

GKN Driveline

Romax consulting and software support GKN Driveline to design low-noise high-efficiency eDrive gearboxes



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Theo Gassmann,
Vice President Advanced Engineering
GKN Driveline

The evolution of electric vehicles (EVs) and hybrid electric vehicles (HEVs) is having a significant impact on automotive engineering, particularly transmission and driveline design. The world's leading manufacturer of automotive driveline components, GKN Driveline has applied Romax software and consulting to focus the optimization of gearbox efficiency in electric motor-driven transmission without accepting trade-offs in noise and durability.

After identifying the main contributors to power loss, investigating how changes to macro- and micro-geometry would affect efficiency, and optimizing the geared system in RomaxDESIGNER, GKN Driveline manufactured the resulting gears and evaluated experimentally the driveline efficiency. Results showed improvements across the speed and torque range of interest of up to 2% without compromising on durability and N&V. This provided valuable insights into how GKN Driveline continuously initiates performance improvements in its customer applications.

Client

The world's leading manufacturer of automotive driveline components: 24,000 employees at 45 manufacturing facilities and three product development centers in 22 countries.

Challenge

Develop more powerful and efficient transmissions for greener electric-driven vehicles, capitalize on new market opportunities without trade-offs in durability and noise and vibration (N&V).

Solution

Approx. 10-year (Japan since 2004 and Europe since 2010) relationship with Romax, using RomaxDESIGNER software and consulting expertise for advanced modeling, simulation and analysis of geared systems.

Benefits

One of the best-in-class 'whole system' approaches for faster and more effective right-first-time design of low-noise gearboxes for hybrids and EVs; tests showed a 2% gain in overall gearbox efficiency without compromising on durability or N&V.

Hybrids and EVs: a market opportunity

GKN Driveline develops the latest driveshaft and geared component technologies. "During first hype of electrification four to five years ago, everyone talked about quick introduction of Battery-Electric Vehicles," says Theo Gassmann, Vice President Advanced Engineering. "The reality was that the technology wasn't ready - for instance, battery technology is too expensive - and customers aren't ready, particularly regarding range limitations. So the EV market experienced a slow start." He says this led companies to change strategy, embracing a hybrid approach to develop the marketplace.

"GKN Driveline, as market leader in driveline technology, is growing fast in conventional and electrified driveline systems. Coming from AWD systems we successfully launched transmissions for Hybrid and Electric vehicles in the last years. Transmission has not been our core business, but we utilized our driveline expertise and technologies to expand our portfolio successfully." Gassmann says transmission issues for EV and HEV are broadly similar to non-electric applications: "Powertrain efficiency, durability and N&V. Differences come regarding the duty cycle and loads, between coast and drive. The driveline is different. And when you have to invest in battery capacity, you don't want to waste energy in the transmission. The biggest challenge is arguably N&V. Missing masking noise from combustion engine and lightweight-design leads to an early focus on NVH improvements."

Why Romax?

Conventional methods to increase transmission efficiency can have adverse effects on durability and quiet running; lack of engine noise in EVs renders current design practices unacceptable. In addition, the pressure to improve efficiency of the eDrive gearbox in GKN Driveline's all-wheel drive hybrids required a new approach. "We've worked with Romax for several years, in a step-by-step process that started in Japan then moved into Germany and Sweden," says Dr. Artur Grunwald, Supervisor, Advanced Geared Systems Calculations. "We saw the value of analyzing the whole system, to identify where the greatest benefits could be gained, then working to balance efficiency, durability and N&V across the entire system. RomaxDESIGNER provided the accuracy in modeling and analysis, and we worked with Romax people on a project and consulting basis to learn how to best use the software and apply our engineering expertise.

"We use RomaxDESIGNER for problem solving and for system optimization from concept to production design. Perfect components don't always equal a perfect system when combined. That's why we use RomaxDESIGNER: it shows where you can have the most impact and where the benefits lie. It's one of the few software systems capable of this type of system analysis. Our goal is, systematically, to separate the useful parameters from the possible in order to enable the biggest benefit at acceptable cost level."

Taking a 'whole system approach' to optimize design

Romax abilities to improve efficiency were tested in a project that saw an eDrive gearbox connecting an electric drive to the rear axle of a PSA Peugeot Citroen passenger car, with a conventional IC drive connected to the front wheels. The original gearbox was analyzed using RomaxDESIGNER, which explored potential improvements through changes to gear geometries, comparing predicted N&V and durability with the original design. GKN Driveline manufactured a redesigned set of gears, with extensive tests confirming overall efficiency improvements and, in the all-important coast condition that determines energy recuperation performance, a 1-2% gain across the speed and torque range required. "The efficiency of the gearbox was assessed by calculation of the component losses from gears, bearings, seals and oil churning," Dr. Grunwald says. "Efficiency results from the simulation are compared against frictional torque measurements taken during testing under a range of torque and speeds. The methodology used allows advanced parametric studies to be carried out in an all-in-one approach with RomaxDESIGNER to consider the effect of a wide range of design changes on efficiency at the same time as durability and NVH performance."

He adds, "We also have several years' experience of working with Romax people, who have been extremely reliable and professional. We clearly benefit from that valuable experience. As a business, we want to develop a common understanding of simulation issues, and use consistent methodologies from concept to production. Our requirement to take a whole-system approach will increase with future projects and applications, and across different regions and product ranges. The way RomaxDESIGNER integrates with other software packages also saves us time. Its ability to provide interfaces and to share results for interpretation by our engineers is another reason we use it internationally."

Theo Gassmann adds, "We're moving into a new era of hybrids and electric cars. Genuinely high-performance products demand the effective application of system know-how from concept to production, so you can find the best possible balance. To meet increasing customer expectation and faster development cycles, GKN Driveline has to get 'right first time' to the required product performance, and Romax helps us achieve that - so we can continually improve our methodologies and products for our customers."

Since the time of writing this case study, the Romax product offering has evolved. The features and benefits described here most clearly map onto our new products Romax Energy, Romax Enduro and Romax Spectrum.





Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications.

Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Romax, part of Hexagon's Manufacturing Intelligence division, provides world-leading solutions for the design, analysis, testing and manufacture of gearboxes, drivetrains and bearings. Learn more at romaxtech.com. Hexagon's Manufacturing Intelligence division provides solutions that utilise data from design and engineering, production and metrology to make manufacturing smarter.

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