Monitoring Insights

Alternate performance specifications for relative accuracy in EPA CAMD's power sector emissions data

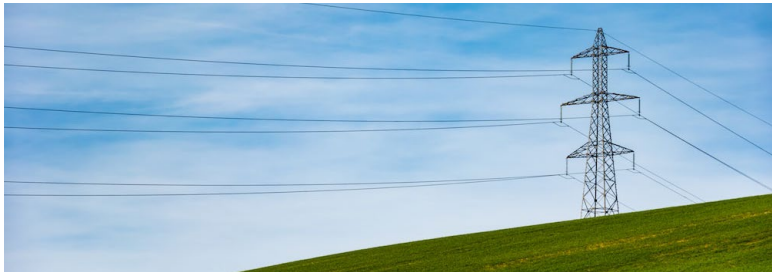
November 7, 2022

40 CFR part 75 requires regular quality assurance (QA) testing to ensure that continuous emission monitoring systems (CEMS) are providing accurate, consistent, and reliable data.

Power plant operators are required to perform several QA tests on each CEMS. One of the required tests is a relative accuracy test audit, or RATA—a test performed by stack testers to compare a CEMS's measurement to a measurement determined using an EPA reference method. RATAs are performed for CEMS that monitor sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon dioxide (CO_2) or oxygen (O_2) concentration, and volumetric flow of the flue gas (known as stack gas flow). Generally, CEMS must achieve relative accuracy (RA) values ≤10.0% to pass. Refer to the Monitoring Insights on RATAs to learn more.

For affected CEMS with emission measurements below certain thresholds, there are alternate performance specifications for RATAs.

As concentrations, emission rates, or flow rates decrease, achieving a percent accuracy of that value becomes increasingly difficult (i.e., 10% of 10 ppm is harder to achieve than 10% of 1000 ppm). Units that meet certain emission rates or concentrations in the flue gas can qualify to use alternate performance specifications to evaluate the CEMS's relative accuracy.



EPA

Alternate performance specifications for part 75 RATAs

How are the alternate performance specifications determined?

The alternate performance specifications are represented as the mean difference between the reference method values and the corresponding CEMS values during the RATA.

The mean difference is calculated as:

$$d = \frac{1}{n}\sum_{i=1}^{n} \mathrm{d}_i$$

Where:

d= Arithmetic mean of the differences

n= Number of test runs

$\sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{d}_\mathrm{i}$ = Algebraic sum of the individual differences d_i

d_i = The difference between a reference method test value and the corresponding CEMS value

Refer to part 75 appendix A equation A-7 for details.

Alternate performance specifications for part 75 RATAs

What are the alternate performance specifications?

Table 1 lists the alternate performance specifications by parameter. If the results of the RATA are at or below the mean difference (MD) value in Table 1's annual MD specification column, the CEMS passes the RATA and qualifies for less frequent RATAs (i.e., the next RATA is due in four operating quarters.) If the mean difference is higher than the annual specification but at or below the value in Table 1's semiannual MD specification column, the CEMS passes the RATA but is required to do a follow up RATA in two operating quarters. If neither of these mean differences are achieved, the monitoring system fails the RATA.

Table 1: Alternate performance specifications and qualification requirements

RATA	RATA qualification	Semiannual MD	Annual MD
SO_2 or NO_X (PPM)	≤250	±15.0	±12.0
NO_X rate (lb/mmBTU)	≤0.200	±0.020	±0.015
Flow (fps)	≤10	±2.0	±1.5
CO_2 or O_2 (%)	None	±1.0% CO_2 or O_2	±0.7% CO_2 or O_2
Moisture (%)	None	±1.5% H_2O	±1.0% H_2O

ppm=parts per million; fps = feet per second;
lb/mmBtu=pounds per million British thermal units

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Almost 20% of part 75 RATAs have low emission rates or concentrations and are conducted using alternate performance specifications

Table 2: Alternate performance specification use by parameter (2010—2021)

Parameter	Alternate specification use (% of total passed tests)
SO_2 concentration	25.0%
NO_X rate	29.9%
CO_2 concentration	1.5%
O_2 concentration	4.3%
Stack gas flow	1.9%
All Parameters	16.8%

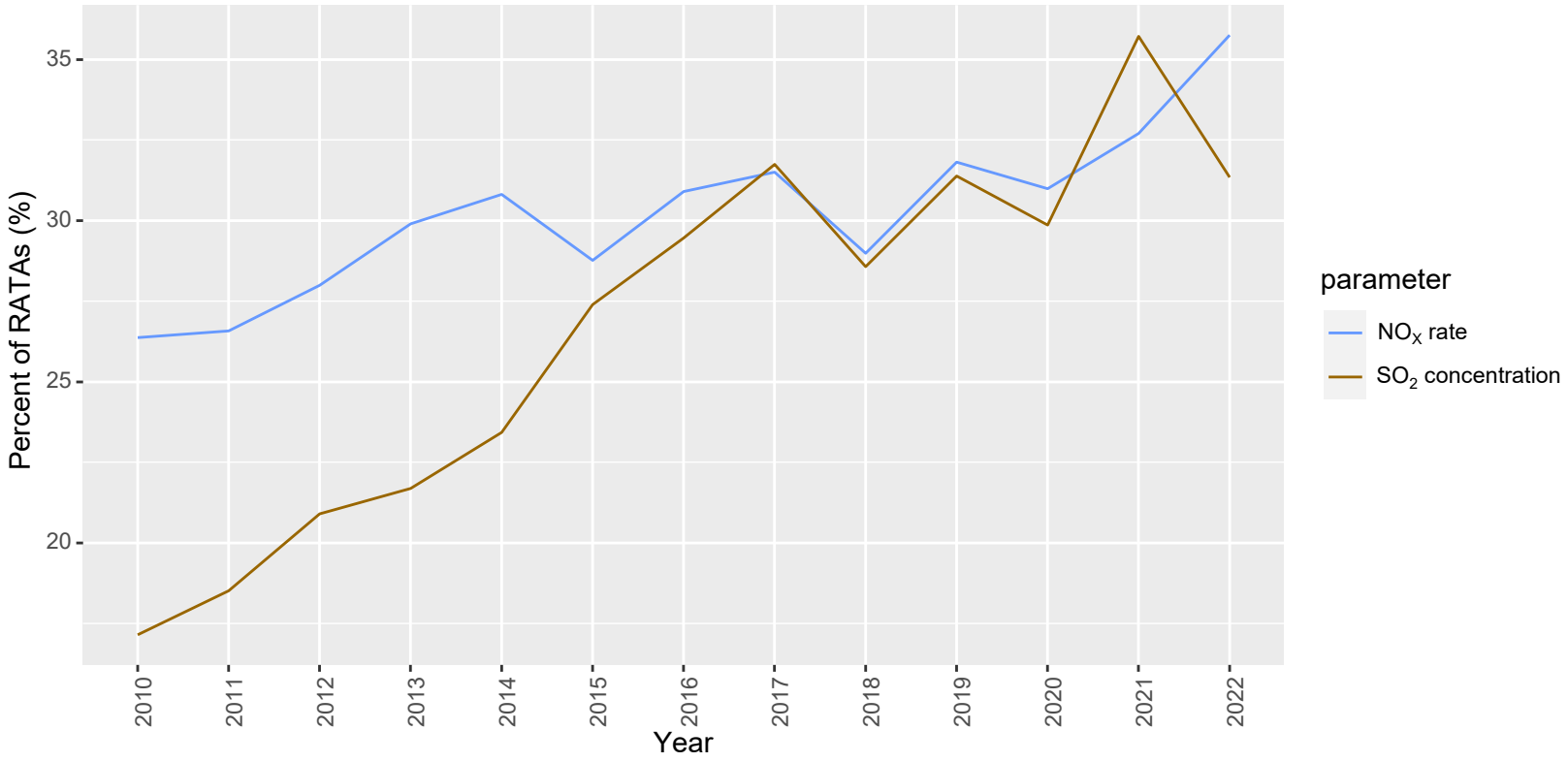
Alternate performance specification usage varies by parameter.

In the years 2010—2021:

- For stack gas flow, CO_2, and O_2 concentrations, alternate specifications were used in less than 5% percent of RATAs.
- SO_2 concentration and NO_X rate, expressed as NO_X pounds per million Btu of heat input have the highest percent utilization at around 25-30%.

This analysis focuses on NO_X rate and SO_2 concentration RATAs because the alternate performance specifications for these parameters are used most frequently.

Use of alternate performance specifications increased for NO_X rate and SO_2 concentration from 2010 to 2021

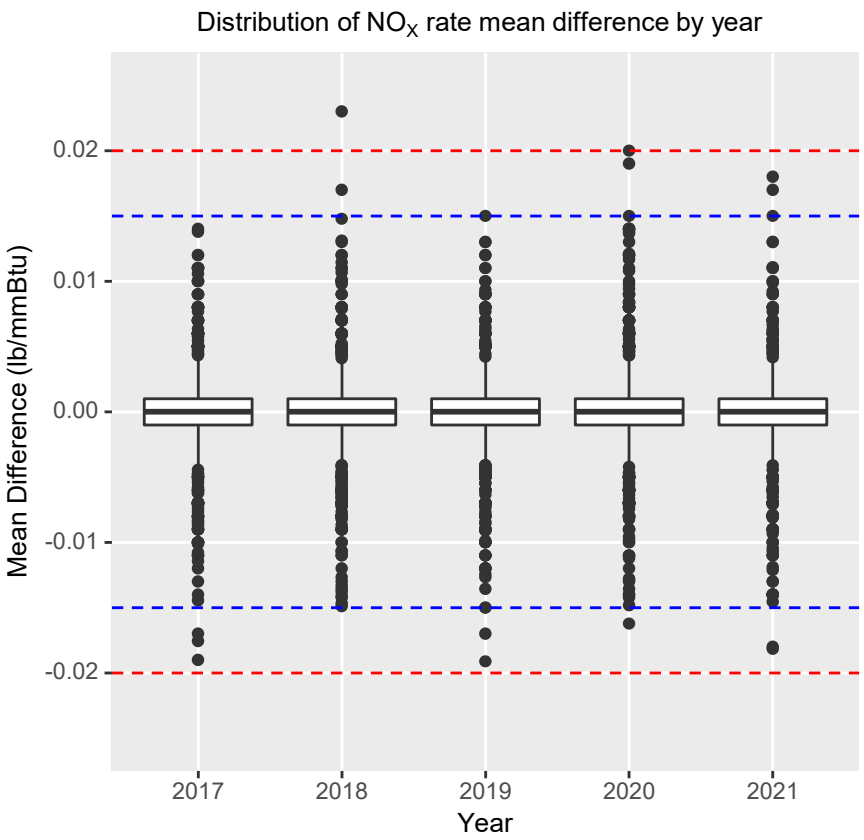


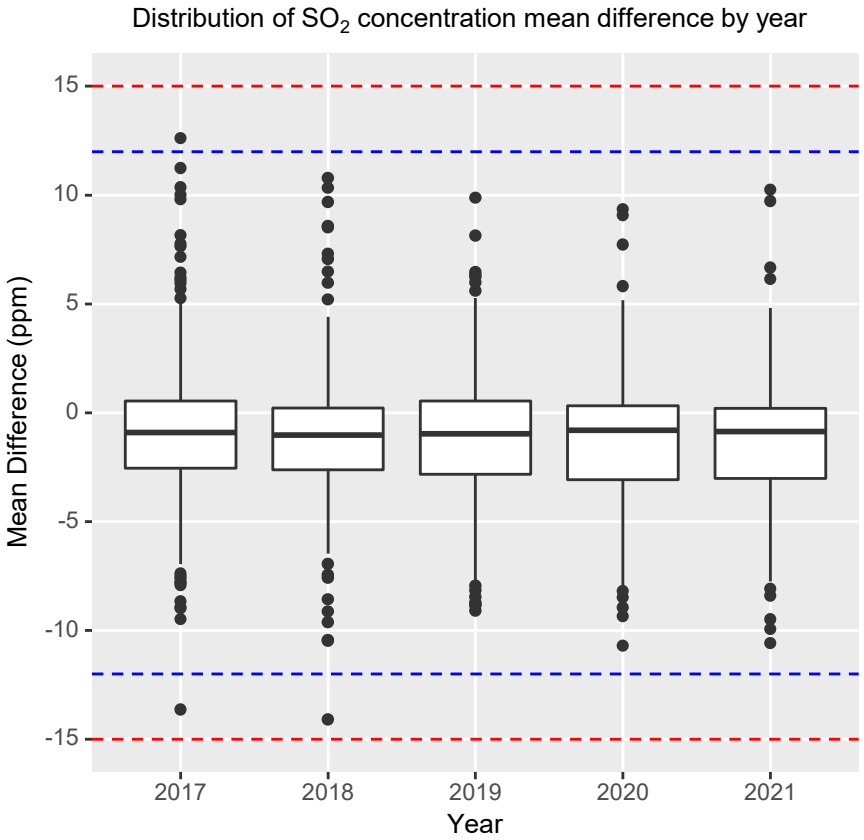
Results and conclusions for alternate performance specification use

Use of alternate performance specifications for SO_2 concentration and NO_X rate RATAs increased from 2010 to 2021.

Facilities with part 75-certified CEMS use the alternate performance specifications for SO_2 concentration and NO_X rate more than for other parameters because today's SO_2 and NO_X emission rates are dramatically lower than the rates from the early 2000s. The addition of advanced control devices to capture pollutants like SO_2 and NO_X before they are released to the atmosphere contribute to the lower emission rates. The dramatically lower concentrations makes meeting the primary specifications—expressed as a percent difference—more challenging.

Mean differences for NO_X lb/mmBtu and SO_2 ppm RATAs using alternate performance specifications are concentrated near zero





For information about how to read these figures, refer to page 11

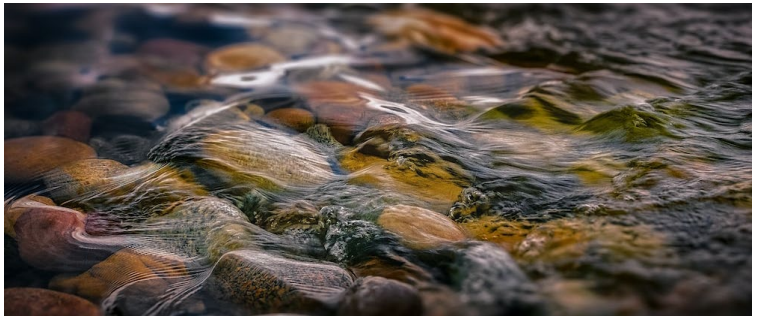
Results and conclusions for RATA mean difference when using alternate performance specifications

Mean differences for SO_2 concentration and NO_X rate are lower than required and centered around zero.

The mean differences of RATAs conducted with alternate specifications are concentrated below ±0.015 lbs/mmBTU (NO_X) and ±10 ppm (SO_2), meaning that most units that pass the RATA based on the alternate specifications also qualify for reduced RATA frequency. A lower mean difference indicates a smaller difference between the CEMS value and the reference method.

Mean differences for SO_2 concentration and NO_X rate are relatively stable.

For SO_2 concentration and NO_X rate, the mean differences and spread of data is relatively consistent from 2017 through 2021.The key finding is that the distribution of the mean differences for each calendar year are stable indicating the mean differences are consistent over the time period.



For more information about the data or this analysis…

Contact information

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EPA's part 75 monitoring and reporting program

- Relative Accuracy Test Audit Monitoring Insight
- 40 CFR part 75—Continuous Emission Monitoring
- Plain English Guide to Part 75 (PDF)
- EPA CAMD power sector programs—progress reports

Power Sector Emissions Data

- CAMD's Power Sector Emission Data
- CAMD's Power Sector Emissions Data Guide

Analytical methodology

This analysis was completed in R. If you would like to review the code or source data, contact Stacey Zintgraff.

The steps in this analysis include:

1. Compile all RATA results from 2010 through 2021, including relative accuracy, parameter (e.g., pollutant), year, and test result.
2. Filter out parameters not included in this analysis, tests that passed using primary performance specifications and aborted tests.
3. Calculate percent utilization of alternate specifications by parameter by dividing the number of tests that passed with alternate specifications by the total number of tests.
4. Remove all parameters except SO_2 concentration and NO_X rate.
5. Calculate percent utilization of alternate performance specifications by parameter by dividing the number of tests that passed with alternate performance specifications by the total number of tests in each year.
6. Calculate quartiles and median for each year and parameter.
7. Create figures. (Outliers were included in this analysis.)

By the numbers

Count of RATAs passed using alternate specifications in this analysis

2017

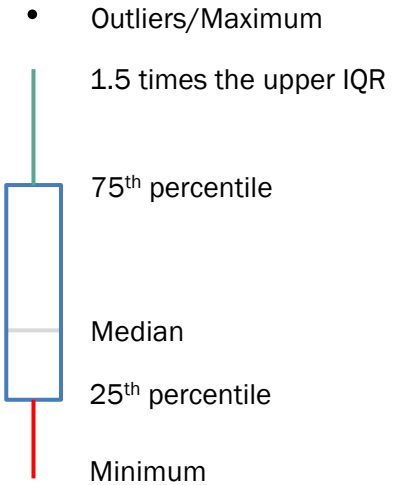
- CO_2: 13 RATAs
- SO_2: 213 RATAs
- O_2: 1 RATA
- NO_X rate: 913 RATAs
- Flow: 41 RATAs

2021

- CO_2: 12 RATAs
- SO_2: 180 RATAs
- O_2: 0 RATAs
- NO_X rate: 938 RATAs
- Flow: 23 RATAs

Appendix A: How to read a box plot

Box plot key



The RATA results for all reporters are displayed using a "box plot" also known as a "box-and-whisker plot".

A box plot is a method to depict groups of numerical data in quartiles. It illustrates the distribution, central tendency, and variability.

In the example box plot on the left:

- The blue box represents the middle half of all values—also known as the interquartile range (IQR)—those that fall between the 25th and 75th percentile.
- The grey horizontal line represents the median value (i.e., the 50th percentile value).
- The green vertical line, or top whisker, represents the values between the 75th percentile and 1.5 times the upper interquartile range.
- The red vertical line, or bottom whisker, represents the values between the minimum and the 25th percentile.
- The black dot represents outliers or values outside 1.5 times the IQR. The highest dot represents the maximum value.

Each box plot provides visual representations of both the magnitude and variability of values for all reporters in a given year in a single chart.