

**UNITED STATES DEPARTMENT OF AGRICULTURE  
ANIMAL AND PLANT HEALTH INSPECTION SERVICE  
PLANT PROTECTION AND QUARANTINE**

**CONTAINMENT FACILITY GUIDELINES  
FOR VIRAL PLANT PATHOGENS AND THEIR  
VECTORS**

[(Revised Feb. 2010) - Viral Pathogens]

# CONTAINMENT GUIDELINES FOR VIRAL PLANT PATHOGENS

## CONTENTS

### I. PURPOSE OF THIS DOCUMENT

### II. CONSTRUCTION STANDARDS FOR THE ENTIRE CONTAINMENT STRUCTURE

- A. Location and Identification
- B. Floor Plan
- C. Walls, ceilings, and floors
- D. Windows
- E. Doors
- F. HVAC system
- G. Electrical system
- H. Plumbing system
- I. Vacuum Cleaning systems
- J. Vacuum Aspiration system
- K. Communication system

### III. CONSTRUCTION STANDARDS FOR SPECIALIZED ROOMS

- A. Greenhouses
- B. Vestibules
- C. Showers and Restrooms

### IV. EQUIPMENT STANDARDS

- A. Benches, tables and other furniture
- B. Sterilization or Decontamination equipment
- C. Cages and Containers
- D. Biosafety Cabinet

### V. OPERATIONAL STANDARDS

- A. Containment Director
- B. Authorized Personnel
- C. Apparel
- D. Personal Cleanliness
- E. Facility Cleaning and disinfecting
- F. Opening and Handling packages
- G. Starting, Growing, and Storing cultures
- H. PPQ Regulatory Requirements

# CONTAINMENT GUIDELINES FOR VIRAL PLANT PATHOGENS

## I. PURPOSE OF THIS DOCUMENT:

These guidelines are a reference to help you (a scientist of a state, federal, or commercial entity) design, build, maintain, and operate a containment facility for non-indigenous viral plant pathogens and their vectors. These guidelines are not intended for use with plant pathogenic bacteria, funguses, protozoa and nematodes. Widely distributed indigenous viral plant pathogens may not require a containment facility. These guidelines are not intended for pathogens and vectors of medical and veterinary importance. If there is doubt as to the applicability of guidelines to specific organisms, contact Containment Facility (CF), or Pest Permit Evaluation (PPE) scientific personnel for appropriate guidance.

During inspections or reinspections of your facility, USDA, APHIS, PPQ personnel will review these guidelines and any risk mitigation instructions that may accompany your permit. When your facility meets containment standards and risk mitigation instructions, USDA, APHIS, PPQ it will be considered "adequate" from a containment standpoint. Permits may then be issued to you.

The inspection and permitting procedures of the USDA, APHIS, PPQ are intended to prevent the release of nonindigenous plant pests to the environment of the United States. Accidental or purposeful release of these organisms is a violation of the **PLANT PROTECTION ACT** and is subject to civil and/or criminal penalties, loss of permits, and destruction of valuable cultures.

## Components of this Document:

Your containment facility must meet the “**Standards**” listed in the grey, shaded boxes. To help you meet these standards, ask biotechnology industries, university Biosafety committees, and/or contractors for research hospitals and other research institutions to recommend specialized professional contractors. Professionals know state, local and federal laws that regulate construction, including the installation of emergency doors, incinerators, air intake and exhaust ducts, emergency lighting, plumbing, and many other features. PPQ’s permit specialists have little or no knowledge of these laws.

**N.B.** Notify PPQ of any structural changes prior to implementation, the development of blueprints, signing of construction documents, start of construction, etc.

The “**Suggestions**” listed under each Standard are methods or equipment that are commonly used at this time to accomplish each containment standard. The design, construction and operation of your containment facility may vary, depending on the organisms you wish to contain, your research objectives, the functionality of your equipment and structural components, and your location. For example, your containment would change if viruses were grown only in winter climates when no vectors were present; if a particle gun or Ago-infection were used to

transmit virus; or if under specific conditions, vectoring and various types transmission were proven impossible. **Again, we recommend professional advice on all design issues.**

**Safety of facility personnel should not be compromised by containment requirements. Emergency exits should not be blocked by equipment; their operation should not be obstructed with tape or caulk.**

We encourage Good Laboratory Practices (GLP) in all facilities; however the standards and suggestions listed here only cover containment. Cross contamination of cultures within the containment may or may not signify poor containment.

USDA, APHIS, PPQ welcomes alternatives that are proven to meet or exceed the standards. To insure timely permitting, please review this document, and research design alternatives. Once design options are narrowed, call or fax PPQ's Containment Facility staff at (301) 734-5592 or FX (301) 734-5392 and continue discussions as the facility is planned and built.

[Other useful containment references (non-USDA-APHIS) are 1) "Containment Facilities and Safeguards for Exotic Plant Pathogens and Pests" 1999. R. P. Kahn and S. B Mathur. (eds). APS Press, St. Paul, MN; 2) "A Practical Guide to Containment (Plant Biosafety in Research Greenhouses) ". Adair, D. and R. Irwin. 2008 (revised edit.).Information Systems for Biotechnology, Virginia Tech, Blacksburg (<http://www.isb.vt.edu>); 3) "Containment Standards for Facilities Handling Plant Pests" 2009. (1st edition) Canadian Food Inspection Agency, Office of Biohazard Containment and Safety, (<http://www.inspection.gc.ca/english/sci/bio/plaveg/placone.shtml>)].

## II. CONSTRUCTION STANDARDS FOR THE ENTIRE STRUCTURE

**CONSTRUCTION STANDARD A. Locate the facility in areas with minimal human, agricultural and environmental risk. Identify the facility as dedicated and secure.**

### **SUGGESTIONS:**

1. Locate the facility in areas relatively free of agricultural zones, high-risk microclimates (e.g. known flood zones) or other high-risk areas.
2. If possible design the containment facility as a separate, dedicated building. If this is not possible, design and build to prevent pest escape.
3. Install a 15 foot- wide buffer strip of gravel and/or pavement from the foundation and around the containment building(s). (Mowed lawn is not acceptable for grass or legume viruses.)
4. Install a fence 6 ft or higher around the facility.
5. At the main entry to containment, post:
  - Containment director/ containment officer name and contact numbers.
  - A sign stating “ACCESS IS BY AUTHORIZED PERSONNEL ONLY”.
  - Emergency telephone numbers.

**CONSTRUCTION STANDARD B. Design the floor plan to prevent escape of the enclosed organism(s).**

### **SUGGESTIONS:**

1. Install one primary entry/exit.
2. Install a shower and restroom at the primary entrance.
3. If local building code allows, install vestibules for emergency exits. Install a vestibule at entries or exits that lack a shower.
4. Build restrooms outside of containment areas. However, if restrooms must be built inside a containment room, use the same construction standards used throughout the facility and place the restroom next to low risk areas.
5. Build offices outside of containment areas.
6. Install self-closing doors throughout the containment structure(s). Install exterior doors that lock.
7. Install a central closet for cleaning supplies.
8. Insure air moves from the least to most hazardous rooms.
9. Set up a light switch so that lights in the vestibules turn off when any door is opened and turn on only when both doors are fully closed. (See Vestibule Construction)

**CONSTRUCTION STANDARD C. Construct walls, ceilings and floors that are impenetrable to the enclosed organisms, and withstand repeated cleaning and decontamination**

**SUGGESTIONS:**

1. Construct the walls and ceilings with building materials that resist moisture and withstand repeated decontaminations with bleach or other caustic solutions.
2. Paint the ceilings and walls with a light-colored, washable paint.
3. Install floors that are impenetrable to the organism and withstand repeated cleanings. Monolithic (in one-piece) floors, e.g. poured concrete, asphalt tile, chemically resistant paint etc. are desirable. Wood floors are **not** acceptable.
4. Install floor drains to collect liquid wastes for sterilization.
5. Seal junctions, holes or penetrations of walls, ceilings, and floors with plaster, caulk, or equivalent materials.
6. Suspended or dropped ceilings are **not** acceptable.

**CONSTRUCTION STANDARD D. If windows are necessary, install Windows impenetrable to the enclosed organisms.**

**SUGGESTIONS:**

1. Install breakage resistant glazing (Plexiglas, Lexan, etc).
2. Install windows that do not open.
3. Seal joints between the windowsills, frames, etc. and walls with appropriate materials.
4. Store extra transparent panels nearby for emergency use.

**CONSTRUCTION STANDARD E. Install Doors that contribute to the security of the facility.**

**SUGGESTIONS:**

1. Install self-closing, steel doors with magnetic gaskets throughout the containment structure(s).
2. Install exterior doors that lock.
3. Install thresholds and gaskets that seal the exterior and interior doors with their frames. The space between seal and doorframe should not exceed 6.3mm (0.250 inch).

4. Install windowless doors, or block windows in door leading to most hazardous rooms, with blinds or other covers to prevent organisms (vectors) from moving toward the light (toward the doors and beyond).
5. Emergency doors
  - Post signs on the exterior and interior of emergency exits stating USDA, APHIS Containment Facility - Emergency Exit Only.
  - Insure emergency doors are not commonly used as an entrance (remove exterior handles, use doors with interior or internal hinges, etc.).
  - Install audible alarms that activate when emergency exit doors are opened

**CONSTRUCTION STANDARD F.** Design and install an **HVAC System** (Heating, Ventilation and Air Conditioning) that prevents escape of the contained organisms.

#### **SUGGESTIONS:**

1. If possible, install a closed HVAC system dedicated to the containment areas. If not possible, then install filters to prevent organism escape from containment areas to areas or buildings outside of containment.
2. Install metallic mesh or screen over the following air sources:
  - External exhaust screen --- which excludes mobile forms of pests living in the external environs that, if introduced to the contained area, may transmit contained viruses (80 mesh is usually required). This screen prevents external pest entry into the ventilation system in the event of power loss.
  - Internal exhaust/ return grille/ vent --- Screen that excludes mobile forms of pests of all plants grown in containment (80 mesh is usually required).
  - Outside air intake – Screen that excludes mobile forms of pests living in the external environs that, if introduced to the contained area, may transmit contained viruses (80 mesh is usually required)
  - Internal air diffuser/register--- Screen that excludes mobile forms of pests of all plant grown in containment. This screen prevents internal pest entry into the ventilation system in the event of power loss. (80 mesh is usually required).
3. Insure air moves from outside to inside when exterior doors are opened.
4. Insure air moves from the least to most hazardous rooms. Install equipment to measure airflow direction.
5. Seal connections in air ducts, plenums, etc. with caulk or an equivalent material.
6. Seal vents to interior surfaces with caulk or an equivalent material.
7. Install filters and screens of the HVAC system so that they are easy to clean, decontaminate and replace.

8. Install tandem filters so one side of the ventilation ductwork and its filter can be decontaminated while the other side supplies air.

**CONSTRUCTION STANDARD G.** Design and install an **Electrical System** that maintains containment features under normal and emergency situations and is impenetrable to the contained organisms.

**SUGGESTIONS:**

1. Install an alarm to indicate power failure.
2. Install an alternative power source (generator, battery bank, etc.) for use when normal power is lost or interrupted.
3. Install weatherproof electrical boxes, receptacles, light fixtures, switches, etc.
4. Seal electrical boxes, lighting, switches, wiring, conduit, etc, with appropriate materials (caulk, foam, etc,) that are impenetrable to the contained organisms and withstand repeated decontaminations with bleach or other caustic solutions.

**CONSTRUCTION STANDARD H.** Design and install a **Plumbing System** to contain the organisms and remove liquid wastes.

**SUGGESTIONS:**

1. Seal sewer or drains (sink, floor, shower, etc.) with metallic 80 mesh screen to prevent escape of arthropod vectors.
2. Collect and sterilize effluents from sinks, floor drains, restrooms in the containment area, etc. with steam heat or its equivalent before releasing them into the sewer system.

**CONSTRUCTION STANDARD I.** If Vacuum Systems are used for cleaning, Install **Vacuum Systems** that prevent the escape of the contained organisms

**SUGGESTIONS:**

1. Use vacuum cleaning appliance only in facility.
2. Autoclave or sterilize vacuum filters and waste before disposal.

**CONSTRUCTION STANDARD J.** The following system is not a containment requirement. However if installed, insure the **Vacuum Aspiration System** prevents the escape of the contained organisms.

**SUGGESTION:**

1. Autoclave or sterilize vacuum filters and waste before disposal.

**CONSTRUCTION STANDARD K. Install Communication System** that allows communication between the interior and exterior of the facility and prevents organism escape.

**SUGGESTIONS:**

1. Install a telephone(s) or intercom system.
2. Install a computer (LAN, modem, etc.) or Fax machine to allow for communication and data transfer to and from the facility.
3. Electronic equipment (i.e. cell phones) are not permitted inside the facility unless they can be decontaminated before exit.

**III. CONSTRUCTION STANDARDS FOR SPECIALIZED ROOMS.**

**CONSTRUCTION STANDARDS FOR SPECIALIZED ROOMS A. Build greenhouses with security and containment features**

**SUGGESTIONS:**

1. The greenhouse should not be placed on top of another building. Increases in height of the structure increase the possibility of wind damage. Consider placing windbreaks (fences, walls, hedges, trees) if necessary beyond the buffer area to protect against storms and high winds.
2. Construct the foundation of concrete, concrete block, brick, or similar material.
3. Extend the foundation below the soil line to insure a permanent and stable structure. Build the foundation at least 3 ft. above the soil line.
4. Construct greenhouse floors of concrete or other materials that are impervious to the contained organisms and can withstand repeated disinfecting with caustic liquids. There should be provision for collection and decontamination of liquid runoff.

5. Install a frame strong enough to support the translucent walls and ceilings and resist local environmental conditions such as storms, snow loading, high winds, etc.
  - Install translucent wall and ceiling materials strong enough to guarantee the security of the facility. Plexiglas, Lucite, lexon, safety glass, and wire-reinforced glass are acceptable. Polyethylene, vinyl or plastic sheeting are NOT acceptable.
  - Seal the translucent panels to the frame with caulk or appropriate materials on the inside and outside surfaces.
  - Consider the installation of screens over the roof to protect it from hail.
  - Consider the installation of an alarm system to detect broken glazing panels or other breaches of containment.
6. Seal joints between the greenhouse and other containment rooms with caulk or other suitable material.
7. If containment greenhouse is detached from the primary containment facility, install a vestibule at each door. (See specialized room section on **Vestibules.**)
8. Install doors between the greenhouse and the rest of the facility that close completely, and seal to their frames.
9. Insure the HVAC system can be turned off to allow greenhouse fumigation.
10. The HVAC system and ducts for the greenhouse should be the designed as for the main containment facility with appropriate screens, filters, and negative air pressure.
11. The green house must be tested for leaks upon new construction, when repairs are performed, and on an annual basis.

## CONSTRUCTION STANDARDS FOR SPECIALIZED ROOMS B. Vestibules

### **SUGGESTIONS:**

1. Install a vestibule in each entrance and /or exit. (Have contractor check local construction codes on vestibules at emergency exits, as they may be prohibited.)
2. Shower rooms can count as a vestibule for the main entrance (see restroom construction).
3. Design vestibule to be at least 6 feet long from door threshold to door threshold. Doors should be designed so that they cannot be opened at the same time.
4. When winged vectors are present, set up lights in vestibules so they turn off when any door is opened and turn on only when both doors are fully closed.
5. Insure that unoccupied vestibules are darker than adjacent rooms.
6. Insure that vestibule doors interlock, so that only one door can be opened at a time.
7. Insure thresholds and gaskets of doors seal to their frames. No space can exceed 6.3 mm (0.250 inch).

**CONSTRUCTION STANDARDS FOR SPECIALIZED ROOMS C. Install Showers and Restrooms to prevent organism escape.**

**SUGGESTIONS:**

1. Place showers/ restrooms near lowest risk rooms.
2. Insure thresholds and gaskets of restroom doors seal to their frames. No space can exceed 6.3 mm (0.250 inch).

**IV. EQUIPMENT STANDARDS**

**EQUIPMENT STANDARD A. Use Benches, Tables and Other Furniture that are easy to inspect and clean.**

**SUGGESTIONS:**

1. Install work surfaces and laboratory furniture (bench tops, etc.) that are seamless (or monolithic) impervious to water, and resistant to chemicals and heat.
2. Insure spaces between benches, wall cabinets, and equipment are easy to clean and inspect.
3. Dedicate cleaning equipment (mops, brooms, buckets, etc.) for use only in the containment area, and store it in the containment area.

**EQUIPMENT STANDARD B. Use equipment to Sterilize contained organisms, soil, plant material, solid waste or Decontaminate solid waste and contaminated or infested articles before removing it from the facility. In some cases, sterilize or decontaminate incoming materials to prevent entrance of external vectors.**

**SUGGESTIONS:**

1. Install an autoclave. Double-door pass-through model is recommended. Conduct tests annually to evaluate effectiveness of autoclave.
2. Install a gas sterilizer for articles that would be damaged by steam. Double-door pass-through model is recommended. Conduct tests annually to evaluate effectiveness.

3. If you are considering an incinerator within the facility for waste disposal, consult your contractor about state, local, and federal laws and ordinances.
4. Stock the facility with appropriate sterilizing materials for arthropod vectors; insect killing jars, 70% alcohol, and/or bleach.

**EQUIPMENT STANDARD D. Install a Biosafety cabinet to work with organisms**

**SUGGESTIONS:**

1. Install a Biosafety cabinet, Class II, type A/B3 in which to open foreign source packages. The biosafety cabinet should be tested on an annual basis by a trained technician.

**V. OPERATIONAL STANDARDS**

**OPERATIONAL STANDARD A. A Containment Director** is responsible for the daily operation of the facility and its physical integrity.

**SUGGESTIONS:**

A **Containment Officer** is responsible for the organisms contained in the facility. He/she also maintains a copy of the Standard Operating Procedures (SOP) Manual for the facility. SOPs contain directions for normal use, maintenance, and disinfection of the facility and its equipment.

SOPs also describe how to:

- Respond to a typical emergency event (power outage, fire, glass breaks in containment area (flood, hurricane, earthquake, tornadoes, etc.). Biosecurity for unauthorized removal of materials from containment area.
- Replace translucent panels in greenhouse.
- Monitor visitors.

Copies of SOPs should be available to workers within the containment areas. Each revision must be dated. Revisions should be made when operating procedures change, SOPs should be reviewed annually.

**Containment Officer:**

- Implements the SOPs and conditions listed in permits for organisms held by the facility.
- Trains employees and/or authorized personnel in the SOPs.
- Updates copies of construction records (blueprints) for the facility.
- Maintains daily, weekly and monthly maintenance records of the facility.

The **Containment Officer** updates these lists:

- The names and phone numbers of those to call during emergencies as changes occur.
- The plants species in facility, as changes occur.
- Authorized personnel, as changes occur.
- Incoming and outgoing shipments of permitted organisms, including dead or destroyed incoming organisms, and submits list to USDA, APHIS, PPQ, PRA (Permits & Risk Assessment) by January 31 of each year (see address on last page.)

**SOPs also describe procedures related to all operating standards listed below:**

**OPERATIONAL STANDARD B.** Only **Authorized Personnel** have routine access to the facility.

Once your facility is adequate to receive plant pests, the behaviors of people who have access to your facility will have far more impact on the containment of the organism than any containment feature. Your selection of individuals to work in this facility is critical to maintenance of plant pest containment. In addition to picking good personnel, please consider the suggestions below.

**SUGGESTIONS:**

1. Lock exterior doors at all times. Insure only authorized personnel have keys.
2. Train authorized personnel in the SOPs.
3. List the personnel authorized to enter the facility.
4. Require that visitors sign a logbook. Authorized personnel must accompany visitors at all times to insure they do not bring in or carry out pests.
5. Insure emergency exit doors are not used routinely as an entrance.

**OPERATIONAL STANDARD C.** Wear, sterilize, and handle personal Apparel to minimize the risk of organism escape.

**SUGGESTIONS:**

1. Insure visitors and employees wear laboratory coat in the containment area and remove it prior to leaving the containment area. Depending on the nature of the plant pathogen to be contained head and foot covers, coveralls and showers may be appropriate.
2. Prohibit entry of overcoats, hats, backpacks, purses, etc. into the containment areas, as these articles may allow organisms to hide and escape.

**OPERATIONAL STANDARD D.** Use Personal Cleanliness to contain organisms.

**SUGGESTIONS:**

1. If vectors are present in the facility, insure authorized personnel and visitors completely shower before exiting.

**OPERATIONAL STANDARD E.** Clean and Disinfect the interior of the facility and its equipment regularly.

**SUGGESTIONS:**

1. List materials and methods used to clean and disinfect the facility, its furniture, and its equipment.
2. Describe how to change air filters without contamination of containment area.
3. Eliminate undesired pests and pathogens (e.g., aphids, mealy bugs, whiteflies, scale insects, any arthropods which might vector contained entomopathogens) from the facility.
4. Autoclave or sterilize solid wastes (cultures, plant materials, soil, trash, etc.) prior to disposal.
5. Laboratory coats, coveralls and other clothing should be autoclaved before being removed from the facility for cleaning.

**OPERATIONAL STANDARD F. Open and Handle packages** of permitted organisms to prevent organism release.

**SUGGESTIONS:**

1. Establish one enclosed area that is easy to disinfect, to open packages received from foreign sources.
2. Place foreign source packages in the biosafety cabinet before opening.
3. Autoclave or incinerate packing materials immediately after the removal of specimens and cultures.
4. Establish procedures to eliminate hitchhiking pests (insects and pathogens, fungus, bacteria, etc.)

**OPERATIONAL STANDARD G. Start, grow, and store cultures** with as few exotic contaminants as possible. Cross contamination indicates poor laboratory practice. However, it may not indicate containment problems.

**SUGGESTIONS:**

1. List all nonindigenous plant materials used to culture plant pathogens.
2. Sterilize/destroy all packing materials from shipments and contaminants shortly after receipt.
3. Autoclave or sterilize media used to rear organisms before removing it from the facility.
4. Destroy contaminated organisms as soon as detected. This may mean destroying beneficial cultures, if pathogens are found in the culture.
5. Store tissue cultures in screw top vials or equivalent.

**OPERATIONAL STANDARD H. Follow all PPQ Regulatory Requirements** for organisms received, reared in, or released from the containment facility.

**SUGGESTIONS:**

1. Meet all PPQ requirements or conditions as listed in permits for organisms kept in the facility. Permits from other Federal and State Agencies may also be required for certain plant pests. Receipt of USDA Plant Pest Permits does not relieve applicants from the

responsibility of obtaining other permits. USDA Permits may be withheld or revoked if other Federal and State requirements are not satisfied

2. Send SOP and blueprints to:

Containment Facilities Program Assistant  
USDA, APHIS, PPQ, PPB, CF, Unit 133  
4700 River Road, Riverdale, MD 20737  
Phone (301) 734-5592  
FAX (301) 734-5392

3. Obtain permission from PPQ prior to shipping regulated organisms outside of the facility.
4. Maintain a list of all organisms described in PPQ permits that enter and leave the facility. Submit the above list to USDA APHIS PPQ (at address below) by January 31 of every year

USDA, APHIS, PPQ, PPB, Unit 133  
4700 River Road, Riverdale, MD 20737  
Phone (301) 851-2046  
FAX (301) 734-4300

5. If the facility stops operating as a containment facility, either temporarily or permanently, notify PPQ in writing.
6. Notify PPQ of any structural or containment changes prior to implementation, the development of blueprints, signing of construction contracts, start of construction, etc. in writing.

Subject: Containment of Non-indigenous Viral Plant Pathogens  
To: Prospective Permittee

Enclosed are DRAFT CONTAINMENT GUIDELINES FOR VIRAL PLANT PATHOGENS  
AND THEIR VECTORS.

Please review these documents and discuss specifications for your containment facility with the  
PPQ Containment Facility staff, phone (301) 734-5304, or fax (301) 734-5392 before you  
contract or start construction.

Thank you,

Containment Facility Staff