Case Study: **Interseals**

Gasket Manufacturer Delivers Product 16 Weeks Earlier by Reducing Prototype Iterations with Marc FEA Simulations

Overview

The traditional approach for suppliers to the automobile industry has been to build parts according to drawings provided by original equipment manufacturers (OEMs). Today, OEMs are delegating much more of the design responsibility to suppliers. This trend significantly changes the role of suppliers who, instead of competing primarily on quality, price and delivery time, are now often judged based on their ability to develop an innovative design that can meet the OEM's requirements and be produced at a high level of quality and a low cost.

As a leading supplier of gaskets to the automotive industry and other markets, Interseals responded to these trends by increasing the size and capabilities of its engineering team. Yet, in the past, the company still faced difficulties in meeting its customers' requests for innovative and economical designs. Gaskets are difficult to design because rubber components can undergo large deformations under load, sustaining strains of up to 500% in engineering applications. The load-extension behavior of rubber is extremely nonlinear and time and temperature dependent. Previously, when Interseals engineers based their initial designs on experience and handbook formulas, they usually found that the initial prototype did not meet the customer's requirements. Typically, it took two more iterations to get the design right. Each design iteration cost an average of 5,000 Euros in tooling expenses and took between six and eight weeks.

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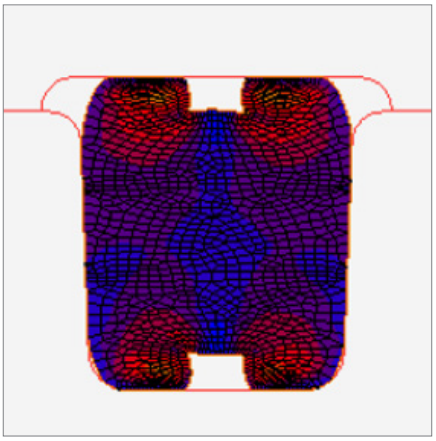
Pierino Izzo, R&D Manager for Interseals

Challenge

Interseals management made the decision to look at simulation software to see if they could find a software package capable of predicting the complex nonlinear behavior, while taking into account time and temperature effects and being able calculate compressible and incompressible material models based on test data. Interseals engineers evaluated the world's three leading nonlinear finite element analysis software packages. They created several test cases based on gaskets which they had developed in the past and for which test results were available. They asked each of the software vendors to simulate the test cases and provide the results. Interseals checked the simulation results against physical measurements and also evaluated the ease of use of each software package and the technical support provided by its developer.



Gasket stress

Solution

Marc provided the most accurate results on the test cases. "Marc provides a strong and reliable nonlinear solution that in its analysis of our test cases demonstrated the ability to accurately simulate the performance of rubber gaskets," said Pierino Izzo, R&D Manager for Interseals. "We also like the speed and ease of use provided by the software's graphical user interface. Additional features that are valuable in our applications are Marc's ability to manage hyperelastic material fitting, the ease of setting up contacts and the ability to perform either 2D or 3D simulation.

In a recent example, Interseals engineers used Mentat and Marc to simulate a gasket for the battery charge electronic control unit (ECU) for a new electric vehicle. The gasket is made of silicone rubber and is designed to seal the aluminum enclosure against water and dirt at temperatures ranging from -40 to +85oC. The first step in the simulation process was to characterize the material. Interseals technicians performed physical testing including tensile and axial tests at different temperatures and thermal expansion tests. Then engineers defined the initial geometry with computer aided design (CAD) software. They created three different cross-sections representing the design intent and the largest and smallest geometry allowed by normal manufacturing tolerances.

Next they exported the cross-section of the seal in order to perform a 2D simulation, which is usually done first because its fast solution times enable engineers to quickly run multiple iterations to improve the design. Engineers imported the geometry into the Mentat pre-processor and created a quadrilateral mesh. They defined hyperelastic material properties and a fixed boundary condition at the lowest-most rigid body. They created contacts between the gaskets and the adjoining rigid bodies. They generated different cases with friction and

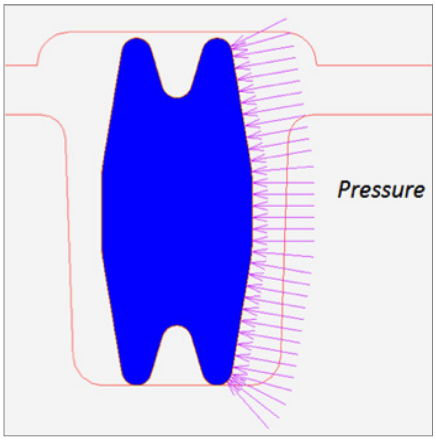
Key Highlights:

Product: Marc

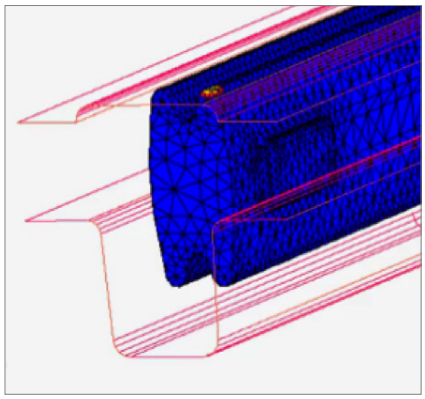
Industry: Automotive Supplier

Benefits:

- Marc has been capable of predicting the complex nonlinear behavior, while taking into account time and temperature effects and calculate compressible and incompressible material models based on test data.
- Using simulation allowed the customer to save an estimated 10,000 Euros in additional tooling costs and made it possible to deliver the gaskets 16 weeks earlier than with the previous design methods



Applied pressure



Gasket loading procedure

frictionless contacts between the gaskets and the rigid bodies. The simulation results showed deformed shape of the gasket after installation, contact pressure and reaction forces of the gasket against the cover.

After about a dozen iterations, Interseals engineers found a design that appeared to work well in 2D simulation. But when engineers performed a 3D simulation it showed that at its largest allowable size a slot in the gasket was too large to fit into a groove in the ECU cover, making it impossible to close the cover after the gasket was installed. Engineers changed the cross-section to reduce the size of the slot and ran another simulation. Over a series of design iterations, the profile was changed to make the groove narrower and deeper. The gasket has retention ribs around its lateral wall that help retain the gasket in its groove and the shape of these ribs were also changed. In iterating the design, engineers considered not only the performance of the gasket design but also the cost of the tooling required to build a particular design. Finally, engineers found a design that met all of the requirements based on the 3D simulation.

Results/Benefits

Interseals engineers shared the simulation results with the customer and the customer gave the go-ahead to build the mold. When the mold was completed, Interseals made a number of prototypes and provided them to the customer. “The customer tested the prototypes and said that they met every requirement,” Izzo said. “Getting the design right the first time saved an estimated 10,000 Euros in additional tooling costs and made it possible to deliver the gaskets 16 weeks earlier than if 2 additional prototype iterations had been required as was normal with our previous design methods.”

About Interseals

Interseals Srl was founded in 1995. The company has over 120 employees and revenues of about 18,000,000 Euros in 2015. The company’s sales are divided between the automotive industry (60%), appliance industry (30%) and medical device industry (10%).

For more information on Marc and for additional Case Studies, please visit **www.mscsoftware.com/marc**

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