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Water Cooled Exhaust Manifold and Full Load EGR Technology Applied to a Downsized Direct Injection Spark Ignition Engine

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ABSTRACT

Gasoline engine downsizing is one of the main technologies being used to reduce automotive fleet CO_2 emissions. However, the shift in operating point to higher loads which goes with aggressive downsizing means that real world fuel economy can be affected by the amount of over-fuelling required to maintain exhaust gas temperatures within acceptable limits. In addition there is a drive to lower the exhaust gas temperature limit in order to reduce the material costs required for high temperature operation.

A water-cooled exhaust manifold is one technology, which can be used to minimize the over-fuelling region. This paper investigates the effects of this technology applied to a twin-charger 1.4-litre gasoline direct injection engine. Data is presented which quantifies the benefits in conjunction with other downsizing technologies including cooled EGR and variable geometry turbochargers. The thermal and combustion phasing benefits are found to provide significant advantages over a wide operating region on this highly boosted engine. The downside of the approach is the requirement for increased heat rejection from the coolant and this is also quantified.