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Improving Base Engine Calibrations for Diesel Vehicles Through the Use of DoE and Optimization Techniques

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ABSTRACT

Recent developments in diesel engine technologies have led to considerable emissions and performance improvements, however the task to calibrate the increased degrees of freedom is challenging and complex. There is a requirement for improved experimental and data processing approaches that simplify and accelerate the calibration procedure. This paper presents an approach that simplifies the analysis of a six factor experimental system, where the settings for a multiple injection strategy, exhaust gas recirculation and boost pressure have all been investigated. Design of Experiments (DoE) and optimization techniques have been integrated and applied at five speed and torque conditions, in order to define calibration changes that meet various constraint criteria. The calibration changes determined at these sites have been extrapolated over the region of the operating map covered in the New European Drive Cycle. The focus has been to reduce the smoke and NO_x outputs of the engine at no penalty to the base engine emissions and performance characteristics. This approach has resulted in a modified calibration, which reduces the smoke output by 12 % and NO_x by 15 % over an estimated NEDC. Equivalent base engine levels of CO, HC, fuel consumption and engine stability were maintained.