FEV Motorentechnik GmbH
Neuenhofstraße 181
52078 Aachen · Germany

Phone (+49) (0) 241/56 89-0
Fax (+49) (0) 241/56 89-119
E-Mail marketing@fev.com
Internet http://www.fev.com

Powertrain NVH Development

Combustion Noise Optimization

Introduction

Combustion noise plays a considerable role in the acoustic tuning of gasoline and diesel engines. It comprises all load-dependent engine noise shares. New combustion processes designed to improve fuel consumption elevate combustion noise excitations (i.e. direct injecting gasoline engines). This leads to higher vibration excitation and airborne noise emissions during stratified operation

Noise Optimization during Combustion Process development

For the gasoline engine, the noise is significantly reduced by retarding ignition timing, higher exhaust gas recirculation rates and leaning (if this is possible with regard to the catalyst). For the diesel engine, the best effects are achieved by optimizing pre- and main injection timing and pre-injection quantity. At cold start and at part load, increasing the combustion chamber temperature can reduce noise. Acoustic and thermodynamic effects are not necessarily diametrically opposed. By optimizing pre-injection, exhaust gas recirculation, noise reductions can be achieved, while simultaneously improving, or at least maintaining, fuel consumption and emission values.

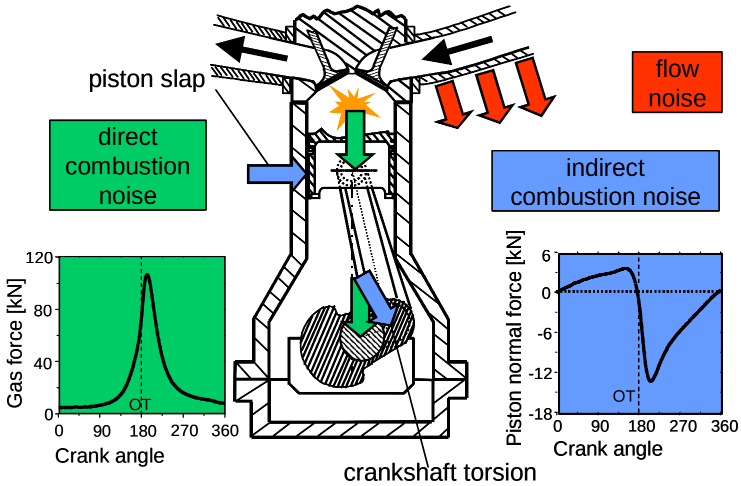
As part of the combustion process development, acoustic parameters are established that facilitate a prognosis of the expected engine noise. The analysis can be based on the real acoustic transfer functions of the engine, if known from NVH test bench investigations, or on acoustic transfer functions taken from FEV's database. For particularly demanding acoustic targets, certain phases of the combustion process development can be carried out at FEV's semi anechoic test bench specially equipped for exhaust emission & fuel consumption measurements, facilitating a highly reliable prediction of the acoustic behavior.

Combustion Noise Shares

The total noise of a combustion engine can be divided into mechanical noise, combustion noise and noise caused by the accessories. Combustion noise is composed of a direct and indirect combustion noise and an additional air flow noise share.

Combustion Noise Prediction Tool

Thermodynamic measurements are utilized to predict the acoustic effects of combustion. Indexes for each noise share have been developed. By multiplying the index of a noise share with the accompanying structure transfer function the third octave spectra of the noise share is calculated. By summation of the three combustion noise shares, the combustion noise can be calculated, and if the mechanical noise is known, the engine noise can also be calculated and thereby optimized.



The results presented here were partly obtained within the scope of a research program of Forschungsvereinigung Verbrennungskraftmaschinen e.V. (FVV, Frankfurt) promoted by The Federal Ministry of Economics and Technology (BMWi, Berlin, Bonn) via the Arbeitsgemeinschaft industrieller Forschungsver-einigungen e. V. (AiF, Köln).

CONTACT: Dr.-Ing. Norbert Alt
FEV Motorentechnik
Neuenhofstrasse 181
52078 Aachen, Germany

Phone: +49 (0)241 5689-419
Fax: +49 (0)241 5689-119

E-Mail: alt@fev.de
Internet: http://www.fev.com