

# Tackling tough NVH challenges at BorgWarner

BorgWarner leverages expertise with innovative NVH processes and technology to maintain a competitive edge.



Squeeze cost every way you can by using parts with less material, but make sure these lighter and thinner components of a complex vehicle driveline system do not vibrate excessively. Come up with new concepts for less-expensive yet high-performing rotating subassemblies. Then ensure these bright ideas stay within acceptable noise limits. Reduce the number of prototype tests you are running, but accurately predict the sound quality characteristics of your new product early in development. And by the way, cut product development cycle time by half over the next few years.

Such unrelenting pressure might be too much for some automotive suppliers nuts, but it is all in a routine day's work for the NVH group at BorgWarner TorqTransfer Systems. "Dealing with these demanding, yet often conflicting engineering requirements is a business reality," says Sue Stroope, Supervisor of NVH Engineering at BorgWarner. "If you want to be in the game, you have to play by some tough rules. NVH is serious business here. Our specialists have outstanding skills and work very hard. But that is not enough in today's world. We have to leverage that expertise with innovative NVH processes and technology tools to maintain a competitive edge."

### Raising the bar for NVH

As an automotive supplier, BorgWarner faces tough challenges in a competitive market where development time and product costs must be continually reduced, often through the use of lighter materials, such as magnesium. This clearly represents unique challenges for noise and vibration. According to Stroope, these demands are always raising the bar for NVH (Noise, Vibration and Harshness) as a key consideration in development of the BorgWarner transfer cases: the box bolted to the rear of the transmission and filled with planetary gearsets and chain drives for distributing torque to both axles in four-wheel-drive vehicles.

"Transfer cases have lots of rotating components contacting one another under heavy loads, often at high speeds. The aim of the NVH group is to help steer the whole product team in identifying and avoiding sources of excessive noise and vibration in these assemblies, and balancing NVH against other often-

conflicting vehicle attributes such as durability and overall weight," Stroope explains. The demand for new transfer cases has grown significantly in recent years, with continued strong truck sales and increased popularity of SUVs and all-wheel-drive passenger cars. BorgWarner supplies these products to major OEMs, such as Ford, GM, Honda, Mercedes, Isuzu, and Hyundai.

"The way the supply chain works today, we have to bid on every new vehicle model," says Stroope. "The quoting process is extremely intense, and NVH requirements are stringent. We have to get the design right, without any problems with gearset or chain noise when vehicles are tested. At that late stage, big design changes are too expensive and time-consuming. We absolutely must refine and optimize the design early in development, before the product is built."

### Reducing reliance on prototype testing

Stroope explains that the OEMs set targets for overall vehicle performance characteristics, which the automaker then cascades down to important parameters needed in the design of the transfer case. "The OEM gives us vehicle mounting locations, driveshaft position, and performance features they want in terms of speed and torque ranges," Stroope says. "They also specify packaging requirements to avoid interference with adjacent components under the vehicle such as the catalytic converter, transmission, heat shields, driveshafts and fuel lines."

This information is provided to BorgWarner in the initial bidding process and defines design parameters for the transfer case early in the process. In turn, BorgWarner is similarly cascading



transfer case performance targets down to its own component suppliers. Stroope notes that the NVH group uses a combination of testing and simulation tools in effectively meeting these tough NVH-related engineering challenges.

In working with design concepts early in development, BorgWarner uses LMS Sysnoise to simulate the performance of new transfer cases and predict their resulting sound signatures. “We rely on up-front simulation more heavily to catch and fix any NVH problems early in development,” says Stroope, who notes that designs are more easily optimized and refined in the initial stages of development, compared to troubleshooting problems in prototype testing and then changing the design. The aim is to reduce reliance on prototype tests because of the time and expense of changing transfer case castings and reworking dies, which can take months to complete and cost thousands of dollars.

“The goal is to use simulation in studying NVH characteristics early in development to avoid big problems later,” explains Stroope. “In this way, the NVH group works side by side with design in

guiding the development of a qualitative, economical product delivered on time.”

### Final product roll-out

When parts become available, Stroope says physical testing and analysis to accurately measure NVH characteristics in the test lab, especially on the component level, are important tools in helping verify the design and avoiding unexpected trouble on full-vehicle prototypes right before a product launch.

“We often vary the type of parts in existing transfer cases to see if a modified gear, fewer pinions, or a low-weight sprocket, for example, improves or degrades the noise level,” she notes. “Occasionally we find that parts may be unnecessarily over-designed. Conversely, ideas that may look good to save material end up producing too much vibration.”

For this experimental work, Stroope’s group relies on the LMS CADA-X multichannel acoustic and vibration testing and analysis system. Test stands in the NVH lab allow BorgWarner technicians to replicate the operating environment the transfer case will

experience in an actual vehicle, whether it is a truck pulling out a stump or passenger car plodding through snow.

The TorqTransfer System NVH lab is part of BorgWarner’s new Powertrain Technical Center that consolidates design and testing operations for the various components of the company in the Detroit area. By locating the various groups in a single facility, the company plans to leverage technology in individual departments across the entire company, allowing all groups to benefit from the synergy of collaboration, instead of each operating separately.

Future plans for the NVH group call for even greater emphasis on up-front simulation to refine designs early, which then changes the need for physical testing to “confirmation” instead of “development.”

“NVH is a critical factor throughout product development, from concept all the way to final product roll-out,” explains Stroope. “In this entire process, LMS technology is an indispensable tool in helping us leverage our expertise to meet our targets.” ■



#### **LMS INTERNATIONAL**

Researchpark Z1, Interleuvenlaan 68  
B-3001 Leuven [Belgium]  
T +32 16 384 200 | F +32 16 384 350  
info@lmsintl.com | www.lmsintl.com

#### **Worldwide**

For the address of your local representative, please  
visit [www.lmsintl.com/lmsworldwide](http://www.lmsintl.com/lmsworldwide)

LMS is an engineering innovation partner for companies in the automotive, aerospace and other advanced manufacturing industries. LMS enables its customers to get better products faster to market, and to turn superior process efficiency to their strategic competitive advantage. LMS offers a unique combination of virtual simulation software, testing systems and engineering services.

LMS is focused on the mission critical performance attributes in key manufacturing industries, including structural integrity, system dynamics, handling, safety, reliability, comfort and sound quality. Through our technology, people and over 25 years of experience, LMS has become the partner of choice for most of the leading discrete manufacturing companies worldwide.

LMS is certified to ISO9001:2000 quality standards and operates through a network of subsidiaries and representatives in key locations around the world.

