CST Environmental & Acoustic Consultants

Environmental Report
(Acoustics & Odour Control Revision 1)

29 - 30 High Holborn
London
WC 1V 6AX

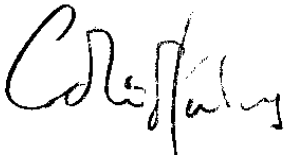
Prepared by Colin Stanbury
MCIEH.AMIOA.FRSH.DMS

September 2013

15 Piquet's Way, Banstead, Surrey SM7 1AB
Telephone: 01737 373868
Fax : 01737 851 795

Issue 2.0

Contents **Page**



Report Prepared by: **… ……..**

Checked by:……LDS
Date:……6th September 2013

1.0 Introduction

1.1 This revised report should be read in conjunction with our original report (June 2013) in support of a forthcoming Town Planning application for A 3 use (Restaurant) with cooking and other kitchen services. It presents revised calculations and assessments and is in response to requests from the local planning authority to:

(i) re calculate noise impacts following a joint site visit in August 2013 when it was discovered that potentially sensitive residential accommodation existed both closer to and differently located to that accounted for in our original submission.

(ii) Incorporate design changes to the proposed kitchen extract plant so as to incorporate a system of active odour control. In discussion with David Barker Heating Engineers it is now proposed to incorporate a Trion T4002 Electrostatic precipitator into the design.

1.2 The baseline local sound environment has been determined from a measurement survey undertaken by ourselves in December 2009. From recent visits to the site there does not appear to have been any development since this time that might have resulted in the measurement data becoming out of calibration.

1.3 Photographs at Appendices ii and v show the revised receptor positions.

2.0 Details of Proposals

2.1 A detailed specification for the restaurant and kitchen extract plant has been prepared by David Barker Building Services Engineer and incorporated into a design scheme prepared by architects Draper Neal Associates. Relevant extracts of the revised (September 2013 drawings are appended at Appendix v to this report).

2.2 It is still proposed to construct a new brick clad vertical flue to serve basement kitchen extract fans and motors. These will continue to be located externally on the rear elevation of the subject building. The plant will be visually screened at roof deck level

2.3 There will continue to be 2 No. potential sources of mechanical noise fixed plant associated with the restaurant use. The Trion ESP will be a ducted "in line" unit located internally. The incorporation of this extra plant will not represent a new and additional noise source but it will however cause an additional pressure drop on the main kitchen extract fan (VST "T" line). To counteract this the fan will need to operate at slightly higher fan speed (approx 2235rpm) to the original design and in turn this will result in some marginal increase in noise emission from this unit. The changes are accounted for in the revised noise calculations at section 10 (appendix 4).

2.4 The proposed plant comprises as before:

(a) 1No. VEX Max 17 or equivalent Air Handling Unit (AHU) which provides make up air and extracts vitiated air both from the basement and ground floors.

(b) 1 No. VES "T Line 120" extract fan serving the kitchen.

2.5 Noise Mitigation In line attenuators are to be fitted to the kitchen extract outlet as well as to both the inlet and outlet of the AHU. The kitchen extract fan will also be fitted with attenuators supplied by VES. The AHU attenuators will be standard Woods or equivalent at 1150mm length with 150mm internal spacing. The relevant insertion losses are as detailed in our calculation spreadsheet which is to be found at appendix iv.

2.6 Odour Control - To deal with concerns about residual odours and fumes it is proposed to install an in line ducted Trion Electrostatic Precipitator (Model T4002). Exhaust air will be ducted via a new full height flue on the rear elevation as shown on the amended drawings. The flue will be brick with a stainless steel liner. The construction form will provide excellent sound insulation, virtually eliminating any perceptible sound break out at high level.

2.6 The following table sets out a schedule of proposed external mechanical plant /machinery. Extracts from manufacturers data sheets are to be found at appendix vi

Table 1 List of Proposed External Plant (Potential Noise Generating)

Plant	Location	Type / Manufacturer	Data Sheet Provided ?	Report Reference
Supply Air Handling Unit	First Floor Rear Roof	VES Max 17	√	Appendix iv & vi
AHU discharge Attenuator	First Floor Rear Roof	VES	√	Appendix iv & vi
Air Handling Unit Casing	First Floor Rear Roof	VES	√	Appendix iv & vi
Kitchen Extract	First Floor Rear	VES T Series	√	Appendix iv & vi
Attenuators suction and discharge with a length of 1150mm	First Floor Roof	Woods	√	Appendix iv & vi

3.0 Local Noise Standards

3.1 LB Camden has published and adopted local policies in relation to protection of amenity in the borough. Within the 2010 Local Development Framework policy DP 28 makes special reference to noise.

3.2 For ease of reference Table E of DP 28 is reproduced below:

Table E: Noise levels from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dB$_{LAeq}$

Extract - DP 28 Table E

4.0 Noise Survey

4.1 A noise survey was undertaken at the subject property from 16th - 17th December 2009. Measurements commenced just after 14:45 hrs on 16th December and were collected continuously until around 14:10 hrs on Thursday 17th December. A recent site inspection did not reveal reason for suspecting that the data collected in 2009 might now be out of calibration.

4.2 A Svantek 959 integrating sound level meter / noise analyser was used for the measurements (serial number 11229). The meter has traceable calibration and was further calibrated using a Castle Associates calibrator (serial number 0500301) both before and directly after the measurement period – no drift in calibration was found to have occurred.

4.3 The weather was dry and fine for most of the survey period with a slight northerly breeze. Some light snow fell from around 12:00 hrs on the 17th December but this does not appear to have adversely affected the measurement results which conform to expected patterns for a central London location.

4.4 A single survey point was established at 1st floor level to the rear of 31- 33 High Holborn. This point was chosen as a good surrogate for the local sound environment. Photograph 1 shows the survey point. The survey location is also marked up on an aerial photograph of the site shown at Appendix iii. Measurement data are set out in graphical format at Table 2 below. Sound levels are expressed in terms of "A" weighted decibels.

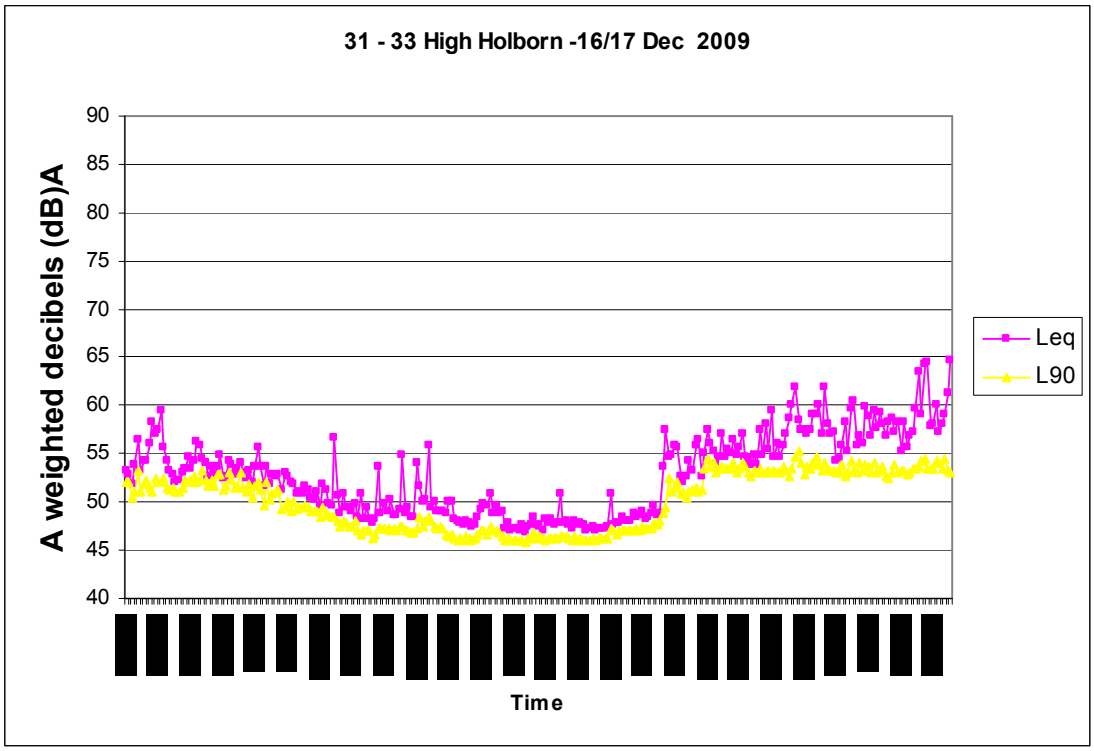


Table 2 Noise Survey Results

5.0 Discussion of Results and Calculations

5.1 In common with most of central London, the local sound environment is influenced to a material degree by road traffic, even though the rear of the property is shielded from the direct effect of main road traffic on High Holborn.

5.2 The next part of the assessment is to examine the survey results and to suggest appropriate noise criteria in order to meet the local standards as set out in section 2 above.

5.3 The starting point is therefore to identify the lowest recorded background or L_{A90} level from the survey data. The survey data revealed a typical steady daytime background noise level of 53dBL_{A90}. At around 21:00 hrs background levels reduced to 46dBL_{A90} - a level which again remained reasonably constant just after 04:00 hrs when background levels rose as a result of increased road traffic locally.

5.4 Having established the baseline background noise environment (L_{A90}) it is then possible to calculate the noise impact of the proposed plant on the nearest sensitive receptors. Finally the predicted impacts can be compared to the local standards set out in DPD 28 (Table E) which are set out at paragraph 3.2 above.

5.5 An impact Assessment is shown in tabulated form below. Standard acoustic sound level prediction formulae are used to derive noise emission standards for the new plant.

5.6 The following table sets out a summary impact assessment of the proposed plant in noise terms. The detailed calculations that underpin the assessment have been undertaken using an in house spreadsheet. Printouts of the calculations are appended as appendix iv.

Table 3 – Impact Assessment

Receptor	**Impact**
5th Floor Rear windows of No 31 – 33 High Holborn (Nearest Residential receptor)	Baseline Sound Data Night Time (23:00 - 07:00) Background Level recorded = **46.0**dBL_{A90} Daytime (07:00 - 23:00) Background Noise Level recorded **53.0**dBL_{AeqT} LBC requirements Night – to meet background minus 10dB @ 1m from façade of nearest sensitive receptor: Maximum permitted plant sound emission Level (23:00 - 0700) = 46 – 10 = **36d**B(A)@ 1metre from receptor Day – to meet background minus5 dB @ 1m from façade of nearest sensitive receptor: Maximum permitted plant sound emission Level (07:00 - 23:00) = 53 -5 = **48** dB(A)@ 1metre from receptor Calculated Impact @ nearest sensitive receptor (d= 16m)[1] (i) Proposed 1st Floor Plant - AHU Sound Emission (from manufacturers datasheet)* = 29.0dBLAeqT @ 16m - (from calculation spreadsheet) Ref: appendix iv (ii) Sound Emission from Inlet (Suction) Sound Emission (from manufacturers datasheet)* =261dBLAeqT @ 11m - (from calculation spreadsheet) Ref: appendix iv (iii) Sound Emission from Discharge Sound Emission (from manufacturers datasheet)* = 28.7dBLAeqT @ 11m - (from calculation spreadsheet) Ref: appendix iv (iv) 1st Floor Plant - Kitchen Extract Sound Emission from casing (from manufacturers datasheet) = 28.7BLA_{eqT} at receptor (see calculation spreadsheet)

[1] * attenuation is derived from standard formula for hemispherical propagation from a point source of 20* log d1/d2 where d1 = 1 meter (from source) and d2 = distance

Receptor	Impact
	(v) Proposed Flue = New Brick Flue taken above roof level (Sound breakout therefore negligible) Total sound emission from new plant = i+ ii + iii + iv = **34.3**dBL_{Aeq} Daytime Result -34.3dB(A) - 48dB(A) = 13.7dB(A) below design criteria = **PASS** Night time Result - 34.3dB(A) - 36dB(A) = 1.7dB(A) below design criteria = **PASS** Compliance with LBC local standards for fixed plant day and night

6.0 Conclusions

6.1 An updated and revised environmental assessment for proposals to permit restaurant use for the basement and ground floors together with kitchen facilities at the subject property has been carried out.

6.2 This assessment has demonstrated that it will be possible to comply with LBC noise standards with confidence.

6.3 The installation of full air handling and extract mechanical plant together with the construction of a full height brick clad flue to the rear of the subject property will effectively deal with the potential impact of cooking fumes and odours from the proposed scheme on the nearest sensitive receptors.

7.0 Appendix i – Glossary of Acoustic Terms

7.1 Noise is measured in decibels (dB). To establish a reference framework it is useful to consider two noise levels which are at the extreme ends of the range to be considered. At the low end, 35 to 40 dB (A) is the normal noise level in a quiet living room, 35 dB (A) is the noise level given as a target for suburban bedrooms by the Wilson Report; a government report on noise published in 1963. At the high end is the noise level experienced at the pavement edge of a busy city centre street, a level of 75 to 80 dB (A).

7.2 The sensitivity of the human ear varies with pitch or frequency. The designation "A" used in this assessment simply means that the noise level was measured using a meter which is able electronically to respond very closely to the performance of the human ear.

7.3 Decibels are measured using a logarithmic scale, and therefore two numerically equal values cannot be added together arithmetically. Two equal noise levels occurring together form a new level which is 3 dB (A) higher than either alone. Thus two identical vehicles each producing 65 dB (A) outside someone's window will produce, not 130 dB (A), but 68 dB (A) if both engines are running together at the same distance from the microphone.

7.4 If one source of noise is 10 dB (A) below an adjacent louder source, then the combined effect will be virtually no different to the louder one alone.

7.5 Experiments have shown that most people will indicate that a noise has become twice as loud, when on a measuring meter it has risen by about 10 dB (A). Also it is generally accepted that a difference in 3 dB (doubling in energy terms) is the smallest incremental step that can be distinguished by the average human ear.

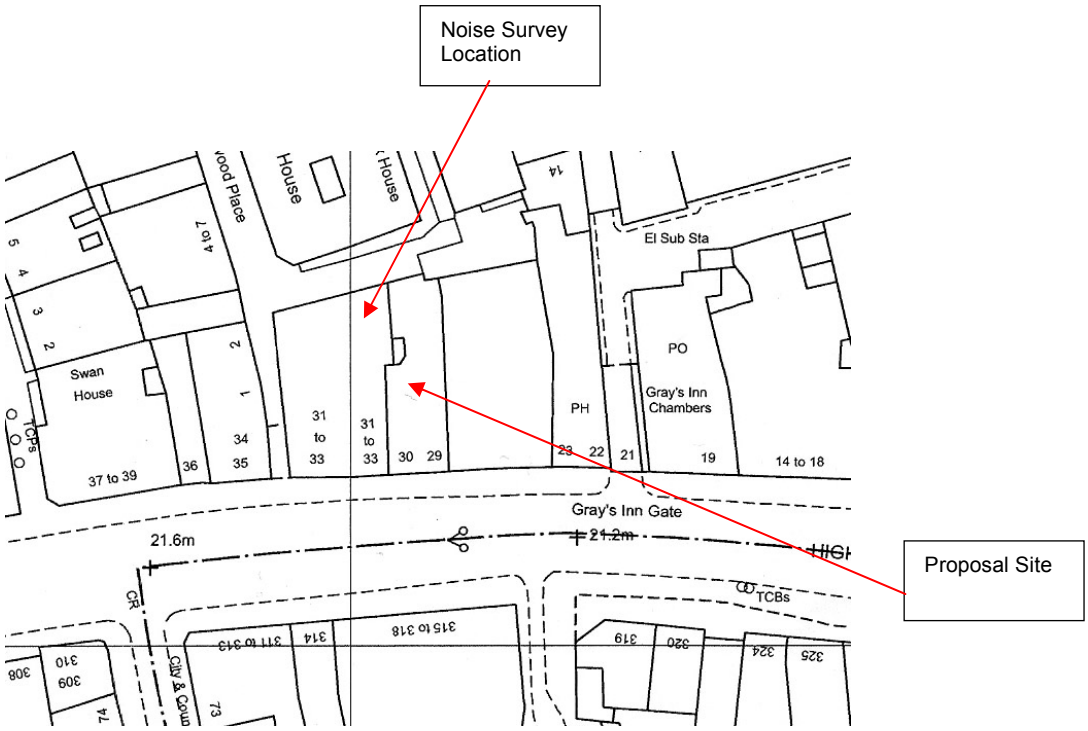
7.6 Some additional acoustic terms are also referred to in this report. These are:

L_A90. This is the noise level exceeded for 90% of a time interval T. L_A90 and it is termed background noise level. It is effectively a measure of the minimum noise level which is experienced in the absence of specific noisy events such as brake squeal or engine backfire.

$L_{Aeq(T)}$ is the equivalent continuous noise level over a time T, which can be described as the "energy - average" noise level.

L_A max is the highest noise level recorded by the measuring meter during a single event e.g. overlying aircraft. In this assessment the meter was set to "slow" response.

8.0 Appendix ii – Location Plan



9.0 Appendix iii - Photographs

Aerial View of Site - Showing Noise Survey Location

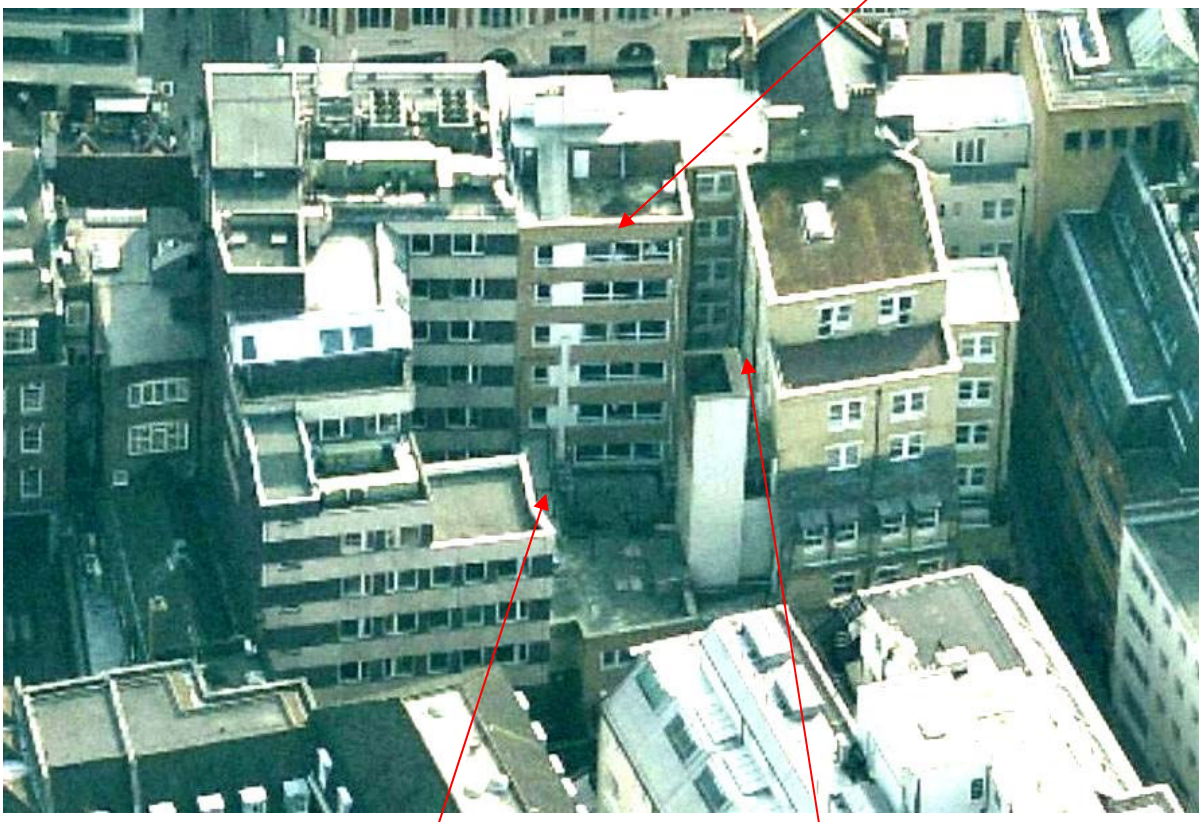
Photograph 1

31 – 33 High Holborn - noise survey position

Photograph 2 - 29 - 30 High Holborn - Rear Elevation Existing Ventilation plant and flue

Photograph 3 - Nearest residential receptor

Photograph 4 - Bird's Eye View



10.0 Appendix iv –Calculations and Plant Specification

Table 4 Calculation Spreadsheet Printout

Title **29 - 30 High Holborn**

VES TLL 400/2/3 Kitchen Extract

Instructions - enter octave band levels as required. Delete unused lines. A-weighted level is automatically calculated

Addr.	**31.5**	**63.0**	**125.0**	**250.0**	**500.0**	**1k**	**2k**	**4k**	**8k**
SWL		77.0	81.5	86.0	86.5	83.0	79.0	74.5	70.0
Distance		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Q Factor									
1		45.2	49.7	54.2	54.7	51.2	47.2	42.7	38.2
2		48.2	52.7	57.2	57.7	54.2	50.2	45.7	41.2
4		51.2	55.7	60.2	60.7	57.2	53.2	48.7	44.2
8		54.2	58.7	63.2	63.7	60.2	56.2	51.7	47.2
Insertion Loss		12.0	16.0	28.0	33.0	43.0	47.0	54.0	51.0
SPL		51.2	55.7	60.2	60.7	57.2	53.2	48.7	44.2
A correction		*26.0*	*16.0*	*9.0*	*3.0*	*0.0*	*-1.0*	*-1.0*	1.0
A Spectrum		13.2	23.7	23.2	24.7	14.2	7.2	-4.3	-7.8
Total dBA									
Total dBA		**29.0**							

Title **29 - 30 High Holborn**

AHU VES Max 17 case emsission

Instructions - enter octave band levels as required. Delete unused lines. A-weighted level is automatically calculated

Addr.	**31.5**	**63.0**	**125.0**	**250.0**	**500.0**	**1k**	**2k**	**4k**	**8k**
SWL		75.0	74.5	71.0	69.5	68.0	66.0	62.0	58.0
Distance		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Q Factor									
1		43.2	42.7	39.2	37.7	36.2	34.2	30.2	26.2
2		46.2	45.7	42.2	40.7	39.2	37.2	33.2	29.2
4		49.2	48.7	45.2	43.7	42.2	40.2	36.2	32.2
8		52.2	51.7	48.2	46.7	45.2	43.2	39.2	35.2
Insertion Loss		9.0	11.0	14.0	28.0	29.0	28.0	28.0	28.0
SPL		40.2	37.7	31.2	15.7	13.2	12.2	8.2	4.2
A correction		*26.0*	*16.0*	*9.0*	*3.0*	*0.0*	*-1.0*	*-1.0*	1.0
A Spectrum		14.2	21.7	22.2	12.7	13.2	13.2	9.2	3.2
Total dBA									
Total dBA		**26.1**							

Combined SPL at Receptor

30.8 dBLAeq(T)

Title **29 - 30 High Holborn**

AHU VES Max 17 discharge

Instructions - enter octave band levels as required. Delete unused lines. A-weighted level is automatically calculated

Addr.	**31.5**	**63.0**	**125.0**	**250.0**	**500.0**	**1k**	**2k**	**4k**	**8k**
SWL		75.0	74.0	71.0	69.0	68.0	66.0	62.0	58.0
Distance		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Q Factor									
1		43.2	42.2	39.2	37.2	36.2	34.2	30.2	26.2
2		46.2	45.2	42.2	40.2	39.2	37.2	33.2	29.2
4		49.2	48.2	45.2	43.2	42.2	40.2	36.2	32.2
8		52.2	51.2	48.2	46.2	45.2	43.2	39.2	35.2
Insertion Loss		4.0	7.0	13.0	25.0	32.0	32.0	23.0	15.0
SPL		45.2	41.2	32.2	18.2	10.2	8.2	13.2	17.2
A correction	*39.0*	*26.0*	*16.0*	*9.0*	*3.0*	*0.0*	*-1.0*	*-1.0*	1.0
A Spectrum		19.2	25.2	23.2	15.2	10.2	9.2	14.2	16.2
Total dBA									
Total dBA		**28.7**							

Title **30 High Holborn**

AHU VES Max 17 suction

Instructions - enter octave band levels as required. Delete unused lines. A-weighted level is automatically calculated

Addr.	**31.5**	**63.0**	**125.0**	**250.0**	**500.0**	**1k**	**2k**	**4k**	**8k**
SWL		75.0	74.0	71.0	69.0	68.0	66.0	62.0	58.0
Distance		11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Q Factor									
1		43.2	42.2	39.2	37.2	36.2	34.2	30.2	26.2
2		46.2	45.2	42.2	40.2	39.2	37.2	33.2	29.2
4		49.2	48.2	45.2	43.2	42.2	40.2	36.2	32.2
8		52.2	51.2	48.2	46.2	45.2	43.2	39.2	35.2
Insertion Loss		4.0	7.0	13.0	25.0	32.0	32.0	23.0	15.0

SPL		45.2	41.2	32.2	18.2	10.2	8.2	13.2	17.2
A correction	*39.0*	*26.0*	*16.0*	*9.0*	*3.0*	*0.0*	*-1.0*	*-1.0*	1.0
A Spectrum		19.2	25.2	23.2	15.2	10.2	9.2	14.2	16.2
Total dBA									
Total dBA		**28.7**							

Totals	**dB(A)**
Extract Fan	29.0
AHU Case	26.1
Outlet	28.7
Suction	28.7
Total	**34.3**

Proposed Plant Specification

Air Handling Unit (AHU)

The supply air handling unit is a VES 'MAX' size 17 (data sheet extract attached) operating at 1.16$m^3.s^{-1}$ at an external pressure of 250Pa

The fan is a forward curve belt driven type fan SWL is 81dB. The fan has the following corrected spectrum.

Hz (mid band freq)	63	125	250	500	1k	2k	4k	8k
SWL (dB)	81	81	81	81	81	81	81	81
Correction	-6	-7	-10	-12	-13	-15	-19	-23
SWL (dB)	75	74	71	69	68	66	62	58

The air handling unit casing is available with a number of construction options I have selected 25mm with high density infill and this has the following insertion loss.

Hz (mid band freq)	63	125	250	500	1k	2k	4k	8k
Insertion loss (dB)	9	11	14	28	29	28	28	28

In Line attenuators to be fitted the suction and discharge of the AHU. These to be standard "Woods" (1100mm) or similar which will give the following insertion losses both for outlet and suction.

Hz (mid band freq)	63	125	250	500	1k	2k	4k	8k
Insertion loss (dB)	9	11	14	28	29	28	28	28

Kitchen Extract Fan

A VES "T-Line 120" model TLL400/22-3 is to be installed as shown on the plans. Installation will be designed to run the fan at about 37Hz i.e. 2175rpm. VES data sheet shows the following noise emission characteristics - rounded up the nearest 0.5dB running at 2175revs.m^{-1}

Hz mid band freq	63	125	250	500	1k	2k	4k	8k
dB SWL	76.5	81.5	86	86.5	83	79	74.5	70

The unit will be fitted with an acoustic weather proof casing. VES quote the following insertion loss for the acoustic casing.

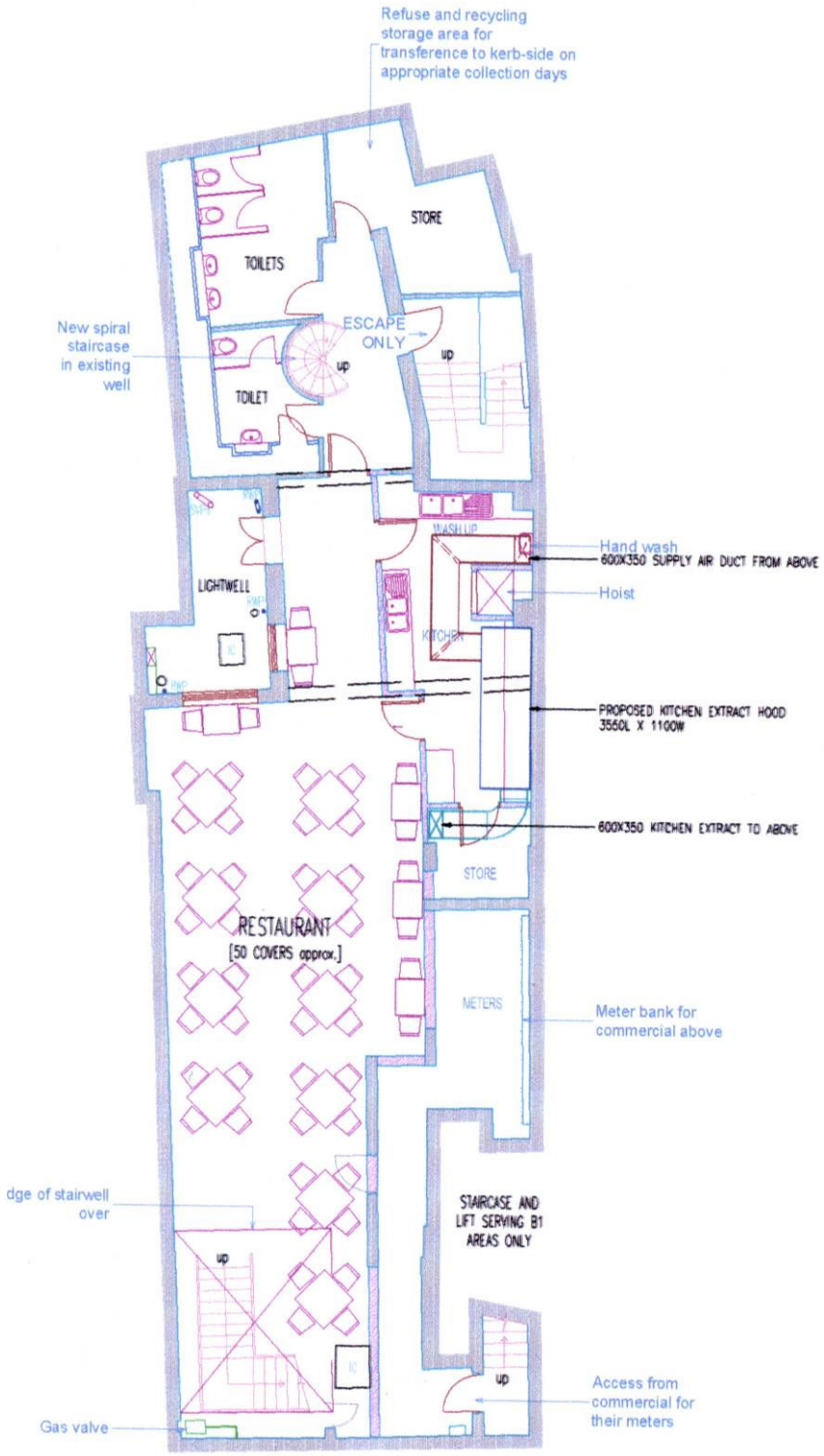
Hz mid band freq	63	125	250	500	1k	2k	4k	8k
Unit 400	12	16	28	33	43	47	54	51

VES cleanable type attenuators will be fitted to the extract fan to match (607H x 1150L - standard length) these have the following insertion loss.

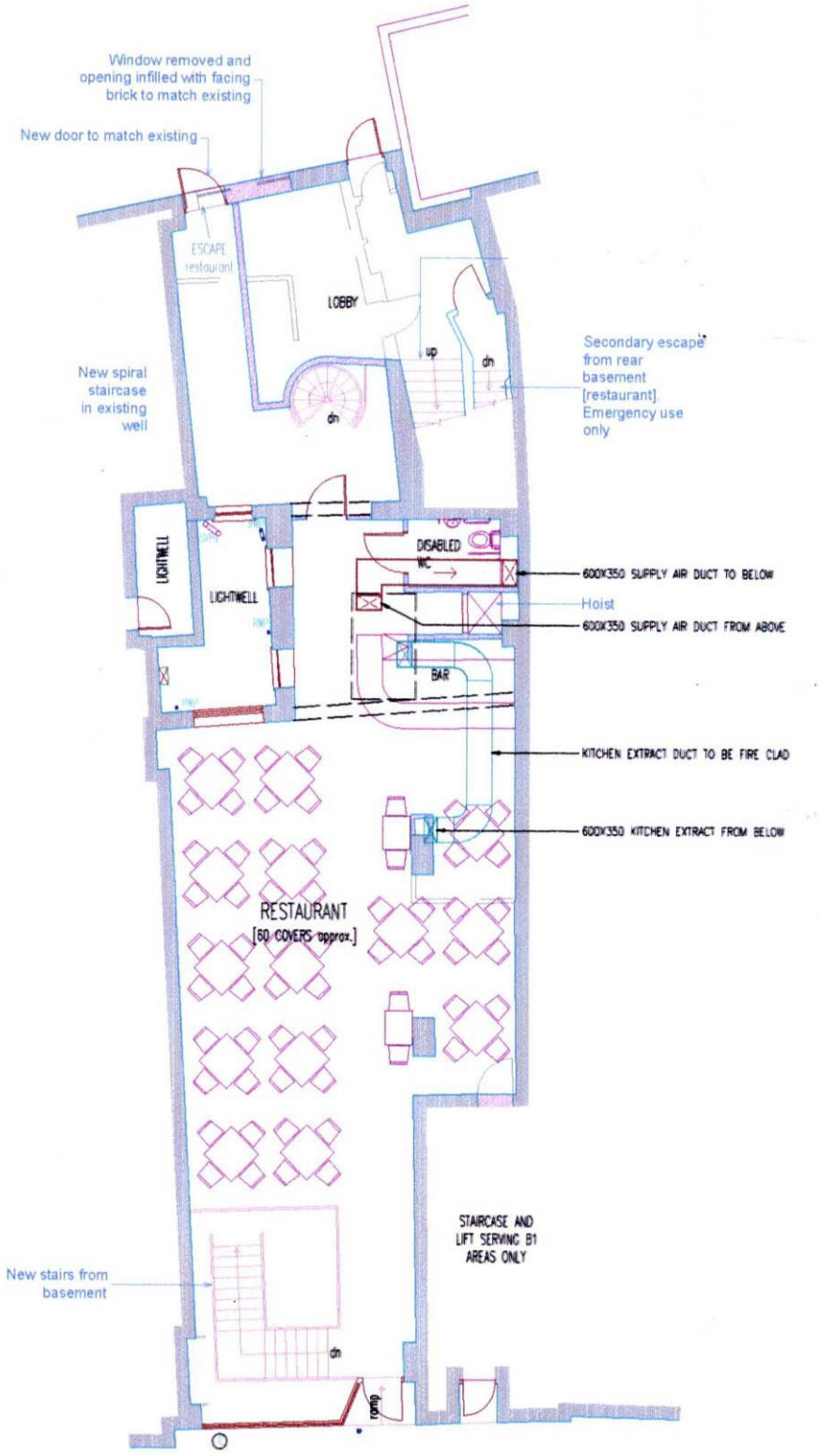
Hz (mid band freq)	63	125	250	500	1k	2k	4k	8k
Insertion loss (dB)	3	6	13	23	29	29	17	10

Air pressure through attenuator is approx. 25Pa.

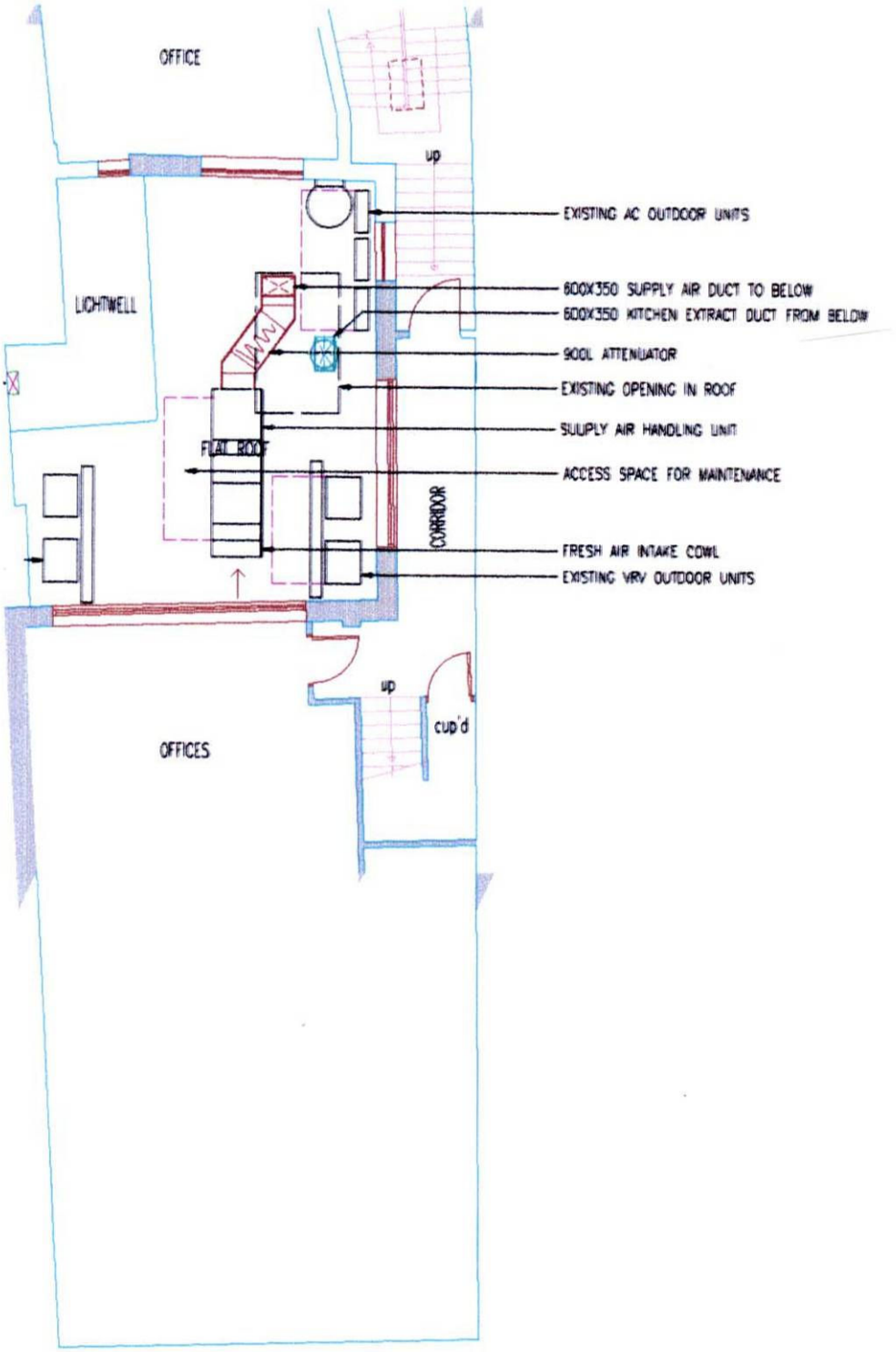
11.0 Appendix v - Kitchen M & E Plant Layout



BASEMENT PLAN AS PROPOSED



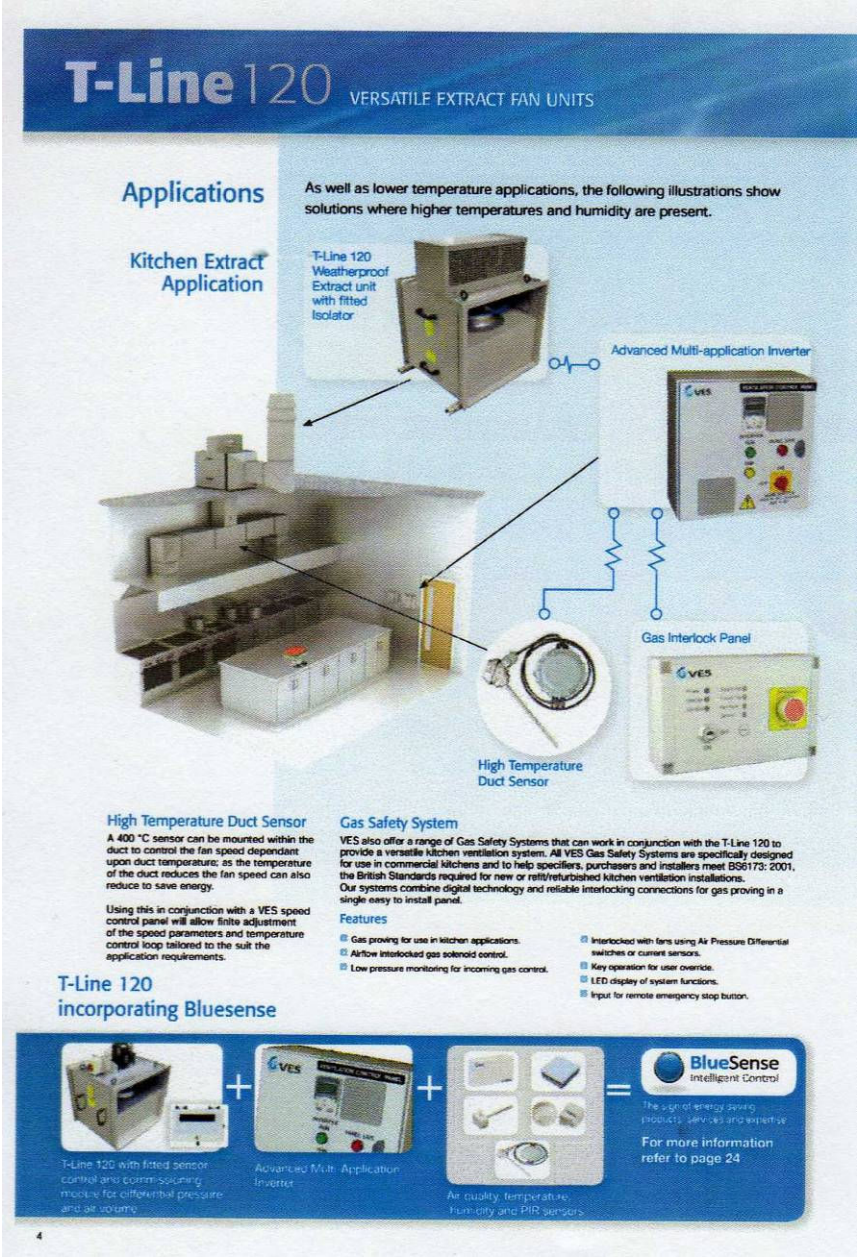
GROUND FLOOR PLAN AS PROPOSED



FIRST FLOOR PLAN AS PROPOSED

12.0 Appendix vi - Manufacturers Data

VES - T Line (Kitchen Extract) - Schematic



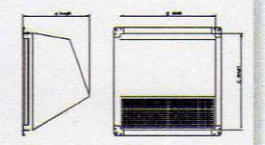
T Line 120 Extract - Schematic Use for Kitchen

T Line Acoustic Information - Silencers

T-Line 120 VERSATILE EXTRACT FAN UNITS

Ancillaries

Horizontal Weather Cowl - CWL



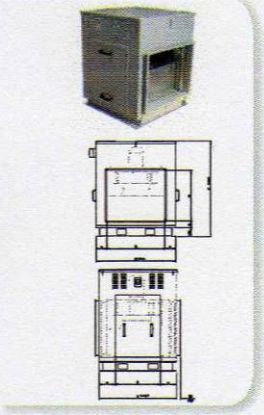
Features & Dimensions

- Suitable for fitting to end of silencers.
- Suitable for fitting to end of units up to 710.
- Supplied with 30mm MEZ frame.
- Powdercoated as standard for external mounting.

Cowl Part No.	Dimensions mm Width	Height	Length	Weight kg
TLLCWL250/H	380	380	300	5
TLLCWL350/2/H*	600	600	350	12
TLLCWL350/4/H	500	500	450	10
TLLCWL400/2/H*	800	800	500	20
TLLCWL400/4/H	700	600	450	14
TLLCWL450/H	750	600	500	16
TLLCWL500/H	800	700	500	19
TLLCWL560/H	850	750	500	20
TLLCWL630/4/H*	1200	1200	600	45
TLLCWL630/6/H	900	800	600	25
TLLCWL710/4/H*	1350	1350	600	50
TLLCWL710/6/H	1100	1000	600	35
TLLCWL800/H*	1500	1500	600	60

Cowl parts marked * are not suitable for fitting direct to the unit.

Acoustic Enclosure



Features & Dimensions

- Internally vibration isolated.
- High quality acoustic liner.
- Suitable for plantroom and external mounting.
- Access doors both sides.

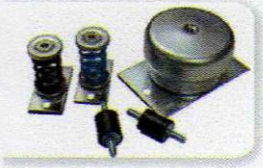
Part Number	Dimensions mm A	B	C (height)	D (width)	E (length)	F	Weight kg
TLLAE250	380	380	970	630	680	91	60
TLLAE350	500	500	1090	750	800	91	100
TLLAE400	700	600	1210	900	900	91	135
TLLAE450	750	600	1285	1223	900	91	170
TLLAE500	800	700	1385	1092	1000	91	215
TLLAE560	850	750	1535	1150	1235	91	255
TLLAE630/4	900	800	1610	1200	1235	111	330
TLLAE630/6	900	800	1610	1200	1235	111	330
TLLAE710/4	1100	1000	1785	1300	1335	111	390
TLLAE710/6	1100	1000	1785	1300	1335	111	390
TLLAE800	1250	1050	1970	1500	1485	111	690

Note: Enclosure weights include the weight of the T-Line unit.

Acoustic Enclosure Insertion Loss Table

	Sound Spectrum dB re 10^{-12} w PWL Centre Frequency Hz 63	125	250	500	1k	2k	4k	8k
TLL250 - TLL450	12	16	28	33	43	47	54	51
TLL500 - TLL800	14	22	32	34	39	45	51	52

Anti Vibration Mounting Kit



Features & Dimensions

- Spring or rubber AV mounts dependent on unit size.
- Double flex flange.
- Separate kits for units with bottom inlet.

AHU - VES Max - Acoustic Information - 1

Spectrum Calculation Example

To calculate the sound power level for a given unit take the dBW from the power Level Guide table on page 34 and subtract the Spectrum Correction.
The following worked example is for a Max size 20 fitted with direct drive plug.

Centre Frequency Hz	63	125	250	500	1k	2k	4k	8k
Fan dBW	80	80	80	80	80	80	80	80
Spectrum Correction	-12	-8	-5	-5	-10	-14	-19	-23
Resultant Sound Power Level	68	72	75	75	70	66	61	57

Casing Insertion Loss

A range of case and frame options are available to reduce noise breakout.

Construction	Centre Frequency Hz							
	63	125	250	500	1k	2k	4k	8k
25mm Standard Case	8	10	12	26	29	27	27	26
25mm Case with high density infill	9	11	14	28	29	28	28	28
25mm Case with high density infill & heavy weight infill	11	12	15	29	30	29	29	30
50mm Standard Case	13	17	18	35	39	39	38	38
50mm Case with 50% mineral wool & 50% high density infill	17	19	22	38	41	42	43	42
50mm Case with 50% mineral wool & 50% high density infill & heavy weight infill tubes	19	22	25	40	42	43	43	42

Note: Alternative case construction and infill available for further case insertion loss.

Case Breakout Example

To calculate the insertion loss for the AHU casework subtract the insertion loss from the Casing Insertion Loss table above from the Resultant Sound Power Level.
The following worked example is for casing breakout for a 50mm standard infill using the Resultant Sound Power Level from calculation example above.

Calculated Sound Power Level	68	72	75	75	70	66	61	57
Insertion Loss	-13	-17	-18	-35	-39	-39	-38	-38
Casing Breakout	55	55	57	40	31	27	23	19

Attenuation due to distance

Deduct 20 x log + 8 dB from noise at source.

When D = distance in metres
D ≤ 5m -4dB

∴ Attenuation at 12 metres is 30 dB.
This figure can be applied to each frequency band.

Rule of thumb - noise decreases at the rate of 6 dB per doubling of distance from a source.

3 metres	14 dB
6 metres	24 dB
12 metres	30 dB
24 metres	36 dB
48 metres	42 dB

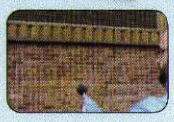
35

AHU - VES Max - Acoustic Information - 2

Max® BESPOKE AIR HANDLING UNITS

Acoustic Information

Fan noise levels vary with size, speed, fan type, absorbed power and pressure generated. The following sound power levels are provided as a guide for each unit based on mid-duty point for Direct Drive and Belt Drive fans, with filter, heater, cooler and an external resistance between 150 and 350 Pa depending on unit size.
The VES sales office will provide an accurate sound spectrum for all units.



Power Level Guide

MAX Model		150 Pa External									
		1	2	3	4	5	6	7	8	9	10
Direct Drive	Plug	N/A	N/A	75	N/A	70	74	72	73	73	74
	Rotor Motor	70	69	78	69	78	80	76	76	76	76
Belt Drive	Forward Curved	N/A	N/A	N/A	N/A	N/A	N/A	75	77	75	76
	Backward Curved	N/A	N/A	N/A	N/A	N/A	N/A	82	84	80	81

MAX Model		250 Pa External									
		11	12	13	14	15	16	17	18	19	20
Direct Drive	Plug	79	79	79	80	80	79	80	81	79	80
	Rotor Motor	75	75	76	76	76	79	79	89	89	84
Belt Drive	Forward Curved	80	79	80	81	81	81	81	83	83	81
	Backward Curved	84	84	84	86	87	85	86	79	76	85

MAX Model		250 Pa External									
		21	22	23	24	25	26	27	28	29	30
Direct Drive	Plug	80	70	86	81	83	82	82	84	82	83
	Rotor Motor	87	N/A	95	88	86	86	85	86	86	86
Belt Drive	Forward Curved	83	85	88	84	84	86	85	85	85	90
	Backward Curved	85	85	76	85	86	86	85	86	86	N/A

MAX Model		250 Pa External									
		31	32	33	34	35	36	37	38	39	40
Direct Drive	Plug	85	84	84	84	83	85	88	87	86	88
	Rotor Motor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Belt Drive	Forward Curved	88	87	89	90	93	88	92	89	90	94
	Backward Curved	N/A	N/A	N/A	N/A	94	88	94	90	90	90

MAX Model		350 Pa External									
		41	42	43	44	45	46	47	48	49	50
Direct Drive	Plug	85	88	93	89	92	95	96	98	97	100
	Rotor Motor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Belt Drive	Forward Curved	97	95	94	96	99	98	97	99	98	100
	Backward Curved	95	97	95	96	99	101	97	96	98	97

Spectrum Correction

These corrections will give a sound power level spectrum in dB (re 10^{-12}wPWL).
To obtain the NR level within a conditioned space or at a given distance acoustic analysis calculations are necessary. VES engineers will be pleased to give advice on this and with any necessary silencer selections.

MAX Model	Centre Frequency Hz	63	125	250	500	1k	2k	4k	8k
Direct Drive	Plug	-12	-8	-5	-5	-10	-14	-19	-23
	Rotor Motor	-6	-3	-8	-10	-15	-17	-20	-18
Belt Drive	Forward Curved	-6	-7	-10	-12	-13	-15	-19	-23
	Backward Curved	-4	-6	-7	-9	-11	-15	-19	-23

34

AHU Attenuator Acoustic Information - Standard "Woods" specification

TABLE 7.2
Attenuation by 200 mm thick sound absorbing splitter modules in a duct

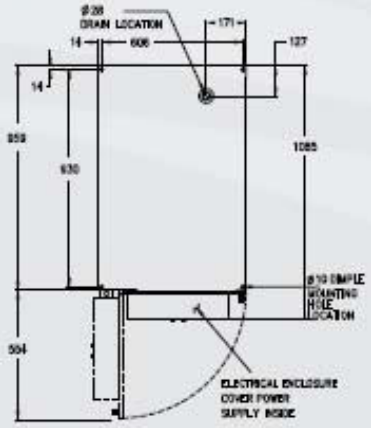
Length mm	*Air passage width mm*	*Attenuation in dB in octave bands Hz*							
		63	125	250	500	1000	2000	4000	8000
900	50	8	16	27	45	55	55	55	50
1200	50	10	20	36	55	55	55	55	55
1500	50	13	24	42	55	55	55	55	55
1800	50	15	30	51	55	55	55	55	55
2100	50	17	34	55	55	55	55	55	55
2400	50	19	38	55	55	55	55	55	55
900	75	6	11	19	34	45	45	39	28
1200	75	7	14	26	46	55	55	52	38
1500	75	9	17	30	48	55	55	55	42
1800	75	10	20	34	50	55	55	55	46
2100	75	12	23	40	55	55	55	55	55
2400	75	13	26	45	55	55	55	55	55
900	100	5	9	16	30	39	39	31	26
1200	100	6	12	23	40	51	51	41	29
1500	100	8	15	26	43	53	53	45	32
1800	100	9	17	30	47	55	55	49	36
2100	100	11	20	35	55	55	55	55	43
2400	100	12	23	40	55	55	55	55	47
900	125	4	7	13	25	32	32	23	15
1200	125	5	9	19	33	42	42	30	18
1500	125	7	12	22	38	47	47	34	20
1800	125	8	14	26	43	52	52	39	23
2100	125	9	17	30	50	55	51	46	28
2400	125	10	19	34	55	55	55	52	32
900	150	3	6	11	20	25	25	15	8
1200	150	4	7	15	26	23	33	19	11
1500	150	5	9	18	33	41	41	24	13
1800	150	6	11	22	39	49	49	29	16
2100	150	7	13	26	45	55	55	34	19
2400	150	8	15	29	52	55	55	39	21

Electrostatic Precipitator - Trion 4002

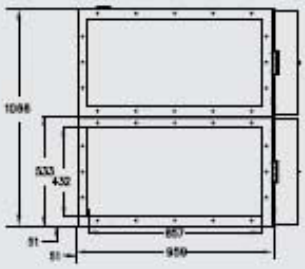
Air Boss® T4002 Specifications

T4002	
Dimensions	635L x 1065W x 1073H mm
Installation	Free Standing, Wall or Frame Mounted
Unit Weight	160 kg
Input Voltage	230Vac/1phase/50 Hz
Cell Power	100 watts
Output Voltage	12 kV/6 kV
No of cells	4
Cell Weight	15 kg
Air Volume	4420 - 6640 m³/hr
Controls	On/Off Switch with Indicator
Pre-filter	Aluminum Standard Mesh (Optional Impinger)
Primary Filter	Electronic Ionizer/Collector Cell
After Filter	Optional Disposable Charcoal After Filter
Power Supply	High Frequency Solid State Design
Efficiency	To 95% Based on D.O.P. Test Method To 99% for Double Pass (Calculated)
General	Multiple Units Can Be Joined Together for Increased Volume or Efficiency

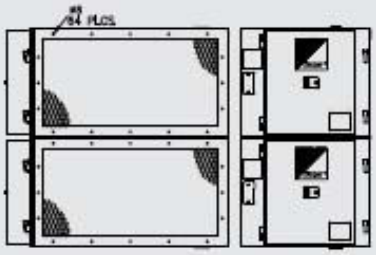
Top View



Discharge End



Front View & Intake End



4 www.trion.co.uk

Engineered Solutions For Clean Air

The Trion® T-Series is ideal for the removal of smoke, fumes, and oil/coolant smoke and mist. The T-Series has the ability to clean contaminated indoor air and recirculate it back to the work area, reducing energy costs by not having to exhaust conditioned air to the outside. Models T1300, T2600 and T5200 can be installed either unducted or ducted for source capture. Models T1001 and T2002 are designed for ducted applications.

Features

- Ceramic Insulators (stand off)
- Solid State Power Supply
- Spiked Ionising Blades
- Extra Depth Collector Cells
- Totally Enclosed Fan Cooled Motor (Blowerd Units)
- Electrical Component Box Mounted out of Air Stream
- Modular Approach for Greater Flexibility

Benefits

- Ceramic Insulators — Out of Airstream for Increased Reliability
- Extra Depth Collector Cell with Greater Dirt Holding/Collecton Capacity
- Spiked Ioniser — No Ionising Wires to Replace, Reducing Maintenance: No Consumable Parts
- High Efficiency — up to 95% on Single Pass and 99% on Double Pass Option (DOP Test Method)
- Permanent Ioniser/Collector Elements — No Consumable Filter Cost; Just Wash, Dry and Reinstall
- Low Pressure Drop (90 Pa — Lower Energy Cost to Operate Compared to Media and Cartridge Units
- Hinged Door Filter Access — Quick & Easy access — No Tools Required

www.trion.co.uk

How it Works

The Trion® T-Series utilizes the principle of Electrostatic Precipitation. Air is drawn by the motor/blower through a washable metal mesh pre-filter which traps large dust particles. The remaining particles, some as small as 0.01 microns, pass into a strong electrical field (ionising section) where the particulate receives an electrical charge. The charged particles then pass into a collector plate section made up of a series of equally spaced parallel plates. Each alternate plate is charged with the same polarity as the particles, which repel, while the interleaving plates are grounded, which attract and collect.