Title:	Four Peer Reviews in Support of EPA's Tier 3 Inventory Process
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Appendix B: Elements to be Addressed in the Charge to the Peer Reviewers

This Appendix has been divided into five sections. Each of the four sections which follow addresses individually the products for which EPA has requested an independent peer review.

This first section contains a brief discussion of concerns which apply to all reviewers across all products for peer review.

In their comments, reviewers should distinguish between recommendations for clearly defined improvements that can be readily made based on data or literature reasonably available to EPA and improvements that are more exploratory or dependent on information not readily available to EPA. Any comment should be sufficiently clear and detailed to allow a thorough understanding by EPA or other parties familiar with the analysis or the model. EPA requests that the reviewers not release the peer review materials or their comments to anyone else until the Agency makes its report and supporting documentation public.

If a reviewer has questions about what is required in order to complete this review or needs additional background material, please direct the reviewer to contact the contractor's project manager for this effort. If a reviewer has a question about the EPA peer review process itself, please have the reviewer contact Ms. Ruth Schenk in EPA's Quality Office, National Vehicle and Fuel Emissions Laboratory by phone (734-214-4017) or through e-mail at schenk.ruth@epa.gov .

Appendix B.1 Fuel Sulfur Effects report

Sulfur in gasoline has long been known to reduce the efficiency of automobile exhaust aftertreatment systems. Some emission studies have suggested an increase in catalyst sensitivity to sulfur (in terms of binding to active catalytic sites) with increasing stringency of vehicle emission standards (as standards have ratcheted down on exhaust emissions), due possibly to the higher catalytic efficiencies required for compliance with recent emission standards. Though, historically, light-duty vehicle emission standards have been high enough to mask any impact of fuel sulfur level as negligible.

However, in promulgating its Tier 2 light-duty vehicle emission standards, EPA recognized the importance of fuel sulfur level. Reductions to new vehicle exhaust emission standards under the Tier 2 vehicle and fuels program were accompanied with corresponding reductions in fuel sulfur level to improve the cost and feasibility of the vehicle technology changes required for compliance. Under this arrangement, though, the drop in fuel sulfur level itself is not counted as responsible for separate or additional emission reductions in new vehicles subject to the new emission standards. Since fuel sulfur standards should affect all on-highway gasoline vehicles – not just those subject to the new tailpipe emissions standards – lower fuel sulfur standards may be responsible for significant collateral emission reductions in vehicles already on the road (the 'in-use' fleet).

These in-use exhaust emission reductions are an important part of the overall regulatory benefit of emission controls and previous studies have generally not provided data that can quantify these reductions in a straightforward manner. Many studies looked for a change in emissions at a single point in time, after a change in fuel sulfur, for example, which does not account for catalyst sulfur loading that occurs under in-use driving conditions. Other studies had measured the effects on catalyst aging of using fuels having various sulfur levels, not giving any indication of effects when fuel sulfur level is changed only partway through a particular vehicle's useful life. Thus, the two types of data targeted in this study were the level of reversible loading in catalysts found in-use, Tier 2 vehicles and the relative emission differences due to sulfur reloading for two different sulfur level fuels in the same vehicle.

In the 2005/2006 timeframe, EPA's Mobile Source Air Toxics/MSAT-2 study[1] examined the effects of fuel sulfur, benzene and volatility levels on exhaust emissions from a fleet of nine Tier 2-compliant cars and trucks assembled from various vehicle manufacturers. The study examined four non-ethanol gasolines, blended in a step-wise manner, from a base fuel (at 6ppm S) containing the lowest levels of the three properties of interest (RVP, benzene, and Sulfur) to three additional blends containing higher levels of RVP, benzene, and Sulfur. The level of fuel sulfur was increased by using a small amount of doping agent. Thus, a sulfur effect was deduced by comparing emission results between the final fuel (at 32 ppm S) and each one just before it in the blending sequence. The test vehicles had emission component systems (catalysts, oxygen sensors, etc.) bench-aged to the equivalent of 120,000 miles.

FTP-weighted emission reductions related to fuel sulfur changes in this program for NOx, THC, CO and methane were all statistically significant ($\alpha = 0.9$). However, due to specific catalyst prep procedures that compared a fully cleaned-out catalyst with low sulfur fuel to a fully-loaded catalyst with high sulfur fuel, these results may only represent a "worst case" bracketing of emission results than would be expected under more realistic driving conditions. Nonetheless, these data suggested reversible sulfur loading on Tier 2 vehicle catalysts and likely significant emission reductions available through further fuel sulfur level control.

The test program described in this report used two fuels with properties identical to conventional federal certification gasoline, except for sulfur level. The higher sulfur fuel had a similar level to the national average in-use fuel, approximately 30 ppm. The lower sulfur fuel had 5 ppm sulfur, nominally. In order to generate in-use fleet emission data, privately-owned in-use vehicles were recruited for the study. Given this arrangement, it was not feasible to damage or destroy catalysts to directly measure any sulfur loading. Therefore, the behavior of emissions relative to a baseline was used as a proxy for catalyst sulfur loading.

1 ""Proposed Rule: Control of Hazardous Air Pollutants from Mobile Sources" Preamble and Regulations (published March 29, 2006). See http://www.epa.gov/oms/toxics.htm.

The report to be reviewed contains information on the hypothesis, design, and execution of this test program as well as an in-depth statistical analysis of the results. EPA is seeking the reviewers' expert opinion on the methodologies used to evaluate the effects of both cleanout and sulfur level on emissions and whether these techniques are likely to yield accurate results. EPA asks the reviewer to also consider the appropriateness of the statistical techniques described in this report and their appropriateness in the context of data accuracy and quality issues. To this end, each subject matter expert is encouraged to comment on all aspects of the report with particular emphasis on sulfur level and cleanout techniques, the statistical methodology employed to analyze the data and the overall conclusions drawn in this study pertaining to the impact of reduced fuel sulfur levels on the in-use, Tier 2 vehicle fleet.