MOL.20070405.0030

QA:N/A

United States Environmental Protection Agency | Office of Air Quality Planning and Standards Research Triangle Park, NC 27711 | EPA-454/R-99-008 April 1999

Air

GUIDELINE ON DATA HANDLING CONVENTIONS FOR THE PM NAAQS

Contains Data for Postscript Only.

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EPA-454/R-99-xxx
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GUIDELINE ON DATA HANDLING CONVENTIONS FOR THE PM NAAQS

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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GUIDELINE ON DATA HANDLING CONVENTIONS FOR THE PM NAAQS

What does this guideline cover?

This guidance provides information you, the state or local agency responsible for monitoring and interpreting air quality, need to determine whether you are meeting the standards for particulate matter in 40 CFR Part 50. It clarifies requirements for data handling and completeness in Appendix N to 40 CFR Part 50. It tells you how to handle missing data, different sampling frequencies, and calculating spatial averages for the $PM_{2.5}$ annual standard.

How is this guideline presented and organized?

This guideline is organized in a question and answer format. Questions are sorted by topic into chapters:

- Chapter 1 Comparing Your Data to the Standards
- Chapter 2 Sampling Frequency
- Chapter 3 Monitoring Issues
- Chapter 4 Miscellaneous Issues

Chapter 1: Comparing Your Data to the Standards

1. What are the standards for particulate matter?
2. How do I round my numbers? How many decimal places do I keep?
3. How do I compute the 3-year average annual mean for PM_{10}?
4. How do I compute the 3-year average, spatially averaged, annual mean for $PM_{2.5}$?
5. How do I compute the 3-year average 99^{th} percentile for PM_{10}?
6. How do I compute the 3-year average 98^{th} percentile for $PM_{2.5}$?
7. Is there another way to determine the 98^{th} or 99^{th} percentile?
8. How do I make sure my data is complete enough to meet the standards?
9. What if I want to show I meet the standards but I don't have complete data?
10. How do I fill in for missing data to show I meet the standards?
11. May I use data from a PM_{10} monitor to show that I meet the $PM_{2.5}$ standards?
12. May I ignore years with high concentrations if they have incomplete data?
13. How little data may I use to show I'm NOT meeting the standards?
14. May I fill in for missing data to show that I don't meet the standards?
15. What if I don't meet the minimum of 11 samples in a quarter? Can I still show I don't meet the annual standards?

16. May I show that I meet the standards, or that I don't meet the standards, if I have only 1 or 2 years of data?
17. What do I do about a monitor that has stopped monitoring?

Chapter 2: Sampling Frequency

18. If I've collected more samples than were scheduled, may I use all the data to show I've met or not met the 24-hour standards?
19. How do I calculate the 98th and 99th percentiles when my sampling frequencies are seasonal?
20. How do I compute quarterly averages when parts of the quarter are sampled at different frequencies?
21. Under what circumstances may I reduce the required sampling frequency at a site for a year or a season?
22. May I use a correlated acceptable continuous (CAC) monitor to reduce my sampling frequency?
23. If I've missed a scheduled sample, may I make it up?
24. How do I use scheduled samples with make-up and other non-scheduled samples to show that I meet or don't meet the standards?

Chapter 3: Monitoring Issues

25. Which monitors do I compare to which standards?
26. What are "community monitoring zones" (CMZs), and how do I decide which sites to include in a spatial average?
27. If a monitor is reassigned to a different CMZ during the three-year period, which CMZ assignment should I use to calculate the spatial average?
28. How many hourly values make up a valid 24-hour average for a continuous monitor?

Chapter 4: Miscellaneous Issues

29. How do I handle data from uncontrollable or natural events?
30. How do I determine whether wildland and prescribed fires managed for resource benefits significantly contribute to violations of the $PM_{2.5}$ or PM_{10} NAAQS?

Chapter 1

Comparing Your Data to the Standards

1. What are the standards for particulate matter?

Appendix N of 40 CFR Part 50 says air quality meets

- The annual PM_{10} standard whenever the 3-year average of the annual mean PM_{10} concentrations at each monitoring site is less than or equal to 50 $\mu g/m^3$.

- The 24-hour PM_{10} standard whenever the 3-year average of the annual 99th percentile values for PM_{10} at each monitoring site is less than or equal to 150 $\mu g/m^3$.

- The annual $PM_{2.5}$ standard whenever the 3-year average of the spatially averaged annual mean $PM_{2.5}$ concentrations (among designated monitors) is less than or equal to 15.0 $\mu g/m^3$. [Designated monitors are sites designated for spatial averaging in a State PM Monitoring Network Description. This applies only if you opt to do spatial averaging in your area as discussed in 40 CFR Part 58. When you don't opt to do spatial averaging, use the annual average of the single site.]

- The 24-hour $PM_{2.5}$ standard whenever the 3-year average of the annual 98th percentile values for $PM_{2.5}$ at each monitoring site is less than or equal to 65 $\mu g/m^3$.

Each standard is based on three consecutive, complete, calendar years of air quality data.

2. How do I round my numbers? How many decimal places do I keep?

- If you're doing an initial calculation with 24-hour average $PM_{2.5}$ concentrations, such as entering 24-hour averages into a computer program, use one decimal place. Truncate any extra digits.

  Example: 10.314 $\mu g/m^3$ truncates to 10.3 $\mu g/m^3$
  10.37 $\mu g/m^3$ truncates to 10.3 $\mu g/m^3$

- If you're doing an initial calculation with 24-hour average PM_{10} concentrations, such as entering 24-hour averages into a computer program, use the integer part. Truncate any decimal parts.

  Example: 45.29 $\mu g/m^3$ truncates to 45 $\mu g/m^3$
  45.816 $\mu g/m^3$ truncates to 45 $\mu g/m^3$

- If you're doing an intermediate calculation, such as a quarterly-average PM_{10} value from the 24-hour averages, keep all available digits and decimal places on your calculator. [Note that for the sake of brevity this Guideline does not include all available digits in its examples.]

- If you're comparing a result to a standard, which includes deciding whether to use incomplete data with high concentrations, round as follows:

  -- Annual $PM_{2.5}$: Round to the nearest 0.1 $\mu g/m^3$. Round decimals 0.05 or greater up and those less than 0.05 down.

  Example: **15.049** rounds to **15.0 $\mu g/m^3$** (not above the standard)
  15.05 rounds to **15.1 $\mu g/m^3$** (above the standard)

  -- 24-Hour $PM_{2.5}$: Round to the nearest 1 $\mu g/m^3$. Round decimals 0.5 or greater up and those less than 0.5 down.

  Example: **65.49** rounds to **65 $\mu g/m^3$** (not above the standard)
  65.5 rounds to **66 $\mu g/m^3$** (above the standard)

  -- Annual PM_{10}: Round to the nearest 1 $\mu g/m^3$. Round decimals 0.5 or greater up to and those less than 0.5 down.

  Example: **50.486** rounds to **50 $\mu g/m^3$** (not above the standard)
  50.51 rounds to **51 $\mu g/m^3$** (above the standard)

  -- 24-Hour PM_{10}: Round to the nearest 10 $\mu g/m^3$. Round integers of 5 or greater up and those less than 5 down.

  Example: **154.893** rounds to **150 $\mu g/m^3$** (not above the standard)
  155.51 rounds to **160 $\mu g/m^3$** (above the standard)

3. How do I compute the 3-year average annual mean for PM_{10}?

Follow these steps:

a. Calculate the four quarterly means for each year. Add all of the 24-hour sample concentrations within a quarter; then, divide by the number of samples in the quarter.

Example:

Suppose you took 87 24-hour average PM_{10} measurements (in $\mu g/m^3$) during Quarter 1 of Year 1, of which the first eight are 39, 42, 58, 66, 45, 28, 36, and 27.

In this case, the

$$\text{quarterly mean} = \frac{(39 + 42 + 58 + 66 + 45 + 28 + 36 + 27 + \ldots)}{87}\ \mu g/m^3.$$

b. Calculate the annual mean from the four quarterly means. Add the four quarterly means; then, divide by 4.

Example:

Assume the four quarterly means for Year 1 of the three-year period for which you are to compare readings to the NAAQS are as follows: Quarter 1 - 43.23 $\mu g/m^3$; Quarter 2 - 44.72 $\mu g/m^3$, Quarter 3 - 40.96 $\mu g/m^3$, and Quarter 4 - 40.77 $\mu g/m^3$.

Then, the annual mean $= \frac{(43.23 + 44.72 + 40.96 + 40.77)}{4}\ \mu g/m^3 =$ **42.42 $\mu g/m^3$.**

c. Calculate the 3-year average annual mean. Add the three annual average means; then, divide by 3.

Example:

Assume you've also calculated the PM_{10} annual means for Years 2 and 3 as **57.17** and **53.23 $\mu g/m^3$**, respectively. If so, the 3-year average annual mean =

$$\frac{(42.42 + 57.17 + 53.23)}{3}\ \mu g/m^3 = \textbf{50.94 } \mu g/m^3.$$

d. Round the 3-year average annual mean. Because you're trying to calculate the 3-year average annual mean for PM_{10}, round to the nearest integer. Round up decimal parts of 0.5 or greater; round down decimal parts less than 0.5.

Example:

Round **50.94 μg/m³** up to **51 μg/m³**.

e. Compare your result to the standard. 51 μg/m³ is greater than 50 μg/m³, so this example doesn't meet the PM_{10} annual standard.

4. How do I compute the 3-year average, spatially averaged, annual mean for $PM_{2.5}$?

Spatial averages are computed across all designated sites in a Community Monitoring Zone (CMZ) (see 40 CFR Part 58). If the CMZ has only one site, you can follow the procedures described here or the slightly simpler ones in Question 3. If you follow the ones in Question 3, round the $PM_{2.5}$ three-year average annual mean to the nearest 0.1 μg/m³ before comparing it with the standard.

Assume you've designated three monitors to use for computing the 3-year average, spatially averaged, annual mean.

a. Calculate the four quarterly means for each site. Add all of the 24-hour sample concentrations; then, divide by the number of samples.

b. Calculate the annual mean from the four quarterly means. For each site, add the four quarterly means; then, divide by 4.

Example:

Assume the four quarterly means for one site for the first year are 11.6, 12.4, 15.1, and 12.1 μg/m³. If so, the annual mean is

$$\frac{(11.6 + 12.4 + 15.1 + 12.1)}{4} \text{ μg/m}^3 = \mathbf{12.8\ \mu g/m^3}.$$

Calculate the annual means for the other sites and other years using the same approach to give the results shown in Table 4-1. Note that site 3 had insufficient data in Year 1 (fewer than 11 samples in one or more quarters, as indicated by "NA"), so the annual mean is not available.

Table 4-1. Using Annual Means ($\mu g/m^3$) from Three Sites for Spatial Averaging.

	Site Number		
Year	One	Two	Three
1	12.8	14.2	NA
2	13.0	13.5	12.9
3	15.2	14.8	17.1

c. Calculate the spatially averaged annual mean of the designated monitors in the area. Add all values for a given year across all sites; then, divide by the number of sites with data for that year.

Example:

Year 1. $\frac{(12.8 + 14.2)}{2}$ $\mu g/m^3$ = **13.5 $\mu g/m^3$.**

Year 2. $\frac{(13.0 + 13.5 + 12.9)}{3}$ $\mu g/m^3$ = **13.13 $\mu g/m^3$.**

Year 3. $\frac{(15.2 + 14.8 + 17.1)}{3}$ $\mu g/m^3$ = **15.7 $\mu g/m^3$.**

d. Calculate the 3-year average, spatially averaged, annual mean. Add the three spatially averaged annual means and divide the total by 3.

Example:

$\frac{13.50 + 13.13 + 15.70}{3}$ $\mu g/m^3$ = **14.11 $\mu g/m^3$.**

e. Round to the nearest 0.1 $\mu g/m^3$. Round decimals 0.05 or greater up and those less than 0.05 down.

Example:

Round **14.11** down to **14.1 μg/m³**.

f. Compare your result to the standard. 14.1 is less than 15.0 μg/m³, so this example meets the $PM_{2.5}$ annual standard of 15.0 μg/m³.

5. How do I compute the 3-year average 99th percentile for PM_{10}?

This computation is explained with an example. If you've collected more than the scheduled number of samples in a year, you will need to modify step c of this calculation as shown in the example for Question 18.

Examine Table 5-1, which presents some sample data on 24-hour concentrations of PM_{10} collected once every three days over a three year sampling period. The table shows only the three highest and three lowest values for each year. In this example, a total of 110 samples were collected in Year 1; 98 samples in Year 2; and 100 samples in Year 3.

Table 5-1. Sample Values for Computing the 3-year Average 99th Percentile for PM_{10}.

YEAR 1 (110 total samples) Value (μg/m³)	YEAR 2 (98 total samples) Value (μg/m³)	YEAR 3 (100 total samples) Value (μg/m³)
88	150	40
130	93	52
120	90	144
85	97	140
128	148	48
87	143	147
⋮	⋮	⋮

a. Sort all data values collected in each year from lowest to highest. The result should look like Table 5-2.

Table 5-2. Arranging Data Values in Ascending Order.

YEAR 1 Value ($\mu g/m^3$)	YEAR 2 Value ($\mu g/m^3$)	YEAR 3 Value ($\mu g/m^3$)
85	90	40
87	93	48
88	97	52
⋮	⋮	⋮
120	143	140
128	148	144
130	150	147

b. Assign a rank to each data value. Assign rank 1 to the lowest 24-hour average in each year, rank 2 to the second-lowest average, and so on. The results should look like Table 5-3.

Table 5-3. Data Values with Assigned Ranks.

Year 1		Year 2		Year 3	
Rank	Value ($\mu g/m^3$)	Rank	Value ($\mu g/m^3$)	Rank	Value ($\mu g/m^3$)
1	85	1	90	1	40
2	87	2	93	2	48
3	88	3	97	3	52
⋮	⋮	⋮	⋮	⋮	⋮
108	120	96	143	98	140
109	**128**	97	148	99	144
110	130	**98**	**150**	**100**	**147**

c. Calculate the rank of the 99th percentile value for each year.

- Multiply the number of samples taken in the year by 0.99.

Example (from Table 5-3):

Year 1: **110** x 0.99 = **108.9**
Year 2: **98** x 0.99 = **97.02**
Year 3: **100** x 0.99 = **99.0**

- Take the integer part of the product and add 1. This step gives you the ranking that corresponds to the 99th percentile:

Example:

Year 1. Result is **108.9**; integer part is **108**. **108** + 1 = **109**.
Year 2. Result is **97.02**; integer part is **97**. **97** + 1 = **98**.
Year 3. Result is **99.0**; integer part is **99**. **99** + 1 = **100**.

The 99th percentile ranks are therefore **109**, **98**, and **100.**

d. Find the value that corresponds to each rank.

Example:

Referring to Table 5-3,

Year 1. Rank **109** corresponds to **128 µg/m³**.
Year 2. Rank **98** corresponds to **150 µg/m³**.
Year 3. Rank **100** corresponds to **147 µg/m³**.

e. Calculate the 3-year average of all three values for the 99th percentile.

Example:

$\frac{128 + 150 + 147}{3}$ = **141.67 µg/m³**.

f. Round to the nearest 10. In this case, round **141.67** down to **140 µg/m³**.

g. Compare your result to the standard. 140 is less than 150 µg/m³. This example meets the 24-hour standard of 150 µg/m³ for PM_{10}.

6. How do I compute the 3-year average 98th percentile for $PM_{2.5}$?

First, review answer 5, above, which is similar to this problem. Then, work through the example below. However, if you've collected more than the scheduled number of samples in a year, you will need to modify step c of this calculation as shown in the example for Question 18.

This example assumes you have data on 24-hour concentrations of $PM_{2.5}$ collected on an every day sampling schedule over a three year period: 281 samples in Year 1; 304 samples in Year 2; and 296 samples in Year 3.

a. Sort all data values collected in each year from lowest to highest.

b. Assign a rank to each data value. Assign rank 1 to the lowest 24-hour average in each year, rank 2 to the second lowest, and so on.

The results for this example site after steps a and b are in Table 6-1, below.

Table 6-1. Rankings of Sample Values for One Site over Three Years.

Year 1		Year 2		Year 3	
Rank	Value ($\mu g/m^3$)	Rank	Value ($\mu g/m^3$)	Rank	Value ($\mu g/m^3$)
1	40.7	1	40.6	1	45.1
⋮	⋮	⋮	⋮	⋮	⋮
275	58.9	296	54.3	290	66.0
276	**59.0**	297	57.1	**291**	**68.4**
277	62.2	**298**	**63.0**	292	69.8
⋮	⋮	⋮	⋮	⋮	⋮
281	64.4	304	65.8	296	70.9

c. Calculate the rank of the 98th percentile for each year.

- Multiply the number of samples taken in the year by 0.98.

  Example (from Table 6-1):

  Year 1. **281** x 0.98 = **275.38**
  Year 2. **304** x 0.98 = **297.92**
  Year 3. **296** x 0.98 = **290.08**

- Take the integer part of the product and add 1. This gives you the ranking that corresponds to the 98th percentile:

Example:

Year 1. **275** + 1 = **276**
Year 2. **297** + 1 = **298**
Year 3. **290** + 1 = **291**

The 98th percentile ranks are therefore **276**, **298**, and **291**.

d. Find the value that corresponds to each rank.

Example (from Table 6-1):

Year 1. Rank **276** corresponds to **59.0 µg/m³**.
Year 2. Rank **298** corresponds to **63.0 µg/m³**.
Year 3. Rank **291** corresponds to **68.4 µg/m³**.

e. Calculate the 3-year average of all three values for the 98th percentile.

Example:

$\frac{59.0 + 63.0 + 68.4}{3}$ = **63.47 µg/m³**.

f. Round to the nearest integer. Round decimals 0.5 or greater up and those less than 0.5 down.

Example:

Round **63.47** down to **63 µg/m³**.

g. Compare your result to the standard. 63 is less than 65 µg/m³, so this example meets the 24-hour standard of 65 µg/m³ for $PM_{2.5}$.

7. Is there another way to determine the 98th or 99th percentile?

Yes, you may also use Table 7-1, below, to calculate the 98th and 99th percentiles. Note that for this method PM concentrations are ranked from highest to lowest (i.e., 1 = highest concentration). If you've collected more than the scheduled number of samples in a year, see Question 18 for an example of how to modify the calculations.

Table 7-1. 98th and 99th Percentiles Defined by Appendix N.

Samples[1]	nth Max. for 98th Percentile[2] Value of n	nth Max. for 99th Percentile[3] Value of n
1-50[4]	1	1
51-100[5,6]	2	1
101-150[7]	3	2
151-200	4	2
201-250	5	3
251-300	6	3
301-350	7	4
351-366	8	4

[1]Samples are all the monitored daily PM values in a year unless you've collected more than the scheduled number of samples. In that case, see Question 18.
[2]nth Max for the 98th percentile is the nth highest value in a year that represents the 98th percentile. (1 is the highest value measured in a year, 2 is the second highest value, etc.)
[3]nth Max for the 99th percentile is the nth highest value in a year that represents the 99th percentile.
[4]1 in 6 day sampling achieving 75 to 85% data completeness would be in this category.
[5]1 in 6 day sampling achieving 85 to 100% data completeness would be in this category.
[6]1 in 3 day sampling achieving 75 to 82% data completeness would be in this category.
[7]1 in 3 day sampling achieving 83 to 100% data completeness would be in this category.

Work through the example below, which uses the same $PM_{2.5}$ data as the example for answer 6. In years 1, 2, and 3, your data sets from the site contained 281, 304, and 296 samples, respectively.

a. Sort all of the data values collected in any given year from highest to lowest. The results should look like Table 7-2, which is a rearrangement of Table 6-1 (the values go from the highest to the lowest). This table has the nth highest value listed for each n so it is easy to use it with Table 7-1.

b. Find n from Table 7-1 and find the nth highest value from Table 7-2. For $PM_{2.5}$, calculate the 98th percentile. For PM_{10}, calculate the 99th percentile.

Table 7-2. Maxima of Sample $PM_{2.5}$ Values from One Site for a Three-Year Period.

n	Year 1 n^{th} highest value ($\mu g/m^3$)	Year 2 n^{th} highest value ($\mu g/m^3$)	Year 3 n^{th} highest value ($\mu g/m^3$)
1	64.4	65.8	70.9
2	63.7	65.2	70.8
3	63.1	64.9	70.3
4	62.8	64.5	70.0
5	62.2	64.1	69.8
6	**59.0**	63.8	**68.4**
7	57.9	**63.0**	66.0
8	57.3	57.1	65.6
9	54.7	54.3	65.6
⋮	⋮	⋮	⋮

Example:

In Year 1 there were 281 $PM_{2.5}$ samples. For $PM_{2.5}$, you calculate the 98th percentile. From Table 7-1, n equals 6. From Table 7-2, the n^{th} highest value equals **59.0 $\mu g/m^3$**. Similarly, for Years 2 and 3, n equals 7 and 6, and the n^{th} highest values equal **63.0** and **68.4 $\mu g/m^3$**, respectively.

c. Calculate the 3-year average of all three values for the 98th or 99th percentile.

Example:

$\frac{59.0 + 63.0 + 68.4}{3}$ = **63.47 $\mu g/m^3$**.

d. Round to the nearest integer for $PM_{2.5}$ and to the nearest multiple of 10 for PM_{10}. For $PM_{2.5}$, round decimals 0.5 or greater up and those less than 0.5 down. For PM_{10}, round integers 5 or greater up and those less than 5 down.

Example:

Round **63.47** down to **63 µg/m³**.

e. Compare your result to the standard. 63 is less than 65 µg/m³ so this example meets the 24-hour standard of 65 µg/m³ for $PM_{2.5}$.

8. How do I make sure my data is complete enough to meet the standards?

Table 8-1 summarizes how complete data must be to show you meet the standards.

Table 8-1. How Complete Data Must Be to Show that an Area Meets the NAAQS for PM.

Standard	Data Completeness to Show You Meet the Standards
Daily $PM_{2.5}$	Single site: at least 75% of the scheduled sampling days per quarter
Daily PM_{10}	Single site: at least 75% of the scheduled sampling days per quarter
Annual $PM_{2.5}$	Single site: if each quarter has at least 75 % of the scheduled sampling days, the annual mean for that year and site is valid. Community monitoring zone: In each of the three years, at least one site must have a valid annual mean. The valid sites may be the same every year, or may vary from year to year.
Annual PM_{10}	Single site: at least 75% of the scheduled sampling days per quarter

9. What if I want to show I meet the standards but I don't have complete data?

Appendix N says you may have compelling reasons to use less complete data, but the Regional Administrator must approve it. The Regional Administrator may want to consider filling in for missing scheduled sampling days using the procedures in Question 10 if you

- Have at least 50% of the scheduled number of samples for each quarter for all three years.

- Show that the emissions and meteorology for the substitute quarters compare to the emissions and meteorology for the quarters in question.

- Meet the standards based on the incomplete data.

10. How do I fill in for missing data to show I meet the standards?

First, you should meet the criteria from Question 9. Then, you may use either of two approaches to fill in for missing scheduled sampling days:

(1) Replace missing data with collocated data for the same year and quarter.

(2) Replace missing data with the maximum data value across all three years for the same quarter.

Approach No. 1: How you may use collocated data to substitute for missing data

You may use collocated data in either of two ways:

(1) If you have collocated PM_{10} or TSP data from a monitor for the same year and quarter, you may use it to replace missing PM_{10} or $PM_{2.5}$ values on scheduled sampling days.

(2) If you have collocated $PM_{2.5}$ data from a monitor for the same year and quarter, you may use it to replace missing $PM_{2.5}$ values on scheduled sampling days.

The following notes apply in either case:

- You must substitute for all missing scheduled sampling days where collocated data is available, not just for selected days in that quarter.

- If you didn't collect the collocated data on the same day as the scheduled sampling day, you can use collocated data from the nearest day (within two days before or after) to replace missing PM concentrations. The emissions and meteorology for the substitute day must compare to the emissions and meteorology for the missing day.

- The collocated PM_{10} or $PM_{2.5}$ monitor must use a Federal Reference Method or Equivalent Method, or must be a collocated QA monitor.

Example: How to Substitute Collocated PM_{10} Data for Missing Data and Use It to Calculate the Annual $PM_{2.5}$ Standard

For this example, assume

- Your $PM_{2.5}$ monitor is on a once every three days schedule, and it has a collocated PM_{10} monitor that has collected three years of data and measured it using a Federal Reference Method.
- The site is the only site in a community monitoring zone.
- In Years 1 and 3 of sampling, the annual average concentrations of $PM_{2.5}$ are 12.84 and 12.43 $\mu g/m^3$, respectively.
- In Quarter 3 of Year 2 (see Table 10-1), you got only 23 samples from the 31 scheduled sampling days.
- The total $PM_{2.5}$ concentration of the 23 samples is 292.1 $\mu g/m^3$.
- You have collocated PM_{10} data for only three of the eight scheduled sampling days that are missing $PM_{2.5}$ data. The three PM_{10} values are 30, 21, and 54 $\mu g/m^3$.
- You meet the criteria from Question 9. [To show that you meet the annual $PM_{2.5}$ standard based on the incomplete data, repeat steps b to f below without using the substituted data. In step b, the average for Quarter 3 of Year 2 is 12.70 $\mu g/m^3$ without using the substituted data. Then, in step e, the resulting rounded 3-year average annual mean is 12.8 $\mu g/m^3$, which meets the annual $PM_{2.5}$ standard of 15.0 $\mu g/m^3$.]

For Quarter 3 of Year 2, you had 31 scheduled sampling days but only 23 samples. 75% of 31 equals 24 (rounding up to the next integer). So you don't meet the data completeness requirement of 24 samples. You need at least one more sample.

Table 10-1. $PM_{2.5}$ Quarterly Statistics for Year 2 (in $\mu g/m^3$).

Quarter	Number of Samples	Total*	Quarterly Average* ($\bar{x}_q$)
1	28	332.9	11.89
2	29	426.0	14.69
3	23	292.1	12.70
4	28	369.9	13.21

*Calculated from available $PM_{2.5}$ concentrations.

a. Combine the three PM_{10} samples with the 23 $PM_{2.5}$ samples collected in Quarter 3 of Year 2. This total of 26 samples constitutes a valid quarter because 26 is at least 75% of 31. Thus, you can use the combined data from this quarter to show you've met the standard.

b. Calculate the average for Quarter 3 of Year 2.

$$\bar{x} = \frac{292.1 + (40.1 \times 8)}{23 + 8}$$

$$= \frac{292.1 + 320.8}{31} = \mathbf{19.77\ g/m^3}$$

c. Calculate the average for Year 2.

$$\bar{y}_2 = \frac{11.89 + 14.69 + 19.77 + 13.21}{4} = \mathbf{14.89\ g/m^3}$$

d. Calculate the 3-year average.

$$\bar{y} = \frac{12.84 + 13.77 + 12.43}{3} = \mathbf{13.01\ g/m^3}$$

e. Apply the rounding convention. Round the 3-year average annual mean for $PM_{2.5}$ to the nearest 0.1, so **13.01 μg/m³** rounds down to **13.0 μg/m³.**

f. Compare your result to the standard. Because 13.0 μg/m³ is below the annual standard for $PM_{2.5}$ of 15.0 μg/m³, you've met the standard.

Example: How to Substitute Collocated PM_{10} Data for Missing Data and Use It to Calculate the 24-Hour $PM_{2.5}$ Standard

Consider the same example (see Table 10-1) and also assume that

- In Years 1 and 3 of sampling the annual 98th percentile values are 58.7 and 54.3 μg/m³, respectively.
- In Year 2, the highest three of the 108 measured $PM_{2.5}$ concentrations are 75.7, 70.4, and 50.9 μg/m³.
- You meet the criteria from Question 9. [To show that you meet the 24-hour $PM_{2.5}$ standard based on the incomplete data, repeat steps b to f immediately below without using the substituted data. In step c, the number of samples equals 108, n equals 3 from Table 7-1, and the 3rd highest value equals 50.9 μg/m³ without using the substituted data. Then, in step e, the resulting rounded 3-year average 98th percentile is 55 μg/m³, which meets the 24-hour $PM_{2.5}$ standard of 65 μg/m³.]

Follow these steps.

a. Combine the three PM_{10} samples with the 23 $PM_{2.5}$ samples collected in Quarter 3 of Year 2. This total of 26 samples constitutes a valid quarter because 26 is at least 75% of 31. Thus, you can use the combined data from this quarter to show you've met the standard. In Year 2 there are 108 measured $PM_{2.5}$ concentrations. The combined data has a total of 111 samples in Year 2.

b. Sort the combined data from highest to lowest. For Year 2, the original three highest values are 75.7, 70.4, and 50.9 μg/m³. The three substituted PM_{10} samples are 30, 21, and 54 μg/m³. Then, the highest four of the 111 samples in the combined data are 75.7, 70.4, 54, and 50.9 μg/m³.

c. Find n from Table 7-1 and find the nth highest value. There are 111 samples. From Table 7-1, n equals 3. The 3rd highest value equals **54 μg/m³**.

d. Calculate the 3-year average of all three values for the 98th percentile.

$$\frac{58.7 + 54 + 54.3}{3} = \mathbf{55.67\ \mu g/m^3}.$$

e. Round to the nearest integer for $PM_{2.5}$. For $PM_{2.5}$, round decimals 0.5 or greater up and those less than 0.5 down.

Round **55.67** up to **56 µg/m³**.

f. Compare your result to the standard. 56 is less than 65 µg/m³ so this example meets the 24-hour standard of 65 µg/m³ for $PM_{2.5}$.

Approach No. 2: How you may use maximum observed values to substitute for missing data

Replace each missing scheduled sampling day in an incomplete quarter with the maximum observed value from the same site and the same quarter (from any of the three years).

Example: How to Substitute Maximum Observed Values for Missing Data and Use Them to Calculate the Annual $PM_{2.5}$ Standard

Consider the same set of $PM_{2.5}$ observations used in the example above (see Table 10-1). Assume

- You have no collocated data available, so you must substitute for each of the eight scheduled $PM_{2.5}$ sampling days that are missing in Quarter 3 of Year 2.
- Emissions and meteorology of the quarter in question are typical for Quarter 3 throughout the three years.

With these assumptions, you can substitute data from Quarter 3 of all three years to show you meet the annual $PM_{2.5}$ standard.

a. Combine eight substituted maximum values with the 23 $PM_{2.5}$ samples collected in Quarter 3 of Year 2. Substitute the maximum $PM_{2.5}$ concentration observed in Quarter 3 in any of the most recent three years for all eight missing samples. The maximum may occur on one of the 23 non-missing days in Quarter 3 of Year 2, or in Quarter 3 of Year 1 or Year 3.

You review Quarter 3 data for all three years, and find the maximum value is 40.1 µg/m³. It occurred in Quarter 3 of Year 2. (You would get the same results if the maximum for that quarter occurred in Year 1 or Year 3). Substitute 40.1 µg/m³ for each of the eight missing sampling days scheduled in Year 2, Quarter 3.

b. Calculate the average for Quarter 3 of Year 2.

$$\bar{x} = \frac{292.1 + (40.1 \times 8)}{23 + 8}$$

$$= \frac{292.1 + 320.8}{31} = \mathbf{19.77\ g/m^3}$$

c. Calculate the average for Year 2.

$$\bar{y}_2 = \frac{11.89 + 14.69 + 19.77 + 13.21}{4} = \mathbf{14.89\ g/m^3}$$

d. Calculate the 3-year average. Because the averages for Year 1 and Year 3 (from the previous example) are

$\bar{y}_1 =$ **12.84 µg/m³** and $\bar{y}_3 =$ **12.43 µg/m³**,

the three-year average is

$$\bar{y} = \frac{12.84 + 14.89 + 12.43}{3} = \mathbf{13.39\ g/m^3}$$

e. Apply the rounding convention and compare your result to the standard. This three-year average of **13.39 µg/m³** rounds to **13.4 µg/m³**, which is below the $PM_{2.5}$ annual standard. Thus, this example meets the $PM_{2.5}$ annual standard.

Example: How to Substitute Maximum Observed Values for Missing Data and Use Them to Calculate the 24-Hour $PM_{2.5}$ Standard

Continue the same example.

a. Combine the eight substituted maximum values with the 23 $PM_{2.5}$ samples collected in Quarter 3 of Year 2. In Year 2 there are 108 measured $PM_{2.5}$ concentrations. The combined data has a total of 116 samples in Year 2.

b. Sort the combined data from highest to lowest. For Year 2, the original three highest values are 75.7, 70.4, and 50.9 $\mu g/m^3$. The eight substituted maximum values are all equal to 40.1 $\mu g/m^3$. Then, the highest three of the 116 samples in the combined data are also 75.7, 70.4, and 50.9 $\mu g/m^3$.

c. Find n from Table 7-1 and find the n^{th} highest value. There are 116 samples. From Table 7-1, n equals 3. The 3^{rd} highest value equals **50.9 $\mu g/m^3$**.

d. Calculate the 3-year average of all three values for the 98^{th} percentile.

$$\frac{58.7 + 50.9 + 54.3}{3} = \mathbf{54.63\ \mu g/m^3}.$$

e. Round to the nearest integer for $PM_{2.5}$. For $PM_{2.5}$, round decimals 0.5 or greater up and those less than 0.5 down.

Round **54.63** up to **55 $\mu g/m^3$**.

f. Compare your result to the standard. 55 is less than 65 $\mu g/m^3$ so this example meets the 24-hour standard of 65 $\mu g/m^3$ for $PM_{2.5}$.

11. May I use data from a PM_{10} Monitor to show that I meet the $PM_{2.5}$ standards?

Yes, if the monitor meets $PM_{2.5}$ siting requirements and the acceptable $PM_{2.5}$ sampling schedule, you may treat the PM_{10} data as if it were $PM_{2.5}$ data and compare it to the standards as in Questions 4 and 6. However, you may not use PM_{10} data to show that you do not meet the $PM_{2.5}$ standards.

12. May I ignore years with high concentrations if they have incomplete data?

No. For the 24-hour standards, Appendix N says you must include data from years with quarters which have less than 75% completeness if the resulting annual 98^{th} or 99^{th} percentile (rounded under the conventions in Question 2) exceeds the standard. For the annual standards, Appendix N says you must include data from years with less than 75% completeness but at least 11 samples per quarter, if the resulting annual mean (rounded under the conventions in Question 2) exceeds the standard.

13. How little data may I use to show I'm NOT meeting the standards?

Generally, you must use data from years meeting the rules for completeness in Table 8-1 above. Plus, Appendix N says you must keep data from years with high values that don't meet those rules. The minimum data you need to show you're not meeting the standards follows:

- For the 24-hour standards: You must keep any year where the annual percentile exceeds the standard, even if there was only one measurement in that year and that single measurement exceeded the standard.

- For the annual PM_{10} standard: You must keep any year where

  -- the annual mean exceeds the standard, and
  -- there were at least 11 samples in each quarter.

- For the annual $PM_{2.5}$ standard: For one monitor, the rule is the same as for the annual PM_{10} standard. When there are multiple monitors designated for spatial averaging in a CMZ, you must keep any year where

  -- the spatially averaged annual mean exceeds the standard, and
  -- at least one of the monitors has in each quarter at least 11 samples.

Of course, in all of these cases, data from three years is averaged.

14. May I fill in for missing data to show that I don't meet the annual standards?

No, except in some of the situations described in the answer to Question 15, where the annual mean exceeds the standard but you don't meet the minimum of 11 samples in a quarter.

15. What if I don't meet the minimum of 11 samples in a quarter? Can I still show I don't meet the annual standards?

Appendix N says that situations may arise in which there are compelling reasons to retain years containing quarters which do not meet the minimum number of 11 samples, and the use of less than complete data is subject to the approval of the Regional Administrator.

If, for example, a site is missing part or all of a quarter, the Regional Administrator may want to consider examining data from the same quarters in the other two years and/or data from nearby monitors during the same quarter for all 3 years. Consistent meteorology and emissions data between the quarter with missing data and the one from which data are substituted would also be a factor to examine.

If, as another example, a site is missing part or all of a quarter, the Regional Administrator may want to consider substituting 0 (zero) for the missing data to demonstrate that the site has an annual average that does not meet the standard. The Regional Administrator could also consider substituting the historically lowest 24-hr concentration observed at the site. Since this is a compelling argument, the Regional Administrator might consider using this approach for several quarters with no data.

In any situation, the Regional Administrator could combine these approaches to strengthen the argument for a determination that the site does not meet the standards.

16. May I show that I meet the standards, or that I don't meet the standards, if I have only 1 or 2 years of data?

- For the 24-hour PM standards and the annual PM_{10} standard, you must wait for the third year of data if your site is still operating.

- For the annual $PM_{2.5}$ standard, a site may contribute only 1 or 2 years to the spatial average across a CMZ, as long as in each of the 3 years, at least one site contributes. For more on this method, see Question 4 of this guidance or Example 1 in Appendix N.

17. What do I do about a monitor that has stopped monitoring?

The appropriate Regional Office must be notified prior to shutting down a NAMS or SLAMS site that has exceeded the level of the particulate matter NAAQS. The air quality status at a NAMS or SLAMS site that has stopped monitoring after two years must be handled on a case-by-case basis. Factors to consider are the reasons that the site stopped monitoring, the magnitude of the particulate matter concentrations measured, and the likelihood that additional monitoring data may be available in future years.

Chapter 2

Sampling Frequency

18. If I've collected more samples than were scheduled, may I use all the data to show I've met or not met the 24-hour standards?

Yes, but the 98th and 99th percentiles are based on the *applicable* number of samples, rather than the actual number of samples.

For the 24-hour standards, you won't receive credit for more samples than the maximum number of scheduled sampling days in a quarter. For each quarter, the *applicable* number of samples is the lower of the actual number of samples and the scheduled number of samples. The percentile will be calculated as in Question 7 using the *applicable* number of samples for the year in Table 7-1. This policy ensures the annual 98th or 99th percentiles aren't biased low by extensive sampling over a short period when values are low. If "extra" samples are collected when values are high, those samples could contribute to a violation. If this occurs for an uncontrollable or natural event, see Question 29 for additional data handling considerations.

If you prefer to use the calculations from Questions 5 and 6, then you must modify step c. To calculate the rank of the 99th percentile for each year: Multiply the applicable number of samples by 0.99. Take the integer part of the product, add 1, and then add the number of extra samples beyond the number of scheduled samples. To calculate the rank of the 98th percentile for each year: Multiply the applicable number of samples by 0.98. Take the integer part of the product, add 1, and then add the number of extra samples beyond the number of scheduled samples.

The answers to this question and to Question 20 show that the calculations for the 24-hour and annual standards use all the samples that were collected. Therefore, all measured sample concentrations must be reported to AIRS, including any extra samples beyond the number of scheduled samples.

Example:

Assume that in Year 1 the scheduled sampling frequency for $PM_{2.5}$ was once every three days. Assume that the numbers of samples collected and scheduled were as shown in Table 18-1. Assume that the four highest values in the year (among all 228 samples) were 66.7, 62.2, 62.1, and 62.1 $\mu g/m^3$.

Table 18-1. Actual and Applicable Number of Samples for Year 1.

Quarter	Actual Number of Samples	Scheduled Number of Samples	Applicable Number of Samples = Minimum (Actual, Scheduled)
1	90	30	30
2	89	30	30
3	25	30	25
4	24	31	24
Total	228	121	109

Using Table 7-1

a. Calculate the applicable number of samples. For each quarter, the applicable number of samples is the lower of the scheduled number of samples and the actual number of samples. For each year, the applicable number of samples is the total of the applicable number of samples in each quarter. From Table 18-1, in quarters 1 and 2 the scheduled number of samples was 30, but you collected 90 samples in quarter 1 and 89 samples in quarter 2. For each of those quarters you will only be credited with 30 samples. For quarters 3 and 4 you collected less than the scheduled number of samples, so the applicable number of samples is the actual number of samples. The total number of applicable samples for Year 1 is **109**.

b. Find n from Table 7-1 and the n^{th} highest value from the sorted values. For PM_{10} you calculate the 99^{th} percentile. For $PM_{2.5}$ you calculate the 98^{th} percentile. The total number of applicable samples is **109**. The value of n from Table 7-1 is 3. The 98^{th} percentile for Year 1 is the 3^{rd} highest value from all 228 samples, i.e. **62.1 $\mu g/m^3$**.

Using the Calculated Rank

a. Calculate the applicable number of samples. As before, from Table 18-1 the total number of applicable samples for Year 1 is **109**.

b. Multiply the number of applicable samples by 0.98 or 0.99. For PM_{10} you multiply by 0.99. For $PM_{2.5}$ you multiply by 0.98.

109 x 0.98 = **106.82.**

c. Take the integer part of the product, add 1, and add the number of extra samples beyond the number of scheduled samples. From Table 18-1, the number of extra samples was **228** actual samples minus **109** applicable samples, i.e., **119**. (You get the same number of extra samples if you add the 60 extra samples in quarter 1 to the 59 extra samples in Quarter 2.)

106 + 1 + 119 = **226.**

The value with rank 226 is the 226th lowest value, which equals **62.1 µg/m³**.

19. How do I calculate the 98th and 99th percentiles when my sampling frequencies are seasonal?

You calculate the percentiles by finding the smallest measured concentration, x, that makes $W(x) > .98$ (or .99) where:

$$W(x) = \frac{d_{High}}{d_{High} + d_{Low}} F_{High}(x) + \frac{d_{Low}}{d_{High} + d_{Low}} F_{Low}(x),$$

d_{High} = number of calendar days in the "High" season,
d_{Low} = number of calendar days in the "Low" season, ($d_{High} + d_{Low}$ = days in a year),

$$F_a(x) = \frac{number\ of\ samples\ in\ season\ a\ that\ are \leq x}{number\ of\ samples\ in\ season\ a},$$

such that a can be either *High* or *Low*,
x is the measured concentration, and
$d_{High}/(d_{High} + d_{Low})$ and $d_{Low}/(d_{High} + d_{Low})$ are constant and are called seasonal "weights."

The following example shows how you find the percentile using this formula. Suppose you expect high $PM_{2.5}$ values during January, February, November, and December, but you expect low PM concentrations the rest of the year. You now know that $d_{High} = 120$ and $d_{Low} = 245$, so you can calculate the seasonal weights as **0.329** and **0.671**.

You schedule samples to be taken every day during the High months and once every 3 days the rest of the year. In the year in question, suppose you actually got 105 samples out of a possible 120 in the High season and you got 70 samples out of a possible 82 for the Low season.

Rank or sort the samples from each season. The highest concentrations have the highest ranks. Suppose the results are as shown in Table 19-1.

Table 19-1. Ranking of High Values in High and Low Seasons. Concentrations in μg/m³.

High Season		Low Season	
Rank of Samples	x Concentration	Rank of Samples	x Concentration
105	74.3	70	60.9
104	71.2	69	58.7
103	70.0	68	43.6
102	67.5	67	35.7
101	64.8	66	28.5
100	59.2	65	25.0
99	55.1	64	20.3
98	50.0	63	20.1

Ranking will allow you to calculate $F_{High}(x)$ and $F_{Low}(x)$. Looking at the first line in the table, you calculate $F_{High}(74.3)$ as $\frac{105}{105} = \mathbf{1}$, because 105 of 105 samples are ≤ 74.3. Similarly, calculate $F_{Low}(60.9)$ as $\frac{70}{70} = \mathbf{1}$. Likewise, calculate $F_{High}(71.2)$ as $\frac{104}{105} = \mathbf{0.990}$ and $F_{Low}(58.7)$ as $\frac{69}{70} = \mathbf{0.986}$. Your results are in Table 19-2, below.

Table 19-2. Distribution Functions of High Values in High and Low Seasons. Concentrations in μg/m³.

High Season			Low Season		
Rank of Samples	x Concentration	$F_{High}(x)$	Rank of Samples	x Concentration	$F_{Low}(x)$
105	74.3	1.000	70	60.9	1.000
104	71.2	0.990	69	58.7	0.986
103	70.0	0.981	68	43.6	0.971
102	67.5	0.971	67	35.7	0.957
101	64.8	0.962	66	28.5	0.943
100	59.2	0.952	65	25.0	0.929
99	55.1	0.943	64	20.3	0.914
98	50.0	0.933	63	20.1	0.900

Next, you rank or sort all the values in a year (both seasons) to help you calculate $W(x)$. If a concentration value wasn't measured in the Low (or High) season, you find the value of F_{Low} (or F_{High}) from the next lowest measured concentration. For example, 74.3 wasn't measured in the Low season; the next lowest measured concentration in that season was 60.9. $F_{Low}(74.3) = F_{Low}(60.9) = 1.000$. As another example, $F_{High}(58.7) = F_{High}(55.1) = 0.943$. Table 19-3 shows the results with the calculated values of $W(x)$.

Table 19-3. Calculating Weighted Percentiles for Two Seasons. Concentrations in μg/m³.

	Seasonal		Seasonal		
Concentration	Weight	$F_{High}(x)$	Weight	$F_{Low}(x)$	W(x)
74.3	0.329	1.000	0.671	1.000	1.000
71.2	0.329	0.990	0.671	1.000	0.997
70.0	0.329	0.981	0.671	1.000	0.994
67.5	0.329	0.971	0.671	1.000	0.990
64.8	0.329	0.962	0.671	1.000	0.988
60.9	0.329	0.952	0.671	1.000	**0.984**
59.2	0.329	0.952	0.671	0.986	0.975
58.7	0.329	0.943	0.671	0.986	0.972
55.1	0.329	0.943	0.671	0.971	0.962
50.0	0.329	0.933	0.671	0.971	0.959

Using the formula for $W(x)$, calculate $W(74.3)$ as $0.329 \times 1.000 + 0.671 \times 1.000 = 1.000$. You calculate $W(71.2)$, $W(70.0)$, and so on, in the same way. Now you can find the smallest x for which $W(x)$ is > 0.98 by moving up the right hand column until you find the first number greater than but not equal to 0.98 (0.984). This value corresponds to the concentration of **60.9 µg/m³**, which is the 98th percentile for this year.

This method has two advantages. First, the seasons don't have to be contiguous months and can even be planned episodic monitoring with concurrence from the appropriate regional administrator. Second, if you set one of the seasons to have 0 days, the method will calculate a percentile identical to one calculated using the procedures in Appendix N.

20. How do I compute quarterly averages when parts of the quarter are sampled at different frequencies?

You should use the same calculation as in Question 3 (for PM_{10}) or Question 4 (for $PM_{2.5}$). The quarterly average is the arithmetic mean of the measured concentrations in that quarter, so you add all the sampled values and divide by the number of samples. [Note that "extra" samples beyond the scheduled sampling days are included when you calculate the annual mean.] The arithmetic mean should represent the true average concentrations during that quarter reasonably well, even if the scheduled sampling frequencies change.

21. Under what circumstances may I reduce the required sampling frequency at a site for a year or season?

Review our *Interim Guidelines for Granting Schedule Exemptions for PM_{10} Monitoring*, (attachment to *Waivers for PM_{10} Sampling Frequency* memorandum, from William F. Hunt, Jr. to EPA Regional Office Air Program Directors, December 2, 1997) which describes methods and decision rules for shifting certain sites from every-day and one-in-three-day sampling for PM_{10} schedules to one-in-six-day sampling. You must show there is little or no chance of exceeding the daily standard. A brief summary follows. [Note that EPA is developing similar guidance for $PM_{2.5}$ sampling frequencies. For initial guidance on $PM_{2.5}$ sampling frequencies see *Guidelines for Granting Exceptions for Daily $PM_{2.5}$ Monitoring* memorandum, from William F. Hunt, Jr. to EPA Regional Office Air Program Directors, April 9, 1998. For information on $PM_{2.5}$ sampling frequencies for calendar year 1999 only, see *$PM_{2.5}$ Site Types and Sampling Frequency During CY-99* memorandum, from William F. Hunt, Jr. to EPA Regional Office Air Program Directors, May 18, 1998.]

Requesting a Year-Round Exemption for PM_{10}

The Regional Administrator may grant a year-round exemption that allows you to sample only once in six days. To request this year-round exemption, you must, at least, show one of the following:

- The mean 99th percentile for the most recent three years is statistically significantly lower than the 24-hour standard. Apply a statistical t-test at the 10 percent significance level.

- The annual standard is the controlling standard. Show that the three-year average annual mean divided by the annual standard level is greater than the three-year average annual 99th percentile divided by the 24-hour standard level.

- The 99th percentile estimated using an exponential distribution is lower than the 24-hour standard. Fit an exponential distribution to the top 25 percent of the concentrations measured over the most recent three years. Show that the fitted 99th percentile is below the daily standard level.

Requesting a Seasonal Exemption for PM_{10}

The Regional Administrator may grant a seasonal exemption to allow your site to sample once in three days or once in six days instead of every day, but you must show

- The site has met Appendix N's minimum requirements for data completeness.

- Every value during that season for the past two years was below the level of the 24-hour standard.

22. May I use a correlated acceptable continuous (CAC) monitor to reduce my sampling frequency?

You may use the CAC monitor to reduce the required $PM_{2.5}$ sampling frequency from every day to once in three days at a core monitor under the following conditions, as given in 40 CFR 58.13(f).

(1) You must show the CAC monitoring data is correlated with $PM_{2.5}$ data from a collocated monitor using a Federal Reference Method or Equivalent Method.

(2) In a Priority 1 PM monitoring area, you must collect at least two complete years of $PM_{2.5}$ monitoring data using a Federal Reference Method or Equivalent Method before

being considered for permission to reduce the sampling frequency. A Priority 1 PM monitoring area, as defined in 40 CFR Part 58(f)(2):

- Is a Metropolitan Statistical Area with a population of 1 million or more
- Has an average annual 98th percentile $PM_{2.5}$ greater than or equal to 80% of the 24-hour standard level for $PM_{2.5}$.

23. If I've missed a scheduled sample, may I make it up?

EPA publishes schedules for each calendar year that give the dates on which you should collect particulate matter samples at State and Local Air Monitoring Stations (SLAMS) or other monitoring sites. EPA publishes these schedules for one-in-three-day sampling and for one-in-six-day sampling. Your scheduled sample might be missed or invalidated for various reasons, including sampler malfunctions and power outages. EPA encourages but does not require you to make up missing scheduled samples by collecting samples on other days, referred to as replacement sampling days. You may want to use these make-up samples to help meet the requirements for data completeness.

The EPA Regional Office is responsible for ensuring that uses of make-up samples avoid bias by being consistent with this and other EPA guidance and with the data validation procedures in the State's Quality Assurance Project Plan (QAPP). If you decide to use make-up samples,

You must

- Make up the sample no later than one week after the scheduled sampling day

You should

- Discuss the use of make-up sampling in the QAPP
- Report the reason why the scheduled sample was missing or invalidated to the Regional Office
- Include the reason why the scheduled sample was missing or invalidated in the State's internal database

You must not

- Intentionally invalidate or fail to collect scheduled samples

- Select whether a missing scheduled sample will be made up based on the level of the expected concentrations

- Select replacement sampling days based on the level of the expected concentrations

You should not

- Make-up 6 or more scheduled samples in any calendar quarter

- Consistently have to use make-up samples to meet requirements for data completeness

The preferred approach is to make up all missed or invalid scheduled samples whenever practicable within the one week time limit. If the QAPP does not include such a plan, the EPA Regional Office may not want to approve make-up samples on days that are not representative of the corresponding scheduled sampling day. For example, this might include make-ups after a severe stagnation or after a brief period of extremely high emissions.

The replacement sampling day should be chosen as follows:

Preferred Approach: Sample before the next scheduled sampling day

- If your monitor samples once every six days, and if other sites in the same network sample once every three days, choose the next scheduled one-in-three-day sampling day. This gives additional spatial resolution and is likely to be most convenient.

- Otherwise, choose the earliest possible day before the next scheduled sampling day. This increases the probability that the replacement day has similar meteorological conditions.

Alternative Approach: Sample exactly one week later

- This approach reduces potential biases due to the variation of emissions patterns with the day of the week.

24. How do I use scheduled samples with make-up and other non-scheduled samples to show that I meet or don't meet the standards?

Treat make-up samples and other non-scheduled samples exactly the same as the scheduled samples for the calculations showing that you meet or don't meet the particulate matter standards:

- The comparisons with the standards use all valid 24-hour samples except for data affected by natural or uncontrollable events and excluded under Appendix N provisions (see Question 29). The actual number of samples (in Question 18) is the total number of

  -- samples on scheduled sampling days

  -- make-up samples on non-scheduled sampling days, as described in the answer to Question 23

  -- samples substituted for missing data as described in the answers to Questions 10 and 15

  -- any other non-scheduled samples

- For quarters with one-in-three-day or one-in-six-day sampling, the scheduled number of samples is the number of sampling days in the published schedule for the sampling frequency

- For quarters with every day sampling, the scheduled number of samples is the number of days in the calendar quarter

- Data completeness percentages are given by the ratios of the actual number of samples to the scheduled number of samples

Chapter 3

Monitoring Issues

25. Which monitors do I compare to which standards?

- Is the PM monitoring data collected using a Federal Reference Method or Federal Equivalent Method?

- Does the monitored data meet the Part 58 requirements for data quality assurance, sampling frequency, monitor siting, and, if necessary, spatial averaging?

If so, you may compare that data with the applicable PM_{10} or $PM_{2.5}$ standards, as described below. If not, you generally may not compare that data to the PM standards in order to decide whether or not you've met the standards. Part 58 and its appendices discuss some exceptions.

Handling PM_{10} Data:

Compare your PM_{10} data with the annual and 24-hour standards for PM_{10} if you collect PM_{10} data

- At State and Local Air Monitoring Stations (SLAMS) or at National Air Monitoring Stations (NAMS)—a subset of the SLAMS network.

- At a Special Purpose Monitor (SPM) that the State intends to use to show that the PM_{10} standards are met (i.e., they are included in the PM Monitoring Network Description).

Handling $PM_{2.5}$ data:

Follow Table 25-1 below to determine how to compare your $PM_{2.5}$ data to the standards.

Table 25-1. How to compare your $PM_{2.5}$ data to the standards.

If your monitor is a . . .	And if the location is . . .	And if the spatial scale (see Part 58, App D, 2.8) is . . .	And if the location represents	Then compare with these $PM_{2.5}$ standards
SLAMS or NAMS or SPM*	population-oriented	neighborhood, urban, or regional		annual and 24-hour
SLAMS or NAMS or SPM*	population-oriented	micro or middle scale	many locations in the area	annual and 24-hour
SLAMS or NAMS or SPM*	population-oriented and a local hot spot	micro or middle scale	a unique area	24-hour only
SLAMS or NAMS or SPM*	a background site	neighborhood, urban, or regional		annual and 24-hour, but address failures to meet the NAAQS at these sites as part of the PM implementation program

*Special purpose monitors that meet Part 58 requirements will be exempt from NAAQS comparisons with the $PM_{2.5}$ NAAQS for the first two calendar years of their operation to encourage $PM_{2.5}$ monitoring initially (see 40 CFR 58.14(b)).

Table 25-1. How to compare your $PM_{2.5}$ data to the standards.

If your monitor is a . . .	And if the location is . . .	And if the spatial scale (see Part 58, App D, 2.8) is . . .	And if the location represents	Then compare with these $PM_{2.5}$ standards
SLAMS or NAMS or SPM*	a transport site	urban or regional		annual and 24-hour, but address failures to meet the NAAQS at these sites as part of the PM implementation program
SLAMS or NAMS or SPM*	not population oriented, and not a background or transport site			neither standard
SPM with at most two years of data	population-oriented			neither standard, but if your data violates the NAAQS, report the results in the State's annual monitoring report and consider whether these sites should become SLAMS

*Special purpose monitors that meet Part 58 requirements will be exempt from NAAQS comparisons with the $PM_{2.5}$ NAAQS for the first two calendar years of their operation to encourage $PM_{2.5}$ monitoring initially (see 40 CFR 58.14(b)).

26. What are "community monitoring zones" (CMZs) and how do I decide which sites to include in a spatial average?

A community monitoring zone (CMZ) is an area that contains one or more sites with relatively similar concentrations of $PM_{2.5}$ that are impacted by similar emission sources. The states define CMZs in their PM Monitoring Network Description, based on 40 CFR Part 58. For the $PM_{2.5}$ annual standard, the states may spatially average the annual means over the sites in the

CMZ (each site-year with data is given equal weight in the computation of the annual spatial average). They compare the average of the three annual spatial averages to the level of the standard. CMZs are defined to meet the following three conditions, only the first of which is required (see Part 58, Appendix D, §2.8.1.6.1):

- The annual average concentrations at every site in the CMZ must be no less than 80% or more than 120% of the annual spatial average [required]

- The 24-hour average concentrations should have strong correlations (a correlation coefficient of 0.6 or greater) [recommended]

- Emissions from the same source or types of sources of $PM_{2.5}$ affect the entire CMZ [recommended]

State and local agencies that regulate air quality must develop descriptions for the $PM_{2.5}$ network. In those descriptions, they must group sites into CMZs if they choose to do spatial averaging. If the CMZ's data does not meet the three conditions above, then states may need to redefine the CMZs before comparing the data to the NAAQS. To decide which sites to include in the spatial average, follow these steps:

a. Calculate the annual mean for each year and site. Average the four quarterly means. Don't use data for a year and site that does not meet the criteria for data completeness of the annual mean.

b. Calculate the spatially averaged annual mean for each year. Average the annual means across the designated sites in the CMZ.

c. Check each year to see whether all sites' annual means are greater than or equal to 80 percent and are less than or equal to 120 percent of the spatially averaged annual mean for that year.

   - YES. The annual averages meet the first condition for a CMZ. Check the other two conditions.

   - NO. The annual averages do not meet the first condition for a CMZ. Redefine the CMZ.

d. Calculate the spatial correlations between the 24-hour average concentrations. Compute the Pearson correlation coefficients between the 24-hour average concentrations at each pair of sites for each year. Suppose the n pairs of concentrations at sites X and Y measured on the same day in a year are $(X_1, Y_1),(X_2,$

Y_2), (X_3, Y_3), . . . (X_n, Y_n). Then the Pearson correlation coefficient, r_{xy}, for sites X and Y in a year is given by the formula:

$$r_{xy} = \frac{\sum_{i=1}^{n} X_i Y_i - \frac{\sum_{i=1}^{n} X_i \sum_{i=1}^{n} Y_i}{n}}{\sqrt{\left(\sum_{i=1}^{n} X_i^2 - \frac{\left(\sum_{i=1}^{n} X_i\right)^2}{n}\right)\left(\sum_{i=1}^{n} Y_i^2 - \frac{\left(\sum_{i=1}^{n} Y_i\right)^2}{n}\right)}}$$

e. Check to see whether all the spatial correlations between the 24-hour average concentrations are at least 0.6.

- YES. The 24-hour average concentrations meet the second condition for a CMZ. Check the third condition.

- NO. The 24-hour average concentrations do not meet the second condition for a CMZ. Consider redefining the CMZ.

f. Check to see if emissions from the same source or source-types affect the CMZ. For help with this, see the *Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}*, December 15, 1997, Section 5.5.

- YES. The emissions meet the third condition for a CMZ.

- NO. The emissions do not meet the third condition for a CMZ. Consider redefining the CMZ.

Example: How to check site annual averages across a CMZ for consistency

For this example, examine Table 26-1 below. Assume the CMZ contains 5 sites, numbered 1 to 5. Assume each site and quarter is at least 75% complete.

a. Calculate the annual means. The annual means are as shown in Table 26-1.

b. Calculate the spatially averaged annual mean. The spatially averaged annual means (**10.80**, **14.08**, and **13.99 μg/m³**) for each year are shown in the row "Spatial mean." For example, in Year 1, the spatially averaged annual mean is

$$\frac{10.38 + 13.71 + 10.62 + 10.50 + 8.79}{5} = \mathbf{10.80\ \mu g/m^3}.$$

c. Check whether each site's annual means are between 80 and 120 percent of the spatially averaged annual mean. The spatially averaged annual means multiplied by 0.8 and by 1.2 are shown in the rows "spatial mean × 80%" and "spatial mean × 120%." For example, in Year 1, 80% of the spatially averaged annual mean is 10.80 × 0.8 = **8.64 μg/m³**. In year 2, all five sites have annual means between 80 and 120 percent of the spatially averaged annual mean (i.e., between 11.26 and 16.90). However, in Year 1, site 2 is more than 120% of the spatially averaged annual mean (13.71 > 12.96). In Year 3, site 1 is less than 80% of the spatially averaged annual mean (9.71 < 11.19). In Year 3, site 2 is more than 120% of the spatially averaged annual mean (20.36 > 16.79). Thus, the first condition for a CMZ is not met for this example. Redefine the CMZ before evaluating whether or not the NAAQS is met.

Table 26-1. Example of Consistency Checks for the CMZ's Annual Average. ($PM_{2.5}$ concentrations in μg/m³).

Site	Year 1	Year 2	Year 3
1	10.38	13.21	9.71
2	13.71	16.32	20.36
3	10.62	12.50	16.11
4	10.50	12.51	11.66
5	8.79	15.84	12.10
Spatial mean	10.80	14.08	13.99
Spatial mean × 80%	8.64	11.26	11.19
Spatial mean × 120%	12.96	16.90	16.79

Example: How to check spatial correlations between 24-hour average concentrations across a CMZ for consistency

d. Calculate the spatial correlations between the 24-hour average concentrations. Suppose that a CMZ has 3 sites, numbered 1, 2, and 3. Table 26-2 shows correlation coefficients for one year calculated by the equation given in step 4 above:

Table 26-2. Example of Consistency Checks for the CMZ's Spatial Correlations.

Correlations	Site 1	Site 2	Site 3
Site 1	X	0.68	0.71
Site 2		X	0.63
Site 3			X

e. Check to see whether all the spatial correlations between the 24-hour average concentrations are at least 0.6. Since the correlations are all greater than 0.6, sites 1, 2, and 3 in this year meet the second condition for a CMZ. To complete the test of the condition for strong spatial correlations, check whether all other correlations between pairs of sites in the rest of the years are all greater than or equal to 0.6.

f. Check to see if emissions from the same source or source-types affect the CMZ. Assume that using the guidance provided in the document sited in step 6 above shows that $PM_{2.5}$ emissions are from the same source type throughout the CMZ. The third condition for a CMZ is met.

27. If a monitor is reassigned to a different CMZ during the three-year period, which CMZ assignment should I use to calculate the spatial average?

Apply the most recent definition of the CMZ to all three years.

Example:

Suppose that in Year 1, sites 1, 2, and 3 formed one CMZ, and site 4 formed another. In Year 3, the state or local agency reassigns site 2 to the second CMZ. Calculate whether you meet the standard based on having sites 1 and 3 in one CMZ and sites 2 and 4 in the other CMZ. Use all valid annual means for the three-year period. Apply the three conditions for a CMZ described in the answer to Question 26 to each of these CMZs, so you can decide whether you need to subdivide one or both CMZs.

28. How many hourly values make up a valid 24-hour average for a continuous monitor?**

- If measurements are available for at least 75 percent (18 or more) of the hours during the 24-hour period, the 24-hour average is valid. You'll compute it by summing the hourly concentrations and dividing by the number of hourly measurements.

- If measurements are available for less than 75 percent (17 or less) of the hours during the 24-hour period, you must treat the 24-hour average as invalid, unless the concentrations are too high to be ignored, as determined by the following calculation:

  a. Compute the lower bound. Substitute zero for each missing hour and compute the average over all 24 hours.

  b. Round the lower bound. Round the lower bound to the nearest 1 $\mu g/m^3$ for $PM_{2.5}$ concentrations (round up decimals 0.5 or greater). Round the lower bound to the nearest 10 $\mu g/m^3$ for PM_{10} concentrations (round up integers of 5 or greater).

  c. Compare the rounded lower bound to the standard. If the rounded lower bound exceeds the level of the 24-hour standard, use the unrounded lower bound as the valid 24-hour average. Otherwise, treat the 24-hour average as invalid.

Example: How to calculate 24-hour averages from hourly concentrations

Suppose the hourly PM_{10} measurements are as follows, where "M" denotes a missing value: M, M, M, M, M, M, 112, M, 109, 95, 110, 113, 140, 150, 160, 160, 160, 165, 160, 170, 140, 130, 135, 140 $\mu g/m^3$. You have 17 hourly concentrations and 7 missing values. Because there are fewer than 18 valid hours, you must calculate the lower bound. The lower bound equals $(0 + 0 + 0 + 0 + 0 + 0 + 112 + 0 + 109 + \ldots + 135 + 140) /24 =$ **97.9 $\mu g/m^3$**. Rounding to the nearest 10 gives a rounded value of **100 $\mu g/m^3$**. This value is lower than the level of the 24-hour standard, 150 $\mu g/m^3$, so the 24-hour average for this day is invalid.

**Note: See 40 CFR Part 50 Appendix J (for PM_{10}) and Appendix L (for $PM_{2.5}$) for the rules on determining how many hours make a valid 24-hour average for an integrated 24-hour measurement.

Chapter 4

Miscellaneous Issues

29. How do I handle data from uncontrollable or natural events?

First, you should review the following three documents for guidance on how to address PM data that are affected by uncontrollable or natural events.

- *Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events*, EPA 450/4-86-007, July, 1986.

- *Areas Affected by PM-10 Natural Events*, Memorandum from Mary D. Nichols, Assistant Administrator for Air and Radiation, to EPA Regional Office Air Program Directors, May 30, 1996.

- *Interim Air Quality Policy on Wildland and Prescribed Fires*, Memorandum from Richard D. Wilson, Acting Assistant Administrator for Air and Radiation, to EPA Regional Administrators, May 15, 1998.

The *Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events* addresses uncontrollable events such as structural fires, high pollen count, chemical spills and industrial accidents, and activities that temporarily affect a nearby monitor. The *Natural Events Policy for the Particulate Matter National Ambient Air Quality Standards* addresses the treatment of data that are affected by volcanic and seismic activities, unwanted wildland fires (wildfires), and high wind events. The *Interim Air Quality Policy on Wildland and Prescribed Fires* addresses the treatment of air quality data that are affected by wildland and prescribed fires that are managed to achieve resource benefits. Actions to be taken depend upon whether the wildland and prescribed fires managed for resource benefits significantly contribute to violations of the PM NAAQS; the answer to Question 30 shows you how to decide this.

Appendix N generally sets forth what is needed to determine whether the PM standards are met, based on three consecutive, complete years of air quality data. Section 1.0(b) of Appendix N allows EPA to give special consideration to data affected by uncontrollable or natural events. While all valid ambient air quality data should be submitted to the EPA Aerometric Information Retrieval System (AIRS), appendix N provides that in some cases it may be appropriate for you to exclude such data from the calculations because they could result in inappropriate values to compare with the levels of the PM standards. In other cases, you should use all the data to calculate the comparison with the standards and you should then follow the regulatory response determined to be appropriate by EPA, which could include approaches

outlined in the Natural Events and Interim Air Quality policies. The appropriate Regional Administrator is responsible for approving the exclusion, adjustment, or retention of data affected by uncontrollable or natural events.

30. How do I determine whether wildland and prescribed fires managed for resource benefits significantly contribute to violations of the $PM_{2.5}$ or PM_{10} NAAQS?

The *Interim Air Quality Policy on Wildland and Prescribed Fires* addresses the flagging (in section VII.B) and treatment of air quality data that are affected by wildland and prescribed fires that are managed to achieve resource benefits. Actions to be taken depend upon whether the wildland and prescribed fires managed for resource benefits significantly contribute to violations of the PM NAAQS. You may consider fires managed for resource benefits to have significantly contributed to a violation of the $PM_{2.5}$ or PM_{10} NAAQS if the corresponding standard was not met and if

- For the 24-hour standards: 25 percent or more of all the PM concentrations that are above the level of the standards have been flagged as being due to fire impacts.

- For the annual standards: the sum of all measured PM concentrations flagged as being due to fire impacts, divided by the total number of sample days (fire days plus non-fire days) is greater than or equal to 25 percent of the annual standard.

Follow the calculations in these examples, which also show how you should apply the rounding conventions:

Example: How to Decide if Fires Managed for Resource Benefits Have Significantly Contributed to a Violation of the 24-hour PM_{10} NAAQS.

Steps a to e of this example follow the steps given in Question 7 to decide if the site meets or does not meet the 24-hour standard for PM_{10}. If the site does not meet the standard, follow steps f and g to decide whether fires managed for resource benefits have significantly contributed to a violation of the PM_{10} NAAQS.

a. Sort all of the data values collected in any given year from highest to lowest. Consider the set of PM_{10} observations given in Table 30-1. The values have been sorted from highest to lowest. Assume 111 values were measured in Year 1, 99 values in Year 2, and 101 values in Year 3. Assume one of the values (in Year 2) has been flagged as being due to fire impacts, as shown by the superscript f.

Table 30-1. Maxima of Sample PM_{10} Values from One Site for a Three-Year Period.

n	Year 1 111 values n^{th} highest value ($\mu g/m^3$)	Year 2 99 values n^{th} highest value ($\mu g/m^3$)	Year 3 101 values n^{th} highest value ($\mu g/m^3$)
1	**170**	**203** [f]	**175**
2	130	**155**	147
3	128	152	144
4	120	143	140
5	95	133	133
6	90	120	120
7	90	100	100
8	88	97	99
9	86	90	99
⋮	⋮	⋮	⋮

[f] Concentration flagged as being due to fire impacts.

b. Find n from Table 7-1 and find the n^{th} highest value from Table 30-1. The 99^{th} percentile value for Year 1 is the 2^{nd} highest value (130 $\mu g/m^3$), for Year 2 is the highest value (203 $\mu g/m^3$), and for Year 3 is the 2^{nd} highest value (147 $\mu g/m^3$).

c. Calculate the 3-year average of all three values for the 99^{th} percentile.

$$\frac{130 + 203 + 147}{3} = \mathbf{160.0\ \mu g/m^3}.$$

d. Round to the nearest multiple of 10 Round integers of 5 or greater up and those less than 5 down. Round **160.0** to **160 $\mu g/m^3$**.

e. Compare your result to the standard. 160 is greater than 150 $\mu g/m^3$ so this example does not meet the 24-hour standard of 150 $\mu g/m^3$ for PM_{10}.

f. Count the number of rounded concentrations that exceed the standard (exceedances). For the 24-hour standard for PM_{10}, concentrations are rounded to the nearest 10 before being compared to the standard of 150 $\mu g/m^3$. Therefore the exceedances are any concentrations that are greater than or equal to 155 $\mu g/m^3$. Table 30-1 shows 4 exceedances (in bold).

g. Calculate the percentage of flagged concentrations among the exceedances. 1 out of 4 exceedances are flagged as being due to fire impacts, which is 25 percent. Since 25 percent or more of the exceedances standard have been flagged as due to fire impacts, fires have caused or significantly contributed to the 24-hour PM_{10} standard being violated in this area.

Example: How to Decide if Fires Managed for Resource Benefits Have Significantly Contributed to a Violation of the 24-hour $PM_{2.5}$ NAAQS.

Steps a to e of this example follow the steps given in Question 7 to decide if the site meets or does not meet the 24-hour standard for $PM_{2.5}$. If the site does not meet the standard, follow steps f and g to decide whether fires managed for resource benefits have significantly contributed to a violation of the $PM_{2.5}$ NAAQS.

a. Sort all of the data values collected in any given year from highest to lowest. Consider the set of $PM_{2.5}$ observations given in Table 30-2. The values have been sorted from highest to lowest. Assume 281 values were measured in Year 1, 304 values in Year 2, and 296 values in Year 3. Assume 13 values have been flagged as being due to fire impacts, as shown by the superscripts f.

Table 30-2. Maxima of Sample $PM_{2.5}$ Values from One Site for a Three-Year Period.

n	Year 1 281 values n^{th} highest value ($\mu g/m^3$)	Year 2 304 values n^{th} highest value ($\mu g/m^3$)	Year 3 296 values n^{th} highest value ($\mu g/m^3$)
1	64.9 [f]	**72.0** [f]	**73.0** [f]
2	64.6 [f]	**70.0** [f]	**71.0** [f]
3	64.5 [f]	**68.4** [f]	**70.5** [f]
4	64.4	**67.8** [f]	**70.0** [f]
5	64.2	**67.2** [f]	**69.8** [f]
6	64.0	**66.5**	**68.4**
7	57.9	**65.5**	**68.4**
8	54.0	65.4	**66.0**
9	54.0	54.3	62.7
⋮	⋮	⋮	⋮

[f] Concentration flagged as being due to fire impacts.

b. Find n from Table 7-1 and find the n^{th} highest value from Table 30-2. The 98^{th} percentile value for Year 1 is the 6^{th} highest value (64.0 $\mu g/m^3$), for Year 2 is the 7^{th} highest value (65.5 $\mu g/m^3$), and for Year 3 is the 6^{th} highest value (68.4 $\mu g/m^3$).

c. Calculate the 3-year average of all three values for the 98^{th} percentile.

$$\frac{64.0 + 65.5 + 68.4}{3} = \mathbf{65.97\ \mu g/m^3}.$$

d. Round to the nearest integer. Round decimals of 0.5 or greater up and those less than 0.5 down. Round **65.97** to **66 $\mu g/m^3$**.

e. Compare your result to the standard. 66 is greater than 65 $\mu g/m^3$ so this example does not meet the 24-hour standard of 65 $\mu g/m^3$ for $PM_{2.5}$.

f. Count the number of rounded concentrations that exceed the standard (exceedances). For the 24-hour standard for $PM_{2.5}$, concentrations are rounded to the nearest integer before being compared to the standard of 65 $\mu g/m^3$. Therefore the exceedances are any concentrations that are greater than or equal to 65.5 $\mu g/m^3$. Table 30-2 shows 15 exceedances (in bold).

g. Calculate the percentage of flagged concentrations among the exceedances. 10 out of 15 exceedances are flagged as being due to fire impacts, which is 66.7 percent. Since 25 percent or more of the exceedances standard have been flagged as due to fire impacts, fires have caused or significantly contributed to the 24-hour $PM_{2.5}$ standard being violated in this area.

Example: How to Decide if Fires Managed for Resource Benefits Have Significantly Contributed to a Violation of the Annual PM_{10} NAAQS.

This example uses the same data as the example given in Table 30-1.

a. Use the calculations given in Chapter 1 to decide if the site meets or does not meet the annual standard for PM_{10}. Assume for this example that the site does not meet the annual standard for PM_{10}.

b. Calculate the sum of all measured PM_{10} concentrations flagged as being due to fire impacts. From Table 30-1, only one concentration is flagged, and this sum equals 203 $\mu g/m^3$.

c. Divide by the number of sample values. Include fire days and non-fire days. For this example, the ratio equals

$$\frac{203}{111+99+101} = \mathbf{0.65\ \ g/m^3}$$

d. Compare the result to 12. 25 percent of the annual standard for PM_{10} equals 12 $\mu g/m^3$ (after rounding to the nearest integer). Since 0.65 is less than (and not equal to) 12 $\mu g/m^3$, fires have not caused or significantly contributed to the annual PM_{10} standard being violated in this area.

Example: How to Decide if Fires Managed for Resource Benefits Have Significantly Contributed to a Violation of the Annual $PM_{2.5}$ NAAQS.

This example uses the same data as the example given in Table 30-2. Assume that the area has not been designated for spatial averaging and has a single site.

a. Use the calculations given in Chapter 1 to decide if the area meets or does not meet the annual standard for $PM_{2.5}$. Assume for this example that the area does not meet the annual standard for $PM_{2.5}$.

b. Calculate the sum of all measured $PM_{2.5}$ concentrations flagged as being due to fire impacts. If the area has been designated for spatial averaging, sum across all flagged days and across all sites in the CMZ. From Table 30-2, 13 concentrations were flagged, and their sum equals

64.5 + 64.6 + 64.9 + 67.2 + 67.8 + 68.4 + 70.0 + 72.0 + 69.8 + 70.0 + 70.5 + 71.0 + 73.0 = **893.7 $\mu g/m^3$**.

c. Divide by the number of sample values. Include fire days and non-fire days. If the area has been designated for spatial averaging, sum across all sites in the CMZ. For this example, the ratio equals

$$\frac{893.7}{281+304+296} = \mathbf{1.01\ \ g/m^3}$$

d. Compare the result to 4. 25 percent of the annual standard for $PM_{2.5}$ equals 4 $\mu g/m^3$ (after rounding to the nearest integer). Since 1.01 is less than (and not equal to) 4

$\mu g/m^3$, fires have not caused or significantly contributed to the annual $PM_{2.5}$ standard being violated in this area.

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-454/R-99-009		

4. TITLE AND SUBTITLE	5. REPORT DATE
Guideline on Data handling Conventions for the PM NAAQS	April 1999
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
Jonathan Cohen (ICF Kaiser), Terence Fitz-Simons, Miki Wayland	
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
Air Quality Trends Analysis Group (MD-14) U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Research Triangle Park, NC 27711	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
Director Office of Air Quality Planning and Standards Office of Air and Radiation U.S. Environmental Protection Agency Research Triangle Park, NC 27711	14. SPONSORING AGENCY CODE EPA/200/04

15. SUPPLEMENTARY NOTES

Document is available electronically at "http://www.epa.gov/ttn/oarpg/"

16. ABSTRACT

This report provides technical guidance on the data handling conventions for the Particulate Matter National Ambient Air Quality Standards (NAAQS). The report is written in the "plain English" question and answer (Q&A) style. The following data handling issues are addressed:

1) Comparing your data to the standards
2) Sampling frequency
3) Monitoring issues
4) Uncontrollable or Natural events

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Particulate Matter, PM, PM_{10}, $PM_{2.5}$ Compliance PM Standard Ambient Air Quality Standards (NAAQS)	Air Pollution Control	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(Report)*	21. NO. OF PAGES
Release Unlimited	Unclassified	54
	20. SECURITY CLASS *(Page)*	22. PRICE
	Unclassified	

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OAR Policy and Guidance Metarecord

Document Title/Subject: Guideline on Data Handling Conventions for the PM NAAQS & Cover Memo (pmguide) **Related Documents:**	**Signed by:** David Mobley, Director EMAD **Signature Date:** May 11, 1999 **Contact:** Miki Wayland Terence Fitz-Simons.	**Filename(s):** http://www.epa.gov/ttn/oarpg/t1/memoranda/pmguide.pdf http://www.epa.gov/ttn/oarpg/t1/memoranda/pmguide.wpd http://www.epa.gov/ttn/oarpg/t1/memoranda/pmfinal.pdf http://www.epa.gov/ttn/oarpg/t1/memoranda/pmfinal.wpd **URL(s):**
Regulatory Authority: Title 1	**Division:** Emissions, Monitoring, and Analysis Division (OAQPS)	**Submitted By:** wayland.miki
Document Type: Policy & Guidance Memos	**EPA Document Number:** EPA-454/R-99-008 **Federal Register:**	**Supersedes:**
Subject Category: AIR	**Keywords:** Particulate matter Data Handling Standards	**Terms:** Standards

Abstract:
This report provides technical guidance on the data handling conventions for the Particulate Matter National Ambient Air Quality Standards (NAAQS). The report is written in the plain English question and answer style.

Last updated on Wednesday, March 8th, 2006
URL: http://www.epa.gov/ttncaaa1/t1/meta/m16345.html