Part 1 General

1.1 Summary

.1 Unless otherwise indicated, follow the guidelines below when planning for laboratories in new or renovated spaces. These guidelines are not intended to restrict or replace professional judgment.

.2 For Teaching Laboratory Planning, this document should be read with the Classrooms Standards (see Special Building Areas – Classrooms)

.3 These guidelines should be read with the specific technical sections of McGill's Building Design and Technical Standards mentioned in Part 2. – Related Technical Sections.

1.2 Quality Control

.1 If, for valid reasons, a deviation from the Standards becomes necessary, it must be addressed in the "Variance Form".

1.3 Scope

.1 The purpose of this section is to provide safe, efficient and healthful laboratory spaces to the McGill community while respecting the operational needs of the building in which these spaces are located.

1.4 Definition – Laboratory

.1 Laboratories are defined as spaces being used for research, experimentation or teaching involving the *use and storage of hazardous materials* as defined by the Workplace Hazardous Materials Information System (WHMIS).

1.5 Laboratory classification

.1 Prior to commencing a laboratory project, the Designer must obtain from the Project Manager, McGill's Environmental Health and Safety (EHS) risk assessment report of the hazardous materials or processes to be used in the projected laboratory space.

1.6 Codes and Standards

.1 The research activities in McGill's laboratories often result in non-conventional spaces for which no specific Fire Protection and Life Safety requirements are described within the Codes and Regulations of the Provincial, Municipal and other Authorities having jurisdiction. For the safety of the users, McGill requires the following best practices standards be applied to its Laboratories Design:

.1 Normes et lignes directrices canadiennes sur la bio-sécurité
.2 ANSI Z358.1: Emergency Eyewash and Shower Equipment;
.3 ASHRAE Z9.5: American National Standard for Laboratory Ventilation;
.4 ASHRAE 110: Method of Testing Performance for Laboratory Fume Hoods;
.5 CSA Z316.5 Fume Hoods and Associated Exhaust Systems;

.6	NFPA 30:	Flammable and Combustible Liquids;
.7	NFPA 45:	Standard on Fire Protection for Laboratories Using Chemicals;
.8	NFPA 55:	Compressed Gases and Cryogenic Fluids Code;
.9	NFPA 400:	Hazardous Materials Code;
.10	NFPA 5000:	Building Construction and Safety Code: Chapter 34 – High Hazard Contents;
.11	NIH:	Specifications 15991 and 15992 – On site testing of Fume Hoods.

.2 If a requirement cannot be met, the designer shall submit a variance form to McGill's Design Services and explain the reason why it cannot be met.

1.7 Accessibility

.1 Laboratories must be designed to be accessible to physically challenged individuals, refer to McGill's Accessibility on Campuses Guidelines;

.2 There should be at least one fume hood for disabled individuals per laboratory floor (prevent disabled from having to transport hazardous products in elevators);

1.8 Flexibility and Versatility

.1 Considering most researchers have unique sets of laboratory design requirements, laboratory spaces should be planned considering long term usage and research, teaching, and experiments repurposing.

.2 For flexibility and versatility, laboratories spaces on McGill University's Campuses should be designed:

.1 to be separated from adjacent spaces with Fire Separations of a minimum 1 hour Fire Rating; (whenever possible)

.2 to have their services and utilities main lines placement planned so the building's or adjacent spaces' services, and utility systems, will not be disturbed in the event of laboratory reconfiguration/repurposing; (whenever possible)

.3 to have their connection point to services and utilities (valves and emergency disconnect) planned to facilitate future modification and adaptability to special research needs, without major changes;

.4 in buildings where biological materials are handled, follow the physical requirements of the Canadian Biosafety Standards and Guidelines (CBSG);

.5 in buildings where the storage and usage of radioactive materials is prevalent, to follow the Canadian Nuclear Safety Commission's Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms (GD-52, Appendix C).

1.9 Design Requirements for Laboratories

.1 Aisles and circulations

.1 The arrangement of aisles must be regular and provide a logical path to the exit (laboratories emergencies are often accompanied by heavy smoke and fumes complicating egress and exit locating);

.2 Major aisles between equipment and benches must be planned to provide the most possible direct access to the exit door (s);

.3 Aisles between equipment and benches must have a minimum clear wide of 1500mm (for safe passage behind persons working at benches);

.4 Avoid aisles longer than 6m.

.2 Biological Safety Cabinets (BSC)

.1 Biological Safety Cabinets should be located away from turbulence e.g. proximity to an air supply, pedestrian traffic, fume hoods, or other cabinets.

.3 Building Envelope

.1 Building envelopes performance and components can be adversely affected when adding negatively pressured spaces to a building. The impact of adding such space in an existing building should be carefully assessed at early design stage in order to implement remediation measures, when needed, to avoid triggering building envelope malfunctions. (e.g. humidity infiltration through walls, other areas exterior doors and windows difficult to open, etc.).

.4 Cleaning

.1 Laboratories must be designed and finishes selected to be easily cleaned;

.2 Floors and bench tops should be seamless to avoid contamination;

.3 Furniture must be impermeable to facilitate decontamination and cleanup procedures in the event of a hazardous material spill or incidental spread of contamination.

.5 Cold Rooms

.1 Cold rooms must have viewing windows and three-ways light switches for internal and external control of light inside the cold room;

.2 Latch and frame must be designed to allow door functioning under all conditions (e.g. freezing). Magnetic latches are preferred.

.6 Communications

.1 Safety in the laboratory should not depend on cellular phone communication. Each laboratory must be equipped with a telephone or alternate wired emergency communication system:

.1 this wired communication equipment must be easy to reach, located in a high visibility point, preferably close to the primary entrance door or safety station, and clearly identified,

.2 it should be accessible to people using wheelchairs and,

.3 its location should be consistent from laboratory to laboratory;

.2 Access to the University computer network must be possible in each laboratory.

.7 Doors

.1 Whenever feasible, each laboratory should have two exits;

.2 In buildings where the usage of hazardous materials is prevalent, laboratory spaces of 100 m2 and more must have at least two exit doors. (The likelihood of laboratories using high hazard materials at some point is increased in these building);

.3 Doors from laboratory to corridor must open outward (whenever possible);

.4 Doors from laboratory to corridor must be self-closing (whenever possible);

.5 Provide clearance on both sides of door for moving of equipment and carts (space in front of doors must be free of obstacle and have side clearance).

.8 Emergency cut-off

.1 In the event of an emergency, the laboratory might be unsafe to enter. The laboratory's electrical circuit breakers and gas and vacuum lines shut off valves should be located outside the laboratory, but in a close proximity to the laboratory and in a well identified location permitting easy and rapid access for cut-off.

.9 Emergency power and lighting

.1 Emergency egress lighting must be provided in the area where hazardous products or process are used;

.2 Laboratory must be designed with at least one power point on emergency power;

.3 Fume hoods must be connected to an emergency power system capable of supplying at least half of the normal air-flow (in the event of power failure, back-up power will ensure that chemicals continue to be exhausted).

.10 Floor drains

.1 Floor drains in laboratories must be limited to emergency shower's area, below the shower head, and be installed as far as possible from hazardous materials (including storage and fire cabinets) and fume hoods.

.11 Flooring

.1 Flooring must be seamless, impervious, resistant to chemicals, washable and with 150mm high integral coving on the walls, fixed furniture or fixed equipment (liquid tight);

.2 Strippable and replaceable coating, for easier clean-up if contaminated, is preferred.

.3 Finishes in corridors from support spaces to laboratory spaces must offer leveled surfaces with no joints for safe transport of hazardous materials, glassware, etc.;

.4 Penetrations for electrical, plumbing, and other must be permanently sealed.

.12 Fume hoods

.1 There should be at least one Fume Hood per laboratory (or one dedicated ducted line for subsequent installation);

.2 Ductless chemical fume hoods are not acceptable;

.3 Location: The air curtain in front of a fume hood cabinet can be easily disturbed by people walking or other air movements.

Fume hoods:

.1 Should be located away from interfering room air currents (e.g. doorways, room ventilation registers),

.2 Should be located out of the normal traffic pattern,

.3 Should not be located close to the primary exit (less than 3m),

.4 Face to face location is to be avoided. If installed opposite a Biological Safety Cabinet (BSC) or another Fume Hood distance must be more than 3m face to face,

.5 Should not be located opposite workstations where personnel will spend much of their working day (e.g. desks or microscope benches);

.4 There should not be opening windows in spaces where Fume Hoods are installed. If opening windows are present in an existing space to be renovated as a laboratory, these windows must be locked in place with temper proof fasteners;

.5 Motors for chemical hoods shall be explosion proof if the motor is located in the air stream. Metal parts are to be covered with HERESITE coating.

.6 Manifolding of hoods is only allowed for fume hoods with similar type of use and where no chemical reaction can occur. Fume hoods designed for the exhaust of perchloric acid or radioactive contaminants must have dedicated exhausts.

.7 No laboratory hood installation is allowed in rooms with return air to other spaces. All chemical use rooms shall have 100% exhaust capability.

.8 The design professional shall specify, on design drawings, the following parameters for each fume hood: full open and operating design face velocities and area. Also specify minimum flow and response time.

.9 Fume hood and ventilation system design shall be flexible enough to allow for the hibernation and de-commissioning of up to 25% of the hoods located in a space supplied by the same air make-up system. Careful consideration should be taken when sizing and selecting ducts, fans, diffusers, etc.

.10 Fume hoods must be certified to ensure safe working conditions with face velocities as low as 60 fpm using the ASHRAE-110 Method of Testing. However, McGill does not suggest that fume hoods should be operated at such a velocity. Operating parameters, including allowable face velocity, shall be determined through a risk analysis outlined below.

.11 Fume hoods shall be designed with occupancy detection at the fume hood level to modulate face velocity and the system's static set point when the fume hood is unoccupied.

.1 The control system shall reduce fume hood face velocity and airflow rates to the minimum allowed values.

.2 These values shall be determined through a risk analysis conducted by the design team in conjunction with representatives of laboratory users, McGill's Environmental Health and Safety, and Facilities, with respect to applicable standards and regulations.

.3 Among others, the risk analysis shall take into account: the amount and nature of chemicals that will be used under the fume hoods, the expected by-products of chemical reactions, the time of use of the

hoods, the types of users and their level of experience, and the impact of the surroundings on the fume hood's performance.

.4 The risk analysis shall be documented, include recommendations on the face velocity and ventilation rates to be maintained in the fume hood and in the laboratory during occupied and unoccupied times, and the rationale behind the recommended values.

.12 All fume hoods controls shall be connected to DDC controls (Building Automation System).

.13 Furniture and Casework

.1 Laboratory furniture and casework must be arranged to provide unobstructed sight lines to exits for people standing;

.2 Long runs of fixed casework must be minimized;

.3 Mobile casework on wheels or other options to maximize flexibility and minimize costs are preferred;

.4 Shelves for chemical should not be located above eye level when standing;

.5 Furniture and casework should be located and designed to facilitate ease of egress and ease of travel within the laboratory;

.6 A backsplash must be provided at each bench junction with a wall.;

.7 Island type benches make it possible for users to move around quickly to reach emergency equipment and exits, they are McGill preferred arrangement. Peninsula type benches (one end attached to a wall) are acceptable if there is an exit at both ends;

.8 Furniture and casework must be positioned to allow for proper cleaning of floor (spills and regular) and access for maintenance (equipment and other).

.9 Preferred material: steel for new installation, wood reserved only to complete existing installation.

.14 Gases

.1 Whenever possible, line supplied gases must be used instead of gas cylinders since line supplied gases increase the potential for additional laboratories in buildings (multiple cylinders limit the quantity of gas);

.2 Compressed gases:

.1 Laboratory using compressed gases cylinders should have recessed areas for cylinders (maximum of two cylinders per alcove);

.2 The alcoves must be equipped with chains or metal brackets, able to remain intact in a fire, to secure the cylinders in place (at 1/3 and 2/3 of cylinder height). Nylon cylinder straps are not acceptable;

.3 Adequate provisions must be made for the storage of compressed gases cylinder. The cylinder must never be located:

.1 In an exit or corridor providing access to an exit,

.2 Under a fire escape, outside exit stair, passage or ramp,

.3 Within 1 meter of any exit.

.3 Line supplied gases (natural gas, liquefied petroleum gases, compressed gases):

.1 Each point of supply must be identified with labels for each type of gases;

.2 Each valves at work station must be color coded for identification of the gas it supplies;

.4 Each point of supply to the laboratory must have a manual shut off valve clearly identified as such. For flammable or corrosive gases, this valve must be located in a safety cabinet with a breakable transparent door (for emergencies).

.15 HVAC Terminal Elements

.1 Terminal elements shall consist of venturi valves with pressure-independent flow control, for variable-speed operation. The valves shall be complete with variable speed motor and accessories.

.2 The valves shall be provided with their own stand-alone controls, which shall be compatible with the Building Automation System (BAS).

.3 Terminal boxes are not acceptable. Any variation of concept or design of the terminal elements described here, need to be submitted to McGill's Facility Operations (FOD) Energy and Maintenance Departments through a variance form.

.16 Laboratory support spaces

.1 As a general rule, every effort must be made to bring together, by floor, all the resources researchers use on a daily basis while avoiding duplication of laboratory support spaces whenever efficient and possible (e.g. write up spaces, break rooms, secure coat rooms, etc).

.17 Laboratory (Hazard) zoning

.1 The path to the exit door(s) should not require passing through a zone of higher hazard. Therefore, Laboratories should be planned in zones to provide safe egress from all points;

.2 Laboratory from non-laboratory activities should be segregated (e.g. students access to laboratory personnel outside scheduled experimentation time);

.3 Seated workstations (laboratory desks) where users tend to concentrate their attention on a limited field of vision, thus being potentially less aware of other activities in the laboratory (microscopy, computer, writing, etc), should be located near an exit and preferably in the path of fresh make up air;

.4 Experimental work spaces/stations should be physically segregated from other laboratory functions/activities such as:

.1 Write-up spaces (paper/computer spaces),

.2 Central chemical storage,

.3 Equipment or instrument rooms,

.4 Bottled/compressed gas storage,

.5 Coat and boot storage;

.5 Connecting office and laboratory spaces should be designed to prevent laboratory emissions from entering office spaces;

.6 Food and drinks are not allowed in laboratory spaces. Unless there is a nearby cafeteria or departmental eating area, design of the laboratory, and adjacent support spaces, must incorporate, a break space physically separated from the laboratory and equipped with a sink for storage or consumption of food and drinks.

.18 Research Equipment

.1 Attempts should be made to centralize the location of heat generating equipment in spaces dedicated and designed for the purpose (e.g. minus 80 freezers, incubators, centrifuges, autoclaves, dishwashers, etc):

.1 Autoclave: to better control the effect of heat generating equipment in the laboratory and to maximize energy efficiency, whenever possible and practical, autoclaves should be centralized in one shared room,

.2 Freezers, refrigerators and other heat-generating equipment shall be in freezer farms or in antechambers separated from the main laboratory area and office space so as to maximize heat recovery from these appliances.

.2 Research appliances, particularly freezers and refrigerators, shall be high energy efficiency and Energy Star rated, when applicable.

.3 Servers scattered around campus put a strain on HVAC systems and the heat they generate can seldom be recovered in a cost effective manner. McGill's central data centre, managed by Content and Collaboration Solutions (CCS) department (IT Services), is highly efficient and reliable. It has its own dedicated emergency power system to ensure continuous operation of the servers and the air conditioning systems to support them; heat generated by the servers is recovered and used to heat other buildings in the vicinity. All servers and computer capacity shall be installed in McGill's central data centre.

.4 Water-consuming equipment (e.g., cage-washers) shall be designed so as to reuse water and reduce water consumption.

.19 Safety station

.1 Each laboratory must be equipped with at least one safety station located next to its primary exit;

.2 Safety station must comprise:

.1 an eye-wash,

.2 an emergency shower,

.3 a floor drain,

.4 a fire-extinguisher and,

.5 a hand washing sink (if not provided otherwise);

.3 Whenever feasible, an easily accessible recess must be designed for housing the shower curtain;

.4 If corrosive or highly irritating or toxic substances are used in the laboratory, each fume hood shall be within 10 seconds of an emergency eye-wash/shower station;

.5 Floor under the safety shower must be leveled and of a contrasting color to facilitate detection of shower location and placement of body under the shower head in case of an emergency (people have a tendency to walk with their head down, looking at the floor, in case of an emergency);

.6 Clear space at safety station must allow for wheelchair access and safety station utilization;

.7 Safety stations must be placed in high visibility locations and be identified by highly visible signs (refer to McGill's Interior Signage Standards);

.8 Safety station arrangement and location, in laboratory, must be as consistent as possible from laboratory to laboratory;

.9 An eye-wash/emergency shower safety station should be installed in all laboratories using cryogenics.

.20 Seismic stabilization

.1 Seismic stabilization must be provided for furniture, casework and equipment that have the potential for falling over and for wall mounted shelving.

.21 Sinks

.1 Laboratory sinks must have lips to prevent overspills;

.2 There should be at least one dedicated hand washing sink in each laboratory;

.3 Wash-up sinks should be located in low traffic areas.

.22 Storage

.1 In order to avoid built-up on top of shelves, cabinets and the like, and in corridors, adequate bulk storage of dedicated laboratory supplies should be planned for laboratory spaces;

.2 Storage space for personal items must be provided outside the area where hazardous products or process are used (shelving, laboratory coats hooks, secured coat room, lockers, etc);

.3 Coat hooks, for hanging up laboratory coats and other personal protective equipment, must be installed close to the exit of the laboratory (one per work station);

.4 To free aisles and maintain safe circulation widths in the laboratory, enough dedicated space must be planned in the laboratory for a variety of waste collection containers (trash, hazardous waste, broken glass, sharps, recyclable, etc), preferably integrated to the laboratory casework;

.5 Every effort must be made to avoid multiple hazardous products storage areas on one floor. Whenever possible and practical, hazardous products storage should be centralized in one shared room;

.6 Storage spaces should be planned so there will be no vertical transport of hazardous materials other than for delivery and routine disposal.

.23 Storage Cabinets

.1 Flammable and acids storage cabinets must be vented unless odor or vapor control is not a concern;

.2 If vented cabinets are used, they must be vented independently to the outdoor with ducting providing a fire protection at least equivalent to the cabinets'. Exhaust through the building general ventilation system is not acceptable;

.3 Preferred location of vented acids and flammable cabinets is below fume hoods;

.4 Cabinets must not be stored in or adjacent to exits and travel path of egress;

.5 If not vented, the standard ventilation openings in the cabinets must be sealed with caps providing a fire protection at least equivalent to the cabinets'.

.24 Utilities and Services

.1 McGill's utility distribution networks and central systems shall be preferred over independent systems.

.2 Systems should be designed to allow for grey water collection and usage.

.3 Vacuum systems and water-purifying systems shall be designed to high energy and water efficiency standards.

.4 McGill's utility distribution networks and central systems shall be preferred over independent systems.

.5 Specific equipment and activities, other than life safety and building integrity, may be required to maintain the continuity of the University's mission. Professionals shall identify such elements and activities early in the design process for analysis by University Services.

.25 Ventilation

.1 General room ventilation shall be provided to prevent the build-up of fugitive emissions in the laboratory. A general room ventilation system shall be designed to maximize the clearance of contaminants from the room while minimizing overall energy use.

.2 Variable air volume (VAV) should be used.

.3 Laboratory exhausts should be manifolded to allow heat recovery. Heat recovery systems shall be designed to prevent cross-contamination.

.4 The design professional shall provide a "basis of design" statement for all laboratory designs that clearly defines all system criteria and assumptions made during the project design process. Documentation shall include, but not be limited to, items such as laboratory air change rates, anticipated chemical usage, description of the air flow control system, equipment loading, anticipated occupancy, and diversities as well as references to codes and standards used.

.5 All new and retrofitted laboratories shall be equipped with occupancy detection to control lighting and ventilation.

.6 Laboratory ventilation rates must be maintained based on Occupied or Unoccupied modes. The ventilation rates, fresh air and temperature set points shall vary with occupation and based on applicable codes.

.7 The designer must demonstrate that the proposed ventilation rate will control room air contaminant concentrations below the current Threshold Limit Value – Time weighted Average (TLV-TWA).

.8 The designer shall include provisions for room purge mode in rooms where the storage of high hazard chemicals is anticipated.

.9 The ventilation system that supplies make-up air to laboratories and the ventilation system(s) for other types of spaces in the building (e.g., office, conference rooms, common areas, etc.) shall be segregated (separate units, separate controls, separate exhausts, no combative situations).

.10 A run-around coil-heat recovery system, heat pipe, or heat pump shall be provided between the main laboratory exhaust and the make-up fresh air unit.

.26 Windows and natural lighting

.1 For avoiding adversely affecting the room pressures, there must be no opening windows in mechanically ventilated lab spaces;

.2 In laboratory spaces handling biological material, with no mechanical ventilation or fume hoods, opening windows must be fitted with insect screens;

.3 Direct natural light and views to the outside should be favored for laboratories and offices;

.4 If natural light and views to the outside cannot be provided, interior windows between the room and the corridor should be considered;

.5 All laboratories windows at ground floor level must be secured to prevent unauthorized access.

Part 2 **Related Technical Sections**

The technical sections of the McGill Building Design and Technical Standards should be consulted with the current document, most notably (but not limited to) the following:

Section Number	Title of Section
Special Building Areas	Animal Facilities
01 47 00	Guide en efficacité énergétique
07 92 10	Joint Sealing
08 11 14	Metal Doors and Frames
08 14 10	Interior Flush Wood Doors
09 22 27	Suspended Ceiling
09 65 16	Resilient Sheet Flooring
09 91 26	Painting
11 53 13	Laboratory Fume Hoods
12 35 53	Laboratory Casework
12 35 54	Chemical Storage Cabinets
12 50 00	Furniture
22 42 01	Appareils spéciaux
22 42 02	Éviers et cuviers

END OF SECTION