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# Measurement of Ozone Emission from Air Cleaners

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**February 2008**

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**241356**

**Indoor Environment**

## Abstract

The Danish Technological Institute carried out measurement of air flow and ozone emission from 4 air cleaners, type AirManager AS-LOG3-100 (LC), AS-LOG10-200, AS-LOG5-900 and Domestic. The measurements were carried out in the period 6th – 12th February 2008. The tests comprised measurements of ozone concentration across the air stream at the face of each of the units. Furthermore, the build-up of ozone concentration in a room during 24 hour constant operation of the AS-LOG10-200 was measured.

When measuring across the air stream at the face of the units, large variations in the ozone concentration in the exhaust air was found. Average ozone concentrations are shown in the table below.

| **Model** | **Air flow [$m^3$/h]** | **Average ozone conc. [ppm]** |
|---|---|---|
| AS-LOG3-100 | 40 | 0.01 |
| AS-LOG10-200 | 140 | 0.02 |
| AS-LOG5-900 | 700 | 0.05 |
| Domestic | 16 | 0.02 |

The Danish Working Environment Authority has laid down a limit value (OEL) for ozone in the working environment of 0.1 ppm. The ozone limit value must not be exceeded at any time.

The Danish Working Environment Authority recommends that the ozone concentration in the vicinity of ozone emitting equipment is below 0.1 ppm, if there is a work place in that room.

The build-up of ozone concentration was measured by leaving the unit turned on for more than 24 hours in the laboratory. The measured ozone concentrations are listed in the table below.

Ozone concentration build-up, AS-LOG10-200

| **Date / time [dd.mm.yy / hh:mm]** | **Ozone concentration [ppm]** |
|---|---|
| 08.02.08 / 07:30 | <0.001 |
| 08.02.08 / 07:45 | 0.002 |
| 08.02.08 / 08:00 | 0.002 |
| 08.02.08 / 08:15 | 0.002 |
| 08.02.08 / 08:30 | 0.003 |
| 08.02.08 / 09:30 | 0.010 |
| 08.02.08 / 11:30 | 0.014 |
| 08.02.08 / 14:30 | 0.014 |
| 08.02.08 / 15:30 | 0.014 |
| 08.02.08 / 16:20 | 0.014 |
| 09.02.08 / 17:20 | 0.014 |

The results show that the ozone concentration measured at the face of the units does not exceed the Danish OEL of 0.1 ppm for any of the tested air cleaners. Furthermore, the results show that when the AS-LOG10-200 unit is operated continuously for more than 24 hours in a 60 $m^3$ laboratory (air change rate: 0.7 $h^{-1}$), the ozone concentration in the room does not exceed the Danish OEL of 0.1 ppm.

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## 1. Assignor

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## 2. Background

AirManager Nordic A/S, Ole Thorn, assigned the Danish Technological Institute to carry out measurements of ozone emission from 4 air cleaners, type AirManager AS-LOG3-100 (LC), AS-LOG10-200, AS-LOG5-900 and Domestic.

The measurements were carried out in the period 6$^{th}$ – 12$^{th}$ February 2008. The tests comprised measurements of total air flow and ozone concentration across the air stream at the face of each of the units. Furthermore, the build-up of ozone concentration in a room during 24 hour constant operation of the AS-LOG10-200 was measured.

## 3. Methods

All measurements were carried out with the air cleaners placed on a table in a laboratory with a volume of 60 m$^3$. Surfaces in the laboratory are: linoleum flooring, walls and ceiling: painted gypsum board.

The air change rate in the laboratory was prior to the ozone measurements determined by means of tracer gas ($SF_6$) and decay method.

**Air flow**
The total air flow rate through the units was measured using a hot wire anemometer, TSI 8830 Velocicheck and different ALNOR measuring funnels. The air flow through the units was measured with the filter installed.

**Ozone**
The ozone concentration was measured using an ozone monitor, TEI model 560, which measures by means of chemiluminiscense principle. Prior to the measurements the ozone monitor was calibrated against an ozone generator, TEI model 565, at the concentration of 0.1 ppm.

All measurements were carried out with the filters installed.

## 4. Results

**Laboratory conditions**

| | |
|---|---|
| Temperature: | 23°C |
| Relative humidity: | 50 % RH |
| Background ozone concentration: | < 0.001 ppm |
| Atmospheric pressure: | 1005 hPa during measurements on AS-LOG3-100<br>1025 hPa during measurements on AS-LOG10-200 and LOG5-900<br>1038 hPa during measurements on Domestic |
| Air change rate: | 0.7 $h^{-1}$ |

| **Air cleaner data / model** | **Serial no.** |
|---|---|
| AS-LOG3-100 | 4735 |
| AS-LOG10-200 | 4560 |
| AS-LOG5-900 | 4303 |
| Domestic | 4751 |

When measuring across the air stream at the face of the units, large variations in the ozone concentration in the exhaust air was found. Average ozone concentrations in the air streams are shown in the table below.

| **Model** | **Air flow [$m^3$/h]** | **Average ozone conc. [ppm]** |
|---|---|---|
| AS-LOG3-100 | 40 | 0.01 |
| AS-LOG10-200 | 140 | 0.02 |
| AS-LOG5-900 | 700 | 0.05 |
| Domestic | 16 | 0.02 |

Ozone concentrations measured in the exhaust air at points evenly distributed across the face of the units are shown below.

*Domestic, front view. Concentrations given in ppm*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.008 | 0.006 | 0.005 | 0.004 | 0.005 | 0.02 | 0.03 | 0.02 | 0.002 | 0.02 | 0.02 |
| 0.009 | 0.009 | 0.006 | 0.005 | 0.006 | 0.02 | 0.03 | 0.03 | 0.006 | 0.02 | 0.025 |
| | | | | | | | | | | |
| 0.01 | 0.008 | 0.008 | 0.004 | 0.007 | 0.007 | 0.025 | 0.03 | 0.03 | 0.025 | 0.05 |
| 0.015 | 0.012 | 0.002 | 0.006 | 0.008 | 0.028 | 0.03 | 0.03 | 0.015 | 0.015 | 0.045 |

*AS-LOG3-100, right side. Concentrations given in ppm*

| | | Air intake | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.003 | 0.004 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 | 0.007 | 0.007 | 0.007 | 0.008 | 0.009 | 0.007 | 0.008 |
| 0.004 | 0.005 | 0.005 | 0.005 | 0.006 | 0.005 | 0.006 | 0.008 | 0.02 | 0.015 | 0.015 | 0.015 | 0.015 | 0.012 | 0.014 | 0.014 | 0.012 | 0.012 |
| 0.005 | 0.005 | 0.005 | 0.006 | 0.006 | 0.008 | 0.025 | 0.04 | 0.03 | 0.025 | 0.025 | 0.02 | 0.02 | 0.018 | 0.018 | 0.018 | 0.015 | 0.012 |

*AS-LOG3-100, left side. Concentrations given in ppm*

| | | | | | | | | Air intake | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.009 | 0.008 | 0.008 | 0.008 | 0.007 | 0.006 | 0.006 | 0.007 | 0.007 | 0.008 | 0.007 | 0.004 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 |
| 0.012 | 0.008 | 0.009 | 0.008 | 0.008 | 0.007 | 0.008 | 0.007 | 0.008 | 0.009 | 0.007 | 0.007 | 0.005 | 0.004 | 0.005 | 0.005 | 0.005 | 0.004 |
| 0.01 | 0.01 | 0.009 | 0.009 | 0.009 | 0.009 | 0.008 | 0.008 | 0.009 | 0.009 | 0.009 | 0.01 | 0.009 | 0.008 | 0.007 | 0.006 | 0.006 | 0.006 |

*AS-LOG3-100, front view. Concentrations given in ppm*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Air intake | | | | | | | | | |
| 0.009 | 0.009 | 0.008 | 0.009 | 0.008 | 0.008 | 0.008 | 0.005 | 0.009 | 0.01 | 0.01 |
| 0.012 | 0.012 | 0.01 | 0.012 | 0.012 | 0.01 | 0.01 | 0.009 | 0.01 | 0.012 | 0.012 |
| 0.012 | 0.012 | 0.012 | 0.014 | 0.014 | 0.015 | 0.015 | 0.01 | 0.014 | 0.014 | 0.012 |

*AS-LOG5-900, front view. Concentrations given in ppm.*

| | | | |
|---|---|---|---|
| 0.015 | 0.018 | 0.025 | 0.015 |
| 0.022 | 0.05 | 0.044 | 0.02 |
| 0.044 | 0.044 | 0.12 | 0.022 |
| 0.046 | 0.044 | 0.022 | 0.04 |

The build-up of ozone concentration was measured by leaving the AS-LOG10-200 unit turned on for more than 24 hours in the laboratory. The measured ozone concentrations are listed in the table below.

Ozone concentration build-up, AS-LOG10-200

| **Date / time [dd.mm.yy / hh:mm]** | **Ozone concentration [ppm]** |
|---|---|
| 08.02.08 / 07:30 | <0.001 |
| 08.02.08 / 07:45 | 0.002 |
| 08.02.08 / 08:00 | 0.002 |
| 08.02.08 / 08:15 | 0.002 |
| 08.02.08 / 08:30 | 0.003 |
| 08.02.08 / 09:30 | 0.010 |
| 08.02.08 / 11:30 | 0.014 |
| 08.02.08 / 14:30 | 0.014 |
| 08.02.08 / 15:30 | 0.014 |
| 08.02.08 / 16:20 | 0.014 |
| 09.02.08 / 17:20 | 0.014 |

The results show that the ozone concentration measured at the face of the units does not exceed the Danish OEL of 0.1 ppm for any of the tested air cleaners. Furthermore, the results show that when the AS-LOG10-200 unit is operated continuously for more than 24 hours in a 60 $m^3$ laboratory (air change rate: 0.7 $h^{-1}$), the ozone concentration in the room does not exceed the Danish OEL of 0.1 ppm.