Flipper vehicles in triplicate IM147 tests from Arizona random sample

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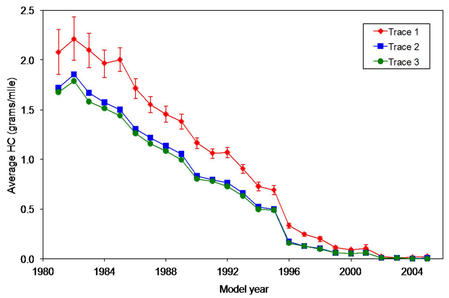
Problem: Intermittent equipment malfunctions cause some vehicles to fail an emissions test shortly after passing their previous test. As a result, some vehicles are falsely passed in state I/M programs.

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.

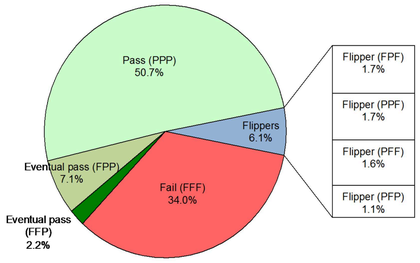
Method: Analysis of tests conducted between Sep 2002 and Feb 2007, on 42,000 1981+ vehicles.

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



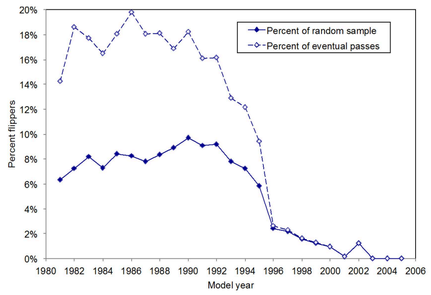
↑ Emissions are 10% to 25% lower on second trace than on first trace, and 1% to 5% lower on third trace than on second trace

- 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)

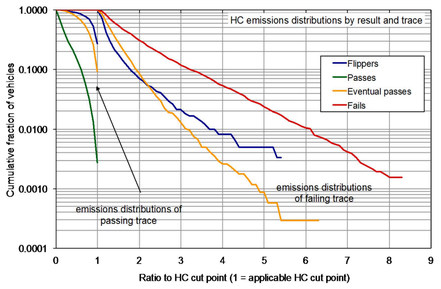
- 9.3% of vehicles failed initial trace, but passed subsequent trace (eventual pass)
- 6.1% failed a trace within minutes of passing a subsequent trace (flippers)
- Sample is weighted towards failing vehicles: 9.2% of all vehicles that passed a previous trace are flippers

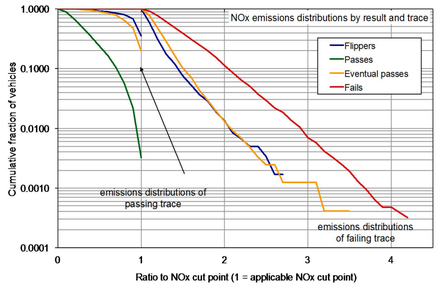


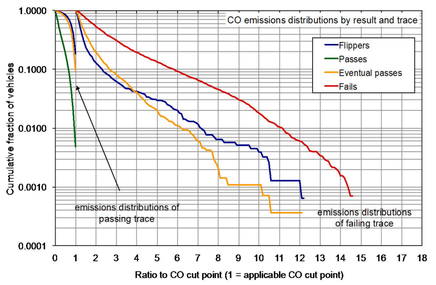
↑ Percent of vehicles that eventually passed that are flippers:

- 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 MY96 in 2006

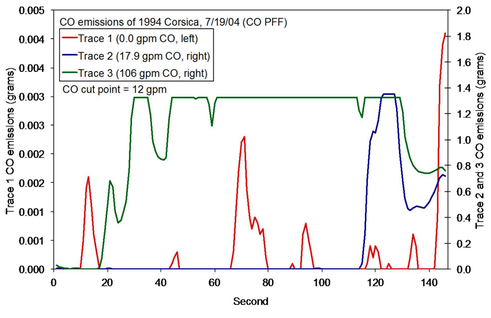


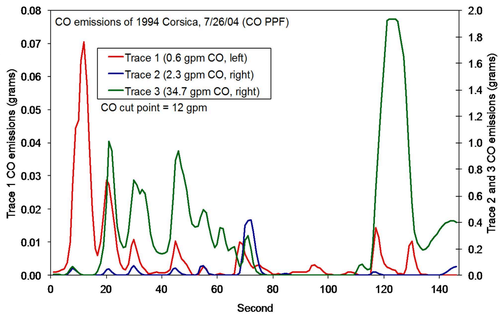


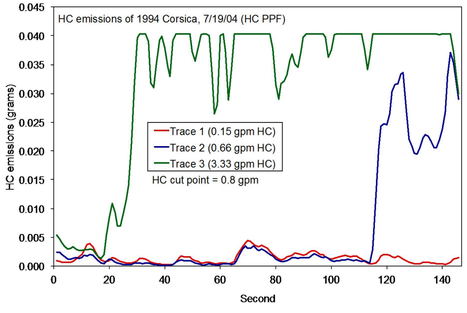


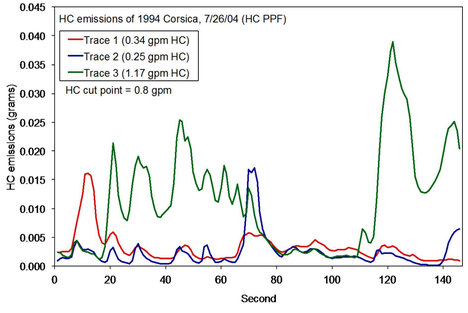
←Vehicles that passed all three traces (green)have much lower emissions than those that failed all three traces (red)

- Flippers have comparable emissions on their failing trace as vehicles that eventually passed: about 95% have slightly lower emissions, while 5% have substantially higher emissions, than vehicles that eventually passed
- Flippers are not passing and failing because of marginally low or high emissions.









↓ Table shows three flipper vehicles tested twice within two weeks (presumably after repair) with same emissions pattern

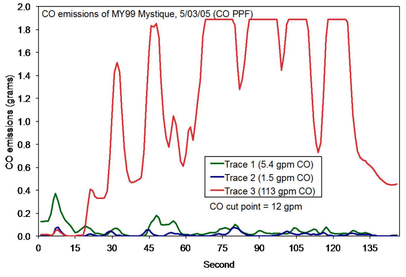
- Increases in CO and HC accompanied by decreases in NOx

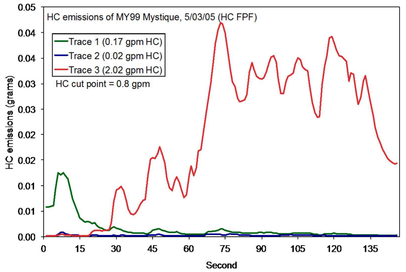
MY	Date	Time			Pass/fail CO			CO grams per mile		
		1	2	3	1	2	3	1	2	3
1994	7/19/04	15:01	15:03	15:06	P	F	F	0.03	17.9	106.0
1994	7/26/04	12:55	12:58	13:00	P	P	F	0.57	2.33	34.6
1995	8/30/04	16:08	16:11	16:13	P	P	F	1.93	10.0	77.
1995	9/2/04	12:42	12:46	12:48	P	F	F	11.0	53.1	126.2
1999	5/3/05	9:28	9:31	9:34	P	P	F	5.43	1.49	113.5
1999	5/6/05	7:59	8:02	8:05	P	P	F	2.24	1.84	88.2

←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 understates actual emissions of failing vehicles

↓ Although rare, OBD vehicles can also be flippers





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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