

Charge Air Sub-Cooling for Improved Transient Response

Neil Fraser, Ian Reynolds and James Miller
MAHLE Powertrain Ltd.

Dr.-Ing. Peter Wieske and Rene Dingelstadt
MAHLE International GmbH

Dr. Andreas Eilemann
MAHLE Behr & Co. KG

ABSTRACT

Downsizing in combination with turbocharging is an effective method for improving vehicle fuel economy. This is especially true for light-load operation. However, the transient response of the engine generally decreases with reduced engine displacement. Here, the potential of charge air sub-cooling for transient response improvement is examined.

Typical A/C systems are designed for a rapid cabin cool down and are oversized for the continuous operation, once cool-down has been achieved. Thus, there is spare capacity within the A/C system, which could be employed to cool the engine charge air below the ambient temperature, where necessary. By this mechanism the A/C system is acting as a 'thermal compressor'.

This paper focusses on the transient response and fuel economy benefits achievable with such a 'thermal compressor' when taking a bespoke A/C compressor strategy into account. The required components are packaged within the engine bay of a C-segment vehicle and results from engine and vehicle testing are presented.