

## Summary of Greenhouse Features

**TABLE 6** provides a comparison of the important features of a containment greenhouse facility. The features are recommended or required, as noted, for the prescribed biosafety levels or criteria of containment, according to guidelines issued by the NIH, USDA-ARS, and USDA-APHIS agencies. This table is compiled for the convenience purposes; for details relating to specific containment requirements, the appropriate agencies should be consulted. (The page number refers to the relevant discussion of the feature in the Guide text.)

**TABLE 6. Important Features of a Greenhouse Containment Facility.**

Feature	Criteria	NIH				ARS	APHIS					Pg #
		BL1-P	BL2-P	BL3-P	BL4-P	BSL-3Ag	Arthropods	Bacteria	Fungi	Virus	Weed	
ACCESS	Training prior to access <b>required</b>	•	•	•	•	•	•	•	•	•	•	27
	Entry pre-authorization <b>required</b>			•	•	•	•	•	•	•	•	
	Hand washing station at exit			•	•	•					•	
	Shower on exit, depending on experiment			•			•					
	Shower required upon exit				•	•		•	•	•		
	Entry logbook required, users				•	•						
	Entry logbook, visitors						•	•	•	•	•	
	Visitors prohibited				•	•						
Materials enter and leave through a double door autoclave, airlock, or fumigation chamber			•	•	•			•				
APPAREL	Street clothing acceptable	•	•									28
	Lab coat, coverall, or additional covers upon entry which remain in facility or disposed						•	•		•	•	
	Complete clothing change <b>required</b>			•	•	•			•			
	Lab clothing autoclaved prior to laundering or disposal			•	•	•			•	•	•	
SIGNAGE	Indicate restricted experiments in progress and include relevant contact information		•	•	•	•	•	•	•	•	•	28
	Post signs at emergency exits stating “USDA-APHIS Containment Facility–Emergency Exit Only”						•	•	•	•	•	

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		BL1-P	BL2-P	BL3-P	BL4-P	BSL-3Ag	Arthropods	Bacteria	Fungi	Virus	Weed	
TERMINATION	Clean and disinfect facility			•	•	•	•	•	•	•	•	30
	Experimental material rendered biologically inactive before disposal	•	•	•								
	Autoclave recommended for treating material before removal from facility			•	•	•	•	•	•	•	•	
	Double door pass-through autoclave <b>recommended</b>				•		•	•	•	•	•	
	Double door pass-through autoclave <b>required</b>				•	•						
	Liquid waste sterilized before entering sewer system				•	•	•	•	•	•	•	
PEST CONTROL	Pest control program <b>required</b>	•	•	•	•	•	•	•	•	•	•	32
RECORDS	Movement of live materials in and out of greenhouse facility		•	•	•	•	•	•	•	•	•	33
	Record all personnel entry and exit			•	•	•						
	Documentation and reporting of inadvertent release of microorganisms/experimental material to appropriate authority		•	•	•	•	•	•	•	•	•	
INSPECTION	Inspection conducted by regulators before permitted work begins followed by scheduled or unannounced reinspections					•	•	•	•	•	•	34
SECURITY	Facility surrounded by a security fence or equivalent measure (CCTV, bollards, motion sensors)			•	•	•	•	•	•	•	•	35
	A personal security risk assessment required to access experimental materials						•					
STRUCTURE	Foundation of concrete, concrete block, brick, or similar material			•	•	•	•	•	•	•	•	41
	Rigid, reinforced greenhouse framing (aluminum and/or steel typical)			•	•	•	•	•	•	•	•	
	Resistant to disinfecting chemicals			•	•	•	•	•	•	•	•	

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		BL1-P	BL2-P	BL3-P	BL4-P	BSL-3Ag	Arthropods	Bacteria	Fungi	Virus	Weed	
GLAZING	Rigid thermoplastic acceptable	•	•	•			•	•	•	•	•	42
	Sealed and break resistant glazing material			•	•	•	•	•	•	•	•	
	Glass break sensors recommended			•	•	•	•	•	•	•	•	
FLOORS AND DRAINS	Concrete floor <b>recommended</b> . Porous material under benching acceptable	•	•									44
	Impervious to organisms and tolerant of disinfection			•	•	•	•	•	•	•	•	
	Ability to collect and decontaminate liquid waste			•	•	•						
	HEPA filtration of sewer vents				•	•			•			
DOORS	Rigid, e.g., steel, self-closing doors with sweeps			•	•	•	•	•	•	•	•	44
	Double set of locking, self-closing doors			•	•	•						
	Emergency doors without exterior hardware, with audible alarms upon opening			•	•	•	•	•	•	•	•	
	Key card or equivalent entry system tracking recommended			•	•	•	•	•	•	•	•	
VESTIBULES	Interlocking, sealing doors installed in facility entryways					•	•	•	•	•	•	45
	Consider air curtains and/or light traps for insects						•			•		
SCREENING	Standard, 30 mesh or higher insect screen on openings to the exterior	•	•				•	•		•	•	46
VENTILATION	Allow evaporative pad and free air cooling on vents	•	•									47
	Air conditioning system designed for containment			•	•	•	•	•	•	•	•	
	Install filters/screens on air handling system						•	•		•		
	HEPA filtration of exhaust air: Bag-in, bag-out system that is recertified annually or upon filter change. Filters must be sterilized before disposal.			•	•	•			•			
	System designed to accommodate fumigation						•	•	•	•		

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PRESSURIZATION	Directed airflow to maintain negative pressure			•	•	•			•			49
	Install differential pressure transducers to read conditions and trigger alarms			•	•	•			•			
INFILTRATION	Perform annual testing for greenhouse tightness				•	•			•			49
BENCHING/WORK SURFACES	Tolerates frequent disinfecting; easy to clean and inspect			•	•	•	•	•	•	•	•	50
CONTROL AND ELECTRICAL SYSTEMS	Computer control with remote access capability recommended or required			•	•	•	•	•	•	•	•	51
	Can maintain containment under loss of power			•	•	•	•	•	•	•	•	

**NOTE.** *These are general approaches to containment at various regulated levels. Individual situations may require more or less stringent strategies.*