Title
Flipper Vehicles in Triplicate IM147 Tests from Arizona Random Sample

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Problem: Intermittent equipment malfunctions cause some vehicles to fail an emissions test shortly after passing their previous test. As a result, some vehicles are falsely passed in state I/M programs.

Data: Second-by-second emissions from three triplicate 147-second traces (IM147) on a stratified random sample of Phoenix vehicles:
• a random sample of passing vehicles;
• a similar-sized sample of random failing vehicles;
• once a failing vehicle was included, all subsequent tests of that vehicle were also given a full IM147 test until it passed a retest.

Method: Analysis of tests conducted between Sep 2002 and Feb 2007, on 42,000 1981+ vehicles.

Results: 6% of all vehicles, and 9% of all passing vehicles, failed a trace within minutes of passing a previous trace.

↑ Emissions are 10% to 25% lower on second trace than on first trace, and 1% to 5% lower on third trace than on second trace
• Likely due to engine and catalyst fully warming up and lighting off during previous traces

↑ 51% of vehicles passed all three traces (PPP); 34% failed all three traces (FFF)
• 9.3% of vehicles failed initial trace, but passed subsequent trace (eventual pass)
• 6.1% failed a trace within minutes of passing a subsequent trace (flippers)
• Sample is weighted towards failing vehicles: 9.2% of all vehicles that passed a previous trace are flippers

↑ Percent of vehicles that eventually passed that are flippers:
• 17% of MY81 to 92 vehicles
• 12% of MY93 to 95 vehicles
• only 2% of MY96+ (OBD-II) vehicles
• Fraction of OBDII vehicles that are flippers does not increase much as they age, from 1.9% of all MY96 vehicles in 2002 to 3.7% of MY95 in 2006

Table shows three flipper vehicles tested twice within two weeks (presumably after repair) with same emissions pattern
• Increases in CO and HC accompanied by decreases in NOx

↑ Four figures show CO (top) and HC (bottom) emissions of same MY94 vehicle tested on 7/19 (left) and 7/26 (right)
• Trace 3 emissions (green) decreased from previous inspection, but still high and a PPF flipper
• Analyzer saturation causes emission “plateaus” in first inspection trace 3, which understate actual emissions of failing vehicles

Conclusions
Estimated 9% of all vehicles that pass an I/M test would fail a subsequent test minutes later. Flippers are more prevalent in older vehicles, but can occur in OBDII vehicles.
These results confirm other findings regarding flippers based on roadside pullover and off-cycle change-of-ownership tests.

Recommendation
EPA and states should develop strategies to better quantify the prevalence and causes of vehicles whose emissions flip from low to high within minutes of passing I/M emission tests.

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