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## **Application of the Passive MAHLE Jet Ignition System and Synergies with Miller Cycle and Exhaust Gas Recirculation**

Driven by legislation, economics and increasing societal awareness, engine and vehicle manufacturers are facing increasing pressure to reduce vehicle emissions and deliver improved fuel economy. Significant reductions in carbon dioxide (CO<sub>2</sub>) emissions will need to be achieved to meet these requirements whilst at the same time satisfying the more stringent forthcoming emissions regulations. This focus on techniques to reduce the tailpipe CO<sub>2</sub> is increasing the interest in novel combustion technologies, including dilute combustion in gasoline engines. The pre-chamber based jet ignition concept produces high energy jets of partially combusted species that induce ignition at multiple locations in the main combustion chamber to enable rapid, stable combustion, even with dilute mixtures.

The present study focusses on the beneficial synergies of the pre-chamber system with high geometric compression ratio (CR), Miller cycle operation and cooled external exhaust gas recirculation (EGR). The study has been undertaken using the MAHLE 1.5 liter, 3-cylinder, downsized demonstrator engine. The interaction of the various technologies applied to the engine, will be discussed and the improvements in fuel consumption due to the technology package that has been applied relative to the baseline engine will be presented. A critical challenge for pre-chamber based combustion systems is achieving operation over a wide operating region and under low load and cold start conditions. Results from the study demonstrating the capability of the pre-chamber concept to enable whole map operation as well as idle stability, catalyst light-off capability to a conventional central spark plug will also be presented.