MEASUREMENT OF REAL-WORLD EMISSIONS FROM HEAVY-DUTY DIESEL VEHICLES: THE STATE-OF-THE-ART

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ABSTRACT

A considerable amount of effort is being devoted toward generating exhaust emissions data from heavy-duty, on-highway diesel engines operating under normal in-use conditions. Engine manufacturers and various regulatory bodies (U.S. Environmental Protection Agency, California Air Resources Board) alike will use this information to ensure that emissions standards are met throughout the useful life of 2007, and later, model year heavy-duty, on-highway diesel engines. Efforts are also being focused on monitoring not-to-exceed emissions compliance. As a result, a fair understanding of in-use and Federal Test Procedures (certification cycle) emission levels from on-highway engines has been afforded. However, there is very sparse information on in-use and steady-state certification cycle emissions from non-road engines. Moreover, the extrapolation of this sparse amount of data to provide estimates of the emissions impact these non-road vehicles have on air quality could lead to large errors (recent work at West Virginia University [WVU] has shown that in-use emissions from non-road engines are severely overestimated by 8-mode steady state certification cycles). An established set of measurement protocols and system design recommendations providing for accurate on-board measurement tools has been the missing link to attaining this information.

In response to such needs, WVU has developed, and continues to evolve, an on-board, in-use emissions measurement system called the Mobile Emissions Measurement System (MEMS) that allows determination of in-use, brake-specific emissions from heavy-duty diesel-powered vehicles. This work is a part of the future trends toward moving out of the certification test cells and into actual in-field emissions measurements. This paper discusses some of the in-use emission results for on-highway engines, marine vessels (from a recently completed study on a high-speed hydrofoil), and non-road engines that were obtained by WVU using the MEMS. Such fieldwork has not only provided WVU with valuable experience related to in-use testing protocols, but also with ideas concerning future on-board emissions measurement system design.

This paper will discuss general in-use test procedures, as well as the essential components of generic, on-board emissions measurement tools. Aspects such as accuracy, precision, "ultra-portability," and system flexibility will be discussed pertaining to in-use testing of emissions from both on-highway and non-road engines. Advanced concepts, such as fuel-specific emissions, and their impact on design of measurement systems used for compliance and development work are discussed.