Guidance on Anemometers and Airflow Monitoring of LEV Systems

1. Introduction

Airflow monitoring in Local Exhaust Ventilation (LEV) systems such as Chemical Fume Hoods and Microbiological Safety Cabinets (MSCs) is crucial for ensuring user safety and prevention of environmental contamination from hazardous substances.

Continuous monitoring using on-board measuring devices such as airflow indicators or manometers provides ongoing assurance to users and operators of LEV systems that airflow is adequate and often also include audible and visual alarms to indicate when a system is out of range. However, supplementary performance monitoring of LEV systems is also carried out by recording manual airflow readings at the capture point with an anemometer. Manual performance monitoring is important in a number of situations including:

a. <u>Verification of performance</u>; alarms can sometimes be triggered incorrectly or fail to trigger when they should. Manual checks allow you to verify the alarm's accuracy and ensure the system is operating as expected and, in some cases, there is a regulatory requirement to perform these additional checks – *refer to the **Safety Code of Practice: Local Exhaust Ventilation (LEV) Systems** for further details.*

b. <u>Detecting gradual changes</u>; LEV systems can experience a gradual decline in airflow due to factors like blockages in filters or ducting, wear and tear of extract fans, etc. which may not be detected by a continuous monitoring system. Manual checks, especially as part of a trend analysis, can help identify these changes early on allowing for timely intervention and maintenance to prevent major safety issues or downtime.

c. <u>Identifying the root cause of faults</u>; an alarm might indicate an issue, but manual checks can help pinpoint the location and cause helping in more targeted and effective maintenance.

2. Scope

This guidance covers anemometers and their use in manual airflow monitoring for supplementary performance testing of LEV systems.

Performance specifications of specific LEV systems including commissioning testing, onboard continuous airflow monitoring systems, and all other aspects of LEV operation are outside scope of this guidance.

3. Definitions

Anemometer – device used to measure speed of airflow.

Face velocity – the speed of air at the point of entry into the LEV system measured across the face or plane of cabinets, hoods, booths, etc. which indicates whether the LEV system is performing adequately to capture airborne contaminants.

Local Exhaust Ventilation (LEV) system – LEVs are a type of engineering control used to safely remove or discharge hazardous airborne contaminants (such as dust, fumes, vapours, or microorganisms) at or near their source to prevent worker exposure and/or contamination of an environment.

Microbiological Safety Cabinet (MSC) – type of LEV system used for the safe handling of hazardous microorganisms.

4. Airflow Monitoring Equipment

4.1 Introduction & Selection

Anemometers are instruments used to measure air speed and sometimes air direction. There are several types, each based on different principles of operation, however the most widely used for measuring airflows in LEV systems are vane anemometers and thermoelectric ('hot-wire') anemometers.

Vane anemometers utilise a small rotating vane; the rotation speed of the vane correlates with air velocity. They are robust and easy to use; however, they have reduced sensitivity at lower air speeds due to the mechanical inertia of the vane making it essential that care and attention is given to calibration and accuracy of devices when used in applications below 1m/s.

Hot-wire anemometers utilise a thin wire between two probes heated by an electric current; air movement cools the wire, and the rate of cooling is used to determine air speed. They are highly sensitive, accurate, and responsive; however, they are expensive, fragile, and susceptible to environmental factors such as temperature, humidity, and airborne contaminants impacting their accuracy.

Due to these considerations, the Advisory Committee on Dangerous Pathogens (ACDP) and Health and Safety Executive (HSE) recommend using vane anemometers rather than hot wire anemometers for measuring face velocities of Microbiological Safety Cabinets (MSCs) due to their practicality and robustness which reliably provides consistent and repeatable measurements in real-world conditions. Additional sensitivity and accuracy are not necessary for MSC face velocity checks, which are well within the vane's effective range.

However, hot-wire anemometers may be of benefit during fault investigations, and can be used to supplement vane anemometers, where the high precision and response rates can help pinpoint issues such as localised turbulence, partial filter blocks, damage etc.

The use of either vane or hot-wire anemometers is acceptable when assessed as suitable for local requirements.

4.2 Calibration & Accreditation

Regular calibration of anemometers is essential to maintain their accuracy and reliability. Anemometers are typically calibrated in a wind tunnel against a reference standard. The choice of reference standard is crucial in providing assurance for measuring the performance of LEV systems.

A calibration service which uses a laser Doppler anemometer (LDA) as the reference standard is recommended where minimising the uncertainty of measurement is critical. For example, when measuring performance of an LEV within narrow acceptable limits at low speeds such as those seen in a Class I Microbiological Safety Cabinet (0.7-1.0m/s).

It is recommended that users always use a calibration service accredited to ISO 17025.

5. Conducting Airflow Monitoring

5.1 Local Protocols

Clear written procedures should be available for each area detailing who is responsible for the testing of LEV systems, what monitoring equipment is suitable for each LEV system being tested and the arrangements for calibrating the equipment being used. The procedures should also clearly identify who is responsible for preparing an LEV system for testing and ensuring that they are accessible and safe, and the performance specifications of each LEV system.

5.2 Training & Competency

An assessment of LEV performance should only ever be performed by a competent person. This includes having the technical knowledge, understanding and ability to ensure that the LEV system is maintained in a satisfactory condition. To be deemed competent an individual should have received training on the operation of the airflow monitoring equipment, be familiar with LEV system being assessed and its performance requirements and understand what to do in the event of any issues being identified.

5.3 Frequency of Monitoring & Record Keeping

Performance testing should be conducted at regular intervals in line with either a recognised standard e.g. BS EN 12469 or following the design specification of the LEV system. However, the frequency of monitoring may be increased if there are any concerns about the performance of the system e.g. system reaching end of life, return to operation following remedial repairs, identification of intermittent faults, etc.

Documentation for recording airflow monitoring should contain basic instructions on conducting monitoring for the LEV system being tested and include acceptable result ranges that account for uncertainty of measurement identified during calibration. Users carrying out monitoring should also be aware that in addition to acceptable ranges for individual position readings, many types of LEV systems also stipulate limits on results deviating from a baseline or average. In addition, records should also contain the date of testing, the initials of the individual performing the testing and serial number or identifier of the air monitoring equipment being used for traceability purposes. An example of a LEV airflow monitoring record can be found in the Appendix.

Records of testing should be retained in line with the university's 'Master Records Retention Schedule' which can be found here.

See also:

- **Safety Code of Practice: Local Exhaust Ventilation (LEV) Systems**

7. Appendix

LEV Airflow Monitoring Record – Class I Microbiological Safety Cabinet

YEAR: ………………… CABINET INVENTORY NUMBER ……….…………

Whilst the cabinet is running, position the anemometer vertically in the plane of the aperture, make air velocity measurements at each of the five positions as indicated. The measured inflow air at all points must be between 0.7 and 1.0 m/sec after adjusting for measurement of uncertainty *(e.g. 1% uncertainty means acceptable airflow must be 0.71m/s to 0.99m/s – refer to calibration certificate)*. All readings must also be within ≤20% of the average (mean).

Position 1		Position 2
	Position 5	
Position 3		Position 4

JANUARY		FEBRUARY		MARCH	
Date:	**Initials**	**Date:**	**Initials:**	**Date:**	**Initials:**
Anemometer Inv. No.:		**Anemometer Inv. No.:**		**Anemometer Inv. No.:**	
Acceptable range:		**Acceptable range:**		**Acceptable range:**	
#1 #5 #2 #3 #4		#1 #5 #2 #3 #4		#1 #5 #2 #3 #4	
Average:	**Pass? Y / N**	**Average:**	**Pass? Y / N**	**Average:**	**Pass? Y / N**
APRIL		**MAY**		**JUNE**	
Date:	**Initials:**	**Date:**	**Initials:**	**Date:**	**Initials:**
Anemometer Inv. No.:		**Anemometer Inv. No.:**		**Anemometer Inv. No.:**	
Acceptable range:		**Acceptable range:**		**Acceptable range:**	
#1 #5 #2 #3 #4		#1 #5 #2 #3 #4		#1 #5 #2 #3 #4	
Average:	**Pass? Y / N**	**Average:**	**Pass? Y / N**	**Average:**	**Pass? Y / N**
JULY		**AUGUST**		**SEPTEMBER**	
Date:	**Initials:**	**Date:**	**Initials:**	**Date:**	**Initials:**
Anemometer Inv. No.:		**Anemometer Inv. No.:**		**Anemometer Inv. No.:**	
Acceptable range:		**Acceptable range:**		**Acceptable range:**	
#1 #5 #2 #3 #4		#1 #5 #2 #3 #4		#1 #5 #2 #3 #4	
Average:	**Pass? Y / N**	**Average:**	**Pass? Y / N**	**Average:**	**Pass? Y / N**
OCTOBER		**NOVEMBER**		**DECEMBER**	
Date:	**Initials:**	**Date:**	**Initials:**	**Date:**	**Initials:**
Anemometer Inv. No.:		**Anemometer Inv. No.:**		**Anemometer Inv. No.:**	
Acceptable range:		**Acceptable range:**		**Acceptable range:**	
#1 #5 #2 #3 #4		#1 #5 #2 #3 #4		#1 #5 #2 #3 #4	
Average:	**Pass? Y / N**	**Average:**	**Pass? Y / N**	**Average:**	**Pass? Y / N**

NOTE: ALL errors (including any associated remedial or corrective actions) should be recorded in the equipment record.

Figure 1: Example of airflow monitoring record for a Class I Microbiological Safety Cabinet

8. Document Control

Document title:	Guidance on Anemometers and Airflow Testing of LEV Systems
Document ID code:	HS G304
Date approved:	23rd July 2025
Approving body:	Health Safety & Wellbeing Team
Last review date:	N/A – New document
Revision history:	v1 – July 2025
Retention Period:	5 years after superseded
Next review date:	July 2028
Related documents:	https://www.sussex.ac.uk/hso/hsoatoz
Document Owner:	Health Safety & Wellbeing Team
Point of Contact:	Simon Lewis