vary by season, time of day, and geographic location. Given that the overall goal of the Act is to help bring localities and regions into compliance with the National Ambient Air Quality Standards (NAAQS), the Agency chose to focus attention on the contribution of A/C to vehicle emissions during typical high ozone situations. Analyses of ozone exceedances revealed that ozone exceedances typically occur on days with a mean ambient temperature of 95 °F, 30–40 percent relative humidity, and limited cloud cover.

In August and September 1994, the Agency conducted an instrumented vehicle study in Phoenix, Arizona. Preliminary analyses of the survey data indicate that the average A/C usage was 77 percent for days that reached a peak temperature between 90 °F and 100 °F. The A/C compressor was actually engaged 61 percent of the total time (see Technical Reports and the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis for full analysis). The high use of A/C in ozone exceedance conditions makes the accurate simulation of A/C during the FTP more important.

D. Additional Elements Affecting Engine Load

A comprehensive evaluation of additional elements affecting engine load would require surveys of the frequency of occurrence of the elements in-use, as well as evaluation of interactive effects with driving behavior. For road grade, a 1980 EPA report[18] indicated that positive road grades average 1.66 percent nationally and that roughly six percent of national VMT is spent on grades of four percent or higher. The Agency sought to supplement this information with driving behavior data over road grade, gathered during the chase car portion of the in-use driving surveys. Unfortunately, problems with noise and insufficient resolution on the measure of grade rendered the data inadequate, and no alternative data source was available. In addition, EPA was unable to conduct in-use surveys in the areas of passenger/cargo loading and trailer towing, due to the scope and nature of the necessary survey instrument. As a consequence, EPA has insufficient data for use in evaluating the additional elements affecting engine load that were originally identified as areas of concern.

[18] 18 U.S. Environmental Protection Agency, Passenger Car Fuel Economy: EPA and Road, EPA# 460/3–80–010, September 1980, p. 119.

VII. Representative Driving Cycles

In order to evaluate the emission impacts of in-use driving and soak behavior, EPA designed three driving cycles that were representative of the in-use survey results, using segments of actual in-use driving survey data. Concurrently, EPA determined weighting factors to reflect the fraction of in-use operation represented by each cycle; these factors are used to properly weight the emissions from the cycles when doing an emission assessment.

The Agency developed separate cycles for start driving and aggressive driving. The Agency chose to develop individual cycles rather than a single ''representative'' cycle in order to evaluate EPA's areas of concern independently. This is most critical in the case of aggressive driving where both capturing the diversity of aggressive driving behavior and representing it proportionally in a single cycle covering all in-use operation would lead to a very long cycle.

The Start Cycle (ST01) represents three successive 80-second segments of in-use driving immediately following the initial idle. Testing using ST01 allowed separate determination of start driving emissions; ST01 was also used to quantify the emissions effects of varying soak duration.

The second cycle, characterizing aggressive driving, was the Representative Non-LA4 Cycle (REP05). This cycle targeted speeds and accelerations, as well as microtransient effects, not covered by the current LA4.

To complete the representation of in-use driving behavior for emission assessment purposes, a third cycle, the Remnant Cycle, was developed to characterize in-use driving behavior not represented by either the ST01 or REP05.

The Agency used the same basic cycle development methodology for each of the three representative cycles. A full discussion of the methodology used, the composition of each cycle, and how it compares to the cycle in the FTP is found in the Technical Reports.

It seemed clear from the in-use survey data that rapid speed fluctuations, including ones not well represented on the LA4, could be found in all types of in-use vehicle operation. The Agency's use of actual microtrips as the building blocks for the three representative cycles directly incorporated such microtransient driving behavior into all three cycles.

The Agency has assumed that driving behavior is not affected significantly by A/C operation and that the representative driving cycles developed from the in-use driving survey data are equally applicable to testing with the A/C system on and off. In fact, even though the Atlanta driving survey was the only one of the three surveys conducted during the summer, that city had the most aggressive driving of the three cities. Thus, it does not seem likely that A/C operation could have a significant impact on driving behavior. Nonetheless, the Agency welcomes data and comments on the relationship between A/C operation and driving behavior.

VIII. Emission Inventory Assessments

An assessment of emissions from four areas for potential emission control was conducted using the representative test cycles developed from the survey data. A full description of the test programs and the results can be found in the Technical Reports. The following summarizes the conclusions for each area considered.

A. In-Use Driving Behavior

The FTP Review's emission assessment of in-use driving behavior was based on a vehicle emission test program conducted cooperatively by EPA, CARB, AAMA, and AIAM during 1993 and early 1994 (referred to subsequently as the Non-LA4 Emissions Test Program).[19]

On the basis of the EPA data, the project team concluded that the LA4 under-predicts actual in-use hot stabilized emissions by 0.043 g/mi NMHC, 2.8 g/mi CO, and 0.083 g/mi NO_X on current technology, properly operating vehicles.[20] These numbers do not have any direct bearing on the FTP standards; they are simply an estimate of the additional amount such vehicles actually emit in-use, compared to the FTP test results.

Table 3 shows the percentage contribution to the in-use emission increase from the Start (ST01), Remnant, and aggressive (REP05) driving cycles, weighted by their respective proportion of in-use driving. As expected, the aggressive driving of REP05 contributed significantly to the difference. More surprisingly, however, significant contributions to the increase also came from the Start and Remnant Cycles, particularly for NMHC and NO_X.

[19] EPA's assessment was limited to EPA's and AAMA/AIAM data. Due to differences in testing hardware, CARB's emission results were not directly comparable.

[20] These estimates are only for the emission under-prediction related to driving behavior. Other factors such as soak are addressed in the sections to follow.