

Subject 867

March 20, 2007

To:           Subscribers to UL's Standards Service for Electrostatic Air Cleaners  
  
                  Subscribers to UL's Listing and Recognition Services for Electrostatic Air  
                  Cleaners and Ionizers

Subject:       Clarification for Ozone Testing of Electrostatic Air Cleaners and Ionizers

UL announces a clarification for repeatability and reproducibility (R&R) of ozone test requirements for Electrostatic Air Cleaners and Ionizers covered by UL 867. Attached as Appendix A is an expanded rendition of Section 37 (including new 37A) of the standard in which test criteria are more fully explained and "best practices" are identified. Note that this document is not a Standard and has not gone through the standards development process.

As currently described, the UL 867 ozone test method lacks specificity with regard to the test chamber and conditions of operation. The test R&R clarifications included herein have been developed from feedback provided by members of the Ozone Working Group of UL's Standards Technical Panel (STP) responsible for UL 867 and supporting documents.<sup>1</sup>

Ozone test R&R depends upon many factors, the most critical of which include: stability of temperature and humidity conditions within the defined range, uniformity of conditions within the test environment and chamber half-life.

As cited in the clarification of requirements, the chamber half life of  $16 \pm 1$  minutes is specified based upon nominal chamber half-life calculated from variables defined within "Technical Assessment for CPSC – Part II: Ozone Devices Modeling Considerations," Shaughnessy, R; Krause, D; Ball, L. When calculating the half life using the equation  $C_t = C_0 e^{-kt}$ , the following assumptions were made:

- A ventilation rate of  $0.35 \text{ h}^{-1}$  is specified by the International Mechanical Code (2003), and the International Residential Code (2003) as the minimum that should be provided by windows or mechanical means within a home. This therefore is the maximum air exchange rate allowed within the test chamber.
- A deposition velocity of  $1.76 \pm 0.612 \text{ m/h}$  was calculated from a study of 43 homes by Lee et al (1999). A rate of  $1.15 \text{ m/h}$  ( $1.76 - 0.612 \text{ m/h}$ ) was therefore chosen as the appropriate deposition velocity.
- The nominal chamber surface area to volume ratio is 2.

---

<sup>1</sup> *BS EN ISO 16000-9:2006 - Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method*

*ECMA-328 – Determination of Chemical Emission Rates from Electronic Equipment*  
*Blauer Engel's Basic Criteria for the Award of the Environmental Label for Printers RAL-UZ 85 – Test Method for the Determination of Emissions of Hardcopy Devices*

UL will be proposing standard revisions, consistent with the clarifications, to the to UL 867 STP. The STP will consider the proposal in accordance with UL's ANSI accredited consensus standards development process. When the revised UL 867 is published and effective, this clarification document will be withdrawn.

Questions regarding certification requirements for electrostatic air cleaners and ionizers should be directed to Chante' White Maurio, 12 Laboratory Dr., RTP, NC 27709; phone (919) 549-1995; email [Chante.W.Maurio@us.ul.com](mailto:Chante.W.Maurio@us.ul.com).

UNDERWRITERS LABORATORIES INC.

REVIEWED BY:



CHANTE' MAURIO (x11995)  
Principal Engineer  
Air Movement and Treatment Appliances

TOM BLEWITT (x22332)  
Managing Engineer (PDE)  
HVAC, Appliances, Lighting

## APPENDIX A

For the purpose of clarification, the Ozone Test Section (37) of UL 867 is amended as follows. New and revised text is identified by underlining and ~~strikethrough~~.

[new] 37.0 The test described in paragraphs 37.1 – 37.7 shall be conducted on a total of two samples of each air cleaning product.

Exception: Only one sample shall be subjected to this test when maximum ozone concentration of the first sample tested measures less than 0.030 parts per million.

[revised] 37.1 A portable air cleaning product for household use shall not produce a concentration of ozone exceeding 0.050 parts per million by volume when tested as described in 37.2 - 37.7. A transitory concentration in excess of 0.050 ppm but less than 0.100 ppm is acceptable. However, the average of any five consecutive measurements taken 60 seconds apart shall be less than 0.050 parts per million.

Exception: An air cleaning product intended for duct or plenum connection is not required to comply with the test described in this section.

[revised] 37.2 The test is to be conducted in a room having a volume of 950 - 1100 cubic feet (26.9 - 31.1 m<sup>3</sup>) with a minimum side dimension of 8 feet (2.4 m) and a maximum height dimension of 10 feet (3.0 m) without openings. The test chamber walls and ceiling are to be covered with a sheet(s) of polyethylene or aluminum. The floor is to be of a nonporous material such as vinyl tile or aluminum.

[new] Exception: Surface treated (polished) stainless steel or other nonporous and non-reactive material is an acceptable substitute for the room construction materials.

[new] Note: A test room having a volume of 1000 cubic feet with side and height dimensions of 10 ft (3 m) was used to develop test parameters and is recommended for testing.

[new] Note: The test chamber materials described in paragraph 37.2 shall be low emitting and low absorbing as validated by the half-life procedure of paragraph 37.2.1 and background level of paragraph 37.3.1.

[new] 37.2.1 Performance of the “test chamber” shall be validated prior to each test and after any modification or cleaning through verification of the ozone half-life at the air exchange rate used for testing (37.3). The ozone half-life is determined using an initial steady state concentration of 0.100 to 0.200 ppm ozone. The measured ozone half-life for the chamber shall be 16 + 1 minutes.

[new] 37.2.2 Prior to testing, the unit shall be subjected to a 72 hour run-in period. During the run-in period the unit shall be operated at maximum ozone output, speed, etc.

37.3 During the test, the test room is to be maintained at a temperature of  $25 \pm 2^{\circ}\text{C}$  ( $77 \pm 4^{\circ}\text{F}$ ) and a relative humidity of  $50 \pm 5$  percent. Prior to the start of and immediately after this test, the ozone background level is to be measured with the product off. The background level average shall be calculated and subtracted from the maximum measurement during the test.

[new] Note: The following criteria achieve the desired conditions, including a stable background level.

- The test chamber shall be sufficiently airtight to avoid uncontrolled air exchange. The chamber is considered sufficiently airtight if at least one of the following requirements are fulfilled:
  - o the air leakage is less than 0.5% of the chamber volume per minute at an overpressure of 1000 Pa;
  - o the air leakage is less than 5% of the supply airflow rate.
- The test chamber shall possess air exchange rate between 0 and 0.35, where the air exchange rate is defined as the ratio of the volume of clean air brought into the chamber per hour to the unloaded chamber volume.
- The test chamber shall have proper mixing verified via the mixing procedure of ASTM 6670 and shall not create local airflow across the surface of the unit under test exceeding 0.1 m/s.
- The test chamber supply air system shall be equipped with sufficient carbon and HEPA media to remove particles, reactive VOCs, and ozone.

[new] 37.3.1 With respect to determining background level, the following measurement criteria shall be applied:

- a) Each ozone background measurement shall not exceed 0.005 ppm. Measurements above this value may interfere with emissions determinations.
- b) Background measurements within the chamber shall be taken immediately prior to the inception of testing and subsequent to testing 15 minutes after the chamber has maintained a new steady-state ozone level after purging.
- c) Purging is defined as the flushing of the chamber with 4 chamber volumes of clean, filtered air subsequent to the completion of the ozone emissions monitoring period.

[new] Note: For the purpose of this measurement, steady state is defined as a fluctuation not greater than + 10% or 0.0020 ppm, whichever is greater, during a fifteen minute period.

[revised] 37.4 The product is to be located in the center of the test room floor and ~~about~~

- a) 30 inches (762 mm) above the floor for a table-mounted products
- b) Attached to the ceiling or other horizontal non-reactive surface at a minimum height of 30 inches (762 mm) for ceiling-mounted products
- c) Attached to a non-reactive vertical surface at a minimum height of 30 inches (762 mm) for wall-mounted products

[revised] 37.5 ~~The~~ A single ozone monitor sampling tube is to be positioned with the sample tube opening located 2 inches (50 mm) from the air outlet of the product and is to point directly into the air stream. Monitoring shall occur where ozone emissions are highest as determined by the test of Section 37A.

37.6 The emission of ozone is to be monitored for 24 hours to determine the concentration.

[new] Note: Ozone analysis equipment meeting the following criteria are considered appropriate for the application:

- Ranges of 0.02, 0.04, 0.1, 0.2, 0.4, 1, and 2 mg/m<sup>3</sup> on the full scale (or have auto ranging capability);
- The capability to detect at least 4 µg/m<sup>3</sup>;
- A precision of + 2% from the mean value in the 0 mg/m<sup>3</sup> to 0.2 mg/m<sup>3</sup> range (ie 2 µg/m<sup>3</sup> or 1% on the full scale);
- A sampling rate of not less than once every 60 seconds.

- A sampling line of minimum length, not to exceed 6.56 ft. (4 m), made of a flexible material that is inert, such as PTFE.

[new] Note: To prevent impact on the test, the ozone monitor shall be placed outside of the chamber.

37.7 If the filter cell or other high voltage component can be energized with any of its fans not functioning or with filters removed, the test described in 37.1 - 37.6 is to be repeated with the various components not operating or with filters removed.

[new] 37.7.1 If the appliance is provided with multiple speeds/output levels of operation, the test described in 37.1 – 37.6 is to be repeated on each speed/output level.

[new] Note: For those appliances with continuous or near-continuous dial settings, tests shall be conducted at the minimum, middle, and maximum settings.

[new] 37.7.2 If ozone-monitoring circuitry is provided as part of the appliance, the test described in 37.1 – 37.6 shall be repeated with the circuitry bypassed unless it's reliability has been demonstrated. Air cleaners must comply with the requirements of paragraph 37.1 in both operational states (with and without circuitry).

[new] Note: Ozone monitoring circuitry shall not be user-defeatable.

[new] Note: For the sake of this test, reliability is defined as compliance with the applicable requirements of UL 991, UL1 998, or UL 60730, whichever is most suitable.

#### [new] 37A Peak Ozone Emission Location Determination

[new] 37A.1 The peak ozone location for monitoring shall be determined by pre-testing the product in an open space with a minimum volume of 4000 ft<sup>3</sup> (15.87 m<sup>3</sup>) and a min. dimension in any direction of 10 ft (3.05 m). The air cleaner shall be placed in the center of the test space. Tabletop models shall be tested in the center of a square table with a surface that extends 1 ft. (0.30 m) beyond the perimeter of the product and is located 30" (0.76 m) above the floor. Lab ventilation should be sufficient to prevent a change in background lab ozone levels during conduct of the pre-test. Lab ventilation shall not cause turbulence around the air cleaner's discharge air stream or otherwise alter its performance.

[new] 37A.2 Using an anemometer or other appropriate means, the periphery of the air stream in a plane parallel to and 2" (5.08 cm) from the surface of the air cleaner discharge grille shall be established. If the air stream boundary is smaller than the discharge grille in either dimension, the corresponding discharge grille dimension shall be used to establish the air stream's boundary. The area of this bounded plane shall be divided using a 2 " x 2" (5.08 cm x 5.08 cm) grid pattern for purposes of locating the ozone analyzer sampling probe. In no case shall there be fewer than a total of 10 ozone sampling locations.

[new] 37A.3 The ozone emitted from the air cleaner shall be measured in the open space at each grid intersection point. The air cleaner shall be operated on both the highest and lowest fan speed if so equipped. If the air cleaner is equipped with special ionizers that can be activated independently, they shall be "on" for purposes of the test. The sampling probe shall be positioned at a grid intersection point and allowed sufficient time for stabilization of ozone levels before recording the peak ozone level at each grid intersection point. Identify the grid location and operating condition that produced the highest ozone reading in the air stream for use during the Ozone Test, Section 37.