

Case study: UNISEAL SOUNSECURE™ Hybrid
Body Panel Reinforcement (BPR) and reduction
of Noise, Vibration and Harshness (NVH)

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TABLE OF CONTENTS

Executive Summary	1
Introduction	2
Process and Solution	3-4
Results.....	5

UNISEAL – a Global Supplier to Automotive OEMs

UNISEAL is a global supplier of specialty adhesives and sealants. UNISEAL products are used in many industries, but the company is particularly active in automotive markets. In addition to pumpable adhesives and sealants, UNISEAL produces extruded and die-cut thermoplastic and thermoset laminates and patches for sound dampening and reinforcement. UNISEAL is known for its development of custom formulations to meet customers' unique specifications. By optimizing formulations to specifically fit customers' product designs and manufacturing processes, UNISEAL helps its customers increase throughput and efficiency, along with improved quality ratings.

Innovative developments in polymeric chemistries mean UNISEAL's research and development labs are sparked by the industry's demand for leaner, lighter and more cost-efficient and environmentally-friendly solutions in a variety of materials, including:

- Hybrid epoxies
- Polyurethane
- Silicone
- Acrylic
- PVC

UNISEAL is owned by Koch Enterprises, Inc. UNISEAL headquarters are located in Evansville, Indiana. Primary manufacturing facilities are located in Evansville, Shanghai (China) and Derby (United Kingdom).

UNISEAL was acquired by Koch Enterprises, Inc. in 1984 and has seen considerable growth since that time. The growth of the company has been through the development of innovative new technologies to assist its customers in improving quality, reducing weight and simplifying manufacturing processes. The automotive industry has been particularly active in these areas as OEMs have sought to reduce weight, improve fuel economy and improve the aesthetics of their respective vehicles.

Frost & Sullivan Award for Product Leadership



UNISEAL was recently awarded the 2014 North American Frost & Sullivan Award for Product Leadership. The award recognizes UNISEAL's ability to develop need-based solutions to suit a wide range of automotive and industrial bonding needs.

Executive Summary

Hybrid NVH/BPR Material Produces Cost/Time Savings

Significant savings in automotive production costs can be achieved through the replacement of traditional NVH/BPR options and application with a single hybrid material that meets OEM specifications for both NVH and BPR.

Designed to Enhance Lightweighting

The responsibility for achieving lower emissions and improved fuel efficiency in vehicles has largely been placed on the ability to make automobiles and trucks lighter. One of the ways this has been achieved is to use lighter metals on body panels. While most automakers have adopted the use of lightweight steel, aluminum alloys and magnesium, they still use hand-applied patches to reduce vibration and hand-applied laminates to provide body panel reinforcement. This is not only expensive and time consuming, but the hand-applied laminate has more strength than the metal in the body panel. This can cause “read through” because the excess strength deforms the metal. This can cause the outline of the laminate to be visible on the outside of the vehicle, creating a cosmetic defect.

Cost Reductions in Four Major Areas

UNISEAL, Inc. has developed SOUNSECURE™ Hybrid NVH Metal Reinforcement which reduces cost in materials, labor, logistics and floor space. SOUNSECURE™ Hybrid NVH Metal Reinforcement is the only material needed to achieve OEM specifications for both NVH and BPR.

SOUNSECURE™ Hybrid NVH Metal Reinforcement reduces material costs by an average of 43% and, because it is robotically applied, reduces labor costs by 100%. Logistics costs and floor space requirements are also reduced by 30% and 57% respectively, when compared to the needs of traditional options to provide specified performance for NVH/BPR.

Proven Solution

SOUNSECURE™ Hybrid is a proven solution. It was first put into OEM production in November 2014 and is now embraced by progressive automakers because of its immediate benefits in both performance and to the bottom line.

Introduction

The push to achieve lower emissions and improved fuel efficiency in automobiles has resulted in higher use of lightweight steel and aluminum alloys in body panels. The net weight reduction offered by the lighter metals has had a positive impact on fuel emissions, but lighter metals mean thinner skins. Thinner skins on body panels present multiple challenges to auto design engineers. They lack rigidity, which makes them vulnerable to denting. The thinner skins are also prone to vibration and noise.

Automakers compensate for rigidity and Noise, Vibration and Harshness (NVH) challenges by applying Body Panel Reinforcements (BPR) and sound damping products to the inside of body panel parts.

Traditional BPR Options

BPR have traditionally consisted of either hand-applied laminates or liquid-applied material (see Figure 1). Hand-applied laminates typically consist of structural polymer teamed with a woven glass fabric. These are self adhesive and, prior to entering the E-coat oven, are applied by hand to the panel inner. Two pounds of hand pressure is then applied over the entire surface area.

Liquid-applied BPR, such as UNISEAL 2010, are typically epoxy adhesives that are applied with a sprayable system. Liquid-applied BPR cure in the E-coat oven.

Traditional NVH Options

Traditional solutions for vibration and noise have been either a hand-applied, rubber-based patch or a liquid-applied material. Patches are self adhesive and are applied by hand to the panel. Hand pressure is then applied over the entire surface area to ensure adhesion.

Liquid-applied NVH solutions, such as UNISEAL's SOUNSECURE™ 2054, are waterborne sealants. They are applied on an E-coat panel and expand in the paint shop oven (120° C).

The Down Side of Traditional BPR and NVH Solutions for Body Panels

While hand-applied options for both BPR and NVH can perform effectively, they are not optimum. Hand-applied options are labor intensive, time intensive and costly. They add weight and there is no guarantee of uniform application

Liquid-applied options are either reinforcing or dampening. *This means it takes two products applied separately to achieve both BPR and NVH performance specifications.*

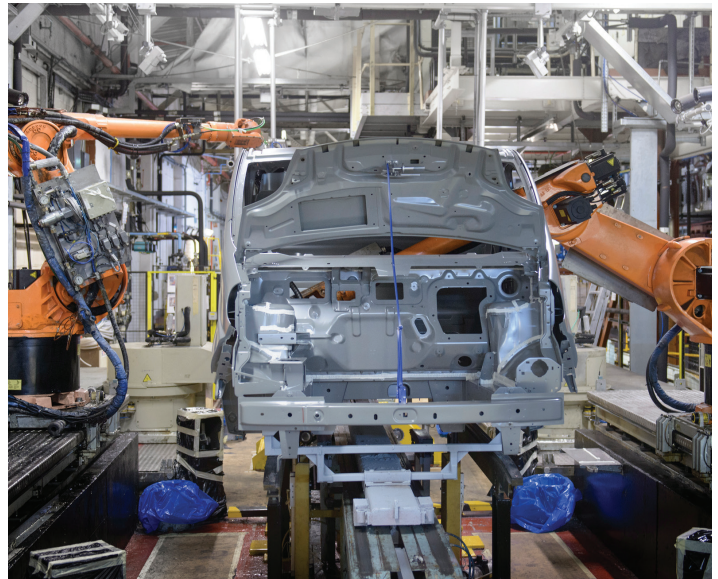


Figure 1: Liquid applied BPR can be applied with a sprayable system.

Process and Solution

Challenges in Developing Ideal Solution

UNISEAL faced multiple challenges in developing a pumpable hybrid single-material, single-application solution that would achieve NVH/BPR requirements.

Seeking Single Solution for Opposing Properties

“NVH and BPR materials are basically thermoset polymers in nature with a highly-crosslinked polymer network,” says Dr. Thanikaivelan Veeraraghavan (Dr. Velan), Vice President Research and Development at UNISEAL.

“They are highly crystalline. To improve sound deadening properties, one needs to increase the amorphous nature in the crosslinked network. Doing this typically results in a reduction of the stiffening (structural) properties.”

“Our ultimate aim is to improve NVH properties in structural BPR without sacrificing stiffening properties. We introduced a reactive toughening mechanism to improve the amorphous medium in structural materials. This allows us to reduce the modulus and still retain the desired mechanical properties.” (Figure 3)

General OEM Specs for NVH and BPR

The OEM standard for NVH products applied to lightweight metals used on most body panels is a minimum composite loss factor of .1 (SAE J 1637). The OEM specification for BPR products applied to today’s lightweight metals on most body panels is a minimum of 50 N flexural strength at peak deflection at 23° C.

Solution Process Starts with Proven Product

UNISEAL approached the process of developing a hybrid material by starting with a proven NVH product: SOUNSECURE™ 2051, a one-component, epoxy-based, high-viscosity, extrudable vibration dampening coating.

SOUNSECURE™ 2051 was chosen as an ideal starting point because it meets all NVH properties criterion for the development of the hybrid material:

- Robotically applied
- Excellent sag and slump resistant
- Excellent acoustical performance
- Excellent wash resistance
- Compatible with Zircobond, regular E-coat and top coat
- Non-corrosive

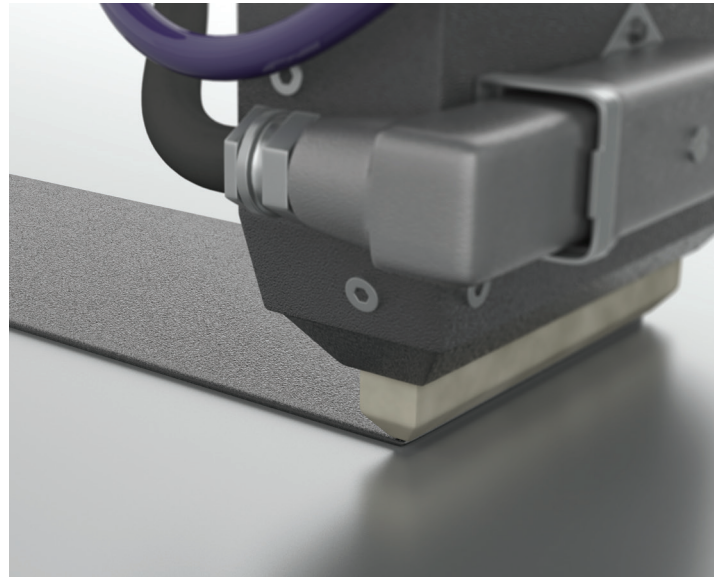


Figure 2: SOUNSECURE™ Hybrid NVH Metal Reinforcement requires the use of a shovel gun system that conditions the material in the hose to 35° C.

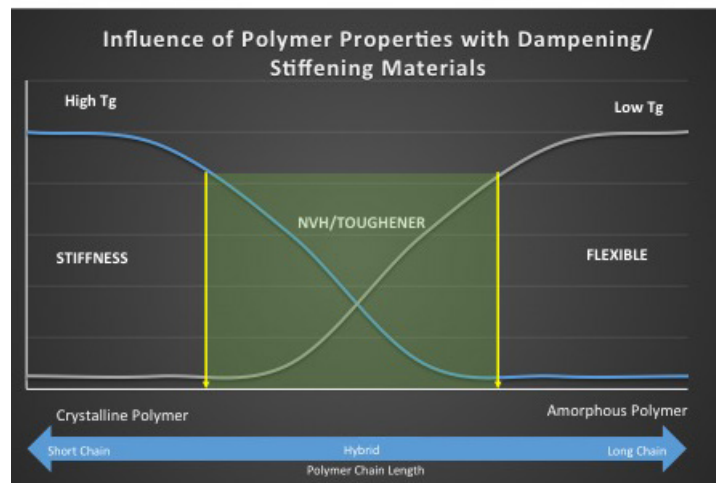


Figure 3

Solution Must Work with Full Range of Lubes

SOUNSECURE™ 2051 also has a proven track record for use on “oily” metal substrates where vibration damping is required, such as door, roof or side panel applications. The new hybrid material would need to be able to “bite” through a variety of lubes, including the very challenging lubes used on aluminum alloys.

“SOUNSECURE™ 2051 offered everything we wanted in terms of NVH, but it had no flexural strength,” says Dr. Velan. “We started experimenting on formulations that would add the necessary strength to our hybrid product.”

Adding Strength Requires Precision

Adding strength required a great deal of precision because of the product’s use with lighter gauge steel and aluminum alloys. It has to meet the minimum specifications established by the automaker, but it cannot be stronger than the metal to which it adheres.

BPR Material Cannot Dominate Metal

“If the hybrid material is stronger than the metal, then it becomes dominant and pulls the metal toward the material,” says Dr. Velan. “This creates ‘read-through’. You can see the outline of the applied material from the outside of the vehicle.”

Dr. Velan estimates it took over two years of development and testing before achieving all NVH and BPR objectives.

This innovative material was commercialized under the name SOUNSECURE™ Hybrid 2017.1 NVH Metal Reinforcement and was incorporated into OEM production in November 2014.

“The unique characteristics of SOUNSECURE™ Hybrid allow designers to tailor metal thickness for specific parts and applications while optimizing BPR and NVH placement and performance,” says Dr. Velan. “SOUNSECURE™ Hybrid is the most diverse and customizable design solution.”

Mechanical Properties:

BAKE CYCLE:	Minimum bake cycle 170° C/20 minutes Maximum bake cycle 205° C/40 minutes
FLEXURAL STRENGTH (N): (1" x 6", 1 mm patch on 1 mm thick AL panel)	50 N (at peak deflection)
COLD SLAM TEST at -40° C: (4" x 4", 1 mm thickness patch on 10" x 10" size AL panel)	10 slams. No crack and no failure in adhesion.
COMPOSITE LOSS FACTOR: (SAE J 1637, 2.4 Kg/m ² , 200 Hz)	0.1

Figure 4

Results

Automotive OEMs Embrace Hybrid Solution to Reduce NVH and Provide BPR

UNISEAL's observation of an unmet need in the automotive industry for a single material that could deliver both NVH and BPR on body panels at OEM specifications has been verified by automakers.

SOUNSECURE™ Hybrid NVH Metal Reinforcement was first put into OEM production in November 2014. By the end of 2015, several automakers were employing it instead of traditional NVH/BPR solutions on automobiles using lightweight metals on body panels.

Collectively, the automakers embracing SOUNSECURE™ Hybrid NVH Metal Reinforcement have averaged: a 43% reduction in materials, 100% labor savings, 30% savings in logistics cost and 57% reduction in floor space.

SOUNSECURE™ Hybrid requires the use of a shovel gun system that conditions the material in the hose to 35° C. The average estimated return on investment for the purchase of the application equipment is less than two years.

Today, SOUNSECURE™ Hybrid is used on the number one volume production vehicle in North America. And development programs are underway with five OEMs on global platforms.

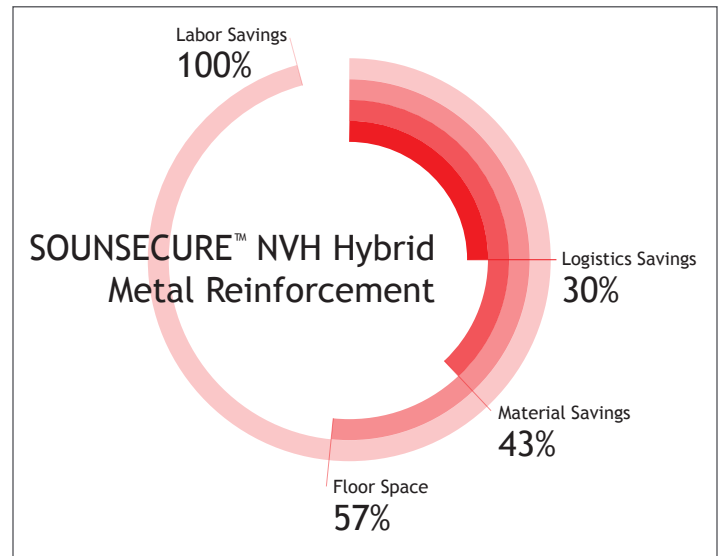


Figure 5



UNISEAL is a global supplier of specialty adhesives and sealants. Our products are custom developed to help you quickly tackle your most difficult challenges.