



CONTAINMENT STANDARDS

For Facilities Handling Plant Pests

First Edition



Biohazard Containment and Safety
Science Branch
Canadian Food Inspection Agency

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CHAPTER

1

Introduction

CHAPTER 1 – INTRODUCTION

1.1 Scope

This document describes the minimum acceptable physical and operational requirements for **facilities**¹ that work with **plant pests**² other than weeds, soil,³ genetically modified plants and arthropod **biological control**⁴ agents.

Some of the information presented in these standards may be useful for the **containment** of biocontrol arthropods. However, the North American Plant Protection Organization's Regional Standard for Phytosanitary Measures (RSPM) No. 22, entitled *Guidelines for the Construction and Operation of a Containment Facility for Insects and Mites used as **Biological Control Agents***, takes precedence over the present document for the containment of biological control arthropods.

This document is intended as a resource for Canadian Food Inspection Agency (CFIA) staff and for other persons who grow, raise, culture or produce anything that is a pest or is infected or infested with a pest. It provides guidance on the operation of plant pest containment facilities such as laboratories, **greenhouses** and **screenhouses**. Compliance with these standards and with documents such as Import Permits will help to ensure that economically and environmentally significant plant pests do not inadvertently escape into the environment and become established in Canada.

1.2 Background

The *Containment Standards for Veterinary Facilities*, published in 1996 by Agriculture and Agri-Food Canada, provides guidance for those who design, build, operate or work in facilities in which animal pathogens are handled. The *Laboratory Biosafety Guidelines*, 3rd Edition, published in 2004 by the Public Health Agency of Canada, provide similar guidance

¹ See the Glossary for the definition of the bolded terms in the text.

² Any thing that is injurious or potentially injurious, whether directly or indirectly, to plants or to products or by-products of plants, and includes any plant prescribed as a pest [Plant Protection Act, 1990]. This includes any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (IPPC, 2002) including, but not limited to, arthropods, molluscs, bacteria, fungi, nematodes, phytoplasmas, viruses, and viroids.

³ Soil is regulated under Directive D95-26: "Phytosanitary requirements for soil and related matter, alone or in association with plants" (<http://www.inspection.gc.ca/english/plaveg/protect/dir/d-95-26e.shtml>).

⁴ Refer to NAPPO (2004) and De Clerck-Floate (2006) for the importation and release process for biological control arthropods and for containment facility requirements, respectively.

for those involved with laboratories in which human pathogens are handled. Neither of these two documents addresses the containment of plant pests.

Plant pests almost never infect or infest healthy people, and they therefore pose little direct risk to laboratory personnel. Some can, however, pose a significant threat to agricultural production, forests and natural environments. As a result, it is important that personnel working with plant pests and the facilities housing these organisms take steps to prevent the accidental escape of potentially damaging pests into the environment. The level of containment required to prevent escapes will depend on specific pest biology and the impact that an escape might have on the Canadian environment.

Most countries, including Canada, have developed regulations to prevent the introduction and spread of economically and environmentally significant plant pests. Canada's *Plant Protection Act* (PPA) serves to protect plant life and the agricultural and forestry sectors of the Canadian economy by preventing the importation, exportation and spread of pests, and by controlling or eradicating pests in Canada. The *Plant Protection Act and Regulations* give the CFIA the authority to prohibit or restrict the movement into, within, and out of Canada⁵ of any plant pest or other thing that is or could be infested with a pest, or is or could be a biological obstacle to the control of a plant pest. The Act also provides other authorities such as inspection powers.

Researchers frequently undertake studies on the biology, ecology, detection, identification, control and eradication of plant pests. Additionally, scientists often study exotic beneficial organisms to determine whether they have potential as biological control agents. Persons wishing to import plant pests or potential biological control agents must apply to the CFIA for a Permit to Import.⁶ For first-time introductions of foreign biological control agents, a full petition meeting the standards of the North American Plant Protection Organization⁷ (NAPPO) must be submitted to the CFIA, requesting authority to import and release the agent into the environment. The petition must

⁵ Certain plant pathogens that could be used to develop biological weapons appear on the Export Control List and are regulated by the Department of Foreign Affairs and International Trade (DFAIT). See <http://www.dfait-maeci.gc.ca/eicb/military/epe-en.asp>

⁶ See <http://www.inspection.gc.ca/english/for/pdf/c5256e.pdf> for instructions for permits to import.

⁷ For a full explanation of this process, see De Clerck-Floate, R.A., P.G. Mason, D.J. Parker, D.R. Gillespie, A.B. Broadbent and G. Boivin. 2006. *Guide for the importation and release of arthropod biological control agents in Canada*. AAFC publication, Ottawa. In Press.

contain detailed information on the agent's biology and ecology obtained through careful scientific survey and/or experimentation. Risks associated with each importation are assessed by regulatory scientists, who determine whether the importation should be allowed or should be prohibited or restricted. Where importation is restricted, the CFIA will stipulate import conditions designed to mitigate pest risks, and site visits may be conducted by CFIA inspectors to verify that the proposed facilities and operational procedures are appropriate for the containment of imported pests.

CHAPTER

2

Plant Pest Containment

CHAPTER 2 – PLANT PEST CONTAINMENT

2.1 Pest Biology and Containment

In order for a plant pest to survive, establish and spread in an environment, the following conditions must be met: 1) the pest must be able to find a suitable host; 2) susceptible material (e.g. plant tissue) must be available; and 3) the environment must be conducive to the pest's establishment and development. These three factors must all occur over a sufficient and overlapping period of time. Natural limitations to any one of the three factors and/or human intervention, such as the use of chemical or biological controls, can influence pest establishment or spread. Thus, plant pests can be contained by spatial and temporal isolation from their hosts, either in the natural environment or in **containment facilities**.

In order to prevent the escape and the establishment of plant pests in the environment, the facilities that work with such pests and their operating procedures must be appropriate to the biology of the specific pests under consideration. In addition, the operating procedures must prevent the introduction of organisms into the facility that could contaminate, kill or transmit contained pests. Singh (1999) states that: "Containment requirements for various pathogen [and other pest] groups will vary according to the pest risks they pose to...agriculture because of their unique biologies, particularly their modes of dispersal, and their survival potential under adverse conditions." In the absence of arthropod vectors, organisms such as bacteria, viruses, phytoplasmas and nematodes generally have no means of becoming dispersed over long distances. Arthropods can actively disperse or be passively dispersed by air currents; however, their spread can be prevented by sealing facilities in which they are kept and by using appropriately sized filters and screening. Fungi that are not well adapted for aerial dispersal can also be contained fairly easily, but those fungi that produce spores adapted for efficient aerial dispersal are very difficult to contain and may require the use of sealed facilities with **HEPA filtered** ventilation systems. Containment precautions must also be appropriate to the proposed type of work. Containing pests *in vitro* (e.g. as pure cultures on petri plates) is inherently easier than containing pests *in vivo* (e.g. on infected or infested plants) and, similarly, containing pests in small-scale experiments presents a lower risk of pest escape than containing them in large-scale experiments.

Effective containment involves the use of trained personnel, appropriate and documented operational procedures, effective use of **primary containment** devices and facilities designed to limit access to authorized personnel.

2.2 Risk Assessment, Risk Management and Containment

Facilities that handle plant pests should be constructed and operated to achieve the containment levels required for the pests concerned. The level required depends on the risk of the plant pest escaping and becoming established in the environment and on the environmental, economic, agricultural, forestry and trade consequences of such an introduction.

To provide a framework for ensuring appropriate biological containment in facilities that work with plant pests in Canada, a containment classification system has been developed that is consistent with the systems for human and animal pathogens. It has four containment levels: Basic; **Plant Pest Containment Level 1 (PPC-1)**; **Plant Pest Containment Level 2 (PPC-2)**; and **Plant Pest Containment Level 3 (PPC-3)**. Physical and operational requirements for these levels are described below (section 2.3) and comprehensive and detailed descriptions for PPC-1, PPC-2 and PPC-3 are discussed in chapter 3 (Physical Requirements) and 4 (Operational Practices) of this document. The containment requirements for a particular organism are frequently project-specific, and are determined after assessing pest risk factors such as:

- the known presence or absence of the organism in Canada;
- its host range and the local presence of potential hosts;
- the existence of, or the potential for, significant organism biotypes or strains that are exotic to an area;
- the history of the organism in other new environments;
- the virulence or aggressiveness of the organism;
- the availability of pest risk information;
- the nature of the proposed work (*in vitro*, *in vivo* or large-scale *in vivo*);

Chapter 2 – Plant Pest Containment

- the location, proximity of suitable hosts and time of year of the proposed work;
- the mode of transmission or spread (e.g. active flight, passive airborne, contact, soil-borne, water-borne);
- its potential rate of local and long-distance spread;
- the presence of vectors in Canada (e.g. arthropods, fungi, nematodes);
- the presence of vectors in or near the containment facility;
- the persistence of the organism in the environment and its potential for overwintering;
- environmental requirements for establishment and spread;
- the potential capacity to control or eradicate the organism if it escapes;
- the potential for economic or environmental loss from the organism;
- the economic and environmental significance of potential pest organisms and their host plants; and
- biosecurity-related risks (e.g. the potential for theft and misuse).

Based on a review of the above, regulatory scientists make risk management recommendations aimed at reducing the risk of organism escape and establishment in Canada. Appropriate containment levels are determined by a reviewer, who uses the conceptual risk model (Figure 1) shown below. The risk model demonstrates the general principle of requiring increased levels of containment with increasing risk of plant pest escape and establishment and increasing economic, environmental, agricultural, forestry and trade consequences associated with an escape. There are many methods of assessing risk. Figure 1 is a simplified graphical representation of how risk can be categorized for plant pests.

Figure 1. Conceptual Risk Model for Determining Containment Level

Likelihood of Escape and Establishment	High	PPC-1	PPC-2	PPC-3	PPC-3
	Medium	PPC-1	PPC-1	PPC-2	PPC-3
	Low	BASIC	BASIC	PPC-1	PPC-2
	Very Low	No containment required	BASIC	PPC-1	PPC-1
		Very Low	Low	Medium	High
		Consequence			

2.3 Plant Pest Containment Levels

Regardless of the containment level of the facility, the physical attributes of the facility and the operational procedures must be suitable for containing the pest(s) under consideration and should be tailored to that purpose. In view of the variables involved, the appropriate containment of plant pests must be determined on a case-by-case basis and specific applications may require precautions in addition to those described for each of the containment levels.

The concept of biological containment is usually applied to work done in buildings, **growth chambers** or greenhouses which have, or present, physical barriers to prevent the escape of pests. Although the concept of biocontainment under field conditions seems contradictory, there are some pests that can safely be contained under quarantine conditions in the field. For example, areas with natural geographic isolation (e.g. islands), a local absence of susceptible host tissue or a climate unsuitable for long-term pest survival may be effective in preventing the escape and establishment of particular plant pests.

Comprehensive descriptions of each containment level are provided in chapter 3 (Physical Requirements) and 4 (Operational Practices). Simplified facility diagrams for PPC-1, PPC-2 and PPC-3 are presented in Appendix 1. The following brief descriptions explain the major features of each containment level and provide illustrative examples of the type of plant pest work that would be appropriate at each level.

2.3.1 BASIC

Basic containment is the lowest containment level for plant pests and it provides simple, but adequate, barriers to pest escape. Facilities may consist of field plots, basic laboratories or simple glass, plastic or screen houses which may have dirt or gravel floors and unscreened vents. Containment of plant pests is achieved through sanitation (see 4.1.5.16), spatial isolation from susceptible hosts, physical security, signage, destruction of waste and destruction of all viable pests at the end of the experiment or the testing period.

The following are examples of the types of work that could be appropriately conducted (with or without supplemental conditions) in Basic containment:

- establishing a field plot using plants infected with a virus that can only be transmitted by grafting;
- using lyophilized virus-infected plant tissue as a control in an ELISA test; or
- using plant tissue infected with a common strain of tobacco mosaic virus to inoculate tobacco plants for a high school biology project.

2.3.2 Plant Pest Containment Level 1 (PPC-1)

PPC-1 containment is the next highest containment level for plant pests. Facilities include permanent structures such as laboratories, greenhouses and screenhouses. Windows that can be opened must be fitted with appropriate screens, and greenhouses must be fully screened and caulked to both contain and exclude arthropods. An autoclave must be available to treat waste and waste water must be treated to kill pests where appropriate. Containment is achieved primarily through operational practices including training in safety and containment precautions, limiting access to authorized personnel, use of protective clothing, effective sanitation and housekeeping, monitoring for and controlling undesired pests, and the use of good laboratory practices.

The following are examples of the types of work that could be appropriately conducted (with or without supplemental conditions) in PPC-1 containment:

- inoculating host plants with isolates of plum pox or other plant viruses in the absence of the vectors of those viruses;
- importing low-risk tropical insects into butterfly houses for study, display or rearing; or
- studying and rearing nematodes of quarantine concern in Canada that have low spread potential (e.g. *Globodera rostochiensis* and *Ditylenchus destructor*).

2.3.3 Plant Pest Containment Level 2 (PPC-2)

PPC-2 facilities include permanent structures such as laboratories and greenhouses but not screenhouses. Containment is achieved through facility design, operational procedures and the use of specialized equipment. All PPC-1 physical and operational requirements also apply to this containment level.

Key additional operational practices include:

- use of primary containment devices;
- use of dedicated or disposable laboratory clothing;
- appropriate decontamination of solid and liquid waste;
- pest monitoring and regular inspection of screens, filters and caulking for defects;
- clear documentation of **standard operating procedures (SOPs)**;
- mandatory personnel training; and
- the availability of suitable emergency response plans.

Key additional physical requirements include:

- restricted access via an anteroom;
- an on-site autoclave; and
- greenhouses that are mechanically ventilated with screened or filtered inlet and exhaust air.

Key additional physical requirements for PPC-2 arthropod facilities include:

- sealing or screening all penetrations into the work area;
- **inward directional airflow**; and
- access via a dedicated anteroom.

The following are examples of the types of work that could be appropriately conducted (with or without supplemental conditions) in PPC-2 containment:

- conducting plant inoculations with an isolate of *Ralstonia solanacearum* Biovar 2, Race 3, the causal agent of Potato Brown Rot disease;
- morphological examination and DNA extraction of sporangia of *Synchytrium endobioticum*, the causal agent of Potato Wart, and their use as diagnostic controls;
- growing chrysanthemum plants infected with *Puccinia horiana*, the causal agent of Chrysanthemum White Rust;
- rearing the arthropod pest *Anoplophora glabripennis*, the Asian longhorned beetle;
- conducting plant inoculations with specific races of the corn pathogen *Helminthosporium turcicu*;
- conducting fruit inoculations in a laboratory using *Alternaria gaisen*, the causal agent of Black Spot of pear; or
- culture work with, and diagnostics for, *Phytophthora ramorum*, the causal agent of Sudden Oak Death.

2.3.4 Plant Pest Containment Level 3 (PPC-3)

PPC-3 is the highest containment level for plant pests. All PPC-1 and PPC-2 physical and operational requirements apply to this containment level. Containment is achieved through the use of highly specialized facilities, stringent operational procedures and specialized equipment. Designing, constructing and maintaining a PPC-3 greenhouse facility is complex and expensive. The use of growth chambers or **growth rooms** within a PPC-3 facility can be a cost-effective alternative to constructing a PPC-3 greenhouse.

Key additional operational practices include:

- designation of a person with responsibility for the overall operation of the facility;
- a high level of physical security;
- restricted access with a log being kept of personnel and visitors entering the facility;
- full clothing change before entering the facility with the possibility of washing or showering on exit, if required;
- checks to confirm inward directional airflow and regular inspections for deterioration in seals; and
- a procedural manual, including standard operating procedures (SOPs), that addresses all emergencies including those relating to containment.

Key additional physical requirements include:

- dedicated anterooms with change areas;
- sealed facilities with inward directional airflow from “clean” to “dirty” areas;
- HEPA filtered exhaust air;
- drains routed to an effluent treatment system;
- electronic data transfer capability;
- emergency power for critical containment systems; and
- break-resistant glazing for greenhouses.

The following are examples of the types of work that could appropriately be conducted (with or without supplemental conditions) in PPC-3 containment:

- conducting plant inoculations with isolates of *Phakopsora pachyrhizi*, the causal agent of Asian Soybean Rust, in an area in close proximity to susceptible hosts;
- conducting plant inoculations with imported isolates of *Gymnosporangium yamadae*, the causal agent of Japanese Apple Rust, in an area in close proximity to susceptible hosts;

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- biocontrol research with exotic microbial plant pests that are difficult to contain and in cases where the establishment risks are poorly documented; or
- conducting plant inoculations with pests of environmental and/or economic concern that have a high establishment and/or trade potential risk and that produce airborne spores, such as the pathogen *Phytophthora ramorum*.

CHAPTER

3

Physical Requirements for
Containment Facilities

CHAPTER 3 – PHYSICAL REQUIREMENTS FOR CONTAINMENT FACILITIES

This chapter describes physical requirements for the containment of plant pests. The facility must be suitable for containing all pest organisms in use and it must be capable of containing the pest requiring the highest level of containment. New facilities must be constructed to meet applicable construction standards.

3.1 Primary Containment

Primary containment devices (e.g. **biological safety cabinets**⁸ [BSCs], insect cages etc.) and the use of good laboratory techniques reduce the overall pest pressure inside the **containment perimeter**. Primary containment therefore reduces reliance on the **secondary containment** provided by the design of the facility.

Biological safety cabinets protect personnel, products and the environment from airborne or aerosolized microorganisms. Class II BSCs, Type A1, A2, B1 and B2, are appropriate for work carried out with plant pathogens. The exhaust air from these cabinets is HEPA filtered, thus providing an extra level of protection against pest escape. Similarly, insect cages provide increased levels of containment by preventing the unrestricted movement of arthropods or by excluding potential arthropod vectors. Growth chambers and growth rooms can offer a cost-effective alternative to containment greenhouses while providing more precise levels of environmental control. Growth chambers and growth rooms can be located within a **containment zone** and thus provide primary containment or they can be sealed and modified to meet PPC-2 or PPC-3 containment requirements.

3.2 Secondary Containment

Facility design and construction provides effective secondary containment to prevent the release of plant pests that have escaped from primary containment. The selection, design and installation of doors, windows, screening and air handling systems, along with the use of appropriate sealants, are factors that determine how well a facility can contain plant pests. Facility design and construction must be complemented with dedicated and trained staff who follow documented procedures and effectively utilize primary containment measures whenever feasible to minimize pest escape.

⁸ Refer to Chapter 9 of the Laboratory Biosafety Guidelines (<http://www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index.html>) for a detailed description of BSCs and their installation, certification and use.

3.3 Risk Mitigation

Risk mitigation measures should be applied within containment facilities, where feasible, to reduce the risk of pest escape and thereby effectively reduce the physical containment requirements needed for a particular plant pest. These measures may include providing adequate isolation between infected and uninfected hosts, providing a vector-free environment, caging insects and plants, and rendering all material non-viable at the end of experiments. Risks from plant pests can also be mitigated by locating containment facilities in areas where susceptible hosts are not present, and by conducting work during periods of the year when local hosts are not present or where, or when, local weather conditions would kill any pests that escape.

3.4 Design Considerations for New Facilities

Facility design needs to address pest-specific issues in order to enhance the overall performance and operation of a containment laboratory, greenhouse or screenhouse. Designers, owners and operators should consider:

- Facility location - The site chosen for a containment facility should include an assessment of local agricultural and forestry programs as well as the local environment. A containment facility can be safely constructed in almost any location depending on available resources and construction methodologies. The risks to agriculture, forestry and the environment, including the impact of possible pest releases, should be considered before any work is begun with a particular pest. In areas prone to natural disasters, buildings and support systems should meet enhanced building code measures for the construction of containment facilities.
- Energy conservation - If energy conservation measures are envisaged (e.g. through the use of building automation controls, night air-change setback [reductions], heat recovery and air recirculation), these measures must not compromise the level of containment provided by the facility.
- Inward directional airflow - Several standards (e.g. ANSI/AIHA Z-9.5-1992 and NFPA 45) recommend or require the use of inward directional airflow for new laboratory construction. Although it is advisable for new and existing facilities to have inward directional airflow, this is only a requirement for PPC-2 arthropod facilities and all PPC-3 facilities.

- Sealed PPC-3 containment zones should be located away from exterior walls to avoid pressure reversals associated with high winds. This cannot be done with greenhouses but their construction must be designed to prevent unplanned air infiltration.
- New facilities require storage space for supporting operations, cleaning, spill management, emergency safety response programs and tools and equipment. Providing dedicated equipment, washroom facilities, storage areas and clerical workstations inside the containment zone should be considered as a way to minimize traffic into and out of the containment facility.
- Containment facilities require frequent washdowns of surfaces and these surfaces need to be resistant to chemical attack and absorption. The underside of plastic laminated benches may contain absorptive organic materials which, in the case of PPC-3 facilities, must be sealed to facilitate cleaning and to prevent absorption of fumigants. Use of epoxy bench-top surfaces, stainless steel or other non-absorptive solid surfaces is recommended.
- To facilitate decontamination and maintenance, systems such as liquid effluent treatment systems and HEPA filter housing systems must be located as close to the containment perimeter as possible, and consideration should be given to installing valves to isolate sections of ductwork and drains. Appropriately sized screens or filters need to be used to protect all openings that may provide routes for incoming or escaping arthropods.
- Circuit breakers and shut-off valves should be located outside of the containment perimeter to facilitate maintenance.

3.5 Greenhouse Design Considerations

All requirements for ventilating and controlling containment laboratories need to be considered when designing ventilation requirements for greenhouses. Typically, greenhouses have high humidity, high heat production, significant cold weather influences and increased risks of ingress or egress of flying vectors. Ventilation strategies need to include screening of all forced-air and

natural air venting systems. Air conditioning may include a combination of cooling/heating (temperature control), humidity control, CO₂ control and air circulation patterns. In greenhouses that rely on screened natural air venting, it will be difficult to maintain negative pressure in areas prone to high winds. Greenhouses that are designed to be tight require verification of their as-constructed performance and regular testing for leaks.

A control system that integrates lights, ventilation requirements, temperature control and shading systems should be envisaged when constructing a containment greenhouse.

Where it is necessary to collect and treat waste water, greenhouse floors should be sloped toward drains and have curbs to contain water.

To increase physical security, consideration should be given to locating greenhouses away from public walkways and other amenities. Consideration should also be given to the use of **kneewalls**, windbreaks and physical barriers to reduce the probability of loss of containment through mechanical damage to the greenhouse caused by things such as machinery and carts.

3.6 Screenhouses

Screenhouses may be constructed to provide BASIC or PPC-1 containment.

3.7 Physical Containment Requirements

The following tables describe physical containment requirements for facilities (e.g. laboratories, greenhouses, screenhouses) working with plant pests. The following symbols are used:

● Required

○ Recommended⁹

The absence of a symbol in the tables indicates that an item is either not required or not applicable. Where ● or ○ are followed by an “A” suffix, the item applies only to arthropod facilities. Where the “A” suffix is not present, the item applies to all facilities, including those working with arthropods.

⁹ Recommended items are optional, depending upon the nature of the pest(s) requiring containment.

3.7.1 Structure, Location and Access

3.7.1	Structure, Location and Access	PPC-1	PPC-2	PPC-3
1	Appropriate security to be provided for the building (e.g. fencing, motion sensors, physical barriers, patrols).		○	●
2	Signage to be installed on entry doors within the containment zone indicating containment level, contact information, and entry requirements.	○	●	●
3	Entry to the containment zone is via self-closing and lockable doors.	○	●	●
4	Restricted access to the containment zone is to be ensured through a controlled access system (e.g. electronic access card, code or equivalent).	○	●	●
5	Entry and exit is to be via an anteroom. Where stipulated by building codes, anterooms that permit rapid emergency egress are to be placed at emergency exits. Corridors are acceptable as anterooms for non-arthropod PPC-2 areas.		●	●
6	If separate from a containment facility, greenhouse and screenhouse entry and exit is to be via an anteroom. Corridors and headerhouses are acceptable for PPC-1 and PPC-2 facilities.	○	●	●
7	Anteroom doors are to be self-closing and shall not open simultaneously (interlocking doors, and audible or visual alarms are acceptable).		●	●

3.7.1	Structure, Location and Access <i>(continued)</i>	PPC-1	PPC-2	PPC-3
8	Anteroom to be provided with windowless self-closing doors and lights that automatically switch off when either door is opened, and switch on only when both doors are closed, to avoid attracting phototropic arthropods.		● A	● A
9	Entry is to allow for separation of personal clothing from dedicated facility clothing (i.e. “clean” change area separated from “dirty” change area).		● A	●
10	Anterooms can be considered as a change room, and a single change room can include both a clean and a dirty change area with a line demarcating the two areas.		● A	●
11	Insect traps (e.g. sticky, pheromone, visible or ultraviolet light) to be provided in the anteroom of the containment zone.	○ A	● A	● A
12	Tight-fitting doors (e.g. with weather stripping, magnetic seals, brush barriers or flexible flanges) and, preferably, a raised threshold to be provided to deter ingress or egress of arthropods.		● A	● A
13	Inner anteroom door to be fitted with a forced-air curtain, as required, to deter arthropods from exiting the containment zone.		○ A	○ A

3.7.1	Structure, Location and Access <i>(continued)</i>	PPC-1	PPC-2	PPC-3
14	Mirrors to be installed within the containment zone and immediately inside the anteroom to permit self-inspection for hitchhiking arthropods.		● A	● A
15	Emergency exits are to be provided, where required, that open only from the inside, are alarmed and display “Emergency Exit Only” signage to deter unauthorized access.	○	●	●
16	Dedicated laboratory clothing and personal protective equipment are to be stored separately from street clothing.	○	●	●
17	Lowered ceilings to be provided in arthropod rearing rooms to facilitate arthropod recapture.		○ A	○ A
18	Facilities, including greenhouses and screenhouses, are to be designed to withstand extremes of local weather and anticipated maximum snow and ice loads, as well as wind, windborne debris and hail.	○	●	●
19	Greenhouses are to be constructed with a rigid reinforced frame with walls, floors and glazing forming a shell. All perforations and joints in greenhouses and between the greenhouse and other contained structures are to be sealed to provide a continuous containment barrier.		●	●

3.7.2 Surface Finishes and Casework

Surface finishes should be scratch and stain resistant, easy to clean and durable enough to withstand repeated disinfection, while offering minimal opportunity for pests to persist and cross-contaminate samples. Appropriate surface coloration is important for facilities working with arthropods, to facilitate the detection of escaped individuals.

3.7.2	Surface Finishes and Casework	PPC-1	PPC-2	PPC-3
1	<p>Surfaces are to be continuous and compatible with adjacent and overlapping materials (to maintain adhesion and a continuous perimeter).</p> <p>For PPC-3 containment, walls and floors with welded seams are acceptable. A continuous 100 mm (minimum) cove floor finish up the wall is recommended.</p>		● A	●
2	Floors to be slip-resistant in wet areas.		●	●
3	Interior coatings are to be easy to clean and resistant to gas and chemicals, as well as to repeated disinfection in accordance with function (e.g. will withstand disinfection, fumigation).		●	●
4	Bench tops to be non-absorptive, impervious to water, and resistant to acids, alkalis, organic solvents and moderate heat. Backsplashes to be installed tight to wall and sealed at wall-bench junction.	○	○	●
5	Greenhouse floors to be impervious to water and easy to clean (e.g. concrete).	○	●	●

3.7.3 Containment Perimeter

The containment perimeter is the continuous floor, ceiling and wall surfaces that form a barrier against the ingress or egress of plant pests, including all windows, doors and service penetrations into the area.

3.7.3	Containment Perimeter	PPC-1	PPC-2	PPC-3
1	Autoclave or other validated and acceptable means of waste treatment/disposal are to be located within the containment zone or, if not available in the containment zone, then procedures must be in place to safely transport waste for treatment/disposal elsewhere.	●	●	
2	Dedicated double-door barrier autoclave with bio-seal flange is to be located on the containment barrier; equipped with interlocking doors (recommended) or audible or visual alarms, to prevent the simultaneous opening of both doors. Body of autoclave should be located outside of containment for ease of maintenance.			●
3	Autoclave to be equipped with a cycle log recorder to record time, temperature, and pressure.	○	●	●
4	For materials that require removal from the containment zone and cannot be autoclaved (e.g. heat sensitive equipment, samples, film), other proven and validated treatment technologies (e.g. irradiation, chemicals, gas) are to be provided at the containment barrier.			●

3.7.3	Containment Perimeter (continued)	PPC-1	PPC-2	PPC-3
5	All penetrations of the containment perimeter, including all conduits and wiring, are to be sealed with an appropriate sealant to facilitate cleaning and fumigation and to prevent arthropod escape.		● A	●
6	Windows positioned on containment barrier are to be non-opening and sealed to suit local climactic conditions; window glazing material must provide the required level of security.		● A	●
7	Containment zone to be screened or sealed for PPC-1 and PPC-2, and sealed for PPC-3 and PPC-2 arthropod containment zones.	●	●	●
8	Spare greenhouse window panels, emergency glazing and screening to be stored nearby for emergency repairs.	○	●	●
9	Greenhouse glazing must be break-resistant (e.g. double glazing, laminated or tempered glass, polycarbonate) and provide the required level of security.		● A	●
10	Greenhouse glazing must be sealed to the greenhouse framework with a sealant that provides a tight, flexible and continuous seal resistant to degradation by chemical disinfectants, UV radiation and temperature changes.		●	●

3.7.4 Heating, Ventilation and Air Conditioning (HVAC)

Systems must be capable of providing a comfortable environment for laboratory staff that is also suitable for the organisms with which they work.

3.7.4	Heating, Ventilation and Air Conditioning	PPC-1	PPC-2	PPC-3
1	Inward directional airflow is to be provided such that air will always flow towards areas of higher containment (e.g. ± 12.5 to 25 Pa differential).		● A ●	●
2	Supply and exhaust air to be appropriately filtered or screened in order to contain and exclude pests.		● A	
3	Supply and exhaust air systems are to be designed to prevent backdraft of contaminated air to other areas.		● A	
4	Supply and exhaust air ducts to be equipped with dampers to allow for screen or filter cleaning, removal and replacement.		● A	
5	Supply and exhaust air ducts to be equipped with bubble-tight dampers to permit gaseous or fumigant decontamination (the bubble-tight dampers can also be used to provide backdraft protection and isolation of the HEPA filters).			●
6	Exhaust air is to be HEPA-filtered. HEPA filters to be installed in a certifiable housing.			●
7	Bubble-tight dampers should be installed as close as possible to the containment perimeter.			○

3.7.4	Heating, Ventilation and Air Conditioning <i>(continued)</i>	PPC-1	PPC-2	PPC-3
8	Pre-filters or screens should be installed to protect and extend the life of the HEPA filters.			○
9	Filter housings and ductwork must be able to withstand pressure changes due to air supply and/or exhaust fan failures.			●
10	HEPA filter efficiency is to be demonstrable with the filter in place.			●
11	Airflow control devices and duct sensors to be located downstream of the exhaust HEPA filter and upstream of the supply bubble-tight damper or HEPA filter.			●
12	Supply and exhaust air systems to be interlocked to prevent sustained laboratory positive pressurization.		● A	●
13	Supply and exhaust air ductwork to be sealed airtight between the room perimeter and HEPA filter or bubble-tight damper(s) in accordance with SMACNA Seal Class A 1985.		○ A	●
14	Alarms (audible or visible) to be provided both inside and outside the containment zone to signal air handling systems failure.		○ A	●
15	Visual pressure-monitoring devices to be provided at the entry to the containment zone.		○ A	●

3.7.4	Heating, Ventilation and Air Conditioning <i>(continued)</i>	PPC-1	PPC-2	PPC-3
16	Greenhouse vents and greenhouse HVAC penetrations to be screened with appropriate mesh screening to prevent pest escape.	●	●	
17	Greenhouses constructed to meet PPC-3 level must undergo and pass the following tests: (a) an air infiltration test conducted according to ASTM E 283-91: the test pressure difference will be 6.24 pounds per square foot positive static pressure, and the allowable leakage rate is 0.03 cfm per square foot; (b) a static pressure water resistance test conducted according to ASTM E 331-93: the minimum test pressure will be 10 pounds per square foot, and the passing standard is no water penetration to the interior surface; and (c) a dynamic pressure water resistance test conducted according to AAMA 501.1-94: the minimum test pressure will be 10 pounds per square foot, and the passing standard is no water penetration to the interior surface.			●
18	Greenhouse ventilation system to be designed to allow for greenhouse fumigation and pesticide applications.	●	●	●

3.7.5 Facility Services

Facility services include all plumbing, electrical, gas, oil and safety equipment, etc. related to the operation of the facility. All such systems must be installed in a manner that does not compromise the containment required for the plant pests that will be used in the facility.

3.7.5	Facility Services	PPC-1	PPC-2	PPC-3
1	A handwashing sink (or, if required, a sink and a shower) to be located within the containment zone and near the point of exit.	○	●	●
2	Handwashing sinks to be provided with "hands-free" capability.		○	●
3	Appropriate primary containment devices to be available (e.g. BSCs), as required, to minimize the potential contamination of the containment zone.	○	●	●
4	Emergency eyewash facilities to be provided in the laboratory containment zone in accordance with activities and applicable regulations (i.e. ANSI Z358.1-1998).	●	●	●
5	Emergency shower equipment to be provided in the laboratory containment zone in accordance with activities and applicable regulations (i.e. ANSI Z358.1-1998).	●	●	●
6	Facility service supply controls to be located both inside and outside of the containment zone, as required, to facilitate servicing.		○	○

3.7.5	Facility Services (<i>continued</i>)	PPC-1	PPC-2	PPC-3
7	All drains and associated piping to be connected to a validated effluent sterilization system consistent with laboratory activity and local regulations.			●
8	150-mm drain traps to be provided to avoid trap drying.		● A	●
9	Soil traps to be installed in drains as required.	●	●	●
10	Plumbing vent lines (including effluent sterilization system) to be appropriately screened or filtered to prevent ingress and egress of arthropods.		● A	● A
11	Communication system (e.g. fax, LAN, modem) to be provided to allow the electronic transfer of information and data from the containment zone to other areas.		○ A	●
12	Intercom or telephone system to be provided to allow voice communication beyond the containment zone and to reduce traffic into and out of containment zones.		○ A	●
13	Laboratory to be adequately equipped (e.g. BSCs, thermocyclers, ELISA plate readers, centrifuges and microscopes) to avoid moving equipment into or out of the containment zone.		○	●
14	Alarm system to be installed to detect loss of containment due to unauthorized entry or mechanical or power failure.		○	●

3.7.5	Facility Services (<i>continued</i>)	PPC-1	PPC-2	PPC-3
15	Monitoring and security system to be installed to monitor critical containment systems. System monitoring to be available outside of the containment zone.		○	●
16	Emergency power system to be provided for HVAC, lighting, BSCs, essential equipment and other safety systems.		○	●
17	Vacuum pump contamination to be minimized by filtration of vacuum line and use of disinfectant traps.		○	●



CHAPTER

4

Operational Practices in
Containment Facilities

CHAPTER 4 – OPERATIONAL PRACTICES IN CONTAINMENT FACILITIES

This section describes containment practices applicable to plant pests. Operational practices must be adequate to contain all organisms in use. Facility personnel, including scientists, technicians, and maintenance and greenhouse staff, all play an essential role in the successful containment of plant pests and the exclusion of unwanted pests from containment facilities.

4.1 PPC-1 Practices

The following general practices are required when working with plant pests in a PPC-1 facility.

4.1.1 Access

Limit access to containment zone and support areas to authorized personnel only.

4.1.2 Documentation

- 4.1.2.1 Designate and name a contact person for the facility, or one for each area or experiment.
- 4.1.2.2 Keep an up-to-date inventory of all imported plant material and plant pests.

4.1.3 Training

Personnel must be provided with training on pest-associated hazards and the precautions necessary to prevent the release of contained pests. Personnel must show evidence that they know and understand the required precautions; training must be documented; and refresher and retraining programs must be implemented as appropriate.

4.1.4 Personal Protective Equipment

- 4.1.4.1 Appropriate protective clothing, properly fastened, should be worn by all personnel, as well as visitors, trainees and others, when working in the facility, to ensure that pests are not inadvertently transported outside of the containment facility on street clothing.

- 4.1.4.2 Potentially contaminated laboratory clothing must not be worn in non-laboratory/greenhouse/screenhouse areas if this presents a risk of inadvertently disseminating pests.
- 4.1.4.3 Gloves (e.g. latex, vinyl, co-polymer) can be worn, as appropriate, to avoid the inadvertent contamination of samples and work areas; gloves are to be removed when leaving the containment zone and **decontaminated**, as appropriate, along with other laboratory wastes, prior to disposal.

4.1.5 Work Practices

- 4.1.5.1 Comply with all conditions stipulated on Permits to Import.
- 4.1.5.2 Render all organisms non-viable prior to disposal.
- 4.1.5.3 Employ good laboratory practices to prevent the escape of pests.
- 4.1.5.4 Keep doors closed to reduce the potential movement of plant pests.
- 4.1.5.5 Eating, chewing gum, drinking, smoking, storing of food and utensils, storing of personal belongings, applying cosmetics, and inserting or removing contact lenses should not occur in the containment zone. The wearing of contact lenses is recommended only when other forms of corrective eyewear are not suitable.
- 4.1.5.6 Long hair is to be tied back or restrained so that it cannot come into contact with hands, specimens, containers or equipment in view of the potential for disseminating pests.
- 4.1.5.7 Treat all pests and materials in a containment zone in accordance with the highest containment requirement for that area (e.g. if PPC-1 and PPC-2 pests are in the same room, PPC-2 practices must be followed).

- 4.1.5.8 All pests and material that is infested or suspected of being infested with a pest must be moved or transported in containers that are secure, leak-proof and not easily broken, in order to prevent the accidental release or escape of a pest. The containers may only be opened within a facility that provides the appropriate containment level for the pest in question.
- 4.1.5.9 Keep all work areas within a containment zone, including dedicated clerical work stations, clean and tidy. Storage of materials should be minimized, and paperwork should be done outside of containment zones if this presents a risk of disseminating pests.
- 4.1.5.10 Keep workplace exposure to any plant pest at the lowest practical level and avoid the generation of aerosols when manipulating pests or inoculating plants.
- 4.1.5.11 Cultures are to be stored in sealed, preferably break-resistant, containers such as screw-top vials. Cultures are to be clearly identified and dated. Where possible, petri dish cultures of sporulating fungi should be sealed with stretch film.
- 4.1.5.12 Contaminated materials and equipment must be properly cleaned and decontaminated before leaving the facility for servicing or disposal.
- 4.1.5.13 Render non-viable all unintentionally introduced pests, including those contaminating cultures, as soon as they are detected.
- 4.1.5.14 Where practical, confine all arthropods in cages or other containers that prevent escape.
- 4.1.5.15 Where applicable, disinfectants that are effective against the organisms in use must be available at all times when plant pests are handled or stored.

4.1.5.16 Sanitation practices should be implemented when working with plants and plant pests. These practices include:

- treating all plants and soils as if they are infected/infested;
- minimizing entry of personnel into laboratory and plant growth areas;
- providing adequate separation and/or physical barriers between plants infected or infested with different plant pests;
- washing hands (after removing gloves) before leaving the containment zone, and at any time after handling materials known or suspected to be contaminated with plant pests, if this poses a risk of inadvertently spreading pests;
- using decontaminated soil, soil-less potting mix or inert growing media, and cleaning up spilled soil or growing medium;
- watering plants carefully, avoiding soil and water splash, and avoiding touching plants with the hose;
- avoiding the use of automated watering systems where their use presents a risk of disseminating pests;
- cleaning and decontaminating work surfaces as appropriate with a suitable disinfectant;
- disinfecting items such as clippers, pruners and knives during and after use, as appropriate, to avoid plant-to-plant transfer of pests;
- cleaning and decontaminating pots, stakes and saucers after use, or using disposables that are decontaminated and discarded after use;

- surface sterilizing plant material before planting or transferring to tissue culture;
 - maintaining obligate parasites (e.g. viruses, nematodes) in tissue culture plantlets where possible;
 - eliminating unwanted pests by heat or cold therapy, surface sterilization, meristem culture or other suitable means;
 - inspecting for, and removing and destroying, host plants infected or infested with unwanted organisms;
 - using good housekeeping practices to keep the area neat, clean and free of dead plant material and unwanted plants and pests; and
 - using dedicated cleaning equipment (e.g. brooms, mops, garbage cans) within containment zones.
- 4.1.5.17 Work surfaces that have become permeable (i.e., cracked, chipped, or loose) must be repaired, sealed or replaced.
- 4.1.5.18 Regularly monitor autoclaves used for decontamination using biological indicators to ensure efficacy (e.g. consider weekly or monthly monitoring, depending on the frequency of use of the autoclave). Monitoring records must be kept for three years.
- 4.1.5.19 Loss of containment must be reported immediately to the laboratory supervisor and remedied as soon as possible. Written reports of such incidents must be maintained for three years, and the results of incident investigations used for continuing education.
- 4.1.5.20 Maintain an effective bird, rodent, weed and plant pest control program to prevent entry and eliminate undesired pests from the containment zone.
- 4.1.5.21 Greenhouse personnel who apply pesticides must be appropriately trained and protected.

4.2 PPC-2 Practices

In addition to the practices required for PPC-1 facilities that handle plant pests, the following sections describe the minimum operational practices required for PPC-2 containment facilities.

4.2.1 Access

- 4.2.1.1 Entry must be restricted to authorized laboratory and maintenance staff and other persons on official business.
- 4.2.1.2 Entry to PPC-2 arthropod containment zones must be restricted to authorized laboratory staff, maintenance staff and other persons on official business. Access to specific areas within these containment zones shall be granted on an “as needed” basis only.

4.2.2 Documentation

- 4.2.2.1 A Procedures Manual covering safety and general laboratory and greenhouse operations, including entry and exit protocols and cleaning schedules, must be available to all staff, and its requirements followed; it must be reviewed and updated regularly. The Procedures Manual may consist of a series of Standard Operating Procedures.
- 4.2.2.2 An Emergency Response Plan must be available that describes emergency procedures, including those for accidents, fires, chemical spills, air handling failure, BSC failure, power loss and containment loss. Plans must cover emergency entry/exit procedures, corrective actions and notification of key personnel and government officials.
- 4.2.2.3 The Laboratory Director or the Director’s designate(s) such as supervisors are responsible for:
 - organisms that enter, are held within, or leave the containment zone;
 - compliance with all regulatory requirements;

- maintenance of SOPs and the Procedures Manual;
- compliance with SOPs and the Procedures Manual; and
- determining who is authorized to work in the facility.

4.2.2.4 Records shall be kept of activities in the facility for three years, including records of all building and equipment maintenance, shipments received, confirmations of pest identification, dates of import, CFIA Permits to Import, associated imported plant material, associated organisms detected, decontamination of packaging materials and transfer of plant pests or organisms to other facilities where authorized by a CFIA inspector. Records shall also be kept of all inoculations or infestations of plant material and the movement of plant material and plant pests into or out of containment.

4.2.2.5 Appropriate signage indicating the nature of the plant pests/organisms being used (i.e. type and containment level) must be posted on the inner entry door to each laboratory. If there are special provisions for entry, the relevant information must be included on the sign; the contact information of the laboratory supervisor or other responsible person(s) must be listed.

4.2.3 Training

4.2.3.1 Personnel working in the containment zone must be trained in, and follow, the Standard Operating Procedures for the area. Trainees must be supervised by a trained staff member. Visitors, maintenance staff, janitorial staff and others must be provided with training and/or supervision commensurate with their anticipated activities in the containment zone.

4.2.4 Personal Protective Equipment

- 4.2.4.1 Personnel entering the containment zone may need to wear protective clothing up to and including full coverage protective clothing. All protective clothing must be removed prior to exiting the containment zone.
- 4.2.4.2 Dedicated or disposable footwear (e.g. rubber boots, shoe covers) should be worn when working with soil or soilborne pests in situations where the floor may be contaminated with infested plant material or soil. Where such footwear is used, it must be removed for reuse or decontamination prior to exiting the containment zone.
- 4.2.4.3 Where appropriate, BSCs or other primary containment devices are to be used for procedures involving potential allergens and for procedures that involve high concentrations or large volumes of plant pests or their propagules.

4.2.5 Work Practices

- 4.2.5.1 Personnel may not bring unnecessary personal belongings (e.g. hats, coats, purses) into the containment zone if there is a risk that these items could harbour pests on exit, resulting in a loss of containment.
- 4.2.5.2 Laboratory doors must be kept closed as required by the facility design.
- 4.2.5.3 To minimize places where plant pests can persist, avoid using containment zones for general storage of items not used in that area.
- 4.2.5.4 To facilitate minor repairs, a basic tool kit should always be available inside the containment zone.
- 4.2.5.5 Packages of pests from foreign sources must be opened in a BSC or a sleeved cage, as appropriate, and packaging material must be decontaminated as soon as possible.

- 4.2.5.6 Where appropriate, footbaths (e.g. trays containing cloth pads soaked in disinfectant) shall be provided in the anteroom of facilities containing soilborne pests, to disinfect footwear, shoe covers or dedicated footwear.
- 4.2.5.7 If there is a risk of disseminating pests in clothing known to be or suspected of being contaminated, such clothing must be decontaminated (e.g. heat-treated, frozen, autoclaved or soaked in a 5% bleach solution) before laundering. Clothing does not need to be decontaminated if there are laundering facilities within the containment zone and the facilities have been proven to be effective in killing the pests in use.
- 4.2.5.8 If there is a risk of disseminating pests with the movement of paper, use an electronic communication system to transfer information and data from the containment zone.
- 4.2.5.9 All contaminated materials, solid or liquid, including soil from soil traps, must be decontaminated using validated methods before disposal or reuse. Wastes should be sterilized in a timely manner and not allowed to accumulate and decay.
- 4.2.5.10 All liquids potentially contaminated by pests must be decontaminated. Liquids must be collected and treated with steam, heat, chemicals or other proven and validated treatment technology prior to discharge into sewer or septic systems.
- 4.2.5.11 Periodic inspections of the containment zone must be made by facility staff to check for faults and deterioration (e.g. deteriorated door seals and brushes, screens or caulking); corrective action must be taken and records kept for three years. Such inspections shall occur at least every six months.

- 4.2.5.12 Supply and exhaust filters, pre-filters and screens are to be inspected and cleaned or replaced by a designated person on a regular basis.
- 4.2.5.13 Where applicable, inward directional airflow must be confirmed on a regular basis using a smoke pencil, tape, tissue or other suitable means.
- 4.2.5.14 An effective and appropriate monitoring system (e.g. insect traps, spore traps, susceptible sentinel host plants) and pest control program should be in place to control undesired pests and to detect escaped pests.
- 4.2.5.15 Inspect all plant material and insect traps on a regular basis. Remove all debris and dead plant material so that it does not act as a refuge for plant pests.
- 4.2.5.16 Keep areas surrounding greenhouses free of debris, garbage, compost piles and overhanging shrubs and trees.
- 4.2.5.17 Where appropriate, staff must examine themselves, or be examined by others, for hitchhiking arthropods prior to exiting the containment zone. Hitchhiking arthropods must be removed or killed before exit.

4.3 PPC-3 Practices

All operational practices for PPC-1 and PPC-2 containment facilities apply to PPC-3 facilities. The following sections describe the additional minimum operational practices required in PPC-3 containment facilities.

4.3.1 Access

Entry to the containment zone must be restricted to authorized laboratory staff, maintenance staff and others on official business. Access to specific areas within the containment zone may be granted on an “as needed” basis only.

4.3.2 Documentation

4.3.2.1 The Laboratory Director or the Director's designate is responsible for all organisms that enter, are held within, or leave the facility; for compliance with all regulatory requirements, including permit requirements; for maintenance of the Standard Operating Procedures (SOP) manual; for ensuring compliance with the SOP manual; and for determining who is authorized to work in the facility.

4.3.2.2 The Laboratory Director or designate is responsible for the SOP manual that includes procedures specific to the operation of the facility. It must be kept current, and employees must certify that they have understood and agree to abide by relevant SOPs. The SOP manual must include policies and procedures for the following:

- entry of authorized personnel;
- receipt of exotic material;
- organism handling;
- waste disposal;
- identification of received pests;
- record keeping;
- housekeeping, cleaning and disinfection;
- entry, exit and decontamination protocols for equipment, samples, and solid and liquid waste;
- cleaning of soil traps and disposing of contents;
- monitoring of visitors;
- monitoring for pest escapes;
- emergency contacts;
- operation, repair and maintenance of air handling systems;

- operation, repair and maintenance of waste treatment systems;
- emergency repair procedures;
- training of staff;
- use of equipment; and
- inoculation of plants.

4.3.2.3 The above SOPs are to be supplemented with SOPs specific to the nature of the work being conducted and to each project or activity, as appropriate.

4.3.2.4 A log book of all people entering and leaving the facility must be maintained and kept for three years.

4.3.3 Training

4.3.3.1 Personnel entering the containment zone must have completed training in the procedures specific to the containment zone and must show evidence of having understood the training; training must be documented and signed by the employee and supervisor.

4.3.3.2 Personnel must demonstrate proficiency in appropriate practices (SOPs) and techniques.

4.3.3.3 Personnel working in the containment zone must possess knowledge of the physical operation and design of the facility (e.g. air pressure gradients between zones, directional airflow patterns, alarm signals for air pressure failure, and the containment perimeter).

4.3.4 Personal Protective Equipment

4.3.4.1 Personnel entering the containment zone must remove street clothing, jewelry, etc., and change into dedicated laboratory clothing and shoes; dedicated laboratory clothing and shoes must be removed in a manner that minimizes the potential transfer of pests from potentially contaminated laboratory clothing before leaving the

containment zone. The use of full coverage protective clothing (i.e. completely covering all street clothing and hair) may be an acceptable alternative. Personnel must wash their face and hands prior to exiting the containment zone.

- 4.3.4.2 In the event of life-threatening emergencies, personal health and safety are a priority. Exit protocols shall have been established in advance which allow routine procedures to be bypassed while maintaining pest containment as much as possible.

4.3.5 Work Practices

- 4.3.5.1 Personnel entering a containment zone should make an effort to bring all materials they will need with them; if something has been forgotten, established traffic patterns must still be adhered to (i.e. either telephone for someone to bring it in, or exit using proper protocols).
- 4.3.5.2 If aerosol exposure presents a risk of pest escape, protocols must be in place to determine whether showering is required on exit from the containment zone.
- 4.3.5.3 Smoke testing (i.e. using a smoke pencil held at the door between the anteroom and the containment zone, and other doors as required) is to be done periodically by staff to verify inward directional airflow.
- 4.3.5.4 A containment check must always be performed before entering the containment zone (i.e. verify correct readings on the pressure monitoring device).
- 4.3.5.5 Routine cleaning must be done by personnel who use the containment zone, or by other personnel specifically trained for this task, in order to minimize the number of people exposed to the pests under containment and thus the possibility of pest escape.

- 4.3.5.6 The containment zone must be kept locked and all doors must remain closed when not in use.
- 4.3.5.7 Work with plant pests in open vessels on open benches must be kept to a minimum.
- 4.3.5.8 Viable plant pests must be either stored inside the containment zone, or kept in leak-proof containers which are placed in locked storage located outside of the containment zone.
- 4.3.5.9 Drain traps must be kept filled with water or disinfectant (e.g. through regular sink usage, automatic primers or by filling traps in areas that are not frequently used).

CHAPTER

5

Decontamination Processes

CHAPTER 5 – DECONTAMINATION PROCESSES

Decontamination methods used for all contaminated or potentially contaminated materials (e.g. rearing materials, infected or infested plant materials, cultures) must be validated. Depending on the particular organism and the life stage concerned, decontamination may be achieved by methods such as hot water immersion, freezing, rapid heating, drying, dry heating, steaming, autoclaving, fumigation or chemical disinfection. All decontamination and waste management procedures must be in accordance with applicable federal, provincial and municipal regulations.

CHAPTER

6

Facility Certification

CHAPTER 6 – FACILITY CERTIFICATION

When appropriate, CFIA inspectors may conduct site visits and certify that facilities meet these standards, thereby providing assurance that they can appropriately contain plant pests.

6.1 Certification

Laboratories handling plant pests should refer to chapters 3 and 4 of these Standards to verify that their operational practices and physical containment are adequate to contain the pests that will be used there. In order to receive a Permit to Import, PPC-2 and PPC-3 facilities must be certified by the CFIA. Facilities importing pests and planning work that requires PPC-2 containment may be inspected by CFIA inspectors, and/or facility staff may be required to complete a detailed inspection checklist. Facilities importing pests and planning work that requires PPC-3 containment will undergo an initial inspection by CFIA inspectors. Certifications are valid for a period of two years. If a facility is not granted certification, or certification is revoked for any reason, the deficiency or deficiencies must be corrected before the facility can be certified or re-certified.

The critical containment components to be verified during initial certification of PPC-3 facilities are provided in section 6.3. All of these components are to be verified during the commissioning of a new facility. Certification and re-certification records must be retained for three years and they must be available for review by a CFIA inspector, who may elect to re-verify some or all of the components. All as-built drawings of the PPC-3 facility with specifications of surfaces must be submitted for review. Operational protocols must be submitted for review before work with plant pests at the PPC-3 level can be carried out. Training of personnel must be completed and documented. Users must understand containment principles and proposed procedures. Detailed records of the certification process and test reports for PPC-2 and PPC-3 facilities must be kept for three years.

6.2 Re-certification

Re-certification of PPC-3 facilities must initially be conducted annually. Detailed records and test reports are required for re-certification and these must be retained for three years. Before **program changes** can be implemented at PPC-3 facilities, operational procedures must be submitted for review and approval by the CFIA. Program changes include changes related to the nature of the work or the procedures employed that would increase the risk of pest escape from the facility.

6.3 Verification and Performance Testing of PPC-3 Facilities

6.3.1 Room Integrity

Room integrity is to be verified by smoke testing the room perimeter to detect leaks. All joints, corners and sealed penetrations are to be smoke-tested for leaks.

6.3.2 Air Handling Systems

Particle challenge testing of HEPA filters is to be performed *in situ* by the particle scanning method to ensure they do not contain leaks in the filter media, the bond between the media and frame or around the frame gasket and support. Particle penetration is not to exceed 0.01%.

Ductwork systems are to be pressure decay tested to confirm that leakage rates do not exceed 0.2% of duct vol/min at 500 Pa. The American Society of Mechanical Engineers (Standard N510 *Testing of Nuclear Air Treatment Systems*, 1995, gives procedures for testing the leak-tightness of ducts and plenums.

Room pressure control systems are to operate as specified (i.e. ensure negative pressures are maintained). Control systems are to be tested for fail-safe operation by testing for failure of system components. Alarms are to be tested for the detection of positive pressurization and air handling systems failure is to be tested by simulation of alarm conditions.

6.3.3 Fume hoods

Fume hoods and associated exhaust systems are to comply with relevant design and installation requirements and they must be tested *in situ* in accordance with CSA Z316.5-04, *Fume Hoods and Associated Exhaust Systems* (2004). Fume hoods are to comply with the requirements for HEPA filtration. The installation of a charcoal filter prior to the HEPA filter may be envisaged as a measure to protect the HEPA filter from deleterious effects of chemical vapours and also as protection for personnel performing maintenance and certification testing of the HEPA filter.

6.3.4 Biological Safety Cabinets

Testing and certification of BSCs shall be performed in accordance with CSA Z316.3-95 or the applicable NSF Standard. Interlocks (i.e. Class II Type B2 BSC internal cabinet supply fan and exhaust fan) are to be tested in accordance with the applicable NSF standard. Manufacturer's requirements for airflows for BSCs must be met.

6.3.5 Emergency Power

Emergency electrical generators must be tested under appropriate load conditions to ensure systems will operate as specified.

6.3.6 Surface Finishes

Benches, casework, walls and floors are to be inspected to determine whether they are cleanable and can withstand decontamination methods. Where applicable, surfaces should be continuous and without seams to allow for thorough cleaning and decontamination, and penetrations must be sealed.

6.3.7 Communication Devices

Where they are present, communication and electronic data transfer systems (e.g. computer, telephone, facsimile) are to be tested to ensure that they will operate as specified.

6.3.8 Access Control / Security Devices

Security systems (e.g. controlled access) must be tested/verified to ensure that they will operate as specified.

6.3.9 Autoclaves and Decontamination Systems

All treatment systems (e.g. autoclaves, liquid effluent treatment systems) must be verified to ensure that they operate as specified and tested using representative loads. Biological indicators or an internal load temperature probe should be used to confirm that treatment parameters have been achieved. All other decontamination systems (e.g. dunk tanks, gas sterilizers) are to be tested to ensure that they operate as specified. References

pertaining to the maintenance and efficacy of decontamination systems and disinfectants must be kept for three years. A description of the procedure to be followed must be provided to the CFIA.

6.3.10 Effluent Treatment System Plumbing

Drains and associated piping leading to liquid effluent treatment systems (including associated vent lines) must be tested in accordance with Section 3.6 of the National Plumbing Code of Canada (1995).

6.3.11 Standard Operating Procedures

Standard operating procedures for the facility must be updated on a regular basis, and updated SOPs must be submitted to the CFIA at the time of re-certification.

CHAPTER

7

Contact Information

CHAPTER 7 – CONTACT INFORMATION

For information regarding the Containment Standards for Facilities Handling Plant Pests please contact:

Office of Biohazard Containment and Safety
Canadian Food Inspection Agency
159 Cleopatra Drive
Ottawa, ON
K1A 0Y9
Tel. (613) 221-7068
Fax (613) 228-6129
<http://www.inspection.gc.ca/english/sci/bio/bioe.shtml>

For information regarding Permits to Import for plant pests please contact:

Plant Health Division
Permit Office
Canadian Food Inspection Agency
59 Camelot Drive
Ottawa, ON
K1A 0Y9
Tel. (613) 225-2342
Fax (613) 228-6605
<http://www.inspection.gc.ca/english/plaveg/internat/internate.shtml#2>

CHAPTER

8

Glossary

CHAPTER 8 – GLOSSARY

ANSI	American National Standards Institute
Biological control (Biocontrol)	Pest control strategy making use of living natural enemies, antagonists, or competitors and other self-replicating biotic entities (IPPC, 2004).
Biological control agent	A natural enemy, antagonist or competitor, and other self-replicating biotic entity used for pest control (IPPC, 2004).
Biological safety cabinet (BSC)	A primary containment device that provides protection for personnel, the environment, and, in some cases, products from airborne or aerosolized microorganisms. BSCs consist of a leak-tight box, HEPA filter(s) and a motor/blower system to provide controlled air movement through the box and filters.
Containment	Restricting plant pests to their intended locations through the use of operational procedures, physical barriers and facility design.
Containment facility	A structure whose purpose is to prevent escape of material held within it, into the environment (NAPPO 2005).
Containment perimeter	The continuous floor, ceiling and wall surfaces that form a barrier against the ingress or egress of plant pests, including all windows, doors and service penetrations into the area.
Containment zone	A contiguous physical area within a physical structure that meets specified containment requirements.
Decontaminate	To render a plant pest non-viable.
Facility	Laboratories, greenhouses, screenhouses, growth chambers and other supporting structures and buildings.

Greenhouse	A structure with a floor and transparent walls and roof designed and used principally for growing plants in a controlled and protected environment.
Growth chamber	A mechanical device designed to provide a suitable environment for growing plants under controlled light and temperature conditions.
Growth room	A structure with walls, a roof and a floor designed and used principally for growing plants or other organisms in a controlled and protected environment (VLAREM II 2005).
Headerhouse	A building connected to one or more greenhouses that may include laboratories, offices, storage and greenhouse support areas.
HEPA filter	High Efficiency Particulate Air filters with a minimum efficiency of 99.97% at 0.3 μm .
Inward directional airflow	Airflow created by a ventilation system such that air will always flow to areas of higher risk of contamination (e.g. 12.5 – 25 Pa differential).
Kneewall	A partial-height solid wall in a greenhouse that is placed to minimize the possibility of glass breakage.
NAPPO	North American Plant Protection Organization
Pass-box	A sealed box with two doors constructed through and sealed to the containment perimeter. The box is equipped with interlocking doors (preferred), or audible or visual alarms to prevent the simultaneous opening of both doors.

Plant pest	Any thing that is injurious or potentially injurious, whether directly or indirectly, to plants or to products or by-products of plants, and includes any plant prescribed as a pest [PPA 1990]. This includes any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (IPPC 2004) including, but not limited to, arthropods, molluscs, bacteria, nematodes, fungi, phytoplasmas, viruses and viroids.
Primary containment	The protection of hosts within the containment zone from exposure to plant pests. Primary containment is achieved through the use of good microbiological techniques that prevent the release of pests into the zone and through the use of appropriate primary containment devices such as BSCs and insect cages.
Program change	A change in a PPC-3 facility that relates to the nature of work or the procedures employed and that would increase the risk of pest escape from the facility.
Screenhouse	A structure with a roof, floor and screened walls, designed and used principally for growing plants in a protected environment.
Secondary containment	The protection of hosts outside the containment zone from exposure to plant pests. Secondary containment is provided by the resistance of the containment zone to the active or passive movement of pests combined with good operational practices.
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
Standard operating procedures (SOPs)	Documents that describe the procedures used for a specific task.
Validated	Demonstrated to be suitable for a specific purpose.

CHAPTER

9

Selected References

CHAPTER 9 – SELECTED REFERENCES

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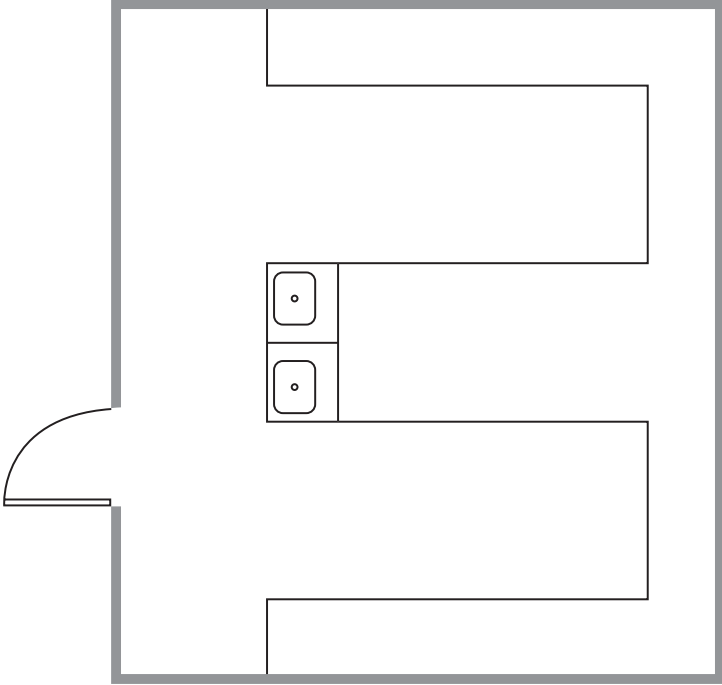
APPENDIX

1

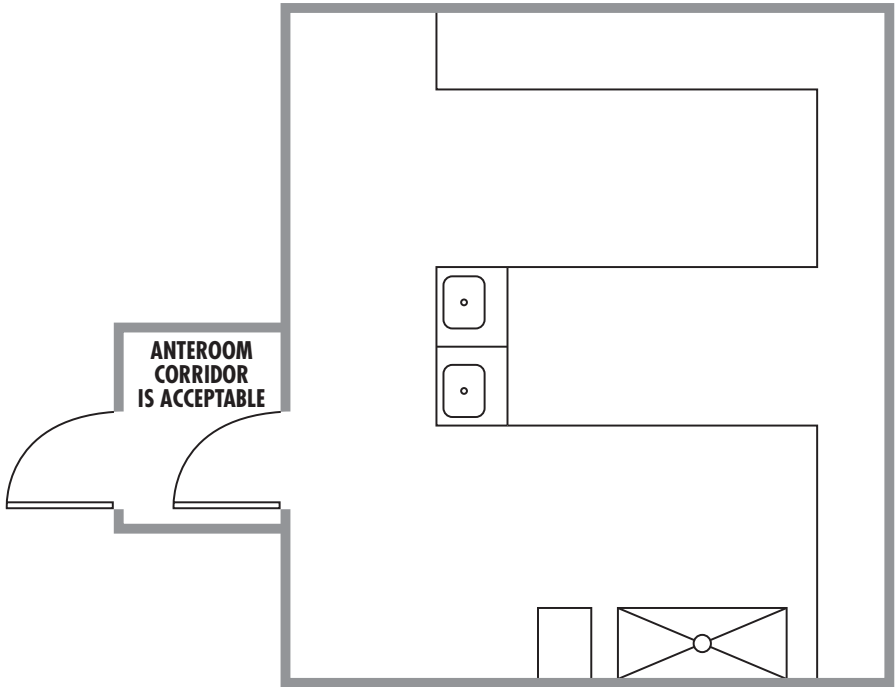
Simplified Examples of PPC-1, PPC-2 and PPC-3 Facilities

APPENDIX 1 – SIMPLIFIED EXAMPLES OF PPC-1, PPC-2 AND PPC-3 FACILITIES

PPC-1



PPC-2

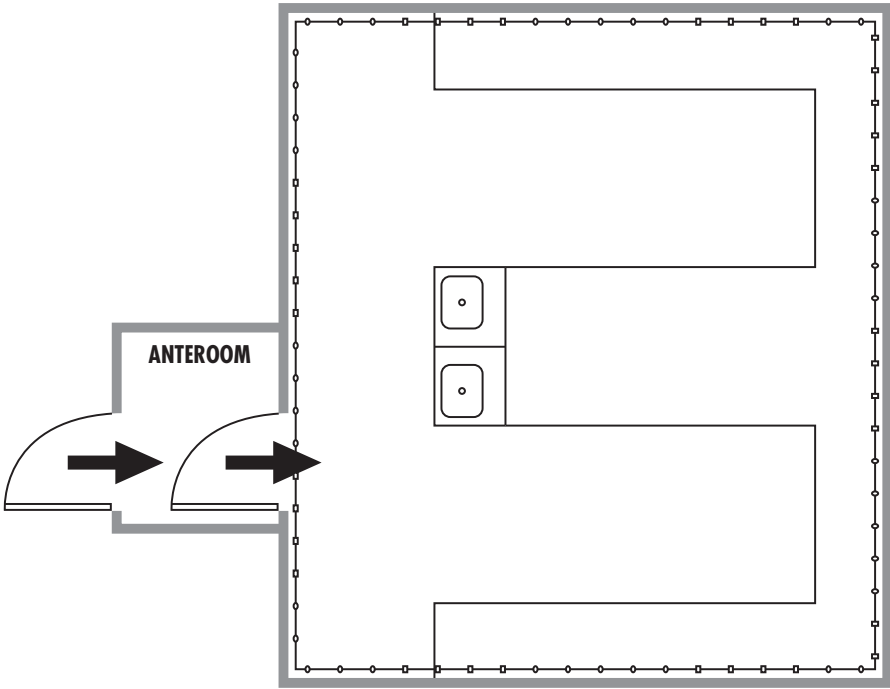


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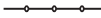


Biological Safety Cabinet

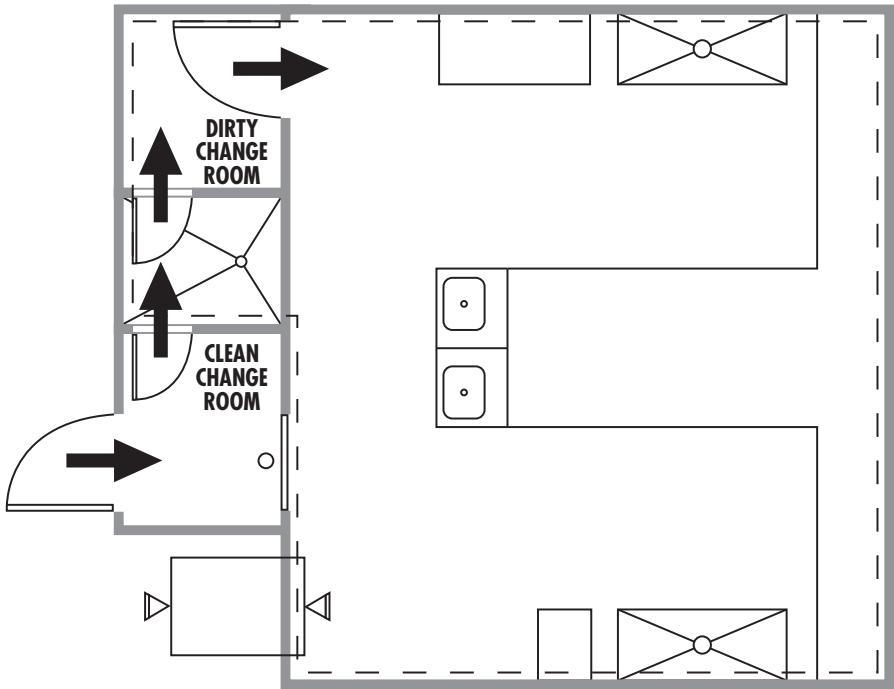
PPC-2 Arthropod









LEGEND

-  Airflow
-  Perimeter to prevent arthropod ingress and egress

PPC-3



LEGEND

-  Airflow
-  Shower
-  Biological Safety Cabinet
-  Sealed containment perimeter
-  Equipment entry
-  Double-door autoclave

