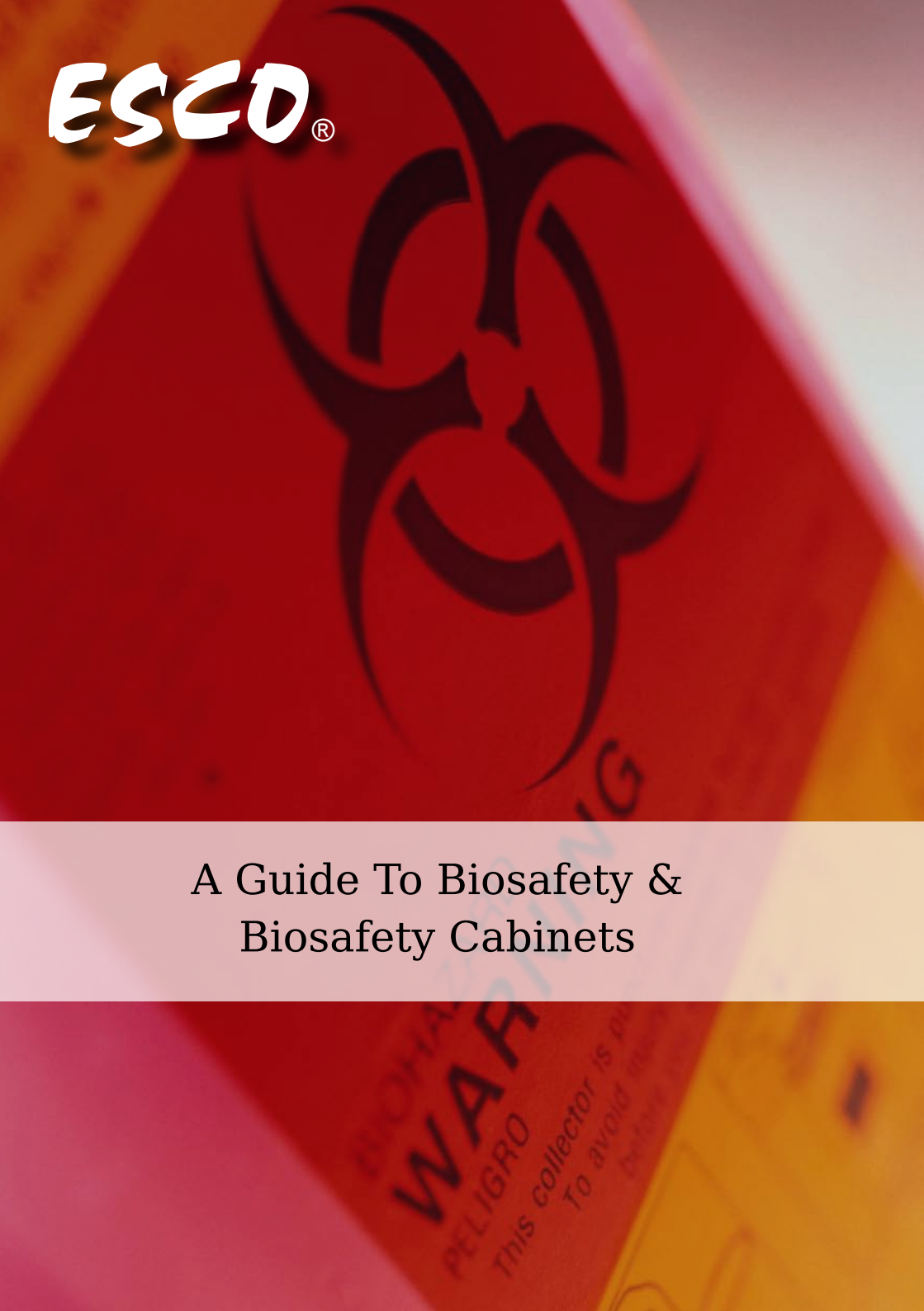


A Guide To Biosafety & Biosafety Cabinets

Foreword

This booklet was developed as a guide to biosafety cabinets that provides basic knowledge of biosafety and biosafety cabinets. The information presented is unbiased and generic in nature compiled with help from experienced microbiologists, engineers and safety enclosure users.

I. Biohazards and Biosafety Levels

The word biohazard is a contraction of the words biological and hazard, and defined as: "an infectious agent, or part thereof, presenting a real or potential risk to the well-being of man, animals and / or plants, directly through infection or indirectly through disruption of the environment."

Biosafety Levels 1 through 4 were established by the Centers for Disease Control (CDC) and the National Institutes of Health (NIH) and are combinations of laboratory practices and techniques, safety equipment and facilities. All of these levels are appropriate for the biohazard posed by the agents used and for the laboratory activity.

Biosafety Level 1

Practices, safety equipment and facilities appropriate for work with defined and characterized strains of viable micro organisms not known to cause disease in healthy adult humans. The laboratory is not necessarily separated from the general traffic patterns in the building. Work is generally conducted on open bench tops using standard microbiological practices. Special containment equipment or facility design is neither required nor generally used. Laboratory personnel have specific training in the procedures conducted in the laboratory and are supervised by a scientist with general training in microbiology or a related science. A biohazard safety cabinet is generally not required for work involving these agents.

Biosafety Level 2

Practices, safety equipment and facilities appropriate for work done with a broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease in varying severity. It differs from biosafety level 1 in that:

a) laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists;
b) access to the laboratory is limited when work is being conducted;
c) extreme precautions are taken with contaminated sharp items; and
d) certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment. A Class I or Class II biohazard safety cabinet is highly recommended for work involving these agents.

Biosafety Level 3

Practices, safety equipment and facilities appropriate for work done with indigenous or exotic agents with a potential for respiratory transmission

which may cause serious and potentially lethal infection. More emphasis is placed on primary and secondary barriers to protect personnel in the contagious area, the community, and the environment from exposure to potentially infectious aerosols. A Class I or Class II biohazard safety cabinet is required for work involving these agents.

Biosafety Level 4

Practices, safety equipment and facilities appropriate for work done with dangerous and exotic agents which pose a high risk of life threatening disease. May be transmitted via the aerosol route, and for which there is no available vaccine or therapy. Members of the laboratory staff have specific and thorough training in handling extremely hazardous infectious agents and they understand the primary and secondary containment functions of the standard and special practices, the containment equipment, and the laboratory design characteristics. They are supervised by competent scientists who are trained and experienced in working with these agents. Access to the laboratory is strictly controlled by the laboratory director. The facility is either in a separate building or in a controlled area within a building, which is completely isolated from all other areas of the building. A specific facility operations manual is prepared or adopted. A Class III biohazard safety cabinet is required for work involving these agents.

From: ***Biosafety in Microbiology and Biomedical Laboratories****, U.S. Department of Health and Human Services, HHS publication (CDC) 99-8395, 4th ed. April 1999. p 11-14.*

Table 1. Summary of Biosafety Levels and Infections Agents

Biosafety Level	Infectious Agents	Examples	Practices and Techniques	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	*Not known to consistently cause disease in healthy adults*	Bacillus subtilis, Naegleria gruberi, Infectious canine, hepatitis virus, E.coli	Standard Microbiological practices	None Required	Open benchtop sink required.
2	*Associated with human disease.* Primary hazards are percutaneous injury, ingestion, mucous membrane exposure	Measles virus, salmonellae, Toxoplasma spp, Hepatitis B Virus.	Level 1 plus: • Limited access • Biohazard warning signs • "Sharps" precautions • Biosafety manual defining any needed waste decontamination or medical surveillance policies • Respiratory protection as required	*Primary barriers:* Class I or II BSCs or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials. *Personal protective equipment*: lab coats,gloves, face protection as needed	Level 1 plus: • Autoclave available
3	Indigenous or exotic agents with potential for aerosol transmission, disease may have serious or lethal consequences	M. Tuberculosis, St. louis encephalitis virus, Coxiella Burnetii, Bacillus anthracis (production level)	Level 2 plus: • Controlled access • Decontamination of waste • Decontamination of lab clothing • Baseline serum samples of lab personnel	*Primary barriers:* Class I or II BSCs or other physical containment devices used for all open manipulations of agents. *Personal protective equipment:* lab clothing, gloves, respiratory protection as needed	Level 2 plus: • Physical separation from access corridors • Self-closing, double door access • Exhaust air not recirculated • Negative airflow into laboratory
4	Dangerous / exotic agents that pose a high risk of life threatening disease. Aerosol-transmitted lab infections or related agents with uknown risk of transmission	Ebola zaire, Sin Nombre Virus, Rift Valley Fever	Level 3 plus: • Clothing change before entry into lab • Shower on exit • All material decontaminated on exit from lab	*Primary barriers:* All procedures conducted in Class III or I or II BSCs in combination with full-body, air-supplied, positive-pressure personnel suit	Level 3 plus: • Separate building or isolated zone • Dedicated supply/ exhaust vacuum, and decontamination systems • Additional requirements as outlined in Biosafety in Microbiological and Biomedical Laboratories

Source: ***Biosafety in Microbiology and Biomedical Laboratories****,U.S. Department of Health and Human Services, HHS publication (CDC) 99-8395, 4th ed. p 52-53.*

II. Biological Safety Cabinets

The terms biological safety cabinet and biosafety cabinet have been widely used to describe a variety of containment devices equipped with HEPA filter(s), designed to provide personnel or both personnel and product protection from biohazardous materials. The terms should only be applied to those devices that meet the requirements of Class I, II, or III specifications, based on their construction, airflow velocities and patterns, and their exhaust systems.

Major International Standards for Biosafety Cabinets :

- American Standard NSF 49:2002
- European Standard EN 12469:2000
- Australian Standard AS 2252
- Japanese Standard JIS K 3800:2000

Table 2. Biohazard Safety Cabinet Classes

Class	Inflow V (m/s)	Recycle Air (%)	Exhaust Air (%)	Control Plenum Surrounded by	Exhaust Alternatives	Biosafety Level
I	US:0.38 EN:0.70	0	100	Outside Air	Inside room / Hard duct	1, 2 & 3
II A1	US:0.38 EN:0.40	70	30	Outside Air	Inside room / Thimble duct	1, 2 & 3
II A2	US:0.50 EN:0.40	70	30	Negative Plenum	Inside room / Thimble duct	1, 2 & 3
II B1	US:0.50 EN:0.40	30	70	Negative Plenum	Hard duct only	1, 2 & 3
II B2	US:0.50 EN:NA	0	100	Negative Plenum	Hard duct only	1, 2 & 3
III	Closed: >50”WC	0	100	Negative Plenum	Inside room / Hard duct	1, 2, 3 & 4

Source*: **Laboratory Biosafety Manual**. Second Edition (revised). Interim guidelines. World Health Organization. p32.*

Class I Biohazard Safety Cabinet

The Class I cabinet has the most basic and rudimentary design of all biohazard safety cabinetry available today. A stream of inward air moving into the cabinet contains aerosols generated during microbiological manipulations. It then passes through a filtration system that traps all airborne particles and contaminants. Finally, clean, decontaminated air is exhausted from the cabinet. The filtration system usually consists of a pre-filter and a HEPA (High Efficiency Particulate Air) filter.

Although the Class I cabinet protects the operator and the environment from exposure to biohazards, it does not prevent samples being handled in the cabinet from coming into contact with airborne contaminants that may be present in room air. Naturally, there is a possibility of cross-contamination that may affect experimental consistency. Consequently the scope and application of Class I cabinets is limited and it is largely considered obsolete.

All Class I biohazard safety cabinets are suitable for work with microbiological agents assigned to biological safety levels 1, 2 and 3.

Class II Biohazard Safety Cabinet

Like Class I safety cabinets, Class II cabinets have a stream of inward air moving into the cabinet. This is known as the inflow and it prevents the aerosol generated during microbiological manipulations to escape through the front opening. However, unlike Class I cabinets, the inflow on Class II cabinets flows through the front inlet grille, near the operator. None of the unfiltered inflow air enters the work zone of the cabinet, so the product inside the work zone is not contaminated by the outside air.

A feature unique to Class II cabinets is a vertical laminar (unidirectional) HEPA-filtered air stream that descends downward from the interior of the cabinet. This continuously flushes the cabinet interior of airborne contaminants and protects samples being handled within the cabinet from contamination and is known as the downflow.

The differences between the various Class II cabinets available lie primarily with the percentage of air exhausted to that of air re-circulated from the common air plenum. In addition, different Class II cabinets have different means of cabinet exhaust. Some cabinets may exhaust air directly back to the laboratory, while others may exhaust air through a dedicated ductwork system to the external environment.

Despite these differences, all Class II cabinets, like Class I cabinets, protect both the operator and environment from exposure to biohazards. In addition, Class II cabinets also protect product samples from contamination during microbiological manipulations within the cabinet interior and are all suitable for work with agents assigned to biological safety levels 1, 2 and 3.

Class II Type A (A1/A2) Biohazard Safety Cabinet

The Class II Type A biohazard safety cabinet is the most common Class II cabinet. It is also the most common safety cabinet of all the different types available. It has a common plenum from which 30% of air is exhausted, and 70% re-circulated to the work area as the downflow.

Type A cabinets exhaust air directly back to the laboratory, and they may contain positive pressure contaminated plenums. When toxic chemicals must be employed as an adjunct to microbiological processes, these cabinets should not be used. Exhaust HEPA filtration only removes airborne aerosols including biohazards, and not chemical fumes.

The Class II Type A1 has the positively-pressurized contaminated plenum bordering the ambient environment, and therefore is less safe than the Class II Type A2 that has a negative pressure surrounding the positively pressurized contaminated plenum. In case there is a leakage on the positive plenum, the leaking aerosol will be pulled by the negative pressure back to the positive plenum, and it wont leak outside. Because of the safety issue, the Type A1 design is now considered obsolete. In the A2 cabinet, about 70% of air from the positive plenum is re-circulated as downflow, and the remaining 30% is discharged to the lab through the exhaust filter.

Fig 2. Class II Type A2 BSC

Class II Type B Biohazard Safety Cabinets

The main difference between Type A and Type B cabinet is: Type B cabinets must be operated with an external blower and it exhausts air to the external environment via a dedicated ductwork system. Without the external blower, the cabinets internal blower will blow the air (and microbiological agents) inside the work zone through the front operator, towards the operators face, creating a dangerous situation. This cabinet is not self-balancing in the sense that its own blower can only create downflow and the cabinet relies on the external blower to create inflow.

On all Type B cabinets, environmental protection may be enhanced by installing a scrubbing system between the exhaust of the biohazard and the final exhaust point outside the building to neutralize the chemical fumes present in exhaust air.

Although Type B cabinets are commonly used when chemicals are involved in your work processes, they theoretically provide an increased level of safety as compared to other Type A cabinets. By exhausting air directly to the external environment, they provide an additional "fail-safe" in the event that the regular exhaust HEPA filtration ceases to function.

Class II Type B1 Biohazard Safety Cabinet

The Class II Type B1 biohazard safety cabinet was originally specified by the American National Cancer Institute. It has a common plenum from which 70% of air is exhausted, and 30% re-circulated to the work area as the downflow.

Type B1 cabinets also have a dedicated exhaust feature that eliminates re-circulation when work is performed towards the back within the interior of the cabinet. Toxic chemicals employed as an adjunct to microbiological processes should only be employed if they do not interfere with work when re-circulated in the downflow.

Class II Type B2 Biohazard Safety Cabinet

In the Class II Type B2 cabinet all inflow and downflow air is exhausted after HEPA filtration to the external environment without recirculation within the cabinet. Type B2 cabinets are suitable for work with toxic chemicals employed as an adjunct to microbiological processes under all circumstances since no re-circulation occurs. In theory, Type B2 cabinets may be considered to be the safest of all Class II biohazard safety cabinets since the total exhaust feature acts as a fail-safe in the event that the downflow and / or exhaust HEPA filtration systems cease to function normally.

Fig 3. Class II Type B2

Class III Biohazard Safety Cabinet

The Class III biohazard safety cabinet provides an absolute level of safety, which cannot be attained with Class I and Class II cabinets. All Class III cabinets are usually of welded metal construction and are designed to be gastight. Work is performed through glove ports in the front of the cabinet. During routine operation, negative pressure relative to the ambient environment is maintained within the cabinet. This provides an additional fail-safe mechanism in case physical containment is compromised.

On all Class III cabinets, a supply of HEPA filtered air provides product protection and prevents cross contamination of samples. Exhaust air is usually HEPA filtered and incinerated. Alternatively, double HEPA filtration with two filters in series may be utilized. Materials are transferred into the cabinet using a pass-through unit installed at the side of the work area. Class III cabinets usually exhaust air back to the laboratory; however, air may also be exhausted via a dedicated ductwork system to the external environment. When a dedicated ductwork system is employed, they are also suitable for work employing toxic chemicals as an adjunct to microbiological processes.

All Class III biohazard safety cabinets are suitable for work with microbiological agents assigned to biological safety levels 1, 2, 3 and 4. They are frequently specified for work involving the most lethal biological hazards.

Fig 4. Class III BSC

HEPA & ULPA Filter

The HEPA filter is the heart of the biosafety cabinet. The HEPA filter is a disposable dry-type filter, constructed of boron silicate microfibers cast into a thin sheet, much like a piece of paper

- HEPA: High Efficiency Particulate Air: Modern "American-convention" HEPA: 99.99% at 0.3 microns
- ULPA: Ultra Low Penetration Air: Modern "American-convention" ULPA: 99.999% at 0.12 microns

HEPA / ULPA filter construction:

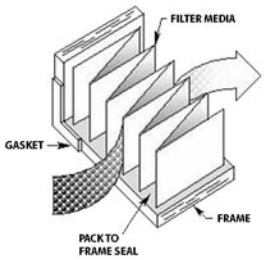


Fig 5. Pack is glued into a frame - Frame is gasketed to form final assembly

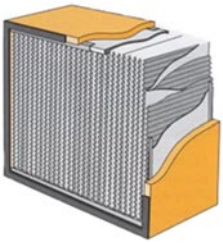


Fig 6. Separator Type

Fig 7. Separatorless Type

HEPA/ULPA filters are designed to remove a broad range of airborne contaminants, including:

- Fine dust
- Smoke
- Bacteria (typical size: 500 to 0.3 micron)
- Soot
- Pollen
- Radioactive particles
- Impurity ion -> can affect Integrated Circuit speed

III. Proper Selection, Installation & Safe Use Of BSCs

A. Selection of A Biological Safety Cabinet

A BSC should be selected primarily in accordance with the type of protection needed: product protection; personnel protection against Risk Group 1–4 microorganisms; personnel protection against exposure to radionuclides and volatile toxic chemicals; or a combination of these. Table 3 shows which BSCs are recommended for each type of protection.

Table 3. Biohazard Safety Cabinet Selection

Type of protection	BSC Selection
Personnel Protection, microorganisms in Risk Groups 1-3	Class I, Class II, Class III
Personnel Protection, microorganisms in Risk Groups 4, glove box laboratory	Class III
Personnel Protection, microorganisms in Risk Groups 4, suit laboratory	Class I, Class II
Product Protection	Class II, Class III only if laminar flow included
Volatile radionuclide / chemical protection, minute amounts	Class IIB1, Class IIA2 vented to the outside
Volatile radionuclide / chemical protection	Class I, Class IIB2, Class III

Source: **Laboratory Biosafety Manual.** Second Edition (revised). Interim guidelines. World Health Organization. p29.

Volatile or toxic chemicals should not be used in BSCs that recirculate exhaust air to the room, i.e. Class I that are not ducted to building exhaust systems, or Class IIA1 or Class IIA2 cabinets. Class II B1 cabinets are acceptable for work with minute amounts of volatile chemicals and radionuclides. A Class IIB2 cabinet, also called a total exhaust cabinet, is necessary when significant amounts of radionuclides and volatile chemicals are expected to be used.

B. Using Biological Safety Cabinets in The Laboratory

1. Location

The velocity of air flowing through the front opening into a BSC is about 0.45 m/s. At this velocity the integrity of the directional air inflow is fragile and can be easily disrupted by air currents generated by people walking close to the BSC, open windows, air supply registers, and opening and shutting doors.

Ideally, BSCs should be situated in a location remote from traffic and potentially disturbing air currents. Whenever possible a 30 cm clearance should be provided behind and on each side of the cabinet to allow easy access for maintenance. A clearance of 30–35 cm above the cabinet may be required to provide for accurate air velocity measurement across the exhaust filter and for exhaust filter changes.

2. Operators

If BSCs are not used properly, their protective benefits may be greatly diminished. Operators need to be careful to maintain the integrity of the front opening air inflow when moving their arms into and out of cabinets. Arms should be moved in and out slowly, perpendicular to the front opening.

Manipulations of materials within BSCs should be delayed for about 1 min after placing hands and arms inside to allow the cabinet to adjust and to "air sweep" the surface of the hands and arms. The number of movements across the front opening should also be minimized by placing all necessary items into the cabinet before beginning manipulations.

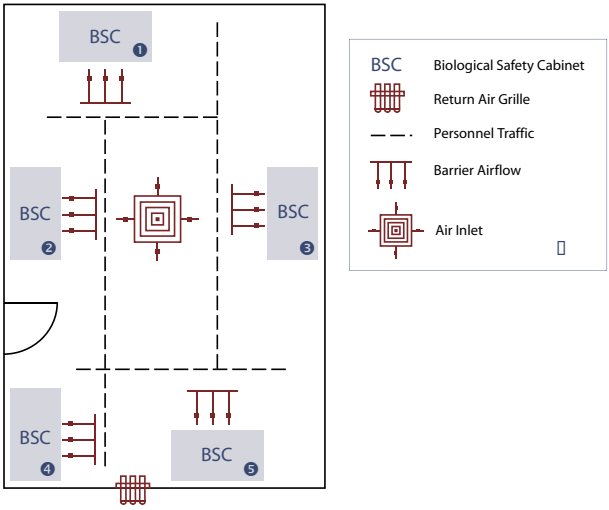


Fig 8. *A typical Class II Cabinet Installation*

3. Material Placement

The front intake grill of Class II BSCs must not be blocked with paper, equipment or other items. Materials to be placed inside the cabinet should be surface-decontaminated with 70% alcohol. Work may be performed on disinfectant-soaked absorbent towels to capture splatters and splashes.

All materials should be placed as far back in the cabinet, towards the rear edge of the work surface, as practical without blocking the rear grill. Aerosol-generating equipment (e.g. mixers, centrifuges, etc.) should be placed towards the rear of the cabinet. Bulky items, such as biohazard bags, discard pipette trays and suction collection flasks should be placed to one side of the interior of the cabinet. Active work should flow from clean to contaminated areas across the work surface.

The autoclavable biohazard collection bag and pipette collection tray should not be placed outside the cabinet. The frequent in-and-out movement needed to use these containers is disruptive to the integrity of the cabinet's air barrier, and can compromise both personnel and product protection.

4. Operation and Maintenance

Most BSCs are designed to permit operation 24 h/day, and investigators find that continuous operation helps to control the levels of dust and particulate materials in the laboratory. Class IIA1 and IIA2 BSCs exhausting to the room or connected by thimble connections to dedicated exhaust ducts can be turned off when not in use. Other types such as IIB1 and IIB2 BSCs, which have hard-duct installations, must have air flow through them at all times to help maintain room air balance.

Cabinets should be turned on at least 5 min before beginning work and after completion of work to allow the cabinet to "purge", i.e. to allow time for contaminated air to be removed from the cabinet environment.

All repairs made on BSCs should be made by a qualified technician. Any malfunction in the operation of the BSC should be reported and repaired before the BSC is used again.

5. Ultraviolet Lights

Ultraviolet lights are not required in BSCs. If they are used, they must be cleaned weekly to remove any dust and dirt that may block the germicidal effectiveness of the light. Ultraviolet light intensity should be checked when the cabinet is recertified to ensure that light emission is appropriate. Ultraviolet lights must be turned off while the room is occupied, to protect eyes and skin from inadvertent exposure.

6. Open Flames

Open flames should be avoided in the near microbe-free environment created inside the BSC. They disrupt the air flow patterns and can be dangerous when volatile, flammable substances are also used. To sterilize bacteriological

loops, micro-burners or electric "furnaces" are available and are preferable to open flames.

7. Spills

A copy of the laboratory's protocol for handling spills should be posted, read and understood by everyone who uses the laboratory. When a spill of biohazardous material occurs within a BSC, cleanup should begin immediately, while the cabinet continues to operate. An effective disinfectant should be used and applied in a manner that minimizes the generation of aerosols. All materials that come into contact with the spilled agent should be disinfected and / or autoclaved.

8. Annual Certification

The functional operation and integrity of each BSC should be certified to national or international performance standards at the time of installation and regularly thereafter by qualified technicians, according to the manufacturer's instructions.

Evaluation of the effectiveness of cabinet containment should include tests for cabinet integrity, HEPA filter leaks, downflow velocity profile, face velocity, negative pressure/ventilation rate, air flow smoke pattern, and alarms and interlocks.

Optional tests for electrical leaks, lighting intensity, ultraviolet light intensity, noise level and vibration may also be conducted. Special training, skills and equipment are required to perform these tests and it is highly recommended that they are undertaken by a qualified professional.

9. Cleaning and Disinfection

All items within BSCs, including equipment, should be surface-decontaminated and removed from the cabinet when work is completed, since residual culture media may provide an opportunity for microbial growth. The interior surfaces of BSCs should be decontaminated before and after each use. The work surfaces and interior walls should be wiped with a disinfectant that will kill any microorganisms that might be found inside the cabinet. At the end of the work day, the final surface decontamination should include a wipe-down of the work surface, the sides, back and interior of the glass. A solution of bleach or 70% alcohol should be used where effective for target organisms. A second wiping with sterile water is needed when a corrosive disinfectant, such as bleach, is used. It is recommended that the cabinet be left running. If not, it should be run for 5 min in order to purge the atmosphere inside before it is switched off.

10. Decontamination

BSCs must be decontaminated before filter changes and before being moved. The most common decontamination method is by fumigation with formaldehyde gas. BSC decontamination should be performed by a qualified professional.

11. Personal protective equipment

Personal protective clothing should be worn whenever using a BSC. Laboratory coats are acceptable for work being performed at Biosafety Levels 1 and 2. A solid front, back-closing laboratory gown provides better protection and should be used at Biosafety Levels 3 and 4 (except for suit laboratories). Gloves should be pulled over the wrists of the gown rather than worn inside. Elasticized sleeves can be worn to protect the investigator's wrists. Masks and safety glasses may be required for some procedures.

12. Alarms

BSCs can be equipped with one of two kinds of alarm. Sash alarms are found only on cabinets with sliding sashes. The alarm signifies that the operator has moved the sash to an improper position. Corrective action for this type of alarm is returning the sash to the proper position. Air-flow alarms indicate a disruption in the cabinet's normal air-flow pattern. This represents an immediate danger to the operator or product. When an air-flow alarm sounds, work should cease immediately and the laboratory supervisor should be notified. Manufacturers' instruction manuals should provide further details. Training in the use of BSCs should cover this aspect.

13. Supplementary Information

Selecting the correct type of BSC, installing it, using it properly and annually certifying its operation are complex processes. It is highly recommended that they proceed under the supervision of a well-trained and experienced biosafety professional. The professional should be highly familiar with the relevant literature listed in the References section, and should have been trained on all aspects of BSCs. Operators should receive formal training in the operation and use of BSCs.

C. Safe Use of Biosafety Cabinets

1. Using BSCs: Startup

- Wear gloves for hand protection
- Load the cabinet with all items required prior to starting work and surface decontaminate
- Surface decontaminate the work surface, side walls and inner back walls
- Allow the work zone air to purge for a few minutes before commencing work
- Do not overcrowd the work zone
- Close the drain valve before operation

2. Using BSCs: Operation

- Do not obstruct the front or back air grilles
- Work as far in to the cabinet as possible
- Minimize arm movement; make slow movements to avoid disrupting cabinet airflow
- When removing arms from cabinet be sure to surface decontaminate first, and move arms out slowly of the cabinet (in direction perpendicular to plane of work zone opening)
- Minimize external airflow disturbances
- Work from "clean to dirty"
- Biohazard collection bags should be placed inside the cabinet instead of outside
- Use absorbent pads on the work surface where appropriate to minimize splatter and aerosol generation in case of a spillage
- Surface decontaminate before removing potentially contaminated items from the interior
- Place aerosol-generating instruments as far in to the interior of the cabinet as possible
- Clean materials should be at least 150mm away from aerosol generating objects to minimize the chance for cross contamination
- Hold lids / covers above dishes / sample plates in order to prevent impingement of downward air
- Do not use a gas flame whenever possible as it interferes with airflow
- Put air turbulence generating equipment such as centrifuge, blender, or sonicator in the back 1/3 of the cabinet

3. Bunsen Burner

Burners can cause an outflow of air from inside the cabinet that can endanger the operator. On Class II cabinets, protection against cross contamination may also be compromised. There have been incidents where the sash of a recirculating Class II safety cabinet was closed while the burner was still on, causing heat build up in the cabinet that damaged the filters.

Bunsen Burner Safety:

1. An electronic burner which automatically reduces the gas supply to maintain a smaller flame during periods of non-use
2. An emergency shut off valve should be easily accessible near to the cabinet in case of an emergency.

3. The burner should be placed as far into the cabinet working space as possible to minimize its effect on cabinet performance.
4. A solenoid valve can be interlocked with the gas supply to automatically shut off the burner

4. Using BSCs: Shutdown

Note: operate the cabinet continuously whenever possible to maximize protection- Surface decontaminate all items

- Seal biohazard bags if used
- Surface decontaminate the cabinet innerside walls, back wall, work surface, drain pan and the inner side of the sliding sash / hinged window
- Allow work zone air to purge
- When available: install front closure or close sash and activate UV lamp (if desired)

5. User maintenance

- Pre-filter replacements once every 3 months
- UV lamp replacement once a year
- Operational verification if appropriate (e.g. Alarm checks, basic airflow measurements etc.)

IV. Biohazard Spills & Cleanup Procedures

A. Inside the BSC:

- Wait at least five minutes to allow the BSC to contain aerosols.
- Wear lab coat, safety glasses and gloves during cleanup.
- Allow cabinet to run during cleanup.
- Apply disinfectant and allow a minimum of 20 minutes contact time.
- Wipe up spillage with disposable disinfectant-soaked paper towel.
- Wipe the walls, work surface and any equipment in the cabinet with a disinfectant-soaked paper towel.
- Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures (e.g. autoclave or BFI).
- Place contaminated reusable items in biohazard bags, autoclavable pans with lids or wrap in newspaper before autoclaving and cleanup.
- Expose non-autoclavable materials to disinfectant (20 minute contact time) before removal from the BSC.
- Remove protective clothing used during cleanup and place in a biohazard bag for autoclaving.
- Run cabinet 10 minutes after cleanup before resuming work or turning cabinet off.

B. Inside the lab, outside the BSC:

- Call the biosafety office if the material is BSL-2 or greater containment.
- Clear area of all personnel. Wait at least 15 minutes for aerosol to settle before entering spill area.
- Remove any contaminated clothing and place in biohazard bag to be autoclaved.
- Put on a disposable gown, safety glasses and gloves.

Initiate cleanup with disinfectant as follows:

1. Place dry paper towel on spill (to absorb liquids); then layer a second set of disinfectant soaked paper towels over the spill.
2. Encircle the spill with additional disinfectant being careful to minimize aerosolization while assuring adequate contact.
3. Decontaminate all items within spill the area.
4. Allow 20 minutes contact time to ensure germicidal action of disinfectant.
5. Wipe equipment with appropriate disinfectant.
6. Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures (e.g., autoclave or BFI).
7. Disinfect reusable items

C. Inside The Centrifuge

- Clear area of all personnel.
- Wait 30 minutes for aerosol to settle before attempting to clean up spill.
- Wear a lab coat, safety glasses and gloves during cleanup.
- Remove rotors and buckets to nearest biological safety cabinet for cleanup.
- Thoroughly disinfect inside of centrifuge.
- Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures (e.g., autoclave or BFI).

D. Outside The Lab, In Transit

- Transport labelled biohazardous material in an unbreakable, well-sealed primary container placed inside of a second unbreakable, lidded container (cooler, plastic pan or pail) labelled with the biohazard symbol.
- Should a spill occur in a public area, do not attempt to clean it up without appropriate personal protective equipment.
- Secure the area, keeping all people well clear of the spill.
- Call professional help to assist in cleanup.
- Stand by during spill response and cleanup activity and provide assistance only as requested or as necessary.

From*: UCSD Biosafety handbook, UCSD EH&S Biosafety Team 1996*.
THE UNIVERSITY OF CALIFORNIA, USA. p95-97.

V. References:

1. **User & Service Manual.** *Labculture® Class II Type A2 Biohazard Safety Cabinet: ESCO Micro Pte Ltd.*
2. **Biosafety in Microbiological and Biomedical Laboratories (BMBL).** *4th Edition. Office of Health and Safety (OHS), Centers for Disease Control and Prevention (CDC). US Department of Health.*
3. **Laboratory Biosafety Manual.** *Second Edition (revised). Interim guidelines. World Health Organization.*
4. **UCSD Biosafety handbook**, *UCSD EH&S Research Community for Biosafety. 1996.*
5. **UCSD Biosafety handbook**, *UCSD EH&S Biosafety Team 1996. THE UNIVERSITY OF CALIFORNIA.*

PRODUCTS AVAILABLE FROM ESCO BIOTECH:

Vertical Laminar Flow Cabinets
Horizontal Laminar Flow Cabinets
PCR Vertical Laminar Flow Cabinets

Class II Biosafety Cabinets
Class III Biosafety Cabinets

Cytotoxic Cabinets
IVF Cabinets
Weighing Cabinets
Animal Handling Workstations

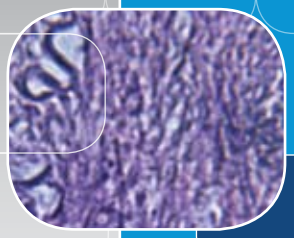
Custom-Made Clean-Air / Containment Workstations

Esco Biotechnology Equipment Division

21 Changi South Street 1
Singapore 486777
tel: +65 6542 0833 fax: +65 6542 6920
email: biotech@escoglobal.com
website: biotech.escoglobal.com

Your local distributor:

©2005 Esco Micro Pte. Ltd.



Airstream®

*Airstream Class II, Biological Safety Cabinet (E-series), Model AC2-4E_*

Class II, Biological Safety Cabinets

The Safety Solution for Life Science Laboratories

ESCO
WORLD CLASS. WORLDWIDE.

Main Features

Unique Esco Dynamic Chamber™ plenum design delivers quiet, uniform airflow.

Negative pressure plenum surrounds contaminated positive pressure plenum; no fabric bags are used.

- Dual, long-life ULPA filters for supply and exhaust airflow.

Esco Sentinel™ microprocessor supervises all cabinet functions.

- Ergonomically angled front improves reach and comfort.
- Actual work opening is 25.4 mm (1") larger than tested sash opening to provide additional work space.

Frameless, shatterproof sash is easier to clean, offers larger, unobstructed viewing area.

- Removable one-piece work surface simplifies cleaning (applicable to AC2-S series and AC2-D series).

E-Series cabinets include multi-piece tray components which lift and remove to provide easy access encourage surface decontamination and can be sterilized inside autoclave.

Raised airflow grille maintains safety by preventing blockage.

Airstream E-Series Class II Biological Safety Cabinet features glass sides to enhance visibility inside the work area. Model AC2-4E_.

Airstream S-Series Class II Biological Safety Cabinet with stainless steel side, Model AC2-4S_.

Airstream AC2 Series Model Number, Side Wall Configuration

Cabinet Size	Glass, E-Series	Stainless Steel S-Series	Stainless Steel, DUO, D-Series
0.6 meters (2')	AC2-2E_	NIL	NIL
0.9 meters (3')	AC2-3E_	AC2-3S_	NIL
1.2 meters (4')	AC2-4E_	AC2-4S_	AC2-4D_
1.5 meters (5')	AC2-5E_	AC2-5S_	NIL
1.8 meters (6')	AC2-6E_	AC2-6S_	AC2-6D_

Note: The last digit of the Model Number _ indicates desired electrical service (60Hz, 50Hz). See the Specification Chart for details. Specify voltage/Hz when ordering.

- Improved lighting is brighter, more uniform, reduces glare.
- Optional UV lamp is located behind control panel away from line of sight; lamp operates on programmable timer.
- Esco ISOCIDE™ antimicrobial surface on all painted surfaces minimizes contamination.
- Integrated RFI and electrical noise filters eliminate interference with and from adjacent equipment.

Airstream Duo, Class II Biological Safety Cabinet with stainless steel side, dual blower motors and dual exhaust filter, Model AC2-4D_.

E-Series with Tempered Glass Side Walls

- Multi-piece work surface removal simplifies cleaning.
- Glass sides increase visibility and prevent the operator from being "boxed-in."

S-Series with Stainless Steel Side Models

- Enhanced side-capture zones and negative pressure side walls optimize containment.
- Interior work area formed from a single piece of stainless steel with large radius corners to simplify cleaning.

D-Series Duo, with Stainless Steel Sides, Dual Blower Motors, Dual Exhaust Filters

- Dual fan design for redundant operation.
- Dual exhaust filters for added safety.
- If one fan fails, the second fan provides minimum containment.

Containment and Protection

- A combination of a supply ULPA filter and an exhaust ULPA filter create a fully integrated performance envelope for product, operator and environmental protection.
- Inflow of room air enters the front air grille to establish operator protection; room air does not enter the work zone, preventing product contamination.
- Raised armrest prevents the likelihood of inflow grille blocking by operator's arms.
- Auto-purge holes located at the front side walls (on AC2-S Series) eliminate eddy currents and dead air pockets in the critical area behind the sash window.
- The inflow velocity, downflow velocity, air flow path and intake geometry are precision tuned and tested to create an optimum air curtain on the front aperture; this curtain maintains personal and product protection even in the unlikely event of a severe inflow or downflow imbalance that would compromise protection in a conventional cabinet.

Integrated Filtration System

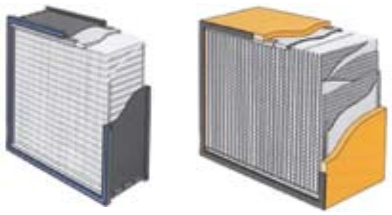
Independent supply and exhaust filters provide 99.999% typical efficiency for particle sizes of 0.1 to 0.3 microns. Airstream filters meet the IEST-RP-CC001.3 recommended practice for ULPA performance (USA), and EN 1822 for H14 performance (EU).

Operator, Product and Environmental Protection

Esco Airstream Class II Biological Safety Cabinets offer a premium level of operator, product and environmental protection with advanced technology at an economical price. Intelligent, ergonomic design enhances productivity, operator comfort, maintenance and utility value. With an extensive track record of safety, reliability and performance, Airstream cabinets make ideal investments for a wide range of general laboratory applications. Airstream biological safety cabinets provide protection against Biosafety Levels 1, 2 and 3,and can be used for handling Biosafety Level 4, provided that the operator wears a positive pressure suit.

- ULPA filters (per IEST-RP-CC001.3), are tested to a typical efficiency of >99.999% for 0.1 to 0.3 micron particles; these provide better filtration capability than conventional H13 HEPA filters that have a typical efficiency of > 99.99% for 0.3 micron particles.
- Modern separatorless mini-pleat filter construction maximizes the filter surface area to extend filter life and eliminate possible filter media damage by thin and sharp aluminum separators used in conventional HEPA filter construction.
- The filter assembly is constructed in accordance with EN1822 requirements.
- The supply filter provides ISO Class 3 (per ISO14644.1) clean air to the work surface in a gentle vertical laminar flow for product protection.
- The exhaust filter traps biohazard particles acquired from the work surface before air is exhausted to the room, offering personal and environmental protection.
- The Airstream Duo includes two exhaust filters to double exhaust protection.
- The exhaust filter media is protected from mechanical damage by an integrated metal screen guard, which is absent from conventional HEPA filters.

Mini-pleat Separatorless Filter (left) vs. Conventional Aluminum Separator Filter (right)



Esco cabinets use Swedish Camfil Farr® mini-pleat filters without aluminum separators to increase filter efficiency, minimize the chance of leakage, and to prolong filter life. Filters include a lightweight aluminum frame for structural stability and elimination of swelling common to conventional wood frames.

Single Blower System, Airstream S-Series and E-Series Models

The AC2 blower system is designed for high performance operation, maximum energy efficiency and minimal maintenance.

- Industry exclusive backward curved, motorized impeller design replaces conventional blowers.
- Improved energy efficiency lowers operating costs.
- Reduced noise and vibration levels over conventional blowers provide a comfortable working environment.
- An integral blower hour meter tracks operating life and aids in predictive maintenance planning.
- Built-in RFI and electrical noise filters eliminate interference with adjacent instrumentation.
- The external rotor motor design allows for optimum cooling of the motor during extended operations and extends the motor bearing life.
- Speed can be adjusted electronically without the need for mechanical adjustment.
- To prevent fan damage, a paper-catch grille traps papers or towels that may drop down on the drain pan, preventing them from being pulled into the column by fan suction.

Dual Blower System, Airstream D-Series Duo Models

The Airstream Duo includes a dual blower system designed for redundancy.

- Dual permanently lubricated direct-drive external rotor motor/blowers assure cabinet safety in the event of a motor failure.
- The external rotor motor design allows for optimum cooling of the motor during extended operations.
- The double blower system assures inherently safe operation if one blower fails.

Front Sash Assembly

The front sash is counterbalanced for convenient one-hand operation.

- The frameless sash eliminates operator's line of sight blockage.
- A generous sash opening allows for easier access into the work zone, provides ample room for transferring of small equipment; see Specifications.
- The sliding window can be fully opened to insert and remove larger instrumentation and equipment.

Sentinel™ Microprocessor Control, Alarm, Monitoring System

The Esco Sentinel™ microprocessor-based control system supervises operation of all cabinet functions.

- The control panel is located on the center of the cabinet, and angled down for easy access by the operator
- Continuous monitoring of cabinet airflow is displayed on a bright, easy-to-read LCD panel. The large display monitors operational parameters.
- A true airflow velocity sensor provide independent measurement of inflow and downflow velocities despite room temperature fluctuation.
- All electronic parts are contained inside a plug-and-play module that permits easy exchange if required.
- Microprocessor software updates are available from Esco for download via the Internet.

Consult your Esco Operating Manual or contact Esco or your Sales Representative for information on user-preference programming capabilities built into the Sentinel microprocessor platform.

Cabinet Construction

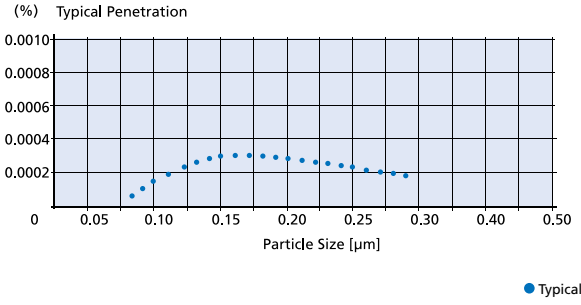
Robust construction and enhanced safety features qualify the cabinet for the most demanding laboratory applications. The cabinet is fully assembled and ready to install and operate when shipped.

- The cabinet work zone has no welded joints to collect contaminants or rust.
- All stainless steel work surfaces are accessible for cleaning.
- S Series cabinets (stainless steel sides) include interior sides and back wall formed from a single piece of stainless-steel with large radius corners to simplify interior cleaning.
- E Series cabinets (tempered glass sides) include multi-piece tray components which lift and remove to provide easy access and to encourage surface decontamination.
- A recessed central area and drain pan channels spills and prevent liquids from entering the lower filtration and blower systems.
- The drain pan is flush with the side walls to eliminate concealed or hard-to-clean spaces.
- There are no screws on the front or sides to trap contaminants or complicate cleaning.
- External surfaces are coated with Esco Isocide™ antimicrobial coating to protect against surface contamination and inhibit bacterial growth. Isocide eliminates 99.9% of surface bacteria within 24 hours of exposure.

Service Fitting Access

The cabinet is prepared for easy installation of optional gas and vacuum fittings; see Accessories.

Esco ULPA Filter Efficiency



Independent supply and exhaust filters provide 99.999% typical efficiency for particle sizes of 0.1 to 0.3 microns. Airstream Series filters meet the IEST-RP-CC001.3 recommended practice for ULPA performance (USA), and EN 1822 for HEPA performance (EU).

Touchpad data entry buttons permit control settings and access to diagnostics, default settings and hierarchical menus.

Color coded indicator lamps display green for primary function (fan operation); blue for secondary function (fluorescent lights and electrical outlet); and orange for caution (UV lamp ON).

Programmable automatic UV light timer simplifies operation, enhances contamination control, extends UV lamp life and saves energy.

A graphical interface indicates cabinet performance.

Digital read-out with alpha-numeric display indicates all input, status and alarm functions.

All functions can be user activated through touch-pad programming access; see Operations Manual.

Sentinel Microprocessor Control System, Programmable

When programmed ON

- *the start-up sequence confirms status with Air Safe and local time display.*
- *the Personal Identification Number (PIN) access restricts unauthorized adjustments.*
- *an airflow alarm warns of deviations from normal velocities.*

- Optional service fittings openings are offset for easier access.

Comfortable Ergonomic Design

The cabinet is engineered for comfort, utility value and safety.

- The angled viewing window and narrow profile front grille improves reach into the work area.
- The instant-start 5000k fluorescent lamp operates on an electronic ballast to reduce heat, improve comfort and conserve energy.
- The lamp delivers uniform lighting to the work surface for greater comfort, reduced glare and improved productivity; see Specifications.
- The front armrest is raised above the work zone to improve comfort and to minimize blockage of forward airflow perforations.
- The optional adjustable support stand provides work surface height control.
- The frameless sash eliminates operator's line of sight blockage.
- A generous sash opening allows for easier access into the work zone, provides ample room for transferring of small equipment; see Specifications.
- The sliding window can be fully opened to insert and remove larger instrumentation and equipment.

Electrical Safety and Certification

All components meet or exceed applicable safety requirements.

- Each cabinet is individually factory tested for electrical safety.
- Documentation specific to each cabinet serial number is maintained on file.
- Certified to major world standards for microbiological safety cabinets, including the EN12469 (refer to technical specifications for the full list).
- Contact Esco or your Sales Representative for site preparation information; see Electrical Specifications.

Warranty

Airstream AC2 Series cabinets are warranted for 3 years excluding consumable parts and accessories.

- Each cabinet is shipped with a comprehensive User's Manual complete with a report documenting all test procedures.
- Additional IQ/OQ/PQ documentation is available upon request.
- Contact your local Sales Representative for specific warranty details or documentation requests.

Accessories and Options

Esco offers a variety of options and accessories to meet local applications. Contact Esco or your local Sales Representative for ordering information.

Support Stands

- Fixed height, available 737 mm (29") or 838 mm (33"), ±38.1 mm (1.5")
  - With leveling feet
  - With casters
- Adjustable height, hydraulic range 737 mm (29") to 838 mm (33")
  - With casters
- Telescoping height stand, nominal range 737 mm (29") or 838 mm (33")
  - Adjustable in 25.4 mm (1") increments
- Infinitely adjustable cradle stand, with casters
  - Elevates to seating or standing work surface height
  - When lowered permits movement through standard doorway

Note: Increases exterior dimensions

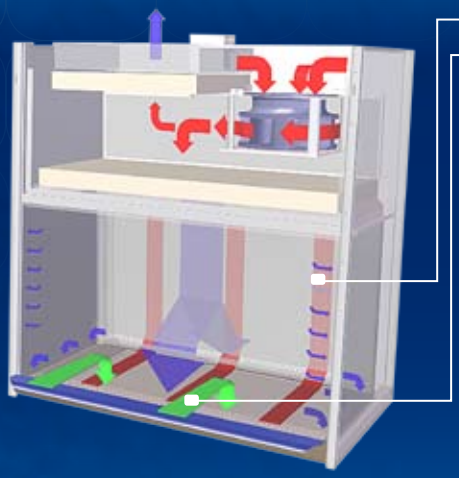
Electrical Outlets and Utility Fixtures

- Electrical outlet, ground fault, North America
- Electrical outlet, Europe / Worldwide
- Petcock (air, gas, vacuum)
  - North America (American) style
  - Europe / Worldwide style DIN 12898, DIN 12919, DIN 3537

Cabinet Accessories

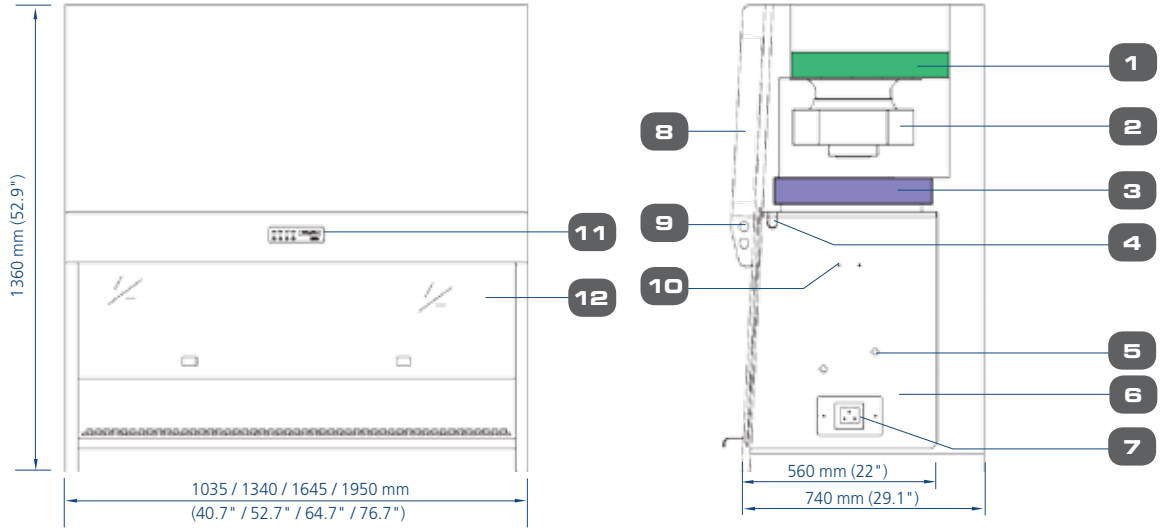
- Germicidal UV lamp
  - Controlled by automatic UV lamp timer through Sentinel™ microprocessor control panel
  - Emission of 253.7 nanometers for most efficient decontamination

Cabinet Filtration System
Stainless Steel Side Walls/ Tempered Glass

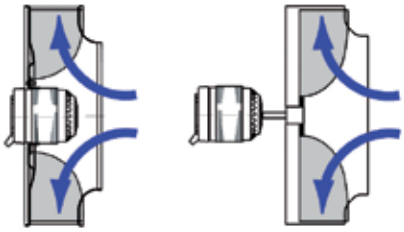


- Ambient air is pulled through the perforations located towards the work zone front to prevent contamination of the work surface and work product. The inflow does not mix with the clean air within the cabinet work zone. Inflow air travels through a return path toward the common air plenum (blower plenum) at the top of the cabinet.
- The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.
- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones at a higher velocity (small blue arrows).
- A combination of inflow and downflow air streams forms an air barrier that prevents contaminated room air from entering the work zone, and prevents work surface emissions from escaping the work zone.
- Air returns to the common air plenum where the 35% exhaust and 65% recirculation process is continued.

Airstream Model AC2 (E-Series) Biological Safety Cabinet Technical Specifications, Stainless Steel Side Walls



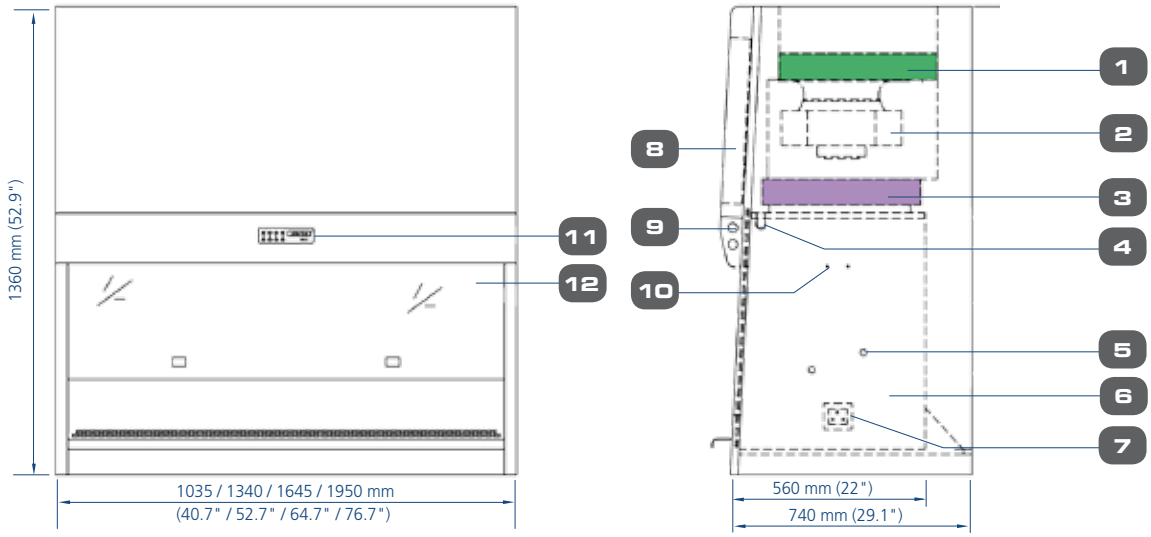
1. *Exhaust ULPA filter*
2. *Blower*
3. *Downflow ULPA filter*
4. *Standard UV light Retrofit Kit Provision*
5. *Plugged service fixture provisions (2 on each side)*
6. *Stainless steel work zone*
7. *Electrical outlet Retrofit Kit provision (2 & 3 ft model - only 1 single outlet in work zone left side wall)*
8. *Electrical panel*
9. *Fluorescent lamp*
10. *IV bar Retrofit Kit provision*
11. *Esco Sentinel microprocessor control system*
12. *Sash window*



Esco Centrifugal Fan with External Rotor Motor (left) vs. Conventional Fan with Standard Motor (right)

- *Esco Airstream cabinets use a combination of high performance scroll blowers (supply) and German made **ebm-papst**® permanently lubricated, centrifugal motor/blowers with external rotor designs (exhaust).*
- *Selected for energy efficiency, compact design, and flat profile, the completely integrated exhaust blower assembly optimizes motor cooling, with unified rotating parts and overall component balance for smooth, quiet, vibration-free operation.*
- *Weight is equally distributed to all bearings to extend bearing life, transfer heat and maximize speed control.*

Airstream Model AC2 (S-Series) Biological Safety Cabinet Technical Specifications, Stainless Steel Side Walls



1. *Exhaust ULPA filter*
2. *Blower*
3. *Downflow ULPA filter*
4. *Standard UV light Retrofit Kit Provision*
5. *Plugged service fixture provisions (2 on each side)*
6. *Stainless steel work zone*
7. *Electrical outlet Retrofit Kit provision (2 & 3 ft model - only 1 single outlet in work zone left side wall)*
8. *Electrical panel*
9. *Fluorescent lamp*
10. *IV bar Retrofit Kit provision*
11. *Esco Sentinel microprocessor control system*
12. *Sash window*

(cont.)

- Lamp is positioned away from operator line of sight for safety and proper exposure to interior surfaces.

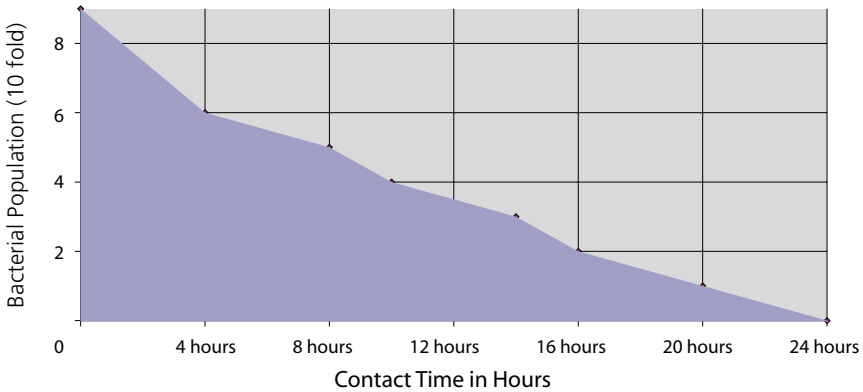
- PVC armrest
  - Chemically treated, improves operator comfort, easy to clean. 712 mm (28") standard size.
- Ergonomic lab chair
  - Laboratory grade construction, meets Class 100 cleanliness; alcohol resistant PVC materials
  - Adjustable 395-490 mm (15.6"-19.3")
- Ergonomic foot rest
  - Angled, helps maintain proper posture
  - Adjustable height
  - Anti-skid coating, chemical resistant finish
- IV bar, with hooks
  - Stainless steel construction
  - Available for all standard Esco cabinets
- Microscope viewing device
  - Mounting and viewing pouch integrated into sash. Factory installed; specify when ordering.

Microbiological Testing

Esco performs testing in accordance with more than 10 of the world's most recognized standards for local, regional and international criteria.

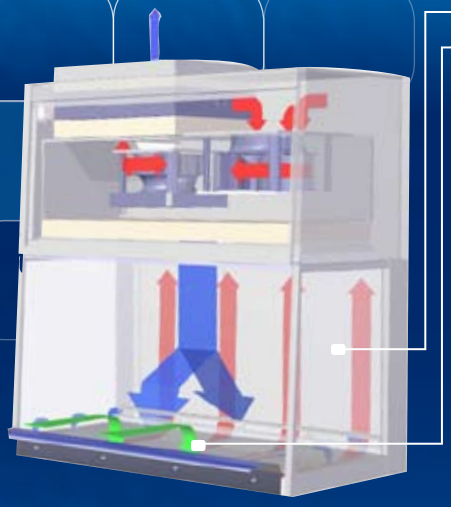
Testing in our microbiology laboratory is conducted according to NSF/ANSI 49: 2004, EN12469:2000, and JIS K3800:2005. An NSF-accredited biohazard cabinet field certifier is available in-house full-time to supervise all testing work, using harmless Bacillus atrophaeus (formerly Bacillus Subtilis) bacteria that is used to challenge the cabinet, then incubated

ISOCIDE™ Antimicrobial Powder-Coating



All exterior painted surfaces are powder-coated with Esco Isocide, an antimicrobial inhibitor to minimize contamination. Isocide is integrated into the coating substrate and cannot wash out or diminish by repeated cleaning. Performance results are available upon request. Contact Esco or your Esco Sales Representative for details.

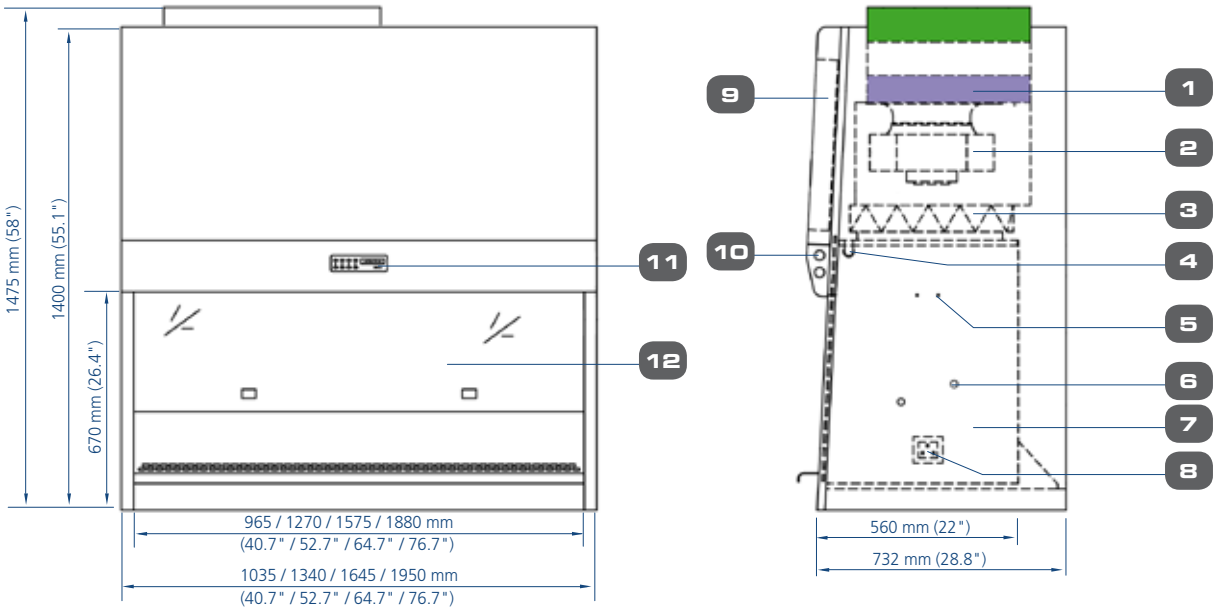
Cabinet Filtration System (Duo, Stainless Steel Side Walls)



- Ambient air is pulled through the perforations located towards the work zone front to prevent contamination of the work surface and work product. The inflow does not mix with the clean air within the cabinet work zone. Inflow air travels through a return path toward the common air plenum (blower plenum) at the top of the cabinet.
- Dual blowers and dual exhaust filters provide an added measure of protection. If the primary blower fails, the secondary blower still pushes the air across the exhaust filters to maintain inflow and containment.
- Approximately 35% of the air in the common plenum is exhausted through the ULPA filter to the room. The remaining 65% of the air is passed through the downflow ULPA filter and into the work area as a vertical laminar flow air stream bathing the work surface in clean air.
- The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.
- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones at a higher velocity (small blue arrows).
- A combination of inflow and downflow air streams forms an air barrier that prevents contaminated room air from entering the work zone, and prevents work surface emissions from escaping the work zone.
- Air returns to the common air plenum where the 35% exhaust and 65% recirculation process is continued.

ULPA-filtered air
Unfiltered / potentially contaminated air
Room air / Inflow air

Airstream Duo Model AC2 (D-Series) Biological Safety Cabinet Technical Specifications, Stainless Steel Side Walls, Dual Blowers



1. *Exhaust ULPA filter*
2. *Blower*
3. *Downflow ULPA filter*
4. *Standard UV light Retrofit Kit Provision*
5. *IV bar Retrofit Kit provision*
6. *Plugged service fixture provisions (2 on each side)*
7. *Stainless steel work zone*
8. *Electrical outlet Retrofit Kit provision (2 & 3 ft model - only 1 single outlet in work zone left side wall)*
9. *Electrical panel*
10. *Fluorescent lamp*
11. *Esco Sentinel microprocessor control system*
12. *Tempered glass sash window*

General Specifications, Airstream Class II, Biological Safety Cabinets (E-Series)

Note to customer: Insert electrical voltage number into last model number digits _ when ordering

Model		AC2-2E_	AC2-3E_	AC2-4E__	AC2-5E__	AC2-6E__
Nominal Size		0.6 meters (2')	0.9 meters (3')	1.2 meters (4')	1.5 meters (5')	1.8 meters (6')
External Dimensions (W x D x H)		730 x 740 x 1435 mm 28.7 " x 29.1" x 56.5"	1035 x 740 x 1360 mm 40.7" x 29.1" x 52.9"	1340 x 740 x 1360 mm 52.7" x 29.1" x 52.9"	1645 x 740 x 1360 mm 64.7" x 29.1" x 52.9"	1950 x 740 x 1360 mm 76.7" x 29.1" x 52.9"
Internal Work Area, Dimensions (W x D x H)		660 x 560 x 670 mm 26.0" x 22.0" x 26.4"	965 x 560 x 670 mm 38.0" x 22.0" x 26.4"	1270 x 560 x 670 mm 50.0" x 22.0" x 26.4"	1575 x 560 x 670 mm 62.0" x 22.0" x 26.4"	1880 x 560 x 670 mm 74.0" x 22.0" x 26.4"
Internal Work Area, Space		0.29 m^2 (3.1 sq.ft)	0.43 m^2 (4.6 sq.ft)	0.58 m^2 (6.2 sq.ft)	0.73 m^2 (7.7 sq.ft)	0.87 m^2 (9.3 sq.ft)
Average Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint, audible/visual alarm will activate at 0.40 m/s (80 fpm)				
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than +/- 20%				
Airflow Volume	Inflow	185 m^3/h (109 cfm)	270 m^3/h (159 cfm)	356 m^3/h (209 cfm)	441 m^3/h (260 cfm)	527 m^3/h (310 cfm)
	Downflow	423 m^3/h (249 cfm)	563 m^3/h (331 cfm)	741 m^3/h (436 cfm)	919 m^3/h (591 cfm)	1096 m^3/h (645 cfm)
	Exhaust	185 m^3/h (109 cfm)	270 m^3/h (159 cfm)	356 m^3/h (209 cfm)	441 m^3/h (260 cfm)	527 m^3/h (310 cfm)
ULPA Filter Typical Efficiency	Downflow	>99.999% at 0.1 to 0.3 microns as per IEST-RP-CC001.3 USA >99.995% at MPPS as per EN 1822 (H-14) EU				
	Exhaust					
Sound Emission (Typical)	NSF 49	<65 dBA	<64 dBA	<65 dBA	<65 dBA	<66 dBA
	EN 12469	<62 dBA	<61 dBA	<62 dBA	<62 dBA	<63 dBA
Fluorescent Light Intensity At Zero Ambient		>900 Lux (> 84 foot candles)	>1130 Lux (>105 foot candles)	>1280 Lux (>119 foot candles)	>1050 Lux (>97 foot candles)	>1220 Lux (>113 foot candles)
Cabinet Construction	Main Body	1.2 mm (0.06") 16 gauge electrogalvanized steel with white oven-baked epoxy Isocide antimicrobial powder coated finish				
	Work Zone	1.5 mm (0.06") 16 gauge stainless steel, type 304, with 4B finish				
	Side Walls	UV absorbing tempered glass, 5 mm (0.2"), colorless and transparent				
Electrical*	220-240V, AC, 50Hz, 1ø	AC2-2E1	AC2-3E1	AC2-4E1	AC2-5E1	AC2-6E1
	110-130V, AC, 60Hz, 1ø	AC2-2E2	AC2-3E2	AC2-4E2	AC2-5E2	AC2-6E2
	220-240V, AC, 60Hz, 1ø	AC2-2E3	AC2-3E3	AC2-4E3	AC2-5E3	AC2-6E3
Net Weight**		160 kg (353 lbs)	177 kg (390 lbs)	277 kg (611 lbs)	270 kg (595 lbs)	300 kg (661 lbs)
Shipping Weight**		187 kg (412 lbs)	230 kg (507 lbs)	322 kg (710 lbs)	326 kg (718 lbs)	354 kg (780 lbs)
Shipping Dimensions, Maximum (W x D x H)**		850 x 860 x 1750 mm 33.5" x 33.9" x 68.9"	1140 x 890 x 1715 mm 44.9" x 35" x 67.5"	1440 x 860 x 1650 mm 56.7" x 33.9" x 65"	1750 x 860 x 1650 mm 68.9" x 33.9" x 65"	2060 x 860 x 1680 mm 81.1" x 33.9" x 66.1"
Shipping Volume, Maximum**		1.28 m^3 (45.6 cu.ft.)	1.6 m^3 (57 cu.ft.)	2.04 m^3 (72 cu.ft.)	2.48 m^3 (88 cu.ft.)	2.98 m^3 (105 cu.ft.)

* *Additional voltages may be available; contact Esco for ordering information.*
** *Cabinet only; excludes optional stand*

for 48 hours and the Colony Forming Units (CFU) are counted to determine the testing results. Increased microbiological challenge tests with objects inside the cabinet work zone, Bunsen burner, external airflow disturbance, and Human-As-Mannequin test adapted from Fume Hood development were performed to simulate real-world conditions.

Personnel Protection Test

The test objective is to evaluate the safety of the cabinet for the personnel operating on potentially hazardous samples in the cabinet work zone.

- A nebulizer containing 55 mL of 5 to 8 x 10^8 spores/mL B.atrophaeus spores is placed inside the work zone, 10 cm (4") behind the front opening sash.
- Target slit air samplers and impingers are placed outside the work zone to capture possibly escaping B.atrophaeus spores, then the sample is incubated.
- Acceptance: The number of Bacillus atrophaeus CFU recovered from the agar plates shall not exceed 10 CFU per test.

Product Protection Test

The test objective is to determine cabinet protection to the product/samples inside the cabinet work zone from environmental contaminants.

- A nebulizer containing 55 mL of 5 to 8 x 10^6 spores/mL B.atrophaeus is placed at 10 cm (4") in front of sash window.
- Target agar plates are placed throughout the entire work surface.
- Acceptance: The number of Bacillus atrophaeus CFU recovered from the agar plates shall not exceed 5 CFU per test.

Cross Contamination Test

The test objective is to evaluate cabinet protection from cross contamination of samples placed simultaneously inside the work zone.

- A nebulizer containing 55 mL of spores (5 to 8 x 10^4/mL) is placed against one of the work zone sidewalls.
- Target agar plates are placed 360 mm (14") away from the same side wall

General Specifications, Airstream Class II, Biological Safety Cabinets (S-Series)					
Note to customer: Insert electrical voltage number into last model number digits _ when ordering					
Model		AC2-3S_	AC2-4S_	AC2-5S_	AC2-6S_
Nominal Size		0.9 meters (3')	1.2 meters (4')	1.5 meters (5')	1.8 meters (6')
External Dimensions (W x D x H)		1035 x 740 x 1360 mm 40.7" x 29.1" x 52.9"	1340 x 740 x 1360 mm 52.7" x 29.1" x 52.9"	1645 x 740 x 1360 mm 64.7" x 29.1" x 52.9"	1950 x 740 x 1360 mm 76.7" x 29.1" x 52.9"
Internal Work Area, Dimensions (W x D x H)		965 x 560 x 670 mm 38.0" x 22.0" x 26.4"	1270 x 560 x 670 mm 50.0" x 22.0" x 26.4"	1575 x 560 x 670 mm 62.0" x 22.0" x 26.4"	1880 x 560 x 670 mm 74.0" x 22.0" x 26.4"
Internal Work Area, Space		0.43 m^2 (4.7 sq.ft)	0.58 m^2 (6.2 sq.ft)	0.73 m^2 (7.7 sq.ft)	0.87 m^2 (9.3 sq.ft)
Average Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint, audible/visual alarm will activate at 0.40 m/s (80 fpm)			
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than +/- 20%			
Airflow Volume	Inflow	270 m^3/h (159 cfm)	356 m^3/h (209 cfm)	441 m^3/h (260 cfm)	527 m^3/h (310 cfm)
	Downflow	563 m^3/h (331 cfm)	741 m^3/h (436 cfm)	919 m^3/h (591 cfm)	1096 m^3/h (645 cfm)
	Exhaust	270 m^3/h (159 cfm)	356 m^3/h (209 cfm)	441 m^3/h (260 cfm)	527 m^3/h (310 cfm)
ULPA Filter Typical Efficiency	Downflow	>99.999% at 0.1 to 0.3 microns as per IEST-RP-CC001.3 USA >99.995% at MPPS as per EN 1822 (H-14) EU			
	Exhaust				
Sound Emission (Typical)	NSF / ANSI 49	<64 dBA	<65 dBA	<65 dBA	<66 dBA
	EN 12469	<61 dBA	<62 dBA	<62 dBA	<63 dBA
Fluorescent Light Intensity At Zero Ambient		>1040 Lux (>97 foot candles)	>1190 Lux (>111 foot candles)	>920 Lux (>85 foot candles)	>1020 Lux (>95 foot candles)
Cabinet Construction	Main Body	1.2 mm (0.06") 16 gauge electrogalvanized steel with white oven-baked epoxy Isocide antimicrobial powder coated finish			
	Work Zone	1.5 mm (0.06") 16 gauge stainless steel, type 304, with 4B finish			
	Side Walls	1.2 mm (0.05") 18 gauge stainless steel, type 304			
Electrical*	220-240V, AC, 50Hz, 1ø	AC2-3S1	AC2-4S1	AC2-5S1	AC2-6S1
	110-130V, AC, 60Hz, 1ø	AC2-3S2	AC2-4S2	AC2-5S2	AC2-6S2
	220-240V, AC, 60Hz, 1ø	AC2-3S3	AC2-4S3	AC2-5S3	AC2-6S3
Net Weight**		180 kg (397 lbs)	218 kg (481 lbs)	295 kg (650 lbs)	305 kg (672 lbs)
Shipping Weight**		230 kg (507 lbs)	292 kg (644 lbs)	426 kg (939 lbs)	354 kg (780 lbs)
Shipping Dimensions, Maximum (W x D x H)**		1130 x 860 x 1650 mm 44.5" x 33.9" x 65.0"	1440 x 860 x 1650 mm 56.7" x 33.9" x 65"	1750 x 860 x 1650 mm 68.9" x 33.9" x 65"	2100 x 950 x 1880 mm 82.7" x 37.4" x 74.0"
Shipping Volume, Maximum**		1.6 m^3 (57 cu.ft.)	2.04 m^3 (72 cu.ft.)	2.48 m^3 (88 cu.ft.)	3.75 m^3 (132 cu.ft.)

* *Additional voltages may be available; contact Esco for ordering information.*
** *Cabinet only; excludes optional stand.*

- Acceptance: The number of Bacillus atrophaeus CFU recovered on agar plates shall not exceed 2 CFU per test.

KI Discus Containment Test According to EN 12469:2000 (Potassium Iodide)

Esco is currently one of the few companies in the world equipped to perform the KI Discus test for our customers. The KI Discus test is defined in the European Standard for microbiological safety cabinets, EN12469:2000, as a test method for validating the operator/personnel protection capabilities of the cabinet.

- The KI Discus test shows excellent correlation with the microbiological test method for operator protection, and is useful for validating the actual containment performance of the cabinet on-site.
- The KI-Discus takes only 45 minutes as opposed to 2 days for microbiological testing.
- Thus, each Esco Airstream FC2 model is type tested using the KI Discus method for operator safety.

	For Microbiological Safety Cabinets*	For Air Quality	For Filtration	For Electrical Safety
Standards Compliance	Type-tested to EN 12469:2000, Europe	ISO 14644.1 Class 3, Worldwide IEST-G-CC1001, USA IEST-G-CC1002, USA	IEST-RP-CC034.1, Worldwide IEST-RP-CC007.1, Worldwide IEST-RP-CC001.3, Worldwide EN 1822, Europe	IEC 61010-1, Worldwide EN 61010-1, Europe UL 61010A-1, USA CAN/ CSA C22.2 No. 61010-1, Canada

* *For details on most recent certifications contact Esco or your Esco Sales Representative.*

General Specifications, Airstream Class II, Biological Safety Cabinets (D-Series)

Note to customer: Insert electrical voltage number into last model number digits _ when ordering

Model		AC2-4D_	AC2-6D_
Nominal Size		1.2 meters (4')	1.8 meters (6')
External Dimensions (W x D x H)		1340 x 740 x 1475 mm 52.8" x 29.1" x 58"	1950 x 740 x 1360 mm 76.7" x 29.1" x 52.9"
Internal Work Area, Dimensions (W x D x H)		1270 x 560 x 670 mm 50" x 22.0" x 26.4"	1880 x 560 x 670 mm 74.0" x 22.0" x 26.4"
Internal Work Area, Space		0.58 m^2 (sq.ft)	0.87 m^2 (9.3 sq.ft)
Average Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint, audible/visual alarm will activate at 0.40 m/s (80 fpm)	
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than +/- 20%	
Airflow Volume	Inflow	270 m^3/h (159 cfm)	527 m^3/h (310 cfm)
	Downflow	563 m^3/h (331 cfm)	1096 m^3/h (645 cfm)
	Exhaust	270 m^3/h (159 cfm)	527 m^3/h (310 cfm)
ULPA Filter Typical Efficiency	Downflow	>99.999% at 0.1 to 0.3 microns as per IEST-RP-CC001.3 USA >99.995% at MPPS as per EN 1822 (H-14) EU	
	Exhaust		
Sound Emission (Typical)	NSF / ANSI 49	<65.5 dBA	<66 dBA
	EN 12469	<62.5 dBA	<63 dBA
Fluorescent Light Intensity At Zero Ambient		>1200 Lux (>111.5 foot candles)	>1020 Lux (>95 foot candles)
Cabinet Construction	Main Body	1.5 mm (0.06") 16 gauge electrogalvanized steel with white oven-baked epoxy Isocide antimicrobial powder coated finish	
	Work Zone	1.2 mm (0.06") 16 gauge stainless steel, type 304, with 4B finish	
	Side Walls	1.2 mm (0.05") 18 gauge stainless steel, type 304	
Electrical*	220-240V, AC, 50Hz, 1ø	AC2-4D1	AC2-6D1
	110-130V, AC, 60Hz, 1ø	AC2-3D2	AC2-6D2
	220-240V, AC, 60Hz, 1ø	AC2-3D3	AC2-6D3
Net Weight**		223.5 kg (492.7 lbs)	305 kg (672 lbs)
Shipping Weight**		245.5 kg (541.2 lbs)	354 kg (780 lbs)
Shipping Dimensions, Maximum (W x D x H)**		1500 x 950 x 1880 mm 59" x 37.4" x 74"	2100 x 950 x 1880 mm 82.7" x 37.4" x 74"
Shipping Volume, Maximum**		2.68 m^3 (96.4 cu.ft.)	3.75 m^3 (132 cu.ft.)

* *Additional voltages may be available; contact Esco for ordering information.*
** *Cabinet only; excludes optional stand*

Comprehensive Performance Testing At Esco

Every Airstream model manufactured by Esco is individually tested, documented by serial number and validated with the following test methods.

- *Inflow / downflow velocity*
- *PAO aerosol challenge for filter integrity*
- *Light, noise and vibration*
- *Airflow pattern visualization*
- *Electrical safety to IEC61010-1*
- *Additional microbiological testing is performed on statistical sampling basis.*

ESCO Airstream® E-Series Class II Biosafety Cabinet - 2 feet version

Independently type-tested by Health Protection Agency (Porton Down, UK) to the EN 12469, European Standard for Class II biosafety cabinets, Esco Airstream® Class II biosafety cabinets are now available in compact 2ft widths, designed for laboratories with space constraints.

This model features many key innovations for which Esco is recognized for: ***mini-pleat separatorless ULPA filter technology****, the best product protection in the world, microprocessor-based control system, external rotor motors, superior filter mechanical construction.*

Esco Airstream® Class II biosafety cabinets are equipped with ***ULPA filters (typical efficiency of 99.9998% at 0.3 microns)*** *that offer a significantly higher efficiency than conventional HEPA filters (99.99% at 0.3 microns) used by most other manufacturers.*

MAIN FILTRATION AGENTS

➠ **ISO Class 3 air cleanliness** within workzone as per ISO 14644.1 (equivalent to Class 1 as per the US Federal Standard 209E, **100 times cleaner** than the usual Class 100 classification on cabinets offered by the competition).

➠ **Minipleat separatorless ULPA filter technology**, operating at the typical efficiency of **99.9999% at MPPS, 0.3 and 0.12 microns** provides better operator, product and environmental protection than conventional HEPA filters. This cabinet employs 2 ULPA filters, 1 for downflow and 1 for exhaust airflow filtration.

CABINET CONTROL SYSTEM

➠ **Esco Sentinel™ Microprocessor Cabinet Control System** allows the user to easily access all cabinet functions. The control system monitors and displays cabinet airflow constantly on the control LCD screen, prompting the user with audible and visual alarms in case of any unsafe condition.

➠ Fail-safe system ensures that in case of airflow failure, the cabinet automatically shuts down to ensure safety to the user and the environment.

➠ True airflow velocity (both for downflow and inflow velocity) sensing technology, with temperature compensation for improved sensor accuracy.

➠ Audible and visual alarms for low airflow, unsafe sash positions.

➠ Automatic warm-up cycle is enabled upon turning on the cabinet, ensuring all contaminants are purged from the cabinet workzone before the operator can use the cabinet. All menu functions are inactive during this period. Automatic post-purge cycle is also enabled at shutdown, ensuring all residue contaminants are purged out of the workzone before deactivation.

➠ **An admin PIN** can be set to restrict unauthorized access to all menu functions.

ERGONOMIC FEATURES

➠ **Ergonomic sloped front design** allows for maximum visibility into the workzone.

➠ **The frameless tempered glass sliding front sash** and tempered glass sidewalls provide a greater visibility into the workzone.

➠ **Built-in 5000k fluorescent lighting** offers excellent illumination throughout the workzone. **Electronically-ballasted lighting system** is instant-start, non-flickering and energy-efficient.

➠ **Cabinet armrest** is raised above the workzone to ensure that the operator's arms do not block the front inflow perforations. (*Optional* PVC soft armrest-padding available upon request. Refer to our Accessories catalogue.)*

CABINET BODY CONSTRUCTION

➠ All components designed for maximum chemical resistance for long service life and durability. All cabinet components are cleanroom compatible.

➠ Industrial-grade main body constructed of electrogalvanised steel: with an abrasion-resistant white oven-baked powder-coated finish. Attractive two-piece stainless steel work trays are easy to remove for purposes of cleaning and auto-claving.

➠ Permanently lubricated direct drive centrifugal blower(s); **energy efficient external rotor motor** type design reduces operating costs; extremely low noise and vibration levels (less than 60dBA at working position) due to proprietary construction and mounting technology.

➠ **The cabinet's airflow is self-regulating***:* the motor / blower system is able to compensate automatically to maintain airflow as the filter is loaded with particulates.

➠ Built-in solid state variable speed controller(s) (infinitely adjustable from zero to the maximum setting) with built-in RFI and noise filters is superior to conventional "step" controllers.

➠ **Superior electrical safety for the operator**; all electrical components are UL listed or UL recognized; all cabinets are factory tested for electrical safety after production at manufacturing site.

➠ Designed to meet the general safety requirements of the IEC 61010-1 / EN 61010-1 / UL 61010A-1 / CSA C22.2 No. 1010.1-92.

OPTIONAL ACCESSORIES

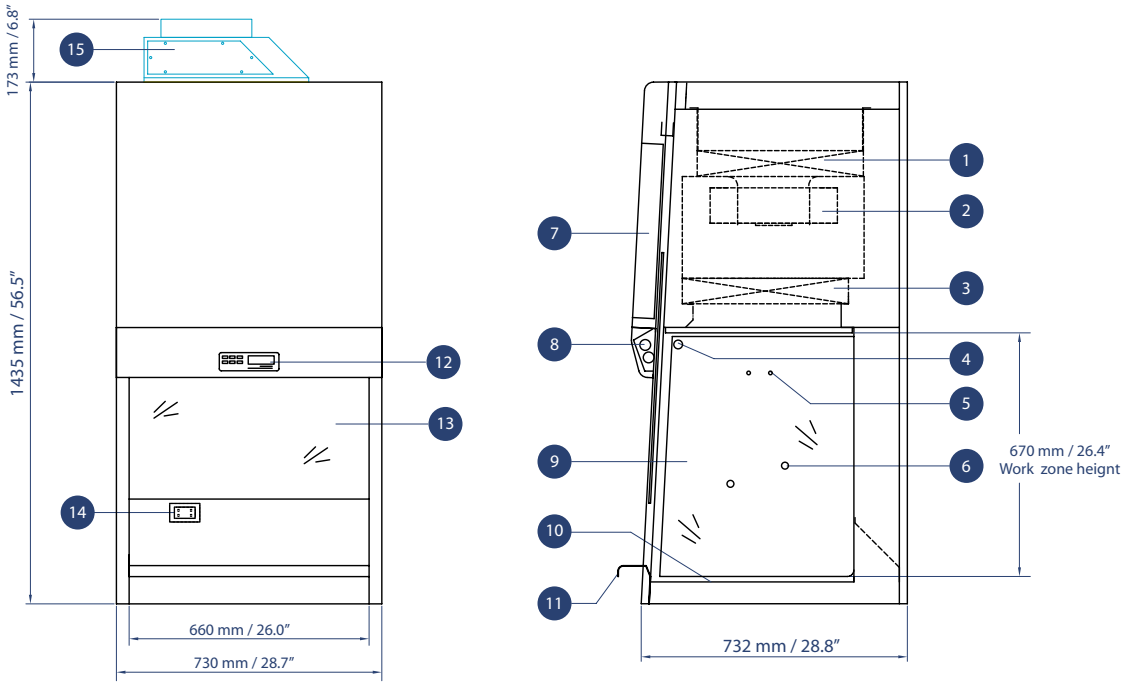
Support Stand with castor wheels or levelling feet. Cabinet construction allows for the cabinet to be lifted directly on to our *optional* support stand (available with castor wheels or levelling feet).

Exhaust collar for non-airtight thimble ducting of the cabinet.

For other optional and ergonomic accessories, check our catalogue:
http://biotech.escoglobal.com/PDF/optErgAcc.pdf

Technical Specifications and Engineering Diagram

Esco Catalogue Revision No: AC2.2ft.v1.12.2005
Specifications subject to change without notice.
©2005 Esco Micro Pte. Ltd.



1. Exhaust ULPA Filter ***2.*** Blower ***3.*** Downflow ULPA Filter ***4.*** UV Light Retrofit Kit™ Provision ***5.*** IV Bar Retrofit Kit™ Provision
6. Service Fixture Retrofit Kit™ Provisions (2 One Each Side) ***7.*** Electrical & Electronics Panel ***8.*** Fluorescent Lamps
9. Tempered Glass Sidewalls ***10.*** Stainless Steel Divided Work Tray (2pcs) ***11.*** Stainless Steel Armrest
12. Esco Sentinel™ Microprocessor Control System ***13.*** Tempered Glass Sliding Sash
14. Electrical Outlet Retrofit Kit™ Provision ***15.*** *Optional* Exhaust Collar

General Specifications			AC2-2EX
External Dimensions (L x W x H)			730 x 732 x 1435 mm / 28.7" x 28.8" x 56.5"
Internal Work Zone (L x W x H)			660 x 560 x 670 mm / 26.0" x 22.0" x 26.4"
Standards Compliance			**EN 12469:2000 type-tested (exceeds requirements for Class II microbiological safety cabinets**) Air cleanliness: ISO 14644.1 Class 3, IEST-G-CC1001, IEST-G-CC1002 and other equivalent requirements Filter performance: IEST-RP-CC034.1, IEST-RP-CC007.1, IEST-RP-CC001.3 and EN1822 Electrical safety: IEC 61010-1 / EN 61010-1 / UL 3101-1 / CSA C22.2 No. 1010.1-92
Average Airflow Velocities		Inflow	Initial setpoint: 0.45 m/s or 90 fpm (audible / visual alarm will activate at 0.4m/s or 80fpm)
		Downflow	Initial setpoint: 0.31 m/s or 61 fpm (uniformity is +/-20%)
Airflow Volumes At Initial Airflow Velocity Setpoints		Inflow	159 cmh / 94 cfm
		Downflow (70%)	384 cmh / 226 cfm
		Exhaust (30%)	159 cmh / 94 cfm
Cleanliness Within Working Area			ISO 14644.1 Class 3, US Federal Standard 209E Class 1 / M1.5, AS 1386 Class 1.5, JIS B9920 Class 3, BS5295 Class C, Class M10,000 as per KS 27030.1 and equivalent classes of VDI 2083 and AFNOR X44101
Downflow and Exhaust Filter Type			ULPA filter with integral metal guards and filter frame gaskets; fully compliant with EN 1822 and IEST-RP-CC001.3 requirements (each cabinet has individual downflow and exhaust filters)
Filter Efficiency Ratings			Minimum: 99.9995% at 0.3µm / 99.9994% at 0.12µm / 99.9991% at MPPS Typical: 99.9999% at 0.3µm / 99.9999% at 0.12µm / 99.9998% at MPPS
Noise Level			Typically <60 dBA at initial blower speed setting, according to EN 12469:2000 (subject to acoustic properties of test environment)
Light Intensity			>750 Lux / >70 foot candles, (measured at work surface level (zero background) as per NSF49 test grid)
Main Body Construction			1.5mmt / 0.06" / 16 gauge electro-galvanized steel with white oven-baked epoxy powder-coated finish
Side Wall Construction			Colourless and transparent UV-absorbing 5mm / 0.2" tempered glass
Work Surface Construction			1.2 mmt / 0.05" / 18 gauge stainless steel grade 304 with BA finish
Maximum Power Consumption / Current	220-240VAC / 50Hz 1Ph	Cabinet Power / Current	300W / 1.5A
		Outlet Power / Current	1000VA / 5A
	110-130VAC / 60Hz 1Ph	Cabinet Power / Current	385W / 3.5A
		Outlet Power / Current	500VA / 5A
Net Weight (Approximate)			160 kgs / 352 lbs
Max Shipping Weight			240 kgs / 530 lbs
Max Shipping Dimensions (L x W x H)			885 x 917 x 1690 mm / 34.8" x 36.1" x 66.5"
Max Shipping Volume			1.37 cbm / 48.4 cbf

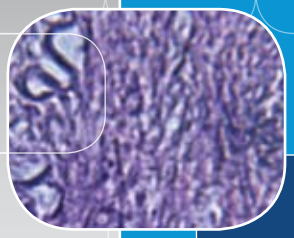
Esco Biotechnology Equipment Division

Esco Biotech is a highly focused manufacturer of laminar flow, biohazard safety and other HEPA-filtered cabinets for the laboratory with a history of quality cabinets since 1978. We are predominantly oriented towards the international marketplace, with sales in more than 70 countries and 90% of turnover exported. Our products have been independently tested to standards such as AS1807.5 and EN12469. Products are manufactured under an ISO 9001 registered quality system.

ISO 9001 REGISTERED FIRM | ISO 14001 REGISTERED FIRM

Your local distributor:

21 Changi South Street 1 · Singapore 486 777 · Tel: +65 6542 0833 · Fax: +65 6542 6920 · Email: biotech@escoglobal.com · biotech.escoglobal.com



NSF 49, UL 61010, JIS K3800, SFDA YY-0569, EN 12469, SANS 12469

Labculture Class II, Type A2
Biosafety Cabinet, Model LA2-4A_.

Labculture®

Class II, Type A2 Biological Safety Cabinets

The Safety Solution for Life Science Laboratories

ESCO
WORLD CLASS. WORLDWIDE.

Main Features

- Unique Esco Dynamic Chamber™ plenum.
- Negative pressure plenum surrounds contaminated positive pressure plenum; no fabric bags are used.
- Dual, long-life ULPA filters for supply and exhaust (per IEST-RP-CC001.3) with 99.999% efficiency for particle size between 0.1 to 0.3 microns.
- Angled supply filter matches cabinet profile to achieve best downflow uniformity.
- Esco Sentinel™ microprocessor.
- Frameless, shatterproof sash is easier to clean.
- Ergonomically angled front improves reach and comfort.
- Actual work access height is 45 mm (1.8") higher than tested sash opening.
- Removable one-piece work surface simplifies cleaning.
- Raised airflow grille maintains safety by preventing blockage.
- Optional UV lamp is located behind control panel away from line of sight. (Does not apply to 1.8 m / 6' models.)
- Esco ISOCIDE™ antimicrobial coating on all painted surfaces minimizes contamination.
- Enhanced side-capture zones optimize containment.
- Work area on Esco 0.9 meter (3') cabinet is equivalent to work area offered on larger 1.2 meter (4') conventional cabinet.

Each cabinet is KI-Discus tested for performance integrity. Available in 0.9, 1.2, 1.5 and 1.8 meter models (3', 4', 5' and 6'). Shown with optional telescoping stand.

NSF 49, UL 61010, JIS K3800, SFDA YY-0569, EN 12469, SANS 12469

Esco Labculture has passed more performance tests in more languages, for more certifications throughout more countries than any other biological safety cabinet in the world.

Operator, Product and Environmental Protection

The Esco Labculture Class II, Type A2 Biosafety Cabinet provides operator, product and environmental protection against Biosafety Levels 1, 2 and 3. This cabinet can be used for handling Biohazard Level 4, provided that the operator wears positive pressure suit.

Containment and Protection

The airflow ratio of 63% recirculation to 37% exhaust increases operator protection beyond the 70%/30% ratio of conventional biological safety cabinets.

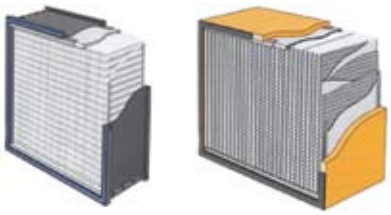
- The inflow and downflow balance is precisely established by an external exhaust damper and is adjustable without decontaminating the cabinet.
- Inflow of room air enters the front air grille to establish operator protection; room air does not enter the work zone, preventing product contamination.
- The front grille has proportionally larger perforations on the extreme left and right side. Combined with the side air gap between the work tray and the side wall, the stronger side capture zones increase protection in this critical area where contaminants tend to bleed out in conventional cabinets.
- The convex inflow grille maintains operator protection by discouraging users from placing objects on it.
- Auto-purge holes located at the front side walls eliminate eddy currents and dead air pockets in the critical area behind the sash window. Per NSF/ANSI 49 requirement, these side perforations do not extend completely to the work surface to prevent accidental liquid spills in the work zone from entering the side air column.
- The ULPA downflow (supply) filter is tilted proportional to the cabinet front angle to direct more air forward to the front air grille.
- The inflow velocity, downflow velocity, air flow path, and intake geometry are precision tuned and tested to create an optimum air curtain on the front aperture; this curtain maintains personnel and product protection even in the unlikely event of a severe inflow or downflow imbalance that would compromise protection in a conventional cabinet.

Integrated Filtration System

A combination of a supply ULPA filter and an exhaust ULPA filter give the Labculture cabinet a fully integrated performance envelope for product, operator and environmental protection.

- ULPA filters (per IEST-RP-CC001.3), are tested to a typical efficiency of >99.999% for 0.1 to 0.3 micron particles; these provide better filtration capability than conventional HEPA filters that have a typical efficiency of >99.99% for 0.3 micron particles.

Mini-pleat Separatorless Filter (left) vs. Conventional Aluminium Separator Filter (right)



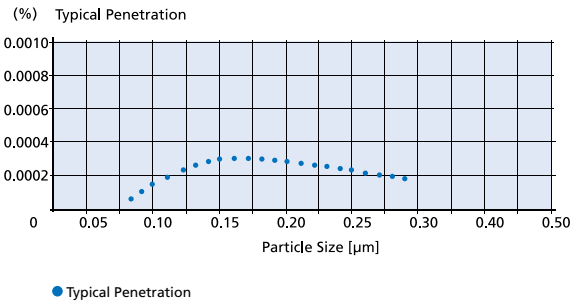
Esco cabinets use Swedish Camfil Farr® mini-pleat filters without aluminum separators to increase filter efficiency, minimize the chance of leakage, and to prolong filter life. Filters include a lightweight aluminum frame for structural stability and elimination of swelling common to conventional wood frames.

- Modern separator-less mini-pleat filter construction maximizes the filter surface area to extend filter life and eliminate possible filter media damage by thin and sharp aluminum separators used in conventional HEPA filter construction.
- The filter frame and media is constructed in accordance with EN1822 requirements for fire retardant properties.
- The supply ULPA filter provides ISO Class 3 (per ISO14644.1) clean air to the work surface in a gentle vertical laminar flow for product protection.
- The exhaust ULPA filter traps biohazard particles acquired from the work surface before air is exhausted to the room, offering personnel and environmental protection.
- The exhaust filter media is protected from mechanical damage by an integrated metal screen guard, which is absent from conventional HEPA filters.
- The top cabinet surface is slanted to discourage users from placing objects which could block the exhaust filter and reduce inflow velocity.

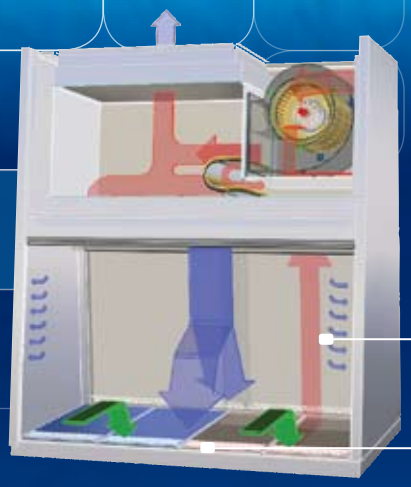
Front Sash Assembly

- Integrated sash proximity contacts sense proper sash position, serve as an interlock for the UV lamp, and activate an alarm if the sash is improperly positioned.
- The magnetic switch eliminates the chance of wear and tear typical of a mechanical switch.
- The back of the sash can be easily cleaned by removing the sash track cover and swinging up the sash glass.
- The sash is counterbalanced for smooth, lightweight operation.

Esco ULPA Filter Efficiency



Esco cabinets use ULPA filters (per IEST-RP-CC001.3) instead of conventional HEPA filters commonly found in biological safety cabinets. While HEPA filters offer 99.99% typical efficiency at 0.3 micron level, ULPA filters provide 99.999% typical efficiency for particle sizes of 0.1 to 0.3 micron level.



ULPA-filtered air
Unfiltered / potentially contaminated air
Room air / Inflow air

Cabinet Filtration System

Side capture zones

Dynamic air barrier, inflow and forward-directed downflow air converge

- Ambient air is pulled through the perforations located towards the work zone front to prevent contamination of the work surface and work product. The inflow does not mix with the clean air within the cabinet work zone. Inflow air travels through a return path toward the common air plenum (blower plenum) at the top of the cabinet.
- Approximately 35% of the air in the common plenum is exhausted through the ULPA filter to the room. The remaining 65% of the air is passed through the downflow ULPA filter and into the work area as a vertical laminar flow air stream bathing the work surface in clean air.
- The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.
- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones at a higher velocity (small blue arrows).
- A combination of inflow and downflow air streams forms an air barrier that prevents contaminated room air from entering the work zone, and prevents work surface emissions from escaping the work zone.
- Air returns to the common air plenum where the 35% exhaust and 65% recirculation process is continued.

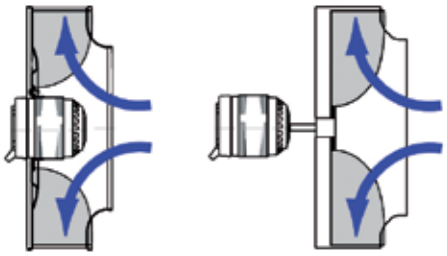
- The counterbalance locking mechanism is inherently safe; it locks the counterbalance in place if either of the 2 cables is detached. The sash cable and cable clip have rated strength of more than 6 times the weight of the sash window of the largest Labculture Class II cabinet (1.8 meter / 6 ft. model).
- The safety glass maintains containment if the sash is accidentally broken during cabinet operation.

Blower Efficiency

The Labculture blower system is designed for high performance operation, maximum energy efficiency and minimal maintenance.

- The external rotor motor design allows for optimum cooling of the motor during extended operations and extends the motor bearing life.
- The blower/motor can maintain airflow for a 150% increase in pressure loss over clean filters without manual speed control adjustment, or 210% increase in pressure drop across the filter with manual speed control adjustment. (Applies to 1.2 meter / 4 ft. model; contact Esco for information on other models.)
- The permanently lubricated direct-drive external rotor motor/blower reduces operating costs.
- Built-in RFI and electrical noise filters eliminate interference with adjacent instrumentation.
- An integral blower hour meter tracks operating life for predictive maintenance planning.
- To prevent fan damage, a paper-catch grille traps papers or towels that may drop down on the drain pan, preventing them from being pulled into the column by fan suction.

Esco Centrifugal Fan with External Rotor Motor (left) vs. Conventional Fan with Standard Motor (right)



- *Esco cabinets use German made **ebm-papst**® permanently lubricated, centrifugalmotor/ blowers with external rotor designs.*
- *Integrated blades narrow the profile and eliminate need for a motor shaft.*
- *Motors are selected for energy efficiency, compact design, and flat profile. The completely integrated assembly optimizes motor cooling.*
- *All rotating parts are unitized and balanced for smooth, quiet, vibration-free operation.*

Sentinel Microprocessor Control, Alarm, Monitoring System

The Esco Sentinel™ microprocessor-based control system supervises operation of all cabinet functions.

- The control panel is located on the center of the cabinet, and angled down for easy access by the operator
- Continuous monitoring of cabinet airflow is displayed on a bright, easy-to-read LCD panel.
- An integrated, temperature-compensated, true airflow velocity sensor provides an accurate airflow reading despite room temperature fluctuation.
- All electronic parts are contained inside a plug-and-play module that permits easy exchange if required.
- Microprocessor software updates are available from Esco for download via the Internet.

Sentinel functions are factory set to default to ON or OFF, depending on worldwide destination and local preferences. Default settings can be user activated through the touchpad data entry access.

- Automatic start-up sequence will prepare the cabinet for normal operation and advise when safe conditions are established.
- An administrator controlled PIN (Personal Identification Number) can be set to restrict access to main menu.

Touchpad data entry buttons permit control settings and access to diagnostics, default settings and hierarchical menus.

Color coded indicator lamps display green for primary function (fan operation); blue for secondary function (fluorescent lights and electrical outlet); and orange for caution (UV lamp ON).

Programmable automatic UV light timer simplifies operation, enhances contamination control, extends UV lamp life and saves energy.

A graphical interface indicates cabinet performance.

Digital read-out with alpha-numeric display indicates all input, status and alarm functions.

All functions can be user activated through touch-pad programming access; see Operations Manual.

Sentinel Microprocessor Control System, Programmable

When programmed ON

- *the start-up sequence confirms status with Air Safe and local time display.*
- *the Personal Identification Number (PIN) access restricts unauthorized adjustments.*
- *an airflow alarm warns of deviations from normal velocities.*

- The airflow alarm can be activated or deactivated depending on user preference and nature of the work.

Consult your Esco Operating Manual or contact your Sales Representative for information on user-preference programming capabilities built into the Sentinel microprocessor platform.

Cabinet Construction

Robust construction and enhanced safety features qualify the cabinet for the most demanding laboratory applications. The cabinet is fully assembled and ready to install and operate when shipped.

- The interior work area is formed from a single piece of stainless-steel with large radius corners to simplify cleaning.
- The cabinet work zone has no welded joints to collect contaminants or rust.
- All stainless steel work surfaces are accessible for cleaning.
- Tray components lift and remove to provide easy access and encourage surface decontamination.
- A recessed central area and stainless steel drain pan channels spills and prevent liquids from entering the lower filtration and blower systems.
- The drain pan is flush with the side walls to eliminate concealed or hard-to-clean spaces.
- There are no screws in on the front or sides to trap contaminants or complicate cleaning.
- Optional service fittings are offset for easier access.
- External plumbing is concealed behind trim panels to maintain aesthetics.
- External surfaces are coated with Esco Isocide™ antimicrobial coating to protect against surface contamination and inhibit bacterial growth. Isocide eliminates 99.9% of surface bacteria within 24 hours of exposure.

Robust Cabinet Construction and Enhanced Safety Features

Service fixtures are offset for easier reach. Standard cabinets include two fixture provisions on each sidewall (one provision on each sidewall for 0.9 meter/3 ft. cabinet). Electrical outlets are mounted below service fixtures to minimize obstructions.

Helpful for certifiers, the hinged maintenance assembly opens to a fixed position on integrated, gas spring struts providing front service access.

All key components, with the exception of the blower/motor assembly, are mounted outside the air stream and away from contaminated air to permit service without decontamination. These include fluorescent lamps, UV lamp, electrical harnesses, electronic boards and microprocessor control.

Panels enclosing potentially hazardous areas or components such as microbiological contamination or electrical shock are color-coded red to warn service technician.

The telescoping Dynamic Chamber™ plenum minimizes physical lifting and accelerates filter change when required.

Work area containment is maintained even when removable components are lifted out for cleaning.

The one piece stainless steel work tray edges are radiused and easy to clean without crevices or joints.

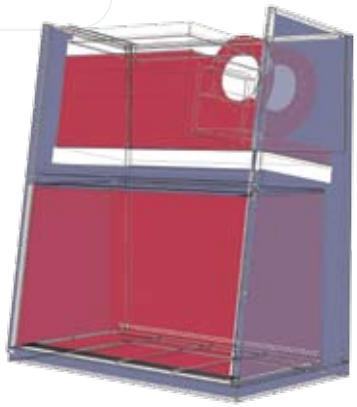
The lower drain trough is a single-piece fabrication with wide open angles and a channel to direct spills to the drain.

The closed sidewall contains no perforations, air return slots or other hidden areas where contaminants can accumulate.

Standards Compliance	Biosafety Cabinets	Air Quality	Filtration	Electrical Safety
	NSF / ANSI 49, USA* EN 12469, Europe JIS K 3800, Japan SFDA YY-0569, China	ISO 14644.1, Class 3, Worldwide JIS B9920, Class 3, Japan JIS BS5295, Class 3, Japan US Fed Std 209E, Class 1 USA	EN-1822 (H14), Europe IEST-RP-CC001.3, USA IEST-RP-CC007, USA IEST-RP-CC034.1, USA	UL-C-61010A-1, USA CSA22.2, No.1010-192, Canada EN-61010-1, Europe IEC61010-1, Worldwide

** Please refer to the specifications table on page 8 for the model listing.*

Dynamic Chamber™ Plenum Design



Negative pressure Positive pressure

The Esco triple-wall design creates a Dynamic Chamber plenum which surrounds contaminated areas with negative pressure, preventing the possibility of contamination from leaks in filter seal, gasket or cabinet structure. The third wall conceals utilities.

Comfortable Ergonomic Design

The LA2 cabinet is engineered for comfort, utility value and safety.

- The 10° angled viewing window and narrow profile front grille improves reach into the work area.
- The instant-start 5000k fluorescent lamp operates on an electronic ballast to reduce heat, improve comfort and conserve energy.
- The lamp delivers uniform lighting to the work surface for greater comfort, reduced glare and improved productivity; see Technical Specifications.
- The front armrest is raised above the workzone to improve comfort and to ensure that the operator's arms do not block the forward airflow perforations.
- The optional adjustable support stand provides work surface height control.
- The frameless sash eliminates operator's line of sight blockage
- A generous sash opening allows for easier access into the work zone, provides ample room for transferring of small equipment.
- The sliding window can be fully opened to insert and remove larger instrumentation and equipment.

Electrical Safety and Certification

All components meet or exceed applicable safety requirements.

- Each cabinet is individually tested for electrical safety at factory.
- Documentation specific to each cabinet serial number is maintained on file.
- UL Listed for USA and Canada.
- Certified to all major world standards for biological safety cabinets, including the NSF / ANSI 49 and EN 12469 (refer to Standards Compliance table on this page for the full list).
- Contact Esco or your Sales Representative for site preparation information; see Electrical Specifications.

Warranty

The Labculture cabinet is warranted for 3 years excluding consumable parts and accessories.

- Each cabinet is shipped with a comprehensive user's manual complete with a report documenting all test procedures.
- Additional IQ/OQ/PQ documentation is available upon request.
- Contact your local Sales Representative for specific warranty details or documentation requests.

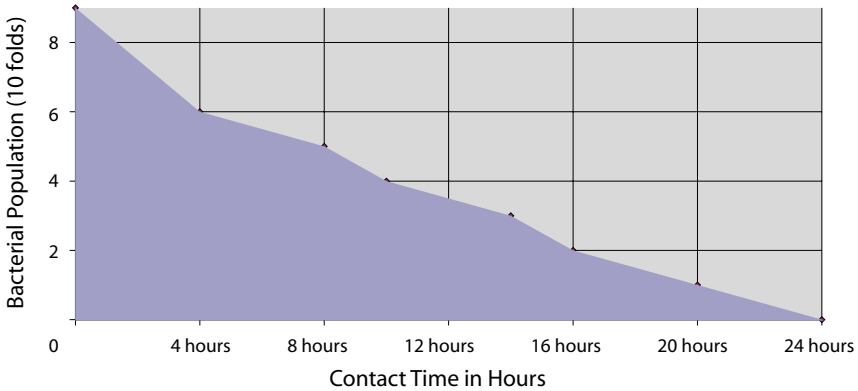
Accessories and Options

Esco offers a variety of options and accessories to meet local applications. Contact Esco or your local Sales Representative for ordering information.

Support Stands

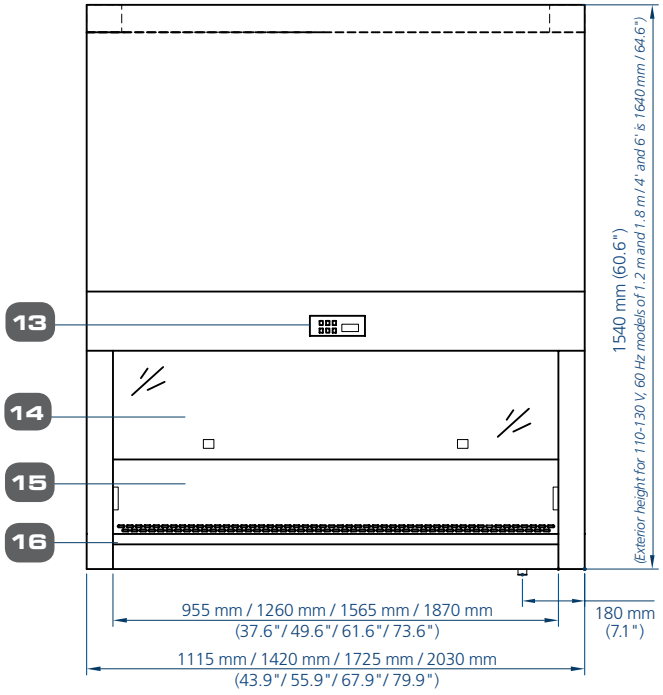
- Fixed height, available 711 mm (28") or 864 mm (34"), ±38.1 mm (1.5")
  - With leveling feet
  - With casters
- Adjustable height, hydraulic range 711 mm to 864 mm (28" to 34")
  - With leveling feet
  - With casters
- Telescoping height stand for leveling feet, nominal range 660 mm or 960 mm (26" or 37.8")
- Telescoping height stand for casters, nominal range 660 mm or 880 mm (26" or 34.6")
  - Adjustable in 25.4 mm (1") increments

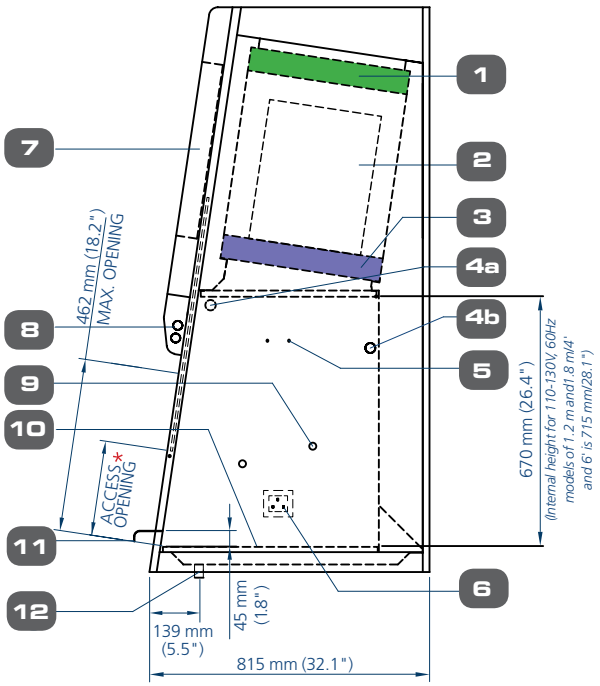
ISOCIDE™ Antimicrobial Powder-Coating



All exterior painted surfaces are powder-coated with Esco Isocide, an antimicrobial inhibitor to minimize contamination. Isocide is integrated into the coating substrate and cannot wash out or diminish by repeated cleaning. Performance results are available upon request. Contact Esco or your Esco Sales Representative for details.

Model LA2 Biological Safety Cabinet Technical Specifications

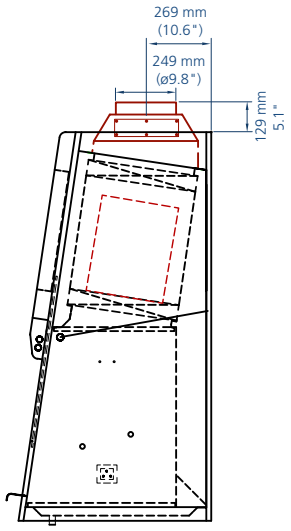




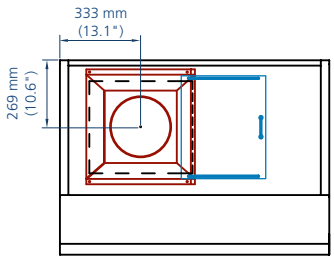
*Cabinet Size	0.9 meter (3')	1.2 meter (4')	1.5 meter (5')	1.8 meter (6')
Testing Opening Height	228.6 mm (9")	228.6 mm (9")	228.6 mm (9")	203.2 mm (8")
Working Access Height	274 mm (10.8")	274 mm (10.8")	274 mm (10.8")	218 mm (8.6")

1. *Exhaust ULPA filter*
2. *Blower*
3. *Downflow ULPA filter, angled*
4a. *UV light Retrofit Kit provision for 0.9, 1.2 and 1.5 meter (3',4' & 5') models.*
4b. *UV light Retrofit Kit provision for 1.8 meter (6') models.*
5. *IV-Bar Retrofit Kit provision*
6. *Electrical outlet Retrofit Kit provision (0.9 meter /3' model - one single outlet in workzone) (1.2, 1.5 and 1.8 meter / 4',5' & 6' models - two single outlets in workzone)*
7. *Electrical / Electronics panel*
8. *Fluorescent lamp*
9. *Plugged service fixture provisions (2 on each side)*
10. *Stainless steel single-piece work tray*
11. *Stainless steel armrest*
12. *Drain valve Retrofit Kit provision*
13. *Esco Sentinel microprocessor control system*
14. *Safety glass sliding sash window*
15. *Single-piece stainless steel back wall and side walls*
16. *Removable side panel for plumbing access*

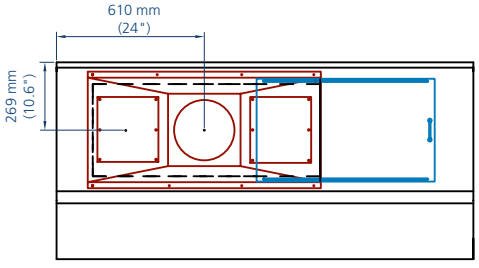
Optional Exhaust Collar Positions for Thimble-Ducting for LA2 Models



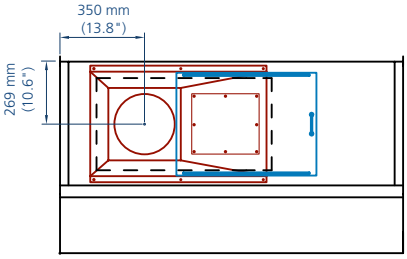
Side View - All Sizes



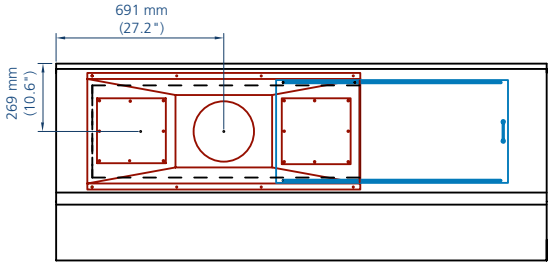
*Top View - LA2-3A_*



*Top View - LA2-5A_*



*Top View - LA2-4A_*



*Top View - LA2-6A_*

General Specifications North America Models *(USA, Canada, Mexico / 115 V, 60 Hz)*		LA2-3A2	LA2-4A2	LA2-5A2	LA2-6A2
Nominal Size		0.9 meters (3')	1.2 meters (4')	1.5 meters (5')	1.8 meters (6')
External Dimensions (W x D x H)		1115 x 810 x 1540 mm 43.9" x 31.9" x 60.6"	1420 x 815 x 1640 mm 55.9" x 32.1" x 64.6"	1725 x 815 x 1540 mm 67.9" x 32.1" x 60.6"	2030 x 815 x 1640 mm 79.9" x 32.1" x 64.6"
Gross Internal Dimensions (W x D x H)		955 x 623 x 670 mm 37.6" x 24.5" x 26.4"	1260 x 623 x 715 mm 49.6" x 24.5" x 28.1"	1565 x 623 x 670 mm 61.6" x 24.5" x 26.4"	1870 x 623 x 715 mm 73.6" x 24.5" x 28.1"
Usable Work Area		0.45 m^2 (4.8 sq.ft.)	0.6 m^2 (6.5 sq.ft.)	0.75 m^2 (8.1 sq.ft.)	0.9 m^2 (9.7 sq.ft.)
Tested Opening		228.6 mm (9")	228.6 mm (9")	228.6 mm (9")	203.2 mm (8")
Working Opening		274 mm (10.8")	274 mm (10.8")	274 mm (10.8")	248 mm (9.8")
Average Airflow Velocity	Inflow	.53 m/s (105 fpm)			
	Downflow	0.35 m/s (70 fpm)	0.35 m/s (70 fpm)	0.35 m/s (70 fpm)	0.33 m/s (65 fpm)
Airflow Volume	Inflow	419 m^3 / h (246 cfm)	552 m^3 / h (325 cfm)	685 m^3 / h (403 cfm)	742 m^3 / h (437 cfm)
	Downflow, 63%	702 m^3 / h (413 cfm)	924 m^3 / h (544 cfm)	1147 m^3 / h (675 cfm)	1289 m^3 / h (758 cfm)
	Exhaust, 37%	419 m^3 / h (246 cfm)	552 m^3 / h (325 cfm)	685 m^3 / h (403 cfm)	742 m^3 / h (437 cfm)
	Required Exhaust With Optional Thimble Exhaust Collar	707 m^3 / h (416 cfm)	901 m^3 / h (530 cfm)	1114 m^3 / h (656 cfm)	1256 m^3 / h (739 cfm)
ULPA Filter Typical Efficiency		>99.999% for particle size between 0.1 to 0.3 microns per IEST-RP-CC001.3			
Sound Emission	NSF / ANSI 49	<66 dBA	<64.5 dBA	<66 dBA	<67 dBA
	EN 12469	<63 dBA	<61.5 dBA	<63 dBA	<64 dBA
Fluorescent Lamp Intensity		> 1230 Lux (> 114 foot-candles)	> 1400 Lux (> 130 foot-candles)	> 1070 Lux (> 100 foot-candles)	> 1225 Lux (> 114 foot-candles)
NSF / ANSI 49 Certified		Pending	Yes	Yes	Yes
Cabinet Construction		Electrogalvanized steel with Isocide oven-baked epoxy-polyester powder coating			
		1.2 mm (0.05") /18 gauge	1.5 mm (0.06") /16 gauge	1.2 mm (0.05") /18 gauge	1.5 mm (0.06") /16 gauge
Electrical *		110-130V, AC, 60Hz, 1 ø			
Net Weight **		243 kg / 536 lbs	336 kg / 741 lbs	317 kg / 698 lbs	434 kg / 957 lbs
Shipping Weight **		292 kg / 644 lbs	400 kg / 880 lbs	410 kg / 904 lbs	523 kg / 1153 lbs
Shipping Dimensions, Maximum (W x D x H) **		1230 x 940 x 1900 mm 48.4" x 37" x 74.8"	1530 x 940 x 1900 mm 60.2" x 37" x 74.8"	1910 x 940 x 1900 mm 75.2" x 37" x 74.8"	2150 x 940 x 1980 mm 84.6" x 37" x 77.9"
Shipping Volume, Maximum **		2.20 m^3 (78 cu.ft.)	2.73 m^3 (97 cu.ft.)	3.41 m^3 (121 cu.ft.)	4.00 m^3 (141 cu.ft.)

** Additional voltages may be available; contact Esco for ordering information.*
*** Cabinet only, excludes optional stand.*

Accessories and Options (Cont.)

- Cradle stand, electrical hydraulic, infinitely adjustable, with casters
  - Elevates to seating or standing work surface height.
  - When lowered permits movement through standard doorway.

  Note: Increases exterior dimensions.

Electrical Outlets and Utility Fixtures

- Electrical outlet, ground fault, North America
- Electrical outlet, Europe / Worldwide
- Petcock (air, gas, vacuum)
  - North America (American) style
  - Europe / Worldwide style DIN 12898, DIN 12919, DIN 3537

Cabinet Accessories

- Germicidal UV lamp
  - Controlled by automatic UV lamp timer through Sentinel micro-processor control panel.
  - Emission of 253.7 nanometers for most efficient decontamination.
  - Lamp is positioned away from operator line-of-sight for safety and proper exposure to interior surfaces.

  Note: UV lamp intensity reduces over time and its effectiveness is subject to factors such as relative humidity in the cabinet, ambient air temperature and microbial species in the work zone.
- PVC armrest
  - Chemically treated, improves operator comfort, easy-to-clean. 712 mm (28") standard size.
- Ergonomic lab chair
  - Laboratory grade construction, meets Class 100 cleanliness; alcohol resistant PVC materials
  - Adjustable 395-490 mm (15.6"-19.3")
- Ergonomic foot rest
  - Angled, helps maintain proper posture.
  - Adjustable height
  - Anti-skid coating, chemical resistant finish.
- IV bar, with hooks
  - Stainless steel construction
  - Available for all standard Esco cabinets.
- Microscope viewing device
  - Mounting and viewing pouch integrated into sash. Factory installed; specify when ordering.

General Specifications International Models *(Europe, Asia-Pacific, Africa, Latin America / 230 V, 50 & 60 Hz)*		LA2-3A1 LA2-3A3 LA2-3J5	LA2-4A1 LA2-4A3 LA2-4J5	LA2-5A1 LA2-5A3 LA2-5J5	LA2-6A1 LA2-6A3 LA2-6J5
Nominal Size		0.9 meters (3')	1.2 meters (4')	1.5 meters (5')	1.8 meters (6')
External Dimensions (W x D x H)		1115 x 810 x 1540 mm 43.9" x 31.9" x 60.6"	1420 x 815 x 1540 mm 55.9" x 32.1" x 60.6"	1725 x 815 x 1540 mm 67.9" x 32.1" x 60.6"	2030 x 815 x 1540 mm 79.9" x 32.1" x 60.6"
Gross Internal Dimensions (W x D x H)		955 x 623 x 670 mm 37.6" x 24.5" x 26.4"	1260 x 623 x 670 mm 49.6" x 24.5" x 26.4"	1565 x 623 x 670 mm 61.6" x 24.5" x 26.4"	1870 x 623 x 670 mm 73.6" x 24.5" x 26.4"
Usable Work Area		0.45 m^2 (4.8 sq.ft.)	0.6 m^2 (6.5 sq.ft.)	0.75 m^2 (8.1 sq.ft.)	0.9 m^2 (9.7 sq.ft.)
Tested Opening		228.6 mm (9")	228.6 mm (9")	228.6 mm (9")	203.2 mm (8")
Working Opening		274 mm (10.8")	274 mm (10.8")	274 mm (10.8")	248 mm (9.8")
Average Airflow Velocity	Inflow	.53 m/s (105 fpm)			
	Downflow	0.35 m/s (70 fpm)	0.35 m/s (70 fpm)	0.35 m/s (70 fpm)	0.33 m/s (65 fpm)
Airflow Volume	Inflow	419 m^3/ h (246 cfm)	552 m^3/ h (325 cfm)	685 m^3/ h (403 cfm)	742 m^3/ h (437 cfm)
	Downflow, 63%	702 m^3/ h (413 cfm)	924 m^3/ h (544 cfm)	1147 m^3/ h (675 cfm)	1289 m^3/ h (758 cfm)
	Exhaust, 37%	419 m^3/ h (246 cfm)	552 m^3/ h (325 cfm)	685 m^3/ h (403 cfm)	742 m^3/ h (437 cfm)
	Required Exhaust With Optional Thimble Exhaust Collar	707 m^3/ h (416 cfm)	901 m^3/ h (530 cfm)	1114 m^3/ h (656 cfm)	1256 m^3/ h (739 cfm)
ULPA Filter Typical Efficiency		>99.999% at particle size between 0.1 to 0.3 microns			
Sound Emission	NSF / ANSI 49	<66 dBA	<63.5 dBA	<66 dBA	<67 dBA
	EN 12469	<63 dBA	<60.5 dBA	<63 dBA	<64 dBA
Fluorescent Lamp Intensity		> 1230 Lux (> 114 foot-candles)	> 1400 Lux (> 130 foot-candles)	> 1070 Lux (> 100 foot-candles)	> 1225 Lux (> 114 foot-candles)
Cabinet Construction		Electrogalvanized steel with Isocide oven-baked epoxy-polyester powder coating			
		1.2 mm (0.05") / 18 gauge			
Electrical *	220-240V, AC, 50Hz, 1ø	LA2-3A1	LA2-4A1	LA2-5A1	LA2-6A1
	220-240V, AC, 60Hz, 1ø	LA2-3A3	LA2-4A3	LA2-5A3	LA2-6A3
	100V, AC, 50/ 60Hz, 1ø	LA2-3J5	LA2-4J5	LA2-5J5	LA2-6J5
Net Weight **		243 kg / 536 lbs	283 kg / 624 lbs	317 kg / 698 lbs	350 kg / 772 lbs
Shipping Weight **		292 kg / 644 lbs	345 kg / 761 lbs	410 kg / 904 lbs	486 kg / 1072 lbs
Shipping Dimensions, Maximum (W x D x H) **		1230 x 940 x 1900 mm 48.4" x 37" x 74.8"	1530 x 940 x 1900 mm 60.2" x 37" x 74.8"	1910 x 940 x 1900 mm 75.2" x 37" x 74.8"	2150 x 940 x 1980 mm 84.6" x 37" x 77.9"
Shipping Volume, Maximum **		2.20 m^3 (78 cu.ft.)	2.73 m^3 (97 cu.ft.)	3.41 m^3 (121 cu.ft.)	4.00 m^3 (141 cu.ft.)

** Additional voltages may be available; contact Esco for ordering information.*
*** Cabinet only, excludes optional stand.*

Comprehensive Performance Testing At Esco

Every Labculture LA2 model manufactured by Esco is individually tested, documented by serial number and validated with the following test methods.

- *Inflow / downflow velocity*
- *PAO aerosol challenge for filter integrity*
- *Light, noise and vibration*
- *Airflow pattern visualization*
- *Electrical safety to IEC61010-1*
- *KI-Discus containment*
- *Additional microbiological testing is performed on statistical sampling basis.*

ESCO
WORLD CLASS. WORLDWIDE.

Microbiological Testing

Esco performs testing in accordance with more than 10 of the world's most recognized standards for local, regional and international criteria. Testing in our microbiology laboratory is conducted according to NSF / ANSI 49, EN 12469, and JIS K3800. An NSF-accredited biohazard cabinet field certifier is available in-house full-time to supervise all testing work.

Harmless Bacillus atrophaeus (formerly Bacillus Subtilis) bacteria is used to challenge the cabinet, then incubated for 48 hours and the Colony Forming Units (CFU) are counted to determine the testing results. Increased microbiological challenge tests with objects inside the cabinet work zone, Bunsen burner, external airflow disturbance, and Human-As-Mannequin test adapted from Fume Hood development were performed to simulate real-world conditions.

Personnel Protection Test

The test objective is to evaluate the safety of the cabinet for the personnel operating on potentially hazardous samples in the cabinet workzone.

- A nebulizer containing 55 mL of 5 to 8 x 10^8 spores/mL B.atrophaeus spores is placed inside the workzone, 10 cm (4 inches) behind the front opening sash.
- Target slit air samplers and impingers are placed outside the workzone to capture possibly escaping B.atrophaeus spores, then the sample is incubated
- Acceptance: The number of Bacillus atrophaeus CFU recovered from the agar plates shall not exceed 10 CFU per test.

Product Protection Test

The test objective is to determine cabinet protection to the product/samples inside the cabinet workzone from environmental contaminants.

- A nebulizer containing 55 mL of 5 to 8 x 10^6 spores/mL B.atrophaeus is placed at 10 cm (4 inches) in front of sash window.
- Target agar plates are placed throughout the entire work surface.
- Acceptance: The number of Bacillus atrophaeus CFU recovered from the agar plates shall not exceed 5 CFU per test.

Cross Contamination Test

The test objective is to evaluate cabinet protection from cross contamination of samples placed simultaneously inside the workzone.

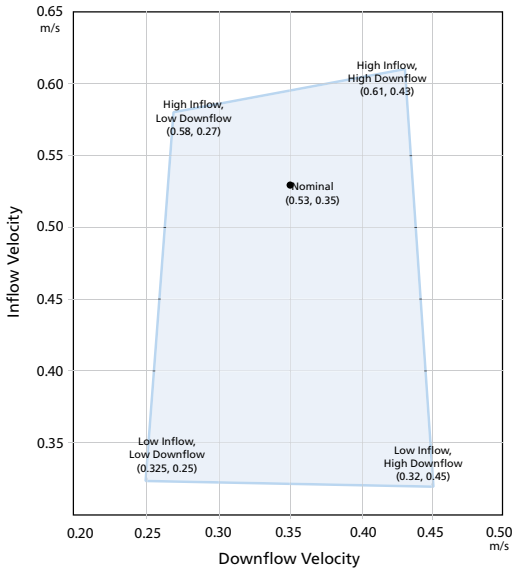
- A nebulizer containing 55 mL of spores (5 to 8 x 10^4/mL) is placed against one of the workzone sidewalls.
- Target agar plates are placed 36 cm (14") away from the same side wall
- Acceptance: The number of Bacillus atrophaeus CFU recovered on agar plates shall not exceed 2 CFU per test.

HPV Test Compliant: Safer Hydrogen Peroxide Decontamination Compatibility

Esco biological safety cabinets are Hydrogen Peroxide Vapor (HPV) compliant and decontaminatable cabinets approved by BIOQUELL for this patented process. HPV is a safer and more efficient alternative to conventional decontamination using formaldehyde (CH20):

- HPV is non-carcinogenic and odorless, while formaldehyde is carcinogenic, toxic and has pungent smell.
- If there is a gap on the cabinet sealing, escaping HPV to the lab will decompose to become oxygen and water. Escaping formaldehyde, however, is harmful to people in the lab. Therefore HPV decontamination can be performed while people still working inside the lab, while formaldehyde decontamination must be performed with no one present in the lab. The HPV method improves safety, productivity, and reduces the time to seal the cabinet.
- HPV biological efficacy is independent of environmental variables, whereas formaldehyde efficacy is dependent on such variables.
- HPV has a better penetration capacity, resulting in a full decontamination of the cabinet. The formaldehyde method is known to result in incomplete decontamination.
- HPV is more effective and rapid against biological organisms compared to formaldehyde.
- HPV requires approximately 4-7 hours for set-up, decontamination, and tear-down, compared to a total of 12-15 hours needed to complete a formaldehyde decontamination process.
- HPV decontamination effectiveness is independent of temperature and humidity. Formaldehyde requires temperature above 20°C and relative humidity above 65%.
- For information on the BIOQUELL HPV methodology contact Esco or your Sales Representative.

The Performance Envelope Concept



Esco cabinets are designed to operate within a performance envelope to maintain protection for personnel, product and the environment.

Airflow parameters used to frame the performance envelope include both inflow velocity and downflow velocity.

The graph illustrates the boundaries of the performance envelope (based on a 1.2 meter / 4 ft. cabinet), as well as the nominal performance point at which tests are conducted.

The range between high and low Inflow, and high and low downflow, together with the fluid dynamics achieved through sophisticated cabinet design, proportionally size capture slots, and uniform laminar airflow, combine to deliver a complete containment and safety solution expected of a professional biological safety cabinet.

For details on the Esco performance envelope contact Esco or your Esco Sales Representative.

KI Discus Containment Test According to EN 12469 (Potassium Iodide)

Esco is currently one of the few companies in the world equipped to perform the KI Discus test for our customers. The KI Discus test is defined in the European Standard for microbiological safety cabinets, EN 12469, as a test method for validating the operator/personnel protection capabilities of the cabinet.

- The KI Discus test shows excellent correlation with the microbiological test method for operator protection, and is useful for validating the actual containment performance of the cabinet on-site.
- The KI-Discus takes only 45 minutes as opposed to 2 days for microbiological testing.
- Thus, each Esco Labculture LA2 model is factory tested using the KI Discus method for operator safety.

Purchase Specifications

LA2 Series Class II, Type A2 Biological Safety Cabinet

General Performance and Certifications

1. The biological safety cabinet shall comply with one or more of the following international standards, and the manufacturer shall provide a certified copy of containment and performance tests equivalent to or greater than specified in the following independent international standards for biological safety, electrical and other functional characteristics: Class II, Type A2 per NSF / ANSI 49 (USA); Class II per EN 12469, JIS K3800, SFDA YY-0569, SANS12469.
2. The cabinet shall protect (a) the operator and laboratory environment from particulates generated within the work zone; (b) the product and process within the work zone from airborne contamination from ambient air; (c) and the product and process within the work zone from cross contamination.
3. Before shipment each cabinet shall be individually tested by the KI-Discus test (European Standard EN12469:2000) to validate operator/personnel protection. The retention efficiency for the front aperture shall be not less than 99.999%. Microbiological testing for cabinet performance shall be performed on a statistical sampling basis.
4. Each cabinet shall be listed by Underwriters' Laboratories (UL, CUL) or CE for electrical safety.
5. Original documentation specific to each cabinet serial number shall be provided with the cabinet and maintained in the manufacturers' records. Test data verifying all performance criteria shall be available upon request to include: (a) inflow velocity through direct inflow measurement method; (b) downflow velocity and uniformity; (c) filter leak scan with aerosol challenge for both filters; (d) light, noise, vibration; (e) and electrical safety.

Filtration System

6. The cabinet shall have one supply downflow filter and one exhaust filter. Both filters shall be ULPA-type per IEST-RP-CC001.3 and meet EN1822 (H14) requirements.
7. The filters shall be within an aluminum frame with mini-pleat design without aluminum separators; no wood or fiberboard shall be used in the filter assembly.
8. Typical filter efficiency shall be 99.9997% at MPPS and 99.999% for 0.1 to 0.3 microns.
9. An integral filter guard shall be affixed to prevent damage to the filter media.
10. The filters shall be (a) individually scan tested by the manufacturer, (b) individually scan tested after assembly, and (b) easily accessible for scan testing in situ by means of a dedicated upstream sampling port accessible from within the cabinet.
11. The supply filter shall be angled and oriented to the 10° cabinet front angle to maximize downflow uniformity over the work surface.
12. A removable, perforated metal diffuser shall be installed below the supply filter to optimize airflow uniformity and to protect from damage.

Blower System

13. The cabinet shall have a direct drive, permanently lubricated centrifugal blower/motor dynamically balanced in two planes compliant to ISO2710 for low noise, low vibration and long filter life.
14. The blower/motor shall have an external rotor design and include an automatic thermal cut-out to disable the motor in case of overheating.
15. The blower/motor shall have an automatic speed control to compensate for filter loading.
16. The blower/motor system shall be enclosed within a dynamic chamber shaped steel plenum and integrated with the removable supply filter assembly to simplify filter changing.
17. The integral damper shall be externally adjustable.

Cabinet Design, Construction, Cleaning

18. The cabinet shall be of triple wall design whereby all positive pressure plenums capable of handling contaminated air shall be surrounded by negative pressure. No positive pressure areas shall be accessible external to the cabinet. The third wall shall conceal utilities.
19. The cabinet shall maintain containment performance even when removable work area components are removed for cleaning.
20. The work tray shall be one-piece, removable, stainless steel with radius corners without crevices or joints.
21. The cabinet shall have a stainless steel, one-piece fabricated drain trough with open angles to channel spills to a common drain.
22. The closed sidewall shall be sealed without perforations, return air slots or concealed areas which can contain contaminants.
23. The cabinet shall be free of sharp edges, non-functional protrusions, bolts, screws or hardware, and all metal edges shall be deburred.
24. The cabinet exterior top shall be slanted to discourage placement of foreign objects and to maintain proper exhaust airflow.

Ergonomics and Convenience

25. The front sash shall be frameless to maximize visibility, and accessible for cleaning front and back. Sash glass shall be safety glass.
26. The sash counterbalance shall be suspended on two high-strength cables, and the sash shall lock into position in the event one cable becomes detached.
27. Magnetic, not mechanical, proximity sensors shall work in conjunction with the control system to indicate proper sash position for containment.
28. Fluorescent lamps shall be mounted behind the control panel module out of the work zone. Electronic ballasts shall be used to eliminate flicker, extend lamp life and reduce heat output.
29. The UV lamp, if installed, shall be mounted behind the control panel and away from the user's line of site for protection. (Note: Does not apply to 1.8 meter/ 6 ft. model.)
30. The UV lamp shall operate via an automatic timer with automatic shut-off managed by the microprocessor controller and shall be interlocked with the blower/motor and fluorescent lights for safety.
31. The cabinet shall be designed with a 10° angled front to optimize user comfort, reduce glare and maximize reach into the work area.
32. The front grille shall be raised to prevent airflow blockage and improve comfort.
33. Penetrations for petcocks and service fittings shall be provided; penetrations shall be offset to improve user access.
34. The cabinet shall accommodate an optional mounting stand for fixed-height or adjustable-height configurations.

Control and Alarm System

35. All cabinet functions shall be managed by a programmable microprocessor control system capable of software updates via Internet downloads.
36. The microprocessor controller shall be mounted on the main control panel facing down toward the user.
37. The controller shall include soft-touch keypad controls and backlit LCD displays to permit operation of the blower/motor, light, UV lamp, electrical outlet(s) and menu.
38. The controller shall be user programmable in situ to enable or disable functions such as PIN (personal identification number) access restriction, cabinet start-up protocol, airflow alarm and other microprocessor controlled operations outlined in the user manual.
39. When programmed ON, the start-up protocol shall perform an automatic pre-purge and post-purge cycle to ensure proper cabinet operation.
40. The controller shall include a blower/motor hours meter to display aggregate motor running time to assist in predictive maintenance.
41. Audible and visual alarms shall be provided for unsafe conditions such as improper airflow or sash position.
21. Airflow shall be monitored by a temperature compensating, thermistor-based, true air velocity sensor mounted in the cabinet.
43. The airflow display and alarm system shall be individually calibrated before shipment.
44. The main control panel shall exhibit continuous display of air velocity and a 24-hour clock display.

Certification, Service and Decontamination

45. The cabinet shall be approved for both hydrogen peroxide vapor (HPV) and formaldehyde decontamination protocol.
46. All panels leading to potentially contaminated and/or hazardous areas shall be color coded red.
47. All components with the exception of blower/motor and ULPA filters shall be located outside of contaminated air spaces to facilitate servicing without the need to decontaminate the cabinet.
48. All exterior surfaces shall be painted with a permanent antimicrobial inhibitor coating to minimize contamination.

Esco Labculture® Plus Class II Type A2 Biosafety Cabinet

www.escoglobal.com

The **Esco Labculture® Plus Class II Type A2 biosafety cabinet** is an enhanced version of our internationally certified Labculture® Class II Type A2 biosafety cabinet model. Providing operator, product and environment protection from hazardous aerosols through superior minipleat ULPA filters, the product combines the best product performance features with Esco's ergonomic design.

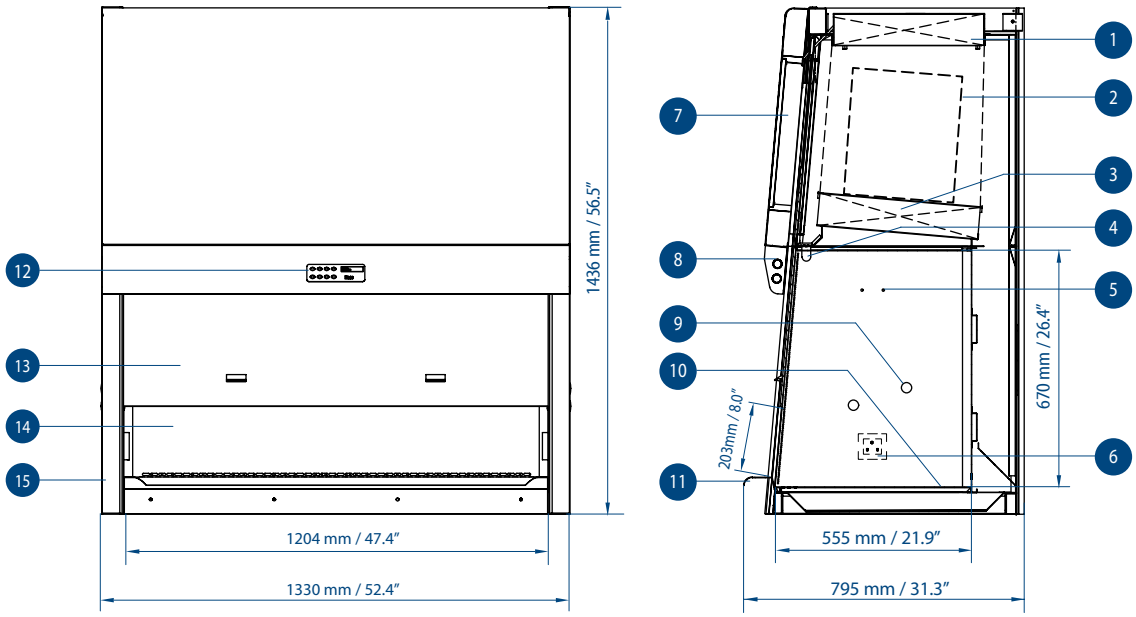
The cabinet features Esco Isocide™ antimicrobial coated external body structure and a reduced overall height for low-ceiling laboratories.

Key Features

- **Pending LNE/NF certification to EN 12469**
- **Product / Operator / Environment Protection**
- **ULPA Filters** with typical efficiency at >99.999% at 0.12µm provide ISO Class 3 cleanliness within work zone.
- **Easy-to-Clean**: Single sheet internal walls
- **Isocide™ antimicrobial coated structure** eliminates 99.9% of bacterial presence on external surfaces within 24 hours.
- **Ergonomic sloped front** eliminates glare off the front window, and ensures operator comfort during extended usage
- **Microprocessor-based control and alarm system**
- Esco Accuflow™ microprocessor-based motor speed controller
- **Reduced height** for low ceiling laboratories
- **Extremely low noise level** for quiet working environment
- **Laminated shatter-proof sliding sash** for extra protection

Technical Specifications and Engineering Diagram

Esco Catalogue Revision LP2.v1.6.2006
Specifications subject to change without notice
©2006 Esco Micro Pte Ltd



Engineering Details

1. Exhaust ULPA Filter ***2.*** Blower ***3.*** Downflow ULPA filter ***4.*** Standard UV Light Retrofit™ Kit Provision ***5.*** IV Bar Retrofit Kit™ Provision
6. Electrical Outlet Retrofit Kit™ Provision (2 single outlets) ***7.*** Electrical / Electronics Panel ***8.*** Fluorescent Light
9. Plugged Service Fixture Provisions (2 on each side wall) for Gas/Vacuum/Water. (*Solenoid Gas Valve Option Available*)
10. Stainless Steel Multi-piece Work tray ***11.*** Stainless Steel Armrest
12. Esco Sentinel™ Microprocessor Control System ***13.*** Laminated Shatter-Proof Sliding Sash Window
14. Single-piece Stainless Steel Back Wall and Side Wall ***15.*** Removable Side Panel for Plumbing Access

General Specifications			LP2-4AX
External Dimensions (L x W x H)			1330 x 795 x 1486 mm / 52.4" x 31.3" x 56.5"
Internal Work Zone (L x W x H)			1204 x 555 x 670 mm / 47.4" x 21.9" x 26.4"
Standards Compliance			**Pending LNE certification to EN12469** Air cleanliness: ISO 14644.1 Class 3, IEST-G-CC1001, IEST-G-CC1002 and other equivalent requirements Filter performance: IEST-RP-CC034.1, IEST-RP-CC007.1, IEST-RP-CC001.3 and EN1822 Electrical safety: IEC 61010-1 / EN 61010-1 / UL 61010A-1 / CSA C22.2 No. 1010.1-92
Average Airflow Velocities	Inflow		Initial setpoint: 0.45 m/s or 90 fpm
	Downflow		Initial setpoint: 0.33 m/s or 65 fpm
			Uniformity is better than +/-15%
Airflow Volumes At Initial Airflow Velocity Setpoints	Inflow		396 cmh / 233 cfm
	Downflow (65%)		772 cmh / 454 cfm
	Exhaust (35%)		396 cmh / 233 cfm
Cleanliness Within Working Area			ISO14644.1 Class 3, US Federal Standard 209E Class 1 / M1.5, AS1386 Class 1.5, JIS B9920 Class 3, BS5295 Class C, Class M10,000 as per KS27030.1 and equivalent classes of VDI2083 and AFNOR X44101
Downflow and Exhaust Filter Type			ULPA filter with integral metal guards and filter frame gaskets; fully compliant with EN 1822 and IEST-RP-CC001.3 requirements (each cabinet has individual downflow and exhaust filters)
Filter Efficiency Ratings			Typical: 99.9998% at 0.3µm / 99.9998% at 0.12µm / 99.9997% at MPPS
Noise Level			<56.5 dBA
			The above measurement was taken at initial blower speed setting on a standard 4ft model, as per EN12469 specifications. Figures are subject to acoustic properties of test environment
Light Intensity			>1200 Lux; measured at work surface level (zero background) as per NSF49 test grid
Main Body Construction			1.5mmt / 0.06" / 16 gauge electro-galvanised steel with white oven-baked epoxy anti-microbial Isocide™ antimicrobial powder-coated finish
Maximum Power Consumption / Current	220-240VAC / 50Hz 1Ph	Cabinet	575W / 4A
		Outlet	1000VA / 5A
	110-130VAC / 60Hz 1Ph	Cabinet	765W / 11.5A
		Outlet	500VA / 5A
Net Weight (Approximate)			275 kgs / 606 lbs
Max Shipping Dimensions (L x W x H)			1520 x 950 x 1800 mm / 60" x 37.4" x 70.9"
Max Shipping Volume			2.6 cbm / 92 cbf

Your Local Distributor:

ESCO®
Esco Biotechnology Equipment Division
21 Changi South Street 1, Singapore 486777
Tel: +65 6543 0833 • Fax: +65 6542 6920
Email: biotech@escoglobal.com • Website: biotech.escoglobal.com

Esco Labculture® Lead-Shielded Class II Type A2 Biosafety Cabinet

www.escoglobal.com

Esco Labculture Lead-Shielded Class II with the standard horizontal sliding lead glass

The Esco Labculture® Lead-Shielded Class II biosafety cabinet is designed for radiopharmaceutical industry usage and protects the operator during work involving radioisotopes.

SUPERIOR PROTECTION FOR RADIOISOTOPE LABORATORIES

The operator is protected from radiation by the lead-shielded sides, lead shielded work zone bottom and front sliding sash. Horizontal sliding lead glass piece provides additional protection to the operator during work involving radioisotopes.

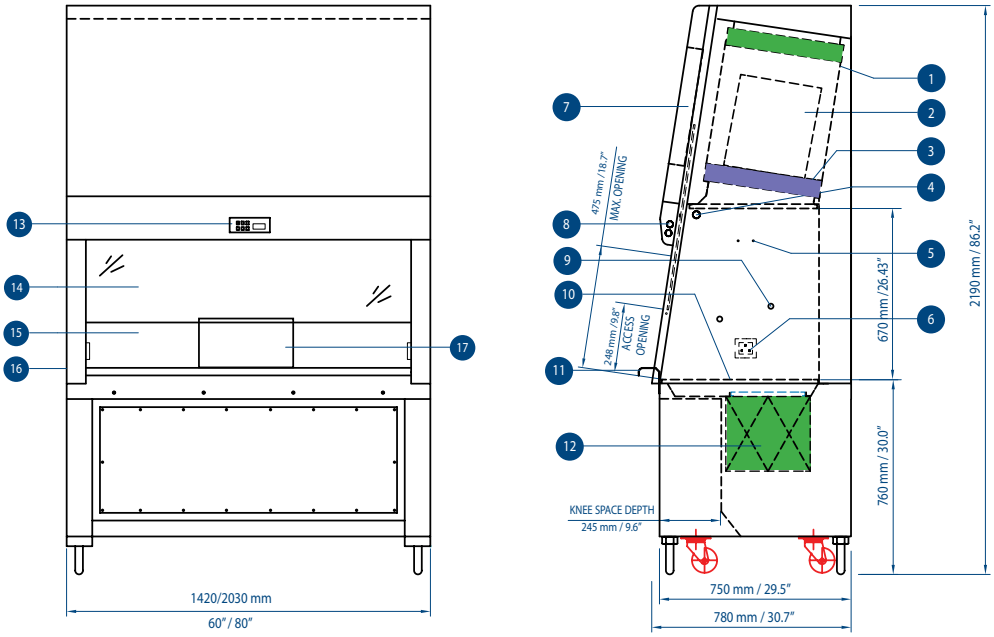
The air enters the cabinet through the front air grille, and travels through the KI-impregnated carbon filter on which radioactive iodine is adsorbed. Air then travels to the blower plenum where it is filtered by high-efficiency ULPA filters before being exhausted.

Main Features

- **Class II Product / Operator / Environment Protection**
- **Extra Safety:** Cabinet air is filtered via 2 exhaust filters. This feature allows for filter-changing without prior decontamination of the cabinet.
- **Lead-Shielded Protection:** 3mm lead shielding on cabinet sides, work zone bottom
- **Radiation proof glass with lead equivalence of 3mm.**
- **Horizontal sliding lead glass piece** for additional operator protection.
- **KI (potassium iodide) impregnated carbon filter for iodine adsorption**
- **ULPA Filters** with typical efficiency at >99.999% at 0.12µm provide ISO Class 3 cleanliness within work zone.
- **Isocide™ antimicrobial coated structure** eliminates 99.9% of bacterial presence on external surfaces within 24 hours.
- **Ergonomic sloped front** eliminates glare off the front window, and ensures operator comfort during extended usage
- **Microprocessor-based control and alarm system**
- **Extremely low noise level** for quiet working environment
- **Additional options:**
  - Lead-shielded back panel
  - Increased thickness of lead shielding (standard is 3mm)

Technical Specifications and Engineering Diagram

Esco Catalogue Revision LS2.v2.7.2006
Specifications subject to change without notice
©2006 Esco Micro Pte Ltd

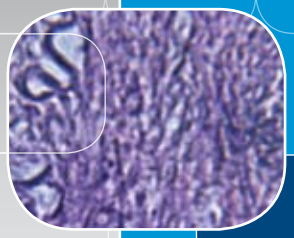


1. Exhaust ULPA Filter ***2.*** Blower ***3.*** Downflow ULPA Filter ***4.*** Standard UV Light Retrofit™ Kit Provision
5. Standard IV-Bar Retrofit™ Kit Provision ***6.*** Electrical Outlet Retrofit™ Kit Provision (Two Single Outlets in Workzone)
7. Electrical and Electronics Panel ***8.*** Fluorescent Light ***9.*** Plugged Service Fixture Provisions (2 on each side)
10. Stainless Steel Multi-piece Work Tray ***11.*** Stainless Steel Armrest ***12.*** KI-Impregnated Carbon Filter
13. Esco Sentinel™ Microprocessor Control System ***14.*** Lead-Shielded Glass Sliding Sash Window
15. Stainless Steel Back Wall ***16.*** Lead-Shielded Side Walls ***17.*** Horizontal Lead-Glass Sliding Door

General Specifications			LS2-4AX	LS2-6AX
External Dimensions (L x W x H)			1420 x 780 x 2190 mm / 55.9" x 30.7" x 86.2"	2030 x 780 x 2190 mm / 79.9" x 30.7" x 86.2"
Internal Work Zone (L x W x H)			1260 x 603 x 670 mm / 49.6" x 21.3" x 26.4"	1870 x 603 x 670 mm / 73.6" x 21.3" x 26.4"
Standards Compliance			Designed to comply and exceed the requirements of: DIN12980: Laboratory Equipment Cytostatic Workbenches: Requirements, Testing EN12469: Performance Criteria for Microbiological Safety Cabinets Air cleanliness: ISO 14644.1 Class 3, IEST-G-CC1001, IEST-G-CC1002 and other equivalent requirements Filter performance: IEST-RP-CC034.1, IEST-RP-CC007.1, IEST-RP-CC001.3 and EN1822 Electrical safety: IEC 61010-1 / EN 61010-1 / UL 61010A-1 / CSA C22.2 No. 1010.1-92	
Average Airflow Velocities	Inflow		Initial setpoint: 0.45 m/s or 90 fpm (audible / visual alarm will activate at 0.40 m/s or 80fpm)	
	Downflow		Initial setpoint range: 0.30 m/s or 60 fpm	
Airflow Volumes At Initial Airflow Velocity Setpoints	Inflow		460 cmh / 270 cfm	680 cmh / 400 cfm
	Downflow (65%)		780 - 910 cmh / 460 - 535 cfm	1160 - 1350 cmh / 680 - 794 cfm
	Exhaust (35%)		460 cmh / 270 cfm	680 cmh / 400 cfm
Cleanliness Within Working Area			ISO14644.1 Class 3, US Federal Standard 209E Class 1 / M1.5, AS1386 Class 1.5, JIS B9920 Class 3, BS5295 Class C, Class M10,000 as per KS27030.1 and equivalent classes of VDI2083 and AFNOR X44101	
Exhaust Carbon Filter			KI (potassium iodide) impregnated carbon filter (installed directly below the work surface).	
Downflow ULPA Filter Type			ULPA filter with integral metal guards and filter frame gaskets; fully compliant with EN 1822 and IEST-RP-CC001.3 requirements. Typical efficiency: 99.9997% at MPPS; 99.9998% at 0.3 and 0.12µm	
Exhaust ULPA Filter Type			ULPA filter with integral metal guards and filter frame gaskets; fully compliant with EN 1822 and IEST-RP-CC001.3 requirements. Typical efficiency: 99.9997% at MPPS; 99.9998% at 0.3 and 0.12µm	
Noise Level	According to EN12469		<61 dBA	<65 dBA
	The above measurements were taken at initial blower speed setting (figures subject to acoustic properties of test environment)			
Light Intensity			>1000 Lux / >93 foot candles (measured at work surface level (zero background) as per NSF49 test grid)	
Maximum Usable Workzone Depth			510 mm / 20" (does not include the 110 mm / 4.3" front air grille)	
Maximum Usable Work Area (*excludes front air grille*)			0.64 sqm / 6.89 sqf	0.95 sqm / 10.22 sqf
Knee Space Depth			245 mm / 9.6"	
Main Body Construction			1.5mmt / 0.06" / 16 gauge electro-galvanised steel with white oven-baked epoxy anti-microbial Isocide™ powder-coated finish. 3mm / 0.12" lead shielding on cabinet side walls and work zone bottom	
Maximum Power Consumption / Current	220-240VAC / 50Hz 1Ph	Cabinet	675W / 4A	765W / 4A
		Outlet	1000VA / 5A	1000VA / 5A
	110-130VAC / 60Hz 1Ph	Cabinet	835W / 11.5A	1045W / 11.5A
		Outlet	500VA / 5A	500VA / 5A

Your Local Distributor:

ESCO®
Esco Biotechnology Equipment Division
21 Changi South Street 1, Singapore 486777
Tel: +65 6543 0833 • Fax: +65 6542 6920
Email: biotech@escoglobal.com • Website: biotech.escoglobal.com



NEW FOR 2007

Infinity®

Esco Infinity tested to EN 12469 and TUV-GS certified for safety and performance. Model FC2-4A_, with optional support stand.

Class II Microbiological Safety Cabinet

The Industry's Premier Biological Safety Solution from Esco

ESCO

WORLD CLASS. WORLDWIDE.

Main Features

- Unique Dynamic Chamber™ plenum with angled filter delivers superb airflow uniformity with deviation no greater than 5% to 6% of average downflow, exceeding European Standard EN 12469 by more than three times.
- Negative pressure plenum surrounds contaminated positive pressure plenum; no fabric bags are used.
- Dual fan design for guaranteed safety. If one fan fails, minimal protection is still maintained with only one fan running.
- Esco next-generation Sentinel™ microprocessor supervises all cabinet functions.
- A large easy-to-read digital display and ergonomically sized touchpad controls improve user interface.
- Fully closable, motorized sash provides an airtight seal for better safety when cabinet is inoperative overnight.
- Frameless, shatterproof sash is easier to clean, offers larger, unobstructed viewing area.
- Ergonomically angled front improves reach and comfort.
- Multi-piece work surface removal simplifies cleaning.
- Raised armrest maintains safety by preventing blockage.
- Esco ISOCIDE™ antimicrobial surface on all painted surfaces minimizes contamination.
- Downflow air sensor mounted in interior.

Each cabinet is KI-Discus tested for performance integrity. Available in 0.9, 1.2, 1.5 and 1.8 meter models (3', 4', 5' and 6'). Shown with optional telescoping stand.

TÜV NORD

Tested to EN 12469 and TÜV-GS certified for safety and performance.

- Accuflow™ microprocessor speed controller maintains safe cabinet airflow despite supply voltage fluctuations.
- Integrated RFI and electrical noise filters eliminate interference with and from adjacent equipment.
- Low noise level <58dBA (1.2 meter (4') cabinet) is significantly quieter than conventional cabinets.
- Dual, long-life ULPA (per IEST-RP-CC001.3) filters for supply and exhaust airflow.
- Enhanced side-capture zones optimize containment.
- Independent exhaust sensor mounted exterior to work area.
- Single piece side and back wall construction.
- Improved lighting is brighter, more uniform and reduces glare.
- Optional UV lamp operates on programmable timer.
- HPV-compliant and approved for safe decontamination using BIOQUELL technology.

- The front sash is motorized for convenient one-hand operation. The sash control is mounted on the front control panel.
- Integrated sash proximity contacts sense proper sash position, serve as an interlock for the UV lamp, and activate an alarm if the sash is improperly positioned.
- When fully lowered the sash seals automatically against a closed-cell peripheral gasket to isolate the interior and prevent escape of contaminants during decontamination.

Motorized Front Sash Assembly and Sash Seal

- *The magnetic switch eliminates the chance of mechanical wear and tear typical of a mechanical switch.*
- *The laminated glass maintains containment if the sash is accidentally broken during cabinet operation.*
- *The back of the sash can be easily cleaned by removing the sash track cover to swing up the sash glass.*

Operator, Product and Environmental Protection

Infinity Class II Model FC2-4A_ delivers three times better downflow uniformity than required by European Standard EN 12469, and provides protection from airborne contaminants to the operator, product and the environment. Model FC2-4A_ shown with optional height adjustable stand with casters and optional adjustable footrest.

A graphical interface indicates cabinet performance.

Display language can be user-programmed for English, German, French, Italian or Spanish.

Enlarged, multi-line digital read-out with alpha-numeric display indicates all input, status and alarm functions.

Indicators for filter life and UV life are reverse scaled from 100% to 0% and displayed on the LCD panel.

When programmed ON

- *the start-up sequence confirms status with Air Safe and local time display.*
- *the Personal Identification Number (PIN) access restricts unauthorized adjustments.*
- *an airflow alarm warns of deviations from normal velocities.*

Advanced Engineering

The Esco Infinity microbiological safety cabinet, includes a number of design and performance features not found on our popular Labculture® series cabinets. These include:

- An aerosol tight window for additional safety while the cabinet is inoperative.
- Double fan design guarantees safety in the event of the failure of one fan.
- Motorized front sash for one-hand operation.
- Larger LCD display for easy monitoring of operational parameters.
- Reduced height permits cabinet installation for seated operation in standard 2.4 meter (nominal, <8') laboratory ceiling height. Cabinet shown on optional mounting stand with casters, seated height work surface 711 mm (28").

Containment and Protection

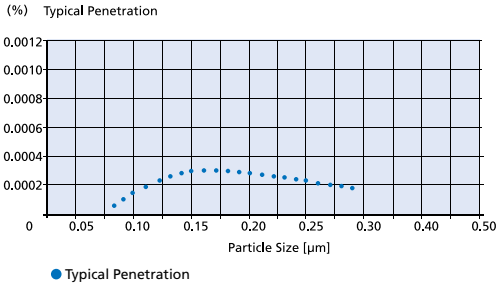
The Esco Infinity Class II Microbiological safety cabinet (FC2) provides operator, product and environmental protection against Biosafety Levels 1, 2 and 3. This cabinet can be used for handling Biosafety Level 4, provided that the operator wears positive pressure suit.

- The airflow ratio of 65% recirculation to 35% exhaust increases operator protection beyond the 70% / 30% ratio of conventional microbiological safety cabinets.
- Inflow of room air enters the front air grille to establish operator protection; room air does not enter the work zone, preventing product contamination.
- Raised armrest prevents the likelihood of inflow grille blocking by operator's arms.
- Auto-purge holes located at the front side walls eliminate eddy currents and dead air pockets in the critical area behind the sash window.
- The downflow (supply) filter is tilted proportional to the cabinet front angle to direct more air forward to the front air grille.
- The inflow velocity, downflow velocity, and airflow path, and intake geometry are precision tuned and tested to create an optimum air curtain on the front aperture; this curtain maintains personal and product protection even in the unlikely event of a severe inflow or downflow imbalance that would compromise protection in a conventional cabinet.

Integrated Filtration System

Independent supply and exhaust filters provide 99.999% typical efficiency for particle sizes of 0.1 to 0.3 microns. Infinity Series filters meet the IEST-RP-CC001.3 recommended practice for ULPA performance (USA), and EN 1822 for H14 performance (EU).

- ULPA filters (per IEST-RP-CC001.3), are tested to a typical efficiency of >99.999% for 0.1 to 0.3 micron particles; these provide better filtration capability than conventional H13 HEPA filters that have a typical efficiency of > 99.99% for 0.3 micron particles.



Esco Filter Efficiency

Independent supply and exhaust filters provide 99.999% typical efficiency for particle sizes of 0.1 to 0.3 microns. Infinity Series filters meet the IEST-RP-CC001.3 recommended practice for ULPA performance (USA), and EN 1822 for HEPA performance (EU).

Color coded indicator lamps display green for fan operation; blue for fluorescent lights and electrical outlet; and orange for UV lamp ON caution.

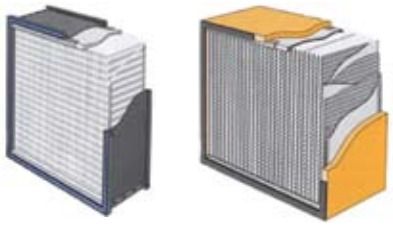
Programmable automatic UV light timer simplifies operation, enhances contamination control, extends UV lamp life and saves energy.

Enlarged touchpad data entry buttons with tactile feedback permit control settings and access to diagnostics, default settings and hierarchical menus.

Esco Next-Generation Sentinel Microprocessor Control System

- *The Sentinel microprocessor-based control and alarm system supervises all cabinet functions.*
- *Setpoints and other applications are user activated through touch-pad programming access detailed in the Operations Manual.*
- *A key switch located on the cabinet prevents unauthorized use of the cabinet.*
- *The motorized sash is controlled by an up/down button.*
- *A data output for remote monitoring and information management to meet FDA21CFR and other criteria is available; contact Esco or your Sales Representative for details.*

Mini-pleat Separatorless Filter (left) vs. Conventional Aluminium Separator Filter (right)



Esco cabinets use Swedish Camfil Farr® mini-pleat filters without aluminum separators to increase filter efficiency, minimize the chance of leakage, and to prolong filter life. Filters include a lightweight aluminum frame for structural stability and elimination of swelling common to conventional wood frames.

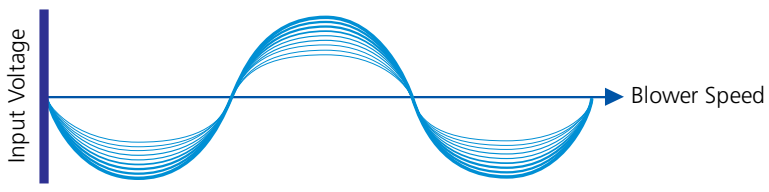
- Filter assembly is constructed in accordance with EN1822 requirements.
- The supply filter provides ISO Class 3 (per ISO14644.1) clean air to the work surface in a gentle vertical laminar flow for product protection.
- Modern separatorless mini-pleat filter construction maximizes the filter surface area to extend filter life and eliminate possible filter media damage by thin and sharp aluminum separators used in conventional HEPA filter construction.
- The exhaust filter traps biohazard particles acquired from the work surface before air is exhausted to the room, offering personal and environmental protection.
- The exhaust filter media is protected from mechanical damage by an integrated metal screen guard, which is absent from conventional HEPA filters.

Sentinel Microprocessor Control, Alarm, Monitoring System

The Esco Sentinel microprocessor-based control system supervises operation of all cabinet functions.

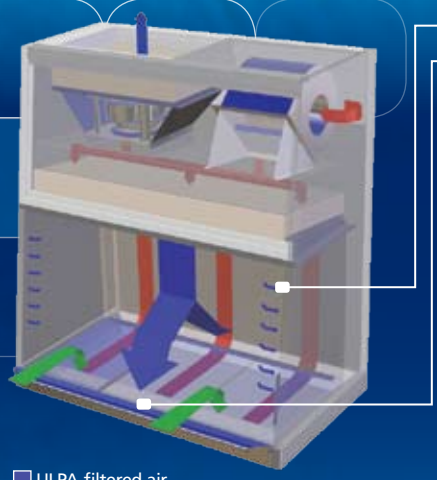
- Continuous monitoring of cabinet airflow is displayed on a bright, easy-to-read LCD panel. The large display monitors operational parameters.
- The control panel is located on the center of the cabinet, and angled down for easy access by the operator.
- A back-up battery maintains alarm function for airflow, power and pressure alarm in the event of a power failure.
- Two integrated, temperature-compensated true airflow velocity sensors provide independent measurement of inflow and downflow velocities despite room temperature fluctuation.
- A pressure sensor monitors pressure drop across the filter plenum and computes estimated remaining filter life.
- A one-touch half-speed setting can be activated at the end of the work day to reduce energy consumption, prolong filter life and maintain interior work zone cleanliness for the next day's work.
- All electronic parts are contained inside a plug-and-play module that permits easy exchange if required.
- Microprocessor software updates are available from Esco for download via the Internet.
- Sentinel functions are factory set to default to ON or OFF, depending on worldwide destination and local preferences. Default settings can be user activated through the touchpad data entry access.

Esco Accuflow Microprocessor Speed Controller



The Esco Accuflow™ microprocessor speed controller maintains steady motor/blower speed despite building voltage fluctuations, thereby assuring constant face velocity and downflow for optimum safety, containment and protection.

Cabinet Filtration System



- Ambient air is pulled through the perforations located towards the work zone front to prevent contamination of the work surface and work product. The inflow does not mix with the clean air within the cabinet work zone. Inflow air travels through a return path toward the common air plenum (blower plenum) at the top of the cabinet.
- Approximately 35% of the air in the common plenum is exhausted through the ULPA filter to the room. The remaining 65% of the air is passed through the downflow ULPA filter and into the work area as a vertical laminar flow air stream bathing the work surface in clean air.
- The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.
- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones at a higher velocity (small blue arrows).
- A combination of inflow and downflow air streams forms an air barrier that prevents contaminated room air from entering the work zone, and prevents work surface emissions from escaping the work zone.
- Air returns to the common air plenum where the 35% exhaust and 65% recirculation process is continued.

- Automatic start-up sequence will prepare the cabinet for normal operation and advise when safe conditions are established.
- An administrator controlled PIN (Personal Identification Number) can be set to restrict access to main menu.
- The airflow alarm can be activated or deactivated depending on user preference and nature of the work.

Consult your Esco Operating Manual or contact Esco or your Sales Representative for information on user-preference programming capabilities built into the Sentinel microprocessor platform.

Redundant Blower System

The Infinity blower system is designed for high performance operation, redundancy, maximum energy efficiency and minimal maintenance.

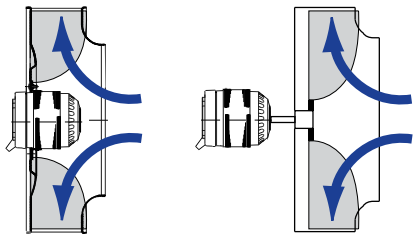
- Dual permanently lubricated direct-drive external rotor motor/blowers safety in the event of a motor failure.
- The external rotor motor design allows for optimum cooling of the motor during extended operations and extends the motor bearing life.
- The inflow and downflow balance is precisely established by two independent Accuflow fan speed controls.
- The Accuflow microprocessor based speed controller maintains constant, stable airflow despite building supply voltage fluctuations.
- Speed can be adjusted electronically without mechanical adjustment.
- Built-in RFI and electrical noise filters eliminate interference with adjacent instrumentation.
- An integral blower hour meter tracks operating life and aids in predictive maintenance planning.
- To prevent fan damage, a paper-catch grille traps papers or towels that may drop down on the drain pan, preventing them from being pulled into the column by fan suction.

Cabinet Construction

Robust construction and enhanced safety features qualify the cabinet for the most demanding laboratory applications. The cabinet is fully assembled and ready to install and operate when shipped.

- The interior sides and back wall are formed from a single piece of stainless-steel with large radius corners to simplify interior cleaning.
- The cabinet work zone has no welded joints to collect contaminants or rust.
- All stainless steel work surfaces are accessible for cleaning.
- Multi-piece tray components are easily lifted and removed to encourage surface decontamination.
- A recessed central area and stainless steel drain pan channels spills and prevent liquids from entering the lower filtration and blower systems.

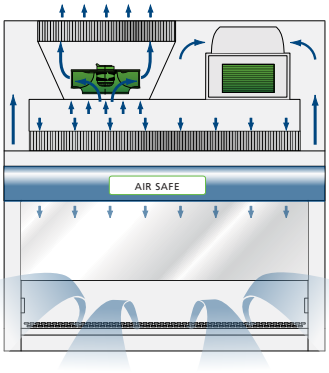
Esco Centrifugal Fan with External Rotor Motor (left) vs. Conventional Fan with Standard Motor (right)



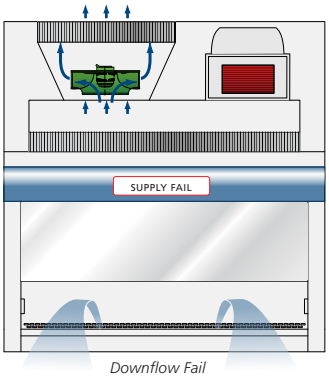
Esco Infinity cabinets use a combination of high performance scroll blowers (supply) and German made ebm-papst® permanently lubricated, centrifugal motor/blowers with external rotor designs (exhaust). Selected for energy efficiency, compact design, and flat profile, the completely integrated exhaust blower assembly optimizes motor cooling, with unified rotating parts and overall component balance for smooth, quiet, vibration-free operation. Weight is equally distributed to all bearings to extend bearing life, transfer heat and maximize speed control.

Double Blower System

Provides the maximum possible level of safety by enabling safe cabinet shut down in the event of a single blower failure.

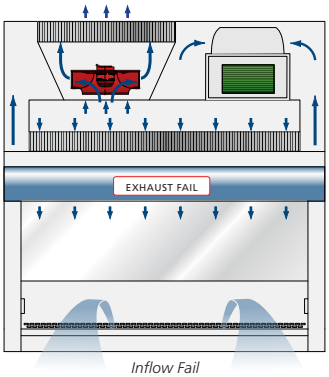


1A: *Under normal operation with both blowers operating (1a) the supply blower creates a negative pressure surrounding the contaminated positive pressure plenum and pushes air across the supply and exhaust filters. The exhaust blower boosts the air pressure through the exhaust filter to create better inflow and operator protection. Supply and exhaust blowers automatically operating at reduced speeds extend blower life.*



Downflow Fail

1B: *If the supply blower fails (1b), downflow to the work area is suspended. The exhaust blower ramps up to maximum power to provide inflow to the cabinet to help maintain containment. The control panel warns of downflow failure. With the supply blower offline, the cabinet still provides protection by maintaining inflow above 0.40 m/s as required by EN 12469.*



Inflow Fail

1C: *If the exhaust blower fails (1c), the supply blower continues to provide inflow to the cabinet and downflow to the work area. The control panel warns of inflow failure. With the exhaust blower offline, the cabinet maintains protection by maintaining inflow above 0.40 m/s as required by EN 12469.*

Dynamic Chamber™ Plenum Design

Negative pressure *Positive pressure*

The Esco triple-wall design creates a Dynamic Chamber plenum which surrounds contaminated areas with negative pressure, preventing the possibility of contamination from leaks in filter seal, gasket or cabinet structure. The third wall conceals utilities.

- External surfaces are coated with Esco Isocide antimicrobial coating to protect against surface contamination and inhibit bacterial growth. Isocide eliminates 99.9% of surface bacteria within 24 hours of exposure.
- There are no screws in the front or sides to trap contaminants or complicate cleaning.

Service Fitting Access

The cabinet is pre-plumbed for easy installation optional gas and vacuum fittings; see Accessories.

- The Service fitting openings are offset for easier access.
- The External plumbing is concealed behind trim panels to preserve cabinet aesthetics.
- A normally closed gas solenoid valve automatically shuts off gas flow in the event of a cabinet alarm or unsafe condition.

Comfortable Ergonomic Design

The cabinet is engineered for comfort, utility value and safety.

- The angled viewing window and narrow profile front grille improves reach into the work area.
- The instant-start 5000k fluorescent lamp operates on an electronic ballast to reduce heat, improve comfort and conserve energy.
- The lamp delivers uniform lighting to the work surface for greater comfort, reduced glare and improved productivity; see Specifications.
- The front armrest is raised above the work zone to improve comfort and to minimize blockage of forward airflow perforations.
- The optional adjustable support stand provides work surface height control.
- The frameless sash eliminates operator's line of sight blockage.
- A generous sash opening allows for easier access into the work zone, provides ample room for transferring of small equipment; see Specifications.
- The sliding window can be fully opened to insert and remove larger instrumentation and equipment.

Electrical Safety and Certification

All components meet or exceed applicable safety requirements.

- Each cabinet is individually factory tested for electrical safety.
- Documentation specific to each cabinet serial number is maintained on file.
- Certified to the renowned world standard for microbiological safety cabinets; the TUV GS mark for compliance, to EN 12469 (May, 2007).
- Contact Esco or your Sales Representative for site preparation information; see Electrical Specifications.

Warranty

The Infinity is warranted for 3 years excluding consumable parts and accessories.

- Each cabinet is shipped with a comprehensive User's Manual complete with a report documenting all test procedures.
- Additional IQ/OQ/PQ documentation is available upon request.
- Contact your local Sales Representative for specific warranty details or documentation requests.

	Microbiological Safety Cabinets*	Air Quality	Filtration	Electrical Safety
Standards Compliance	Certified, TUV-GS to EN 12469:2000 (May, 2007)	ISO 14644.1 Class 3, Worldwide AS 1386 Class 1.5, Australia JIS B9920 Class 3, Japan BS 5295 Class C, UK KS27030.1, Class M10,000, Korea IEST-G-CC1001, USA IEST-G-CC1002, USA	IEST-RP-CC034.1, USA IEST-RP-CC007.1, USA IEST-RP-CC001.3, USA EN 1822, Europe	IEC 61010-1, Worldwide EN 61010-1, Europe UL 61010A-1, USA CSA C22.2 No. 1010.1-92, Canada

**Models FC2-4A1 and FC2-6A1. Certification for additional models is pending or in process.*
For details on most recent certifications contact Esco or your Sales Representative.

Accessories and Options

Esco offers a variety of options and accessories to meet local applications. Contact Esco or your local Sales Representative for ordering information.

Perforated Work Tray

Available for applications where a perforated work surface is preferred. Must be specified when ordering.

Electrical Outlets and Utility Fittings

- Electrical outlet, ground fault, North America
- Electrical outlet, Euro/Worldwide
- Petcock (air, gas, vacuum)
  - North America (American) style
  - Euro/Worldwide style DIN 12898, DIN 12919, DIN 3537

Support Stands

- Fixed height, available 737 mm (29") or 838 mm (33"), ±38.1 mm (1.5")
  - With leveling feet
  - With casters
- Adjustable height, hydraulic range from 737 mm (29") to 838 mm (33")
  - Manual or electrical lift
  - With casters
- Telescoping height, nominal range from 737 mm (29") to 838 mm (33")
  - Adjustable in 25.4 mm (1") increments
- Infinitely adjustable cradle stand, with casters
  - Elevates to seating or standing work surface height
  - When lowered permits movement through standard doorway

  Note: Increases exterior dimensions.

Cabinet Accessories

- PVC armrest
  - Chemically treated, improves operator comfort, easy-to-clean, 712 mm (28") standard size
- Ergonomic lab chair
  - Laboratory grade construction, meets Class 100 cleanliness; alcohol resistant PVC materials
  - Adjustable 395-490 mm (15.6"-19.3")
- Germicidal UV lamp
  - Controlled by automatic UV lamp timer through Sentinel microprocessor control panel
  - Emission of 253.7 nanometers for most efficient decontamination
  - Lamp is positioned away from operator line-of-sight for safety and proper exposure to interior surfaces

  Note: UV lamp intensity reduces over time and its effectiveness is subject to factors such as relative humidity in the cabinet, ambient air temperature and microbial species in the work zone.
- Ergonomic foot rest
  - Angled, helps maintain proper posture
  - Adjustable height
  - Anti-skid coating, chemical resistant finish
- IV Bar, with hooks
  - Stainless steel construction
  - Available for all standard cabinets
- Microscope viewing device
  - Mounting and viewing pouch integrated into sash
  - Factory installed; specify when ordering

Service fixtures are offset for easier reach. Standard cabinets include two fixture provisions on each sidewall (one provision on each sidewall for .9 meter/3' cabinet). Electrical outlets are mounted below service fixtures to minimize obstructions.

The one piece stainless steel side wall is radiused on the corner and easy to clean without crevices or joints.

Helpful for certifiers, the hinged maintenance assembly opens to a fixed position on integrated, gas spring struts providing front service access.

All key components with the exception of the motor/blower assembly are mounted outside the air stream and away from contaminated air to permit service without decontamination. These include fluorescent lamps, UV lamp, electrical harnesses, electronic boards and microprocessor control.

Panels enclosing potentially hazardous areas or components such as microbiological contamination or electrical shock are color-coded red to warn service technician.

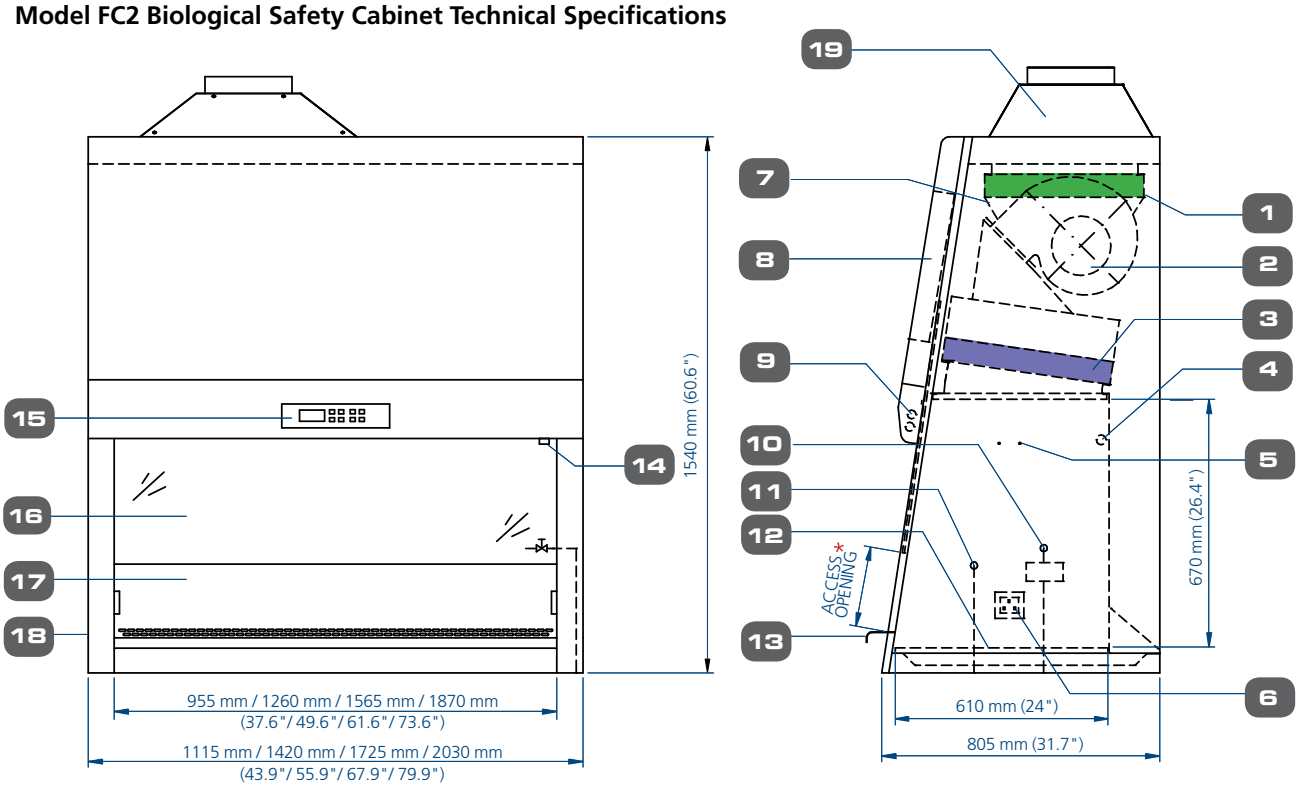
The telescoping Dynamic Chamber™ plenum minimizes physical lifting and accelerates filter change when required.

Work area containment is maintained even when removable components are lifted out for cleaning.

The lower drain trough is a single-piece fabrication with wide open angles and a channel to direct spills to the drain.

Robust Cabinet Construction and Enhanced Safety Features

Model FC2 Biological Safety Cabinet Technical Specifications

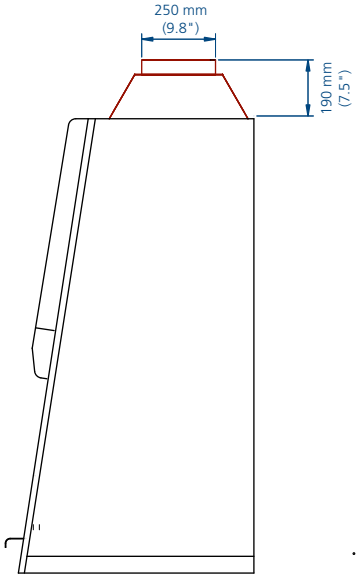


1. *Exhaust filter*
2. *Blower*
3. *Downflow filter*
4. *Standard UV light Retrofit Kit™ provision*
5. *Standard IV-Bar Retrofit Kit provision*
6. *Universal electrical outlet (0.9 meter / 3' model - one single outlet in work zone) (1.2, 1.5 and 1.8 meter / 4', 5' & 6' models - two single outlets in work zone)*
7. *Exhaust fan*
8. *Electrical / Electronics panel*
9. *Fluorescent light*
10. *Gas service fixture with solenoid valve*
11. *Vacuum service fixture*
12. *Stainless steel single-piece work tray*
13. *Stainless steel armrest*
14. *Key switch*
15. *Esco Sentinel microprocessor control system*
16. *Motorized sliding sash (aerosol tight)*
17. *Single piece stainless steel back wall and side wall*
18. *Side removable panel for plumbing access*
19. *Thimble exhaust collar (optional)*

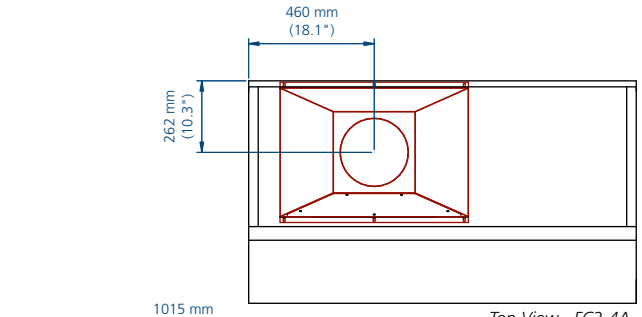
*Access Opening Height	All Model Sizes
Testing Opening Height	200 mm (7.9")
Working Area Height	210 mm (8.3")

**The combination of the Esco raised armrest and recessed work surface creates additional space within the working area than typically specified.*

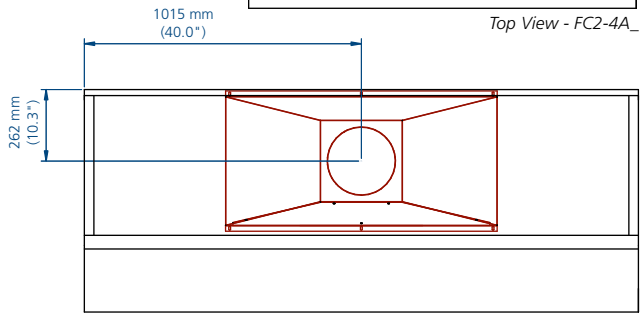
Optional Exhaust Collar Positions for Thimble-Ducting for FC2 Models



Side View - All Sizes



*Top View - FC2-4A_*



*Top View - FC2-6A_*

General Specifications			FC2-3A_	FC2-4A_	FC2-5A_	FC2-6A_
Nominal Size			0.9 meters (3')	1.2 meters (4')	1.5 meters (5')	1.8 meters (6')
External Dimensions (W x D x H)			1115 x 805 x 1535 mm 43.9" x 31.7" x 60.4"	1420 x 805 x 1535 mm 56.0" x 31.7" x 60.4"	1725 x 805 x 1535 mm 67.9" x 31.7" x 60.4"	2030 x 805 x 1535 mm 80.0" x 31.7" x 60.4"
Internal Work Area Dimensions (W x D x H)			955 x 610 x 670 mm 37.6" x 24.0" x 26.4"	1260 x 610 x 670 mm 49.6" x 24.0" x 26.4"	1565 x 610 x 670 mm 61.6" x 24.0" x 26.4"	1870 x 610 x 670 mm 73.6" x 24.0" x 26.4"
Internal Work Space Area			0.47 m^2 (5.06 sq.ft.)	0.62 m^2 (6.67 sq.ft.)	0.77 m^2 (8.29 sq.ft.)	0.92 m^2 (9.90 sq.ft.)
Tested Opening			200 mm (7.9")	200 mm (7.9")	200 mm (7.9")	200 mm (7.9")
Working Opening			210 mm (8.3")	210 mm (8.3")	210 mm (8.3")	210 mm (8.3")
		Power Rating Code[1]				
Average Airflow Velocity	Inflow	1, 3	0.48 m/s (95 fpm) at initial setpoint			
		2	0.53m/s (105 fpm) at initial setpoint			
	Downflow	1, 2, 3	0.35m/s (70 fpm) at initial setpoint			
Airflow Volume	Inflow	1, 3	332 m^3/h (195 cfm)	437 m^3/h (257 cfm)	593 m^3/h (319 cfm)	646 m^3/h (380 cfm)
		2	336 m^3/h (216 cfm)	483 m^3/h (284 cfm)	599 m^3/h (353 cfm)	714 m^3/h (420 cfm)
	Downflow	1, 2, 3	702 m^3/h (413 cfm)	929 m^3/h (544 cfm)	1147 m^3/h (675 cfm)	1367 m^3/h (804 cfm)
	Exhaust	1, 3	332 m^3/h (195 cfm)	437 m^3/h (257 cfm)	543 m^3/h (319 cfm)	646 m^3/h (380 cfm)
		2	336 m^3/h (216 cfm)	483 m^3/h (284 cfm)	599 m^3/h (353 cfm)	714 m^3/h (420 cfm)
Sound Emission (Typical)	NSF 49	1, 3	<60 dBA	<61 dBA	<63 dBA	<64 dBA
		2	<61 dBA	<62 dBA	<64 dBA	<65 dBA
	EN 12469	1, 3	<57 dBA	<58 dBA	<60 dBA	<61 dBA
		2	<58 dBA	<59 dBA	<61 dBA	<62 dBA
ULPA Filter Typical Efficiency	Downflow		>99.999% at 0.1 to 0.3 microns as per IEST-RP-CC001.3 USA >99.995% at MPPS as per EN 1822 (H-14) EU			
	Exhaust					
Fluorescent Lamp Intensity			> 1200 Lux (111 foot-candles)			
Cabinet Construction	Main Body		1.2 mm (0.06") 16 gauge electrogalvanized steel with white oven-baked epoxy Isocide antimicrobial powder coated finish			
	Work Zone		Stainless steel grade 304; Work tray: 1.2 mm (0.04"); Walls and drain pan: 0.9 mm (0.03")			
	Side Walls		Stainless steel grade 304			
Electrical *	220-240V, AC, 50Hz, 1ø	A1	FC2-3A1	FC2-4A1	FC2-5A1	FC2-6A1
	110-130V, AC, 60Hz, 1ø	A2	FC2-3A2	FC2-4A2	FC2-5A2	FC2-6A2
	220-240V, AC, 60Hz, 1ø	A3	FC2-3A3	FC2-4A3	FC2-5A3	FC2-6A3
Net Weight **			228 kg / 503 lbs	298 kg / 657 lbs	372 kg / 820 lbs	447 kg / 985 lbs
Shipping Weight **			280 kg / 617 lbs	354 kg / 780 lbs	443 kg / 977 lbs	522 kg / 1150 lbs
Shipping Dimensions, Maximum (W x D x H) **			1200 x 900 x 1870 mm 47.2" x 35.4" x 73.6"	1530 x 900 x 1870 mm 60.2" x 35.4" x 73.6"	1910 x 900 x 1870 mm 75.2" x 35.4" x 73.6"	2150 x 900 x 1870 mm 84.6" x 35.4" x 73.6"
Shipping Volume, Maximum **			2.02 m^3 (71 cu.ft.)	2.58 m^3 (91 cu.ft.)	3.22 m^3 (114 cu.ft.)	3.62 m^3 (128 cu.ft.)

** Additional voltages may be available; contact Esco for ordering information.*
*** Cabinet only, excludes optional stand.*
[1] AC power specifications are to be specified in the last digit of the model number when ordering: 1, 220 240V, 50Hz; 2, 110-130V 60Hz; 3, 220-240V, 60Hz.
Note: 60 Hz models meet or exceed NSF 49 standards for safety and performance. For information contact Esco or your Sales Representative.

Microbiological Testing

Esco performs testing in accordance with more than 10 of the world's most recognized standards for local, regional and international criteria. Testing in our micro-biology laboratory is conducted according to NSF49, EN12469, and JIS K3800. An NSF-accredited biohazard cabinet field certifier is available in-house full-time to supervise all testing work, using harmless Bacillus atrophaeus (formerly Bacillus Subtilis) bacteria that is used to challenge the cabinet, then incubated for 48 hours and the Colony Forming Units (CFU) are counted to determine the testing results. Increased microbiological challenge tests with objects inside the cabinet work zone, Bunsen burner, external airflow disturbance, and Human-As-Mannequin test adapted from Fume Hood development were performed to simulate real-world conditions.

Personnel Protection Test

The test objective is to evaluate the safety of the cabinet for the personnel operating on potentially hazardous samples in the cabinet work zone.

- A nebulizer containing 55 mL of 5 to 8 x 10^8 spores/mL B.atrophaeus spores is placed inside the work zone, 10 cm (4") behind the front opening sash.
- Target slit air samplers and impingers are placed outside the work zone to capture possibly escaping B.atrophaeus spores, then the sample is incubated.
- Acceptance: The number of Bacillus atrophaeus CFU recovered from the agar plates shall not exceed 10 CFU per test.

Product Protection Test

The test objective is to determine cabinet protection to the product/samples inside the cabinet work zone from environmental contaminants.

- A nebulizer containing 55 mL of 5 to 8 x 10^6 spores/mL B.atrophaeus is placed at 10 cm (4") in front of sash window.
- Target agar plates are placed throughout the entire work surface.
- Acceptance: The number of Bacillus atrophaeus CFU recovered from the agar plates shall not exceed 5 CFU per test.

Cross Contamination Test

The test objective is to evaluate cabinet protection from cross contamination of samples placed simultaneously inside the work zone.

- A nebulizer containing 55 mL of 5 to 8 x 10^4 spores/mL is placed against one of the work zone sidewalls.
- Target agar plates are placed 360 mm (14") away from the same side wall.
- Acceptance: The number of Bacillus atrophaeus CFU recovered on agar plates shall not exceed 2 CFU per test.

HPV Test Compliant: Safer Hydrogen Peroxide Decontamination Compatibility

Esco biological safety cabinets are Hydrogen Peroxide Vapor (HPV) compliant and decontaminatable cabinets approved by BIOQUELL for this patented process. HPV is a safer and more efficient alternative to conventional decontamination using formaldehyde (CH_20):

- HPV is non-carcinogenic and odorless, while formaldehyde is carcinogenic, toxic and has pungent smell.
- If there is a gap on the cabinet sealing, escaping HPV to the lab will decompose to become oxygen and water. Escaping formaldehyde, however, is harmful to people in the lab. Therefore HPV decontamination can be performed while people are working inside the lab, while formaldehyde decontamination must be performed with no one present in the lab. The HPV method improves safety, productivity, and reduces the time to seal the cabinet.
- HPV biological efficacy is independent of environmental variables, whereas formaldehyde efficacy is dependent on such variables.
- HPV has a better penetration capacity, resulting in a full decontamination of the cabinet. The formaldehyde method is known to result in incomplete decontamination.
- HPV is more effective and rapid against biological organisms compared to formaldehyde.
- HPV requires approximately 4-7 hours for set-up, decontamination, and tear-down, compared to a total of 12-15 hours needed to complete a formaldehyde decontamination process.
- HPV decontamination effectiveness is independent of temperature and humidity. Formaldehyde requires temperature above 20°C and relative humidity above 65%.
- For information on the BIOQUELL HPV methodology contact Esco or your Sales Representative.

KI-Discus Containment Test According to EN 12469:2000 (Operator Protection)

Esco is currently one of the few companies in the world equipped to perform the KI-Discus test for our customers. The KI-Discus test is defined in the European Standard for microbiological safety cabinets, EN12469:2000, as a test method for validating the operator/personnel protection capabilities of the cabinet.

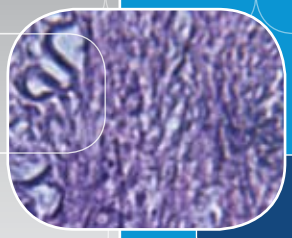
- The KI-Discus test shows excellent correlation with the microbiological test method for operator protection, and is useful for validating the actual containment performance of the cabinet on-site.
- The KI-Discus takes only 45 minutes as opposed to 2 days for microbiological testing.
- Thus, each Esco Infinity FC2 model is factory tested using the KI-Discus method for operator safety.

Esco builds quality from the inside out.

Comprehensive Performance Testing At Esco

Every Infinity model manufactured by Esco is individually tested, documented by serial number and validated with the following test methods.

- *Inflow/downflow velocity*
- *PAO Aerosol challenge for filter integrity*
- *Light, noise and vibration*
- *Airflow pattern visualization*
- *Electrical safety to IEC61010-1*
- *KI-Discus containment*
- *Additional microbiological testing is performed on statistical sampling basis.*



Labculture®

Labculture Class II, Type B2 Biosafety Cabinet, Model LB2-4B_.

Class II, Type B2 (Total Exhaust) Biological Safety Cabinets

The Safety Solution for Life Science Laboratories

ESCO
WORLD CLASS. WORLDWIDE.

Each cabinet is KI-Discus tested for performance integrity.
Available in 0.9, 1.2, 1.5 and 1.8 meter models (3', 4', 5' and 6').
Shown with optional telescoping stand.

Main Features

- Unique Esco Dynamic Chamber™ plenum.
- Negative pressure plenum surrounds supply positive pressure plenum; no fabric bags are used.
- Long-life supply ULPA filter (per IEST-RP-CC001.3) with >99.999% efficiency for particle size between 0.1 to 0.3 microns.
- Angled supply filter matches cabinet profile to achieve best downflow uniformity.
- Esco Sentinel™ microprocessor.
- Frameless, shatterproof sash is easier to clean.
- Ergonomically angled front improves reach and comfort.
- Actual work access height is 45 mm (1.8") higher than tested sash opening to provide additional work space.
- Removable one-piece work surface simplifies cleaning.
- Raised airflow grille maintains safety by preventing blockage.
- Optional UV lamp is located behind control panel away from line of sight. (Does not apply to 1.8 m / 6' models.)
- Esco ISOCIDE™ antimicrobial coating on all painted surfaces minimizes contamination.
- Enhanced side-capture zones optimize containment.
- Work area on Esco 0.9 meter (3') cabinet is equivalent to work area offered on larger 1.2 meter (4') conventional cabinet.

Esco Labculture has passed more performance tests in more languages, for more certifications throughout more countries than any other biological safety cabinet in the world.

Operator, Product and Environmental Protection

The Esco Labculture Class II, Type B2 Biosafety Cabinet provides operator, product and environmental protection against Biosafety Levels 1, 2 and 3. This cabinet can be used for handling Biohazard Level 4, provided that the operator wears positive pressure suit.

Containment and Protection

- The total exhaust design of the LB2 makes the cabinet suitable for microbiological work involving trace amounts of toxic chemicals.
- The non-recirculating design guarantees safety in cases where exhaust HEPA-filtration fails to ensure containment.
- Inflow of room air enters the front air grille to establish operator protection; room air does not enter the work zone, preventing product contamination.
- The front grille has proportionally larger perforation on the extreme left and right side. Combined with the side air gap between the work tray and the side wall, the stronger side capture zones increase protection in this critical area where contaminants tend to bleed out in conventional cabinet.
- The inflow grille has a convex shape to maintain operator protection by discouraging users from placing objects on it.
- Raised armrest prevents the likelihood of inflow grille blocking by operator's arms.
- Auto-purge holes located at the front side walls eliminate eddy currents and dead air pockets in the critical area behind the sash window. Per NSF / ANSI 49 requirement, these side perforations do not extend completely to the work surface to prevent accidental liquid spills in the work zone from entering the side air column.
- The ULPA downflow (supply) filter is tilted proportional to the cabinet front angle to direct more air forward to the front air grille.
- The inflow velocity, downflow velocity, and air flow path, and intake geometry are precision tuned and tested to create an optimum air curtain on the front aperture; this curtain maintains personal and product protection even in the unlikely event of a severe inflow or downflow imbalance that would compromise protection in a conventional cabinet.

Integrated Filtration System

A combination of a supply ULPA filter and an exhaust HEPA filter give the Labculture cabinet a fully integrated performance envelope for product, operator and environmental protection.

- ULPA supply filter (per IEST-RP-CC001.3), is tested to a typical efficiency of >99.999% for 0.1 to 0.3 micron particles; providing better filtration capability than conventional HEPA filters that have a typical efficiency of > 99.99% for 0.3 micron particles.
- HEPA exhaust filter (per IEST-RP-CC001.3), is tested to a typical efficiency of >99.99% for 0.3 micron particles.

Mini-pleat Separatorless Filter (left) vs. Conventional Aluminium Separator Filter (right)

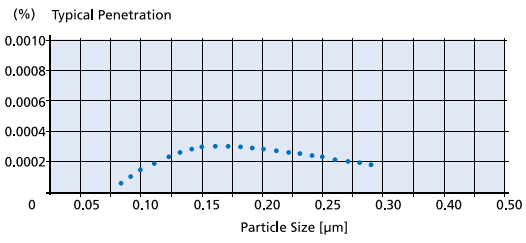
Esco cabinets use Swedish Camfil Farr® mini-pleat filters without aluminum separators to increase filter efficiency, minimize the chance of leakage, and to prolong filter life. Filters include a lightweight aluminum frame for structural stability and elimination of swelling common to conventional wood frames.

- Modern separator-less mini-pleat filter construction maximizes the filter surface area to extend filter life and eliminate possible filter media damage by thin and sharp aluminum separators used in conventional HEPA filter construction.
- The filter frame and media is constructed in accordance with EN1822 requirements for fire retardant properties
- The supply ULPA filter provides ISO Class 3 (per ISO14644.1) clean air to the work surface in a gentle vertical laminar flow for product protection.
- The exhaust HEPA filter traps biohazard particles acquired from the work surface before air is exhausted via the ducting system to the external environment. The Model LB2 is provided with an integral exhaust collar for connecting the cabinet exhaust to an airtight ducting system. NB: Ductworks are not provided with standard product.

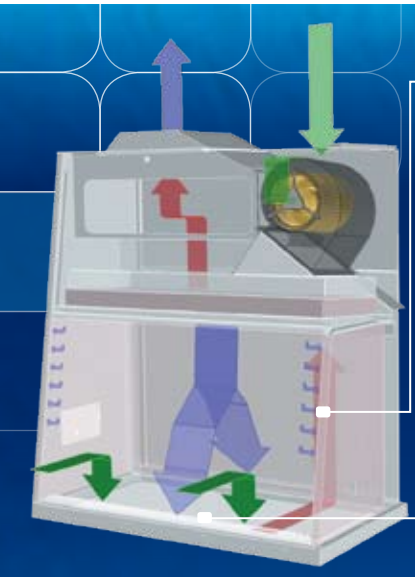
Front Sash Assembly

- Integrated sash proximity contacts sense sash position, serve as an interlock for the UV lamp, and activate an alarm if the sash is improperly positioned.
- The magnetic switch eliminates the chance of mechanical wear and tear typical of a mechanical switch.
- The back of the sash can be easily cleaned by removing the sash track cover and swing up the sash glass.
- The sash is counterbalanced for smooth and light sash moving operation.
- The counterbalance locking mechanism is inherently safe; it locks the counter-balance in place if either of the 2 cables is detached. The sash cable and cable clip have rated strength of more than 6x the weight of the sash window of the largest Labculture Class II cabinet (1.8 meter/6 ft model)
- The safety glass maintains containment if the sash is accidentally broken during cabinet operation.

Esco ULPA Filter Efficiency



Esco cabinets use ULPA filters (per IEST-RP-CC001.3) instead of conventional HEPA filters commonly found in biological safety cabinets. While HEPA filters offer 99.99% typical efficiency at 0.3 micron level, ULPA filters provide 99.999% typical efficiency for particle sizes of 0.1 to 0.3 micron level.



ULPA-filtered air
Unfiltered / potentially contaminated air
Room air / Inflow air

Cabinet Filtration System

Side capture zones

Dynamic air barrier, inflow and forward-directed downflow air converge

- Ambient air is pulled through the front grille to prevent contamination of the work surface and work product. The inflow does not mix with the clean air within the cabinet work zone. Inflow air travels through a return path toward the common air plenum (blower plenum) at the top of the cabinet.
- Ambient air is taken in through a pre-filter at the top of the cabinet, and passes through the downflow ULPA filter, entering the work zone as laminar flow. The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.
- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones (small blue arrows).

The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.

- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones at a higher velocity (small blue arrows).
- A combination of inflow and downflow air streams forms an air barrier that prevents contaminated room air from entering the work zone, and prevents work surface emissions from escaping the work zone. The downflow combined with the inflow air enters the common air plenum.
- All air in the common plenum is HEPA-filtered and exhausted via a dedicated ducting system to the external environment.

Blower Efficiency

The Labculture blower system is designed for high performance operation, maximum energy efficiency and minimal maintenance.

- The blower/motor can maintain airflow velocity within 10% of original setpoint for a 50% increase in pressure loss over clean filters without manual speed control adjustment.
- The permanently lubricated direct-drive external rotor motor/blower reduces operating costs.
- The external rotor motor design allows for optimum cooling of the motor during extended operations and extends the motor bearing life.
- Built-in RFI and electrical noise filters eliminate interference with adjacent instrumentation.
- An integral blower hour meter tracks operating life and aids in predictive maintenance planning.
- To prevent fan damage, a paper-catch grille traps papers or towels that may drop down on the drain pan, preventing them from being pulled into the column by fan suction.

Sentinel Microprocessor Control, Alarm, Monitoring System

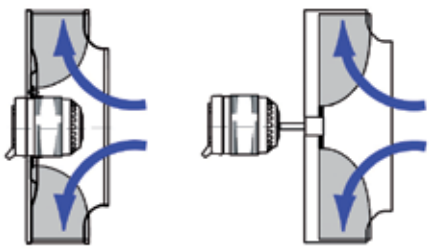
The Esco Sentinel microprocessor-based control system supervises operation of all cabinet functions.

- The control panel is located on the center of the cabinet, and angled down for easy access by the operator.
- Continuous monitoring of cabinet airflow is displayed on a bright, easy-to-read LCD panel.
- An integrated, temperature-compensated true airflow velocity sensor provides an accurate airflow reading despite room temperature fluctuation.
- All electronic parts are contained inside a plug-and-play module that permits easy exchange if required.
- Microprocessor software updates are available from Esco for download via the Internet.

Sentinel functions are factory set to default to ON or OFF, depending on worldwide destination and local preferences. Default settings can be user activated through the touchpad data entry access.

- Automatic start-up sequence will prepare the cabinet for normal operation and advise when safe conditions are established.
- An administrator controlled PIN (Personal Identification Number) can be set to restrict access to main menu.
- The airflow alarm can be activated or deactivated depending on user preference and nature of the work.

Esco Centrifugal Fan with External Rotor Motor (left) vs. Conventional Fan with Standard Motor (right)



- *Esco cabinets use German made **ebm-papst**® permanently lubricated, centrifugal motor/blowers with external rotor designs.*
- *Integrated blades norrow the profile and eliminate the need for a motor shaft.*
- *Motors are selected for energy efficiency, compact design, and flat profile. The completely integrated assembly optimizes motor cooling.*
- *All rotating parts are unitized and balanced for smooth, quiet, vibration-free operation.*

Touchpad data entry buttons permit control settings and access to diagnostics, default settings and hierarchical menus.

Color coded indicator lamps display green for primary function (fan operation); blue for secondary function (fluorescent lights and electrical outlet); and orange for caution (UV lamp ON).

Programmable automatic UV light timer simplifies operation, enhances contamination control, extends UV lamp life and saves energy.

A graphical interface indicates cabinet performance.

Digital read-out with alpha-numeric display indicates all input, status and alarm functions.

All functions can be user activated through touch-pad programming access; see Operations Manual.

Sentinel Microprocessor Control System, Programmable

When programmed ON

- *the start-up sequence confirms status with Air Safe and local time display.*
- *the Personal Identification Number (PIN) access restricts unauthorized adjustments.*
- *an airflow alarm warns of deviations from normal velocities.*

Consult your Esco Operating Manual or contact your Sales Representative for information on user-preference programming capabilities built into the Sentinel microprocessor platform.

Cabinet Construction

Robust construction and enhanced safety features qualify the cabinet for the most demanding laboratory applications. The cabinet is fully assembled and ready to install and operate when shipped.

- The interior work area is formed from a single piece of stainless-steel with large radius corners to simplify cleaning.
- The cabinet work zone has no welded joints to collect contaminants or rust.
- All stainless steel work surfaces are accessible for cleaning.
- Tray components lift and remove to provide easy access and encourage surface decontamination.
- A recessed central area and stainless steel drain pan channels spills and prevent liquids from entering the lower filtration and blower systems.
- The drain pan is flush with the side walls to eliminate concealed or hard-to-clean spaces.
- There are no screws in on the front or sides to trap contaminants or complicate cleaning.
- Optional service fittings are offset for easier access.
- External plumbing is concealed behind trim panels to maintain aesthetics.
- External surfaces are coated with Esco Isocide antimicrobial coating to protect against surface contamination and inhibit bacterial growth. Isocide eliminates 99.9% of surface bacteria within 24 hours of exposure.

Robust Cabinet Construction and Enhanced Safety Features

Service fixtures are offset for easier reach. Standard cabinets include two fixture provisions on each sidewall (one provision on each sidewall for 0.9 meter/3 ft. cabinet). Electrical outlets are mounted below service fixtures to minimize obstructions.

Helpful for certifiers, the hinged maintenance assembly opens to a fixed position on integrated, gas spring struts providing front service access.

All key components, with the exception of the blower/motor assembly, are mounted outside the air stream and away from contaminated air to permit service without decontamination. These include fluorescent lamps, UV lamp, electrical harnesses, electronic boards and microprocessor control.

Panels enclosing potentially hazardous areas or components such as microbiological contamination or electrical shock are color-coded red to warn service technician.

The Dynamic Chamber™ plenum minimizes physical lifting and accelerates filter change when required.

Work area containment is maintained even when removable components are lifted out for cleaning.

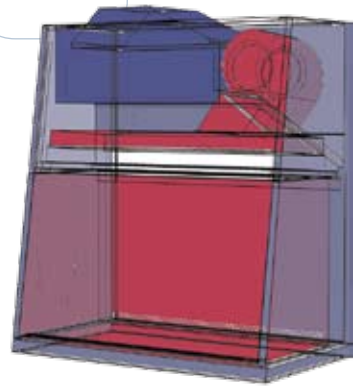
The one piece stainless steel work tray edges are radiused and easy to clean without crevices or joints.

The lower drain trough is a single-piece fabrication with wide open angles and a channel to direct spills to the drain.

The closed sidewall contains no perforations, air return slots or other hidden areas where contaminants can accumulate.

Standards Compliance	Biosafety Cabinets	Air Quality	Filtration	Electrical Safety
	NSF / ANSI 49, USA (LB2-4B2, LB2-6B2) SFDA YY-0569, China	ISO 14644.1, Class 3, Worldwide JIS B9920, Class 3, Japan JIS BS5295, Class 3, Japan US Fed Std 209E, Class 1 USA	EN-1822 (H14 & H13), Europe IEST-RP-CC001.3, USA IEST-RP-CC007, USA IEST-RP-CC034.1, USA	UL-C-61010A-1, USA CSA22.2, No.1010-192, Canada EN 61010-1, Europe IEC61010-1, Worldwide

Dynamic Chamber™ Plenum Design



High negative pressure

Negative pressure *Positive pressure*

The Esco triple-wall design creates a Dynamic Chamber plenum which surrounds contaminated areas with negative pressure, preventing the possibility of contamination from leaks in filter seal, gasket or cabinet structure. The third wall conceals utilities.

Comfortable Ergonomic Design

The LB2 cabinet is engineered for comfort, utility value and safety.

- The 10° angled viewing window and narrow profile front grille improves reach into the work area.
- The instant-start 5000k fluorescent lamp operates on an electronic ballast to reduce heat, improve comfort and conserve energy.
- The lamp delivers uniform lighting to the work surface for greater comfort, reduced glare and improved productivity; see Technical Specifications.
- The front armrest is raised above the workzone to improve comfort and to ensure that the operator's arms do not block the forward airflow perforations.
- The optional adjustable support stand provides work surface height control.
- The frameless sash eliminates operator's line of sight blockage
- A generous sash opening allows for easier access into the work zone, provides ample room for transferring of small equipment (See Specifications.)
- The sliding window can be fully opened to insert and remove larger instrumentation and equipment.

Electrical Safety and Certification

All components meet or exceed applicable safety requirements.

- Each cabinet is individually factory tested for electrical safety.
- Documentation specific to each cabinet serial number is maintained on file.
- UL Listed for USA and Canada.
- Certified to the US standard NSF / ANSI 49 for Class II biohazard cabinetry (refer to Standard Compliance table at the top of this page for the full list).
- Contact Esco or your Sales Representative for site preparation information; see Electrical Specifications.

Warranty

The Labculture cabinet is warranted for 3 years excluding consumable parts and accessories.

- Each cabinet is shipped with a comprehensive user's manual complete with a report documenting all test procedures.
- Additional IQ/OQ/PQ documentation is available upon request.
- Contact your local Sales Representative for specific warranty details or documentation requests.

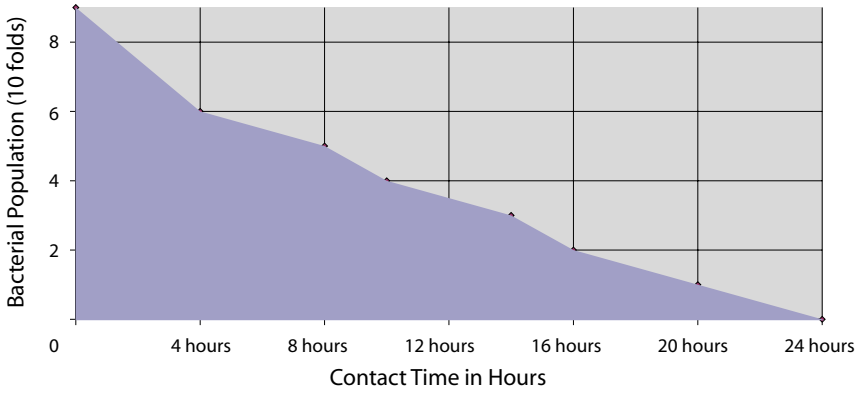
Accessories and Options

Esco offers a variety of options and accessories to meet local applications. Contact Esco or your local Sales Representative for ordering information.

Support Stands

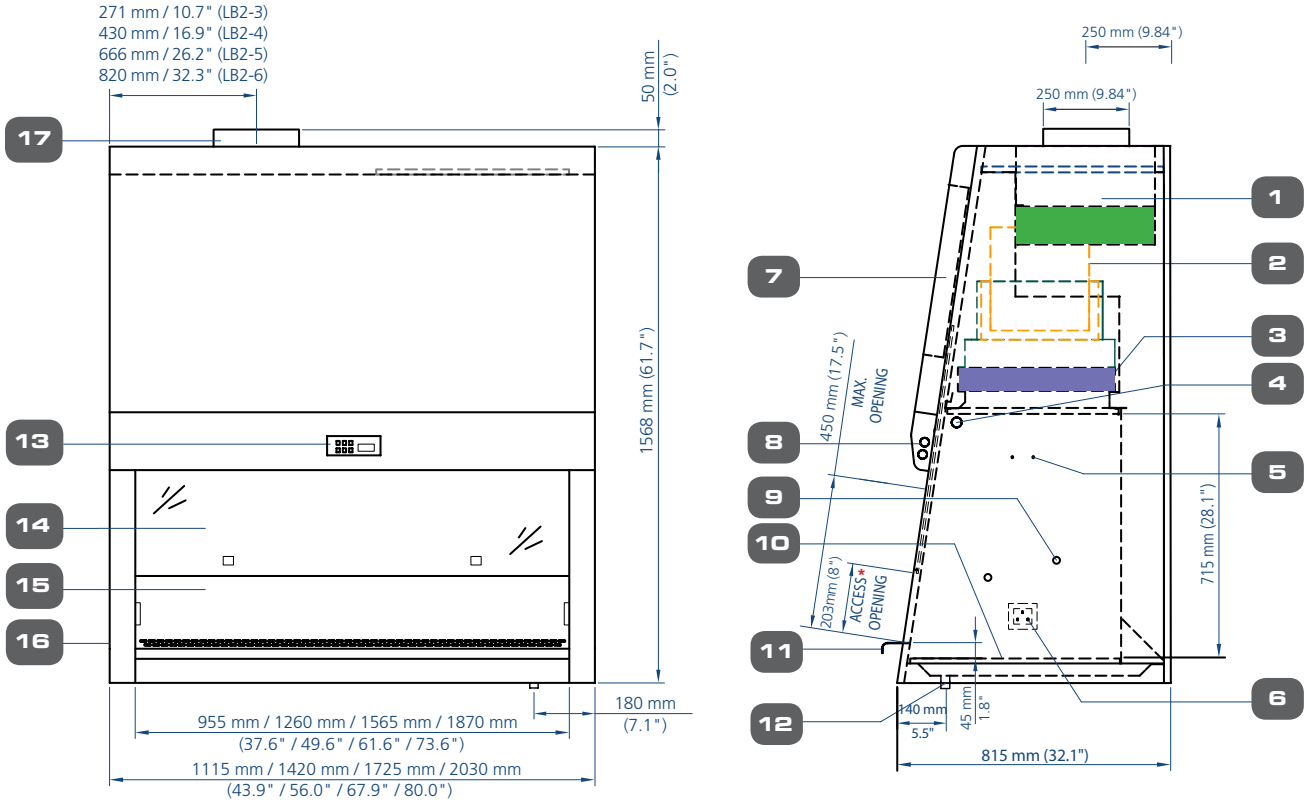
- Fixed height, available 711 mm (28") or 864 mm (34"), ±38.1 mm (1.5")
  - With leveling feet
  - With casters
- Telescoping height stand for leveling feet, nominal range 660 mm or 960 mm (26" or 37.8")
- Telescoping height stand for casters, nominal range 660 mm or 880 mm (26" or 34.6")
  - Adjustable in 25.4 mm (1") increments

ISOCIDE™ Antimicrobial Powder-Coating



All exterior painted surfaces are powder-coated with Esco Isocide, an antimicrobial inhibitor to minimize contamination. Isocide is integrated into the coating substrate and cannot wash out or diminish by repeated cleaning. Performance results are available upon request. Contact Esco or your Esco Sales Representative for details.

Model LB2 Biological Safety Cabinet Technical Specifications



*Cabinet Size	0.9 meter (3')	1.2 meter (4')	1.5 meter (5')	1.8 meter (6')
Testing Opening Height	203 mm (8")	203 mm (8")	203 mm (8")	203 mm (8")
Working Access Height	248 mm (9.8")	248 mm (9.8")	248 mm (9.8")	248 mm (9.8")

1. *Exhaust ULPA filter*
2. *Blower*
3. *Downflow ULPA filter, angled*
4. *UV light Retrofit Kit™ provision*
5. *IV-Bar Retrofit Kit provision*
6. *Electrical outlet Retrofit Kit provision (0.9 meter / 3' model - one single outlet in workzone) (1.2, 1.5 and 1.8 meter / 4',5' & 6' models - two single outlets in workzone)*
7. *Electrical / Electronics panel*
8. *Fluorescent lamp*
9. *Plugged service fixture provisions (2 on each side)*
10. *Stainless steel single-piece work tray*
11. *Stainless steel armrest*
12. *Drain valve Retrofit Kit provision*
13. *Esco Sentinel microprocessor control system*
14. *Safety glass sliding sash window*
15. *Single-piece stainless steel back wall and side walls*
16. *Removable side panel for plumbing access*
17. *Integral exhaust collar*

Accessories and Options (Cont.)

- Cradle stand, electrical hydraulic, infinitely adjustable, with casters
  - Elevates to seating or standing work surface height
  - When lowered permits movement through standard doorway

Note: Increases exterior dimensions.

Electrical Outlets and Utility Fixtures

- Electrical outlet, ground fault, North America
- Electrical outlet, Europe / Worldwide
- Petcock (air, gas, vacuum)
  - North America (American) style
  - Europe / Worldwide style DIN 12898, DIN 12919, DIN 3537

Cabinet Accessories

- Germicidal UV lamp
  - Controlled by automatic UV lamp timer through Sentinel micro-processor control panel
  - Emission of 253.7 nanometers for most efficient decontamination.
  - Lamp is positioned away from operator line-of-sight for safety and proper exposure to interior surfaces.

Note: UV lamp intensity reduces over time and its effectiveness is subject to factors such as relative humidity in the cabinet, ambient air temperature and microbial species in the work zone.

- PVC armrest
  - Chemically treated, improves operator comfort, easy-to-clean. 712 mm (28") standard size
- Ergonomic lab chair
  - Laboratory grade construction, meets Class 100 cleanliness; alcohol resistant PVC materials
  - Adjustable 395-490 mm (15.6"-19.3")
- Ergonomic foot rest
  - Angled, helps maintain proper posture
  - Adjustable height
  - Anti-skid coating, chemical resistant finish
- IV bar, with hooks
  - Stainless steel construction
  - Available for all standard Esco cabinets
- Microscope viewing device
  - Mounting and viewing pouch integrated into sash. Factory installed; specify when ordering

General Specifications			LB2-3B_	LB2-4B_	LB2-5B_	LB2-6B_
Nominal Size			0.9 meters (3')	1.2 meters (4')	1.5 meters (5')	1.8 meters (6')
External Dimensions (W x D x H)			1115 x 815 x 1568 mm 40.7" x 33.3" x 61.7"	1420 x 815 x 1568 mm 52.7" x 33.3" x 61.7"	1725 x 815 x 1568 mm 64.7" x 33.3" x 61.7"	2030 x 815 x 1568 mm 80.0" x 33.3" x 61.7"
Gross Internal Dimesnsions (W x D x H)			955 x 603 x 715 mm 37.6" x 21.3" x 28.1"	1260 x 623 x 715 mm 49.6" x 24.5" x 28.1"	1565 x 603 x 715 mm 61.6" x 21.3" x 28.1"	1870 x 603 x 715 mm 73.6" x 21.3" x 28.1"
Usable Work Area			0.44 m^2 (4.7 sq.ft.)	0.59 m^2 (6.4 sq.ft.)	0.74 m^2 (7.9 sq.ft.)	0.89 m^2 (9.6 sq.ft.)
Tested Opening			203 mm (8")	203 mm (8")	203 mm (8")	203 mm (8")
Working Opening			248 mm (9.8")	248 mm (9.8")	248 mm (9.8")	248 mm (9.8")
Average Airflow Velocity	Inflow		0.53 m/s (105 fpm)			
	Downflow		0.35 m/s (70 fpm)			
Airflow Volume	Inflow		368 m^3/h (217 cfm)	489 m^3/ h (288 cfm)	608 m^3/ h (358 cfm)	725 m^3/ h (427 cfm)
	Downflow		702 m^3/h (413 cfm)	924 m^3/h (544 cfm)	1147 m^3/h (675 cfm)	1369 m^3/h (806 cfm)
	Exhaust		1074 m^3/h (632 cfm)	1415 m^3/h (833 cfm)	1755 m^3/h (1033 cfm)	2097 m^3/h (1234 cfm)
	Pressure Capacity Requirements for Exhaust Ducting*	+50%	820 Pa / 3.29 in H_20	690 Pa / 2.77 in H_20	640 Pa / 2.57 in H_20	620 Pa / 2.49 in H_20
		+100%	1060 Pa / 4.26 in H_20	880 Pa / 3.53 in H_20	810 Pa / 3.25 in H_20	770 Pa / 3.09 in H_20
Supply ULPA Filter Typical Efficiency			>99.999% for particle size between 0.1 to 0.3 microns.			
Exhaust HEPA Filter Typical Efficiency			>99.99% at 0.3 microns.			
Sound Emission	NSF / ANSI 49		<62.5 dBA	<62.5 dBA	<64 dBA	<64.5 dBA
	EN 12469		<59.5 dBA	<59.5 dBA	<61 dBA	<61.5 dBA
Fluorescent Lamp Intensity At Zero Ambient			> 1335 Lux (> 124 foot-candles)	> 1440 Lux (> 134 foot-candles)	> 1200 Lux (> 112 foot-candles)	> 1230 Lux (> 114 foot-candles)
Cabinet Construction	LB2-4B2, LB2-6B2		1.5 mm (0.06") 16 gauge electro galvanized steel with Isocide white oven-baked epoxy polyester powder-coating			
	All other variants		1.2 mm (0.05") 18 gauge electro galvanized steel with Isocide white oven-baked epoxy polyester powder-coating			
Electrical **	220-240V, AC, 50Hz, 1Ø		LB2-3B1	LB2-4B1	LB2-5B1	LB2-6B1
	110-130V, AC, 60Hz, 1Ø		LB2-3B2	LB2-4B2	LB2-5B2	LB2-6B2
	220-240V, AC, 60Hz, 1Ø		LB2-3B3	LB2-4B3	LB2-5B3	LB2-6B3
Net Weight ***			288 kg / 634 lbs	335 kg / 739 lbs	386 kg / 851 lbs	438 kg / 906 lbs
Shipping Weight ***			336 kg / 741 lbs	391 kg / 862 lbs	450 kg / 991 lbs	508 kg / 1120 lbs
Shipping Dimensions, Maximum (W x D x H) ***			1230 x 940 x 1900 mm 49.8" x 35.4" x 73.4"	1530 x 940 x 1900 mm 59.1" x 35.4" x 73.4"	1910 x 940 x 1900 mm 74.8" x 35.4" x 74.8"	2150 x 940 x 1980 mm 82.7" x 35.4" x 74.8"
Shipping Volume, Maximum ***			2.20 m^3 (71.3 cu.ft.)	2.73 m^3 (89.2 cu.ft.)	3.41 m^3 (114.7 cu.ft.)	4.00 m^3 (126.8 cu.ft.)

* *These figures are the required exhaust fan pressure capacity left at the cabinet's duct connection, plus 50% and 100% extra safety margin, but not including the presure capacity required to overcome the pressure drop from bends, elbows, valves, etc in the duct work. These required pressure capacity has been claculated to overcome the increased exhaust HEPA filter pressure drop by +50% and +100% due to particle loading. The minimum recommended pressure capcity is +50%, but to prolong the "life" of exhaust filter, +100% is a safer choice.*

** *Additional voltages may be available; contact Esco for ordering information.*

*** *Cabinet only, excludes optional stand.*

Comprehensive Performance Testing At Esco

Every Labculture LB2 model manufactured by Esco is individually tested, documented by serial number and validated with the following test methods.

- *Inflow / downflow velocity*
- *PAO aerosol challenge for filter integrity*
- *Light, noise and vibration*
- *Airflow pattern visualization*
- *Electrical safety to IEC61010-1*
- *KI-Discus containment*
- *Additional microbiological testing is performed on statistical sampling basis.*

Microbiological Testing

Esco performs testing in accordance with more than 10 of the world's most recognized standards for local, regional and international criteria. Testing in our microbiology laboratory is conducted according to NSF / ANSI 49, EN 12469, and JIS K3800. An NSF-accredited biohazard cabinet field certifier is available in-house full-time to supervise all tests.

Harmless Bacillus atrophaeus (formerly Bacillus Subtilis) bacteria is used to challenge the cabinet, then incubated for 48 hours and the Colony Forming Units (CFU) are counted to determine the testing results. Increased microbiological challenge tests with objects inside the cabinet work zone, Bunsen burner, external airflow disturbance, and Human-As-Mannequin test adapted from Fume Hood development were performed to simulate real-world conditions.

Personnel Protection Test

The test objective is to evaluate the safety of the cabinet for the personnel operating on potentially hazardous samples in the cabinet workzone.

- A nebulizer containing 55 mL of 5 to 8 x 10^8 spores/mL B.atrophaeus spores is placed inside the workzone, 10 cm (4 inches) behind the front opening sash.
- Target slit air samplers and impingers are placed outside the workzone to capture B.atrophaeus spores that may escape, then the sample is incubated
- Acceptance: The number of B. atrophaeus CFU recovered from the agar plates shall not exceed 10 CFU per test.

Product Protection Test

The test objective is to determine cabinet protection to the product/samples inside the cabinet workzone from environmental contaminants.

- A nebulizer containing 55 mL of 5 to 8 x 10^6 spores/mL B.atrophaeus is placed at 10 cm (4 inches) in front of sash window.
- Target agar plates are placed throughout the entire work surface.
- Acceptance: The number of Bacillus atrophaeus CFU recovered from the agar plates shall not exceed 5 CFU per test.

Cross Contamination Test

The test objective is to evaluate cabinet protection from cross contamination of samples placed simultaneously inside the workzone.

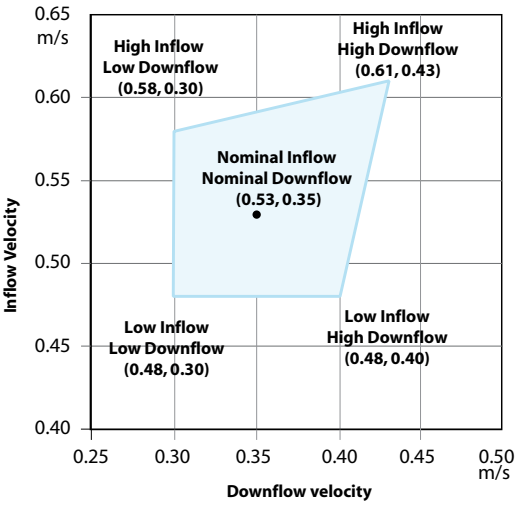
- A nebulizer containing 55 mL of spores (5 to 8 x 10^4/mL) is placed against one of the workzone sidewalls.
- Target agar plates are placed 36 cm (14") away from the same side wall as the nebulizer.
- Acceptance: The number of Bacillus atrophaeus CFU recovered on agar plates shall not exceed 2 CFU per test.

HPV Test Compliant: Safer Hydrogen Peroxide Decontamination Compatibility

Esco biological safety cabinets are Hydrogen Peroxide Vapor (HPV) compliant and decontaminatable cabinets approved by BIOQUELL for this patented process. HPV is a safer and more efficient alternative to conventional decontamination using formaldehyde (CH20):

- HPV is non-carcinogenic and odorless, while formaldehyde is carcinogenic, toxic and has pungent smell.
- HPV biological efficacy is independent of environmental variables, whereas formaldehyde efficacy is dependent on such variables.
- If there is a gap on the cabinet sealing, escaping HPV to the lab will decompose to become oxygen and water. Escaping formaldehyde, however, is harmful to people in the lab. Therefore HPV decontamination can be performed while people still working inside the lab, while formaldehyde decontamination must be performed with no one present in the lab. The HPV method improves safety, productivity, and reduces the time to seal the cabinet.
- HPV has a better penetration capacity, resulting in a full decontamination of the cabinet. The formaldehyde method is known to result in incomplete decontamination,
- HPV is more effective and rapid against biological organisms compared to formaldehyde.
- HPV requires approximately 4-7 hours for set-up, decontamination, and tear-down, compared to a total of 12-15 hours needed to complete a formaldehyde decontamination process.
- HPV decontamination effectiveness is independent of temperature and humidity. Formaldehyde requires temperature above 20°C and relative humidity above 65%
- For information on the BIOQUELL HPV methodology contact Esco or your Sales Representative.

The Performance Envelope Concept



Esco cabinets are designed to operate within a performance envelope to maintain protection for personnel, product and the environment.

Airflow parameters used to frame the performance envelope include both inflow velocity and downflow velocity.

The graph illustrates the boundaries of the performance envelope, as well as the nominal performance point at which tests are conducted.

The range between high and low Inflow, and high and low downflow, together with the fluid dynamics achieved through sophisticated cabinet design, proportionally size capture slots, and uniform laminar airflow, combine to deliver a complete containment and safety solution expected of a professional biological safety cabinet.

For details on the Esco performance envelope contact Esco or your Esco Sales Representative.

KI Discus Containment Test According to EN 12469 (Potassium Iodide)

Esco is currently one of the few companies in the world equipped to perform the KI Discus test for our customers. The KI Discus test is defined in the European Standard for microbiological safety cabinets, EN 12469, as a test method for validating the operator/personnel protection capabilities of the cabinet.

- The KI Discus test shows excellent correlation with the microbiological test method for operator protection, and is useful for validating the actual containment performance of the cabinet on-site.
- The KI-Discus takes only 45 minutes as opposed to 2 days for microbiological testing.
- Thus, each Esco Labculture LB2 model is factory tested using the KI Discus method for operator safety.

Purchase Specifications

LB2 Series Class II, Type B2 (Total Exhaust) Biological Safety Cabinet

General Performance and Certifications

1. The biological safety cabinet shall comply with one or more of the following international standards, and the manufacturer shall provide a certified copy of containment and performance tests equivalent to or greater than specified in the following independent international standards for biological safety, electrical and other functional characteristics: Class II, Type B2 per NSF / ANSI 49 (USA).
2. The cabinet shall protect (a) the operator and laboratory environment from particulates generated within the work zone; (b) the product and process within the work zone from airborne contamination from ambient air; (c) and the product and process within the work zone from cross contamination.
3. Before shipment each cabinet shall be individually tested by the KI-Discus test (European Standard EN 12469) to validate operator/personnel protection. The retention efficiency for the front aperture shall be not less than 99.999%. Microbiological testing for cabinet performance shall be performed on a statistical sampling basis.
4. Each cabinet shall be listed by Underwriters' Laboratories (UL, CUL) or CE for electrical safety.
5. Original documentation specific to each cabinet serial number shall be provided with the cabinet and maintained in the manufacturers' records. Test data verifying all performance criteria shall be available upon request to include: (a) inflow velocity through direct inflow measurement method; (b) downflow velocity and uniformity; (c) filter leak scan with aerosol challenge for both filters; (d) light, noise, vibration; (e) and electrical safety.

Filtration System

6. The cabinet shall have one supply downflow filter and one exhaust filter. Supply filter shall be ULPA-type per IEST-RP-CC001.3 and meet EN1822 (H14) requirements. Exhaust filter shall be HEPA-type per IEST-RP-CC001.3 and meet EN 1822 (H13) requirements.
7. The filters shall be within an aluminum frame with mini-pleat design without aluminum separators; no wood or fiberboard shall be used in the filter assembly.
8. Typical ULPA filter efficiency shall be >99.9997% at MPPS and 99.999% for 0.1 to 0.3 microns. Typical HEPA Filter shall be >99.99% at 0.3 microns.
9. An integral filter guard shall be affixed to prevent damage to the filter media.
10. The filters shall be (a) individually scan tested by the manufacturer, (b) individually scan tested after assembly, and (b) easily accessible for scan testing in situ by means of a dedicated upstream sampling port accessible from within the cabinet.
11. The supply filter shall be angled and oriented to the 10° cabinet front angle to maximize downflow uniformity over the work surface.
12. A removable, perforated metal diffuser shall be installed below the supply filter to optimize airflow uniformity and to protect from damage.

Blower System

13. The cabinet shall have a direct drive, permanently lubricated centrifugal blower/motor dynamically balanced in two planes compliant to ISO 2710 for low noise, low vibration and long filter life.
14. The blower/motor shall have an external rotor design and include an automatic thermal cut-out to disable the motor in case of overheating.
15. The blower/motor shall have an automatic speed control to compensate for filter loading.
16. The blower/motor system shall be enclosed within a dynamic chamber shaped steel plenum and integrated with the removable supply filter assembly to simplify filter changing.
17. **The cabinet shall be equipped with** an integral exhaust collar for connection to the laboratory ducting system.

Cabinet Design, Construction, Cleaning

18. The cabinet shall be of triple wall design whereby all positive pressure plenums capable of handling contaminated air shall be surrounded by negative pressure. No positive pressure areas shall be accessible external to the cabinet. The third wall shall conceal utilities.
19. The cabinet shall maintain containment performance even when removable work area components are removed for cleaning.
20. The work tray shall be one-piece, removable, stainless steel with radius corners without crevices or joints.
21. The cabinet shall have a stainless steel, one-piece fabricated drain trough with open angles to channel spills to a common drain.
22. The closed sidewall shall be sealed without perforations, return air slots or concealed areas which can contain contaminants.
23. The cabinet shall be free of sharp edges, non-functional protrusions, bolts, screws or hardware, and all metal edges shall be deburred.

Ergonomics and Convenience

24. The front sash shall be frameless to maximize visibility, and accessible for cleaning front and back. Sash glass shall be safety glass.
25. The sash counterbalance shall be suspended on two high-strength cables, and the sash shall lock into position in the event one cable becomes detached.
26. Magnetic, not mechanical, proximity sensors shall work in conjunction with the control system to indicate proper sash position for containment.
27. Fluorescent lamps shall be mounted behind the control panel module out of the work zone. Electronic ballasts shall be used to eliminate flicker, extend lamp life and reduce heat output.
28. The UV lamp, if installed, shall be mounted behind the control panel and away from the user's line of site for protection. (Note: Does not apply to 1.8 meter/ 6 ft. model.)
29. The UV lamp shall operate via an automatic timer with automatic shut-off managed by the microprocessor controller and shall be interlocked with the blower/motor and fluorescent lights for safety.
30. The cabinet shall be designed with a 10° angled front to optimize user comfort, reduce glare and maximize reach into the work area.
31. The front grille shall be raised to prevent airflow blockage and improve comfort.
32. Penetrations for petcocks and service fittings shall be provided; penetrations shall be offset to improve user access.
33. The cabinet shall accommodate an optional mounting stand for fixed-height.

Control and Alarm System

34. All cabinet functions shall be managed by a programmable microprocessor control system capable of software updates via Internet downloads.
35. The microprocessor controller shall be mounted on the main control panel facing down toward the user.
36. The controller shall include soft-touch keypad controls and backlit LCD displays to permit operation of the blower/motor, light, UV lamp, electrical outlet(s) and menu.
37. The controller shall be user programmable in situ to enable or disable functions such as PIN (personal identification number) access restriction, cabinet start-up protocol, airflow alarm and other microprocessor controlled operations outlined in the user manual.
38. When programmed ON, the start-up protocol shall perform an automatic pre-purge and post-purge cycle to ensure proper cabinet operation.
39. The controller shall include a blower/motor hours meter to display aggregate motor running time to assist in predictive maintenance.
40. Audible and visual alarms shall be provided for unsafe conditions such as improper airflow or sash position.
41. Airflow shall be monitored by a temperature compensating, thermistor-based, true air velocity sensor mounted in the cabinet.
42. The airflow display and alarm system shall be individually calibrated before shipment.
43. The main control panel shall exhibit continuous display of air velocity and a 24-hour clock display.

Certification, Service and Decontamination

44. The cabinet shall be approved for both hydrogen peroxide vapor (HPV) and formaldehyde decontamination protocol.
45. All panels leading to potentially contaminated and/or hazardous areas shall be color coded red.
46. All components with the exception of blower/motor and ULPA filters shall be located outside of contaminated air spaces to facilitate servicing without the need to decontaminate the cabinet.
47. All exterior surfaces shall be painted with a permanent antimicrobial inhibitor coating to minimize contamination.

ESCO Airstream® Class II Type B2 Biosafety Cabinets

Class II Type B2 biohazard safety cabinets provide product, operator and environmental protection and are suitable for general microbiological work with agents assigned to biological safety levels I, II or III. In a Class II Type B2 cabinet, all inflow and downflow air is exhausted after HEPA/ULPA filtration to the external environment without recirculation within the cabinet.

These cabinets are supplied with an integral exhaust collar that allows the cabinet exhaust to be ducted to the external environment via a dedicated exhaust system.

As they incorporate a non-recirculating total exhaust design, Class II Type B2 cabinets are suitable for work with toxic chemicals when these are present in trace amounts.

MAIN FILTRATION AGENTS

- **ISO Class 3 air cleanliness** within workzone as per ISO 14644.1 (equivalent to Class 1 as per the US Federal Standard 209E, **100 times cleaner** than the usual Class 100 classification on cabinets offered by the competition).

- **Minipleat separatorless H13 HEPA / U15 ULPA filter technology**, operating at the typical efficiency of **99.999% at MPPS, 0.3 and 0.12 microns** provides better operator, product and environmental protection than conventional HEPA filters.

CABINET CONTROL SYSTEM

- **Esco Sentinel™ Microprocessor Cabinet Control System** allows the user to easily access all cabinet functions. The control system monitors and displays cabinet airflow constantly on the control LCD screen, prompting the user with audible and visual alarms in case of any unsafe condition.

- True airflow velocity sensing technology, with temperature compensation for improved sensor accuracy.

- Audible and visual alarms for low airflow, unsafe sash positions.

- Automatic warm-up cycle is enabled upon turning on the cabinet, ensuring all contaminants are purged from the cabinet workzone before the operator can use the cabinet. All menu functions are inactive during this period. Automatic post-purge cycle can be configured at shutdown, ensuring all residue contaminants are purged out of the workzone before deactivation.

- Fail-safe system ensures that in case of exhaust failure, the cabinet's main fan automatically shuts down to ensure safety to the user and the environment.

- An admin PIN can be set to restrict unauthorized access to all menu functions.

ERGONOMIC FEATURES

- **Attractive stainless steel internal side walls and back wall** are made from a single sheet of stainless steel, which eliminates welded joints where contaminants may accummulate. The single-piece inner liner enhances the cleanability of the workzone and is non-glaring for operator comfort.

- Additional UV-interlock ensures UV lamp feature is deactivated when the sash is not fully closed.

- **Built-in 5000k fluorescent lighting** offers excellent illumination throughout the workzone. **Electronically-ballasted lighting system** is instant-start, non-flickering and energy-efficient.

- **Sloped front design and frameless front sliding sash** allow for maximum visibility into the workzone.

- **Cabinet armrest** is raised above the workzone to ensure that the operator's arms do not block the front inflow perforations.

CABINET BODY CONSTRUCTION

- All components designed for maximum chemical resistance for long service life and durability. All cabinet components are cleanroom compatible.

- Industrial-grade main body constructed of electrogalvanised steel: with an abrasion-resistant white oven-baked powder-coated finish. Attractive single-piece stainless steel work surface is easy to remove.

- **Inherently safe design** maintains containment for protection even with work tray removed, thus ensuring safety for the operator during cleaning.

- Permanently lubricated direct drive centrifugal blower(s); **energy efficient external rotor motor** type design reduces operating costs; extremely low noise and vibration levels (less than 64dBA at working position) due to proprietary construction and mounting technology.

- Built-in solid state variable speed controller(s) (infinitely adjustable from zero to the maximum setting) with built-in RFI and noise filters is superior to conventional "step" controllers.

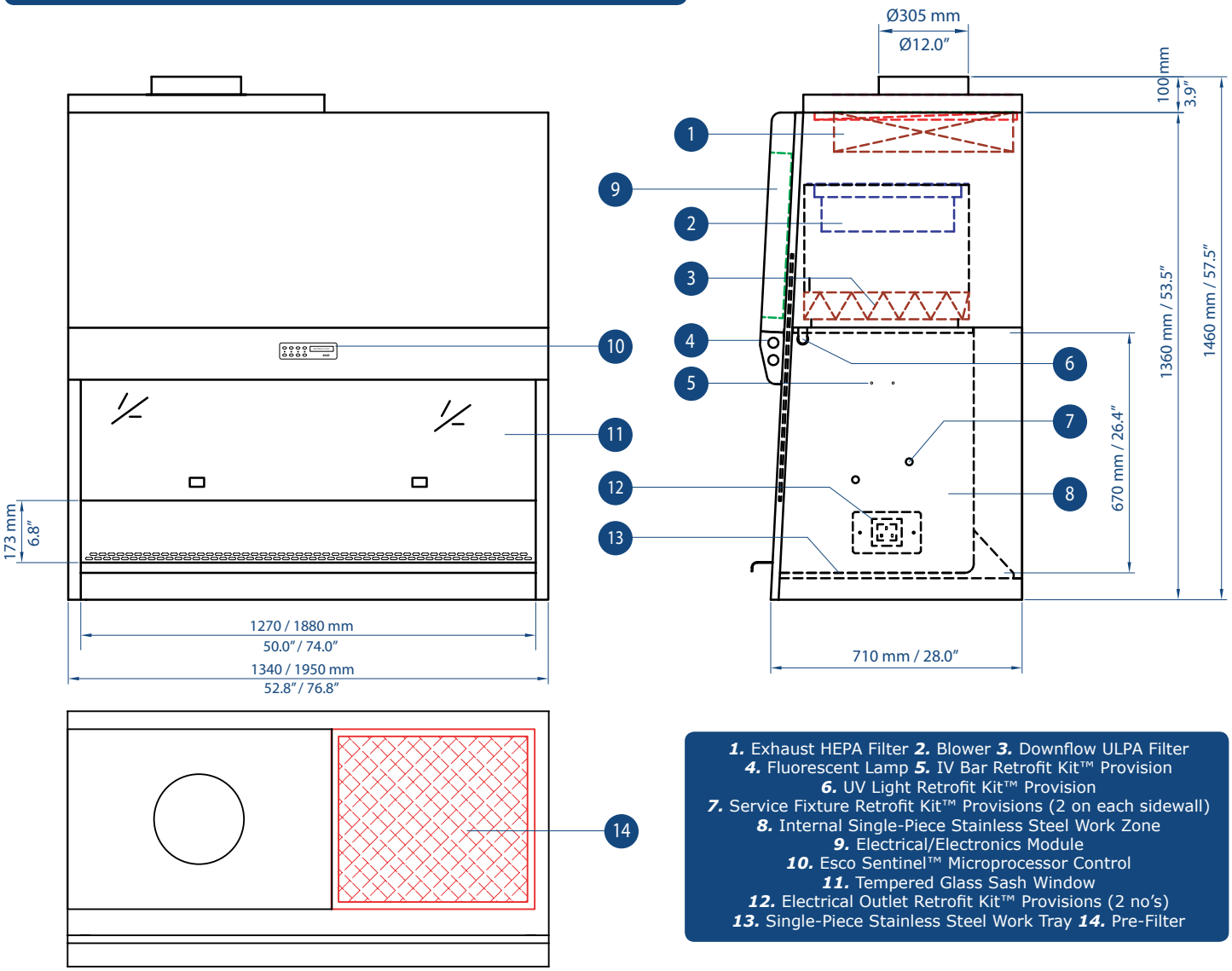
- **Superior electrical safety for the operator**; all electrical components are UL listed or UL recognized; all cabinets are factory tested for electrical safety after production at manufacturing site.

- Designed to meet the general safety requirements of the IEC 61010-1 / EN 61010-1 / UL 61010A-1 / CSA C22.2 No. 1010.1-92.

- Cabinet is shipped fully-assembled; simply plug the unit into a power source for operation - no local installation is required; unit is supplied with a 3-pin plug; 10 international plug types are available (specify order code when ordering).

Technical Specifications and Engineering Diagram

Esco Catalogue Revision No. AB2.v2.03.2005
Specifications subject to change without notice.
© 2005 Esco Micro Pte Ltd.



1. Exhaust HEPA Filter ***2.*** Blower ***3.*** Downflow ULPA Filter
4. Fluorescent Lamp ***5.*** IV Bar Retrofit Kit™ Provision
6. UV Light Retrofit Kit™ Provision
7. Service Fixture Retrofit Kit™ Provisions (2 on each sidewall)
8. Internal Single-Piece Stainless Steel Work Zone
9. Electrical/Electronics Module
10. Esco Sentinel™ Microprocessor Control
11. Tempered Glass Sash Window
12. Electrical Outlet Retrofit Kit™ Provisions (2 no's)
13. Single-Piece Stainless Steel Work Tray ***14.*** Pre-Filter

General Specifications		AB2-4SX*	AB2-6SX*
External Dimensions (L x W x H)		1340 x 710 x 1460 mm / 52.8" x 28.0" x 57.5"	1950 x 710 x 1460 mm / 76.8" x 28.0" x 57.5"
Internal Work Zone (L x W x H)		1270 x 550 x 670 mm / 50.0" x 21.7" x 26.4"	1880 x 550 x 670 mm / 74.0" x 21.7" x 26.4"
Standards Compliance		Designed to meet and exceed the requirements of: **EN 12469:2000 and ANSI / NSF49 Standards** Air cleanliness: ISO 14644.1 Class 3, IEST-G-CC1001, IEST-G-CC1002 and other equivalent requirements Filter performance: IEST-RP-CC034.1, IEST-RP-CC007.1, IEST-RP-CC001.3 and EN1822 Electrical safety: IEC 61010-1 / EN 61010-1 / UL 61010A-1 / CSA C22.2 No. 1010.1-92	
Average Airflow Velocities	Inflow	Initial setpoint: 0.53 m/s or 105 fpm	
	Downflow	Initial setpoint: 0.31 m/s or 61 fpm (uniformity is +/-20%)	
Airflow Volumes At Initial Airflow Velocity Setpoints	Inflow	419 cmh / 246 cfm	621 cmh / 365 cfm
	Downflow	897 cmh / 528 cfm	1327 cmh / 781 cfm
	Total Exhaust	1166 cmh / 686 cfm	1714 cmh / 1008 cfm
		Audible/visual alarm will activate when exhaust airflow volume drops below 12% of the initial volume.	
Pressure Drop Requirements for Exhaust Ducting		440 Pa / 1.77" WG	365 Pa / 1.47" WG
Cleanliness Within Working Area		ISO 14644.1 Class 3, US Federal Standard 209E Class 1 / M1.5, AS 1386 Class 1.5, JIS B9920 Class 3, BS5295 Class C, Class M10,000 as per KS 27030.1 and equivalent classes of VDI 2083 and AFNOR X44101	
Downflow Filter Type		ULPA filter with integral metal guards and filter frame gaskets; Typical efficiency 99.999% at 0.3µm, 0.12µm and MPPS; fully compliant with EN 1822 and IEST-RP-CC001.3 requirements	
Exhaust Filter Type		HEPA filter with integral metal guards and filter frame gaskets; Typical efficiency 99.99% at 0.3µm; fully compliant with EN 1822 and IEST-RP-CC001.3 requirements	
Power Supply Options		*Choose from the following options and specify option number when ordering, (e.g. AB2-4S**1** for 220-240VAC 50HZ) **1.** 220-240VAC 50HZ, 1 phase **2.** 110-130VAC 60HZ, 1 phase **3.** 220-240VAC 60HZ, 1 phase **4.** 110-130VAC 50HZ, 1 phase **5.** 100-110VAC 50HZ / 60HZ	

Esco Biotechnology Equipment Division

Esco Biotech is a highly focused manufacturer of laminar flow, biohazard safety and other HEPA-filtered cabinets for the laboratory with a history of quality cabinets since 1978. We are predominantly oriented towards the international marketplace, with sales in more than 70 countries and 95% of turnover exported. Our products have been independently tested to standards such as AS1807.5 and EN12469. Products are manufactured under an ISO 9001 registered quality system.

PT Esco Bintan Indonesia

ISO 9001 REGISTERED FIRM | ISO 14001 REGISTERED FIRM

Your local distributor:

21 Changi South Street 1 · Singapore 486 777 · Tel: +65 6542 0833 · Fax: +65 6542 6920 · Email: biotech@escoglobal.com · biotech.escoglobal.com
Global Offices: Philadelphia, USA ~ Leiden, Netherlands ~ Santiago, Chile ~ Shanghai, China ~ Kuala Lumpur, Malaysia ~ Mumbai, India ~ Dubai, U.A.E.

ESCO Airstream® Class III Biosafety Cabinet

Esco Airstream® Class III biohazard safety cabinets offer the highest level of product, operator and environmental protection from infectious/biohazardous aerosols and are suitable for microbiological work with agents assigned to biological safety levels 1, 2, 3, or 4. Designed for an absolute level of containment, they are frequently used for work involving the deadliest biohazards, bacteria, viruses and microorganisms. Manufactured to meet and exceed the latest Class III biohazard safety cabinet requirements of the EN 12469:2000.

MAIN FILTRATION AGENTS

ISO Class 3 air cleanliness within work zone as per ISO 14644.1 (equivalent to Class 1 as per US Federal Standard 209E, 100 times "cleaner" than the usual Class 100 classification on cabinets offered by the competition). All materials used in our products are cleanroom compatible.

Mini-pleat separatorless ULPA filter technology reduces energy consumption and delivers increased laminar airflow uniformity for better product and cross contamination protection. ULPA filters are double scan-tested, at the time of manufacturing, and after installation.

Exclusive vertical laminar flow design ensures that **air within the chamber is decontaminated** in a consistent fashion, thus preventing the accumulation of particulate contamination in "dead air corners". Product protection is guaranteed by the ULPA-filtered vertical laminar air flow within the cabinet workzone.

Exhaust air is double-filtered through high-quality ULPA filters with a rated efficiency of **99.999% at 0.12 microns**, thus ensuring complete product, operator and environmental protection from airborne biological hazards; a built-in pre-filter also extends main filter life.

CONTROL FEATURES

Microprocessor-based Esco Sentinel™ control system provides visual / audible alarms for airflow. Easy-to-clean membrane touch control panel is supplied with an LCD display.

Magnehelic pressure gauge* is mounted in the backwall of the workzone for monitoring pressure in the workzone during usage.

*Registered trademark of Dwyer Instruments, Inc

CONSTRUCTION FEATURES

State-of-the-art Neoprene™ synthetic arm-length gloves; flame and abrasion-resistant, cleaner, and more resistant to chemicals and flames than regular latex gloves; each glove is individually tested for airholes. Glove ports are designed to make **glove-changing easy and most importantly, absolutely safe**. Gloves available in sizes 6 and 7.

Integrated pass-through with interlocking doors at side of main chamber allows materials to be transferred into the cabinet without the risk of environmental contamination.

A sloped cabinet front ensures an ergonomic working posture for increased operator productivity and reduces glare from the glass surface.

Durable and easy to clean stainless steel work surface will never rust or cause contamination.

Built-in warm white, **electronically ballasted** lighting is comfortable to the eyes and offers excellent illumination throughout the work zone in order to reduce operator fatigue. Light tubes are mounted out of the air stream for better airflow uniformity.
UV-resistant tempered glass window with built-in stainless steel glove ports (for the number of gloves ports, refer to engineering diagrams provided) is designed to be 100% leak-free.

Industrial-grade support frame constructed of electro-galvanised steel with an abrasion-resistant oven-baked powder-coated finish.

Cabinet airflow is regulated by double fans (refer to diagrams on page 3), thus ensuring a fail-safe system that guarantees absolute safety.

Permanently lubricated direct drive centrifugal blower(s); **energy efficient external rotor** motor type design reduces operating costs.

Built-in solid state variable speed controller (infinitely adjustable from zero to the maximum setting) with built-in RFI and noise filters is superior to conventional "step" controllers.

Complete welded construction ensures an **air-tight cabinet carcass** for absolute containment and operator/environmental safety.

Exclusive **Dynamic Chamber™ design** surrounds all contaminated air plenums with negative pressure plenums for additional safety. Unique airflow technology maintains **cabinet negative pressure at -274Pa / 1.1inWater** within the chamber under all circumstances for maximum safety and containment.

Designed to meet the safety requirements of IEC 61010-1 / EN 61010-1 / UL 3101-1 / CSA C22.2 No. 1010.1-92. Components are UL listed / recognised.

Extended warranty period of 3 years excluding consumable parts and accessories.

INDIVIDUAL PERFORMANCE TESTING

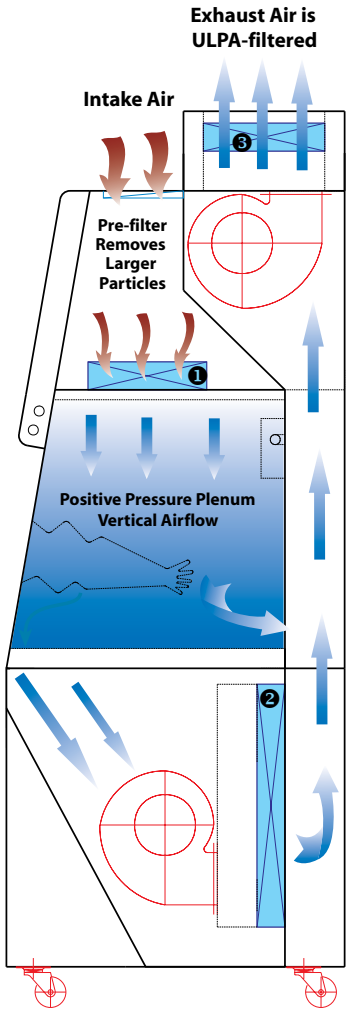
Your safety means the world to us: the following tests are performed individually at our in-house laboratory on every cabinet produced:

a. Airflow velocities
b. Cabinet leak test
c. Aerosol challenge test for filter integrity
d. Light intensity / noise / vibration levels
e. Airflow pattern visualisation test
f. Electrical safety tests

A detailed report is included with every cabinet detailing the tests performed and results obtained.

Extensive testing is continuously performed at our research and development laboratories to improve cabinet containment and performance.

Recommended re-certification is 12 months from initial date of operation; in addition, we recommend that where possible, on-site testing after delivery and installation should be conducted in accordance with the following standard: EN12469:2000 (Section 6 Table 5).



❶ *Downflow / Supply ULPA Filter*
❷ *First Exhaust ULPA Filter*
❸ *Second Exhaust ULPA Filter*

Esco Airstream® Class III Biohazard Safety Cabinet: Airflow Profile

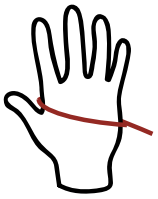
- Air taken in from above the cabinet passes through a pre-filter and an ULPA filter. Moving into the main chamber of the cabinet in a vertical air stream, it provides product protection from airborne particulate matter and cross contamination. This vertical flow air stream is also known as the downflow.
- Close to the work surface, the downflow air stream "splits" with a portion entering grilles towards the front or back of the cabinet, providing a uniform downflow over the entire working area of the chamber.
- Esco's unique airflow design ensures that air within the cabinet is replaced consistently, eliminating excessive air turbulence and the accumulation of particulate contamination in "dead air corners".
- Air is moved within the cabinet below the work table, where is passes through two ULPA filters; one mounted below the work table, and the other above the main chamber. This provides a fail-safe mechanism in case any one of the ULPA filters fails to maintain containment.
- Esco's unique blower system maintains negative pressure within the main work chamber under all circumstances. Unlike the competition, our Class III biohazard safety cabinets do not utilize supply blowers, which, when improperly balanced, may result in the working area being positively pressurized.
- All exhaust air is ULPA-filtered and exhausted directly back to the laboratory without re-circulation. Optionally, an exhaust collar can be fitted to allow air to be ducted via a dedicated ducting system to the external environment.
- Air velocity through an open glove port will be a minimum of 0.7m/s (140fpm) when a single port is open.

Class III Biohazard Safety Cabinets are commonly specified for use with the world's deadliest microbes. Drawing on the resources and expertise of our cleanroom engineering division, Esco is able to provide a complete turn-key service for the construction of critical environments to complement applications in which Class III cabinets may be used.

Although a Class III safety cabinet provides an unparalleled degree of operator and environmental protection, safety can still be increased by the construction of negative pressure laboratories and the use of isolation suits. When a Class III safety cabinet is operated within a negative pressure laboratory, any failure in the Class III cabinet will still be isolated within the laboratory. Assuming the cabinet fails, contamination from the cabinet will "spill-over" into the laboratory but will not contaminate the general environment, since all air within the laboratory is filtered before being exhausted to the external environment.

Engineering Diagrams for Available Sizes

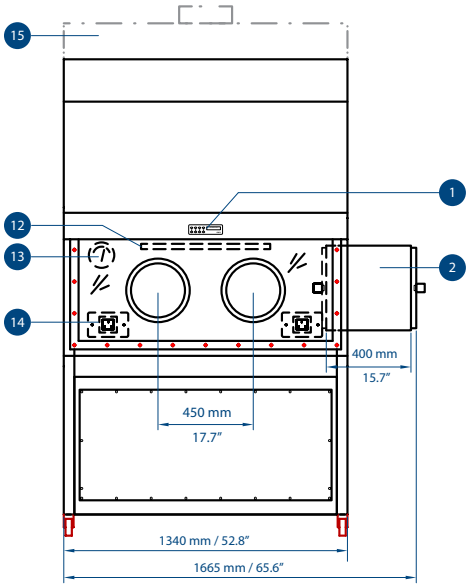
GLOVE SIZES



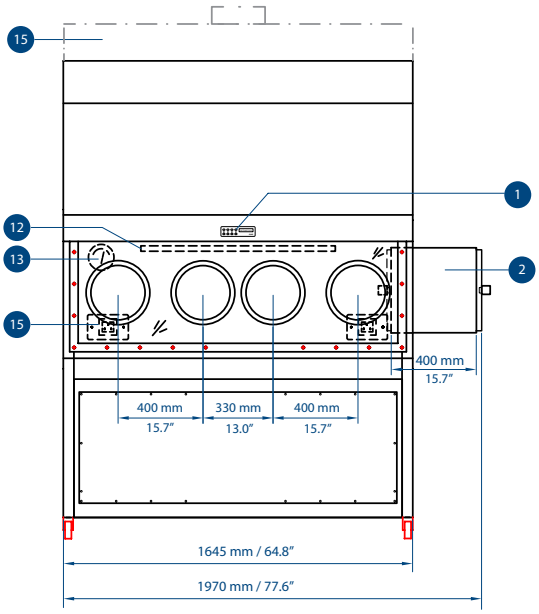
To find out your glove size, measure (in inches) around your hand with a tape measure at the place indicated on the diagram. This measurement, in inches, is the closest to your glove size, i.e. 8” is equal to a glove size of 8.

You should use your dominant hand, the right if you are right-handed, and the left if you are left-handed.

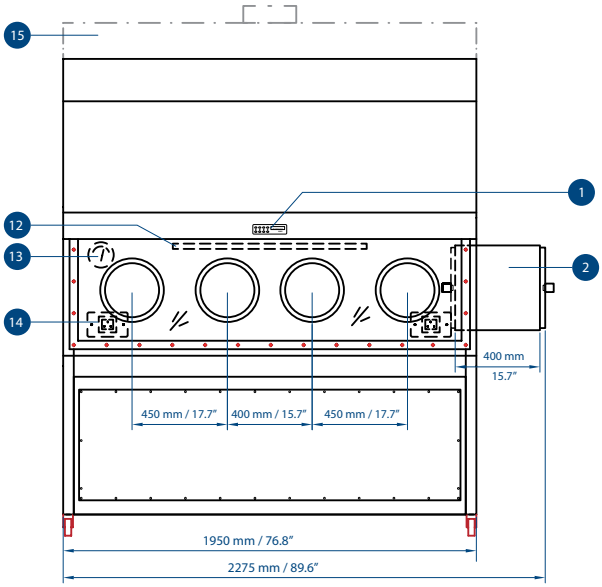
AC3-4 (Standard Model)
External Width: 1.34m / 4ft



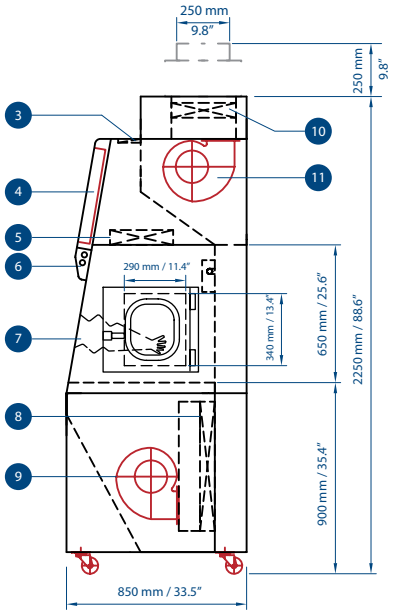
AC3-5
External Width: 1.645m / 5ft



AC3-6
External Width: 1.95m / 6ft



AC3 Side Diagram for All Sizes



Engineering Details

1. Esco Sentinel™ Microprocessor Control ***2.*** Pass Box ***3.*** Pre-filter ***4.*** Electrical / Electronics Panel
5. ULPA Filter (Downflow) ***6.*** Fluorescent Light ***7.*** Glove Ports (Gloves available in sizes 7,8 & 9)
8. First Exhaust ULPA Filter ***9.*** First Exhaust Blower ***10.*** Second Exhaust ULPA Filter ***11.*** Second Exhaust Blower
12. *Optional* UV Lamps ***13.*** Pressure Gauge
14. *Work Zone Back Wall*: *Optional* Electrical Outlet Retrofit Kit™ Provisions: 2 outlets in work zone one on each side)
15. Optional Exhaust Collar

Esco Catalogue Revision No: AC3.v3.6.2005
Specifications subject to change without notice.
©2005 Esco Micro Pte. Ltd.

Custom-made Cabinets

Esco Airstream® Class III biosafety cabinets are available in full stainless steel on a customized basis, suitable for the pharmaceutical industry.

Contact Esco for more information.

Left: Custom-made 4ft fully stainless steel Esco Airstream® Class III cabinet (AC3-4SX)

Optional Retrofit Kits™ and Accessories

The following optional Retrofit Kits™ are available from Esco for Airstream Class III biohazard safety cabinets. Esco's Retrofit Kit™ system allows the user to field-upgrade their cabinets with optional accessories post-purchase. **NOTE:** Service fixtures are not allowed in Class III biosafety cabinets, as Class III biosafety cabinet construction is required to be airtight.

-Germicidal UV lamp Retrofit Kit™

-Standard electrical socket outlet Retrofit Kits™ (total 6A rating for all outlets in the work zone). GFCI (ground fault circuit interrupter) electrical socket outlets (115VAC units only).

-Hard (air-tight) duct exhaust collar

-Formalin vaporiser *(see image).* For biosafety cabinet decontamination.

General Specifications		AC3-4BX (Standard Size)	AC3-5BX	AC3-6BX
External Dimensions (Width x Depth x Height)		1340 x 850 x 2250 mm 52.8" x 33.5" x 88.6"	1645 x 850 x 2250 mm 64.8" x 33.5" x 88.6"	1950 x 850 x 2250 mm 76.8" x 33.5" x 88.6"
Internal Work Zone (Width x Depth x Height)		1240 x 650 x 650 mm 48.8" x 25.6" x 25.6"	1545 x 650 x 650 mm 60.8" x 25.6" x 25.6"	1850 x 650 x 650 mm 72.8" x 25.6" x 25.6"
Number of Glove Ports		2 ports (refer to drawing on page 3)	4 ports (refer to drawing on page 3)	4 ports (refer to drawing on page 3)
Glove Type & Sizes Available		Neoprene® polychloroprene synthetic rubber gloves: Available in sizes 7, 8 (standard size) and 9.		
Air Volume (At Initial Velocity)		603 cmh / 355 cfm	756 cmh / 445 cfm	902 cmh / 531 cfm
Cabinet negative pressure		274Pa / 1.1inH²O (exceeds EN12469:2000 requirement of 199.3Pa / 0.8inH²O and NSF49 requirement of 124.5Pa / 0.5inH²O		
Standards Compliance		Individually performance tested and certified at factory under controlled conditions for: General requirements: IEST-RP-CC002.2 and AS1386.5 Air cleanliness: ISO 14644.1 Class 3, IEST-G-CC1001, IEST-G-CC1002 and other equivalent air cleanliness requirements Filter performance: IEST-RP-CC034.1, IEST-RP-CC007.1, IEST-RP-CC001.3 and EN1822 Electrical safety: IEC 61010-1 / EN 61010-1 / UL 61010A-1 / CSA C22.2 No. 1010.1-92		
Air Cleanliness Within Working Area		ISO 14644.1 Class 3, US Federal Standard 209E Class 1 / M1.5, AS 1386 Class 1.5, JIS B9920 Class 3, BS5295 Class C, Class M10,000 as per KS 27030.1 and other equivalent cleanliness classifications of the VDI 2083 and AFNOR X44101		
Main Filter Type	Downflow	ULPA filter with integral metal guards and filter frame gaskets; fully compliant with EN1822 and IEST-RP-CC001.3 requirements		
	Exhaust (x2)	ULPA filters with integral metal guards and filter frame gaskets; fully compliant with EN1822 and IEST-RP-CC001.3 requirements		
Main Filter Efficiency Ratings	Downflow	Minimum: 99.997% at 0.3µm / 99.988% at 0.12µm / 99.987% at MPPS Typical: 99.99927% at 0.3µm / 99.9977% at 0.12µm / 99.9972% at MPPS		
	1st Exhaust	Minimum: 99.99962% at 0.3µm / 99.99965% at 0.12µm / 99.99946% at MPPS Typical: 99.999928% at 0.3µm / 99.99996% at 012µm / 99.999924% at MPPS		
	2nd Exhaust	Minimum: 99.99916% at 0.3µm / 99.9985% at 0.12µm / 99.9982% at MPPS Typical: 99.99983% at 0.3µm / 99.99979% at 012µm / 99.99971% at MPPS		
Pre-Filter		Disposable and non-washable polyester fibers with 85% arrestance / EU3 rated		
Noise Level		Typically <60 dBA at initial blower speed setting measured as per EN 12469:2000, based on 4 feet cabinet, subject to acoustic properties of test environment		
Light Intensity		>1700 lux / >158 foot candles, measured at work surface level (zero background) as per IEST-RP-CC002.2		
Main Body Construction		1.5mmt / 0.06" / 16 gauge electro-galvanised steel with white oven-baked epoxy powder-coated finish		
Front Window Construction		Colourless and transparent UV-absorbing 8mm / 0.31" tempered glass		
Work Surface Construction		1.2mmt / 0.05" / 18 gauge stainless steel grade 304		
Maximum Power Consumption /Current	220-240VAC / 50Hz 1Ph	1144W / 4.97A	1164W / 5.06A	1180W / 5.13A
	110-130VAC / 60Hz 1Ph	1632W / 13.6A	1652W / 13.77A	1668W / 13.9A
Net Weight (Approximate)		351.5 kgs / 775 lbs	439.4 kgs / 969 lbs	527.3 kgs / 1163 lbs
Max Shipping Weight		601 kgs / 1325 lbs	751.2 kgs / 1656 lbs	901.5 kgs / 1988 lbs
Max Shipping Dimensions (W x D x H)		1995 x 1300 x 2750 mm 78.5" x 51.2" x 108.3"	2245 x 1300 x 2750 mm 88.4" x 51.2" x 108.3"	2550 x 1300 x 2750 mm 100.4" x 51.2" x 108.3"
Max Shipping Volume		7.13 cbm / 251.8 cbf	8.03 cbm / 283.6 cbf	9.12 cbm / 322.07 cbf

Esco Biotechnology Equipment Division

Esco Biotech is a highly focused manufacturer of laminar flow, biohazard safety and other HEPA-filtered cabinets for the laboratory with a history of quality cabinets since 1978. We are predominantly oriented towards the international marketplace, with sales in more than 70 countries and 90% of turnover exported. Our products have been independently tested to standards such as AS1807.5 and EN12469. Products are manufactured under an ISO 9001 registered quality system.

ISO 9001 REGISTERED FIRM | ISO 14001 REGISTERED FIRM

Your local distributor:

21 Changi South Street 1 · Singapore 486 777 · Tel: +65 6542 0833 · Fax: +65 6542 6920 · Email: biotech@escoglobal.com · biotech.escoglobal.com

ESCO Formalin Vaporizer for Decontamination

The Esco Formalin Vaporizer (FVP-00X) *is a microprocessor-controlled unit that simplifies and automates the decontamination process for all sizes and makes of biohazard safety cabinets. This also increases safety for the decontamination operator and laboratory personnel since no manual intervention is required during the entire process.*

The unit enables decontamination to be accomplished by the standard protocol as recommended in EN12469 (European standard for microbiological safety cabinets) with formalin and ammonia solutions. ANSI/NSF49 (American standard for Class II cabinets) recommends decontamination using paraformaldehyde and ammonium bicarbonate which is a similar protocol but with agents in the solid (instead of liquid phase), and as such this vapouriser can also be said to be in compliance with the ANSI/NSF49 recommended decontamination protocol.

Decontamination Cycle

- Operator starts process by pressing a button on the touch pad
- Pre-delay timer allows decontamination operator to seal up the cabinet before vaporization of ammonia commences. Delay period can be set from 1 to 59 minutes.
- Vaporization of formalin solution commences to release the formaldehyde gas to decontaminate the cabinet
- LCD display will show reminder for operator to cycle the cabinet fans to ensure even distribution of the gas
- Heater automatically cuts off when formalin solution has completely boiled off
- Contact time timer starts to regulate the period for which the formaldehyde gas is exposed to the cabinet internal surfaces for the decontamination to take effect
- Neutralisation process begins automatically to vaporize the ammonia solution to neutralise the formaldehyde gas
- LCD display will show reminder for operator to cycle the cabinet fans to ensure even distribution of the gas
- Neutralisation timer starts to regulate the period for which the neutralisation reaction takes place

General Construction Features

- Durable, heavy-duty full stainless steel construction
- Electrical and electronic components are isolated from the heating chamber to prevent exposure to chemical fumes and heat which can reduce component life
- Side mounted handles for easy carrying
- Generously-sized formalin and ammonia chambers (800mL maximum capacity in total) which allows even the largest of safety cabinets (up to 6 foot console units) to be decontaminated with the maximum agent volume recommended in EN12469
- Thermostats for the formalin and ammonia chambers to prevent overheating
- Backup thermostat to ensure the temperature of the external casing does not rise above a safe level
- Increased diameter liquid chamber inlets to allow the formalin and ammonia solutions to be poured into the chambers more easily without spillage
- Internal heat insulation to prevent cross heating of chambers and damage to the electrical and electronics components
- Manual shut-off isolating switch and safety fuse
- Universal IEC power inlet design (appropriate cordset must be specified on order depending on country of use)

Control System Features

- The first and only microprocessor controlled vaporizer unit in the world specifically designed for safety cabinet decontamination
- Automatic control of the entire decontamination cycle .
- No manual intervention required for the entire process
- In case of power failure, the vaporizer will recover automatically once the power resumes without any intervention
- Microprocessor unit has a built-in watchdog and will self-reset in case of any processor failure
- Pre-delay, contact time, neutralisation timers are adjustable using the touch control pad on the front of the unit
- Large, backlit, LCD display
- Audible and visual alarms for in case of overheating during a cycle
- Password control to prevent decontamination timers from being adjusted by unauthorised personnel
- Easy to clean touch control panel without any switches or manual relays to corrode

Ordering

- Esco Formalin Vaporizer is available with the following electrical configurations. Please ensure that the ordering code corresponds to your electrical configuration requirements when ordering.

Power Supply Options	Ordering Codes
220-240VAC, 50HZ / 60HZ, 1 phase	**FV-001**
100-130VAC, 50HZ / 60HZ, 1 phase	**FV-002**

Esco Catalogue Revision No: FV.v1.10.2004 ~ Specifications subject to change without notice. ~ ©2004 Esco Micro Pte. Ltd.

ESCO® Esco Biotechnology Equipment Division

Esco Biotech is a highly focused manufacturer of laminar flow, biohazard safety and other HEPA-filtered cabinets for the laboratory with a history of quality cabinets since 1978. We are predominantly oriented towards the international marketplace, with sales in more than 60 countries and 90% of turnover exported. Our products have been independently tested to standards such as AS1807.5 and EN12469. Products are manufactured under an ISO 9001 registered quality system.

ISO 9001 ISO 14001

Your local distributor:

21 Changi South Street 1 · Singapore 486 777 · Tel: +65 6542 0833 · Fax: +65 6542 6920 · Email: biotech@escoglobal.com · biotech.escoglobal.com