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Subject:
Procedure for testing air cleaners when five valid data points above the minimum measurability limit cannot be achieved.

Summary:
An interpretation to ANSI/AHAM AC-1 was issued on February 24, 2009 to address the minimum measurability limit (MML) for the concentration of smoke, dust and pollen in the test chamber. Following publication of this interpretation, the Program Laboratory was unable to complete pollen CADR evaluation on units with certified pollen CADR values greater than 400. This results in multiple pollen runs by the Program Laboratory on high CADR units in an effort to obtain the minimum data for CADR calculation. The following procedure was developed to minimize the number of pollen tests run, while achieving a statistically valid pollen CADR.

Question:
How should an air cleaner be tested for pollen if the laboratory is not able to obtain the minimum data in a single test?

Answer:
The expected CADR value should not be taken into account when performing the initial pollen tests; therefore, Sections 7.1 and 7.2 of ANSI/AHAM AC-1 shall be followed for all pollen tests with the following modifications:

1. When preparing for a pollen test, weigh the amount of pollen to be used for six pollen tests and pile into a cone. Elongate the cone with a razor on glass into a line approximately 3 inches long and ¼ inch wide. This sample will be known as the total pollen sample and will be divided into six equal individual samples. The six individual samples shall be taken sequentially from the same end of the pollen line.

2. Separate one-sixth of the total pollen sample from one end of the line and use this sample to perform the pollen natural decay procedure outlined in Section 7.1 of ANSI/AHAM AC-1. The pollen natural decay procedure will be performed one time, regardless of the number of pollen tests performed with the unit operating.

3. Take a second individual pollen sample equal to one-sixth of the total pollen sample to perform the test procedure in section 7.2 of ANSI/AHAM AC-1. If this test successfully produces five valid data points above the MML, proceed to calculations in Section 8 of ANSI/AHAM AC-1 to determine the CADR for pollen.

If the Program Laboratory cannot obtain the minimum required data in step 2, the following procedure shall be used to obtain three valid data sets, each with four points above the MML. These three data sets must be from the same total pollen sample (obtained in Step 1) and utilize a single natural decay measurement (obtained in Step 2).

The following procedure shall be used only if the four data points from the three tests are consecutive and the fifth point was eliminated because it fell below the MML. If the four points in any single data set are not consecutive, or if the fifth point was invalidated for any reason other than the MML, this procedure does not apply.

1. Using the third individual sample of pollen equal to one-sixth of the total pollen sample, run a second pollen test (Test 2) with the unit operating, in accordance with section 7.2 of ANSI/AHAM AC-1.

2. If Test 2 successfully produces five data points above the MML, use these data for the calculation procedure in Section 8 and ignore the first test (Test 1).

3. If Test 2 does not produce five valid data points above the MML, use the fourth individual pollen sample taken from the total pollen sample and run a third test with the unit operating, according to section 7.2 of ANSI/AHAM AC-1 (Test 3).

4. If Test 3 successfully produces five data points above the MML, use these data for the calculation procedure in Section 8 and ignore Tests 1 and 2.

5. If Test 3 does not produce five valid data points above the MML, the data sets from Tests 1, 2 and 3 shall be aggregated and analyzed.

Question:
How shall the separate data sets from Tests 1, 2, and 3 be normalized, aggregated, and used to determine calculate pollen CADR?

Answer:
To determine the pollen CADR from three tests, data from Tests 1, 2, and 3 shall be normalized to account for different starting concentrations and aggregated using the following procedure:

1. Data below the MML shall be eliminated. Only the first four points of the three data sets shall be aggregated.
2. Determine the natural log of the concentration for each data point in Tests 1, 2 and 3.
3. Since the initial concentrations will differ slightly for each of the three tests, the three data sets shall be normalized to a single initial concentration.
    a. For data from Test 1, add a normalization constant, X, to the natural log of the concentration at time 0 to make this value equal to 10 (Ex: $\ln[\text{Pollen}]+X = 10$) . Add X to the natural logs of the remaining three data points for Test 1.

b. For data from Test 2, add a normalization constant, Y, to the natural log of the concentration at time 0 to make this value equal to 10. Add Y to the natural logs of the remaining three data points for Test 2.
c. For data from Test 3, add a normalization constant, Z, to the natural log of the concentration at time 0 to make this value equal to 10. Add Z to the natural logs of the remaining three data points for Test 3.

4. Treating the normalized data as a single set containing 12 data points, eliminate data points according to Section 8.1 of ANSI/AHAM AC-1.
5. Complete a linear regression on the 12 points and use the slope to determine the total pollen decay, according to section 8.2 of ANSI/AHAM AC-1.
6. Use the total pollen decay rate determined in step 5, with the natural decay rate previously determined according to section 7.1 of ANSI/AHAM AC-1 to calculate the unit's pollen CADR as specified in Section 8.4 of ANSI/AHAM AC-1.

For example, if three tests produced the measured concentration listed in the following table, values for the ln(Normalized Concentration) will be used to calculate the decay constant.

	Time	Measured Concentration	ln(Concentration)	Normalization Factor	ln(Normalized Concentration)
Test 1	0	8.63	2.16	X=7.84	10.00
	1	4.69	1.55		9.39
	2	2.55	0.94		8.78
	3	1.38	0.33		8.17
Test 2	0	8.93	2.19	Y=7.81	10.00
	1	4.78	1.57		9.38
	2	2.56	0.94		8.75
	3	1.37	0.32		8.13
Test 3	0	8.13	2.10	Z=7.90	10.00
	1	4.44	1.49		9.39
	2	2.43	0.89		8.79
	3	1.33	0.28		8.18

X = 10 – ln(Test 1 Concentration) = Normalization constant for Test 1
Y = 10 – ln(Test 2 Concentration) = Normalization constant for Test 2
Z = 10 – ln(Test 3 Concentration) = Normalization constant for Test 3

Question:
How will the pollen CADR of an air cleaner be calculated if four data points greater than the MML cannot be achieved?

Answer:
If initial pollen concentration is within the range specified by ANSI/AHAM AC-1 (latest edition) and less than four data points are greater than the MML are obtained in any of the three tests, the unit is outside the scope of ANSI/AHAM AC-1 (latest edition).