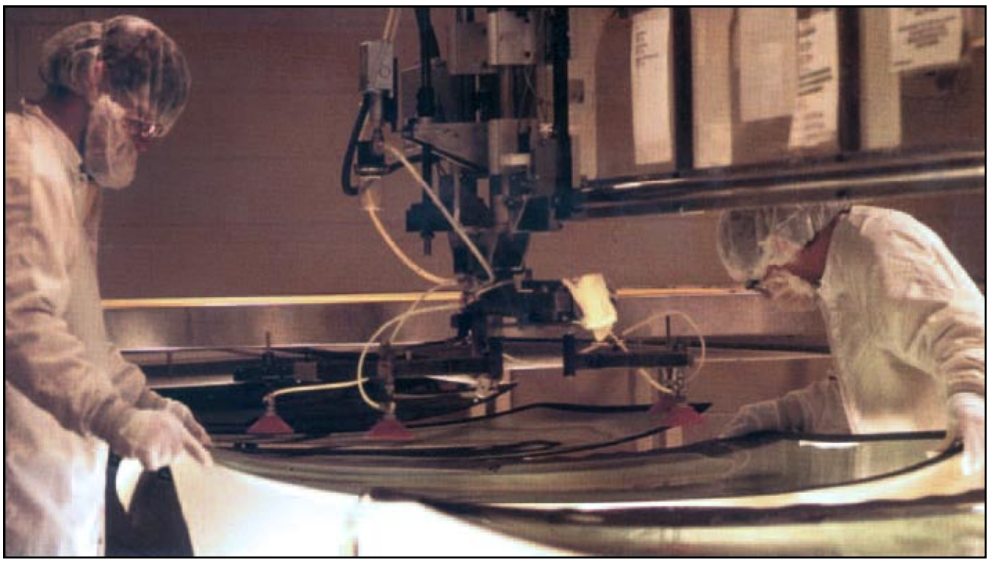
# As Clear as Glass

## MSC.Marc Simulation Aids Glass Development at Guardian Automotive



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**Customer:**
Guardian Europe S.A., Luxembourg
www.guardian.com

**Software/Services:**
MSC.Marc®, MSC.Software Professional Services

**Summary:**
Guardian Automotive uses MSC.Marc and MSC.Software Professional Services in the development of glass products such as windows for the automotive industry. Simulation with MSC. Software products enabled Guardian to try different temperature situations without interrupting the actual production process and to predict the behaviour of the various materials - both in different production stages and in their final use mounted in cars. The validated MSC.Marc simulations showed Guardian what the layout of the window should look like, and enabled them to demonstrate to their customers whether a certain heating system was suitable. As a result, Guardian benefited from increased efficiency and significant time savings.

The manufacture of car windows is a complex production process, since several variable factors are involved. Manufacturer Guardian Automotive is developing simulation techniques to obtain an accurate prediction of how these factors will interact. These simulations are made with the aid of MSC.Software.

Guardian is one of the largest global producers of flat glass and products made from this glass. The automotive industry is one of Guardian's main customers, purchasing a range of exterior products. Guardian is also a significant player in the architectural market, and at the same time has become the largest producer of mirrors. Guardian Automotive has two production plants in Europe: one in Spain and one in Luxembourg. These factories deliver directly to major car manufacturers as well as to car repair businesses. The complex production process, which uses glass furnaces, requires a continuous operation environment.

When you sit in your car and look out of the window windscreen, side window, or rear window, it is difficult to imagine that such a complicated process is required to produce these windows, not just in the manufacturing stage but in the design and drawing-board stage as well. Charles Courlander, senior development engineer at the Luxembourg facility, knows all about this. One of his primary tasks is to optimize these production processes, on the one hand to enable Guardian to meet the wishes and demands of the car manufacturers, and on the other hand to generate the necessary internal efficiency. Courlander can regularly be found at the proverbial drawing-board, where he works with various MSC.Software products. Nowadays all data relating to the production environment is stored in the CAD environment. Each design Guardian has to take into account the components and functions that will be incorporated by the client in the car window, such as rubber attachment strips, rain detectors, rear-view mirror, aerial, and heating elements.

There are two ways to design car windows. The first is to make the windows from one piece of glass. The second is to use laminated glass, which is made up of two sheets of glass brought together with a synthetic layer. Sometimes accessories such as electrical wires or coatings can be fitted between the glass layers. In both cases Guardian has to take into account factors such as sound insulation, burglary prevention, image distortion for the driver due to the curvature of the glass, and safety. In case of an accident, the window should shatter into small fragments to minimize the danger of injury to occupants.

MSC Software

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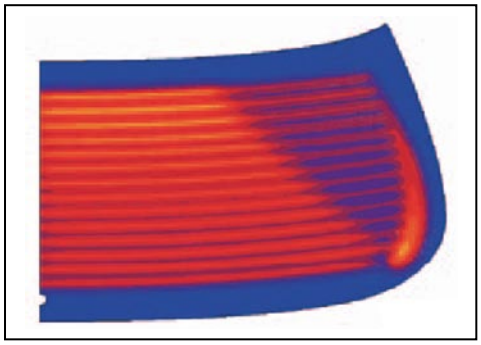

To predict the behaviour of the various materials as accurately as possible, both in the different production stages and in their final use mounted in cars, Guardian Automotive uses simulation. "There are two main situations in which simulations are applied," Courlander says. "In the first we simulate the way in which a windscreen or rear window heats up when used to de-ice on frosty mornings. This is so that we can predict the temperature distribution over the entire window. This enables us to localize hot spots, which may possibly be weak spots. We have now mastered this simulation method, and apply it regularly with good results."

"We are now developing the second use of simulation to obtain the right shape for the window. Each car has its own characteristics, and each window must therefore be tailor-made. We heat the windows to obtain the right shape. Various temperature situations are simulated to see how the bending process will develop. The material composition also has to be taken into account in the simulation, as this has a major influence on the bending process. This is often a highly elaborate process. The furnaces have different heating elements that ensure that the glass is heated in different places. We therefore want to know what happens to the glass when we 'play' with the temperature in the furnace. In simulations we can try this without interrupting the actual production process."

"In view of the fact that we have many different customers, all with their own individual wishes, these simulations will save us a great deal of time," explains Courlander. "The validated simulations show us a priori exactly what the layout of the car window should look like and will show us how the machines should be set up for the actual production."

A large part of the simulation work is carried out with MSC.Software products, specifically MSC.Marc. Courlander has worked with MSC.Software products since 1983 and with MSC.Marc since 1998 – so he is clearly highly experienced in this regard. MSC.Marc is a general-purpose finite element programme used by businesses in various industries including the rubber/tyre, automotive, aerospace, electronics, biomedical, construction, and manufacturing industries. It can be used for virtual product development whereby efficient product designs can be analysed and improved before a physical prototype is made and tested. MSC.Marc has a user-friendly interface so it is easy to integrate in the existing technological infrastructure.

Guardian Automotive decided to use MSC.Marc because the product is suitable for analysing the layout of the heating elements in rear windows. "MSC.Marc is ideal for this; it was exactly what we were looking for. We were able to substitute simulations for the development runs, which was very costeffective," explains the engineer. At a later stage MSC.Marc was also used to simulate the glass bending process.

The glass manufacturer contracted the services of MSC.Software as well as the products. This was because although Guardian had no difficulty with the modelling aspects, the expertise of MSC.Software was required to imitate the situation in the furnace. Courlander is very impressed with the speed with which problems were understood and solved. In addition to providing vital information on the progress of various production stages, the use of simulation could be intensified in some parts of the process. Courlander states, "We still have many questions. We are constantly occupied with process optimization. At present we often seek answers by means of trial and error, but this costs a great deal of time and money."

External pressures are another important motive for the application of simulation methods. Many car manufacturers are urging the use of simulations so that these can ultimately be used in a total car model. This total car model can subsequently be used in further simulations. "This also illustrates that Guardian aims to achieve high quality and wants to fully understand its production processes," adds Courlander.

The method has now become indispensable for Guardian. "The manufacturer presents us with the desired layout for the window. The heating system used and the position of the mirrors, antenna, and rain detector are also specified by the manufacturer. All these factors are taken into account in the simulations which have to be carried out each time," says Courlander. "We present the results to the manufacturer and this enables us to demonstrate whether a certain heating system is suitable or unsuitable. With simulation, we can investigate and evaluate the wishes and demands of our customers with the greatest accuracy."

Now that the current simulation methods have been developed effectively, Courlander is devoting time to the perfection of the methods. He also has great expectations for the 'gateway' that he plans to implement in the near future. This will facilitate the integration of MSC.Software simulation software with the CAD system CATIA Dassault Systèmes. The gateway product is supplied by MSC.Software and has been developed in cooperation with Dassault. At present, the output of the CAD system has to be imported into the simulation environment. This is inefficient and inflexible. As an example, Courlander points to the mesh used to reproduce the car window in the CAD system. It is better to generate this mesh in the CAD environment than in the simulation environment because the CAD system offers further advantages. Simulations are increasingly easy to execute so CAD users can work with the system as well, and the time savings and increased efficiency also constitute significant benefits for Guardian. "With less time being spent on setting up the simulation environment, we can devote more time to our profession," concludes Courlander. "We want to concern ourselves with the glass itself. Glass is our core business. Simulation is just a facilitator – but a very important one."

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