



FEV SPECTRUM



Fig. 1: 7H-AMT developed by FEV

Transmission Design and CAE

In close cooperation with our customers and suppliers, FEV develops and optimizes complete powertrain units. In such projects, the focus is on the complete process from the initial concept through development and ending with implementation for SOP. FEV presents a broad field of capabilities including transmission engineering services and the complete design and development process.

FEV, with its extensive knowledge of development, quality and cost-oriented engineering, is the ideal partner for a successful close cooperation project that includes a variety of transmissions and special applications (e.g. MT, DCT, AMT, AT and hybrid solutions). FEV offers complete solutions, beginning with a detailed concept phase featuring early involvement of the relevant transmission experts. The solution continues with modern CAE-supported approaches for optimization of driveline dynamics, stresses and acoustics and is finalized with a detailed design, including complete machining drawings considering all process relevant aspects.

The 3D design employs all of the important CAD systems and the support of an extensive risk analysis (FMEA), as well as all relevant benchmarking data. The detailed investigation of major components, such as gears, shafts, synchronizers, housings and the shift mechanism, using various modern CAE tools, is a significant step toward bringing a new transmission closer to production. These investigations begin with a kinematic gear set layout that includes detailed geometry and safety calculations and continues with Finite Element Analysis (FEA) as well as dynamic simulation tools to calculate stresses, deflections as well as resultant forces for the structural investigation and optimization of housings.

FEV's transmission development support also includes the benchmarking of new transmissions and

hybrid powertrains, featuring reporting and troubleshooting during the development process and after SOP. FEV employees can also leverage their long-term experience to support FEV's customers by monitoring their system suppliers.

Continuously increasing comfort level requirements also drive an increased importance for transmission NVH in vehicles. Potential issues in the shaft and gear design are calculated and optimized in the first design loop with a combination of FEA and MBS (multi body system) models. Transmission housing NVH optimization is standard in any development program. These measures help to achieve high acoustic transmission quality in the first prototype, which dramatically reduces the experimental NVH effort in the subsequent development process.

The transmission design and CAE process includes:

- Concept and detailed design in 3D CAD
- Generating specific production drawings
- MBA and FEA of:
 - Gear teeth (profile and micro geometry layout)
 - Complete gear set, shifting parts and synchronization
 - Strength of shafts, housing and shift mechanism
 - Dynamic vibration analysis of the complete system
- CAE optimization loops
- Risk analysis (FMEA)
- Comprehensive tolerance analysis
- NVH optimization of transmission components and the complete driveline system
- Procurement of prototype parts
- Benchmarking and reporting in the context of FEV scatterbands
- Accompanying documentation