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Evaluation of the Effects of Air Conditioning Operation and Associated Environmental Conditions on Vehicle Emissions and Fuel Economy

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ABSTRACT:

The Coordinating Research Council (CRC), California Air Resources Board (ARB), and Texas Commission on Environmental Quality sponsored a program to evaluate the effects of air conditioning (AC) operation on vehicle emissions and fuel economy.

Phase 1 of this work measured the effect of AC use with vehicles operated over several standard driving cycles and verified results previously obtained by other investigators. Phase 2 provided a better understanding of the effects of the interactions between ambient conditions (solar load, temperature, and humidity) and AC operation on emissions and fuel economy. The Phase 2 program also verified results of Phase 1 by using a different population of vehicles.

The program results demonstrated that AC operation had a substantial impact on emissions and fuel consumption. Operation of the vehicle AC system over a range of environmental conditions resulted in consistent increases in vehicle emissions of nitrogen oxides (NO_x) and carbon monoxide (CO). NO_x increased from 0.1 to 0.6 g/mile, depending on the severity of the test cycle and ambient conditions. CO increased from 0.5 to 12 g/mile. However, analyses indicated that increases in CO were actually due to the increases in ambient temperatures that were employed in the experiments. The application of solar load to the vehicle increased the impact of AC operation. The application of solar load increased NO_x emissions from 0.10 to 0.14 g/mile.

Although this experiment was not designed to specifically address fuel economy, operation of the vehicle AC system caused substantial decreases in vehicle fuel economy, ranging from 2.5 to

4.5 miles/gallon. The addition of solar load increased the effect on fuel economy, primarily at less severe ambient conditions. Solar load caused a decrease of 1.3 miles/gallon at 80°F and moderate humidity.

The results of the program were intended to aid in the improvement of vehicle emissions inventory models. NO_x emission increases due to the use of AC ranged from 15% to 100% of baseline values. This level of effect indicates that AC use should be well accounted for in these models.

