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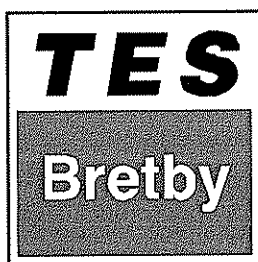
# Report

## MONITORING OF OZONE GAS CONCENTRATIONS DURING TRIAL OPERATIONS OF THE OZONE CLEAN LIMITED OC1500 OZONE GENERATOR-DESTRUCTOR MACHINE

Carried out for: Ozone Clean Limited

Job reference: ED/AD/17226

Report prepared by: F G Green  
Date of issue: 20 August 2007  
Revision no: 0



### TES Bretby

PO. Box 100,  
Burton-on-Trent,  
Staffordshire  
DE15 0XD  
United Kingdom

Telephone : 01283 554400  
Fax: 01283 554422

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Approved By: S R Hunneyball  
S R Hunneyball  
Associate Director: Operations

Report No TES/07/401

20 August 2007

## **SUMMARY**

The results indicated that the maximum general body concentration of ozone gas during trial operations of the Ozone Clean Limited OC1500 "Ozone Generator-Destructor Machine" was 2.65 ppm.

On completion of all of the five tests, general body concentrations of ozone gas within the room monitored were less than 0.01 ppm.

## 1. **INTRODUCTION**

- 1.1 A request was received from Mr D Powell, General Manager, Ozone Clean Limited for TES Bretby to carry out monitoring of ozone gas concentrations during trial operations of the Ozone Clean Limited OC1500 "Ozone Generator-Destructor Machine". This report refers to the monitoring carried out at the Spring Lane Luxury Retirement Home, Finchley, London,
- 1.2 The purpose of the monitoring was in order to determine a) general body ozone gas concentrations during trial operations of the Ozone Clean Limited OC1500 Ozone Generator-Destructor Machine and b) whether or not employee exposure during actual operations of the Ozone Generator-Destructor was likely to be within the prescribed legal limits, as required by Regulation 7 (Prevention or Control of Exposure to Substances Hazardous to Health) of the Control of Substances Hazardous to Health Regulations, 2002.

## 2. **SAMPLING STRATEGY**

- 2.1 Arrangements were made visit to the Spring Lane Luxury Retirement Home, Finchley, London, on 24 July 2007 and carry out monitoring of ozone gas concentrations during trial operations of the Ozone Clean Limited OC1500 "Ozone Generator-Destructor Machine". Measurements were taken between the period 10:30 to 13:51 hours. During this time the Ozone Generator-Destructor Machine was operated at two different cycle settings, namely 15-minutes and 30-minutes. Four 15-minute cycle measurements and one 30-minute cycle measurements were obtained during the survey. During the two different cycles, the Ozone Generator-Destructor operated as follows:-

15-minute cycle;1)	1 x minute room exit time .
(Test 1 and Test 2)	2) 10 second warning alarm.
	3) 105 second, ozone generation.
	4) 2 x minutes, pause.
	5) 11 minutes 15 seconds, ozone destruction.
	6) 10 second safe entry alarm.

30-minute cycle;1)	1 x minute room exit time .
(Test 3)	2) 10 second warning alarm.
	3) 6 x minutes, ozone generation.
	4) 2 x minutes, pause.
	5) 23 minutes, ozone destruction.
	6) 10 second safe entry alarm.

15-minute cycle;1)	1 x minute room exit time .
(Test 4 and Test 5)	2) 10 second warning alarm.
	3) 2 minutes, ozone generation.
	4) 2 x minutes, pause.
	5) 11 minutes, ozone destruction.
	6) 10 second safe entry alarm.

- 2.2 General body measurements were taken from within Room 6 (ground floor) of the building. The room was of dimensions 4.5 (L) x 4.4 (W) x 2.8 (H) metres and comprised a sleeping area with adjoining bathroom (door open). The room was furnished at the time of the survey and the windows and door (passageway) were kept closed throughout the survey.

- 2.3 The sampling equipment used during the survey comprised the following:-

- 1) Advanced Ozone Products Limited, Aeroqual Series 500 Monitor with data logging (Serial No.OZHC4300602-111). Measuring range 0 - 0.5 ppm (Low range cell fitted) and 0.5 - 20 ppm (High range cell fitted).
- 2) Drager CMS, hand-held, analyser (Serial No.ARME-0774). Measuring range 0.025 - 1 ppm (25 - 1000 ppb).

The Aeroqual Series 500 Monitor was used throughout each measurement period, in order to determine the maximum and average concentrations of ozone gas. The Drager CMS instrument was used at the beginning and end of each measurement period, in order to determine the concentrations of ozone gas and to ensure that the room was safe to re-enter.

- 2.4 During each measurement period the Ozone Clean Limited OC1500 Ozone Generator-Destructor Machine and the Advanced Ozone Products Limited, Aeroqual Series 500 Monitor were positioned approximately 70 cms apart and in the centre of the rooms (see attached Photograph 1). The Aeroqual Series 500 Monitor was operated throughout each measurement period/cycle and was positioned at approximately 1.1 metres above floor level during Test 1 and 0.65 metres above floor level during Tests 2 - 5.

### 3. **RESULTS**

- 3.1 The air concentrations of ozone gas, measured during each of the five tests using the Advanced Ozone Products Limited, Aeroqual Series 500 Monitor and the Drager CMS, hand-held, analysers are given in Tables 1 - 5. The results obtained using the Aeroqual Series 500 Monitor are also depicted graphically in Figures 1 - 5.

### 4. **WORKPLACE EXPOSURE LIMITS**

- 4.1 The HSE publishes a list of Workplace Exposure Limits (WELs) in their Guidance Note EH40 2005, which form part of the requirements of the Control of Substances Hazardous to Health (COSHH) Regulations, 2002 (as amended).
- 4.2 EH40 specifies the following Workplace Exposure Limits appropriate to this survey:

Substance	Long-term (8 hour) Exposure Limit (ppm)	Short-term (15 minutes) Exposure Limit (ppm)
Ozone	0.2*	0.2

\* No short-term limit specified. Limit calculated in accordance with recommendations given in paragraph 93 of EH40.

### 5. **DISCUSSION**

- 5.1 The results indicated that the maximum general body concentration of ozone gas during trial operations of the Ozone Clean Limited OC1500 Ozone Generator-Destructor Machine was 2.65 ppm (one minute average value). This concentration of ozone gas was generated during a 30 minute cycle setting of the OC1500 Ozone Generator-Destructor Machine and after a period of approximately 7 minutes from the start of the run. An exposure to ozone gas of between 1.5 -2 ppm for 2 hours typically results in a cough, substernal pain and excessive sputum.
- 5.2 The results indicated that, on completion of all of the five tests, general body concentrations of ozone gas within the room monitored were less than 0.025 ppm (Drager CMS).

### 6. **CONCLUSIONS**

- 6.1 It was understood during the survey that future operators of the OC1500 Ozone Generator-Destructor Machine will be given strict instructions to vacate all rooms within which the apparatus will be operated. Warning sirens are sounded by the Ozone Generator-Destructor; prior to the generation of ozone gas and also at the completion of the ozone destruction cycle (observed to be the case during the survey). It is considered that should this procedure be followed by operators, then likely employee exposure to ozone gas will be well below the relevant workplace exposure limits (WEL), given in paragraph 4, above.

## 7. **RECOMMENDATIONS**

- 7.1 Employees should be made aware of the hazards associated with exposure to ozone gas and trained in the correct use of any engineering control measures and RPE that are provided.

## **REFERENCES**

1. The Control of Substances Hazardous to Health Regulations, 2002.
2. HSE Guidance Notes: EH40, Workplace Exposure Limits.  
HSG53, Respiratory Protective Equipment: a Practical Guide for Users

**Table 1****Ozone Clean Limited - Spring Lane Luxury Retirement Home****Test 1 - Ozone Concentrations**

Location; Room 6  
Ozone Generator/Disperser start time; 10:30 hours  
Cycle duration; 15 minutes  
Measurement height; 1.1 metres above floor level

	<b>Ozone Concentration (ppm)</b>	
<b>Time</b>	<b>Aeroqual Series 500 (High range cell)</b>	<b>Drager CMS</b>
10:17 - 10:27	-	<0.025
10:30	0	-
10:31	0	-
10:32	0.41	-
10:33	1.15	-
10:34	1.39	-
10:35	1.39	-
10:36	1.2	-
10:37	0.77	-
10:38	0.76	-
10:39	0.69	-
10:40	0.52	-
10:41	0.47	-
10:42	0.36	-
10:43	0.33	-
10:44	0.29	-
10:45	0.22	-
10:46	0.19	-
10:47	0.17	-
10:48	0.08	-
10:49	0.04	-
10:50	0.02	-
10:51	0	-
10:48 - 10:58	-	<0.025

**Table 2****Ozone Clean Limited - Spring Lane Luxury Retirement Home****Test 2 - Ozone Concentrations**

Location; Room 6  
 Ozone Generator/Disperser start time; 11:01 hours  
 Cycle duration; 15 minutes  
 Measurement height; 0.65 metres above floor level

Time	Ozone Concentration (ppm)	
	Aeroqual Series 500 (High range cell)	Drager CMS
10:48 - 10:58	-	<0.025
11:01	0	-
11:02	0	-
11:03	0.55	-
11:04	1.42	-
11:04	1.42	-
11:05	1.35	-
11:06	1.32	-
11:07	1.01	-
11:08	0.91	-
11:09	0.81	-
11:09	0.81	-
11:10	0.6	-
11:11	0.56	-
11:12	0.43	-
11:13	0.39	-
11:14	0.35	-
11:15	0.27	-
11:16	0.24	-
11:17	0.22	-
11:18	0.14	-
11:20	0.11	-
11:21	0.07	-
11:22	0.06	-
11:23	0.04	-
11:24	0	-
11:18 - 11:28	-	<0.025

**Table 3****Ozone Clean Limited - Spring Lane Luxury Retirement Home****Test 3 - Ozone Concentrations**

Location; Room 6  
 Ozone Generator/Disperser start time; 11:30 hours  
 Cycle duration; 30 minutes  
 Measurement height; 0.65 metres above floor level

Time	Ozone Concentration (ppm)	
	Aeroqual Series 500 (High range cell)	Drager CMS
11:18 - 11:28	-	<0.025
11:30	0	-
11:31	0	-
11:32	0.75	-
11:33	1.38	-
11:34	1.89	-
11:35	2.42	-
11:36	2.57	-
11:37	2.65	-
11:38	2.39	-
11:39	2.33	-
11:40	1.73	-
11:41	1.58	-
11:42	1.43	-
11:43	1.14	-
11:44	1.03	-
11:45	0.91	-
11:46	0.72	-
11:47	0.63	-
11:48	0.56	-
11:49	0.45	-
11:50	0.41	-
11:51	0.33	-
11:52	0.3	-
11:53	0.27	-
11:54	0.22	-
11:55	0.19	-
11:56	0.16	-
11:57	0.1	-
11:58	0.06	-
11:59	0	-
12:00	0	-
12:01	0	-
11:23 - 11:27	-	<0.025



**Table 4****Ozone Clean Limited - Spring Lane Luxury Retirement Home****Test 4 - Ozone Concentrations**

Location; Room 6  
Ozone Generator/Disperser start time; 12:40 hours  
Cycle duration; 15 minutes  
Measurement height; 0.65 metres above floor level

	<b>Ozone Concentration (ppm)</b>	
<b>Time</b>	<b>Aeroqual Series 500 (High range cell)</b>	<b>Drager CMS</b>
11:23 - 11:27	-	<0.025
12:40	0	-
12:41	0.24	-
12:43	1.6	-
12:44	1.67	-
12:45	1.54	-
12:46	1.37	-
12:47	1.21	-
12:48	1.07	-
12:49	0.81	-
12:50	0.71	-
12:51	0.56	-
12:52	0.49	-
12:53	0.44	-
12:54	0.35	-
12:55	0.32	-
12:56	0.28	-
12:57	0.21	-
12:58	0.13	-
12:59	0.08	-
13:00 - 13:01	-	<0.025

**Table 5****Ozone Clean Limited - Spring Lane Luxury Retirement Home****Test 5 - Ozone Concentrations**

Location; Room 6  
Ozone Generator/Disperser start time; 13:36 hours  
Cycle duration; 15 minutes  
Measurement height; 0.65 metres above floor level

	<b>Ozone Concentration (ppm)</b>	
<b>Time</b>	<b>Aeroqual Series 500 (High range cell)</b>	<b>Drager CMS</b>
13:00 - 13:01	-	<0.025
13:37	0.02	-
13:38	0.78	-
13:39	1.63	-
13:40	1.51	-
13:41	1.5	-
13:42	1.21	-
13:43	1.04	-
13:44	0.95	-
13:45	0.77	-
13:46	0.69	-
13:47	0.54	-
13:48	0.51	-
13:49	0.47	-
13:50	0.39	-
13:51	0.36	-
13:52	0.33	-
13:53	0.3	-
13:54	0.25	-
13:55	0.2	-
13:56 - 14:06	-	<0.025

Figure 1

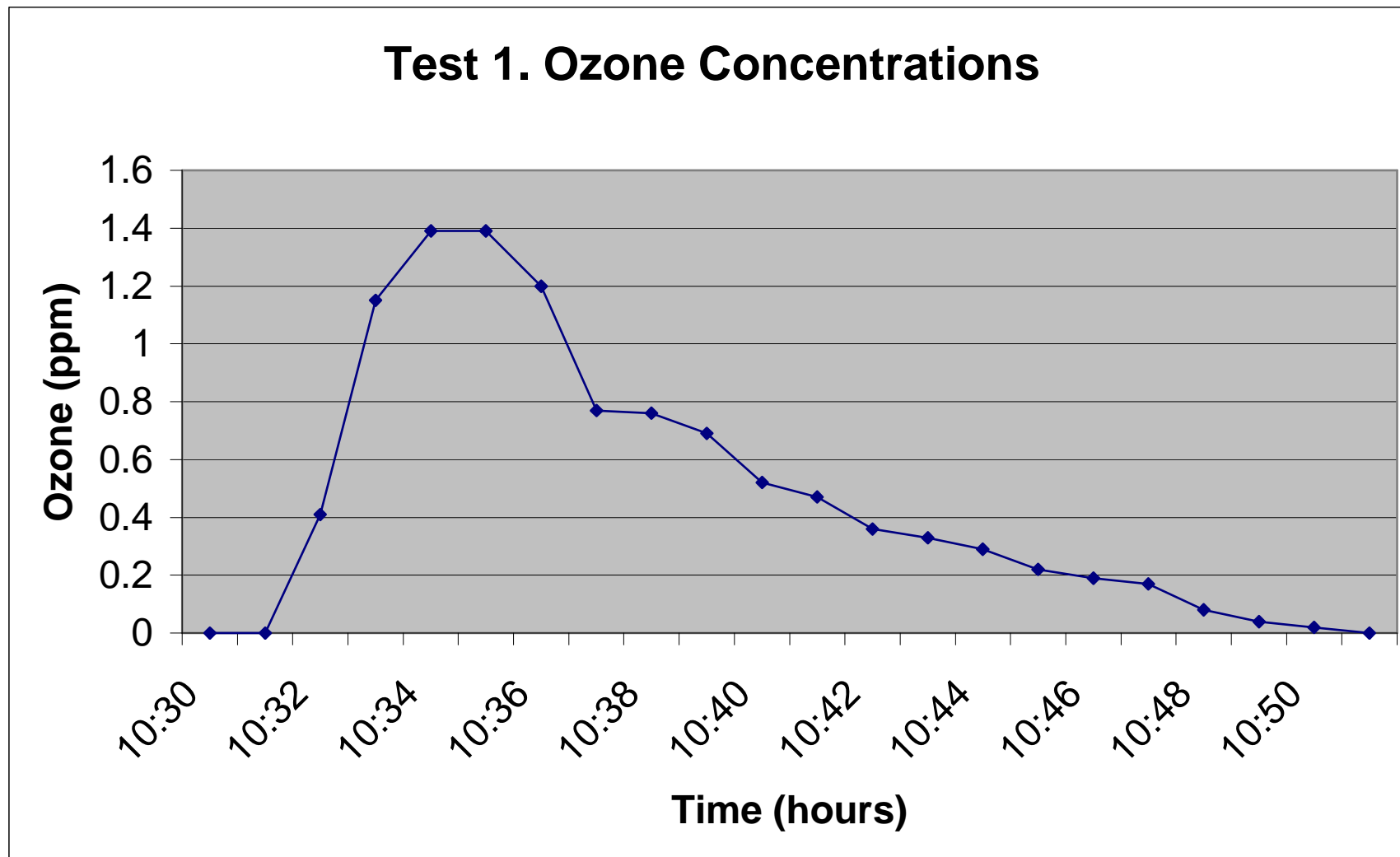


Figure 2

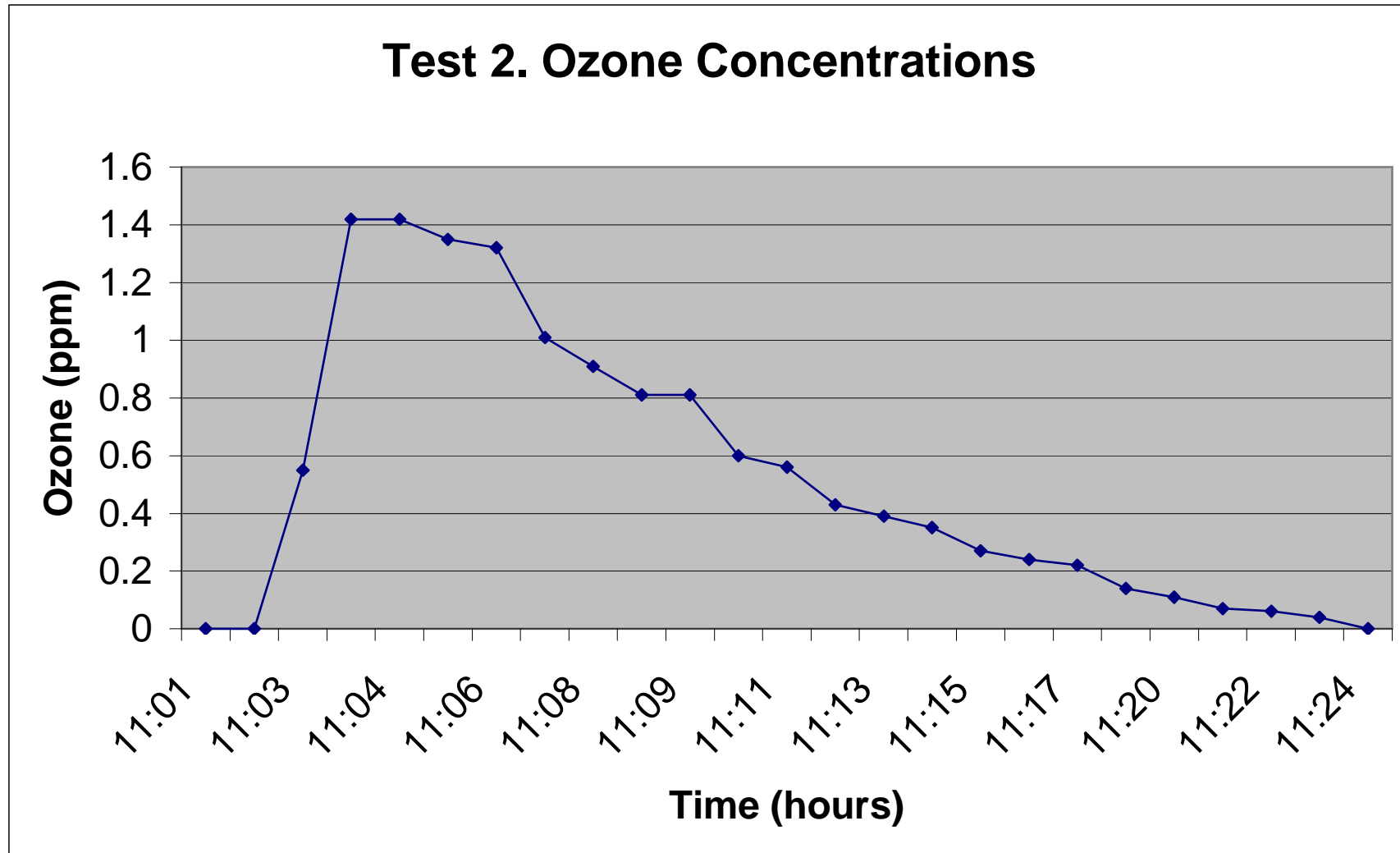


Figure 3

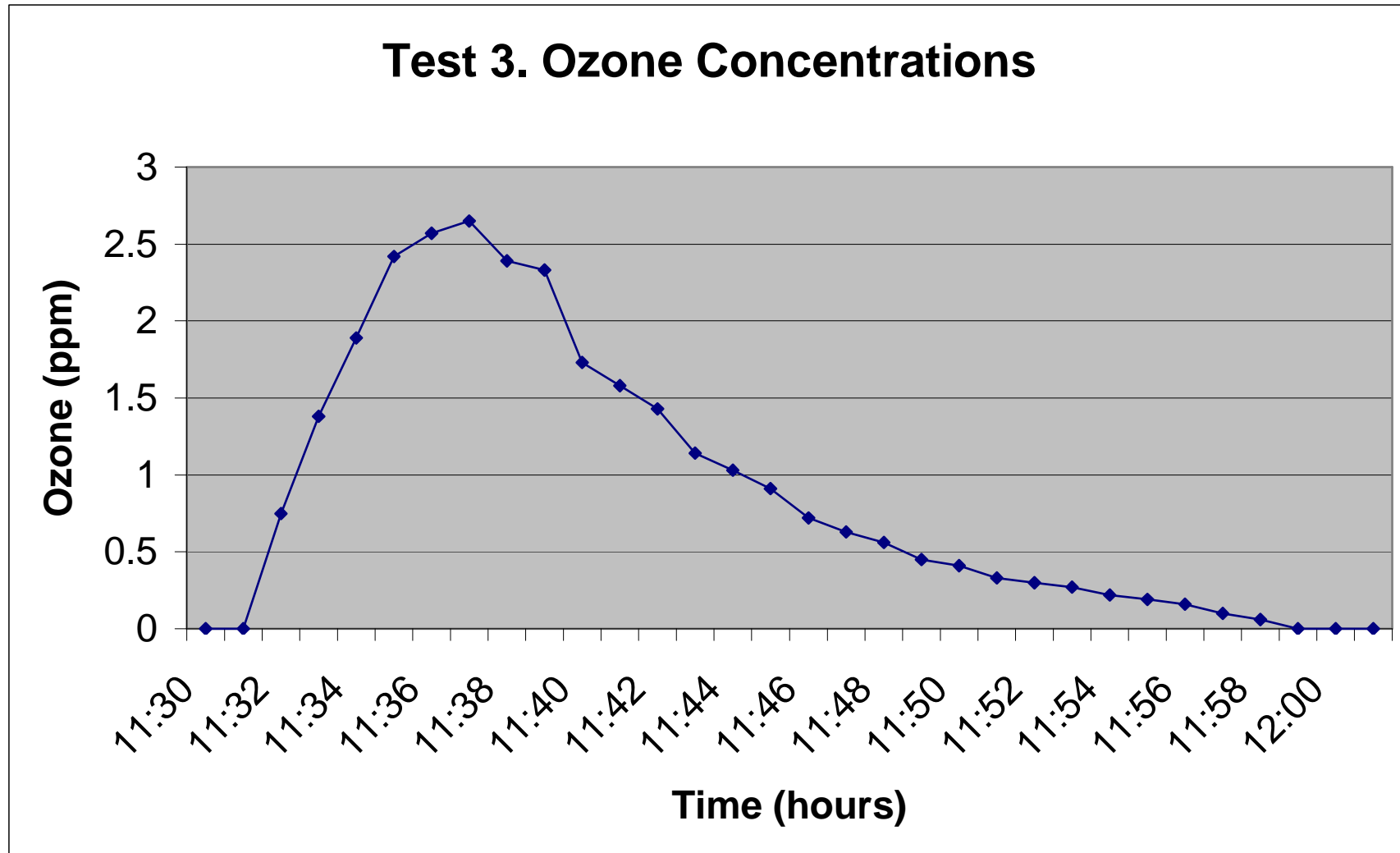


Figure 4

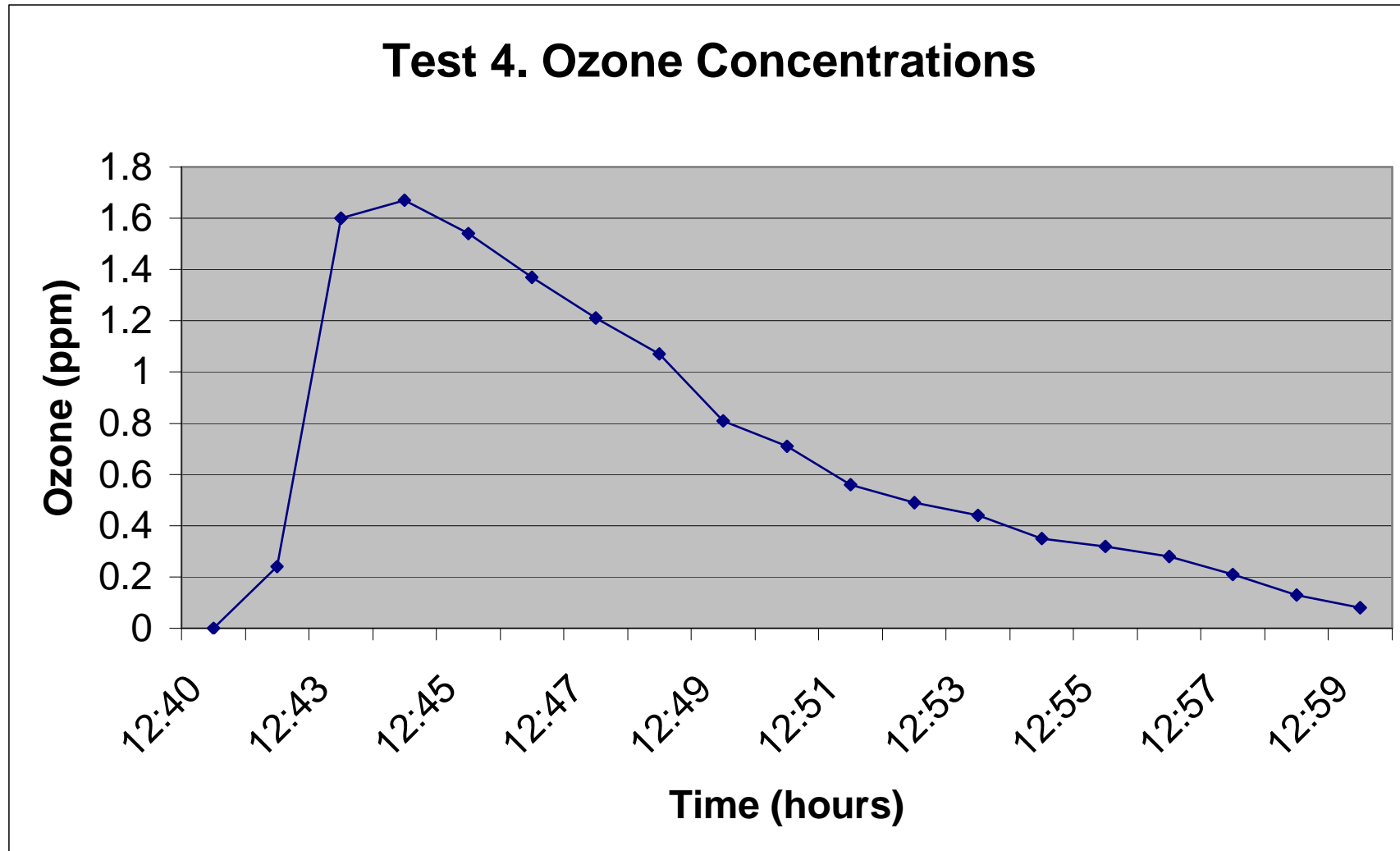
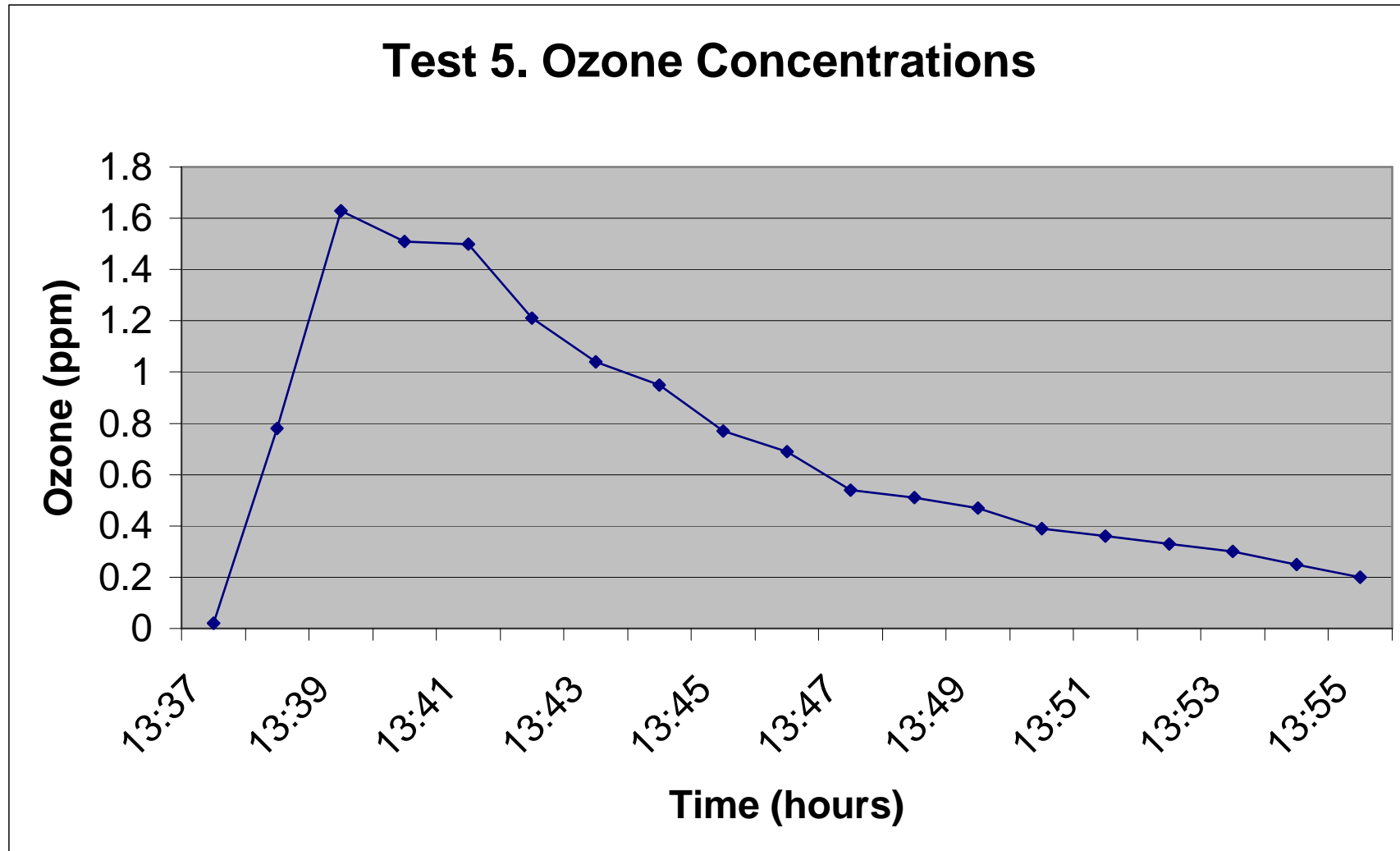


Figure 5



**Photograph 1. Spring Lane Luxury Retirement Home, Room 6**





**Appendix 1**  
**Calibration Certificates**



Aeroqual Limited  
109 Valley Road, Mount Eden, Auckland, New Zealand  
Phone: +64-9-623 3013 Fax: +64-9-623 3012  
www.aeroqual.com

**Calibration Certificate No. 3363**

**Calibration Date: 16 Jan 2007**

**Model:** OZH - Ozone high concentration 0.50 to 20.00 ppm

**Serial No:** OZHC4300602-111

**Environmental Conditions**

Temperature 27 °C

Relative Humidity 45 %

**Measurements**

Calibration Standard /ppm	0.00	0.50	0.88	4.45
AQL Sensor (Mean) /ppm	0.00	0.52	0.91	4.45
AQL Sensor (Std. Dev) /ppm	0.000	0.002	0.002	0.055

\*The Mean and Standard Deviation are calculated from three consecutive readings.

**Calibration Standard**

The Aeroqual ozone sensors are calibrated in a controlled environment against a NATA\* certified ozone UV photometer whose traceability is maintained with international standards organisations.

\*NATA is Australia's national body for accreditation of producers of certified reference materials.

**QC Approval:**

**Date:**

16.1.07