Flex Dur Technology Sdn Bhd

Air Flow and Acoustic Research and Development Study of various Air Outlets

Report No. 30B-10-0406-TRP-595133-2

Vipac Engineers & Scientists Pty Ltd
Melbourne, Australia
July 2011

NATA
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Air Flow and Acoustic Research and Development Study of various Air Outlets

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30B-10-0406-TRP-595133-2

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KEY WORDS: Air Flow, Pressure, Noise

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1.0 INTRODUCTION

This report presents the results of acoustic and airflow development tests carried out on nineteen (19) Diffusers supplied by Flex Dur Technology Sdn Bhd, as described below.

This report is issued as a NATA certified report under the terms of Vipac's NATA accreditation No 676.

2.0 TEST SPECIMEN

The units under test are detailed in Table 1 below.

Table 1: Units Under Test

#	Test Item	Model	Face Dimensions (mm)	Plenum Box Face Dimensions (mm)	Plenum Box Neck Dimensions (mm)
1	4-way Diffuser	CSD – A	595 x 595	481 x 481 x 200	Ø145mm
2	4-way Diffuser	CSD – A	595 x 595	481 x 481 x 200	255mm x 105mm
3	4-way Diffuser	CSD – A	595 x 595	481 x 481 x 200	315mm x 135mm
4	4-way Diffuser	CSD – A	595 x 595	481 x 481 x 200	380mm x 180mm
5	4-way Diffuser	CSD – A	595 x 595	481 x 481 x 250	420mm x 220mm
6	Swirl Diffuser	CSW – S	595 x 595	550 x 550 x 200	Ø145mm
7	Swirl Diffuser	CSW – S	595 x 595	550 x 550 x 200	255mm x 105mm
8	Swirl Diffuser	CSW – S	595 x 595	550 x 550 x 200	315mm x 135mm
9	Swirl Diffuser	CSW – S	595 x 595	550 x 550 x 200	380mm x 180mm
10	Swirl Diffuser	CSW – S	595 x 595	550 x 550 x 250	420mm x 220mm
11	Air Light Troffer (2-sides)	CCLT – S – D	1200 x 600	N/A	250mm x 120mm
12	Air Light Troffer (4-sides)	CCLT – S – Q	600 x 600	N/A	388mm x 160mm
13	Round Diffuser	CRC – A	Ø200 (Neck Size)	N/A	N/A
14	Round Diffuser	CRC – A	Ø250 (Neck Size)	N/A	N/A
15	Round Diffuser	CRC – A	Ø300 (Neck Size)	N/A	N/A
16	Linear Bar Grille	LFB – A	900 x 95	N/A	N/A
17	Linear Slot Diffuser (2-slots)	LFS – A	128 x 1200 x 2	182 x 116 x 1197	260mm x 112mm
18	Linear Slot Diffuser (3-slots)	LFS – A	175 x 1200 x 3	182 x 162 x 1197	315mm x 135mm
19	Double Deflection Grille	RVD – A	600 x 200	N/A	N/A

Figures 1 –17 show the test samples:

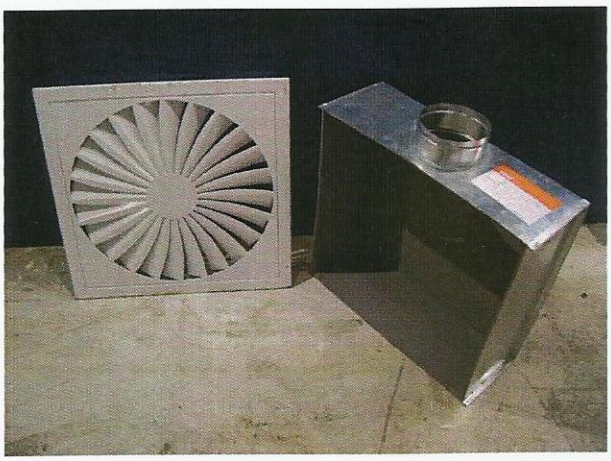

Figure 1: Test Unit No.1 – Swirl Diffuser with Plenum Box (145mm dia. Neck)

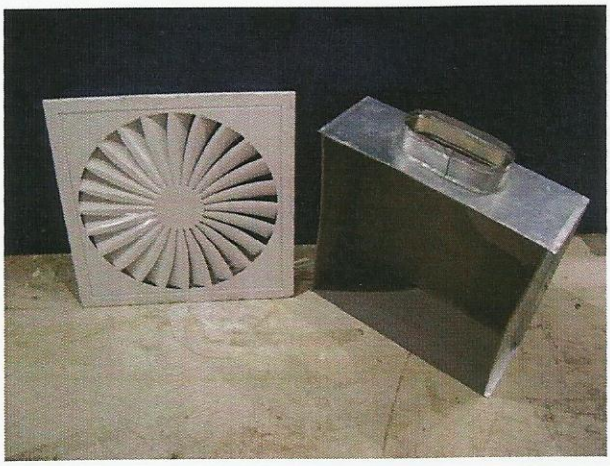

Figure 2: Test Unit No.2 – Swirl Diffuser with Plenum Box (255x105mm neck)

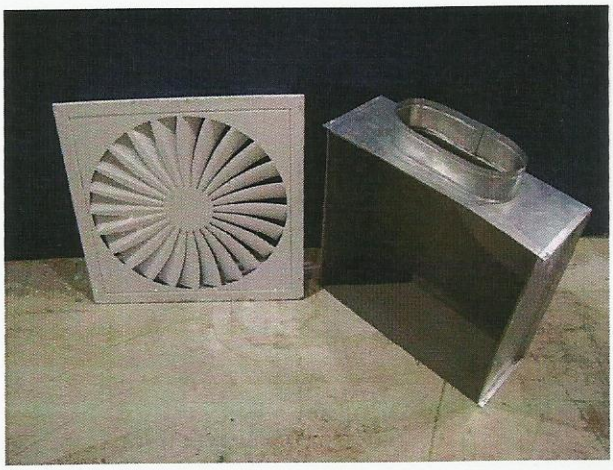

Figure 3: Test Unit No.3 – Swirl Diffuser with Plenum Box (315x130 mm neck)

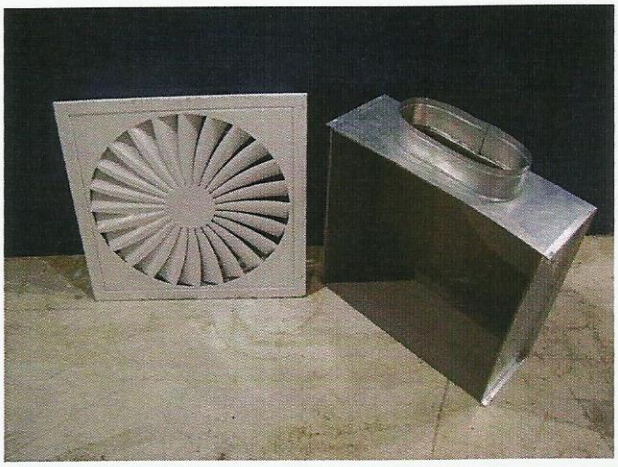

Figure 4: Test Unit No.4 – Swirl Diffuser with Plenum Box (380x180mm neck)

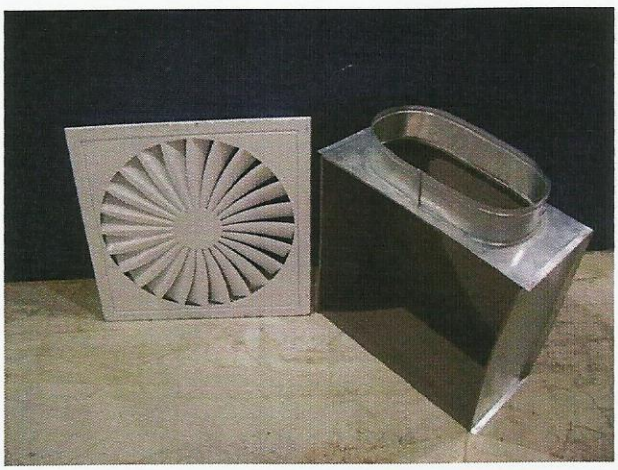

Figure 5: Test Unit No.5 – Swirl Diffuser with Plenum Box (420x220mm neck)

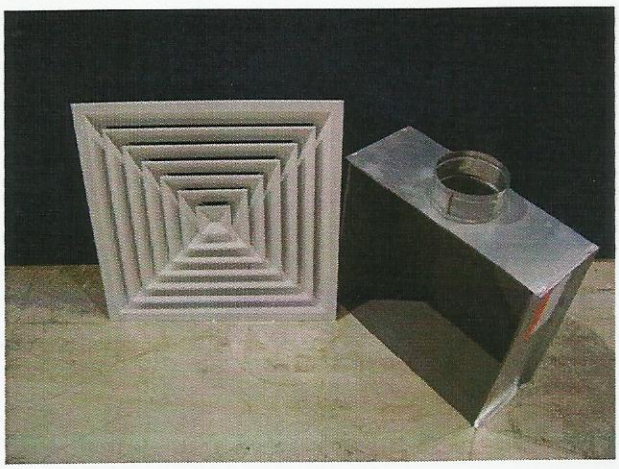

Figure 6: Test Unit No.6 – 4-way Diffuser with Plenum Box (145 mm dig. Neck)

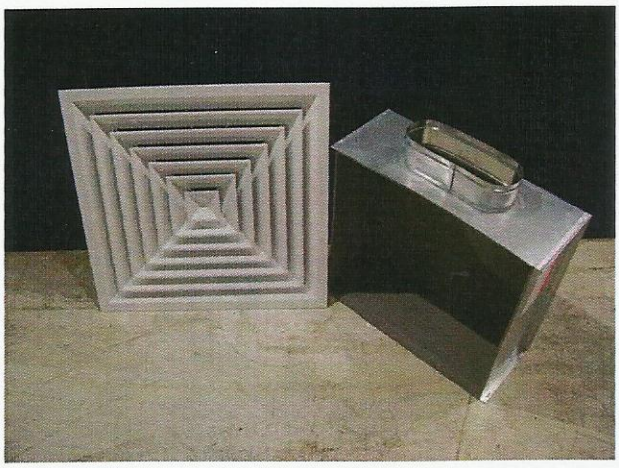

Figure 7: Test Unit No.7 – 4-wayDiffuser with Plenum Box (255x105mm neck)

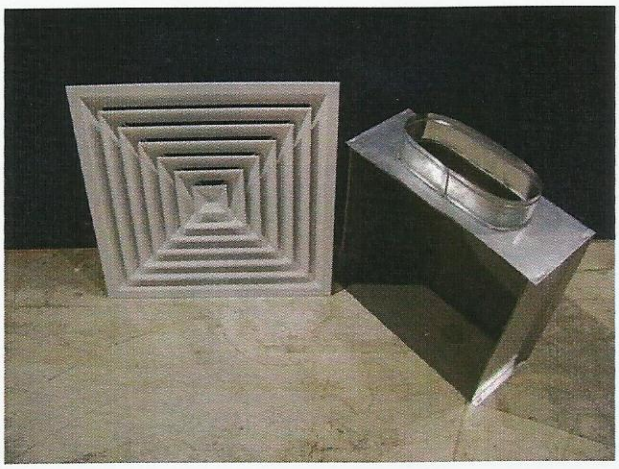

Figure 8: Test Unit No.8 – 4-way Diffuser with Plenum Box (315x130mm neck)

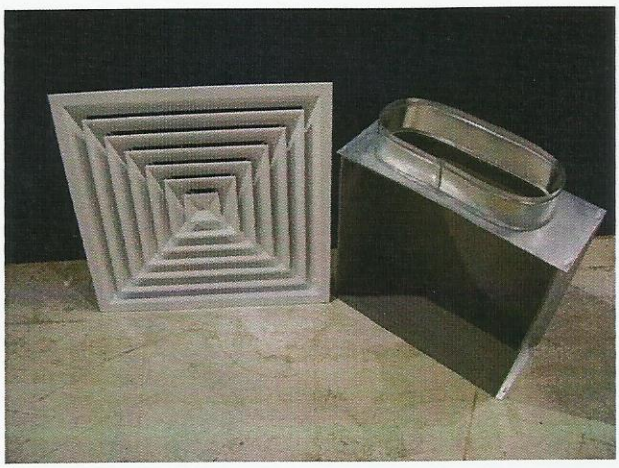

Figure 9: Test Unit No.9 – 4-way Diffuser with Plenum Box (380x180mm neck)

Figure 10: Test Unit No.10 – 4-way Diffuser with Plenum Box (420x220mm neck)

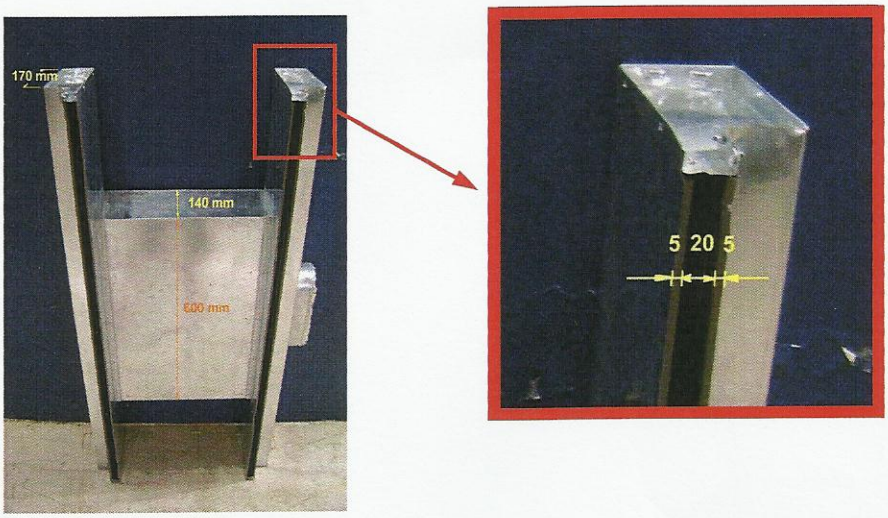

Figure 11: Test Unit No.11 –Air Light Troffer – 2 Sides

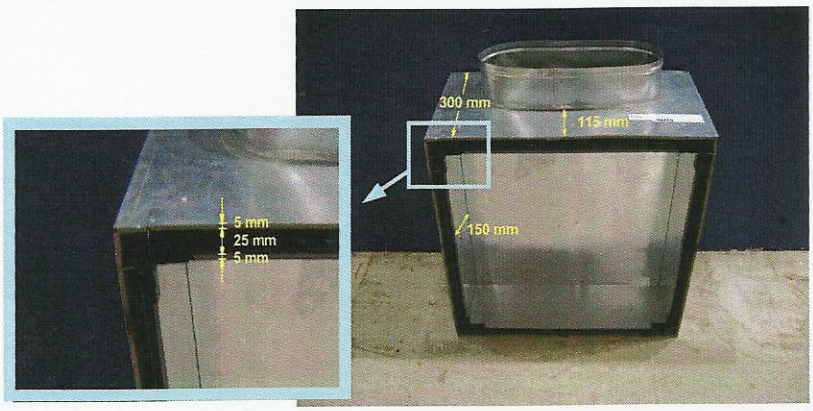

Figure 12: Test Unit No.12 –Air Light Troffer – 4 Sides

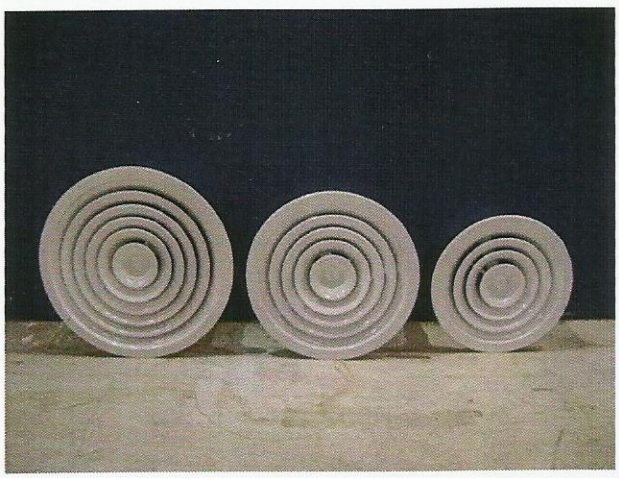

Figure 13: Test Units No.13, 14 & 15 – Round Diffusers (left to right) 300, 250 & 200 mm diameter.

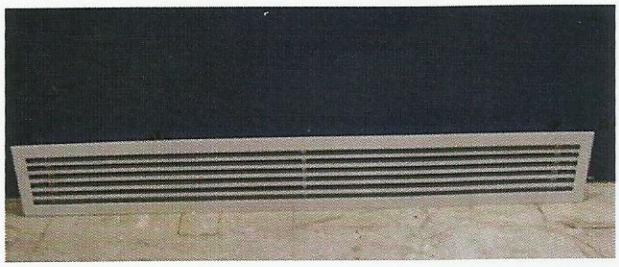

Figure 14: Test Unit No.16 – Linear Bar Grille

Figure 15: Test Unit No.17 – Linear Slot Diffuser (2 Slots)

Figure 16: Test Unit No.18 – Linear Slot Diffuser (3 Slots)

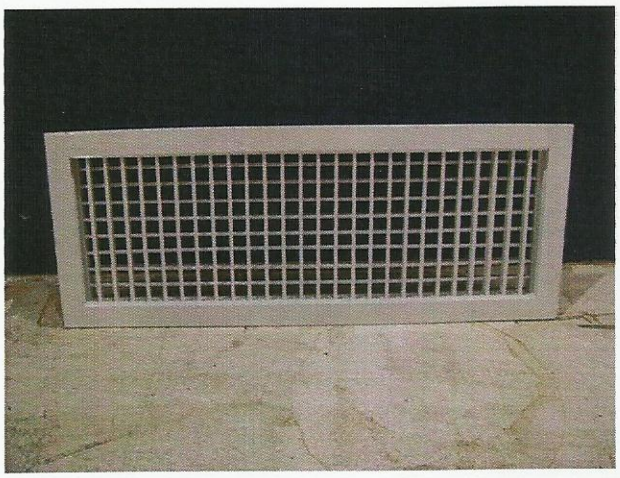

Figure 17: Test Unit No.19 – Double Deflection Grille

3.0 TEST CONDITIONS AND APPLICABLE STANDARDS

3.1 TEST CONDITIONS

The units under test were supplied with ambient temperature air at the following conditions:

Test Air Temperature	17 degrees C	± 2.0 degree C
Room Air Temperature	19 degrees C	± 2.0 degree C
Barometric Pressure	1020 millibar	± 5 millibar
Relative Humidity	55	± 10%

3.2 APPLICABLE STANDARDS

The units were tested at a range of flow conditions, as shown on the Test Certificates.

The test set up was in general accordance with ANSI/ASHRAE 70-2006. Measurements were taken in general accordance with the following standards:

ACOUSTICS

AS1217.2 Acoustics - Determination of sound power levels of noise sources Part 2: Precision methods for broad-band sources in reverberation rooms.

AIRFLOW

ANSI/ASHRAE 70-2006, Method of Testing the performance of Air Outlets and Air Inlets

THROW & STATIC PRESSURE DROP

ANSI/ASHRAE 70-2006, Method of Testing the performance of Air Outlets and Air Inlets

4.0 TEST SET UP AND SPECIFICATION

Vipac's Reverberation Test Room has a volume of 170m^3 has been qualified in accordance with the procedures in AS 1217.2 - 1985 for determination of sound power in octave bands with Centre Frequencies from 125 Hz to 8000 Hz.

The units under test were set up in the Air Distribution (Reverberation) Test Chamber and connected to a quiet air supply.

Adjustments on the blade angle/position of each light troffers and slot diffusers were set to ensure maximum horizontal throw where possible.(See Figures 18).

Following calibration checks, sound pressure levels were measured and converted to sound power levels using the comparison method of AS1217.2 - 1985 (ie. using a reference sound source of known Sound Power to determine room correction).

Airflow rates were measured using ∅ 150 mm orifice plate. Static pressure drop was recorded using a (Static Pressure) probe and a digital manometer. Throw was measured using a hotwire type anemometer.

Figures 18 to 25 show the test setups:

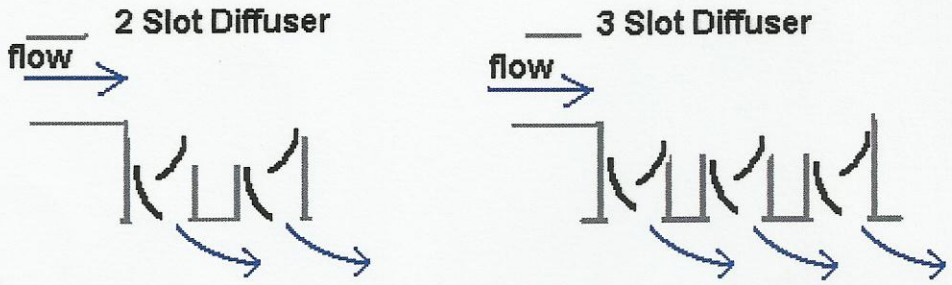

Figure 18: Test Set-up (Slot Diffuser Blade Angles to produce maximum horizontal flow)

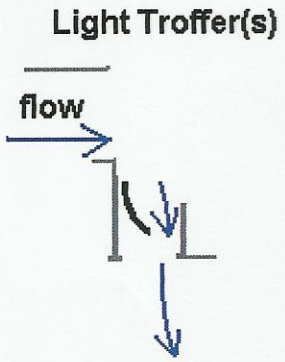

Figure 19: Test Set-up (Light Troffer Blade Angles)

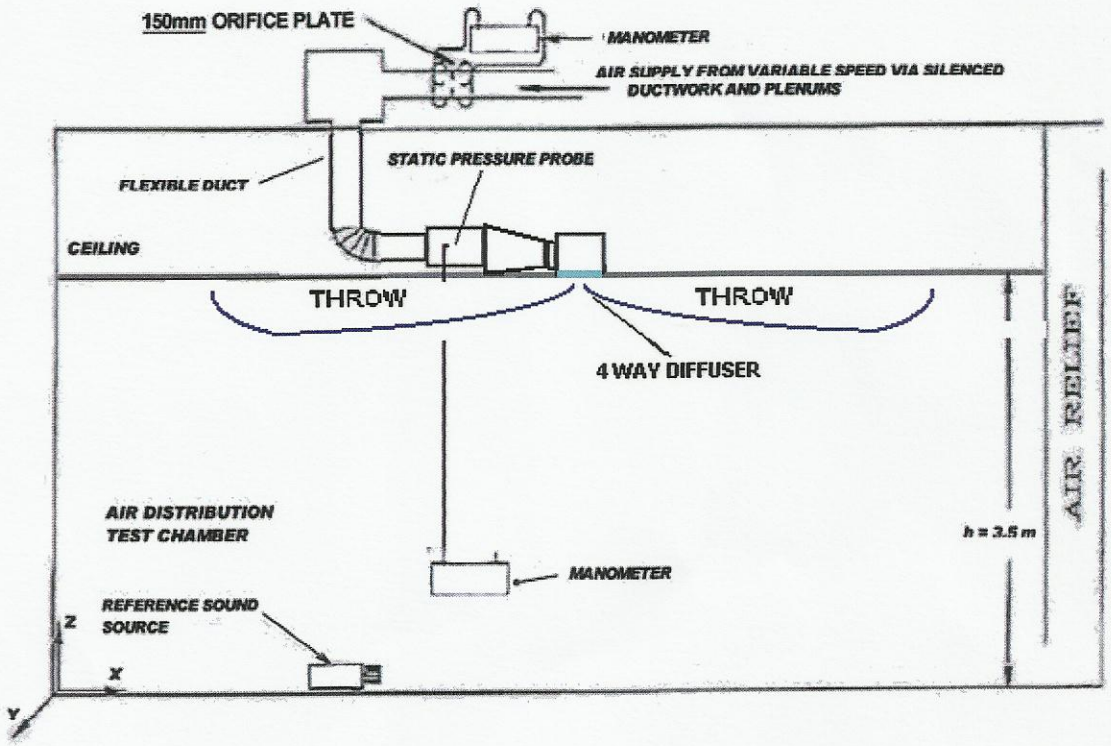

Figure 20: Test Set-up (Test Samples 1 – 5)

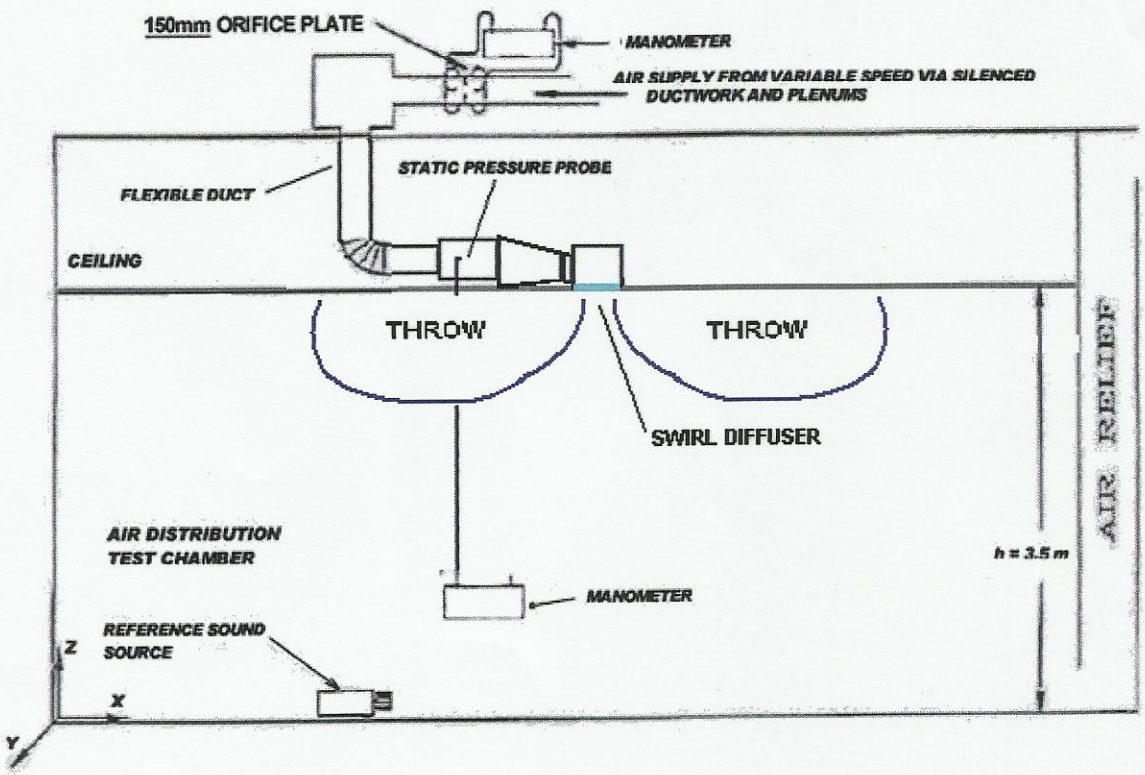

Figure 21: Test Set-up (Test Samples 6 - 10)

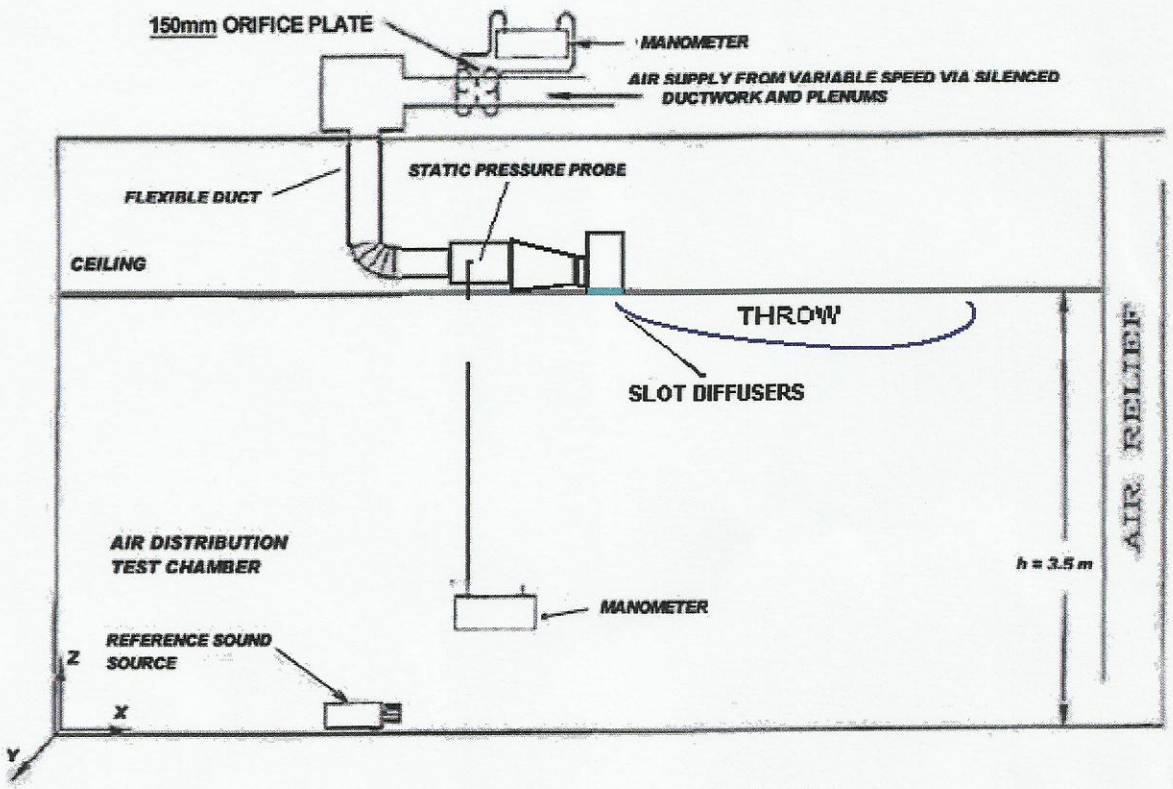

Figure 22: Test Set-up (Test Samples 17 & 18)

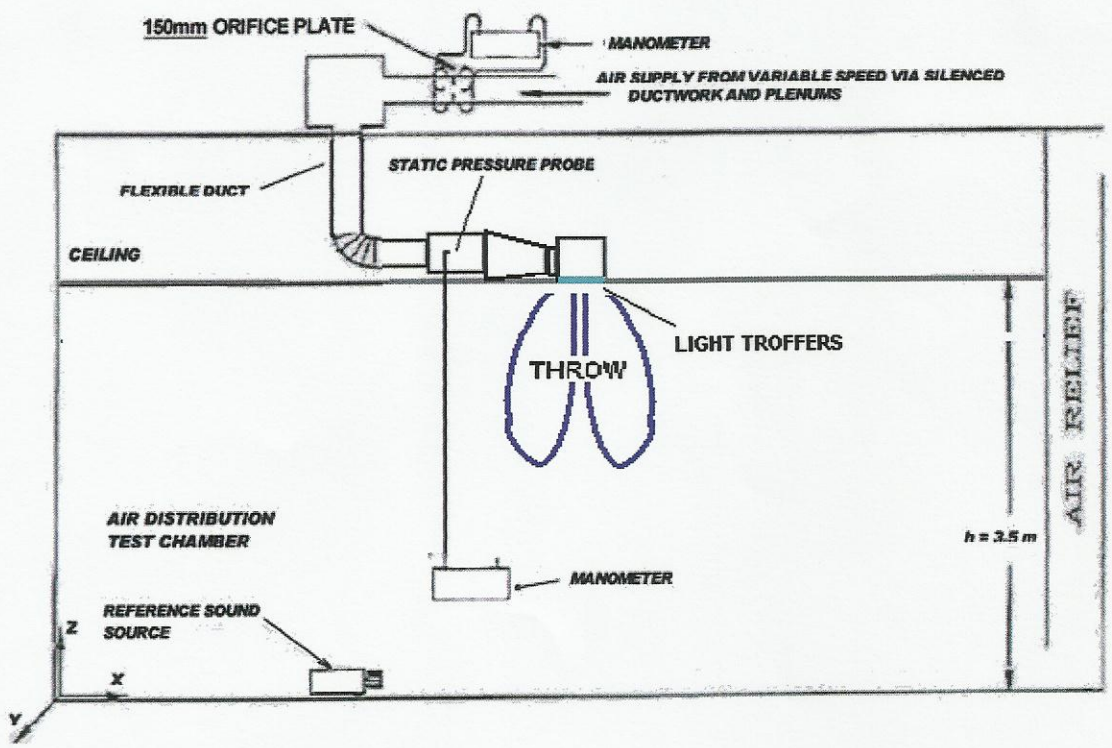

Figure 23: Test Set-up (Test Samples 11 & 12)

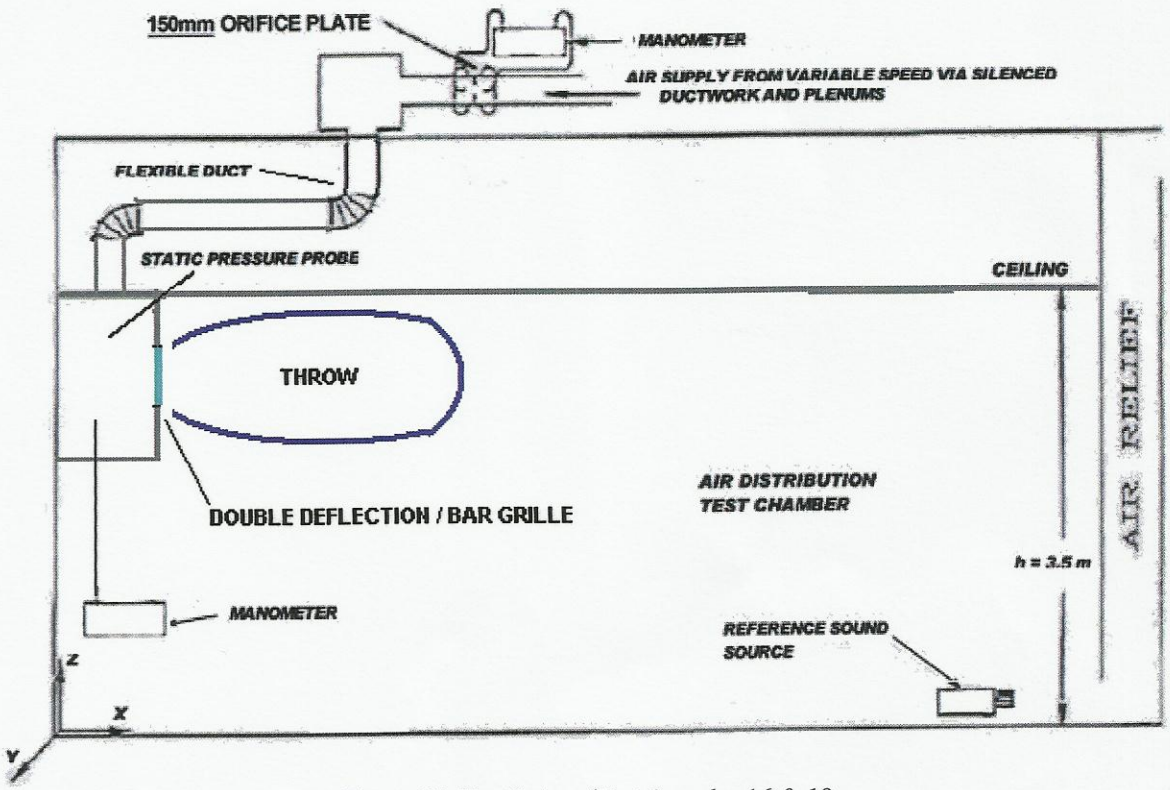

Figure 24: Test Set-up (Test Samples 16 & 19

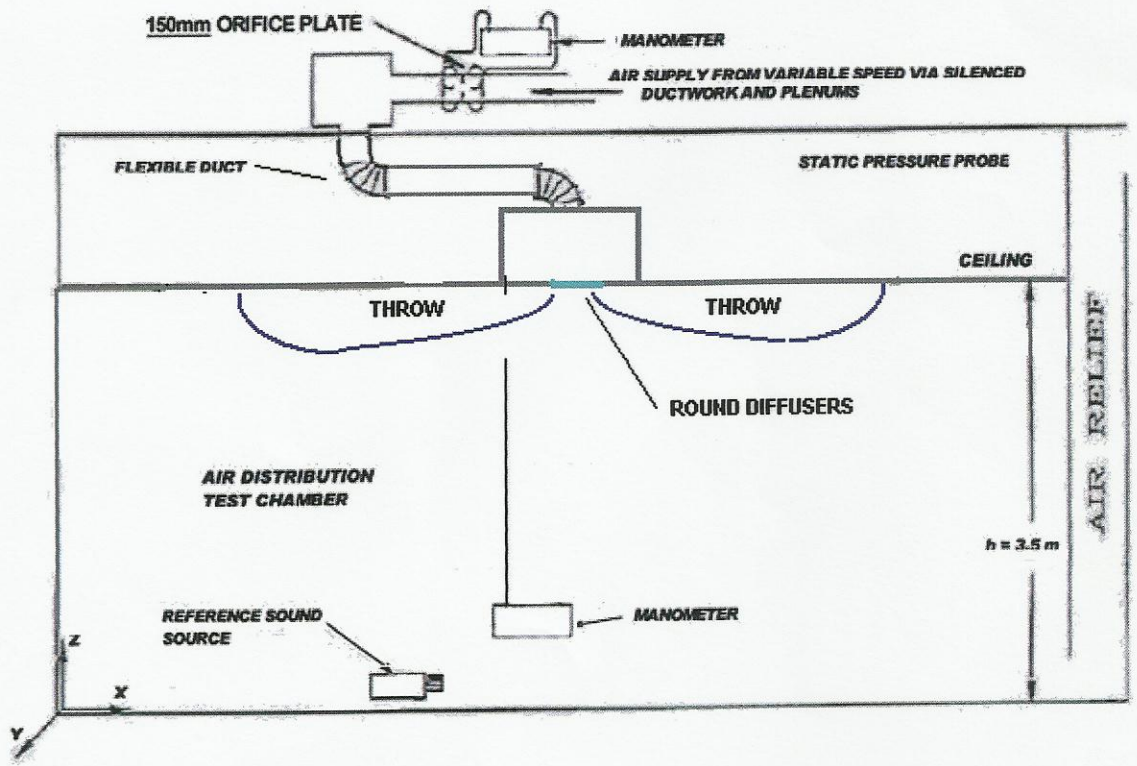

Figure 25: Test Set-up (Test Samples 13, 14 & 15)

5.0 INSTRUMENTATION

INSTRUMENT	MAKE & MODEL	CALIBRATION		SERIAL NO.
		BY	DATE	
Sound Level Meter	ONO SOKKI LA-5570	Vipac	Feb 2011	47958 / 20627
Microphone	MI-3310	Vipac	Feb 2011	21367
Acoustic Calibrator	B&K 4230	Vipac	Feb 2011	831145
Manometer	TSI DP-Calc	TSI	Dec 2010	000010147
Orifice Plates	Vipac	Vipac	May 2001	-
Hotwire Anemometer	TSI 9545-A	TSI	Feb 2011	9545A0813010

6.0 ORDERS OF ACCURACY

Sound Pressure Level:

Octave Band Centre Frequency (Hz)	Standard Deviation (1) (dB)
125	±3.0
250	±2.0
500 to 4000	±1.5
8000	±3.0

Pressure Drop: + 5% or 0.5 Pa whichever is greater

Airflow: ± 5% or 10 l/s whichever is greater

7.0 RESULTS

The results obtained are shown in the attached Test Certificates.

Report Prepared by:
VIPAC ENGINEERS AND SCIENTISTS LTD.

.....

BRYAN DALZIEL
PROJECT ENGINEER

.....

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 1

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT/MODEL:	**4-way Diffuser and Plenum Box / CSD - A**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**481 mm x 481 mm x 200 mm**
NECK (INLET) SIZE:	**Ø 145mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
81	21	2.9	18	<44.4	<36.1	33.9	29.4	21.2	<16.1	<11.4
97	30	3.5	24	<45.0	40.4	39.2	34.6	28.8	19.3	<11.6
119	44	4.4	30	46.8	45.1	44.8	40.7	36.3	28.2	<13.4
147	64	5.5	35	49.5	51.0	49.3	45.3	42.4	35.6	18.0
185	100	7.0	41	55.3	56.0	55.3	51.9	49.8	43.8	28.2

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 2

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT/MODEL:	**4-way Diffuser with Plenum Box / CSD - A**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**481 mm x 481 mm x 200 mm**
NECK (INLET) SIZE:	**Oval Neck: 255mm x 105mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
121	18	5.1	19	<44.1	37.3	34.6	27.7	20.3	<14.5	<10.5
138	24	5.8	24	<45.2	41.7	39.4	34.2	28.0	18.1	<10.6
178	40	>7	31	47.3	48.1	46.3	41.9	37.2	28.6	<12.4
210	54	>7	36	50.5	52.8	50.9	46.6	43.3	35.8	18.3
252	82	>7	42	55.0	57.7	56.6	52.3	49.9	43.3	27.5

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 3

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**4-way Diffuser with Plenum Box / CSD - A**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**481 mm x 481 mm x 200 mm**
NECK (INLET) SIZE:	**Oval Neck: 315mm x 135mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
148	2	6.9	18	<44.5	37.1	34.0	27.0	19.4	<14.8	<11.1
189	5	>7	25	<45.8	43.2	40.8	36.0	29.8	20.2	<11.6
224	8	>7	31	47.9	48.6	46.4	41.9	37.3	29.1	<13.0
266	12	>7	38	52.9	54.3	51.8	48.1	44.8	37.8	20.2
317	20	>7	42	56.2	57.8	56.2	52.5	50.1	44.0	28.0

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 4

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**4-way Diffuser with Plenum Box / CSD - A**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**481 mm x 481 mm x 200 mm**
NECK (INLET) SIZE:	**Oval Neck: 380mm x 180mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
212	7	>7	21	<43.6	39.2	36.9	31.1	24.9	<17.2	<11.7
251	9	>7	26	45.4	43.5	41.1	35.8	30.3	21.9	<12.4
307	15	>7	32	50.0	50.3	46.9	42.3	38.3	31.0	16.5
363	22	>7	37	54.1	54.7	51.3	47.2	44.3	37.7	21.9
393	26	>7	40	57.0	57.9	54.8	50.7	48.3	42.5	27.3

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 5

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**4-way Diffuser with Plenum Box / CSD - A**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**481 mm x 481 mm x 250 mm**
NECK (INLET) SIZE:	**Oval Neck: 420mm x 220mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
198	2	>7	18	<44.3	39.4	33.8	28.4	23.5	<17.0	<10.8
259	3	>7	24	47.8	44.9	39.4	35.5	30.9	24.4	<12.9
307	5	>7	31	49.7	48.9	43.7	41.1	37.1	31.0	16.3
362	7	>7	35	52.8	53.8	47.9	45.5	41.8	36.1	21.7
396	8	>7	37	55.7	56.1	50.9	48.0	45.1	39.1	25.8

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 6

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Swirl Diffuser with Plenum Box / CSW - S**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**550 mm x 550 mm x 200 mm**
NECK (INLET) SIZE:	**Ø 145mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
73	22	0.5	21	<42.0	39.6	36.5	30.5	21.2	<14.8	<10.8
92	34	0.6	26	<44.2	45.6	42.0	37.7	30.5	19.3	<11.0
104	44	0.7	31	46.3	49.3	45.7	42.0	35.8	25.9	<11.5
120	58	0.9	35	49.2	51.5	48.7	45.1	39.3	30.3	<13.1
137	76	1.0	40	53.3	55.2	53.3	50.1	45.4	37.8	20.2

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw (vortex air distribution) in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

NATA Accredited Laboratory Numbers: 676

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO / IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian / national standards.

TEST CERTIFICATE No. 7

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Swirl Diffuser with Plenum Box / CSW - S**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**550 mm x 550 mm x 200 mm**
NECK (INLET) SIZE:	**Oval Neck: 255mm x 105mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
101	19	1.3	20	<42.5	40.4	36.0	28.0	18.0	<14.0	<10.8
119	26	1.6	27	<44.0	46.2	42.7	37.9	29.8	17.9	<10.9
150	40	2.1	35	47.6	51.9	49.0	45.8	39.5	29.1	<12.3
174	53	2.5	39	51.9	55.1	53.0	49.4	44.2	34.7	15.7
198	67	2.9	43	55.5	59.3	56.5	53.8	49.3	41.2	22.9

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw (vortex air distribution) in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 8

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Swirl Diffuser with Plenum Box / CSW - S**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**550 mm x 550 mm x 200 mm**
NECK (INLET) SIZE:	**Oval Neck: 315mm x 135mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
119	13	1.8	22	<42.6	41.3	37.7	30.3	19.6	<14.7	<10.8
138	17	2.1	27	<43.4	44.9	42.6	36.2	27.2	<16.0	<11.0
162	24	2.6	32	45.2	49.2	47.2	42.2	34.5	22.5	<11.2
188	33	3.0	36	47.6	52.6	51.0	47.0	41.3	30.6	<12.8
228	47	3.8	41	52.2	55.0	54.6	51.3	46.9	38.2	19.6

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw (vortex air distribution) in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 9

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Swirl Diffuser with Plenum Box / CSW - S**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**550 mm x 550 mm x 200 mm**
NECK (INLET) SIZE:	**Oval Neck: 380mm x 180mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
140	14	2.3	19	<42.1	37.4	35.2	27.9	18.3	<14.2	<10.8
152	17	2.6	23	<42.6	39.6	38.5	32.4	22.1	<15.5	<11.5
171	23	2.9	27	<43.7	42.2	42.5	37.0	28.2	18.3	<11.9
200	33	3.5	32	48.1	49.2	46.5	43.0	36.2	25.7	<12.0
224	43	4.0	36	50.8	51.6	49.2	46.4	40.6	30.2	<13.1
262	61	4.8	41	55.3	55.6	53.4	51.5	47.4	38.8	23.3

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw (vortex air distribution) in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 10

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Swirl Diffuser with Plenum Box / CSW - S**
DIFFUSER SIZE:	**595mm x 595mm**
PLENUM SIZE:	**550 mm x 550 mm x 250 mm**
NECK (INLET) SIZE:	**Oval Neck: 420mm x 220mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
155	13	3.7	20	<42.5	39.8	36.0	29.4	18.9	<14.3	<10.7
164	15	4.0	24	<43.2	41.8	39.5	34.7	25.2	<16.7	<10.9
181	20	4.4	29	<44.4	44.6	42.2	40.1	29.4	18.0	<11.1
233	42	5.8	35	48.2	49.9	47.2	45.5	37.7	27.0	<12.1
266	60	6.7	40	51.7	53.4	52.1	50.1	44.8	34.5	16.1

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 11

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Air Light Troffer (2 Sides) / CCLT - S - D**
SIZE:	**1200mm x 600mm**
NECK (INLET) SIZE:	**Oval Neck: 250 x 120 mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
92	24	>4	18	<41.6	36.8	33.7	27.0	18.4	<14.5	<10.9
118	39	>4	23	<42.6	41.3	38.8	34.1	28.0	18.9	<11.1
139	54	>4	27	<43.9	45.3	42.6	38.3	33.9	26.2	<12.4
189	101	>4	36	48.9	51.8	50.0	46.5	44.7	39.4	26.5
244	169	>4	43	55.3	57.2	56.1	52.7	52.0	48.4	36.7

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
Th - Vertical Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 12

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Air Light Troffer (4 Sides) / CCLT - S - Q**
SIZE:	**600mm x 600mm**
NECK (INLET) SIZE:	**Oval Neck: 388 x 160 mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
117	19	>4	19	<43.4	36.4	32.5	31.0	21.1	<14.5	<10.7
136	26	>4	24	<44.1	39.6	36.7	36.0	29.2	18.2	<11.0
168	39	>4	31	<45.6	45.0	42.5	42.0	38.3	28.9	<13.7
210	61	>4	38	49.1	50.3	48.0	48.9	45.5	39.3	24.1
243	82	>4	42	52.9	54.0	51.4	52.8	49.4	45.9	30.8

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Vertical Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 13

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Round Diffuser / CRC - A**
DIFFUSER (FACE) SIZE:	**Ø 295mm**
DIFFUSER (NECK) SIZE:	**Ø 200mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
71	20	1.2	18	46.4	40.6	34.4	25.3	16.2	<13.9	<10.5
74	22	1.3	23	47.4	45.2	36.6	28.1	19.4	<14.6	<10.6
92	34	1.6	28	50.3	48.4	43.8	35.2	27.9	18.3	<10.8
107	45	1.9	33	53.2	50.7	48.0	40.1	33.4	23.7	<10.9
129	66	2.3	37	55.9	52.0	52.0	46.9	41.4	32.7	14.9
149	88	2.8	42	60.2	55.3	55.2	52.3	47.4	38.9	21.8

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 14

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Round Diffuser / CRC - A**
DIFFUSER (FACE) SIZE:	**Ø 345mm**
DIFFUSER (NECK) SIZE:	**Ø 250mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
119	22	2.4	22	48.7	44.0	37.5	29.8	20.7	<15.5	<10.6
139	30	2.7	27	50.3	47.4	43.0	34.6	27.1	17.6	<10.7
154	37	3.1	32	50.6	48.9	46.7	37.5	31.2	21.0	<10.9
198	61	3.9	37	56.8	52.8	52.0	47.2	41.3	32.7	15.4
220	77	4.4	42	59.7	55.4	55.6	52.4	46.3	38.1	22.7

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 15

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Round Diffuser / CRC - A**
DIFFUSER (FACE) SIZE:	**Ø 395mm**
DIFFUSER (NECK) SIZE:	**Ø 300mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
101	14	2.9	18	<44.6	40.8	32.0	22.6	<15.4	<13.8	<10.5
124	21	3.5	23	46.8	44.5	38.6	29.5	20.9	<15.0	<10.5
138	26	3.9	27	47.8	45.6	42.6	33.5	27.0	<17.1	<10.5
167	38	4.6	35	51.4	48.4	49.5	40.6	34.7	25.3	<11.5
214	62	5.9	41	55.6	52.0	55.5	51.4	44.6	36.1	18.5

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 16

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Linear Bar Grille / LFB - A**
GRILLE (FACE) SIZE:	**900mm x 95mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
231	19	>7	21	<41.9	39.0	36.9	29.9	23.0	18.5	<11.7
246	22	>7	24	<43.2	39.8	39.2	32.8	26.2	21.0	<12.5
283	30	>7	28	44.1	44.7	43.3	38.6	32.4	28.5	15.9
325	40	>7	33	46.7	47.6	47.8	42.9	37.4	34.1	21.1
400	63	>7	39	53.0	51.8	53.2	48.6	44.8	42.0	29.8

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

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PROJECT ENGINEER

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N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 17

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Linear Slot Diffuser (2-slots) & Plenum Box / LFS - A**
DIFFUSER (FACE) SIZE:	**128mm (W) x 1200mm (L)**
PLENUM SIZE:	**182 mm x 116 mm x 1197 mm**
PLENUM NECK (INLET) SIZE:	**260mm x 112mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
92	26	2.4	21	<43.1	37.8	36.4	28.5	20.0	<14.6	<10.7
105	33	2.8	26	<42.8	42.3	41.3	34.4	27.3	18.0	<10.9
134	55	3.6	32	45.4	48.8	47.6	42.6	37.5	30.3	<12.7
158	77	4.3	38	48.3	53.1	52.3	47.1	43.2	37.4	18.0
183	103	5.0	42	51.6	56.6	55.9	51.2	48.1	43.7	25.3

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 18

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY:	**FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY:	**VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE:	**MARCH 2011**
CLIENT:	**FLEX DUR TECHNOLOGY SDN BHD**
UNIT:	**Linear Slot Diffuser (3-slots) & Plenum Box / LFS-A**
DIFFUSER (FACE) SIZE:	**175mm (W) x 1200mm (L)**
PLENUM SIZE:	**182 mm x 162 mm x 1197 mm**
PLENUM NECK (INLET) SIZE:	**315mm x 135mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
128	20	3.8	20	<42.4	38.6	36.0	27.2	17.7	<14.3	<10.9
160	32	4.8	25	<43.6	44.4	42.0	35.5	28.5	18.7	<11.1
179	41	5.4	30	44.6	47.0	45.1	39.1	33.0	24.4	<11.5
212	58	6.4	35	47.4	51.4	49.8	44.9	40.3	33.4	15.1
259	88	>7	41	52.7	57.2	56.1	51.4	48.5	43.8	25.4

LEGEND

Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
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N.A.T.A. SIGNATORY

TEST CERTIFICATE No. 19

ACOUSTIC AND AIRFLOW PERFORMANCE TEST

SUPPLIED BY: **FLEX DUR TECHNOLOGY SDN BHD**
TESTED BY: **VIPAC ENGINEERS & SCIENTISTS PTY LTD**
TEST DATE: **MARCH 2011**
CLIENT: **FLEX DUR TECHNOLOGY SDN BHD**
UNIT: **Double Deflection Air Grille / RVD - A**
GRILLE (FACE) SIZE: **600mm x 200mm**

TEST CONDITIONS				**SOUND POWER LEVEL**, dB re 1E-12w OCTAVE BAND CENTRE FREQUENCY (Hz)						
Qs (L/s)	Ps (Pa)	T (m)	NC	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
282	31	6	20	44.7	38.9	36.0	30.9	26.7	22.4	<13.4
323	54	7	25	46.6	43.6	41.0	35.8	31.5	27.7	16.3
360	75	>7	29	50.3	46.7	44.4	39.6	34.9	31.0	19.6
400	101	>7	33	52.6	49.7	47.9	43.4	39.0	35.0	23.6
454	137	>7	37	57.3	52.8	51.6	47.7	43.7	40.2	27.6

LEGEND
Qs - Primary Air Flow Rate (L/s)
Ps - Supply Static Pressure (Pa)
< - Insufficient margin above background noise to allow accurate determination
NC - Noise Criterion based upon room absorption of 10 dB
T - Horizontal Throw in meters at terminal velocity of 0.25m/s

BRYAN DALZIEL
PROJECT ENGINEER

ZARKO DRINIC
N.A.T.A. SIGNATORY