

AUTOMATIC APPLICATION OF SELF-ADHESIVE SEALS

Vehicle body mounted door seals on a roll

The automatic application of self-adhesive seals presents a particular challenge because the seals easily lose their shape and can be stretched or compressed under tension or pressure. However, in future an automated process will be available for applying self-adhesive seals directly to doors and bodies on vehicle production lines as a result of a partnership between 3M, the Fraunhofer IPA (Institute for Manufacturing Engineering and Automation) and seal manufacturer GTG.

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Body mounted door seals are currently supplied to the production line as closed rings or cut to length to fit each individual door opening. In addition, existing seals with a metal core are heavier than the new, self-adhesive products. In future, seals will be available in large rolls. A sensor-controlled robotic tool will be used to position them around the door opening and they will then be bonded in place, with both pressure and tension accurately predefined.

The idea behind this innovative approach, which is currently in the final phase of development, was to create a completely new system which combines the tool, the seal and the adhesive tape. *The developers at the technology center of 3M in Neuss, Germany, felt that the existing tools used to apply seals to vehicle doors did not offer the option of easily adjusting the pressure and tension on the rubber seals which would allow them to be bonded accurately. Another requirement for the new tool developed by the IPA was that it should be as slim as possible at the tip to enable the seal to be applied to the door opening. In ad-*



Using a robot, the new application system bonds the seals to the bead on the bodywork.

dition, the tool had to be robust, safe and simple to use, so that it could withstand the demanding production line environment.

New seal with “rubber anvil”

While these considerations were being taken into account by the teams at the IPA and 3M, GTG was in the process of producing a completely new rubber seal in close cooperation with 3M. The only difference in the new seal at first glance

is that it has no metal parts. However, inside the seal is another very important innovation: a so-called rubber anvil.

On the side of the seal where the adhesive tape is positioned, there is a thicker area in the middle of the seal which narrows towards the outside. This ensures that the pressure on the seal during the application process is evenly distributed on the adhesive tape.

This change not only benefits the bonding process, but also the tool devel-

oped by the IPA. The “anvil” on the seal functions as a guide rail when the seal and adhesive tape are applied to the door opening. This guide rail fits exactly in the two “tracks” on the front pressure roll of the tool and allows the seal to be positioned precisely in the door opening. This example clearly indicates the importance of the new seal application method, which represents a genuine innovation involving all three integrated components of the process: the tool, the seal and the adhesive tape.

On the test bench

The new process is currently being used to develop and test new adhesive tapes which will allow it to be used in volume production. Existing acrylic foam tapes currently used to apply seals to vehicle doors are not suitable for the bodywork flange. As the surface of the bodywork flange is at 90 degrees in relation to the edge of the door, more demanding requirements are placed on the tape because of the shear forces to which it is subjected. Improvements to the seal and the design of the bodywork will also be necessary.

In order to apply the combination of adhesive tape and seal to the door opening while keeping stresses to a minimum, the sensor-controlled system uses the rolling speed of the pressure roll to determine the speed of the feed unit for the seal, which takes the form of a caterpillar puller. A decentralised control unit which forms part of the tool control system ensures that the communication between the robot and the application tool can be restricted to only a few digital signals for synchronisation purposes.

Influencing the “Fulling effect”

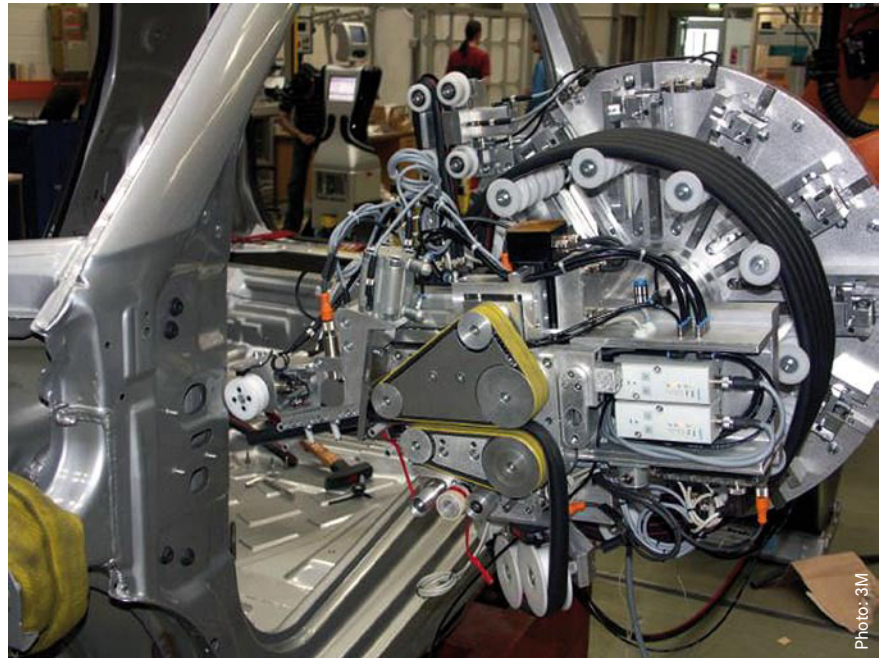
The pressure roll is also subjected to torque independently of its speed.

At the tip the new application system is very slim to enable the seal to be positioned accurately in the door opening.

This allows the so-called “Fulling effect” produced by the pressure, which



The new application system is sufficiently flexible to be used with almost all types of vehicle body.

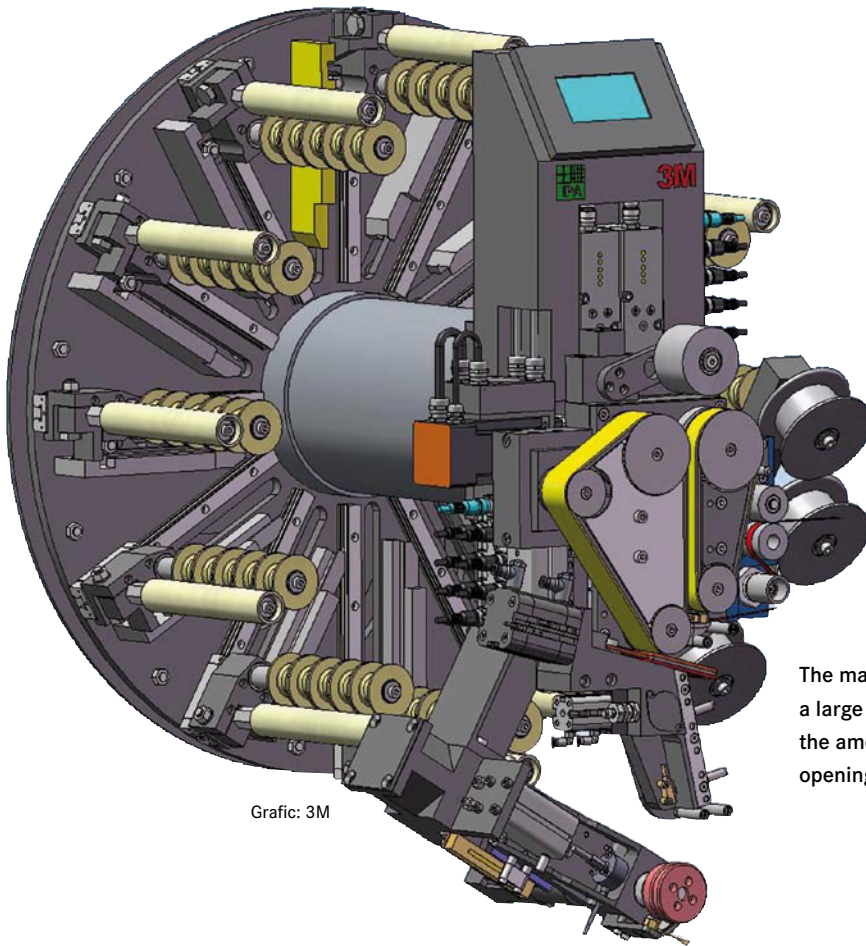


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results in the seal being stretched even further, to be controlled. Depending on the amount of torque applied, the stretch on the seal can be reduced to zero. It is even possible to compress the seal using this mechanism, which means that the

seal can be reproducibly positioned, in particular on the tight curves in the door opening.

In addition, a magazine mounted on a flange mounted magazine ensures that the seal is correctly tensioned as it is



Grafic: 3M



Photo: 3M

The new seal with the internal "rubber anvil" (above) compared with a current seal containing a metal section.

The magazine is fed continuously from a large roll and contains almost 1.5 times the amount of seal needed for each door opening.

passed into the door opening. The magazine can be continuously fed from a large roll and contains about 1.5 times the amount of seal required for each door opening. The cutting system on the new tool also takes an innovative approach. In existing systems, the seal is always cut through to the protective covering. Now a power-controlled puller removes the covering from the seal before it is cut. This allows another potential problem to be avoided, which relates to control over the stretching of the seal during application. The fork directly in front of the pressure roll acts as a regulator to help prevent any minor fluctuations which may occur during the process.

Flexible system for use with any vehicle body

The strength of the new application system lies in its suitability for almost

any type of bodywork and any type of vehicle paint. Other benefits include a weight saving of up to four kilograms per vehicle, a reduction in the cost of the advance preparation of the seal and of the necessary logistics. The new development highlights the role played by project leader 3M not only as a manufacturer of adhesives and adhesive tapes, but also as a specialist in integrated systems for the automotive industry. 3M can work together with vehicle manufacturers to define the parameters of the entire bonding process for the automated application of seals to doors and bodies long before the start of volume production. This allows possible development errors to be avoided in advance, resulting in further cost savings. German car manufacturers are currently evaluating the benefits of the new system. ■

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