

# **BONDING & SEALING IN THE RAILWAY INDUSTRY**

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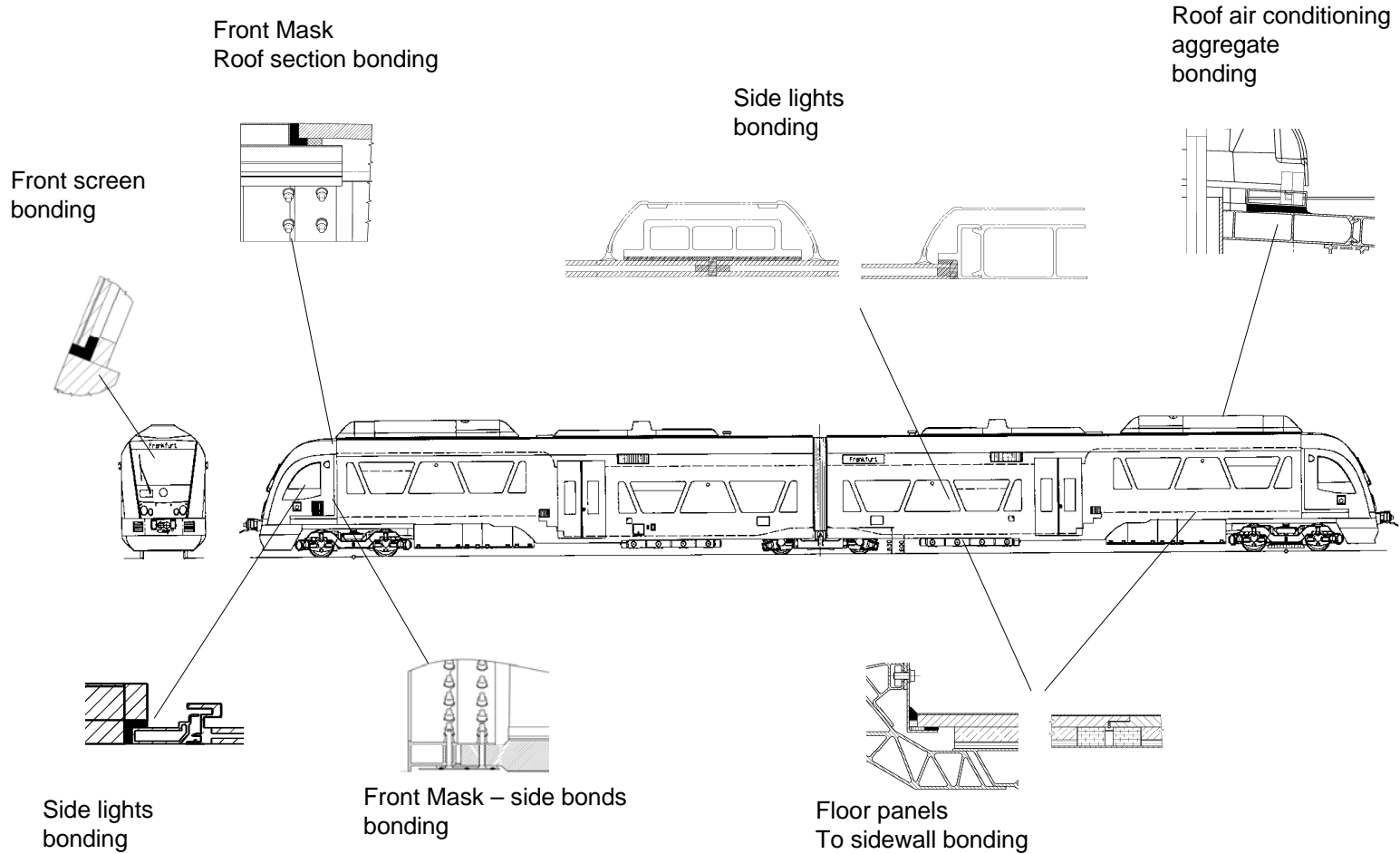
Use of qualified bonding and sealing processes as preferred technology of joining in the vehicle industry increased drastically over the past decade.

Advantages:

- Joining dissimilar substrates with all the positive material properties of the different materials.
  - No injury of the substrates
  - No heat deformation
  - Lightweight design materials like GRP or CRP and the possibility to utilize the material thickness only in the areas with stress
  - Freedom in design
  - Level out production tolerances
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1. Project definition and situation Analysis
  2. Design Phase – Decision on Substrates and joining methods
  3. Definition of loads
  4. First Decision on adhesives and auxiliary materials, activators, primer
  5. Pretesting of suggested Bonding / Sealing Systems
  6. Preparation of actual Substrates Bonding / Sealing of this substrates  
Laboratory testing and report
  7. Training of staff on the vehicle
  8. Preparation of working procedures / process description
  9. Active training during start up
  10. Follow up meetings and support
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# Bonding & Sealing on train



# Floor panel bonding process



# Side windows bonding process

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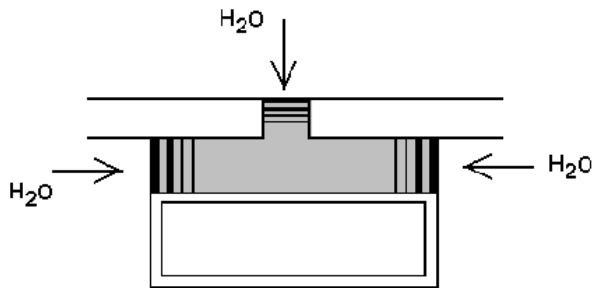


# Front window and Front mask

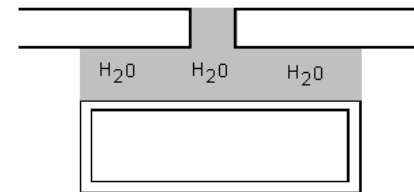


## Advantages of accelerated PU adhesives

Comparison between standard 1K with 1K plus



Polymerisation:  
diffusion controlled



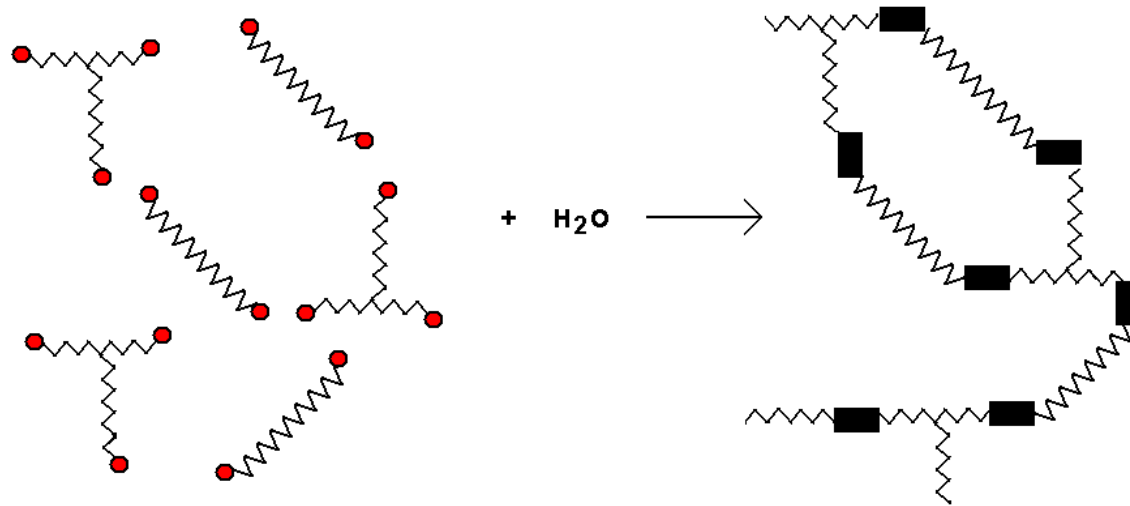
Polymerisation:  
independent of humidity



## 1K DINITROL adhesive

General description:

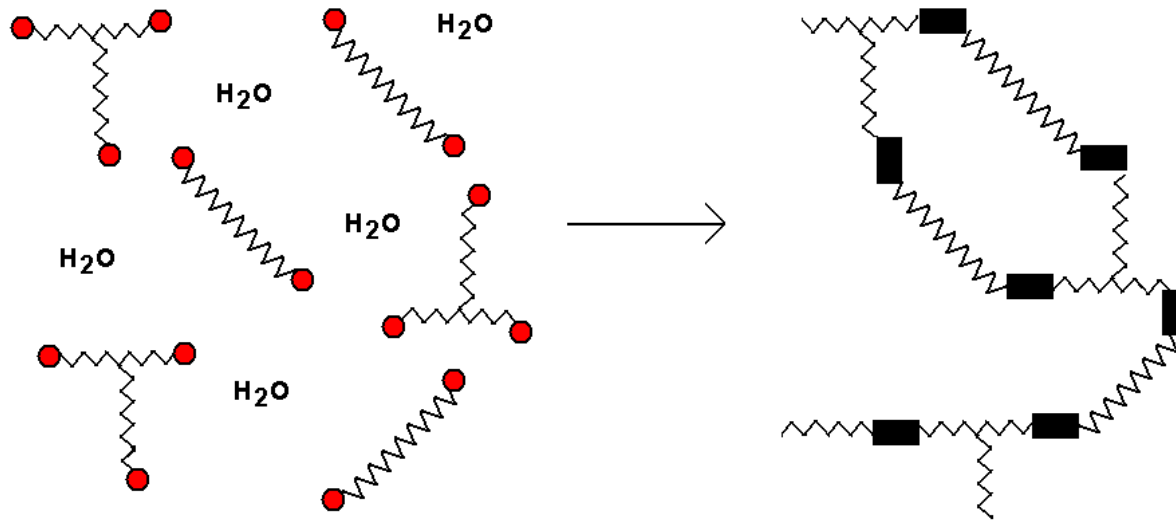
Cross-linked with humidity



## DINITROL adhesives with accelerated paste

(water based)

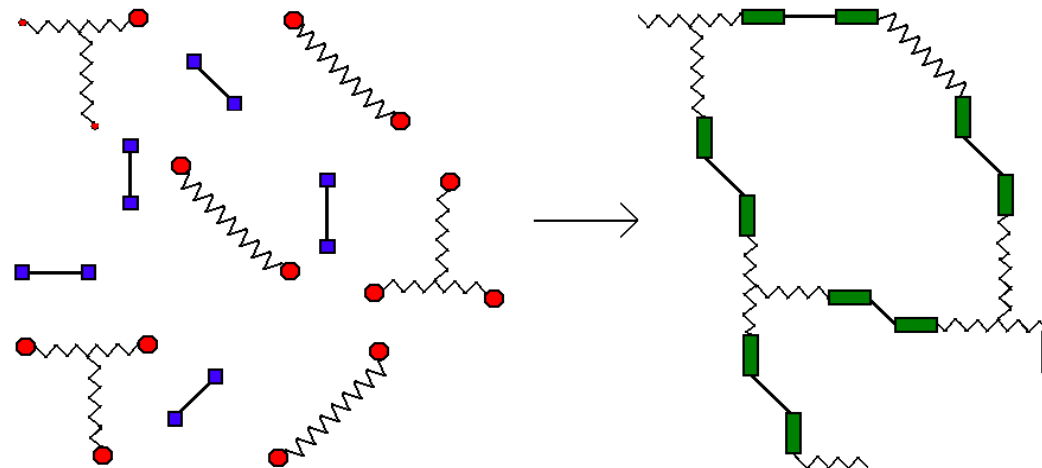
Mixing of the cross-linked component water



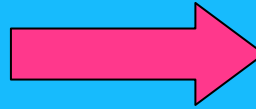
# Accelerated PU adhesives from DINOL

Reactive accelerated paste from  
(chemical)

Cross-linked with polyole



**1 Formula**



**4 Adhesives**

**DINITROL 515 A**

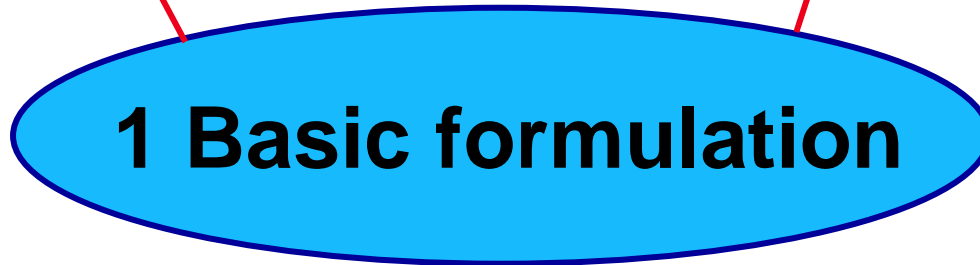
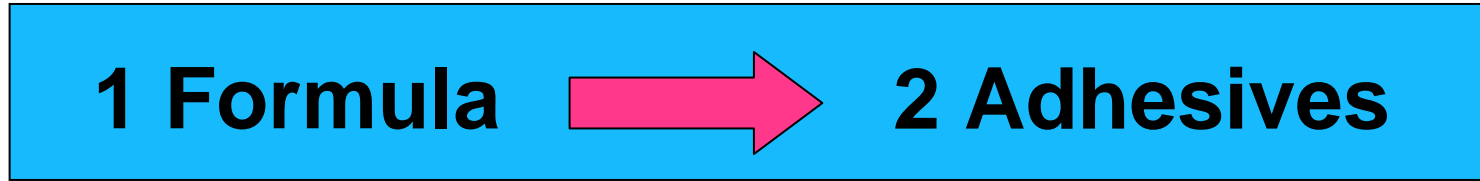
**DINITROL 516 A**

**1 Basic formulation**

**DINITROL F 500 LP**

**DINITROL 500 LV**

**Polyurethanes**



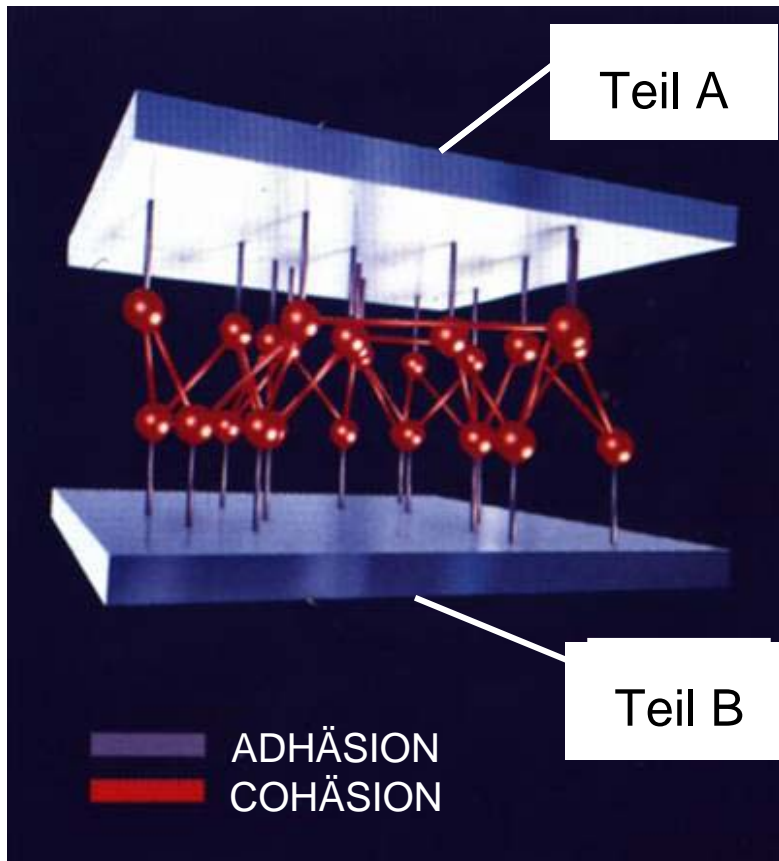
- **Best available products**
- **Best available application equipment**
- **Adequate pre-treatment**
- **Tests and documentation**
- **Well trained, motivated certified customer staff**

**In combination –  
the best quality warranty available**

## **Bonding is a special joining method**

- evaluation of the performance is possible only by means of destructive testing
  - in the initial phase of the use of bonding technology in the railway vehicles occurred large number of miss happenings, (e.g. side windows lost adhesion and felt out).
  - Failures caused damage, if not personal then definitely economical.
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Adhesion is only as good as its weakest link.



- Adhesion on Substrates
- Cohesive break
- Adhesion spectrum
- bead thickness
- width of the bond



- DVS-Merkblatt 1618:  
Elastic bonding in the railway industry

Was created and issued to handle claims in the Transportation industry

Factors of influence:

- Temperature
  - undefined Substrates
  - ambient conditions in production
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- this directive was to describe the quality assurance in elastic bonding
  - first calculations and interpretation of adhesive bond
  - Peel test was the adhesion test (under different conditions)
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The handling of claims became issue in competence of planning department and workers, resulting in:

- quite a few factories wants bonding technologie
  - the requirement of training guidelines for bonding staff was necessary
- DVS\_Richtlinie 3310:  
Quality management in the bonding technology

Requirements given:

- Safety for persons
  - energy aspects (weights)
  - repair and maintenance (lost time)
  - different coaches
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Factors influential on long term performance of bonds:

- **Chemical resistance**

  - Media

  - Moisture/ Humidity

  - Oxygen from the air

- **Mechanical stresses**

  - Static

  - dynamic/ cyclic

  - chock like

- **Physical influence**

  - Temperature

  - Radiation

  - electrical current

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Requirement for methods of calculation and testing of simulated life cycle of a bond

- high cost resulted in consolidation of railway industry and producers of adhesives for this project (investigations of adequate methods)
- Target is standardisation of test result interpretation in bonding

**Result:** Industrial code system:

**DIN 6701**

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## Norms and codes for quality standardisation

- **DIN 6701-1:**  
Fundamental terms, basic rules
- **DIN 6701-2:**  
Qualification of manufacturer of adhesive bonded materials, quality assurance
- **DIN 6701-3:**  
Guideline for construction design and verification of bonds on railway vehicles (design, dimensioning and documented evidence of structural conformity)

### **Qualification profile of the bonding system**

- **DIN 6701-4:**  
Manufacturing controls and quality assurance
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## Summary

- economic and safe production process needs close cooperation between the producers of vehicles and adhesives
- development of bonding systems, pre-treatments, application equipment and repair systems creating complete solutions for the bonding and sealing issues throughout the entire service life of the vehicle
- knowledge of production processes in the vehicle build, repair and maintenance, as well as familiarity with design issues
- Working together to create a complete solution, including training of staff

**These are necessary ingredients in effective introduction and development of bonding and sealing to the vehicle production, repair and maintenance. Early involvement of the producer of the adhesives in the project work is an essential factor of success.**

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