Fume cupboards
Standards and ACOP Common to UK Market

Institute of Local Exhaust Ventilation Engineers – Information Day - 17 May 2016

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This presentation is not intended as a masterclass in fume cupboards. Information provided is available in the public domain and provides a general awareness of a selection of common UK fume cupboard standards and approved codes of practices. Information and conclusion in this presentation should not be considered those of the presenter. Further this information should not be considered as professional advice. You are recommended to consult with and seek advice from competent persons before proceeding with designs, work or testing with implications for health and safety.

It is hoped this presentation may:

- Highlight experience, knowledge, judgement, ability and integrity of individuals undertaking the inspection/test is a major component in the inspection/test process.
- Remove any stigma associated with an inquisitive, diligent and thorough approach.
- Encourage participants to further their knowledge and bolster confidence for participants to accept and effectively deal with enquiries for fume cupboard validation, commissioning, testing and inspections.
What is a Fume Cupboard? (1)

In the past organisations have avoided fume cupboard standard compliance by claiming that containment devices were ‘ventilated enclosures’ (and not fume cupboards).

**BS EN 14175-1:2003 Fume cupboards - Part 1: Vocabulary**

Defines a fume cupboard as being a “protective device with an enclosure…limiting the spread of airborne contaminants...ventilated by an induced flow of air through an adjustable working opening”

Controlling airborne contaminants at work A guide to local exhaust ventilation (LEV) - HSG258 confirms

“**Small booths** 119 - A fume cupboard is a partial enclosure”

**Partial enclosures - Booths/fume cupboards 354**: Fume cupboards and microbiological safety cabinets should also be further tested according to appropriate BS or EN Standards.
Typical Information Required when Preparing Proposals to Test a Fume Cupboard (1)

What standard is the fume cupboards to be evaluated against at this test /inspection?

What is the fume cupboard generic type?

- Ducted
- Recirculatory
- Face and By-pass
- Constant Volume
- Variable Air Volume
- Vertical Sash
- Horizontal sash
- Combination sash
- Powered sash
- Proximity sensor sash control
Typical Information Required when Preparing Proposals to Test a Fume Cupboard (2)

**Face and Bypass**
Combination – Vertical & Horizontal

**VAV Control (no by pass)**
Vertical Multiple Sashes

**Filtration Re-circulation**
Vertical Sash
Typical Information Required when Preparing Proposals to Test a Fume Cupboard (3)

What is the intended use of the fume cupboard?

- General purpose
- Flammable liquids
- Distillation
- Kjeldahl process
- High heat and acid use
- Perchloric acid
- Hydrofluoric acid
- Radioactive materials
Principal UK Standards for Fume Cupboards – BS EN 14175 (1)

BS EN 14175 - Fume cupboards
BS EN 14175-1:2003 - Part 1 - Vocabulary
BS EN 14175-2:2003 - Part 2 Safety and performance requirement
BS EN 14175-3:2003 - Part 3 Type test methods
BS EN 14175-4:2004 - Part 4 On-site test methods
DD CEN/TS 14175-5:2006 - Part 5 Rec. for Installation & Maintenance
BS EN 14175-6:2006 - Part 6:Variable air volume fume cupboards
BS EN 14175-7:2012 Part 7: Fume cupboards for high heat and acidic load
The BS EN 14175 covers general purpose fume cupboards and is a product standard allowing National Bodies to set their own requirements for operational use. The standard is applicable to fume cupboards installed after 2003 but currently expressly excludes:

- **Microbiological Safety Cabinets (MSC) BS EN 12469:2000 & BS 5726 -2:1992** (BSI-LBI/001/01 currently discussing review of this standard to align it with European Norms and current BS EN 14175 group of documents).

- **Devices used for Radiological materials applications** *(Drafting in process by CEN TC 332 WG4 for submission but requires agreement from National Radiological protective bodies.)*

- **Recirculatory/filtration fume cupboards BS 7989:2001** *(Final draft by CEN TC 332 WG4 for filtration fume cupboards was submitted in October 2015 for CEN approval).*
BS EN 14175 is a **product standard** and describes methods and test to evaluate the performance of one product (fume cupboard) for comparison with another. The on site test described are used for comparison with the type test to compare installed operating conditions with the type test information for the fume cupboard. Variances from the type test are reported with conclusion suggesting possible reasons for variances and recommendations.

- Although fume cupboards installed before 2003 may not have been type tested the test procedures in BS EN14175 are commonly considered appropriate to evaluate the performance of such fume cupboards.
- The EN14175 European Norm allows National bodies, specifiers and users to specify and prescribe specific on site installed operating requirements for fume cupboards. The evaluation and testing described in EN14175 can be performed by any party which has the required equipment and the necessary knowledge and expertise to perform the tests.
Principal Requirements of BS EN 14175 (1)

Fume cupboards shall be designed and constructed such that:

- Concentrations or quantities of hazardous airborne contaminants are prevented from escaping from the fume cupboard chamber and fumes are removed efficiently to reduce explosive or hazardous atmosphere within the workspace.
- Users and others are protected from splashes of substances and flying particles.
- Materials used in construction of the fume cupboard shall be suitable for the anticipated mechanical, chemical and environmental conditions during expected use.
- The materials of construction (excludes services and controls) which are likely to come into contact with the fumes shall be suitable for the process specified to be carried out within the fume cupboard.
Conformity evaluation – Type Test
For conformity evaluation, an example of a production model of the fume cupboard installed in accordance with the manufacturer's instructions in a test room shall undergo a type test in accordance with BS EN 14175-3:2003

Type test report
When a fume cupboard has been type tested in accordance with BS EN 14175-3:2003, the party which carried out the test shall issue a BS EN 14175-3:2003 compliant test report.

Certificate of conformity or supplier's declaration
If after type test the fume cupboard is compliant with the requirements of BS EN 14175 Part 2, a certificate of conformity or supplier's declaration (dated, with reference number clearly identifying model of tested fume cupboard) is issued confirming the fume cupboard was tested in accordance with BS EN 14175-3 and complied with requirements of BS EN 14175 Part 2.
Inspection and Tests BS EN 14175 (1)

• All BS EN14175 documents contain an Annexe A which is not included in other versions of the EN14175 published in mainland Europe. The Annexe A consists predominantly of design, installation, operation and maintenance guidance originally included in BS7258 Laboratory Fume Cupboards. The Annex A will have many specific test and inspection requirements (many relevant to LEV) not included in European versions of EN14175.

• If asked to contractually comply with EN14175 seek confirmation prior to tendering whether you are expected to also comply with the BS EN14175 including Annex A.

• With regard to testing BS EN 14175 describes procedures, instrumentation and conditions including methods for calculations and the format/presentation content of reports.

• For compliance with BS EN 14175 Part 3 Type test methods all of the test described shall be performed.

• For compliance with BS EN14175 Part 4 On Site test methods the selection, number and type of tests is subject to prior agreement between parties and there is no obligation on any party to perform all of the tests described. BS EN14175 Parts 6 and 7 have additional test requirements.

• There are in excess of 120 inspections, tests and procedures described in the current published parts of BS EN14175. When asked to test in accordance with BS EN14175 obtain confirmation of the actual tests required. This will include any special site conditions required for test.
Inspection and Tests BS EN 14175 (2)

Excluding Annex A the most commonly UK specified on site tests from BS EN 14175 Part 4 On site test methods specific to the fume cupboard device are:

- **Inner plane velocity** using hot wire anemometer
- **Inner plane containment** using SF6 tracer gas and infra red gas analyser
- **Outer plane containment** using SF6 tracer gas and infra red gas analyser
- **Outer plane robustness of containment** using SF6 tracer gas and infra red gas analyser
- **Volume flow** using hot wire anemometer or pitot tube
- **Flow visualisation** using smoke tracer
- **Fume cupboard pressure drop test** using manometer
- **Sound pressure** using a sound level meter
- **Flow alarm monitor test** in accordance with manufacturers instruction
Inspection and Tests BS EN 14175 (3)

Inner Measurement Plane BS EN 14175-3:2003 – 3.2 Figures 1 & 2

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Inspection and Tests BS EN 14175 (4)

BS EN 14175-3:2003 5.2 Face velocity 5.2.2 probe & grids (inner plane)

a = 100 mm
b ≤ 400 mm
c ≤ 400 mm
Inspection and Tests BS EN 14175 (5)

BS EN 14175-3:2003 5.3 Containment 5.3.3 probe & grids (inner plane)

- \( a = 130 \text{ mm} \)
- \( b \leq 600 \text{ mm} \)
- \( c \leq 600 \text{ mm} \)
- \( d = 160 \text{ mm} \)
- \( e = 200 \text{ mm} \)
Inspection and Tests BS EN 14175 (6)

Outer measurement plane BS EN 14175-3:2003 – 5.3.4

Key
1 outer measurement plane
2 test sash opening

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BS EN 14175:2003 5.3 Containment 5.3.4 injector probe & grids (outer plane & robustness)
BS EN 14175-3:2003 5.4 Robustness of containment typical illustration of arrangement
5.4.1 test equipment - 5.4.3 Positioning of test equipment – 5.4.4 test procedure
Inspection and Tests BS EN 14175 (9)

BS EN 14175 Parts 6 and Part 7 have supplementary additional tests which are common UK specified site tests.

BS EN 14175 Part 6 Variable air volume fume cupboards

- Measure extract volume flow rate at minimum opening and at 50% of test sash position.
- Measure parameters the VAV system uses for control (volume flow rate, velocity or pressure difference) with sash at minimum, maximum and 50% opening.
- Measure and record response time for the sash from closed to open recording the time for either the volume flow rate to return to the initial value within ±10% or the pressure drop to return to the initial value within ±20%.
- Measure and record outer plane containment at the minimum pressure difference of the VAV system and the fume cupboard with the VAV system adjusted to the minimum extract volume flow rate and at the test sash opening specified by the manufacturer of the fume cupboard.
• Measure and record outer plane containment at the maximum pressure difference of the VAV system and the fume cupboard with the VAV system adjusted to the nominal extract volume flow rate specified by the manufacturer of the fume cupboard and at closed sash position.

• Measure and record the air exchange rate and air volume flow rate at the minimum volume flow specified by the manufacturer for minimum sash opening.

• On site inspections and testing must always be recorded and a detailed report provided to include as a minimum:- manufacturer name and address; fume cupboard type, serial number and location; full description of fume cupboard with all services; inspectors/testers name and address and contact details; individual report number; record of room environmental conditions; description of all equipment and instruments used in test with calibration certificates; description of test and sash positions adopted in test; diagrams of test layout; record of all results and tests and data; details of any adjustments made; comparison to type test if type tested fume cupboard.
Inspection and Tests BS EN 14175 (11)

BS EN 14175 Part 7 High Heat Load and acidic fume cupboards:

- Measure containment in outer measurement grid with hotplates switched off.
- Measure robustness of containment in outer measurement grid with hotplates switched off.
- Measure containment in outer measurement grid with hotplates switched on providing 4kw per meter width in workspace.
- Measure robustness of containment in outer measurement grid with hotplates switched on providing 4kw per meter width in workspace.
- Verify maximum temperature alarm sensor in the top of the fume cupboard operates as specified in the product manual.
BS EN 14175-7:2012 High Heat Load and acidic fume cupboards – 4.4 Testing

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It is feasible testers may not be provided with type test data or operating requirements for the fume cupboard under test. In such instances it may be considered appropriate to assess performance against recognised ‘best practice’ and ‘industry standards’.

Containment and Performance bandings for BS EN 14175 are currently being reviewed by British Standards panel LBI/001/01 and CEN TC332 WG4. Currently there are no agreed performance criteria but the following tables prepared by Dr. Ali Bicen is illustrative of possible formats that may be used for presenting the information.
Illustration by Dr. Ali Bicen of how possible banding and performance tables may be presented in the Annexe of BS EN14175:3 Type test methods & BS EN 14175:4 On-site test methods

- Class 1 as an example - Research Laboratories
- Class 2 as an example - Teaching Laboratories
- Class 3 as an example - School Laboratories
- Lower velocities are allowed subject to the specified containment being achieved

* These tables and values contained in them are illustrations and shall not be considered prescriptive or recommended guidance for compliance.
Inspection and Tests BS EN 14175 (15)

Illustration by Dr. Ali Bicen of how possible banding and performance tables may be presented in the Annexe of BS EN14175-6 Variable air volume fume cupboards

<table>
<thead>
<tr>
<th>Velocity Setpoint</th>
<th>Regulation</th>
<th>Minimum Flow (at min each)</th>
<th>Response Time</th>
<th>Containment</th>
<th>Protection Factor</th>
<th>Air Exchange at min flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40 m/s</td>
<td></td>
<td>20% of flow at 150mm opening</td>
<td>$T_{up} = 5$ sec $T_{down} = 8$ sec</td>
<td>outer plane open, closed, closing each</td>
<td>4.5 $10^5$</td>
<td>50 per hour</td>
</tr>
<tr>
<td>0.30 m/s</td>
<td></td>
<td>30% of flow at 500mm opening</td>
<td>$T_{up} = 5$ sec $T_{down} = 8$ sec</td>
<td>outer plane open, closed, closing each</td>
<td>2.2 $10^5$</td>
<td>30 per hour</td>
</tr>
<tr>
<td>0.30 m/s</td>
<td></td>
<td>50% of flow at 500mm opening</td>
<td>$T_{up} = 5$ sec $T_{down} = 8$ sec</td>
<td>outer plane open, closing each</td>
<td>1.1 $10^5$</td>
<td>30 per hour</td>
</tr>
</tbody>
</table>

* These tables and values contained in them are illustrations and shall not be considered prescriptive or recommended guidance for compliance.
Inspection and tests BS EN 14175 (16)

- BS EN14175 includes a calculation to illustrate ‘Containment Factor’ (CF) unfortunately when only CF evaluation is adopted a conclusion may be drawn that ‘smaller fume cupboards are more efficient than larger fume cupboards’. This is a consequence of the CF calculation using exhaust volume flow. For example if a 1.2m and 1.8m fume cupboard were compared despite both having identical sash height, face velocity and containment performance the 1.2m fume cupboard CF index will be better than the 1.8m fume cupboard because it uses a lower volume flow.

- A proposal is being considered by British Standards panel LBI/001/01 to include Protection Factor (PF) which uses a tidal breathing rate in the formulae and is probably more useful to LEV engineers in their assessments.

- You will note the assessment of performance considers a group of operational requirements and does not use ‘face velocity’ as the only deciding factor in compliance.

- It is considered in appropriate to fail a fume cupboard solely because of its failure to attain a notational ‘acceptable face velocity’. Fume cupboards have shown containment compliance during type testing with face velocities < 0.3m.s\(^{-1}\) @ 0.5m sash opening.
**Special Note:**

Illustrations opposite prepared by Dr. Ali Bicen for Containment Border values and ‘PF’ values shown for EN12469 and CLEAPSS are illustrative and **are not endorsed by** and do not appear in documents published by either CLEAPSS or the National Standards Bodies.

The ‘PF’ values shown opposite for France, Netherlands and Germany are illustrative and **are not endorsed by** and do not appear in documents published by the National Bodies.

**NOTES:**

\[ PF = \frac{Q_{50}}{Q_{sample}} \times 10^6 \]

where:
- \(PF\) is Protection Factor
- \(Q_{50}\) is SFs release rate in lt/min (0.10 x test gas release rate)
- \(Q_{sample}\) is tidal breathing rate in lt/min (10 lt/min)
- \(C_{50}\) is measured SFs concentration in ppm

**OTHER CONTAINMENT BORDER VALUES IN THE UK:**
- **EN 12469:** 62 particles
  - PF: \(10^5\) (based on sampling rate of 100 lt/min)
  - PF: \(10^6\) (based on tidal breathing rate of 10 lt/min)
- **CLEAPSS:** 0.033 ppm
  - PF: \(3 \times 10^6\) (based on sampling rate of 2 lt/min - BS7258)
  - PF: \(6 \times 10^5\) (based on sampling rate of 10 lt/min)

**CONTAINMENT BORDER VALUES IN OTHER EUROPEAN NATIONS:**
- **Germany:** 0.650 ppm
  - PF: \(6.9 \times 10^4\) for all outer plane & robustness
- **Netherlands:** 0.020 ppm
  - PF: \(2.2 \times 10^6\) for outer plane open and closing
  - 0.650 ppm
  - PF: \(6.9 \times 10^4\) for robustness
- **France:** 0.100 ppm
  - PF: \(2 \times 10^5\) for inner plane
Principal UK Standards for Fume Cupboards – BS7989:2001
Specification for recirculatory filtration fume cupboards (1)

- This document is current but a draft for a new European Norm is soon to be submitted by CEN TC 332 WG4 for public comment and it is anticipated BS 7989:2001 will be superseded
- BS 7989:2001 contains a number of test procedures specified in BS 7258: 1:1994 and 4:1994. The BS7258 Laboratory fume cupboards was withdrawn in 2003 and superseded by BS EN14175.
- Within BS 7989 there are type tests and normative tests for monitoring, maintenance and commissioning. The parts most relevant to LEV are as follows.
  - Face velocity in accordance with BS 7258-1:1994 (refer to note above regarding BS 7258 & BS EN 14175)
  - Containment in accordance with BS 7258-4:1994 where not practical to perform test using SF⁶ then smoke tracer may be considered (refer to note above regarding BS 7258 & BS EN 14175)
  - Particulate filter and seal integrity in accordance with Annex D of BS EN 12469:2000
  - Installed gaseous phase filter tests using method Annex A BS 7989:2001
    Challenge twice the occupational exposure limit and typical resultant filter efficiencies are >98%
  - Sound pressure 1m from fume cupboard face and 1.5m from floor (required to be <65 dB(A))
Principal UK Standards for Fume Cupboards – CLEAPSS G9 (1)

- Published by the Consortium of Local Education Authorities for the Provision of Science Services (CLEAPSS).
- CLEAPSS provides support for a consortium of local authorities which currently includes all LAs throughout the British Isles (not Scotland) (100% of those eligible).
- It has around 2000 associate members, in foundation and voluntary-aided schools (where not a member via a local authority); independent schools; incorporated colleges; teacher-training establishments and science learning centres; overseas institutions; field centres, museums; curriculum developers.
- Primarily for Educational establishments.
- Includes guidance on ducted and recirculatory fume cupboards.
- Provides design, inspection, testing and maintenance advice.
Principal UK Standards for Fume Cupboards – CLEAPSS G9 (2)

• The Foreword of CLEAPSS G9 advises readers BS EN14175 is the applicable UK standard for fume cupboards. It also makes reference to the ACOP HSE Controlling airborne contaminates at work HSG258.

• In Section 7 Legal Requirements - 7.7.2 Who carries out maintenance and thorough examination and testing? comments and references made relating to Thorough Examination and Test (TEXT) include the following:

  • CLEAPSS claim to have evidence that some trained on specific courses such as BOHS P601 to undertakes Thorough Examination and Test, have applied quite inappropriate standards to school fume cupboards.
  • CLEAPSS believe attendance at the CLEAPSS Fume Cupboard Testing course (specifically intended for those in member schools who are testing school fume cupboards) may well be a better alternative.
CLEAPSS suggest containment testing for fume cupboards requires sophisticated equipment, expertise and is time consuming. In the document G9 Fume cupboard in schools Revision of DfEE Building Bulletin 88 CLEAPSS propose and recommend alternative tests for commissioning and subsequent monitoring of fume cupboards.

The main tests proposed for ducted fume cupboards (no filters) are minimum face velocity and variation in face velocity. For recirculatory filter fume cupboards tests include minimum face velocity and variation in face velocity, filter seal integrity and a filter saturation challenge test.

Smoke tracer evaluation in the operational sash opening and in front of the fume cupboard are recognised as providing a qualitative indication of containment failure but CLEAPSS current guidance is that smoke tracer evaluation is too subjective and should not form part of any contract.
Principal UK Standards for Fume Cupboards – CLEAPSS G9 (4)

- CLEAPSS G9 is offered as a guide for fume cupboards appropriate for education use and promotes the use of face velocity for certifying containment of fume cupboards.
- CLEAPSS specifies a face velocity $\geq 0.3\text{m.s}^{-1}$ @ 0.4m vertical sash height as the lower limit for compliance to achieve $R/C \geq 100\text{m}^3\text{s}^{-1}$ where:
  
  \[
  \begin{align*}
  \text{Rate of release inside fume cupboard} & \quad (R, \text{cm}^3\text{s}^{-1}) = \geq 100\text{m}^3\text{s}^{-1} \\
  \text{Concentration measured outside fume cupboard} & \quad (C, \text{ppm})
  \end{align*}
  \]

- The 0.3m.s$^{-1}$ value is based on a CLEAPSS research and a project undertaken by J R Crellin in 1982. The recommendation made was for schools use where release rates of toxic gas is anticipated to be less than in research and industry.
- The recommend minimum face velocity of fume cupboards was proposed as $\geq 0.3\text{m.s}^{-1}$ at maximum opening.
- Velocity variations from the mean of all individual face velocity values should not exceed $\pm$ 30%. and variation between face velocities values in any vertical column should not exceed $\pm$ 20%.
- Performance is improved when extract duct is central across the fume cupboard width; baffles are fitted or its ratio of overall height to maximum sash is $>2:1$. 
There are specified test pass/fail/caution criteria in G9, some of which may be considered ambiguous. The principal ones affecting Local Exhaust Ventilation inspections are:

- If fume cupboard, duct or fan are manufactured from asbestos containing materials (ACM) and these are flaking or could produce significant dust levels in room. **Fail**
- The rotational direction of the fan impeller and airflow shall be checked, **Fail if the direction of the air flow is incorrect.**
- All ducting from the fume cupboard to terminal discharge shall be examined for signs of damage. In particular signs of leaks at flanges, joints, change sections and penetrations - **Fail if there is a significant leak at a point where the pressure inside the duct is above atmospheric. Fail if the duct is obstructed or could be obstructed by vermin, birds nests, footballs, vegetation etc.**
- CLEAPSS guidance is that variation of ± 20%, perhaps even ±30%, in face velocity are acceptable but if, all the low velocities are in one vertical column of the operational opening this increases the risk of leakage and is a ‘Fail’.
Inspection and Test – CLEAPSS G9 (2)

• Face velocity should be measured at @ 0.4m sash height if any measurement is less than 0.3m.s\(^{-1}\) the fume cupboard at the opening of 0.4m is considered as Failed.
• If failed at 0.4m, the sash height is lowered to 0.3m and face velocity readings repeated. If the fume cupboard passes, the fume cupboard stop must be relocated to 0.3m and labelled ‘not to be used for chemical reactions’. Subject to risk assessment it may be suitable for dispensing chemicals. If the fume cupboard FAILS at 0.3m it should be clearly marked ‘DO NOT USE’.
• Verify that face velocity on fume cupboard with by-pass with sash set at 0.2m is < 50% of face velocity recorded with sash set at 0.4m. If >50% recommend consideration of suitability
• Velocities > 0.65m.s\(^{-1}\) not recommended as can affect containment and Bunsen burner use.
• On fume cupboards with no by-pass make a report if the upper or lower face velocity variation is greater than 30% or if variance >20% in any vertical column of readings.
• Fume cupboard fans must never be installed on top of the cupboard as this puts ductwork in room under positive pressure.

• Replacement air entering the room to replace that extracted by the fume cupboard and other devices must be adequate and not have adverse effects on the performance of the fume cupboard or result in uncomfortable environmental conditions in the laboratory.

• Ideally, the terminal discharge point should be at a height of 1.25 x the height of the building or 3 m above the highest point of the building, whichever is the greater. The air exiting the terminal outlet must be discharge vertically at a discharge velocity normally ≥ 7 m.s\(^{-1}\).

• Where restraints and restrictions conflict with discharging 1.25 x the height of the building or 3 m above the highest point of the building, CLEAPSS support fumes being discharged in a vertical direction at a minimum of 1 metre above the highest point of the building. In such cases terminal velocity ≥ 15 m.s\(^{-1}\) may be required.

• Cone cap cowls and horizontal terminal discharges are not suitable.
Inspection and Test – CLEAPSS G9 (5)

- Filtration recirculatory fume cupboards must have filters that meet the specification in Table 5.1. The efficiencies in the Table 5.1 ranges from 96.6% to 99%.
- Filters seals on filtration recirculatory fume cupboard should be inspected and tested adopting the procedure described in G9 section ‘9.3 Testing the seating of the filter using polychloroethenes’ If when compared to the values in G9 Table 9.1 the measured concentration of polychloroethenes vapour is greater for the measured release rate the seating must be inspected if the seating is satisfactory then ‘FAIL’ and recommend a new filter is installed. A re-test is required after new filter is fitted.
- The main filter on filtration recirculatory fume cupboard should be checked for saturation using the procedure described in G9 section ‘9.4 Testing the filter for saturation by acid gases’ 9.5 Testing the filter for saturation by alkaline gases’ If the measured concentration for either test is greater than value in Table 9.2 and 9.3 for the measured release rate ‘FAIL’ and recommend a new filter is installed. Re-test is required after a new filter is fitted.
- CLEAPSS current guidance is that for the majority of schools, filter saturation testing can be avoided if:
  - Filters in fume cupboards with minimal to normal use and used in teaching laboratories are replaced every 4 years.
  - Filters in fume cupboards with heavy use in teaching laboratories are replaced every 3 years.
  - Filters in fume cupboards used in Prep Rooms are replaced every 2 years.
Laboratory Specific Criteria BREEAM 2014.

Credit 1: **Use BS EN 14175-2 compliant fume cupboard**

Credit 2: **Reduce Volume flow/linear metre of sash width to <0.16m$^3$s$^{-1}$**

For example if fume cupboard internal sash width is 1m then possibilities may be:

a) Operational sash area of 0.5m$^2$ with resultant average face velocity of 0.32 m.s$^{-1}$
b) Operational sash area of 0.4m$^2$ with resultant average face velocity of 0.4 m.s$^{-1}$

Credit 3: **Reduce Volume flow/linear metre of sash width to <0.12m$^3$s$^{-1}$**

For example if fume cupboard internal sash width is 1m then possibilities are:

a) Operational sash area of 0.5m$^2$ with resultant average face velocity of 0.24 m.s$^{-1}$
b) Operational sash area of 0.4m$^2$ with resultant average face velocity of 0.3 m.s$^{-1}$
<table>
<thead>
<tr>
<th>Best Practice</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Best practice specific fan power rates (as in table)</td>
<td>1.0</td>
</tr>
<tr>
<td>C</td>
<td>Fume cupboard volume flow rate &lt; 0.12 m³/s per m</td>
<td>0.5</td>
</tr>
<tr>
<td>D</td>
<td>Grouping and/or isolation of activities</td>
<td>0.5</td>
</tr>
<tr>
<td>E</td>
<td>Heat recovery from exhaust air</td>
<td>0.5</td>
</tr>
<tr>
<td>F</td>
<td>Cooling energy recovery from exhaust air</td>
<td>0.5</td>
</tr>
<tr>
<td>G</td>
<td>Grouping of cooling loads</td>
<td>0.5</td>
</tr>
<tr>
<td>H</td>
<td>Free cooling in chillers/dry air coolers</td>
<td>0.5</td>
</tr>
<tr>
<td>I</td>
<td>Load responsiveness, variable speed drives</td>
<td>0.5</td>
</tr>
<tr>
<td>J</td>
<td>Clean rooms, particle monitoring systems</td>
<td>0.5</td>
</tr>
<tr>
<td>K</td>
<td>Diversity in plant and duct sizing</td>
<td>0.5</td>
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<td>Reduced room air changes rates</td>
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Other Possible Specified Test/Inspections Procedures

**Health & Safety Executive**
Controlling airborne contaminants at work.
A guide to local exhaust ventilation (LEV) HSG 258
It is assumed attendees are familiar with sections of HSG258 relevant to fume cupboards.

**ASHRAE 110 (2005)**
American standard often offered by companies who market worldwide. This standard has many of the test procedures (albeit with slight variances) found in the BS EN14175.

**BSI – BS7258 Fume cupboards (withdrawn in 2003)**
BS7258-1:1994, BS7258-2:1994, BS7258-3:1994 and BS7258-4:1994 have been withdrawn and superseded by BS EN14175.

**Client specifications**
Formulated using other major standards documents incorporating a mix of current and past standard documents (often including BS EN14175, BS7258, HSG258 & ASHRAE 110).
How to Improve the Protection Afforded by Your Fume Cupboard – C J Saunders (I) F/C

Loading scenarios

Each box 415mm x 265mm x 340mm
Length x Height x Width

Front face of box formation
200mm from plane of sash

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How to Improve the Protection Afforded by Your Fume Cupboard – C J Saunders (2)

– Velocity m.s$^{-1}$

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How to Improve the Protection Afforded by Your Fume Cupboard – C J Saunders (3)
- Containment – SF6 concentration (ppm)

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How to Improve the Protection Afforded by Your Fume Cupboard – C J Saunders (4) Summaries

- **Velocity**
  - Lower average air velocities when loaded
  - Variation increases with loading - particularly if the obstacles are not raised
  - Doesn’t provide information on containment

- **Containment**
  - Excellent when empty (sensitivity!)
  - …but also with blockages when they are raised
  - Issues when blockages placed on the base of the FC
  - Scenario 3 - Smoke tests highlighted the containment problem

- **Critical to fume cupboard performance:**
  - The environment
  - Design
  - Process
  - Use, training and working practices

- **Face velocity is an important metric but not necessary the most important parameter**
References (1)

BS EN 14175-1:2003 - Part 1 - Vocabulary - BSI price member £87 others £174
BS EN 14175-2:2003 - Part 2 Safety and performance requirement - BSI price member £76 others £152
BS EN 14175-3:2003 - Part 3 Type test methods - BSI price member £87 others £174
BS EN 14175-4:2004 - Part 4 On-site test methods - BSI price member £76 others £152
DD CEN/TS 14175-5:2006 - Part 5 Rec. for Installation & Maintenance - BSI price member £76 others £152
BS EN 14175-6:2006 - Part 6:Variable air volume fume cupboards - BSI price member £76 others £152
BS EN 14175-7:2012 Part 7: Fume cupboards high heat and acidic load BSI price member £76 others £152
BS 7989:2001 – Specification for recirculatory filtration fume cupboards
BS7258 Parts 1 to 4 :1994 Laboratory Fume cupboards

Permission to reproduce extracts from British Standards is granted by BSI Standards Limited (BSI). No other use of this material is permitted. British Standards can be obtained in PDF or hard copy formats from the BSI on line shop: www.bsigroup.com/shop
References (2)

- ‘Controlling airborne contaminants at work - A guide to local exhaust ventilation (LEV) HSG 258’ - Health and Safety Executive publication.
- ‘How to Improve the Protection Afforded by Your Fume Cupboard’ - John Saunders Principal Scientist Chemical and Biological Risk Unit Health and Safety Laboratory 2015.
References (3)

• Department for Education & Science Building Bulletin 88 Fume cupboards in Schools (Revision of Design Note 29 Fume cupboards in Schools).

• School fume cupboards, J R Crellin, Education in Chemistry, 12 (6), November 1984 p 185-8.

• Building Research Establishment Environmental Assessment Method (BREEAM).


• Illustration by Dr. Ali Bicen of how possible banding and performance tables may be presented in the Annexe of BS EN14175 Fume cupboards – Dr. Ali Bicen Invent UK Limited.
My thanks for your interest and attention. I hope this presentation may encourage you to further your interest, knowledge and experience in fume cupboards.

Before leaving please wake the person next to you.