



F U M E C U P B O A R D S

## FUME CUPBOARDS

### ENTERPRISE 'DYNAMICFLOW'



#### **Introduction to Enterprise DynamicFlow(tm) Fume Cupboard**

Whilst the safety of laboratory personnel is paramount, the amount of heated/conditioned air consumed by conventional fume cupboards is a constant area of concern to many laboratory managers.

Surprisingly, fume cupboard design has changed little since the 1970s. The conventional operation specification for fume cupboard is to provide an average face velocity of 0.5 m/sec across the open sash area.

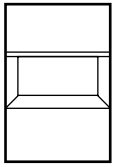
Traditionally this has been taken as a minimum and can actually range up to 0.75 m/sec in

certain circumstances. Where a number of fume cupboards are grouped together the total extract volume is very high which results in a large volume of make-up air being required to balance the laboratory pressure.

Over the past 10 years, it has become standard practice to address this problem not at the fume cupboard itself but by designing sophisticated extract and air input systems, often referred to as variable air volume systems (VAV). These typically use complex sensing and feedback controls to monitor the instantaneous demand at each fume cupboard in order to calculate and adjust the correct volumes required.

Although the VAV approach has proved successful and cost effective in many cases, it does not address the problem at source, namely the volume of air required by an individual fume cupboard to maintain the containment performance.

Premier's new Enterprise DynamicFlow(tm) fume cupboard addresses this problem in a radical and innovative way, achieving the same excellent containment performance as a conventional fume cupboard design, but at a face velocity of 0.25m/sec i.e 50% lower than the standard product.



### Principles of Enterprise DynamicFlow Fume Cupboard

The primary philosophy behind the development of the Enterprise DynamicFlow fume cupboard was to achieve high levels of containment of hazardous substances providing safe operating conditions without resorting to high air velocities. The aim was to reduce the overall operational face velocities from the customarily accepted 0.5 m/sec to 0.25 m/sec and in turn reduce the volume of supply and extract air by 50%.

The starting point for the new design was to take Premier's proven Enterprise model and, in a radical departure from previous practice, redesign the fume cupboard critical construction details. The following Computerised Fluid Dynamic (CFD) analysis diagrams (Figs 1 & 2) show how this was accomplished. The resulting innovative design features are now protected by a worldwide patent.



Fig 1: Airflow within the Enterprise DynamicFlow Fume Cupboard with Sash Open.



Fig 2: Airflow within the Enterprise DynamicFlow Fume Cupboard with Sash Open and an operator in position

### Testing and Validation

When type tested to the laboratory fume cupboard standard BS 7258 :1994 Part 4, the Enterprise DynamicFlow fume cupboard recorded excellent containment results, specifically: highest maximum < 0.010 ppm, highest mean < 0.005 ppm.

The fume cupboard has recently been independently type tested to the new European standard EN 14175 - part 3. The main difference between the BS standard and the EU standard is that the robustness test (which is not included within the BS at present) is a more realistic test in that it induces disturbance at the face of the fume cupboard during the containment test.

Results achieved from the containment tests carried out were as follows:-

**Outer plane – <0.005ppm**  
(UK recommendation <0.005ppm)

**Inner plane – <0.005ppm**  
(UK recommendation <0.005ppm)

**Robustness – <0.040ppm**  
(UK recommendation <0.100ppm)

From above results you will see that our DynamicFlow fume cupboard complies with recommendations for UK i.e 0.005 ppm for inner and outer plane containment tests and 0.100 ppm for the robustness test. It is worth noting that these results are specified for fume cupboards operating in the range of 0.40 to 0.50 m/sec and we achieve these at a face velocity of 0.30 m/sec.

You will also note the high level of containment performance achieved during the robustness test i.e 0.040 ppm as opposed to the UK standard of 0.100 ppm (Note, German standard is 0.650 ppm!!!).



F U M E C U P B O A R D S

# FUME CUPBOARDS

## ENTERPRISE 'DYNAMICFLOW'

Another important test which is carried out and is of particular interest on low volume fume cupboard is the 'air efficiency test'. This measures the time involved with respect to the removal of all fumes within the chamber. The minimum requirement is 15 seconds and the DynamicFlow fume cupboard recorded less than this timescale when tested at 0.30m/sec.

### Summary of User Safety Testing

- Independent tested to BS 7258: Part 4: 1994, achieved excellent containment levels
- Independently tested to new EU standard EN14175-part 3, achieved high level of containment performance.
- The containment performance of the Enterprise DynamicFlow fume cupboard has been proved by computer modelling
- Containment is unaffected when an operator moves in front of the fume cupboard
- Containment is unaffected when bulky equipment is placed within the fume cupboard

### Summary of User Benefits

- Save up to 50% (£1000.00 /annum/fume cupboard) on energy costs
- No need for complex, expensive air management systems
- Air supply/extract plant, simpler, therefore less costly to install
- Provides 100% diversity (fume cupboard use) capability
- Can be retro-fitted into existing laboratories with increased numbers of fume cupboards utilising existing ventilation plant
- Less air movement means greater user comfort and very low noise levels
- Lower velocity eases handling of fine powders and weighing of substances
- No costly annual maintenance required

### Energy Conservation Calculations

It is a simple calculation to compare the energy consumption of an installation using conventional fume cupboards and an installation utilising Premier's new Enterprise DynamicFlow fume cupboards. The following calculations are based on a typical installation employing thirty 2m wide fume cupboards.

The volume of air consumed by a conventional fume cupboard is a constant figure calculated by:-

**Sash open width (m) x sash open height (m) x face velocity (m/sec).**

**So for a 2m wide cupboard:-**

$$1.7 (m) \times 0.5 (m) \times 0.5 (M/sec) = 0.425 m3/sec.$$

The total extract volume from a laboratory equipped with thirty conventional fume cupboards would therefore be:-

$$30 \times 0.425 m3/sec = 12.75 m3/sec (45,900 m3/hour).$$

This volume of air will be replaced by the supply air system plus a small quantity of air drawn from adjacent areas to maintain a negative pressure within the laboratory. This air would be heated/cooled from the ambient air temperature to the desired laboratory air temperature (typically 21°C).

Assuming an average day time temperature for the UK of 9°C over the whole year, the average energy consumption per hour is given by the formula:-

$$Volume (m3/sec) \times temperature rise (t^{\circ}C) \times 1.21 (constant for air)$$

In this case:-

$$Average Consumption = 12.75 m3/sec \times 12^{\circ}C \times 1.21 = 185 kW (per hour)$$

Assuming a fume cupboard usage of 8hrs/day, 5 days/week and 48 weeks/year, the average annual energy consumption for a conventional fume cupboard would be:-

$$Annual Consumption = 185kW \times 8 hrs/day \times 5 days/week \times 48 weeks/yr = 355,200 kWh/yr.$$

As the Enterprise DynamicFlow fume cupboard operates on a face velocity of 0.25 m/sec as opposed to 0.5 m/sec the required volume is 50% lower than the equivalent conventional fume cupboard.

Therefore

$$Average Energy Consumption = 355,200 \times 0.5 = 177,600 kWh/yr$$

The above figures are given as a guide to the potential energy savings when utilising Enterprise DynamicFlow instead of conventional fume cupboards.

The calculations do not include for any cooling requirements which can be calculated using a similar method.

The typical cost per kWh used in the UK is £0.10 and is based on a combination of direct fuel costs, plant maintenance, and depreciation of plant, ie a true cost of energy.

Applied to the examples above, the total running cost for a 'conventional' versus an Enterprise DynamicFlow installation can be stated in general terms as follows:

Fume Cupboard Type	Energy Costs (per yr)
Conventional:	£35,520
Enterprise DynamicFlow:	£17,760
Saving:	£17,760



**Premier Laboratory Systems**

Already a recognised leader in the design, manufacture and installation of fume cupboards and associated systems.

The introduction of the new Enterprise Dynamic Flow fume cupboard now offers customers the most complete fume cupboard installation package available today.

**Experience counts**

Our engineers have an unrivalled breadth of technical knowledge and experience, ensuring that all project management is successfully completed, regardless of size or complexity. We offer free consultancy service regarding relevant standards, safety and efficiency on all matters relating to the safe removal of corrosive/hazardous fumes.

Design and drawings are produced using the latest CAD technology. Manufacturing is in accordance with ISO 9001 Approved Quality Procedures.

**Project Management**

Planning a new or upgrading an existing facility is invariably a team effort. A successful outcome is dependent on the manufacturer's ability to convert the Customer's requirements into an engineered, value-for-money solution. The larger the project, the higher the level of expertise needed.

Our Design Engineers are available to assist laboratory planners, architects, engineers and users at every stage of the project from initial conception to final acceptance. As our existing customers will testify, no-one has more experience

in laboratory fume cupboard installations.

**A Step-by-Step Approach**

Our comprehensive design-to-commission service includes not just a thorough analysis of the Customer's basic requirements, but also full consideration of a range of other aspects of the final design; noise attenuation, condensate drainage, fire compartmentation and pre-discharge fume treatment.

Premier Laboratory Systems Ltd  
10 Tollpark Place,  
Wardpark East,  
Cumbernauld,  
Glasgow G68 0LN,  
United Kingdom

Tel: +44 (0)1236 457545  
Fax: +44 (0)1236 457345

email: [info@premierlabs.co.uk](mailto:info@premierlabs.co.uk)  
web: [www.premierlabs.co.uk](http://www.premierlabs.co.uk)