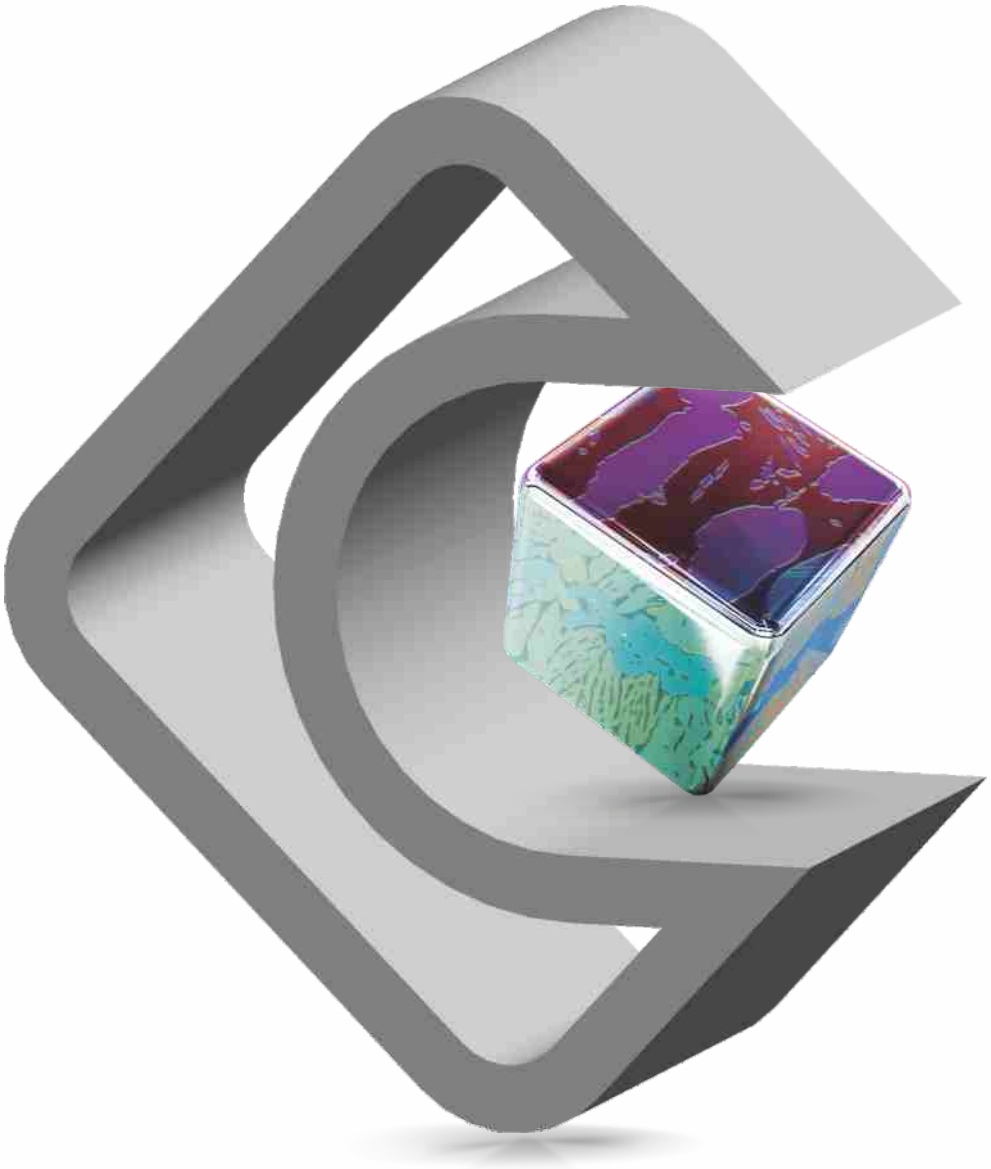
COMTES FHT®

Complete Technological Service - Forming, Heat Treatment



R&D in metals

COMTES FHT a.s.

Head office in Dobřany

Our team

Professionalism, flexibility

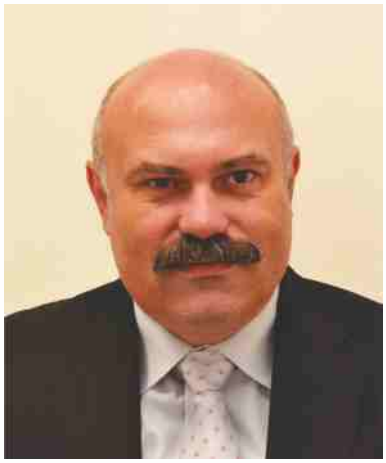
The company's focus is captured in its name COMplete TEchnological Service for Forming and Heat Treatment.

Providing highly professional services in research and development remains the main company's focus. The first company's residence was situated in the rental offices in Borská street in Pilsen, since 2004 COMTES have operated in their own premises in Lobezská street in Pilsen. Since 2008, the company has been housed in a new modern complex in Dobřany. In the same year the current company development was completed with the transformation into a joint stock company with a research organization in accordance with the rules of the EU Community Framework.

In 2011, COMTES began to implement the investment project of West-Bohemian Centre of Materials and Metallurgy (WBCMM) within the operational program titled Research and Development for Innovation, a subprogram of the Regional Research Centre.

The project was successfully completed in 2014. It allowed the expansion of the instrumentation and building two new buildings, offices & labs (metallurgical laboratory and computer modelling) and metallurgical hall with a vacuum furnace, hydraulic press and universal rolling mill, which is unique not only in the Czech Republic but also in Europe.

COMTES FHT a.s. employs more than 80 specialists in the field of research and development of metallic materials and metal processing technologies. The company's vision is to be a leading European research organization that provides research and development in the field of advanced metallic materials.



Libor Kraus
Chairman of the Management Board

Dr. Zbyšek Nový
Vice-Chairman of the Management Board

COMTES FHT a.s. provides comprehensive activities in the following

- design of materials
- design of new technologies (forming, heat treatment)
- design of tools, jigs, fixtures, special equipment
- analysis of material properties (mechanical, thermo-mechanical, structural, thermophysical, magnetic)
- prototyping
- numerical and physical modelling of technological processes
- numerical and physical modelling of material properties
- expert opinions and reports
- training, consultancy, counselling
- preparation and implementation of national and international research and investment projects

Metallurgical technology

The Metallurgical Technology Department focuses on research and development of basic metallurgical processes from in-house production of metallic materials through hot and cold forming, thermal and thermomechanical treatment up to hardening and thermochemical processing.

Typical outputs of the Department include new types of metallic materials and complex technological processes tailored to industrial companies.

Technologies and production facilities:

1 / VACUUM INDUCTION FURNACE

- melting and casting ingots, shaped castings
- charge weight: 50 to 500 kg
- materials: steel, nickel alloys, aluminium alloys or other metallic materials

2 / HYDRAULIC FORGING PRESS

- maximum forging force: 2,500 t
- open die and closed die forging
- simulation of different types of presses and hammers
- prepared for software-controlled forging

3 / ROLLING MILL

- reversing rolling
- hot two-high configuration and cold four-high configuration rolling of strips and sheets
- thermomechanical rolling
- coil winding option
- straightening and grinding of rolled products

4 / HEAT TREATMENT

- conventional and vacuum heat treatment
- annealing in special atmospheres
- thermochemical treatment (nitriding, carburizing, boriding, etc.)
- surface hardening by induction heating

5 / SPECIAL FORMING

- continuous extrusion with ConformTM S315i machine
- grain refinement using the ECAP and Conform methods
- processing of tubes and wires on the HMP R4 – 4, rotary forging machine

Casting of ingots and shaped castings in a vacuum furnace up to 50 l (steel, nickel alloys and others).

Alloy addition in a protective atmosphere.

Reforging ingots up to 1 t, specimens and others.

Open die and closed die forging.

Software-controlled forging technology (automatic open die forging).

Max. pressing force of	2,500 tonnes
Working area of	800 × 800 mm
Max. stroke	500 mm
Open height	900 mm

Hot and cold reversing rolling of strips and plates up to 380 mm width.

Hot rolling of sheet metal with optional thermomechanical treatment.

Cold rolling of sheet with optional coil winding.

Two-high configuration

Max. temperature	1250°C
Max. thickness	100 mm
Min. thickness	2 mm
Max. sheet length	6 m

Four-high configuration

Max. sheet thickness	10 mm
Min. thickness	0.2 mm

Computer modelling

The Computer Modelling Department provides services in the field of development or optimization of design and technologies in a virtual environment. Simulations are mainly focused on forming and heat treatment processes.

Provided services:

1 / Design development - specialized in the following areas:

- development of components and structures, static and dynamic analyses
- optimization of structures, material selection
- extended life of structures
- designing tools and fixtures for both conventional and special technologies
- prototype tools for mechanical testing
- 2D- and 3D-model preparation for numerical simulations
- designof alternative joints of special materials

Equipment:

CAD programs: CATIA, SolidWorks, SolidEdge

CAE products: MARC, ABAQUS, AutoForm

---

2 / Simulation of manufacturing technology - mainly the following activities are performed:

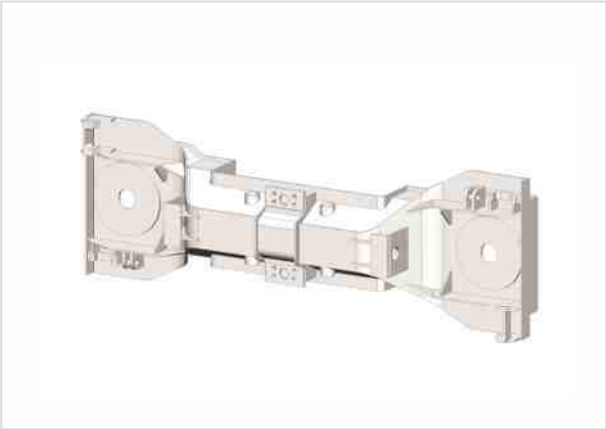
- preparation of material models for numerical simulations
- calculation of work-hardening curves and thermophysical values based on the chemical composition
- design and optimization of forming processes (forging, rolling, extrusion, pipe production, deep drawing)
- development of special forming processes (hydroforming, SPD, explosive forming, microforming)
- design of heat treatment, thermochemical treatment, and thermomechanical processing sequences
- design of induction and resistance heating solutions
- development of special purpose software applications and subroutines to customer requirements
- solutions for open die forging

Equipment:

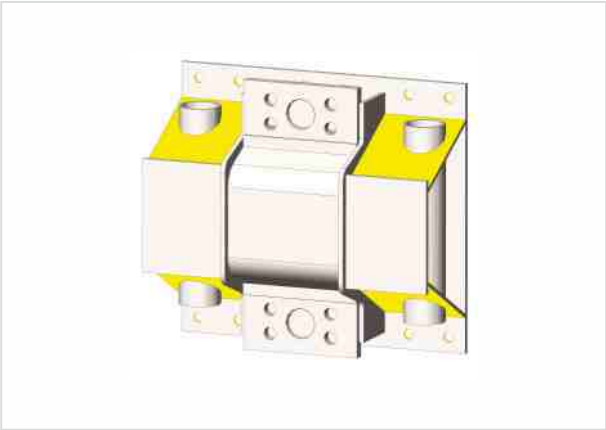
CAE products: DEFORM, MARC, ABAQUS, AutoForm, JMatPro

Development of fixtures and tools

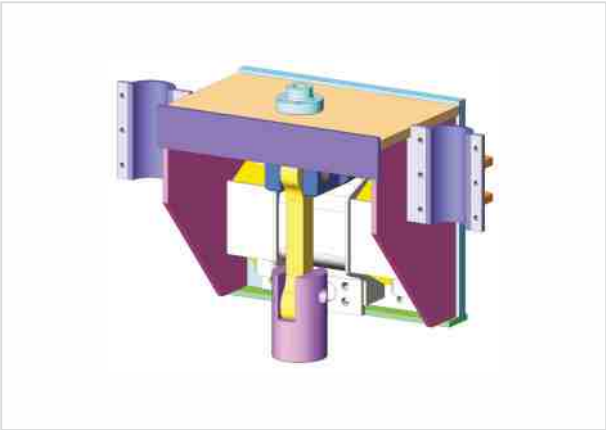
Design and sizing of a fixture for fatigue testing



Test part model



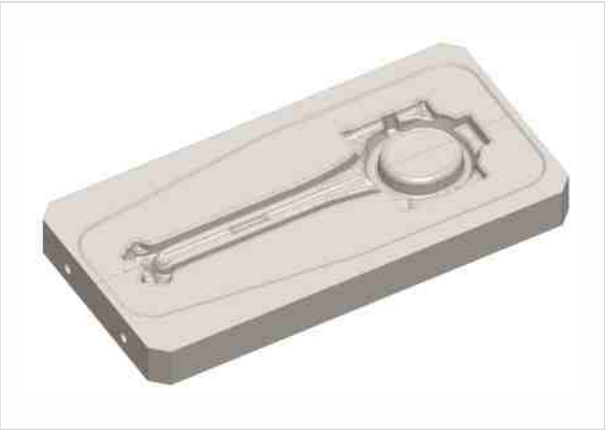
Fatigue testing segment



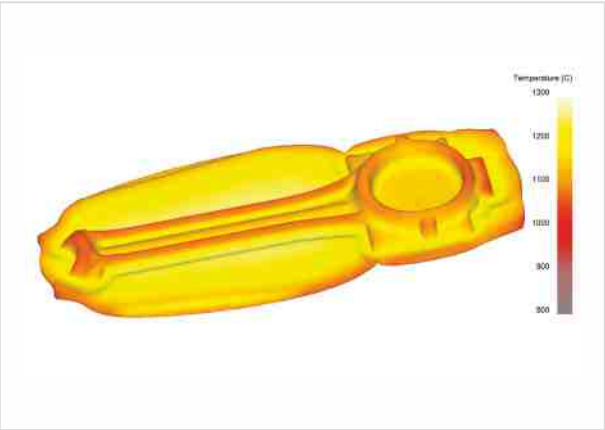
Test fixture

Modelling of closed die forging of connecting rod

Connecting rod model



Die for connecting rod forging



Modelling of closed die forging of connecting rod

Material analyses

The staff of the Material Analysis Department significantly contribute to the development of new metallic materials, especially new types of advanced steels and nickel alloys. Material analyses represent an integral and an essential part of the research and development of metallic materials. Analyses of aluminium, copper, titanium alloys, steels of all kinds, superalloys and others are commonly performed. Chemical bulk analyses are carried out, as well as microvolume analyses, analyses of high-purity materials and chemically very complex materials. Phases in ultra-fine structures are identified using electron microscopes.

Material analyses have been performed in COMTES FHT a.s. since the very beginning of company activities. Accreditation of laboratories and more than ten years of experience guarantee the quality valued especially by clients who commission expert materialographic reports.

Provided services:

- determining the microstructure and macrostructure of ferrous and nonferrous metalls
- phase analysis, identification and determination of fractions of phases
- measurement of porosity in alloys
- spectroscopic analysis of the chemical composition including gas content analysis
- chemical analysis (point, line scan, and area scan analysis)
- fractography, fracture surface analysis
- hardness testing (in the field)
- microhardness, nanoindentation
- microscopic measurement of layer thickness
- determining the causes of defects and accidents, identifying process errors
- portable metallography - microstructure characterization and documentation in the field
- WPQR testing

Equipment:

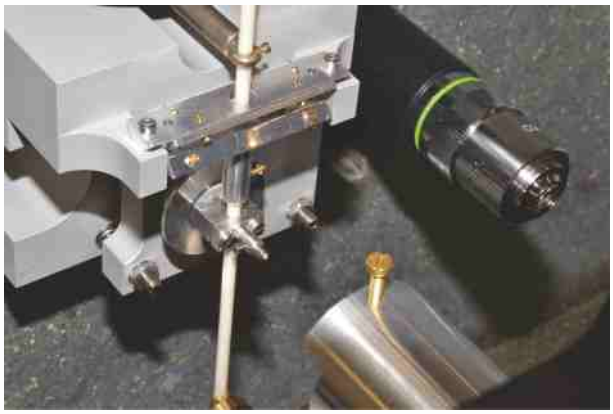
Metallographic sample preparation (Struers and Buehler)

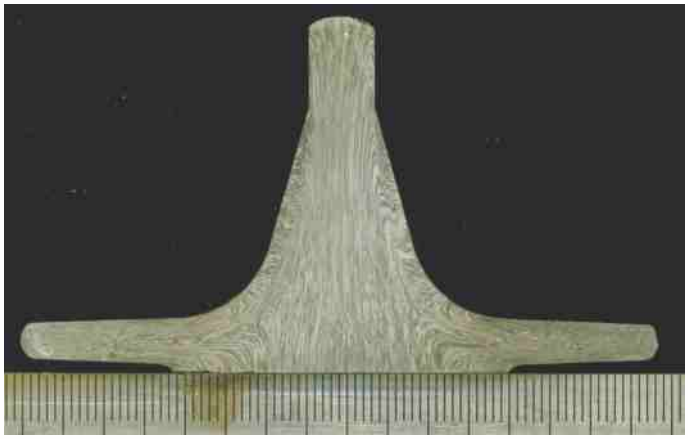
Optical microscopes (Nikon and Carl Zeiss)

JEOL scanning electron microscopes with EDX and EBSD detectors

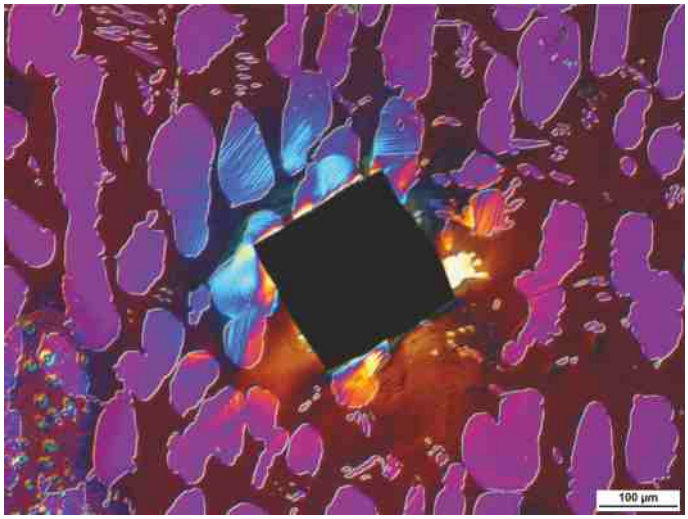
Microhardness tester Struers Durascan 50, Vickers + Knoop

Instrumented NanoTest Vantage nanoindenter

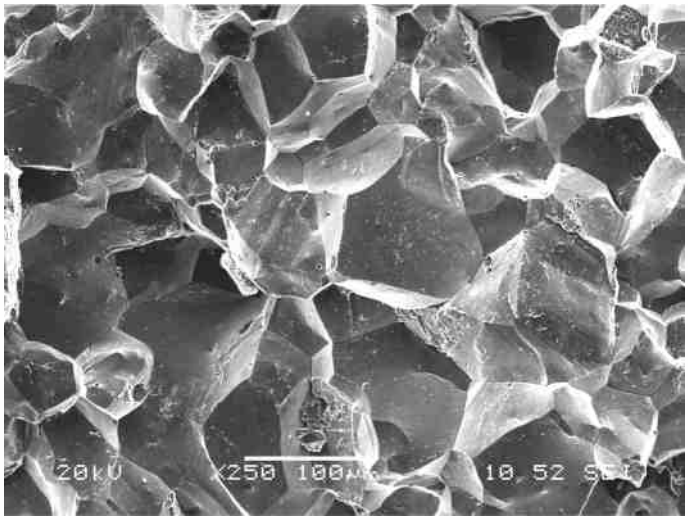




Forging macrostructure after the Spike test.



Microhardness indentation in a two-phase stainless steel sample.



Intergranular fracture in a part affected by intergranular corrosion.

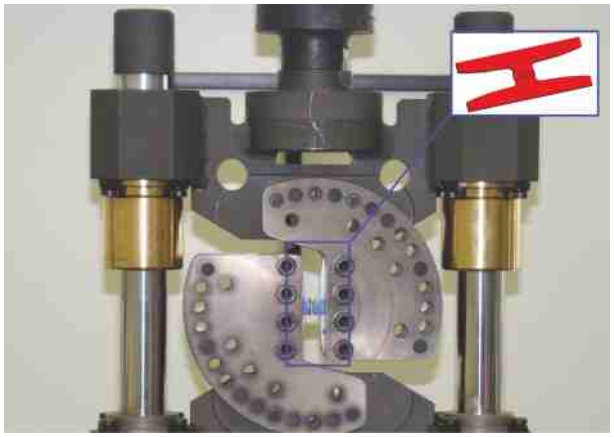
Mechanical testing and thermo-physical measurement

In terms of the number of devices and equipment used this Department surpasses all others. The range of activities includes sampling, test specimen production, mechanical testing over a wide range of temperatures, loads, speeds, and tests in a diverse, often extreme environment. Very important areas of interest include thermo-physical measurements that provide data necessary to run correct technological calculations and create the most precise material models. The Department services include the development and implementation of special tests upon the customer request - e.g. measurement of mechanical properties of the supercooled austenite, measurement under combined stress, physical simulation of thermomechanical processes, stress relaxation tests, etc.

Provided services:

The testing laboratory disposes of the ARAMIS optical measuring system, high-speed camera, laser extensometers and video extensometer to measure deformations. The special Electric Discharge Sampling Equipment provides on-site sampling capability for a very small amount of material for further analysis in the operation without thermal or mechanical influences.

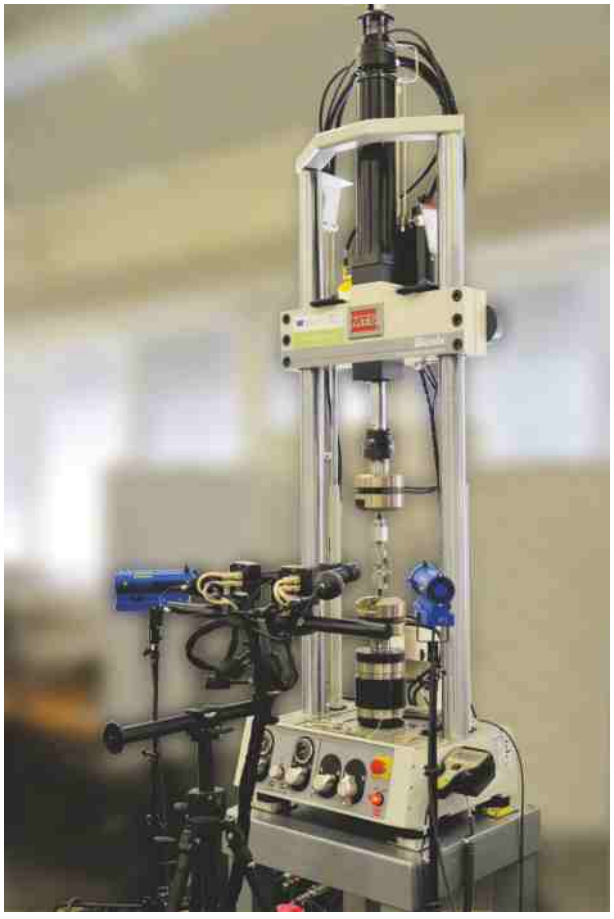
- accredited tests (tensile test, instrumented impact tests, hardness)
- static and dynamic tests (tensile, compression, bending) at speeds up to 25 m/s, dynamic Young's modulus tests
- wide temperature range of testing (-200 °C to 1400 °C)
- low-cycle and high-cycle fatigue tests
- short-term creep tests
- torsion and biaxial load tests
- testing on miniature specimens (Small Punch Test)
- determining the transition temperature
- fracture toughness test
- formability limit curves (FLC diagrams)
- component testing
- construction of CCT and TTT diagrams
- measurement of thermal conductivity and expansion of materials



"Butterfly" sample testing tool, 0-90°

High-speed camera, max. 680,000 frames/s, resolution 1.0 MPx

High-speed thermal imager, max. 4,000 frames/s, resolution 1.3 MPx

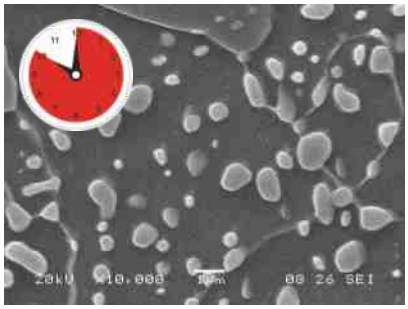


MTS Bionix servo-hydraulic biaxial testing machine, piston 1: 1 m/s 25 kN, 150°/s 250Nm, piston 2: 500 mm/s, 10 kN

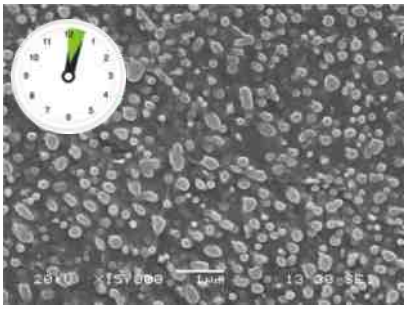
Drop tester tool energy 3000 J, max. loading speed 25 m/s

R&D examples

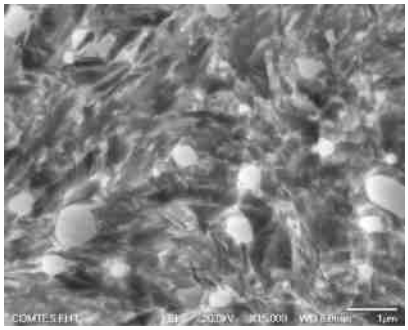
ASR (Accelerated Spheroidization and Refinement) - acceleration of soft annealing and recrystallization annealing processes



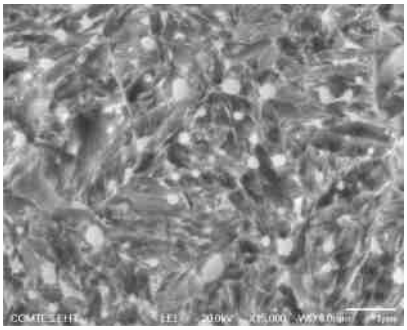
208 HV – Conventional annealing



262 HV – ASR annealing



679 HV – Conventional heat treatment



709 HV – Heat treatment after ASR

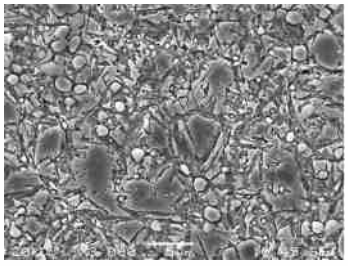
ASR ensures:

- Time and energy savings
- Finer carbides
- Finer austenitic grain
- Finer martensite after quenching and tempering
- Improved final properties

Process:

- Thermomechanical treatment (can be integrated in the rolling mills, etc.)
- Induction heat treatment

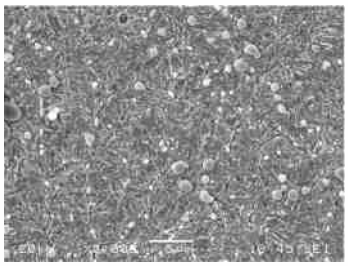
Deep cryogenic treatment of steel



Classic heat treatment, coarse martensite with a high content of retained austenite, coarse carbides

Effects:

- Elimination of retained austenite
- Refinement of martensite and carbides
- Increased wear resistance



Heat treatment with cryogenic processing, fine martensite with very low retained austenite content, fine carbides

Process:

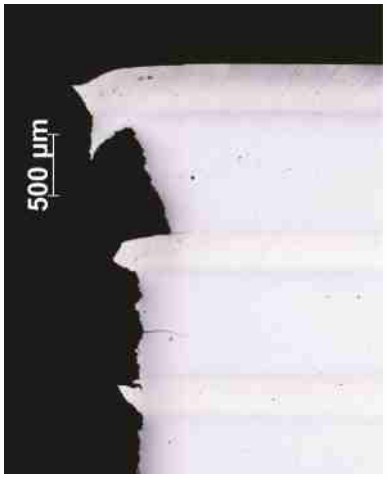
- Hardening + freezing to the temperature <-100 °C
- Hold at the cryogenic temperature for approx. 2-15 hours depending on the part dimensions and the chemical composition of steel
- Standard tempering

R&D examples

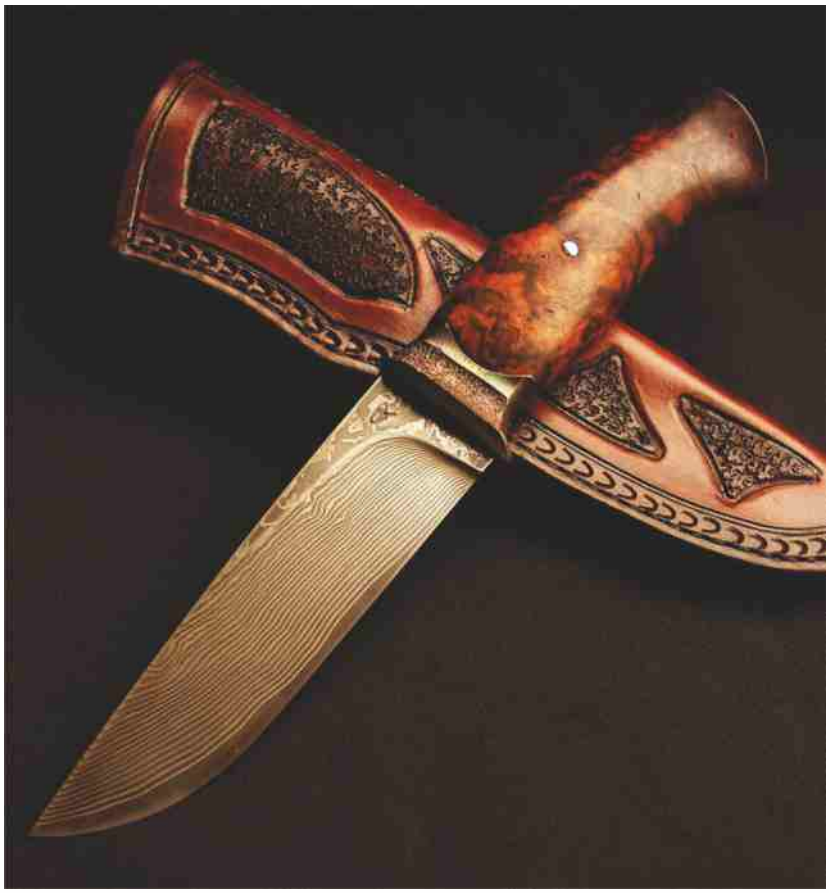
Preparation of laminated materials by hot rolling

- Diffusion joining of several kinds of steel through hot rolling
- Option to combine different mechanical properties
- Preparation of functionally and visually attractive materials
- Development of multilayer materials for the safety features of vehicles

Layered rolled steel sheet



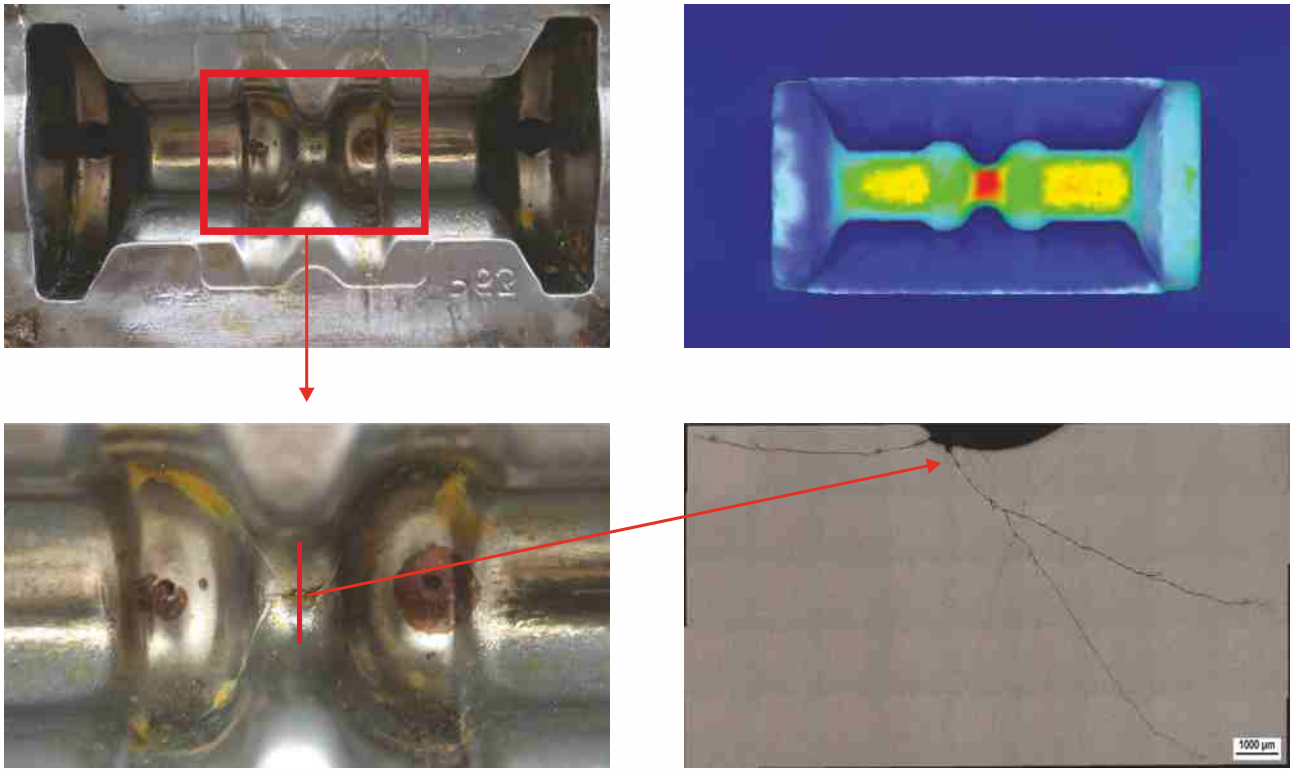
Notch impact testing of laminated sheet



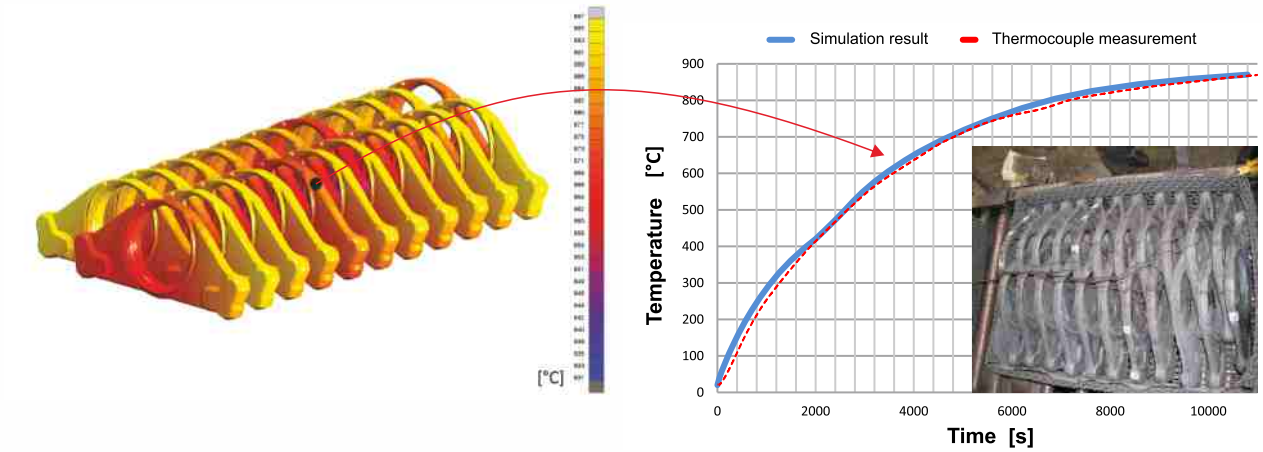
Knife made of rolled Damascus steel, knife author Róbert Dóka

R&D examples

Computation-experimental verification of critical points in a die

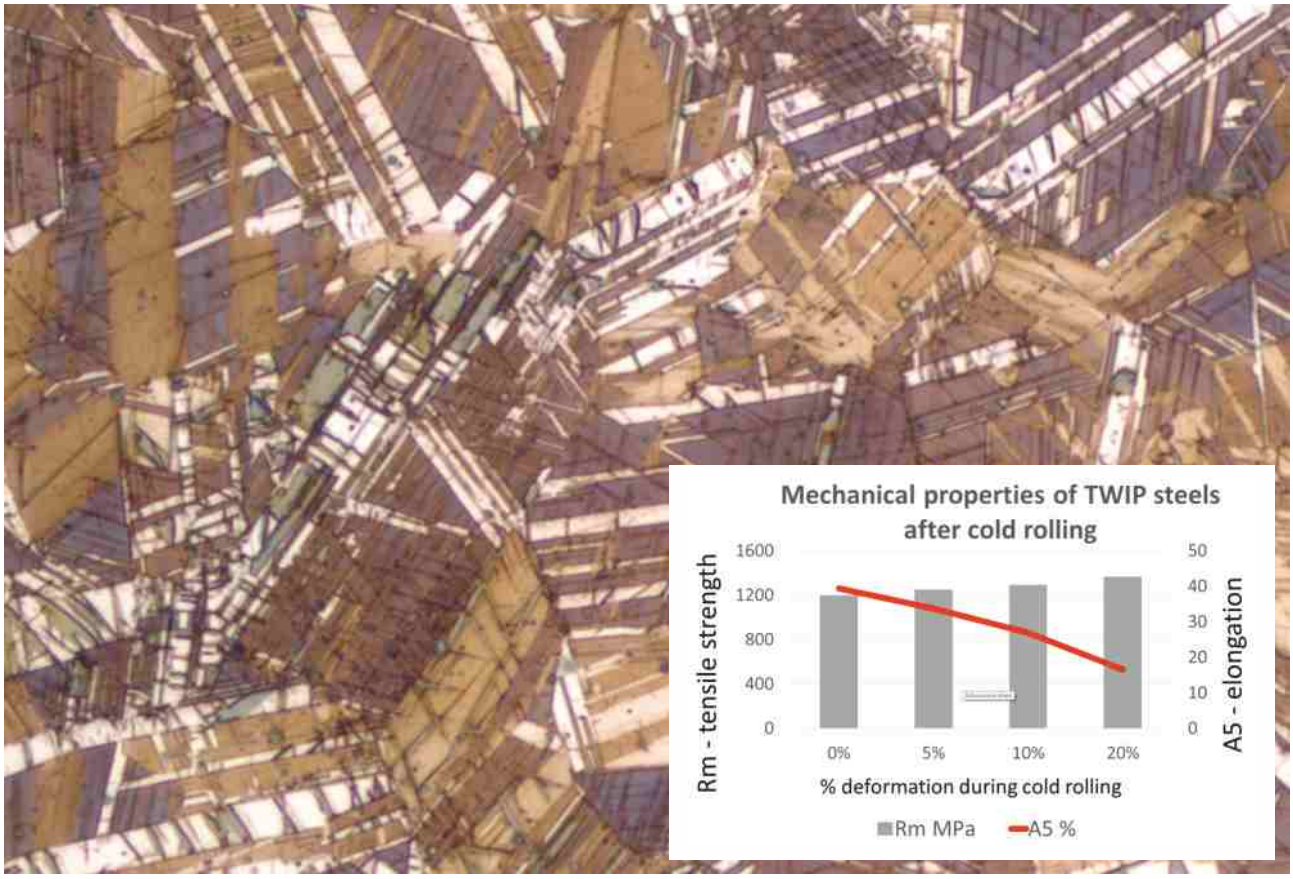


Thermal analysis of heating of forgings in a continuous furnace



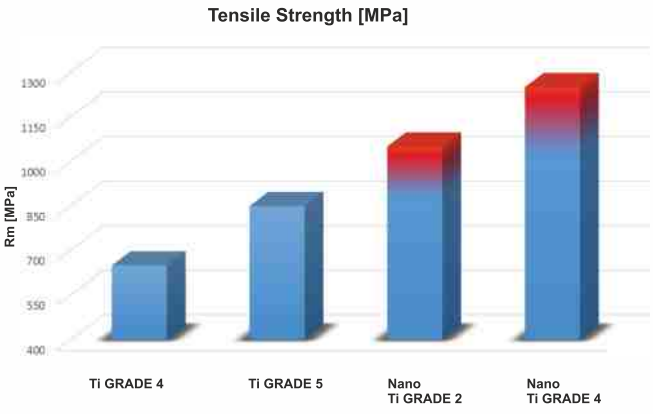
R&D examples

Development of high-strength ductile TWIP steels



Development of very high strength ductile TWIP steels

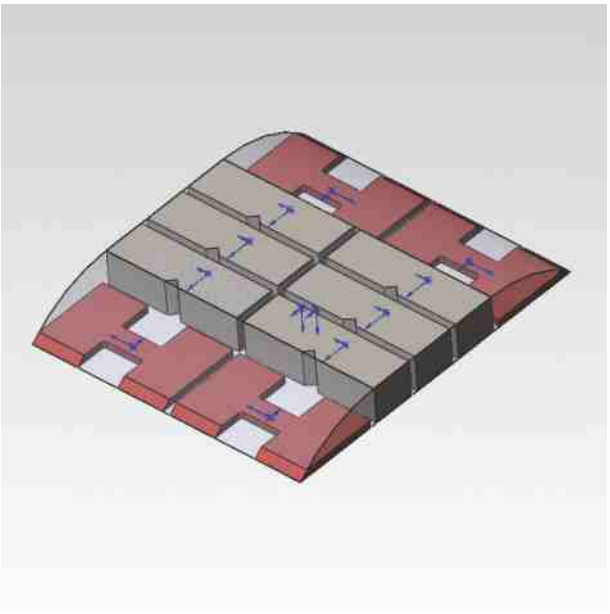
Development of Ti Gr 5 ultra-fine grained alloy

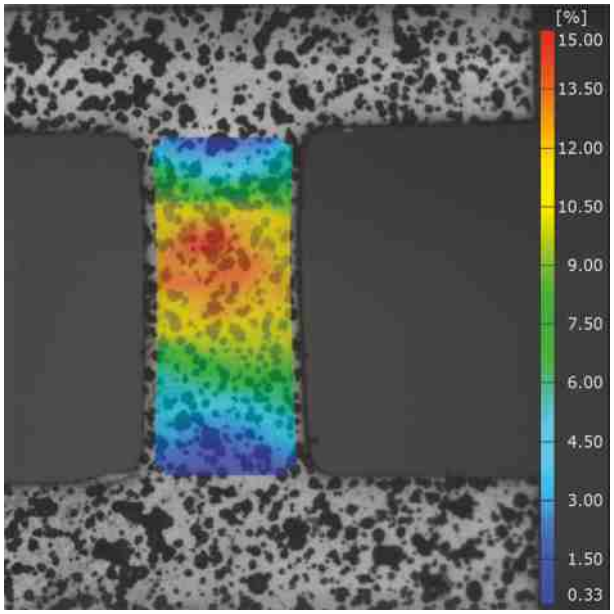


R&D examples

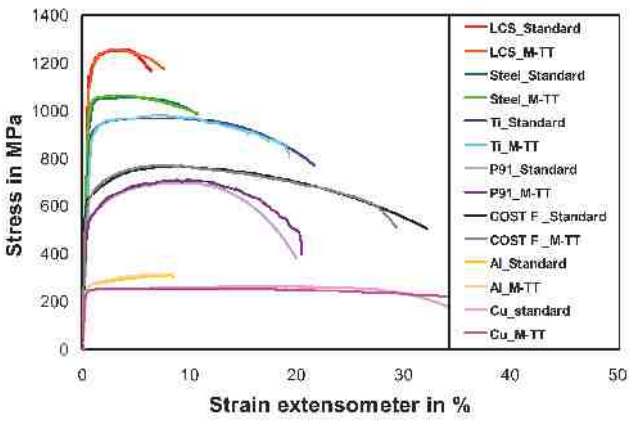
Taking and testing of miniature samples

Nondestructive sampling of experimental material



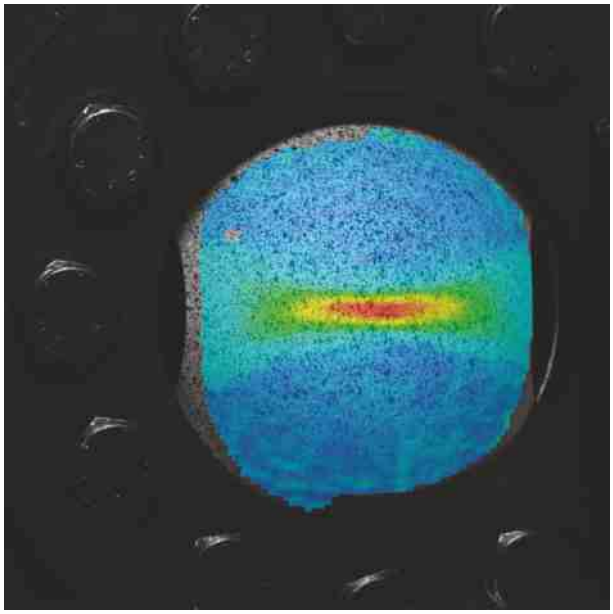


Micro-tensile test with the DIC measurement

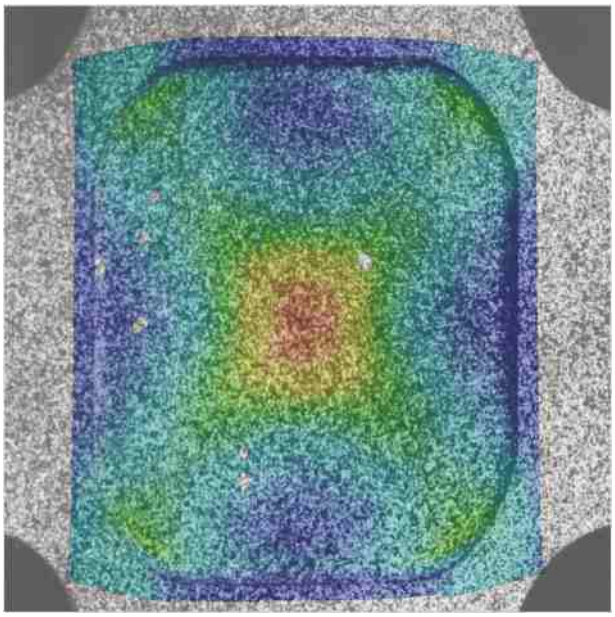


R&D examples

Assessment of formability of a deep-drawing sheet



FLC (Nakajima tests) and cruciform sample tests



Our partners

Research organizations

ČVUT
ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

TU BERGAKADEMIE FREIBERG

SIGILLUM UNIVERSITATIS STUDII PRAGENSIS

ZÁPADOČESKÁ UNIVERZITA V PLZNI

MISIS
National University of Science and Technology

UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

TECHNISCHE UNIVERSITÄT CHEMNITZ

TECHNICKÁ UNIVERZITA V KOŠICIACH

University of Glasgow

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

VŠB-TU OSTRAVA 1849

Institute of Physics of Advanced Materials
УГАТУ

Our partners

Industrial enterprises

BENTELER

BILSTEIN GROUP

DAIMLER

BONATRANS

Buderus Edelstahl

CPF
CZECH PRECISION FORGE

DOOSAN

Constellium

LuK INA FAG
SCHAEFFLER GRUPPE

_metatech

Mubea
light.efficient.global.

PILSEN STEEL

ŠKODA

ŠKODA

ŠKODA
ŠKODA JS a.s.

STEINHOFF
Kaltwalzen

voestalpine

ZDAS

Contact

COMTES FHT a.s.

Prumyslova 995
334 41 Dobrany
Czech Republic

+420 377 197 311

comtes@comtesfht.cz

http://www.comtesfht.com

COMTES FHT a.s.

Maximilian Strasse 35A
Munich
Germany

+49-(0)89/24218-127

uwe.ruettgers@comtesfht.com

http://www.comtesfht.com