of technologies with integrated heat treatment (HMGF of stainless steel, form hardening based on active media)
- Design and application of induction (and magnetic) heating equipment for component integrated into the tool or added externally
- Process development for innovative materials (steels for hot stamping, stainless steels, superplastic Aluminum, Magnesium, Titanium)
- Investigation of sensors for process monitoring



hydroforming tool door frame

flangeless B-pillar

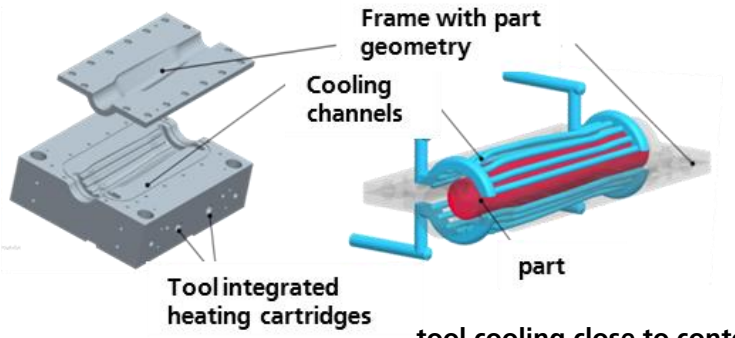
crash-resistant head rest bracket

hydroforming distribution beam

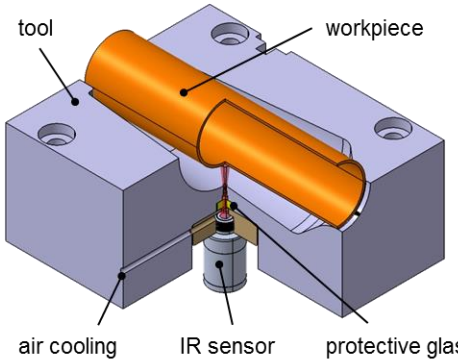
Temperature supported Hydroforming

Our Expertise

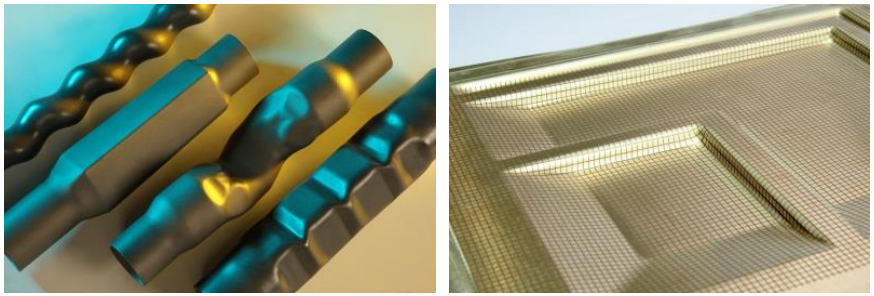
- Further development of the forming processes based on active media, considering the temperature as a process parameter
  - Saving of intermediate annealing operations and preforming stages
  - Process-integrated heat treatment
  - Reduction of the forming
  - Forming of Aluminum, Magnesium, steel, Titanium and plastics
- Development of tool and process
  - Ensuring the required temperature gradients for the forming and cooling down stages in the tool
- Development of process combinations
  - Hydroforming & press hardening
  - Hydroforming & superplastic forming



tool cooling close to contour



tool-integrated temperature sensor



hot formed components

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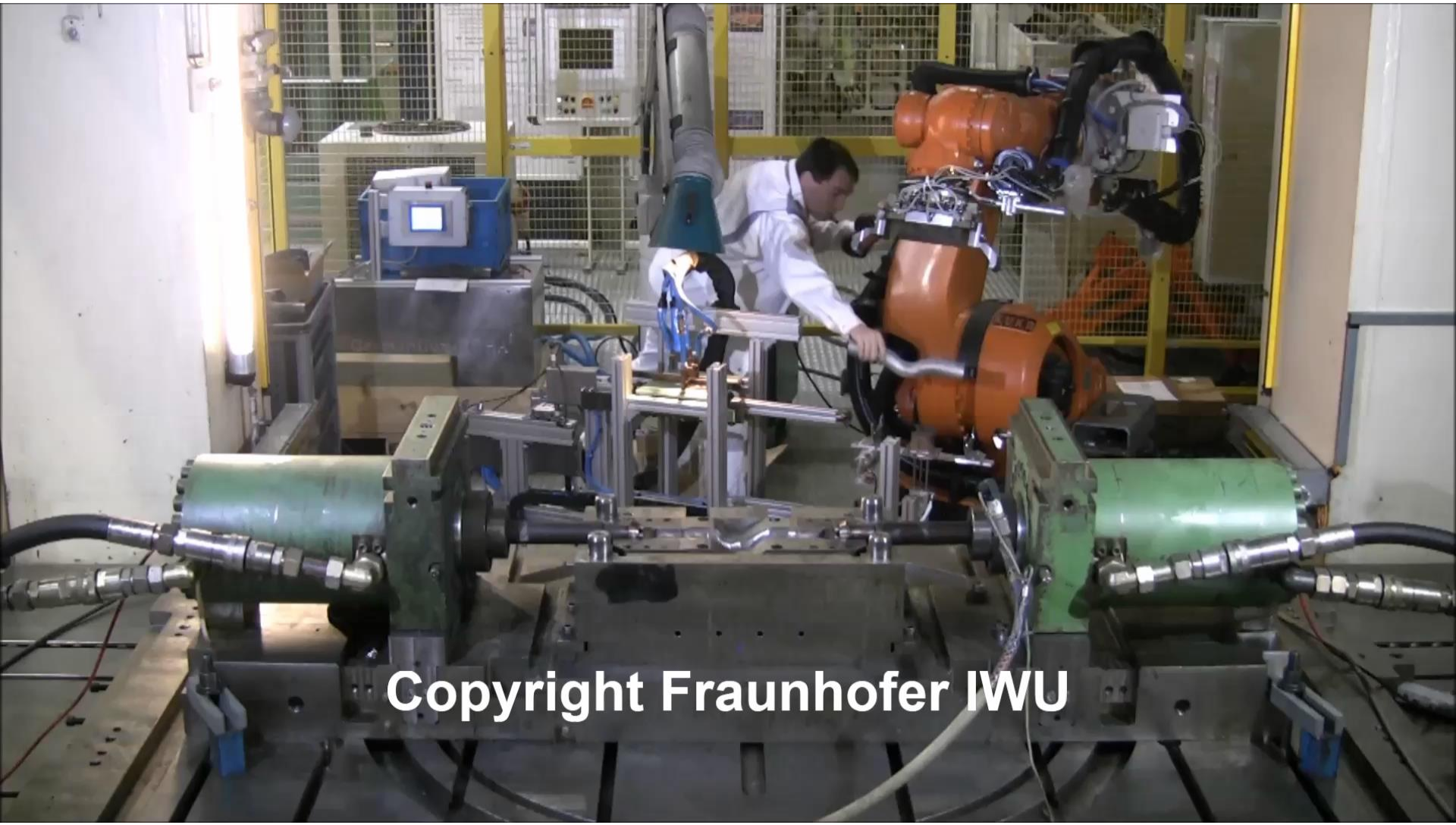
Gas Forming of ferritic stainless steel tubes



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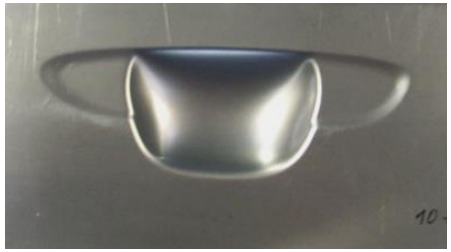
Electromagnetic Forming - EMF

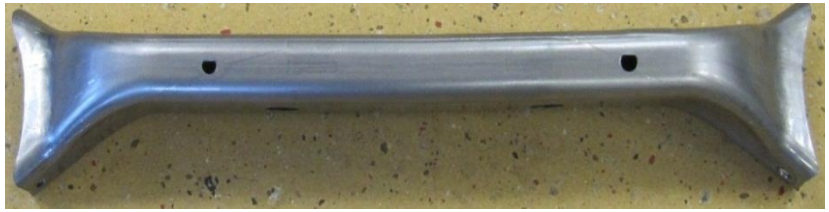
Our Expertise

- Analysis and **design of the multi-physical process**
- Production-oriented **component design**
- Design of **process combinations** and **process chains**
  - Deep drawing with integrated EMF
  - Electromagnetic joining with subsequent hydroforming
- Design of **joining and cutting operations**
- **Simulation** of the forming and joining process
  - Electromagnetic and structural mechanically coupled simulation
  - Simplified highly efficient simulation strategies
  - Numerical determination of the compound strength in joining
- Development and implementation of **tool concepts**
  - Inductors
  - Fieldshapers
  - Dies

pulsed power generator for EMF



EMF formed door handle cavity



EMF formed reinforcement part

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Thank you for your attention!