Institut für Energie- und Umwelttechnik e.V. (IUTA)

Luftreinhaltung & Filtration

Bliersheimer Straße 58-60

47229 Duisburg

Germany

Anna Caspari

Ute Schneiderwind

Dr. Stefan Schumacher

Report UN2-201110-T5599900-318B **Determination of ozone and nitrogen oxide emissions of an air cleaner**	
Customer: **ProActiveAir GmbH** **G. Heinrich, A. Wartha, M. Zahlen** **Marie-Curie-Straße 4** **71083 Herrenberg-Gültstein**	IUTA, Managing Director Institut für Energie- und Umwelttechnik e.V. (IUTA) Bliersheimer Straße 60 47229 Duisburg Duisburg, 21 December 2020

Report UN2-201110-T5599900-318B

Determination of ozone and nitrogen oxide emissions of an air cleaner

Institut für Energie- und Umwelttechnik e.V. (IUTA)
Bliersheimer Straße 58–60 47229 Duisburg, Germany
Phone: +49 2065 418 0
E-Mail: info@iuta.de
Web page: www.iuta.de
IUTA contact: Dr. Stefan Schumacher
Abteilung: Luftreinhaltung & Filtration

Date: 21 December 2020

IUTA quotation no.: UN2-201110-T5599900-318
Date of quotation: 10 November 2020

Customer: ProActiveAir GmbH
Marie-Curie-Straße 4
71083 Herrenberg-Gültstein

Customer contact: Gunter Heinrich
Andreas Wartha
Marcel Zahlen

Date of order: 10 December 2020
Period of processing: December 2020

Number of pages: 6

Contents

1. Background

ProActiveAir GmbH contracted IUTA e.V. to measure possible ozone and nitrogen oxide emissions from an air cleaner. The measurement of ozone emissions was carried out in accordance with UL 867-37 (Standard for Electrostatic Air Cleaners - Ozone Test) and the result was compared with the limit value for the volume concentration of 50 ppb specified there. There is no comparable test specification or corresponding limit value for nitrogen oxides. Therefore, the same test procedure was used here as for the ozone measurements according to UL 867-37.

2. Tested Air Cleaner

The tested air cleaner was delivered by ProActiveAir GmbH without any noticeable damage and was tested for correct function. The air cleaner did not contain any replaceable filters that had to be inserted or conditioned in advance. The unit was operated at the highest continuous fan level (level 3). The air cleaner was positioned on the floor in the center of the test chamber as required by UL 867-37.

3. Measurements

3.1 Test Chamber

All measurements were performed in a standardized test chamber that meets the conditions of UL 867-37. The internal dimensions of the chamber are 3.45 m × 3.40 m × 2.50 m, which corresponds to a volume of 29.3 m³. It is therefore within the permissible range of 26.9 to 31.1 m³ with a minimum wall length of 2.40 m and maximum height of 3.00 m. The walls of the test chamber were lined with polyethylene foil in accordance with UL 867-37. The bottom of the chamber is made of stainless steel, which meets the conditions for a non-porous material.

3.2 Test and Measurement Equipment

The following test and measurement equipment was used for the measurements:

- Ozone emissions were measured using an online ozone monitor (2B Technologies 106-L). Data were recorded with a time resolution of 10 s and averaged over 1 min each for evaluation to minimize natural noise.

- Nitrogen oxide emissions were measured using a nitrogen oxide analyzer (Environnement AC32M). Nitrogen monoxide (NO), nitrogen dioxide (NO_2) and the sum concentration NO_x were recorded. The time resolution was 10 s.

3.3 Test Procedure

First, the test room was cleaned by a second air cleaner to minimize the background concentration of particles and volatile organic compounds. The temperature was set to (25 ± 2) °C and the relative humidity to (50 ± 5) %rh. Since temperature and humidity cannot be controlled during the measurement, some fluctuations occurred over the course of 24 h, but these should not affect the result of the measurement. Sampling for ozone and nitrogen oxides was performed 50 mm in front of the air outlet of the air cleaner as required by UL 867-37. The sampling was oriented directly into the air stream. First, the natural background was recorded for 60 min without operating the air cleaner. Subsequently, the air cleaner was switched on at the highest level and operated for 24 hours.

4. Results

4.1 Ozone

The natural ozone background in the chamber shown in Figure 1 was in average (2.0 ± 1.1) ppb, which is within typical expectations. After switching on the air cleaner, the ozone value increased to about 27 ppb within one hour and only slightly further from there (see Figure 2). At the latest from about 18 h measurement time, an almost constant equilibrium concentration of (33.6 ± 0.7) ppb was reached. After subtraction of the natural background, the maximum measured ozone concentration was (31.6 ± 1.3) ppb. The limit value of 50 ppb specified by UL 867-37 was therefore undercut.

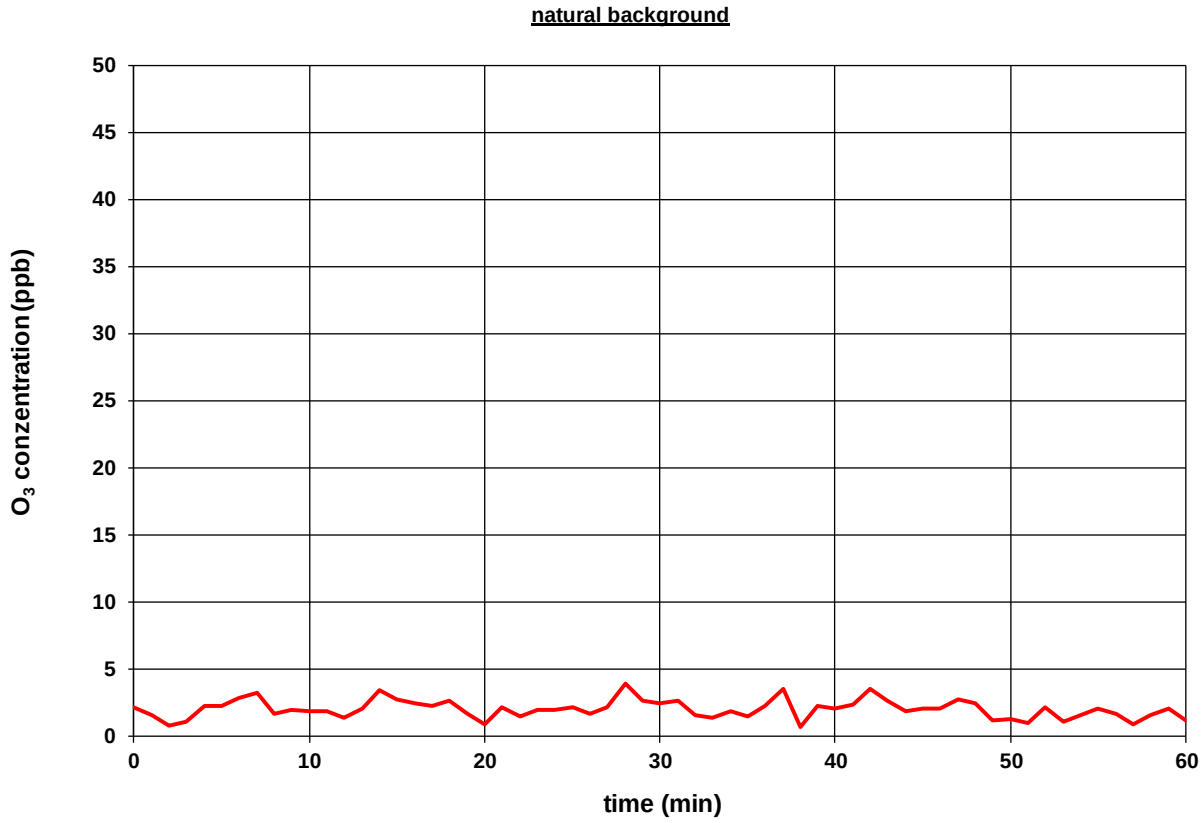

Figure 1 Measurement of the natural ozone background in the test chamber over 60 min.

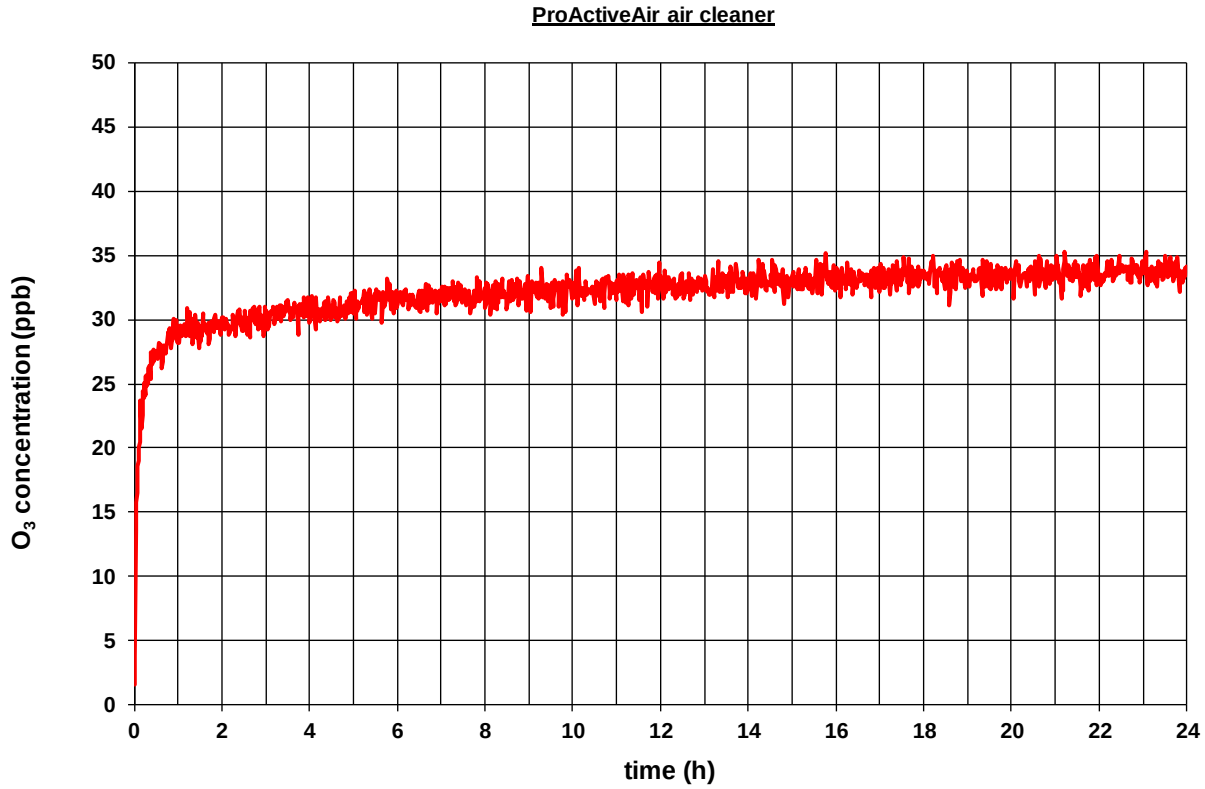

Figure 2 Measurement of ozone emissions with the air cleaner running for 24 h.

4.2 Nitrogen Oxides

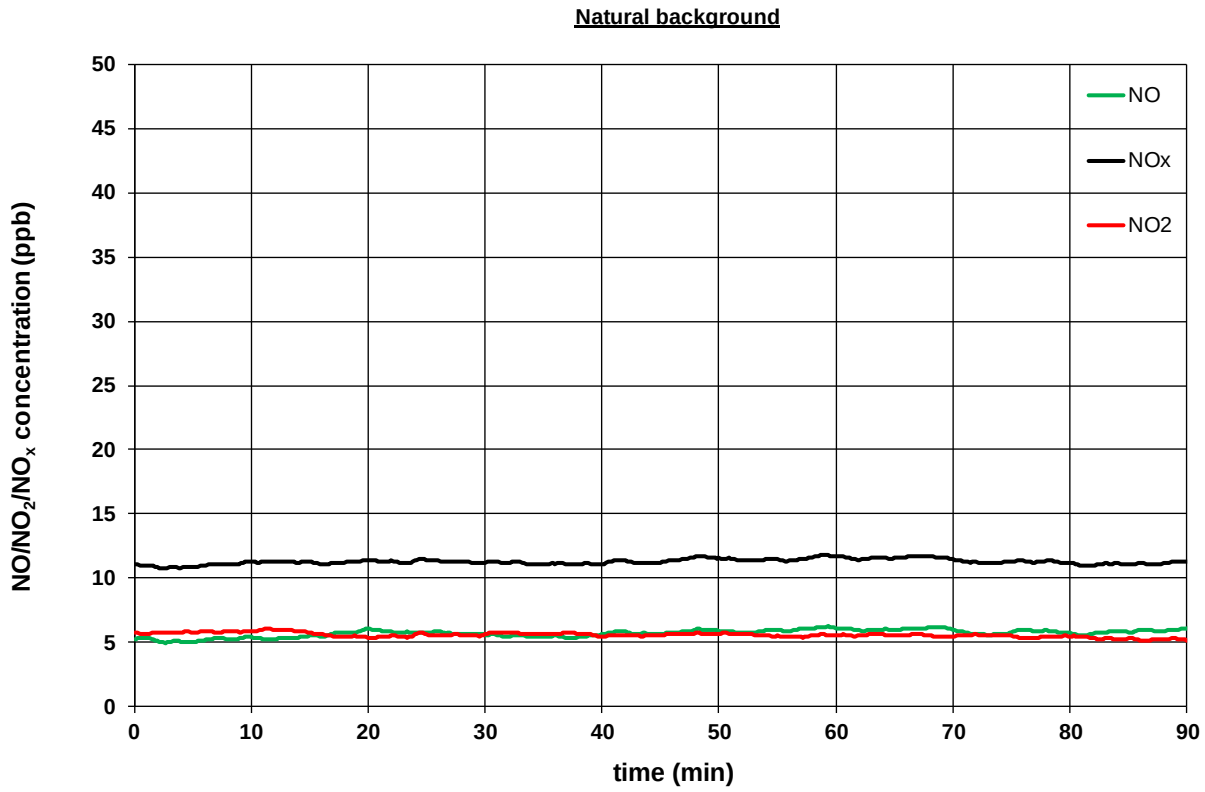

Figure 3 Measurement of the natural nitrogen oxide background in the test chamber over 90 min.

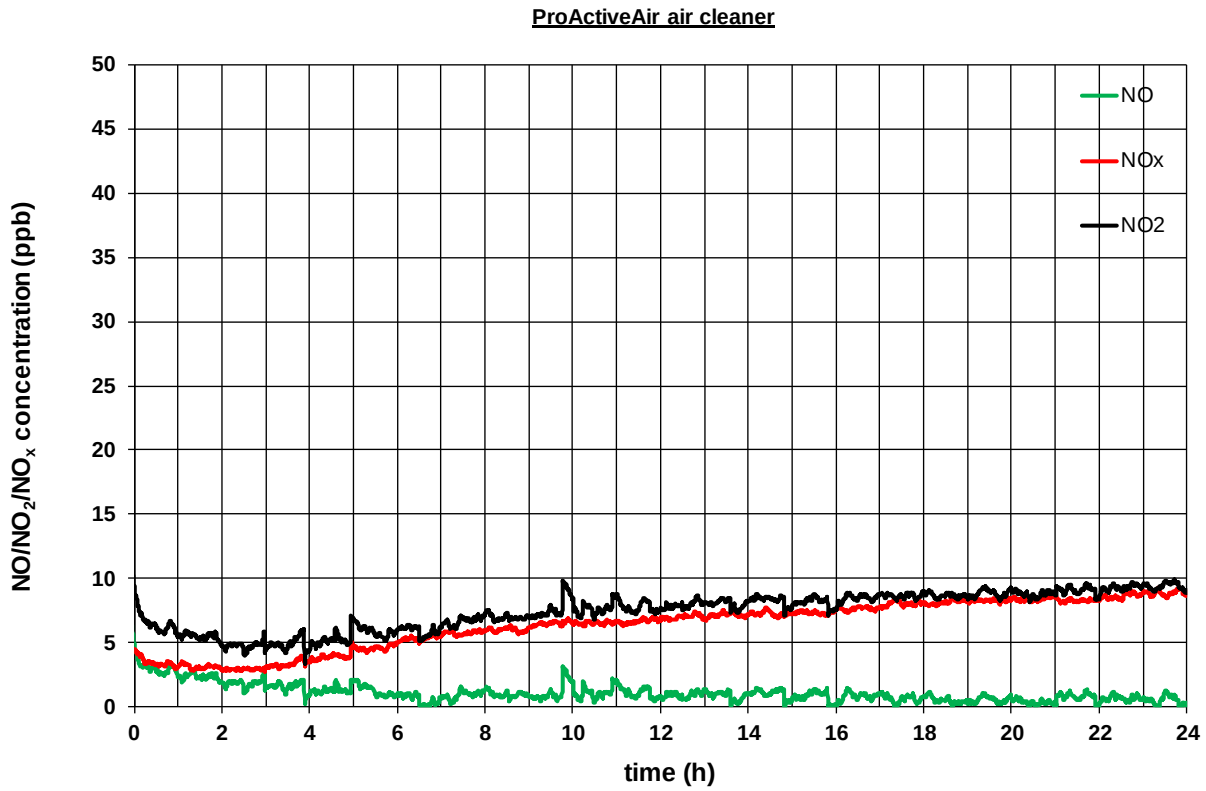

Figure 4 Measurement of nitrogen oxide emissions with the air cleaner running for 24 h.

The natural background concentration in the chamber averaged over the measured 90 min was (5.6 ± 0.3) ppb for NO, (5.6 ± 0.1) ppb for NO_2 and (11.2 ± 0.3) ppb for the sum concentration of NO_x (see Figure 3). After switching on the air cleaner, the NO value decreased continuously, while the course of NO2 approached the original background concentration of NO_x (see Fig. 4). This indicates conversion processes of the already naturally present nitrogen oxides by ozone, i.e. in particular an oxidation of NO to NO_2. However, there was no effective emission of nitrogen oxides. Overall, the maximum measured NO_x concentration during the 24-hour measurements was 10 ppb, below the mean background value of (11.2 ± 0.3) ppb.

5. Summary

During the 24-hour measurement according to UL 867-37, an equilibrium concentration of (31.6 ± 1.3) ppb was found. This value is below the maximum permissible concentration of 50 ppb according to UL 867-37. Effective nitrogen oxide emissions from the air cleaner could not be determined.

S. Schumacher

Dr. Stefan Schumacher
Air Quality & Filtration