

# **Measurements of PM Traps**

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# Characterizing Very Low PM Emissions

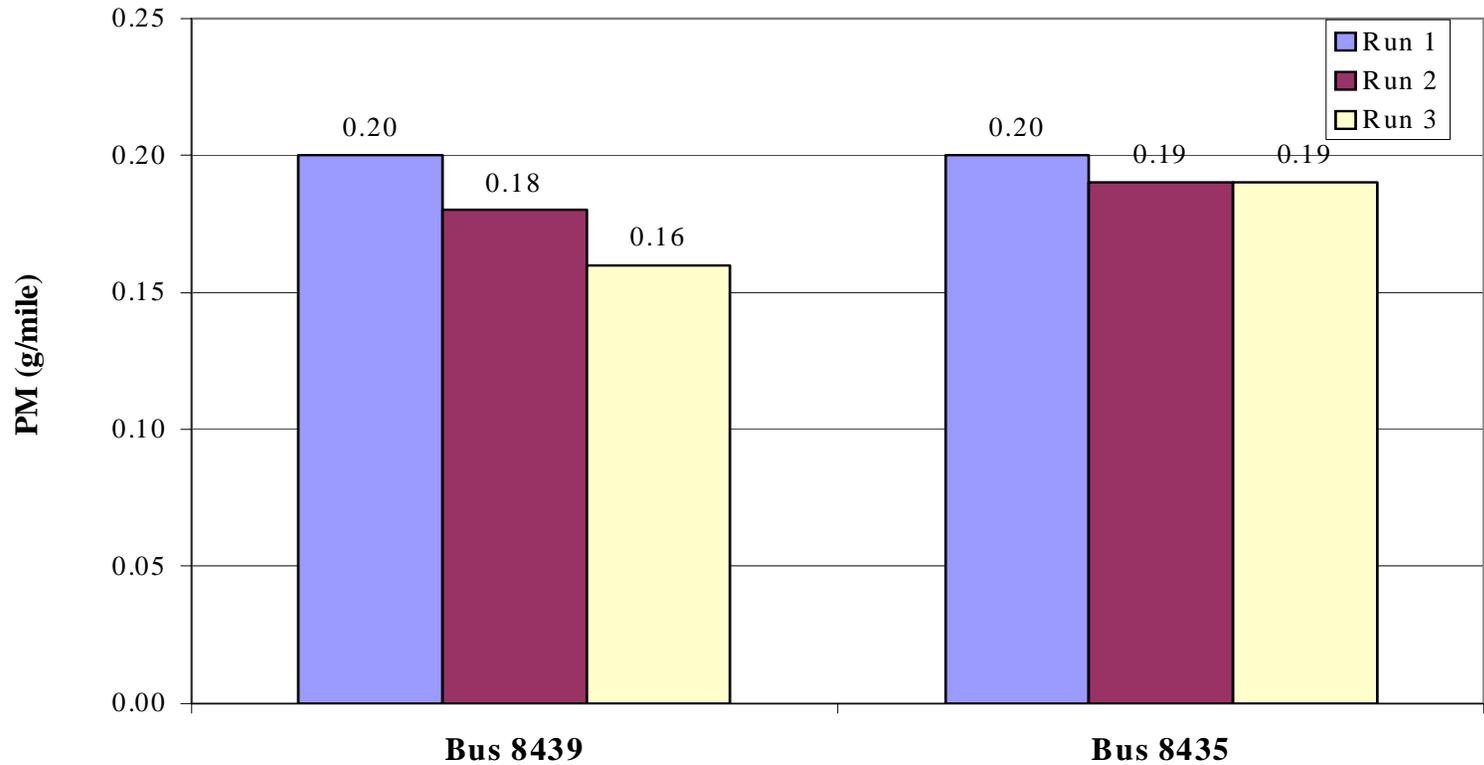
- Diesel engines over the past decade have been certified to 0.1 g/bhp-hr PM
- This translates to 0.1 to 0.2 g/mile for typical chassis cycles
- PM Traps reduce the PM mass by one to two orders of magnitude
- PM mass becomes difficult to characterize

# Gathering of Vehicle Data



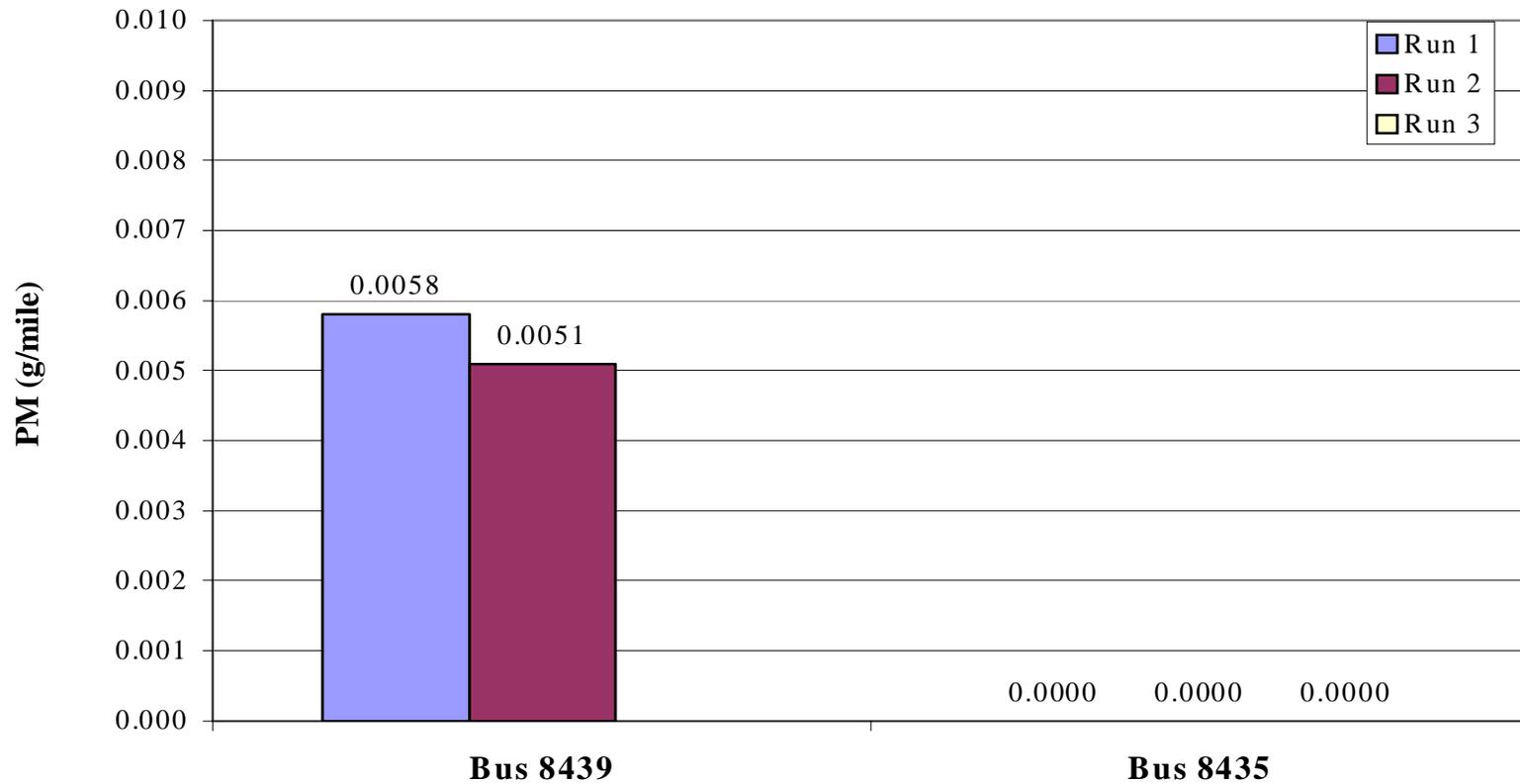
# Typical Chassis Emissions No Trap

Round 1: PM emissions without DPX (San Diego School Bus)



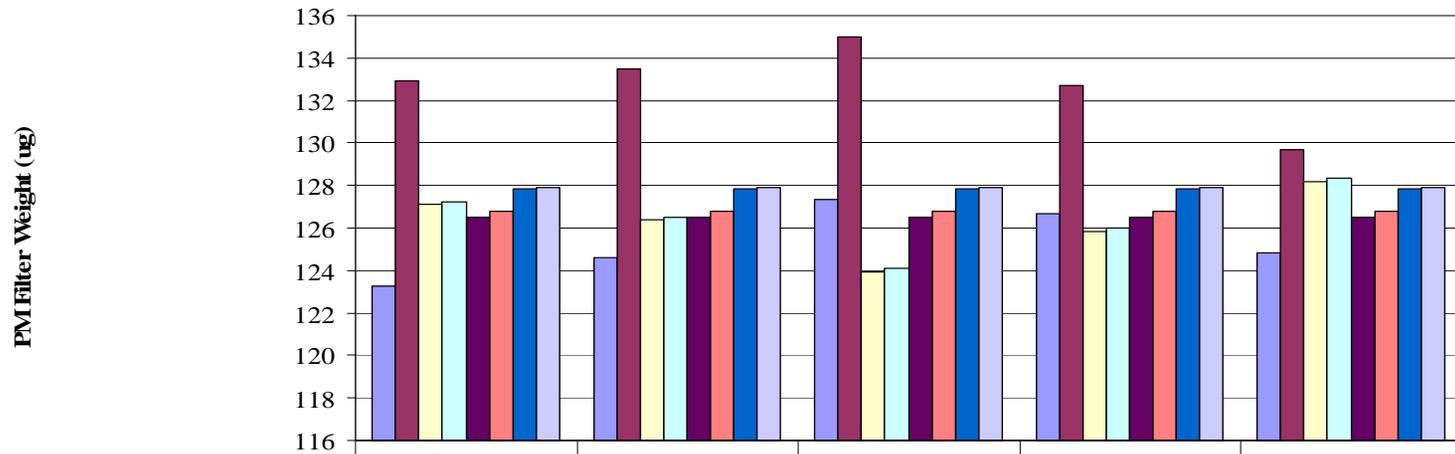
# Low Chassis PM with DPX

Round 1: PM Emissions with DPX (San Diego School Bus)



# Filter Weights CSHVR No Trap

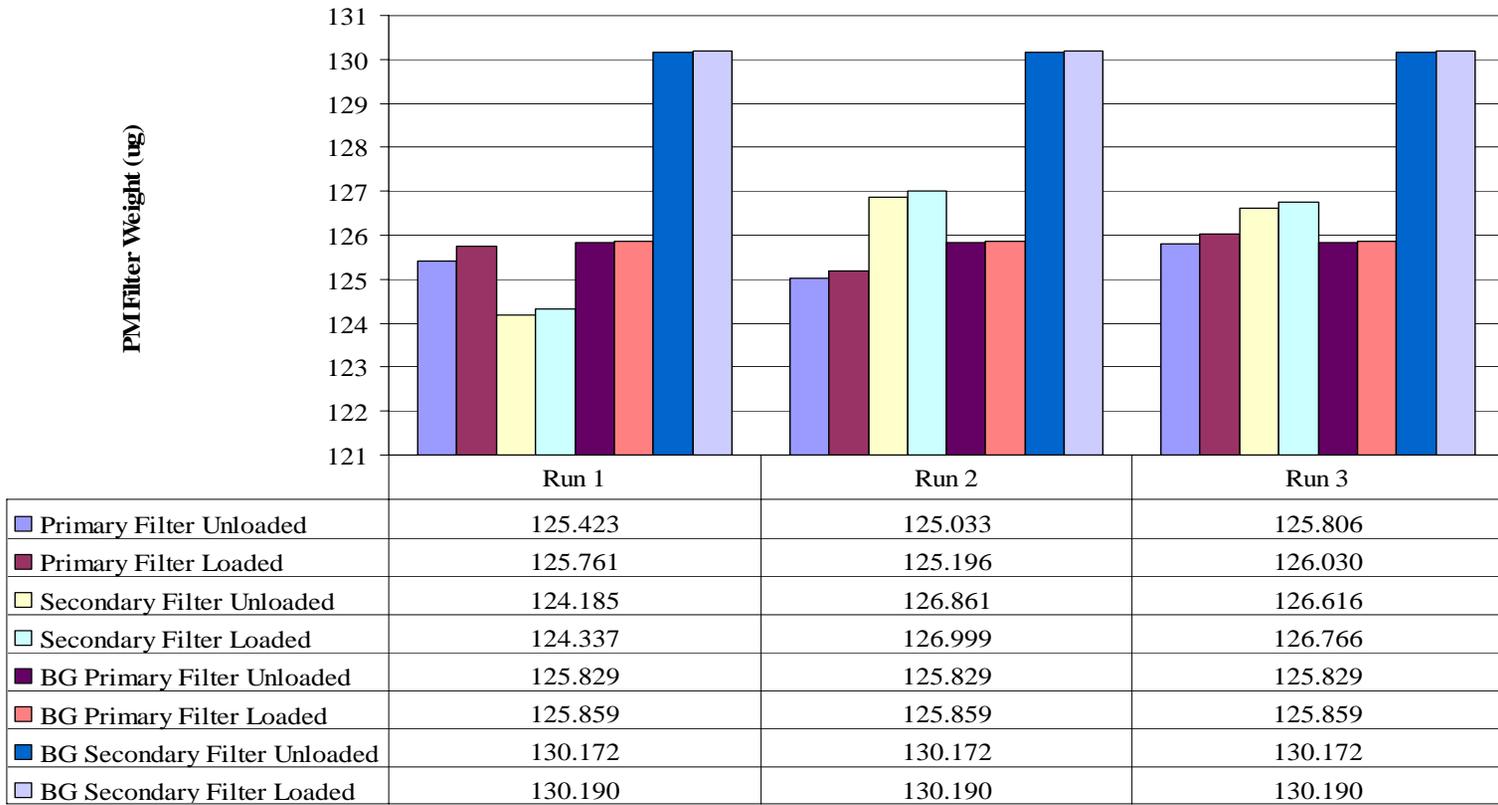
**Round 1: PM Filter Weight without PM Trap (Ralph's Grocery Truck)**



	Run 1	Run 2	Run 3	Run 4	Run 5
Primary Filter Unloaded	123.268	124.618	127.366	126.689	124.836
Primary Filter Loaded	132.930	133.508	135.007	132.684	129.681
Secondary Filter Unloaded	127.105	126.386	123.956	125.860	128.184
Secondary Filter Loaded	127.208	126.516	124.081	125.992	128.327
BG Primary Filter Unloaded	126.522	126.522	126.522	126.522	126.522
BG Primary Filter Loaded	126.764	126.764	126.764	126.764	126.764
BG Secondary Filter Unloaded	127.833	127.833	127.833	127.833	127.833
BG Secondary Filter Loaded	127.910	127.910	127.910	127.910	127.910

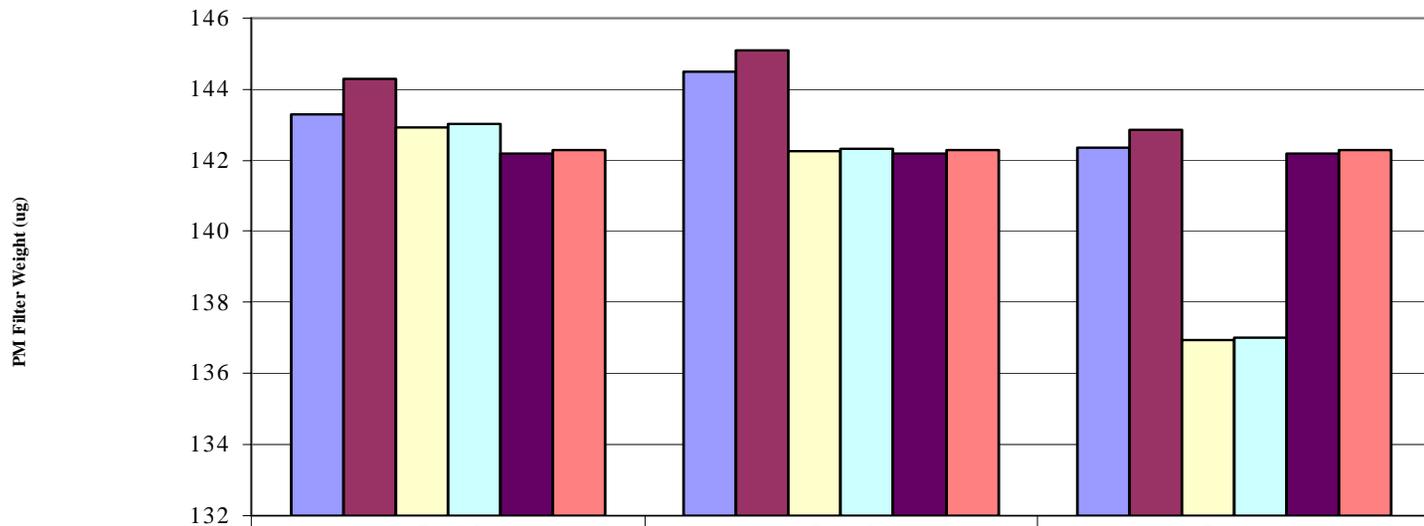
# Filter Weights 2xCSHVR CRT

**Round 1: PM Filter Weight with PM Trap (Ralph's Grocery Truck)**



# Bus Filter Weights - with CRT

**Round 2: PM Filter Weight with DPX (San Diego School Bus)**



	Run 2	Run 3	Run 4
Primary Filter Unloaded	143.305	144.502	142.349
Primary Filter Loaded	144.282	145.114	142.864
Secondary Filter Unloaded	142.908	142.246	136.946
Secondary Filter Loaded	143.019	142.332	137.001
BG Primary Filter Unloaded	142.192	142.192	142.192
BG Primary Filter Loaded	142.284	142.284	142.284

Importance of knowing the precise  
dilution ratio, which differs from the  
CFR dilution factor

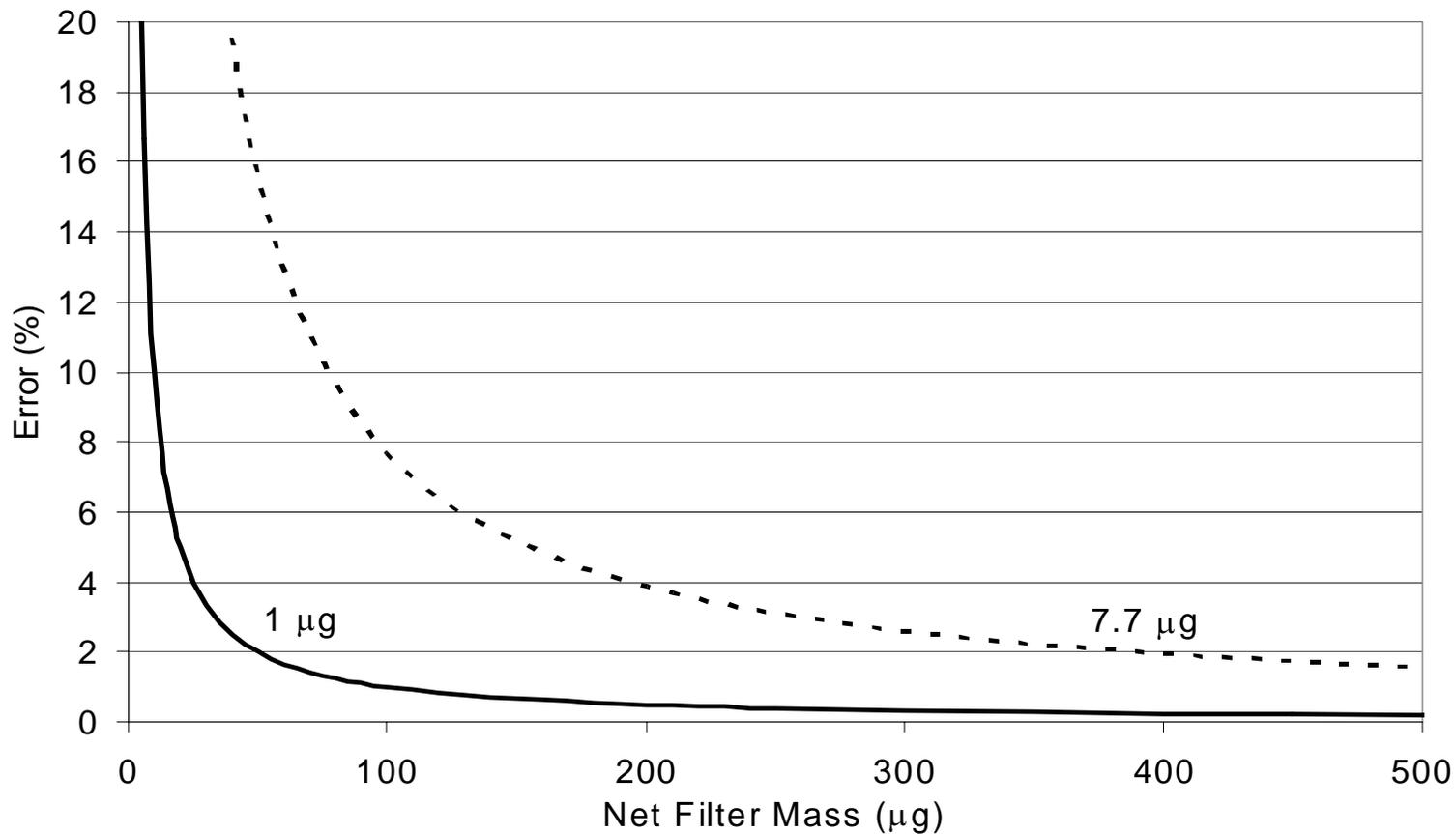
$$P = (V_{MIX} + V_{SF}) \left[ \frac{P_F}{V_{SF}} - \left( \frac{P_{BF}}{V_{BF}} \left[ 1 - \frac{1}{DF} \right] \right) \right]$$

# Filter Weighing Test Program

(Conducted by Greg Thompson)

- Five researchers weighed filters
- Cahn 32 & Mettler-Toledo UMX2 used
- 624 total measurements with 39 70mm filters
- Average standard deviations were 7.4 micrograms and 7.7 micrograms for the two scales.

# Results of Weighing Tests



# Conclusions

- PM Traps reduce the PM mass substantially, leading to difficulties in quantifying PM mass and hence “percent reduction of PM”
- For the field measurements, primary filter net mass was between 150 and 900 micrograms
- This primary filter alone may not meet a 2% accuracy requirement