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The Development of a Real-Time Evaporative Emission Test

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Powertrain Control Center
Current Product Engineering
General Motors Corporation

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ABSTRACT

In recent years various parties have proposed new evaporative emission test procedures focused on controlling "excess" evaporative emissions, on hot "ozone prone" days. Studies by General Motors established the need for real-time measurements of daily emissions from parked vehicles and of "running losses" from vehicles that are driven to quantify and control the mobile source contribution to VOC inventory. "Resting losses" are shown to be a previously unidentified major source of hydrocarbon emissions. This paper describes the theories, data and development of GM's Real-Time Test Procedure.

WRITERS NOW Characterize the 1990's as "The Decade of the Environment." Public concern for the environment is at a new high. Many urban areas, for example, exceed the National Ambient Air Quality Standard (NAAQS) for ozone. The problem is particularly severe in California. Figure 1 shows the 1988 hourly ozone measurements for four California locations. The horizontal line indicates the 0.12 part per million (ppm) standard that should not be exceeded more than once a year on average. As Figure 1 indicates, Azusa exceeded the standard 125 times in 1988.

Figure 2, on the other hand, shows the locations of the nine most severe ozone areas identified by EPA. Figure 3 shows the 1988 ozone monitor records for four of these cities, Chicago, New York, Houston, and Kenosha. These exceedances are not as chronic as the California results.

Against that backdrop, additional control measures for all organic compounds, including the hydrocarbons from motor vehicles, are being considered. The current exhaust and evaporative emission test procedures and standards have achieved significant reductions in in-use emission levels, but they are now more than a decade old. [1] [1] Combinations of higher ambient temperatures, high fuel volatility, extended driving, and multiple day park episodes have revealed higher levels of evaporative emissions than were previously assumed to exist.

In recent years, and particularly since 1988, there have been significant advances in the measurement and characterization of in-use evaporative emissions. [2] These advances have demonstrated that the current procedures and standard, as well as the assumptions about in-use vehicle performance upon which they were based, are obsolete. This important point is largely conceded by most participants in the current rulemaking process. A new focus on high temperature, "ozone-prone" conditions for control of evaporative emissions has resulted.

The Environmental Protection Agency (EPA) in January, 1990 proposed new evaporative emission test procedures designed to further reduce the mobile source contribution to air pollution. Another proposal, the subject of this paper, has been developed by General Motors. [3] Another new test procedure from the California Air Resources Board (CARB) [4] included many features of the GM Real-Time proposal.

EPA's new evaporative emission control proposal [5] differs substantially from the CARB and GM proposals. The EPA proposal's most significant change from the current test protocol is the use of multiple diurnal heat builds (two rather than one) conducted at higher temperatures (72 to 96°F instead of 60 to 84°F) thought to be

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1. Numbers in brackets designate references listed at the end of the paper.

Figure 1.

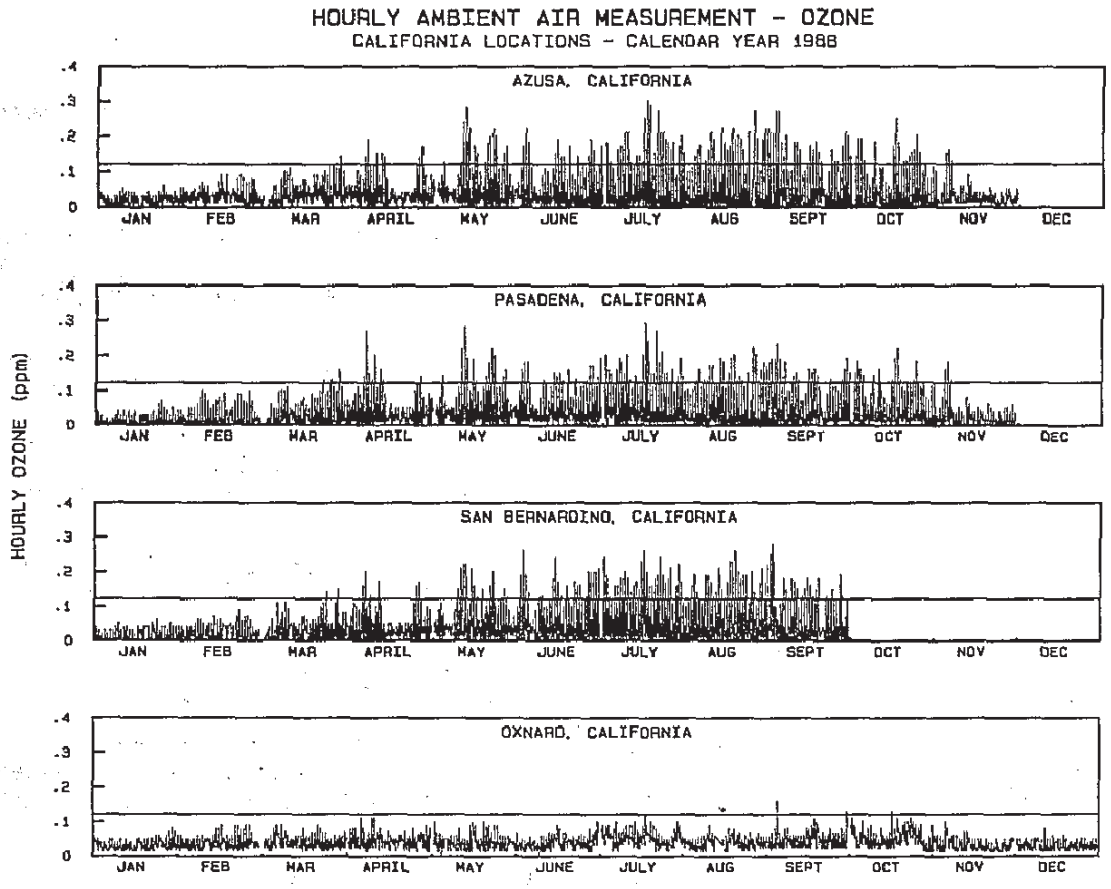


Figure 2.

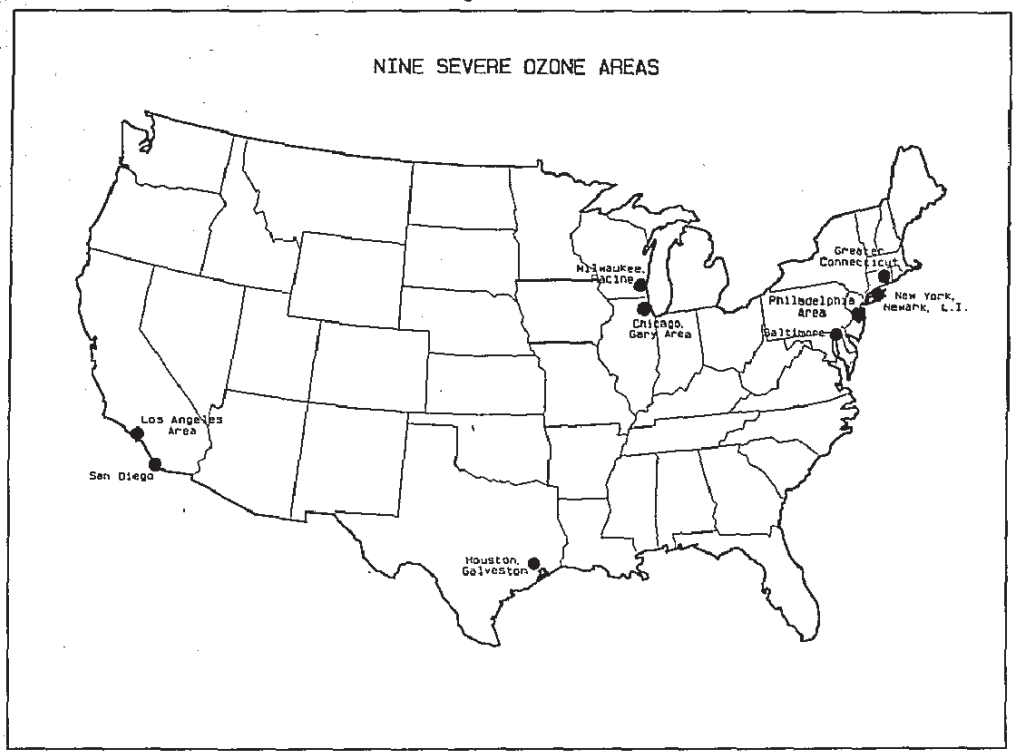
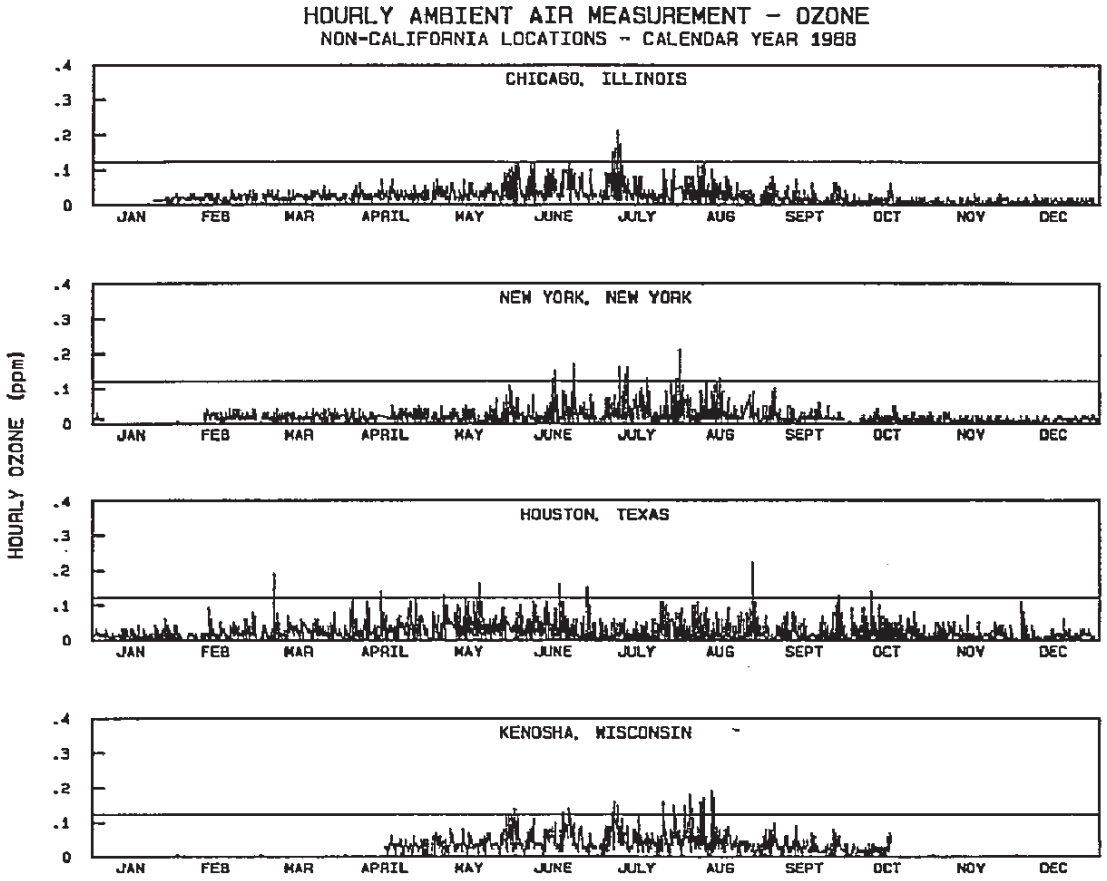


Figure 3.



representative of high ozone days. EPA's new procedure relies on various design-review requirements and test procedure changes to influence vehicle purge rates in order to regulate "running losses". It does not directly measure vehicle running losses. It also leaves the hot soak measurement procedure at the laboratory ambient (i.e., 76 instead of 96°F) temperatures.

California's proposal includes direct measurements for high-temperature hot soaks and running losses. It also measures emissions from vehicles in extended-park situations on a "real-time" (24 hour) basis, rather than with the traditional time-compressed diurnal test procedure. It shares many of the same features with the GM proposal. The major differences are the daily high temperature (105°F vs. 96°F), three diurnals vs. two, the tank fill level (40% vs. 60%), and the standard.

The purpose of this paper is to describe the theories, data, and tests that were part of the development of the GM "Real-Time" Environmentally Based Evaporative Test Procedure.

There are four parts to this paper:

1. Test Procedure Goals
2. Test Methodologies
3. Test Parameters
4. The Procedure, the Standard and Estimated Benefits

TEST PROCEDURE GOALS

As explained below, the Real-Time test procedure would require manufacturers to optimize vehicle evaporative emissions control during a very high percentage of hot urban driving episodes and during extended-park "diurnal" events. It would require stringent control of "resting losses", which are a large and growing segment of the uncontrolled in-use vehicle evaporative emissions inventory. As a result, the Real-Time test procedure will almost certainly involve increased compliance risks in the early years of the new program.

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