Fig. 5: Realised design of a VCR-conrod for a heavy duty diesel application and prototype

VCR – Variable Compression Ratio

Modern combustion engines are characterized by an increasing level of variability. By variation of the compression ratio the fuel consumption of high boosted gasoline engines can be reduced, due to operating with higher compression ratios at low load compared to an engine with fixed compression ratio. With heavy duty diesel engines lowering the compression ratio at high loads high EGR-rates can be realized while maintaining the air fuel ratio. In this manner the peak firing pressure load does not increase significantly, so that no strengthening measures would be necessary.

Already with a two-stage VCR-system a big part of the fuel saving potential of a fully variable solution can be exploited and this generally with less modifications to be done to an existing engine. FEV has evaluated several existing and new solutions for two-stage VCR-systems.

The variable length conrod realized by an eccentrically mounted piston pin can be considered superior with regard to integrability and production costs. The conrod length variation is realized by means of a rotation of an eccentric bearing in the conrod small end. The moment acting on the eccentric, resulting from superimposed gas and inertia forces, is used to adjust the conrod length. This is the key feature to meet a cost effective VCR solution, because no expensive and power consuming actuators are needed and all functional elements are concentrated into only one component, the conrod.

At first the functionality of this VCR-principle was investigated and successfully verified with a prototype for gasoline applications by means of motored engine tests. Based on the positive results a VCR-conrod for a heavy duty diesel engine was designed and realized in a prototype. By means of fired engine tests ε-switchover sequences were performed in the entire map. The switchover times from ε=14 to ε=17 and vice versa were in between 1 to 2 seconds and have shown a reproducible behavior. Within the performed tests (appr. 6.000 ε-transitions) no significant signs of wear could be detected.

The results can be seen as promising steps toward a VCR production engine. In view of the pressing concern for a reduction of carbon dioxide emissions especially, within the downsizing trend, this represents a further important entity of the FEV technology portfolio.

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