THE UNIVERSITY of EDINBURGH

Laboratory Ventilation Policy

Purpose	1. The purpose of this policy is: 1.1. To enable energy, cost and carbon savings while maintaining or improving safety and compliance within University of Edinburgh laboratories 1.2. To standardise good practice in the design and operation of the various ventilation systems within University of Edinburgh laboratories.
Overview	2. Lab ventilation is highly energy intensive due to the expulsion of heated or cooled air from the building, requiring fresh 'make-up' air to be heated or cooled as it enters the building. Air change rates for rooms, and flow rates for localised extract ventilation (e.g. fume cupboards, downdraught tables, biological safety cabinets, extract snorkels, etc.) are a major determinant of lab energy consumption, and should be set based on evidence. Safety of occupants must be prioritised, but should be achieved with the lowest energy consumption possible. 3. This policy seeks to ensure provision of adequate, flexible and safe ventilation, including avoiding operating ventilation systems at a fixed rate which is designed to cope with a 'worst-case-scenario' chemical spill all the time. This is an inappropriately crude approach to the issue of safe and sustainable ventilation, and results in unnecessary consumption of energy and resources.
Scope	4. For the purposes of this policy, the term "laboratory" refers to "wet labs" but could also include clinical areas. The following areas are considered within this policy: 4.1. The frequency of air changes per hour (ACH) generated by air handling systems supplying air to laboratory rooms, and how to reach a safe and comfortable minimum ACH. 4.2. The speed (face velocity in m/s) and therefore also volume of air being drawn through fume cupboards, and how to reach a safe minimum face velocity. 4.3. The frequency of air changes per hour (ACH) generated by air handling systems supplying air to animal housing facility rooms, and how to reach a safe and compliant minimum ACH. 4.4. The use of individually ventilated cages in animal housing facilities, and how this interacts with room ventilation systems. 4.5. The speed (and control thereof) of fume cupboard exhaust air as it exits the exhaust stacks.
The Policy	5. The overarching principles of the policy aim to reduce the 'consumption' of heated or treated air within University of Edinburgh science buildings, and associated energy, carbon and cost implications, whilst in no way compromising safety and health.

	6. Appropriate ventilation shall be provided for each scenario across the University of Edinburgh in order to deliver appropriate conditions for the safety and comfort of occupants and effective operation of equipment. 7. An evidence-based approach should be used to ensure ventilation rates should be set as to the lowest safe level (for both general lab room ventilation and fume cupboard ventilation). 7.1. With appropriately designed sills fume cupboards can often operate safely at 0.35m/s face velocity. Higher face velocities may be required for highly hazardous materials such as radio-isotopes. Face velocities should be checked annually and must be within ±10% of the commissioning velocity. 7.2. In a non-responsive system general lab ventilation should set-back to 4 air changes per hour (ACH) outside of working hours and should aim for as low as possible to achieve safety during working hours. Numerous labs[1] have adopted 6ACH when occupied, others 8ACH. Evidence of need should be provided if a lab is to be ventilated at a rate exceeding 12ACH. 7.3. All tasks undertaken in a lab should be risk assessed (details provided in supporting Lab Ventilation Guidance). This will determine the level of ventilation and control measures such as fume cupboards required to ensure tasks are undertaken safely. 7.3.1. Guidance on risk assessments is available on the Health and Safety website at https://www.ed.ac.uk/health-safety/online-resources/risk-assessments. 7.3.2. All risk assessments should be undertaken by 'competent persons' – more details on this is given in the University Health and Safety Policy, Framework: Arrangements Section 18 Risk Assessments, http://www.docs.csg.ed.ac.uk/Safety/Policy/Framework_-_Arrangements.pdf 7.3.3. Current risk assessments will need to be reviewed in light of the use of lower velocity fume cupboards. 7.3.4. Particular focus needs to be given to the appropriate control measures for higher risk activates to ensure safety is not compromised. 8. Where suitable, control equipment should be installed to vary the ventilation rate in response to varying requirements. Supply air should be controlled to modulate in line with varying extract air rates. Examples include; 8.1. VAV fume cupboards with automated sash closers 8.2. Demand controlled room ventilation systems (e.g. Aircuity) 8.3. Wind responsive fume exhaust (via stacks) 9. Within animal laboratory and holding facilities the volume of highly conditioned air required (i.e. tightly controlled for temperature and humidity), should be minimised.

[1] E.g. Harvard, Stanford, Cornell

	9.1. E.g. through technology such as individually ventilated cages where this is compatible with the practices of the facility users/demands of science. 10. Where a relative difference in air pressure with neighbouring spaces is required air pressures should be monitored and maintained at the design pressure by a Building Management System, and checked every 3 years and/or whenever any structural or procedural changes have occurred within the area to ensure the pressure is ±10%[2] of the design pressure.

Date approved	11/12/18
Approving authority	Sustainable Strategy Advisory Group
Consultation undertaken	Health and Safety Manager for each School Sustainable Laboratories Steering Group (January and May 2018) Assistant Director of Estates and Head of Estates Operations Occupational Hygiene and Projects Manager – Health and Safety Director – Health and Safety Health and Safety Officer - Central Bioresearch Services Deputy Director - Central Bioresearch Services Departmental Operations Manager – Central Bioresearch Services Chief Technical Officer - Central Bioresearch Services School Facility Unit Officer – Central Bioresearch Services Zebrafish Unit Manager – Central Bioresearch Services CBS/IGMM Operations Manager - Central Bioresearch Services Director – Veterinary Scientific Services
Impact assessment	
Date of commencement	
Amendment dates	
Date for next review	TBC – 12 months after commencement
Section responsible for policy maintenance and review	Health and Safety, Estates, SRS With additional input sought from lab users.
Related Policies, Procedures, Guidelines & Regulations	• University of Edinburgh Estates Mechanical Engineering Guidelines • University of Edinburgh Climate Strategy "Zero by 2040" • Health and Safety at Work Act 1974 • Control of Substances Hazardous to Health Regulations 2002 • Provision & Use of Work Equipment Regulations 1998 • Electricity at Work Regulations 1989 • BS 7258, Parts 1, 2, 3 and 4 – which apply to fume cupboards installed in the work place prior to 2004, and

[2] (Jan 2018: this is currently being queried with a lab ventilation contractor to ascertain if this is suitable or not)

	• BS EN 14175, Parts 1, 2, 3, 4, 5 and 6 for fume cupboards installed from 2004 • Maintenance, Testing and Examination of Local Exhaust Ventilation, HSG37, 1993. HSE publication. • Controlling Airborne Contaminants at Work, HSG258. 2011. HSE publication. Clearing the Air, INDG408, 2011. HSE Publication. • Control of Animal Allergens, EH76, 2011. HSE publication • Animals (Scientific Procedures) Act 1986
Policies superseded by this Policy	

Appendix:

Laboratory Ventilation Policy Guidance

1. Introduction

This Laboratory Ventilation Policy Guidance has been produced in order to provide guidance on **how** to implement the Laboratory Ventilation Policy and sources of supporting information regarding best practice. Both the Laboratory Ventilation Policy and the Guidance document are available on the University of Edinburgh website at https://www.ed.ac.uk/about/sustainability/staff/laboratories/resources and https://www.ed.ac.uk/about/sustainability/governance-publications-reports.

2. Background

The University of Edinburgh has stated its commitment to reduce carbon emissions resulting from its operations in the Climate Strategy, with a target of becoming zero-carbon by 2040. To achieve this target all areas of the University of Edinburgh will need to look for ways to reduce their energy consumption and associated carbon emissions.

Lab ventilation is highly energy intensive due to the expulsion of heated or cooled air from the building, requiring fresh 'make-up' air to be heated or cooled as it enters the building. Air change rates for rooms, and flow rates for localised extract ventilation (e.g. fume cupboards) are a major determinant of lab energy consumption, and should be set based on evidence. Safety of occupants must be prioritised, but should be achieved with the lowest energy consumption possible.

Currently some University of Edinburgh ventilation systems operate at a fixed rate which is designed to cope with a 'worst-case-scenario' chemical spill all the time. This is an inappropriately crude approach to the issue of safe and sustainable ventilation, and results in unnecessary consumption of energy and resources.

The introduction and adoption of the Laboratory Ventilation Policy will assist in reducing energy, cost and carbon emissions while maintaining or improving safety and compliance within University of Edinburgh laboratories. It will also serve to standardise good practice in the design and operation of the various ventilation systems within University of Edinburgh laboratories.

3. Legislative Framework

The key pieces of legislation related to this policy area are listed below:

- Health and Safety at Work Act 1974
- Control of Substances Hazardous to Health Regulations 2002
- Provision & Use of Work Equipment Regulations 1998
- Electricity at Work Regulations 1989
- BS 7258, Parts 1, 2, 3 and 4 – which apply to fume cupboards installed in the work place prior to 2004, and

- BS EN 14175, Parts 1, 2, 3, 4, 5 and 6 for fume cupboards installed from 2004
- Animals (Scientific Procedures) Act 1986

4. Targets

In implementing this Policy, the following targets are proposed:

- All new fume cupboards should be ‘low flow’ (c. 0.35m/s face velocity) unless site or activity specific circumstances require otherwise (e.g. radio-isotopes)
- All new fume cupboards should be VAV controlled and fitted with absence detection sensors connected to auto-sash closers
- Annual fume cupboard testing to ensure face velocities are ±10% of design
- All lab ventilation either be fitted with responsive controls or be risk assessed, and the ACH adjusted accordingly, including opportunities for night set-back
- All new animal facilities consider options for IVCs, and where IVCs are installed the general room ventilation be adjusted accordingly
- Three-yearly checks of lab air pressure differentials to ensure ±10% of design
- Where appropriate wind responsive controls should be fitted to exhaust stacks
- Where 24/7 ventilated storage is required this should be provided on a separate system from the fume cupboards, to allow fume cupboards to be switched off when no activity is taking place.

University of Edinburgh Climate Strategy

- Reduce emissions of carbon per £million turnover by 50% from a 2007/8 baseline year by 2025
- Return our carbon emissions to 2007/8 baseline year levels by 2025
- Become net zero carbon by 2040

5. Policy Objectives

Appropriate ventilation shall be provided for each scenario across the University of Edinburgh in order to deliver appropriate conditions for the safety and comfort of occupants and effective operation of equipment.

An evidence-based approach should be used to ensure ventilation rates should be set as to the lowest safe level (for both general lab room ventilation and fume cupboard ventilation).

5.1. Fume Cupboards

5.1.1. Purchasing preference should be for new and replacement fume cupboards to be “low flow” fume cupboards with appropriately designed sills which can operate safely at 0.35m/s face velocity.

5.1.2. Higher face velocities may be required for highly hazardous materials such as radio-isotopes.

5.1.3. Face velocities should be checked annually and must be within ±10% of the commissioning velocity.

5.1.4. Fume cupboards should be fitted with VAV controls and automated sash closers

5.1.5. Where technically and financially feasible exhaust stacks should be fitted with wind responsive controls to modulate e-flux velocity in line with measured wind speed.

5.1.6. Where 24/7 ventilated storage is required this should be provided on a separate system from the fume cupboards, to allow fume cupboards to be switched off when no activity is taking place.

5.2. General Lab Room Ventilation

5.2.1. Where suitable, demand responsive control equipment should be installed to vary the general room ventilation rate in response to changing ventilation requirements. Supply air should be controlled to modulate in line with varying extract air rates.

5.2.2. In a non-responsive system all tasks undertaken in a lab should be risk assessed. This will determine the level of ventilation and control measures such as fume cupboards required to ensure tasks are undertaken safely.

5.2.2.1. Guidance on risk assessments is available on the Health and Safety website at https://www.ed.ac.uk/health-safety/online-resources/risk-assessments.

5.2.2.2. All risk assessments should be undertaken by 'competent persons' – more details on this is given in the University Health and Safety Policy, Framework: Arrangements Section 18 Risk Assessments, http://www.docs.csg.ed.ac.uk/Safety/Policy/Framework_-_Arrangements.pdf

5.2.2.3. It is recommended that risk assessments should be undertaken by collaborative work between the lab user and their local/school health and safety advisor/manager.

5.2.2.4. Current risk assessments will need to be reviewed in light of the use of lower velocity fume cupboards.

5.2.2.5. Particular focus needs to be given to the appropriate control measures for higher risk activates to ensure safety is not compromised.

5.2.3. In a non-responsive system general lab ventilation should set-back to 4 air changes per hour (ACH) outside of working hours and should aim for as low as possible to achieve safety during working hours.

5.2.4. In a non-responsive system 6-8ACH should be targeted during occupied periods

5.2.5. Evidence of need should be provided if a lab is to be ventilated at a rate exceeding 12ACH.

5.3. Within animal laboratory and holding facilities the volume of highly conditioned air required (i.e. tightly controlled for temperature and humidity), should be minimised.

5.3.1. E.g. through technology such as individually ventilated cages where this is compatible with the practices of the facility users/demands of science.

5.4. Where a relative difference in air pressure with neighbouring spaces is required air pressures should be monitored and maintained at the design pressure by a Building Management System, and checked every 3 years and/or whenever any structural or procedural changes have occurred within the area to ensure the pressure is ±10%[3] of the design pressure.

[3] (Jan 2018: this is currently being queried with a lab ventilation contractor to ascertain if this is suitable or not)

Appendix A – Reference Documents and Information Resources

Legislation

- Health and Safety at Work Act 1974
- Control of Substances Hazardous to Health Regulations 2002
- Provision & Use of Work Equipment Regulations 1998Electricity at Work Regulations 1989
- BS 7258, Parts 1, 2, 3 and 4 – which apply to fume cupboards installed in the work place prior to 2004, and
- BS EN 14175, Parts 1, 2, 3, 4, 5 and 6 for fume cupboards installed from 2004
- Maintenance, Testing and Examination of Local Exhaust Ventilation, HSG37, 1993. HSE publication.
- Controlling Airborne Contaminants at Work, HSG258. 2011. HSE publication. Clearing the Air, INDG408, 2011. HSE Publication.
- Control of Animal Allergens, EH76, 2011. HSE publication
- Animals (Scientific Procedures) Act 1986

Related University of Edinburgh Policies and Strategies

- University of Edinburgh Estates Engineering Guidelines
- University of Edinburgh Climate Strategy “Zero by 2040”
- University of Edinburgh Health and Safety COP P5CL3
- University of Edinburgh Design Guides (draft)

Websites

- http://www.kcl.ac.uk/governancezone/Estates/Fume-Cupboard-Management-Policy.aspx
- http://studylib.net/doc/7172434/general-fume-cupboard-requirements
- https://www.ehs.washington.edu/fsodesignrev/s3labventilation.pdf
- https://sp.ehs.cornell.edu/lab-research-safety/chemical-safety/lab-ventilation/Documents/LVMP%202017_Gap%20Analyses_1_2017.pdf
- http://www.ucl.ac.uk/medicalschool/msa/safety/docs/fumecupboard.pdf
- http://www.ucl.ac.uk/estates/contractors-and-designers/documents/sustainability/SKA%20Labs%20Template%20v2.xlsx
- https://www.ehs.harvard.edu/sites/ehs.harvard.edu/files/EHS%20Guidelines%20for%20Design%202017_0.pdf
- https://ehs.stanford.edu/manual/laboratory-standard-design-guidelines/general-ventilation-considerations
- http://ehs.yale.edu/sites/default/files/files/laboratory-design-guidelines.pdf
- http://dcm.ucdavis.edu/cdg/documents/2017/iii-construction-divisions/div_11_equipment_15.pdf
- http://www.nerc.ac.uk/about/policy/safety/procedures/guidance-laboratories/
- http://ehs.colorado.edu/wp-content/uploads/2014/11/Fume-Hood-QandA.pdf
- http://www.research.northwestern.edu/ors/forms/chemical-fume-hood-handbook.pdf
- http://www.forensic-applications.com/hoods/face.html#2

- http://www.escoglobal.com/resources/pdf/guide-fumehoods.pdf
- http://ateam.lbl.gov/PUBS/cec/Appendix/doc/EE_FumeHoods.pdf
- http://www.waldner-inc.com/portals/11/secuflow-usa_2014.pdf
- https://www.aiha.org/aihce07/handouts/po110smith.pdf
- https://sp.ehs.cornell.edu/lab-research-safety/chemical-safety/lab-ventilation/Documents/LVMP%202017_Gap%20Analyses_1_2017.pdf
- https://cds.fs.cornell.edu/file/230540_Laboratories.pdf
- https://acsdchas.files.wordpress.com/2015/06/a-strategy-with-lab-ventilation-management-to-enhance-sustainability.pdf
- https://www.ehs.harvard.edu/sites/ehs.harvard.edu/files/EHS%20Guidelines%20for%20Design%202017_0.pdf
- http://www.nerc.ac.uk/about/policy/safety/procedures/guidance-laboratories/
- http://www.inive.org/members_area/medias/pdf/Inive%5Cclima2007%5CA09%5CA09F1245.pdf
- https://engineering.purdue.edu/~yanchen/paper/2012-7.pdf
- http://www.egnaton.com/LinkClick.aspx?fileticket=vnKIU2JGm30%3D&tabid=80
- http://www.sciencedirect.com/science/article/pii/S1871553209000024

Journals

- ASHRAE Report Number 2438 RP 70, K.J. Caplan and G.W. Knutson, 1978
- Bell, G. and Dale Sartor, “ASHRAE 110 Tracer Gas Containment Report-SDSU: Berkeley hood; Labconco Prototype, Alpha VersionRev. 2.” Lawrence Berkeley National Laboratory Report LBID-2456
- Jin, M. et al, “Experimental study of ventilation performance in laboratories with chemical spills” Building and Environment, Volume 57, November 2012, Pages 327–335,
- Memarzadeh, F., “Effect of reducing ventilation rate on indoor air quality and energy cost in laboratories” Journal of Chemical Health and Safety, Volume 16, Issue 5, September–October 2009, Pages 20–26
- Klein, R.C. et al. “Laboratory air quality and room ventilation rates,” Journal of Chemical Health and Safety (2009)

Design Guides

- Sustainable Design of Research Laboratories: Planning, Design, and Operation By Kling Stubbins, 2011, p135
- Crane, J.T. "Biological laboratory ventilation and architectural and mechanical implications of biological safety cabinet selection, location, and venting." ASHRAE Transactions: 1994, Vol.100, Part 1.
- ACGIH (American Conference of Governmental Industrial Hygienists) Industrial Ventilation Handbook
- https://www.wbdg.org/building-types/research-facilities/animal-research-facility

Appendix B – Lis of Abbreviations of Common Laboratory Ventilation Related Terms

ACH	Air Changes per Hour
BSC	Biological Safety Cabinet (see MSC)
CAV /CV	Constant (Air) Volume
DBV / DCV / DRV	Demand Based Ventilation / Demand Controlled Ventilation / Demand Responsive Ventilation
FC	Fume Cupboard/Fume Cabinet
LEV	Localised Extract Ventilation
MSC	Microbiological Safety Cabinet (see BSC)
VAV	Variable Air Volume