Recirculating Chamber and Duct Testing

Removal of Gaseous Contaminants

Tested For: ProlAQ, Feb 2026

Tested By: Independent Accredited Testing Laboratory

Test Standard: ASHRAE 145.4P — Removal of Gaseous Contaminants

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Test Air Purification Devices

The following devices were evaluated in this testing:

- ProlAQ CM1 Carbon In Duct System
- ProlAQ PCOPRO Cordierite In Duct System
- ProlAQ A
- Competitive UVC+ Carbon Cell In-Duct System (Model 1)
- Competitive Active Air Purification System (Model 2)
- Competitive Catalytic Converter Active Purification System (Model 3)
- Competitive Active Air Purification System with Hydro Peroxides (Model 4)

1. Scope

An independent accredited testing laboratory performed chamber with side-duct recirculation tests for ProlAQ, modeled on the ASHRAE 145.4P test procedure for the removal of gaseous contaminants. The purpose of these tests was to determine the toluene removal rates over time for seven duct-mounted air cleaning devices.

The air cleaning devices were mounted in a 24" × 24" stainless-steel test duct connected to a 1,007 ft³ stainless-steel chamber. The test airflow rate was 100 cubic feet per minute (CFM), corresponding to 6 air changes per hour (ACH).

2. Test Methods

Gases

The gaseous contaminant was injected into the chamber and mixed with ceiling fans and floor box fans prior to starting the recirculating airflow. The mixing fans were operated throughout the entire test duration. The nominal starting challenge concentration was 200 ppb for toluene.

The test chamber air was sampled using an Aerodyne/Tofwerk Vocus PTR-TOF-MS. Additionally, an Aerodyne QC-TILDAS was used to measure formaldehyde and an Ecotech Serinus 10 was used to measure ozone. The test duration was 60 minutes for all tests.

3. Test Air Cleaning Device Information

- ProlAQ CM1 Carbon In Duct System
- ProlAQ PCOPRO Cordierite In Duct System
- ProlAQ A
- Competitive UVC+ Carbon Cell In-Duct System (Model 1)
- Competitive Active Air Purification System (Model 2)
- Competitive Catalytic Converter Active Purification System (Model 3)
- Competitive Active Air Purification System with Hydro Peroxides (Model 4)

4. Test Sequence and Test Conditions

The Carbon devices were tested with their lamps powered on and powered off. All other test devices were powered on for testing. Two natural decay tests were conducted.

Table 1 shows the starting temperature and relative humidity conditions for each test.

Table 1. Test Conditions

Test Seq.	Test Device	Temp (°F)	Rel. Humidity (%)
1	Natural Decay #1	72.9	49.7
2	Model 1 (without power)	72.9	48.5
3	Model 1 (with power)	72.6	47.0
4	**ProlAQ Carbon (without power)**	72.5	45.8
5	**ProlAQ Carbon (with power)**	72.5	45.4
6	**ProlAQ Cordierite**	72.4	46.6
7	**ProlAQ A**	72.6	45.4
8	Model 2	72.5	50.7
9	Model 3	73.0	48.8
10	Model 4	72.7	48.0
11	Natural Decay #2	72.7	46.9

5. Equipment

Aerodyne/Tofwerk Vocus Scout PTR-TOF-MS

Technology: Proton transfer reaction time-of-flight mass spectrometer Range: 0–10 ppm | Lower Detection Limit: <5 ppt

Aerodyne QC-TILDAS Formaldehyde Monitor

Technology: Tunable infrared laser direct absorption spectroscopy Range: 0–15 ppm formaldehyde (0–30 ppm formic acid) | Precision: <100 ppt

Ecotech Serinus 10 Ozone Analyzer

Technology: Non-dispersive UV absorption | Range: 0–20 ppm Noise: <0.25 ppb | Lower Detection Limit: <0.5 ppb | Precision: Greater of 0.5 ppb or 0.2% of reading

TSI VelociCalc 9545 Air Meter

Temperature Accuracy: ±0.5 °F | Relative Humidity Accuracy: ±3% RH

6. Test Results

6.1 Toluene Challenge Test Results

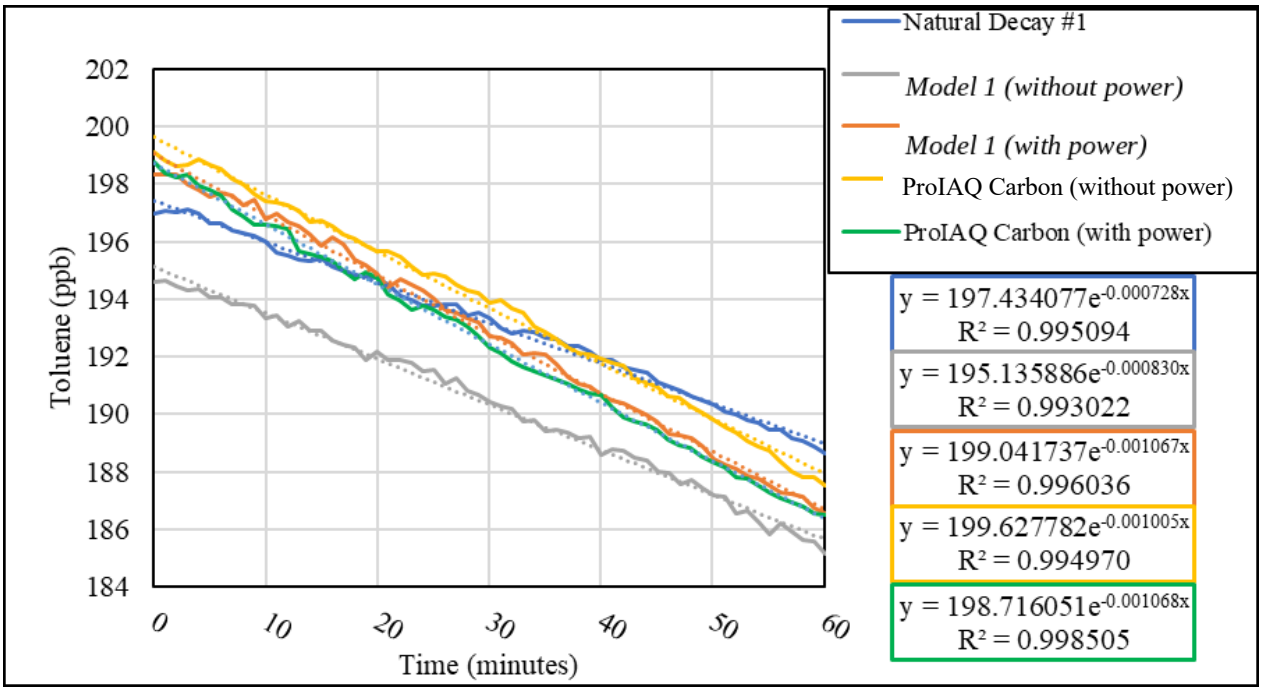
Table 2 shows the starting toluene concentration, ending toluene concentration, and net change for all tests. Toluene CADR results are determined from the k-value slope method described in Appendix A.

Table 2. Starting and Ending Toluene Concentrations — All Tests

Test Seq.	Test Device	Starting Toluene (ppb)	Ending Toluene (ppb)	Net Change (ppb)
1	Natural Decay #1	197.0	188.7	-8.3
2	Model 1 (without power)	194.6	185.2	-9.4
3	Model 1 (with power)	198.3	186.6	-11.8
4	ProIAQ Carbon (without power)	199.1	187.5	-11.6
5	ProIAQ Carbon (with power)	198.8	186.5	-12.3
6	ProIAQ Cordierite	203.3	187.7	-15.7
7	ProIAQ A	199.5	186.6	-12.9
8	Model 2	196.0	184.9	-11.1
9	Model 3	193.9	184.2	-9.7
10	Model 4	202.7	190.7	-12.0
11	Natural Decay #2	191.1	182.3	-8.8

Figure 10 shows the toluene concentration data for tests 1-5 from Table 1 and Figure 12 shows the toluene concentration data for tests 6-11.

Figure 10. Toluene concentration data for tests 1-5



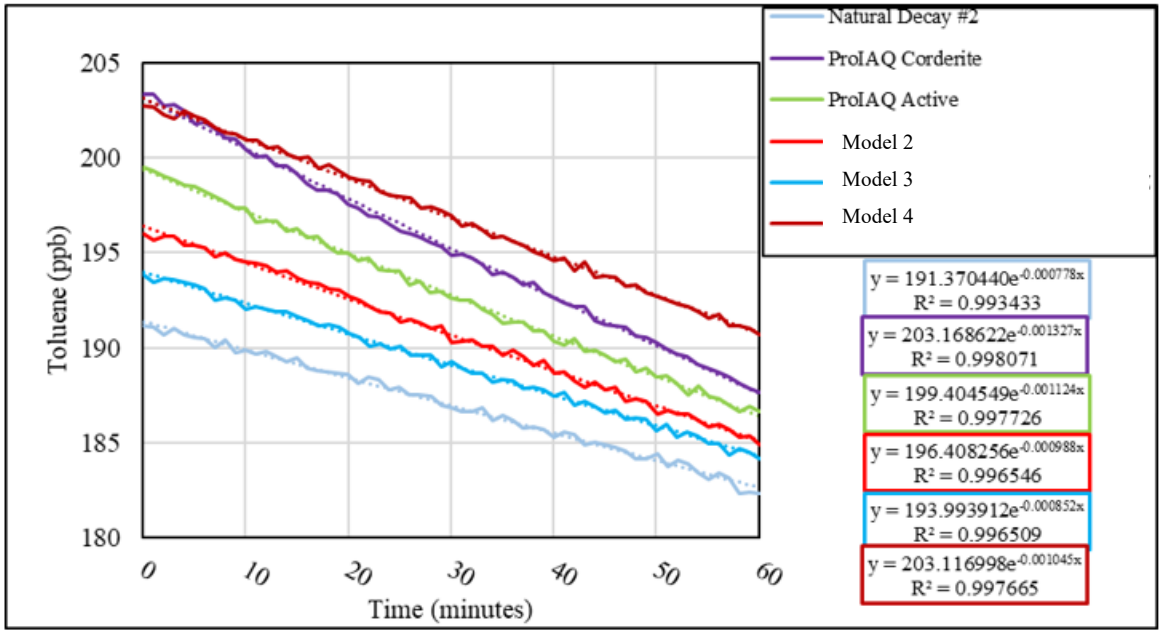


Figure 12. Toluene concentration data for tests 6-11

Figure 11 and Figure 13 chart the ln[C_t/C_0] of the toluene data from tests 1-5 and tests 6-11, respectively, to determine the k-values for CADR calculations. The k-values from the two Natural Decay tests were averaged.

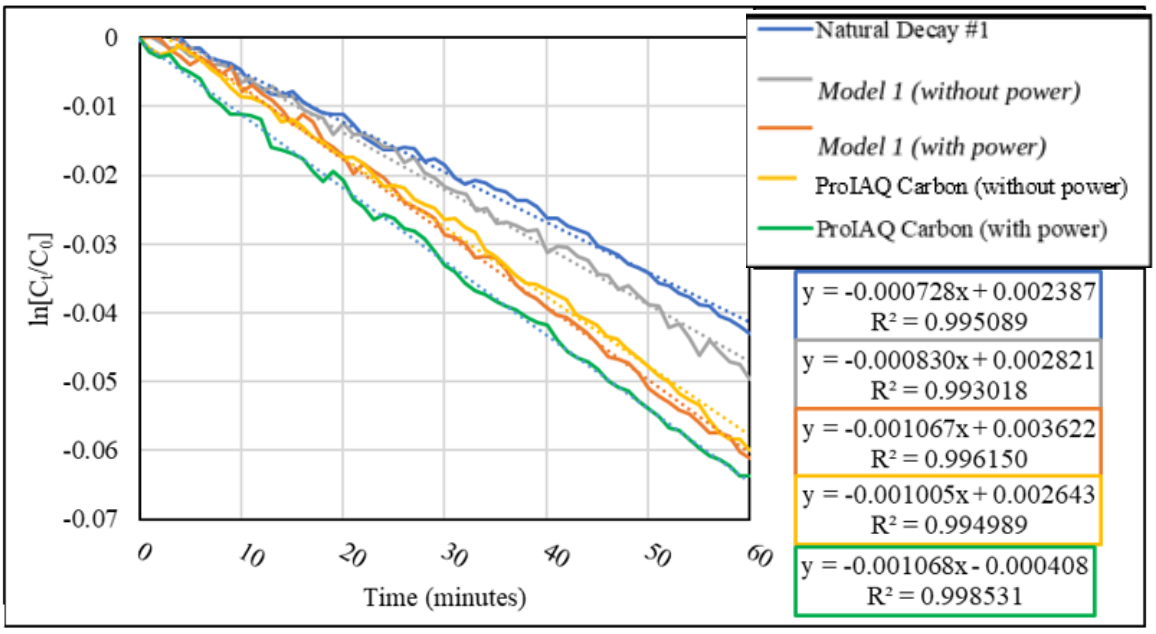


Figure 11. ln[C_t/C_0] of toluene concentration data for tests 1-5

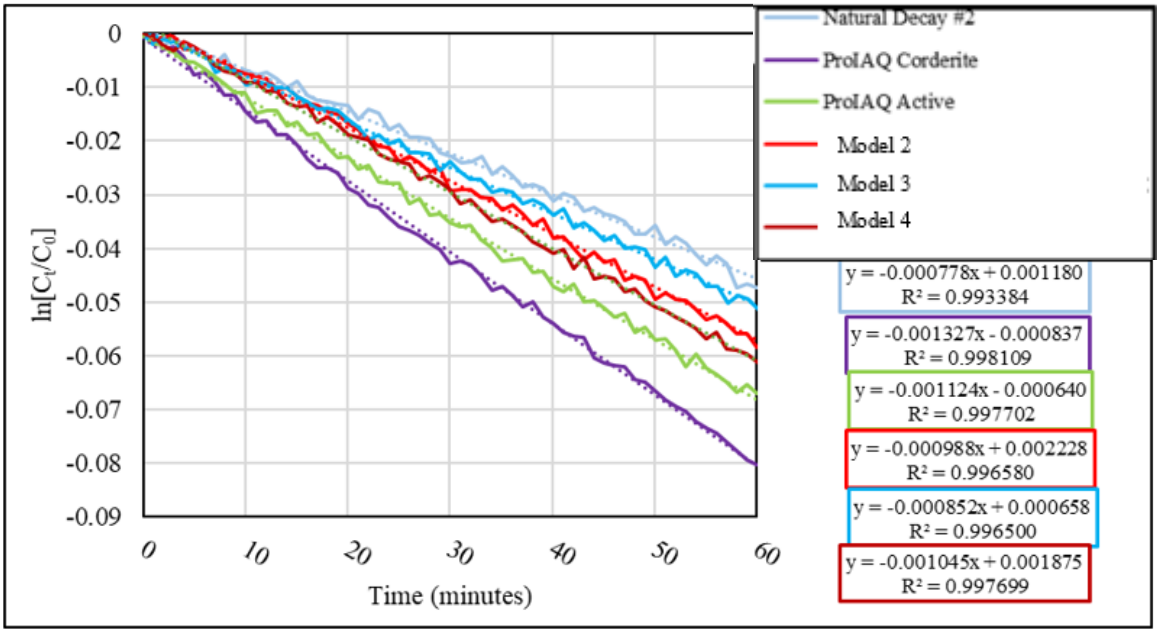


Figure 13. ln[C_t/C_0] of toluene concentration data for tests 6-11

Table 2 shows the toluene CADR results.

Table 2. Toluene CADR results

Test Sequence	Test Device	k-value	CADR (cfm)
1	Natural Decay #1	0.000728	N/A
2	Model 1 (without power)	0.000830	0.1
3	Model 1 (with power)	0.001067	0.3
4	ProIAQ Carbon (without power)	0.001005	0.3
5	ProIAQ Carbon (with power)	0.001068	0.3
6	ProIAQ Corderite	0.001327	0.6
7	ProIAQ Active	0.001124	0.4
8	Model 2	0.000988	0.2
9	Model 3	0.000852	0.1
10	Model 4	0.001045	0.3
11	Natural Decay #2	0.000778	N/A
	Natural Decay (Average)	0.000753	N/A

Table 3 is a summary of the starting toluene concentration, ending toluene concentration, and net change for all tests.

Table 3. Starting and ending toluene concentrations and net toluene change for all tests

Test Sequence	Test Device	Starting Toluene (ppb)	Ending Toluene (ppb)	Net Change (ppb)
1	Natural Decay #1	197.0	188.7	-8.3
2	Model 1 (without power)	194.6	185.2	-9.4
3	Model 1 (with power)	198.3	186.6	-11.8
4	ProIAQ Carbon (without power)	199.1	187.5	-11.6
5	ProIAQ Carbon (with power)	198.8	186.5	-12.3
6	ProIAQ Corderite	203.3	187.7	-15.7
7	ProIAQ Active	199.5	186.6	-12.9
8	Model 3	196.0	184.9	-11.1
9	Model 4	193.9	184.2	-9.7
10	Model 5	202.7	190.7	-12.0
11	Natural Decay #2	191.1	182.3	-8.8

Appendix A: Calculation of k-Values and CADR

Contaminant decays follow the exponential decay function:

$$Ct = Ci \cdot e^{(-k \cdot t)} \qquad \text{(Equation 1)}$$

Where Ct is the concentration at time t, Ci is the concentration at time = 0 minutes, k is the decay rate constant, and t is time.

The decay rate constant is found from the slope of the ln[Ct/Ci] vs. t curve:

$$\ln(Ct/Ci) = -k \cdot t + b \qquad \text{(Equation 2)}$$

The following formula was used to determine the device clean air delivery rate (CADR) for toluene, using a test chamber volume (V) of 1,007 ft³ and the average k-value of the two Natural Decay tests:

$$CADR = V \times (k_{air\_cleaning\_device} - k_{natural\_decay}) \qquad \text{(Equation 3)}$$

CADR results for each ProIAQ and comparative device are derived using this methodology applied to the toluene test data above.