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Detection of High PM Emitters

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CE-CERT

Smog Check Technology Forum and Roundtable Discussion
South Coast Air Quality Management District
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Sponsor

- Air Resources Board

Co-Investigators

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- ESP: Gary Full
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Overview

- Recruit in-use high PM vehicles
- Characterize PM emissions using standard CVS filter methods
- Characterize emissions with new potential screening methods
- Repair vehicles
- Re-test

Vehicle Identification

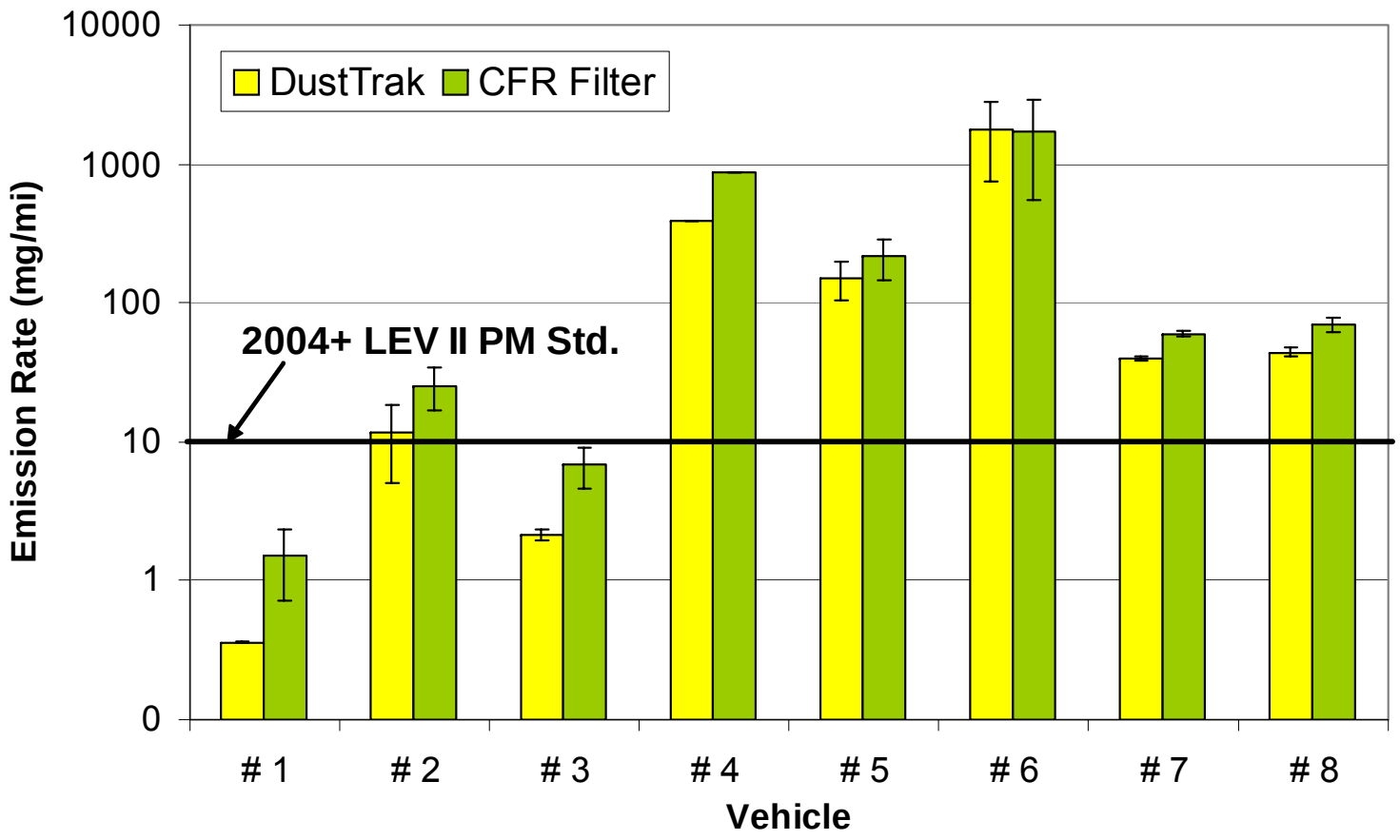
#	MY	OEM	Model	Type	Disp.(L)	Mileage	Target Smoke Type	Target PM (mg/mi)
1	1997	Ford	Escort	PC	2.0	25,598	Normal emitter (no smoke)	< 5
2	1985	Toyota	Camry	PC	2.0	268,423	Light Black (invisible)	25 to 75
3	1991	GMC	Sonoma	LDT	4.3	171,487	Light Blue (invisible)	25 to 75
4	1981	Toyota	Pickup	LDT	2.4	119, 728	Moderate Blue	50 to 500
5	1995	Dodge	Dakota	LDT	2.5	123,974	Moderate Black	50 to 500
6	1963	Studebaker	Avanti	PC	4.6	high	Heavy Blue	50 to 500
7	1998	Toyota	Camry	PC	3.0	82,704	Heavy Black	50 to 500
8	1986	Mitsubishi	Max	LDT	2.0	163,913	Gray	50 to 500

PC = Passenger Car; LDT = Light-Duty Truck.

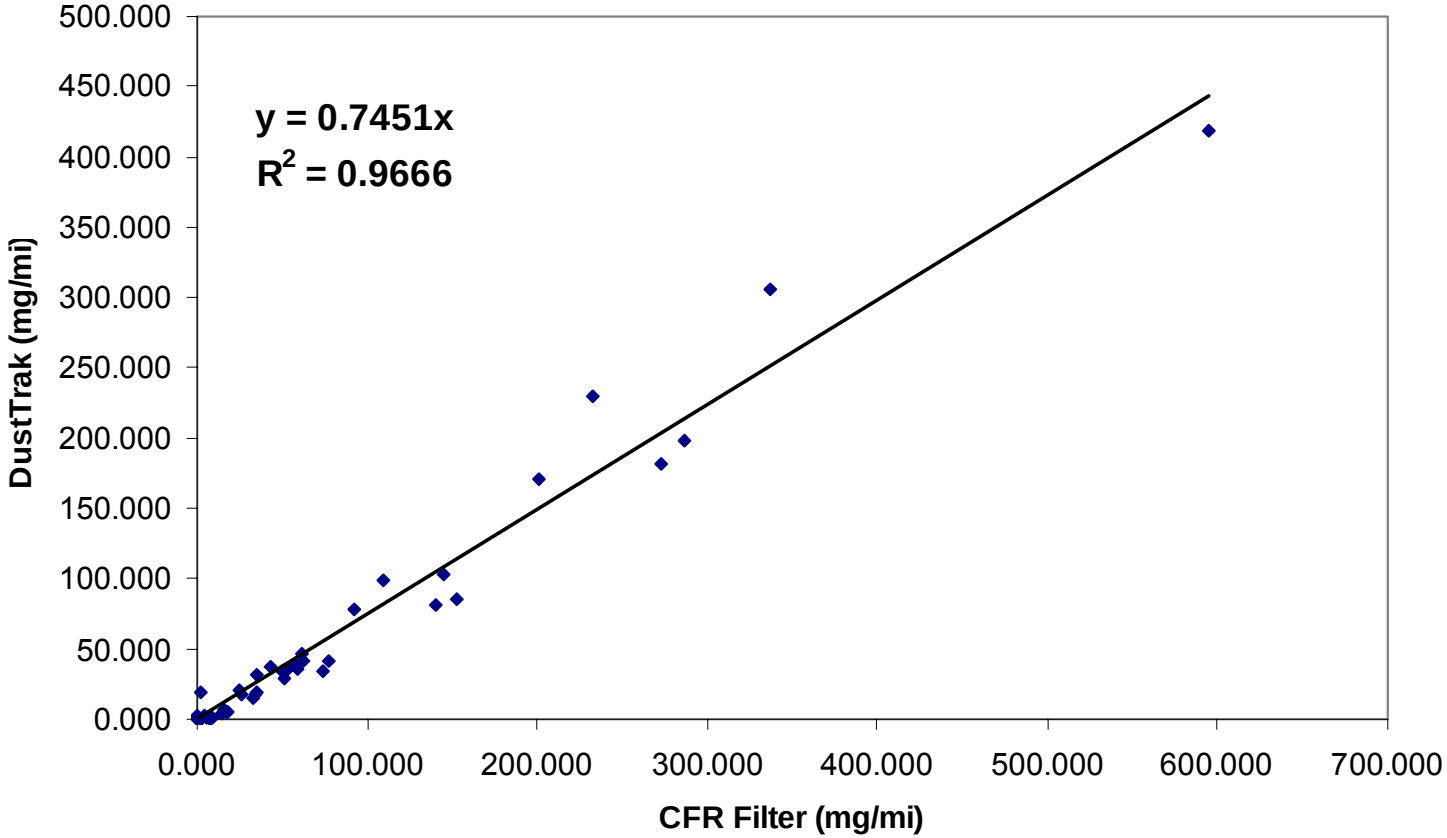
Measurement Approaches

- Standard CVS Testing
  - Filters
  - DustTrak
  - CPC
- Smog Check Screening
  - Mini-CVS with DustTrak
- Remote Sensing Devices
  - UV Transmissometer
  - IR Transmissometer
  - UV Lidar

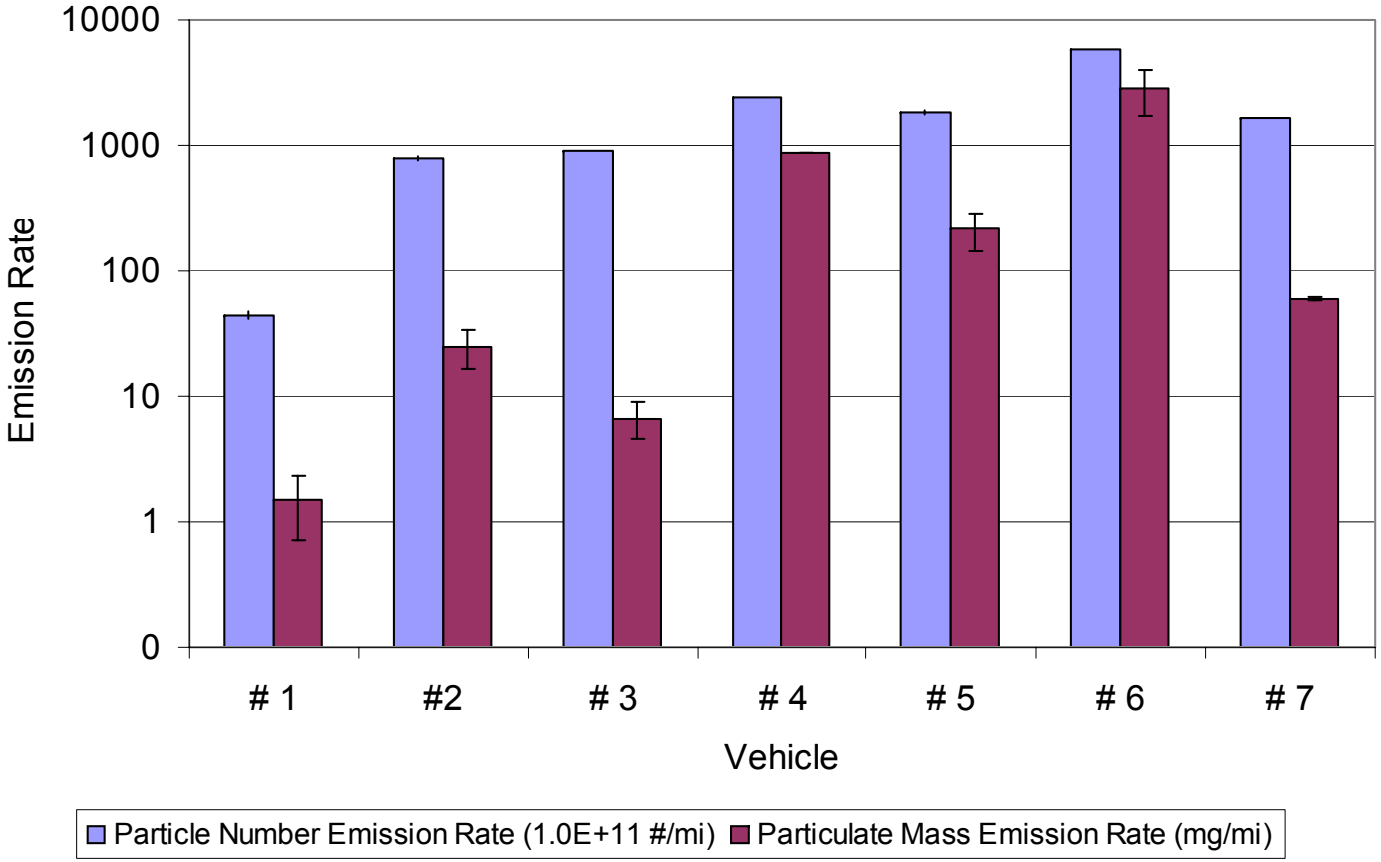
Mass over Unified Cycle



DustTrak Correlation



Particle Number over Unified Cycle



Smog Check Results

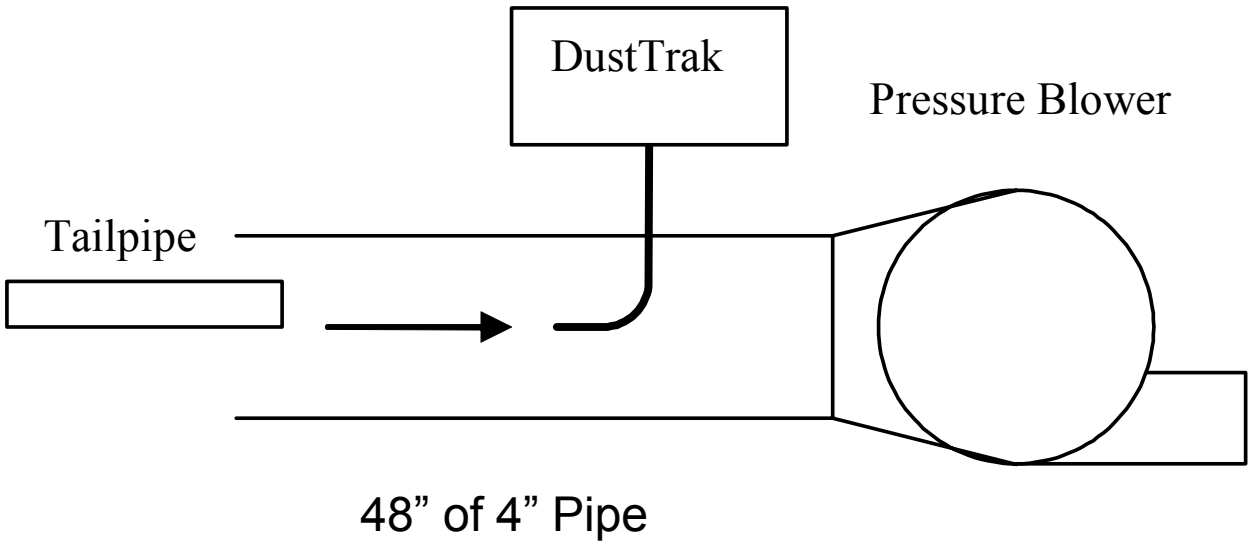
Vehicle	First Smog Check		Second Smog Check	
	Pass	Failed Emissions	Pass	Failed Emissions
1	√		√	
2	√		√	
3	√		×	HC
4	×	HC, NO	×	NO
5	×,GP	HC, ?	×,GP	HC, ?
6	×,GP	HC, CO	×,GP	HC, CO
7	×,GP	HC, CO	×,GP	HC, CO
8	√		×	HC, CO

√ : Pass; ×: Fail; GP: Gross Polluter; ?: Incomplete

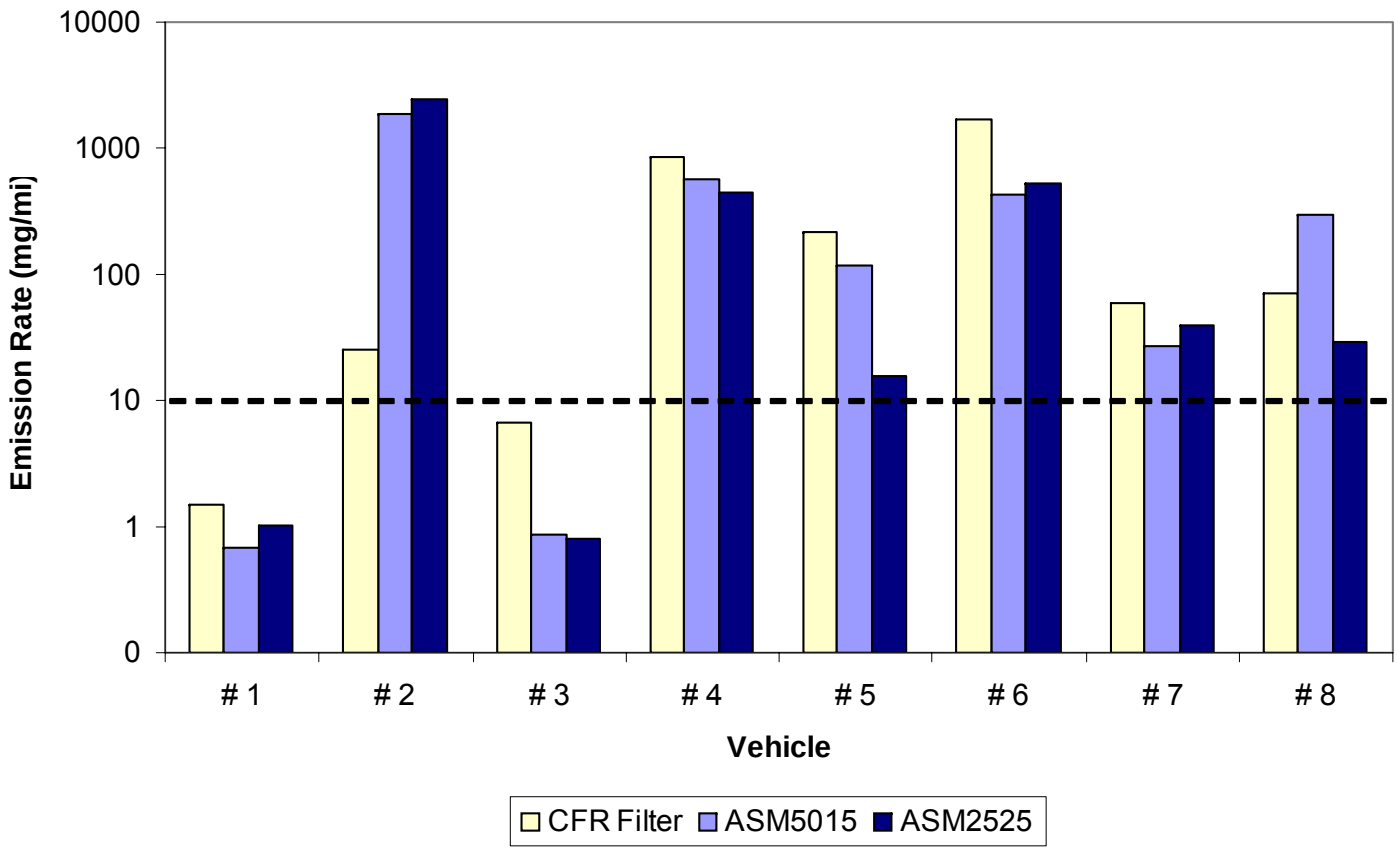
Mini-CVS

- Total Flow = 150 cfm
- Dilution air = Unfiltered ambient air
- Sensor = DustTrak
- Power = 12-volt car battery
- Alternate Sensor = filter + aethalometer

Mini-CVS



Unified Cycle and ASM Mass



Remote Sensing Equipment for PM

- ESP UV Transmissometer
- ESP IR Transmissometer
- DRI UV Lidar

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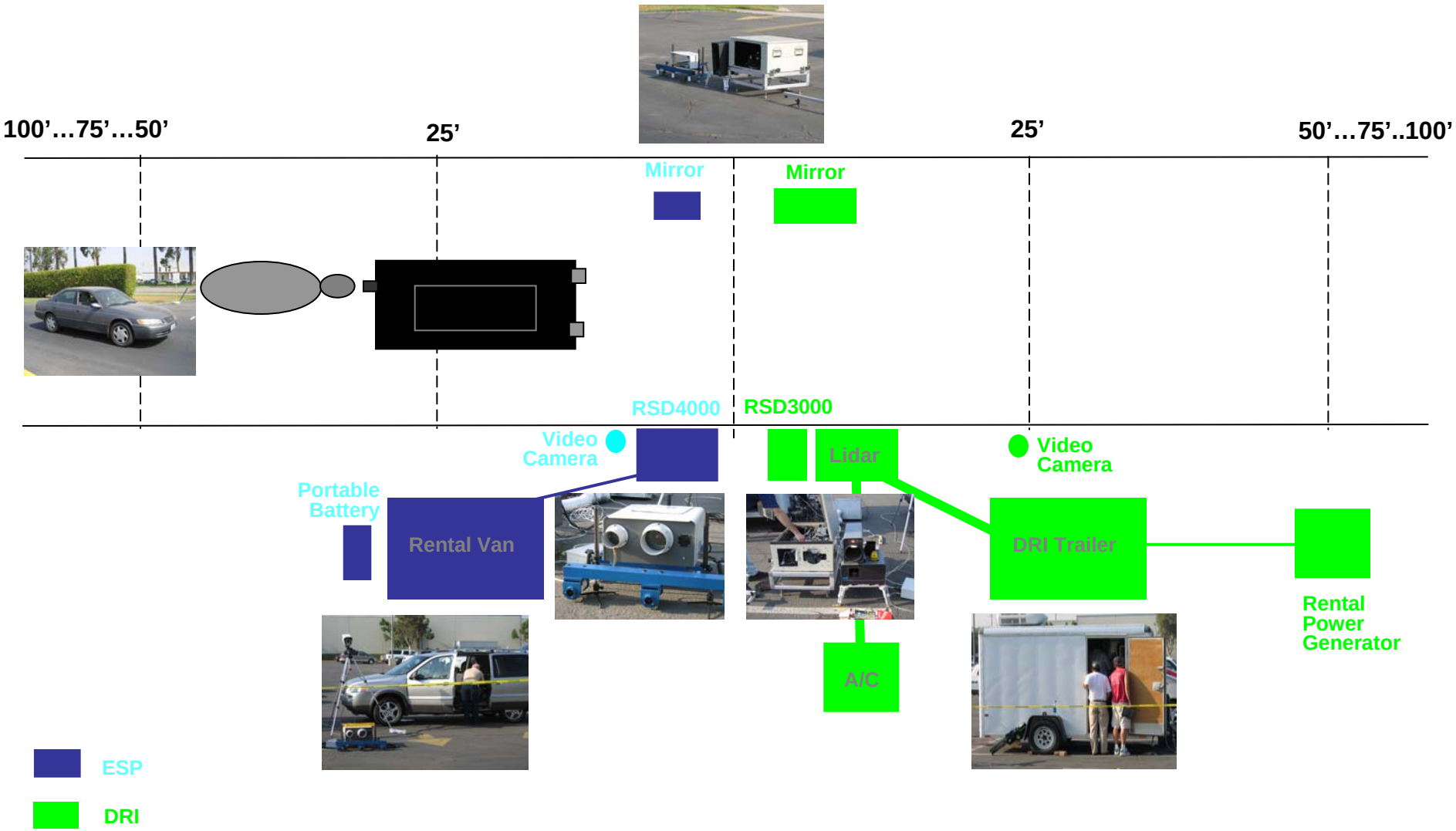
RSD Test Layout



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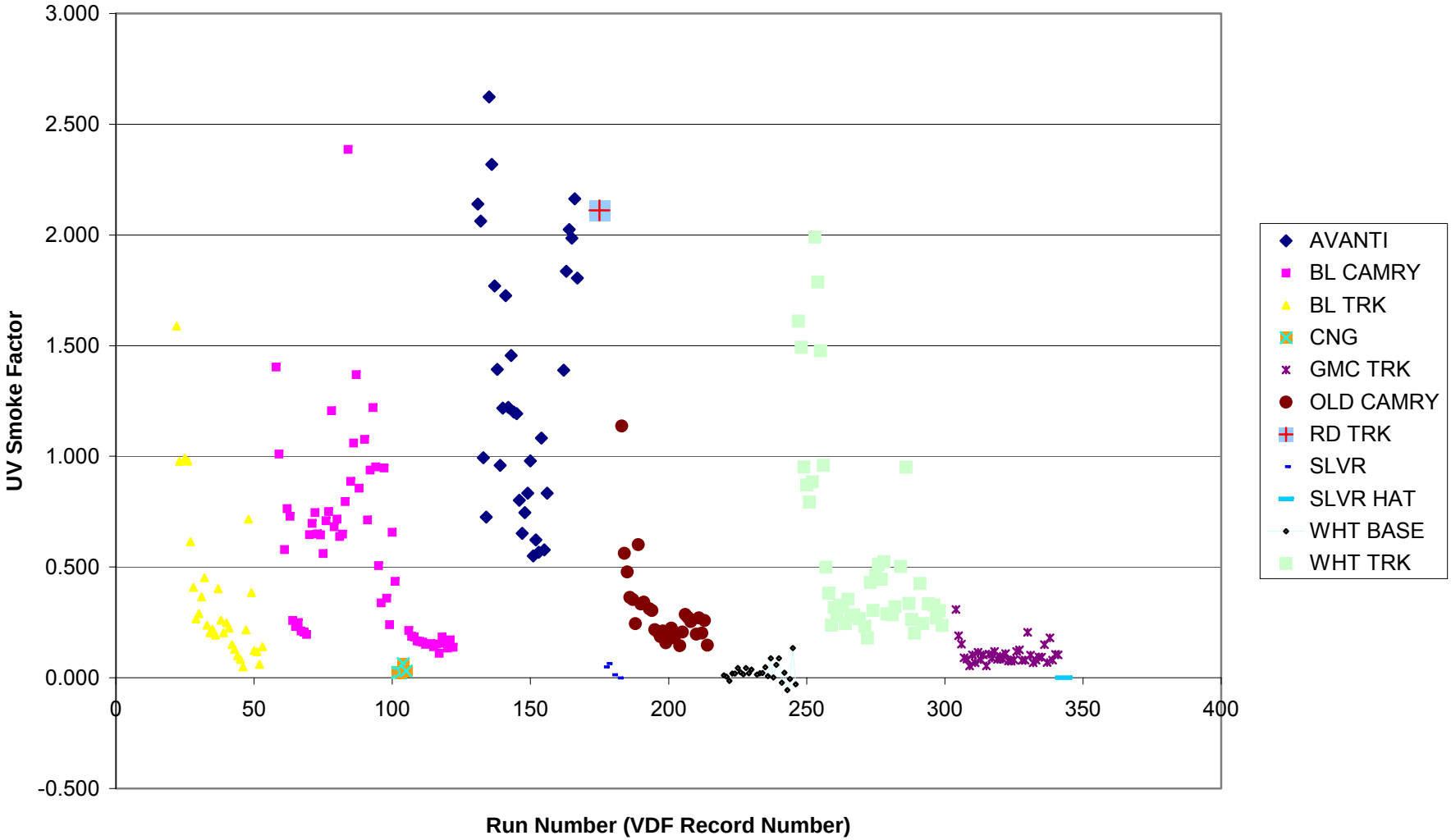
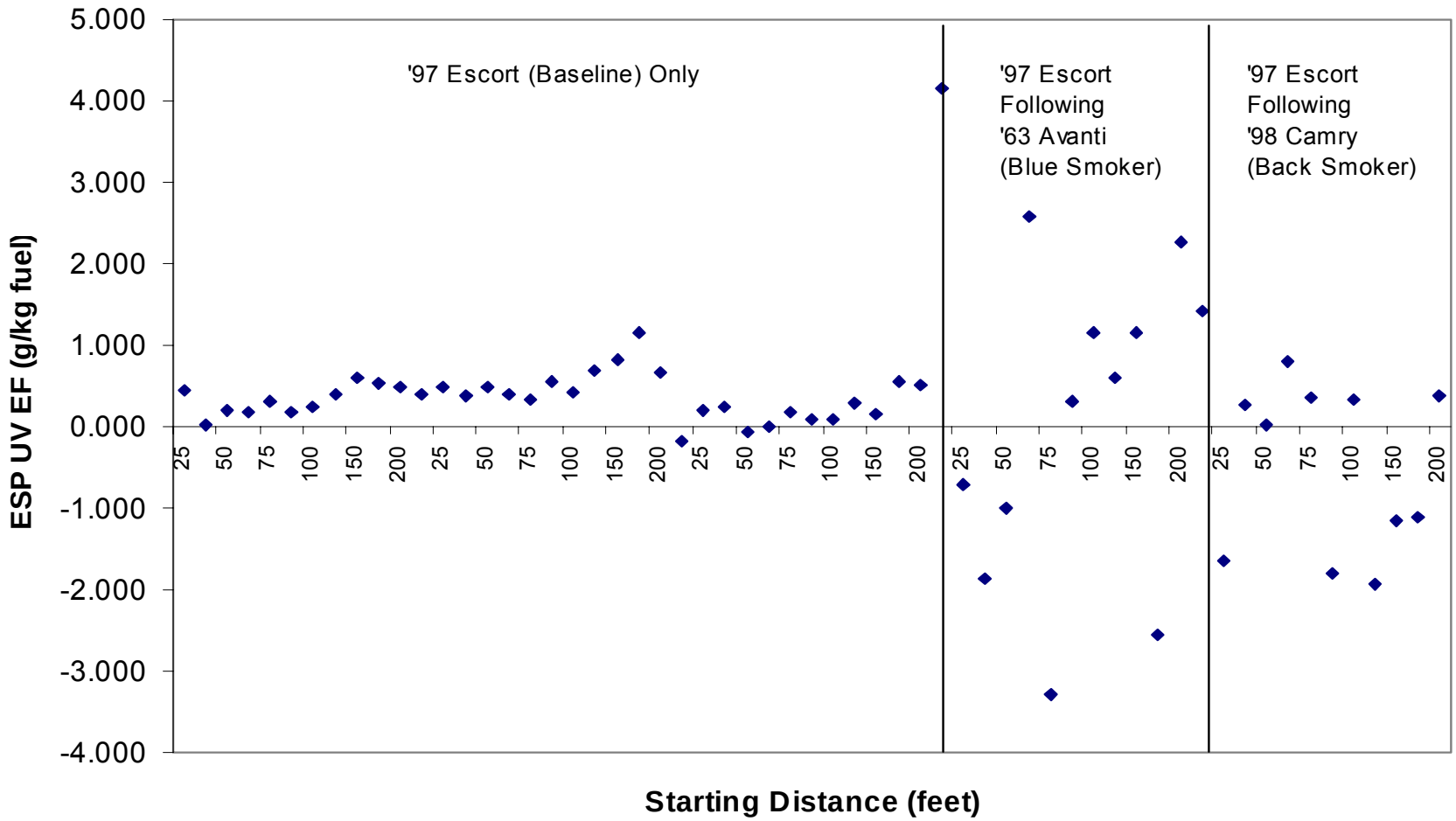
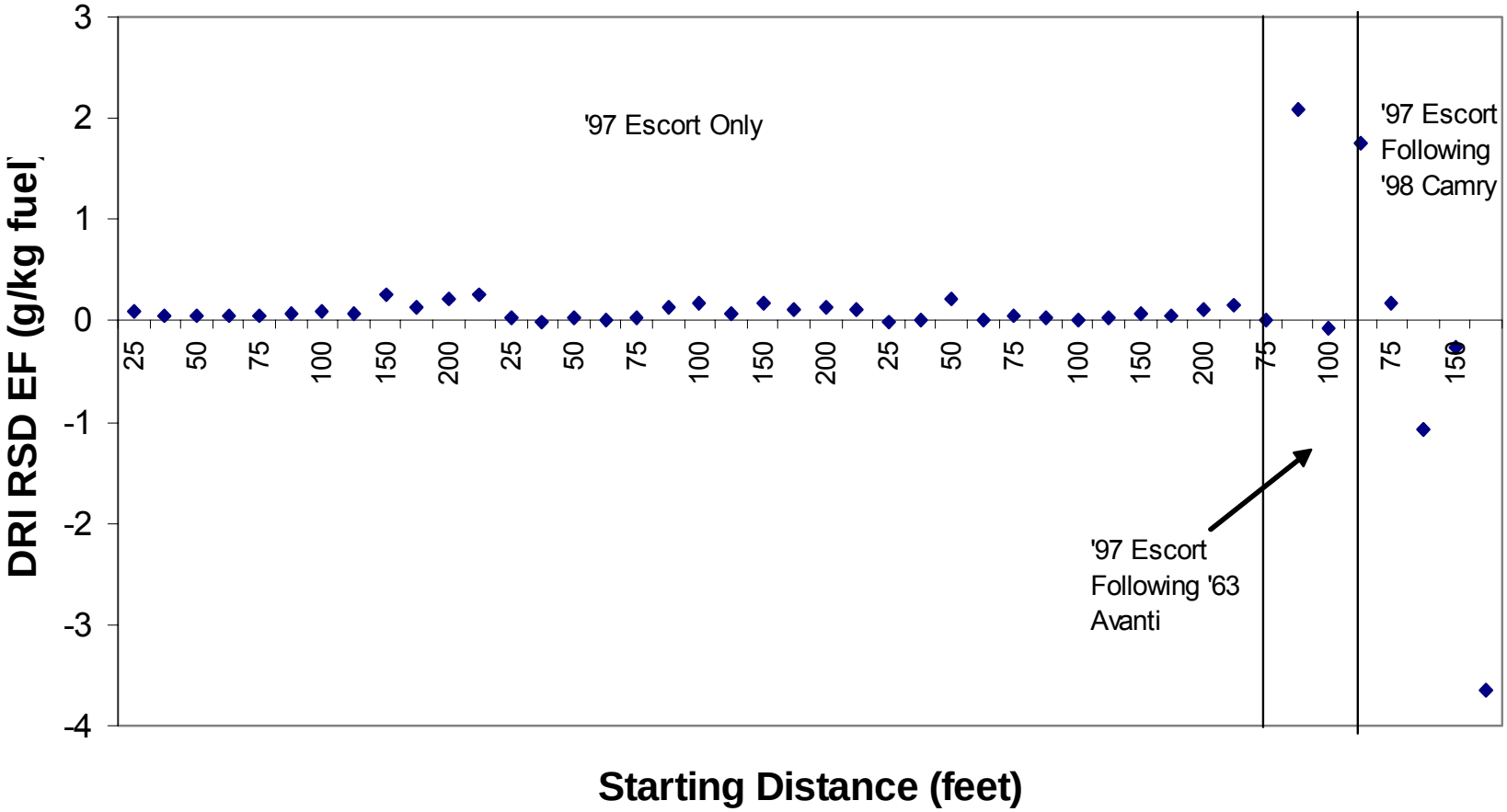
Example RSD Test Day



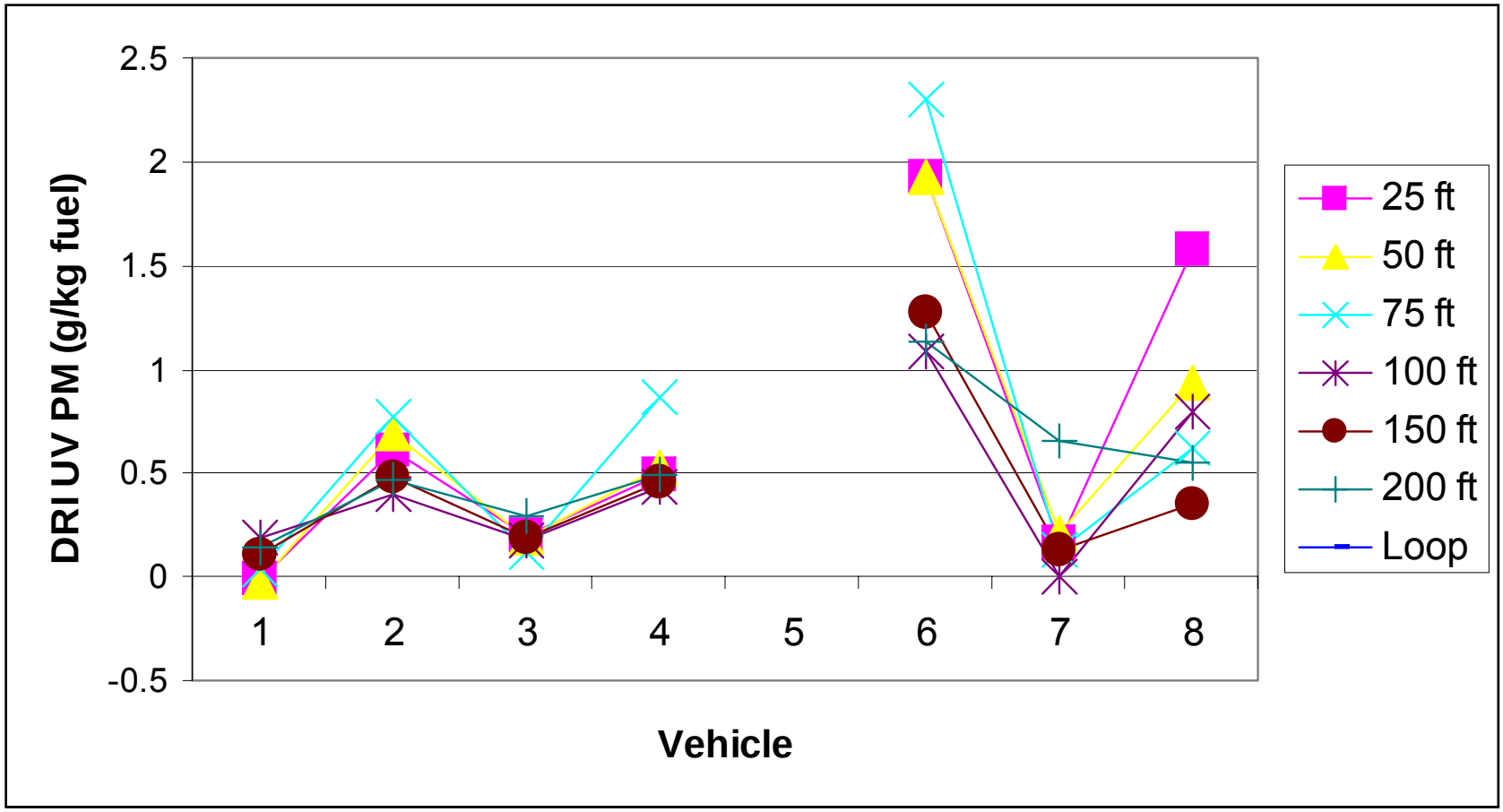
RSD Inter-Vehicle Interference



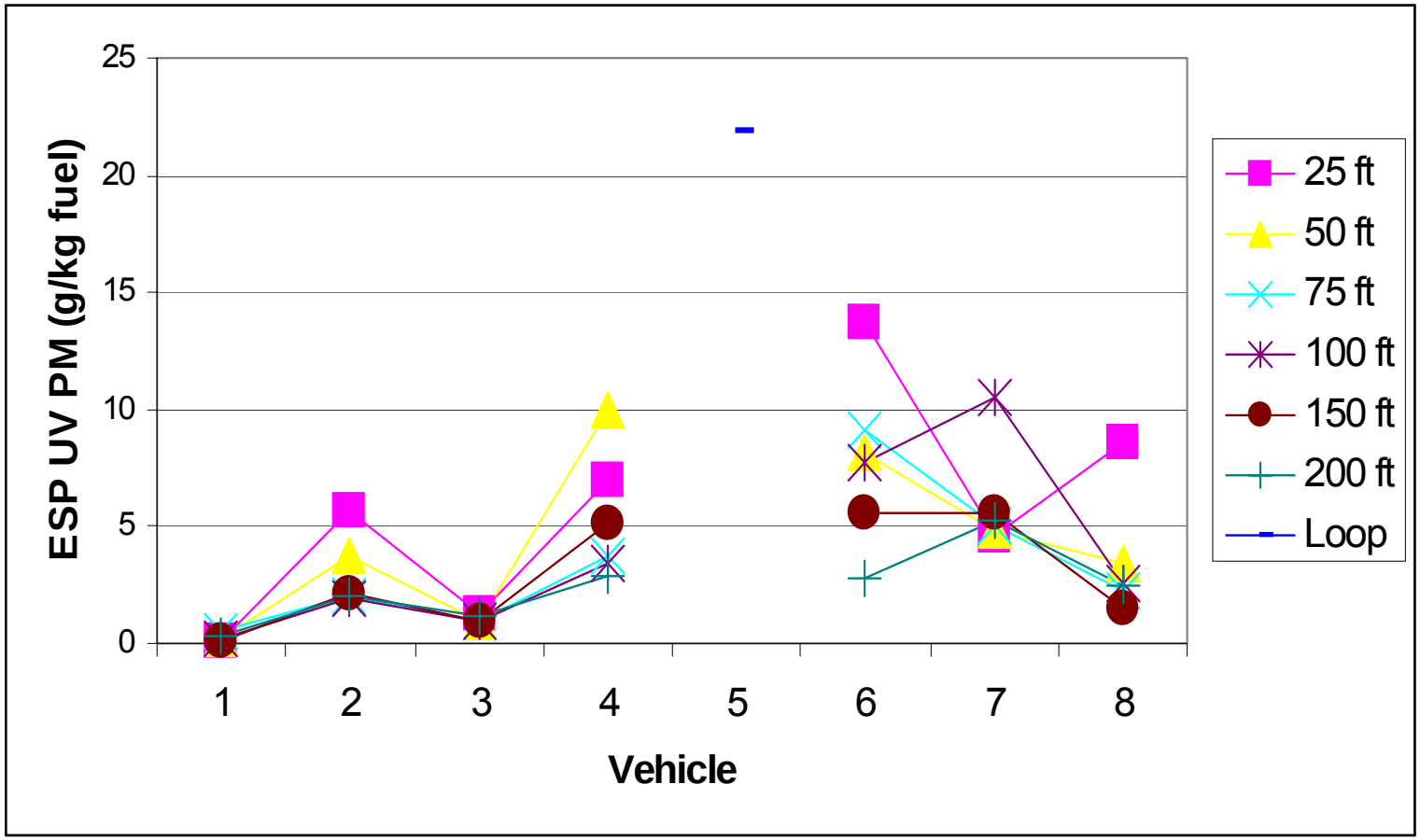
RSD Inter-Vehicle Interference



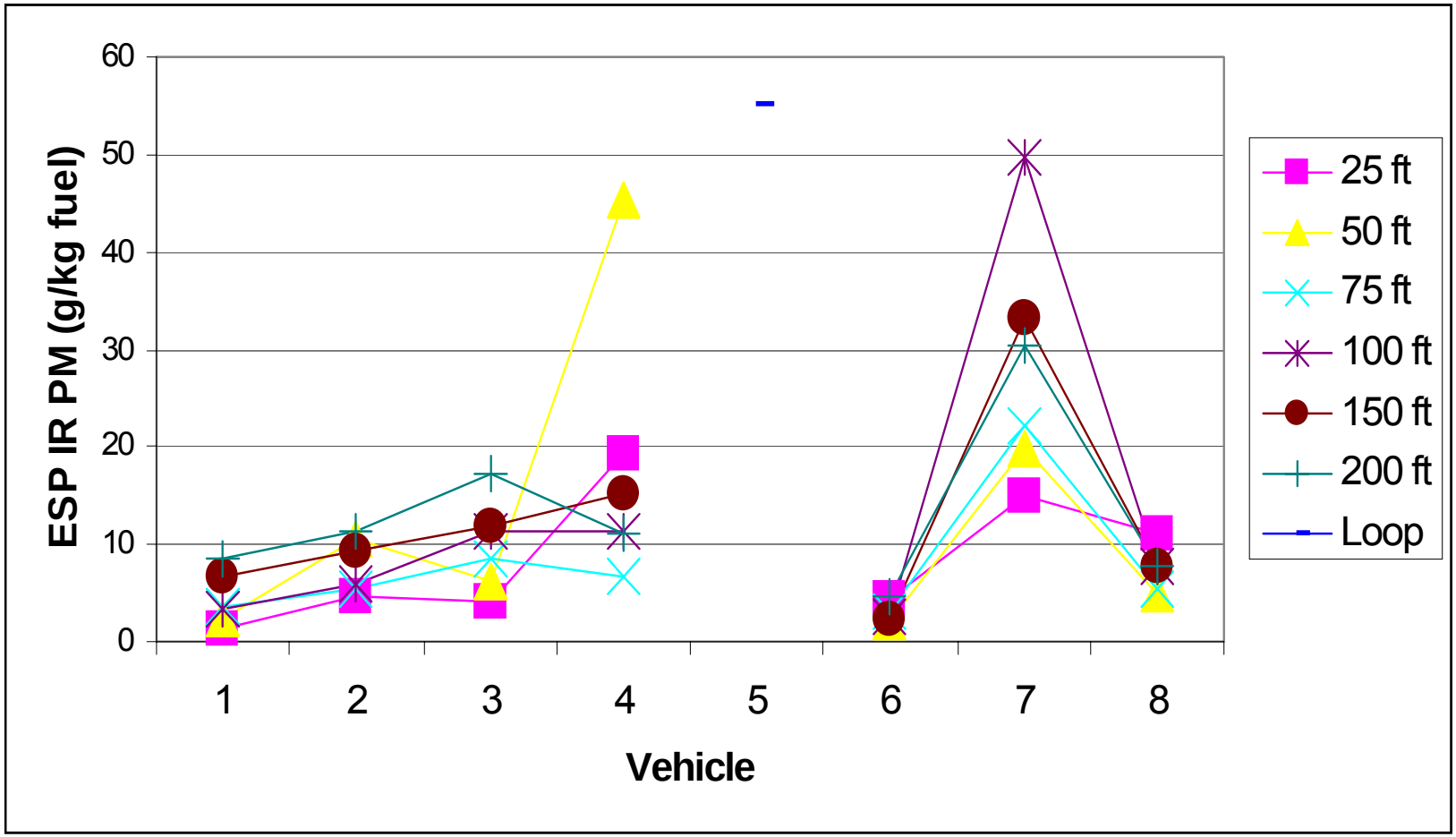
DRI UV Backscatter



ESP UV Transmission



ESP IR Transmission



Vehicle Repair

#	MY	Model	Description	Book	Cost	Repair Needed
1	1997	Escort	Baseline	$2,500	N/A	None
2	1985	Camry	Faint smoke	$ 500	$7,300	Rebuild/new
3	1991	Sonoma	No smoke	$2,000	N/A	(Valve guides)
4	1981	Toy. PU	Blue, Light	$ 500	$6,300	Rebuild/new
5	1995	Dakota	Black, Light	$1,500	$2,200	Fuel and Wiring sys.
6	1963	Avanti	Blue, Heavy	$9,500	N/A	Rebuild
7	1998	Camry	Black, Heavy	$6,500	$2,000	O2 Sensor, Catalyst
8	1986	Max	Grey	$1,000	$1,700	Valve guide, Carb.

Conclusions to Date

- Supplemented ASM testing and RSD testing are each capable of identifying high-PM emitting vehicles.
- Each would require development of standardized test conditions.
- Quantitative relationships with standard emission test procedures has not been established.
- The cost of repairing high-PM emitters in our test sample was generally more than the value of the vehicle.