



# INTEGRITY TEST REPORT

For the **Putty Pad** (IA 2484)

## FIRST FLOOR OFFICE REFURBISHMENT

Carried out on the

**14<sup>th</sup> September 2009**

at the

PRESSURE TEST  
OFFICE'S

UNIT 15, 37, IVANHOE ROAD  
THE HOGWOOD INDUSTRIAL ESTATE  
FINCHAMPSTEAD  
WOKINGHAM  
BERKSHIRE  
RG40 4QQ

## Introduction

The Integrity Test on the office refurbishment on the 1<sup>st</sup> Floor located at Pressure Test Limited, 37, Ivanhoe Road, Finchampstead, was carried out on Monday the 14<sup>th</sup> September 2009.

Testing was performed as part of the leakage verification: Integrity Test requirement, and witnessed by Mr. Andy Nutman on behalf of Fire and Sound Limited and Fischer Fixings UK Limited, Oxfordshire, OX10 9AT to confirm if the structure's ability to prevent fire and smoke ingress after the installation of the designated materials on known leakage paths is within the acceptable tolerances.

The Integrity of an enclosure is its ability to retain a suppressant (if utilised) in addition to this the enclosure boundaries need to be capable of preventing the ingress of both smoke and fire, in order to achieve this, the enclosure needs to be adequately sealed. In order to reduce / prevent the occurrence of a fire condition an enclosure needs to be effectively fire stopped / sealed to prevent fire / smoke entering a compartment / zone.

If the leakage rate is high any extinguishant (if utilized) will tend to escape, reducing the concentration and hence the suppression system's effectiveness and extinguishing capabilities, in addition to this a source of fire and smoke ingress may occur, both being severely detrimental to an enclosure's ability to function correctly.

### Test No1 – enclosure prior to creating service passages

Enclosure	<b>1<sup>st</sup> Floor office Area</b>
Volume	131.2 m <sup>3</sup>
Maximum Risk / Enclosure Height	2.68 m
Required Protected Height	2.20 m
Measured Leakage Area (total E.L.A.)	0.0378 m <sup>2</sup>
Simulated Extinguishant (Argon, IG 01)	43.0 %
Predicted Retention @ a Protected Height 2.2 m	17.2 minutes
Summary	<b>Satisfies the test requirement</b>

From these results it is concluded that the leakage area is within the required current tolerance for retention purposes, indicating that the enclosure satisfies the integrity test requirements.

### Test No2 – enclosure after creating service passages – NO Firestopping

Enclosure	<b>1<sup>st</sup> Floor office Area</b>
Volume	131.2 m <sup>3</sup>
Maximum Risk / Enclosure Height	2.68 m
Required Protected Height	2.20 m
Measured Leakage Area (total E.L.A.)	0.0959 m <sup>2</sup>
Simulated Extinguishant (Argon, IG 01)	43.0 %
Predicted Retention @ a Protected Height 2.2 m	6.8 minutes
Summary	<b>FAILS the test requirement</b>



## Test 2

From these results it is concluded that the leakage area is now greater than the current tolerance for retention purposes, indicating that the enclosure **fails** the integrity test requirements, as it is unable to retain the agent at the indicated concentration for a period at least equal to the 10-minute recommended minimum requirement.

This enclosure has therefore failed the integrity test requirements as it has failed to meet the required retention criteria under these conditions. This indicates that structural remedial sealing works are required around the enclosure's perimeter boundaries to reduce the leakage by a great enough degree to enable the enclosure to retain the extinguishant effectively and for the recommended minimum retention time.

### Test No3 – enclosure after creating service passages – With Firestopping IA2484

Enclosure	1 <sup>st</sup> Floor office Area
Volume	131.2 m <sup>3</sup>
Maximum Risk / Enclosure Height	2.68 m
Required Protected Height	2.20 m
Measured Leakage Area (total E.L.A.)	0.0959 m <sup>2</sup>
Simulated Extinguishant (Argon, IG 01)	43.0 %
Predicted Retention @ a Protected Height 2.2 m	17.0 minutes
Summary	Satisfies the test requirement

The enclosure was tested again, but this time all the penetrations specifically made for the installation were sealed with the advised product (No other penetrations were sealed).

Once all the new penetrations had been “effectively” sealed the retention time observed was almost identical to that highlighted during the initial test.

This indicates that if installed correctly the materials detailed are able to effectively negate leakage whilst at the same time providing a good fire barrier both in and out of the enclosure.

### **Observations**

The enclosure was measured up and all details and criteria logged on to the data sheets. A visual inspection was carried out in order to verify the requirements for sealing and to highlight any possible leakage areas. Protection is provided to the room, floor void and ceiling void all simultaneously; as a result, the system provides a total flood capability to the risk area as all available zones are covered.

### **Equipment**

The tallest (essential) equipment requiring protection (at the time of testing) was measured and this was taken as the required protected height. N.B. any alterations to this will affect the retention results.

### **Enclosure Evaluation (Leakage Sites)**

An Integrity Test was conducted and a result which is within the required tolerance was achieved. As the area has satisfied the retention requirements, the recommendation is to ensure all materials remain intact for the duration of the installation, regular inspections should be undertaken.

## **Dampers & Ducts**

Means of prompt ventilation of an enclosure following a discharge is recommended so the decomposition/combustion products & agent residue can be safely removed to atmosphere (for personnel & equipment purposes). If any additional ducts are utilised (supply or extract) then these should be fitted with dampers at the enclosure boundary, linked to the control panel and configured to close prior to a discharge to prevent the air ingress and loss of extinguishant, in order to maintain the enclosure integrity.

## **Pressure Relief/Venting Requirements**

High pressures can occur in the event of a discharge and need to be controlled or compensated for if the extinguishing ability is not to be impaired. It is important that consideration be given to provide pressure relief in areas where structural damage may occur if there is not sufficient venting to allow the dispersal of spike pressures in the event of a discharge.

For the calculation of the pressure relief area, common wall strengths of 250 Pascals are generally utilised, if the structural strength differs then the vent area will alter.

The relief area should be compared to a proportion of the current\* natural leakage area and any discrepancies compensated for by the addition of a Pressure Relief Facility. The pressure relief facility should be catered for as part of the system installation by the installation / design team regardless of these test results, to ensure that it is adequately catered for at all times.

\*The current “natural” leakage area is liable to fluctuations due to natural wear and tear along with general deterioration and will actually reduce if improvements are made to the enclosure. For this reason the natural leakage on its own should not be relied upon to provide an adequate relief facility.

The nature of the putty pads means that structurally they will part before any structural damage occurs

## **Validity**

This procedure is used only to verify the ability of the enclosure to retain the Extinguishing Agent. It does not evaluate the design, equipment or installation of the fire suppression system, detection & control devices.

It assumes that these have been designed and installed in accordance with the requirements of the relevant Standards and that full conformance and regular maintenance is in place.

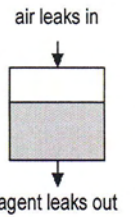
See photographic evidence of leakage paths before and after sealing.



# PASS/FAIL Enclosure Integrity Report

CleanAgent 2001 retention time prediction program revision 2.5.4. Complies with NFPA 2001 Appendix C, year 2000 edition.  
 By Retrotec, Inc, 2200 Queen Street, Bellingham, WA USA 98229 360-738-9835 www.retrotec.com  
 Software Licensed to: **Pressure Test Limited**

Building, Location **Unit 15, 37 Ivanhoe Road, Finchampstead, RG40 4QQ**  
 Company, Contact **Fire & Sound Limited, Andy Nutman / Cliff Miles**  
 Room name **1st Floor Offices** Test number **1**  
 Calibration Certificate # **4025** Certificate created **2009/03/27**



Test date/time	<b>2009/09/17 08:07</b>	Net Protected Volume, V	<b>131 m<sup>3</sup></b>
Tester	<b>Andy Nutman</b>	Maximum Protected Height, H <sub>o</sub>	<b>2.68 m.</b>
Certified to Level:	<b>2 - Single fan NFPA room test</b>	Minimum Protected Height, H	<b>2.20 m.</b>
Signature	.....	Static during retention, P <sub>SH</sub>	<b>0.0 Pa</b>
Elevation above sea level	<b>25 m.</b>	Operating temperature	<b>21 C</b>
Correction method	<b>NFPA 2001 (2000) Formula A-3-5.3.3</b>	Initial concentration, C	<b>43.00%</b>
Correction factor	<b>0.99</b>	Mixing during retention	<b>No</b>
Agent	<b>Argon (IG-01)</b>	Agent quantity	<b>73 m<sup>3</sup></b>
Total room leakage, ELA	<b>0.0378 m<sup>2</sup></b>	Minimum concentration, C <sub>F</sub>	<b>43.00%</b>
Lower Leakage, BCLA	<b>0.0189 m<sup>2</sup></b>	Minimum retention time	<b>10.0 minutes</b>

**Below ceiling leakage defaulting to worst case -- 50% of total leakage.**

This enclosure was tested in compliance with NFPA 2001 and 12A. Assuming no continual mixing during the retention period, enclosure leakage could allow sufficient agent to be lost to cause an air/agent interface to descend from a Maximum Protected Height of **2.68 m.** to the Minimum Protected Height specified of **2.20 m.**

The retention time would then be **17.2 minutes** which exceeds the minimum retention time of **10 minutes**. The enclosure therefore **passes** this acceptance procedure.

Notes **Initial test is based on the enclosure as found prior to the installation of any cables, this test is utilised to verify the background leakage from the enclosure prior to any works on the enclosure perimeter boundaries**

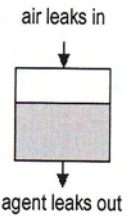
Time (minutes)	Maximum Protected Height (m.)	Agent Height (m.)	Minimum Protected Height (m.)
0	2.68	2.68	2.20
1	2.68	2.63	2.20
2	2.68	2.58	2.20
3	2.68	2.53	2.20
4	2.68	2.48	2.20
5	2.68	2.43	2.20
6	2.68	2.38	2.20
7	2.68	2.33	2.20
8	2.68	2.28	2.20
9	2.68	2.23	2.20
10	2.68	2.18	2.20

Witnesses **Andy Nutman**

# DOOR FAN TEST -- Total Room Leakage Data

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 Company, Contact **Fire & Sound Limited, Andy Nutman / Cliff Miles**  
 Room name **1st Floor Offices** Test number **1**  
 Calibration Certificate # **4025** Certificate created **2009/03/27**



## Total Room Leakage

Operator In the room Smoke moves out of the room Temperature during test (C)  
 Static pressure 0 Pa 21 inside 21 outside

Depressurization		Range for room pressures: -10.0 to -13.0
Blower range	Room pressure	-12
	Auto corrected RP	-12.2
Ring C2	Flow Pressure	125
	Auto corrected FP	127.2
Corrected flow (m <sup>3</sup> /sec.)		-0.1027

Pressurization		Range for room pressures: 10.0 to 13.0
Blower range	Room pressure	12
	Auto corrected RP	12.2
Ring C2	Flow Pressure	138
	Auto corrected FP	140.6
Corrected flow (m <sup>3</sup> /sec.)		0.1033

	ELA m <sup>2</sup>	@Pa	F <sub>A</sub>	Slope n	Intercept k <sub>1</sub>	Correlation	Standard Error	ELA m <sup>2</sup>		F
Depressurization	0.0377	12.2		0.5000	0.0297	NA	NA			
Pressurization	0.0379	12.2		0.5000	0.0298	NA	NA			
<b>Average</b>	<b>0.0378</b>	12.2	0.50	0.5000	0.0297			<b>0.0378</b>	10.0	0.50

## Lower Leakage

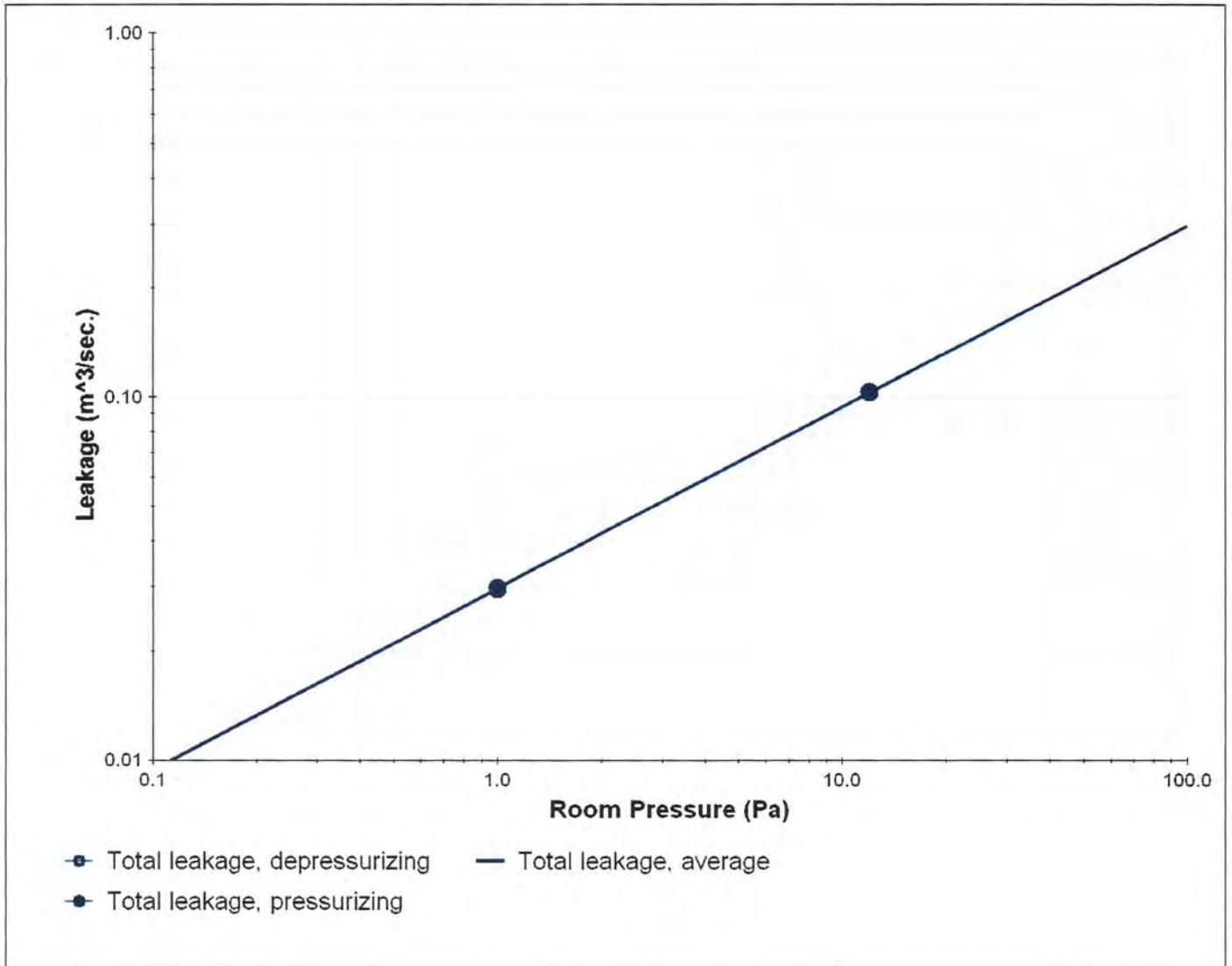
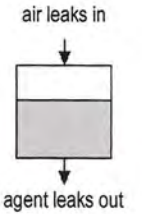
Below ceiling leakage of 0.0189 m<sup>2</sup> @ 10.0 Pa is the worst case assumption of 50%

Technician: **Andy Nutman** Certified to Level: **2 - Single fan NFPA room test**  
**Yes** Level 1 - Fire enclosure design basics for improving agent retention and passive protection  
**Yes** Level 2 - adds single door fan operation and NFPA clean agent retention time calculations  
**No** Level 3 - adds double door fan operation for Lower Leak measurement  
**No** Level 4 - adds multi-point ISO door fan operation and discharge pressure relief vent

# DOOR FAN TEST -- Graph

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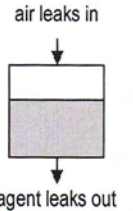




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 Company, Contact **Fire & Sound Limited, Andy Nutman / Cliff Miles**  
 Room name **1st Floor Offices** Test number **2**  
 Calibration Certificate # **4025** Certificate created **2009/03/27**



Test date/time	<b>2009/09/17 08:12</b>	Net Protected Volume, V	<b>131 m<sup>3</sup></b>
Tester	<b>Andy Nutman</b>	Maximum Protected Height, H <sub>o</sub>	<b>2.68 m.</b>
Certified to Level:	<b>2 - Single fan NFPA room test</b>	Minimum Protected Height, H	<b>2.20 m.</b>
Signature	.....	Static during retention, P <sub>SH</sub>	<b>0.0 Pa</b>
Elevation above sea level	<b>25 m.</b>	Operating temperature	<b>21 C</b>
Correction method	<b>NFPA 2001 (2000) Formula A-3-5.3.3</b>	Initial concentration, C	<b>43.00%</b>
Correction factor	<b>0.99</b>	Mixing during retention	<b>No</b>
Agent	<b>Argon (IG-01)</b>	Agent quantity	<b>73 m<sup>3</sup></b>
Total room leakage, ELA	<b>0.0959 m<sup>2</sup></b>	Minimum concentration, C <sub>F</sub>	<b>43.00%</b>
Lower Leakage, BCLA	<b>0.0479 m<sup>2</sup></b>	Minimum retention time	<b>10.0 minutes</b>

**Below ceiling leakage defaulting to worst case -- 50% of total leakage.**

This enclosure was tested in compliance with NFPA 2001 and 12A. Assuming no continual mixing during the retention period, enclosure leakage could allow sufficient agent to be lost to cause an air/agent interface to descend from a Maximum Protected Height of **2.68 m.** to the Minimum Protected Height specified of **2.20 m.** The retention time would then be **6.8 minutes** which is less than the minimum retention time of **10 minutes**. The enclosure therefore **FAILS** this acceptance procedure.

Notes **The second test is performed with all the openings cut around the perimeter to allow the installation to take place. a set of 2" penetrations (circular) where cut to allow the ingress of power cables etc and two sets of 1" penetrations were cut to allow the transfer of both Phone and Computer networks. once all penetrations associated with the installation had been cut and prior to any fire stopping works, the enclosure was retested to indicate the leakage present. (this how they are normally left)**

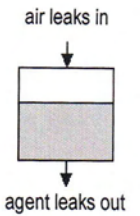
Witnesses **Andy Nutman**



# DOOR FAN TEST -- Total Room Leakage Data

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 Company, Contact **Fire & Sound Limited, Andy Nutman / Cliff Miles**  
 Room name **1st Floor Offices** Test number **2**  
 Calibration Certificate # **4025** Certificate created **2009/03/27**



## Total Room Leakage

Operator In the room      Smoke doesn't move      Temperature during test (C)  
 Static pressure 0 Pa      21 inside 21 outside

Depressurization		Range for room pressures: -10.0 to -13.0
Blower range	Room pressure	-10
	Auto corrected RP	-10.2
Ring C4	Flow Pressure	157
	Auto corrected FP	160.2
Corrected flow (m <sup>3</sup> /sec.)		-0.2374

Pressurization		Range for room pressures: 10.0 to 13.0
Blower range	Room pressure	10
	Auto corrected RP	10.2
Ring C4	Flow Pressure	170
	Auto corrected FP	173.2
Corrected flow (m <sup>3</sup> /sec.)		0.2396

	ELA m <sup>2</sup>	@Pa	F <sub>A</sub>	Slope n	Intercept k <sub>1</sub>	Correlation	Standard Error	ELA m <sup>2</sup>		F
Depressurization	0.0954	10.2		0.5000	0.0751	NA	NA			
Pressurization	0.0963	10.2		0.5000	0.0758	NA	NA			
<b>Average</b>	<b>0.0959</b>	<b>10.2</b>	<b>0.50</b>	<b>0.5000</b>	<b>0.0754</b>			<b>0.0960</b>	<b>10.0</b>	<b>0.50</b>

## Lower Leakage

Below ceiling leakage of 0.0479 m<sup>2</sup> @ 10.0 Pa is the worst case assumption of 50%

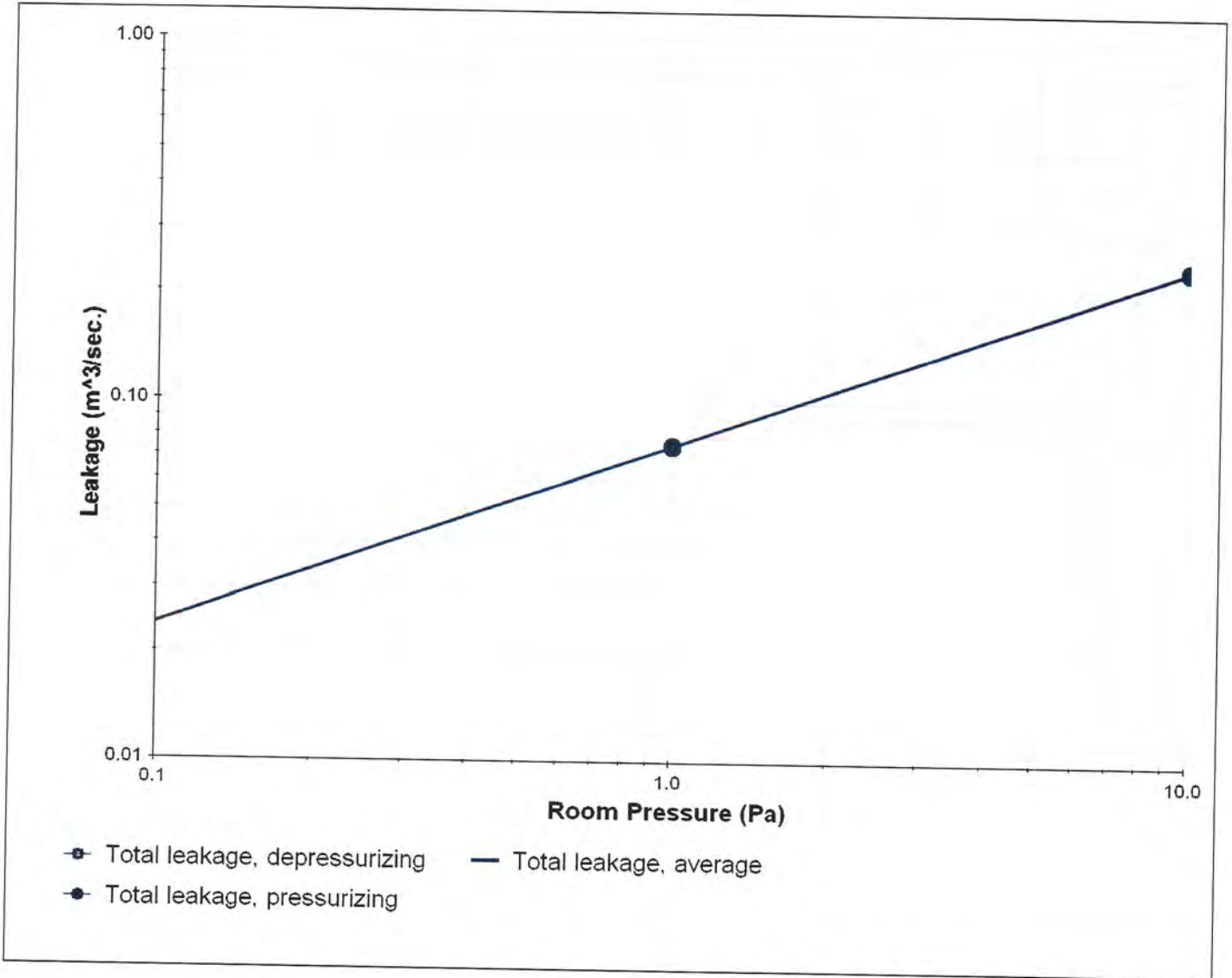
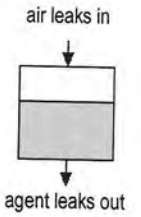
Technician: **Andy Nutman** Certified to Level: **2 - Single fan NFPA room test**

- Yes** Level 1 - Fire enclosure design basics for improving agent retention and passive protection
- Yes** Level 2 - adds single door fan operation and NFPA clean agent retention time calculations
- No** Level 3 - adds double door fan operation for Lower Leak measurement
- No** Level 4 - adds multi-point ISO door fan operation and discharge pressure relief vent

# DOOR FAN TEST -- Graph

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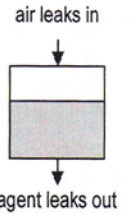




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 Room name **1st Floor Offices** Test number **3**  
 Calibration Certificate # **4025** Certificate created **2009/03/27**



Test date/time	<b>2009/09/17 08:21</b>	Net Protected Volume, V	<b>131 m<sup>3</sup></b>
Tester	<b>Andy Nutman</b>	Maximum Protected Height, H <sub>o</sub>	<b>2.68 m.</b>
Certified to Level:	<b>2 - Single fan NFPA room test</b>	Minimum Protected Height, H	<b>2.20 m.</b>
Signature	.....	Static during retention, P <sub>SH</sub>	<b>0.0 Pa</b>
Elevation above sea level	<b>25 m.</b>	Operating temperature	<b>21 C</b>
Correction method	<b>NFPA 2001 (2000) Formula A-3-5.3.3</b>	Initial concentration, C	<b>43.00%</b>
Correction factor	<b>0.99</b>	Mixing during retention	<b>No</b>
Agent	<b>Argon (IG-01)</b>	Agent quantity	<b>73 m<sup>3</sup></b>
Total room leakage, ELA	<b>0.0383 m<sup>2</sup></b>	Minimum concentration, C <sub>F</sub>	<b>43.00%</b>
Lower Leakage, BCLA	<b>0.0191 m<sup>2</sup></b>	Minimum retention time	<b>10.0 minutes</b>

**Below ceiling leakage defaulting to worst case -- 50% of total leakage.**

This enclosure was tested in compliance with NFPA 2001 and 12A. Assuming no continual mixing during the retention period, enclosure leakage could allow sufficient agent to be lost to cause an air/agent interface to descend from a Maximum Protected Height of **2.68 m.** to the Minimum Protected Height specified of **2.20 m.**

The retention time would then be **17.0 minutes** which exceeds the minimum retention time of **10 minutes**. The enclosure therefore **passes** this acceptance procedure.

Notes **The third test is performed with all the openings cut around the perimeter However this time they have all been specifically sealed / fire stopped with Product IA2484. this if installed corectly prevents leakage occuring through the penetrations made not only ingress but also egress. We observed that after installing this when the test was reperfomed the rate of leakage was almost back to that indicated prior to breaching the perimeter wall fabric. the slight difference in leakage observed was via the "bunched cables"**

This enclosure was tested in compliance with NFPA 2001 and 12A. Assuming no continual mixing during the retention period, enclosure leakage could allow sufficient agent to be lost to cause an air/agent interface to descend from a Maximum Protected Height of **2.68 m.** to the Minimum Protected Height specified of **2.20 m.**

The retention time would then be **17.0 minutes** which exceeds the minimum retention time of **10 minutes**. The enclosure therefore **passes** this acceptance procedure.

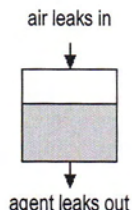
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Time (minutes)	Maximum Protected Height (m.)	Agent Height (m.)	Minimum Protected Height (m.)
0	2.68	2.68	2.20
10	2.68	2.40	2.20

Witnesses **Andy Nutman**

# DOOR FAN TEST -- Total Room Leakage Data

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 Company, Contact **Fire & Sound Limited, Andy Nutman / Cliff Miles**  
 Room name **1st Floor Offices** Test number **3**  
 Calibration Certificate # **4025** Certificate created **2009/03/27**

## Total Room Leakage

Operator In the room Smoke doesn't move Temperature during test (C)  
 Static pressure 0 Pa 21 inside 21 outside

Depressurization		Range for room pressures: -10.0 to -13.0
Blower range	Room pressure	-12
	Auto corrected RP	-12.2
Ring C2	Flow Pressure	128
	Auto corrected FP	130.3
Corrected flow (m <sup>3</sup> /sec.)		-0.1041

Pressurization		Range for room pressures: 10.0 to 13.0
Blower range	Room pressure	12
	Auto corrected RP	12.2
Ring C2	Flow Pressure	141
	Auto corrected FP	143.6
Corrected flow (m <sup>3</sup> /sec.)		0.1045

	ELA m <sup>2</sup>	@Pa	F <sub>A</sub>	Slope n	Intercept k <sub>1</sub>	Correlation	Standard Error	ELA m <sup>2</sup>		F
Depressurization	0.0382	12.2		0.5000	0.0300	NA	NA			
Pressurization	0.0384	12.2		0.5000	0.0302	NA	NA			
<b>Average</b>	<b>0.0383</b>	12.2	0.50	0.5000	0.0301			<b>0.0383</b>	10.0	0.50

## Lower Leakage

Below ceiling leakage of 0.0191 m<sup>2</sup> @ 10.0 Pa is the worst case assumption of 50%

Technician: **Andy Nutman** Certified to Level: **2 - Single fan NFPA room test**

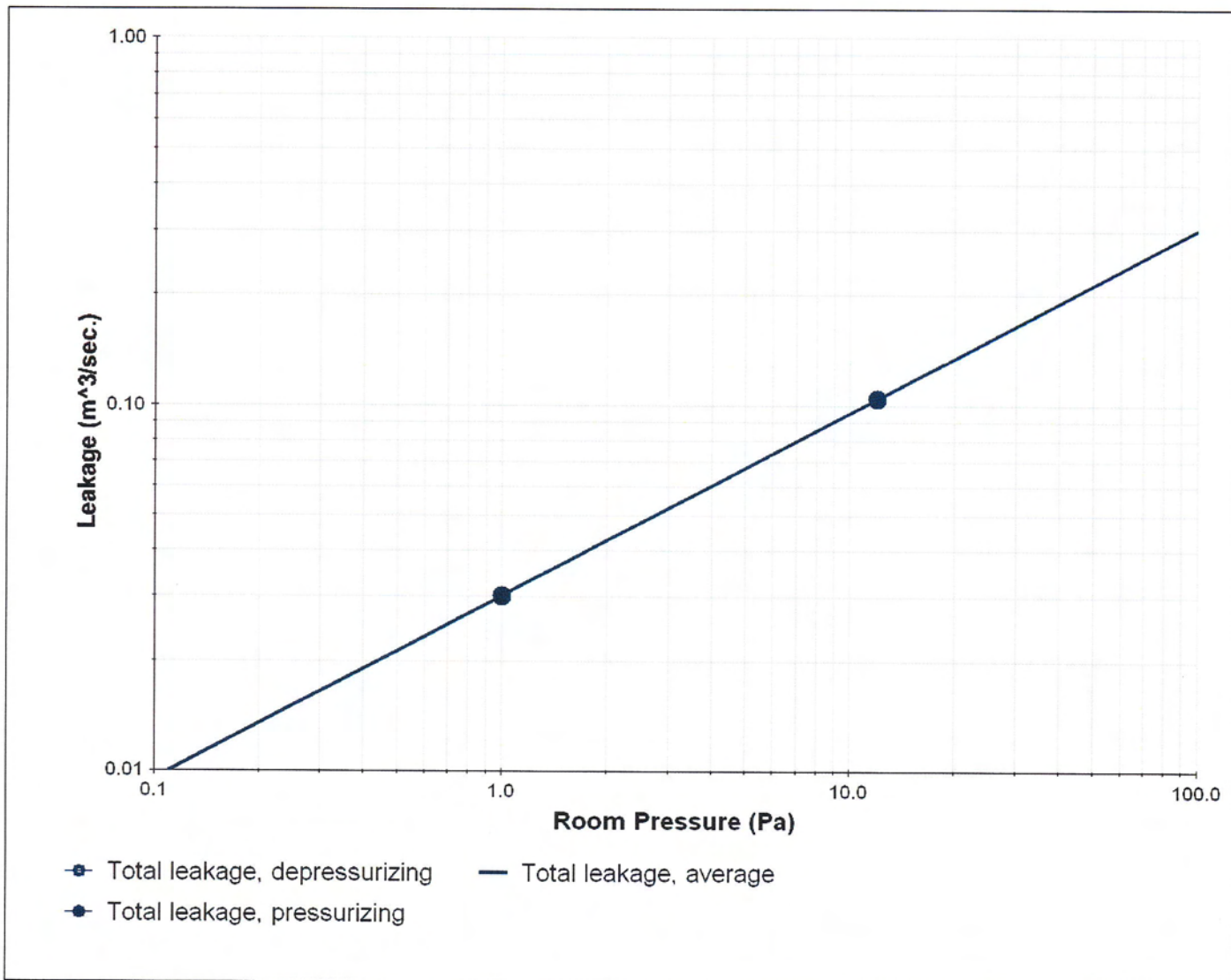
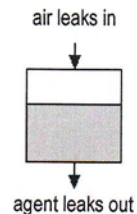
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- Yes** Level 2 - adds single door fan operation and NFPA clean agent retention time calculations
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# DOOR FAN TEST -- Graph

CleanAgent 2001 retention time prediction program revision 2.5.4. Complies with NFPA 2001 Appendix C, year 2000 edition.  
By Retrotec, Inc, 2200 Queen Street, Bellingham, WA USA 98229 360-738-9835 www.retrotec.com  
Software Licensed to: **Pressure Test Limited**

Building, Location **Unit 15, 37 Ivanhoe Road, Finchampstead, RG40 4QQ**  
Company, Contact **Fire & Sound Limited, Andy Nutman / Cliff Miles**  
Room name **1st Floor Offices** Test number **3**  
Calibration Certificate # **4025** Certificate created **2009/03/27**



**One Year Calibration Certificate** Certificate # **4025**

System Model # **Q4E**

System Owned By **Pressure Test Limited**

Console #

For CA2001 ver 2.0 license #

Equipment Calibrated by **Retrotec Inc**

Good for one year

date: **2009/02/02**

expires: **2010/02/02**

This certificate complies with calibration requirements of NFPA 2001 Appendix C, year 2000 edition and ISO 14520. Completed by Retrotec Inc, 2200 Queen Street, Bellingham, WA, USA 98226-4766

**Digital Gauge** This gauge used for All Readings

serial #		<b>095563</b>				
to correct	mult by	& add	gauge	CR	MRC	error Pa
-486.00 - -301.00	1.01	0.17	0.0	0.0	0.0	0.0
-301.00 - -149.00	1.01	0.28	0.0	0.0	0.0	0.0
-149.00 - -74.80	1.01	0.48	0.0	0.0	0.0	0.0
-74.80 - -51.10	1.06	4.15	0.0	0.0	0.0	0.0
-51.10 - -24.40	0.94	-2.07	0.0	0.0	0.0	0.0
-24.40 - 0.00	1.03	0.00	0.0	0.0	0.0	0.0
0.00 - 24.70	1.01	0.07	0.0	0.0	0.0	0.0
24.70 - 49.60	1.02	-0.09	0.0	0.0	0.0	0.0
49.60 - 75.10	1.00	0.83	0.0	0.0	0.0	0.0
75.10 - 150.00	1.03	-1.58	0.0	0.0	0.0	0.0
150.00 - 297.00	1.00	3.20	0.0	0.0	0.0	0.0
297.00 - 600.00	1.01	-1.23	0.0	0.0	0.0	0.0
600.00 - 1,152.00	0.98	14.38	0.0	0.0	0.0	0.0
1,152.00 - 0.00	0.99	0.00	0.0	0.0	0.0	0.0

CR is the Corrected Room pressure.

CR = "gauge" reading X "mult by" factor + "& add" factor.

CF is the Corrected Flow pressure derived the same way.

The corrected readings are compared to the TRUE reading from our Master Reference Calibration (MRC) gauge and the resulting error shown in Pascals. Maximum allowable error is +/- 1 Pa from 0 to 50 Pa and +/- 5 Pa over 50 Pa.



Five Year Calibration Certificate Certificate # **4025**

System Model # **Q4E**

System Owned By **Pressure Test Limited**

Console #

For CA2001 ver 2.0 license #

Equipment Calibrated by **Retrotec Inc**

Good for five years

date: **2009/02/03**

expires: **2014/02/03**

This certificate complies with calibration requirements of NFPA 2001 Appendix C, year 2000 edition and ISO 14520. Completed by Retrotec Inc, 2200 Queen Street, Bellingham, WA, USA 98226-4766

**CALIBRATION EQUATIONS WITH CALCULATION EXAMPLES:**

blower #1 serial # >> 095752

blower	range	N	K	K1	K2	K3	K4	MF	CR	FF	cfm	m <sup>3</sup> / sec
#1	22	0.5214	486.9900	-0.070	0.800	-0.115	0.984	8.6				
#1	A	0.5030	259.0380	-0.075	1.000	0.000	1.011	12.0				
#1	B	0.5000	174.8820	0.000	0.300	0.000	0.916	10.0				
#1	C8	0.5000	78.5000	-0.020	0.500	0.016	0.949	10.0				
#1	C4	0.5140	39.3000	0.080	0.500	0.001	0.943	10.0				
#1	C2	0.5500	20.0000	0.139	0.500	-0.003	0.776	10.0				
#1	C1	0.5410	11.9239	0.122	0.400	0.000	0.740	10.0				

**BLOWER TEST RESULTS:**

Holes	error					
	cm <sup>2</sup>	blower	range	cm <sup>2</sup>	%	cm <sup>2</sup>

This calibration certificate compares the calibration holes in the Retrotec test chamber with the tested blower's measurement of those holes. The left hand column shows the area of holes open in the Retrotec flow chamber. To the right is the comparable Retrotec Door Fan result using the above referenced CA2001 software license. Maximum allowable error is +/- 5%.

This calibration includes both gauge and blower error combined. CR and CF come from the One Year Certificate. For Flow Towards the operator, CF must be reduced by CR before calculating flow to yield FF, the symbol for the Final Flow pressure. For Flow Away from the operator CF=FF. FF must be >=MF and (CR \* K2) otherwise flow pressure is too low for accurate results  
Flow in cfm = (FF-CR\*K1)\*N\*(K+K3\*FF)\*K4 For m<sup>3</sup>/sec, divide by 2118.882.

- Technician: **Andy Nutman** Certified to Level: **2 - Single fan NFPA room test**
- Yes** Level 1 - Fire enclosure design basics for improving agent retention and passive protection
  - Yes** Level 2 - adds single door fan operation and NFPA clean agent retention time calculations
  - No** Level 3 - adds double door fan operation for Lower Leak measurement
  - No** Level 4 - adds multi-point ISO door fan operation and discharge pressure relief vent

