Transmitted by the WHDC secretary

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# Round Robin Testing: Comment on working paper no. GRPE-PMP-17-1

### Summary

The statements made by the UK expert with respect to the validation of the ISO 16183 and US 2007 PM measurement procedures are incorrect and misleading. The WHDC validation exercise (incl. ISO 16183) did not involve a Golden System nor a Golden Engineer. But it was targeted to future PM levels by using engines with closed DPF. Adoption of both ISO 16183 and US 2007 procedures w/o round robin testing is justified, since it is only a modification to already well established procedures. On the other hand, PMP introduces a completely new metric, and must consequently be handled differently. Therefore, the ISO 16183 and US 2007 PM validation procedures must not serve as precedent for the PMP validation.

## Background

In working paper no. GRPE-PMP-17-1, the following statements have been made with respect to the ISO 16183 and US 2007 measurement procedures:

- validation of ISO 16183 involved a single Golden System supported by a Golden Engineer for repeatable set-up and operation of the system,
- validation did not involve additional measurement systems or testing of Euro IV engine technology, as such it was less robust than the PMP light duty vehicle validation,
- round-robin exercises have not generally been considered appropriate or necessary in adopting new sampling/measurement procedures either by industry or regulators.

This document is submitted in response to working paper no. GRPE-PMP-17-1

## ISO 16183 (WHDC) Validation

ISO 16183 partial flow sampling system (PFS) and raw gaseous emissions validation conducted within the WHDC context included several steps at different laboratories. It did not involve a single Golden System, but in total five different PFS from different manufacturers. Testing was conducted at four laboratories under their responsibility w/o the support of a Golden Engineer travelling from lab to lab. After a thorough statistical analysis, including DoE practices, of possible influencing factors, all PFS were compared to the CVS full flow system. In addition, the same engine equipped with closed DPF was tested in two different laboratories giving very similar results.

### **Robustness of Validation**

As indicated above, PFS validation included statistical procedures such as t-test, F-test and DoE for data evaluation. It also included a "mini" round robin between two laboratories, engines equipped with closed DPF to represent future PM levels, and a variety of different test cycles from all over the world. Consequently, ISO 16183 validation is considered more robust than the PMP light duty vehicle validation.

#### **Necessity of Round Robin**

It is true that no round robin was conducted before adopting ISO 16183 procedures for Euro IV & V test procedures. This also holds true for the adoption of the US 2007 test procedures. But there is one fundamental difference between those two procedures and PMP. While PMP suggests a completely new metric, i.e. particle number, the basic metrics, i.e. PM mass, NOx, CO and HC, for both ISO 16183 and US 2007 remain unchanged.

As regards the EU Heavy Duty Directive, the PFS has been in use and well established since 1992 (Euro I marking the first PM regulation in the EU) for steady state testing. At the time of introduction, an industry/type approval authority round robin was in fact conducted. ISO 16183 establishes provisions for the proportional control of PM sampling with the PFS, whereas all other provisions of PM measurement that might influence the PM test result, such as filter material, size, temperature and weighing have not been changed. No specific training of the test cell operator is required for correct system operation. Therefore, adoption based on validation is justified, and no round robin needed.

As regards US 2007 procedures, EPA introduced measures to reduce measurement variability at low PM levels w/o changing the principles of PM mass measurement. Again, in such a case no specific training of the test cell operator is required, adoption based on validation justified, and no round robin needed.

As regards PMP, a new metric is being proposed that is much more complicated to be measured than PM mass. So far, particle number measurement has only been used in engine research by highly skilled technicians. Adoption of PMP within the emissions regulatory framework requires major changes to design and software of test cell control in conjunction with extensive operator training. Therefore, a much more robust validation is needed compared to ISO 16183 and US 2007. This definitely includes a round robin in order to statistically determine repeatability and reproducibility, as also required in Directive 2005/55/EC and in ECE R 49 (§ 5.2) for introduction of new systems.