

A man in a blue and red polo shirt with a tesa logo on the chest is working in a factory. He is looking towards the camera while his right arm is raised, touching a horizontal metal bar. The background shows industrial machinery with various rollers and structural frames.

tesa SE COMPANY INTRODUCTION

Self-Adhesive Tapes and Application Solutions

1. tesa Company
2. Business Development
3. Research and Development
4. Selected Industrial Applications
5. Polyacrylate Pressure Sensitive Adhesives
 - Cross-Linking
6. Control of Viscoelasticity / Rheology
7. FE-Simulation of selected Industrial Applications



tesa COMPANY

Who we are

- A world leading producer of self-adhesive solutions for industry and trade, consumers and craftsmen
- 125 years of experience in ...
 - development and manufacture of **self adhesive tapes**
 - **adhesive design & formulation**
 - Rubber – Resin base
 - **Polyacrylates**
 - ...
 - **coating technology**
- Global market leader in many application fields



OUR COMPANY

Production and Office Locations



4150
employees
worldwide

2200 in Germany
500 in R&D



- 1 headquarters
- 5 regional headquarters
- 8 production sites

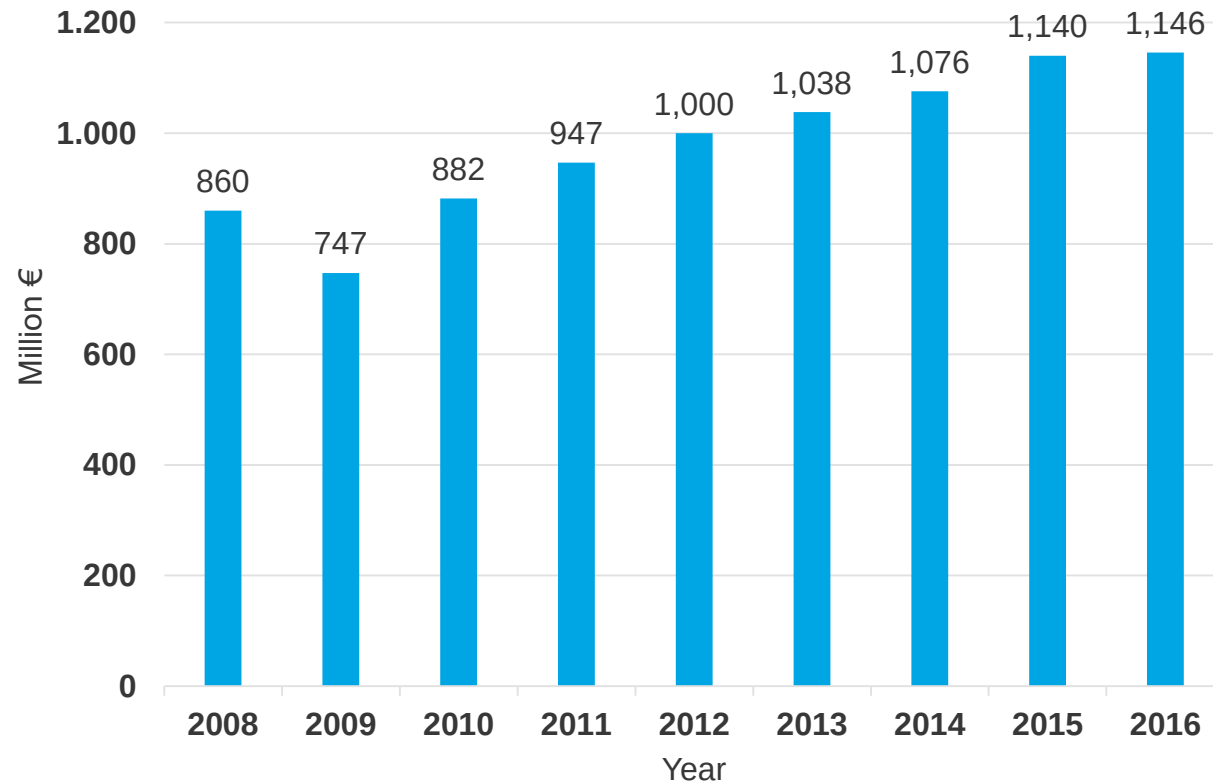
BUSINESS DEVELOPMENT

BUSINESS DEVELOPMENT

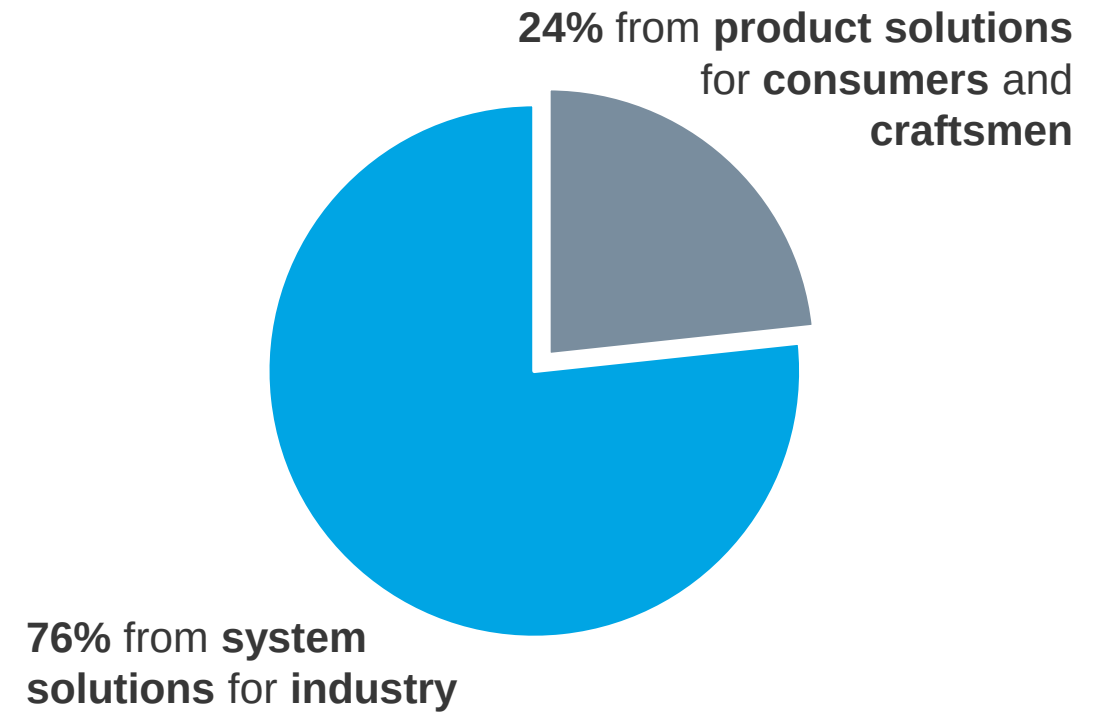
Corporate Sales



For FY 2016: 1,145.8 million €



Turnover distribution:



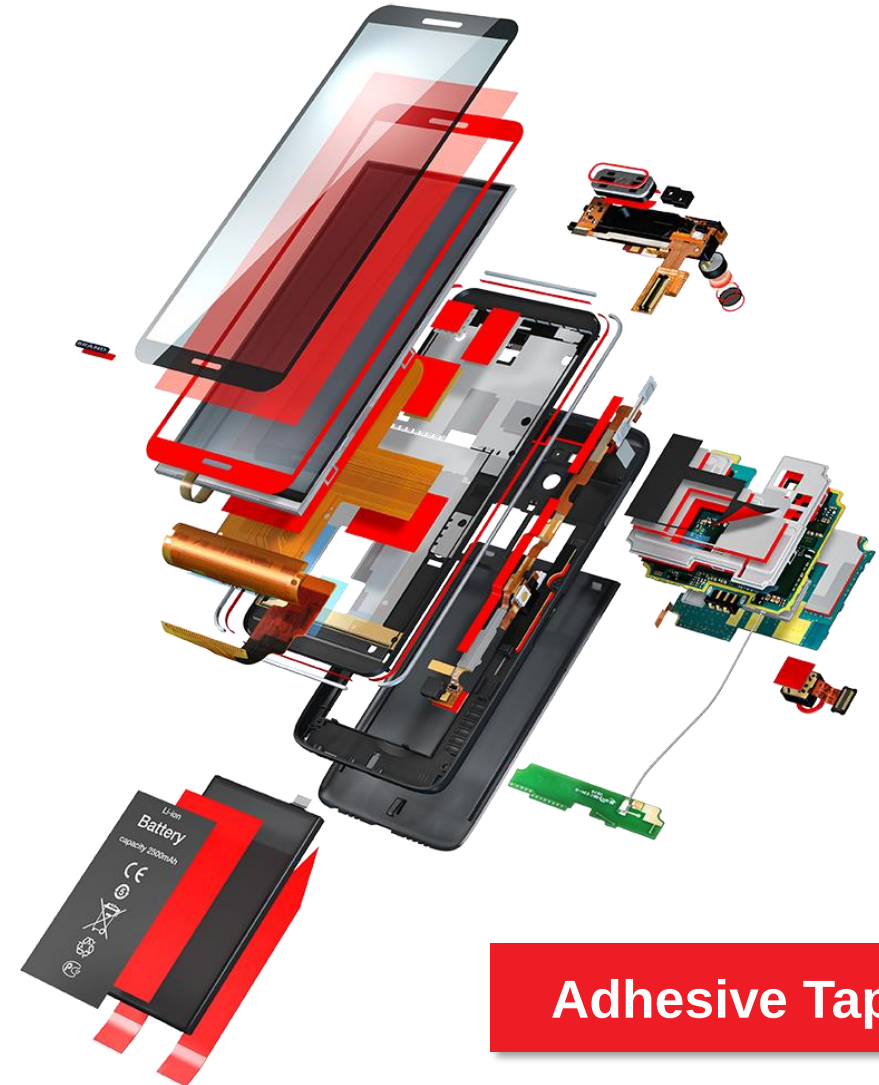
RESEARCH AND DEVELOPMENT

RESEARCH AND DEVELOPMENT

Investment in Innovation



- **5% of our sales invested into R&D**
- **500 employees worldwide** work at the company's own labs transforming innovative ideas into new applications and improving existing products
- **R&D in Germany, the US and China**
- Development of **> 100 new products per annum**
- **More than 50 years of core competency in the synthesis of polyacrylates**

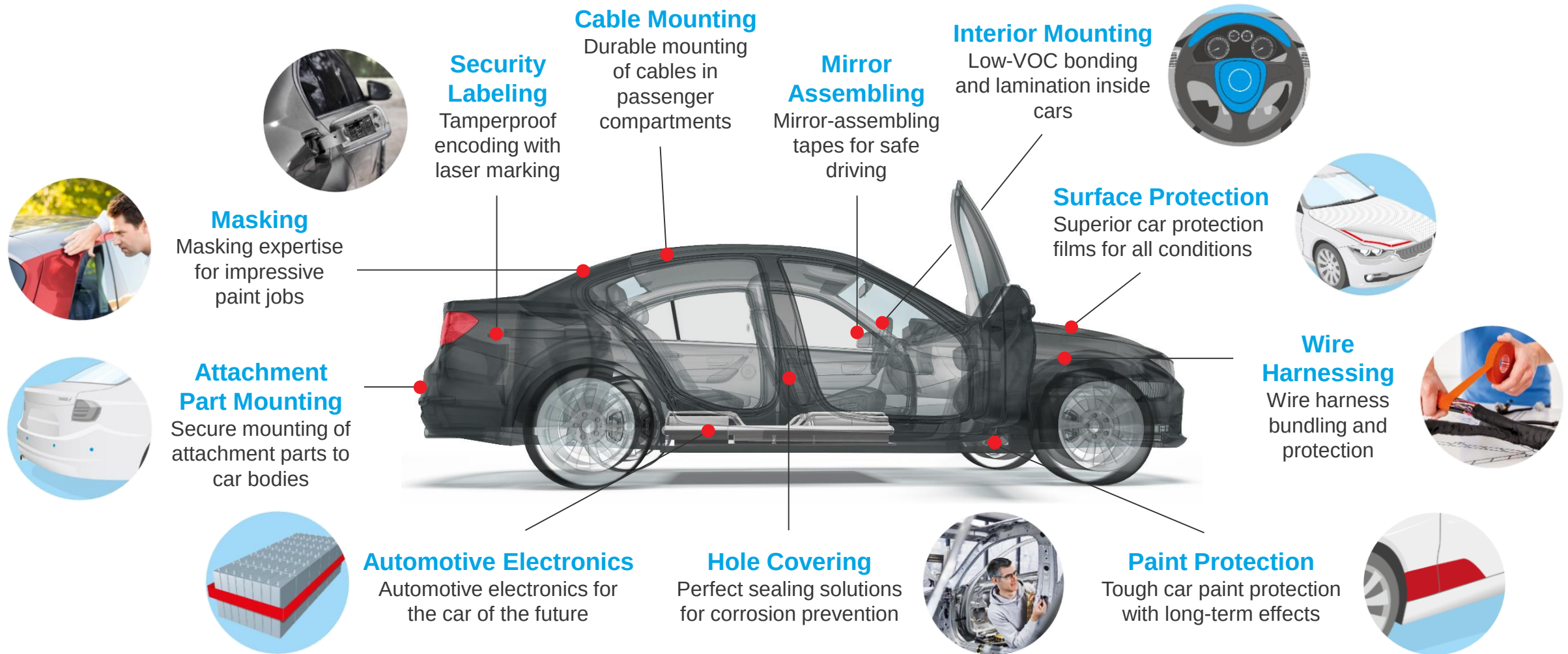


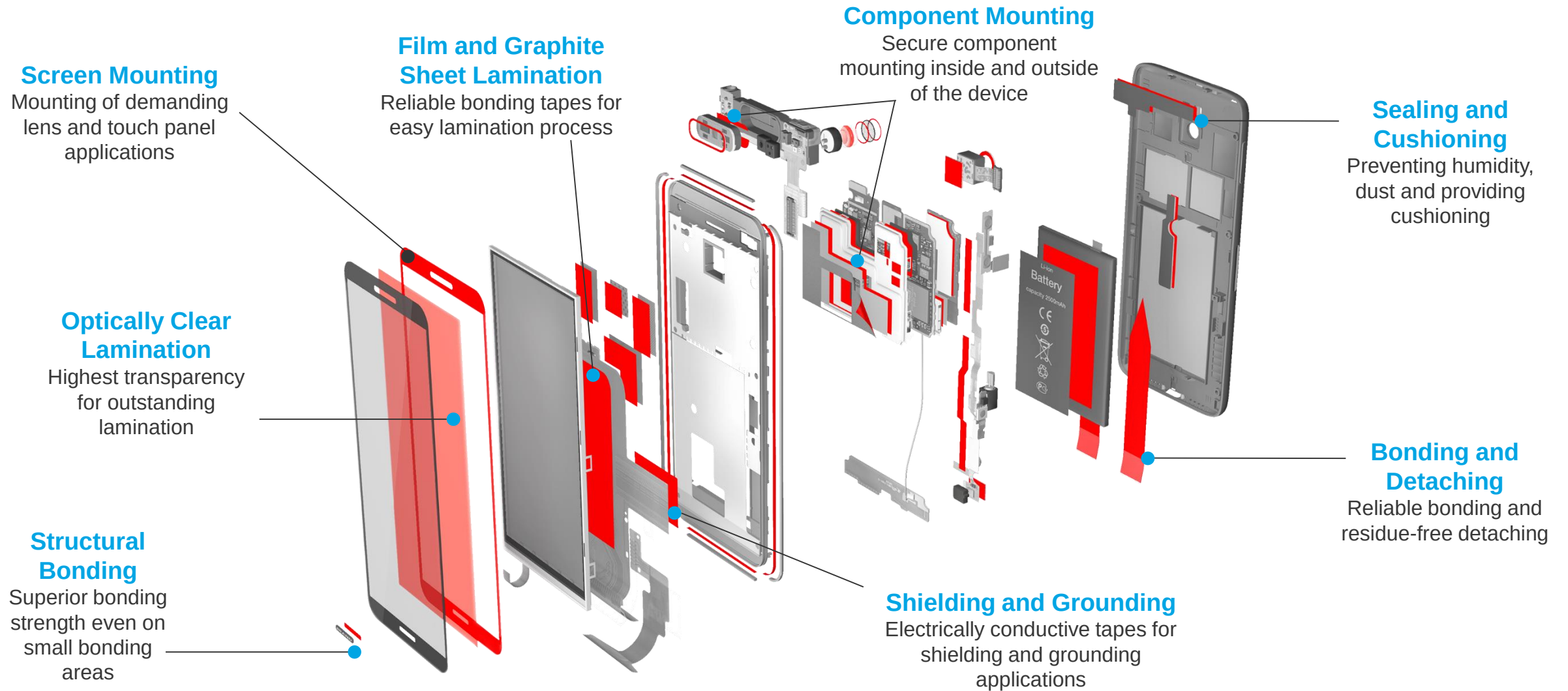
Adhesive Tape

SELECTED INDUSTRIAL APPLICATIONS

SOLUTIONS FOR INDUSTRY

Automotive





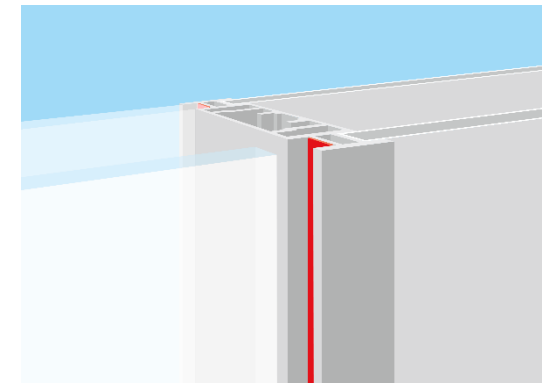
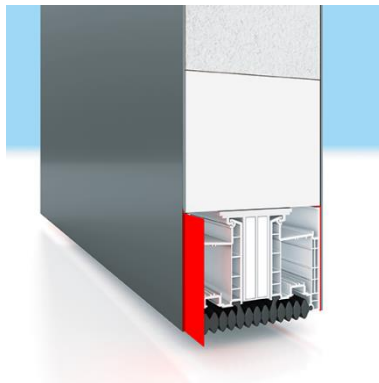
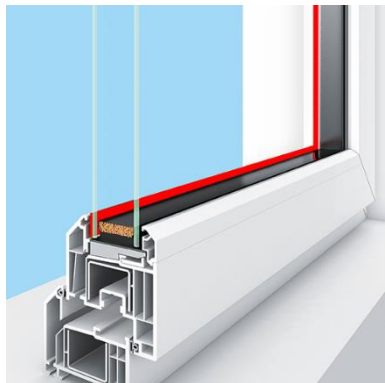
SOLUTIONS FOR INDUSTRY

Constructive Bonding in the Building Industry



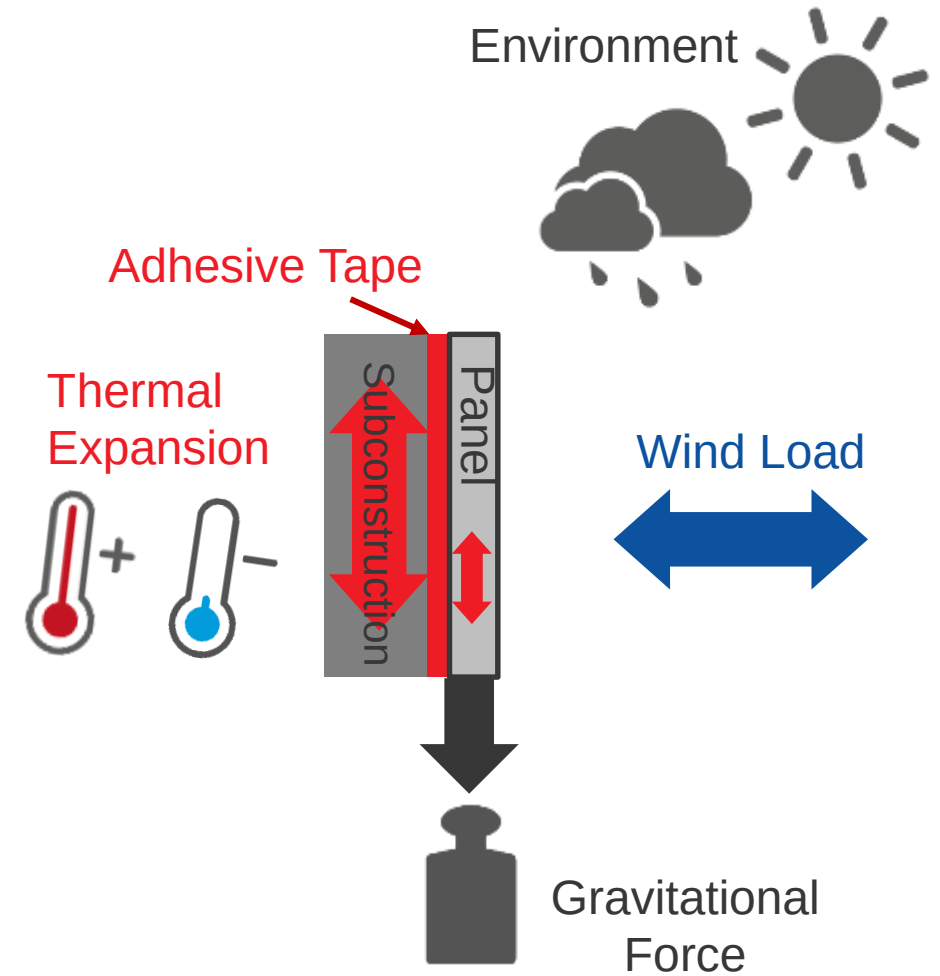
Applications of tesa tapes:

- Constructive window glazing
- Mounting of door panels
- Stiffener Mounting
- Bonding of partition walls
- Building envelope, e.g. structural glazing



CONSTRUCTIVE BONDING IN THE BUILDING INDUSTRY

Environmental Impact



CONSTRUCTIVE BONDING IN THE BUILDING INDUSTRY

Mechanical Properties – Rated Values tesa® ACX^{plus} 70200



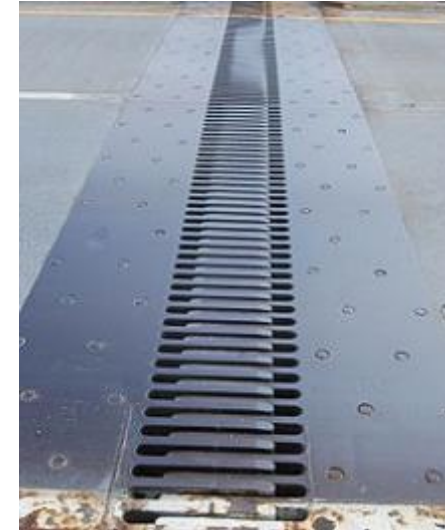
**Static Shear Load
(Dead Load)**

1.7 kPa



**Dynamic Tensile
Load
(Wind Load)**

90 kPa



**Expansion
Compensation**

±150%

Pictures: Wikipedia

Polyacrylate Pressure Sensitive Adhesives

Cross-Linking

3) Pressure Sensitive Adhesives (PSA): In collaboration with associated Partner tesa, we shall focus on **understanding and improving specific properties of PSA:**

(i) **Double sided PSA tapes** are often used to bond two stiff materials with different thermal expansions. The adhesive(s) thus need(s) to **withstand without damage considerable shear loads as temperature changes**. The **right balance of slow and fast exchanging crosslinkers in the adhesive may relax high stresses more effectively during these dimensional changes**.

(ii) PSA tapes may experience **once or repeatedly high deformations** (caused for instance by external high impact forces), which can induce **irreversible damages**. In such a case, tapes able to show **self-healing in specific conditions** are of great interest.

(iii) For various applications it would be desirable to have a **mechanical performance varying little over a wide temperature range**. **Silicone adhesives** often perform this way. The question is, **whether polyacrylate PSAs with properly designed temperature sensitive cross-links can approach such a behavior**.

POLYACRYLATE PRESSURE SENSITIVE ADHESIVES - POLYMERIZATION

Options at lab scale



Polymerization

- Thermally initiated free and controlled free radical polymerization
- Batch and semibatch polymerization
 - Up to 5 independent feeds
- Isobaric / isothermal control in laboratory scale
- Usage of most monomers and solvents including CMR type

Inline Monitoring

- Inline T-control of bath, reactant and cooling units, viscosity (torque) and conversion (NIR)

All Polyacrylate PSAs need subsequent cross-linking

- Acrylic Acid, HO-functionality, ...
- Isocyanates, Epoxides, Metal-Chelates, Hydrogen-Bonding, ...



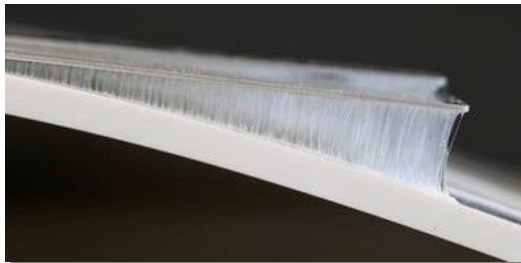
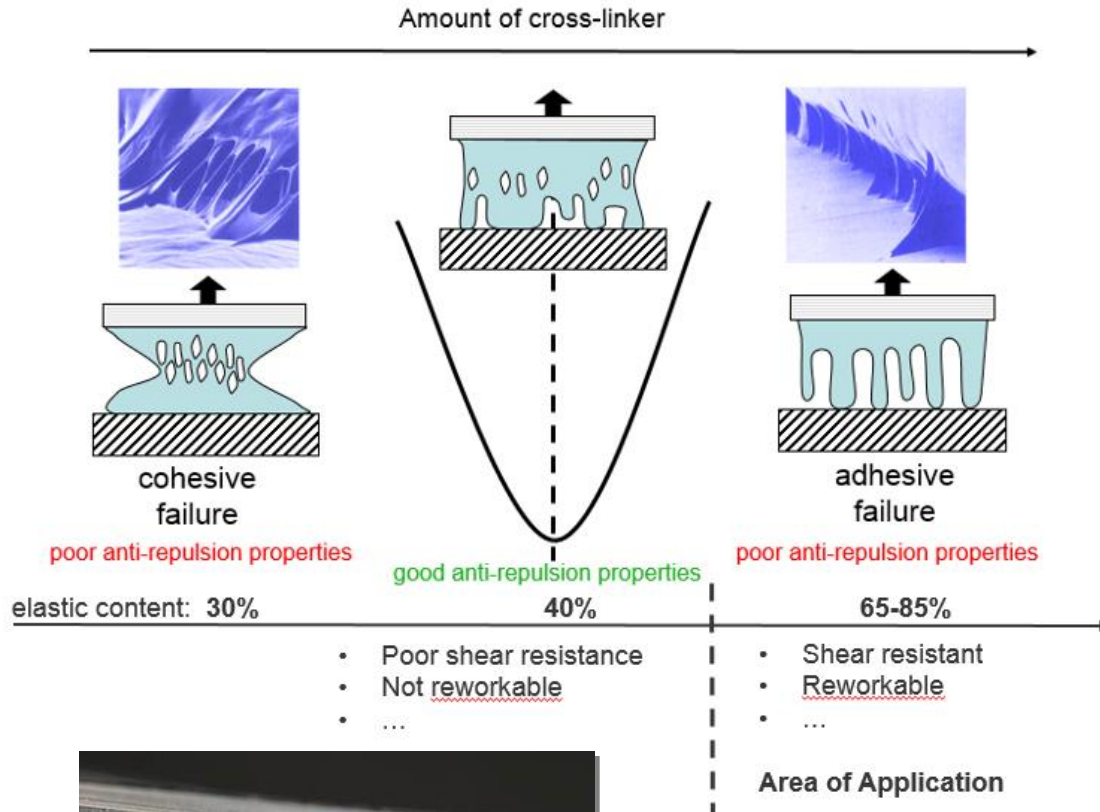
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POLYACRYLATE PRESSURE SENSITIVE ADHESIVES

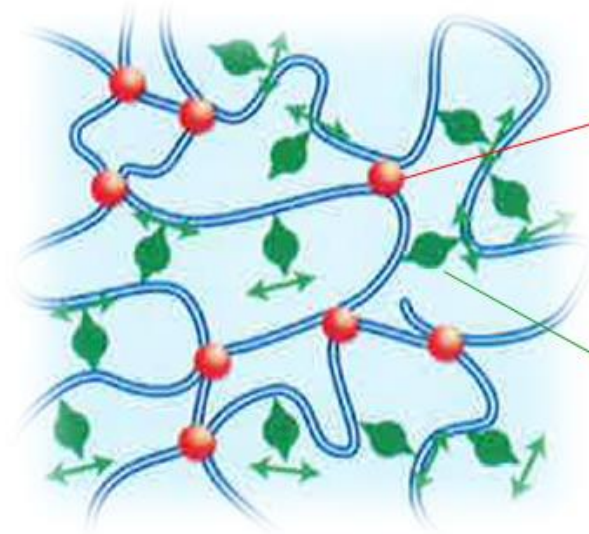
Smart Cross-Linking for Anti-Repulsion Adhesives



Single cross-linker concepts



Dual cross-linking (covalent / coordinative)



Epoxide

Strong and permanent bonds

Metal-Chelate

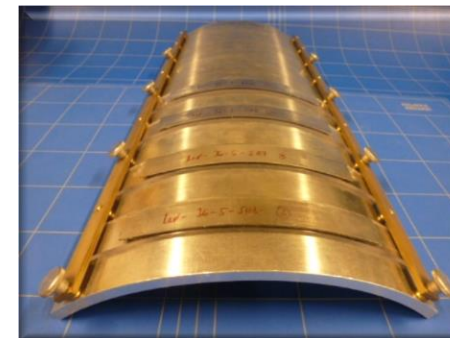
Reversible bonding

@ low frequencies / high T

allowing for energy dissipation due to viscous chain flow

Non Reversible bonding

@ high frequencies / low T



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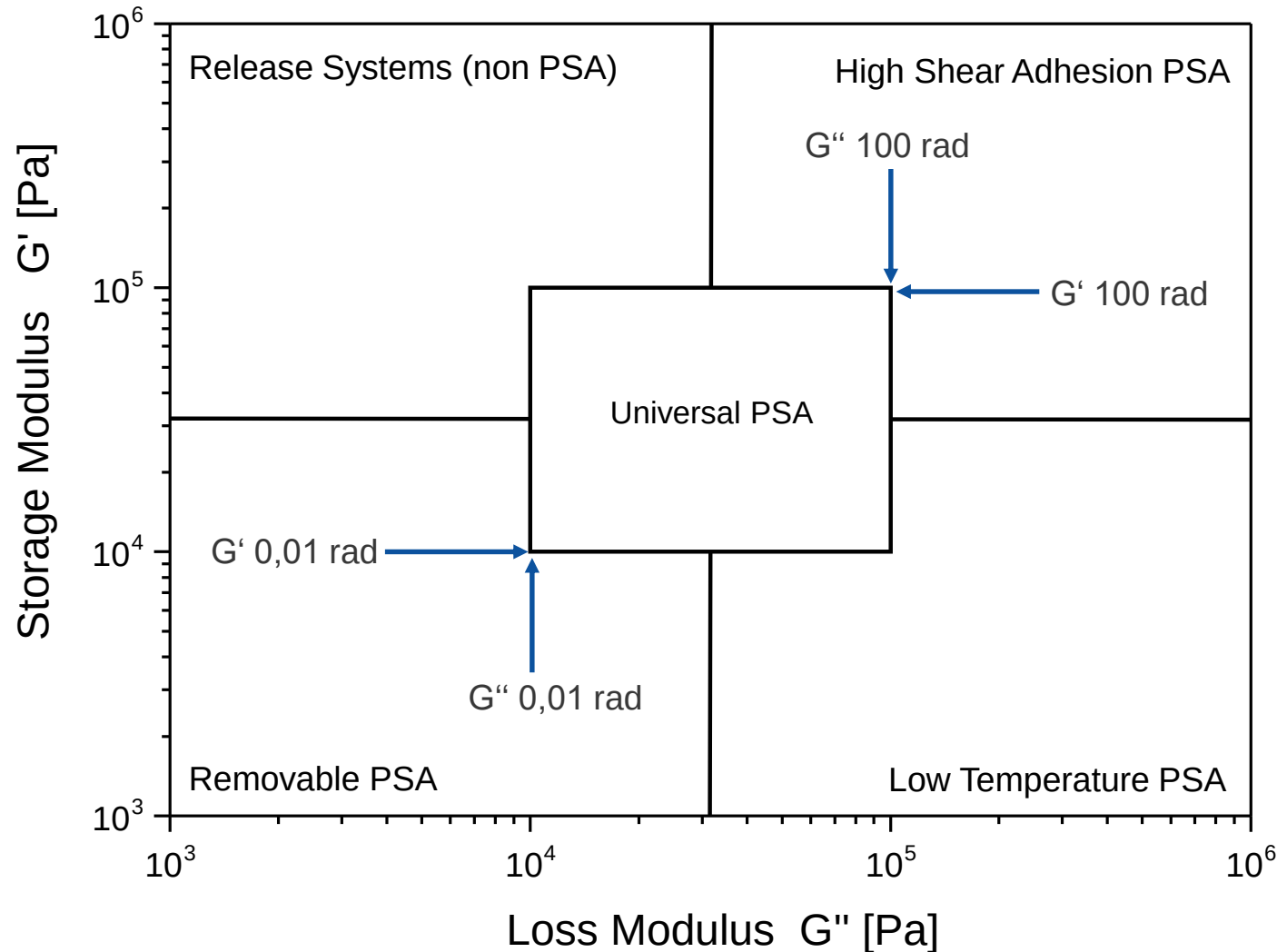
CONTROL OF VISCOELASTICITY / RHEOLOGY

CONTROL OF VISCOELASTICITY / RHEOLOGY

Viscoelastic Window – Basic differentiation of PSA types



DMA done at $T = RT (25^{\circ}C)$; $\omega = 0,01$ to 100 rad/s



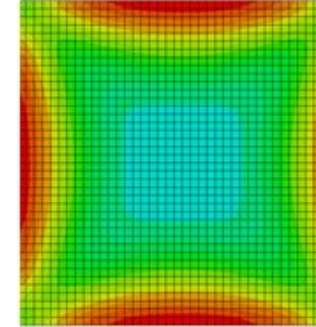
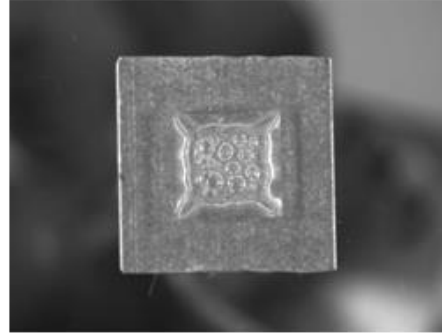
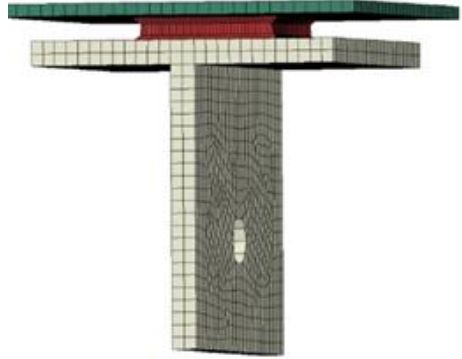
Parameters controlling viscoelastic properties

- Molar mass
- Molar mass distribution
- Molecular architecture
- ...
- Static & dynamic glass transition temperatures
 - kind & amount of comonomers
 - tackifier addition
 - ...
- **Cross-linker system**
- ...
- ...

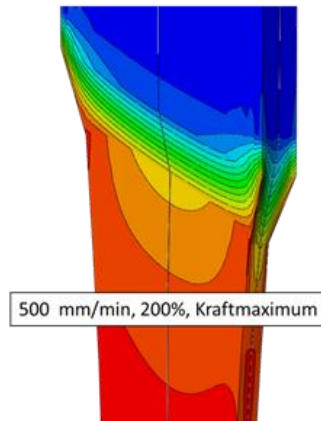
FE-SIMULATION OF SELECTED APPLICATIONS

BOND SIMULATION

Finite Element Analysis (FEM)



T-block test: Comparison of FEM simulation and experiment

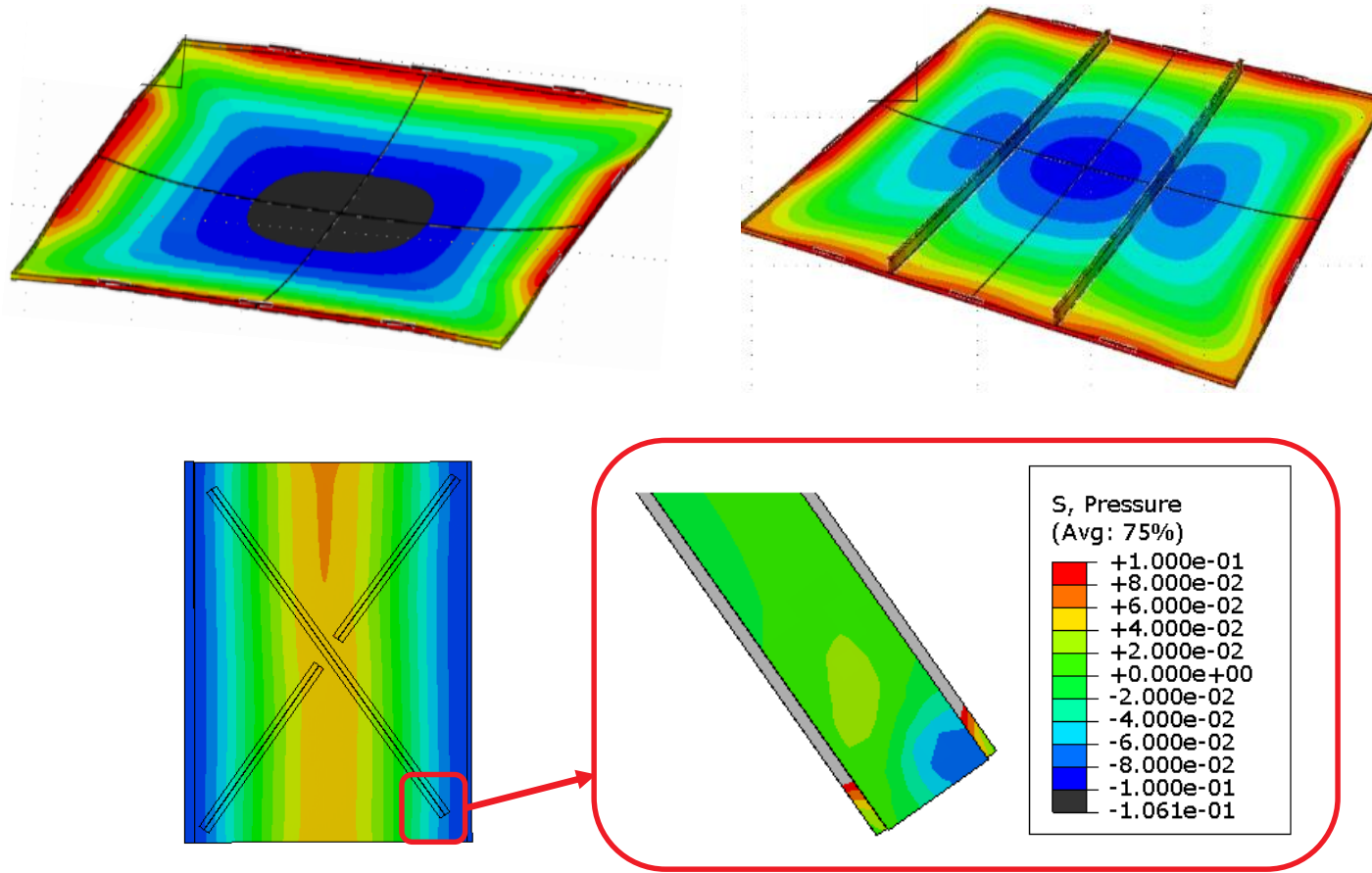


FEM simulation of stress and deformation during the elongation of a visco-elastic high performance pressure sensitive adhesive tape.

- FEM (Finite Elements Modelling) simulation allows to determine adhesive tape stresses and deformation under load.

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- FE-Analysis visualizing the effectiveness of stiffener profiles

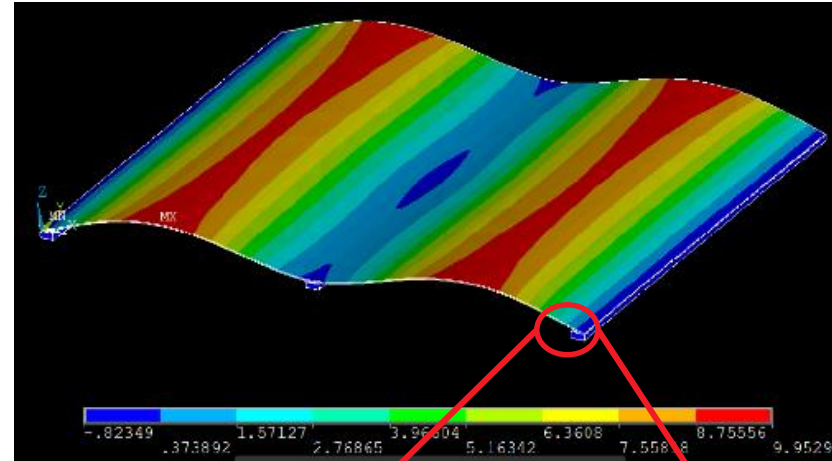


BOND SIMULATION

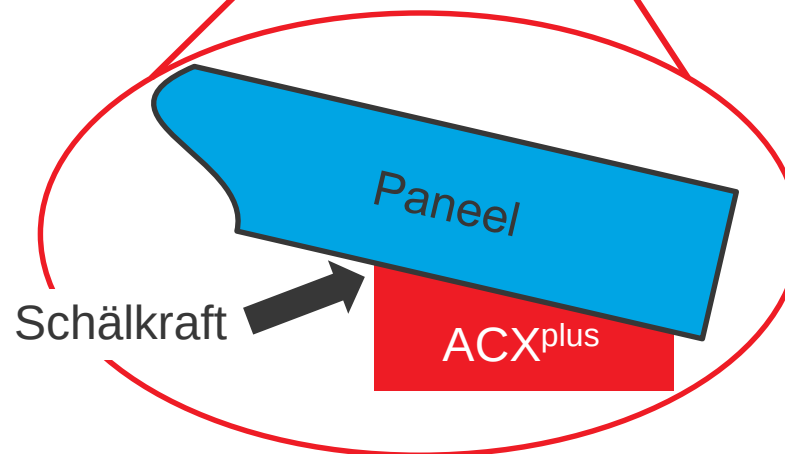
Reinforcement (Stiffener) Profiles



- FE-Analysis visualizing the effectiveness of stiffener profiles



Quelle: MPA Stuttgart



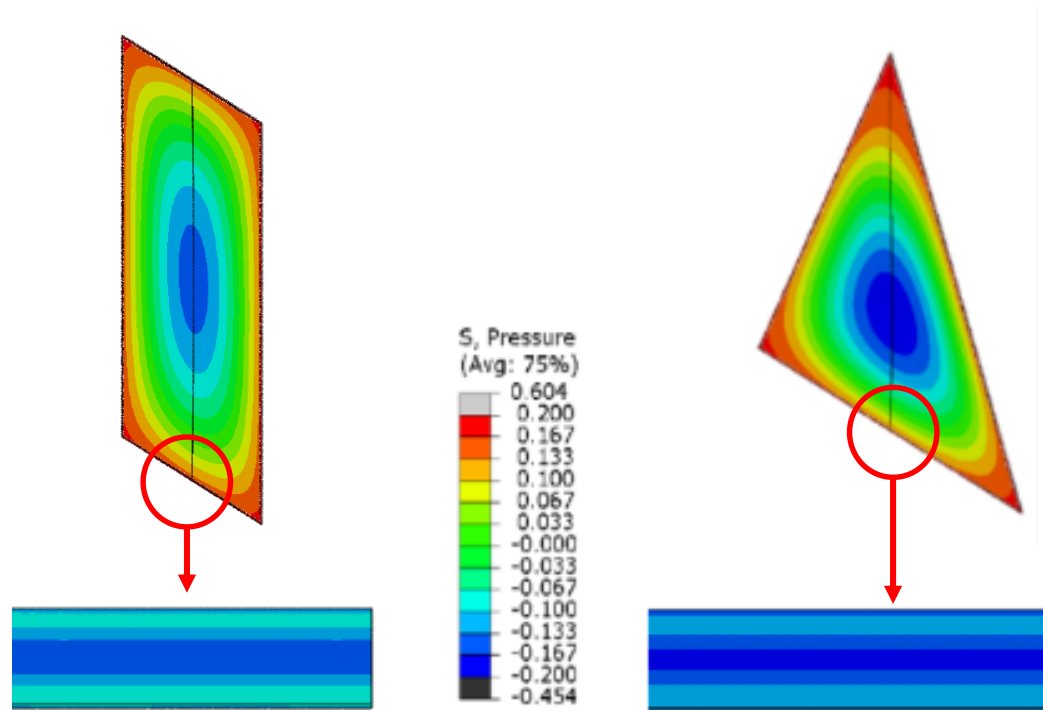
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BOND SIMULATION

Reinforcement (Stiffener) Profiles



- FE-Analysis visualizing the effectiveness of stiffener profiles
- Rectangular and triangular windows



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A photograph of a factory worker in a black t-shirt and dark pants, seen from the back, operating a large industrial machine. The machine is white and has a large roll of white material (likely tape or paper) on the left side. The worker's hands are on the machine's controls. The background shows a factory environment with yellow overhead cranes and various equipment.

THANK YOU

tesa SE

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www.tesa.com



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