
Ozone emission measurements of three PlasmaMade Air Filters

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In this document, the ozone emissions of three samples of the PlasmaMade Air Filter are tested. In these tests it is shown that the PlasmaMade filter is in compliance with the ozone limits as stated in NEN norm: NEN-EN-IEC 60335-2-65 and its associated correction as stated in: NEN-EN-IEC 60335-2-65/C1. The norm states that: in a room with dimensions 2,5 m x 3,5 m x 3 m, where the walls are covered with polyethylene sheet, during a 24 hours test, the percentage of ozone in the room shall not exceed 5×10^{-6} percent. 5×10^{-6} percent equals 0.05 ppm or 50 ppb.

1 Introduction

As well known, ozone, as ambient pollutant, is harmful to human health and well-being. The adverse health effects are documented in studies [1-10]. However ozone can be used as a cleaning agent for many harmful pollutants, such as: oxidizing agent for the removal of bovine proteins from steel surfaces [11], as a retardation agent for banana ripening [12], [13], or as an anti-microbial agent for direct contact with all foods [USFDA, 2001].

Since ozone has strong anti-microbial properties several companies sell ozone generating air filters to the consumer market. These air filters use an ozone generator to clean the air of unwanted particulates, such as: fungal spores, particulate matter, bacterial vectors, and so on. Since an ozone generator is present in a consumer appliance, several governmental institutions put legislation in place to ensure consumer health and safety with regards to ozone generators in consumer machines. In this report, the ozone emissions of three

different PlasmaMade Air filters are measured.

In this report in section 2 the test setup and conditions are described. In section 3 the measurement method and device are described. Lastly, in section 4 the test results are presented and a conclusion is drawn.

2 Test setup and conditions.

In the test chamber, a sample machine is placed on top of an Örnell vent hood. The Örnell vent hood is put on two standards to elevate the whole setup approx 750 mm from the ground, as in accordance with NEN-EN-IEC 60335-2-65 norm. The whole setup is placed in a space with dimensions 2,97 m x 3 m x 3 m, which approximates the volume of the test chamber as stated in the norm. The wall is also covered with dark polyethylene sheet material. For clarity and verification purposes the total setup is shown figure 1(a). The room is accessible by door and the door is sealed shut by utilizing several clips. One of these clips is shown in figure 1(b).

During the testing, the Örnell vent hood operates in the lowest air pump stance, stance 1. Also the vent hood is operated in recirculation mode, i.e. all the air in the ozone test chamber stays in the ozone test chamber.

The ozone measurement machine, Anseros Ozone Analyzer MP, is connected with two hoses to the test chamber. The input hose to the machine is connected to the Örnell hood, 50 mm from the sample filter to be tested. The output hose of the ozone analyzer is connected to the walls of the room. The distance between



(a) The test setup of the GUC1214 within the test chamber. (b) A clip, ensuring that the door stays shut, air tight.

Figure 1: Figures of the test setup (a) and the door clips (b).

the two hoses of the Anseros machine is more than two meters. Therefore it can safely be stated that air going out of the Anseros machine is not direct pumped back into the Anseros machine. The Anseros Ozone analyzer is discussed more extensively in section 3.

Three samples of the PlasmaMade filter are tested in this report. Descriptions of these filters are shown in the itemization below.

- Sample 1: The appliance was used as examination sample.
- Sample 2: Already been tested appliance begin March 2017.
- Sample 3: Plasmamade GUC1214 serie 2 with oacs/iacs control system

3 The method of measurement: The Anseros Ozone Analyzer MP.

The machine used to measure the ozone in the test chamber is an Anseros Ozone Analyzer MP. The Anseros Ozone Analyzer measures the ozone by utilizing ultraviolet photometry. In short, the basic operating principle behind ultraviolet photometry uses two gas flow cells. One cell is a reference cell. The reference cell is scrubbed completely clean of all ozone by an internal scrubbing mechanism. The other cell is the measurement cell. The air being pumped in by the intake hose, goes through the measurement cell. Across both cells, a laser beam is projected. In the reference cell, the laser beam goes through the cell unabated. Therefore the laser beam has not lost anything of its original intensity and power. In the measurement cell, part of the laser light is absorbed by the ozone present in the measurement cell. Therefore the amount of light absorbed in the measurement cell is proportional to the amount of ozone present in the measurement cell. This effect is known as the law of Lambert-Beer [14], [15].

The Anseros machine in our possession has the following specifications:

- Manufacturer and model: Anseros GMBH model MP-6060 serial number 12166313.
- The principle of measuring instrument complies with the requirements of ISO 13964, EN 14625 and VDI 4202
- Machine calibration date: 14-02-2017 According PTB/DKD Standards.

4 The results.

The ozone measurements are performed as stated in the norm: NEN-EN-IEC 60335-2-65. The results are shown in table 1. The maximum average allowed value

Table 1: *The results of the ozone measurements over a 24H period.*

Sample	Average ppm value over 24 hours
Sample 1	0.037 ppm
Sample 2	0.046 ppm
Sample 3	0.038 ppm

of ozone in a 24 hour period is **0.05 ppm**, and so **none** of the three samples exceed this value.

As a closing and concluding statement we can clearly state that: **all three PlasmaMade air filters are in compliance with the norm NEN-EN-IEC 60335-2-65 and its correction NEN-EN-IEC 60335-2-65/C1.**

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