APPENDIX I

PERFORMANCE TEST CALCULATIONS AND REPORTING

1. Applicability

This Appendix contains procedures that should be used in calculating the performance test emission rate results for any testing done in accordance with Section 1.2 of this text.

2. Principle

In calculating results from data collected during performance testing, discrepancies have risen from the number of significant digits carried throughout the calculations. These discrepancies could possibly determine the compliance status of a source for the performance testing in question. The rounding of results also prevents the conception of precision beyond the capabilities of the instruments. The Division has established procedures, based on guidelines provided by the U. S. EPA Office of Air Quality Planning and Standards (OAQPS)[1] and published ASTM procedures[2] that should be used in calculating the results of performance testing required by Section 1.2 of this text to determine the compliance status of a source based on the results of the performance test. These guidelines govern only how many significant digits should be retained in a computed result. They do not estimate the error of a computed result.

3. Guidelines for Recording Measured Data

(a) When making a measurement, all digits from the graduated scale used should be recorded plus one estimated digit. If the measuring device has a vernier scale, the last recorded digit should be the one from the vernier. This approach will maximize the number of significant digits attainable.

(b) The last digit in a measurement is assumed to be uncertain by ± 1. However, the instruments used in source sampling have the uncertainties listed in the following table.

The Uncertainty of Source Sampling Instrument Measurements

Instrument	Applicable Range	Read to the Nearest
Hg Manometer	0.0 – 29.9 in. Hg	0.1 in. Hg
Inclined Oil Manometer	0.000 – 1.000 in. H_2O	0.005 in. H_2O
Vertical Oil Manometer	1.00 – 10.00 in. H_2O	0.02 in. H_2O
Magnehelic Gauge[a]	0.00 – 0.50 in. H_2O	0.01 in. H_2O
Dial Thermometer	0 – 250°F	2°F
Thermocouple[b]	0 – 1000°F	0.1°F[b]
Dry Gas Meter (0.1 ft^3)	0 – 100 ft^3	0.001 ft^3
Dry Gas Meter (1.0 L)	0 – 100 L	0.001 L
Orifice Meter	0.00 – 1.50 cfm	0.02 cfm
Triple Beam Balance	0 – 500g	0.1 g
Analytical Balance	0 – 100 g	0.0001 g
Volumetric Burette	0 – 50 mL	0.01 mL
Graduated Cylinder	0 – 100 mL	0.5 mL
Field Barometer	25.00 – 32.00 in. Hg	0.01 in. Hg
Tape Measure	0 – 50 ft	0.125 in.

[a] Smallest scale commercially available.
[b] Depending on the thermocouple and digital readout device used.

[1] "Performance Test Calculation Guidelines" dated June 6, 1990 authored by William Laxton and John Seitz of OAQPS.
[2] ASTM E 29-02 *Standard Practice for Using Significant Digits in Test Data to determine Conformance with Specifications*

(c) The final result in recorded and calculated data should be considered as least as uncertain as the most uncertain measurement used in computing a result, including the measurements from the analytical laboratory. The final result should reflect the order of this uncertainty through the use of significant digits.

4. Calculating Emissions from Recorded Results

(a) For any emission standard that is given in units of both the metric and English system, the metric emission standard shall be used as the basis to determine compliance. In instances where the emission standard is listed in both the metric and English units, the English units have often times been rounded after the conversion. Therefore, the emission standard in metric units is considered the actual emission standard if both units are provided.

Reporting the emission results in only one system (i.e., the English system) when the standard is listed with two systems is acceptable, unless the reported emissions are within 1 percent of the emission standard. In these cases, the metric system should also be reported to eliminate any error from conversions and rounding.

(b) All emission standards should be considered as having at least two, but no more than three, significant digits. Significant digits are, as defined by ASTM E29-02, any of the figures 0 through 9, excepting leading zeros and some trailing zeros which are placeholders only. For example, an emission limit of 0.1 lb/MMBTU should be considered 0.10 lb/MMBTU and 0.05 kg/Mg should be considered to read 0.050 kg/Mg.

(c) When calculating the emission rate, at least five significant digits should be carried in the intermediate calculations, using either the metric or English system. Once the average emission rate has been calculated from the runs, the final number should be rounded off according to paragraph (d) of this section to determine compliance.

(d) The emission rate values should be rounded to the number of significant digits specified in the standard as described in paragraph (b) of this section. The emission rate should be rounded according to the following:

(i) The last significant digit kept should be increased by one if the first digit eliminated is greater than five.

(ii) The last significant digit should remain unchanged if the first digit eliminated is less than five.

(iii) If the first digit eliminated is exactly a five followed only by zeros, the last significant digit should be rounded upward if the last digit retained in an odd number, but remain unchanged if the last retained digit is an even number. Restated, when the first eliminated digit is exactly five, the retained value should be an even number after rounding. For example, if the emission standard is 80, then 80.421 would be rounded to 80, 80.906 would be rounded to 81, 80.500 would be rounded to 80, and 81.500 would be rounded to 82.

(iv) The rounding procedure should be completed in one step for the most accurate rounded value. Rounding in two or more steps may artificially inflate the resulting value. For example, the value of 68,480 if rounded first to the nearest 100 to become 68,500 and then to the nearest 1000 would result in a value 69,000. However, if the value 68,480 were rounded to the nearest 1000 directly, the resulting value would be 68,000.