

Survey and Report

of

Kitchen Ventilation System

at

Ribeye SteakHouse

8 First Street

Manchester

M15 4FN

By

SWAN Projects

38 Stanway Road

Whitefield

Manchester

M45 8FX

Survey and Report Of Kitchen Ventilation System

at

Ribeye SteakHouse

8 First Street

Manchester

M15 4FN

Contents

- 1. Introduction & scope of report**
- 2. Existing kitchen ventilation design & standards**
- 3. SWAN Projects re-design**
- 4. Necessary alterations to meet SWAN Projects design**
- 5. References**
- 6. Attachments**

1 Introduction and scope of survey

SWAN Projects is an independently owned business, operating for over 14 years, providing design, installation and ongoing regular service and maintenance of Air Conditioning and many types of ventilation systems, including Kitchen Ventilation System.

All designs of kitchen ventilation systems, carried out by SWAN Projects, are in full accordance with DEFRA Guidelines and the relevant HVCA specifications

The proprietor of Ribeye SteakHouse, has reported that the recently installed kitchen ventilation system, does not operate correctly, in so much that the restaurant fills with smoke, when steaks are on the chargrill, and that the standard of installation is below what was expected.

SWAN Projects therefore have been undertaken, to provide an independent and unbiased report of the existing kitchen ventilation system, particularly the design aspect, and also the standard of installation.

2 Existing Kitchen Ventilation Design

The installed kitchen canopy is 4750mm x 1450mm (face area) and the perimeter condense channel is 2000mm from the kitchen floor.

This is in accordance with HVCA Dw172 spec, sect 4.2.

The canopy is classed as an 'island canopy' which is to say that it is not installed against any wall on any of its 4 x sides.

The canopy has an extract plenum along the full 4750mm length with a single duct connection at one end, and 8 x 500mm x 500mm standard baffle type grease filters.

It has a fresh air plenum along the opposite 4750mm length, again, with a single duct connection at one end, and two 'face diffusers' for the supply of fresh replacement air to the kitchen.

Dealing primarily with the extract system, the extract ductwork is 600mm x 500mm, and fire rated with FireMac coating, is of flanged construction, and enters the plantroom, where the odour control equipment is located.

The Odour Control equipment and filtration equipment comprises a panel pre-filter, 2 x Purified Air ESP4500 modules, stacked one on top of the other, followed by 300mm bag filters, followed by 18 x Site Safe Carbon filter cassettes, each 600mm x 600mm x 200mm (nominal)

The ductwork then proceeds to the cycle store, where the fan and silencers are located, before connecting to the plenum and discharging via the exhaust louvre.

The data plate on the extract fan provides the details of the make/model and supplier of the fan, who were contacted to produce the fan design data (attachment No1)

The fan was supplied by Messrs Northern Fans Ltd, and it is manufactured by ELTA Fans Ltd, and the 'duty' of the fan, or the designated performance of the fan is stated as

4.3m³/s with a pressure of 941pa

The extract volume appears excessively high, mainly because that air volume, through a 600mm x 500mm duct, gives a duct velocity of 15m/s when the DEFRA Guidelines and the HVCA DW172 specification, state a 9m/s maximum for extract air. (sect 15.11)

The system pressure at 941 pascals appears very low, particularly when design duct velocities are extremely high.

The system pressure was re-calculated, at the extract volume of $4.3\text{m}^3/\text{s}$ and the result was 2,310.49 pa, far higher than the 941pa designed.

The installed fan is simply not capable of providing 2,310.49 pascals of pressure, and the fan is therefore teetering on stall for the majority of the time.

The extract air volume is oversized, whilst the system pressure is under-calculated, and below what is required, and this will result in a lack of extraction at the canopy.

As the fresh air system is more powerful than the extract system, the lingering smoke and cooking odours are being 'blown' into the restaurant by the fresh air.

The fresh air system is undersized, in comparison to the extract system, providing $1.65\text{m}^3/\text{s}$ @ 683pa (see attachment No3 for data of installed fresh air fan)

DEFRA Guidelines dictate that fresh air should be up to 85% of the extract air volume, (HVCA DW172 spec. sect 3.1) so the system should be providing $3.65\text{m}^3/\text{s}$ (at the design volume of $4.3\text{m}^3/\text{s}$) and even at the re-calculated extract volume, the fresh air system should be providing 85% of $3.0\text{m}^3/\text{s}$ which is $2.55\text{m}^3/\text{s}$

However, as the current extract system, isn't extracting adequately, the fresh air system is placing the cooking area under a +ive plenum, resulting in the cooking smoke and odours being 'blown' into the restaurant.

There is no form of heating or tempering of the incoming fresh air, when the DEFRA Guidelines and DW172 specification state that the incoming fresh air to a kitchen, should not be below $+10^\circ\text{C}$ (HVCA DW172 spec. sect 6.5)

With outside ambient temperatures often at 0°C and occasionally as low as -5°C during winter time, the incoming fresh air will over cool food that is being prepared, or in the case of grilled steak, being left to 'rest' before serving.

Design Conclusion

The extract fan available pressure, is inadequate, and insufficient to provide any form of acceptable extraction, and should be replaced.

The Odour Control equipment, is incorrectly selected and installed, and will require major revisions.

There are no UV modules, there is only a single pass of ESPs, when a double pass is required for heavy smoke (steak) chargrilling, and at the 'design' extraction rate- 18 site safe carbons will be ineffective, due to the air velocity through them.

3 SWAN Projects re-design

Extract System

There are several ways to arrive at an extract air volume.

Thermal Convection Method

This method is a calculation based on the 'known' cooking equipment, and each item of equipment are allocated a thermal convection coefficient, which is the recommended volume of air to be extracted, in m³/s per m² of surface area of the appliance.

This is in accordance with the HVCA DW172 specification, section 5.3 and DEFRA Guidelines section 4.2.2

Our Thermal Convection calculation is shown on Attachment No 4, and calculates an extract volume of 2.677 m³/s

Canopy Face Velocity Method

This method is a calculation based on the open area of the canopy, multiplied by a factor, depending on the loading of the cooking, and is generally used when the cook-line is not known or specified.

This is in accordance with the HVCA DW172 specification, section 5.5

Light cooking is x 0.25

Medium cooking is x 0.35

Heavy cooking is x 0.5

Based on heavy cooking (steaks and chargrill) the extract volume can be calculated as

Canopy face area (4.75m x 1.45m) = 6.88m² x 0.5 = 3.4m³/s

We have carried out 2 calculations, the Canopy Face Method and the generally more accurate Thermal Convection Method.

The average between these 2 calculations is $3.0\text{m}^3/\text{s}$

With the existing extract ductwork sized at 600mm x 500mm, this extract volume will produce a duct velocity of a much more acceptable $10\text{m}/\text{s}$

We have also carried out a new system pressure calculation, based on $3.0\text{m}^3/\text{s}$ with a result of 1214 pa shown on attachment No 5.

With an established new extract air volume, the fresh air volume is a simple calculation of $3.0\text{m}^3/\text{s} \times 0.8 = 2.4\text{m}^3/\text{s}$

We would propose to install 2 x UV modules, at the canopy, 1 x Purified Air UV1000 and 1 x Purified Air UV500 which will help to break down fats and reduce odours.

We would propose to install a second pass of ESP4500s, adjacent to the existing 'stacked' ESP4500s

This second pass, will reduce smoke and heavy particulate by 95% twice, so should result in only 0.25% of smoke and heavy particulates, passing beyond the ESPs (as opposed to 5% with a single pass)

The bag filters will be removed as they are redundant and unnecessary.

With the revised extract air volume of $3.0\text{m}^3/\text{s}$ the 18 x Site Safe carbon filter cassettes will be sufficient and provide effective filtration of odours

Fresh Air System

The design of the fresh air system, or fresh air volume is quite simple,

It is up to 85% of the extract volume, as per HVCA DW172 spec. sect 6.1

Therefore:-

$$3.0\text{m}^3/\text{s} \times 0.85 = 2.55\text{m}^3/\text{s}$$

We have calculated the fresh air system pressure at approx. 450pa – 500pa but a final calculation would be undertaken, once the form of heating is decided.

The heating of the fresh air can be done either by an electric in-line heater battery or heat pump DX system, with a duct mounted coil, connected to condensing units.

Both systems are fully automatic, and once a temperature has been 'set' at 21°C the incoming fresh air, if below 21°C, will be heated up to the set temperature, by a series of heating stages.

Both systems will operate with ambient temperatures as low as -5°C and will remain dormant if ambients are above 21°C

Electric heating

We would propose to install a 60kW heating coil, with integral controls, and field wiring to fore and aft temperature sensors.

The system would require 400v 3ph mains power supply

DX Heating

We would propose to install a duct mounted DX coil, with high grade copper refrigeration pipework to a range of condensing units, mounted in the loading bay area.

The system would have integral, automatic controls, and would activate the condensing unit in 'stages' dependant upon the heating load required

The system would require 400v 3ph supply to the condensing units

4 Necessary modifications to meet SWAN Projects re-design

Extract System

Replace existing extract fan/silencers with new fan/silencers, and duct mods to suit

Add 2 x Purified Air UV modules at the canopy, connected to the extract duct

Add 2 x additional Purified Air ESP4500 modules, and fire rated ductwork to suit

Remove and omit bag filters, as not necessary.

Add extra fire rated access doors, to meet specifications, for cleaning/inspections.

Add 2 x grease filter blanks to the canopy, to adjust extract zones.

Apply additional internal high temp rated sealant to all necessary joints

Connect new extract fan controller to the existing Gas Safety system

Airflow test to prove the system

Fresh Air System

Replace the existing fresh air fan

Add sound attenuators, fore and aft of the new fresh air fan, with duct mods to suit

Add fresh air heating system (electric or DX) with duct mods to suit

Add thermal insulation between the intake louvre and the heating coil

Connect new fresh air fan controller to the existing Gas Safety system

Airflow and temperature tests to prove the system

Any O & M manual (operating and maintenance) should be updated, with revised drawings and equipment schedules.

If O & M manuals do not exist, then SWAN Projects would create, in accordance with the revised design and layouts.

5 References

HVCA DW144 specification	basic specification for ductwork manufacture and installation and would be relevant to the fresh air supply ductwork system
HVCA DW172 specification	specification for ductwork manufacture and installation for commercial kitchens, and would be relevant for the kitchen extract system
DEFRA Guidelines	guidance for the control of odour and noise from commercial kitchen exhaust systems
HVCA DW TR/17	guide to good practice for the Cleanliness of Ventilation Systems

6 Attachments

Attachment 1 data sheet for existing extract fan

Attachment 2 system pressure calculation for existing extract volume of $4.3\text{m}^3/\text{s}$

Attachment 3 data sheet for existing fresh air fan

Attachment 4 new extract volume calculation, based on thermal convection method

Attachment 5 system pressure calculation for new design extract volume of $3.0\text{m}^3/\text{s}$



Represented by:
ELTA FANS LTD (BUILDING SERVICES)
 Tel: +44 (0)1384 275800 Fax: +44 (0)1384 275810 email: sales@eltafans.co.uk
 46 Third Avenue, Pensnett Trading Estate, Kingswinford, West Midlands DY6 7US, UK
 Version 5.21.11 Copyright © 2010-19 Elta Group

Technical Data - Fan Model SLC560/2-3AC

Location:

Designation:

Please Note: Data shown is nominal - enter more criteria for accurate detail.

Performance - Required

Air Flow : 0.00 m³/s
 Static Pressure : 0 Pa
 Selection Pressure: 0 Pa
 Installation Type: n/a
 Air Density: 1.204 kg/m³
 - Atmos. Temp: 20 °C
 - Altitude: 0 m
 - Humidity: 0.0 %

Actual

Air Flow: 0.00 m³/s
 Static Pressure: 0 Pa
 Total Pressure: 0 Pa

Fan Data

Catalogue Code: SLC560/2-3AC
 Description: Axial Duct

Diameter: 560 mm
 Impeller Type: Axial
 Blade Material: -
 Speed: 2950 r/min @50 Hz
 Power, Abs: -
 Input Power: -
 Efficiency Total: -
 SFP: -

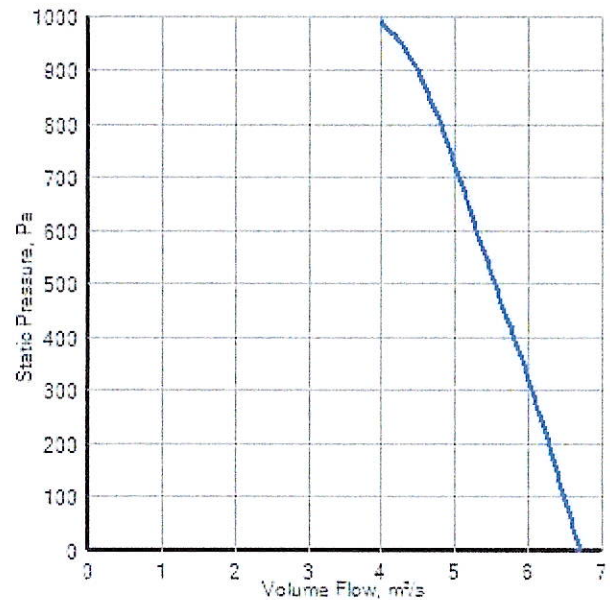
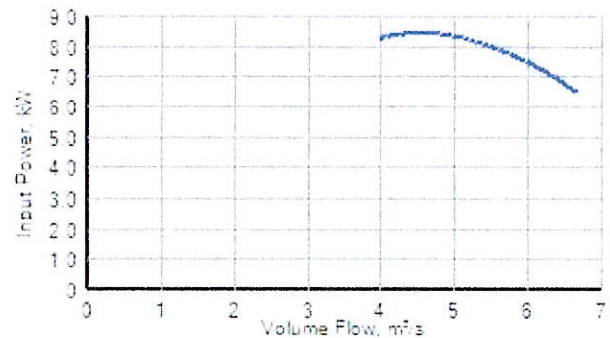
Peak: 7.70 kW

Static: -

Fan Weight: 96.0 kg

Motor Data (at STP)

Motor Type:
 Electrical Supply: 400V 3ph 50Hz
 Motor Frame: 132S
 Motor Power: 7.50kW
 FLC/Start (DOL): 13.90A / 118.15A
 Motor Speed: 2 pole
 Motor Efficiency: -



Sound Data

Spectrum (Hz):	63	125	250	500	1K	2K	4K	8K	dBW	dB(A) @ 3m
Inlet (dB):	93	91	88	97	91	92	89	85	101	78
Outlet (dB):	94	91	88	93	92	91	90	86	100	77

Sound levels are quoted as in-duct values. dB(A) values are average spherical free-field for comparative use only.

[illegible]



MUB 062 560D4 IE2 Multibox

Systemair Multibox acoustic centrifugal fan

Item Number: 33543

Variant: 400V 3~ 50Hz - Y (Star) - Straight air flow



High efficient motor IE2

Speed-controllable via frequency converter

Integral cold conductor (PTC)

Low sound level

Flexible airflow direction due to removable panels

Installation in any mounting position

Easy to maintain and reliable

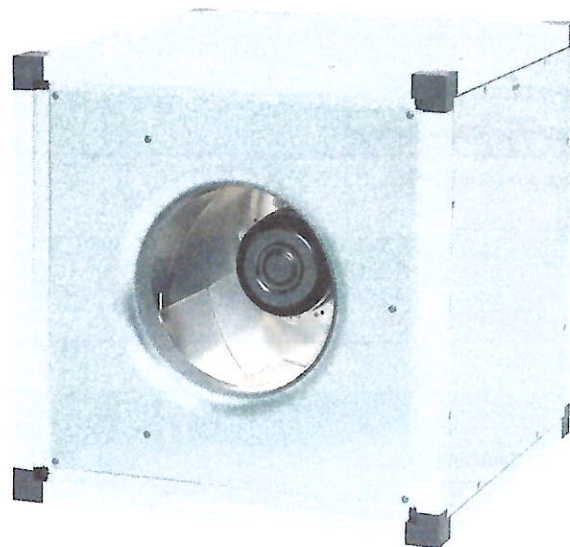
The MUB fans size 560D4-A2 are equipped with high efficient IE2 motors. The MUB fans have an impeller with backward curved blades, manufactured from aluminum. Speed control is only possible by using a frequency converter. Motor protection is done by cold conductors (PTC), which have to be connected to an external motor protection device. The casing consists of an aluminum frame with fiberglass reinforced plastic corners of PA6; highly shock-resistant. The double skin panels are manufactured from galvanized steel with 20 mm mineral wool insulation. To avoid condensation the profile is provided with a separate chamber to fix screws. The Multibox fans are delivered for straight through airflow but can easily be rebuilt due to removable panels. This allows flexible ventilation solutions. The MUB can also be used as extract- or supply air unit in air handling units. Installation in any mounting position is possible.

MUB with additional modules (filters, heaters etc.) are available as air handling units "K025, K042 or K062" on request!

Please note: Speed control by voltage, i.e. voltage transformers, is not possible!

In accordance with Commission Regulation (EC) no 640/2009 of the European Parliament - eco-design requirements for electric motors - the new international efficiency classes are binding as of 16 June 2011. These guidelines defined by CEMEP and EPEAT are regarded as international standard for energy-saving high-efficiency motors for frequencies of 50 or 60 Hz and make the use of IE2 motors mandatory.

With this new and more efficient technology we offer our customers many advantages such as environmentally friendly operation, reduced energy consumption and hence lower emissions. IE2 motors have a higher efficiency even in part load operation and allow optimum adjustment to the operating point. In addition, the IE2 motors generate less noise and develop less heat, which has a positive influence on the efficiency and the cooling requirement of the motor. Please note: IE2 motors cannot be speed controlled by voltage, i.e. voltage transformers.



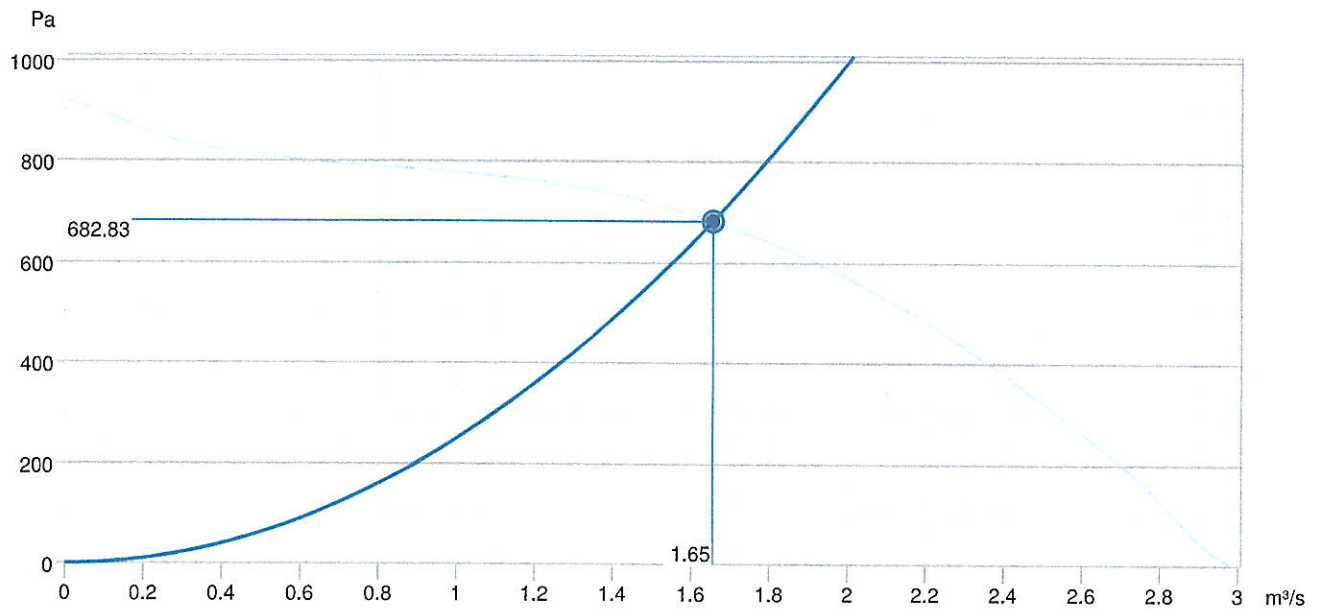
Technical parameters

Norminal data

Voltage (nominal)

400 V

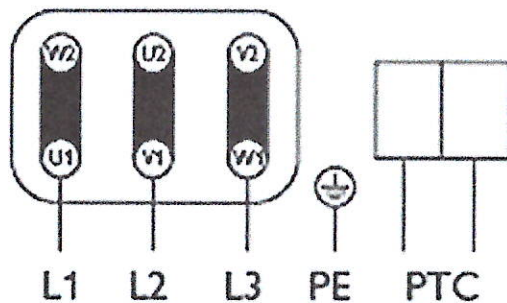
Performance curve



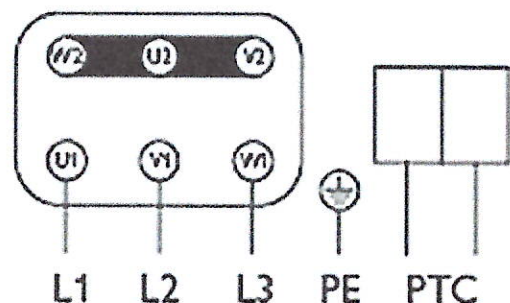
Hydraulic data

Required air flow	1.65 m³/s
Required static pressure	683 Pa
Working air flow	1.65 m³/s
Working static pressure	683 Pa
Air density	1.204 kg/m³
Power	2376.1 W
Fan control - RPM	1444 rpm
Current	4.06 A
SFP	1.437 kW/m³/s
Control voltage	400.0 V
Supply voltage	400 V

Dreiphasenmotor mit Kaltleiter
Three phase motor with cold conductor
Moteur triphasé avec résistance PTC



3 x 230V
D Schaltung
Delta connection
Branchement en triangle



3 x 400V
Y Schaltung
Star connection
Branchement en étoile

Drehrichtungsänderung durch Vertauschen von 2 Phasen
Changing of direction of rotation by interchanging of two phases
Changement de sens de rotation par inversion de deux phases

Typenschild beachten! See label! Voir plaque!

Ecodesign

Product

Trade name	Systemair
Product name	MUB 062 560D4-A2 IE2 Multibox

Ecodesign

ErP compliance	2018
Unit category	NRVU
Drive	External MSD or VSD
Unit type	UVU
Heat recovery type	None
Temperature ratio (UVU)	Not applicable
qv nom	1.799 m³/s
P nom	2.425 kW
Ps nom	656 Pa
Fan efficiency	48 %
External Leakage	5 %
Sound power level LWA	63 dB(A)

ATTACHMENT N^o 4.

RIBEYE STEAKHOUSE						
No	Description	size mm x mm	Power kW	Area m ²	Coefficient	Flow Rate m ³ /s
2	BBQ chargrille	800 x 1500	98kW gas	1.2	0.95	1.14
3	4 ring hob & oven	800 x 600	51kW gas	0.48	0.35	0.168
4	twin fryer	800 x 600	26kW gas	0.48	0.5	0.24
5	table	800 x 800	n/a	0.64	0.03	0.019
6	twin fryer	800 x 600	26kW gas	0.48	0.5	0.24
7	salamander	400 x 800	electric	0.32	0.55	0.176
Theoretical extract volume required						1.983
Canopy factor - island						x1.35
Specific extract flow rate required						2.677

Note:- All dimensions are assumed.

DUCT SYSTEM RESISTANCE

Section	Duct size mm	Area m ²	Length m	ζ	Volume m ³ /s	Velocity m/s	VP	Pa/m	Loss Pa	estimate tbc
canopy					3				80	
duct	600 x 500		0.4		3	11	72.6	1.9	0.76	
bends - table 4.73	600 x 500			3.5	3	11	72.6		254.1	
duct	600 x 500		1.2		3	11	72.6	1.9	2.28	
bend	600 x 500			1.19	3	11	72.6		86.39	
duct (drop)	600 x 500		2.5		3	11	72.6	1.9	4.75	
bend	600 x 500			1.19	3	11	72.6		86.39	
duct	600 x 500		5		3	11	72.6	1.9	9.5	
offset	600 x 500			0.32	3	11	72.6		23.23	
duct	600 x 500		1		3	11	72.6	1.9	1.9	
bend (radiused)	600 x 500			0.25	3	11	72.6		18.15	
expansion				0.6	3		72.6		43.56	
ESP4500 (x2)doubles	1250 x 1100				3				120	
duct connection				0.3	3	2.3	3.17		0.95	
3x2 carbon cubes	1800 x 1200				3				60	
reducer				0.07	3		72.6		5.08	
bend	600 x 500			1.19	3	11	72.6		86.39	
duct (rise)	600 x 500		1.2		3	11	72.6	1.9	2.28	
bend	600 x 500			1.19	3	11	72.6		86.39	
duct	600 x 500		1		3	11	72.6	1.9	1.9	
bend	600 x 500			1.19	3	11	72.6		160.65	
duct	600 x 500		0.5		3	11	72.6	1.9	0.95	
transform				0.05	3				7.68	
sound attenuator	500 dia				3	16	153.6		5	
fan SLC560/2-3AC	560 dia				3					
sound attenuator	500 dia				3	16	153.6		5	
transform to plenum				0.33	3		153.6		50.69	
plenum entry	1200 x 560			0.5	3	4.8	13.82		6.91	
louvre	3000x2000				3				4	
									1214.88	