

## **PLASMA AIR INTERNATIONAL**

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360 Connecticut Ave  
Suite 103  
Norwalk, CT 06954  
Attn: Larry Sunshine

### **Air Purifier Test Report**

(Brand: "Plasma Air" Bipolar Ionization Air Purifier - Model: 102C)

Our Reference No.: 08/1253/RL/RC/001

Prepared by:

**LAWN ENVIRONMENTAL PROTECTION LTD.**

**Tel : 2148 1440**

**Fax : 2148 1445**

**Richard L.T. Liu**

**Technical Manager**

Date: 27. November 2008

## **A. INTRODUCTION**

This report details the findings of the measurement and laboratory test for the air purifier (Brand "Plasma Air" Bipolar Ionization Air Purifier - Model: 102C) in a controlled room size of 1,000 ft<sup>3</sup>, which was performed by LAWN Environmental Protection Ltd (Indoor Air Quality Certificate – Certifies Certificate Issue Body (CIB))

The test was carried out on 31 October 2008 and was to investigate the removal efficiency of the air purifier in regards to Total Volatile Organic Compounds (TVOC), Formaldehyde (HCHO), Airborne Bacteria and Cigarette Smoke Particulates.

## **B. MEASUREMENT METHOD**

### **B.1 TVOC and HCHO measurement was conducted per the following steps:**

Step 1: After preparation of a regular amount of VOC and before the air purifier was in operation, the TVOC and HCHO levels were recorded for 30 minutes.

Step 2: After the air purifier was turned on, the TVOC and HCHO levels were recorded at 15 minute intervals.

### **B.2 Airborne Bacteria measurement was conducted per the following steps:**

Step 1: Before the air purifier was in operation, the Airborne Bacteria were sampled for 4 minutes and sent to a laboratory for analysis.

Step 2: After the air purifier was in operation for 30 minutes, the Airborne Bacteria were sampled for 4 minutes and sent to a laboratory for analysis.

### **B.3 Cigarette Smoke Particulate measurement was conducted per the following steps:**

Step 1: Before the air purifier was in operation, the level of Cigarette Smoke Particulate for different sizes was recorded. One cigarette was burned for particulate generation, recorded after the cigarette was totally burned out.

Step 2: Air purifier was turned on immediately after the cigarette was totally burned out. After the air purifier was turned on, the level of Cigarette Smoke Particulate for different size was recorded at 15 minute intervals.

## C. MEASUREMENT RESULTS

The measurement results of the removal efficiency of the air purifier (Brand "Plasma Air" Bipolar Ionization Air Purifier - Model: 102C) are shown in the following tables.

Parameters		HCHO	TVOC	Airborne Bacteria
Unit		µg/m <sup>3</sup>	µg/m <sup>3</sup>	CFU/m <sup>3</sup>
Sampling description	Survey Date			
Step 1	31/10/08	86	40,400	1,063
Step 2 (after 15 min)	31/10/08	11	7,901	-
Removal rate at 15 min (%)		87.2%	80.4%	
Step 2 (after 30 min)	31/10/08	8	3,002	49
Removal rate at 30 min (%)		90.7%	92.6%	95.3%
Step 2 (after 45 min)	31/10/08	6	2,514	-
Removal rate at 45 min (%)		93.0%	93.8%	
Step 2 (after 1 hour)	31/10/08	4	580	-
Removal rate at 1 hour (%)		<b>95.3%</b>	<b>98.6%</b>	<b>95.3%</b>

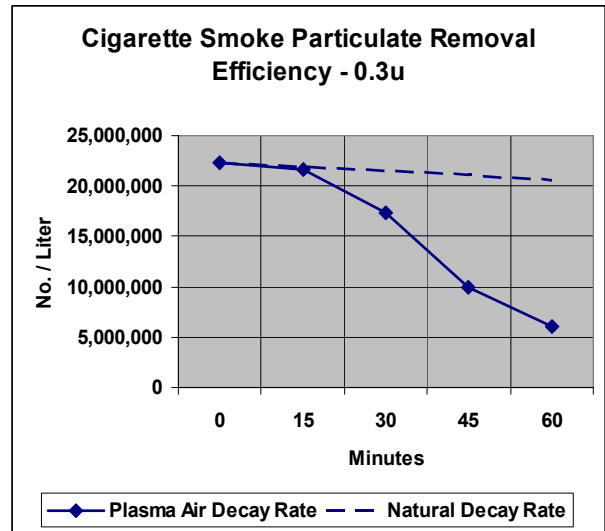
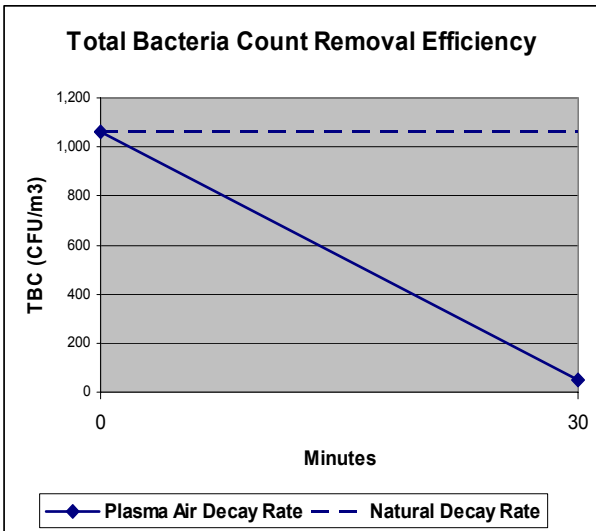
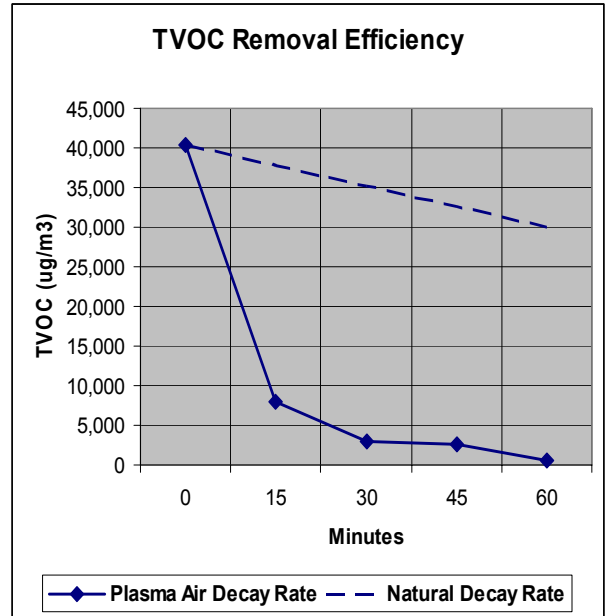
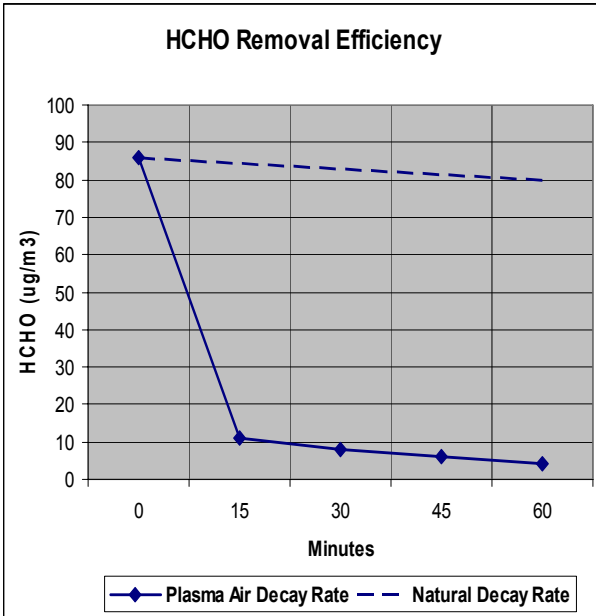
Parameters		Cigarette Smoke Particulates / Liter				
Size: µm		0.3µ	0.5µ	1.0µ	2.0µ	5.0µ
Unit		No.	No.	No.	No.	No.
Sampling description	Survey Date					
Step 1	31/10/08	22,246,740	16,938,360	807,660	87,120	4,230
Step 2 (after 15 min)	31/10/08	21,624,480	4,231,050	119,250	24,750	1,270
Removal rate at 15 min (%)		2.80%	75.0%	85.2%	71.6%	70.0%
Step 2 (after 30 min)	31/10/08	17,363,160	1,908,000	55,170	14,760	720
Removal rate at 30 min (%)		22.0%	88.7%	93.2%	83.0%	83.0%
Step 2 (after 45 min)	31/10/08	9,894,600	723,870	31,590	6,900	360
Removal rate at 45 min (%)		55.5%	95.7%	96.1%	92.1%	91.5%
Step 2 (after 1 hour)	31/10/08	6,008,580	621,270	26,150	4,268	207
Removal rate at 1 hour (%)		<b>73.0%</b>	<b>96.3%</b>	<b>96.8%</b>	<b>95.1%</b>	<b>95.1%</b>

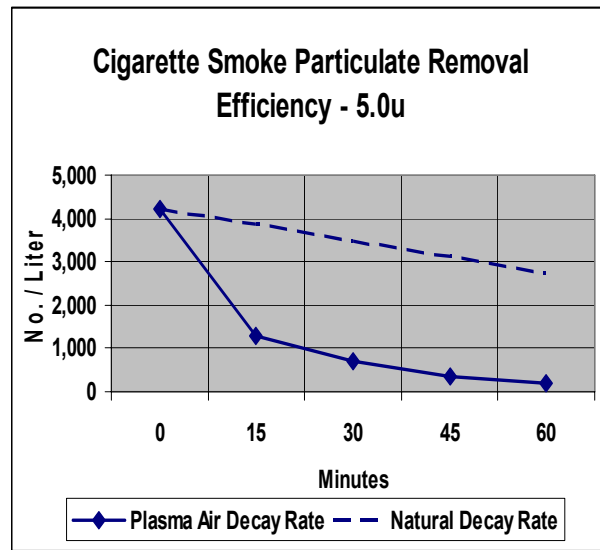
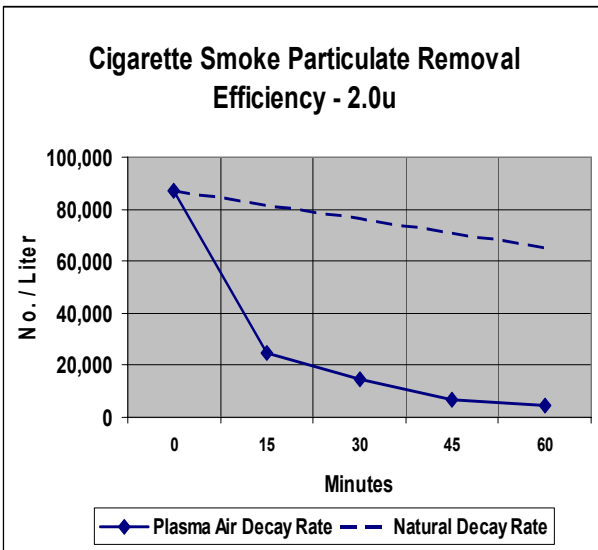
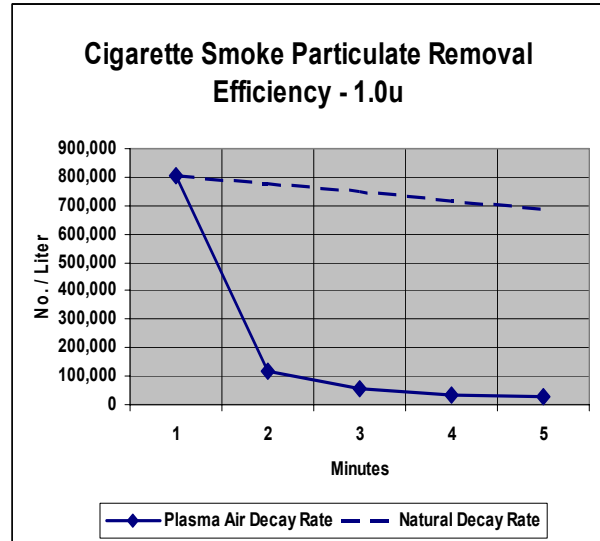
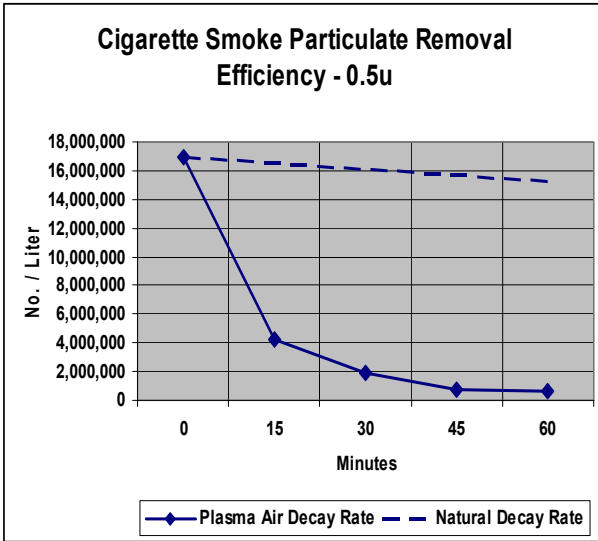
## D. CONCLUSION

### D.1 Written Conclusion

1. From the measurement results, it can be observed that the air purifier can reduce over **70%** of Volatile Organic Compounds, Formaldehyde, Airborne Bacteria and Cigarette Smoke Particulate (0.5µ – 5.0µ) within **15 Minutes**.
2. From the measurement results, it can be observed that the air purifier can reduce over **80%** of Volatile Organic Compounds, Formaldehyde, Airborne Bacteria and Cigarette Smoke Particulate (0.5µ – 5.0µ) within **30 Minutes**.
3. From the measurement results, it can be observed that the air purifier can reduce over **90%** of Volatile Organic Compounds, Formaldehyde, Airborne Bacteria and Cigarette Smoke Particulate (0.5µ – 5.0µ) within **45 Minutes**.
4. From the measurement results, it can be observed that the air purifier can reduce over **95%** of Volatile Organic Compounds, Formaldehyde, Airborne Bacteria and Cigarette Smoke Particulate (0.5µ – 5.0µ) within **60 Minutes**.

### D.2 Graphical Conclusion





## E. APPENDIX

### E.1 APPENDIX A: Equipment method statement

#### 1. *Formaldehyde HCHO*

Equipment: Interscan 4160-DSP  
Sensor type: Electrochemical  
Detectable range: 0-500 ppb  
Accuracy:  $\pm 2\%$

##### *Procedure*

- Set the FUNCTION switch to SAMPLE position to turn on the Interscan. Connect the C-12 zero filter. Adjust the meter to "0" with the ZERO control knob. Remove the filter to start the measurement. Turn on the logger if there is a switch.
- Set the FUNCTION switch to stop the measurement or turn off the logger.

#### 2. *Total Volatile Organic Compounds TVOC*

Equipment: RAE ppbRAE plus  
Sensor type: Photo-ionization sensor with super bright 10.6 eV  
Detectable range: 0-2000 ppm  
Resolution: 1 ppb  
Calibration gas: Isobutylene  
Accuracy:  $\pm 20$  ppb or  $\pm 10\%$  of reading

##### *Procedure*

- Press the MODE key for one second and release.
- Press the Y/+ key to start the measurement.
- Press the MODE key and the display shows STOP.
- Press the Y/+ key to stop the measurement.
- Press the MODE key once and the display shows AVG READING.
- Press and hold the MODE key for 5 seconds and release to turn off the equipment.

#### 3. *Airborne Bacteria*

Equipment: Biotest HYCON Standard RCS Air Sampler  
Reference: Field Guide for the Determination of Biological Contaminants in  
Environmental Samples




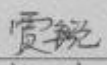
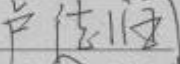
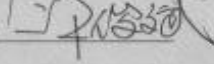

##### *Procedure*

- Clean the head and impellers with alcohol.
- Wait until all alcohol residues vaporized by turning on the RCS Air Sampler using the ON/OFF key.
- Unseal the package containing the agar strip and pull back the package top. Touching the side of the strip, insert the strip in the drum, agar side in.
- Use the ON/OFF key to turn on the RCS Air Sampler.
- Select the 4 minute of 5 permanently programmed sampling times.
- Press the ON/OFF key again to start the 4 minute sampling.
- Remove the agar strip and replace the strip in its package and immediately seal the broken parts of the top package with tape.
- Label the strip with appropriate information.

## E.2 APPENDIX B: Calibration certificates

The calibration certificates of the equipment are attached in the following pages.

1. RAE ppbRAE

	<b>华南国家计量测试中心</b> <b>广东省计量科学研究院</b> SOUTH CHINA NATIONAL CENTER OF METROLOGY GUANGDONG INSTITUTE OF METROLOGY		
<h1>校准证书</h1> <h2>CALIBRATION CERTIFICATE</h2>			
证书编号 Certificate No.	HYQ20082595	第 1 页, 共 3 页 Page of	
委托方 Client	LAWN ENVIRONMENTAL PROTECTION LTD. 乐安环境保护有限公司		
委托方地址 Add. of Client	Room A, 2/F., Wah Ha Factory Bldg., 8 Shipyard Lane, Quarry Bay, Hong Kong.		
计量器具名称 Description	VOC Detector		
型号规格 Model/Type	PGM-7240		
制造厂 Manufacturer	RAE		
出厂编号 Serial No.	250-102589		
接收日期 Date of Receipt	2008 年	7 月	7 日
	Y	M	D
校准日期 Date of Calibration	2008 年	7 月	7 日
	Y	M	D
批准人 Approved Signatory			
核 验 Inspected by			
校 准 Calibrated by			
			
本中心地址: 中国广州市广园中路松柏东街30号 邮政编码: 510405 电话: (8620)86594172 传真: (8620)86590743 E-mail: scm@scn.com.cn Add: No.30, Songbuidong Street, Guangyuanzhong Road, Guangzhou, P. R. China Post Code: 510405 Tel: (8620)86594172 Fax: (8620)86590743			
H10407 1			



华南国家计量测试中心  
广东省计量科学研究所  
SOUTH CHINA NATIONAL CENTER OF METROLOGY  
GUANGDONG INSTITUTE OF METROLOGY



## 说 明

证书编号 HYQ20082595  
Certificate No.

### DIRECTIONS

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Page of

1. 本中心是国家质量监督检验检疫总局在华南地区设立的国家法定计量检定机构, 计量授权证书号是:  
(国) 法计 (2007) 01043号、(国) 法计 (2007) 01032号。  
This laboratory is the National Legal Metrological Verification Institution in southern China set up by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ) under authorization certificates No.(2007)01043 & (2007)01032.
2. 本中心所出具的数据均可溯源至保存在中国计量科学研究院的国家计量基准和国际单位制(SI)。中国计量科学研究院于1999年代表中国签署了“国家计量基准及国家计量研究院出具的校准和测量证书相互承认协议”。  
All data issued by this laboratory are traceable to national primary standards maintained in National Institute of Metrology (NIM) and International System of Units (SI). NIM is the signatory to the Mutual Recognition Arrangement (MRA) for national measurement standards and for calibration and measurement certificates issued by national metrology institutes.
3. 本次校准的技术依据:  
Reference documents for the calibration:  
JJF1172-2007 挥发性有机化合物光离子化检测仪校准规范 C.S. for Volatile Organic Compounds Photo Ionization Detectors

4. 本次校准所使用的主要计量标准器具:  
Major standards of measurement used in the calibration:

设备名称/型号 Name of Equipment /Model	编号 Serial No.	证书号/有效期 Certificate No. /Due Date	计量特性 Metrological Characteristic
异丁烯气体标准物 质(i-C <sub>4</sub> H <sub>8</sub> -Air) i-C <sub>4</sub> H <sub>8</sub> -Air /10.1×10 <sup>-8</sup>	00067	/2009-02-27	2%

5. 校准地点、环境条件:

Place and environmental conditions of the calibration:

地点 本中心理化实验室 温度 (26±1) °C 相对湿度 (58±5) %  
Place Temperature RH

6. 被校准仪器限制使用条件:

Limiting condition of the instrument calibrated:

注: 1. 本证书校准结果只与受校准仪器有关。

2. 未经本中心书面批准, 不得部分复制此证书。

Note: 1. The results relate only to the items calibrated.

2. This certificate shall not be reproduced except in full, without the written approval of our laboratory.





华南国家计量测试中心  
广东省计量科学研究院  
SOUTH CHINA NATIONAL CENTER OF METROLOGY  
GUANGDONG INSTITUTE OF METROLOGY



## 校准结果 RESULTS OF CALIBRATION

证书编号 HYQ20082595  
Certificate No.

原始记录号 020080404  
Record No.

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Page of

- 外观: 合格。  
(Exterior: Pass)
- 示值误差:  
(Error of indication)

标准值 Reference Value	测量值 Measured Value	误差 Error
$2 \times 10^{-6}$	$2.0 \times 10^{-6}$	0.0%FS
$5 \times 10^{-6}$	$5.3 \times 10^{-6}$	+3.0%FS
$10.1 \times 10^{-6}$	$9.7 \times 10^{-6}$	-4.0%FS





[技术要求 (Technical characteristic):  $\pm 10\%FS$ ]

- 重复性: 0.0% [技术要求 (Technical characteristic):  $\leq 3\%$ ]  
(Repeatability)
- 响应时间: 5 s [技术要求 (Technical characteristic):  $\leq 20$  s]  
(Response time)
- 零点漂移: 0.0%FS [技术要求 (Technical characteristic): 不超出允许误差限的二分之一]  
(Zero drift)
- 示值漂移: 0.0%FS [技术要求 (Technical characteristic): 不超出允许误差限的二分之一]  
(Indication drift)

说明:  
(Note)

- 结论: 被校准仪器校准结果符合技术要求。  
(Conclusion: The data of instrument calibrated compliance with the technical characteristics)
- 示值误差测量结果的扩展不确定度:  $U=2.4\%$ ;  $k=2$   
(The expanded uncertainty of error of indication)
- 计算测量结果不确定度的依据: JJG1059-1999 测量不确定度评定与表示  
(The calculation of uncertainty in measurement according to JJF1059-1999 Evaluation and Expression of Uncertainty in Measurement.)
- 建议校准周期为壹年。  
Advised the calibration period is one year.

2. Interscan 4160-500b

 中国计量科学研究院 NATIONAL INSTITUTE OF METROLOGY SH: 21139 DATE CAL: 26-Jul-2007 REC'D BY: CERT NO: NHqt2007-1617	 <b>中国计量科学研究院</b> NATIONAL INSTITUTE OF METROLOGY
<b>测 试 证 书</b> Test Report	
证书编号 NHqt2007-1617 Certificate No.	
器具名称 Instrument	甲醛测试仪 Formaldehyde Gas Detector
型号/规格 Type/Model	4160-500b
生产厂家 Manufacturer	INTERSCAN
出厂编号 Serial No.	21139
客户名称 Name of Client	乐安环境保护有限公司 LAWN Environmental Protection Ltd
客户地址 Address of Client	RoomA,2/F,Wah Ha Factory Building, 8 Shipyard Lane,Quarry Bay,HK
测试日期 Test Date	2007-07-26
授权批准人: Approved by	
	
计量检定机构授权证书号: (国)法计(2002)01001号 Authorization Certificate No.	电话: +86-10-64218631 Tel
地址: 中国·北京北三环东路十八号 Address: No.18 Bei San Huan Dong Lu,Beijing,P.R.China	邮编: 100013 Post Code
传真: +86-10-64271948 Fax	电子邮件: yw@nim.ac.cn Email
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2006-cs-01	

中国计量科学研究院  
NATIONAL INSTITUTE OF METROLOGY



证书编号 NHqt2007-1617  
Certificate No.

<p>一九九九年中国计量科学研究院代表中国在国际计量局 (BIPM) 签署了“国家测量标准及国家计量研究院出具的校准和测量证书相互承认的协议” NIM is the signatory in BIPM to the Mutual Recognition Arrangement (MRA) for National Measurement Standards and for calibration and measurement certificates issued by National Metrology Institutes in 1999 中国实验室国家认可委员会 (CNAL) 认可证书号: No.L0502 NIM is accredited by CNAL, Accreditation certificate</p>															
<p>测试所依据的技术文件 (代号、名称) Reference documents for the measurement (Code, Name) 依据: JJG1022-2007 甲醛气体检测仪检定规程 Verification Regulation for Formaldehyde Gas Analyzer</p>															
<p>测试环境条件及地点 Place and environmental condition of the measurement 温度 Temperature: 28.9℃ 湿度 Humidity: 58%(RH) 地点 Location: NIM 气压 Pressure: 100.1kPa</p>															
<p>测试所使用的主要计量器具 (名称、型号/规格、不确定度/准确度、证书编号) Description of main instrument used in the measurement (Name, Type/Model, Uncertainty/Accuracy, Certificate No. etc)</p> <table border="1"> <thead> <tr> <th>名称 Name</th> <th>型号/规格 Type/Model</th> <th>不确定度/准确度 Uncertainty/Accuracy</th> <th>证书编号 Certificate No. etc</th> </tr> </thead> <tbody> <tr> <td>动态配气装置 (Dynamic Distributing Device)</td> <td>DP-II</td> <td>3%</td> <td>(气) 测字第 2006-(04)-750 号</td> </tr> <tr> <td>秒表 (Stopwatch)</td> <td>TS2102-2</td> <td>0.1s/24h</td> <td>XDsp2006-0421</td> </tr> </tbody> </table>				名称 Name	型号/规格 Type/Model	不确定度/准确度 Uncertainty/Accuracy	证书编号 Certificate No. etc	动态配气装置 (Dynamic Distributing Device)	DP-II	3%	(气) 测字第 2006-(04)-750 号	秒表 (Stopwatch)	TS2102-2	0.1s/24h	XDsp2006-0421
名称 Name	型号/规格 Type/Model	不确定度/准确度 Uncertainty/Accuracy	证书编号 Certificate No. etc												
动态配气装置 (Dynamic Distributing Device)	DP-II	3%	(气) 测字第 2006-(04)-750 号												
秒表 (Stopwatch)	TS2102-2	0.1s/24h	XDsp2006-0421												

注 Note:

1. 我院仅对加盖“中国计量科学研究院测试专用章”完整证书负责  
NIM is responsible for the whole of certificate only with test stamp of NIM
2. 本证书的测试结果仅对所测试的计量器具有效  
The test results would be valid only for the items test
3. 本证书中英文两种语言表达, 准确含义以中文为准  
The certificate is written by Chinese and English. Exact meaning should be explained only on Chinese version

2006-cs-02

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中国计量科学研究院  
NATIONAL INSTITUTE OF METROLOGY



证书编号 NHqt2007-1617  
Certificate No.

测试结果  
Test Results

1. 外观及通电检查：良好；  
Appearance and Electricity test: passed

2. 测试结果 Below the testing results

标准值 concentration of calibration gas	仪器示值 indicating Value
$0.50 \times 10^{-9}$ mol/mol	$508 \times 10^{-9}$ mol/mol
$0.22 \times 10^{-9}$ mol/mol	$228 \times 10^{-9}$ mol/mol
$0.13 \times 10^{-9}$ mol/mol	$119 \times 10^{-9}$ mol/mol

3. 重复性：<1%；  
Repeatability: <1%；




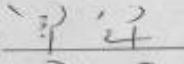
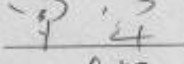
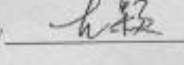

4. 响应时间：10min；  
Response time: 10min；

以下空白

测试员：曹志刚  
Tested by

核验员：刘研玲  
Checked by

3. Biotest HYCON Standard RCS Air Sampler

	<b>华南国家计量测试中心</b> <b>广东省计量科学研究所</b> SOUTH CHINA NATIONAL CENTER OF METROLOGY GUANGDONG INSTITUTE OF METROLOGY		 校准 CNAS L0730
<h1>校准证书</h1> <h2>CALIBRATION CERTIFICATE</h2>			
证书编号 Certificate No.	XGJ20080201	第 1 页, 共 3 页 Page of	
委托方 Client	LAWN ENVIRONMENTAL PROTECTION LTD.		
委托方地址 Add. of Client	Room A, 2/F., Wah Ha Factory Bldg., 8 Shipyard Lane, Quarry Bay, Hong Kong.		
计量器具名称 Description	Air Sampler		
型号规格 Model/Type	RCS		
制造厂 Manufacturer	BIOTEST HYCON		
出厂编号 Serial No.	27230		
接收日期 Date of Receipt	2008 年	3 月	24 日
	Y	M	D
校准日期 Date of Calibration	2008 年	3 月	26 日
	Y	M	D
批准人 Approved Signatory			
核 验 Inspected by			
校 准 Calibrated by			
 证书专用章			
本中心地址: 中国广州市广园中路松柏东街30号 邮政编码: 510405 电话: (8620)86594172 传真: (8620)86590743 E-mail: scm@scm.com.cn Add: No.30, Songhaidong Street, Guangyuanzhong Road, Guangzhou, P. R. China Post Code: 510405 Tel: (8620)86594172 Fax: (8620)86590743			
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华南国家计量测试中心  
广东省计量科学研究所  
SOUTH CHINA NATIONAL CENTER OF METROLOGY  
GUANGDONG INSTITUTE OF METROLOGY



## 说 明

证书编号 XGJ20080201  
Certificate No.

### DIRECTIONS

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1. 本中心是国家质量监督检验检疫总局在华南地区设立的国家法定计量检定机构, 计量授权证书号是:  
(国)法计(2007)01043号、(国)法计(2007)01032号。  
This laboratory is the National Legal Metrological Verification Institution in southern China set up by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ) under authorization certificates No.(2007)01043 & (2007)01032.
2. 本中心所出具的数据均可溯源至保存在中国计量科学研究院的国家计量基准和国际单位制(SI)。中国计量科学研究院于1999年代表中国签署了“国家计量基准及国家计量研究院出具的校准和测量证书相互承认协议”。  
All data issued by this laboratory are traceable to national primary standards maintained in National Institute of Metrology (NIM) and International System of Units(SI). NIM is the signatory to the Mutual Recognition Arrangement(MRA) for national measurement standards and for calibration and measurement certificates issued by national metrology institutes.
3. 本次校准的技术依据:  
Reference documents for the calibration:  
JJG 956-2000 大气采样器检定规程 V. R. of Air Sampler

4. 本次校准所使用的主要计量标准器具:  
Major standards of measurement used in the calibration:

设备名称/型号 Name of Equipment /Model	编号 Serial No.	证书号/有效期 Certificate No. /Due Date	计量特性 Metrological Characteristic
电子秒表 Digital Stopwatch /SW8-3010	30	WSP20071490 /2008-09-17	0.01 s
电子计数式转速表 Electronic Counting Tachometer /DT-2236	L813626	NSS20080028 /2009-01-29	0.1级 Grade 0.1

5. 校准地点、环境条件:

Place and environmental conditions of the calibration:

地点 本中心实验室(Lab. of SCM) 温度 (20.0±1.0) °C 相对湿度 ≤60 %  
Place Temperature RH

6. 被校准仪器限制使用条件:

Limiting condition of the instrument calibrated:

注: 1. 本证书校准结果只与受校准仪器有关。  
2. 未经本中心书面批准, 不得部分复制此证书。

Note: 1. The results relate only to the items calibrated.

2. This certificate shall not be reproduced except in full, without the written approval of our laboratory.



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## 校准结果 RESULTS OF CALIBRATION

证书编号: XGJ20080201

原始记录编号: 120080027

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一. 外观检查: 合格;  
(Appearance: pass)

二. 转速测量(Tachometer):

设定值 (RPM) Set Value	实测值 (RPM) Measured Value	技术要求 MPE
4096	4082	±2%

三. 测量时间(Time)

设定值 (min) Set Value	实测值 (s) Measured Value	技术要求 MPE
0.5	30.42	±2%
1	60.40	±2%
2	121.10	±2%
4	241.65	±2%
8	483.24	±2%

说明:  
(Note)

1. 测量结果的相对扩展不确定度(The expanded uncertainty of sampling quantity):  
转速(Tachometer):  $U_{95} = 2 \text{ RPM}$ ,  $k=2$  ;  
时间(Time):  $U_{95} = 0.29 \text{ s}$ ,  $k=2$  ;
2. 计算不确定度的依据: JJF1059-1999 测量不确定度评定与表示。  
(According to JJF1059-1999 Evaluation and Expression of Uncertainty in Measurement.)
3. 建议校准周期不超过1年。  
The period of calibration advised within one year.