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Sealing, Gluing, Potting – Multiple Solutions for the Automotive Industry

With more than 90 million vehicles produced annually, the automotive industry is one of the largest and most important branches of industry worldwide. Such immense production figures can only be achieved through a high degree of automation. Therefore, applications such as the dispensing of seals, adhesives and potting materials to various components are of particular relevance. Sonderhoff offers the automotive industry materials, machines and contract manufacturing from a single source.

Requirements of the automotive industry

In the automobiles produced today, sealing, potting and adhesive applications based on polyurethane or silicone can be found in many places, e.g. in engine and interior components, for lighting, bodywork and electronics (*Figure 1*). They serve as dust, chemical and moisture protection as well as vibration damping.
The requirements for the different material systems are very different. These are often laid down in a separate standard, e.g. DBL 5450/5452 (Daimler) or TL 848 (VW). The resistance of the seal to the various contact media always depends on the contact duration, temperature and concentration of the medium. Both polyurethane and silicone gaskets achieve high IP protection classes in combination with the respective overall construction. The IP (International Protection) class tests provide information on how protected electrical equipment and products are against various environmental influences. In the area of media resistance and at high temperatures, however, silicone shows better behavior. In some cases, damage to the seal can also be prevented by changing the design of the component. Simple storage tests of the sealing material in the respective contact medium therefore allow only limited conclusions to be drawn; the sealing behavior must always be tested and evaluated on the overall construction. For applications in the temperature range from -40 °C to +80 °C, polyurethane seals are suitable for sealing against dust and moisture. Silicone systems are used in areas with a permanently higher temperature load up to + 250 °C or for sealing against more aggressive contact media. High temperature resistance is generally required for motor applications. Here, however, it must also be critically questioned whether the seal is actually permanently exposed to an increased temperature, since the use of silicone seals is associated with significantly higher costs.
At the sealing specialist Sonderhoff, a consistently high quality of sealing, gluing and potting of components is already decided by the correct selection of raw materials for the formulation of the material systems. The safety, accuracy and ease of operation of Sonderhoff's mixing and dosing systems are also very important for a precise and trouble-free application process of the materials to the components. The precise interaction of different setting parameters and additional functions of the dosing machine is also responsible for this. The machines also enable flexible adaptation to different production situations in the automotive industry, such as changing batch sizes, increasing variant diversity and component complexity.

High process reliability with FIPFG sealing technology

Due to the high level of automation in automotive production, material application must also be highly automated. In recent decades, foamed seals made of polyurethane, but also silicone, have become the standard. These gaskets are applied directly to the component to be sealed using FIPFG (Formed-In-Place-Foam-Gasket) technology with the aid of modern mixing and dosing systems. The PU foam then cures at room temperature to form an elastic soft foam seal. Two- and three-

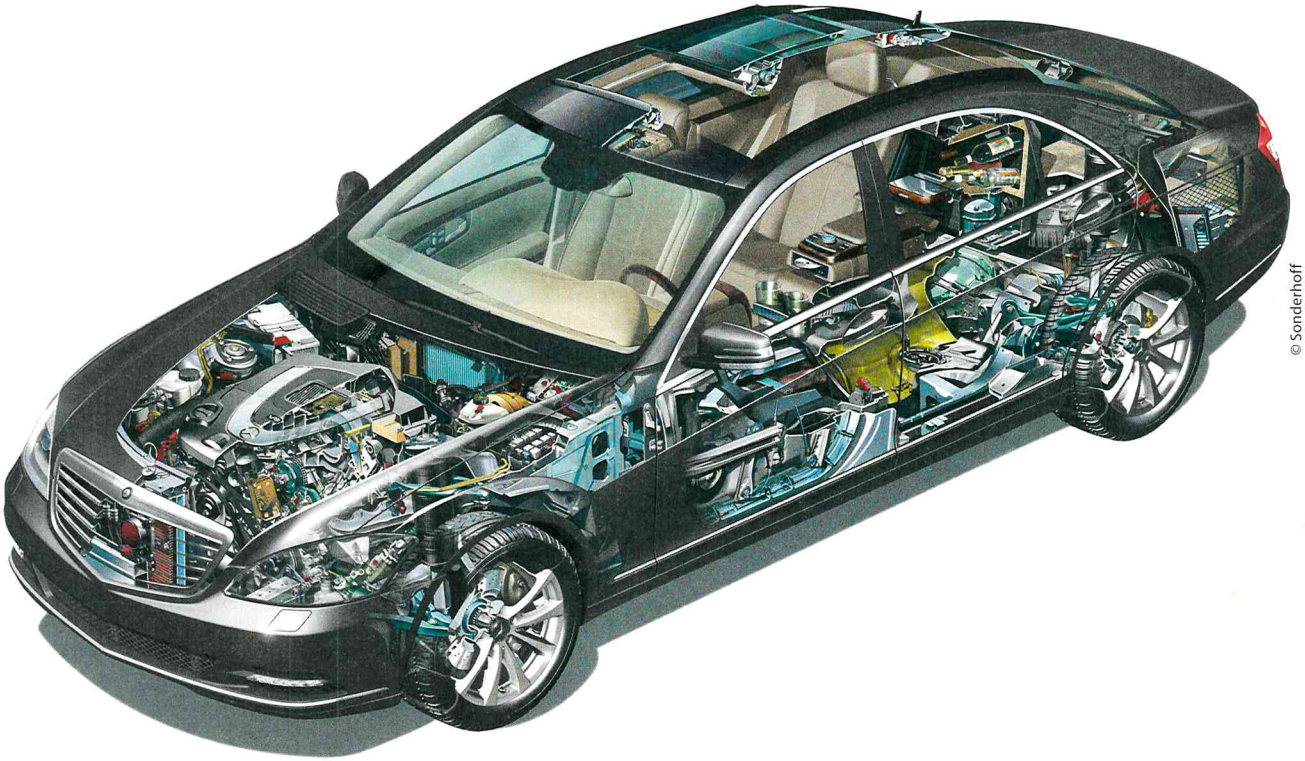

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Figure 1 > Sealing, potting and adhesive applications based on PU and silicone can be found in many places in cars, e.g. in engine and interior components, for lighting, bodywork and electronics. They serve as dust, chemical and moisture protection as well as vibration damping.

dimensional parts are dosed with the same precision as components with and without grooves. With FIPFG technology, much better sealing results are usually achieved than with conventional, manually inserted seals, while at the same time saving costs due to automation. All machine, material and process data relevant for quality assurance are automatically recorded in the Sonderhoff mixing and dosing systems and can therefore be called up at any time. The FIPFG technology together with the traceability of the processing sequences of the system ensures reproducible production quality of the foamed components (*Figure 2*). This supports the zero-error tolerance aimed for in automotive engineering. The high process reliability of the FIPFG technology in turn enables trouble-free production and thus higher productivity.

Company Profile Sonderhoff Group:

- Since July 2017 part of Henkel AG & Co. KGaA
- Worldwide operating system supplier for FIP(FG) technology
- Specialized in customer-specific sealing, gluing and potting solutions
- The offer includes material, machine and contract manufacturing (SYSTEM 3) from one source
- Foam sealing, adhesive and potting systems based on PU, silicone and PVC
- Mixing and dosing systems for automated material application according to FIP(F)G technology
- Contract manufacturing for foam sealing, gluing and potting of industrial components with Sonderhoff mixing and dosing systems
- Contract manufacturing from the sampling of prototypes through small series to series production on a production scale
- Individual automation concepts and technical application advice
- More than 1,000 self-developed formulations, multiple patented knowledge and many years of experience

Low-emission foam seals for clean air in the car

Increasingly, the use of plastics in car interiors to protect vehicle occupants requires compliance with emission values, i.e. the lowest possible release of substances into the environment. Even at very high temperatures in the car, the plastic components must not emit any harmful substances. However, the limit values required vary depending on the manufacturer's standard. In general, however, they can be described as very demanding. After all, the aim is to protect the occupants of the vehicle from harmful substances.

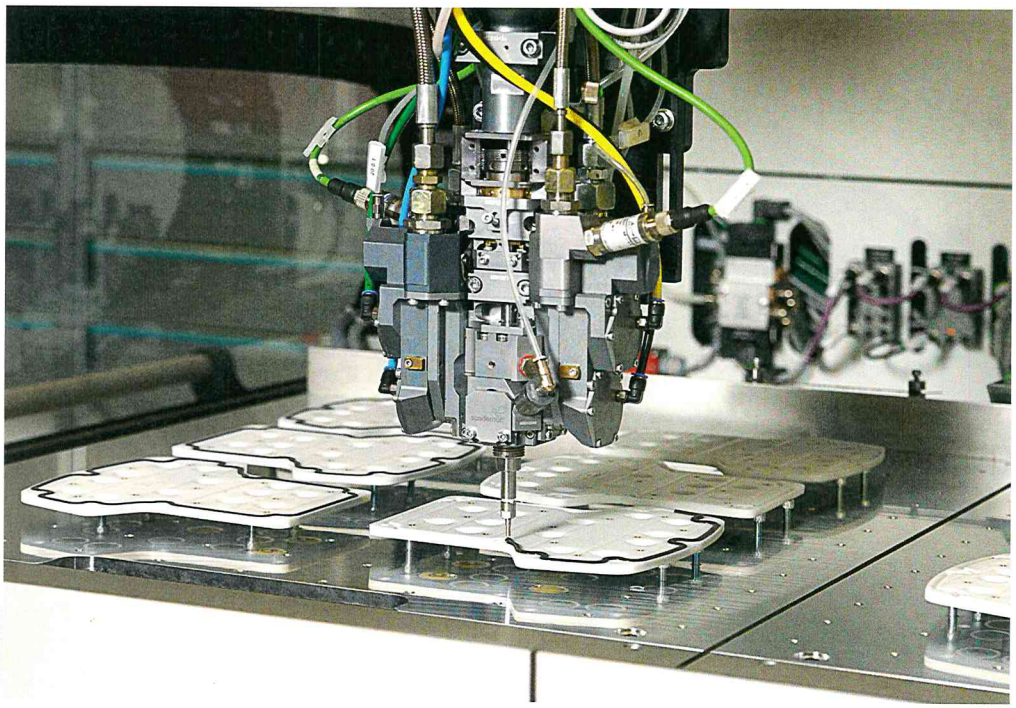

Figure 2 > The high process reliability of the FIPFG sealing technology makes the zero error tolerance required in the automotive industry possible.

At Sonderhoff, the further development of low-emission polyurethane foams has long been an issue. The reduction of emissions is achieved through the selection of raw materials. In the case of sealing foams, this means that volatile components such as blowing agents, oils or plasticizers must not be used. The Fermapor K31 low-emission polyurethane foams developed by Sonderhoff for this purpose meet the strict limit value requirements of all major automobile manufacturers. For example, they meet the target values of Daimler's own specification DBL 5452-13. Here, the target values for VOC emissions are 100 µg and for fogging behavior 250 µg per gram of polyurethane. Thus, the low-emission foam seal also contributes to the reduction of VOC pollution of the air in the vehicle interior. VOC refers to volatile organic compounds that are not always firmly integrated into the molecular structure of plastics or adhesives.

The Fermapor K31 foams, for example, seal filter housings for fresh air intake in the driver's cab. They ensure that the filter is positioned at the air intake duct in the air conditioning systems of cars so that no unfiltered air can get past the filter into the passenger compartment.

Too much VOC in the air often causes fogging. VOC components move in the air from warm to colder zones and are separated there. In a car, this can lead to fogging of the windscreen or the inside of the headlights. In extreme cases, this could impair drivers' road safety.

The low-emission sealing products, which are particularly in demand among car manufacturers and their suppliers, make a decisive contribution to reducing the fogging effect and VOC pollution of the air inside the car (*Figure 3*).

FIPFG "Formed-In-Pace-Foam-Gasket" – the foam gasket that takes shape on the spot

- Liquid or thixotropic 2-component sealing compound is applied directly ("in-place") to the component via a dosing system
- The material reacts to the foam gasket at room temperature on the component
- Advantages: accurate dosing mechanical process, consistently high sealing quality, very efficient, especially for large quantities
- Contour-accurate material application to two- and three-dimensional components by 3-axis or 6-axis robot
- The FIP technology is also suitable for the material application of non-foamed materials such as 2-component adhesives or potting compounds
- High process reliability enables faster production speeds and thus higher productivity in the automotive industry

Fast-cure foam seals for high cycle process manufacturing

When applying a seal to a component, the cycle time with which the components are fed to the mixing and dosing system and subsequently processed is of great importance. Modern mixing and dosing systems have therefore always worked very quickly and with high preci-

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Figure 3 > Low-emission sealing products help to reduce the fogging effect and the VOC load on the air in the passenger compartment.

sion. However, components with a foam seal that has just been applied generally require a certain amount of time before they can be further processed. The reason for this is the cross-linking reaction of the material components polyol and hardener. It must first be completed before the seal surface is tack-free and parts can be handled. The parts can only be installed once the seal has completely reacted and cured. As a rule, the foam seal cures in 25 to 120 minutes.

However, in automotive engineering with high cycle process manufacturing, rapid part handling is required after just a few minutes. For this purpose, the tack-free time can be significantly reduced by using so-called polyurethane-based fast-cure systems (*Figure 4*). The surface of Fermapor K31 fast-cure foam seals is tack-free at room temperature after approx. 120 to 180 seconds, depending on the formulation. The foamed components can thus be quickly further processed in subsequent manufacturing processes and thus installed earlier. This saves energy costs, possible costs for intermediate storage of components, investments in annealing furnaces or transfer belts for long curing lines. Faster further processing and thus earlier final assembly of the components lead to considerable time savings in the entire manufacturing process, lower unit costs and more efficient production.

Special Fermapor K31 fast-cure foam seals also meet the technical requirements of the manufacturer's own automotive industry standards, from Daimler DBL 5452-13 to the VW standard TL848 to the Chrysler/Fiat standard MY 560. Fast-cure foams generally have good adhesion, but on certain substrates only after prior pretreatment, e.g. by primer or plasma activation as an adhesion promoter. The viscosity of fast-cure foams can be flexibly adapted to the respective component geometry from liquid to pasty. Fast-cure foams can be easily installed thanks to different shore hardness.

Typical applications in the automotive industry

Foamed gaskets based on polyurethane or silicone are used in vehicles, for example in the interior and engine com-

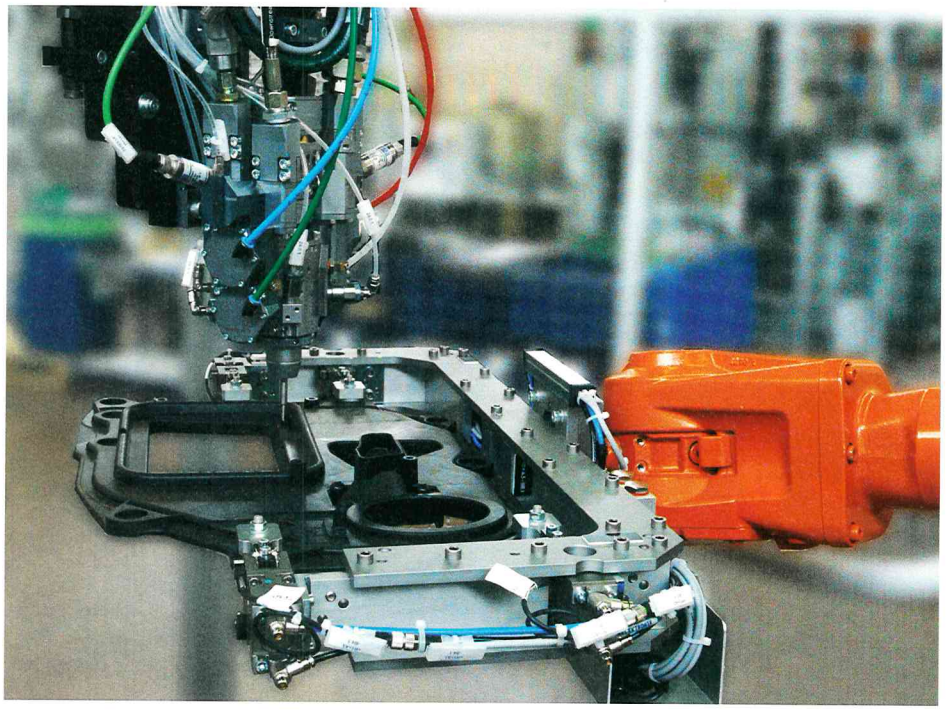

Figure 4 > Fast-cure foam seals for high cycle process manufacturing

partment, as well as for parts of the body, lighting and automotive electronics. Typical applications for foam gaskets include door modules, which have been fitted with directly applied FIPFG gaskets as standard for years (*Figure 5*). The door modules accommodate loudspeakers and electric windows whose electronics must be protected from moisture and dust. Further standard applications are the sealing of plastic housings, e.g. for electronic components or "third brake lights", for which red-coloured seals are often required (*Figure 6*). Polyurethane and silicone seals can also be adjusted in other colors. An example of a sealing application with increased requirements is the timing belt cover. It is located in the engine compartment and is fitted with a silicone seal due to the temperature load there.

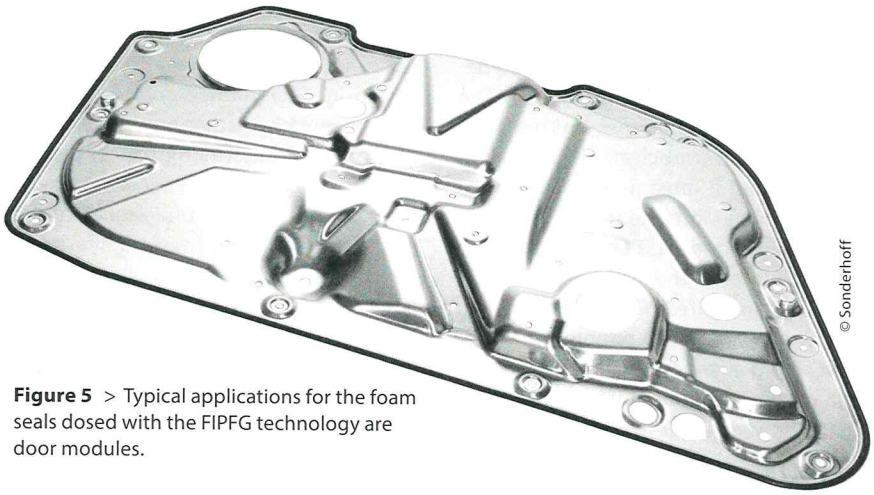

Figure 5 > Typical applications for the foam seals dosed with the FIPFG technology are door modules.

Polyurethane adhesives for lightweight car construction

Thanks to new materials and material combinations, the design possibilities in lightweight car construction have become more versatile. Mounting and attachment parts in cars made of thermoplastics or duroplastics (partly fibre-reinforced) or plastic components with metallic components are increasingly being glued with 2-component polyurethane adhesives. In vehicle construction, this is a multitude of components, such as GRP sandwich structures, KTL coated metal frames for sliding glass roofs, parts made of PMMA or PC with scratch-resistant coatings, roof panels, trim strips and spoilers as well as ABS- or PP-based tailgates.

The automotive industry has access to Sonderhoff's Fermaglue 2C polyurethane adhesives in various degrees of hardness, as well as Henkel's extensive adhesive portfolio. The Fermaglue 2C polyurethane adhesives enable optimum adhesive results for components made of different materials. They also meet the high mechanical and climatic requirements. The perfect gluing process requires precise mixing and dosing of the adhesive components and the adherence to a precisely defined mixing ratio. The Sonderhoff mixing and dosing systems enable exactly this, namely through process-continuous dosing accuracy and systematic process monitoring.

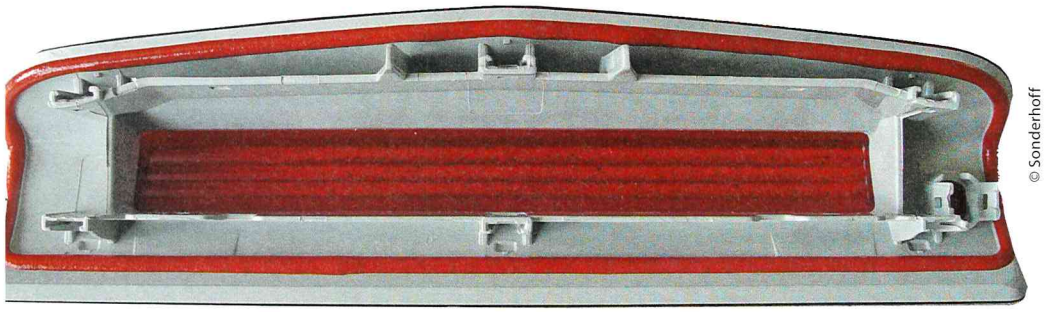

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Figure 6 > Protection of brake lights against moisture with red foam seals

Conclusions

The Formed-In-Place (FIP) sealing technology for the fully automated application of liquid to pasty 2-component material systems made of polyurethane or silicone directly onto the components has established itself as the manufacturing standard in highly automated vehicle construction. The modern Sonderhoff mixing and dosing systems used for this purpose can be very easily integrated into existing production lines and concepts.
With the FIP sealing technology, a large number of very different component geometries can be precisely dosed with soft foam seals, adhesives or potting compounds in reproducible quality. The raw materials used are almost 100 % utilized. The application possibilities for foamed gaskets are particularly diverse and can be perfectly adapted to the requirements of the automotive industry. In addition to emission behavior, temperature and contact media resistance, this includes the good resilience of a foam seal, flexible hardness adjustment and other mechanical properties such as tensile strength and elongation at break. The requirements of the various automotive standards must be taken into account as well as the requirements resulting from the specific application. //

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