GREEN MOBILITY™
ENERGIZED BY LANXESS

Lanxess CAE Service Center Overview

High Performance Material (HPM), LANXESS Hong Kong

LANXESS
Energizing Chemistry

HPM’s CAE service center offers high-end engineering at its best

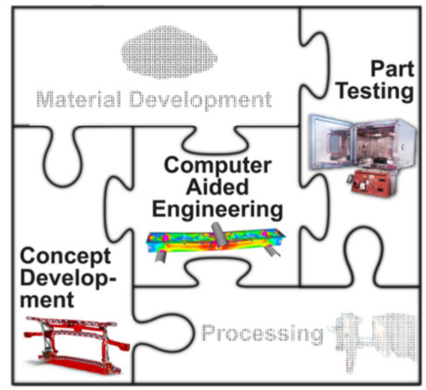
Hong Kong Science & Technology Park

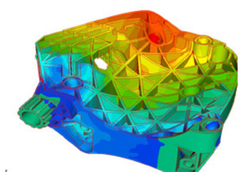
- Park office and laboratory space: 220,000 m^2
- More than 300 high-technology enterprises of all sizes
- Phase 1 & 2 completed and ~95% occupied, Phase 3 completed

LANXESS HPM development services

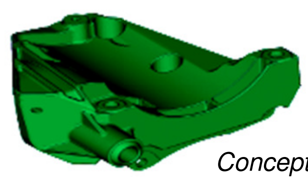
HiAnt®

Part Testing





Computer Aided Engineering



Concept Development

LANXESS

Our value proposition combines materials and high-end engineering know-how at its best

Expertise for all stages of advanced component development

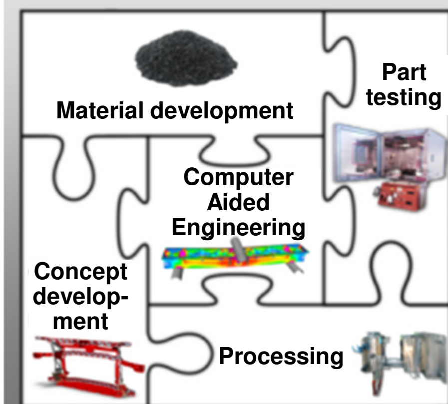
Tailored high-tech plastics compounds and composite sheets

Durethan®

Pocan®

TEPEX®

HiAnt®



- **Material development:** Tailored material solutions
- **Concept development:** Leading in lightweight technology developments
- **Computer Aided Engineering:** Top-notch simulation methods
- **Part testing:** State-of-the-art testing facilities
- **Processing:** Development of material process combinations for new applications

LANXESS

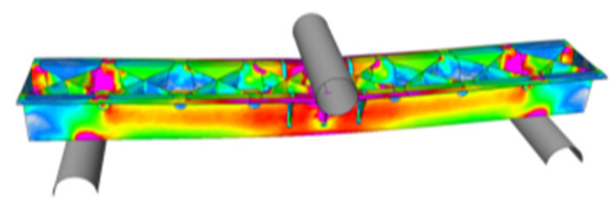
Top-notch simulation tools developed by LANXESS*

HiAnt

Computer Aided Engineering

Developing advanced CAE tools to predict component performance close to reality:

- Processing simulation e.g.
  - Injection molding (moldflow)
  - Forming simulation*
- Integrative simulation technology*
  - Short fiber reinforced plastics*
  - Composite sheets*
- Structural simulation e.g.
  - Crash
  - Fatigue life prediction

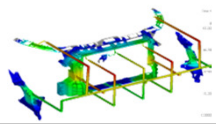


Feasibility study → Detailed development → Tooling → Testing → Production

* Special competence by LANXESS

LANXESS

HPM’s APAC engineering services for our customers

	Feasibility study	Detailed development	Testing / Approval	Production
				
Tasks	▪ Concept proposals ▪ Topology optimization ▪ Structural & rheological analysis on conceptual design	▪ Optimization of detailed design ▪ Virtual evaluation: mechanical analysis ▪ Virtual processing: rheological analysis	▪ Part validation	▪ Trouble shooting – Processing – Parts performance
Deliverables	▪ Preliminary design ▪ Material pre-selection ▪ Processing technology ▪ Estimate of cost & challenges	▪ Serial design of part & mold ▪ Grade selection ▪ Guideline for processing ▪ Guideline for testing ▪ Challenges/Risks	▪ Durability* ▪ Compliance with customer specification ▪ Insight of material and parts performance	▪ Analyze failure sources ▪ Find solutions

* Under various environmental conditions

LANXESS

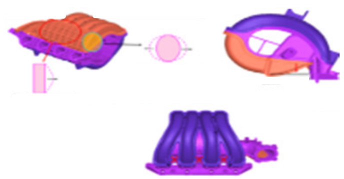
Computer Aided Design & Engineering (CAD & CAE)

HiAnt

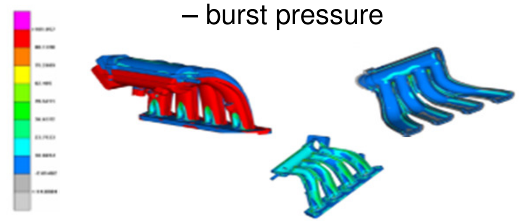
CAD and CAE development steps of air-intake manifolds

Feasibility study → Detailed development → Tooling → Testing → Production

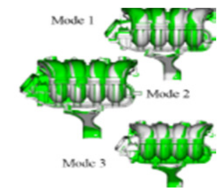
Product design review



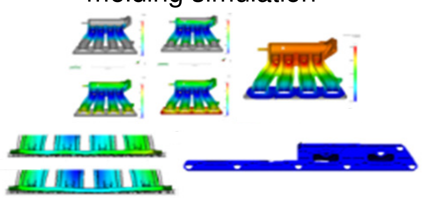
Mechanical FE-analysis (Abaqus)
– burst pressure



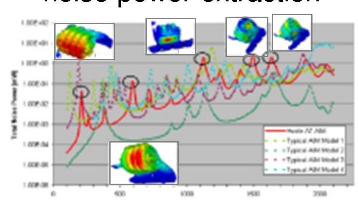
Mechanical FE-analysis (Abaqus)
– eigen mode extraction



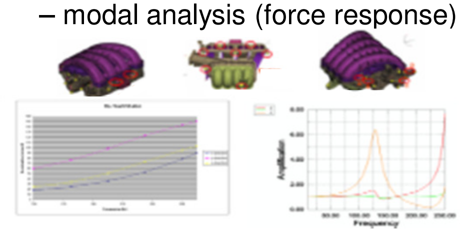
Rheological FE-analysis (Moldflow)
– molding simulation



Mechanical FE-analysis (Abaqus)
– noise power extraction



Mechanical FE-analysis (Abaqus)
– modal analysis (force response)



LANXESS

CAE and Design Service Support

Finite-Element Analysis

- **Rheological FE-Analysis (Moldflow)**
  - Filling pattern (optimizing machine size and surface quality)
  - Glass fiber orientation
  - Shrinkage and warpage
  - Cooling system and cycle time improvement
- **Mechanical/Fluid FE-Analysis**
  - Thermal expansion
  - Stiffness and strength
  - Creep
  - Impact simulation
  - Dynamical behaviour
  - Noise

Part and Mold Design

Part design

- Development of detailed solutions
- Material optimized design
- Incorporation of FE-results into design
- Investigation of joining alternatives

Tool design

- Gate design
- Hot runner systems
- Stiffness of tool
- Demolding techniques

Key Facts

Hardware

- Fujitsu Linux System
- 2 calculation nodes
- Max. 2 CPUs with 12 cores each
- Max. 128 GByte main memory
- 20 TB storage capacity
- Graphic workstations

Software

- SolidWorks
- CATIA
- ANSA
- Hyperworks
- Moldflow
- ABAQUS / LS-Dyna

Simulation types

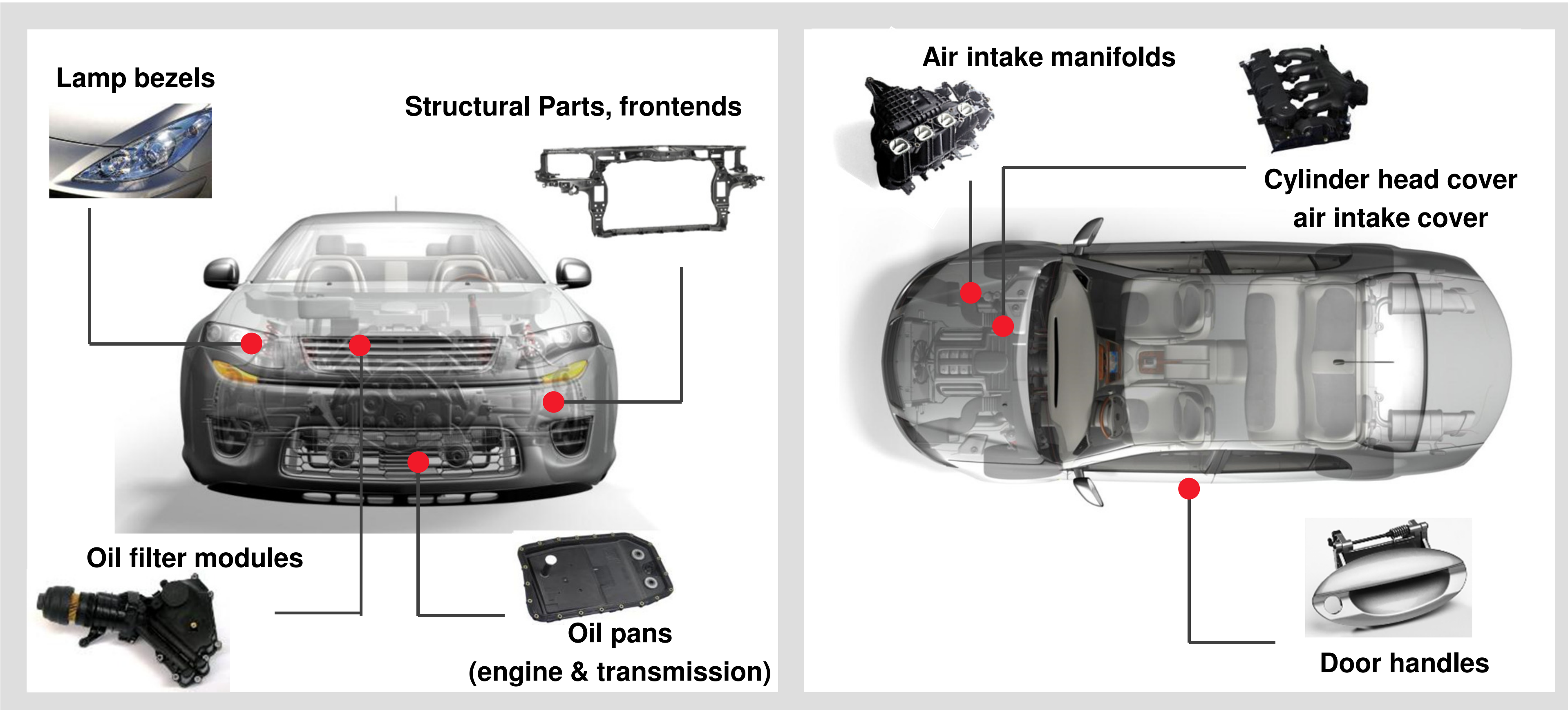
- Rheology
- Topology- / Parametric Optimization
- Linear/Non-linear static
- Crash Simulation
- Acoustic / NVH

Special services

- Development and advancement of material data cards for various simulation codes
- Help with applying material data cards / trouble shooting

LANXESS

HPM's top applications in automotive for the APAC region



Rheology

Rheology

Injection Molding Simulation

Simulation of the injection molding process allows:

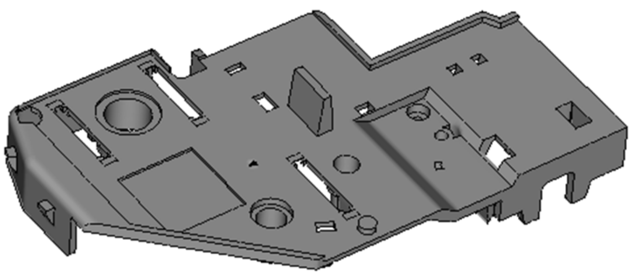
- Determining process ability of a molding (processing window)
- Identification of problem areas (weld lines, entrapped air, warpage,…)
- Determining optimum gate positions and runner dimensions
- Using of calculated fibre orientation in other FEM simulations for more accurate predictions (integrative simulation)
- Evaluate design alternatives without cutting steel

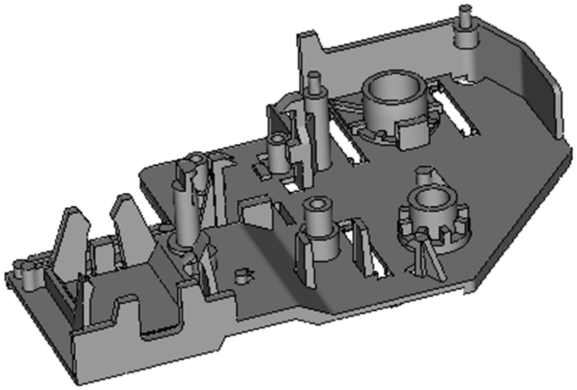
LANXESS

Rheology Example

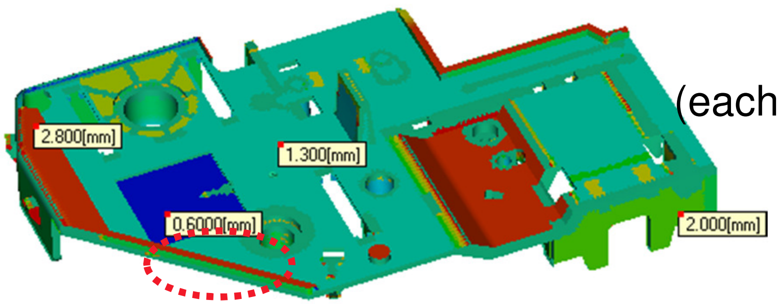
Base Plate – Geometry

Material: 30% glass filled PBT (Pocan B4235)





Part shows high variations in wall thickness

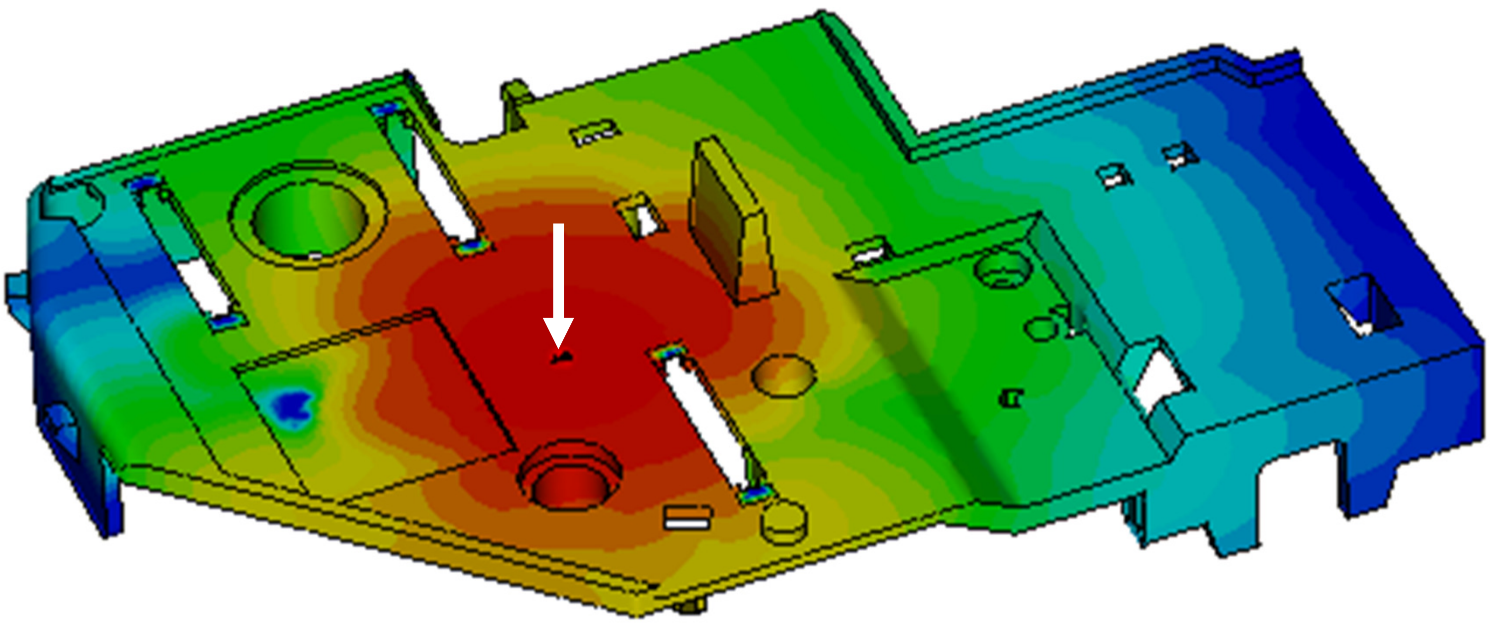


Wall thickness distribution
(each color indicates one wall thickness)

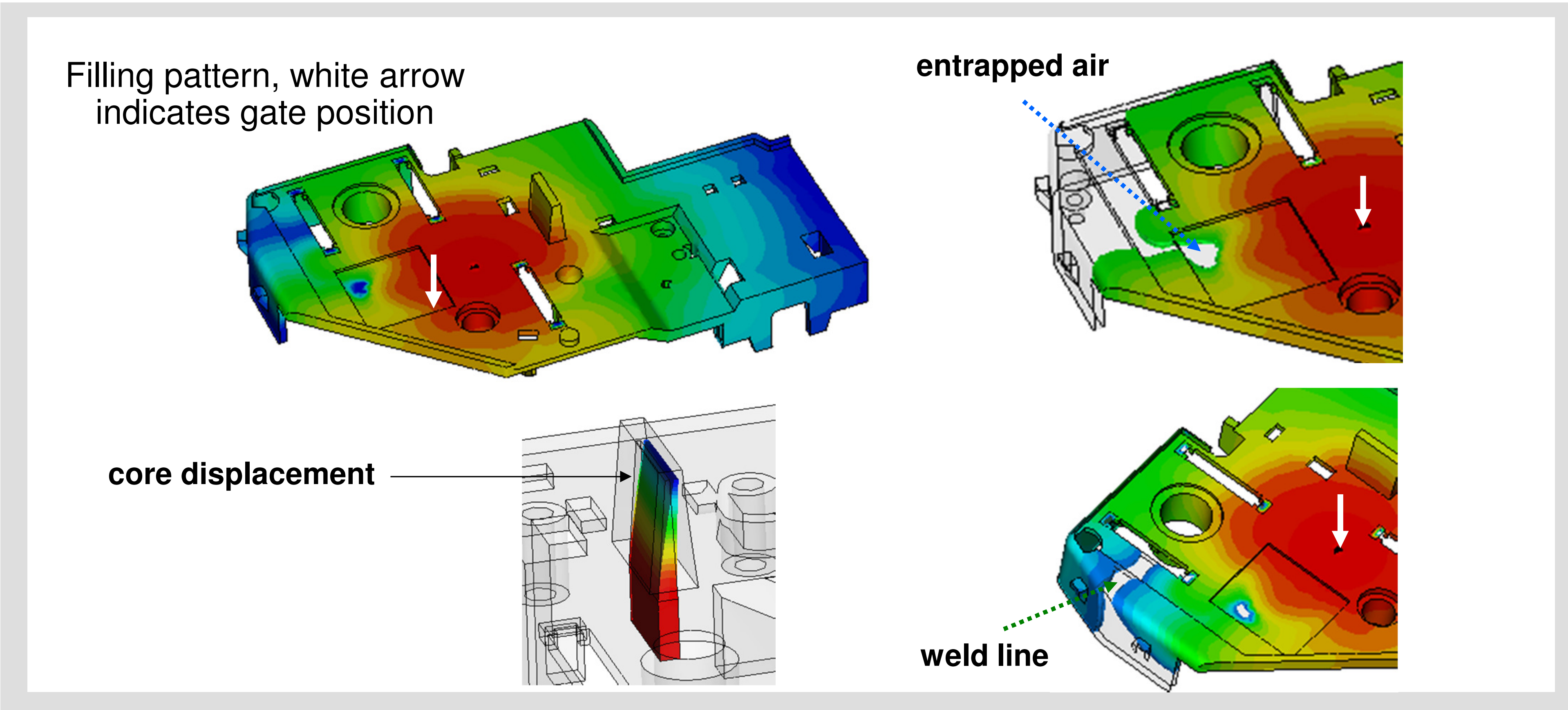
LANXESS

Rheology Results

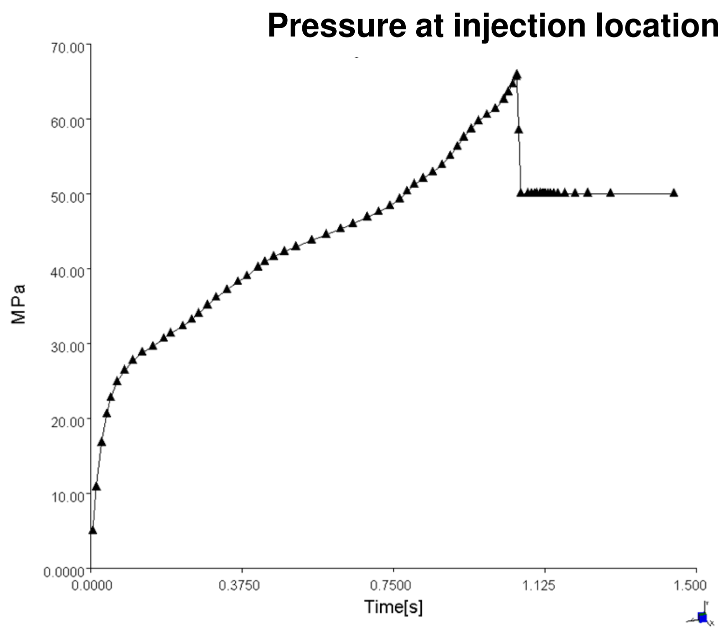
Filling pattern, white arrow indicates gate position

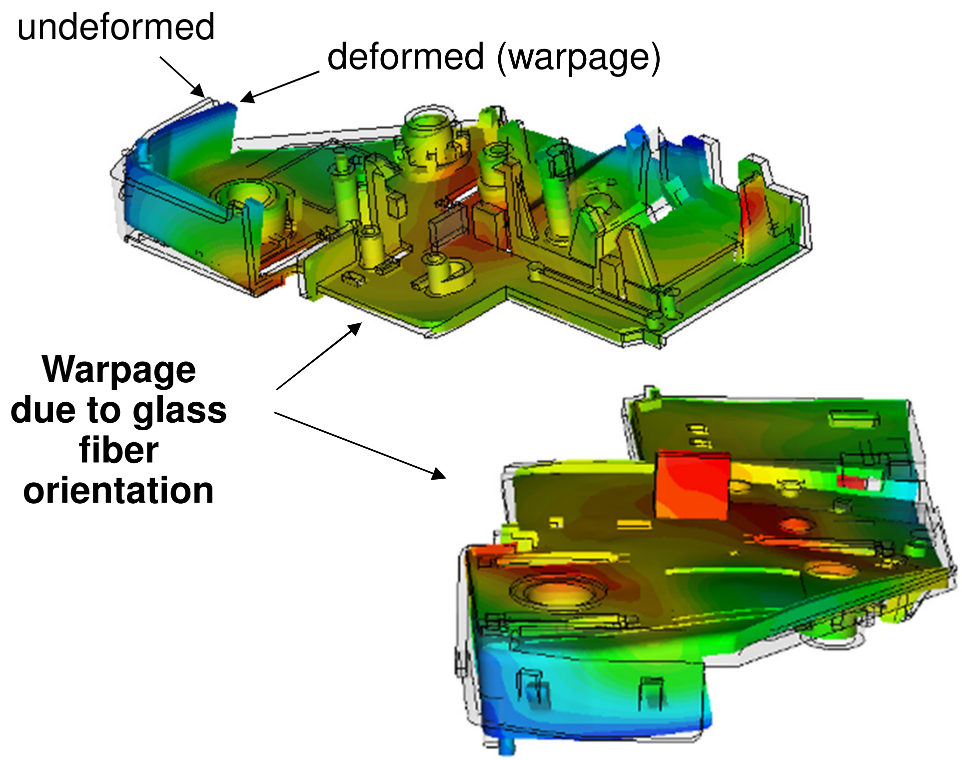


Rheology Results



Rheology Results



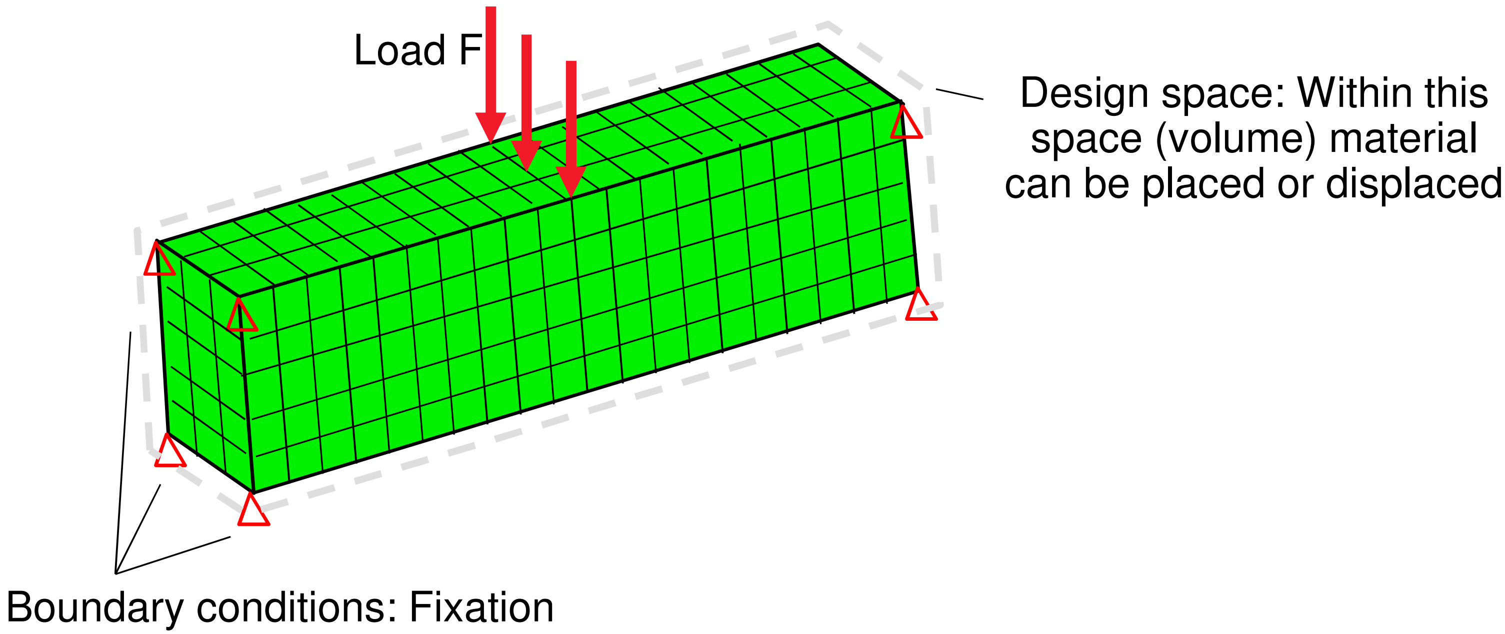


Topology Optimization

LANXESS

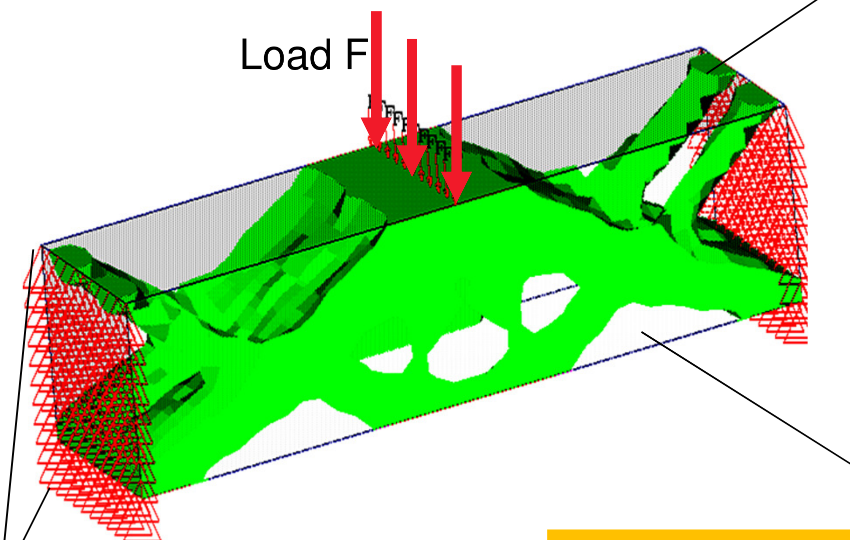
Topology Optimization

How does topology optimization works?



Topology Optimization

How does topology optimization works?



After the automatic iterative optimization process, material is placed in areas contributing to the part‘s stiffness

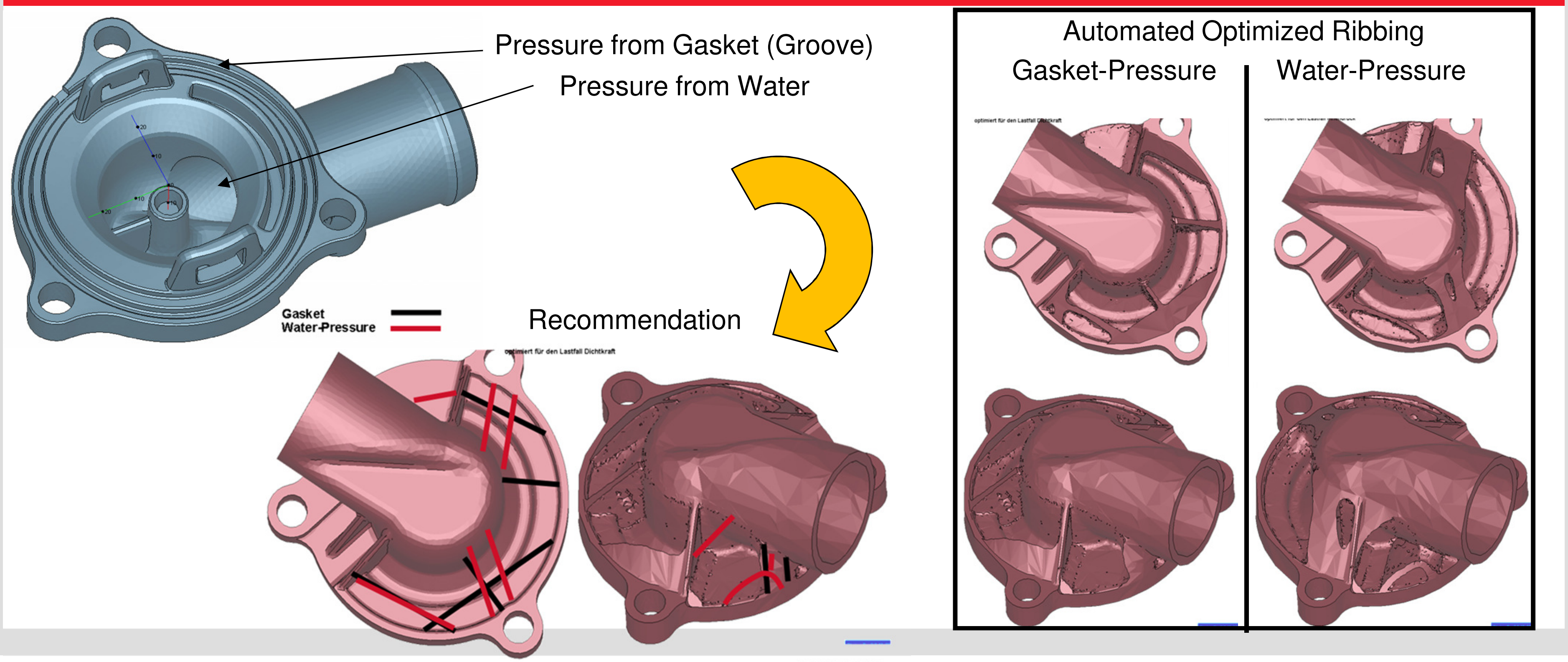
In areas with no static function, material is displaced

- After the automatic iterative optimization process, material is placed in areas contributing to the part‘s stiffness

LANXESS

Topology optimization example

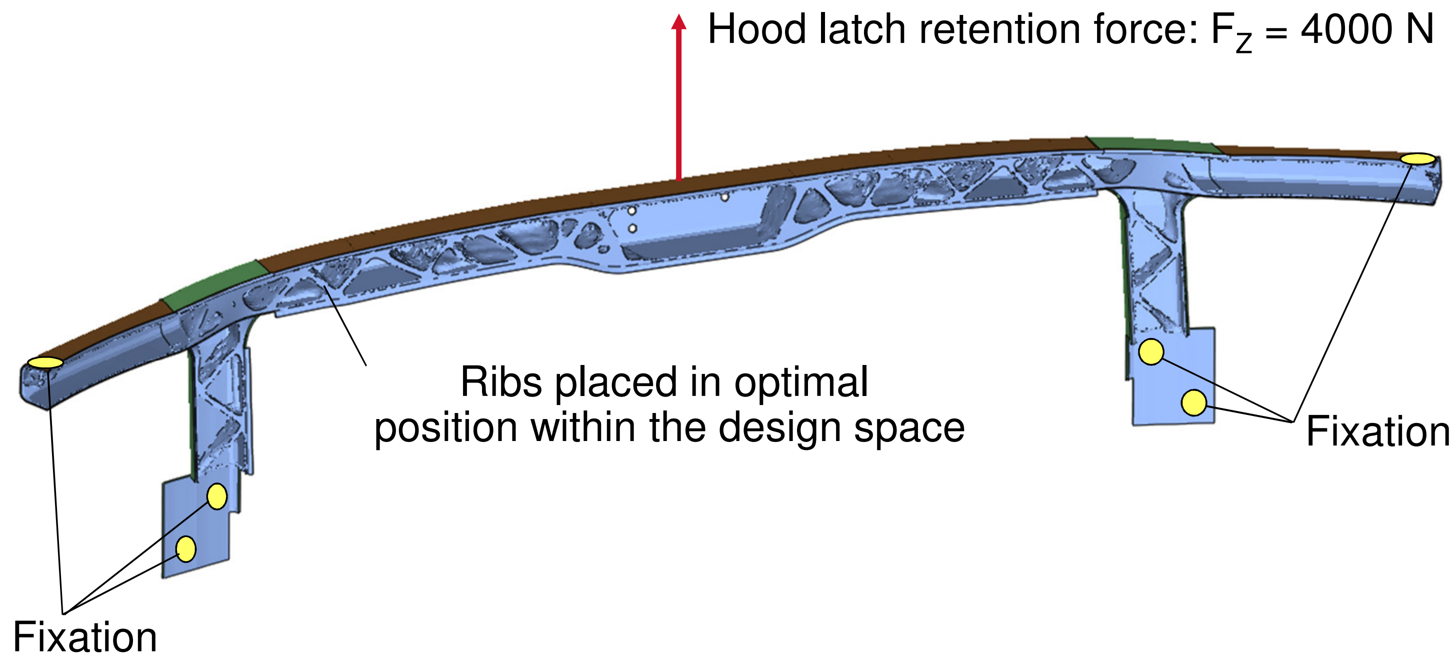
Topology optimization of thermostat housing under gasket and water load



LANXESS

Using topology optimization for design of rib patterns

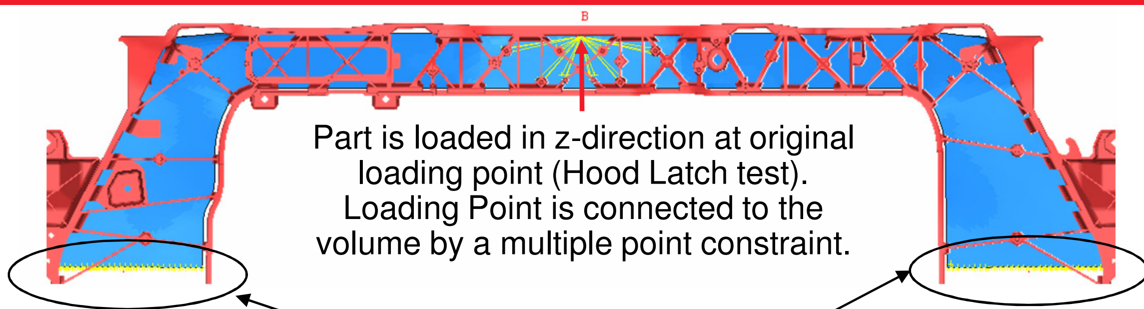
Example 1



LANXESS

Using topology optimization for design of rib patterns

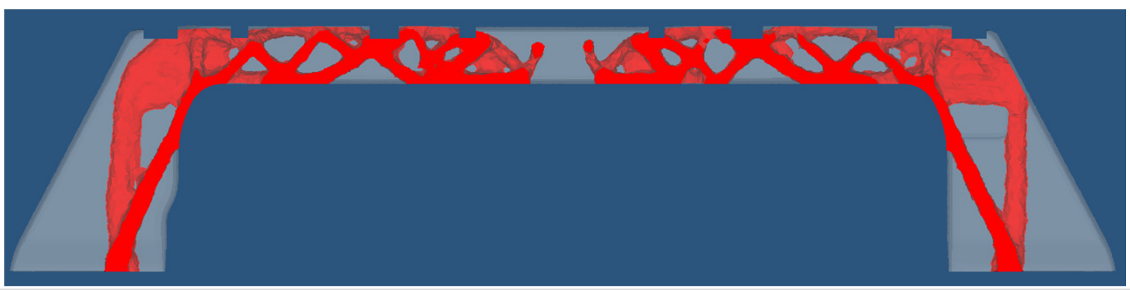
Example 2



Current Rib Structure

Part is fixed in x,y,z
(Translation & Rotation)

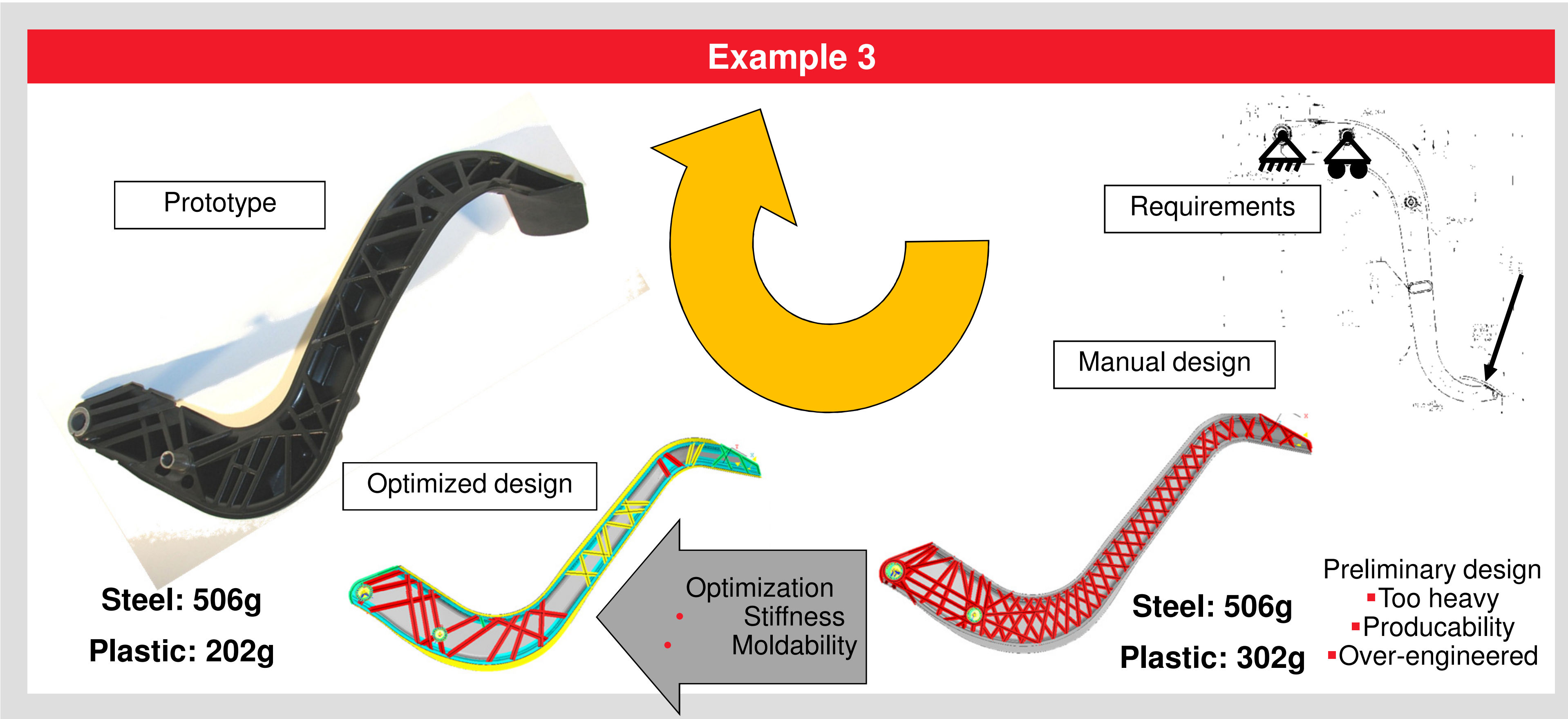
Material in the non-allowable areas are removed in the optimization analysis as shown below.



Optimized Rib Structure

LANXESS

Replacement of Steel Pedal with PMH Design Process



LANXESS

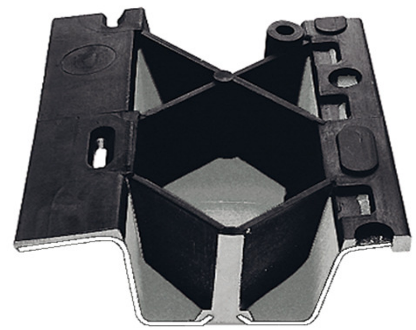
Hybrid Technology

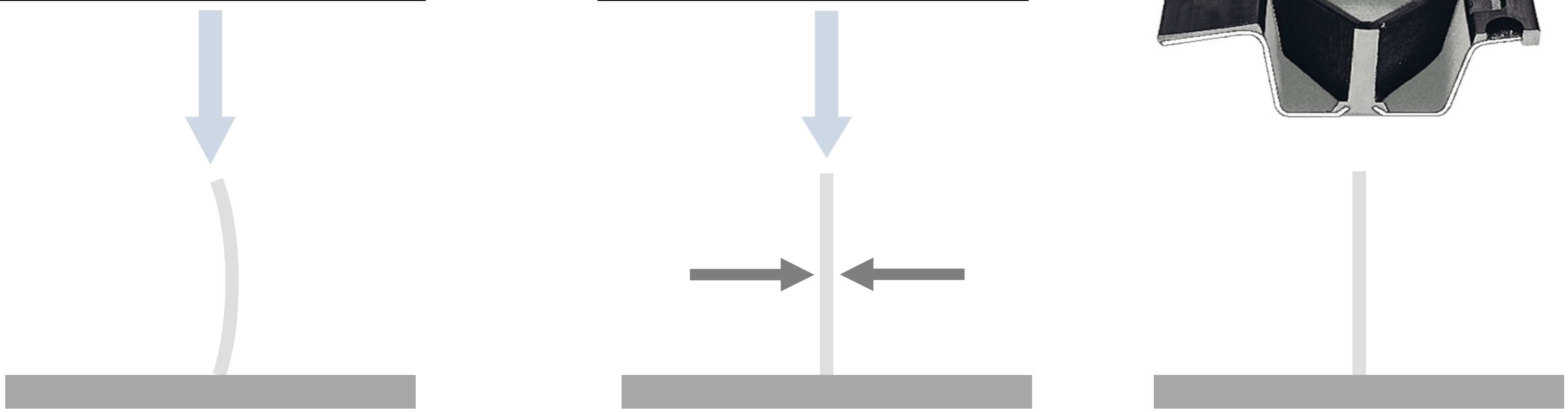
Hybrid Technology Principle

Plastic Keeps Metal in Shape

light weight design
(thin wall thickness)
tends to buckling

low forces
keep
structure in shape





geometry collapses at much higher forces
improved utilization of sheet metal structure properties

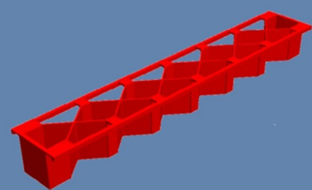
LANXESS

Hybrid Technology Principle

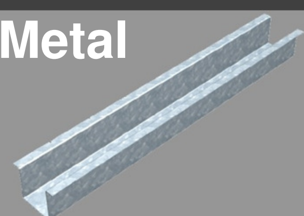
The Best of Two Worlds

Polyamid 6 GF

- design freedom
- low density
- good impact strength and stiffness
- excellent performance under dynamic loading
- high ageing resistance
- resistance against oil, grease and detergent

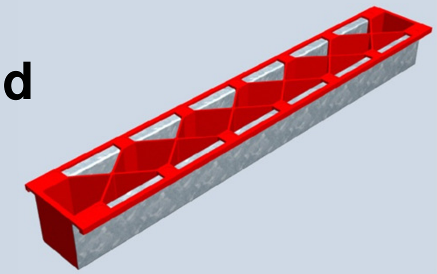


Metal



- high strength and stiffness in a wide temperature range
- ductile crack behaviour
- low CLTE
- good deep drawing behaviour

Hybrid



- reduced tendency to buckling of thin wall metal structures
- high energy absorption
- high temperature resistance (e-coating capability)
- low part weight by thin walls
- high precision in production and use
- high integration of functional elements

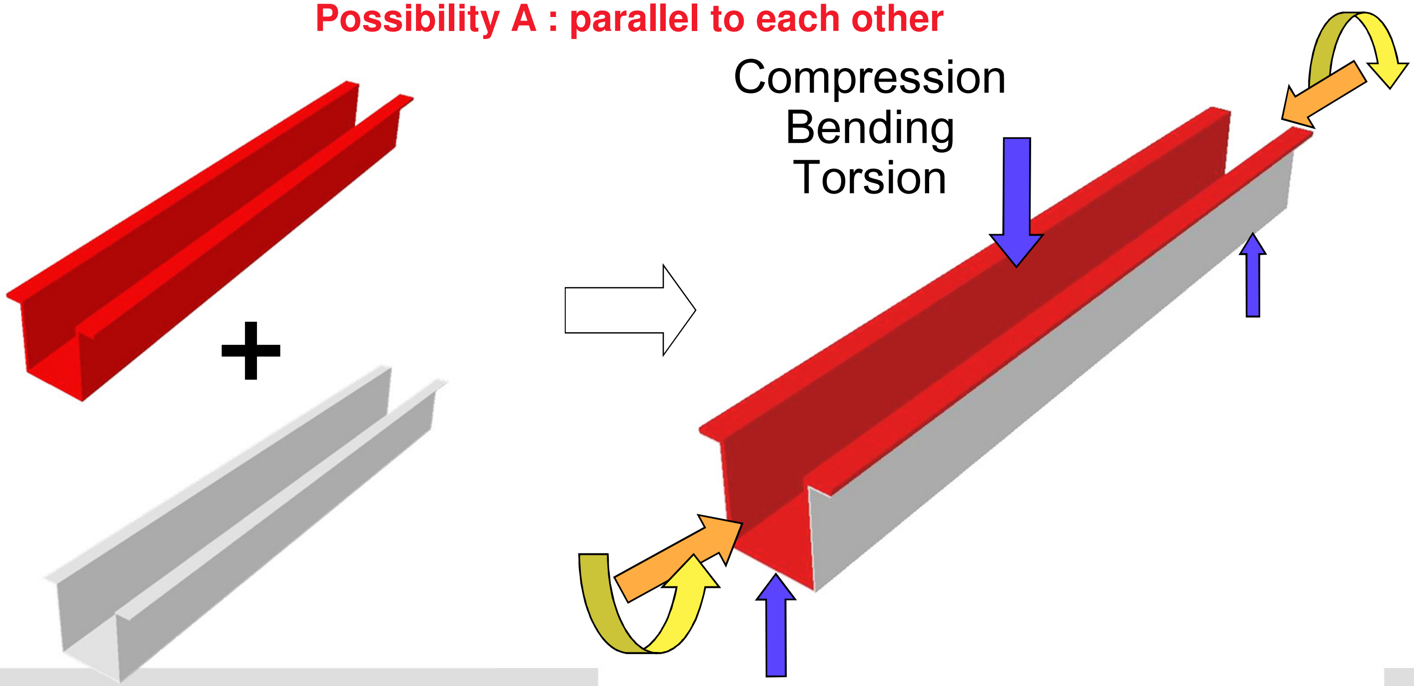
LANXESS

Hybrid Technology

Hybrid Technology Principle

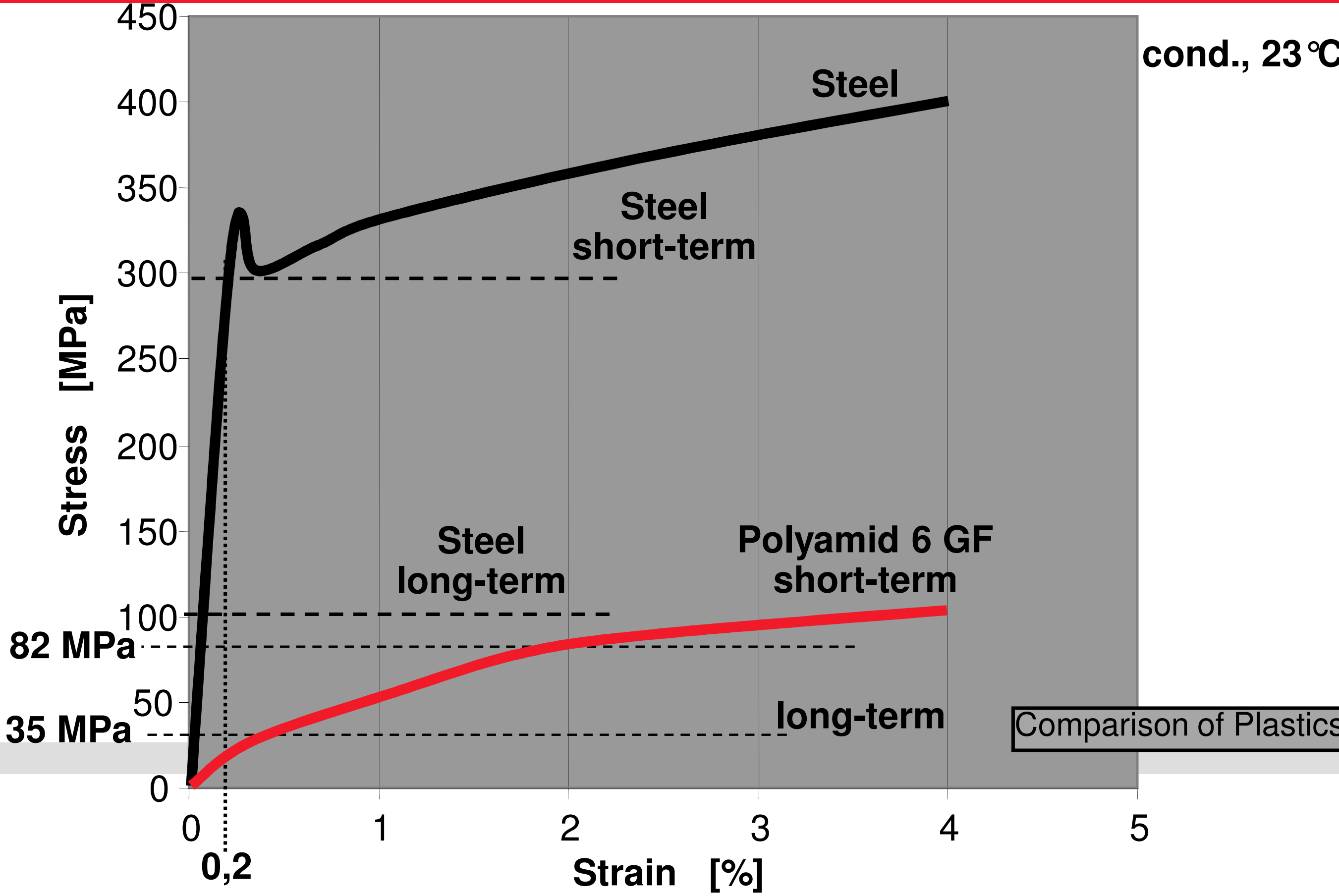
Q: What is the most effective combination of plastic and metal?

Possibility A : parallel to each other



Hybrid Technology

Hybrid Technology Principle



Comparison of Plastics with Metal

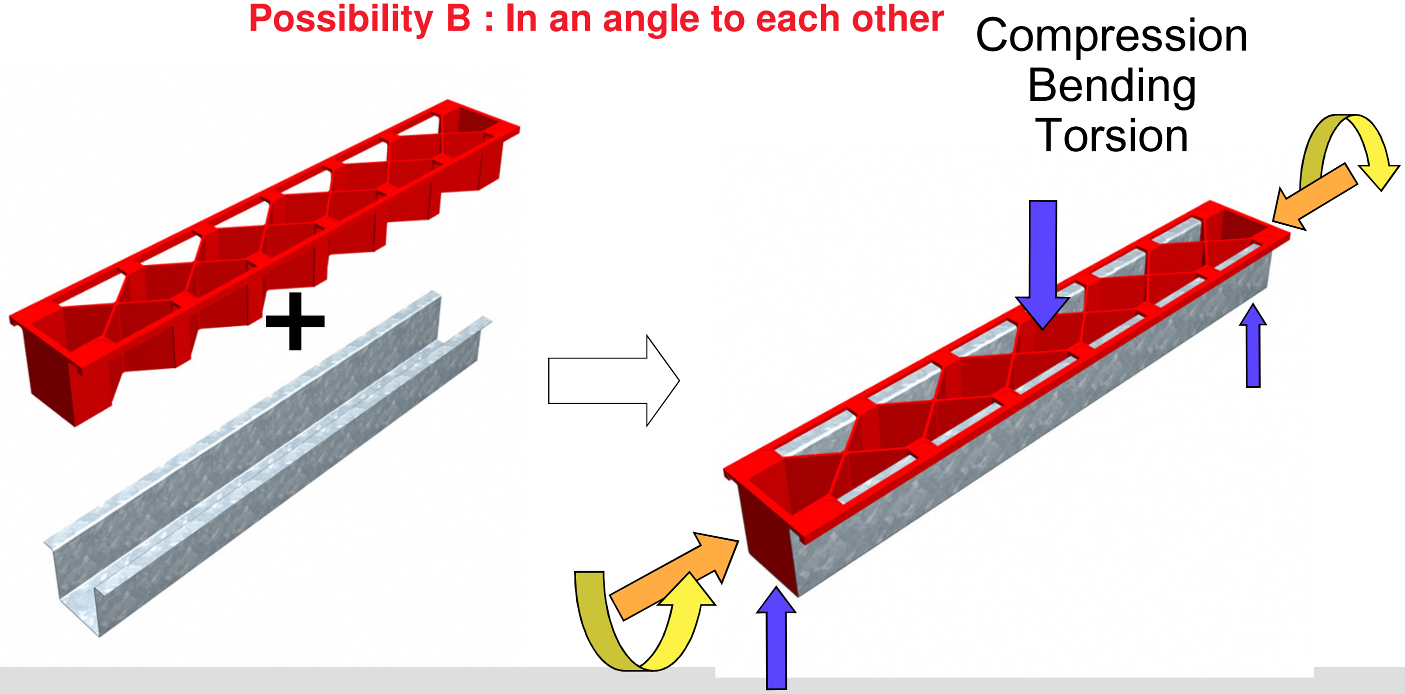
LANXESS

Hybrid Technology

Hybrid Technology Principle

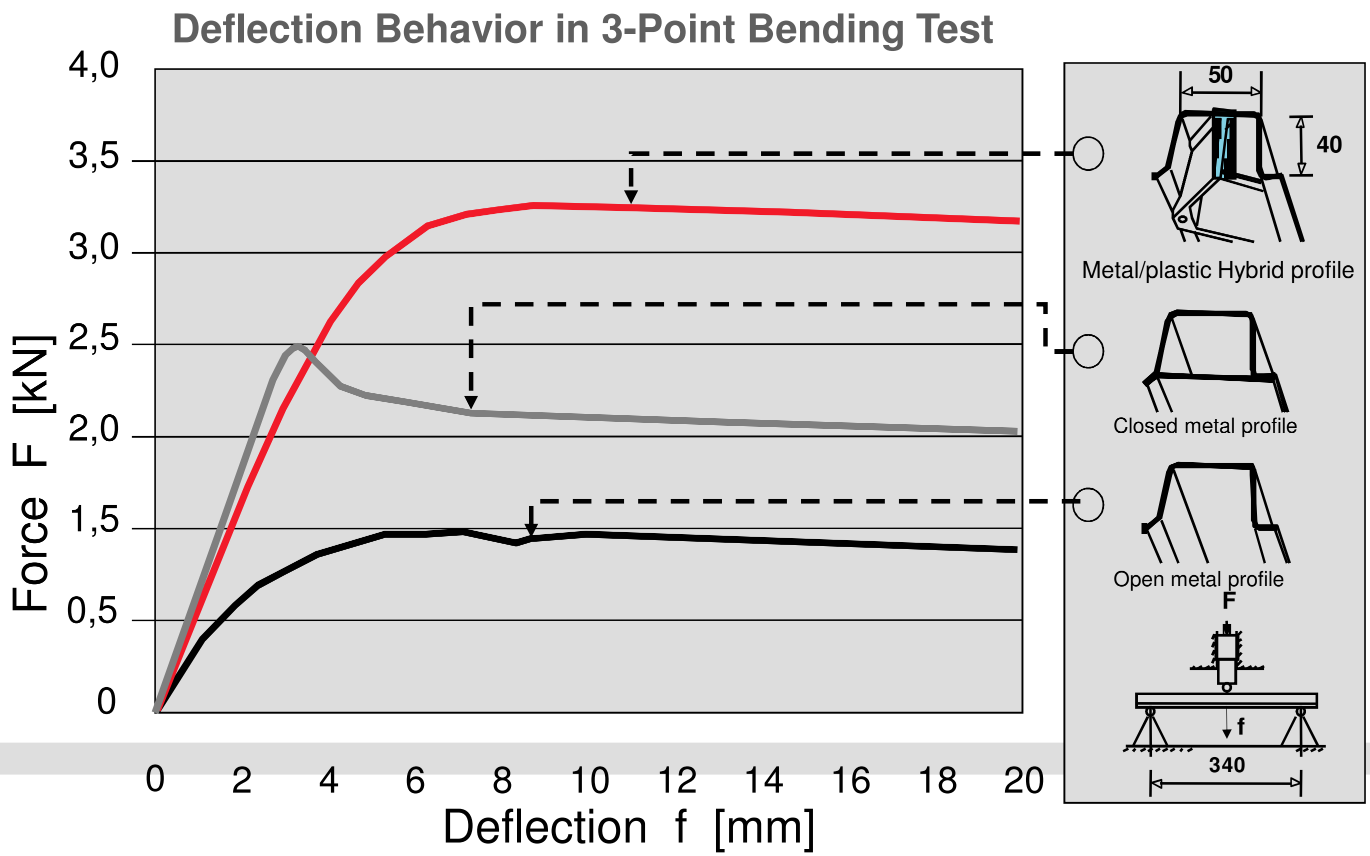
Q: What is the most effective combination of plastic and metal?

Possibility B : In an angle to each other



Hybrid Technology

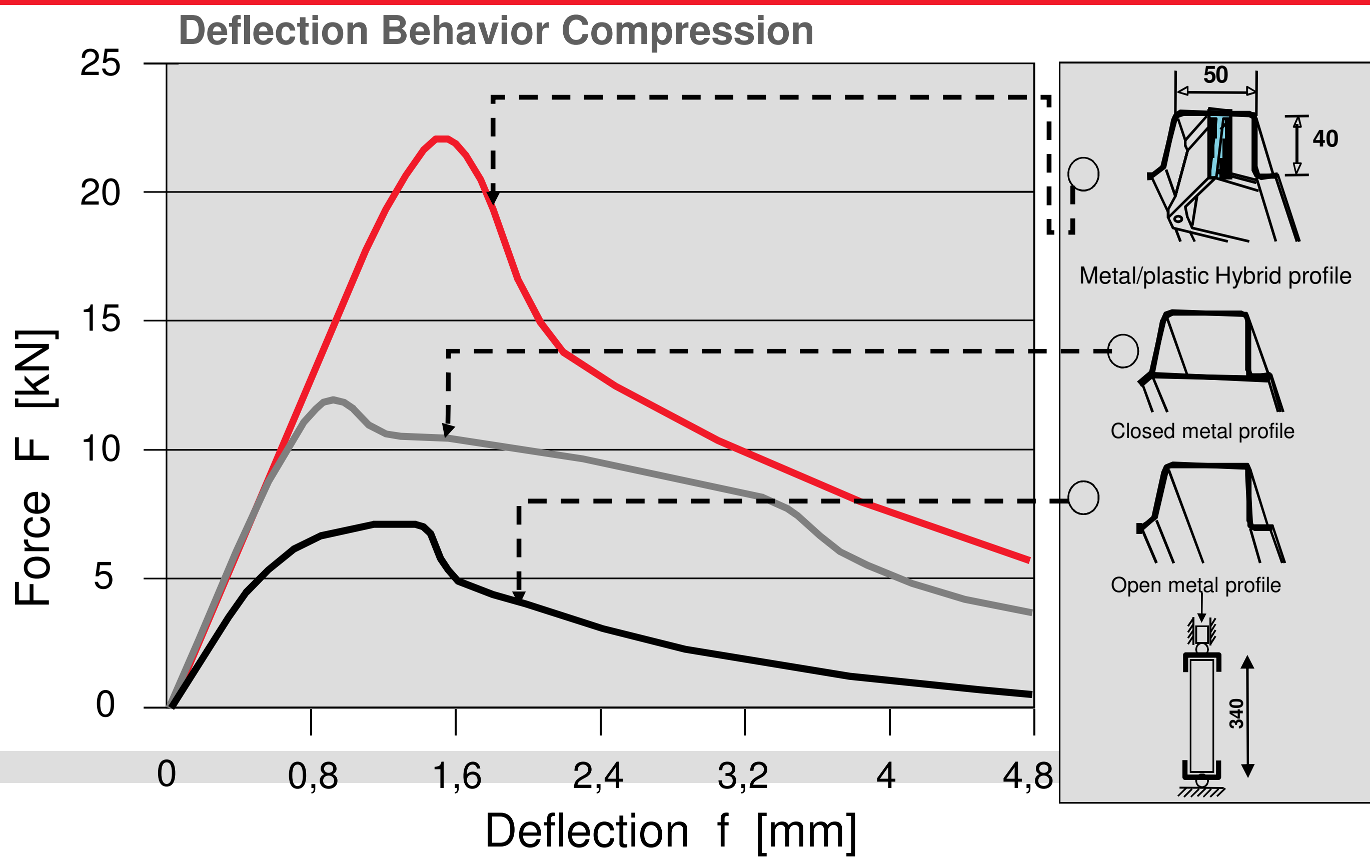
Hybrid Technology Principle



LANXESS

Hybrid Technology

Hybrid Technology Principle

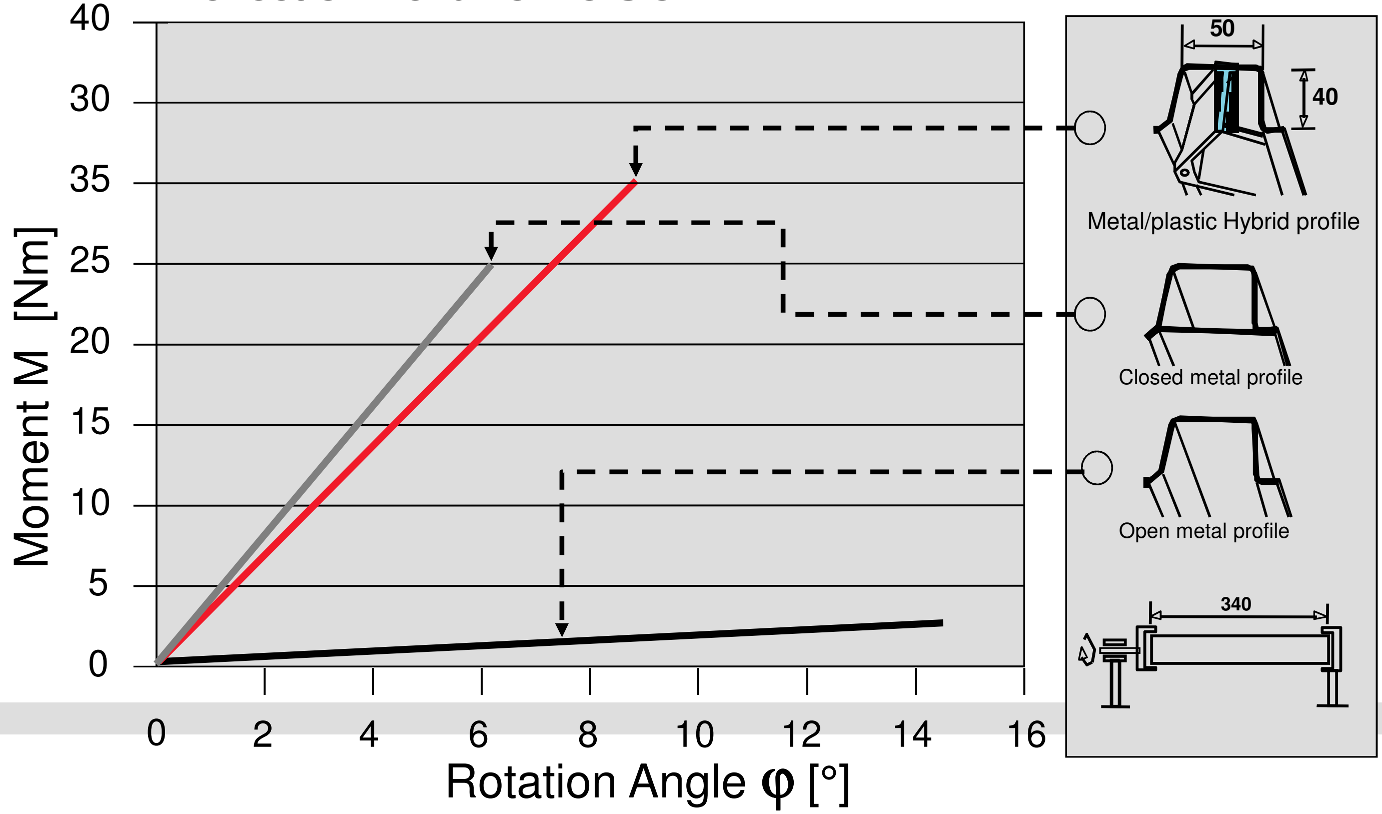


LANXESS

Hybrid Technology

Hybrid Technology Principle

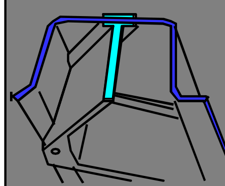
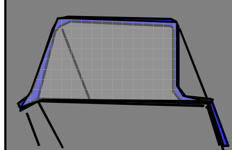
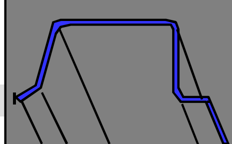
Deflection Behavior Torsion



LANXESS

Hybrid Technology

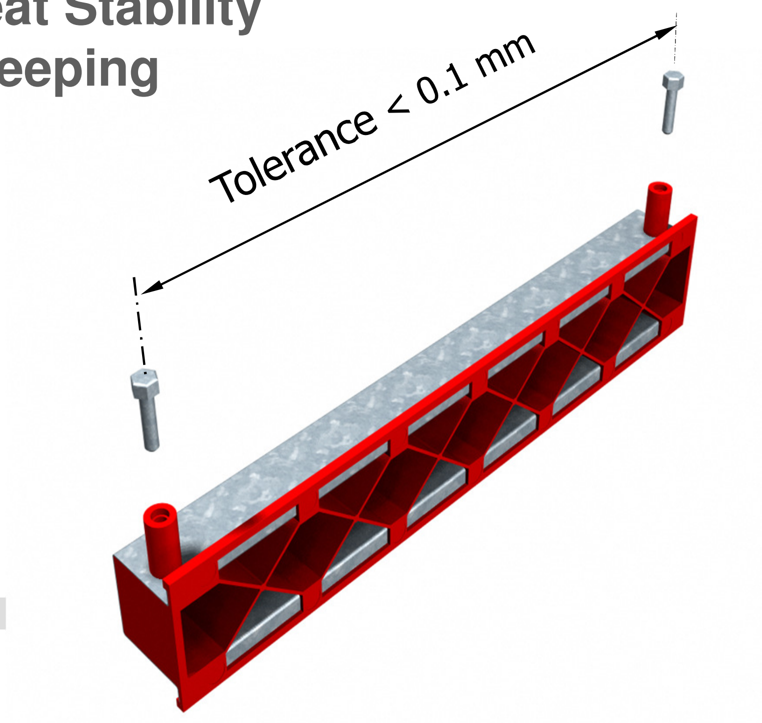
Weight related performance comparison

Beanspruchung / *load* — Profilart / *profile style*	Biegung *bending* Belastbarkeit *loading capacity*	Druck *pressure* Belastbarkeit *loading capacity*	Torsion *torsion* Steifigkeit *stiffness*
 PA-GF 30% x-verrippt *ribbed* Stahl /*steel* s = 0,7 mm	1,8	1,8	13
 Stahl /*steel* s = 0,7 mm	1,1	1	28 w/ face sheet metal 8,5 w/o face sheet metal
 Stahl /*steel* s = 0,7 mm	1	1	1

Hybrid Technology

Hybrid Technology Principle

Tolerances
Warpage
Heat Stability
Creeping



Influencing Factors on Tolerances:

Forming Process:

Stretching, compression and punching of the sheet metal

Dimensional inaccuracy of the sheet metal will be eliminated during the molding process.

Injection Molding Process:

Dimensional changes of the plastic component due to shrinkage are being limited by the strenght/stiffness of the metal profile.

Application:

Dimensional changes due to climatic variations (temperature, humidity) are small because of the dimensional stability of the sheet metal.

LANXESS

Smart solutions for a sustainable future of mobility – energized by LANXESS

- Innovative concepts support sustainable mobility trends
- Computer Aided Engineering pushes boundaries for cost-effective and efficient solutions
- Customized top-notch simulation tools
- Contributing to innovations with new technologies and high performance materials

LANXESS
Energizing Chemistry

GREEN MOBILITY™
ENERGIZED BY LANXESS