The Electric Evolution

CTI Symposium Presents Latest Automotive Transmission Developments and Applications

Matthew Jaster, Senior Editor

The challenges remain the same regarding the electrification of the automotive industry. A majority of the CTI Symposium USA event in Novi, Michigan focused on areas like battery life, battery range, cost issues, buyer needs, buyer incentives and charging stations. The focus in 2019 appears to be on bringing competitors and product families together in order to provide a connected eco-system for electrification.

While the industry continues to plan and prepare for major changes regarding e-mobility, ride-sharing, autonomous vehicles, electric commercial bus and freight fleets and the future of the transmission itself, the audience of this very magazine (the suppliers) will be thrilled to learn that almost every panel expert or market analyst at CTI shared a similar, unified voice regarding component suppliers. The word in question: Opportunity.

"The integration that is occurring in the automotive segment will create many new opportunities for suppliers," said Mayank Agochiya, managing director at FEV Consulting, Inc., USA. "These will include sensor integration, software packages and mobility as a service."

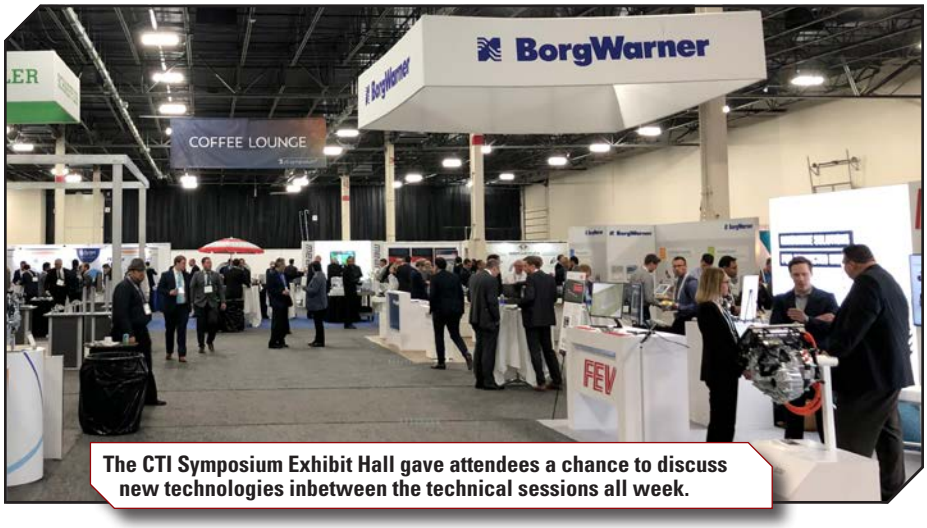
In the coming years, the automotive industry also will rely heavily on new product developments and technologies in areas like bearings, drives, motors, pumps, clutches, brakes, etc. Here's what we learned during the symposium:

NVH in Electric Drive Units

Thomas Wellerman, department manager, transmission and driveline systems at FEV, Inc., examined NVH issues in electric drive units during a presentation at CTI.

Wellerman said that with powertrain electrification as one of the megatrends in the automotive industry, corresponding market forecasts expect significant increase of shares of electrified powertrains. Pure electric vehicles (EV) and hybrid electric vehicles (HEV) are the most popular types of vehicles utilizing electrified powertrains. For achieving CO_2 fleet targets for passenger vehicles, high growth rates for both EV and HEV are expected, resulting in a strong demand for electric drive units (EDUs).

"The transition from combustion engines towards electric propulsion systems is accompanied by a reduction in vehicle exterior and interior noise levels, in particular during low vehicle speed operation. Without masking effects, objectionable sound content from EDUs in the vehicle interior can become crucial for customer acceptance. Further, electric drive units usually have a very tonal and high frequency content, which often result in an unpleasant sound quality. Therefore, it is important to include NVH considerations throughout the entire EDU development phase," Wellerman said.



The CTI Symposium Exhibit Hall gave attendees a chance to discuss new technologies inbetween the technical sessions all week.

An important aspect of electric vehicle development is the change in the vehicle's interior noise behavior. Noise components in the internal combustion engine such as combustion noise, induction and exhaust are no longer present. While these noise levels are reduced, wind and road induced noise become the main contributors to electric vehicle interior noise levels. The noise contribution of an electric drive unit is much lower from a sound pressure level perspective, and has a different noise and frequency content compared to the noise of an internal combustion engine. The tonal noise and high frequency noise character of an EDU is related to both the gear train and the electric motor. This is often subjectively rated as annoying which reduces vehicle pleasantness and ultimately impacts customer satisfaction.

To refine the electric vehicle interior noise level and character, continuous NVH support is needed during the development of the EDU system and its vehicle integration throughout the development process. This includes optimization of the overall EDU system, its individual subcomponents such as the gear drive, electric motor, inverter, and EDU mounting, and their corresponding noise transfer paths into the vehicle. The following areas need to be addressed during the NVH development process for an EDU: Gear train geometry, dynamic gear forces related to EDU drivetrain torsionals, electromagnetic excitation at the rotor/stator interface, stator stiffness, EDU housing stiffness, and power electronics (inverter).

(*www.fev.com*)

A roundtable discussion on electrification took place during the CTI Symposium USA 2019.

From Industrial to Automotive Applications

A prime example of taking knowledge from one industry and transferring that knowledge to another occurred in the case of Marzocchi Pompe S.P.A. The Italian company produced a gear pump specifically for automotive applications based on their expertise in the industrial segment.

North American Product Engineer, Dr. Andrea Rimondi, spoke about how company used its knowledge and engineering expertise from industrial pumps to build one from the ground up for high-volume automotive applications.

"Today, Marzocchi Pompe supplies the automotive market not only with pumps, but also integrated solutions, complete with motor and manifold with valves, actuator systems, and complete power units with reservoir," Rimondi said. "On one side, a range of products with very high performances and on the other side an enviable product know how that allows our engineers to develop new products in smaller sizes, at reliable and affordable cost as well as micro systems integrated into the gear pump."

Marzocchi Pompe consolidated the production of pumps for the automotive industry in a new plant built in 2016 in Zola Predosa, Bologna. It is divided into two divisions: one takes care of the manufacturing of all the gears for the entire Marzocchi's pump and motor range; the other takes care of the assembly and testing of pumps for automotive applications, on specifically designed lines.

These gear pumps have been specifically designed in order to be integrated into assemblies of automatic transmissions, semi-automatic clutches, electro-hydraulics power steering, AWD systems, assistance in hybrid-type of propulsion, etc. (*www.marzocchipompe.com*)

Deep Groove Ball Bearings for EV Motor Support

Motors used in hybrid electric vehicles (HEV), electric vehicles (EV), and similar drives are required to be small and have high-output. The downsizing of the motor brings demands for higher motor speeds to maintain power output. This in turn requires higher bearing performance. Standard steel and polymer cage designs have limiting speeds below what is needed for the faster drives.

Standard steel and polymer cage designs ring have limiting speeds below what is expected to become common for the electric motors driving vehicles of the future. A presentation by Mike Johns, consultant, advanced engineering, at JTEKT, reviewed the development of a two piece symmetrical dual support cage which increases the limiting speed to about 2 million dmn bearing pitch diameter (mm) x rotational speed (rpm) without the aid of more expensive bearing features like ceramic balls.

When using a steel cage, the contact between the ball and cage pocket intensifies with high shaft speeds due to the eccentric motion of the cage and marginal lubrication at the points of contact between each ball and its cage pocket. This can lead to seizure between the balls and cage.

The more standard crown type polymer cage has pocket claws. These asymmetrical claws deform unevenly when subject to high speed centrifugal loads. A more rigid reinforced crown type cage has excellent high speed performance, but also deforms unevenly at high speeds potentially compromising the ball cage contact. These two types of single piece cages generate more heat at higher speeds and are more prone to lubrication failure and seizure.

It was confirmed during the analysis that the developed cage has a high speed performance over 1.3 times that of existing cages (standard and highly rigid cage). Even after heat shock and durability tests, it was confirmed that the developed cage was free of abnormalities and displayed satisfactory durability. In line with the future growth of the HEV and EV markets, it is predicted that motors will have increasingly higher speeds. It is expected that specialized features like this dual support two piece cage will become more common as the electric motor supports the bearings. (*jtekt-na.com*)

Electric Opportunity

In summary, the panel discussions and Q&A sessions during CTI Symposium USA covered everything from sensors and simulation software to hybrid vehicle analysis and the electrification of trucks here in the United States. Experts debated these subjects as they attempted to look into the crystal ball and determine what the automotive industry will really look like 20 years down the road.

For component suppliers, the opportunity is going to be there no matter how the electrification of the industry pans out. Mechatronic systems, component upgrades and more powerful software tools will play a vital role in the coming years in automotive applications in all formats, ICE, EVs, BEVS, hybrids and more. Working closely with your partners and suppliers today will no doubt benefit product innovation and advancement in the future (win-win no matter what the inside of an automotive vehicle looks like).

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