



PM2.5 Federal Reference Method Bridging the Gap between Laboratory and Field Operations

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Overview

- Common Goal
- Field Criteria
- Laboratory Operations Overview
- Minimizing Invalidations
- Communication
- Quiz

Common Goal

- We are in it together



CARB – Field Staff Responsibilities



Importance of Each Sample

- For a site to gain/maintain attainment status, three years of complete data for that site is required.
- A year meets data completeness requirements when the quarterly data capture rates for all four quarters are at least 75 percent.
- Having data completeness <75% can result in non-attainment status.



COMMUNICATION



Field Staff “Authorities”

- Invalidate samples based on field criteria before sending to lab
 - Lab staff will not invalidate field criteria
 - Document on Field Report/CoC
- Request Make-ups from Lab
 - Indicate on Field Report/CoC that sample is make-up
 - Know Make-up “Rules”

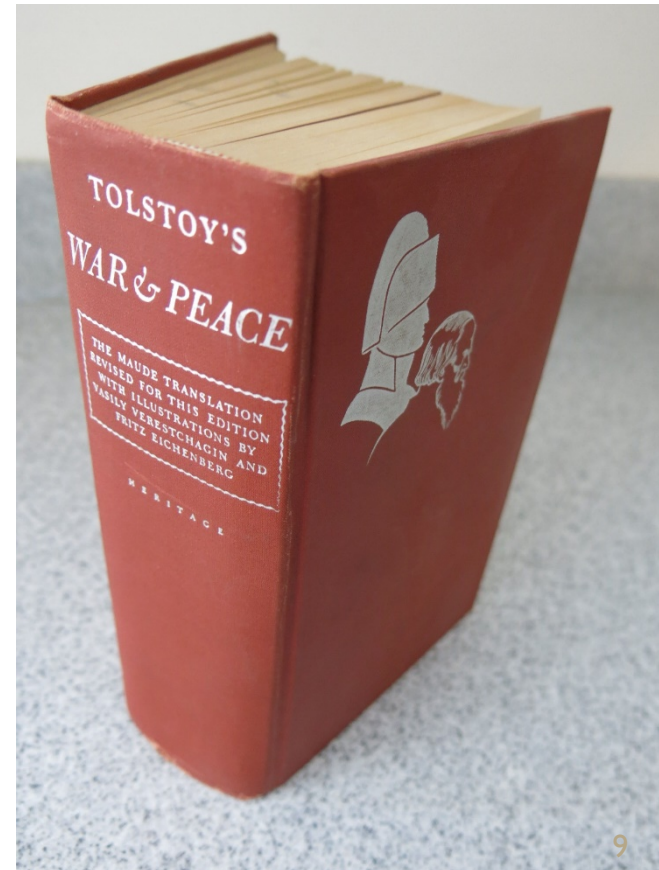


Make-up Sample Rules

- Valid PM_{2.5} make-up samples must run prior to the next sampling day or exactly seven days after the missed or invalid sample.
 - US EPA regulations (40 CFR Part 50, Appendix N)

Field Guiding Documents

- SOPs
- Technical Bulletins
- EPA QA Handbook for Air Pollution Measurement Systems, Volume II



Document Properly

- Include appropriate information on the form.
- The more information the better.
- Write clearly. Blue or black ink only. No pencil. No white out. Strike out and initial changes.



CARB 24 Hour – FIELD SAMPLE REPORT
Federal Reference Monitor (FRM) PM 2.5 Samplers

Bar Code:	PF000001
LIMS Sample ID:	

Site Name: Sacramento 13T
 AIRS Site Number: 34-305
 Field Technician: John Doe
 Agency: CARB

Cassette I. D. Number: R100
 Scheduled Sampling Date: 1/1/16
 Sampler Property #: 20150000

SAMPLE SUMMARY

Start Date / Time: 1/1/16 / 0000
 Total Elapsed Time: 24:00 Hr:min
 Volume: 24.0 M³
 Flow CV: 0.08 %

	MIN	AVG	MAX
Ambient Temp(°C):	20	25	30
Filter Temp (°C):	22	25	28
Pressure (mmHg):	759	760	761

Local Condition Codes: A, J

Sampler Property Codes: None

- | | |
|------------------------------------|---------------------------------|
| <u>A</u> . High Winds | <u>E</u> . Forest Fire |
| <u>K</u> . Farming Nearby | <u>J</u> . Construction Nearby |
| <u>N</u> . Sanding/Salting Streets | <u>L</u> . Highway Construction |
| <u>P</u> . Roofing Operations | <u>Q</u> . Prescribe Burn |

- | |
|--|
| <u>F</u> . Flowrate 5-min average, out of spec |
| <u>T</u> . Filter Temp differential, 30 minutes interval out of spec |
| <u>E</u> . Elapsed sample time, out of spec |

Operator Comments: High winds during sample run, construction nearby

Chain of Custody

ACTION	DATE	TIME	FILTER TEMP °C	NAME
Sample Load	12/31/15	0900		John Doe
Sample Removal	1/2/15	0900		John Doe
Sample placed in freezer	1/2/15	0905		John Doe
Sample shipped to Lab	1/2/15	1100	0	John Doe
Sample received at Lab				
Start post-conditioning				

FOR LABORATORY USE ONLY

Postweigh by:	Mass:	Dup Mass:	Date:	Analyst:	
	Preweight	371.005	371.004	12/15/15	ZZ
	Postweight				

Lab Comments: _____

Field Critical Criteria

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{2.5} Filter Based Local Conditions			
Field Activities			
<i>Sampler/Monitor</i>	NA	<i>Meets requirements listed in FRM/FEM/ARM designation</i>	1) 40 CFR Part 58 App C Section 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
<i>Pre-sampling</i>	<i>all filters</i>	<i>< 30 days before sampling</i>	1,2 and 3) 40 CFR Part 50, App.L Sec 8.3.5
<i>Sample Recovery</i>	<i>all filters</i>	<i>< 7 days 9 hours from sample end date</i>	1,2 and 3) 40 CFR Part 50, App. L 10.10
<i>Sampling Period (including multiple power failures)</i>	<i>all filters</i>	<i>1380-1500 minutes, or if value < 1380 and exceedance of NAAQS ^{1/} midnight to midnight local standard time</i>	1, 2 and 3) 40 CFR Part 50 App L Sec 3.3 and 40 CFR Part 50 App N section 1 for the midnight to midnight local standard time requirement See details if less than 1380 min sampled
<i>Sampling Instrument</i>			
<i>Average Flow Rate</i>	<i>every 24 hours of op</i>	<i>average within 5% of 16.67 liters/minute</i>	1, 2 and 3) Part 50 App L Sec 7.4.3.1
<i>Variability in Flow Rate</i>	<i>every 24 hours of op</i>	<i>CV < 2%</i>	1, 2 and 3) 40 CFR Part 50, App .L Sec 7.4.3.2
<i>One-point Flow Rate Verification</i>	<i>every 30 days</i>	<i>< ± 4.1% of transfer standard < ± 5.1% of flow rate design value</i>	1, 2 and 3) 40 CFR Part 50, App .L, Sec 9.2.5 and 7.4.3.1 and 40 CFR Part 58, Appendix A Sec 3.2.1
<i>Design Flow Rate Adjustment</i>	<i>After multi-point calibration or verification</i>	<i>< ± 2.1% of design flow rate</i>	1,2 and 3) 40 CFR Part 50, App. L, Sec 9.2.6
<i>Individual Flow Rates</i>	<i>every 24 hours of op</i>	<i>no flow rate excursions > +5% for > 5 min. ^{1/}</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 7.4.3.1
<i>Filter Temp Sensor</i>	<i>every 24 hours of op</i>	<i>no excursions of > 5° C lasting longer than 30 min ^{1/}</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 7.4.11.4
<i>External Leak Check</i>	<i>Before each flow rate verification/calibration and before and after PM_{2.5} separator maintenance</i>	<i>< 80.1 mL/min (see comment #1)</i>	1) 40 CFR Part 50 App L, Sec 7.4.6.1 2) 40 CFR Part 50 App L Sect 9.2.3 and Method 2-12 Section 7.4.3 3) 40 CFR Part 50, App. L, Sec 7.4.6.1
<i>Internal Leak Check</i>	<i>If failure of external leak check</i>	<i>< 80.1 mL/min</i>	1) 40 CFR Part 50, App. L, Sec 7.4.6.2 2) Method 2-12 7.4.4 3) 40 CFR Part 50, App. L, Sec 7.4.6.2

https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/PM2.5_Val_Template_4_27_16.pdf

Field Criteria – Holding Times

- Filters sampled more than 30 days from their pre-weight date – Invalid
- Samples left on sampler >7.4 days – Invalid
- Return the samples to the lab promptly



Field Criteria – Sample Period

- Non-midnight Start Times - Invalid
 - Midnight to Midnight - Valid
- Runs 24 Hours \pm 1 are valid
 - One exception for runs between 18 and 23 hours – may be valid. Run a make-up in this situation.



Field Criteria – Flow

- Average Flow Rate: within 5% of 16.67 liters/min - Valid
- Variability in Flow Rate: $CV < 2\%$ - Valid

Field Criteria – Damaged Filters

- Can be unavoidable ☹️ but take a precautions to avoid.
- For the sequential samplers, making sure the piston is in the correct position is important.



Field Criteria – Damaged Filters

- Make sure the piston is in the correct position – align with 'J' notch





Summary

- Use appropriate reference documentation
- Adhere to proper holding time requirements
- Make sure sample runs for the sampling duration
- Verify flow criteria met
- Be careful handling the filters and limit damage

PM 2.5 Filters During Camp Fire

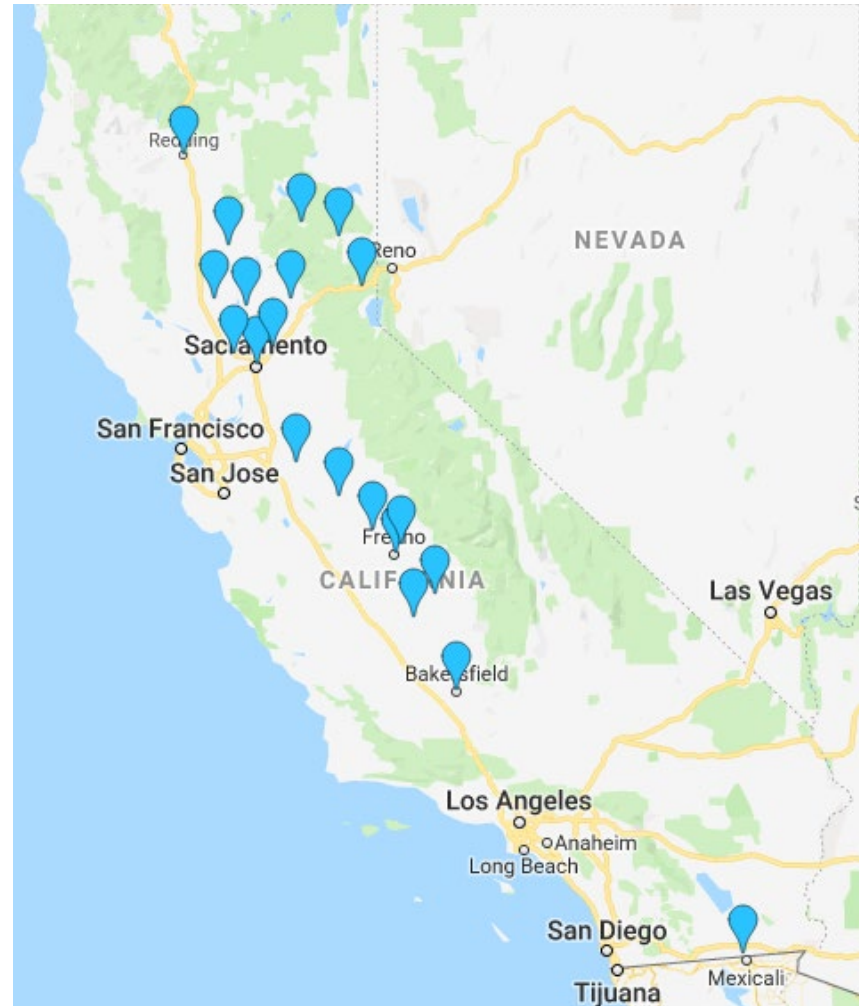


Lab Operation Overview

- 38 Sites Total
- 6,000 filters processed per year
 - Pre- and Post- weights > 12,000 per year



Lab Operation Overview



Guiding Documents

- SOPs – MLD 055
- QAPPs – Particulate Matter Monitoring
- Technical Bulletins
- EPA QA Handbook for Air Pollution Measurement Systems, Volume II
- EPA Quality Assurance Guidance Document 2.12

Lab Operation Overview - Criteria

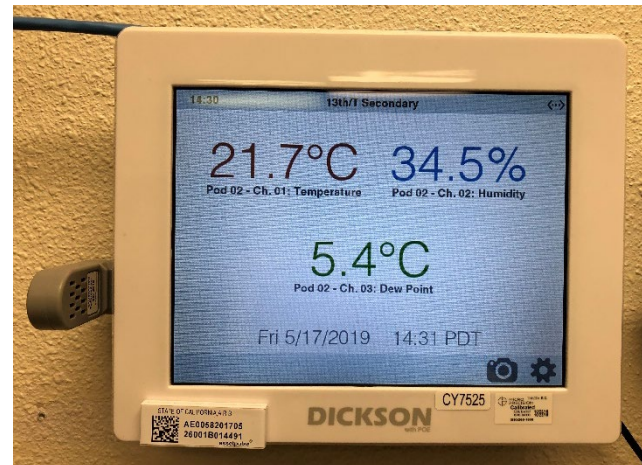
- EPA QA Handbook for Air Pollution Measurement Systems, Volume II
 - Validation Template
 - Critical Criteria
 - Operational Evaluations
 - Systematic Criteria

Lab Operation Overview - Critical Criteria

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{2.5} Filter Based Local Conditions			
<i>Post-sampling Weighing</i>	<i>all filters</i>	<i>≤10 days from sample end date if shipped at ambient temp, or ≤30 days if shipped below avg ambient (or 4° C or below for avg sampling temps < 4° C) from sample end date</i>	1, 2 and 3) 40 CFR Part 50 App L Sec 8.3.6 Sampled filters must be protected from exposure to temperatures above 25C from sample retrieval to conditioning 40 CFR part 50 Appendix L Sec 10.13. See technical note on holding time requirements at : https://www3.epa.gov/ttn/amtic/pmpolgud.html
<i>Filter Visual Defect Check (unexposed)</i>	<i>all filters</i>	<i>Correct type & size and for pinholes, particles or imperfections</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 10.2
Filter Conditioning Environment			
<i>Equilibration</i>	<i>all filters</i>	<i>24 hours minimum</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 8.2.5
<i>Temp. Range</i>	<i>all filters</i>	<i>24-hr mean 20.0-23.0° C</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 8.2.1
<i>Temp. Control</i>	<i>all filters</i>	<i>< 2.1° C SD* over 24 hr</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 8.2.2
<i>Humidity Range</i>	<i>all filters</i>	<i>24-hr mean 30.0% - 40.0% RH or Within +5.0 % sampling RH but > 20.0%RH</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 8.2.3
<i>Humidity Control</i>	<i>all filters</i>	<i>< 5.1 % SD* over 24 hr.</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 8.2.4
<i>Pre/post Sampling RH</i>	<i>all filters</i>	<i>difference in 24-hr means < + 5.1% RH</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 8.3.3
<i>Balance</i>	<i>all filters</i>	<i>located in filter conditioning environment</i>	1, 2 and 3) 40 CFR Part 50, App. L Sec 8.3.2
<i>Microbalance Auto-Calibration</i>	<i>Prior to each weighing session</i>	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec 8.1 2) 40 CFR Part 50, App. L, Sec 8.1 and Method 2.12 Sec. 10.6 3) NA

Lab Critical Criteria

- Balancing Act
 - Balance room must meet Temp. and RH criteria 24 hours period prior to weighing
 - 20-23 °C, 30-40%RH 24 hour mean
 - Filters must be conditioned for 24 hours



Lab Critical Criteria

- **Timing**
 - Filter must be used for sampling within 30 days of pre-weigh ('expiration date')
 - Filter must be weighed within 10 or 30 days from sampling (depending on ship temp)

Temperature at Receipt	Days allowed from sampling to post-weigh
4°C or lower	30
4-25°C & Average ambient temperature $\geq 25^\circ\text{C}$	30
4-25°C & Average ambient temperature $< 25^\circ\text{C}$	10
Greater than 25°C	10
Unknown	10
Field Blanks – Greater than 4°C	10

Invalidation Trends 2018

Statistics on Invalid Samples - 2018	2016
○ Total.....	239 184
○ Damage: Cut/Dent/Tear.....	83 92
○ Filter weighed > 10 / 30 days from sampling.....	39 10
○ Filter sampled > 30 days from pre-weigh.....	31 NA
○ Non-Midnight start time.....	27 24
○ Contamination.....	25 20
○ Sample duration out of range.....	24 24
○ Retrieval > 7.4 Days from sampling.....	10 14

Invalidation Trends 2018

Statistics on Invalid Samples - 2018	2016
○ Total.....	239 184
○ Damage: Cut/Dent/Tear.....	35% 50%
○ Filter weighed > 10 / 30 days from sampling...	16% 5%
○ Filter sampled > 30 days from pre-weigh.....	13% NA
○ Non-Midnight start time.....	11% 13%
○ Contamination.....	10% 11%
○ Sample duration out of range.....	10% 13%
○ Retrieval > 7.4 Days from sampling.....	4% 8%

Minimizing Avoidable Invalidation

- Send samples back to the lab ASAP (even if invalid)
- Communication
- Make-ups (Except daily sites)
 - Before next scheduled run OR
 - Exactly 7 calendar days after missed/invalid run

Minimizing Avoidable Invalidation

- Cut/Dent/Tear/Damage
- Filter sampled > 30 days from pre-weigh
- Filter weighed $> 10 / 30$ days from sampling



Invalid Sample Impact

Meet completeness criteria and required averages to inform attainment status, and inform future decisions



Communication

- Chain-of-custody
 - Is it complete?
 - Is it the sample valid?
 - Is there anything you want the lab to know?
 - Example: “Instrument malfunction, sampler down until further notice. Nice day out though.”

Communication

- Call, email, send a note, or just email

- **Elias Villa**

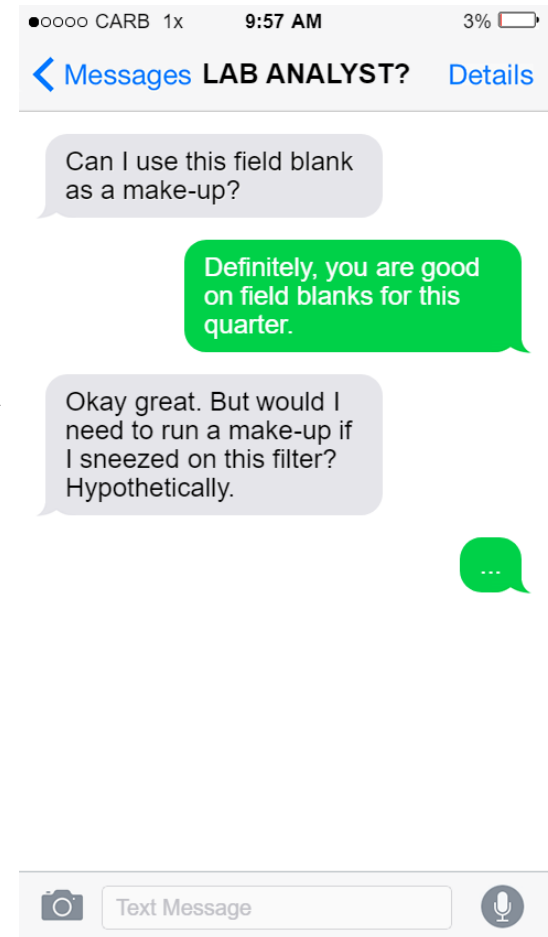
Elias.Villa@arb.ca.gov

(916) 327-0886

- **Sample Handling**

Sample.Handling@arb.ca.gov

(916) 327-3447



Invalidate or Nah?

Q: A sampler loses power and only runs for 21 hours of the 24 hour sample period. Upon post weighing of the filter, the mass was $37 \mu\text{g}/\text{m}^3$.
Invalidate or Nah?

A: Nah! If mass is over $35 \mu\text{g}/\text{m}^3$ runs between 18 and 23 hours may be valid.

Invalidate or Nah?

Q: Filter is pre-weighed on 2/28 and used for sampling on 3/29. Invalidate or Nah?

A: Nah! Filter has not 'expired'.
Difference between pre-weigh and sampling = 29 days.

Invalidate or Nah?

Q: A filter was sampled on April 21; the scheduled run day. The station operator had to repair an ozone analyzer at another site and thus retrieved the filter from the sampler on April 30. Invalidate or Nah?

A: Invalidate! Filters should be pulled from sampler less than 7.4 days from end of sampling period.

Invalidate or Nah?

Q: Filter sampled on 5/16 and shipped to lab on 5/30, a Thursday. Sits with UPS over the weekend, sample arrives in lab above 4°C. Invalidate or Nah?

A: Maybe. Holding times are dependent on average ambient temperature. Lab has 10 or 30 days from sampling to weigh filters. See slide 27.

Invalid Filter Examples



More Invalid Filter Examples



Questions?

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