Laboratory Ventilation Management Program Template

[Instructions for template: The LVMP Template contains pre-written information and an outline of information to include in your organization’s LVMP. The intention is to be a high level organizational document to manage ventilation. It’s a starting point that can be adjusted to meet your organization’s format. Content is optional and can be changed to best fit your laboratories.

Throughout the template are examples or instructions which are marked with *italics* and [brackets]. This is where information should be inserted by the organization.]

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# Introduction

For the purposes of this program, “laboratory ventilation” refers to the once-through movement of air through spaces that is used to maintain the quality and safety of a laboratory environment where hazards are generated.

## Purpose

This Laboratory Ventilation Management Program (LVMP) provides a framework to ensure that [*your organization name*] laboratories balance safety, financial costs, energy efficiency, and carbon emissions associated with the ventilation systems. The LVMP outlines stakeholders, identifies preventative maintenance procedures, and outlines change management processes and other details associated with maintaining the ventilation system for high quality research.

The purpose of this LVMP is to delineate the laboratory ventilation program’s scope and provide procedural guidance for anyone who has responsibility or is affected by the ventilation of laboratories and adjacent support spaces at the organization.

## Scope

This LVMP applies to laboratory ventilation systems in all facilities on [*your organization name*] property. It applies to research, maintenance, and administrative activities and operations within laboratories on the [*list the campuses, sites, boundaries, and locations that apply*], including [*list the types or names of the buildings that apply (what types of labs, if they are leased or owned)*]. The scope is applicable to all organizations, activities, and personnel involved with laboratories, including multiple stakeholders such as laboratory users, administration, facility owners and managers, support organizations, and technical facility officers or engineers.

This program supplements rather than replaces current policies and design standards regarding laboratory ventilation systems. Current documents and policies are listed in the operational tools for reference and consistency when implementing this program. This document does not intend to provide detailed laboratory ventilation guidance but, instead, guidance related to the management and operation of laboratory ventilation systems overall. Questions about the details of this program should be referred to[*insert in contact information for the LVMP coordinator, the organization chemical hygiene officer/industrial hygienist, or laboratory ventilation specialist*].

## Building Information

[*Insert building information in the table below or link a document or database with building information*].

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name or Number of Building** | **Type of Lab** | **Building Square Footage** | **Number of Laboratories (in building)** | **Notes** |
| *[Lab 1]* | *[Chemical/Microbial]* | *[75,000]* | *[15]* | *[This building is very old and requires ventilation updates.]* |
|  |  |  |  |  |
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This LVMP refers to the building information located within this document [*link to document*].

## Exclusions

[*Write exclusions here*]

Example: “*This program excludes specialized ventilation systems for high hazard operations such as biosafety cabinets, laminar flow cabinets, and gloveboxes. Also excluded are heating, ventilating, air conditioning, and refrigeration (HVACR) equipment*.”

# Objectives

This program contains three key objectives:

## Safety

The primary objective is to ensure safe and effective laboratory operations. Safety requirements for laboratory ventilation must be met and will not be compromised to meet other objectives. The purpose of a laboratory ventilation system is to maintain a safe and healthy work environment by removing and minimizing exposure to airborne contaminants created by laboratory research activities while also supporting occupant health and comfort. This is done primarily through the management of the general exhaust in coordination with exposure control devices (ECDs). Effective and coordinated ventilation management ensures safety both in close proximity to dangerous substances as well as within the whole laboratory space. Stakeholders must be trained, risk-aware, and responsive to this ventilation program.

## Energy Efficiency

A secondary objective is to ensure ventilation is appropriately optimized to improve energy efficiency in all laboratory buildings. Laboratory buildings consume a significant amount of energy due to the demands of laboratory ventilation to maintain air contaminant removal and to condition air to ensure temperature and humidity requirements are met for occupant comfort. Without informed and regular assessment, laboratory spaces can become overly ventilated; wasting energy and resources without necessarily improving laboratory safety. Ensuring effective and appropriate ventilation for laboratories and ECDs can improve the efficient use of ventilation and therefore energy in a laboratory.

## Equipment Lifetime and Operation

Lastly, this program focuses on the improved lifetime and operations of laboratory equipment. Laboratory ventilation is a complex system that requires consistent assessment and maintenance to ensure it is running as intended. The LVMP details appropriate procedures and practices to increase the longevity of all ventilation related equipment and reduce the overall maintenance and operating costs of the system.

## Other Organization Objectives

[*Insert your organization’s other objectives*]

Example: “*To best achieve the primary objectives*, [*your organization name*] *aims for consistent communication between parties such as EH&S, laboratory personnel, and facility managers.”*

Example: *“*[*Your organization name*] *aims to save* [*insert amount of money or energy*] *through smart laboratory practices and energy efficient ventilation equipment to best achieve* [*organization initiate or plan*]*.”*

# Relevant Standards/Requirements

## External Requirements

There are several regulatory and non-regulatory standards containing relevant ventilation requirements that are applicable to the systems within the scope of this program.

Regulatory codes include: [*some possible codes to consider are listed, add or remove from the list as you see fit*]

* *State fire or mechanical codes*
* *US NFPA (National Fire Protection Association) Standard 45*
* *US OSHA (Occupational Safety and Health Administration) Regulations*
* *ACGIH Industrial Ventilation Manual*
* *ASHRAE 62.1 Standard on Ventilation for Acceptable Indoor Air Quality*
* *International Mechanical Code (IMC 2009)*
* *ASHRAE HVAC Applications Handbook, Chapter 14/16: Laboratories*
* *European Ventilation Code Information*

Non-regulatory standards include: [*some possible standards to consider are listed, add or remove from the list as you see fit*]

* *ASHRAE Classification of Laboratory Ventilation Design Levels*
* *ANSI/ASSP Z9.5-2022 Standard on Laboratory Ventilation*
* *ANSI Airborne Hazards Safety Standard*
* *BMBL (Biosafety in Microbiological and Biomedical Laboratories) standards*

## Internal Requirements

In order to meet [*your organization name*]’s standards, this program complies with:

* [*insert links to organization plan, program, policy, standard, guide, or requirement such as a design guide, university energy plan, or local exhaust program*] and [*insert link to other organization plan, standard, guide, or requirement*].

# Stakeholder Roles and Responsibilities

Stakeholder collaboration is crucial to the success of the LVMP. Each stakeholder group contains specific responsibilities pertaining to laboratory ventilation that are listed in this section. The goal of these roles is to improve accountability, clear ownership, and communication between stakeholders.

## Roles and Responsibilities Summary Table

[*Stakeholder responsibilities are summarized below in a hierarchy of actions that need to be taken in this program. These roles are generalized as every organization has different names and positions available to fill these responsibilities. You are able to change the positions to fit your organization’s structure.*]

|  |  |
| --- | --- |
| **Role** | **Responsibilities** |
| Laboratory Personnel | * Utilize ECDs within approved safe work practices for that space
* Notify appropriate PI/Supervisor and EH&S staff of any changes that would potentially alter ventilation requirements to maintain a safe work environment
* Report equipment malfunctions and changes involving ECDs to the appropriate parties
* Complete training on all ECDs and use appropriately to ensure safety and maximize energy efficiency
 |
| Principal Investigators/Supervisors | * Looks for opportunities to eliminate or substitute chemical hazards and reduce or decommission ECDs
 |
| Administration/Lab Manager | * Allocate resources for laboratory ventilation improvements
* Allocate laboratory space to ensure proper ECD quantity and type are available for personnel
* Report equipment malfunctions and changes involving ECDs to the appropriate parties
 |
| Mechanical Engineer/Building Controls Tech | * Respond to written variance requests and coordinates maintenance
* Review and approves engineering documents and standards
* Design mechanical systems to appropriately implement the LVMP
 |
| Facility Operations | * Operate building systems and facility conditions in accordance with LVRA and building design
* Provide mechanical support and service to laboratory equipment
* Implement maintenance programs
 |
| Facility Managers | * Monitors and manages ECD and ventilation system operations including certification, maintenance, and repair
* Communicates with respective parties about ECD updates
 |
| Chemical Hygiene Officer/Industrial Hygienist | * Approve safe operating procedures and appropriate PPE for all lab activities according to organization policies and procedures
* Approve appropriate work within ECDs
* LVRA baseline and ongoing assessments in coordination with engineering
* Decide campus minimum and maximum ventilation flow rates
 |
| Environmental Health and Safety (EH&S) | * Validate safe operation in the laboratory
* Is involved in ECD certification, commissioning, and performance requirements and testing
 |
| Sustainability/Energy Staff | * Monitor building equipment
* Track laboratory energy consumption
* Determine opportunities for saving energy
* Coordinate and assist with commissioning
 |
| LVMP Coordinator | * Updates the LVMP, as necessary
* Work collaboratively with many departments
* Coordinate completion of tasks
* Monitor communications between departments
 |

## Training

Stakeholders should have an understanding of the basic LVMP concepts. All workers at [*your organization*] that interact with this program have appropriate education and trainings to fulfill the requirements. Clearly delineate training requirements (not optional) by positions.

Trainings should be included on: [*some possible trainings to consider are listed, add or remove from the list as you see fit*]

* *The LVMP*
* *EH&S training based on specific job activities and hazards*
* *Significant energy use and operation control*
* *ECD management and maintenance*
* *Change management*

Stakeholders who interact with the LVMP must demonstrate competency on environment, safety, and health training. Training requirements are based on specific job activities and hazards. Lab workers receive additional training as specified, based on ECD use, regulatory requirements, best practices, and the potential for enhancing their capabilities in the lab.

Campus lab and facility staff should receive training on ventilation control, LVMP operation, and change management. They should also have knowledge on conducting testing, commissioning, and risk assessments of the lab equipment and space.

[*Optional to insert links to your organization’s specific training programs*]

# Risk Assessment

The primary purpose of laboratory ventilation systems are to mitigate the risk of airborne hazards within laboratories. However, because of the amount of energy that can be wasted and the varying levels of risk, it is important to properly design and operate ventilation systems to ensure a safe and efficient laboratory.

## Laboratory Ventilation Risk Assessment

The Laboratory Ventilation Risk Assessment (LVRA) establishes appropriate ventilation based on laboratory ECD capacities and hazards present. It uses control banding techniques (which are explained more in the LVRA User Guide), to develop initial baseline air flow and ventilation safety requirements for optimization efforts. LVRAs are then conducted each time hazards change in the lab and ECD and air flow requirements need to be re-assessed.

## Assessment Process

The [LVRA User Guide](https://smartlabs.i2sl.org/pdfs/lvra-user-guide.pdf) and [LVRA Tool](https://smartlabs.i2sl.org/docs/lvra-tool.xlsm) are provided to assist with implementing the LVRA process.

[*Insert your organization’s specific LVRA processes if any*]

Example: *“*[*Your organization name*] *laboratories should record and display the date of the last assessment.”*

## Assessment Schedule

To create a baseline for the lab, an initial assessment should be conducted to identify opportunities for ventilation optimization and safety. Afterwards, assessments and site walkthroughs should be conducted with the purpose of optimization.

An LVRA will be conducted when new hazards, chemicals, or processes are introduced. An annual benchmarking assessment will occur every 12 months. The LVMP should be reviewed every 5 years.

[*Insert your organization’s specific LVRA schedule or change the above information if necessary*]

# EH&S Exposure Control Guidelines

[*If your organization already has lower level programs that discuss laboratory ventilation specifications and guidelines, link the documents/programs here. Otherwise, insert relevant information concerning your organization’s laboratory exposure guidelines.*]

Example: “*If any facilities are constructed, renovated, or upgraded, any laboratory spaces and laboratory ventilation systems must be designed according to [insert link to your organization’s design guidelines].”*

*OR*

*“Fume hoods must meet the requirements in [insert link to your organization’s ECD guidelines].”*

*OR*

*“There are a number of different ECD providers on the market; in order to ensure ECDs are compatible with the existing laboratory work, the technical specifications should be approved through [insert link to your organization’s ECD guidelines or specified manufacturer's].”*

# Maintenance

[*If your organization already has lower level programs that discuss laboratory maintenance, testing, and certification, feel free to link the documents/programs here. Otherwise, insert relevant information concerning your organization’s laboratory maintenance plans.*]

Maintenance is crucial to the upkeep and ensures the performance of ECDs are at acceptable levels. Maintenance should be timely and uniform to keep laboratory activities moving forward safely.

## User Maintenance

Laboratory personnel can perform basic maintenance on ECDs to keep them in proper working condition. These tasks include:

* Checking that the alarm and monitors are properly working before and during work.
* Prior to work, checking that the unit has been certified and tested within the last year.
* Regularly cleaning and decontaminating the work surface.

## Professional Maintenance

Professional maintenance should be used when the complex work is required and should be performed by a skilled technician.

### Testing and Certification

[*Insert link to your organization’s testing and certification procedures if applicable*.]

All ECDs must be tested and certified prior to installation and annually after installation by a certified vendor/agency. They must also be tested when upgrades or changes are made to units.

[*Optional to fill out the table of various maintenance that can be performed in your facilities*.]

|  |  |  |  |
| --- | --- | --- | --- |
| **ECD Type** | **Required Testing** | **Frequency** | **Responsibility** |
| *Chemical fume hood* | * *Face velocity testing*
* *Qualitative smoke capture*
* *AFM alarm testing*
 | *Annual and after changes to the exhaust system* | *Facility manager* |
| *Gas cabinet* | * *Face velocity testing*
 | *Annual and after changes to the exhaust system* | *Facility manager* |
| *Snorkel trunks* | * *Capture velocity/total airflow*
* *Qualitative smoke capture*
 | *Annual and after changes to the exhaust system* | *Lab owner* |
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#### ASHRAE 110 Testing

ASHRAE 110 fume hood testing is required to meet the requirements in the ANSI/ASSP Z9.5-2022 standard. Considerations for how to test should be dependent on the ventilation. Utilize environmentally friendly trace gases where appropriate and approved. Testing should occur periodically as described in the table above.

[*Insert organization’s requirements for testing and tracer gas requirements.*]

### Preventative and Corrective Maintenance

Preventative and corrective maintenance is performed on ECDs before a malfunction or problem occurs so as to meet performance requirements. Ventilation systems must have major maintenance performed [*insert your organization’s maintenance schedule, for instance once a year, twice a year*].

[*Optional to fill out the table of various preventative maintenance that can be performed in your facilities*.]

|  |  |  |
| --- | --- | --- |
| **Type** | **Frequency** | **Responsibility** |
| *ECD visual inspection* | *Annual* | *Facility manager* |
| *Alarm airflow verification* | *Annual* | *Facility manager* |
| *Part replacements* | *Bi-annual* | *Facility operator* |
| *Electrical inspection* | *Annual* | *Facility manager* |
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# Energy Management

The goals of this program include maintaining safety and improving the energy efficiency of laboratory ventilation systems. Energy efficiency will be achieved through the utilization of optimized ventilation.

[*This section is for your organization’s energy goals and the approach to achieve them through design and procedures. Any measures can be included such as metering and monitoring energy use, establishing baselines (and what those baselines are), and scheduling Building Automation Systems (BAS) to lower airflow when laboratories aren’t occupied.]*

Example: *“Your organization name strives to save 50% of the laboratory energy used in 2023 by 2030 through various design guidelines and procedures.*

*Design decisions include:*

* *Installing Building Automation Systems (BAS) to control facility ventilation. This includes lowering airflow and turning off lights when laboratories aren’t occupied and adjusting conditioning for occupants automatically.*
* *Using heat coils to pre-condition laboratory air from exhaust air*
* *Utilize Variable Air Volume (VAV) instead of Constant Air Volume (CAV) hoods where possible*
* *Wind tunnel testing*

*Laboratory procedures include:*

* *Monitoring laboratory energy use to set baselines*
* *Implementing the Shut the Sash program to ensure that laboratory personnel are keeping fume hood sashes at a minimum height and closing them when not in use to reduce airflow.*

# Management of Change

Stakeholders are responsible for alerting the appropriate management of changes in research so that ECDs can be added, updated, or altered to fit the needs of the laboratory personnel. It is important for procedures to be created so that changes in the laboratory can be quickly identified and managed. Documentation, even more, ensures that processes and results are reproducible.

Organizations need to first identify main trigger points that could cause a difference in how you manage ventilation decisions within the space. Trigger to consider but is not limited to:

* ECD modification
* ECD malfunction
* ECD certification and testing
* Laboratory inspection
* Changes involving chemicals or hazards
* Changes involving user input
* Changes involving the laboratory space
* Updating as-built drawings and set-points

[*An example change management process is shown below.*]

These procedures should identify who is responsible for coordinating or managing the changes and the process that the laboratory will go through to accept these changes. [*These procedures can be within a separate document that is linked here, or they can be written into the LVMP.*]

Example:

*New mechanical equipment:*

* *Check if the change fits within the current LVRA’s baselines or if another LVRA needs to be conducted*
* *Ensure that change has been approved by the mechanical engineer, lab manager, and EH&S staff*
* *Check if trainings for lab personnel affected by the new equipment or if new trainings need to be developed*
* *Notify lab personnel of changes to the lab environment*

*A new researcher comes into the lab with new equipment, chemicals, and support. How does the lab react to this change?*

* *Industrial hygienist has to approve which chemicals are possible and registered in the chemical management system*
* *The lab manager needs to get workspace or new equipment approved*
* *Assess with LVRA if ventilation is adequate for new research*
* *That needs to go to facility manager to update ventilation rates*
* *New researcher will need to be trained*
* *Alert new researcher of any problems or updates in the lab status*

*Program change:*

* *Discussions about current policies and procedures and what is/isn’t working*
* *LVMP Coordinator and EH&S staff approve program change*
* *Implement program change*
* *LVMP Coordinator records change*

In addition to the production of procedures, consider the creation Building Airflow Management Plan (BMP) for new and/or existing laboratories. The BMP describes and collates building-specific information related to the LVMP and building operations. The BMP will contain completed risk assessments, equipment inventories, the laboratory hood inventory, as-built designs, LVS diagrams, flow and operating specifications, control sequence and parameters, operational boundary conditions, standard operating procedures, and maintenance tasks and schedules.

# Operational Tools

[*Insert links to the relevant documentation that is necessary for the operation of your organization’s LVMP. You can add or subtract sections as you see fit.*]

## Standard Operating Procedures

## Engineering System Design Guide and Construction Standards

## Laboratory Design Guidelines

## Laboratory Ventilation Risk Assessment

## Chemical Hygiene Plan and/or Chemical Purchasing

## Commissioning and Testing

## Other Relevant Programs

## Certification – Performance Standards

# References (to be removed when LVMP template is completed)

## [Smart Labs Toolkit](https://smartlabs.i2sl.org/index.html)

## ANSI/ASSP Z9.5-2022 Standard on Laboratory Ventilation

## Stanford’s Laboratory Ventilation Management Program

## Cornell University’s Laboratory Ventilation Management Program

## Los Alamos National Laboratory’s Laboratory Ventilation Management Plan