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UK PARTICLE MEASUREMENT PROGRAMME - HEAVY DUTY METHODOLOGY DEVELOPMENT SUPPLEMENTARY REPORT PMP PHASE 2 - WHDC AND ISO16183 VALIDATION

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Executive Summary

This report describes a study to compare proposed emissions test procedures for heavy duty engines with current legislative test procedures. The work was carried out as part of Phase 2 of the Heavy Duty Methodology development section of the UK Particle Measurement Programme (PMP). This programme of work was undertaken by Ricardo UK as part of DfT Contract: PPAD 9/33/105.

The objectives of this second engine test programme were to compare WHDC test cycles with existing legislative test cycles in terms of emissions and driveability, and to compare emission results from CVS and ISO16183 type measurement systems. The ISO16183 approach involves sampling of gaseous emissions from the raw exhaust, and uses a partial flow dilution system for particulate mass sampling.

The engine used for this work was the Daimler-Chrysler OM501, previously used as 'Engine 2' of the PMP Phase 2 programme, fitted with a DPF aftertreatment system. Some tests were also carried out without the DPF system.

The engine was installed and instrumented for simultaneous measurement of emissions from CVS and ISO16183 measurement systems. A matrix of test cycles was developed including the WHDC cycles (WHSC and WHTC), European test cycles (ESC and ETC), the US FTP heavy duty cycle and Japanese 13 mode test.

Results of gaseous emissions measurements from the proposed WHDC cycles were generally higher than those from the current ETC and ESC cycles. The control requirements for cycle validation with the WHTC transient cycle were found to be much easier than the ETC.

Good agreement was observed between ISO16183 and CVS sampling methods for NOx and HC emissions at both engine-out and post-DPF levels. However, over transient cycles, ISO16183 measurement of CO emissions at post-DPF levels presents significant problems in terms of analyser accuracy (turn-down ratio) and time alignment with flow measurement data. Post-DPF CO and HC emissions levels proved close to background levels: affecting both absolute accuracy and test repeatability for CVS measurements.

Particulate emissions at engine-out levels showed reasonable correlation between CVS and ISO16183 methods. Correlation at post-DPF levels was only achieved by use of a 'nominal' value for background Pm for correction of the CVS data.

The ISO1683 approach gave generally better test-to-test repeatability than CVS.

It was concluded that the ISO16183 approach is an acceptable alternative to CVS for measurement of emissions at engine-out levels, but this is not yet proven for post-DPF emissions. There is some evidence that ISO16183 may offer a more accurate representation of the post-DPF particulate mass than CVS.