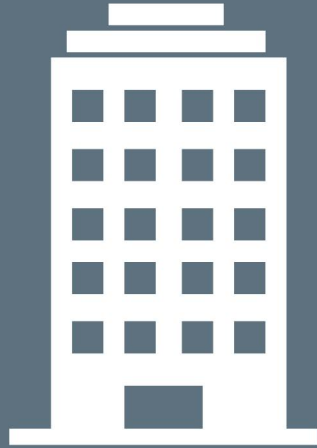


# Laboratories and the Fire Code Classification and Hazards

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# CodeNext

Next Generation Building and Fire Code Professionals

# About CodeNext Inc.

## Next Generation of Building and Fire Code Professionals

Building Code, Fire Code, Building Condition Assessments, and Accessibility

Industrial experience in manufacturing, cannabis extraction, pharmaceutical, warehousing applications, and preparation of Alternative Solutions

### Melinda Amador, P. Eng., M.A.Sc.

15+ years providing fire protection and life safety consulting

Specialization in industrial applications and hazardous materials

Chair of NFPA 420, “Standard on Fire Protection of Cannabis Growing and Processing Facilities”

# Laboratories

## Presentation Outline

- What are Laboratories?
- Classification of Dangerous Goods
- Compliance Elements
- Other Considerations
- Questions



# What are Laboratories?

## Application of the Fire Code

- OFC Section 4.12, “Laboratories” - where flammable liquids and combustible liquids are used or handled
- NFC Section 5.5., “Laboratories” - where *dangerous goods*, including flammable liquids and combustible liquids, are used
- Challenge is associated with identifying laboratories based on **DESIGN** and **USE**
- “Laboratories” is **NOT** a defined term - how do we determine if it is regulated?
- MERRIAM-WEBSTER: “*a place equipped for experimental study in a science or for testing and analysis*”

# What are Laboratories?

## Other Definitions / Guidelines

- NFPA 45, “Standard on Fire Protection for Laboratories Using Chemicals”, 2019 edition:

A facility where the containers used for reactions, transfers, and other handling of chemicals are *designed to be easily and safely manipulated by one person*. A laboratory is a workplace where chemicals are used or synthesized on a *nonproduction basis*.

- NFC, A-5.5.1.1.(1)

The provisions in Section 5.5. apply only to laboratory operations involving the use of dangerous goods, including flammable or combustible liquids. They do not apply to the incidental use of such substances or to their use for maintenance or cleaning purposes only, in which case, requirements in other Sections of the Code would apply.

# What are Laboratories?



# What are Laboratories?

## Important Distinctions - Not All Laboratories are OFC Laboratories!

- A design set or a room label may state that a room is a laboratory - it may not be regulated as a laboratory under the OFC! Also... the space may not use the word laboratory...
  - Computer labs
  - Examination rooms
  - Training labs
  - Autopsy rooms
  - Product or food testing labs
  - Classrooms
  - Electronics labs
  - Research spaces
- The regulation of laboratories under the Building Code and Fire Code is based on the presence **CHEMICALS** and an assumed **LEVEL OF RISK**

# What are Laboratories?

**IS IT A LABORATORY?**  
**WHAT ELSE COULD IT BE?**

## What are the Hazards?

- **MANY** types of chemicals are present
- Chemicals are being **USED** in non-production applications
- Depending on the facility operations - we can encounter many teams or groups working side-by-side with a limited understanding of adjacent hazards, chemicals, or operations
- These spaces can become very busy, cluttered, and over stocked

## What are the Protection Measures?

- **SMALL** volumes and containers
- Chemical use is typically in **FUME HOODS**
- **GENERAL VENTILATION** to limit spread of hazardous vapours to other areas
- **FIRE SEPARATIONS** to limit the spread of fire to other areas
- **TRAINING, SOP, IT&M** and **OPERATIONAL CONTROLS**



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FIRE CODE CLASS	TDG CLASS	WHMIS CLASS	
Compressed Gases	Class 2	A, B1, B5, A+C, A+D1, A+D2, A+E	} OFC
Flammable Liquids	Class 3	B2, B3	
Flammable Solids, Pyrophoric, Water-Reactive	Class 4	B4, B6	
Oxidizing Substances	Class 5	C	} NFC
Toxic & Infectious	Class 6	D's	
Corrosives	Class 8	E	
Dangerously Reactive	-	F	

***Simplified from NFC Table 3.2.7.1.***

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# Compliance Elements

## OFC Section 4.12 & NFC Section 5.5.

- Fire Separations
- Maximum Quantities & Container Sizes
- Gas Cylinders
- Ventilation
- PVE's / Fume Hoods
- Ignition Source Control
- Operational Controls

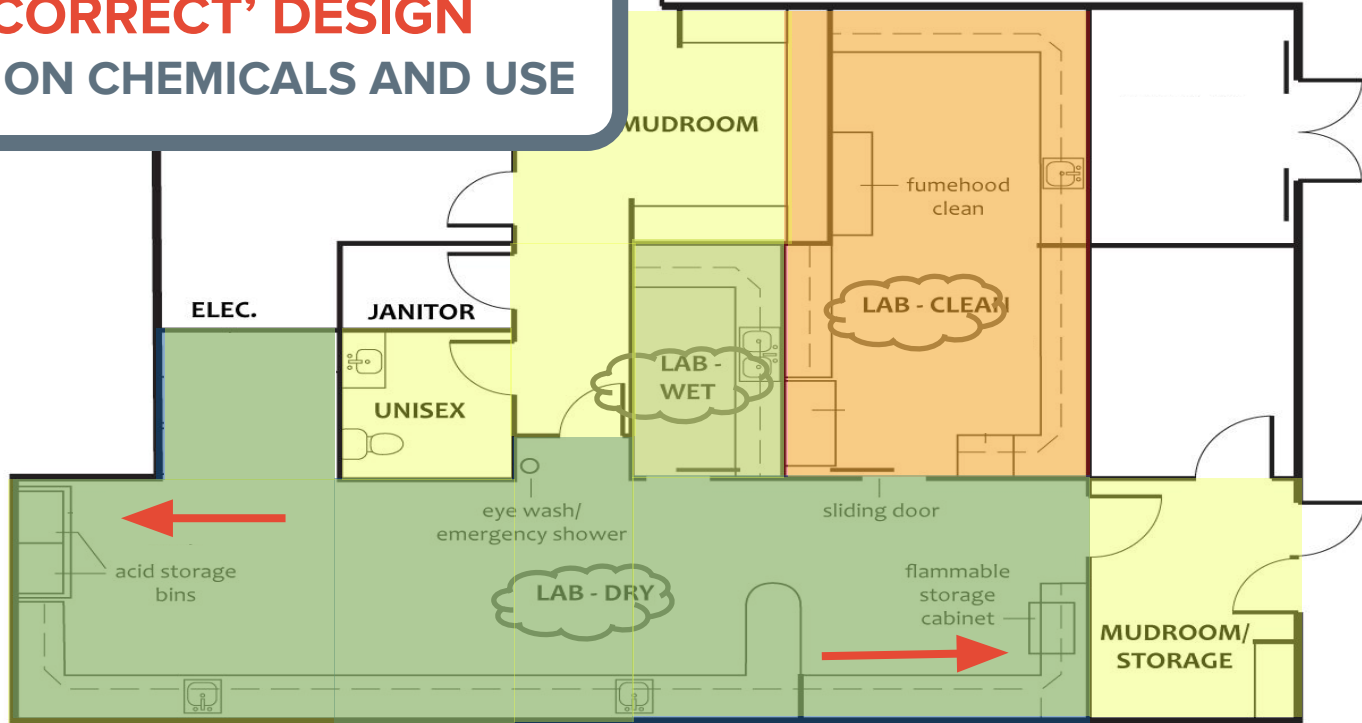


# Compliance Elements

## Fire Separations

- 1 hour fire separation from laboratory to other parts of the building
- The application of OFC Section 4.12 or NFC Section 5.5., is intended to be within the fire compartment
- The boundaries of the fire compartment are important to establish as this impacts maximum quantities of chemicals within the space and the extent of specific mechanical and electrical systems
- Some designs may consider multiple laboratory fire compartments or create multiple 'suites' of laboratory spaces
- Ancillary areas are often included within the fire compartment

**NO 'CORRECT' DESIGN**  
**DEPENDS ON CHEMICALS AND USE**



# Compliance Elements

## Maximum Quantities

- Open Area:
  - OFC - 300 L of flammable + combustible liquids (50 L Class I maximum)
  - NFC - normal operation, or limited in Group A2, D, and B major occupancies
  - **NO STORAGE IN FUME HOODS!** (NFC Sentence 5.5.4.2.(2))
- Cabinet Storage:
  - OFC - Per 4.2.10. & consider occupancy limitations
  - NFC - 1 cabinet volume of storage only

# Compliance Elements

## Container Sizes

- Generally - small containers, easily manipulated by one person
- Where not larger than 5 L - comply with OFC Subsection 4.2.3.
  - TDGR
  - Markings and labels
  - Exemptions: purity, 1 L (Class I) or 5 L (Class II and IIIA), or for quality control purposes
- If require larger containers - must be a ULC Safety Container, not more than 25 L
- NFC 5.5.5.2.(3) - guidance for preservation of specimens in flammable or combustible liquids



# Compliance Elements

## Gas Cylinders

- NFC Article 5.5.5.3.
  - Must be in-use and connected to a regulator or manifold to deliver gas or as a single back-up
  - Firmly secured, labeled piping systems, and shut-off valves
  - Toxic gases in a continuously vented gas storage cabinet with detection systems
  - Pyrophoric gases in continuously vented gas storage cabinet with sprinklers

# Compliance Elements

## Ventilation Systems

- OFC - Compliance with Subsection 4.1.7. and Subsection 4.12.8.
  - Applies throughout the laboratory compartment - fire separation boundaries are important!
  - Certain allowances for existing systems (November 1997)
- NFC - directs the user to the Part 6 of the National Building Code of Canada
- Requirements may be in conflict with energy efficient building design goals or with obligations for 'clean' spaces - be aware of most restrictive requirements and operational needs

# Compliance Elements

## Power-Ventilated Enclosures / Fume Hoods

- Typically provided to house dispensing, transfer, processing of flammable vapours, unstable liquids, heated chemicals
- Exhaust must **NOT** be returned to the building - must be directed to the outdoors!
- NFC Sentence 5.5.4.3.(2) - not to be interlocked with fire detection, fire alarm, or make-up air system
- No dampers - Ontario Building Code
- There are many different styles of fume hoods - not all are suitable for use with flammable or combustible liquids, heated liquids, or unstable liquids

# Compliance Elements

## Ignition Source Control

- Generally, required to comply with the Electrical Code
- Requirements for refrigerators - OFC Sentence 4.1.4.1.(2)
- NFC Article 5.5.3.5. - Ignition Sources and requirements for heating equipment and ignition sources for operations involving flammable liquids
- We often encounter 'home-made' equipment and devices in research environments
- Considering NFPA 45 - Laboratory work areas, laboratory units, and chemical fume hood interiors are typically be considered as unclassified electrically (not hazardous areas for electrical installations)

# Compliance Elements

## Operational Controls

- Emergency Planning - fire safety plans, fire drills (6 month intervals), and training
- Spill procedures and spill kits
- Inspection and maintenance - annual ventilation, semi-annual fume hoods
- NFC - signage / placards to identify dangerous goods
- NFC - chemical waste is to be identified to prevent mixing with incompatible chemicals and included in the total volumes permitted within a compartment
- Operations management - multiple teams, multiple groups, overlapping uses, chemical volumes and experiment scale

# Compliance Elements

## Summary – Risks are Mitigated and Managed

- Risk of multiple chemicals reduced by small containers and restricted total volumes
- Risk of releases limited by local and general ventilation, and spill procedures and spill kits
- Risk of fire spread limited by fire separations and suites having controlled chemical volumes
- Risk of ignition reduced through controlled heating applications and open flames
- Operational controls implement planning and training programs, IT&M, and signage

# Compliance Elements

## Evaluation Framework

- Determine extent of fire compartment
- Confirm chemical inventory, container sizes, and cabinets
- Establish mechanical, electrical, and fire protection system requirements
- Identify Owner/Operator responsibilities for spill control, training, fire safety planning, and IT&M

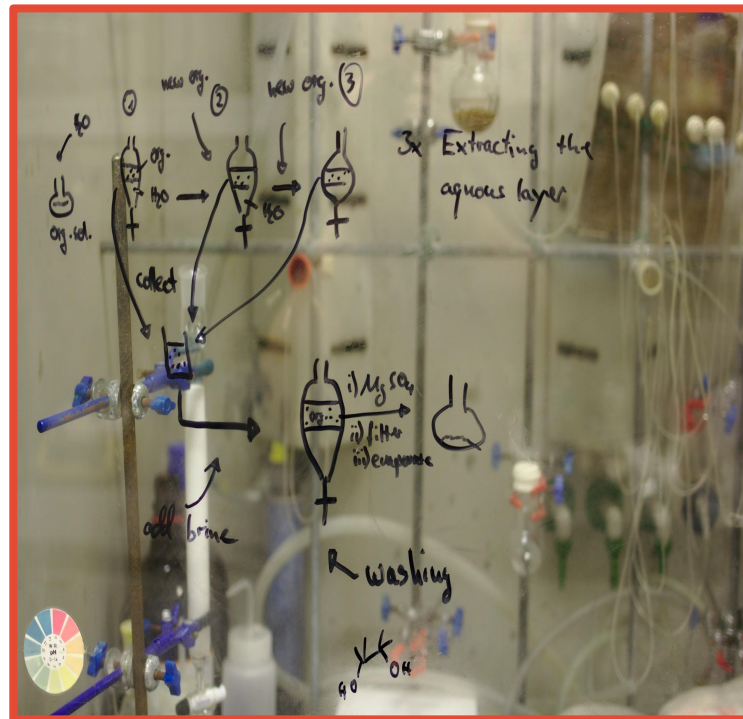
Laboratory spaces can be designed and operated to significantly limit and manage the risk of fire

It is important that these systems and programs be maintained for the lifetime of the space

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# Other Considerations

## Basement Laboratories - Ontario

- Generally, flammable liquids are not permitted to be used in basements
- OFC Subsection 4.12.10. includes allowances for **existing** basement laboratories
  - Limitations on quantities in open area
  - Limitations on container sizes (Class IA not more than 4 L)
  - Ignition source controlled within 0.9 m of the floor OR flammable detection at 10% LEL
  - Explosion venting unless use restricted to fume hoods and Class IAs are not stored in the open area (cabinets only)
- We are often preparing Alternative Solutions for basement laboratories

# Other Considerations

## NFPA 45

- Includes four levels of laboratories based on quantities of chemicals
  - Class A (High Fire Hazard) – Class D (Minimal Fire Hazard)
  - Requirements for fire separations, volumes, location in the building vary
  - Sprinkler hazard levels prescribed
- No Minimum Exemption Limit – NFPA 45 4 L flammable and combustible liquids or 2.2 m3 flammable gas
- Not directly comparable with the Canadian framework for laboratories

# Closing Remarks

## Laboratories

- The requirements in the Fire Codes for laboratories are consistent with measures we are familiar with from Part 4 to limit the spread of flammable vapours and fire hazards
- The unique features of laboratory spaces include the variety of chemicals and typically small volumes required
- The protection measures are reduced from what we would typically expect for bulk handling environments involving chemicals
- Operational controls and maintenance of existing systems and chemical volumes is critical to maintaining compliance

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# Thank You

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