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GUIDELINE ON DATA HANDLING CONVENTIONS FOR THE 8-HOUR OZONE NAAQS

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Guideline on Data Handling Conventions for the 8-Hour Ozone National Ambient Air Quality Standard (NAAQS)

Introduction

This guideline covers the data handling and ambient air quality monitoring data completeness requirements for the 8-hour ozone NAAQS as given in Appendix I. As background for the discussion that follows, the 8-hour primary and secondary ambient ozone air quality standards (40CFR50.10) are:

> (a) The level of the national 8-hour primary and secondary ambient air quality standards for ozone, measured by a reference method based on Appendix D to this part and designated in accordance with part 53 of this chapter, is 0.08 parts per million (ppm), daily maximum 8-hour average.
>
> (b) The 8-hour primary and secondary ozone ambient air quality standards are met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm, as determined in accordance with Appendix I to this part.

For completeness, the full text of Appendix I (40CFR50.10, Appendix I) is provided as an attachment to this guideline. This guideline uses the 'plain English' question and answer (Q & A) format to present the data handling and data completeness issues of concern.

Data Handling Conventions

Q: What monitors does this guidance cover?

This guidance on data handling and data completeness requirements of the 8-hour ozone NAAQS is intended for all ozone monitors that are designated as either National Air Monitoring Stations (NAMS) or State and Local Air Monitoring Stations (SLAMS). All NAMS and SLAMS sites must meet uniform monitor siting and quality assurance requirements established in the monitoring regulations (40CFR58). This guidance also applies to all other ozone monitoring sites, including special purpose monitors (SPM), that have recorded at least three years of ambient ozone data and meet all the monitoring and quality assurance requirements for NAMS and SLAMS.

Q: How do I compute the daily maximum 8-hour average ozone concentration?

The new Aerometric Information Retrieval System (AIRS) will do this computation for you. First, running 8-hour averages are computed from the hourly ozone concentration data for each hour of the year and the result is stored in the first, or start, hour of the 8-hour period. In the event that only 6 (or 7) hourly averages are available, the 8-hour average is computed using 6 (or 7) as the divisor. Generally, if fewer than 6 hours of ozone concentration data are available, then the 8-hour daily maximum concentration for the day is assigned the value of ' missing.' However, just because we are missing more than 2 hours of monitoring data, we do not want to ignore 8-hour concentrations that clearly exceed the level of the standard. When more than 2 hours of monitoring data are missing, we compute the 8-hour average concentration by substituting one-half the minimum detectable limit for the missing hourly concentrations and using 8 as the divisor. In this case, if the computed 8-hour average concentration is greater than 0.08 ppm, it is retained, otherwise the 8-hour concentration for this 8-hour period is assigned the value of 'missing.' In all cases, the computed 8-hour average ozone concentration is reported in parts per million (ppm) to three decimal places (the insignificant digits to the right of the third decimal place are truncated).

Q: What is a valid ozone monitoring day?

An ozone monitoring day is counted as a valid ozone monitoring day if 8-hour averages are available for at least 18 of the 24 possible 8-hour average periods that start within the day, or the daily maximum 8-hour average concentration for the day is greater than 0.08 ppm. The new AIRS automatically computes the number of valid ozone monitoring days.

Q: How many monitoring days are required?

Ozone monitoring seasons vary by state. The designated ozone monitoring seasons for the National Air Monitoring Stations (NAMS) and State and Local Air Monitoring Stations (SLAMS) are listed in the ambient monitoring rule (40CFR58, Appendix D) and are also included in AIRS. These same ozone seasons are used to compute the data completeness requirements for special purpose monitors (SPM) used to demonstrate compliance with the standard.

Q: What is a complete data year?

For the purpose of judging compliance with the standard, a valid year must have valid 8-hour daily maximum ozone concentrations for at least 75 percent (74.5 % rounds up) of the required monitoring days in the ozone season designated for NAMS or SLAMS monitoring sites. All three years must average at least 90 percent data completeness

(89.5% rounds up) to demonstrate attainment.

Q: Can I exclude ozone monitoring data affected by natural events such as stratospheric ozone intrusion from computations used to determine compliance with the NAAQS?

Yes, monitoring data affected by natural events, such as stratospheric ozone intrusion, can be excluded when determining compliance with the 8-hour ozone NAAQS under certain conditions. One of these conditions is that the requesting agency must document that this rare natural event had a significant impact on ozone levels and must submit the request to the appropriate EPA Regional Office. Another is that the decision to exclude or make adjustments to the monitoring data affected by stratospheric ozone intrusion, or other exceptional natural events, is subject to the approval of the appropriate Regional Administrator. Upon EPA Regional Office concurrence, the data must be appropriately flagged in AIRS as an exceptional event if the annual 4th highest daily maximum concentration is to be computed correctly. In the case of stratospheric ozone intrusion, although this event is exceptional, the circumstances or the criteria under which it occurs are difficult to measure and document given generally available meteorological data. Stratospheric ozone intrusions are infrequent and very localized events of short duration, and this fact makes it difficult to use currently available airport meteorological data to determine whether a stratospheric ozone intrusion has occurred. Therefore, determining whether a stratospheric ozone intrusion, or any other natural event, has significantly affected measured ozone concentrations should be a case-by-case decision based on reasonable judgment regarding the season of the year, time of day, and accompanying meteorological conditions associated with the ozone measurement in question. (see EPA, 1986)

Q: Is any credit given toward meeting the 75% minimum data completeness requirement for days with missing monitoring data that would have had low ozone concentrations?

Yes, days with missing monitoring data may be counted toward meeting the minimum 75 percent data completeness requirement, but only if there is no clear pattern to the timing of the missing measurements and the missing measurements can be assumed to be less than the level of the NAAQS. Meteorological data, or ambient measurements from nearby monitoring sites, may be sufficient to demonstrate that missing ozone data at a particular monitoring location would not likely have exceeded the level of the standard. For example, if you can demonstrate that meteorological conditions on days with missing ozone measurements at a site were not conducive to concentrations above the level of the ozone standard, then you may be able to count the day toward meeting the minimum data completeness requirements. The demonstration must follow EPA guidance on the use of statistical analyses of air quality and meteorological data (EPA, 1998) and the results of

the analyses must be submitted to the appropriate Regional Administrator for approval. Once approved, days with missing monitoring data that are assumed to be less than the level of the NAAQS must be appropriately flagged in AIRS to ensure that the percent data completeness calculations are computed correctly.

Q: How do I find the 4th highest daily maximum 8-hour average ozone concentration at an ambient air quality monitoring site?

The simplest way is to look at the annual 4th highest 8-hour daily maximum ozone concentration in a standard AIRS summary report. Otherwise, you simply rank the 8-hour daily maximum ozone concentrations from highest to lowest and identify the 4th highest value.

Q: How many significant figures must I carry in the computations?

Three. The remaining right-most digits are truncated. The units for all computations are parts per million (ppm). AIRS sets this automatically when it computes the daily maximum 8-hour concentrations and for all subsequent computations.

Q: What is the attainment test?

The 8-hour primary and secondary ozone ambient air quality standards are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm (i.e., the site is said to be in attainment). Because the third decimal digit, in ppm, is rounded, 0.084 ppm is the largest concentration that is less than, or equal to, 0.08 ppm.

Q: What is the minimum number of years of data needed to demonstrate attainment with the 8-hour ozone NAAQS?

Three complete years of ozone monitoring data are required to demonstrate attainment at a monitoring site.

Q: How do I compute the average annual 4th highest 8-hour daily maximum ozone concentration at an ambient air quality monitoring site?

The average annual 4th highest 8-hour daily maximum concentration is simply the average of the annual 4th highest 8-hour daily maximum concentrations from each of the last 3 years. For example,

Year	Percent Valid Days	8-hour Daily Maximum Concentrations (ppm)			
		1st	2nd	3rd	**4th**
1993	100%	0.092	0.091	0.090	**0.089**
1994	96%	0.090	0.089	0.086	**0.084**
1995	98%	0.087	0.085	0.083	**0.081**

the average annual 4th maximum ozone concentration is,

Avg 4th max = (0.089 + 0.084 + 0.081)/3 = 0.08466... = **0.084 ppm**

which rounds to **0.08** ppm and the site meets the standard.

Q: What is the ozone air quality design value?

For a concentration-based standard, the air quality design value for a site is defined as the standard-related test statistic. Thus, the 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration (e.g., the 0.084 ppm value calculated in the previous question) is the air quality design value for a site.

Q: What if only 1 or 2 years of data are available at the site?

If only 2 years of data are available at a NAMS or SLAMS monitoring site that is still operating, then you must wait until the 3rd year of data is available before you can determine the air quality status of this monitoring site. Because the form of the standard is an average concentration, the air quality status of a monitoring site cannot be determined using only one year of ambient data. Monitoring sites with only 1 or 2 years of data that indicate a potential to violate the ozone NAAQS should continue to operate so that their air quality status can be determined based on three complete years of data.

Q: How do I judge the air quality status of ozone monitoring sites that have stopped monitoring?

The appropriate EPA Regional Office must be notified prior to shutting down a NAMS

site, or a SLAMS site that has exceeded the level of the ozone 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 ozone concentrations measured, and the likelihood that additional monitoring data may be available in future years.

Q: What if 3 years of ozone monitoring data are available but some years do not meet the data completeness requirements?

While three complete years of ozone monitoring data are required to demonstrate attainment at a monitoring site, fewer than 3 complete years of data may be sufficient to demonstrate nonattainment. Incomplete data may not be used to excuse a clear nonattainment situation. In a year with missing monitoring data, the *true* annual 4th highest 8-hour daily maximum concentration will always be at least as high, or higher, than the observed annual 4th highest daily maximum 8-hour average ozone concentration. Thus, calendar years with less than 75% data completeness must be included in the attainment analysis computation if the 3-year average of the annual fourth highest daily maximum 8-hour average ozone concentration is greater than 0.08 ppm. For example,

Year	Percent Valid Days	8-hour Daily Maximum Ozone Concentrations (ppm)			
		1st	2nd	3rd	**4th**
1993	96%	0.105	0.103	0.103	**0.102**
1994	74%	0.090	0.085	0.082	**0.080**
1995	89%	0.103	0.101	1.101	**0.097**

the 3-year average annual 4th highest daily maximum 8-hour ozone concentration is,

Avg 4th max = (0.102 + 0.080 + 0.097)/3 = **0.093 ppm**

which rounds to **0.09 ppm** and the site has failed the attainment test, even though the 1994 ozone monitoring data do not meet the 75% data completeness requirement.

Q: How do I judge the air quality status of an area that has more than one ozone monitoring site?

The data handling procedures described in this guidance are applied on an individual basis at each monitor in the area. An area is in compliance with the 8-hour ozone NAAQS if, and only if, every monitoring site in the area meets the NAAQS.

Q: How do I compute the area's design value?

The air quality design value for a site is the 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration. The air quality design value for the area is the highest design value among all sites in the area.

References

1. "Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events", EPA-450/4-86-007, U.S. Environmental Protection Agency, Research Triangle Park, N.C., July 1986.

2. "Guideline on Accounting for Missing Data to Meet the Data Completeness Requirements of the 8-Hour Ozone NAAQS", U.S. Environmental Protection Agency, Research Triangle Park, N.C., in preparation.

Appendix I to 40CFR, Part 50

Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone

Appendix I to Part 50--Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone

1. General.

This appendix explains the data handling conventions and computations necessary for determining whether the national 8-hour primary and secondary ambient air quality standards for ozone specified in Sec. 50.10 are met at an ambient ozone air quality monitoring site. Ozone is measured in the ambient air by a reference method based on Appendix D of this part. Data reporting, data handling, and computation procedures to be used in making comparisons between reported ozone concentrations and the level of the ozone standard are specified in the following sections. Whether to exclude, retain, or make adjustments to the data affected by stratospheric ozone intrusion or other natural events is subject to the approval of the appropriate Regional Administrator.

2. Primary and Secondary Ambient Air Quality Standards for Ozone.

2.1 Data Reporting and Handling Conventions.

2.1.1 Computing 8-hour averages. Hourly average concentrations shall be reported in parts per million (ppm) to the third decimal place, with additional digits to the right being truncated. Running 8-hour averages shall be computed from the hourly ozone concentration data for each hour of the year and the result shall be stored in the first, or start, hour of the 8-hour period. An 8-hour average shall be considered valid if at least 75% of the hourly averages for the 8-hour period are available. In the event that only 6 (or 7) hourly averages are available, the 8-hour average shall be computed on the basis of the hours available using 6 (or 7) as the divisor. (8-hour periods with three or more missing hours shall not be ignored if, after substituting one-half the minimum detectable limit for the missing hourly concentrations, the 8-hour average concentration is greater than the level of the standard.) The computed 8-hour average ozone concentrations shall be reported to three decimal places (the insignificant digits to the right of the third decimal place are truncated, consistent with the data handling procedures for the reported data.)

2.1.2 Daily maximum 8-hour average concentrations.

(a) There are 24 possible running 8-hour average ozone concentrations for each calendar day during the ozone monitoring season. (Ozone monitoring seasons vary by geographic location as designated in part 58, Appendix D to this chapter.) The daily maximum 8-hour concentration for a given calendar day is the highest of the 24 possible 8-hour average concentrations computed for that day. This process is repeated, yielding a daily maximum 8-hour average ozone concentration for each calendar day with ambient ozone monitoring data. Because the 8-hour averages are recorded in the start hour, the daily maximum 8-hour concentrations from two consecutive days may have some hourly concentrations in common. Generally, overlapping daily maximum 8-hour averages are not likely, except in those non-urban monitoring locations with less pronounced diurnal variation in hourly concentrations.

(b) An ozone monitoring day shall be counted as a valid day if valid 8-hour averages are available for at least 75% of possible hours in the day (i.e., at least 18 of the 24 averages). In the event that less than 75% of the 8-hour averages are available, a day shall also be counted as a valid day if the daily maximum 8-hour average concentration for that day is greater than the level of the ambient standard.

2.2 Primary and Secondary Standard-related Summary Statistic.

The standard-related summary statistic is the annual fourth-highest daily maximum 8-hour ozone concentration, expressed in parts per million, averaged over three years. The 3-year average shall be computed using the three most recent, consecutive calendar years of monitoring data meeting the data

completeness requirements described in this appendix. The computed 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations shall be expressed to three decimal places (the remaining digits to the right are truncated.)

2.3 Comparisons with the Primary and Secondary Ozone Standards.

(a) The primary and secondary ozone ambient air quality standards are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. The number of significant figures in the level of the standard dictates the rounding convention for comparing the computed 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration with the level of the standard. The third decimal place of the computed value is rounded, with values equal to or greater than 5 rounding up. Thus, a computed 3-year average ozone concentration of 0.085 ppm is the smallest value that is greater than 0.08 ppm.

(b) This comparison shall be based on three consecutive, complete calendar years of air quality monitoring data. This requirement is met for the three year period at a monitoring site if daily maximum 8-hour average concentrations are available for at least 90%, on average, of the days during the designated ozone monitoring season, with a minimum data completeness in any one year of at least 75% of the designated sampling days. When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator.

(c) Years with concentrations greater than the level of the standard shall not be ignored on the ground that they have less than complete data. Thus, in computing the 3-year average fourth maximum concentration, calendar years with less than 75% data completeness shall be included in the computation if the average annual fourth maximum 8-hour concentration is greater than the level of the standard.

(d) Comparisons with the primary and secondary ozone standards are demonstrated by examples 1 and 2 in paragraphs (d)(1) and (d) (2) respectively as follows:

(1) As shown in example 1, the primary and secondary standards are met at this monitoring site because the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations (i.e., 0.084 ppm) is less than or equal to 0.08 ppm. The data completeness requirement is also met because the average percent of days with valid ambient monitoring data is greater than 90%, and no single year has less than 75% data completeness.

Example 1. Ambient monitoring site attaining the primary and secondary O_3 standards.

Year	Percent Valid Days	1st Highest Daily Max 8-hour Conc. (ppm)	2nd Highest Daily Max 8-hour Conc. (ppm)	3rd Highest Daily Max 8-hour Conc. (ppm)	4th Highest Daily Max 8-hour Conc. (ppm)	5th Highest Daily Max 8-hour Conc. (ppm)
1993	100%	0.092	0.091	0.090	0.088	0.085
1994	96%	0.090	0.089	0.086	0.084	0.080
1995	98%	0.087	0.085	0.083	0.080	0.075
Average	98%				0.084	

(2) As shown in example 2, the primary and secondary standards are not met at this monitoring site because the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations (i.e., 0.093 ppm) is greater than 0.08 ppm. Note that the ozone concentration data for 1994 is used in these computations, even though the data capture is less than 75%, because the average fourth-highest daily maximum 8-hour average concentration is greater than 0.08 ppm.

Example 2. Ambient monitoring site failing to meet the primary and secondary O_3 standards.

Year	Percent Valid Days	1st Highest Daily Max 8-hour Conc. (ppm)	2nd Highest Daily Max 8-hour Conc. (ppm)	3rd Highest Daily Max 8-hour Conc. (ppm)	4th Highest Daily Max 8-hour Conc. (ppm)	5th Highest Daily Max 8-hour Conc. (ppm)
1993	96%	0.105	0.103	0.103	0.102	0.102
1994	74%	0.090	0.085	0.082	0.080	0.078
1995	98%	0.103	0.101	0.101	0.097	0.095
Average	89%				0.093	

3. Design Values for Primary and Secondary Ambient Air Quality Standards for Ozone.

The air quality design value at a monitoring site is defined as that concentration that when reduced to the level of the standard ensures that the site meets the standard. For a concentration-based standard, the air quality design value is simply the standard-related test statistic. Thus, for the primary and secondary ozone standards, the 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration is also the air quality design value for the site.

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16. ABSTRACT

This report provides technical guidance on the data handling conventions for the 8-hour ozone 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) Rounding conventions
2) Missing data
3) Treatment of exceptional natural events
4) Data completeness requirements for computing averages
5) Minimum years of data required to demonstrate compliance with the NAAQS
6) Use of data from Special Purpose Monitors (SPM)
7) The attainment test used to judge compliance with the NAAQS

17. KEY WORDS AND DOCUMENT ANALYSIS

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