TABLE 3.—CONTRIBUTIONS TO THE IN-USE G/MI INCREASE BY THREE TYPES OF DRIVING

Driving	NMHC	со	NO _X
All (In-Use In- crease).	0.043 g/mi	2.784 g/ mi.	0.083 g/ mi.
Start Remnant	30.2% 33.8%	17.1% 25.0%	23.0%. 45.6%.
Aggres- sive.	36.0%	57.8%	31.4%.

The AAMA/AIAM portion of the program was conducted in late 1993 and early 1994. This 26-vehicle, 8manufacturer program included hot stabilized testing with REP05, the 505, and the 866, but none with the Remnant or Start Cycles; thus, a complete assessment of in-use hot stabilized driving could not be conducted with the manufacturers' data. Nevertheless, comparisons were made between the EPA and manufacturer program results for REP05 as well as the difference between REP05 emissions and hot stabilized LA4 emissions. In looking at the emission difference between REP05 and hot LA4, the LDV and light lightduty truck (LLDT) average for the EPA tested vehicles was 0.04 g/mi while it was 0.06 g/mi for the vehicles tested by the manufacturers. The CO emissions tracked better, with the REP05 and hot LA4 difference of 5.71 g/mi for EPA and 5.32 g/mi for the manufacturer tests. The manufacturer testing showed a much larger NO_X differential. The NO_X difference between REP05 and hot LA4 was 0.25 g/mi for the manufacturers' testing while only 0.09 g/mi for EPA testing. The NMHC and CO differences are primarily among the LLDTs while the NO_X difference was found in LDVs and LLDTs. The Agency did not test any heavy light-duty trucks (HLDTs); however, the manufacturers' results showed these vehicles as having the largest grams per mile increases from hot LA4 to REP05. This comparison suggests that EPA's emission assessment should provide a reasonable, if not conservative, estimate of in-use emissions.

B. Intermediate Soaks

The Agency conducted the assessment of in-use emissions following intermediate soaks using data from EPA's Soak/Start Test Program, conducted in two phases between July 1993 and June 1994. The testing represented the soaks observed in the driving survey data. The primary cycles used to measure post-soak emission levels for the emission assessment were variations of EPA's representative Start Cycle (ST01).

Post-soak emissions in the Soak/Start Test Program, measured over the ST01 cycle, increased steadily and sharply as soak duration was incremented between 10 minutes and 60 minutes. The average ST01 emissions for all vehicles tested for NMHC, CO, and NO_X were higher following the 60-minute soak than they were for the 10-minute soak by factors of seven, two, and four, respectively. The increases were significant in absolute terms as well; for example, the average NMHC emissions on three Tier 1 vehicles went from about 0.05 g/mi following the 10-minute soak to over 0.50 g/mi following the 60-minute soak. The rate of increase moderated with soaks longer than 60 minutes, such that emissions of all constituents following a 2-hour soak were within 50 percent of cold soak levels. The subset of Tier 1 vehicles in the EPA program showed similar percentage increases as a function of soak duration relative to the Tier 0 vehicles, although the average emission levels of these vehicles were lower than the Tier 0 vehicles.

C. In-Use Air Conditioner Operation

The Agency conducted three test programs and participated cooperatively with AIAM and AAMA in an additional test program during late 1993 and early 1994 with the purpose of assessing inuse emissions due to A/C operation. Detailed descriptions of all of these programs and the results are contained in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis.

The first test program compared emissions during the current FTP A/C simulation to emissions obtained with the A/C actually operating and confirmed that the current A/C simulation method significantly underrepresents the actual load of the A/C on the engine.²¹

The second test program went beyond the current FTP by testing A/C impacts over the three representative cycles (REP05, ST01, Remnant) as well as over the LA4. As in the first program, results from this testing demonstrated an overall increase in actual emissions with the A/C operating. In particular, the magnitude of the NO_x increase in both programs was much larger than expected and caused the Agency to focus further research and analysis on the effects of A/C operation on NO_X emissions.

The third test program was very similar to the second but was designed to collect second-by-second emissions and vehicle operating data. Analysis of these data indicated that the significant A/C-related emission impacts were occurring during idles and accelerations; on the LA4, ST01, and Remnant cycles the combination of idles and accelerations accounted for more than 80 percent of the total observed NO_X increase. As was the case in the previous program, the overall increases in NO_X were heavily weighted towards the moderate and lower speed driving of the ST01, Remnant, and LA4 cycles, although some increases were seen on the REP05 cycle.

A detriment of these test programs is that they did not adequately or fully represent the actual conditions under which A/C systems are likely to be operated. To test vehicles under an accurate simulation of environmental conditions and vehicle speed, an emission testing program (referred to as the AC Rochester [ACR] test program) was conducted by vehicle manufacturers in a sophisticated environmental test facility.²² The Agency and manufacturers cooperatively defined for the testing a set of environmental and meteorological parameters to represent a typical ozone nonattainment day.

Eight vehicles certified to the EPA's Tier 1 emission standards with HFC-134a A/C refrigerant systems were tested in the program. Once again, the effects of A/C operation were most pronounced on the moderate-to-lower speed cycles. On a hot, stabilized LA4, the average increases were 0.011 g/mi for NMHC, 0.3 g/mi for CO, and 0.205 g/mi for NO_X. The increases observed on the REP05 cycle were smaller than on the LA4, but still noteworthy due to the performance of several of the vehicles, causing the Agency some concern about the impact of A/C operation during aggressive driving behavior. Fuel economy decreased by about 13 percent on the REP05 with the A/C operating, substantially less than the 20 percent reduction on the LA4, further indicating that the A/C load as a proportion of total load tends to diminish as speeds and accelerations increase.

²¹ In fact, the Agency believes that the effect on emission values of the additional ten percent dynamometer road load horsepower is negligible and unobservable within the range of current testto-test variability.

²² This program was developed as a cooperative effort between EPA and manufacturers with funding from manufacturers.