

## FASTER COMMERCIAL VEHICLE PRODUCTION WITH CURING-BY-DESIGN TECHNOLOGY

### NEW GENERATION SIKAFORCE® ADHESIVES SPEED UP PRODUCTION CYCLES DESPITE LONGER ASSEMBLY TIME – BUT HOW?

Production efficiency is often a struggle for many manufacturers of commercial and special vehicles, such as buses, trucks, caravans, trailers, etc. While they aim at speeding up manufacture and assembly of vehicle components, they must reduce production costs. Moreover, they have often to cope with order backlogs, which make harder to increase output at lower costs. Among the various methods available for joining manufactured parts, adhesive bonding keeps up with producers' challenging demands as well as opens up possibilities for new lightweight solutions and modular design. In order to achieve the full potential offered by assembly bonding, however, structural adhesives are required to show higher performances and enhanced curing behavior, compared to standard bonding products normally used in commercial transportation industry.

After successful introduction of PowerCure system for Sikaflex® Booster adhesives, Sika innovates also in the field of SikaForce® 2C PUR adhesives with the development of the Curing-by-Design technology. This proprietary Sika technology enables the next evolution of accelerated bonding products by enhancing the curing reaction of adhesive systems without compromising their open times. Thus, the Curing-by-Design technology allows component assembly in shorter cycle times without deployment of extra workforce. In addition, this technology can be combined to Powerflex technology, leading to adhesive joints both strong and flexible over the whole service temperature range of the vehicles.

#### CURING-BY-DESIGN TECHNOLOGY

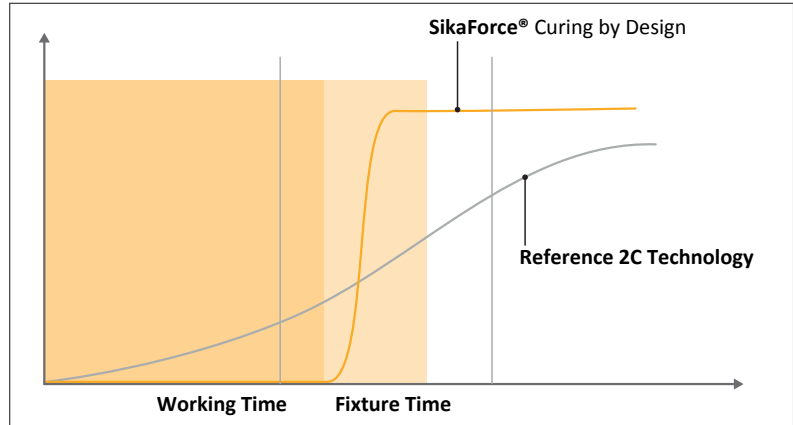
Standard structural adhesives for commercial transportation industry show evident limits when it comes to increase productivity. After adhesive application, the manufactures have typically to wait a long time before moving to the next production step (i.e., long handling time) and even a longer curing time is needed before the standard adhesives reach their final strength. Accelerated adhesive systems can speed up productivity, but this comes to the cost of a reduced working time to close the assemblies (i.e., short open time). For large joints, it may not be feasible to work with a short open time in production or, in the best cases, it would require additional investments in dispensing equipment and/or more workers on the line. Note that the same problems can arise for smaller assemblies if the manufacturing environment is not air-conditioned: high temperatures and/or humidity can further shorten the open time of the adhesives and, so, reduce even more the available working time during warm and/or humid days.



To overcome those issues, Sika has developed the Curing-by-Design technology: it consists of a patented hardening system for 2C adhesives that boosts the polymerization at a precise and customizable time after application. This technology enables Sika to formulate fast curing adhesives independently of the assembly times, which can suit the actual needs of vehicle manufactures. Among the benefits for the end-users, there are:

- Unmatched snap cure effect that reduces handling times
- Suitability for both small and large assemblies with excellent ratio between open time and curing time
- Possibility to be combined with Sika's Powerflex technology
- Easy applicability with standard dispensers and dosing pump equipment
- Compressible with low forces and applicable in big beads (non-sagging)
- No smell and smaller hazard risks compared to standard MMA and epoxy based adhesives

The Curing-by-Design technology has been integrated in the formulation of selected products of the SikaForce®-800 series, which are structural elastic adhesives, specifically designed for assembly of commercial vehicle components. These products also incorporate the Powerflex technology, which enable them to show very stable adhesion and mechanical properties (strength, modulus, elongation, etc.) at both low and high temperatures. This feature makes these adhesives ideal solutions when manufacturers require a strong, reliable bond throughout extreme climate conditions.



**TYPICAL PRODUCT DATA**

Characteristics	SikaForce®-803 L45	SikaForce®-840 L07
Definition	Structural elastic adhesive with long open time and fast handling	Structural elastic adhesive with very fast curing performance
Chemistry	2C Polyurethane	2C Polyurethane
Integrated Sika Technologies	Curing-by-Design Powerflex	Curing-by-Design Powerflex
Mixing Ratio (by volume)	1:1	1:1
Color (mixed)	Black	Black
Open Time	45 minutes	7 minutes
Handling Time (> 0.5 N/mm <sup>2</sup> )	90 minutes	18 minutes
Shore A Hardness	80	95
Lap-shear Strength (1.5 mm thick)	10 N/mm <sup>2</sup>	15 N/mm <sup>2</sup>
Tensile Strength	10 N/mm <sup>2</sup>	15 N/mm <sup>2</sup>
Elongation at Break	300 %	100 %
Glass Transition Temperature	-40°C	-45°C

**ADHESION PERFORMANCE**

SikaForce® Curing-by-Design products (SikaForce®-803 and Sikaforce®-840) show good adhesion on coated metals and composites substrates, usually without surface activation or priming. Because they are based on polyurethane chemistry, SikaForce®-800 adhesives are not recommended for bonding bare metals or specific plastics like PC, PMMA and some others. Adhesion tests must be performed in advance on original component substrates and in the actual assembly conditions.

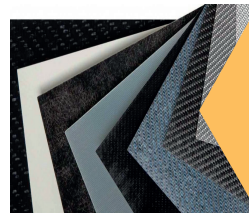


**COATED METALS**

- E-Coats
- Powder Coats
- Corrosion protection coatings

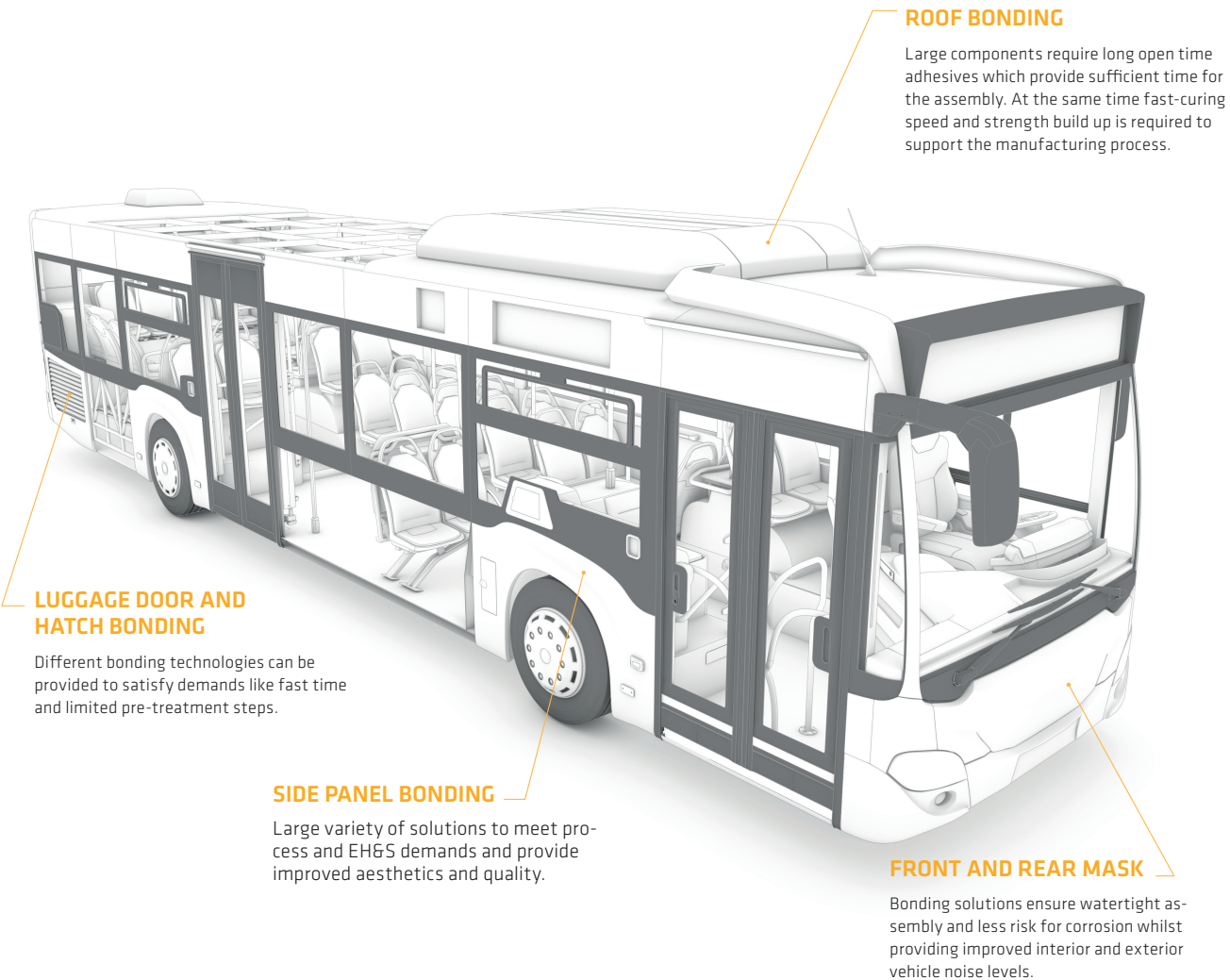
**APPLICATION AREAS - EXAMPLES IN BUS AND COACH MANUFACTURING**

SikaForce® products with Curing-by-Design technology can be used for various applications within the commercial transportation industry. Depending on particular substrate selection and process requirements, structural and flexible SikaForce® adhesives complement the potential application solutions offered by Sikaflex® adhesives for elastic bonding. Examples in bus and coach manufacturing are illustrated below.



**COMPOSITES**

- GRP / SMC / CRFP
- Epoxy and Polyester resins
- Vinyl ester resins
- PUR RIM
- PU and PET Foams



**ROOF BONDING**

Large components require long open time adhesives which provide sufficient time for the assembly. At the same time fast-curing speed and strength build up is required to support the manufacturing process.

**LUGGAGE DOOR AND HATCH BONDING**

Different bonding technologies can be provided to satisfy demands like fast time and limited pre-treatment steps.

**SIDE PANEL BONDING**

Large variety of solutions to meet process and EH&S demands and provide improved aesthetics and quality.

**FRONT AND REAR MASK**

Bonding solutions ensure watertight assembly and less risk for corrosion whilst providing improved interior and exterior vehicle noise levels.

**APPLICATION CASE – Bus roof bonding**

Bus roofs are often made of either steel, aluminum or GFRP. Adhesive bonding is nowadays established as the preferred fixation method, because it transfers load homogenously to the bus walls and eliminates areas of stress concentrations. In addition, use of adhesives provides watertight sealing and copes with different thermal expansion of mixed substrates, e.g. metal frame and GFRP.

The bonding process is usually carried out using 1C or 2C polyurethane adhesives. The application time can reach up to 30 minutes due to the large size of the roof. Among the 1C products, Sikaflex® Booster adhesives guarantee faster handling and curing time compared to regular moisture-curing 1C Sikaflex®. Among the 2C adhesives, SikaForce®-803 L45 is the perfect choice for fastest production, thanks to the Curing-by-Design technology. In addition, its structural properties combined with high elongation enable it to cope effectively with manufacturing tolerances and thermal stresses, which are normally problematic for standard 2C adhesives.



Product	Open Time at 23°C	Handling Time (>0.5N/mm²)	Final Strength	Elongation at break
SikaForce®-803 L45	45 min	1.5 hours	10 N/mm²	300 %
Sikaflex® Booster Adhesives	30 min	2 hours	2.2 – 4.5 N/mm²	400 %
Sikaflex® 1C PUR Adhesives	35 min	8 hours	2.2 – 4.5 N/mm²	450 %

**SIGNIFICANT SAVINGS ACHIEVABLE**

The extended open time and fast curing lead to increased productivity and a significant reduction of required workforce to apply the product. With standard 2C adhesives, up to 6 workers for each roof side were required for the application due to the limited open time and, then, 8 to 12 hours of waiting time were necessary to move the bus to the next production stage due to slow curing. With SikaForce®-803 L45, only 1 or 2 workers are sufficient to complete the adhesive application and the assembly can be moved in less than 2 hours. This lead to significant cost reduction, since the overall assembly process is faster and the workers that are taken away from this operation can cover other bottleneck areas.



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**LEGAL NOTE**

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