# 140-146 CAMDEN STREET
# LONDON NW1

## SERVICES STRATEGY FOR THE PROVISION OF BUILDING SERVICES

RFB/CMW/6082
Issue 5 – 2ND February 2015

This is considered as a working document requiring input from all members of the team. Further issues will be submitted incorporating various comments and observations from team members.

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**140-146 CAMDEN STREET**
**LONDON NW1**

# SERVICES STRATEGY FOR THE PROVISION OF BUILDING SERVICES

## INDEX

## 1. INTRODUCTION

This services strategy summarises the principal strategy for the building services installation for the mixed use scheme at 140-146 Camden Street, London NW1.

This services strategy should be read in conjunction with the energy, sustainability and code assessment reports prepared by Price & Myers. Also, the air quality assessment prepared by Air Quality Consultants.

The building services summarised within this report comprise the following:

(a) A key factor of the development is to reduce carbon emissions and improve sustainability credentials. All options for using sustainable energy technologies shall be considered where practicable and cost effective. Solutions shall be implemented to provide energy and carbon reduction. All shall be considered by the energy specialist.
(b) Utility services such as Electricity, Gas, Drainage, Water and Communications (BT/Cable).
(c) Drainage.
(d) Heating systems.
(e) Ventilation.
(f) Comfort Cooling systems to specific areas, including commercial via absorption chillers. Anumber of residential units shall also be provided with comfort cooling via indidual ASHP.
(g) Hot and cold water services.
(h) Power supply/distribution.
(i) Lighting and emergency lighting.
(j) Communications services.
(k) Security and access control.
(l) Vertical transportation.
(m) Domestic sprinklers.
(n) Goods lift for commercial area.
(o) Passenger lift(s) for residential areas.

## 2. SUSTAINABILITY

Sustainability and carbon reduction will be incorporated into the development proposals for both the commercial and residential premises. This to include improvements, including increased energy efficiency of the building fabric and services.

- Reduction of carbon emissions from the development, by adopting the London Mayor's Energy Hierarchy, 'Be Lean, Be Clean, Be Green.
- The potential for whole house ventilation with heat recovery will be assessed.
- The use of combined heat and power plant (CHP).
- Highly efficient gas condensing boiler.
- Good heating control systems.
- Absorption chiller serving the commercial area.
- Energy efficient lighting
- Metering of major plant and lighting.
- Metering of water use.
- Solenoid valve to water supplies to toilets in commercial areas.
- Water leak detection.
- Solar and PIR control lighting.
- Smart electric metering to all residential and commercial units.
- Heat meters to all residential and commercial units.
- Main water harvesting.
- Use of grey water recycling.

The property has reasonable access to public transport; the sites begin with potential for good environmental credentials.

## 3. UTILITY SERVICES PROVIDERS

3.1 The Utility Services to be provided to serve the building are Drainage, Water, Electricity, Gas, Telecommunications, as summarised below:

### 3.2 Drainage

#### 3.2.1 Sewer Connections

The existing final sewer connection to be retained and adapted to suit the new scheme.

It is noted that a main trunk sewer passes diagonally through the site. This may restrict routing of some in-ground services.

**Main Drainage Collection**

The internal drainage systems are likely to be part gravity fed and part pumped from suitable plant located within the basement plant area.

**Rainwater**

Piped rainwater systems generally to remain.

Local flood prevention measures will be taken using a proprietary collection and discharge system.

Rainwater harvesting shall be adopted for irrigation.

**Above Ground Main Collection**

A system of vertical soil stacks will be employed throughout the development to connect the services for each area to the main drainage plant.

### 3.3 Electricity Supply

Early indications suggest that the development will require a sub-station.

The site is currently served by a substation. We understand the lease for this sub-station with UKPN has expired. Negotiations have commenced to ascertain status of lease and whether the substation can be removed altogether or relocated.

The construction process indicates that UKPN are likely to require de-commissioning during the works. The new substation will be in a position yet to be agreed with UKPN but expected to be off Bonny Street. These negotiations have commenced and will be ongoing for some time. It can take many months to agree leases and contracts with the UKPN legal team.

### 3.4 Gas Supply

It is proposed that LTHW (CHP/boiler) heating to the development will be provided by Natural Gas provided by British Gas/Transco. Gas load to be assessed, relative to the existing gas supply.

### 3.5 Water Supplies

It is proposed that the site will be served by a new metered incoming mains water connection provided by Thames Water.

Individual TWU meters will be provided to each residential and commercial unit. Note that high flow rate meters will be required to meet the flow rates that will be needed for the domestic sprinkler system. The selection of meters should be reviewed in conjunction with the sprinkler specialist prior to ordering.

### 3.6 Telecoms and Cable Communications

British Telecom and local Cable Communications providers will provide suitable digital and analogue communications to serve the development.

Cabled copper and fibre-optic communications services to be terminated within the dedicated communications room within the basement.

Cabled distribution will be provided to all required locations.

The site will require BT Redcare monitored telephone line to provide remote monitoring of the security and like systems, e.g. CCTV, fire alarm, intruder alarms. Telephone lines will also be required for two lifts.

## 4. MAIN PLANT AND SERVICES

The main plant installations will be required for various services are summarised below.

### 4.1 Heating and Hot Water

The space heating to be provided by communal energy centre comprising a gas fired CHP boiler as lead unit and two/three high efficiency low NOx gas boilers.

The Landlord's central energy centre system shall serve heat exchange units within each residential and commercial unit.

Valved capped connections shall be included to the principle flow and return headers for future connection to a district heating system. An area approx. 3x2m shall be marked out for future plant associated with the district heat system including heat exchanger plant space. Puddle flanges and sleeve shall be provided in the basement wall.

### 4.2 Ventilation

Localised 'whole house' ventilation systems will be provided to each residential unit with heat recovery. Air is extracted from bathrooms with the heat being transferred to fresh air being supplied to most habitable rooms, including living and bedrooms. Heat recovery systems transfer heat from air that is being exhausted to fresh air being drawn in. This provides considerable heat recovery and carbon reduction of the building.

Mechanical supply and extract ventilation systems shall be provided to the commercial areas. Heat recovery shall be part of the ventilation plant. Fresh air intake and discharge air shall be via louvres at garden deck area and main façade. The ventilation ductwork shall be exposed suspended from the soffit of the slab above.

Ventilation of corridors to prevent over heating shall be developed as part of the design process expected to make use of vertical shafts, AOV shafts, AOV windows and staircase AOV'S.

All to comply with Building Regulations in accordance with CIBSE Codes or Practice.

### 4.3 Cooling

A vapour absorption single-effect chiller shall be used to provide cooling to the commercial premises. Its cooling process shall be driven by the LTHW circuit of the CHP/boiler plant.

The penthouse residential unit to the front block shall be served by a local highly efficient air source heat pump.

4.4 **Cold Water Services**

The new mains water service to the development shall be boosted. The boosters shall be inverter driven.

Cold water (valved and capped) shall be provided for future tea points in the commercial areas.

4.5 **Hot Water Services**

Hot water shall be provided by the heat interface units to be located in each residential and commercial unit.

Hot water (valved and capped) shall be provided for future tea points in the commercial areas.

4.6 **Gas**

Gas services pipework to be distributed to central boiler plant only.

No gas provision will be provided to any residential or commercial units.

4.7 **Photovoltaic**

Photovoltaic panels have been integrated into the scheme to reduce carbon emissions refer to energy/sustainability report.

5. **SERVICES SYSTEMS**

5.1 **Mechanical Services**

**Heating**

Each unit shall be provided with a heat interface unit (HIU) to transfer heat from the central energy centre system to the individual properties. Space heating to be provided by underfloor heating or radiators, with concealed pipework complete with local thermostatically controlled heating zones distributed from accessible, concealed pipework manifolds.

Local electric floor warming and towel radiators to be considered for bathroom areas so as to allow the central heating plant usage to be minimised in the warmer months.

Heating to the commercial units shall be by communal CHP/boiler plant. This to be developed as part of the design process.

**Ventilation**

Provision of 'whole house' ventilation systems to all residential areas for blocks as detailed below; complete with heat exchanger which is described above. Attenuators will also be provided where required to reduce road noise.

Provision of a mechanical ventilation system shall be provided to the commercial area complete with heat exchanger to provide heat recovery and hence, carbon reduction.

All ductwork will be exposed within the occupied space as no ceiling is proposed.

The ventilation strategy for the dwellings within cores A-D is dependent on the measures set out in the air quality report. This mitigation measure is to reduce excessive levels of nitrogen dioxide (NO2).

Therefore the strategy for Blocks A-D is to include MVHR 'whole house' ventilation and NO2 filtration for the units deemed to be subject to excessive pollution, with the units selected to assist with the SAP Building Regulations compliance calculations and will be complete with heat recovery.

The MVHR units will be installed as Building Regulations 'System 4' with operation at trickle rate, further increased to 'boost' rate by interlocks with light switches or movement detectors where bathrooms include windows for providing natural daylight. MVHR units shall be selected to include 'Summer' bypass function where physically possible given spatial constraints.

A noise assessment has been undertaken for the property (refer to separate report). Where required, atmospheric attenuation will be provided to apartments where traffic noise could exceed the design criteria, either through in-line attenuators for 'System 4' or either window trickle ventilators or through the wall background ventilators for 'System 1'. All to comply with Building Regulations in accordance with CIBSE Codes of Practice.

Further to the above reference of the air quality report and remedial measures, for those dwellings deemed to be subject to NO2 concentration levels above an average mean of 38µg, it is proposed that a nitrogen dioxide filter be installed on a dwelling per dwelling basis, as OEM product 'NITROSORB', manufactured by AAC Eurovent or equal & approved. 'NITROSORB' units will be installed above accessible suspended ceilings for future inspection and maintenance.

All dwellings will have openable windows for purge ventilation and the house owner packs will include a section to advise the residents that day to day ventilation is to be achieved mechanically by the MVHR systems.

'Recirculation' type kitchen extractor fans are proposed. Where a 'System 4' ventilation strategy is employed the MVHR will also extract local to the kitchen hobs.

**Hot Water Service**

Hot water service distribution pipework served from the HIU unit to terminate at local isolation valves and thermostatic blending valves at wash hand basins and showers. Longer runs of pipework shall be trace heated.

**Comfort Cooling**

Comfort Cooling to be provided by cassette and/or concealed fan coil units to commercial and selected apartments including the Penthouse. The details of the condensers shall be developed as part of the design process.

Fan coil units to be low noise type.

## 5.2 Electrical Services

**Lighting and Emergency Lighting**

The illumination will require careful consideration with respect to the following factors.

(a) Compliance with Document L Building Regulations being the provisions of low energy lighting.
(b) Security lighting and limitation on the local night time neighbourhood.
(c) Emergency lighting to comply with the work place regulations, as BS 5266.
(d) The commercial areas shall be provided with lighting to comply with LG7.

**Power to Mechanical Services and Sub-Mains**

Sub-main cables will be provided from the central main switchgear to all main plant, control panels, and to local MCB distribution boards.

The cable routes will be concealed where practicable.

**Local Small Power**

All 13 Amp socket outlets to be protected by 30mA RCD (Residual Current Device).
13 amp connection units to be provided to serve appliances, fan coil units, heated towel rails, U/F heating manifolds, electric floor warming, fire alarm system, intruder alarms, access control system and CCTV.

Connection units to be concealed where practicable.

**Communications and Data**

Provision of a Category 5E structured cable installation throughout the development to be used for Broadband data and voice communications.

A secure communications hub, equipment room to be established in the basement plant area to serve the whole development.

**Security**

The development will require a variety of security systems and services:

(a) An intruder alarm system shall be provided to each unit with facility for off-site monitoring by an authorised watching station service provider.
(b) A site wide perimeter CCTV system with local and remote monitoring.
(c) Access control system to operate the electric gates and at the various entrances to the development.
(d) Audio visual visitors door entry system to communicate between each unit and the main gates and various entrances.

**Fire Alarms**

Various fire alarm provisions will be provided to suit uses commercial and residential. In general, provision of a comprehensive automatic fire alarm system to comply with the requirements of the local fire Officer, comprising an L2 addressable system recommended by BS 5839 to comply with the results of the Fire Risk Assessment for the building.

Remote relay contacts to be provided to control particular systems in the event of a fire, e.g. gas solenoid valves, grounding of the lifts, isolation of the kitchen extract systems, etc.

The Landlord's fire alarm system to be connected to a remote security watching station for monitoring.

An addressable fire alarm system shall be provided to the commercial area.

**AOV**

Automatic opening vents (AOV) shall be provided to meet Building Control requirements. This to all stairs and corridors where required. The details shall be developed as part of the design process in accordance with the fire strategy.

The AOV system may be used to ventilate the corridors. Refer to ventilation section of this document.

**Television/Satellite**

Terrestrial digital and Satellite reception systems to be provided with full interactive TV cable distribution to outlet positions.

Refer to specialist AV/Media/Comms scheme.

**Lightning Protection**

140-146 Camden Street is located in an area with a likelihood of a lightning strike (less than 1 in 25000).

It is proposed to protect the building structure with an air termination network so as to disperse a direct strike to ground in accordance with BS 6651.

Also, due to the installation of communications and media systems equipment, it is proposed to provide suitable electronic surge protection on incoming copper cabled services, electricity, BT, TV aerials/satellite dish etc.

## 6. VERTICAL TRANSPORTATION

A passenger lift shall be provided by the Landlord to serve the residential blocks.

A goods lift shall be provided by the Landlord to serve the commercial area.

## 7. DOMESTIC SPRINKLERS

A domestic sprinkler system shall be provided to each apartment. The system shall be fed via the normal domestic water mains systems to each apartment.

The provision of such a sprinkler system will increase the safety and fire fighting ability of the development and shall form part of the overall development fire strategy. High flow water meters will be required to accommodate the high water flow rates to serve the sprinkler system. All to be in accordance with the sprinkler specialist's requirements.

The sprinkler heads shall be of the concealed type with a disc at ceiling level which drops on riser temperature to some 68°C. When the cover drops, the sprinkler head is exposed and thereby water is released from that head only.

The Kut Partnership
RFB/CMW/6082: 02.02.2015 (Issue 5)

**From:** AAC Sales <sales@aaceurovent.co.uk>
**Sent:** 28 October 2014 13:09
**To:**
**Cc:** charlotte.goodman@rhdhv.com
**Subject:** AAC Eurovernt Limited - Nitrosorb E12485-- 1201 High Road Whetstone
**Attachments:** e12xxx Horizontal Shallow ceiling Scan.pdf; AAC Eurovent A4 LEAFLET Nitrosorb.pdf; AAC LABEL NITROSORB PLAIN -150 x 95mm.pdf; envirocare5112Report4991v3.pdf

**Importance:** High

Our Ref: E12485 /RDE

Hi Sam,
Further to your enquiry for the above mentioned project , we offer our Nitrosorb Units to mitigate the effects of Atmospheric NO2, in our quotation below.
These units are accepted widely by planners in inner City London as acceptable NO2 mitigation, and have been installed on major developments by Berkley Homes, Telford Homes and many more. The units have been independently tested by an MCERTS Laboratory.—(Copy attached. For Building Services Consultants, Air quality Consultants and Planners use Only) .
As discussed we are able to provide you with a quotation for the units so they can be accommodated into shallow false ceiling depths of 160mm deep.

**Upto 40 l/s Horizontal Airflow for installation into false ceiling (Underside Access).**

Materials of construction;
Housing ; Galvanised Mild Steel
Dimensions of each unit 150mm High , x 675 mm Wide x 450mm long (excluding Transformation pieces) or 750mm Long inc Transformations at each end.
Chemisorbant Filter Cells: Black Plastic and Polycarbonate-Transparent (Colourcell) Aluminium Filter slide Channels with Brushpile seals.
Removable Access door with Sponge rubber seals to door and inside of unit to prevent air by-pass.
Unit weight 41kg.
Prefilter included from unit (G3 Panel).
Afterfilter excluded in MVHR by Others.
Design inlet NO2 and SO2 concentration 70 microgrammes/m3 to achieve a discharge condition not to exceed 40 microgrammes/m3.
Active Media Grade : AAC Nitrosorb Media (C/w Unique colourcell patented Media Condition Indicator shall be used)
Pressure Drop 20 Pa.
Lifespan of Media calculated to be in excess of 2 years (up to 5 Years)
Underside Access panel Size to be allowed for Filter Maintenance 750mm Wide x 750mm Long."
**Price for 1 No AAC Swiftpack Nitrosorb Units all as detailed above is £698.00 + VAT supplied and delivered.**
**Budget Costing. Based on 50 Units approx.**

Prefilter £12.65 Each to be checked on a 6 Monthly basis dependent upon the particulate levels.
Replacement Media for this size unit would be £198.00/ Unit every 2-5 years.

Availability - 3-4 weeks from order.

Exclusions/Points To Which We Draw Your Attention

1. Offloading on delivery – by others.
2. Installation of AAC Swiftpack Nitrosorb Units – by others.
3. No fan is supplied within our units. The MVHR provides the means of air movement.

Note: Should you require AAC to provide transformation pieces this could be provided a relatively small additional cost, sizes to suit your ductwork requirements.

Kind Regards,

Robin D Elshout B.Sc. C.Eng. MCIBSE.
07770 774798

AAC Eurovent
http://www.aaceurovent.co.uk
**Tel:** 08444 774884
**Fax:** 08444 774797

**Intl tel:** +44 1543 379 823

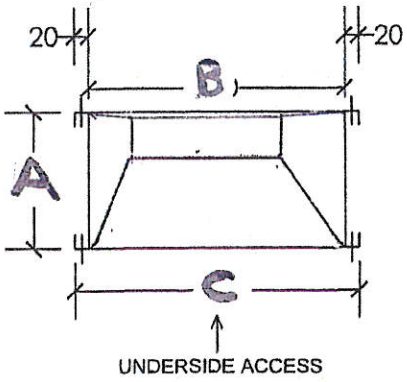
NOTES:

21 L/S

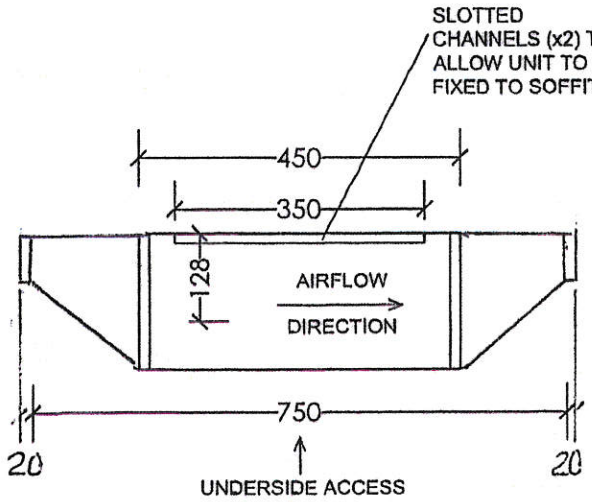
UNIT AVAILABLE IN 29 L/S & 35 L/S 40 L/S

ALL DIMENSIONS SHOWN IN MM.

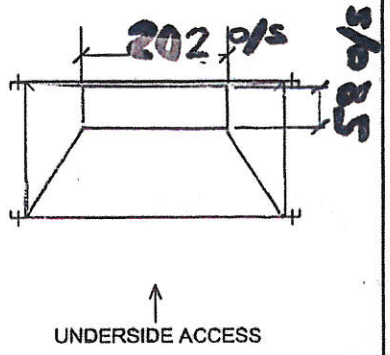
* DIMENSION A INCLUDES LID.




RECTANGULAR DUCT END ELEVATION VIEW 1




SIDE ELEVATION




RECTANGULAR DUCT END ELEVATION VIEW 2

| | A | B | C |
|---|---|---|---|
| 21 L/S | 150 | 400 | 440 |
| 29 L/S | 150 | 525 | 565 |
| 35 L/S | 150 | 600 | 640 |
| 40 L/S | 150 | 675 | 715 |


AAC Eurovent Limited
AAC House, Unit K
Maybrook Road
Brownhills
West Midlands
WS8 7DG

Tel: 08444 774 884
Fax: 08444 774 797


TITLE: HORIZONTAL AIRFLOW U'SIDE ACCESS

CLIENT:

PROJECT:

DRAWN:

CHECKED: R.D.E

DATE: 08.05.14

SCALE: 1:10

DRAWING NO.

REVISION:

LEADERS IN AIR & GAS PHASE FILTRATION TECHNOLOGY

# AAC Swiftpack® with Nitrosorb® media for - *$NO_2$ and NOx Removal*

## Can you be compliant with the EU CAFÉ DIRECTIVE?

### Introduction

Environmental Pollution arising from contaminants such as Nitrogen Dioxide ($NO_2$) are an increasing issue to the air quality of densely populated city environments.

Problems relating to atmospheric pollution and air quality are major considerations to those involved in major construction programmes in built up areas. Consulting Engineers and Environmental Consultants are under increasing pressure from local authority planning departments to comply and conform with the EU Directive 2008/50/EC (the CAFÉ Directive). European Union Air Quality and Clean Air for Europe 2008 and to implement mitigation measures that are designed to improve the indoor air quality of their new build projects.

**NITROSORB™** is an AAC Eurovent dry chemical scrubbing media product, specifically selected for its ability to efficiently remove low concentrations of Nitrogen Dioxide and NOx at levels typically found in atmospheric pollution.

The **AAC Swiftpack®** with Nitrosorb® media provides the ideal solution as a mitigation measure accepted by Local Authority Planners in meeting stringent $NO_2$levels in designated Air Quality management Areas (AQMA).

The **AAC Swiftpack®** is an effective means of reducing high $NO_2$ levels down to the accepted level of 40ug/m3 as a mean annual concentration level. This system has been independently performance tested with extremely good results offering low pressure drops enabling them to be used effectively with Mechanical Ventilation Heat Recovery Units (MVHR'S).

In addition the units are installed with the Patented and unique AAC COLOURCELL® MEDIA FILTER SYSTEM

The **AAC Colourcell®** media filter system provides a visual indication of the condition of media installed. It enables operatives and end users to easily determine when the media needs to be replaced simply by the colour change.

### Features

- Unique **NITROSORB®** media with **AAC Colourcell®** visual condition indication
- Low pressure drop
- Long lifespan of media typically 2-5 years
- Low cost
- Optional PM10 filter can be installed into the unit

### Benefits

- Accepted by planners as an acceptable AQMA $NO_2$ mitigation measure
- Compact size designed to enable installation into small spaces with bespoke designs.
- Independently tested
- Compatible with mechanical ventilation Heat Recovery (MVHR) Units
- Low running cost

The AAC **NITROSORB®** Filter cells can also be installed into Centralised Air Heating Plant by means of the **AAC Swiftkit®** & the AAC skeleton frame products.

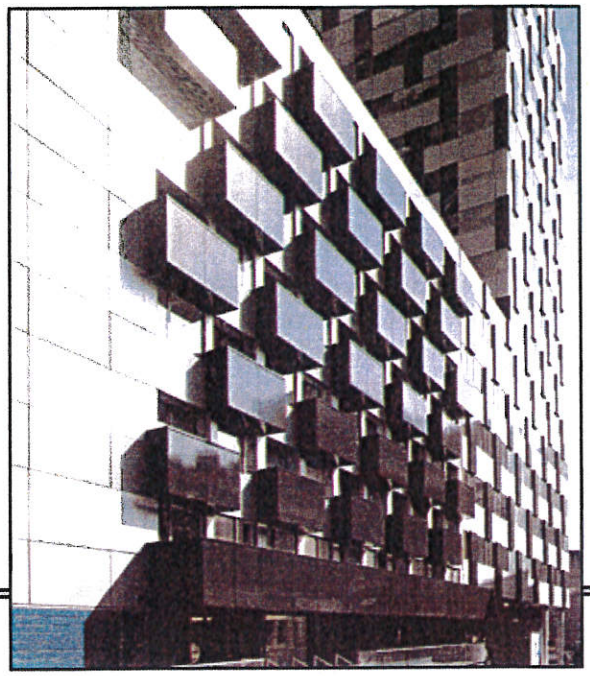
Major Developers and House Builders are specifying the **AAC Swiftpack®**/Nitrosorb® media filter system as their preferred $NO_2$ Mitigation solution.

**Address:** AAC Eurovent Ltd, AAC House, Unit K Maybrook Industrial Estate, Maybrook Road, Brownhills, West Midlands WS8 7DG. UK.
**Tel:** 08444 77 4884 **Fax:** 0844 77 4797 **International Callers Tel:** +44 (0) 1543 379823
**Email:** sales@aaceurovent.co.uk **Website:** www.aaceurovent.co.uk

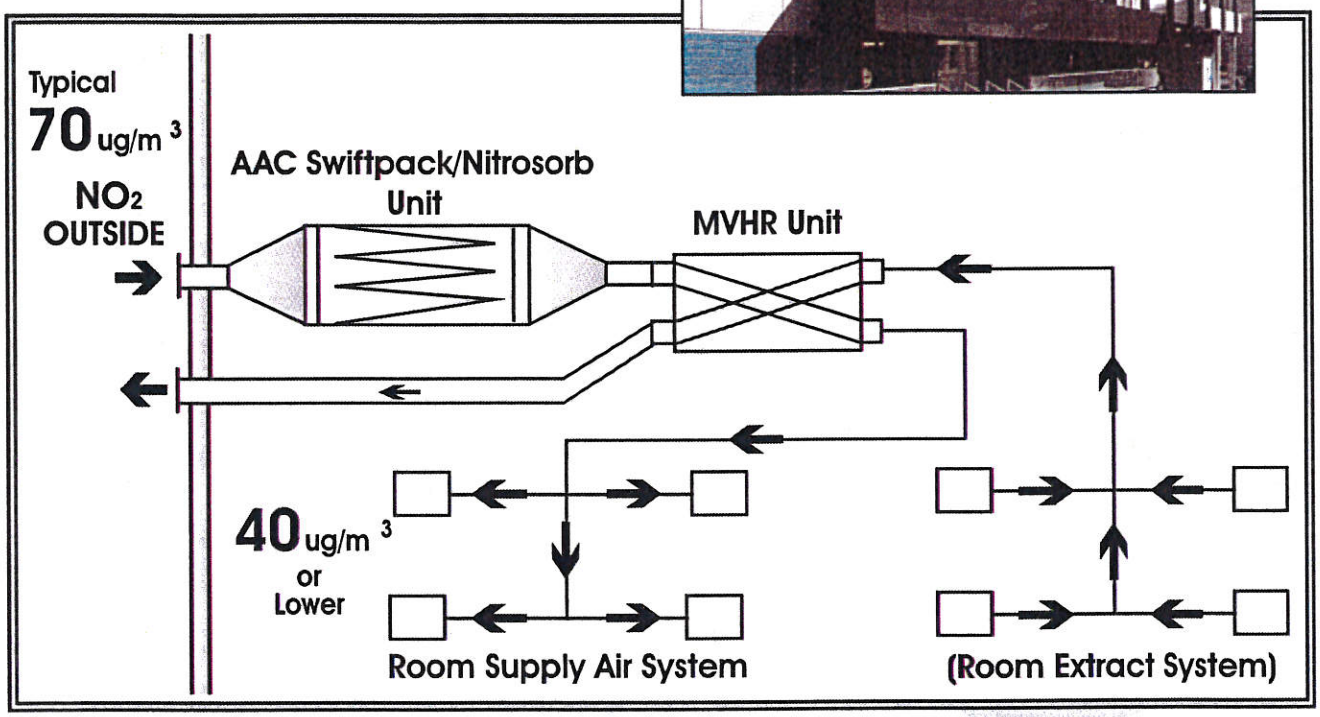
LEADERS IN AIR & GAS PHASE FILTRATION TECHNOLOGY

## $NO_2$ MITIGATION IN AQMA'S

Meets planners requirements in complying with **EU Directive 2008/50/EC** in mitigating high $NO_2$ levels in air quality management as (AQMA'S)



# $NO_2$ AND $NO_X$ REMOVAL




To find out more about the role of the AAC range of products & **NITROSORB™** media in air quality control, call **08444 77 4884**

**Address:** AAC Eurovent Ltd, AAC House, Unit K Maybrook Industrial Estate, Maybrook Road, Brownhills, West Midlands WS8 7DG. UK.
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CLIENT REF

DATE

QUANTITY

Kg

RECOMMENDED MEDIA REPLACEMENT FREQUENCY

MONTHLY

J.....

SERIAL No.

# COLOURCELL®
## MEDIA FILTER SYSTEM

Media in new/ good condition

Media in use with some useful life

Media fully spent. No life remaining

**AAC Colourcell®** media installed - Colour Change Indicates Media Condition

The **AAC Colourcell®** is only used as a guide as to when the media requires replacement, consequently to confirm the visual indication, a sample of media should be removed and chemically tested.

**AAC SWIFTPACK® NITROSORB® MEDIA FILTER FOR $NO_2$, $NO_x$, $SO_2$ and $O_3$ REMOVAL**

Envirocare
CONSULTANCY

Caring for the environment and creating safer workplaces

# Report for the Efficiency Monitoring of the AAC Swiftpack Scrubber at very low $NO_2$ concentrations

# AAC Eurovent Limited

| | |
|---|---|
| Client: | AAC Eurovent Limited |
| Operations: | Filtration Technology |
| Monitoring Dates: | 21 December 2011 |

| | |
|---|---|
| Report Number: | J 4991 |
| Version: | 3 |
| Date of Report: | 5 January 2012 |
| Report Author: | Mr D Fisher |
| MCERTS Registration N°: | MM 08 963 |
| MCERTS Level: | Level 2 (TE1, TE4) |

| | |
|---|---|
| Report Approved by: | Mr A R May |
| MCERTS Registration N°: | MM 05 626 |
| MCERTS Level: | MCERTS Level 2 (TE1, TE3, TE4) |
| Function: | Operations Manager |
| Signed: | |

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## 1.1 Monitoring Objectives

AAC Eurovent Limited is a manufacturer of a range of filtration technologies designed for odour control and pollution abatement.

They have recently developed a new kind of filtration media (AAC Nitrosorb™) designed for use in scrubbers within air conditioning systems to abate elevated levels of $NO_2$ that may be found in urban areas. The AAC Swiftpack Scrubber unit utilises the AAC Nitrosorb™ Media with the unique capability of providing visual condition indication by colour change.

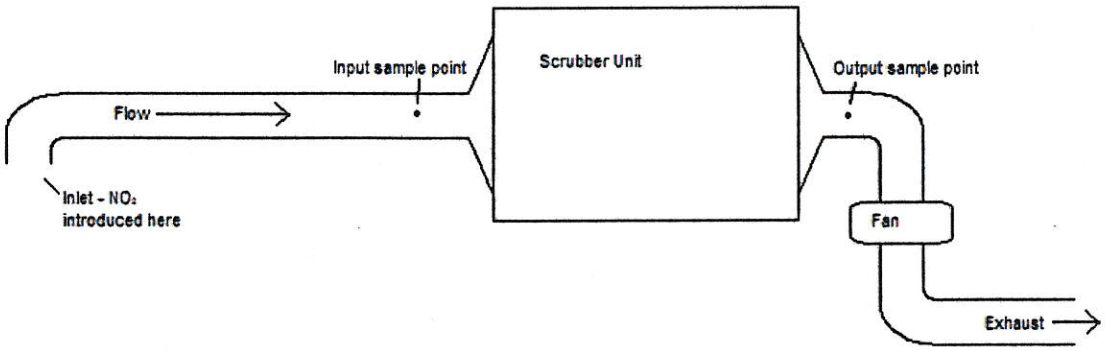
At the request of Mr Robin Elshout, Envirocare were employed to carry out $NO_2$ monitoring of the input and output ducts of a prototype scrubber unit, while varying concentrations of $NO_2$ were introduced, in order to show the scrubber's efficiency.

Envirocare is a UKAS & MCERTS accredited stack monitoring laboratory with a wide range of methodologies in its scope. However, $NO_2$ monitoring using the Signal 447 analyser, as in this campaign, is not in Envirocare's scope.

The results of this monitoring form the basis of this report.

## 1.2 Methodology

### 1.2.1 Photograph & Diagram of Test Rig




### 1.2.2 Description of Method

The equipment was assembled as per the above diagram and photograph, using ducting of 125 mm diameter with the fan positioned after the scrubber unit. The scrubber unit measures 610 x 375 x 850 mm and consists of 9 'single A' trays containing the AAC Nitrosorb™ Media as well as G4 Pleated panel pre- filter and G4 Pleated Panel after filter.

$NO_2$ gas was passed into the inlet to the rig from a gas cylinder of a known concentration. Different concentrations were achieved by using a gas divider to dilute the $NO_2$ with nitrogen.

$NO_2$ measurements were taken alternatively at the input and output sample points using a probe connected to a PTFE sample line running directly into a Signal NOx analyser model 447 (hired by AAC Eurovent Limited from Signal). The probe was left in place for four minutes for each measurement to ensure a steady reading. Repeat measurements were taken with the nominal inlet gas concentration set at three separate levels.

An attempt was made to calibrate the analyser using 5 ppm $NO_2$ calibration gas, however a reading of only 1.4 ppm could be obtained. Whilst this is not ideal, for the purposes of this test – i.e. the comparison of an input reading with an output reading to give an efficiency value – it should not invalidate the test as long as the linearity test on the analyser to be performed by Signal shows the analyser gives a linear response. This reading of 1.4 ppm was repeated at the end of the test, showing the analyser did not drift.

In order to calculate mass emission rates, velocity traverse measurements were taken at both the input and output, including duct temperature measurements. The ambient temperature and barometric pressure were recorded in order to correct the mass emission rate to standard pressure and temperature conditions. In addition, the pressure drop across the AAC Swiftpack was measured and recorded.

# 1.3 Monitoring Results & Calculations

## 1.3.1 Flow Criteria & Static Pressure Measurements

Flow measurements

| | | | | |
|---|---|---|---|---|
| **Stack reference:** | **Input** | | **Date:** | **21/12/2011** |
| **Duct dimensions:** | **12.5** | **cm** | | |
| **Local barometric pressure:** | **997** | **mbar** | | |
| **Ambient Temperature:** | **17** | **°C** | Pitot Coefficient = | 0.997 |
| | | | Micromanometer Calibration (K; mbar) = | 295 1013 |

| Sample port (A) | Traverse point | Traverse position (D) | Distance (cm) | Velocity (m/s) Uncorrd. | Velocity (m/s) Corrd. | Temp (°C) |
|---|---|---|---|---|---|---|
| Single | A1 | 0.05 | 0.6 | 2.7 | 2.7 | 17 |
| | A2 | 0.15 | 1.9 | 2.8 | 2.8 | 17 |
| | A3 | 0.25 | 3.1 | 2.9 | 2.8 | 17 |
| | A4 | 0.35 | 4.4 | 2.9 | 2.8 | 17 |
| | A5 | 0.45 | 5.6 | 2.9 | 2.9 | 17 |
| | A6 | 0.55 | 6.9 | 2.9 | 2.9 | 17 |
| | A7 | 0.65 | 8.1 | 2.9 | 2.9 | 17 |
| | A8 | 0.75 | 9.4 | 2.9 | 2.9 | 17 |
| | A9 | 0.85 | 10.6 | 2.8 | 2.8 | 17 |
| | A10 | 0.95 | 11.9 | 2.8 | 2.8 | 17 |

**Velocity readings (m/s)**

| | | | |
|---|---|---|---|
| **Duct Mean m/s** | **2.8** | | |
| Highest(a) | 2.9 | Lowest (b) | 2.7 |

**Temperature readings**

| | | | |
|---|---|---|---|
| **Duct Mean °C** | **17** | | |
| Duct Mean K | | 290 | |
| Highest(a) | 17.0 | Lowest (b) | 17.0 |

**Volumetic flow rate**

| | | |
|---|---|---|
| Duct dimensions | 12.5 | (cm) |
| Duct area | 0.012 | ($m^2$) |
| Mean duct velocity | 2.8 | (m/s) |
| Mean duct temperature | 17 | (°C) |
| Ambient pressure | 997 | (mbar) |
| **Vol. Flow rate at stack conditions** | **125** | **($m^3$/hr)** |
| **Vol flow rate corrd.** | **115.9** | **($Nm^3$/hr)** |

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| | | | | |
|---|---|---|---|---|
| **Stack reference:** | **Output** | | **Date:** | **21/12/2011** |
| **Duct dimensions:** | **12.5** | **cm** | | |
| **Local barometric pressure:** | **997** | **mbar** | | |
| **Ambient Temperature:** | **17** | **°C** | Pitot Coefficient = | 0.997 |
| | | | Micromanometer Calibration (K; mbar) = | 295 1013 |

| Sample port (A) | Traverse point | Traverse position (D) | Distance (cm) | Velocity (m/s) Uncorrd. | Velocity (m/s) Corrd. | Temp (°C) |
|---|---|---|---|---|---|---|
| **Single** | A1 | 0.05 | 0.6 | 3.3 | 3.3 | 17 |
| | A2 | 0.15 | 1.9 | 3.4 | 3.4 | 17 |
| | A3 | 0.25 | 3.1 | 3.5 | 3.5 | 17 |
| | A4 | 0.35 | 4.4 | 3.5 | 3.5 | 17 |
| | A5 | 0.45 | 5.6 | 3.6 | 3.6 | 17 |
| | A6 | 0.55 | 6.9 | 3.6 | 3.6 | 17 |
| | A7 | 0.65 | 8.1 | 3.5 | 3.5 | 17 |
| | A8 | 0.75 | 9.4 | 3.5 | 3.5 | 17 |
| | A9 | 0.85 | 10.6 | 3.4 | 3.4 | 17 |
| | A10 | 0.95 | 11.9 | 3.4 | 3.3 | 17 |

**Velocity readings (m/s)**

| | | | |
|---|---|---|---|
| **Duct Mean m/s** | **3.5** | | |
| Highest(a) | 3.6 | Lowest (b) | 3.3 |

**Temperature readings**

| | | | |
|---|---|---|---|
| **Duct Mean °C** | **17** | | |
| Duct Mean K | | 290 | |
| Highest(a) | 17.0 | Lowest (b) | 17.0 |

**Volumetic flow rate**

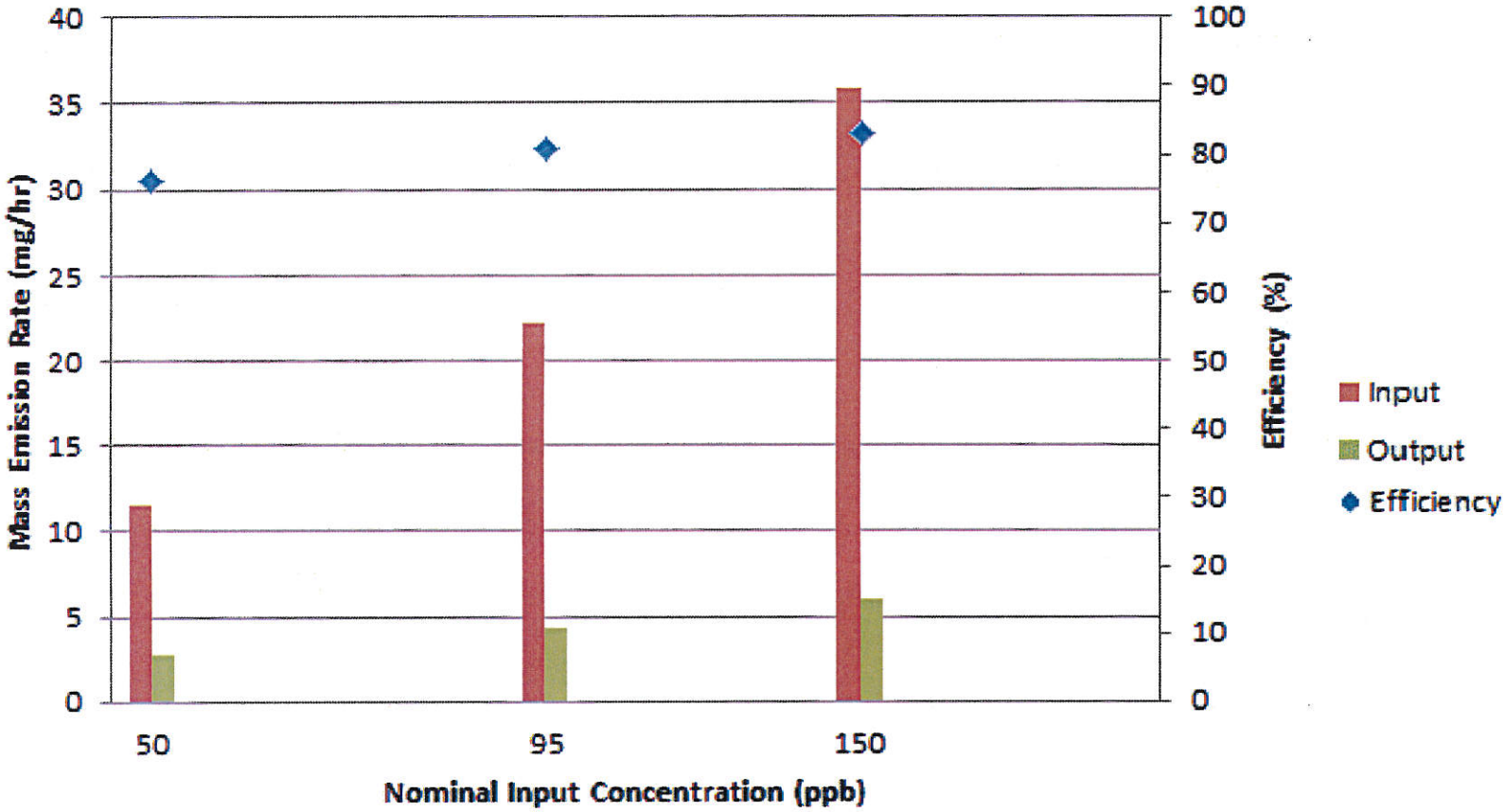
| | | |
|---|---|---|
| Duct dimensions | 12.5 | (cm) |
| Duct area | 0.012 | ($m^2$) |
| Mean duct velocity | 3.5 | (m/s) |
| Mean duct temperature | 17 | (°C) |
| Ambient pressure | 997 | (mbar) |
| **Vol. Flow rate at stack conditions** | **153** | **($m^3$/hr)** |
| **Vol flow rate corrd.** | **141.5** | **($Nm^3$/hr)** |

Static pressure measurements

| Static Pressure (Pa) | | |
|---|---|---|
| Input | Output | Difference |
| 14 | 24 | 10 |

### 1.3.2 Instrumental gas analyser results and Mass Emission Rates & efficiency calculations

| Concentration (ppb) | | | Concentration (µg/m3) | | Volumetric flow rate (Nm3/hr) | | Mass Emission Rate (mg/hr) | | Scrubber Efficiency (%) |
|---|---|---|---|---|---|---|---|---|---|
| Nominal Input | Actual Input | Actual Output | Input | Output | Input | Output | Input | Output | |
| **50** | 52 | 12 | **100.1** | **19.5** | **115.9** | **141.5** | **11.6** | **2.8** | **76.2** |
| | 50 | 11 | | | | | | | |
| | 49 | 8 | | | | | | | |
| | 44 | 7 | | | | | | | |
| | Mean 48.8 | 9.5 | | | | | | | |
| **95** | 92 | 11 | **191.7** | **30.1** | **115.9** | **141.5** | **22.2** | **4.3** | **80.8** |
| | 94 | 16 | | | | | | | |
| | 94 | 17 | | | | | | | |
| | Mean 93.3 | 14.7 | | | | | | | |
| **150** | 140 | 16 | **308.7** | **42.4** | **115.9** | **141.5** | **35.8** | **6.0** | **83.2** |
| | 152 | 26 | | | | | | | |
| | 159 | 20 | | | | | | | |
| | Mean 150.3 | 20.7 | | | | | | | |


40
35
30
25
20
15
10
5
0
Mass Emission Rate (mg/hr)
100
90
80
70
60
50
40
30
20
10
0
Efficiency (%)
50
95
150
Nominal Input Concentration (ppb)
Input
Output
Efficiency

## 1.3 Conclusions

Following the testing of the AAC Swiftpack for $NO_2$ removal efficiency at low inlet concentration levels, we believe that this unit containing the AAC Nitrosorb™ Media will prove very effective in meeting the requirements of the EU Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe (the CAFÉ DIRECTIVE) for Property Developers Planning Application submissions.
The evidence of low pressure drop would also be of benefit in reducing running costs due to the lower power requirement of any fan due to this low pressure drop.