CASE STUDY

Magna Donnelly Corporation
Impact Testing of Mirrors using PULSE

United States of America

Automotive

PULSE, Transducers, Impact Hammers

Magna Donnelly Corporation is a technology driven, customer-focused automotive supplier known for offering the most advanced technologies for automotive mirror systems, window systems and electronically sophisticated sensor systems to customers throughout the world.

Automotive designers are finding that mirrors offer a valuable opportunity to include additional safety and convenience features such as telemetrics, compass, lights, etc., using highly advanced technology. Magna Donnelly has purchased a complete PULSE™ system to test its products.

History

Magna Donnelly Corporation was founded in 1905 and originally manufactured furniture and vanity mirrors. Early in its history there was a shift towards the automotive industry and today this is the company's core market.

With its headquarters at Holland, Michigan, Magna Donnelly has more than 8000 employees in a total of 16 countries in North America, Europe and Asia.

Magna Donnelly is a division of Magna International, which acquired Donnelly Corporation in October 2002.

Automotive Mirrors

Fig. 1
An example of a Magna Donnelly rear view mirror using advanced technology

With strategically placed production facilities, Magna Donnelly Corporation is a world market leader in the design and manufacture of automotive mirror systems and electronically sophisticated sensor systems for the worlds major automotive manufacturers.

There are two or three mirrors added to every car and truck built in the world and they are an integral part of the driving experience, and essential to driving safely in today's high density traffic conditions. Additionally, automotive designers are finding that mirrors offer a valuable opportunity to include additional safety and convenience features such as telematics, compass, lights, etc., using highly advanced technology.

Although Magna Donnelly produces much more than rear view mirrors today, these and other products used for automotive rear vision still account for the single largest part of Magna Donnelly's business. From the simplest day/night prism mirror to sophisticated camera vision systems, Magna Donnelly is the world leader in providing rear vision systems to the global automotive market.

Advanced Technology

Magna Donnelly uses state-of-the-art technologies in all phases of its manufacturing process:

- fabrication of bent, prism, coated and finished glass
- production of precision mirror housings using injection moulded plastics technologies
- painting – automotive manufacturers demand an exact match to the vehicle paint colour

Reducing Glare

One of the fastest growing products in Magna Donnelly's range is the family of electrochromic (EC) mirrors that dim automatically. EC mirrors use advanced sensing technologies to detect headlight glare from trailing vehicles and then use an electric/chemical process to dim the mirror automatically. As the mirror dims, it reduces or eliminates the rear-view headlight glare that is so troubling when driving at night.

Magna Donnelly has also developed a number of other mirror features designed to provide safer and more comfortable driving. These include map lighting and compass and temperature displays on inside mirrors. External mirrors include such features as warning a driver in a blind-spot that you are about to change lanes, ground illumination lighting that brightens the area around a car on a dark night, and mirrors that can be folded with a touch of a switch.

Telematics

In 1999, Magna Donnelly was asked by General Motors to build interior that contain advanced electronics to support GM's OnStar® consumer telecommunications system. With OnStar®, using satellite technology, the traditional handset becomes redundant and, for example, the exact position of the vehicle is known at all times and the system even automatically summons road-side assistance if an airbag is activated. OnStar® is

a great example of how automotive manufacturers are using mirrors as a convenient location for electronic equipment. Magna Donnelly is also working on the concept of using electronics that could make currently available mirrors obsolete.

Fig. 2
General Motors' OnStar® system uses satellite communications and state-of-the art electronics

Camera vision systems on cars and light trucks will eliminate blind spots and will enable automotive designers to avoid bulky exterior mirror housings on vehicles.

In addition to rear-view vision systems, Magna Donnelly also manufactures other automotive components including door handles, keyless entry systems, trunk-release systems, and many more.

NVH Testing

Fig. 3
Mark Brummel is a Product Development Engineer in Magna Donnelly's Rear Vision Systems Product Development group

Mark Brummel and Andrew Weller are Product Development Engineers for inside mirrors in Magna Donnelly's Rear Vision Systems Product Development group.

Mark has a degree in mechanical engineering from Kettering University, Detroit. He has worked at Magna Donnelly for nearly two years. Andrew has a degree in mechanical engineering Michigan Technological University where he specialised in sound and vibration. He has also worked at Magna Donnelly for about two years. Andrew says, "My job is real fun – I get to use the latest equipment and we work on very advanced projects".

PULSE

Fig. 4
Andrew Weller, a Product Development Engineer for inside mirrors, works with PULSE

Magna Donnelly has purchased a Brüel & Kjær 4-channel PULSE Multi-analyzer system, together with accelerometers, impact hammer, shaker, etc., to perform various tests on its products.

Mark explains, "We decided to buy PULSE for a number of reasons. These included Brüel & Kjær's excellent reputation in the field of sound and vibration and both Andrew and I had used Brüel & Kjær equipment during our studies".

Mark adds, "Also, it's very portable and we can make in-car tests on a test track and then post-process the data when we get back to the office. If, in the future, our testing

demands grow, then PULSE can be easily expanded to provide more functionality, and this was another key reason for selecting it".

Testing

Andrew explains, "We use our PULSE system for a wide variety of NVH analyses".

Here are some examples:

- Verification of predictive modal analysis – PULSE is used to verify the modal parameters in the computer model
- In the test lab – using a small anechoic chamber, the buzz, squeak and rattle of products is tested using a shaker energised with a swept sine wave
- Non destructive testing – a mirror can be mounted in a test position and using an impact hammer and one accelerometer, the natural resonance of the mirror can be determined.
- Test-track – a vehicle can be driven under a wide variety of operating conditions. The NVH characteristics of Magna Donnelly products can be fully analysed.

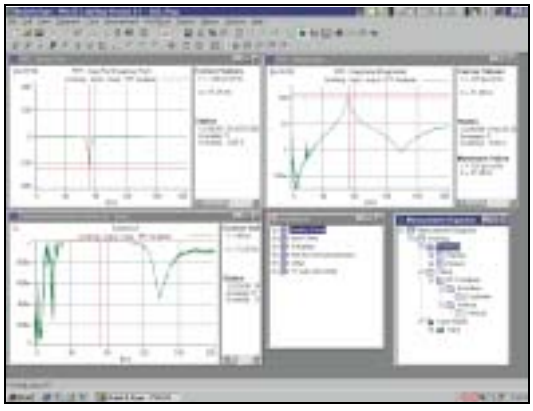

Fig. 5
A mirror is tested using PULSE, an impact hammer and an accelerometer. The display shows that the resonant frequency of the mirror is 71.25 Hz

Mark continues, "The natural resonance frequencies of a vehicle while the engine is idling are in the range of 15 to 30 Hz. Our goal is for our mirrors to have a resonant frequency around 70 Hz. Testing of prototype during the development stage enables us to modify the design, or apply damping material in the right place, or both. Generally, an automotive manufacturer will set the basic specification of an inside mirror. This includes the overall size, field of view, and other required features.

We then make a predictive modal analysis of the design to ensure that it won't resonate at the wrong frequency. When the prototype is built, we use PULSE to verify our predictions".

Magna Donnelly has full ISO 9000 accreditation.

Safety

"There are very stringent automotive safety standards in the USA and the rest of the world", says Andrew. He adds, "For instance, if an airbag deploys in an accident, then it will detach the mirror to avoid risk of head-impact injury to the driver and passengers, so this is an area that we must test very thoroughly".

Data and Reporting

The laptop PC used with PULSE runs on Windows NT®. Test data is archived on CD-ROM. Reports are made using the Microsoft® Office suite. The reports are placed on a database enabling R&D, production departments, etc., all over the world to access the test results. Data from a previous test is often accessed for a comparison with a new test.

Mark says, “One of things that I especially like about PULSE is the data export facility to Word and Excel. It’s easy, quick and effective. If a customer asks us for a report with a specific curve, we can make it immediately”.

Andrew concludes, “We get excellent service and support from Brüel & Kjær’s local office in Livonia, Detroit and their training courses were just great. We are very pleased with our decision to buy PULSE. It always does exactly what we expect and it’s been totally reliable and it’s easy to use”.

Key Facts

- Magna Donnelly Corporation, was founded in 1905 – early in its history there was a shift towards the automotive industry and today this is the company’s core market
- Magna Donnelly has more than 8 000 employees in a total of 16 countries in North America, Europe and Asia
- Magna Donnelly is a division of Magna International, which acquired Donnelly Corporation in October 2002
- Magna Donnelly Corporation is a technology driven, customer-focused automotive supplier known for offering the most advanced technologies for automotive mirror systems, window systems and electronically sophisticated sensor systems
- Automotive designers are finding that mirrors offer a valuable opportunity to include additional safety and convenience features
- Magna Donnelly’s customers include the world’s major automotive manufacturers
- Highly advanced technologies are used in the production of Magna Donnelly’s products
- Magna Donnelly is a leader in the development of telematics
- Magna Donnelly also manufactures a wide range of other automotive components including door handles, keyless entry systems, trunk-release systems, etc.
- Magna Donnelly has purchased a 4-channel PULSE system together with transducers, shaker, impact hammers
- Key factors in the decision to buy PULSE included its portability, future expendability, and Brüel & Kjær’s reputation in the fields of sound and vibration
- “One of things that I especially like about PULSE is the data export facility to Word and Excel. It’s easy, quick and effective”
- Magna Donnelly gets excellent service and support from Brüel & Kjær’s local office in Livonia, Detroit
- “We are very pleased with our decision to buy PULSE. It always does exactly what we expect and it’s been totally reliable and it’s easy to use”

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