4a ENGINEERING

4a engineering - Business Units

Testing hard- and software

Seamless testing and simulation solution for automated material characterization

Material characterization

Static and dynamic material characterization from specimen to component validation – all under one roof

Validated material cards

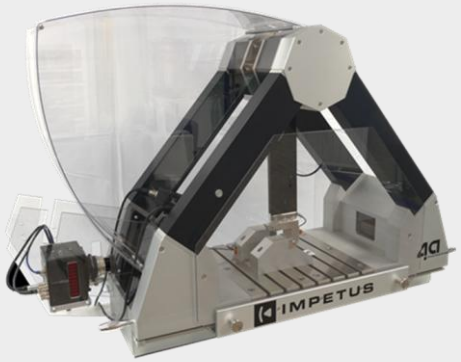
Optimized packages for common material models for LS-Dyna, PamCrash and Abaqus.

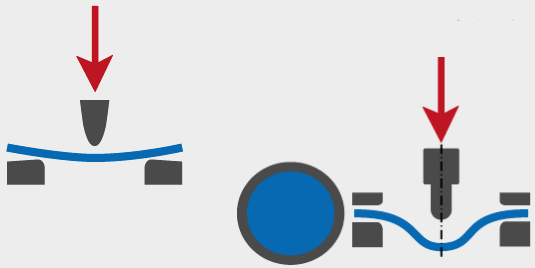
Battery Testing and Simulation

Testing and multiphysics modelling of battery cells, cell stacks and modules.

intelligent reliable solutions for plastics, composites, metals, foams, ...

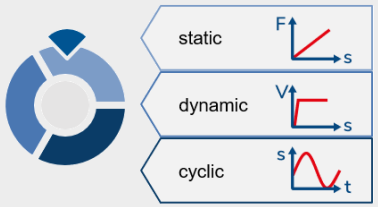
IMPETUS





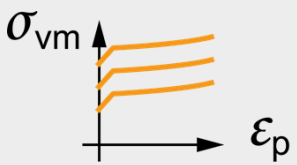
efficient
dynamic testing

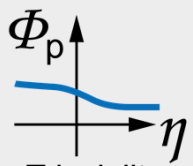
LINOVIS

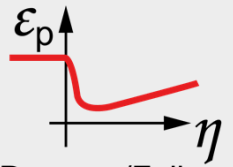


high performance
modular testing

VALIMAT

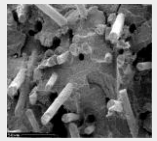


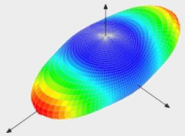




from test to validated
material cards

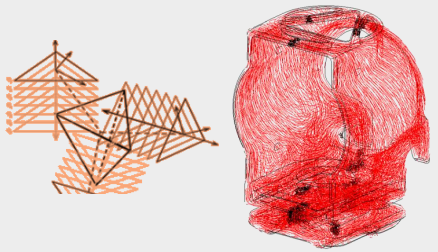
MICROMEC





3D anisotropic
material cards

FIBERMAP



individual mapping
process information

IMPETUS® data specification

Highspeed camera is an optional equipment and can be ordered separately.

technical specifications

maximum energy	50J
length of swing arm	500mm
mass of swing arm	1.5 - 5.5kg
impact velocity	0.5 - 4.4m/s

weights and dimensions

L x W x H	1400 x 600 x 850mm
mass	165kg

desk load and dimensions minimum required

L x W x H	1500 x 800 x 800mm
minimum load	250kg

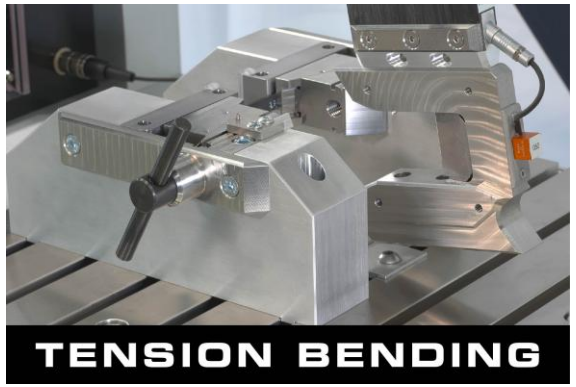
electrical supply data

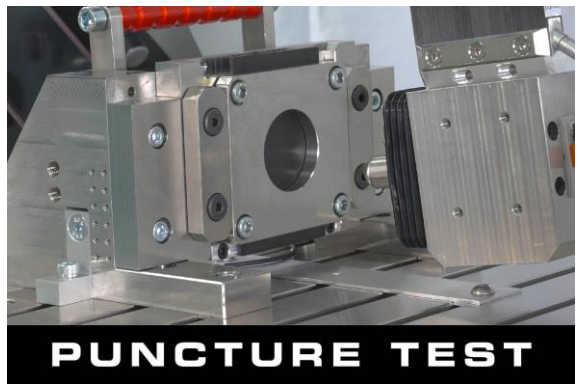
230 VAC 50 Hz	0.5A
115 VAC 60 Hz	1.0A

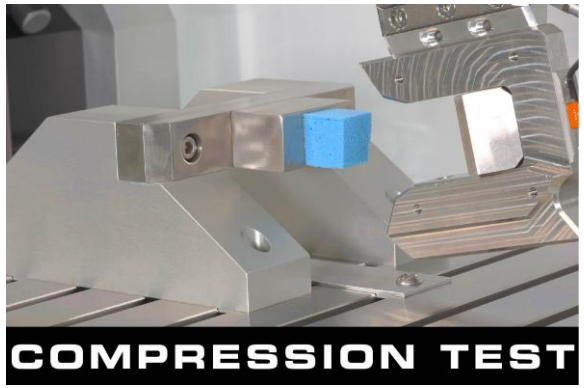
5V camera trigger

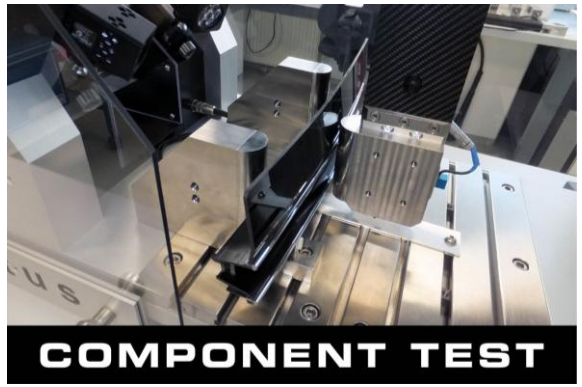
output level high	>2.5V
output level low	<0.5V

IMPETUS® - configurations









BASIC

STANDARD

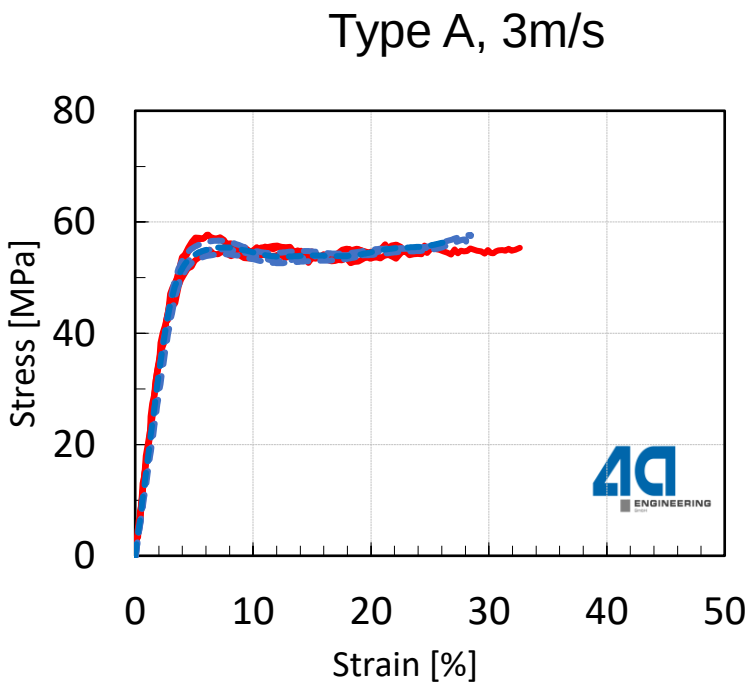
PROFESSIONAL

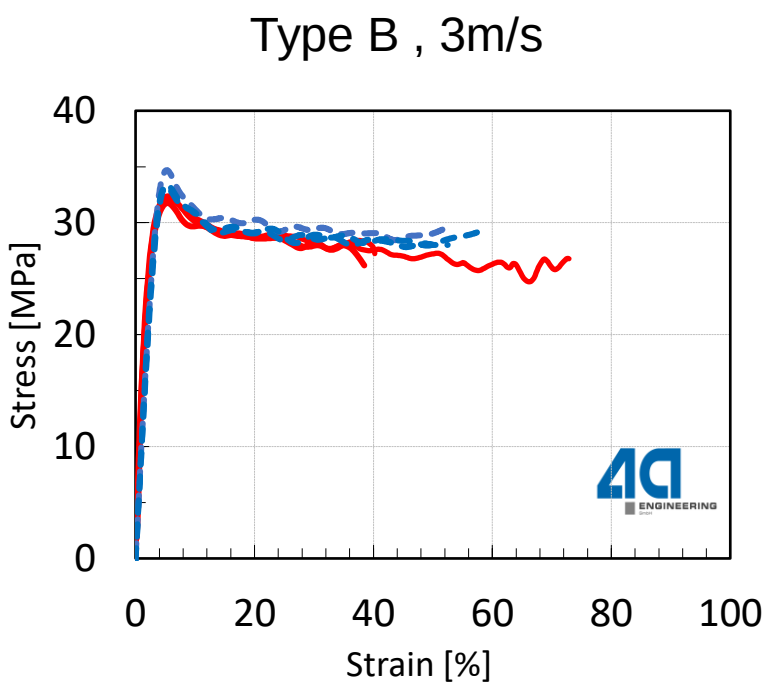
Dynamic tensile test - unreinforced plastic

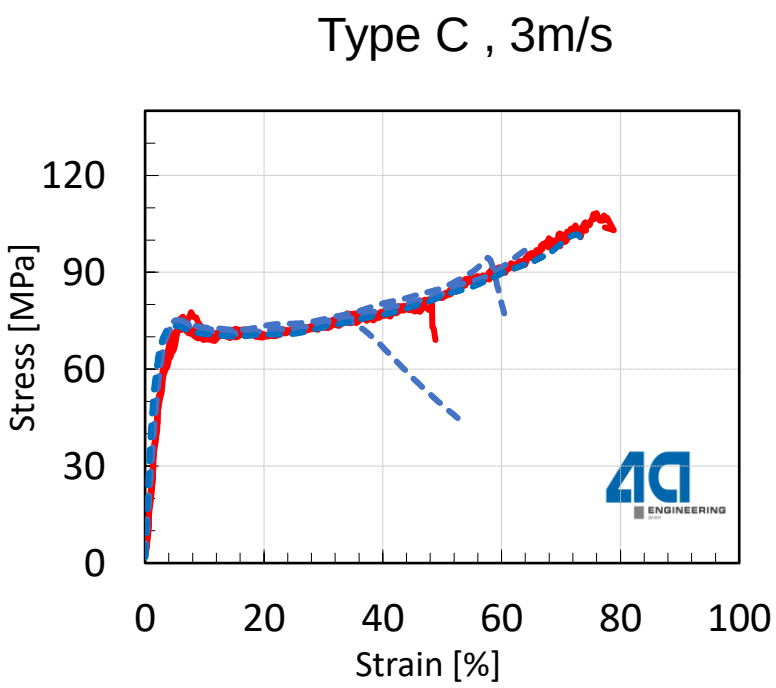
comparison 4a IMPETUS / ZWICK testing machine

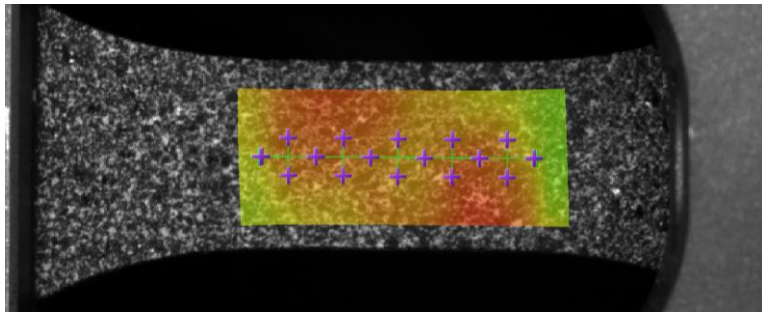
ZWICK testing machine

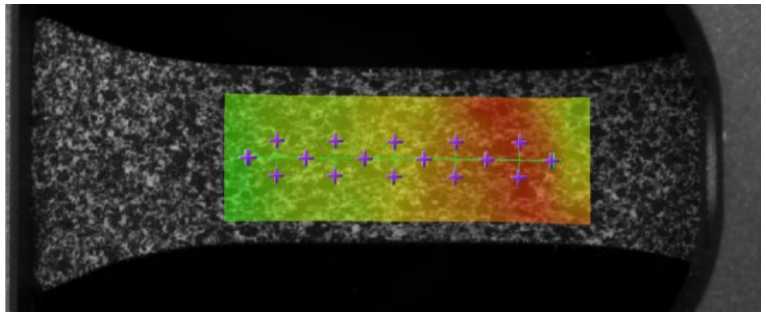
4a IMPETUS

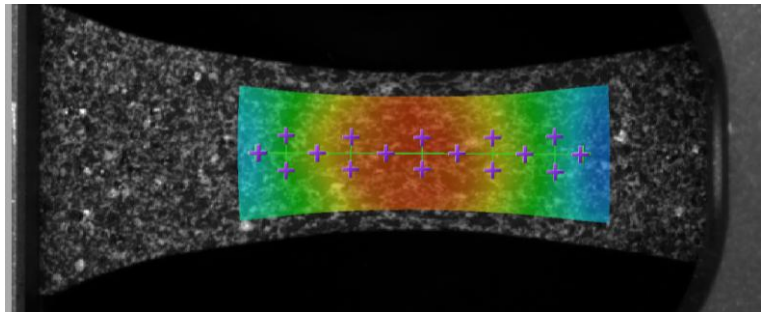












LINOVIS

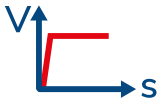
high performance modular testing

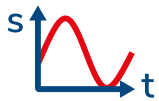
specifications

max. force	25kN
max. speed	3.2m/s
max. stroke	200mm
energy	600J
frequency	~30Hz

modes of operation

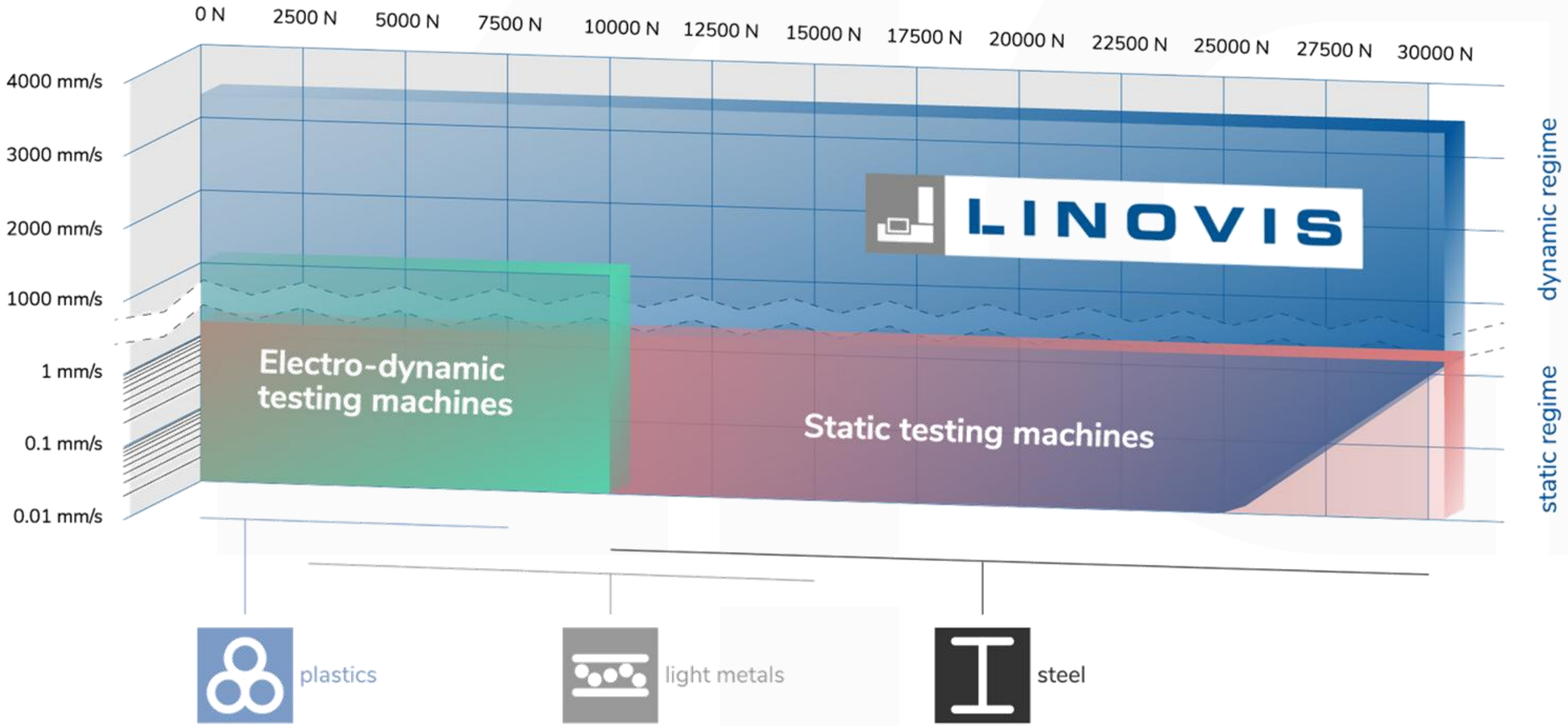
- static 

- dynamic 

- cyclic 

I N P H Y S I C S W E T R U S T

Testing range



LINOVIS

high performance modular testing

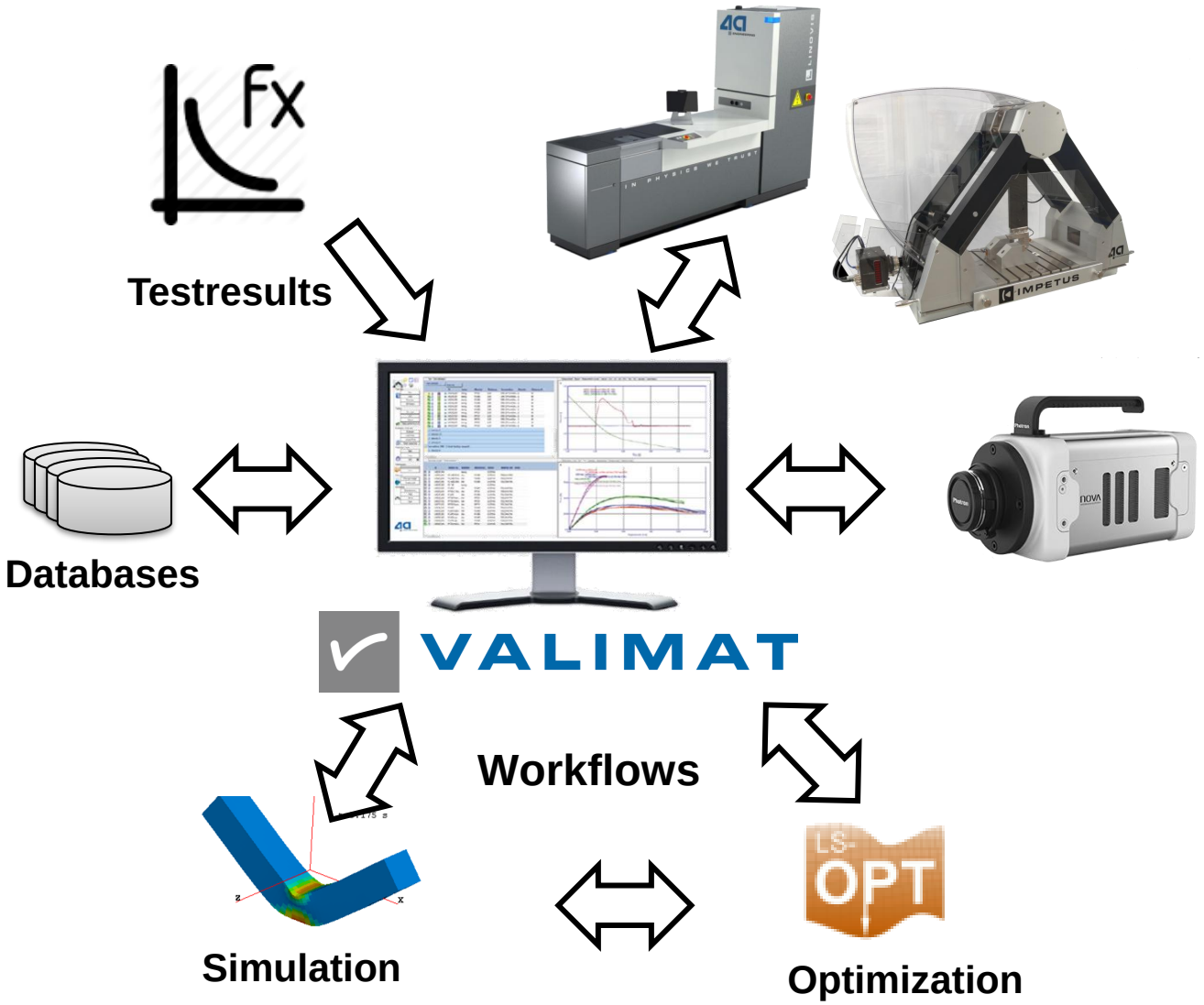
I N P H Y S I C S W E T R U S T

VALIMAT® from test to material card

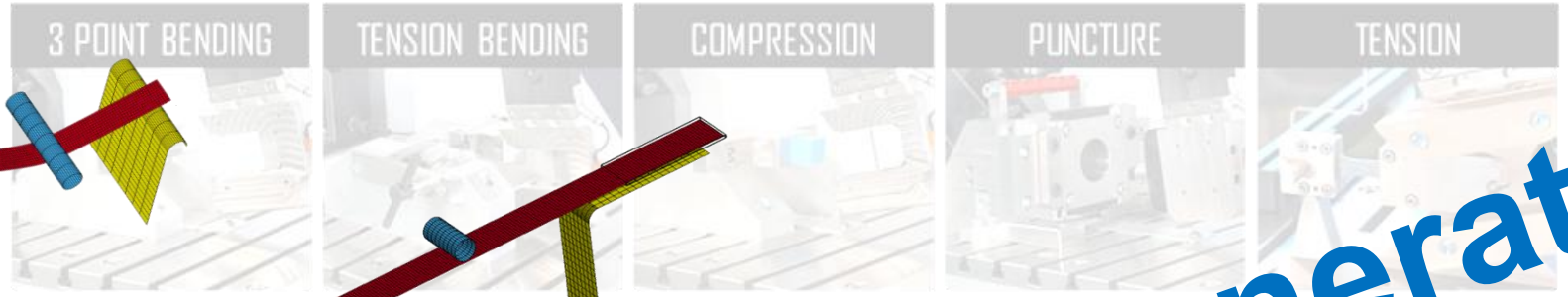
Advantages

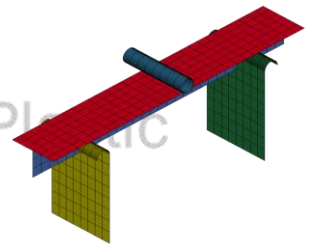
- manage test results (import, export, filter, evaluation)
- statistics
- material card generation
  - automated parameter identification
  - complex models
- validation of material card
- database of test results and simulation data
  - direct link between test and simulation

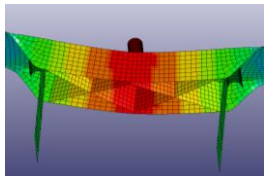
https://www.4a-engineering.at/4a-valimat



VALIMAT® from test to material card







Plastic (1 - 4 mm)

Foam (20 - 4 mm)

Composite (1 - 4 mm)

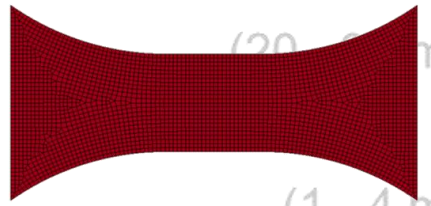
Aluminum (1 – 2.5 mm)

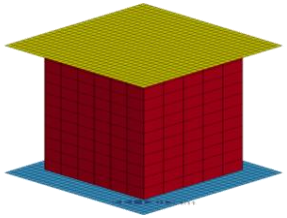
Metals (0.5 – 1.5 mm)

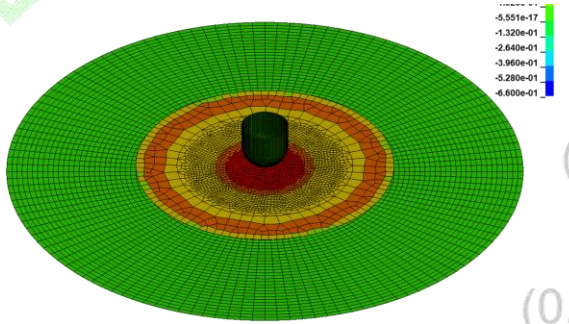
typical thickness

automated FE-model generation

VALIMAT

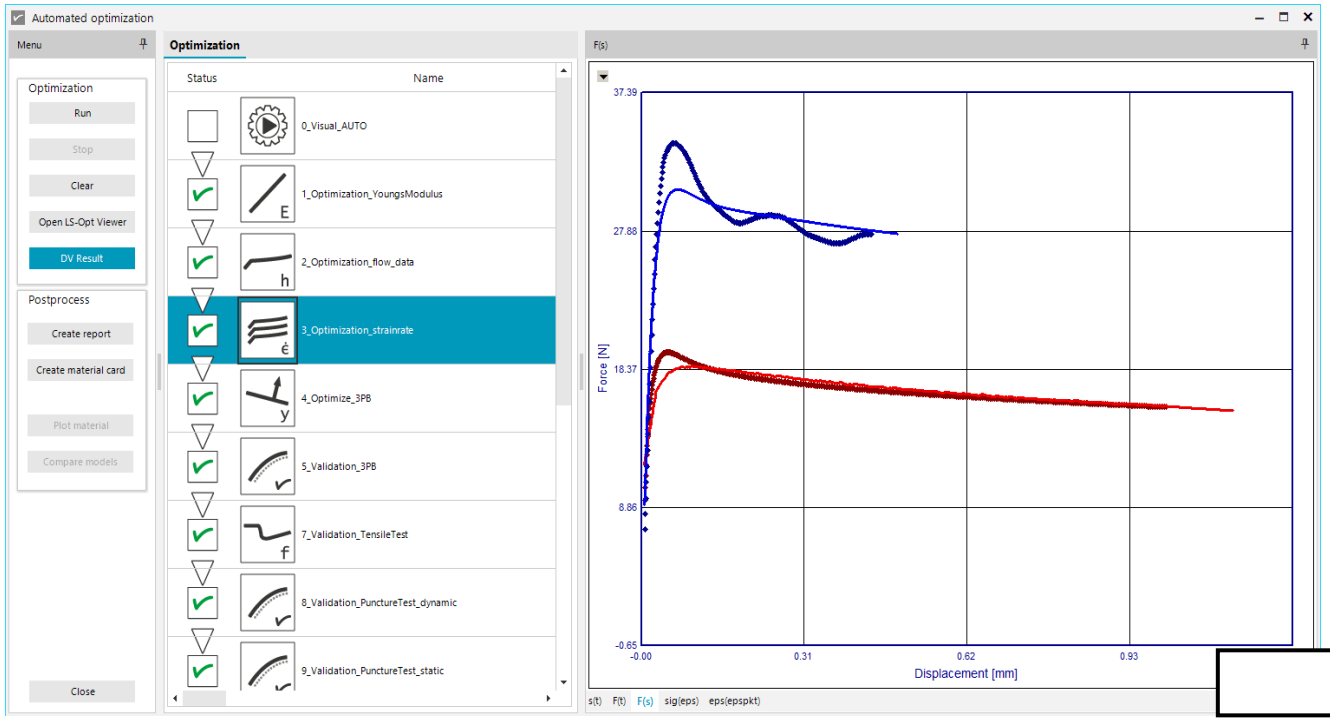




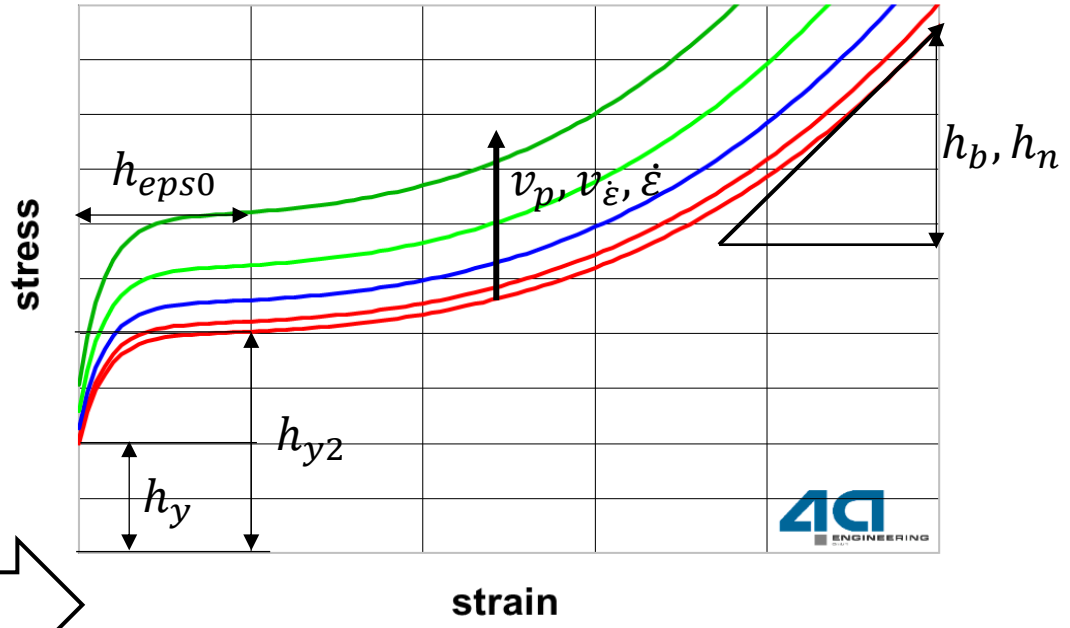


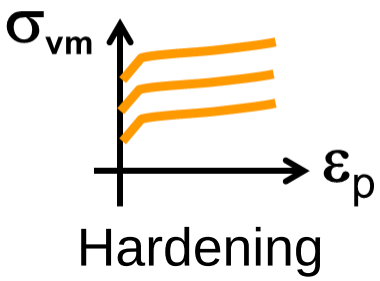
VALIMAT® Workflow for Material Card Generation - AUTOFIT

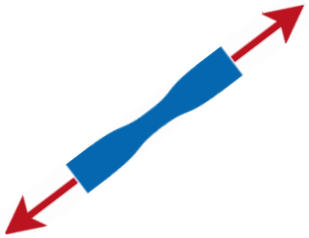
VALIMAT



parametrized material card







for crash and vibration simulations

MATERIAL cards

plastics
engineering
production

excellence in material models

concepts
simulation
lightweight
prototypes

material packages for almost all plastics…

BASIC STD
PRO L PRO

isoP thermoplasts
frP fiber reinforced
comP composites
foam foamed plastics

Sources: [illegible] *Kunststoffmodelle für die Interieur-Crashauslegung bei Audi AG*, 4a Technologietag 2010

PACKAGES

validated material cards
for LS-DYNA®, PamCrash®, Simulia ABAQUS®

isoP isotropic PLASTIC

isotropic elastic visco plastic

frP fiber reinforced PLASTIC

orthotropic elastic visco plastic

comP composite PLASTIC

orthotropic elastic damage

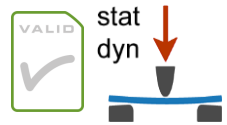
foam foamed PLASTIC

isotropic hyper-elastic
based on static and dynamic compression tests

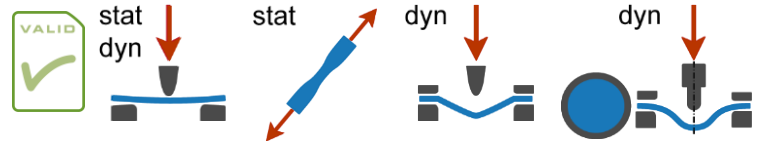
UPGRADES

PLUS – dynamic tensile
TEMP – low and high

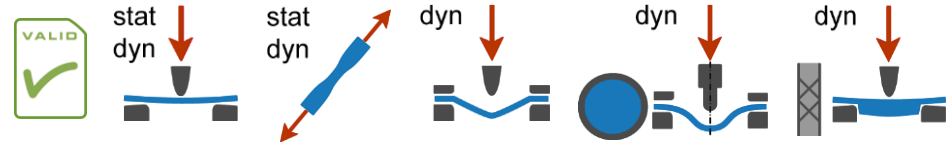
BASIC



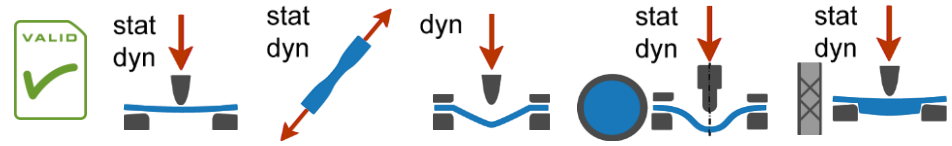
STD



PRO L



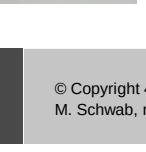
PRO

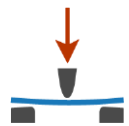


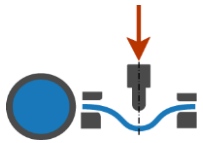
Creation of a „digital twin“ of a material

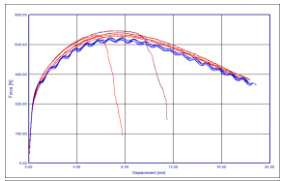
Static and dynamic mechanical characterization

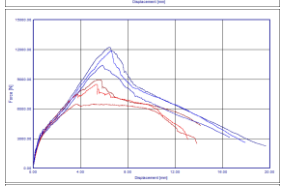
LINOVIS
high performance modular testing

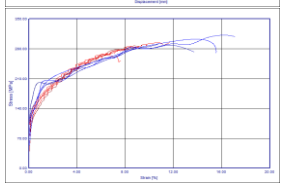




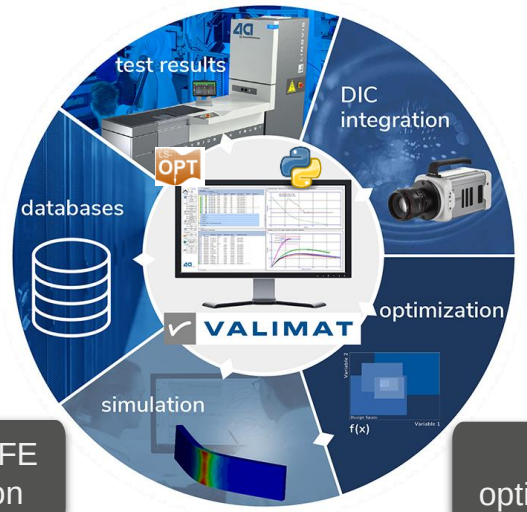




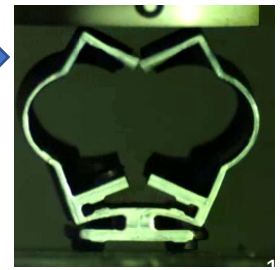


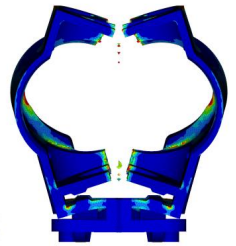


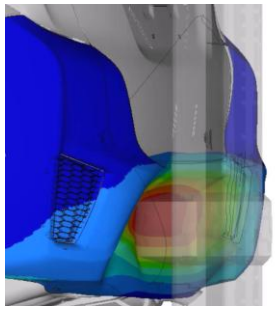
Modelling and parameter identification

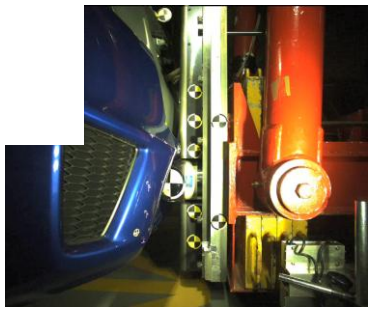


Validation and implementation to bigger models



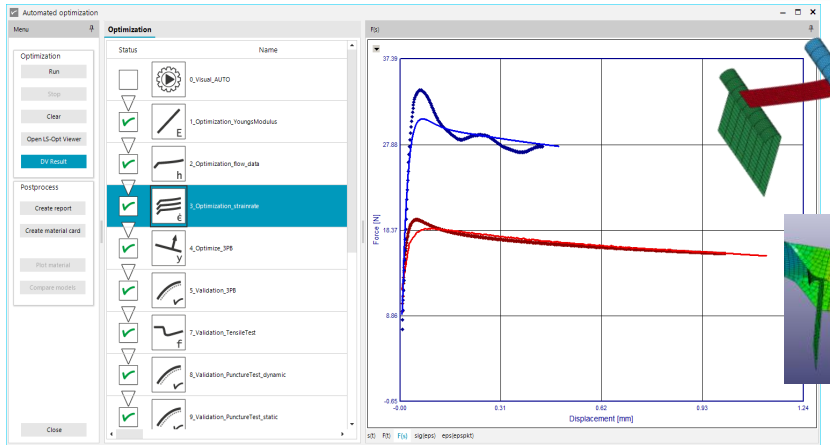


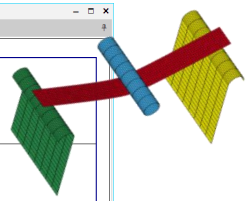


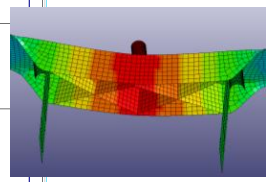


Fully automated FE model generation

Automated optimization workflows

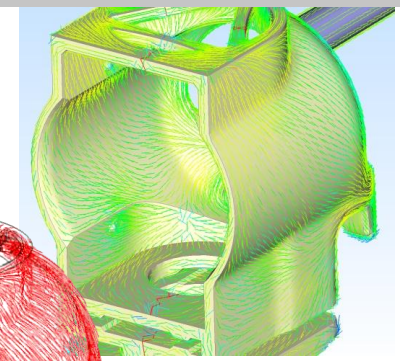






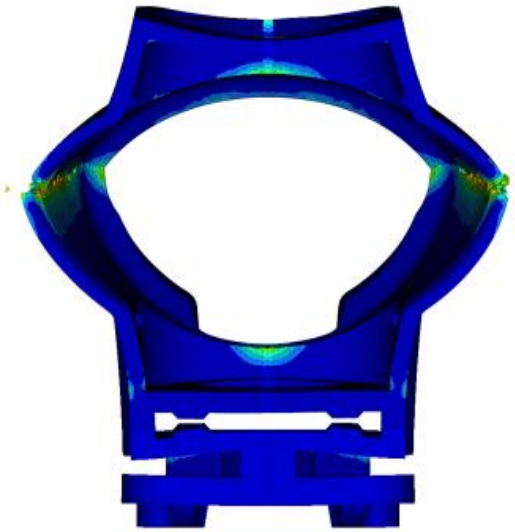
Case: Sleeve

- Common isotropic modelling approach cannot capture local fracture
- Production process (fiber orientation) needs to be accounted for



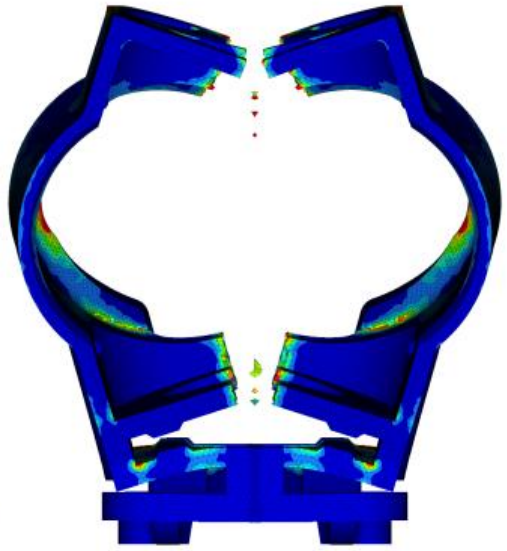
FIBERMAP

***MAT_24**
isotropic



test

***MAT_157/215**
local anisotropy

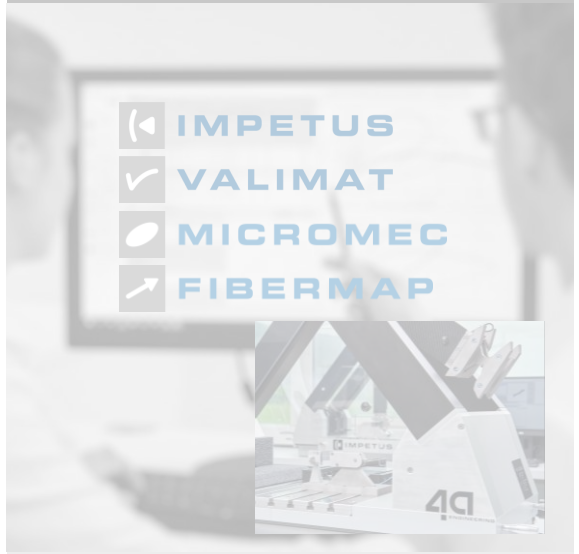


hirtenberger
Automotive Safety

See more: R. Steinberger, et.al. Hirtenberger Automotive Group – *Considering the Local Anisotropy of Short Fiber Reinforced Plastics, European Dynaforum 2017*

4a engineering - Business U

Testing hard- and software

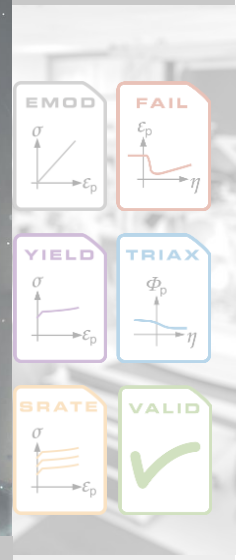


Seamless testing and simulation solution for automated material characterization

M… charac…

Static and … material ch… from speci… componen… all under c…

…aterial …s



…ages for …al models …mCrash

Battery testing and simulation

Testing and multiphysics modelling of battery cells, cell stacks and modules.

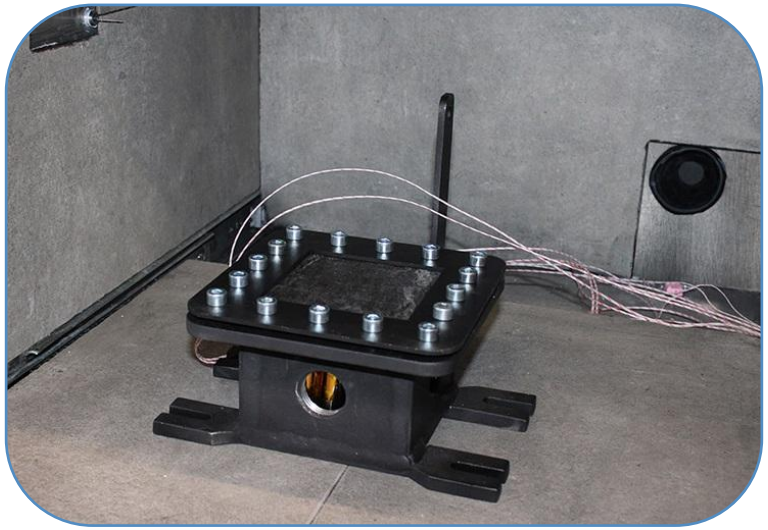
Battery testing and simulation

Testing and multiphysics modelling of battery cells, cell stacks and modules.

Portfolio

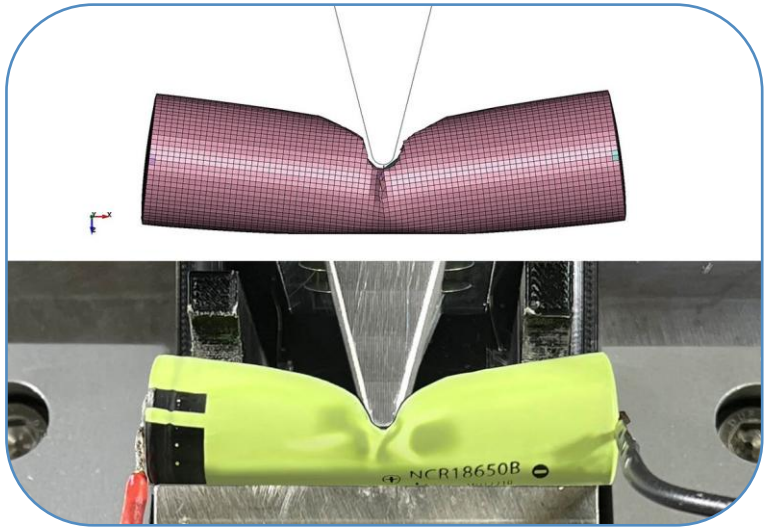
Cell abuse testing

According to existing standards as well as customized solutions



Material durability testing

Standardized solutions (e.g. UL-2596, torch and grit test) as well as customized test set ups



Multiphysics modelling and simulation

Digital twins of battery cells for virtual validation of thermal propagation and crash load cases

HERCULES

high performance battery testing

specifications

max. design pressure	10 bar
max. cell capacity	500 Ah
max. # TCs (type K or N)	100
max. # voltage signals	15
max. # pressure signals	6
high current feedthroughs	70 A
gen. purpose connections	9

- feedthroughs for gas handling
- gas pressure sensors
- quantitative gas analysis

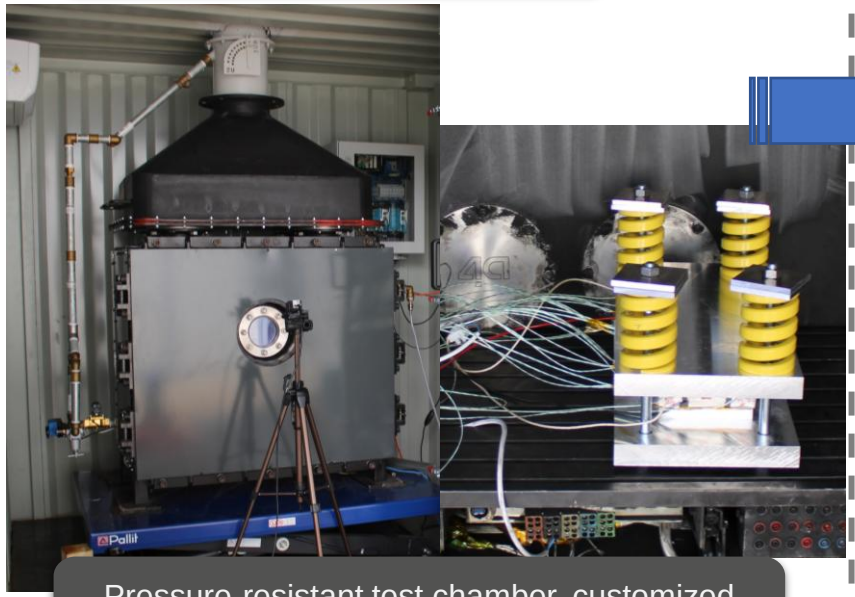
modes of operation

- open with continuous gas extraction
- closed with defined O_2 content
- closed and completely inerted

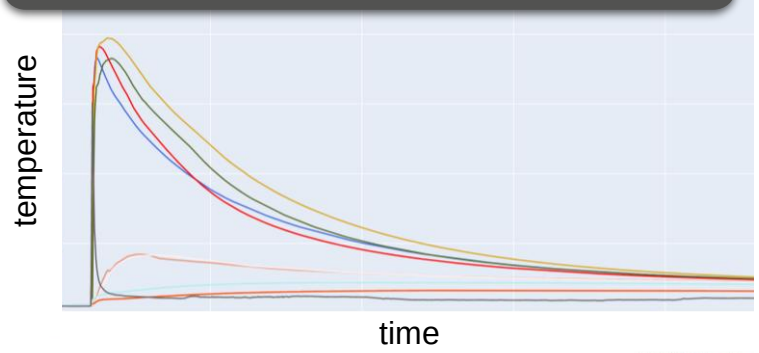
I N P H Y S I C S W E T R U S T

Creation of the thermal simulation model

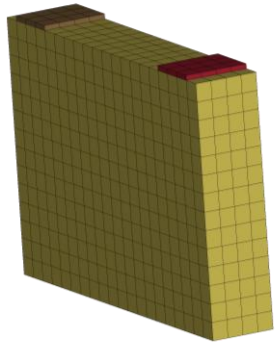
Electro-thermal abuse testing



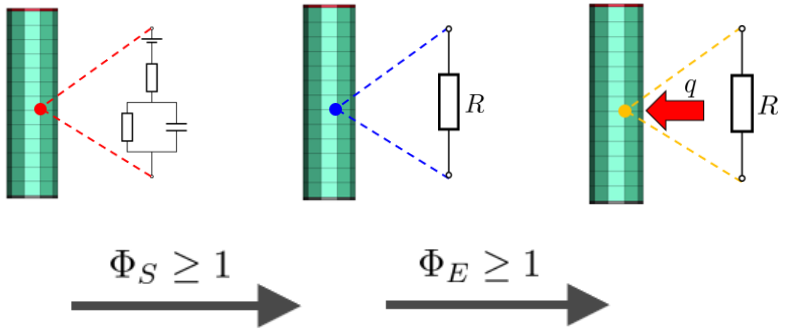
Pressure-resistant test chamber, customized test setups & automated data evaluation



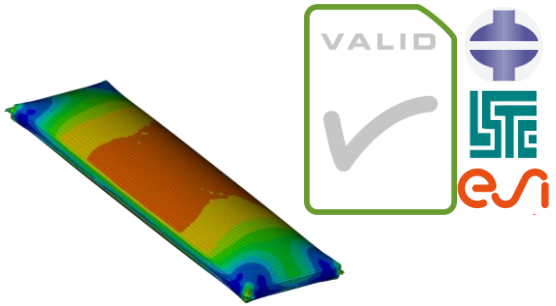
Optimization on a single battery cell



Investigate structural heat conduction directly with mechanical model through BATMAC approach



Validation and integration on component and pack level



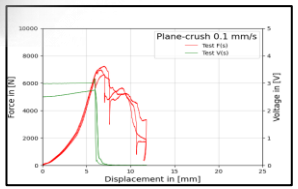
Optimization of the propagation behavior at pack level

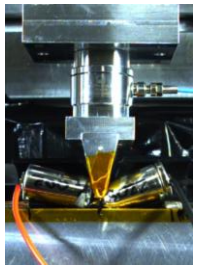
Virtual validation of GB38031 on pack level

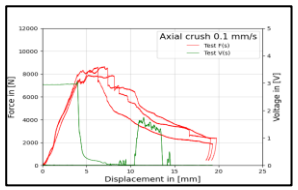
Multi-physics simulation

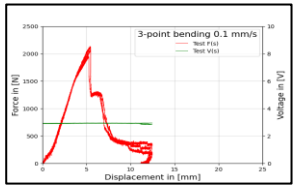
Static and dynamic mechanical characterization

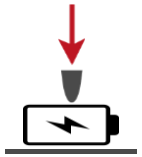
LINOVIS
high performance modular testing

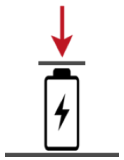


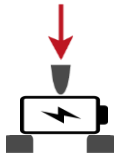




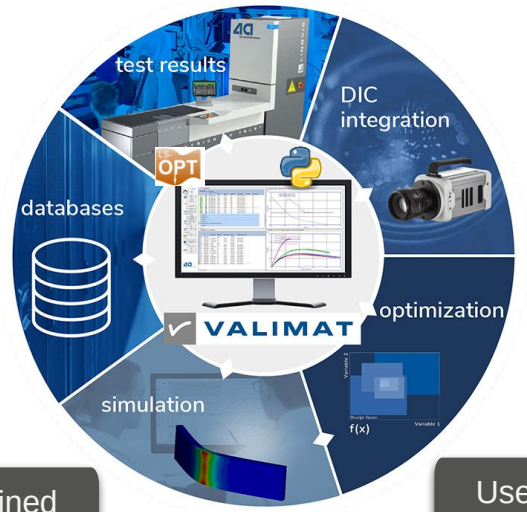




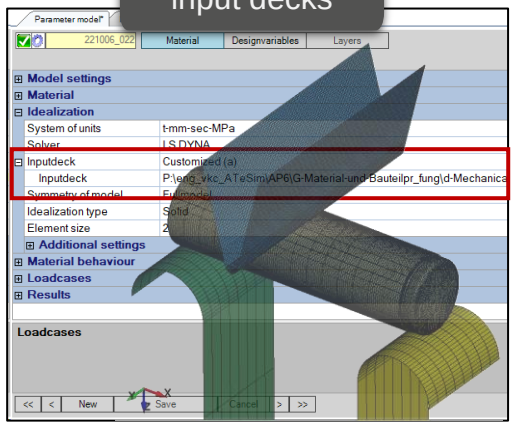




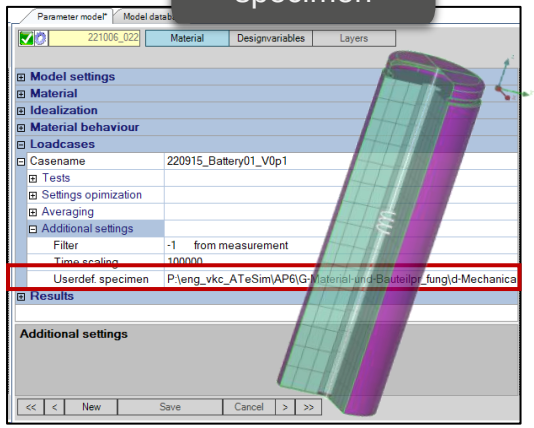
Optimization on a single battery cell



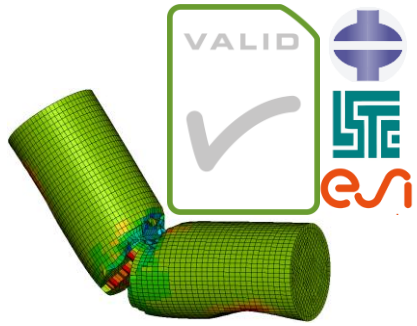
User defined input decks

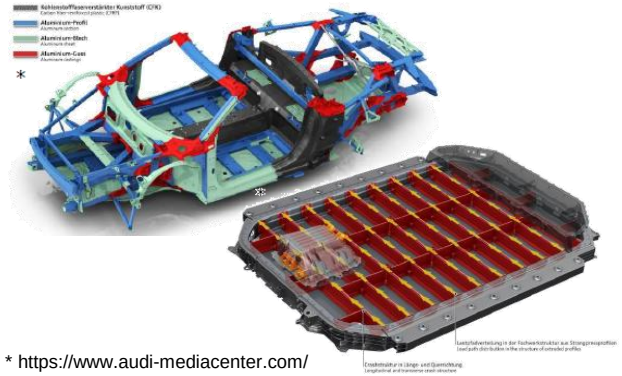


User defined specimen



Validation and implementation to bigger models





* https://www.audi-mediacenter.com/

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