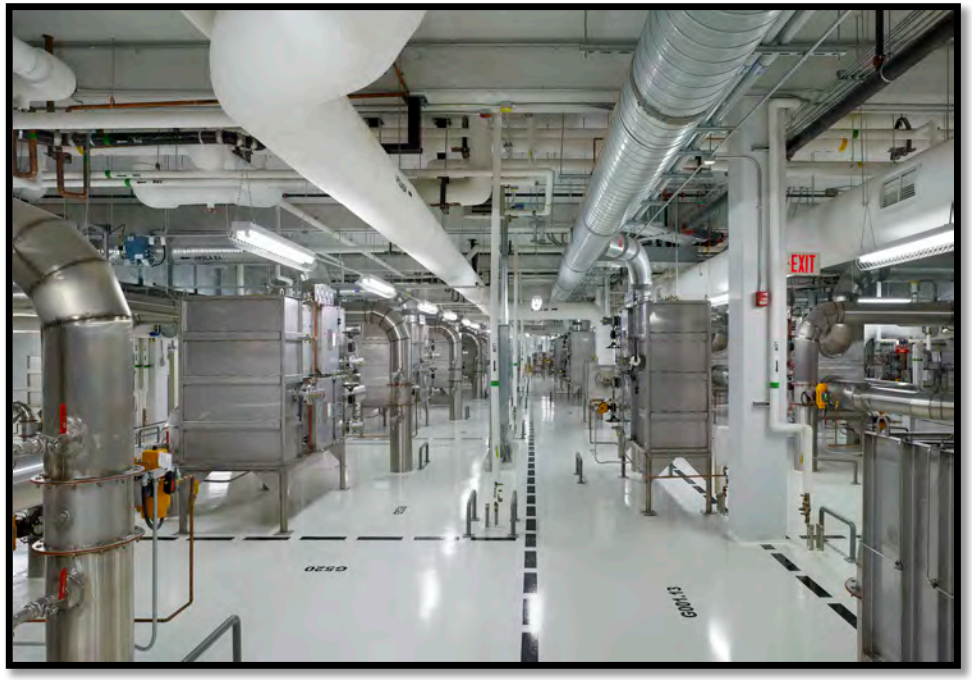


Vaccine and Infectious Disease Organization
- International Vaccine Centre

Managing Aerosols from an Operations & Maintenance Perspective

Tracey Thue, Biosafety Officer

Vaccine & Infectious Disease Organization – International Vaccine Centre

(VIDO-InterVac), University of Saskatchewan

University of Saskatchewan

Managing Aerosols from an O&M Perspective

- Introduction to VIDO-InterVac
- Risk Assessment process
- RG3 pathogens, aerosols
- Engineering controls in CL3-Ag, HEPA filters
- Local Risk Assessment for O&M staff
- Procedure for O&M staff

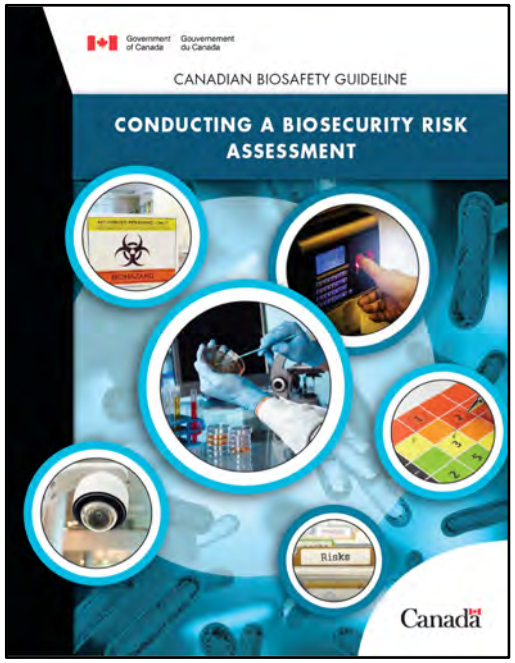
International Vaccine Centre (InterVac)

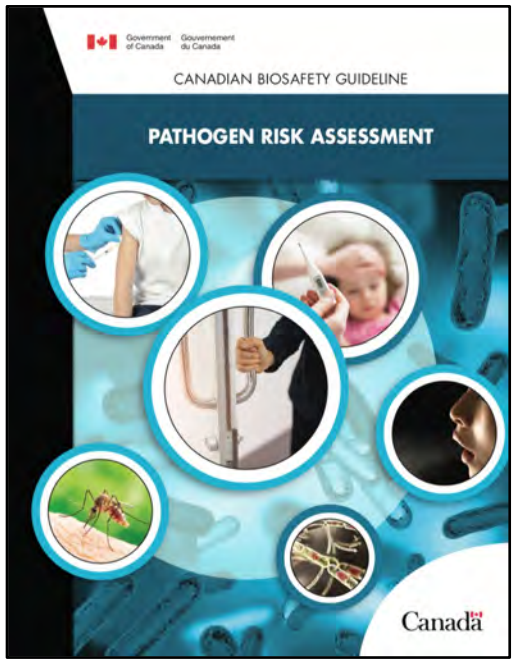
Large CL3 and CL3-Ag facility

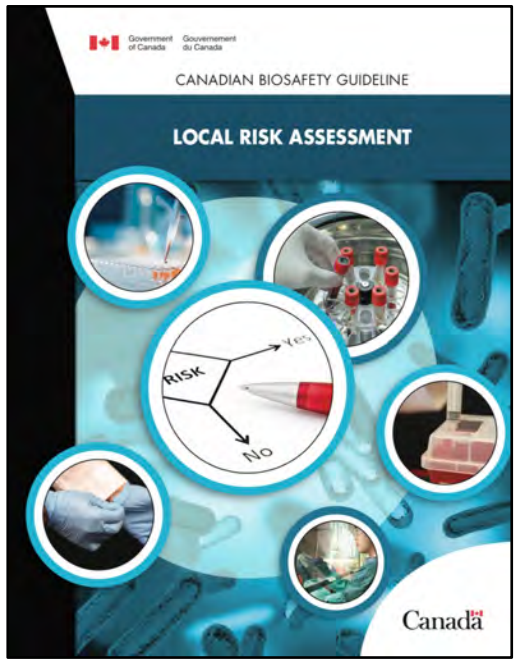
In-house full-time O&M team of 7

Risk Assessment

- Step 1: Identify and Characterize Hazards
- Step 2: Identify and Assess Risk
- Step 3: Develop and Implement Risk Mitigation Strategies
- Step 4: Review and Continually Improve



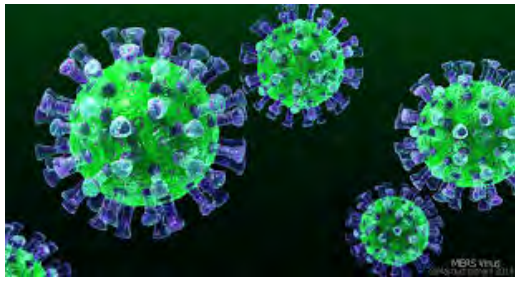




Risk Groups 1 - 4

RG1 *low individual, community risk*

E. coli, Baker's yeast



RG2 *moderate individual, low community risk*

Adenoviruses, PEDV, Influenza, ZV

RG3 *high individual, low community risk*

HPAI, MERS-CoV, *M. tuberculosis, M. bovis*

RG4 *high individual, community*

Ebola virus

Aerosols

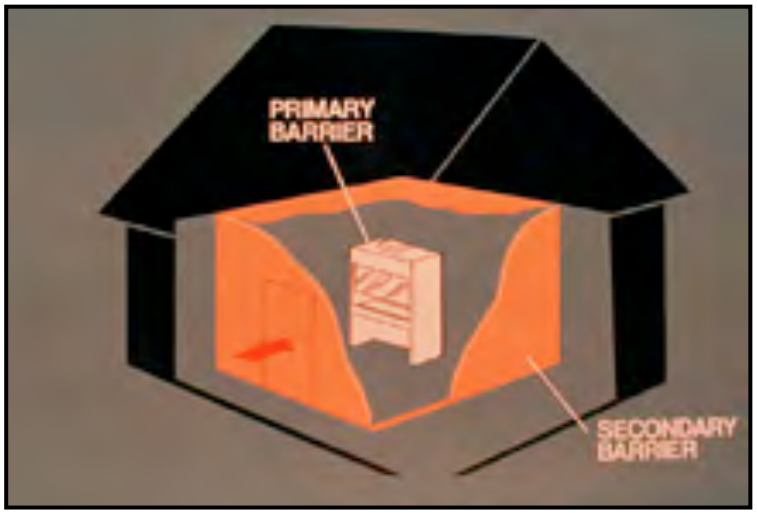
- Created by any action that imparts energy into a liquid or semi-liquid
- Larger aerosol droplets (5 – 100 µm) settle quickly & contaminate surfaces: ingestion hazard
- Smaller droplets (< 5 µm) evaporate rapidly, particulates remain airborne for a long time: inhalation hazard

Controls of Biosafety

- Engineering Controls
- Administrative Controls
- Procedural Controls
- Personal Protective Equipment

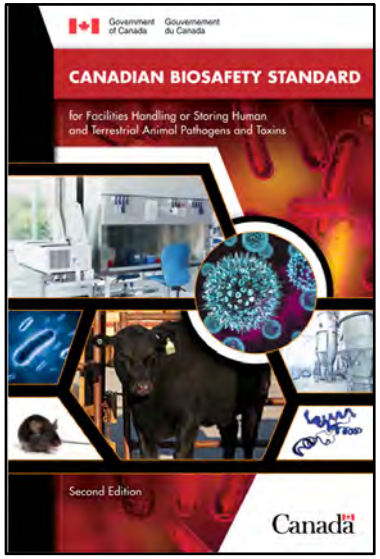
Engineering Controls

Facility Design Secondary Containment



- "Box in a box"
- 1° barrier (BSC) protects worker
- 2° barrier protects environment outside the laboratory
  - ➢ HEPA filters

HEPA Filtration



		CL2	CL2 -Ag	CL3	CL3 -Ag	CL4
3.5.9	Supply and exhaust air systems to be provided with automatic mechanical/electronic **interlocks** that prevent sustained positive pressurization of the containment zone.			■	■	■
3.5.10	Where IDA is provided, exhaust air to be: • passed through a filter that prevents the **release** of **infectious material** or toxins; or • 100% exhausted directly to the outdoors. *[Not required for SA zones.]*	□	■			
3.5.11	Exhaust air to be passed through HEPA filtration.			■	■	

		CL2	CL2 -Ag	CL3	CL3 -Ag	CL4
3.5.12	Exhaust air to be passed through two stages of HEPA filtration.					■
3.5.13	HEPA filters to conform to IEST-RP-CC001.5.			■	■	■
3.5.14	HEPA filter housings to be designed to withstand structural changes at applied pressure of 1000 Pa (i.e., 4 inches water gauge [in. w.g.]) in accordance with ASME N511 and AG-1			■	■	■
3.5.15	HEPA filter housings to be designed to allow ***in situ*** filter isolation, **decontamination**, and testing			■	■	■

Institute of Environmental Sciences & Technology

Recommended practice for basic provisions for HEPA filter units as a basis for agreement b/n customers & suppliers.

Describes 11 levels of performance & 6 grades of filter construction.

Engineering Controls

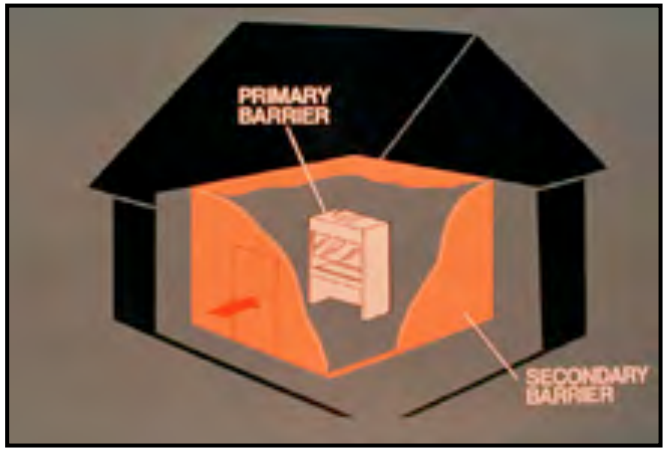
To researchers working in the lab

Engineering Controls

To O&M team on HEPA deck

Engineering Controls

Facility Design Secondary Containment

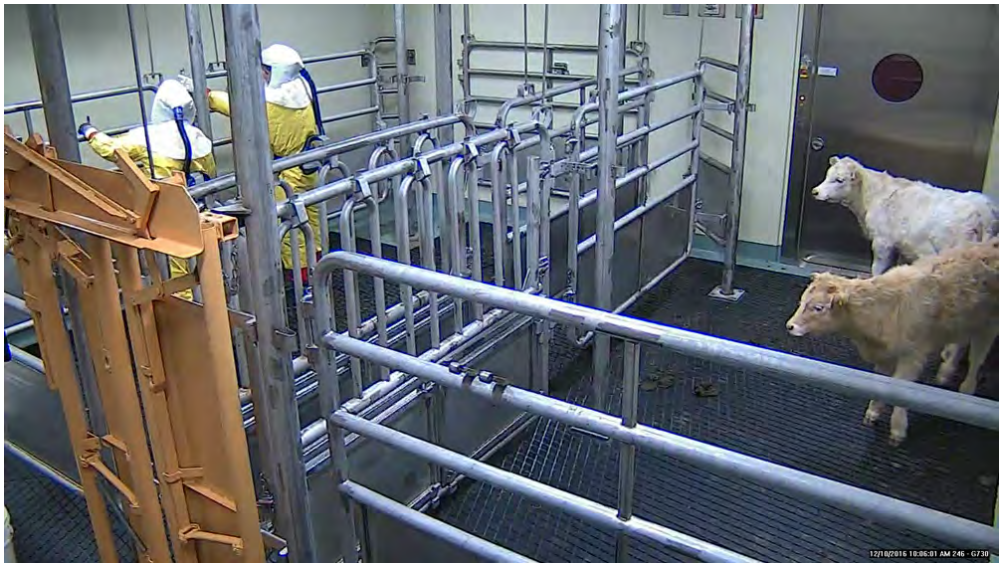


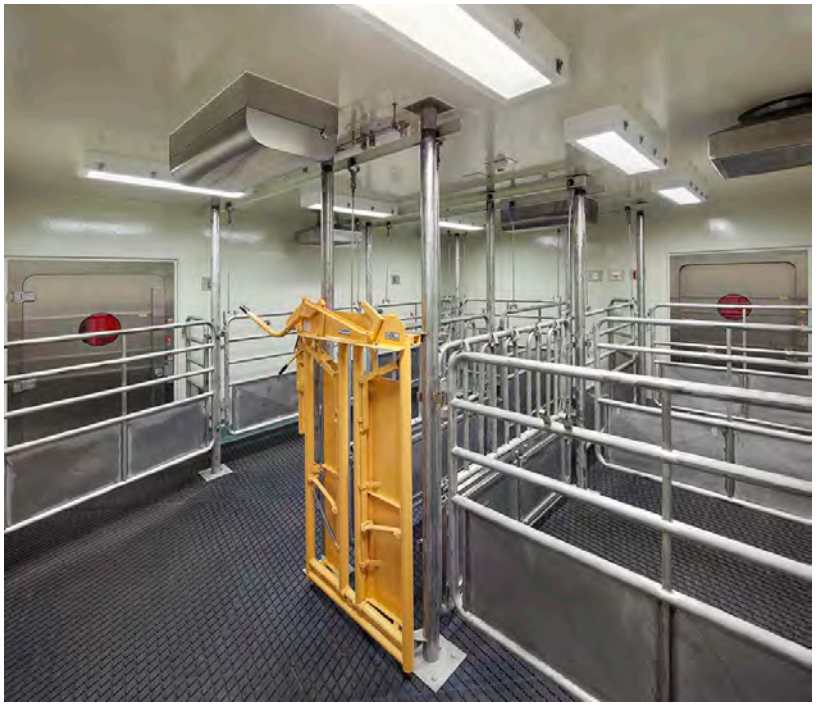
In CL3-Ag, large animals cannot be placed inside containment device, so

- 2º barriers become 1º barriers
- This is why risk ⬆ when working in animal cubicles

Engineering Controls

To researchers working in a large animal cubicle





Engineering Controls

To O&M team on HEPA deck above large animal cubicle

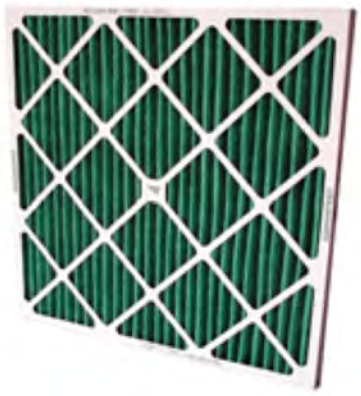
HEPA Filters

Camfil HEPA/ULPA Filter

P/N 5210192 XH Absolute

99.97 – 99.9995% filtering efficiency @ 0.3µm

Micro-fine glass media formed into pleats separated by a corrugated aluminum separator.



Camfil 30/30 Pre-filter

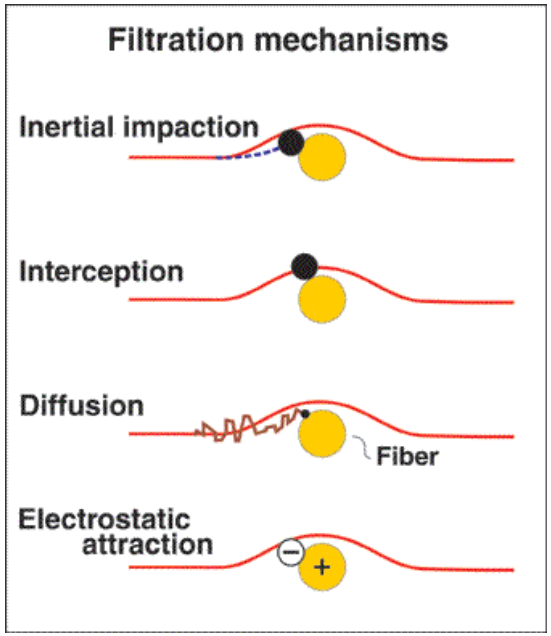
MERV 8 ASHRAE Std 52.2-2007, App J.

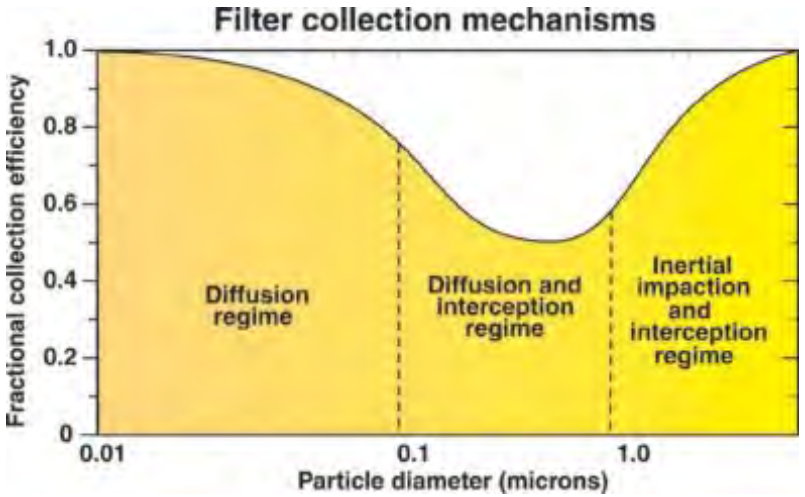
Filters particles of sizes 3.0 – 10µm (and larger)
i.e. Mold, spores, cement dust, **hair, dander**

Cotton and synthetic media with welded wire support grid, beverage board enclosing frame.

HEPA Filters

99.97% Filtering efficiency lowest at 0.3µm particle diameter





Building Design & Engineering Approach to Airborne Infection Control

AIR FILTRATION

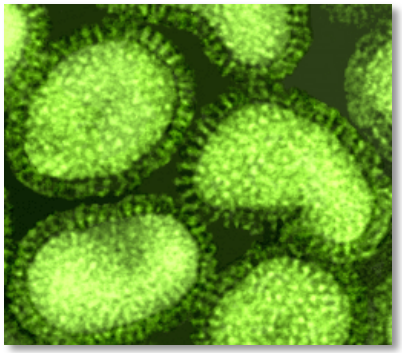
Steve Rudnick*

2010

Book chapter describing construction and function of HEPA filters.

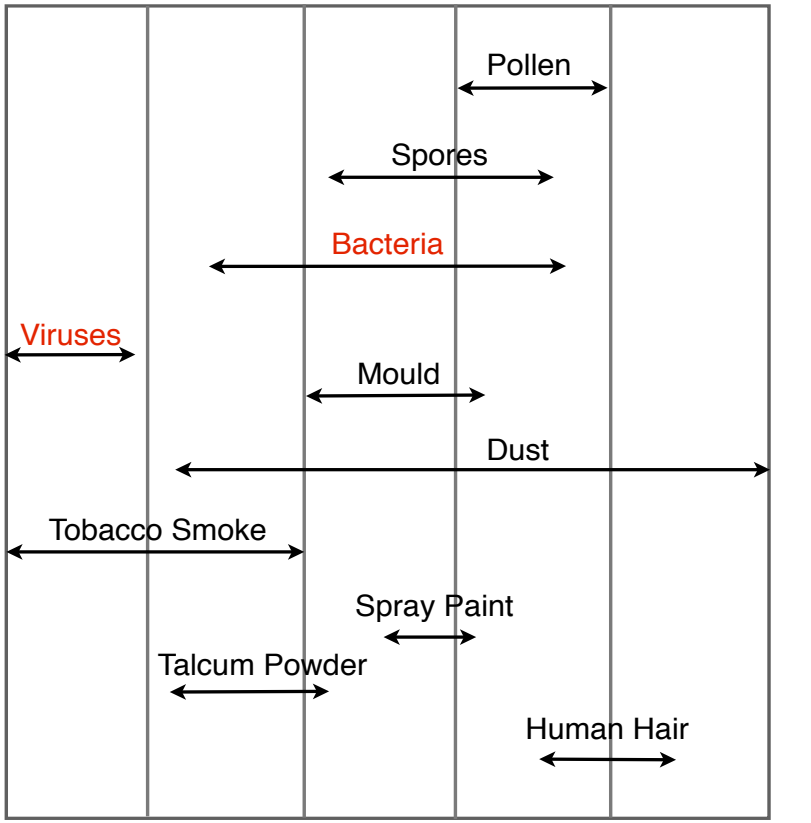
*Exposure, Epidemiology and Risk Program, Dept. of Environmental Health, Harvard School of Public Health, Boston, Massachusetts

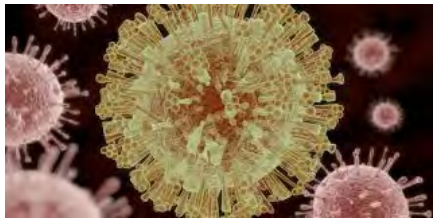
Particle Sizes



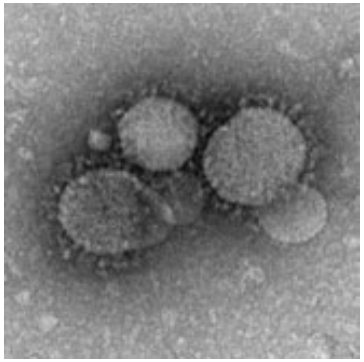
Influenza virus
0.1 - 0.2 µm

M. tuberculosis
1 - 4 µm x 0.25 µm





Zika virus
0.04 µm



MERS Co-V
0.1 - 0.3 µm

CL3 Lab single HEPA filter housing on exhaust air

CL3-Ag Animal Cubicle single HEPA filter housing on supply air

CL3-Ag Animal Cubicle double HEPA filter housing on exhaust air

Local Risk Assessment

1. Hazard Identification

Activity: Scan the HEPA filters

- Open HEPA housing if scan fails

Bag in/bag out design

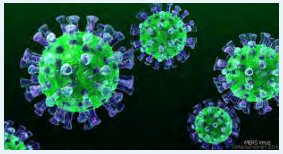
Local Risk Assessment

2. Identify and Assess Risk

Opening contaminated HEPA housing

Risk	Likelihood	Consequence
Exposure to worker	Medium - High	Low – High *Depends on pathogen survival in housing, contact*
Release to environment	Low - Medium	Low – High *Depends on pathogen survival, mobility*

Pathogen Characteristics

Pathogen	Survival @ RT on dry surface	Heat inactivation	Chemical inactivation
M tuberculosis 	Months	> 65C 30 min 121C 15 min	Cavicide 3 min
MERS-CoV 	24hr – 6 days	60C 30 min	5% MicroChem Plus, 10 min
Influenza A 	Hard surface: 24-48hrs Porous surface: 8-12hrs SST+OM: 7days	70C 5 min 80C 2.5 min 90C 1 min	Cavicide 3 min

Local Risk Assessment

3. Develop Risk Mitigation Strategies

- Administrative Controls:
  - Training
  - Documentation of room use
  - Communication
- Procedural Controls:
  - Post signage to communicate status of housing
  - VHP decontaminate housing prior to opening
  - PPE
  - Disposal of HEPA filter

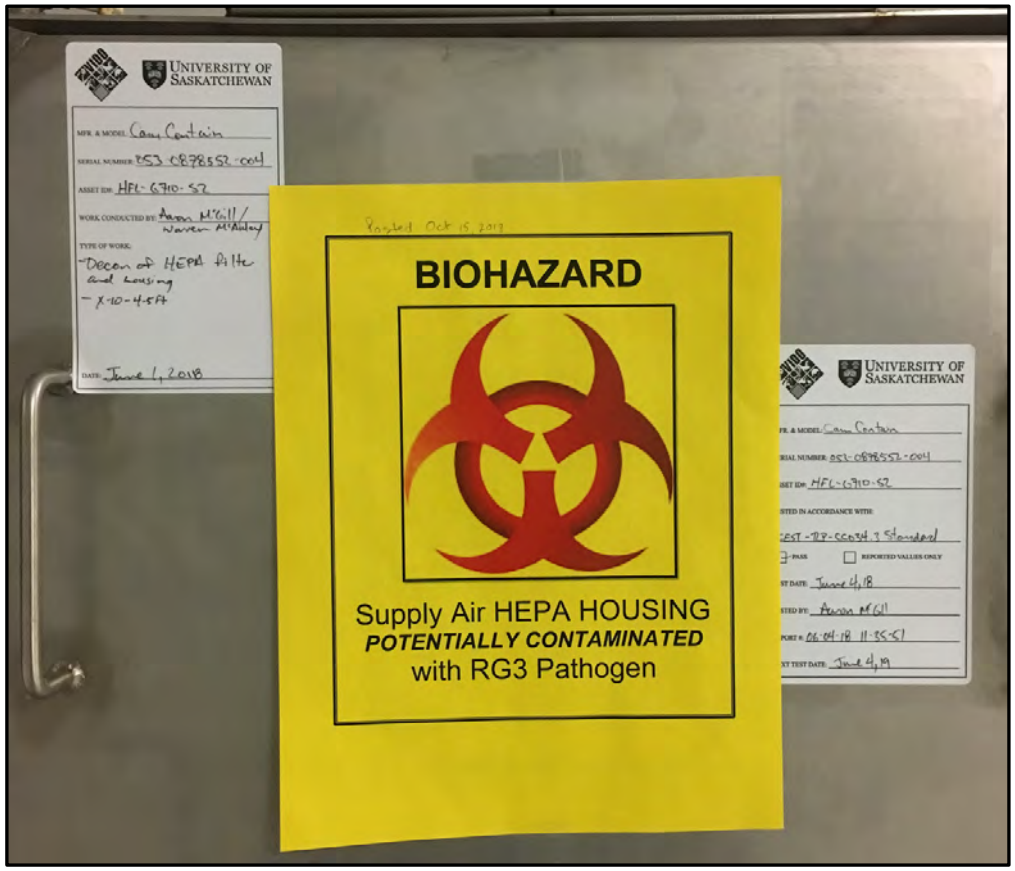
HEPA Filters & Housings

Exhaust Air HEPA Housing

Biohazard sign dated & posted by BSO on day of animal challenge, or shortly before.

From this date until VHP decon, all internal parts of housing considered contaminated.

HEPA Filters & Housings



Supply Air HEPA Housing

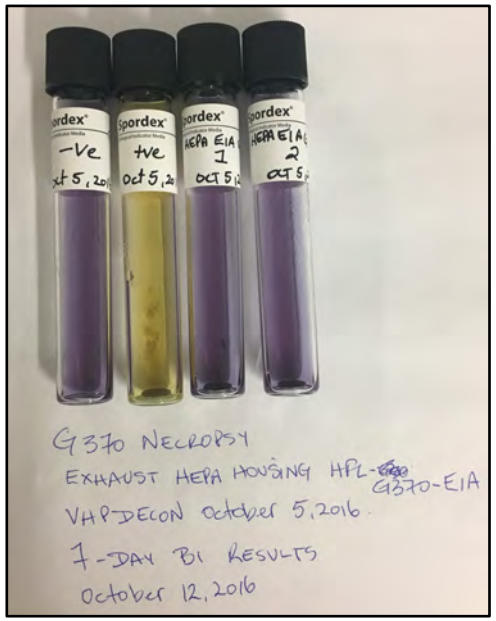
Biohazard sign posted:

"*Potentially contaminated*" unless the room pressure goes positive for any reason.

- Signage is changed to "contaminated", date and reason.

HEPA Filters & Housings

VHP Decontaminate filters and housing

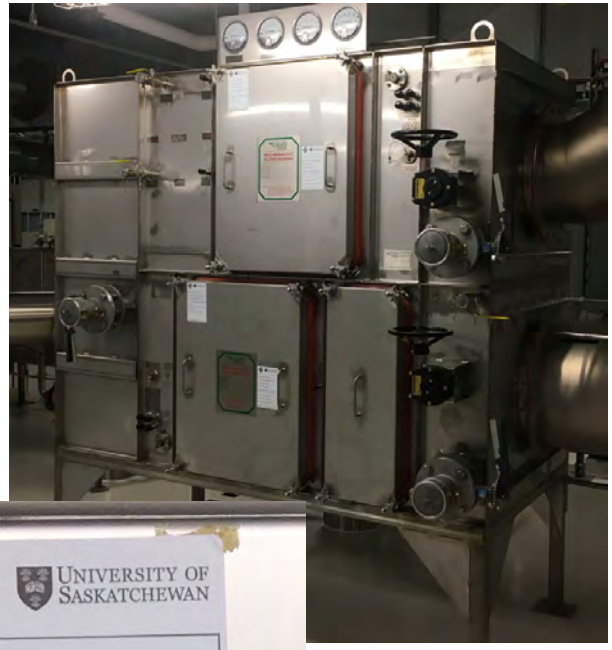


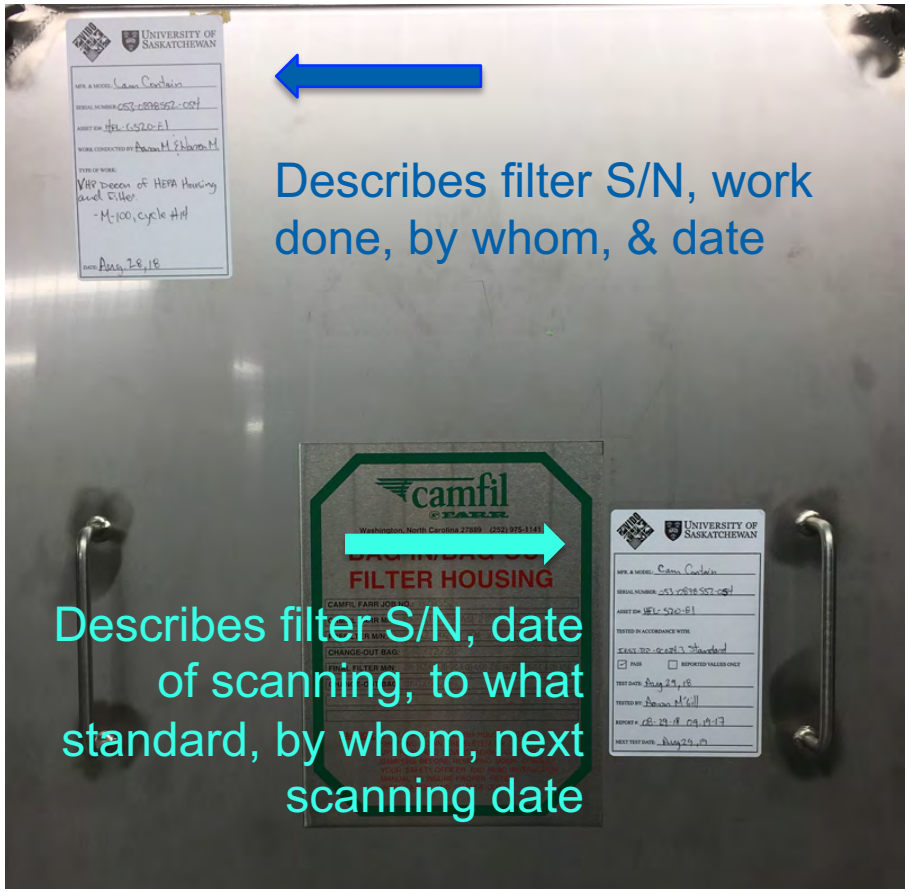
Autoclave filters
& dispose

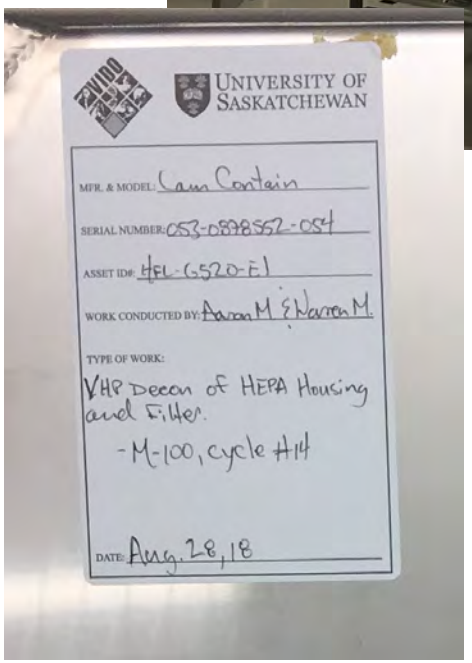
HEPA Filters & Housings

Signage:

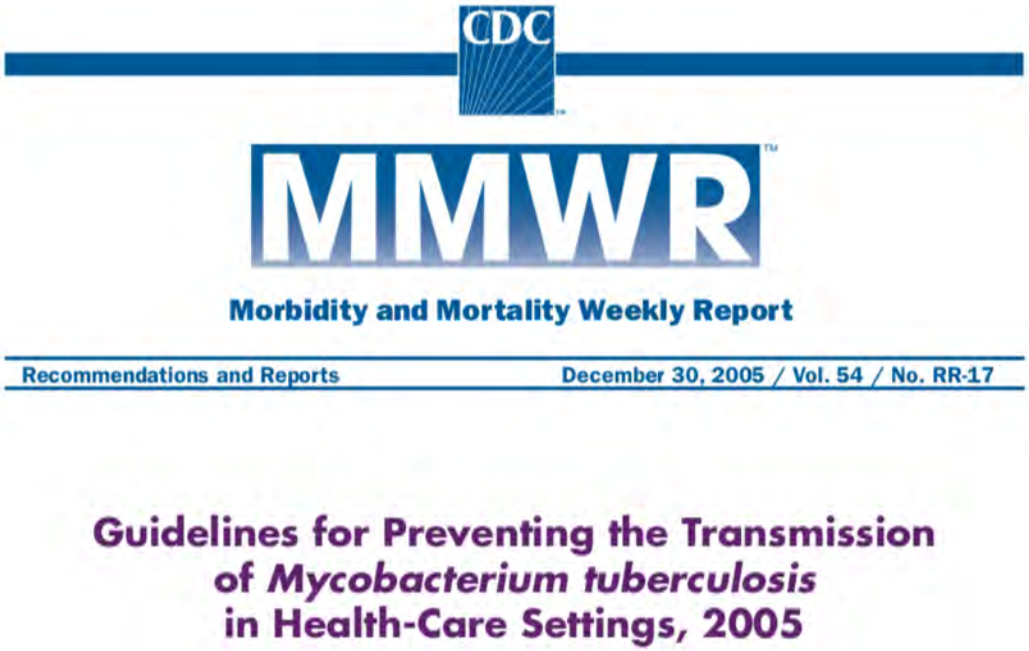
Testing and maintenance work







HEPA Filters & Housings



CDC

MMWR

Morbidity and Mortality Weekly Report

Recommendations and Reports — December 30, 2005 / Vol. 54 / No. RR-17

Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-Care Settings, 2005

or other condition that interferes with the seal of the respirator to the face.

- **How long can I use my respirator for TB exposures before I discard it?** Disposable respirators can be functional for weeks to months and reused by the same HCW. Reuse is limited by hygiene, damage, and breathing resistance, and manufacturer instructions should be considered.
- **Should persons who perform maintenance on and replace filters on any ventilation system that is likely to be contaminated with *M. tuberculosis* wear a respirator?** Laboratory studies indicate that re-aerosolization of viable mycobacteria from HEPA filters and N95 disposable respirator filter media is unlikely under normal conditions; however, the risks associated with handling loaded HEPA filters in ventilation systems under field-use conditions have not been evaluated. Therefore, persons performing maintenance and replacing filters on any ventilation system that is likely to be contaminated with *M. tuberculosis* should wear a respirator (see Respiratory Protection) and adhere to local recommendations for eye protection and gloves.

Local Risk Assessment

4. Review and Improve

- Administrative Controls:
  - Training
  - Documentation of room use
  - Communication

- Procedural Controls:
  - Post signage to communicate status of housing
  - VHP decontaminate housing prior to opening
  - PPE – nitrile gloves, safety glasses
  - Disposal of HEPA filter

Thank you!