Title: **In-use emissions from heavy-duty diesel vehicles**

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Abstract: This is a three part thesis regarding the regulated emissions from in-use heavy duty diesel vehicles. The first part of the thesis involves the collection and analysis of emissions from 21 vehicles. Emissions of particulate matter (PM), nitrogen oxides (NO_x), carbon monoxide (CO), total hydrocarbon (THC) and PM sulfate fraction were measured as well as smoke opacity. The vehicles were tested on three different driving cycles. This study found that when emissions were converted to a g/gallon basis, the effect of driving cycle was eliminated for NO_x and reduced for PM. Sulfate comprised less than 1% of the emitted PM. Smoke opacity was not well correlated with mass emissions of any of the regulated pollutants. Multivariate regression analysis indicated that in-use NO_x emissions did not decrease for this fleet during the years 1986 to 1995 while engine certification standards dropped sharply during that time. A review of all in-use emissions data in the scientific literature supported this result.The review also showed that PM emissions were widely variable among vehicles certified under identical standards. The variability was attributed to environmental factors, inertial weight, test cycle, driver variability and vehicle condition, but the relative importance of these factors could not be determined based on previously collected data. The wide variability in PM emissions within model years and the uniformity of NO_x results despite the change in engine standards showed that engine certification was not an accurate tool to predict and control emissions from vehicles. To better understand the relationship between engine and chassis test results, a computer model was developed that estimates engine speed and load from vehicle speed. Using this model it was possible to detect the use of electronic controls which operate the engine in a different mode during engine testing and other more typical types of operation. The model also showed that the engine certification test generated consistently less PM than the vehicle tests when the model was used to put the engine and chassis emissions on a consistent basis.A good correlation was found between rate of HP increase integrated over the test cycle and PM emissions for both the chassis and engine tests.The engine test procedure includes engine behaviors that cannot be duplicated in in-use operation, and appears to favor lower rates of acceleration than typical chassis operation. The model also showed how small changes in vehicle speeds (+/−2 mph) due to driver variability can lead to a doubling of load on the engine.