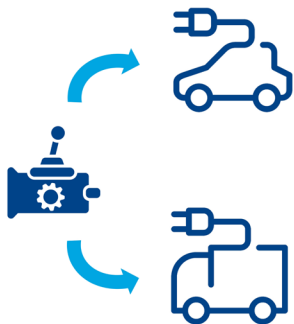


FRICTION INSERTS CASE STUDY

ENABLING MODULAR TWO-SPEED EV TRANSMISSION THROUGH LIGHTWEIGHT DESIGN



- Enable reliable, stable two-speed gearbox usable in both e-passenger cars and e-trucks up to 7.5t
- Secure high torque transmission
- Reduce the weight of gearbox by more than 13%
- Favor same part strategy

The customer is an Austrian tier supplier specialized in the production of electric systems for electric cars with a specific focus on lightweight design.

The customer needed to develop an innovative and exclusive two-speed e-gearbox with modularization potential. The modular gearbox should be usable for e-passenger cars as well as electrified utility vehicles up to 3.5 tons and light transportation vehicles up to 7.5 tons.

CONTEXT AND CHALLENGES

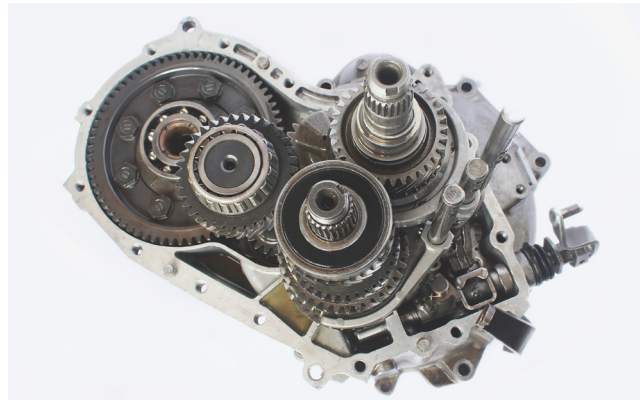
E-cars are not only urban cars anymore and energy efficient, long-range highway cruising must be possible. In regards to transportation, local requirements tend to ban traditional combustion trucks from the city centers, raising the need for powerful electric small and medium-sized trucks.

A two-speed e-gearbox helps get more range out of the battery while also delivering more performance for acceleration and high load pulling. But this system is complex because of high torque requirements, heavy loads on engaged components and reliability challenges.

CUSTOMER NEEDS

Input data of the project

- High performance helical gearing
- Differential integrated
- Parking lock integrated (optional)
- Oil-Reservoir integrated (optional)
- Aluminum housing
- Torque transmission to the gearbox: **900 Nm**
- Max. RPM: **12,000 rpm**
- Second gear to increase Vmax from 80 to **130 km/h**
- Initial weight of the gearbox: **67kg**



Challenge

With a weight of 67kg, the first 2-speed e-gearbox prototype was too heavy and also too large. Lightweighting and downsizing of the whole system was needed to optimize the battery pack, without compromising the structural strength with the same load spectrum.



SOLUTION

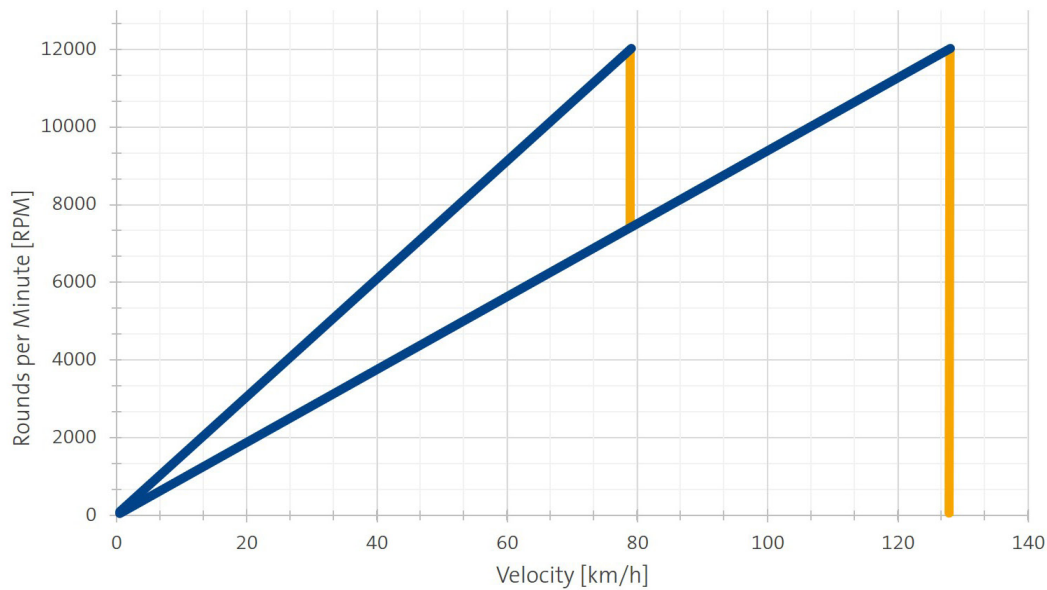
Friction Inserts were used as a design element of a new prototype together with the redesign of some components.

Application areas:

1. Applying Friction Inserts in the areas of the housing bolts enabled a reduction of bolts and allowed for a thinner aluminum housing.
2. Application of Friction Inserts in the flange connection between the e-engine and gearbox helped transmit higher torque without parts slipping. As a result, a smaller flange could be used and the size of the bolts could be reduced.
3. Friction Inserts applied in connections between the mounts and the chassis led to optimized power flow via the friction-locked connections.

MEASUREMENTS

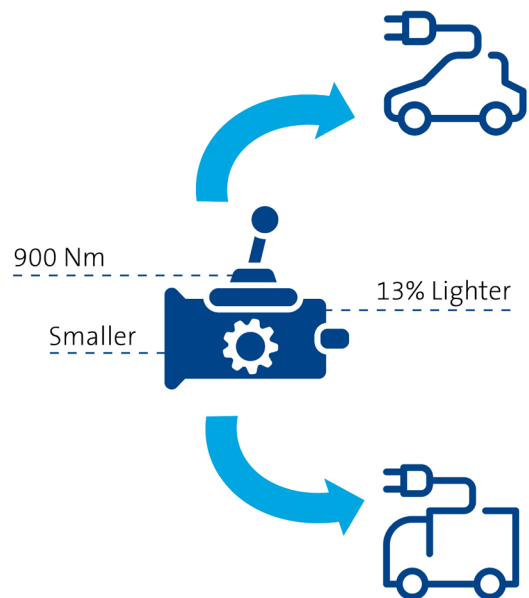
Transmission shift with the new gearbox prototype designed incorporating Friction Inserts



OUTCOME AND BENEFITS

The proof of concept was validated as part of a field test.

- Reliable modular two-speed e-transmission usable in electric cars / commercial e-vehicles up to 3.5t / e-trucks **up to 7.5t**
- Total weight of the gearbox reduced **from 67 kg to 58 kg** when fully equipped, thanks to reduced number of bolts and reduced material thickness
- Optimization of the dimensions of the unit thanks to **smaller flange and smaller bolts**
- Required 900Nm torque transmission between the engine and the gearbox kept even with smaller components
- **Same part strategy** and engineering cost savings enabled by the modular system



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