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(C – Compliant; NC – Non-Compliant; NA – Not Applicable)

Dalhousie FAMIS Project Number: ____________________

Consultant Name Consultant Signature Date YYYY MM DD

Project Manager Name Project Manager Signature Date YYYY MM DD

Note: If the Standard or part of cannot be attained or fulfilled (i.e. NC or NA) during the design process, the Consultant should provide reason(s) why such Standard is not met. Any modification or alterations to the design standards will need to be agreed/accepted by Facilities Management prior to inclusion in the design.

1.0 INTRODUCTION

1.1 Purpose

Dalhousie University has a continuing need to modernize and upgrade its facilities. The resulting construction projects often have significant health and safety requirements due to regulatory requirements. Early interaction with the Environmental Health and Safety Office (EHS Office) on these issues will help ensure that adequate lead-times and monies are allocated for the project. Since many of these regulations can impact the design of a project, the Environmental Health and Safety Office prepared this Laboratory Design Standard to aid the campus community with planning and design issues. The EHS Office believes that the Standard, in conjunction with the EHS Office's review and consultation, improves design efficiency and minimizes changes.

1.2 Application

The document represents the minimum requirements for Dalhousie University laboratories. It is for use by faculty, staff, and design professionals during the planning and design phases of a project. The document applies to construction/renovation projects for all Dalhousie University facilities, including leased properties. The ultimate responsibility for the design, and especially safety, of a laboratory rests with the design team.

1.3 Format of the Guide

The guide is formatted to address laboratory design issues pertinent to general laboratories (e.g., chemical laboratories) in section 2, with additional requirements for Radioactive Materials Laboratories and Biosafety Level 2 Laboratories presented in sections 7 and 8 respectively. Within the sections, specific design criteria are provided.

Comments are included under the specific design criterion to give the user the rational behind the design feature.

1.4 Reference

References include regulations (e.g., NS OHS Act & Regulations), standards (e.g., CSA/ANSI/ASHRAE), and good practices. Good practices stem from industry standards and/or the judgement/knowledge of Dalhousie University's EHS Office professionals.

Design criteria are designated in the following ways:

Shall: Criteria is mandated by applicable regulation(s). The user of the guide is required to include the design feature.

Must: Criteria is based on well-established consensus standards/guidelines. The user of the guide is required to include the design feature.

Should: Criteria is advisory in nature, based on good engineering and safety practices. It is left to the discretion of the user of the guide to include the design feature.

1.5 Limitation of the Standard

The Laboratory Design Standard is not “all inclusive”. It does not cover all regulatory issues, nor does it cover all design situations. It is important to note that use practices must be considered during the design process, as they can directly influence how the laboratory will be designed (e.g., how hazardous materials are used impacts how they are stored, which is a design issue). In all cases, EHS Office should be consulted on questions regarding health, safety, and environment. The ultimate responsibility for the design, and especially safety, of a laboratory rests with the design team.

These documents provide design guidelines only, and are not intended for use, in whole or in part, as a specification. Do not copy the guidelines verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of these documents to the Dalhousie University Project Manager. The Guidelines are intended to be read in conjunction with the local codes and regulations, and in no way are to be considered as a code replacement. The codes and regulations represent the minimum acceptable standard. Where the design guidelines differ from the building codes and other applicable codes and standards, the more stringent of the requirements shall be applied.

1.6 Acknowledgement

Much of this document format was adapted from the Stanford University Laboratory Standard & Design Guide. Dalhousie University Environmental Health and Safety Office expresses great appreciation to Stanford University for all the effort put forth in its original development.

2.0 GENERAL REQUIREMENTS FOR DALHOUSIE UNIVERSITY

2.1 Regulations, Standards and References

Regulations, Standards, and References

Nova Scotia Occupational Safety General Regulations

Canadian Electrical Code (most recent version adopted by Nova Scotia)

National Fire Code of Canada (most recent version adopted by Nova Scotia)

National Building Code of Canada (most recent version adopted by Nova Scotia)

NFPA 101- Life Safety Code

2.2 Scope

The primary objective in laboratory design is to provide a safe environment for laboratory personnel to conduct their work. A secondary objective is to allow for the maximum flexibility for safe research use. Undergraduate teaching laboratories may require other specific design considerations. Therefore, all health and safety hazards must be anticipated and carefully evaluated so that protective measures can be incorporated into the design. No matter how well designed a laboratory is, improper usage of its facilities will always defeat the engineered safety features. Proper education of the facility users is essential.

The general requirements listed in this section illustrate some of the basic health and safety elements to include in all new and remodeled laboratories at Dalhousie University. Variations from these guidelines need approval from Dalhousie University's Environmental Health and Safety Office (EHS Office).

2.3 Building Design Issues

Because the handling and storage of hazardous materials inherently carries a high risk of exposure and injury, segregate laboratory and non-laboratory activities to the extent possible.

a. Non-combustible construction is preferred
b. Walls and doors shall be constructed or painted with a smooth, non-absorbent, washable material
c. Offices should be separated from laboratories

2.4 General Laboratory Design Considerations

1. Laboratory office order of preference is as follow:

    a. Outside of the laboratory
    b. Separated from the laboratory at the front as a separate room within the laboratory or a vestibule to the laboratory
    c. Placement of office space within the laboratory is discouraged but if required must be located near the exit and away from areas of higher contamination
    d. If office areas are in a laboratory then lockers for the storage of personal belongings and outdoor clothing must be provided away from areas of higher contamination and preferably outside of the laboratory

    Good practice per Dalhousie University EHS Office

2. Every laboratory must have a standard 8.5 x 11-inch clear plastic or "snap frame" sign holders placed on the outside door to accommodate laboratory door/entry signage.

Good practice per Dalhousie University EHS Office

3. A marked area (delineate by separate floor colour), preferably at the entry of the laboratory, will be designated as a safety zone. This area should be used for eye wash/ safety shower installation, hand washing sink, mounting a fire extinguisher, mounting a first aid kit, emergency gas shut-off and storage of a spill kit. This space will allow for storage as well as donning and doffing of personal protective equipment. A coat rack and shelf for laboratory coats and safety glasses will be included.

Good practice per Dalhousie University EHS Office

4. Laboratory flooring must be continuous, non-porous and impervious to liquid (e.g., epoxy). Flooring will be coved up the walls and cabinets to prevent spills from penetrating underneath e.g. flash cove.

Good practice per Dalhousie University EHS Office

5. Each laboratory must contain a sink for handwashing.

Good practice per Dalhousie University EHS Office

Sinks to be provided and located to facilitate handwashing upon exit from the laboratory, and shall include soap, paper towel, and trash cans. A separate utility/glassware washing sink to be provided as applicable to function.

6. Chemical storage shelves shall not be placed above laboratory sinks.

Good practice per Dalhousie University EHS Office

7. Sufficient space or facilities (e.g., storage cabinets with partitions) shall be provided so that incompatible chemicals/gases (waste and non-waste) can be physically separated and stored. This will be based on the chemical inventory and use projection provided by the Principal Investigator to the project and EHS Office.

Good practice per Dalhousie University EHS Office

8. All furniture must be sturdy. All work surfaces (e.g., bench tops and counters) must be impervious to the chemicals used. The countertop should incorporate a lip to help prevent run-off onto the floor and it is recommended that countertops be a minimum of one inch thick.

Good practice per Dalhousie University EHS Office

9. A pathway clearance of 1,100 mm must be maintained at the face of the access/exit door.

NFC 2015, Section 2.7.1.2
Good practice per Dalhousie University EHS Office

Laboratory benches must not impede emergency access to an exit. This is also applicable to placement of other furniture and appliances such as chairs, stools, refrigerators, etc.

10. Sufficient space or facilities must be provided for the storage, donning and doffing of personal protective equipment used in the laboratory.

Good practice per Dalhousie University EHS Office

Facilities such as hooks or cabinets for lab coats, containers for safety eyewear and/or hearing protection, must be provided so that personnel are able to don and doff the personal protective equipment (PPE) before entering and exiting the hazardous areas of the laboratory. PPE storage should be separate from any storage provided for ordinary clothing.

11. Laboratory areas shall be fitted with a easily accessible portable method of fire suppression, suitable for the risks within the area. If a specialized extinguisher is not required, a minimum of a 10lb class ABC extinguisher should be included.

12. Laboratory areas shall be provided adequate natural or artificial illumination to ensure sufficient visibility for operational safety.

Nova Scotia Occupational Safety General Regulations, Section 16

13. Consideration should be given to install sufficient outlets adequately spaced to prevent the use of extension cords. The lab should be fitted with an adequate number of electrical outlets, which can accommodate electrical current requirements with an additional 20-40% capacity.

Good practice per Dalhousie University EHS Office

14. It is recommended that emergency power outlets be provided in each lab and properly spaced to run equipment that requires continuous power (refrigerators, freezers, incubators, glove boxes, etc.)

Good practice per Dalhousie University EHS Office

15. Electrical receptacles above counter tops and within 1.5 m of sinks shall be provided with GFCI protection.

Canadian Electrical Code, 2018

3.0 VENTILATION

3.1 Regulations, Standards and References

Regulations, Standards, and References

National Fire Code of Canada (most recent version adopted by Nova Scotia)

National Building Code of Canada (most recent version adopted by Nova Scotia)

CSA Z316.5- Fume hoods and associated exhaust

Dalhousie University Fume Hood Standard

Dalhousie Fume Hood Inspection Policy

NFPA 45- Standard on Fire Protection for Laboratories Using Chemicals

ANSI/AIHA Z9.5-Standard for Laboratory Ventilation

Prudent Practices in the Laboratory Handling and Management of Chemical Hazards, National Research Council (US) Committee on Prudent Practices in the Laboratory

ACGIH, Industrial Ventilation: A Manual of Recommended Practice, 23rd edition, or latest edition

ANSI/ASHRAE Standard 55-2013, Thermal Environmental Conditions for Human Occupancy

3.2 Scope

The purpose of this section is to outline the requirements for new or retrofit laboratory ventilation including fume hoods. This standard is to be considered the minimum requirement; more stringent requirements may be necessary, depending on the specific laboratory function or contaminants generated. In addition to this guide, please consult with the *Dalhousie University Fume Hood Standard* (Appendix A) as an additional resource.

3.3 General Ventilation Considerations

1. The room must have mechanically generated supply air and exhaust air. All lab rooms shall use 100% outside air and exhaust to the outside. There shall be no return of fume hood and laboratory exhaust back into the building.

   ANSI/AIHA Z9.5 -2012, 5.3.1

NFPA 45, Chapter 7.4.1

The air balance of the room cannot be adjusted unless there is mechanically generated supply and exhaust air.

2. Mechanical climate control should be provided to maintain the space temperature within the acceptable range for both the space heating and cooling requirements as defined by ASHRAE standard 55.

Good practice per Dalhousie University EHS Office
ASHRAE 55

Electrical appliances often exhaust heat into a room (e.g., Freezers, incubator, etc.). Failure to take this effect into consideration may result in an artificially warm working environment. Windows must not be opened for a cooling effect since the room air balance will be altered. A cool room must not be heated with a portable heater that may be a fire hazard.

3. Cabinetry or other structures or equipment must not block or reduce effectiveness of supply or exhaust air.

Good practice per Dalhousie University EHS Office

Many supply diffusers and room exhaust room outlets are located along laboratory walls. Storage of boxes near these openings may obstruct the circulation of air and supply or exhaust air functioning.

4. The occupancy state of a laboratory area must be determined by a positive feedback device that validates a lack of physical presence, such as an occupancy sensor. Time of day schedules will not define lab occupancy.

5. Laboratories shall be designed to achieve the following ventilation rates:

a) Occupied mode air change rate (ACH), as designed by the engineer for the specific spaces. The engineer must submit in writing to the university project manager the ACH and what it is based on for final review and approval by the EHS Office and FM
b) 2 ACH, or higher depending on thermal requirements, during physically unoccupied periods.
c) Purge mode: If the space requires a purge mode, its ACH will be designed for suitable evacuation of dangerous substances that could become uncontained.

Good practice per Dalhousie EHS Office

6. Laboratories must be maintained under negative pressure in relation to the corridor or other less hazardous areas. Clean rooms requiring positive pressure should have entry vestibules provided with door-closing mechanisms so that both doors are not open at the same time.

ANSI/AIHA Z9.5 -2012, 5.2.1

As a general rule, airflow should be from areas of low hazard to high hazard, unless the laboratory is used as barrier facility such as a clean or sterile room.

7. The air velocity volume in each duct should be sufficient to prevent condensation or liquid or condensable solids on the walls of the ducts.

NFPA 45, Annex A.7.6

Low velocities in the exhaust system can result in the accumulation of dust particles as well as condensation from condensable vapors.

8. Fume hoods shall not be the sole means of room air exhaust. General exhaust shall be provided as necessary to maintain minimum air change rates and temperature control.

Good practice per Dalhousie University EHS Office

9. Operable windows should be prohibited in new lab buildings and should not be used on modifications to existing buildings. If windows are present, they should be mechanically closed and sealed.

Good practice per Dalhousie University EHS Office

10. Local exhaust ventilation (e.g., “snorkels” or “elephant trunks”), other than fume hoods, shall be designed to adequately control exposures to hazardous chemicals. An exhausted manifold or manifolds with connections to local exhaust may be provided as needed to collect potentially hazardous exhausts from gas chromatographs, vacuum pumps, or other equipment which can produce potentially hazardous air pollutants. The contaminant source needs to be enclosed as much as possible, consistent with operational needs, to maximize control effectiveness and minimize air handling difficulties and costs.

ACGIH, Industrial Ventilation: A Manual of Recommended Practice, 23rd edition, or latest edition

11. Hoods must be labeled to show which fan or ventilation system they are connected to.

Good practice per Dalhousie University EHS Office

12. No laboratory ventilation system ductwork shall be internally insulated. Sounds baffles or external acoustical insulation at the source should be used for noise control.

Good practice per Dalhousie University EHS Office

13. Air exhausted from laboratory work areas shall not pass unducted through other areas.

Good practice per Dalhousie University EHS Office

14. Stainless steel exhaust ductwork should be provided, except in certain specialized applications such as acid digestion hoods where PVC would be the requirement.

Good practice per Dalhousie University EHS Office

3.4 Negative Pressurization

1. Airflow shall be from low hazard to high hazard areas.

ANSI/AIHA Z9.5 -2012, 5.2.1
Good practice per Dalhousie University EHS Office

2. An adequate supply of make up air (90% of exhaust) should be provided to the lab.

Good practice per Dalhousie University EHS Office

3. An air lock or vestibule may be necessary in certain high-hazard laboratories to minimize the volume of supply air required for negative pressurization control. These doors should be provided with interlocks so that both doors cannot open at the same time.

Good practice per Dalhousie University EHS Office

4. A corridor must not be used as a plenum.

Good practice per Dalhousie University EHS Office

3.5 Supply Air Arrangements

1. Room air currents at the fume hood should not exceed 20% of the average face velocity to ensure fume hood containment. This is applicable to most biosafety cabinets (BSCs) as well.

CSA Z316.5-15 Fume Hoods and Associated Exhaust Systems
Prudent Practices in the Laboratory 9.C
ANSI/AIHA Z9.5 -2012, 6.1.2.5
Good practice per Dalhousie University EHS Office

2. Make-up air should be introduced at opposite end of the laboratory room from the fume hood(s) and flow paths for room HVAC systems shall be kept away from hood locations, to the extent practical. This is applicable to most biosafety cabinets (BSCs) as well.

NFPA 45, Chapter 7.3.4, 7.9.1

ANSI/AIHA Z9.5-2012

3. Make-up air shall be introduced in such a way that negative pressurization is maintained in all laboratory spaces and does not create a disruptive air pattern.

Good practice per Dalhousie University EHS Office

4. Cabinetry or other structures or equipment should not block or reduce effectiveness of supply or exhaust air.

Good practice per Dalhousie University EHS Office

3.6 Fume Hood Location

1. Fume hoods should be located away from activities or facilities, which produce air currents or turbulence. Locate away from high traffic areas, air supply diffusers, doors, and operable windows.

CSA Z316.5-15, Section 6.1
NFPA 45, Section 7.3.4 and 7.9.1

Air turbulence affects the capability of hoods to exhaust contaminated air.

2. Fume hoods should not be located adjacent to a single means of access to an exit.

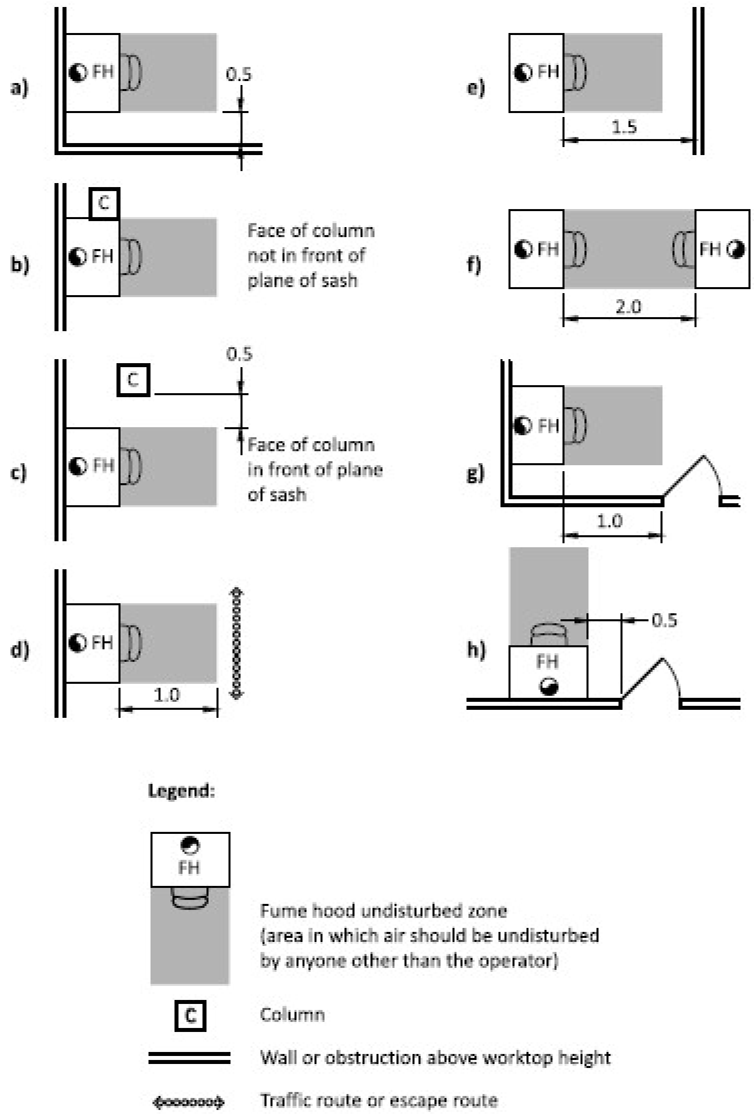
NFPA 45, Section 7.9.2

3. Fume hood openings should not be located opposite workstations where personnel will spend much of their working day, such as desks or microscope benches.

CSA Z316.5-15, Section 6.4
NFPA 45, Chapter 7.9.3

Figures 1 and Figure 2 represent the recommended and non recommended clearances and positioning of fume hood.

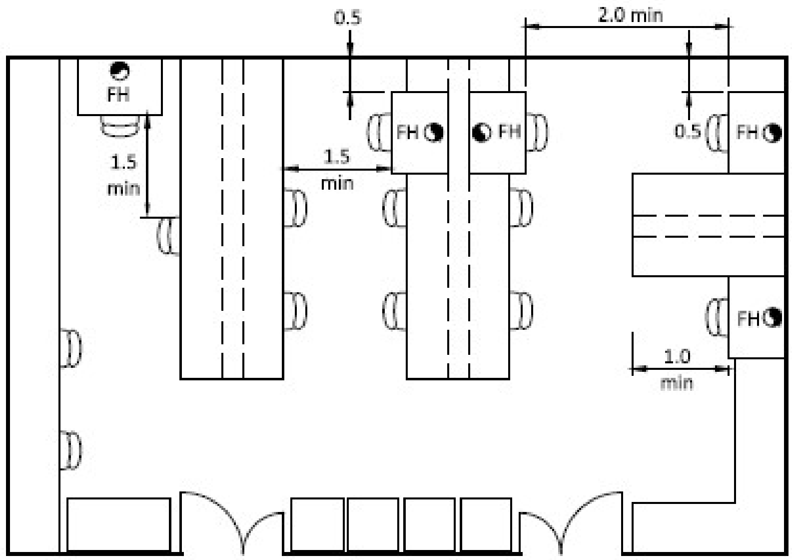
Figure 1: Fume hood Location – (Taken from CSA Z316.5-15 Fume Hoods and Associated Exhaust Systems)



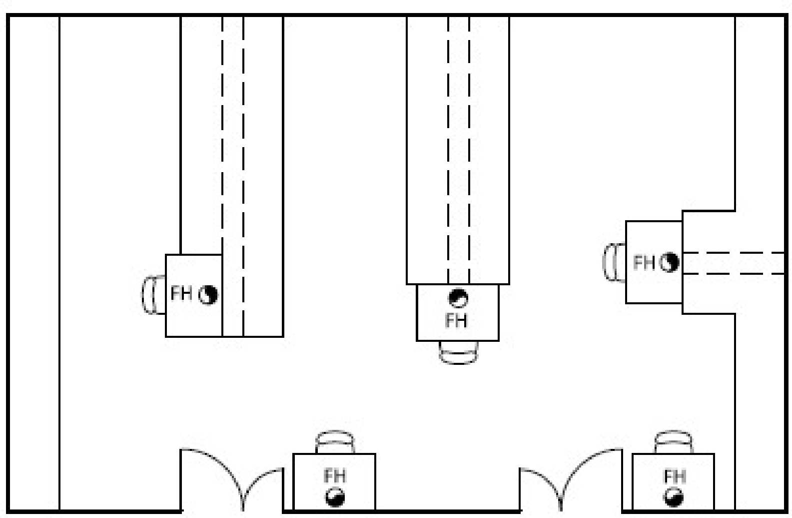
Notes:

1) *All dimensions are in metres and are recommended minimum values. Drawing is not to scale.*
2) *Distances between fume hoods might need to be increased when there are a large number of hoods in the room.*
3) *Supply air grilles should be placed where they will not adversely affect the airflow across the sash opening.*
4) *An engineer experienced in laboratory ventilation should always be consulted when planning fume hood layouts.*

Figure 2: Fume hood (Floor) Plan (Taken from CSA Z316.5-15 Fume Hoods and Associated Exhaust Systems)



a) Recommended



b) Not recommended

Note: *All dimensions are in metres and are recommended minimum values. Drawing is not to scale.*

3.7 Approved Equipment
1. All fume hoods used at Dalhousie University must meet the requirements of Appendix A.

Auxiliary air supply, bypass or recirculating (ductless) fume hoods shall not be used.

3.8 Fume Hood and Local Exhaust Ventilation Selection/Types
1. An assessment of the anticipated activities should be performed before a fume hood is selected to ensure that users are adequately protected and that the fume hood will perform reliably. A systematic process shall be followed to determine what selection criteria apply.

Considerations for selection may include, but are not limited to, the following:

a) quantity of chemical(s) or substance(s) being used;
b) the manner in which the chemical(s) or substance(s) are used;
c) chemical resistance and reactivity;
d) chemical toxicity;
e) radiotoxicity;
f) thermal stress;
g) adsorption and absorption of hazardous substances;
h) explosions;
i) fire;
j) mechanical stress, e.g., vibration;
k) workplace environment; and
l) ergonomics.

CSA Z316.5-15, Section 5.2

2. Perchloric/Hot Acid Hoods:

a) Heated perchloric acid shall only be used in a laboratory hood specifically designed for its use and identified as “For Perchloric Acid Operations.”

CSA Z316.5-15, Section 4.4
NFC 2015, 5.5.5.6
NFPA 45, 7.12.1

Heated perchloric acid will give off vapors that can condense and form explosive perchlorates. Limited quantities of perchloric acid vapor can be kept from condensing in laboratory exhaust systems by trapping or scrubbing the vapors at the point of origin.

b) Perchloric acid hoods and exhaust duct work shall be constructed of materials that are acid resistant, nonreactive, and impervious to perchloric acid.

CSA Z316.5-15, Section 4.4
NFPA 45, 7.12.2

c) The exhaust fan should be acid resistant and spark-resistant. The exhaust fan motor should not be located within the duct work. Drive belts should not be located within the duct work.

CSA Z316.5-15, Section 4.4
NFPA 45, 7.12.3,4,5

d) Ductwork for perchloric acid hoods and exhaust systems shall take the shortest and straightest path to the outside of the building and shall not be manifolded with other exhaust systems. Horizontal runs shall be as short as possible, with no sharp turns or bends. The duct work shall provide a positive drainage slope back into the hood. Duct shall consist of sealed sections. Flexible connectors shall not be used.

NFPA 45, 7.12.6

e) Sealants, gaskets, and lubricants used with perchloric acid hoods, duct work, and exhaust systems shall be acid resistant and nonreactive with perchloric acid.

NFPA 45, 7.12.7

f) A water spray system shall be provided for washing down the hood interior behind the baffle and the entire exhaust system. The hood work surface shall be watertight with a minimum depression of 13 mm (1⁄2 inch) at the front and sides. An integral trough shall be provided at the rear of the hood to collect wash-down water.

NFPA 45, 7.12.8

g) The hood baffle shall be removable for inspection and cleaning.

NFPA 45, 7.12.9

3.9 Fume Hood Labeling

1. All fume hoods, associated exhaust ducts, and fans shall be labelled in a correlated manner.

CSA Z316.5-15, Section 7.3

2. A label must be affixed to each hood containing the following information from the certification process in Appendix B:

a. date of inspection

b. inspector’s name and company name

c. statement that the fume hood has been certified to the testing procedures in Appendix B.

Good practice per Dalhousie University EHS Office

3.10 Fume Hood Construction, Installation & Performance

1. New fume hoods should be mounted above a chemical storage cabinet that is designed for one flammable and one corrosive storage cabinet. The counter of the fume hood should be at 36 inches above finished floor (AFF).

Good practice per Dalhousie University EHS Office

2. Fume hood interior surfaces shall be constructed of corrosion resistant, non-porous, non-combustible materials.

NFPA 45, 7.8.1.1

3. Laboratory hoods shall be provided with a means of containing minor spills.

CSA Z316.5-15, Section 4.3.2.1
ANSI/AIHA Z9.5, 3.1
NFPA 45, 7.8.1.4

4. There must be a horizontal bottom airfoil inlet at the front of the hood.

ANSI/AIHA Z9.5, 3.1

The air foil at the front of the hood floor assures a good sweep of air across the working surface toward the back of the hood. This minimizes the generation of turbulent or eddy currents at the entrance to the hood.

5. Adjustable baffles with horizontal slots must be present in the fume hood interior at the back and top.

ANSI/AIHA Z9.5, 3

Locating the slots in this manner will attain reasonably uniform face velocity under different conditions of hood use as related to heat sources, size, and configuration of equipment in hood.

6. Before a new fume hood is put into operation, an adequate supply of make up air must be provided to the lab.

Good practice as per Dalhousie University EHS Office

A fume hood exhausts a substantial amount of air. For this reason, additional make up air must be brought into the room to maintain a proper air balance.

7. Laboratory fume hoods shall provide a minimum average effective face velocity of 100 feet per minute (fpm), with a minimum of 80 fpm and a maximum of 120 fpm for standard performance fume hoods. The minimum fume hood ventilation rate will be 25 cfm per square foot of fume hood bench area (work space) or another value as recommended by the Engineer that will adequately deal with the known and/or future anticipated substances that may be present in the fume hood. If different than 25 CFM per square foot, the basis of the alternative value must be provided to the University Project Manager in writing for approval by FM and the EHS Office.

CSA Z316.5-15, Section 8.8.2.3
Dalhousie Fume Hood Inspection Policy

8. A measuring device shall be provided and located so that it is visible from the front of the fume hood to alert users to improper exhaust flow.

CSA Z316.5-15, Section 4.3.5
NFPA 45, 7.8.7
ANSI/AIHA Z9.5, 3.3.3

Follow manufacturer's procedures for calibration of air flow indicator during installation, for periodic calibration and maintenance parameters thereafter.

9. Baffles shall be constructed so that they are unable to be adjusted to materially restrict the volume of air exhausted through the chemical fume hood.

NFPA 45, 7.8.1.3

10. Laboratory hoods must not have an on/off switch located in the laboratory; fans must run continuously without local control from hood location or laboratory and independently of any time clocks.

Good practice as per Dalhousie University EHS Office

11. For new installations or modifications of existing installations, controls for chemical fume hood services (gas, air, water, etc.) shall be located external to the hood and within easy reach.

CSA Z316.5-15, Section 4.4
NFPA 45, 7.8.5.1

12. Drying ovens shall not be placed under fume hoods.

Good practice per Dalhousie University EHS Office

3.11 Fume Hood Power and Electrical

1. Fume hoods and exhaust systems shall comply with the applicable requirements of the Canadian Electrical Code, Part I or CAN/CSA-C22.2 No. 61010-1.

CSA Z316.5-15, Section 4.2.1

2. Chemical fume hood exhaust fans should be connected to an emergency power system in the event of a power failure.

Good practice per Dalhousie University EHS Office

This backup power source will ensure that chemicals continue to be exhausted. EHS Office recognizes that it may not be practical to provide emergency power sufficient to maintain fume hood functioning at normal levels but recommends an emergency supply of at least half of the normal airflow.

3. Electrical receptacles located inside the fume hood chamber shall be GFCI protected and shall have a labelled, readily accessible disconnect switch external to the hood chamber. The disconnect switch shall not affect the exhaust system, associated controls, or monitors.

CSA Z316.5-15, Section 4.2.3
NPFA 45, 7.8.4.1

4. Light fixture(s):

a. mounted exterior to the fume hood chamber shall be separated from the fume hood interior by a sealed, transparent, impact-resistant light lens.
b. mounted inside the fume hood chamber shall be resistant to the chemicals that will be present inside the fume hood chamber.
c. mounted inside the fume hood chamber shall be explosion proof (if explosion hazards are present).
d. shall be capable of providing an illuminance at the work surface of a minimum average of 861 lx (80 fc) and a maximum average of 1614 lx (150 fc), or at the level required by applicable health and safety regulations.

CSA Z316.5-15, Section 4.3.3

3.12 Sashes

1. Hoods shall have transparent movable sashes constructed of shatter-resistance, flame resistant material and capable of closing the entire front face.

CSA316.5-15, Section 3,4

2. Vertical-rising sashes are preferred. If horizontal sashes must be used, please consult with EHS Office.

Best practice as per Dalhousie EHS Office

3. Sash operation shall be smooth and easy throughout the sashes travel, and the sash must remain stationary when force is removed.

CSA316.5-15, Section 8.8.1.1

3.13 Ducting

1. Fume hood exhausts can be manifolded together except for:

- perchloric/hot acid hoods
- hoods with washdown equipment
- hoods that could deposit highly hazardous residues on the ductwork
- exhaust requiring HEPA filtration or other special air cleaning
- situations where the mixing of exhausted materials may result in a fire, explosion, or chemical reaction hazard in the duct system

CSA Z316.5-15, Section 4.3.6
NFPA 45, 7.5.10

2. Ducts exhausting air from fume hoods should be constructed entirely of non-combustible material. Gaskets should be resistant to degradation by the chemicals involved and fire resistant.

NFPA 45, 7.5.1

3. Automatic fire dampers shall not be used in laboratory exhaust systems connected to fume hoods.

CSA Z316.5-15, Section 4.3.6.7
NFPA 45, 7.10.3.1

3.14 Exhaust

1. The exhaust fan shall be positioned as close as possible to the termination (discharge end) of the duct, preferably on the roof.

CSA Z316.5-15, Section 4.3.7.1

2. Discharge from exhaust stacks must have a velocity of at least 3,000 fpm. Achieving this velocity should not be done by the installation of a cone type reducer. The duct may be reduced,

but the duct beyond the reduction must be of sufficient length to allow the air movement to return to a linear pattern.

ANSI/AIHA Z9.5, 5.4.6

3. Laboratory ventilation exhaust fans shall be spark-proof and constructed of materials or coated with corrosion resistant materials for the chemicals being transported. Drive belts shall be conductive and shall not be located within the ductwork.

NFPA 45, 7.12.3,5

4. Fans shall be located and arranged so as to afford ready access for repairs, cleaning, inspection, and maintenance.

NFPA 45, 7.7.3

3.15 Laboratory Hood Commissioning

1. Proper operation of fume hoods must be demonstrated by the contractor installing the fume hood prior to project closeout. The recommended containment performance test is Appendix B.

Best practice as per Dalhousie EHS Office

4.0 EMERGENCY EYEWASH AND SAFETY SHOWER EQUIPMENT

4.1 Regulations, Standards, and References

Regulations, Standards, and References

Nova Scotia Occupational Safety General Regulations

American National Standards Institute (ANSI), Z358.1-2014, Emergency Eyewash and Shower Equipment

Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version, The National Academies Press, Washington, D.C., 2011.

4.2 Scope

This section presents the minimum requirements for eyewash and shower equipment for the emergency treatment of the eyes or body of a person exposed to hazardous substances. It covers the following types of equipment: emergency showers, eyewash and eye/facewash equipment, and combination shower and eyewash or eye/face wash.

4.3 Application

1. Provisions for Emergency Eyewashes and Emergency Showers

Where a person's skin or eyes may be acutely affected by an exposure to a caustic, acidic or other hazardous substance, an employer shall provide 1 of the following in the work area where the exposure may occur:

a) an emergency shower;
b) an eye wash;
c) enough flushing fluid to last at least 15 minutes;

Nova Scotia Occupational Safety General Regulations Section 23

2. Laboratories or other areas working with particulate materials such as wood, metal, concrete, rock, or other potentially abrasive materials posing a hazard to the eyes must install an emergency eye wash.

3. Dalhousie EHS Office presumes that laboratory fume hoods contain hazardous substances that require emergency eyewash and shower facilities.

Good practice per Dalhousie University EHS Office

4. Laboratories and laboratory support facilities using and handling hazardous substances will generally require eyewash and safety showers. Laboratories using bleach and other chemical disinfectants will generally require eyewash and safety showers. Consult with EHS Office for any exceptions or if an evaluation is needed.

Good practice per Dalhousie University EHS Office

5. For new construction and major renovations, careful consideration should be given to not only current, but also future use of the laboratory as research needs change. Without an emergency eyewash and safety shower, future use of hazardous materials in the space will be restricted or require potentially costly retrofitting.

Good practice per Dalhousie University EHS Office

6. Where applicable, both an emergency eyewashes and emergency shower, or a combination unit, must be installed.

Good practice per Dalhousie University EHS Office

4.4 Performance Requirements

1. Emergency eyewash and shower equipment shall meet the requirements of ANSI Z358.1-2014. Control valves for all such equipment shall meet the requirements of ANSI Z358.1-2014.

NS OHS Regulations Section 23
ANSI Z358.1-2014

4.5 Location

1. Emergency eyewash and shower equipment shall be on the same level as the hazard and accessible for immediate use in locations that require no more than 10 seconds for the injured person to reach. The path of travel must be free of obstructions. If both eyewash and shower are needed, they shall be located so that both can be used at the same time by one person.

ANSI Z358.1-2014, Section 4.5.2, 5.4.2

2. The average person covers a distance of approximately 55 ft. in 10 seconds when walking at a normal pace. The physical and emotional state of a potential victim (visually impaired, with some level of discomfort/pain, and possibly in a state of panic) should be considered along with the likelihood of personnel in the immediate area to assist. Other potential hazards that may be adjacent to the path of travel that might cause further injury should be considered.

ANSI Z358.1-2014, Appendix B5

3. One intervening door can be present so long as it opens in the same direction of travel as the person attempting to reach the emergency eyewash and shower equipment and the door is equipped with a closing mechanism that cannot be locked to impede access to the equipment (i.e., the door is a panic door). Where the hazard is corrosive, consult with EHS Office.

Good practice per Dalhousie University EHS Office
ANSI Z358.1-2014, Appendix B5

4.6 Signage and Visibility

1. The path of travel shall be clearly identified with signage. Emergency eyewash and shower locations must be identified with a highly visible sign positioned so the sign is visible within the area served by eyewash and shower equipment. The areas around the eyewash or shower must be well lit.

ANSI Z358.1-2014, Section 4.5.3
ANSI Z358.1-2014, Section 5.4.3

2. A large contrasting spot (32” diameter) should be painted on, embedded in, or affixed to the floor directly beneath the shower to indicate its location and the area that must be kept free from any obstruction.

Good practice per Dalhousie University EHS Office

4.7 Prohibitions Around Equipment
1. No obstructions shall be located within 16 inches from the center of the spray pattern of the emergency shower facility. Note: The eyewash is not considered an obstruction.

ANSI Z358.1-2014, Section 4.1.4

2. No electrical apparatus or receptacles (electrical outlets) shall be located within a zone measured 3 feet horizontally and 8 feet vertically of eyewash stations or showers. If a 120-volt outlet or receptacle is present within 6 feet of an eyewash or shower, it shall be equipped with a Ground Fault Circuit Interrupter (GFCI).

Good practice per Dalhousie University EHS Office

4.8 Water Supply
1. Emergency eyewash and shower equipment shall not be limited in the water supply flow rates. Flow rate and discharge pattern shall be provided in accordance with ANSI Z358.1-2014.

NS OHS Regulations Section 23

2. Emergency eyewash and shower equipment shall deliver tepid water (16°C - 38 °C).

ANSI Z358.1-2014

4.9 Design for Maintenance and Use
1. Shut-off valves

The water supply to showers and/or shower/eyewash combination units should be controlled by a ball-type shutoff valve which is visible and accessible to shower testing personnel in the event of leaking or failed shower head valves. If shut off valves are installed in the supply line for maintenance purposes, provisions shall be made to prevent unauthorized shut off.

ANSI Z358.1-2014, Section 6.4.5.
Good practice per Dalhousie University EHS Office

2. Where feasible, floor drains should be installed below or near safety showers, with the floor sloped sufficiently to direct water from the shower into the sanitary sewer drain.

Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version
Good practice per Dalhousie University EHS Office

Lack of floor drains should not be a deterrent for an individual needing to use an emergency washing station. Floor drains will minimize the potential for excessive flooding, which may damage laboratory facilities and equipment, interrupt laboratory operations, cause a reluctance *to use the safety shower or to use it for a sufficient amount of time, and create a slipping hazard. Floor drains will also facilitate required weekly testing.*

3. Where feasible, eyewash basins should be plumbed to sanitary sewer drains.

Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version
Good practice per Dalhousie University EHS Office

Drains will minimize the potential for excessive flooding, which may damage laboratory facilities and equipment, interrupt laboratory operations, cause a reluctance to use the eyewash or to use it for a sufficient amount of time, and create a slipping hazard. Drains will also facilitate required weekly testing.

4. Modesty curtains should be considered for emergency showers. When installed, a minimum unobstructed area of 34 inches shall be provided.

Good practice per Dalhousie University EHS Office
ANSI Z358.1-2014, Section 4.3

The removal of contaminated clothing while using a safety shower is essential. Modesty curtains remove a potential impediment to use and encourage the removal of contaminated clothing.

4.10 Installation

1. Emergency eyewash and shower equipment shall be installed in accordance with the manufacturer's installation instructions.

NS OHS Regulations Section 23

4.11 Verification and Testing

1. Proper operation of the equipment must be verified by the contractor installing the emergency eyewash or shower equipment prior to project closeout and facility occupation. Verification procedures must be in accordance with ANSI Z358.1-2014. Tags to allow weekly testing records to be kept must be affixed to the showers and eyewash fountains.

ANSI Z358.1-2014
Good practice per Dalhousie University EHS Office

By testing the equipment, Dalhousie University can be assured that it is working properly before the users begin their research.

2. Weekly Testing

Plumbed eyewash and shower equipment shall be activated at least weekly to flush the line and to verify proper operation. Self-contained units shall be maintained in accordance with the manufacturer's instructions.

ANSI Z358.1-2014, 4.6.2, 5.5.2

3. All emergency showers and eye washes shall be inspected annually to assure conformance with ANSI Z358.1 standard.

ANSI Z358.1-2014, 4.6.5, 5.5.5

4.12 Self-Contained Units
Self-contained emergency eyewash and shower equipment in lieu of plumbed equipment must be approved by EHS Office. Such equipment shall meet all applicable requirements.

NS OHS Regulations Section 23
ANSI Z358.1-2014

5.0 PRESSURE VESSEL COMPONENTS AND SYSTEMS AND COMPRESSED GAS CYLINDERS

5.1 Regulations, Standards and References
Regulations, Standards, and References

Nova Scotia Occupational Safety General Regulations

National Fire Code (most recent version adopted by Nova Scotia)

National Building Code (most recent version adopted by Nova Scotia)

Compressed Gas Association standard CGA P-1, "Safe Handling of Compressed Gases in Containers"

NFPA 55- Compressed Gases and Cryogenic Fluids Code

5.2 Scope
The Guide applies to all Dalhousie University facilities, including leased properties. It covers all unfired pressure vessels (i.e., storage tanks; compressed gas cylinders) that have been designed to operate at pressures above 15 psig., including the storage and use of compressed gas cylinders and cryogenic fluids.

5.3 Storage of Compressed Gas Cylinders – General
1. Portable compressed gas cylinders must be stored:

a. in a well-ventilated storage area where the temperature does not exceed 52°C;
b. with cylinders grouped by types of gas and the groups arranged to take into account the gases contained;
c. with full and empty cylinders separated;
d. at a safe distance from all operations that produce flames, sparks or molten metal or result in excessive heating of the cylinder;
e. securely; and
f. with protective devices in place.

Nova Scotia Occupational Safety General Regulations, Section 47

Compressed gas cylinders must be firmly attached to a secure structure by a non-combustible material such as metal chain. Nylon straps will burn in a fire and are thus not recommended.

2. Fixed gas detection systems must be installed where deemed a requirement. Gases that require a review for detection include toxic, asphyxiating (e.g., oxygen displacing) and flammable gases.

Good practice per Dalhousie University EHS Office

3. Cylinders are not permitted in unventilated enclosures such as lockers and cupboards.

Good practice per Dalhousie University EHS Office

4. In a storage area for portable compressed gas cylinders the names of the gases stored and signs prohibiting smoking must be posted.

Nova Scotia Occupational Safety General Regulations, Section 47

5. Cylinders, containers, and tanks containing liquefied flammable gases and flammable gases in solution shall be positioned in the upright position.

NFPA 55, Section 7.2.1.2

6. Flammable gases shall not be stored with oxidizing agents.

NFPA 55, Section 6.3.1.6

5.4 Storage of Compressed Gas Cylinders - Toxic and Highly Toxic Gases

1. Laboratory design shall include one of the following storage systems for toxic and highly toxic compressed gas cylinders:

- Ventilated gas cabinets/exhausted enclosures/laboratory fume hoods, or
- Separate ventilated gas storage rooms without other occupancy or use which have explosion control.

Good practice per Dalhousie University EHS Office

2. Cylinders containing toxic gasses stored inside shall be located in a room that:

a. Is separated from the remainder of the building in conformance with Sentence 3.3.6.3.(2) of Division B of the NBC,
b. Is located on an exterior wall,
c. Can be entered from the exterior, and whose closure leading to the interior of the building are in conformance with Sentence 3.3.6.3.(2) of Division B of the NBC, and
d. Is provided with ventilation to the outdoors.

NFC 2015, Section 3.2.8.3

3. Treatment systems for the exhaust of toxic and highly toxic gases must be reviewed and approved by EHS Office. The EHS Office will review treatment systems to ensure they are compliant and consistent.

Good practice per Dalhousie University EHS Office

4. Emergency power shall be provided for exhaust ventilation, treatment system, gas-detection systems, emergency alarm systems, and temperature control systems.

NFPA 55, Section 7.9.5.3

5. Storage areas shall be secured to prevent unauthorized entry.

NFPA 55, Section 7.1.8.2

5.5 Design of Systems and Apparatus for Cryogenic Fluids

1. The position of valves and switches for emergency shutdowns shall be accessible and clearly labeled.

Good practice per Dalhousie University EHS Office

2. Uninsulated pipes or vessels should be positioned and/or identified to prevent inadvertent contact with an unprotected part of the body.

Good practice per Dalhousie University EHS Office

6.0 CHEMICAL STORAGE CABINETS

6.1 Regulations, Standards and References

Regulations, Standards, and References

National Fire Code (most recent version adopted by Nova Scotia)

NPFA 30- Flammable and Combustible Liquids Code

6.2 Scope

Chemical storage cabinets are intended for the storage of flammable and combustible liquids. This Guide applies to all Dalhousie University facilities, including leased properties. It covers the design, construction, and installation of Chemical Storage Cabinets; the Guide does not address the proper use of Chemical Storage Cabinets, for information regarding the use of Chemical Storage Cabinets, please see Dalhousie's Chemical Laboratory Safety Manual.

Deviations from the Design Guideline must be reviewed and approved by EHS Office.

6.3 Construction/Design

1. New flammable liquid storage cabinets must conform to ULC or cUL standard constructed of metal.

Good practice per Dalhousie University EHS Office

Wood cabinets are not acceptable.

2. The maximum quantity of flammable liquid and combustibles liquids stored in a cabinet shall be 500 L*. (*See Dalhousie University Chemical Laboratory Safety Manual for maximum quantities)

National Fire Code of Canada, 2015
Dalhousie University Chemical Laboratory Safety Manual

3. It is not a requirement for flammable storage cabinets to be ventilated. If there are ventilation openings in the cabinet, the ventilation opening must be sealed with materials providing fire protection at least equivalent to that for the construction of the cabinet (example the “bungs” provided with the cabinet).

At no time should a flammable storage cabinet be cut, drilled or altered or modified to make connections for venting, mounting to walls or for any other purpose that may compromise the integrity of the fire protection.

EHS Office must be consulted prior to venting of flammable storage cabinets.

NFC 2015, Section 4.2.10.3
NFPA 30, 9.5.4

4. When flammable or combustible liquids present multiple hazards, the laboratory design shall address the storage requirements for each hazard.

Good practice per Dalhousie University EHS Office

5. Adequate storage provision shall be provided so that incompatible chemicals can be physically separated and stored (waste and non-waste).

Good practice per Dalhousie University EHS Office

6. Corrosion resistant cabinets are required for the storage of acids/bases. Acids and bases should be stored separately.

Good practice per Dalhousie University EHS Office

7. Chemical shelving should be equipped with lipped edges.

Good practice per Dalhousie University EHS Office

6.4 Location

1. Flammable Liquid Storage Cabinets shall NOT be located near exit doorways, stairways, or in a location that would impede egress.

NFC 2015, Section 4.2.2.1
NFPA 30, 9.3

2. Laboratory design must ensure that Flammable Liquid Storage Cabinets are NOT located near an open flame or other ignition source.

Good practice per Dalhousie University EHS Office

An open flame or other ignition source could start a fire or cause an explosion if an accident or natural disaster brought the ignition source and flammable liquids or vapors together.

7.0 ADDITIONAL REQUIREMENTS FOR LABORATORIES USING RADIOACTIVE MATERIALS, RADIATION MATERIALS, RADIATION PRODUCING EQUIPMENT OR LASERS.

7.1 Codes, Standards, and References
Regulations, Standards, and References

Nuclear Substances and Radiation Devices Regulations

Radiation Protection Regulations

CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms

Dalhousie University Radiation Safety Manual 2017, Section E.1.8

7.2 Scope
Laboratory classification will depend on several factors including - the amount of nuclear substance used, the type of operation performed, and the radiotoxicity of the nuclear substance. Facilities must be approved by the Radiation Safety Manager prior to any work beginning with nuclear substances. Renovations or new facilities **shall** meet CNSC's requirements in Regulatory Guide GD-52, **"Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms"**. New or renovated Intermediate Laboratories must have prior approval by the CNSC. The approval process will be co-coordinated through the Radiation Safety Manager.

8.0 **CONTAINMENT LEVEL 2 LABORATORIES**

8.1 Codes, Standards, and References
Regulations, Standards, and References

Human Pathogens and Toxins Act (HPTA)

Human Pathogens and Toxins Regulations (HPTR)

Canadian Biosafety Standards (CBS)

Dalhousie University's Biosafety Manual, 2019

8.2 Scope
Prior to any work being preformed to existing laboratory space (renovation/remodel) that uses biological agents, as well when building a new space that uses biological agents, Dalhousie University's Biological Safety Manager must be contacted. Containment Level 2 laboratories

must meet the Canadian Biosafety Standards (CBS) established by Public Health Agency of Canada, which outlines all of the specific requirements that must be met.

8.3 Biological Safety Cabinets and Other Containment Considerations

1. Selection of a biological safety cabinet (BSC) is based on the type of work that will be preformed. Please consult with Dalhousie's Biosafety Manual regarding proper selection of biosafety cabinets.

2. The location of the cabinet should be in an area where it will not be adversely affected by air currents and is away from pedestrian traffic and other ventilation devices.

3. **The use of open flames is prohibited in the BSC** as they disrupt the air flow patterns and may damage the HEPA filter.

4. BSCs are not to be used without certification by an approved certification company. New BSCs must be certified upon installation and before use. BSCs must be recertified annually, or if repairs are conducted, or if they are moved to a new location.

Dalhousie University's Biosafety Manual, 2019

Appendix A

(See Facilities Management for Original Document)

Dalhousie University Fume Hood Standard

1.0 General

This document sets forth the standards for fume hoods at Dalhousie University whose performance is to achieve safety first, then energy & sustainability savings. This standard is for a bench/cabinet mounted fume hoods in 4, 5, and 6-foot widths.

Fume hoods shall function as ventilated, enclosed workspaces that are designed to capture, contain and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.

This document shall not replace applicable codes & standards. In the event of a conflict the more stringent of the documents shall be applicable.
Applicable codes and standards include but are not limited to:

CSA Z 316.5, most current version

Auxiliary air supply, bypass or recirculating (ductless) fume hoods shall <u>not</u> be used.

The remaining types in Section A.2 of CSA Z 316.5-15 – September 2015 are permitted. Variable Air Volume (VAV) is the preferred fume hood for the majority of general purpose applications. Requests for a Fume Hood other than VAV shall require a written justification from the requestor.

See CSA Z 316.5 for perchloric acid fume hood applications.

Prior to selecting a fume hood, a hazard assessment of the anticipated use of the hood shall be completed to ensure that users are adequately protected and that the fume hood will perform unfailingly. This shall be submitted to the Project Manager and become part of the Project Records.

2.0 Mandatory Requirements

In addition to the requirements of CSA Z 316.5-15 – September 2015

Item	Standard	Rational
Certifications	Be ULC/CSA approved with a clearly identified permanently affixed label	Required by electrical code but we want this as check list item.
Drying cabinets	There shall be no installation of heated drying base cabinets under the fume hoods	Safety. Avoids the cabinet from being used as storage and accidentally heated.
Control	In cases of fume hoods with dedicated exhaust fans, manual control of exhaust fan operation is not allowed	Safety
Documentation	Have all submittal and operations documentation associated with the fume hood number which also shall be clearly identified on the equipment	
Exhaust	Radioisotope and perchloric acid fume hoods must be exhausted separately from each other and from general use chemical fume hoods	Safety
Per Chloric & Radioisotope Hoods	Provide constant-volume fume hoods with restricted bypass. Liner shall be Type 316 and not Type 304 and not less than 0.050-inch nominal thickness	Longevity of the asset.
Sidewall Opening	Hoods shall be supplied with service holes in the sidewall of the main chamber to allow for tubing and instrument wiring without going through the sash opening	Safety & ease of use
Lower Airfoil	Shall be constructed of Stainless Steel and not painted	Painted steel airfoils are prone to chipping as equipment moves in and out, which allows rust to begin. SS to be a standard and not painted.
Safety Lines	There shall be a “Hashed” out caution area (or line), 6 inches back from outer lip.	Items placed within 6 inches of front edge of hood dramatically reduces the efficacy of the hood. A “do not place items here” line or hashed out section will increase user safety.
Sash Operator	Must be chained or toothed belts. No cables.	Chain operating sashes are more durable and reliable, reducing maintenance and downtime
Sash Operator	There shall be NO automatic sash opening/closing system(s) provided.	These increase the cost of the fume hood and historically have a high/frequent failure rate
Sash Position Indicators	Factor installed sash position indicator for height opening/closing compatible with Fume Hood Control System shall be provided	Less cost and ensures the sensor is not in the air stream.

Item	Standard	Rational
Sash Stop	Must have a user over ridable, user friendly sash stop installed at 18 inches of sash opening. CSA Z316.5 Indicates a maximum recommended opening of 18”; any user requiring a sash opening of greater than 18” will require specific approval from the Environmental Health and Safety Office.	Anthropometric data suggests that a sash opening of 18” will allow an adequate ergonomic range of motion for nearly all users working in a fume hood, when the hood is placed at standard countertop height of 36”. For the controls, the University standard is that the hood’s maximum exhaust air flow is that required to achieve 100 FPM at 18 inches of sash opening. The exhaust air flow rate shall not increase above 18 inches of opening. By ASNI standard, when this is the case a sash stop is required.
Sash Window	The sash window shall be impact resistant.	Safety
Sash Direction	Shall operate vertically only	Safer and makes the face velocity control less complicated and less cost.
Lockout	Must have the ability to lock completely shut, preferably with padlock but key is acceptable (factory installed).	The ability to lock hoods shut that have failed inspection or while maintenance is being completed is critical to protect not only laboratory personnel but trades. It is more efficient to have the ability to use a padlock to close the hood, to prevent the issue of key tracking. However, being able to lock it with a hood key may be acceptable if no other options exist.
Lower Cabinets	For the following uses: 1-2 x flammable and/or 1 x Corrosive. If Corrosive, shall have secondary containment pans. Ventilation of Lower Cabinets shall never route into the Hood or prior to its Air Valve. Ventilation shall be via dedicated Air Valve for one or more cabinets in the lab, as practical.	
Electrical	120V outlets (NEMA 5-15/20) on front of fume hood (either side of sash or under), to power equipment, in all cases include the use of GFCI receptacles.	CSA leaves the use of GFCI up to the local code.
Services	Hoods shall be pre-piped for services and cup sinks.	Ease of final connection and holistic responsibility for the Hood & its contents to the manufacturer. Ability to service without

Item	Standard	Rational
	Service connections shall be accessible from the outside of the fume hood, using removable panels	having to decontaminate the hood for service personnel.
Gas Connections	Knockouts for gas connections to be included.	Gas requirements vary greatly per laboratory requirements. Having the ability to add valving through simple knockouts is required. Typically, water and compressed air are used
Work Surface	Work surface shall be temperature and chemical resistant epoxy type. Work Surface and Cup Sink shall be of a “dished” type to prevent small spills from escaping.	Due to their superior chemical and thermal resistance.
Liner	Fiberglass Reinforced Polyester (FRP) are required for general purpose hoods.	Best balance between cost efficiency & chemical resistance.
Lighting	Light fixture(s) in all cases shall be explosion proof/ intrinsically safe.	CSA states “if explosion hazards are present”. Given our inability to know that will be the case for the life cycle of the hood, explosion proof is required in all applications.

The Principal Investigator/ Supervisor/Instructor of a lab must fill out the form (Fume Hood Checklist 2019 05 03 (1)) for each fume hood requested.

Appendix B

(See Facilities Management for Original Document)

Dalhousie University Fume Hood Testing and Certification

Fume Hood Testing Methods

1. AM – As Manufactured
2. AI – As Installed
3. AU – As Used (Periodic)

Specification for As Used Testing on a project:

Responsibilities:

The supplier of the VAV fume hood controls equipment is responsible to certify the chemical fume hoods found in the scope of the project. This may be completed directly or via an independent third party.

No fume hood certification work is to be done before the air balancing portion of the project is completed and that the building/lab is fully operational.

It is the responsibility of the supplier of the VAV fume hoods that all hoods pass the ASHRAE AI or AU testing as per the client's criteria. Any hoods that fail the testing will need to be site adjusted and re-certified at no additional costs to the project.

A detailed report is to be issued to the laboratory operator and project coordinator as to the certification of the fume hoods and its corresponding Face Velocity.

References:

CSA-Z316.5-15, September 2015, Section 8

Face Velocity & Smoke Testing CSA-Z316.5-15, September 2015

Acceptance criteria 60 FPM +/- 10 fpm

Response Time < 3 seconds

Tracer Gas Testing as per CSA-Z316.5-15, September 2015

Acceptance criteria is 0.100 ppm SF6

Cross Flow Testing as per CSA-Z316.5-15, September 2015

Hoods to have instruments & materials inserted inside during testing that represent the work that will be occurring on a regular basis. Instruments & materials and their layout to be provided by the University Project Manager and placed in one of the project's hoods for example purposes.

Testing to occur at the maximum design air change per hour rate for the room. Obtain from the Engineer.

Steps by Hood

1. Observe the hood physical installation surroundings. Are there any potential(s) for crossflow? If yes, stop and advise the University Project Manager
2. Insert instruments & materials as per University provided layout.
3. Once any defects associated with Step 1 have been remedied, Face Velocity & Smoke Testing at the Design Face Velocity of 55 FPM.
    a. If Step 2 is a positive pass, proceed to Tracer Gas Test
    b. If Step 2 is a failure, conduct a Cross Flow Test
        i. The velocity of the cross drafts should not exceed 50% of the face velocity or 0.15 m/s (30 fpm).
    a. Correct the source of any unacceptable Cross Flows. Note physical corrections are not the responsibility of the testing company. The project engineer shall determine who is responsible for which changes.
    b. Repeat Face Velocity & Smoke Testing
4. Tracer Gas Test at the Design Face Velocity of 55 FPM.
5. Once all hoods have been successfully certified the Design Face Velocity of 55 FPM conduct Face Velocity, Smoke & Tracer Gas tests on a single hood, Chosen by the University Project Manager, and determine the lowest Face Velocity that achieves acceptable containment defined as positive Face Velocity, Smoke & Tracer Gas tests.
6. Test 25% of the hoods at the Face Velocity determined from Step 5 plus 10% (i.e. 45 FPM + 4.5 FPM = 49.5 FPM). If all pass, make all Hood Face Velocity Set Points equal to the Face Velocity determined from Step 5 plus 10%

Base Testing Price to include:

Steps 1 & 2 above

Face Velocity & Smoke tests on all hoods

Tracer Gas test on all hoods

Step 5 above

Unit Pricing:

Cross Flow Test for one Hood based on a minimum of 4 tests

Face Velocity & Smoke Testing for one Hood based on a minimum of 4 tests

Cost for Step 6.

Travel & Expenses to and from the site for retesting but not the testing itself.