EMISSION MEASUREMENT CENTER
GUIDELINE DOCUMENT (GD-048)

Calculation of Continuous Emission Monitoring System (CEMS) Relative Accuracy (RA) When Used to Measure Control Device Efficiency

To calculate the RA for a CEMS that measures the control efficiency (emissions reduction) of a control device, use the data from paired test runs of concurrent reference method (RM) sampling and CEMS data at the inlet and outlet of the control device.

1. Calculate the emissions reduction $\boldsymbol{ER_{RM}}$, for each run by using the RM data:

$$ER_{RM,j} = \frac{E_{RM,i,j} - E_{RM,o,j}}{E_{RM,i,j}} x100 \qquad \text{eq. 1}$$

Where:

$\boldsymbol{E_{RM}}$ = emissions rate measured by the RM (same units as RM data, e.g., ppm, g/hr, µg/m^3).
i = inlet to control device
j = run number
o = outlet from control device

2. Calculate the emissions reduction $\boldsymbol{ER_{CEMS}}$, for each run by using the CEMS data:

$$ER_{CEMS,j} = \frac{E_{CEMS,i,j} - E_{CEMS,o,j}}{E_{CEMS,i,j}} x100 \qquad \text{eq. 2}$$

Where:

$\boldsymbol{E_{CEMS}}$ = emissions rate measured by CEMS (same units as CEMS data, e.g., ppm, g/hr, µg/m^3)

3. Calculate d, the arithmetic mean of the differences between the two methods for the emissions reduction for each run:

$$\overline{d} = \frac{1}{n}\sum_{j=1}^{n}\left(ER_{CEMS,j} - ER_{RM,j}\right) \qquad \text{eq. 3}$$

Where:

n = number of runs

4. Calculate S_d, the standard deviation of the mean of the differences:

$$S_d = \left[\frac{\sum_{j=1}^{n} d_j^{\,2} - \frac{\left(\sum_{j=1}^{n} d_j \right)^2}{n}}{n-1} \right]^{1/2}$$ eq. 4

5. Calculate CC, the 2.5 percent error confidence coefficient (one-tailed):

$$CC = t_{0.975} \frac{S_d}{\sqrt{n}}$$ eq. 5

Where:

$t_{0.975}$ = 97.5 the quantile of a t-distribution with n-1 degrees of freedom (from Table 2-1 in Performance Specification 2 (40 CFR part 60, appendix B))

6. Calculate RA, the percent relative accuracy:

$$RA = \frac{\left|\overline{d}\right| + \left|CC\right|}{100 - \overline{ER_{rm}}} x100$$ eq. 6

The RA must be less than or equal to 20 percent. Alternatively, the RA is acceptable if:

$$\left|\overline{d}\right| + \left|CC\right| \le 0.1\left(100 - ER_{std}\right)$$ eq. 7

Where:

ER_{std} = emissions reduction limit as specified by the applicable standard (percent)