MEMORANDUM

DATE: November 16, 2012

SUBJECT: Establishing an Operating Limit for PM CPMS

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TO: Mercury and Air Toxics Standards (MATS) Docket
EPA-HQ-OAR-2009-0234

A. INTRODUCTION

The EPA received many comments about the impracticality of the technique specified for establishing operating limits for the particulate matter (PM) continuous parameter monitoring systems (CPMS) in the May 2012 proposed amendments to Air Toxics Standards and New Source Performance Standards for Portland Cement Manufacturing. Most of the commenters focused on the impact on sources with very low PM emissions who, under the proposed amendments, would be required to conduct several retests due to the CPMS response to fluctuation of the in-stack PM characteristics while the sources were operating well below their PM emission limits. A few of the commenters further pointed out that this is punitive on the most well-controlled sources and some offered "scaling" strategies for establishing the PM CPMS operating limit that they felt would alleviate the problem. Other commenters pointed out that under the proposed approach to establishing the operating limit it would be possible for a source to tie the operating limit to a test run that showed non-compliance with the PM emission limit. We do not wish to promulgate a regulation that is punitive to well-performing sources, nor do we want sources to set operating limits above the level of the emission standard. Therefore, we undertook a study to review these comments and determine a more workable approach for setting the PM CPMS operating limit. This memorandum presents the findings of our analysis and provides guidance and calculations for applying this procedure in Portland cement and other rulemaking (MATS, Industrial Boilers, CISWI, etc.).

B. DISCUSSION

The initial focus of our analysis was to more directly connect the PM CPMS operating limit to the compliance determination, the average of three PM test runs rather than the single highest test run during the performance test. We believe this would alleviate the potential for setting an operating limit that corresponds to an emissions result higher than the emission standard.

We note that a PM CPMS instrument used in this manner must have a sufficient measurement scale to cover not only very low PM concentrations but also values well above the actual emission limit, as the operating limit is a long term average and brief periods of high emissions must be included in such averages.

We then set out to review the scaling alternatives provided by commenters as well as several other alternatives developed internally. Initially we were looking for an approach to “scaling” that leveraged an inverse relationship between PM concentration and the operating limit whereby a source with very low PM concentrations would be provided greater operational flexibility than a source with higher PM concentrations and those closest to the PM emission limit would be provided the least amount of flexibility with respect to the operating limit.

The term “scaling” as used in this memo represents the determination of an instrument response slope based on the average PM CPMS output value (in milliamps) corresponding to a 3-run EPA Method 5 PM performance test and the instrument output at zero PM concentration. Once the slope is established, a PM CPMS output theoretically equivalent to a higher value may be determined, where an operating limit may be established. A significant complication with consideration of scaling options is that PM CPMS are not calibrated instruments with known responses to a series of calibration standards across a wide measurement range, as is a PM continuous emission monitoring system (CEMS). Rather for PM CPMS, the only known relationship between the instrument signal and in-stack PM concentration is the average value established during manual compliance testing. The scaling approach presumes a linear relationship between the instrument and PM concentration. This presents difficulty in leveraging measured values close to the emission limit, as the linearity of this scale is not demonstrated. This concept is contrary to using a calibrated PM CEMS for quantitative determination of a compliance value but holds for qualitative determinations of in-stack PM concentrations.

The options considered were:

1. Establish a linear scale, determine the emission limit on that scale, and allow sources to operate below the emission limit on a 30-day rolling average (Commenter 0261 from the Portland cement rule Response to Comment Document);
2. Establish a linear scale and set the source operating limit at a point where that scale intersects with the PM CPMS average plus some percentage (x) of the “unused” emission limit where x is equal to the percent of the emission limit not consumed by source emissions as established by a compliance test;
3. Establish a linear scale and set the source operating limit at a point equal to the average PM CPMS value measured during the compliance test plus one-half of the remaining scale up to the emission limit;
4. Establish a linear scale and set the source operating limit at a point equal to the average PM CPMS value measured during the compliance test plus one-third of the remaining scale up to the emission limit;
5. Use Option 3, but also roll back the operating limit a distance equivalent to one standard deviation of the three PM CPMS average values recorded during the three performance tests; and
6. Establish a linear scale and set the source operating limit at 75 percent of the emission limit if a source showed compliance below that level, and set the operating limit at the average PM CPMS values for sources demonstrating compliance above that limit.

After a review of these six options we noted the following:

Option 1 placed a great deal of confidence in the presumption that the instrument response to in-stack PM concentrations are linear beyond the average value determined during the performance test. This approach presumes PM CEMS capabilities from an uncalibrated instrument.

Option 2 provided for a great deal of flexibility for the lowest emitting sources but also resulted in operating limits for these sources that were significantly higher than some sources with higher PM concentrations.

Options 3 and 4 provided for flexibility at low concentrations, but also provided flexibility even very close to the PM limit which did not seem appropriate.

Option 5 addressed the issue noted with Options 3 and 4, but added a level of complexity that seemed to confuse rather than simplify the process.

Option 6 provided flexibility for low emitting and well-operated sources, and was determined to be a reasonable compromise of flexibility and protection of the emission standard. Seventy-five percent of the emission limit is an already-established threshold in the Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Commercial and Industrial Solid Waste Incineration Unit (76 FR 15757) to determine the frequency of subsequent compliance testing. In that rule, owners or operators of sources were able to reduce their performance test frequency when emissions were equivalent with or below 75 percent of the limits. Otherwise, performance testing was to occur at the normal frequency prescribed in the rule. We believe this threshold can be used in conjunction within a PM CPMS scaling factor, as results above 75 percent of the equivalent emissions limit would be ineligible for scaling factor use and could lead to increased performance testing, while results equivalent with or below 75 percent of the equivalent emissions limit would be eligible for scaling factor use. Adherence to an operating limit with a 25 percent (1 - 0.75) margin of compliance should ensure continuous, qualitative proof of compliance with a PM standard.

One outcome of this assessment is that we find this approach to be an appropriate technique to establish operating limits for parametric monitors where the monitor is *measuring the pollutant of interest qualitatively*. This approach is not appropriate where a parametric monitor (i.e., pH meter, pressure monitor or thermocouple) represents an operating condition of a control device (i.e., pH, pressure drop, combustion temperature) rather than an actual qualitative measurement of the pollutant of interest.

A second outcome of this assessment is its versatility across production-based standards (e.g., the Portland cement rule's PM/ton-clinker limit and the MATS rule's PM/MWh limit). One need only ensure that the appropriate units are used when developing equations and conducting calculations.

A third outcome is that we find with the Portland cement source category, which includes many sources with emission levels at or near the method detection levels (MDLs) for PM, measurement imprecision is a significant factor that should be ameliorated to the extent possible when establishing an operating limit. Measurement imprecision is typically highest for values measured below or near a method's detection level and decreases as values increase above the method detection level. When establishing such a curve based on a single compliance test series, we recognize longer Method 5 test times and/or duplicate Method 5I tests as a best practice; better data will result in a better operating limit. With this in mind, we recommend source operators and testers to consider extended test times and the use of Method 5I, as appropriate, to adequately quantify in-stack PM concentration and more accurately establish a PM CPMS output relationship to the compliance test results.

C. DETERMINING AN OPERATING LIMIT BOTH FLEXIBLE AND PROTECTIVE

After a review of a number of PM CPMS signal scaling approaches, we arrived at the sixth option above, which is a hybrid approach to allowing scaling of the PM CPMS measurements upward to a point. We find it reasonable to allow flexibility to sources who have demonstrated compliance below 75 percent of the emission limit while holding sources whose compliance test results were closer to the emission limit to an operating limit with less flexibility and tied directly to their PM compliance demonstration.

To establish an operating limit using a PM CPMS a source must conduct a Method 5 or Method 5I performance test – consisting of at least 3 runs – annually and establish the relationship between the average milliamp output from the PM CPMS and the average of the PM test runs. A source whose performance test shows their average PM emission rate to be below 75 percent of the emission standard must then establish a correlation between the average milliamp output from the PM CPMS during the performance tests and the average PM emission rate of the three performance test runs, taking into account the instrument value representing zero PM concentration as part of the theoretical curve.

The scale used to determine the operating limit value at 75 percent of the emission limit is developed using two pieces of information: the PM CPMS output at zero and the average PM CPMS response during the performance test. To simplify the process, we specify a commonly used instrumental output, 4 - 20 milliamps, as the basis for all PM CPMS measurements. To establish the low end of the scale we require an accurate value that represents how the instrument reads zero PM concentration. Theoretically, the zero PM concentration would be represented by a value near 4 milliamps, but not necessarily 4.0, so we leverage the steps presented in performance specification (PS) 11, section 8.6 (5) to direct the source owner/operator in establishing a zero value that is specific to their PM CPMS, preferably in its installed location.

With the PM CPMS output value that represents zero, and the PM CPMS average values recorded during the compliance test, the scale is delineated in units of the emission standard over the instrument output, e.g., for the Portland cement rule, these units would be in terms of lb PM per ton clinker PER milliamp. One could determine this value for the Portland cement rule using the following formula:

$$\mathrm{R} = \frac{Y_1}{(X_1 - z)}$$

Where:

R = the relative lb/ton-clinker per milliamp for a PM CPMS,
Y_1 = the three run average lb/ton-clinker PM concentration from a compliance test,
X_1 = the three run average milliamp output from the PM CPMS, and
z = the milliamp equivalent of a PM CPMS instrument at zero.

Note: Because of the 4 - 20 milliamp scale we need to subtract the value representing zero from the average milliamp output so that we may determine the relationship between PM concentration and the actual milliamp response above zero. The value representing zero is factored back in once this relationship is established (see equation below).

Once the level of PM concentration relating to a milliamp of signal output from the PM CPMS is established, we may determine where on a slope of milliamp output signals the PM concentration representing 75 percent of the emission limit intersects. This represents the operating limit and is determined by the formula:

$$E = z + \frac{0.75(L)}{R}$$

Where, continuing with our use of the Portland cement rule as an example:

E = the operating limit for the PM CPMS, in milliamps.
L = the source emission limit expressed in lb/ton clinker,
z = the instrument zero in milliamps, determined from (1)(i), and
R = the relative lb/ton-clinker per milliamp for the PM CPMS, from above.

Note: With other rulemaking applications, the units above that are Portland cement-specific (i.e., lb/ton-clinker) would need to be replaced with appropriate units of production (e.g., lb/GWh, lb/MMBtu, etc.) depending on the units of compliance determination with the rule.

While this process results in a good deal of flexibility for sources well below 75 percent of the emission limit, we recognize the importance of being protective of the emission limit. Not all PM CPMS instruments are expected to have a linear output in regards to milliamp signal versus PM concentration, we recommend that sources demonstrating compliance at or above 75 percent of emission limit be held to an operating limit representing their average PM CPMS output during the performance testing.

It is important to note that emission testing is a snapshot and not an indicator of long term emission profiles at a source; so we recognize that the relationship established between PM CPMS output and in-stack PM concentration may predicated on data that is subject to other operational and seasonable variability which may present operational challenges to maintaining operations within the established operating limit. Therefore we see the need to provide an allowance for a source to conduct another compliance test and reset this relationship to the most current data set if the source is unable to meet its operating limit. Sources who show compliance in the range just below to anywhere above the 75 percent level are most likely to find themselves facing this mode of operation (i.e., more frequent retesting to reset the operating limit).