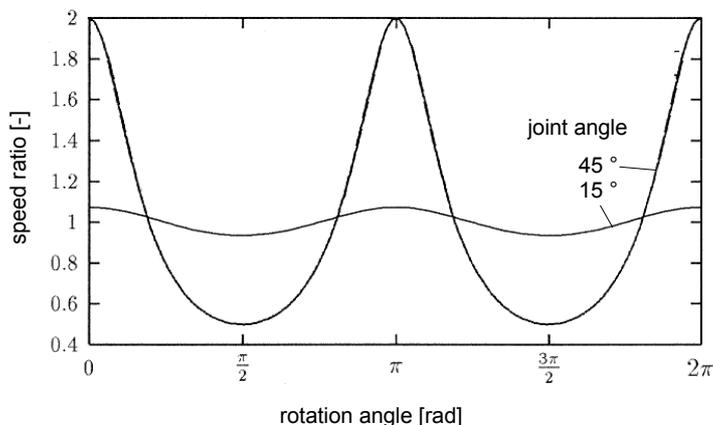


Transmission-Rattle Test Rigs

The excitation of rattle noise arises by torsional vibrations of combustion engines. In particular, the second order of a four-cylinder engine is critical. If the loose parts in transmissions reach their limits, it comes to shock reactions at the contact points and a broadband, rattle noise is generated. Depending on shifted gear and on load situation of transmissions, different loose parts are involved.

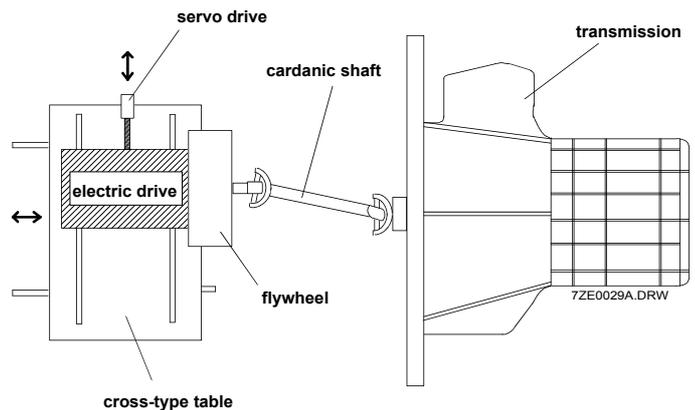
At ika/fka transmission-rattle investigations are carried out on test benches, especially constructed for this purpose. The analysis of idle rattle rig measurements show results about the principal rattle sensibility of a transmission model, independent from the drive train's vibration tuning, however under consideration of important parameters such as oil type and oil temperature. A further test bench enables an investigation of rattle behaviour of the whole drivetrain under load in single gears.

The transmission is driven in both cases by a speed controlled electric engine via a cardanic shaft. Running under joint angle, a rotational irregularity of 2nd order is caused by cardanic joints. In this case and in contrast to the usual design, the two joints are mounted with a rotational offset of 90°, amplifying the irregularity.



A flywheel minimises rotational vibrations at the electric engine. The joint angle is adjusted by transversal moving of the driving machine with the help of an electric servo drive.

This movability and the length compensation are provided by a cross-type table, as described in the following principle sketch.



This design enables a continuous variation of both exciting frequency (by input speed) and amplitude (by joint angle). The following picture shows the idle rattle rig in the anechoic chamber of the institute.



The arrangement with drive, adjust unit and transmission is elastically fixed for vibration isolation in a rolling frame. The test bench for the investigation of rattle under load is presented in the next picture. The complete drivetrain with transmission, sideshafts and wheels is mounted with

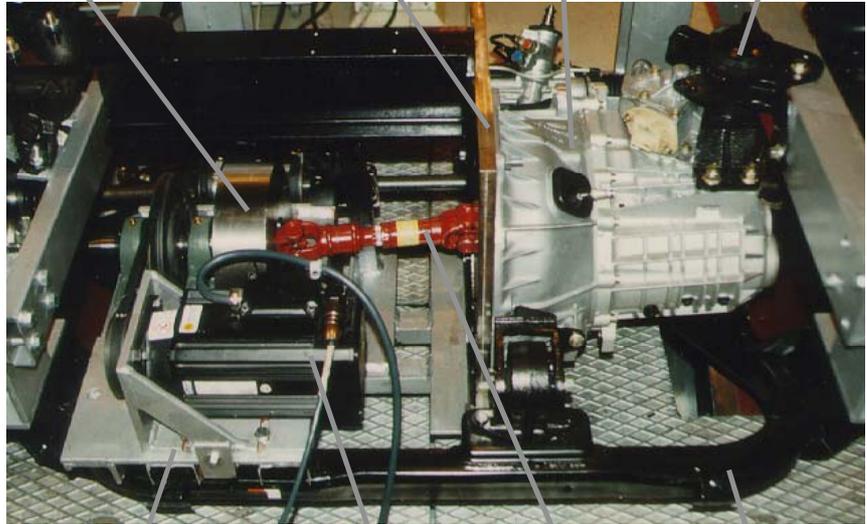
adjustable strut mount

flywheel

transmission plate

transmission

engine mount



acoustic dyno

test bench frame

adjust unit

electric-motor

propshaft

subframe

a chassis subframe and struts using the original engine mounts in a stiff test bench frame. The test bench frame thereby substitutes the vehicle body.

The struts are vertical adjustably connected to the test bench frame. Therefore it is possible to vary the bending angle of the drive shaft with constant wheel load. The torsional vibrations in transmission and drive train are determined with the universal-vibration-analyser (USA) of

Rotec Ltd. Munich. The available system can measure 6 speed channels and 32 analogue channels at the same time. Apart from the calculation of torsional vibrations and order analysis the analysing software enables also animation and simulation of torsional vibrations as well as the single flank test of a bevel gear set according to DIN 3960. For noise measuring conventional microphone technique as well as the HEAD-artificial system are employed.