Multi-material based hybrid solutions as cost-effective, lightweight applications for the automotive industry

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AGENDA

1. **What is the challenge?**
2. **How do we solve it?**
3. **The way forward!**

GLOBAL MEGATRENDS AS RISK AND OPPORTUNITY FOR AUTOMOTIVE INDUSTRY

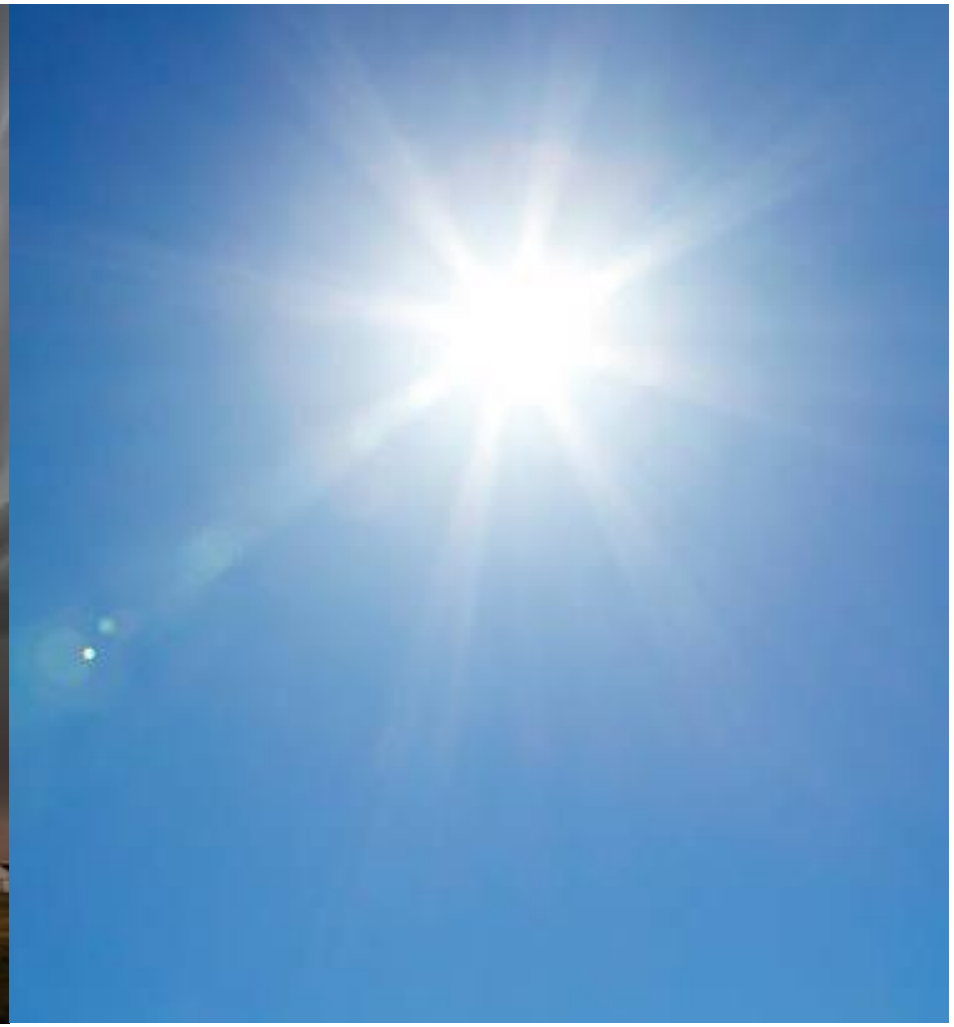
Industry weather forecast

Automotive Megatrends

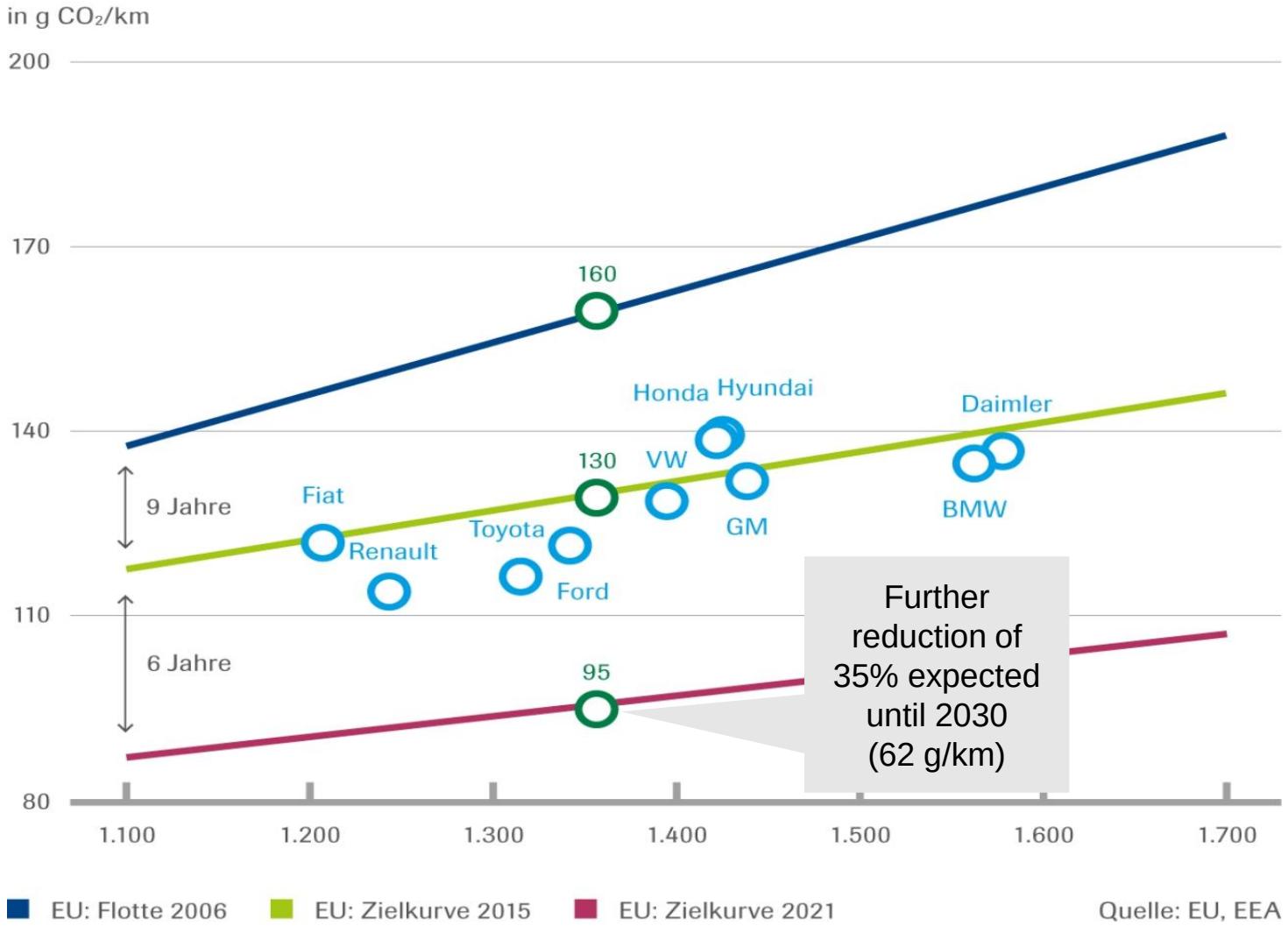
Energy and CO2 Efficiency

Globalization and standardization

Digitalization and IoT



WEIGHT REDUCTION GETS A PRICE-TAG: 100-150 EUR / G CO2 / CAR



Source: VDA; Automobilwoche

VALUE FOR THE CUSTOMER

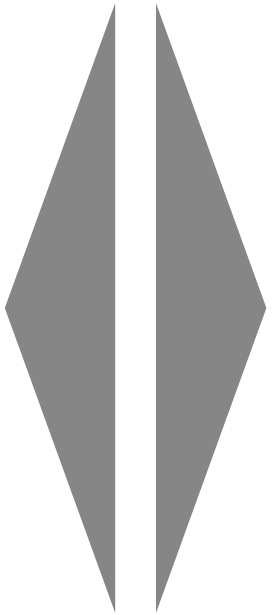
Weight reduction

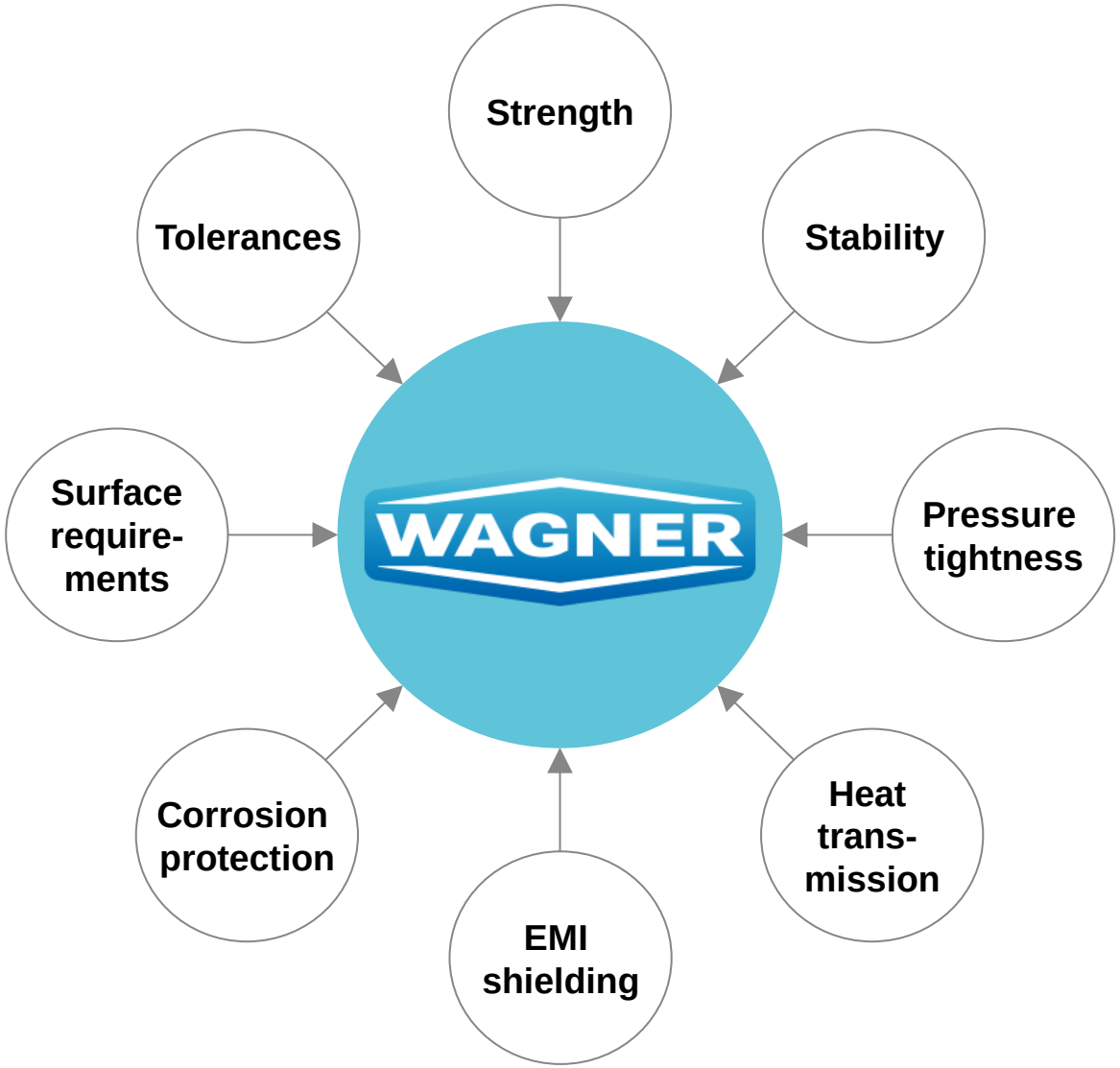
Cost reduction

Function integration

Complexity reduction

TECHNICAL CHALLENGES TO OVERCOME TO CREATE VALUE





AGENDA

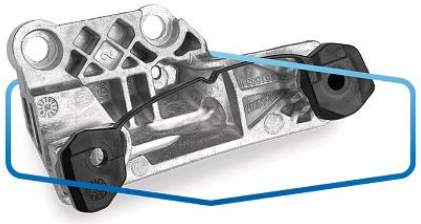
1. **What is the challenge?**
2. **How do we solve it?**
3. **The way forward!**

Your Solution. A part of us.

Die casting

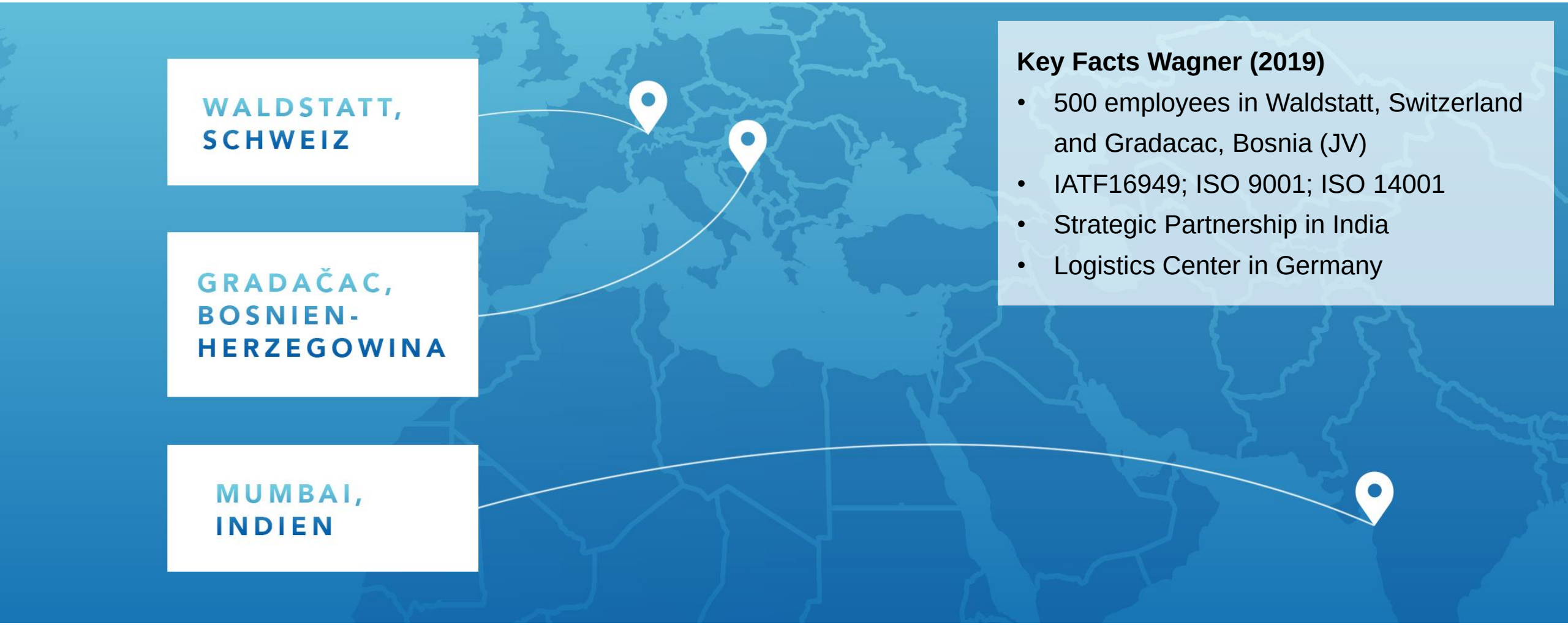
Injection Molding

Hybrid Solutions



Assembly Groups

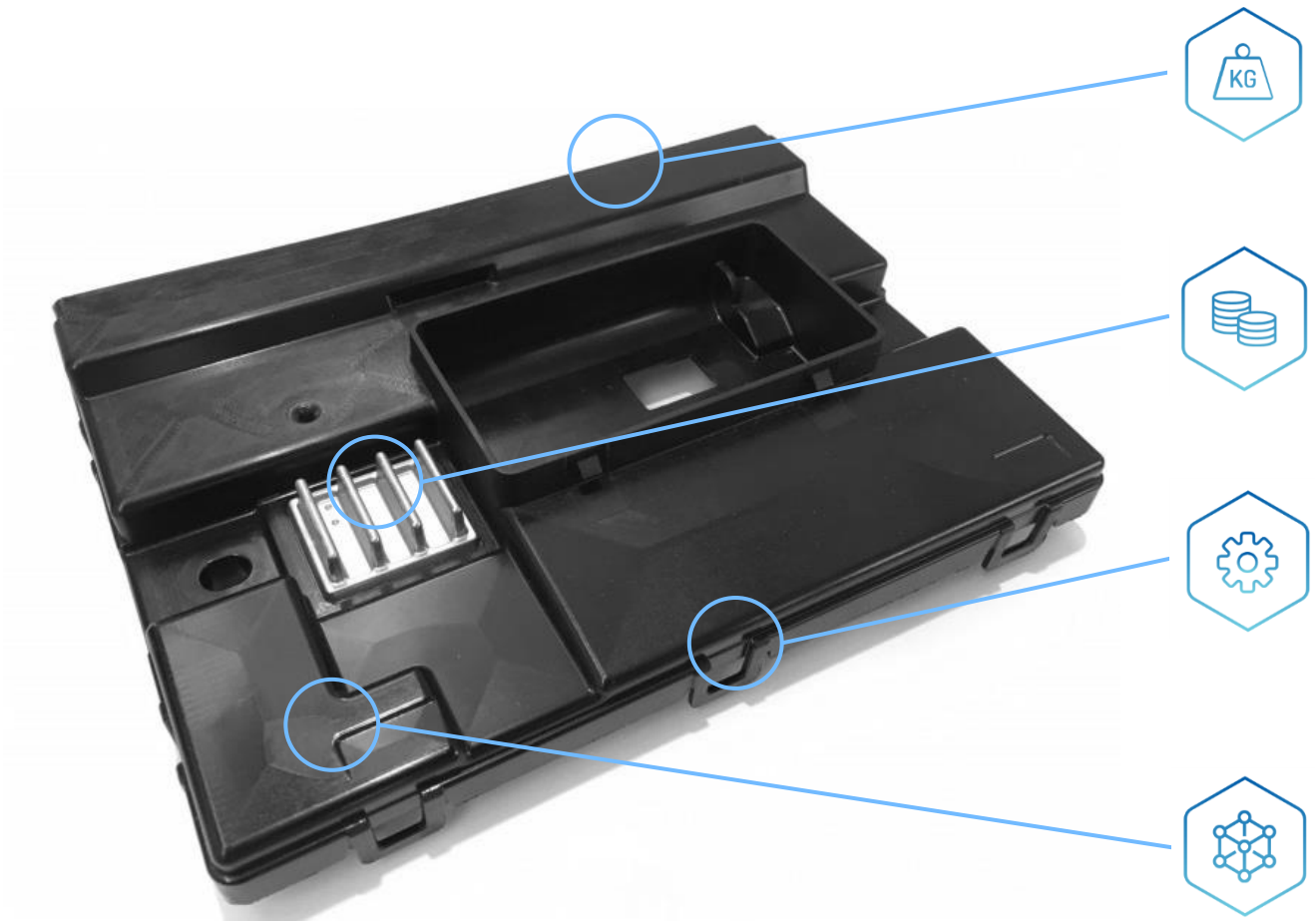
WHERE WE ARE



Key Facts Wagner (2019)

- 500 employees in Waldstatt, Switzerland and Gradacac, Bosnia (JV)
- IATF16949; ISO 9001; ISO 14001
- Strategic Partnership in India
- Logistics Center in Germany

CASE 1: ELECTRONIC HOUSING / HEAT SINK



Weight reduction		Value created
Weight of aluminum Weight of hybrid	192gr 92gr	52%

Cost reduction	Value created
Reduction in material price aluminium vs. TP-polymer	15%

Function integration	Value created
PCB assembly (printed circuit board) and housing assembly using clips	2,5min.

Complexity reduction	Value created
Reduction of assembly parts	- 3 parts

CASE 1: ELECTRONIC HOUSING / HEAT SINK

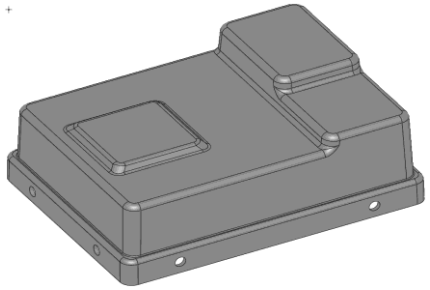
Technical requirements

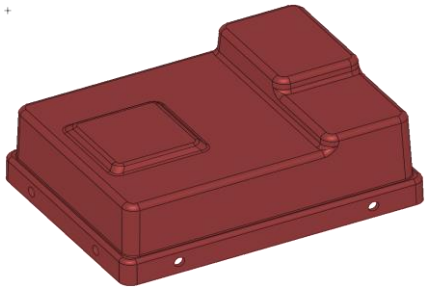
- Ambitious weight target
- Heat transmission is critical for a pure thermoplastic part
- Assembly process must be optimized
- EMI shielding

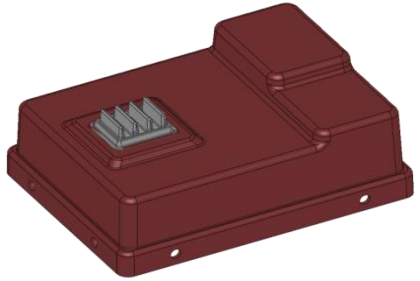
Solution provided

- Substitution of aluminum by high-performance thermoplastic polymer to reach stability targets
- Partial insert, of a simple aluminum die casting part, solves the effective heat transmission
- The PCB’s and also the cover can be assembled by clipping, no screw, no crimping is necessary
- A conductive thermoplastic material was chosen to reach the target of EMI shielding

Prototype housing







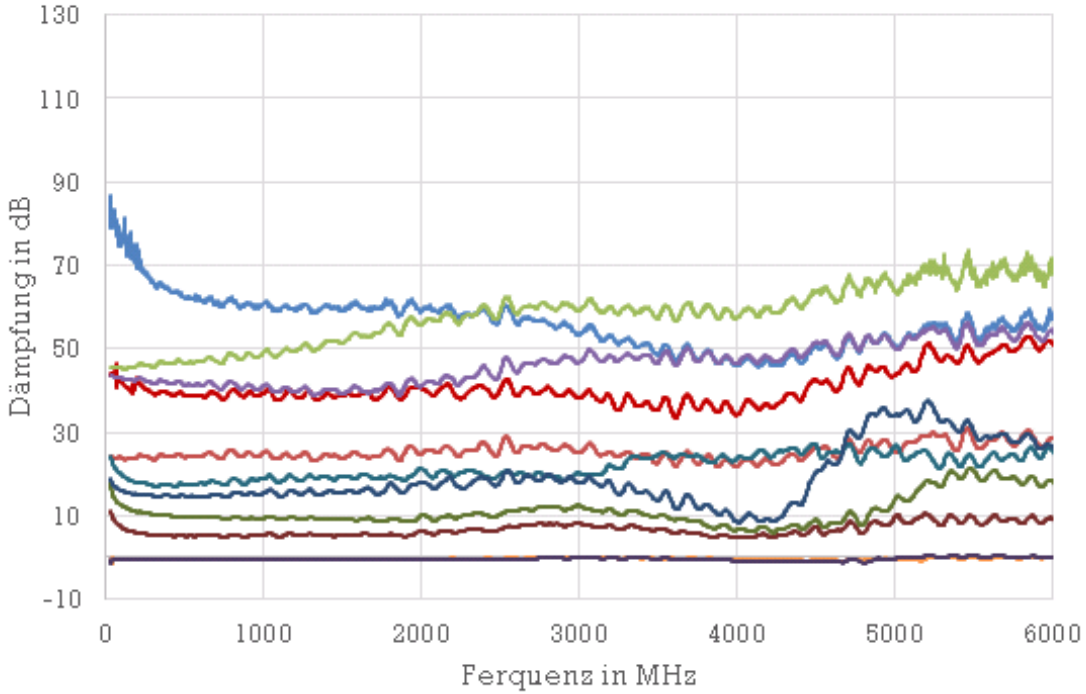
Material concept

- Aluminum
- EN AC-Al Si 9 Cu3 AL226

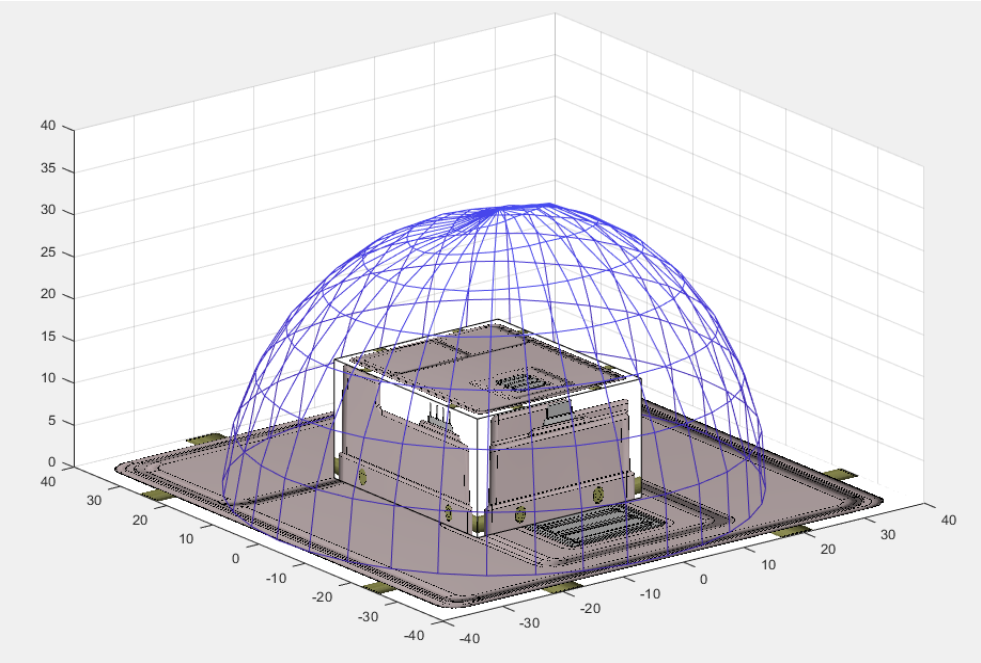
- Thermoplastic polymer
- Several conductive thermoplastics providing EMI shielding

- Hybrid solution
- Several materials in combination

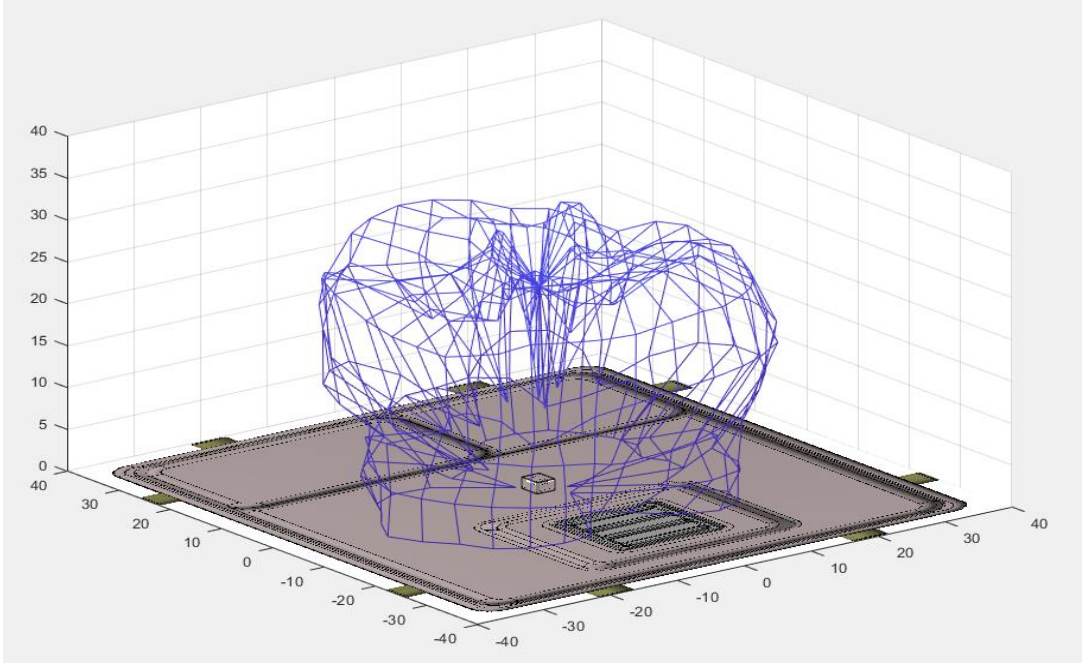
1-D Test results



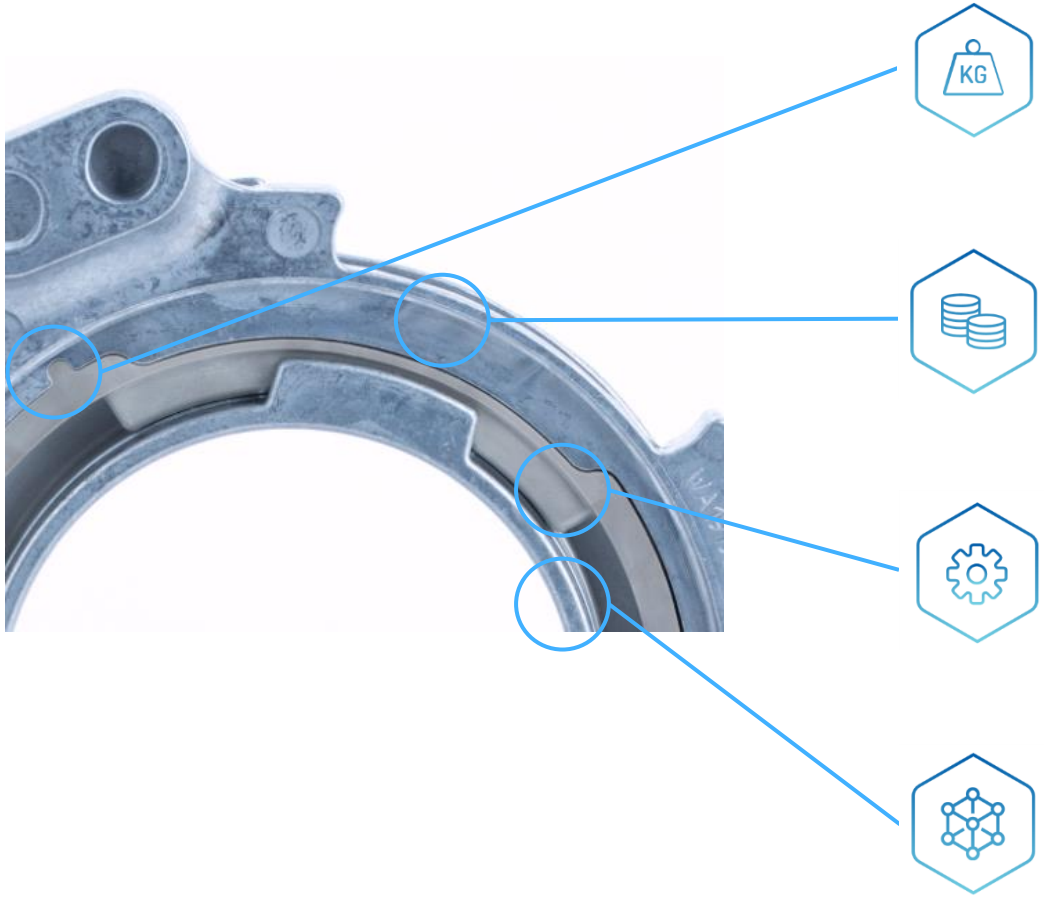
Frequency at 266 MHz



Frequency at 6 GHz



CASE 2: BELT TENSIONER SYSTEM FOR MILD HYBRID APPLICATION



Weight reduction		Value creation
Weight of aluminum Weight of hybrid	245 gr 220 gr	10%

Cost reduction	Value creation
Material / production cost savings, reduction of assembly time	30%

Function integration	Value creation
Friction surface is directly overmolded, no single parts any more	2min.

Complexity reduction	Value creation
Reduction of assembly parts	- 3 parts

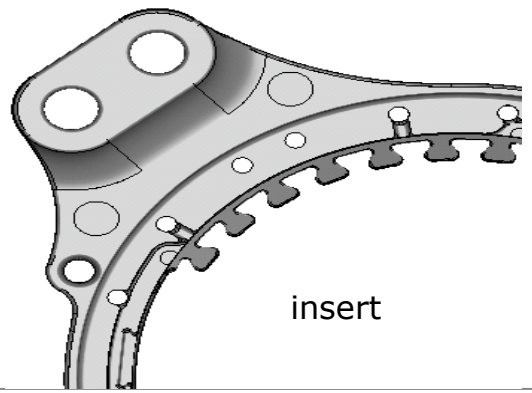
CASE 2: BELT TENSIONER SYSTEM FOR MILD HYBRID APPLICATION

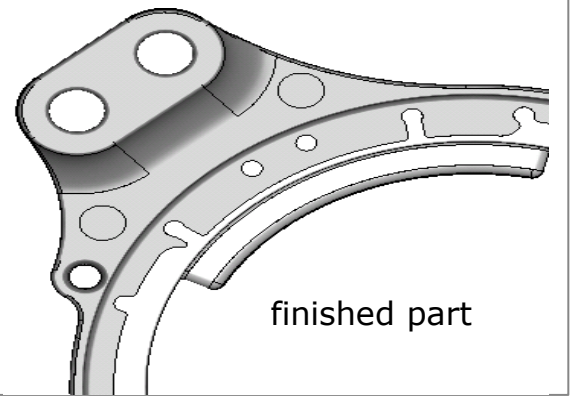
Technical requirements

- Reduction of handling and assembly of the friction surfaces
- The friction surface must stay on the part
- The tolerances of the friction surfaces must be reduced
- The durability and long term physical properties of sliding function must be improved

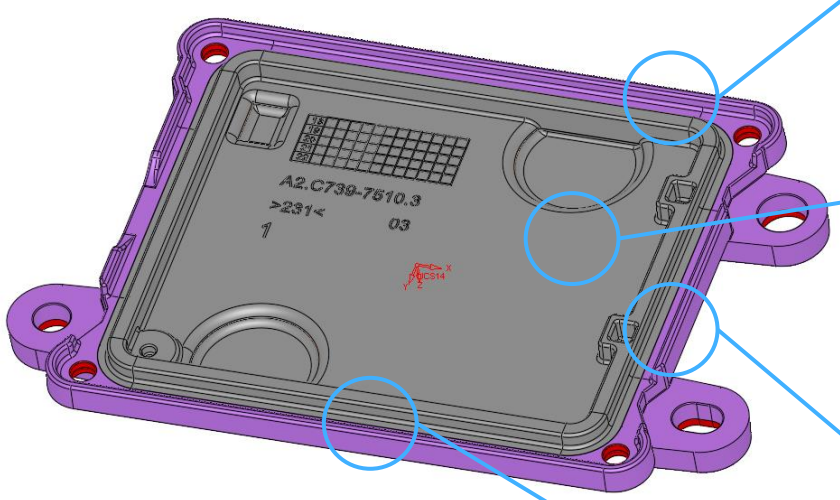
Solution provided

- No assembly needed with over-molding of the friction surfaces
- “Form fit” achieved through optimized geometry, e.g., integrating undercuts, holes, bolts to create fit to die casting part
- Tolerance issues reduced as measurements reached out of tool, without machining
- High performance polymer based on glass fibres and teflon used to avoid abrasion and optimize friction





CASE 3: ELECTRONIC HOUSING AUTONOMOUS DRIVING ASSISTANT SYSTEM



Weight reduction	Value creation
Weight aluminum 120 gr Weight hybrid 48 gr	60%

Cost reduction	Value creation
Machining not necessary, as geometry and tolerances realized with thermoplastic off-tool solution	>15%

Function integration	Value creation
Interface between aluminum and thermoplastic is sealed, no surface protection needed	15%

Complexity reduction	Value creation
The part is produced at one production site, no external production needed	- 1 supplier

CASE 3: ELECTRONIC HOUSING AUTONOMOUS DRIVING ASSISTANT SYSTEM

Technical requirements

- EMI shielding required
- A high cleanliness class necessary to avoid short circuit on the PCB
- The sensor is mounted in the front of the car and must be protected against corrosion
- High level of pressure tightness requested, leakage of 1ml/min allowed at 1 bar testing pressure

Solution provided

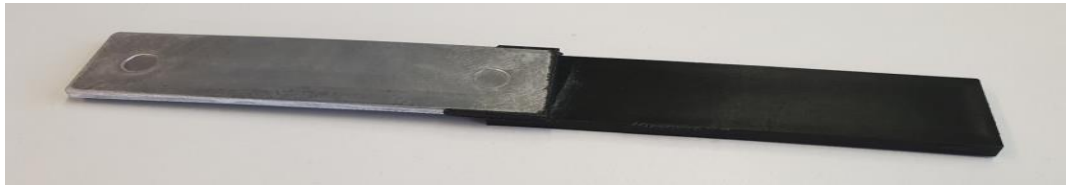
- The PCB is connecting around the aluminum insert (1mm thick) and is ensuring the EMI shielding
- No metallic particles in the manufacturing process, therefore no risk of short circuit
- For corrosion protection a material PBT GF30 was chosen
- Pressure tight interface between aluminum and thermoplastic using adhesive fit through sealing in an inline process

SOLVING THE ISSUE OF ADHESIVE FIT BETWEEN ALUMINUM AND THERMOPLASTIC POLYMER (1/2)

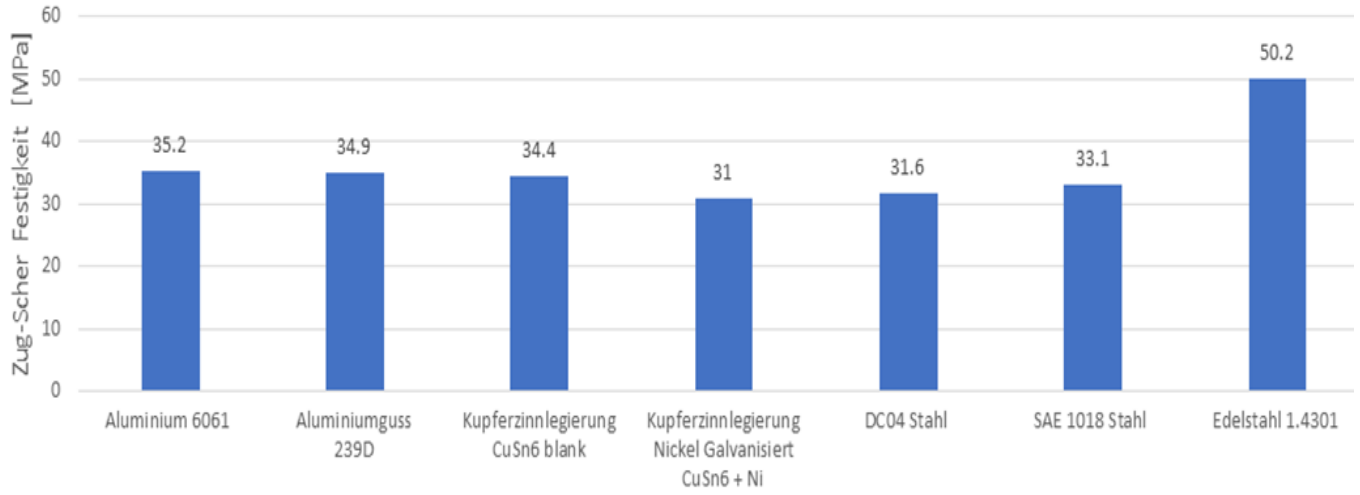
- Adhesive fit between die casting and injection molding critical to reach specific performance elements
  - Geometry / tolerance requirements
  - Shrinkage to be managed
  - Pressure tightness

- Basic mechanical tests of hybrid parts performed to understand correlation of adhesive fit with
  - Metal / polymer type
  - Metal pretreatment

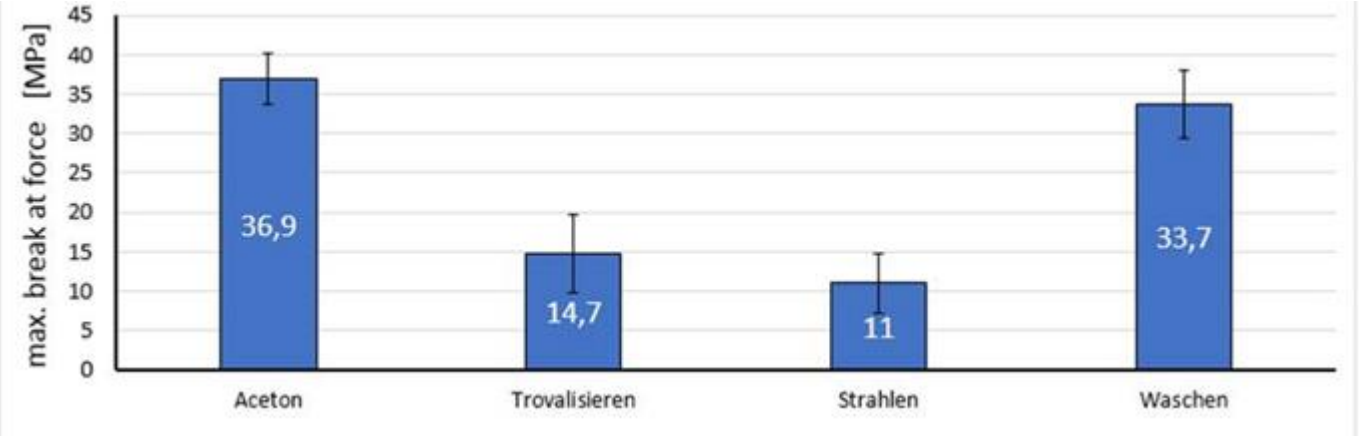
- Different materials and different pre-treatment processes tested to understand correlation with adhesive fit



SOLVING THE ISSUE OF ADHESIVE FIT BETWEEN ALUMINUM AND THERMOPLASTIC POLYMER (2/2)

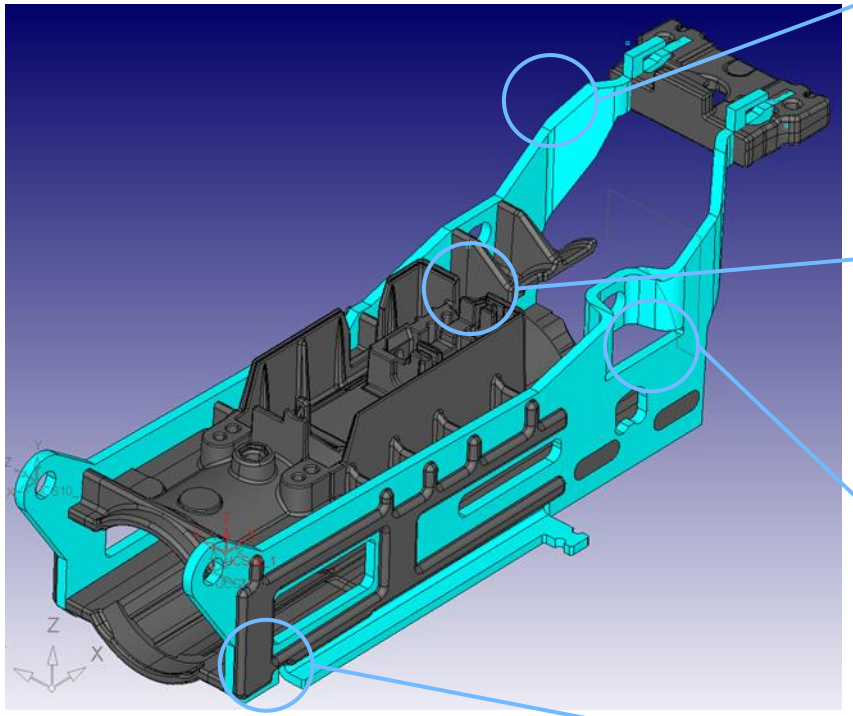


- Shear tension test showing adhesive fit of different metals with thermoplastic PBT GF30
- All test samples cleaned with solvent (Acetone)



- Shear tension test showing effect of different pre-treatments to adhesive fit of die casting part with thermoplastic PBT GF30
- Washing or solvent cleaning process optimize the adhesion

CASE 4: STEERING GEAR HOUSING



Weight reduction	Value creation
Weight of aluminum 420 gr Weight of hybrid 340 gr	20%

Cost reduction	Value creation
Component material and production cost reduction, assembly cost reduction	>15%

Function integration	Value creation
Several flaps, straps, clips, drill holes integrated for assembly optimization	2 min.

Complexity reduction	Value creation
Integration of several parts into one component for assembly	- 4 parts

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3. **The way forward!**

NEXT STEPS – HOW TO SPEED UP THE SOLUTION DEVELOPMENT

Wagner

- Integration of suppliers into raw material research and development
- Further development of materials know-how through correlation analyses of different materials and production processes regarding
  - Adhesive fit
  - EMI shielding
- Development of database / simulation tool to manage correlation of adhesive fit and EMI shielding with material and geometry of component

Customer / OEM

- Early involvement of R&D and engineering departments
- Integration of supplier into prototyping process to test specific requirements e.g., regarding
  - EMI shielding
  - Heat conductivity
  - Stability, rigidity, crash behavior
- Readiness for out-of-the-box thinking and certain risk-taking
- Purchasing process / organization needs to be ready and if necessary adjusted

SOLVING THE CRITICAL TECHNICAL CHALLENGES FOR OUR CUSTOMERS WILL IMPROVE THE WEATHER FORECAST!

Industry weather forecast

Automotive Megatrends

Energy and CO2 Efficiency

Globalization and standardization

Digitalization and IoT

YOUR SOLUTION.
A PART OF US.

THANK YOU VERY MUCH FOR YOUR ATTENTION

Q&A

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