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Summary:

PlasmaMade B.V. Ozone test for production year 2019, meeting conducted at the request of the Dutch and European government.

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INTRODUCTION & FRAMEWORK.

In this report the plasma filters of PlasmaMade B.V. subjected to the ozone test as stated in NEN-EN-IEC 60335-2-65: 2003 clause 32. Plasma filters produce ozone as a by-product in the reaction that the plasma enters with the air to be purified passing through the filter. The ozone tests shown and discussed in this document were conducted in the period from May 2018 until now a month ago, February 2019. The filters are subjected to the ozone test every 3 months on average and are the filters GUC1214, GUC1314 and GUC1212. These are shown in Figures 1 below.







Figure 1 the series PlasmaMade products GUC1214, 1212 and 1314

The PlasmaMade filters must be regularly subjected to the ozone test in clause 32 to pursue different goals:

- 1. Quality check: Is everything in the filters still working properly?
- 2. Safety check: Do the filters not produce too much ozone?
- 3. Product improvement: How can the product be improved?

This report is written with emphasis on point 2, the security check, as requested by the Dutch and European governments. This report then has a 4th goal of providing the Dutch and European governments with sufficient information.

In short, this report has as main research questions:

What are the ozone emissions of the GUC1214 and GUC1314 according to clause 32 of the set standard?

1. Are the filters safe for the test as stated in clause 32?

This report has the following structure. In chapter 1 we discuss clause 32 of standard NEN-EN-IEC 60335-2-65: 2003 and other general data of the tests. In chapter 2 the ozone test results are shown and analyzed. For each measurement, the results are put in a table for clarification. To conclude, we present a brief conclusion in Chapter 3.

1. MEASUREMENT APPROACH AND TEST PERFORMANCE.

A. TEST PERFORMANCE ACCORDING TO CLAUSE 32 OF STANDARD: NEN-EN-IEC 60335-2-65: 2003.

The test is performed according to clause 32 of standard NEN-EN-IEC 60335-2-65: 2003. This clause states:

"32 Radiation, toxicity and similar hazards
This clause of Part 1 is applicable except as follows.

Addition:

The ozone concentration produced by ionization shall not be excessive.

Compliance is checked by the following test, which is carried out in a room without openings having dimensions of 2,5 m \times 3,5 m \times 3,0 m, the walls being covered with polyethylene sheet.

The appliance is positioned in accordance with the instructions. Appliances used on a table are placed in the centre of the room approximately 750 mm above the floor. The room is maintained at approximately 25 °C and 50 % relative humidity. The appliance is supplied at rated voltage for 24 h, removable filters being removed if this is more unfavourable.

The ozone sampling tube is to be located in the air stream 50 mm from the air outlet of the appliance. The background ozone concentration measured prior to the test is subtracted from the maximum concentration measured during the test.

The percentage of ozone in the room shall not exceed 5 x 10-6."

B. ADJUSTMENT OF STANDARD TEST PERFORMANCE.

No adjustments were made to the test execution as set out in the standard.

C. USED TEST EQUIPMENT.	
Ozonemeter: API T204.	Measuring range: 1 ppb to 1 ppm.
	Zero noise: <0.2 ppb.
	Tensioning noise: <0.5% of the RMS value of the
	measurement, from 0.1 ppb.
	Zero: 1% of the full scale in 24 hours,
Rel. Humidity meter:	Measuring range (% RR): 0.1 to 99.9%.
Trotec BZ30 CO2 meter.	Resolution (% r.v.): 0.1.
	Accuracy (% RV): 5.
Thermometer:	Measuring range: -5 Co to 50 Co.
Trotec BZ30 CO2 meter.	Resolution: 0.1 Co.
	Accuracy: 1

D. OTHER REMARKS.

The test execution is shown below in the photo in figure 3.

Figure 3: Photograph of the test set-up of the PlasmaMade filters in the ozone cream used for the measurements performed in this document. The measuring mouth of the ozone measuring machine is not shown. This is added later by a standard and placed on the prescribed 5 cm of the plasma filter.

2.MEASURING RESULTS.

In this chapter, the measurement results are shown that are from May 2018 to February 2019. Each set of measurements per month receives its own sub-chapter within this chapter. The measurements shown are analyzed for each subsection.

2.A FILTER TESTING MAY 2018.

Figure 4 below shows the graph of the GUC1214 and a GUC1314 that have been tested according to clause 32 of the set standard.

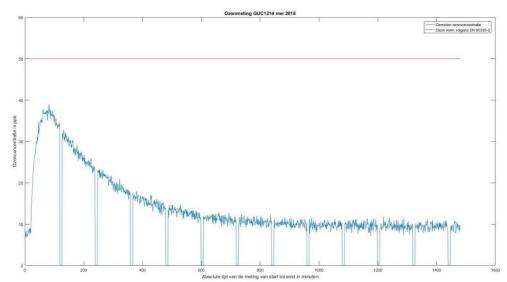


Figure 4a: A measurement of the GUC1214 according to clause 32 made in May 2018, for quality control.

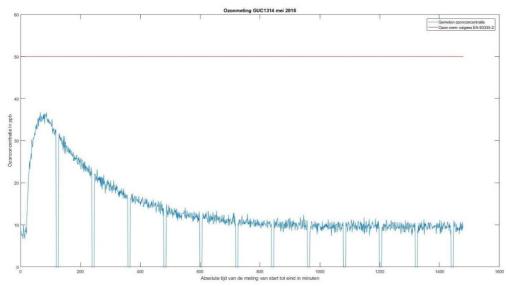


Figure 4b: A measurement of the GUC1314 according to clause 32 in May 2018, for quality control.

With the 2 measurements shown, the time in minutes is shown on the x-axis and the ozone concentration on the y-axis. The x-axis time represents the absolute time, with point 0 being the time when the measurement was started. The red line represents the norm value of 50 ppb in both figures. The blue line are the measured ozone values by the API T204.

The test conditions and results are shown in table form below.

TABLE FOR GUC1214 MAY 2018.		
Test condition:	Waarde:	
Temperature during the test:	20 C° ± 2 C°.	
Humidity during the test:	50 % ± 5 %.	
Background ozone concentration:	7 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	39 ppb.	
Time to reach highest ozone concentration:	82 min.	
Processing according to clause 32 &	39 ppb – 7 ppb = 32 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	32 ppb < 50 ppb: yes, pass.	

TABLE FOR GUC1314 MAY 2018.		
Test condition:	Waarde:	
Temperature during the test:	21 C° ± 2 C°.	
Humidity during the test:	50 % ± 5 %.	
Background ozone concentration:	7 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	37 ppb.	
Time to reach highest ozone concentration:	67 min.	
Processing according to clause 32 &	37 ppb – 7 ppb = 30 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	37 ppb < 50 ppb: yes, pass.	

2.B FILTER TESTING SEPTEMBER 2018.

Figure 5 below shows the graph of the GUC1214 and a GUC1314 that have been tested according to clause 32 of the set standard.

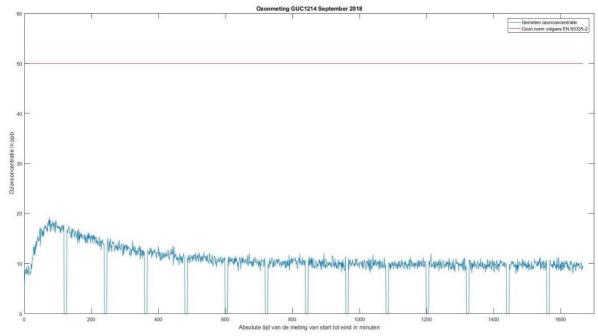


Figure 5a: A measurement of the GUC1214 according to clause 32 made in September 2018, for quality control.

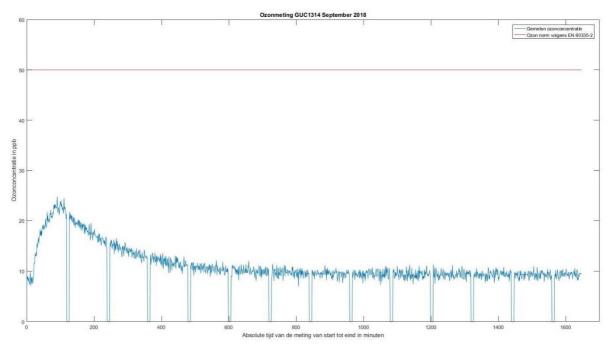


Figure 5b: A measurement of the GUC1314 according to clause 32 made in September 2018, for quality control.

With the 2 measurements shown, the time in minutes is shown on the x-axis and the ozone concentration on the y-axis. The x-axis time represents the absolute time, with point 0 being the time when the measurement was started. The red line represents the norm value of 50 ppb in both figures. The blue line are the measured ozone values by the API T204.

The test conditions and results are shown in table form below.

TABLE FOR GUC1214 SEPTEMBER 2018.		
Test condition:	Waarde:	
Temperature during the test:	24 °C ± 2 °C.	
Humidity during the test:	55 % ± 5 %.	
Background ozone concentration:	8 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	19 ppb.	
Time to reach highest ozone concentration:	70 min.	
Processing according to clause 32 &	19 ppb – 8 ppb = 11 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	11 ppb < 50 ppb: yes, pass.	

TABLE FOR GUC1314 SEPTEMBER 2018.		
Test condition:	Waarde:	
Temperature during the test:	24 C° ± 2 C°.	
Humidity during the test:	55 % ± 5 %.	
Background ozone concentration:	8 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	24 ppb.	
Time to reach highest ozone concentration:	80 min.	
Processing according to clause 32 &	24 ppb – 8 ppb = 16 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	16 ppb < 50 ppb: yes, pass.	

2.C FILTER TESTING DECEMBER 2018.

Figure 6 below shows the graph of the GUC1214 and a GUC1314 that have been tested according to clause 32 of the set standard in December 2018.

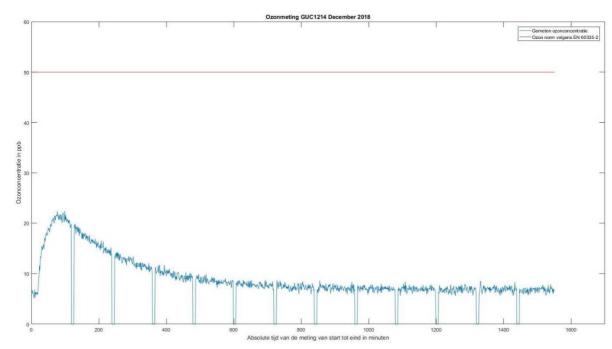


Figure 6a: A measurement of the GUC1214 according to clause 32 made in December 2018, for quality control.

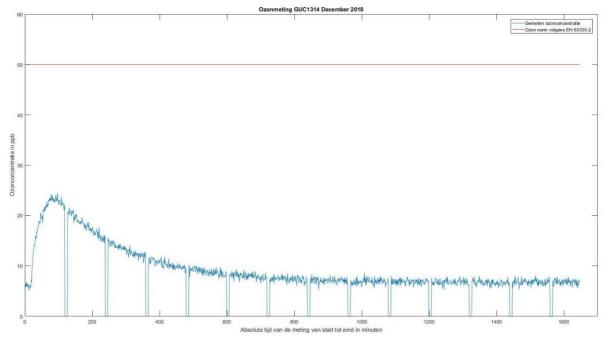


Figure 6b: A measurement of the GUC1314 according to clause 32 made in December 2018, for quality control

With the 2 measurements shown, the time in minutes is shown on the x-axis and the ozone concentration on the y-axis. The x-axis time represents the absolute time, with point 0 being the time when the measurement was started. The red line represents the norm value of 50 ppb in both figures. The blue line are the measured ozone values by the API T204.

The test conditions and results are shown in table form below.

TABLE FOR GUC1214 DECEMBER 2018.		
Test condition:	Waarde:	
Temperature during the test:	20 C° ± 2 C°.	
Humidity during the test:	50 % ± 5 %.	
Background ozone concentration:	6 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	22 ppb.	
Time to reach highest ozone concentration:	72 min.	
Processing according to clause 32 &	22 ppb – 6 ppb = 16 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	16 ppb < 50 ppb: yes, pass.	

TABLE FOR GUC1214 DECEMBER 2018.		
Test condition:	Waarde:	
Temperature during the test:	20 C° ± 2 C°.	
Humidity during the test:	50 % ± 5 %.	
Background ozone concentration:	6 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	23 ppb.	
Time to reach highest ozone concentration:	92 min.	
Processing according to clause 32 &	23 ppb – 6 ppb = 17 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	16 ppb < 50 ppb: yes, pass.	

2.D FILTER TESTING FEBRUARY.

Figure 7 below shows the graph of the GUC1214 and a GUC1314 that were tested in accordance with clause 32 of the standard set in February 2019.

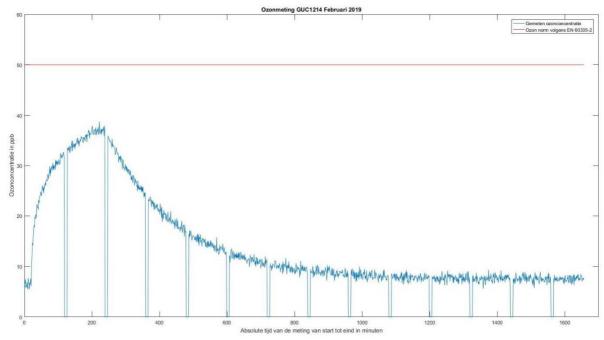


Figure 7a: A measurement of the GUC1214 according to clause 32 made in February 2019 for quality control.

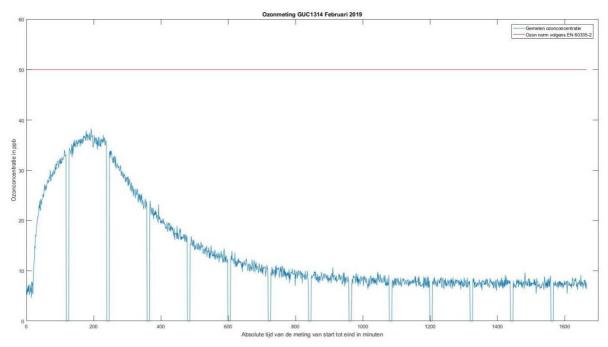


Figure 7b: A measurement of the GUC1314 according to clause 32 made in February 2019 for quality control.

With the 2 measurements shown, the time in minutes is shown on the x-axis and the ozone concentration on the y-axis. The x-axis time represents the absolute time, with point 0 being the time when the measurement was started. The red line represents the norm value of 50 ppb in both figures. The blue line are the measured ozone values by the API T204.

TABLE FOR GUC1214 FEBRUARY 2019.		
Test condition:	Waarde:	
Temperature during the test:	21 C° ± 2 C°.	
Humidity during the test:	50 % ± 5 %.	
Background ozone concentration:	6 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	39 ppb.	
Time to reach highest ozone concentration:	220 min.	
Processing according to clause 32 &	39 ppb – 6 ppb = 33 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	33 ppb < 50 ppb: yes, pass.	

TABLE FOR GUC1214 FEBRUARY 2019.		
Test condition:	Waarde:	
Temperature during the test:	20 °C ± 2 °C.	
Humidity during the test:	50 % ± 5 %.	
Background ozone concentration:	6 ppb \pm 1 ppb.	
Test result:	Waarde:	
Highest ozone concentration achieved in the test:	39 ppb.	
Time to reach highest ozone concentration:	200 min.	
Processing according to clause 32 &	39 ppb – 6 ppb = 33 ppb.	
result test:		
Does the filter meet the requirements of clause 32:	33 pb < 50 ppb: yes, pass.	

3.CONCLUSION AND DISCUSSION.

All tested filters remain below the 50 ppb ozone standard. This means the PlasmaMade filters have been found to be safe in this context.