Thank you for purchasing this Esco Biological Safety Cabinet. Please read this manual thoroughly to familiarize yourself with the many unique features and exciting innovations we have built into your new equipment.

Esco provides many other resources at our website, www.escolifesciences.com, to complement this manual and help you enjoy many years of productive and safe use of your Esco products.

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User Manual

Airstream®

Class III Biological Safety Cabinet

Esco Airstream® Class III BSC (AC3) User Manual
Version D - Released November 2021

Copyright Information

"Material in this manual is provided for informational purposes only. The contents and the product described in this manual (including any appendix, addendum, attachment or inclusion), are subject to change without notice. Esco makes no representations or warranties as to the accuracy of the information contained in this manual. In no event shall Esco be held liable for any damages, direct or consequential, arising out of or related to the use of this manual."

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INTRODUCTION

Warranty Terms and Conditions

Esco products come with a limited warranty. The warranty period will vary depending on the product purchased, beginning on the date of shipment from any Esco international warehousing location. To determine which warranty applies to your product, refer to the appendix below.

Esco's limited warranty covers defects in materials and workmanship. Esco's liability under this limited warranty shall be, at our option, to repair or replace any defective parts of the equipment, provided that these parts, if proven to the satisfaction of Esco, were defective at the time of being sold and that all defective parts shall be returned, properly identified with a Return Authorization.

This limited warranty covers parts only, and not transportation/insurance charges.

This limited warranty does not cover:

- Freight or installation (inside delivery handling) damage. If your product was damaged in transit, you must file a claim directly with the freight carrier.
- Products with missing or defaced serial numbers.
- Products for which Esco has not received payment.
- Problems that result from:
  - External causes such as accident, abuse, misuse, problems with electrical power, improper operating environmental conditions.
  - Servicing not authorized by Esco.
  - Usage that is not in accordance with product instructions.
  - Failure to follow the product instructions.
  - Failure to perform preventive maintenance.
  - Using accessories, parts, or components not supplied by Esco.
  - Damage by fire, floods, or acts of God.
  - Customer modifications to the product.
- Consumables such as filters (HEPA, ULPA, carbon, pre-filters) and fluorescent / UV bulbs.
- Esco is not liable for any damage incurred on the objects used on or stored in Esco equipment. Users are advised to conduct risk assessment and add safety protocols based on their application and sample.

Factory installed, customer specified equipment or accessories are warranted only to the extent guaranteed by the original manufacturer. The customer agrees that in relation to these products purchased through Esco, our limited warranty shall not apply and the original manufacturer's warranty shall be the sole warranty in respect of these products. The customer shall utilize that warranty for the support of such products and in any event not look to Esco for such warranty support.

Esco encourages all users to register their equipment online at https://www.escolifesciences.com/services/warranty-registration or complete the warranty registration form included with each product.

ALL EXPRESS AND IMPLIED WARRANTIES FOR THE PRODUCT, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN TIME TO THE TERM OF THIS LIMITED WARRANTY. NO WARRANTIES, WHETHER EXPRESS OR IMPLIED, WILL APPLY AFTER THE LIMITED WARRANTY PERIOD HAS EXPIRED. ESCO DOES NOT ACCEPT LIABILITY BEYOND THE REMEDIES PROVIDED FOR IN THIS LIMITED WARRANTY OR FOR SPECIAL, INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, ANY LIABILITY FOR THIRD-PARTY CLAIMS AGAINST YOU FOR DAMAGES, FOR

PRODUCTS NOT BEING AVAILABLE FOR USE, OR FOR LOST WORK. ESCO'S LIABILITY WILL BE NO MORE THAN THE AMOUNT YOU PAID FOR THE PRODUCT THAT IS THE SUBJECT OF A CLAIM. THIS IS THE MAXIMUM AMOUNT FOR WHICH ESCO IS RESPONSIBLE.

These Terms and Conditions shall be governed by and construed in accordance with the laws of Singapore and shall be subject to the exclusive jurisdiction of the courts of Singapore.

Technical Support, Warranty Service Contacts
USA: 1 215-441-9661
Singapore: +65 6542 0833
Global Email Helpdesk: support@escolifesciences.com
For more information, visit http://www.escolifesciences.com/
Distributors are encouraged to visit www.escoglobal.net for additional materials.

Product Appendix, Warranty Listings

Biological Safety Cabinets, Laminar Flow Cabinets, Laboratory Animal Research Workstations, HEPA-Filtered Cabinets (except Streamline brand)	3 years limited

Note: The warranty periods may vary by country. Contact your local distributor for specific warranty details.

For international distributors, warranty period starts two months from the date the equipment is shipped from Esco facility. This allows shipping time so the warranty will go into effect at approximately the same time the equipment is delivered to the user. The warranty protection extends to any subsequent owner during the warranty period. Distributors who stock Esco equipment are allowed an additional four months for delivery and installation, providing the product is registered with Esco. User can register their products online at https://www.escolifesciences.com/services/warranty or complete the warranty registration form include with each product.

Policy updated on 1st January 2015 (This limited warranty policy applies to products purchased on and after 1st January 2015)

Introduction

1. Products Covered

Airstream Class III Biological Safety Cabinet			
Electrical Rating	1.2 meters 4 feet	1.5 meters 5 feet	1.8 meters 6 feet
220-240 V AC, 50Hz, 1Φ	AC3-4B1	AC3-5B1	AC3-6B1
110-130 V AC, 60Hz, 1Φ	AC3-4B2	AC3-5B2	AC3-6B2
220-240 V AC, 60Hz, 1Φ	AC3-4B3	AC3-5B3	AC3-6B3

2. Safety Warning

- Anyone working with, on or around this equipment should read this manual. Failure to read, understand and comply with the instructions given in this manual may result in damage to the unit, injury to operating personnel, and / or poor equipment performance.
- Any internal adjustment, modification or maintenance to this equipment must be undertaken by qualified service personnel.
- The use of any hazardous materials in this equipment must be monitored by an industrial hygienist, safety officer or some other suitably qualified individuals.
- Explosive or inflammable substances should never be used in the cabinet unless adequate risk assessment has been carried out.
- If chemical, radiological or other non-microbiological hazards are being used in the cabinet, additional protective measures should be taken based an adequate risk assessment.
- This cabinet should not be used with cytotoxic substances unless it has been determined that the filter can be safely changed. Please note that cytotoxic substances cannot be inactivated by conventional gaseous decontamination method (e.g. formaldehyde) used to inactivate biological agents.
- The biological hazard symbol on the front panel of the cabinet indicates the presence of biological substances that pose a threat to human health.
- Before you process, you should thoroughly understand the installation procedures and take note of the environmental / electrical requirements.
- In this manual, important safety related points will be marked with the symbol. 
- If the equipment is used in a manner not specified by this manual, the protection provided by this equipment may be impaired.

3. Document Management

We recommend that you keep this manual, along with the factory test report close to the cabinet for easy reference by the cabinet operator and qualified maintenance personnel.

If you require replacements for any of the provided documentation (including factory test reports) you can request copies from Esco Customer Services*. Please provide the following information when making requests for replacement documents:

- Company (Organization) Name
- Product Brand and Model
- Product Serial Number
- Documents requested

** There may be a nominal charge for this service.*

4. Limitation of Liability

The disposal and / or emission of substances used in connection with this equipment may be governed by various local regulations. Familiarization and compliance with any such regulations are the sole responsibility of the users. Esco's liability is limited with respect to user compliance with such regulations.

5. European Union Directive on WEEE and RoHS

The European Union has issued two directives:

- **Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE)**

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2012/19/EU. It is marked with the following symbol:

Esco sells products through distributors throughout Europe. Contact your local Esco distributor for recycling/disposal.

Recommended method of disposal is according to The Federal, State and Local Government regulations.

- **Directive 2011/65/EU on Restriction on the use of Hazardous Substances (RoHS)**

With respect to the directive on RoHS, please note that this cabinet falls under category 8 (medical devices) and category 9 (monitoring and control instruments) and is therefore exempted from requirement to comply with the provisions of this directive.

6. Symbols

Information in this manual may be prefaced with the following symbols. They are provided to help you identify important operational, safety, maintenance or conformance issues.

Electrical Hazard: Danger of electric shock

Turn Off and Disconnect From Main Supply Before Proceeding: Do not perform this operation while the unit is operational

The Biohazard Symbol on the front panel of the cabinet indicates the presence of biological substances that pose a threat to human health

Approved Service Engineer Only: Operation to be performed only by approve engineers

Declaration of Conformity

In accordance to EN ISO/IEC 17050-1:2010

We, Esco Micro Pte. Ltd.
of 21 Changi South Street 1
Singapore, 486777
Tel: +65 6542 0833
Fax: +65 6542 6920

declare on our sole responsibility that the product:

Category	**: Class III Biological Safety Cabinet**
Brand	**: Airstream**
Model	**: AC3-4B1, AC3-5B1, AC3-6B1**

in accordance with the following directives:

2014/35/EU	**: The Low Voltage Directive and its amending directives**
2014/30/EU	**: The Electromagnetic Compatibility Directive and its amending directives**
2011/65/EU	**: The RoHS in Electrical and Electronic Equipment Directive and its amending directives**

has been designed to comply with the requirement of the following Harmonized Standard:

Low Voltage	**: EN 61010-1:2010**
EMC	**: EN 61326-1:2013 Class B**
Design/ Performance Criteria	**: EN 12469 (2000) Class I Microbiological Safety Cabinet**

More information may be obtained from Esco's authorized distributors located within the European Union. A list of these parties and their contact information is available on request from Esco.

Lim Lay Yew

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Lim Lay Yew
Director, Esco

This Declaration of Conformity is only applicable for 230V AC 50Hz units

Chapter 1 – Product Information

1.1. About Biological Safety Cabinets (BSCs)

Class III cabinets arguably offer the highest level of product, operator and environmental protection from infectious and bio-hazardous aerosols. They are suitable for microbiological work using agents classified under biosafety levels 1, 2, 3 or 4. Class III cabinets are designed for microbiological work demanding extremely high levels containment and are therefore often used for work involving some of the deadliest biohazards, bacteria, viruses and micro organisms.

Although they provide an unparalleled degree of operator and environmental protection, safety can be further enhanced by operating them inside a negative pressure cleanroom. Please note that while doing so, the operator should be wearing a fullbody positive pressure isolation suit.

This is to ensure that in the event of the cabinet suddenly malfunctioning, the operator is well protected and that any contamination from the cabinet instead of getting leaked out to the outer environment is contained within the cabinet itself.

Safety
Your safety is of paramount importance to us. Thus, Class III biosafety cabinet has been packed with features that would take your safety to an altogether new level. A highlight of these features is as follows:

- Exhaust air goes through double filtering process ensuring complete product, operator and environmental protection from airborne biological hazards.
- All HEPA/ULPA filters are scan-tested once at the time of manufacturing and again after installation.
- Each of the Neoprene synthetic black arm-length gloves are individually tested for air holes.
- Exclusive vertical laminar flow design ensures that air within the chamber is decontaminated in a consistent fashion, thus preventing the accumulation of particulate contaminants in “dead air corners”.
- The use of Dynamic Chamber plenum design means that contaminated areas are surrounded by negative pressure plenums and this eliminates the possibility of filter seal/gasket or cabinet carcass leaks.
- Unique airflow technology maintains a negative pressure of -274 Pa/1.1 w.g. within the chamber under all circumstances for maximum safety and containment.
- All electrical components are UL listed or UL recognized.
- Built-in Smart Control system provides audio-visual alarms for airflow by pressure monitoring.
- Magnehelic* pressure gauge is mounted on the back panel of the work zone for monitoring negative pressure in the work zone during usage.
- Cabinet airflow is regulated by twin fans, thus guaranteeing fool-proof safety.
- UV-resistant tempered glass window has built-in stainless-steel glove ports.
- Electro galvanized steel sheets have been used in the outer shell of the cabinet for greater resistance to rusting.
- Integrated pass-through with interlocking doors allows samples to be transferred into the cabinet without the risk of environmental contamination.

** Registered trademark of Dwyer Instruments, Inc.*

Performance

The cabinet is precisely engineered to deliver the required performance anytime you need it.

- Latest minipleat separatorless H14 HEPA/ULPA filters operating at a typical efficiency of 99.9999% at MPPS can filter out particles as small as 0.3 microns (in case of HEPA) and 0.12 microns (in case of ULPA), thereby providing better protection to the samples, besides enhancing protection from cross contamination. They also reduce energy consumption and increase airflow uniformity.
- Light tubes are mounted in such a way that they are NOT in that path of the air stream. This helps maintain uniformity in the airflow.
- Proprietary construction and mounting technology ensure extremely low noise (less than 60 dbA) and vibration levels.
- ISO Class 3 work zone air cleanliness.
- Built-in solid state variable speed controller – they are infinitely adjustable from zero to the maximum setting -coupled with built-in RFI and noise filters deliver much better performance than conventional “step” controllers.

Cleanability

The issue of cleanability is important to ensure that decontamination procedures can be carried out easily yet properly

- The cabinet has an industrial-grade support frame made of electro-galvanized steel and has an abrasion-resistant oven-baked powder-coated finish.
- Durable and easy to clean stainless steel worktop will never rust or cause contamination.
- All the joints, corners and seams have been properly sealed for maximum cleanability.

Operator Comfort

The features incorporated in this cabinet help maximize operator comfort.

- Glove ports are designed to make changing of gloves easy and safe.
- 5,000k fluorescent lamp provides 1,000 lux of work zone lighting for greater operator comfort and lessened glare.
- Electronic ballast for fluorescent lighting results in lower heat output, higher energy efficiency, increased reliability/service life and most importantly zero-flicker.
- A sloped cabinet front design eliminates glare and increases operator comfort by facilitating an ergonomic working posture.
- A plugged aerosol sampling port for filter testing by the aerosol challenge method is accessible from the work surface itself.

Easy Servicing

We design the cabinets in such a way that the number of people required for servicing them is minimal, besides ensuring that the downtime is as short as possible.

- All controls and fittings are mounted outside of the main chamber. This helps in minimizing down-time since servicing would not require cabinet decontamination.
- Unique hinged front panel.
- Each cabinet is supplied with a convenient hand tool kit and extra fasteners.

Cost Saving
The manufacturer uses the permanently lubricated direct drive centrifugal blowers which employ an energy-efficient external rotor type design. This helps cabinets deliver excellent performance while keeping the operating cost low at the same time.

Testing
Before being shipped, each individual unit is extensively tested for performance and safety and delivered with a detailed test report and certificate of performance. Testing performed at our factory laboratory includes:

- Inflow Velocity
- Operating Pressure
- Operating Air Volume
- Operator Comfort Tests: Noise, Light, Vibration
- Filter Integrity (PAO aerosol challenge)
- Electrical Safety to IEC61010-1

Additional units are also randomly selected on a statistical sampling basis and re-tested using research-grade

1.2. Quick View

Figure 1.1 AC3 General Parts

1. Front Panel
2. Esco Sentinel™ Silver Control System
3. Pressure Gauge
4. Glass Barrier
5. Glove
6. Caster Wheel
7. Transfer Box

1.3. Airflow Pattern

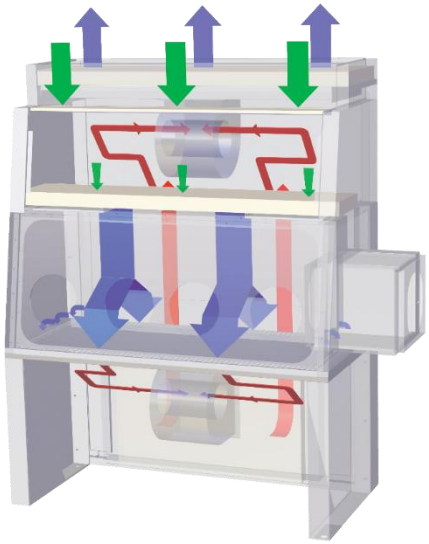


Figure 1.3 Airflow Pattern

- ULPA Filtered Air
- Unfiltered/ Potentially Contaminated Air
- Room/ Inflow Air

- 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 37% of the air in the common plenum is exhausted through the ULPA filter to the room. The remaining 63% 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.
- 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 37% exhaust and 63% recirculation process is continued.

1.4. Further Information

For further information, we have many documents available in our Technical Support Library at www.escolifesciences.com. Here you will find the most up-to-date information in far more details than are possible to include in this manual.

Chapter 2 – Installation

2.1. General Requirement

2.1.1. Location Requirements

The location of your cabinet has a big impact on its performance. Your cabinet's internal airflow velocity is relatively small compared to the airflow disturbances potentially caused by opening of a door, a person walking by or for that matter being exposed to an air-conditioning outlet. All these things can therefore affect the proper functioning of a biosafety cabinet.

Class III cabinets are however completely enclosed and hence the impact of external interferences on these cabinets is fairly limited. However, it is still highly recommended that you take the following precautions:

- The location must be far away from:
  - Flow of personnel traffic
  - Air vents (in and out)
  - Doors and windows
  - Any other sources of disruptive air currents or air drafts

  If the drafts or other disruptive air currents manage to somehow enter the cabinet through the access opening then depending on the severity of the air current, there is a potential for contaminated air to exit or enter the work zone of the cabinet.
- The exhaust filters are especially susceptible to disruptive air currents or air drafts. A minimum clearance of 40 cm is recommended between the highest point of the cabinet and the ceiling. If that much clearance is not available, the airflow alarm system may need to be re-calibrated.

⚠ *The manufacturer does not guarantee that this can always be done successfully. It would have to be verified by your nearest distributor or servicing company*

- For proper exhaust filter leak scanning purposes, a minimum clearance of 50 cm is recommended
- For maintaining proper airflow, a clearance of 183 cm (6 ft) is strongly recommended in front of the cabinet.
- The location should be far away from any kind of heat source (heaters, fan converters etc.) for facilitating optimum operating conditions.
- There should be adequate space left for cleaning the back of the cabinet and for carrying out decontamination procedure.

2.1.1.1. Position Requirements (Based on NSF49:2018 Annex E)

BSCs not connected to an exhaust system should have at least (12 inches [300 mm]) clearance from the filter face and any overhead obstructions when the cabinet is in its final operating position, to allow for testing of the Exhaust HEPA/ULPA filter. At least 12 inches (300 mm) clearance is required if the use of a thermal anemometer exhaust velocity measurement is needed when calculating cabinet inflow velocity.

All BSCs should be placed in a laboratory at a location that provides a minimum of:

- 6 inches (150 mm) from adjacent walls or columns.
- 6 inches (150 mm) between two BSCs.
- 6 inches (150 mm) space between both sides of the cabinet and 6 inches (150 mm) behind the BSC to allow for service operations.
- 40 inches (1020 mm) of open space in front of the BSC
- 60 inches (1520 mm) from opposing walls, bench tops and areas of occasional traffic.
- 20 inches (510 mm) between BSC and bench tops along a perpendicular wall.
- 100 inches (2540 mm) between two BSCs facing each other.
- 60 inches (1520 mm) from behind a doorway.
- 40 inches (1020 mm) from an adjacent doorway swing side.
- 6 inches (150 mm) from an adjacent doorway hinge side.

2.1.2. Environmental and Electrical Requirements

2.1.2.1. Environmental Requirements

- Indoor use only.
- Altitude of up to 2,000 meter (6,600 feet).
- Relative humidity between 20% – 90%
- Temperature between 18oC – 30oC (65oF – 86oF).
- Pollution Degree 2.0
  Pollution degree describes the amount of conductive pollutants present in an operating environment. In pollution degree 2.0, it is assumed that only non-conductive pollutants such as dust are present, except when occasional conductivity caused by condensation.

2.1.2.2. Electrical Requirements

- The cabinet should be connected to its own dedicated power outlet(s).
- The power rating for each model is shown below. Ensure that the outlet is rated accordingly.

Model	Power Rating
AC3-4B8 / AC3-5B8 / AC3-6B8	220-240 V 50/60 Hz
AC3-4B9 / AC3-5B9 / AC3-6B9	110-120 V 50/60 Hz

- The power cable is located on the right hand side of the cabinet and the cord is 2.5 m long. When preparing the installation site, try to ensure the outlet is located to the right of the cabinet for ease of access.
- The cabinet's maximum voltage fluctuation is ±2% of nominal voltage. Therefore, where voltage fluctuation is higher, suitable equipment such as power stabilizer or UPS is recommended.
- Surge protection and UPS are strongly recommended for better protection. Uninterruptible Power Supply (UPS) with power stabilization function could also be used to eliminate or minimize the voltage fluctuation encountered by the cabinet. When UPS is installed, it is recommended that it is able to extend the operation of the BSC up to 20 minutes.
- A reliable protective earth connection is recommended for better operation and safety.

2.2. Unpacking and Moving your Cabinet

1. Check the packing labels and delivery note before unpacking to ensure the correct consignment has been delivered.
2. Put all packing materials to one side and retain. You may need them to repackage the unit if anything untoward is discovered with the unit during installation.
3. Moving the crate
    a. The crate has been designed to protect your cabinet from external impact. However, excessive impact on the crate may damage the cabinet too. Hence all care should be taken to protect the crate from direct impact during the course of moving it.
    b. While lifting and moving the crate, ensure that the floor jack or mechanical lift truck has entered fully under the crate so that the crate can be lifted stably. Otherwise there would be a risk of the crate falling off from the floor jack or mechanical lift truck during handling. Whenever needed, use suitably long extension bars.
4. Opening of the crate
    a. Use a hammer or crowbar to open the top panel carefully. Be mindful of any exposed nails.
    b. Remove the front panel, followed by the two side panels, and finally the back panel.
    c. All the retrofit kits are packed separately and placed on top of the cabinet. These items are listed on the packing checklist pasted on the crate. Check the packing checklist carefully to make sure that you have received all the items. Remove them from the top of the cabinet before proceeding further.
5. The cabinet is packed lying down and the cabinet should be lifted up very carefully using appropriate techniques.
6. If you did not receive one or more retrofit kits listed on the packing checklist, or if any item is damaged, contact your distributor or the manufacturer immediately.
7. Removing the packaging material
    a. The cabinet is protected by styrofoam and has been shrink-wrapped. The cabinet is secured to the pallet by means of straps.
    b. Remove the styrofoam and shrink wrap but leave the straps securing the cabinet to the pallet intact. Ideally, the cabinet should remain strapped to the pallet until it has been placed in its final position.
    c. If you find any damage during this stage of unpacking please refer to freight claim information

⚠ *For the cabinet to deliver optimal performance, it is very important to place it at the most suitable location. There are a lot of factors that determine the location best suited for the cabinet. Please refer to the next chapter for guidelines*

8. Moving the cabinet
    a. While the pallet – with the cabinet strapped to it - is being lifted, make sure that the floor jack or mechanical lift truck has entered fully under the pallet. This would aid stable handling of the cabinet, while reducing the risk of the cabinet falling off. Please use extension bars whenever necessary.

b. While the cabinet is being moved, there should be adequate gap between the ground and supports of the pallet. The pallet should not be dragged on the ground as it would damage the pallet and possibly the cabinet too.

9. Removing the strap
    a. Remove the strapping by cutting it very carefully so as not to scratch the surface of the cabinet
    b. Do not discard the packaging material of your cabinet until you have fully installed and tested the unit along with all its components.

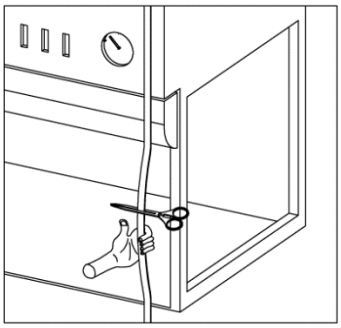


Figure 0.1. Removing the Strap

10. Lifting the Cabinet

⚠

- *The middle portion of the cabinet cannot support weight of the cabinet for extended periods. Hence, as far as possible, the cabinet should not be lifted manually. The cabinet should rather be lifted using a mechanical lift truck. If manual lifting of the cabinet is absolutely essential, at least 6 persons should be employed while doing so.*

- *While lifting the cabinet, there should be enough distance between the forks of the mechanical lift truck and the center of the cabinet.*
  Recommended distance: 50 cm for 3 ft and 90 cm for 4 ft or above.

2.3. Installation

1. Inspect your cabinet carefully. Should you find any defects, refer to the Freight Claim Information Esco Warranty Terms and Conditions
2. Wipe the interior and exterior of the cabinet with water or a mild household detergent
3. Connect the cabinet to the main power supply. Turn the fan on. Leave the cabinet on for 3 minutes in order to purge airborne contamination from the work area. Each cabinet requires a dedicated 8 A (230 V) or 11 A (115 V) power socket which should not be shared with other appliances. For some cabinets which require 2 power sockets, 2 separate and dedicated power outlets should be used.
4. Prior to use, this cabinet should be certified by a qualified certifier. Under normal operating conditions, the cabinet should be re-certified at least annually or whenever it is moved or serviced.
5. The two biohazard decal included with this manual should be pasted on the door leading to your biohazard laboratory

2.3.1. Connecting the Electrical Supply

- Refer to the serial label on the BSC for the proper electrical rating to ensure the BSC is connected to the correct electrical supply.
- Review the electrical wiring diagrams in Appendix section prior to installation. All wiring should be done in accordance with the applicable National Electrical Code.
- Connect the supplied power cord to the input on the top of the BSC. Make sure the cable connector is seated firmly in the socket.
- Ensure the mains electricity supply is switched off and then plug the unit into the wall socket. Do not start the unit up until all connections have been made and the post installation steps have been completed.

2.3.2. Connecting to an Exhaust System

- If you intend to connect the cabinet to an external exhaust system you will need an optional thimble (non air-tight) exhaust collar.
- Full installation instructions are provided with the exhaust collar. Please refer to the instructions provided with the collar.

2.3.3. Connecting to a PC (using RS232)

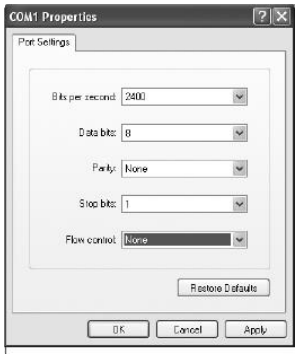
1. Connect the RS232 female connector of the BSC to the RS232 male connector of the PC using DB9 RS232 serial cable.
2. Use these port settings for your RS232 connection:
   - Baud Rate : 2400
   - Data Bits : 8
   - Stop Bits : 1
   - Parity : None
   - Flow Control: None

If you are using Windows XP's HyperTerminal, follow these steps:

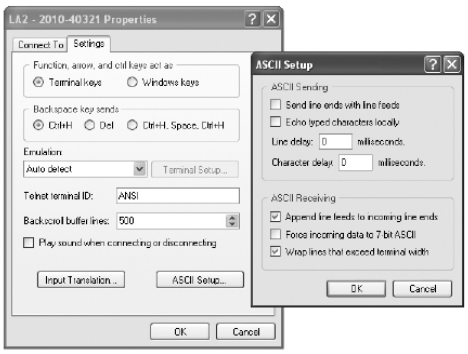
1. Click **Start**, and select **All Programs | Accessories | Communication | HyperTerminal**

2. In the **Name** box and the **Icon** box, enter an appropriate name and icon.

3. Choose the port in the **Connect Using** drop down box, e.g.: COM1



4. Enter the connection's setting.



5. Enter **File | Properties | Setting | ASCII Setup** and tick **Append line feeds to incoming ends**

6. Click OK button twice to return to the HyperTerminal window. The connection is configured successfully
7. The information shown in the HyperTerminal window are current time, inflow velocity, downflow velocity, temperature, sash window position, blower hour meter, and blower condition (or warm up condition).

2.3.4. Safety and Warning Labels on the Cabinet

Anyone using the BSC should familiarize themselves with the various labels displayed in and on the cabinet. It is very important that users are familiar with the meanings of the labels before attempting to use the unit.

2.3.5. Preliminary Cleaning

Wipe the interior and exterior of the BSC with water or a mild household detergent. The compatibility of the cleaning agent should be verified. Note: When the cabinet has been used for work, other suitable interior cleaning and disinfection method should be applied.

2.4. Performance Validation/Certification

After having installed the cabinet but before starting to use it, cabinet performance must be validated and certified to factory standards. It is recommended that this validation and certification be performed only by qualified personnel who is familiar with the methods and procedures for certifying biological safety cabinets.

The testing methods and equipment needed for carrying out the tests are specified on the test report accompanying your cabinet.

2.4.1. Disclaimer

The performance and safety of all Esco BSC are rigorously evaluated at our factory. Regular field certification is important to ensure factory standards are maintained.

2.4.2. References for Qualified Certifiers

North America

- NSF (http://www.nsf.org/Certified/Biosafety-Certifier/)
- Esco (http://escolifesciences.com/)
- IAFCA-member certifying company (http://www.iafca.com/listview)

UK, Vietnam, Middle East/North Africa, Indonesia, Korea, Malaysia, Philippines, Singapore

- Esco offers field certification services directly. Contact local Esco office.

Other Countries

- Contact Esco or local distributor.

Chapter 3 – Sentinel Control System

3.1. Sentinel Control System

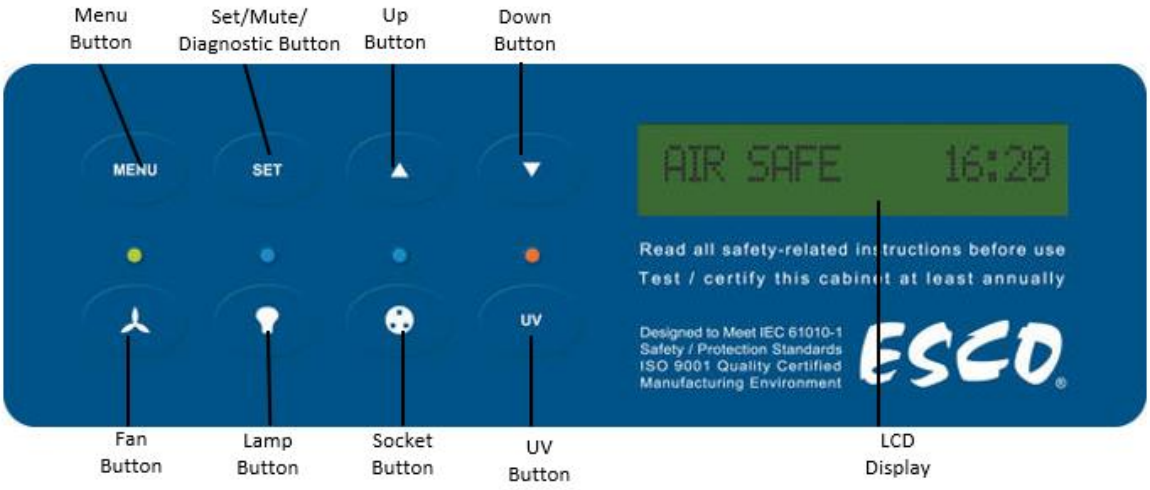


Figure 3.1. Sentinel Silver General Parts

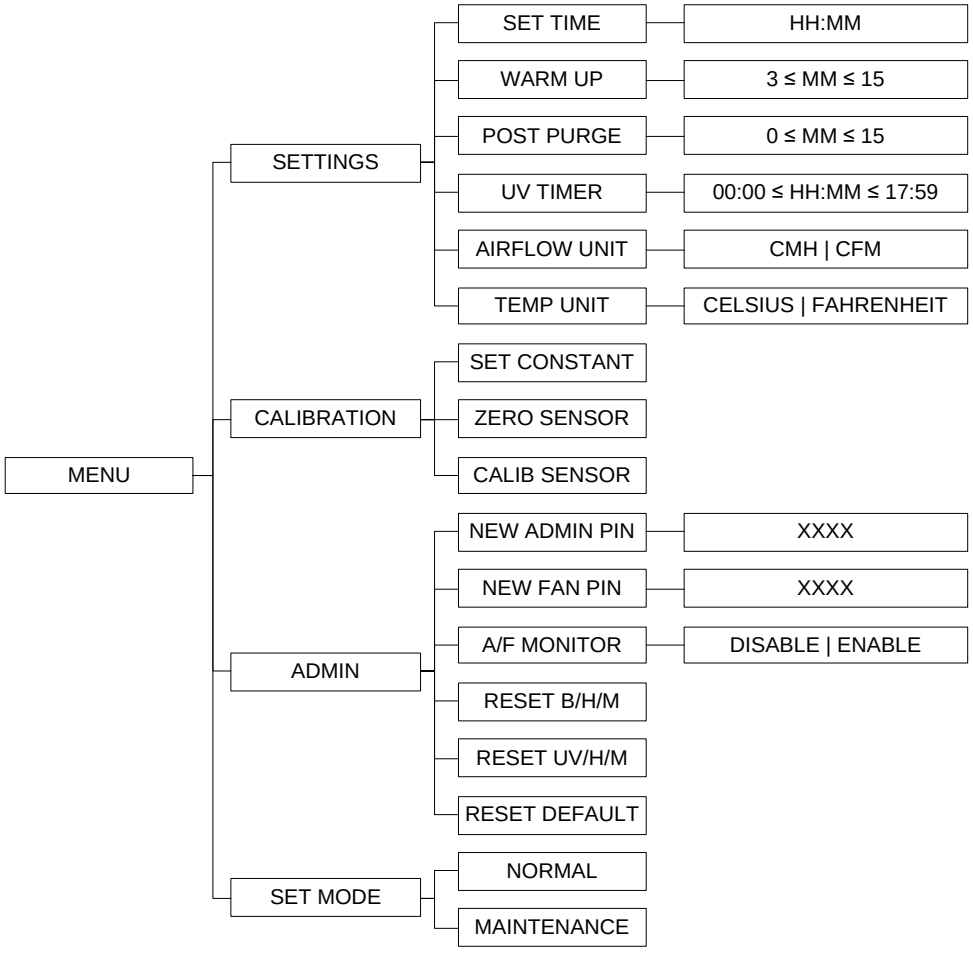
1. Fan Button
    - Turns on and turns off the fan.
2. Lamp Button
    - Turns on and turns off the fluorescent lamps.
3. Socket Button
    - Turns on and turns off the electrical socket (retrofit kit).
    - The maximum rating of all the outlets in the cabinet is 5 A. If there is overload, the fuse will blow.
4. UV/Gas Button
    - Turns on and turns off the UV lamp.
    - UV lamp can only be activated when the sash window is fully closed. Since the sash is capable of filtering UV rays, users are protected from the harmful UV radiation.
5. Up (▲) and Down (▼) Arrow Button
    - Moves the menu options upwards and downwards.
    - Increases and decreases corresponding value inside one of the menu options.
6. Set or Mute or Diagnostic Button
    - To proceed to the next step, level or sequence inside the menu options.
    - To proceed to the next step or sequence inside one of the menu options.
    - To mute the alarm sound (only in fully open state during normal mode).
    - Enters diagnostic mode.
7. Menu Button

> *When you are entering menu options, the alarm will sound to indicate that the microprocessor is not monitoring the operation of the cabinet. No further warnings will be given.*

    - To enter and exit from the menu options.
    - To go back to the previous level of the menu options.
    - To access maintenance mode from error condition.

3.2. Menu Option

Refer to the following diagram for complete reference to all menu options available.



3.2.1. Settings

Users may use the settings menu function to customize the operation of the BSC to meet specific application requirements. The settings menu can be entered using either FAN PIN or ADMIN PIN.

3.2.1.1. Set Clock (Time)

Users can set the time by increasing/decreasing the hour and minute values. The correct time will be maintained even after the unit is turned off.

MENU → SETTINGS → SET TIME → HH:MM

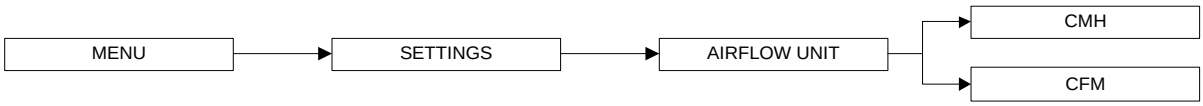
3.2.1.2. UV Timer (if UV is present)

UV timer can be used to switch off the UV lamp automatically after a fixed period. The UV timer can be set up to 18 hours. By default, the timer is set to 60 minutes. Esco does not recommend leaving the UV lamp on for more than 60 minutes per decontamination cycle as it shortens the lifespan of the UV lamp. Unless the UV timer is activated, the lamp has to be switched off manually.

MENU → SETTINGS → UV TIMER → HH:MM

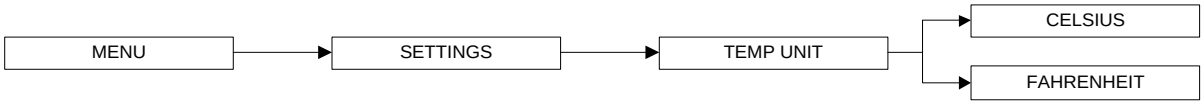
3.2.1.3 Airflow Unit

Using this option, the user can select the unit in which air velocity is measured and displayed. The user can choose between metric (m/s) and imperial (fpm).



3.2.1.4 Temperature Unit

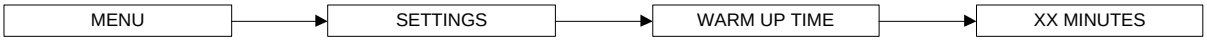
Using this option, the user can select the unit in which temperature is measured and displayed. The user can choose between metric (m/s) and imperial (fpm).



3.2.1.5 Warm Up Time

There will be a warm-up period before the BSC is fully functioning upon activation of the unit. This is to ensure that the sensors, the blower, and the control system are stabilized, as well as to ensure the work zone is purged of contaminants. The default setting is 3 minutes and the user can set it between 3 to 15 minutes. (Note: Please note that WHO Laboratory Biosafety Manual (3rd edition) advocates 5 minutes purging time prior to start of work while US Biosafety in Microbiological and Biomedical Laboratories (5th edition) advocates 4 minutes).

During the warm-up period, the user can use the FAN button to turn off the blower, LIGHT button to turn on and off the fluorescent lamp and MENU button. However, to be able to access the menu, the user needs to input ADMIN PIN and even then, some sections of the menu (WARM UP and all FIELD CALIBRATION) are still not accessible for the user. Entering the menu during this time will put the warmup period on pause.



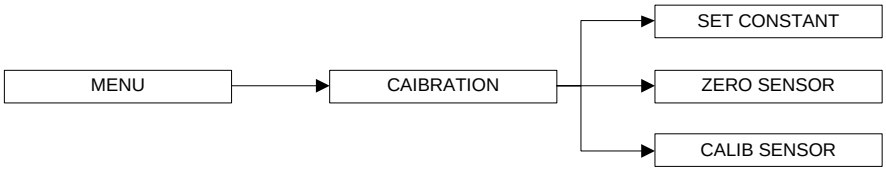
3.2.1.6 Post Purge Time

After the user switches off the BSC blower, there will be a post-purge period, to ensure that all contaminants are purged from the work zone. The default setting is zero minute (disabled) and user can set from 0 up to 15 minutes. It is recommended that BSC is purged for a minimum of 3 minutes after the work is complete.

(Note: Please note that WHO Laboratory Biosafety Manual (3rd edition) advocates 5 minutes post purging time after work is completed while US Biosafety in Microbiological and Biomedical Laboratories (5th edition) advocates 4 minutes).

3.2.2. Calibration

The purpose of calibration is to ensure the accuracy of the airflow display and alarm (if present). This involves measuring airflow with reference instrumentation and establishing reference between airflow sensor(s) on the BSC to the standard reference. Calibration should only be carried out by trained personnel. This section presents a brief overview of the calibration menu function. For more information, refer to test report.



3.2.3. Admin

The admin menu allows you to change both FAN and ADMIN PIN. The reset blower, filter and UV hour meter functions are usually used after you change the blower, filter or UV lamp as they can easily give you the indication on when to do BSC maintenance. While the reset default function will return the options in the settings menu to their factory settings.

3.2.3.1 New ADMIN PIN (default 0009)

ADMIN PIN restricts access to some of the more delicate menu functions, namely admin and field calibration, which should only be accessed by qualified personnel. User must enter four digits ADMIN PIN before accessing these menus.

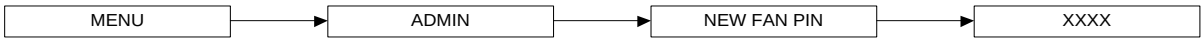
ADMIN PIN can also be used to switch to maintenance mode from error condition.

3.2.3.2 New FAN PIN (default 0001)

FAN PIN restricts access to fan control and some parts of the menu, settings and set mode. User must enter four-digit PIN before switching fan on or off. As such, it can restrict access to operating the BSC by unauthorized personnel. It will also prevent unauthorized shutdown of the BSC when continuous operation is required. Note that continuous operation is recommended for better safety.

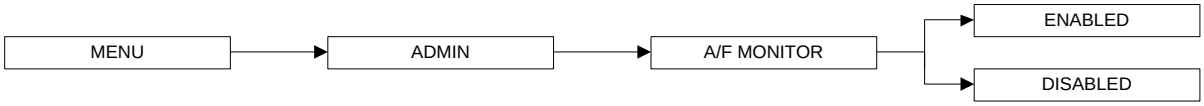
It is recommended that the Fan PIN be issued only to personnel authorized to use the BSC. With FAN PIN, the user can access admin and set mode parts of the menu.

Setting the PIN to 0000 will disable this feature. The FAN PIN is 0001 by default.



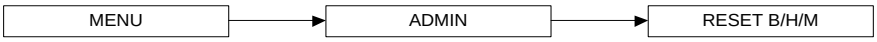
3.2.3.3 Airflow Monitor

Whenever the air velocity falls below the fail point, the air fail alarm will be triggered. This option is used to enable/disable alarm. The alarm is enabled by default.



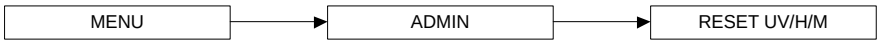
3.2.3.4 Reset B/H/M

This option is used to reset the blower hour meter. The blower hour meter indicates how long the blower has been in operation. There's no maximum value in blower hour meter. The counter value can be checked while in the diagnostic mode. The value can also provide some help in setting up maintenance schedule.



3.2.3.5 Reset UV/H/M

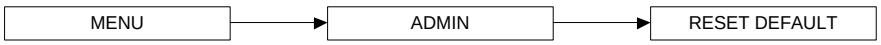
This option is used to reset the UV lamp hour meter. The UV lamp hour meter indicates how long the UV lamp has been in operation. Please reset the UV lamp hour meter after each UV lamp replacement.



3.2.3.6 Reset Default

User can reset the default setting by choosing this option. The features being reset are warm-up period (3 minutes), post-purge period (0 minute), UV timer (60 minute), measurement unit (Metric), Airflow monitor (enabled), ADMIN PIN (0009), and FAN PIN (0001).

Note that the calibration settings cannot be reset as it may cause the BSC to operate in an unsafe manner. The hour meters cannot be reset either.



3.2.4. Setting Mode

AC3 BSC has two working mode; normal mode is used in daily activity and will be set every time the BSC restarted. Maintenance mode should only be accessed by qualified personnel during maintenance. In this mode, all alarms are disabled, and all interlocks are defeated.

3.3. Alarms and Warnings

BSC uses alarms to indicate that the condition inside the BSC is not safe for the operator, so check the LCD display to understand the cause of these alarms.

Chapter 4 – Basic Cabinet Operation

4.1. Starting and Shutting Down the BSC

4.1.1. Turning on the BSC

1. Turn on the fan by pressing the FAN button. Input the Fan PIN if asked (if PIN ≠ 0000). This will start the warm up procedure (default: 3 minutes). All buttons are diabled during warm up period.
2. The BSC is ready for work.

4.1.2. Turning off the BSC

1. Turn off the fan by pressing the FAN button. Input the Fan PIN if asked (if PIN ≠ 0000). This will start the post purge procedure (default: 0 minute). All buttons are diabled during post purge period.
2. Turn on the UV lamp (when present) to decontaminate the work area by pressing the UV button. Leave the UV lamp on to make sure the decontamination is done effectively. The UV lamp can only be turned on after the post purge procedure is finished.

4.2. Working in the BSC

- Surface-decontaminate the work area (work surface, back and side wall, UV lamp) before and after using the BSC.
- Allow the BSC to purge any contaminant by allowing the blower to operate at least 3 minutes before and after using the BSC.
- Surface-decontaminate any item or apparatus with appropriate disinfectant before entering or exiting the work area.
- Place the waste container (containment bag, pippete discard pans, etc.) inside the BSC work area.
- Place all items and apparatus in the safe working area.

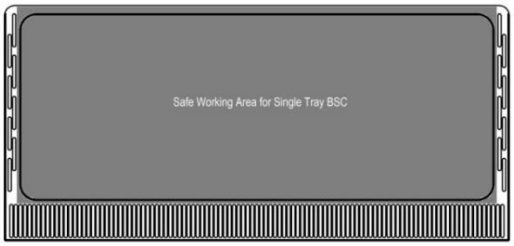


Figure 4.1. Safe Working Area

- Ensure the front and back air grilles are not obstructed by your arms or any other objects.
- Work as far inside the BSC as possible - at least 150 mm (6 inches) behind the front air intake grille.
- The use of Bunsen burner inside the work zone is not recommended. However if the use of Bunsen burner is unavoidable, place the burner in the right side of the work zone.
- Place aerosol-generating instruments as far inside the BSC as possible and at least 150 mm (6 inches) from clean items/materials.
- Place air turbulence generating equipment such as centrifuges, blenders or sonicators towards the back of the BSC. Stop other work while any of this equipment is in operation.

- As far as possible, it is recommended that the BSC be operated continuously in order to achieve optimal containment and cleanliness. Airflow studies have shown that once the fan has been switched off, air from the BSC may escape due to the thermal currents from inside the BSC.

4.3. UV Lamps

Shortwave UV (UVC) is considered as germicidal and virucidal. The UV lamp that Esco provides has a large portion of the spectrum in the UVC range. Unlike many other types of decontamination agent, UV light does not leave any residue. The decontamination action stops upon de-energizing of the lamp. However, the UVC spectrum does not penetrate well.

- UV light decontamination method may be used before and after working with susceptible organisms. However, it should not be the sole decontamination agent. Chemical decontamination agent should still be used.
- There should be minimal amount of material inside the BSC's work area during the process of UV light decontamination. A direct interaction with UV light can degenerate plastic or rubber-based material and can cause other hazards (e.g. Generation of hazardous vapors).
- Before activating the UV lamp, the BSC sash should be in fully closed position and the user should ensure that interlock is working properly. Avoid direct contact with skin and eyes as UV light is classified as a probable human carcinogen.
- The UV timer feature should be used to easily control the decontamination period (**Note:** *UV timer is disabled by default)*. Leaving the UV lamp on for over 60 minutes or even overnight is not recommended because it shortens the lifespan of the lamp. The UV lamps used in Esco BSCs have a lifespan of 2,000 hours.
- The UV lamp should be cleaned of any dust and dirt weekly and changed annually to ensure its effectiveness. Ensure that the lamp is turned off when lamp cleaning and maintenance is carried out.

Note that the use of UV lamp in a BSC has been explicitly discouraged in all major international standards and recommendations.

4.4. Decontamination and Disinfecting Agents

- For stainless steel surfaces, all common disinfectant agents, except chlorine-based ones, are suitable. Where chlorine-based agents are used, sterile water should be used to wipe down the surfaces following the application of the disinfectant agents.
- For powder coated surfaces, all common disinfectant agents are suitable. However, the BSC has been specifically evaluated for use with the following:
    - 1N Sodium Hydroxide
    - 1% Quaternary Ammonium Compound
    - 5% Formaldehyde
    - 5,000 ppm Hypochlorite
    - 2% Iodophor
    - 5% Phenol
    - 70% Ethyl Alcohol
- Adequate contact time should be observed for effective decontamination and the time required depends on the disinfectant agents, the concentration and the object of disinfection.

- There is no one disinfectant agent that works with all organisms. Therefore, users and safety professionals should carry out risk assessment to ensure that appropriate disinfectant agents and validated decontamination procedures are used in decontaminating the BSC.

Decontaminant	*Glutaral-dehyde*	*Peroxide/ Paracetic acid/ Acetic acid*	*Chlorine Dioxide*	*Chlorine*	*Iodophor*	*Alcohol*	*Phenolic*	*Quaternary Ammonium Compounds*
Classification	Sterilant	Sterilant	Sterilant	High Level	Inter-mediate	Inter-mediate	Inter-mediate	Low Level
Parameters for use:								
Concentration	2%	1%	0.01-0.1%	0.01-5%	0.5-2.5%	70-85%	0.2-3%	0.1-2%
Contact time (min.)	10-600	10-720	10-600	10-30	10-30	10-30	10-30	10-30
Stability > 1 week (1)	+		+		+	+	+	+
Agents:								
Bacterial Endospores	+	+	+	+/-				
Naked Viruses	+	+	+	+	+/-	+/-	+/-	
Mycobacterium	+	+	+	+	+	+	+	
Vegetative Bacteria	+	+	+	+	+	+	+	+
Enveloped Viruses	+	+	+	+	+	+	+	+
Characteristics:								
Inactivated by Organics		+		+	+	+	+/-	+
Residual	+	+	+	+/-	+		+	
Corrosive		+		+	+		+	
Flammable						+		
Skin Irritant	+	+	+	+	+		+	
Eye Irritant	+	+	+	+	+	+	+	
Respiratory Irritant	+	+	+	+	+	+	+/-	
Toxic	+	+	+	+	+	+	+	+
Use in BSCs:								
Routine Surface Decon				+/-	+	+		+
Biohazardous Spill		+/-	+	+/-	+		+	+/-

(1) protected from light and air

+ = effective, +/- = results may vary, blank = not effective

4.5. Gaseous Decontamination

Decontamination may frequently be carried out by means of formaldehyde fumigation or using other decontamination agents, such as chlorine dioxide or hydrogen peroxide. Decontamination process should only be carried out by qualified personnel.

In any of the following eventualities, the user should ensure that the BSC has been properly decontaminated, keeping in mind the nature of the pathogens used:

- At the time of moving/relocating the BSC
- At the time of changing the type of work being carried out in the BSC
- Before accessing contaminated areas for servicing (e.g. when filter needs replacement)
- Periodically and as mandated by your risk assessment

4.6. Further Information

- A Guide to Biosafety and Biological Safety Cabinets can be downloaded from https://www.escolifesciences.com/pdf/9010018_Guide%20to%20Biosafety%20and%20Biological%20Safety%20Cabinets_A4_vD_041321.pdf
- An educational video on “Working Safely in your Biological Safety Cabinet” is available for viewing at http://www.youtube.com/watch?v=ZnUW1N-JJz8

Chapter 5 – Maintenance

5.1. Scheduled Maintenance

Proper and timely maintenance is crucial for trouble-free functioning of any device and your Esco BSC is no exception to this rule. We strongly recommend that you follow the maintenance schedule suggested hereunder in order to obtain optimal performance from your Esco BSC.

No.	Description of Task to Perform	Maintenance to be carried out every					
		Day	Week	Month	Quarter	1 Year	2 Years
1	Surface decontaminate the work zone	√					
2	BSC power-up alarm verification	√					
3	Perform thorough surface decontamination on the drain pan		√				
4	Check the paper catch for retained materials		√				
5	Clean UV lamp (where present) of any dust and dirt		√				
6	Clean the exterior surfaces of the BSC			√			
7	Clean the sash window			√			
8	Check all service fixtures (where present) for proper operation			√			
9	Inspect the BSC for any physical abnormalities or malfunction				√		
10	Clean stubborn stains on stainless steel surfaces with MEK				√		
11	Recertification					√	
12	Check the cabinet's functionality					√	
13	Change UV Lamp (where present)					√	
14	Change the fluorescent lamps						√

Cleaning the BSC

- Clean the work surface and walls with appropriate disinfectant and soap water afterward.
- Clean the sash window with appropriate disinfectant and glass cleaner afterward.
- Use a damp cloth to clean the exterior surface of the BSC, particularly on the front and top in order to remove dust that has accumulated there.
- Use sterile water to finish the cleaning and wash away any residue of disinfectant, soap, water and glass cleaner.
- For removing stubborn stains or spots on the stainless-steel surface, make use of MEK (Methyl-Ethyl-Ketone). In such cases, make sure that you wash the steel surface immediately afterwards with sterile water and some liquid detergent. Use a polyurethane cloth or sponge for washing. Regular cleaning of the stainless-steel surface helps retains the attractive factory finish.
- Ensure that the chemicals used are compatible with one another.
- Use appropriate personal protective equipment (PPE) when carrying out the activity.

Test the audible and visual alarm

The simplest method by far would be to move the sash until the glass window is no longer in the sash ready or UV mode position.

Check the cabinet's functionality

- Check the BSC's mechanical functionality (e.g. sash window – lubricate if necessary).
- Check the BSC's electrical functionality (e.g. fluorescent lamp – replace if necessary).
- Check the BSC for any defect and if any, repair immediately.

Recertification

All BSCs must be re-certified annually by a certified engineer. See certification procedures attached to the factory test report.

5.2. Maintenance/ Service Log

It is good practice (and in some cases regulatory requirement) to maintain a log of all maintenance work carried out on your cabinet.