Joining techniques for lightweight constructions in heavy vehicles
Partner for innovation and development in the automotive industry

Flanders’ DRIVE is a research institute for the vehicle industry situated near the Lommel Proving Ground in Belgium. Together with leading companies and research institutions, Flanders’ DRIVE works on high-tech, application-oriented research into the green and smart vehicle of the future.

Flanders’ DRIVE supports the automotive industry through a wide range of activities, focusing on:

► Clean & Energy-Efficient Vehicles
► Lightweight Solutions
► Intelligent Driver & Traffic Systems
► Advanced Manufacturing Processes
► Intelligent Development Tools

The acquired knowledge forms a solid starting point for independent and high-level advice.

Flanders’ DRIVE is supported by the Flemish Government and offers its expertise to European projects.
Joining techniques for lightweight constructions

A 2.5-year research project of Flanders’ DRIVE and 6 partners, which aims to build knowledge of suitable joining techniques for lightweight constructions in heavy vehicles

- Investigation of 30 industrial applications
- Translation into 5 lightweight challenges
- Screening & selection of suitable materials & joining techniques
- Validation on component and system level
- Composition of a structured overview of gained knowledge

Supporting companies in the successful integration of lightweight materials in heavy vehicles, using adequate joining techniques

Research project of Flanders’ DRIVE and project partners

- **Carrosserie Lemeire** is a family business with as main activity the construction of all sorts of mobile shops and sales cars. (www.lemeire.be)
- **CNH** is a worldwide manufacturer of agricultural machines and earth-moving machines. The Belgian plant is specialised in the development and production of combine harvesters, forage cutters and bale presses. (www.cnh.com)
- **Mobil Partner** develops and builds motor caravans for the European market and markets them under the brand name Home-car. (www.homecar-motorhomes.com)
- **Terberg Specials Belgium** specialises in the development and production of all sorts of special government and company vehicles. (www.terbergspecials.be)
- **VDL Bus Roeselare** is a Flemish bus manufacturer, developing both public transport buses and motor coaches. (www.vdlbuscoach.com)
- **Sirris** is the collective centre of the Belgian technological industry, that advises and supports companies in implementing technological innovations. (www.sirris.be)
5 lightweight challenges

1. Joining techniques for sandwich materials in interior structures
   Interior finishing, ceiling, furniture for market cars and motorhomes

2. Joining sandwich materials with frame structures
   Floors of buses, mobile homes and market cars
   Soils/bottom of chassis for mobile homes

3. Joining techniques for lightweight alternatives for glass
   Partitions and separation walls in police vehicles and public buses

4. Joining of materials with different thermal expansion coefficient
   Side/boot panels of buses and coaches, body panels of harvesters

5. Joining of heavily stressed hybrid structures
   Chassis constructions

Screening & selection of suitable joining techniques

► For each challenge
► Based on selected lightweight materials and application requirements
► Followed by validation on component and system level

Adhesives and structural tapes

Welding and soldering techniques

Adhesive joint

Thermal joint

Mechanical joint

Hybrid joint

Combination of joining techniques

Screwed joints, riveted joints
Challenge 1  Joining techniques for sandwich materials in interior structures

Validation of selected sandwich materials and joining techniques

Test on sandwich materials

Test on joining techniques

Result

- Proven applicability of a wide range of joining techniques for lightweight sandwich panels

<table>
<thead>
<tr>
<th>on skin</th>
<th>through in 1 skin</th>
<th>through in 1 skin + core</th>
<th>across panel</th>
<th>interconnection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesives</td>
<td>Glued fasteners</td>
<td>Pressure sensitive tapes</td>
<td>Velcro tapes</td>
<td>Welded studs</td>
</tr>
<tr>
<td>Self-tapping screws</td>
<td>Self-drilling screws</td>
<td>Blind rivets</td>
<td>Blind rivet nuts</td>
<td>Metal spread nut</td>
</tr>
<tr>
<td>Plastic spread nut</td>
<td>Clinching bolts</td>
<td>Twindisk Plug + adhesive integrated</td>
<td>Standard bolt-nut Screw joint</td>
<td>Blind rivets</td>
</tr>
<tr>
<td>Inserts</td>
<td>Rafix connectors</td>
<td></td>
<td>Two-part riveted bolts</td>
<td>Inserts</td>
</tr>
</tbody>
</table>
Challenge 2  Joining sandwich materials with frame structures

Validation of adhesives and structural adhesive tapes as fastening technology

Result ► Proven usability of adhesives and tapes for direct structural joining of sandwich panels on metal frame structures in floor constructions
► Application of lightweight sandwich panels as alternative to existing plywood solution

Sample level joint

Dynamic test on a floor construction

Lap shear test

Accelerated lifecycle test on floor panels

Challenge 3  Joining techniques for lightweight alternatives to glass

Validation of adhesives and pressure-sensitive tapes as joining techniques for transparent polymer materials

Result ► Proven applicability of transparent plastics for bearing structure
► Expertise in application of adhesives and structural adhesive tapes

Dynamic impact test simulation of the impact of a human body

Static pressure test on material and joints
Challenge 4  Joining of materials with different thermal expansion coefficient

Validation of the effect of thermal stress on dissimilar material combinations bonded with different adhesive types and thicknesses

Measuring of deformation

3D-image of deformation plot

Result
► Confirmed usefulness of adhesives as a joining technique for new lightweight multi-material concepts for exterior applications subjected to temperature stress
► Expertise in selection of most suitable adhesives and determination of appropriate thickness

Challenge 5  Joining of heavily stressed hybrid structures

Validation and comparison of joining techniques for hybrid steel structures

Result
► Demonstrated potential added value of high-strength steels as lightweight alternative to traditional steels in chassis constructions
► Expertise about different joining solutions for multi-steel combinations: welding, bolting and structural clinching

Accelerated lifecycle test at sample level

Dynamic tensile test
Solutions based on a system level approach towards lightweight and functionality integration, comprising among others:

- Definition and analysis of requirements
- Independent screening and selection of materials and joining techniques
- Material and design optimization
- Improvement of geometry of individual components and joints
- Aiding successful selection & implementation of adhesives
- Customized validation at component, system and vehicle level
- Technology scouting & benchmarking

Moreover, Flanders’ DRIVE offers its partners access to an international network of experts, covering the whole automotive industry.
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