

## Biological containment level measures: Guidance information

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### 1. Scope

Containment describes facilities, procedures and processes that are used to help prevent exposure of people and the environment to the micro-organisms that are being deliberately manipulated either by accident or once work has finished. It is used in combination with good microbiological practices (e.g. aseptic technique) which is designed to prevent cross-contamination of work but also supplements the containment objectives by preventing the spread of contamination.

Work with micro-organisms (using good microbiological practice) is undertaken in containment laboratories. There are four levels of containment defined under which a particular micro-organism in the corresponding hazard group should be handled (unless a risk assessment determines otherwise). This document summarises the containment measures forming containment levels one to three (CL-1 to CL-3) as defined by government advisory bodies,

regulations and guidance for work with wild-type and genetically modified biological agents or materials contaminated with such agents. Further information and guidance on their application to work activities can be found in the University's biological safety policy (1) and associated documents. For some activities involving both wild-type and genetically modified agents the containment requirements will overlap and in all cases the most stringent measure required should be adhered to. The containment measures for work with genetically modified animals or plants and specified animal pathogens (under SAPO) are not described in this document. However, information on the requirements for these types of work is available in other respective guidance:

- Guidance from The Scientific Advisory Committee on Genetic Modification see URL at (1)
- Animal Pathogens: Guidance on Controls - See URL at (1).

## 2. Requirements for ACDP containment levels 1, 2 and 3

### 2.1 Containment level 1 (CL-1)

CL-1 is suitable for work with agents in Hazard group 1. Although defined as unlikely to cause disease by infection, some agents in this group are nevertheless hazardous in other ways (i.e. they are allergenic or toxigenic) and adequate control measures must be in place. Laboratory personnel must receive suitable and sufficient information, instruction and training in the procedures to be conducted in the laboratory.

1. The laboratory door should be closed while work is in progress.
2. Laboratory coats must be worn in the laboratory and be removed when leaving the laboratory area.
3. Eating, drinking, smoking, storing of food and applying of cosmetics must not take place in the laboratory.
4. Mouth pipetting is prohibited in the laboratory.
5. The laboratory should contain a basin or sink that can be used for hand washing.
6. Hands must be washed and disinfected:-
  - when any contamination is suspected,
  - after handling viable materials,
  - before leaving the laboratory.
7. Personal protective equipment, including protective clothing, must be:

- stored in a well-defined place;
  - checked and cleaned at suitable intervals;
  - repaired or replaced before further use once discovered to be defective.
8. Personal protective equipment which may be contaminated by biological agents must be:
    - removed on leaving the working area;
    - kept apart from uncontaminated clothing and equipment;
    - decontaminated and cleaned or, if necessary, destroyed.
  9. All procedures must be performed so as to minimise the production of aerosols.
  10. Effective disinfectants must be available for immediate use in the event of a spillage.
  11. Bench tops should be cleaned after use.
  12. All contaminated glassware must be decontaminated before removal from the laboratory for washing.
  13. Used laboratory glassware and other materials awaiting decontamination before recycling should be stored in a safe manner. Pipettes, if placed in disinfectant, should be totally immersed.
  14. All waste material that is not to be incinerated must be rendered non-viable before disposal.
  15. Contaminated materials whether for recycling (wash-up) or disposal, should be stored and transported in robust and leakproof containers without spillage.
  16. All accidents and incidents must be recorded, at the time, on an Accident Report Form, available from the Health and Safety Services website or your Department Safety Advisor. They should be returned to your DSA. Your local Deputy Biological Safety Officer (DBSO) and the University Biological Safety Officer should be informed of any accidents or incidents involving genetically modified organisms or human pathogens as soon as possible.

## 2.2 Containment level 2 (CL-2)

CL-2 is suitable for work with agents in Hazard group 2. Laboratory personnel must receive suitable and sufficient information, instruction and training in working safely with biological agents in this hazard group. A high standard of supervision of the work should be maintained.

In addition to the measures described for CL-1:

17. Access must be limited to authorised people.
18. If the laboratory is mechanically ventilated, it must be maintained at an air pressure negative to atmosphere while work is in progress. "Atmosphere" in this context may be taken to mean either the external air and/or other parts of the laboratory suite or building.
19. In most laboratories operating at CL-2 where there is mechanical ventilation simply to provide a comfortable working environment, it may not be practical to maintain an effective inward flow of air. The often constant traffic in and out of CL-2 rooms may interfere significantly with attempts to establish satisfactory airflow patterns. However, where a laboratory is ventilated specifically to contain airborne pathogens in the event of an accident, then engineering controls and working arrangements must be devised so as to counter the risk of airborne transmission to other areas. Maintaining an inward flow of air is necessary only when work is progress.
20. There must be specified disinfection procedures.
21. The hand wash basin should be provided near the exit of the laboratory. Taps should be of a type that can be operated without being touched by hand.
22. When gloves are worn, these should be washed or preferably changed before handling items likely to be touched by others not wearing gloves, for example telephone, paperwork. Computer keyboards and, where practicable, equipment controls should be protected by a removable flexible cover that can be disinfected.
23. Bench surfaces must be impervious to water, easy to clean and resistant to acids, solvents and disinfectants.
24. Laboratory coats or gowns, which should be side or back fastening, should be worn and removed when leaving the laboratory suite. Separate storage (for example, pegs) apart from that provided for personal clothing should be provided in the laboratory suite.
25. There should be adequate space in the laboratory for each worker.
26. There must be safe storage of biological agents.
27. An autoclave for the sterilisation of waste materials should be readily accessible in the same building as the laboratory, preferably in the laboratory suite
28. Materials for autoclaving should be transported to the autoclave in robust containers without spillage.
29. Laboratory procedures that give rise to infectious aerosols must be conducted in a microbiological safety cabinet, isolator or otherwise be suitably contained.

30. There must be access to an incinerator for disposal of infected carcasses. This may mean an incinerator at another site but whether local or distant, carcasses for incineration must be transported in secure containers.
31. There should be means for the safe collection, storage and disposal of contaminated waste.
32. Contaminated waste should be suitably labelled before removal for incineration.

### 2.3 Containment level 3 (CL-3)

CL-3 is suitable for work with agents in Hazard group 3. Laboratory personnel must receive suitable and sufficient information, instruction and training in working safely with agents in this hazard group. A high standard of supervision of the work should be maintained. A list must be kept of employees engaged in work with biological agents in Hazard group 3 indicating the type of work done and, where known, the agent(s) to which they are exposed. This must include, as appropriate, a record of exposure (e.g. resulting from accidents and incidents).

In addition to the measures described for CL-1 and CL-2:

33. The laboratory must be separated from other activities in the same building.
34. The laboratory door should be closed when work is in progress and locked when the room is unoccupied. A biohazard sign should be posted at the entry to the laboratory.
35. There must be an observation window or an alternative (e.g. CCTV) so that occupants can be seen.
36. Side or back fastening laboratory gowns or coats should be worn in the laboratory and removed on leaving it. These should be autoclaved before being sent for laundering. Additional protection, for example, gloves and plastic aprons, should also be made available.
37. Gloves should be worn for all work with infective materials and hands should be washed before leaving the laboratory. Gloves should be washed or preferably removed before touching items that will be touched by others not similarly protected, for example telephone handsets, paperwork. Computer keyboards and, where practicable, equipment controls should be protected by a removable flexible cover that can be disinfected.

38. An autoclave for the sterilisation of items to be recycled and/or waste materials should preferably be situated within the laboratory, but if this is not practicable, then one should be readily accessible in the laboratory suite.
39. A Class I or Class III microbiological safety cabinet (or unit with equivalent protection factor or performance) is the most suitable for laboratory procedures likely to give rise to infectious aerosols. In some cases, equipment which is designed to contain aerosols at source may be in use but its integrity in this respect should be verified before it is accepted as an alternative to containment of the work in a safety cabinet. Where protection of the work is essential (for example cell cultures are in use) and the route of transmission of the agent concerned is primarily percutaneous, a Class II safety cabinet may be used provided that it can be shown to offer operator protection to the appropriate standard under the conditions of use.
40. Safety cabinets must exhaust through a HEPA (High Efficiency Particulate Absorption) filter or equivalent to the outside air or into the laboratory air extract system, and in other respects such as siting, performance in use, protection factor and air filtration, should comply with the performance specifications detailed in the applicable British Standard. If laboratories are faced with a major problem because of difficulties in arranging for the cabinet to exhaust to open air, recirculation of exhaust air through two HEPA filters in series may, in exceptional circumstances, be considered as an alternative. In this case, the maintenance of a continuous airflow into the laboratory during work with infectious material will be of particular importance (see paragraph 44- 47) and such an option should not be adopted without prior consultation with HSE.
41. The laboratory must be sealable to permit decontamination. There may be several ways of achieving decontamination; in practice this has been taken to mean fumigation following a large spillage of material outside of the microbiological safety cabinet or prior to laboratory shutdown for maintenance purposes. Risk assessments should detail spillage decontamination procedures for small and large spillages.
42. The laboratory must contain its own equipment, as far as is reasonably practicable.
43. Where it is not reasonably practicable for the laboratory to contain its own equipment, for example, a deep-freezer, material should be transported in a manner to prevent spillage and in properly labelled robust containers which should be opened only in Containment Level 3 facilities.

### 2.3.1 CL-3 laboratory ventilation systems

44. A CL-3 laboratory must be maintained at an air pressure negative to atmosphere. "Atmosphere" in this context may be taken to mean the external air and/or other parts of the laboratory suite or building. In effect, this means arranging engineering controls such that a continuous inward airflow into the laboratory is maintained but this is generally only necessary when work with biological agents is actually in progress. Provision should be made for comfort factors such as supply of fresh air and temperature control.
45. One of the following means should be adopted to achieve the inward flow of air:
- extracting the laboratory air through independent ducting to the outside air through a HEPA filter (or equivalent);
  - extracting the laboratory air to the outside air with a fan and HEPA filter (or equivalent) sited in a wall or window of the laboratory;
  - ducting the exhaust air from the microbiological safety cabinet to the outside air through a HEPA filter (or equivalent); or
  - a safe variation of these methods.
46. Whichever method is used, maintenance, examination and testing of the system is required. This means that HEPA filters and their fittings and seals must be thoroughly examined and tested at intervals not exceeding 14 months. In practice, depending on the frequency of use, these tests are commonly carried out at shorter intervals, for example, six monthly.
47. In laboratories with a mechanical air supply system, the supply and extract airflows should be interlocked to prevent positive pressurisation of the room in the event of a failure of the extract fan. The ventilation system should also incorporate a means of preventing reverse airflows. The design of systems to achieve the required inward flow of air should aim for simplicity to avoid the chances of failure due to over complicated control mechanisms. Instrumentation should be relevant and sensitive to the factors that contribute to safety. Engineers should be asked to consider as a priority the safety features of the room when arranging heating and ventilation and the disposal of heat generated by equipment. In particular, the influx of cold air and the siting of ventilation outlets and extracts can have a significant effect on the performance of safety cabinets.

### 3. Supplementary containment requirements for work with genetically modified micro-organisms (GMMs) in laboratories and animal facilities.

These measures supplement or in some cases increase the stringency of measures forming the ACDP containment levels. For work with genetically modified animals or plants, please consult the guidance from the Scientific Advisory Committee available via a URL on the Health and Safety Services website - see (1).

#### 3.1 Containment measures for GMMs in laboratories

CONTAINMENT MEASURES	CL-1	CL-2	CL-3
Room			
Isolated Laboratory suite	not required	not required	required
Laboratory sealable for fumigation	not required	not required	required
An observation window or alternative so that occupants can be seen	yes / no (based on risk assessment)	yes / no (based on risk assessment)	required
HEPA filtered lab extract and input air	not required	not required	required for extract only
Entry to lab via air lock	not required	not required	yes / no (based on risk assessment)
Impervious/easy to clean surfaces	required for bench	required for bench	required for bench and floor
Negative pressure relative to the pressure of the immediate surroundings	not required	yes / no (based on risk assessment)	required
Equipment			
Laboratory to contain its own equipment	not required	not required	required

Use of microbiological safety cabinet/enclosure	not required	yes / no (based on risk assessment)	required
Autoclave	required on site	required in building	required in lab suite
System of work			
Access restricted to authorised personnel only	not required	required	required
Specific measures to control aerosol dissemination	not required	required to minimise	required to prevent
Shower	not required	not required	yes / no (based on risk assessment)
Protective clothing	required	required	required
Gloves	not required	yes / no (based on risk assessment)	required
Efficient control of disease vectors (eg for rodents and insects) which could disseminate GMMs	yes / no (based on risk assessment)	required	required
Specified disinfection procedures in place	yes / no (based on risk assessment)	required	required
Written records of staff training	not required	yes / no (based on risk assessment)	required
Safe storage of GMMs	yes / no (based on risk assessment)	required	required
Waste			

Inactivation of GMMs in effluent from handwash basins, showers etc	not required	not required	yes / no (based on risk assessment)
Inactivation of GMMs in contaminated waste and materials	required by validated means	required by validated means	required by validated means within suite
CLASSIFICATION	CLASS 1	CLASS 2	CLASS 3

### 3.2 Containment measures for GMMs in animal units

The measures represent additions or modifications to the requirements for laboratory containment and must be read alongside those measures.

CONTAINMENT MEASURES	CL-1	CL-2	CL-3	Addition/ modification
Isolated animal unit <sup>1</sup>	yes / no (based on risk assessment)	required	required	modification
Animal facilities separated by lockable doors <sup>2</sup>	yes / no (based on risk assessment)	required	required	addition
Animal cages etc designed to facilitate decontamination (waterproof and easily washable material)	yes / no (based on risk assessment)	yes / no (based on risk assessment)	required	addition
Floor and/or walls and ceiling easily washable	yes / no (based on risk assessment)	required for floor	required for floor and walls	modification

Appropriate filters on isolators or isolated rooms <sup>3</sup>	not required	yes / no (based on risk assessment)	required	addition
Incinerator for disposal of animal carcasses	accessible	accessible	accessible	addition
Appropriate barriers at the room exit, at drains and in ventilation ducting	required	required	required	addition
Animals kept in appropriate containment facilities such as cages, pens, tanks but not isolators (see below)	yes / no (based on risk assessment)	yes / no (based on risk assessment)	yes / no (based on risk assessment)	addition
Animals kept in isolators <sup>4</sup>	yes / no (based on risk assessment)	yes / no (based on risk assessment)	required	addition
<b>CLASSIFICATION</b>	<b>CLASS 1</b>	<b>CLASS 2</b>	<b>CLASS 3</b>	

1. "Animal Unit" means a building or separate area within a building containing an animal facility and other areas such as changing rooms, showers, autoclaves, food storage areas etc.
2. "Animal facility" means a facility normally used to house stock, breeding or experimental animals or one which is used for the performance of minor surgical procedures on animals.
3. "Isolators" means transparent boxes where small animals are contained within or outside a cage; for large animals, isolated rooms may be more appropriate.
4. At containment levels 1 & 2 isolators are required where the risk assessment shows they are necessary. They are required at levels 3 & 4 because the risk is much higher. An example of the type of work where animals need to be kept in isolators might be mice and other rodents infected with mycobacterium tuberculosis. You can apply to HSE for a derogation from this requirement giving a full justification and providing details of the alternative containment for example using appropriate air-fed suits in conjunction with appropriate containment facilities such as cages, pens & tanks.

#### 4. Bibliography

1. Health and Safety Services. Biological and Genetic Modification Safety Policy. *Health and Safety Services*. [Online]  
<http://www.bris.ac.uk/safety/biosafety/#policy>.