*Thank you for purchasing this Esco Biological Safety Cabinet. Please read this manual thoroughly to familiarizeyourself with the many unique features and exciting innovations we have built into your new equipment. Esco provides many other resources at our website, www.escoglobal.com, to complement this manual and help you enjoy many years of productive and safe use of your Esco products.*


# User and Service Manual

**For Technical Service, contact**
**North America**
*Esco Technologies, Inc.*
*2940 Turnpike Drive, Units 15-16 •Hatboro, PA 19040, USA*
*Toll-Free USA and Canada 1-877-479-3726*
*Tel 215-441-9661 • Fax 215-441-9660*
*us.escoglobal.com • usa@escoglobal.com*

**Rest of World**
*Esco Micro Pte. Ltd.*
*21 Changi South Street 1 • Singapore 486777*
*Tel +65 6542 0833 • Fax +65 6542 6920*
*www.escoglobal.com • mail@escoglobal.com*

eSafe® Class II
Biological Safety Cabinet

Esco eSafe® Class II BSC User Manual
Version B - Released August 2013

## 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."*

# Table of Contents

**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.

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 www.escoglobal.com/warranty_registrations.php 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: 1-888-479-ESCO
Singapore: +65 65420833
Global Email Helpdesk: support@escoglobal.com
Visit http://escoglobal.com to talk to a Live Support Representative
Distributors are encouraged to visit the Distributor Intranet for self-help materials.

**Product Appendix, Warranty Listings**
Biological Safety Cabinets, Laminar Flow Cabinets, HEPA-Filtered Cabinets (except Streamline brand): 4 years limited
Laboratory Fume Hoods: 2 years limited
Ductless Fume Hoods: 4 years limited for Ascent Opti, 6 years limited for Ascent Max
Cleanroom Equipment: 1 year limited
Thermal Cyclers: 3 years limited for MiniPro, MaxPro, and Provocell; 2 years limited for Spectrum; 2 years on the Blocks and Peltier Units, 2 years on all electronic components, 3 years on the housing and fans
Laboratory Ovens and Incubators: 1 year limited
$CO_2$ Incubators: 2 years limited
Containment/Pharma Products: 2 years limited
ULT Freezer: 5 years limited, 5 years on the compressor

Policy updated on 1st January 2012

Applies to all units ordered on and after 1st January 2012

# Introduction

## 1. Products Covered

| Esco Class II Biological Safety Cabinet | | | | |
|---|---|---|---|---|
| Model | Electrical Rating | 1.2 meters (4 feet) | 1.5 meters (5 feet) | 1.8 meters (6 feet) |
| eSafe | 220-240 V AC, 50 / 60Hz, 1Φ | EC2-4L8 / EC2-4S8 | EC2-5L8 / EC2-5S8 | EC2-6L8 / EC2-6S8 |
| | 110-130 V AC, 50 / 60Hz, 1Φ | EC2-4L9 / EC2-4S9 | EC2-5L9 / EC2-5S9 | EC2-6L9 / EC2-6S9 |

## 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. m
- 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 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)**

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

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

- **Directive 2002/95/EC 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 Conformation

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 II Biological Safety Cabinet** |
| **Brand** | **: eSafe** |
| **Model** | **: EC2-4L8, EC2-4S8, EC2-5L8, EC2-5S8, EC2-6L8, EC2-6S8** |

in accordance with the following directives:

| | |
|---|---|
| **2006/95/EEC** | **: The Low Voltage Directive and its amending directives** |
| **2004/108/CE** | **: The Electromagnetic Compatibility Directive and its amendingdirectives** |

has been certified independently to comply with the requirement of the following Harmonized Standards:

| | |
|---|---|
| **Low Voltage** | **: EN 61010-1:2010** |
| **EMC** | **: EN 61326-1:2006 Class B** |
| **Design/ Performance Criteria** | **: EN 12469 (2000) Class II 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.

**XQ Lin**
Group CEO, ESCO

This Declaration of Conformity isonly applicable for 230V AC 50/60Hz units

# Chapter 1 - Product Information

## 1.1. About Biological Safety Cabinet

Biological safety cabinet plays a significant role in any laboratories that handle biological materials. It is a primary containment device that is designed to protect the operator and environment from biological hazards that would otherwise pose a threat to human life and environment. Class II Biological Safety Cabinet is additionally designed to provide product protection to eliminate or at least minimize the product contamination from outside contaminants or from cross contamination of products worked on inside the work zone.

We encourage you to learn more about the functions and operating principles of your biological safety cabinet. We also further encourage you to conduct risk assessment on your work with your safety professional to determine the biological safety cabinet you require. The information below is provided to help you in your risk assessment.

## 1.2. Major International Standard

International standards play an important role in harmonization and ensuring that cabinets meet established industry guidelines for safety and performance. Consequently, you should understand the scope and application of these standards. The following tables detail some common international standards:

| Various BSC Standards | | |
|---|---|---|
| Standard origin | The standard | Applicability |
| USA | NSF / ANSI 49 | Class II biological safety cabinet |
| Japan | JIS K 3800 | Class II biological safety cabinet |
| Europe | EN 12469:2000 | Class I, II and III biological safety cabinet |
| Australia | AS 2252 | Class I and II biological safety cabinet |

## 1.3. Different Classes of Biological Safety Cabinet

The following table provides a quick summary of the different classes of Biological Safety Cabinet

| Class (Type) | Protection Offered | | Inflow Velocity | Recirc. Air | Exhaust Air | Contaminated Plenum Surrounded By | Exhaust Alternatives |
|---|---|---|---|---|---|---|---|
| | Operator | Product | | | | | |
| I | ✓ | X | ≥ 0.71– 1.0 m/s<br>≥ 140 – 196 fpm | 0% | 100% | Outside air (Lab room) | Inside room / Hard duct |
| | • Unfiltered room air flows into the cabinet, passes through the workzone and then through a filtration system, trapping airborne contaminants. Clean, decontaminated air is exhausted from the cabinet.<br>• The cabinet may or may not require hard ducting but when hard ducted, a long duct run will likely require external exhaust system (in addition to internal fan of the cabinet, if any). | | | | | | |
| II A1** | ✓ | ✓ | ≥ 0.38 m/s*<br>≥ 75 fpm | 70% | 30% | Negative pressure | Inside room / Thimble duct |
| | • Room air enters the cabinet through a front inlet grille and is filtered before entering the workzone, contaminated air is passes through a filtration system trapping airborne contaminants. Clean, decontaminated air is recirculated through the workzone or exhausted from the cabinet.<br>• In the past type A1 cabinets may have a positively-pressurized plenum bordering the ambient environment but recent NSF 49 standard disallow this and require II A1 cabinet to "have all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums".<br>• Type A1 is now largely considered obsolete.<br>• Classification of different types of Class II cabinet are found in NSF 49 and JIS K 3800 (among the standards listed above)<br>• Type A1 cabinets are considered as unsuitable for work with volatile chemicals and tracer amounts of volatile radionuclides. | | | | | | |
| II A2** | ✓ | ✓ | ≥ 0.51 m/s | 70% | 30% | Negative | Inside room / |

| Class (Type) | Protection Offered | | Inflow Velocity | Recirc. Air | Exhaust Air | Contaminated Plenum Surrounded By | Exhaust Alternatives |
|---|---|---|---|---|---|---|---|
| | Operator | Product | | | | | |
| | | | ≥ 100 fpm | | | pressure | Thimble duct |
| | • Similar to Class II Type A1 cabinet in terms of airflow path but higher inflow velocity.<br>• Most European, Japanese, and Australian Class II cabinets have airflow recirculation and exhaust ratios similar to Class II Type A2 cabinet along with the negative pressure isolated plenum operating in the same principle as the NSF Class II Type A2, but with lower inflow velocity requirement.<br>• Type A2 cabinets may be used for work with small amount of volatile chemicals and tracer amounts of volatile radionuclides when the cabinets are exhausted through adequately functioning exhaust canopies / thimble connection. | | | | | | |
| II B1** | ✓ | ✓ | ≥ 0.51 m/s<br>≥ 100 fpm | 30% | 70% | Negative pressure | Hard duct only |
| | • Type B1 cabinets have a dedicated exhaust feature for work done inside the cabinet towards the back of the work zone.<br>• The availability of direct exhaust section towards the back of the work zone means that this area may be used for work with volatile chemicals and tracer amounts of volatile radionuclides provided the chemicals and radionuclides do not adversely impact the work when recirculated in the downflow air.<br>• Due to the inflexibility of type B1 cabinets in terms of work area available for chemical and radionuclides work, the cabinet has largely been replaced by Type B2. | | | | | | |
| II B2** | ✓ | ✓ | ≥ 0.51 m/s<br>≥ 100 fpm | 0% | 100% | Negative pressure | Hard duct only |
| | • Type B2 cabinets exhaust all inflow and downflow air after HEPA filtration to the external environment.<br>• The direct exhaust of all air from the work zone means that the cabinets are suitable for work with volatile chemicals and radionuclides.<br>• The cabinets require stable building exhaust system to be precisely tuned to the cabinet airflow requirements. | | | | | | |
| III | ✓ | ✓ | P >200 Pa****<br>P > 0.8" w.g. | 0% | 100% | Negative pressure | Inside room / Hard duct |
| | • Class III cabinets are designed to be gastight and work is performed through glove ports in the front of the cabinet.<br>• During routine operation, negative pressure relative to the ambient environment is maintained within the cabinet.<br>• When a dedicated ductwork system is employed, they are suitable for working with toxic chemicals as an adjunct to microbiological processes.<br>• Likely used in Biosafety Laboratory level 4 (BSL4) Class III cabinet laboratory. | | | | | | |

Notes:

* EN 12469 requires inflow velocity for Class II cabinet to be ≥ 0.4 m/s

** EN12469 requires downflow velocity for Class II cabinet to be 0.25 – 0.5 m/s

*** EN12469 requires inflow velocity for Class III cabinet to be ≥ 0.7 m/s when one glove is removed

****NSF49 specifies that Class III cabinet is to be maintained at a minimum of 120 Pa negative pressure

## 1.4. Quick View

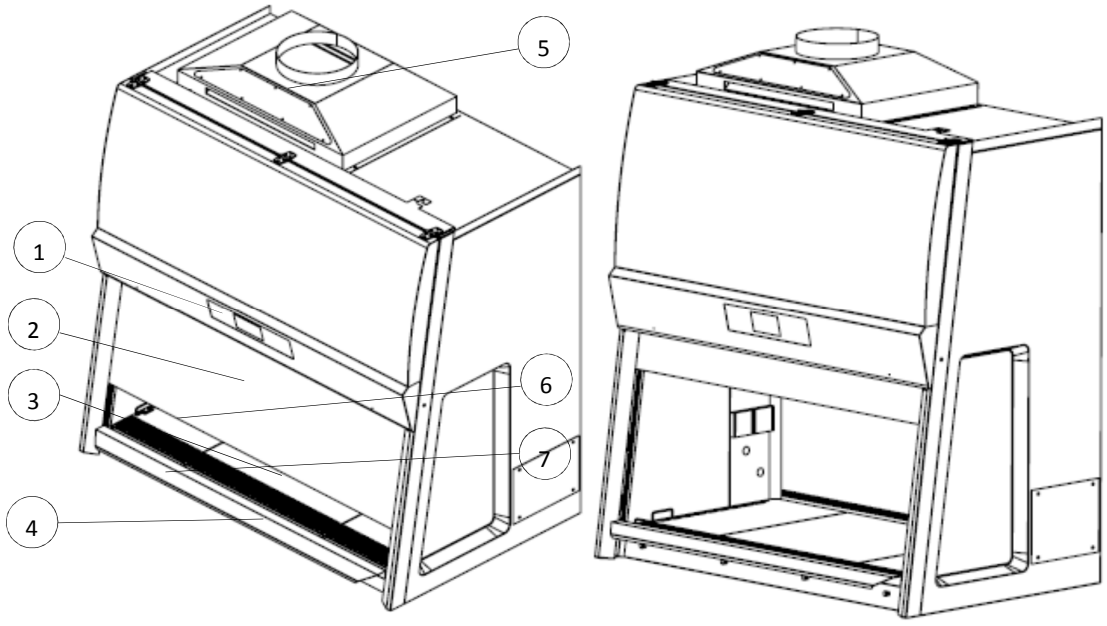



**Figure 1.1. EC2 BSC main parts.**

1. Esco Sentinel Platinum Control System
2. Sash Window
3. Work Tray (Multi-Piece)
4. Armrest
5. Thimble exhaust ducting (Optional)
6. Electrical Outlet
7. Service Fixture (Optional)

## 1.5. Airflow Pattern

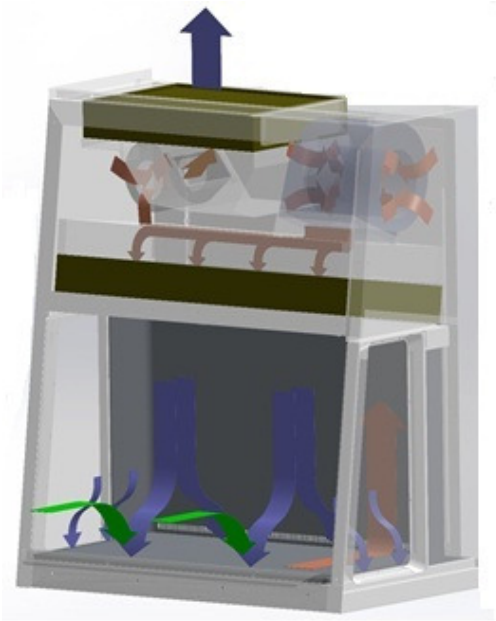


**Figure 1.2. Airflow pattern inside the BSC.**

- 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 biological safety cabinet (BSC) work zone. Inflow air travels through a return path toward the common air plenum (blower plenum) behind the back wall and then to the space above the supply plenum.
- The air from the space is then drawn by the downflow fan to supply filtered air into the work zone and at the same time some of the air is also exhausted by the fan through the exhaust filter.
- 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 on the back wall.
- 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 exhaust plenum.

## 1.6. Further Information

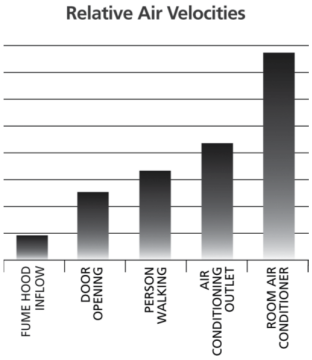
For further information on the topics discussed above, we have many documents available in our Technical Support library at www.escoglobal.com. Here you will find the most up-to-date information in far more details than are possible to include in this manual.

# Chapter 2 - Installation

## 2.1. General Requirement

### 2.1.1. Location Requirements

The BSC needs to be sited in a location that does not compromise the performance of the unit.

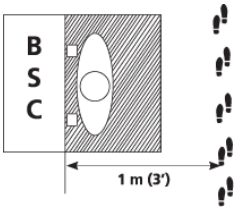



As seen in the chart, your cabinet's internal airflow velocity is relatively low compared to the airflow disturbances potentially caused by opening a door, a person walking by or a direct exposure to an air-conditioning outlet. These external airflow disturbances can affect the containment of the BSC. Therefore, the BSC should be located as far away as possible from sources of airflow disturbance and in an orientation which optimally shields the cabinet's airflow from all external airflow disturbances. There should be adequate SOP in place to minimize events that will affect the performance of the cabinets.

The following requirements should be taken into account:

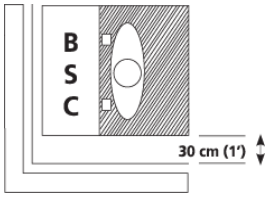
- If necessary, the arm rest and sash cover can be removed to reduce the overall depth of the cabinet. Detailed instructions on how to carry out this step can be obtained from your Esco Service Representative.
- Poor siting of a cabinet can adversely affect performance. A specialist engineer and safety personnel in your facility should be consulted on correct positioning of the cabinet prior to installation.
- Cabinets should never be sited in line with a doorway, a window that can be opened, or adjacent to a thoroughfare. Care should be taken to ensure that potential effect of room air diffusers, fans, extractors, vents, etc. on the BSC are taken into account and any risk of airflow disturbance is appropriately treated (e.g. eliminated, mitigated) before installation.
- Room air supply diffusers should not be within 1.5 meter (5') of the front aperture. If there are large numbers of cabinets in a laboratory this recommendation may be difficult to comply with, but where diffusers have to be placed in close proximity to a safety cabinet, their discharge velocities will need to be low.
- The position of a BSC should satisfy the spatial requirements (e.g. vision, lighting and convenience of access) of the operator and people working nearby. If the cabinet is installed on a bench top, the leading edge should slightly overhang or be flush with the edge of the bench top.
- There should not be an open space between the leading edge of the cabinet and the front of the bench as this may create turbulence in front of the aperture. It also provides an obstacle which could adversely affect airflow across the cabinet face.

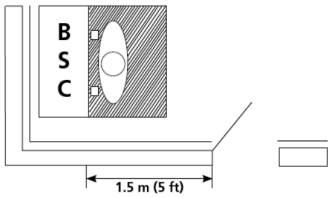
#### 2.1.1.1. Position Requirements




Any pedestrian traffic routes, thoroughfares or walkways should be at least 1.0 metre (3') from the front of the cabinet, so as to preserve zone undisturbed by anyone other than the operator.

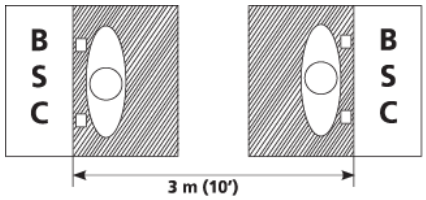
You should not position the cabinet with either side closer than 30cm (1') to adjacent walls or other similar obstructions. Allow at least 30cm (1') clearance on both sides of the cabinet. There should be adequate space left for cleaning the sides of the cabinet and for carrying out decontamination procedures. There should be unobstructed access to the main power supply point(s).

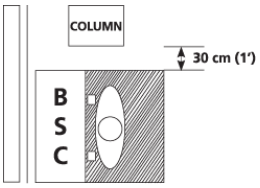



You should not position the cabinet where the distance between the aperture and any doorway is less than 1.5 metres (5') or the distance between the side panel and any doorway is less than 1.0 metre (3'). Door openings cause substantial air turbulence. If the door is fitted with air transfer grills, operator protection factor testing may be carried out to determine suitable reduced clearance.

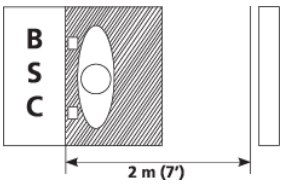
Safety cabinets should not be installed in positions where there is a likelihood of interference from other laboratory equipment. The distance from the aperture to the aperture of an opposing cabinet, fume cupboard, etc. should be in excess of 3 metres (9') for safe operation.

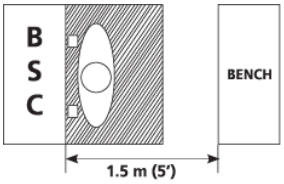



As with walls, any large obstruction such as a pillar or column projecting beyond the plane of the front aperture should not be within 30 cm (3') of the sides of the cabinet.

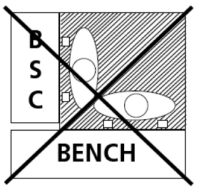
You should not position the cabinet in a location where there is an opposing wall (or other obstruction likely to affect airflow) within 2 metres (7') of the front aperture.



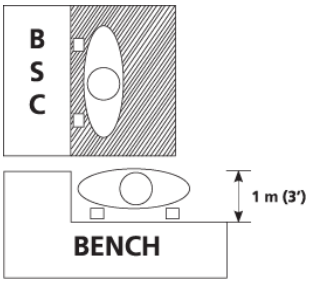




The distance between the aperture of the cabinet and the front of a bench opposite should not be less than 1.5 metres (5'). Containment performance may not be affected if this distance is reduced, to allow the operator to use the bench whilst working in the cabinet for instance. You should measure any such effects using relevant operator protection factor tests to determine safety limits.

Avoid positioning a bench at right angles to the cabinet. Whilst this may reduce traffic in front of the cabinet, any other person working at the bench is likely to disturb airflow close to the cabinet.




A projecting bench will help minimize traffic in front of the cabinet and anyone working at the bench is unlikely to have a significant effect on the airflow as long as the front of the bench is situated at least 1 metre (3') from the side of the cabinet.



### 2.1.2. Preparing For Installation

#### 2.1.2.1. Support Requirements

Esco provides a number of support stand options (Note: Only SPL-_B0 and SPL-_A0 are not GS certified).

- Fixed height
- Adjustable height
- Telescoping height
- Infinitely adjustable cradle stand

Esco support stand with leveling feet is recommended for safety. It is recommended that the installation of thesupport stand be carried out by qualified personnel (contact your Esco Distributor for assistance).After the cabinet is installed on the support stand, use a level placed in the centre of the work tray to adjust thelegs to achieve a level work surface. First level from left to right and then level from front to back. The NSF approved leglevelers provide a maximum 50mm (2") adjustment.

When installing the cabinet onto existing work surface, ensure that the structure can safely support the combined weight of the cabinet and any related equipment. Some modifications to the work surface may be necessary. The work surface should be smooth, nonporous and resistant to those disinfectants and chemicals to which the cabinet is regularly exposed to.

#### 2.1.2.2. Relocating the Cabinet

Normally BSCs are rarely moved once they are in their ideal positions, but should there be a need to relocate or repackage the unit, here are some considerations:

- It is recommended that risk assessment is carried out before the BSC is moved.
- Before moving the BSC, remember to decontaminate the cabinet.
- Before moving the BSC, remember to secure all moving parts (e.g. sash window).
- BSC is heavy so please carry out adequate workplace safety assessment before moving the cabinet. Should only manpower is available (i.e. no suitable equipment), it will usually take 6 or more people to move a BSC manually.

For repackaging:

- Bolt the BSC to the pallet.
- Strap the BSC body down to the pallet.
- Repackage as necessary. If possible, use original packaging.
- When moving the BSC, use material handling equipment and lift the pallet.

### 2.1.3. Environmental Requirements

- Indoor use only.
- Altitude of up to 2,000 meter (6,600 feet).
- Relative humidity between 20% – 90%
- Temperature between 18°C – 30°C (65°F – 86°F).
- 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.*

### 2.1.4. Exhaust Requirements

The exhaust filter area is susceptible to disruptive air currents or air drafts. A clearance of at least 30 cm (1') is recommended between the highest point of the cabinet and the ceiling. If the distance is less than 30 cm (1'), the airflow alarm system may need re-calibration. For proper exhaust filter leak scanning purposes, a minimum clearance of 50 cm (1'8'') is recommended.

Esco does not guarantee that this distance would be sufficient. It would have to be verified by your nearest Esco distributor or your service company.

If you intend to connect your cabinet to an external exhaust system, Esco offers an optional Exhaust Collar for Thimble-Ducting. Installation requirements and instructions are provided with the Exhaust Collar (Note: External exhaust system installation is not GS certified).

### 2.1.5. Electrical Requirements

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

| Model | Power rating |
|---|---|
| **EC2-4L8 / EC2-4S8** | 230 VAC 50/60 Hz |
| **EC2-4L9 / EC2-4S9** | 115 VAC 50/60 Hz |
| **EC2-5L8 / EC2-5S8** | 230 VAC 50/60 Hz |
| **EC2-5L9 / EC2-5S9** | 115 VAC 50/60 Hz |
| **EC2-6L8 / EC2-6S8** | 230 VAC 50/60 Hz |
| **EC2-6L9 / EC2-6S9** | 115 VAC 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 power stabilizer or UPS with appropriate feature 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 seen by the cabinet. Where UPS is installed, it is recommended that the UPS is sized to enable the BSC to operate for about 20 minutes to provide ample time for the personnel to react to the power failure.
- A reliable protective earth connection is recommended for better operation and safety.

### 2.1.6. Service Line Requirements

- All service lines should be installed by a suitably qualified and/or certified engineer, in accordance with all applicable local, state and government regulations.
- Service line attachments should be equipped with an emergency shut off valve that can be accessed quickly and with ease, should the need arises.
- Check whether there is a need to install pressure regulators to reduce the line pressure.
- Your BSC can accommodate service fixtures on the left or right hand side of the cabinet. Make allowance for the positioning of service lines when planning the installation site to ensure ease of access to emergency shut off valves.

## 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. If you have purchased an optional support stand this will be attached to the shipping carton of the cabinet.
4. Cut the retaining straps and remove the stand (if purchased). This will require at least two persons.
5. Remove the shrink wrap from the outside of the main carton and dispose of carefully.
6. If you have not yet done so, remove the retaining straps. Then remove the top of the packing carton.

7. Remove the cardboard outer from the unit by sliding it up and over the unit.
8. Remove the shrink wrap from around the polystyrene panels and dispose of carefully.

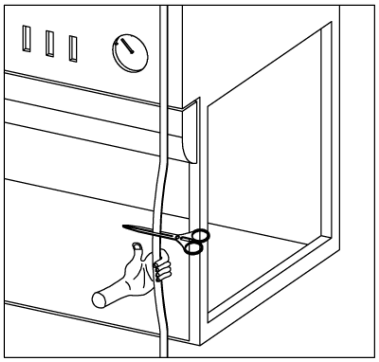


**Figure 2.1. Removing the strapping**

9. Remove all of the polystyrene, cardboard and Styrofoam packing materials and place with the outer carton.
10. Cut the inner shipping straps and remove the large protective plastic bag.
11. There is a protector on the top of the unit (cardboard sheet), remove this before activating the unit.
12. Take out the carton containing the manuals, toolkit and retrofit kits and place safely to one side.
13. Remove the two retaining screws on the side of the front panel. Use caution when raising the front panel to avoid personal injury or damage to the cabinet.

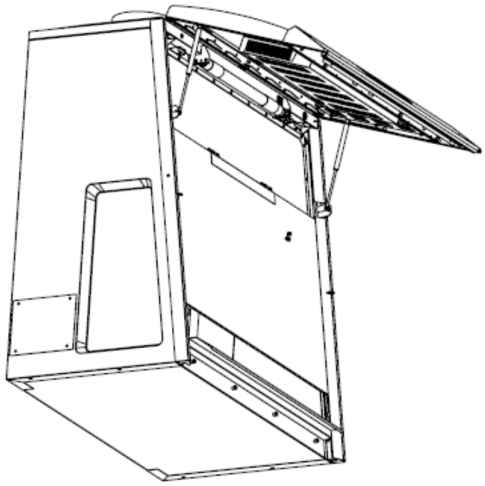


**Figure 2.2. Opening the front panel**

14. Open up the housing and remove all of the packing materials inside the panel (remember to replace the locking screws when you close the panel).
15. Remove any available sash supports and work area shipping supports.
16. Remove the protective plastic coating on the stainless steel work trays and armrest.
17. The cabinet may be fastened to the skids on the shipping pallet with two braces – one on each side. If so, unbolt the cabinet from the skids and remove the braces.
18. At this point you should assemble the stand as per the instructions provided.
19. Using a mechanical lifting truck, the cabinet should be positioned over the stand, the stand offered up to the cabinet and the bolts fastened. After the stand is fastened to the cabinet, lower the assembly to the ground slowly.
20. Check that all bolts have been fastened adequately and then move the cabinet to its final position. The side panel should not be used to liftthe cabinet as it is not a structural component. Please lift by means of the back edge or remove the side panels to liftby means of the side edges. (For information on removing the side panels, please refer to the next chapter).

21. Fasteners securing the armrest – locatedat the lower side of the frame around the sash window – must betightly fastened.

## 2.3. Installation

### 2.3.1. Connecting the Electrical Supply

- Please 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 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 the Service Fixture(s)

- If you have purchased service fixtures for your cabinet these will either have been factory installed or provided in a package located inside the work tray when you unpacked the cabinet.
- If the fixtures have been provided for site installation there will be full instructions provided with them. Please refer to the instructions provided to install your retrofit kits.
- Connecting the cabinet to service lines must be performed by qualified personnel, in accordance with all applicable local, state and government regulations.
- Where applicable, each connection should be tested and certified by qualified personnel.
- Connections to service lines may be subject to the provision of safety device. There should always be an appropriate emergency shut off valve installed within easy reach of the cabinet operator.

### 2.3.3. 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.

### 2.3.4. Check Sash Mechanism

Please refer to section4.1.1to make sure that the sash mechanism operates properly.

### 2.3.5. 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.

### 2.3.6. 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 a qualified personnel who is familiar with the methods and procedures for certifying Biological Safety Cabinets.

The testing methods and equipments 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://www.us.escoglobal.com)
- IAFCA-member certifying company (http://www.iafca.com/listview)

**UK, China, India, Middle East/North Africa, Malaysia, Philippines, Singapore**

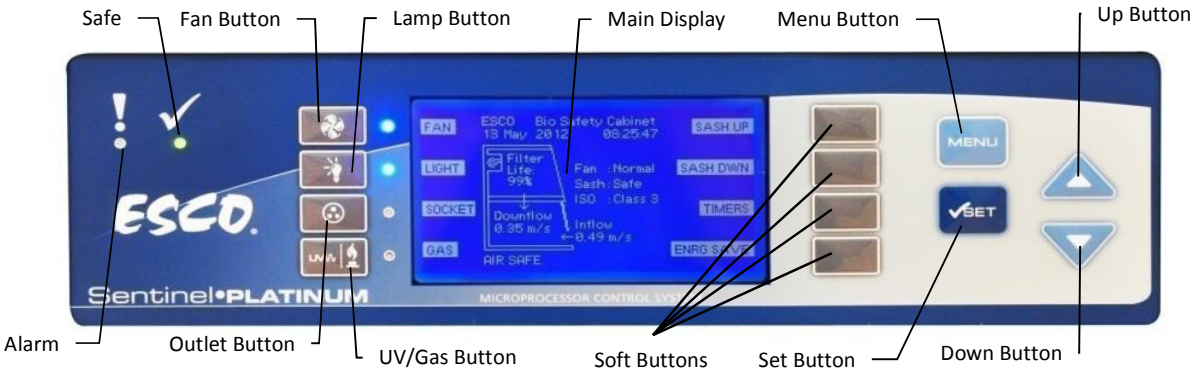
- Esco offers field certification services directly. Contact local Esco office.

**Other Countries**

Contact Esco or local distributor.

# Chapter 3 - Sentinel Control System

## 3.1. Sentinel Control System




1. Fan Button
   - Turns on/off the fan. If the sash is at safe position, there is also an option to set the fan to half speed.
2. Lamp Button
   - Turns on/off the fluorescent lamps.
3. Socket Button
   - Turns on/off the electrical socket (retrofit kit).
   - The maximum rating of all outlets in the cabinet combined is 10 A. If the outlets are overloaded, the fuse will blow.
4. UV/Gas Button
   - Turns on/off the UV lamp when the sash window is fully closed. Since the sash is capable of filtering UV rays, users are protected from the harmful UV radiation. Avoid UV exposure to eyes and skin. Ensure the sash is fully closed before UV lamp is switched ON.
   - Turnson/off Solenoid Valve when the cabinet is in safe operating condition.
5. Up (▲) and Down (▼) Arrow Button
   - Move the menu options upwards and downwards.
   - Increase and decrease corresponding value inside one of the menu options.
   - Accessingthe experiment timer function.
6. Set Button
   - Proceed to the next step or sequence inside one of the menu options.
7. Menu Button

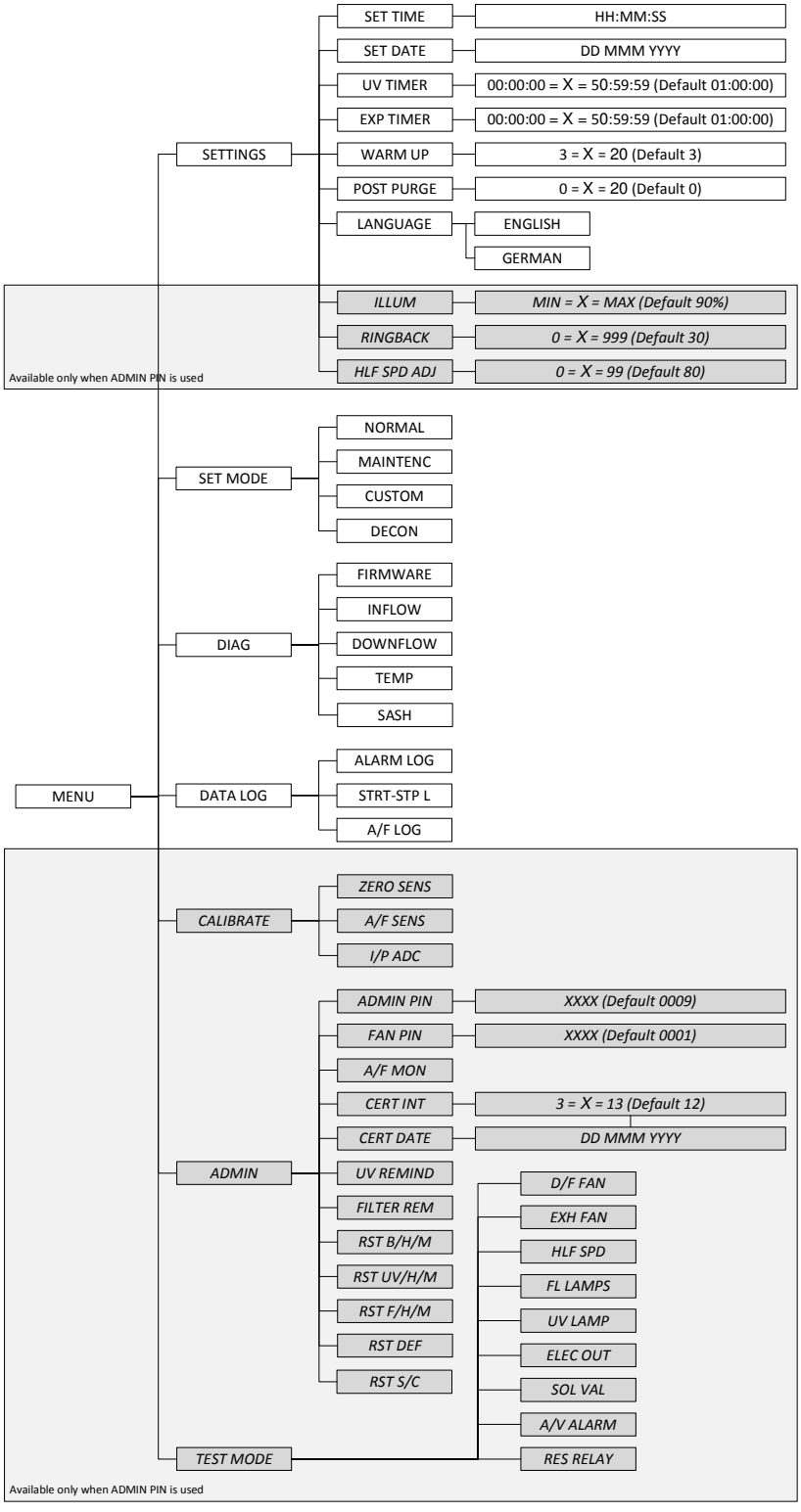
> *When you are entering menu options, the alarm will sound to indicate that the microprocessor is not monitoring the operation of the cabinet. No further warnings will be given.*

   - To enter and exit from the menu options.
   - Soft Button functions are displayed in the main display.

⚠ Before operating the cabinet, please ensure that you have set the ADMIN PIN (0009 by default) and FAN PIN (0001 by default). The ADMIN PIN has higher priority and can be used to control the fan (override the FAN PIN) too. Please contact Esco should you forget your ADMIN PIN.

## 3.2. Menu Options

Please 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 both FAN PIN and ADMIN PIN.

#### 3.2.1.1. Set Time

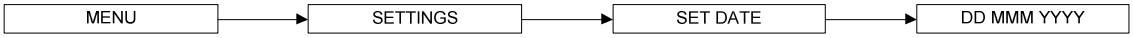
Users can set the time by increasing/decreasing the hour, minute and second values. The correct time will be maintained even after the unit is turned off.


To set time:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm each digit entered.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SET TIME.
6. Use UP / DOWN button to choose the hour (HH). Press SET button to confirm. Repeat the step for the minute and second.

#### 3.2.1.2. Set Date

Users can set the time by increasing/decreasing the date, month and year values. The correct date will be maintained even after the unit is turned off.




To set date:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SET DATE.
6. Use UP / DOWN button to choose the date (DD). Press SET button to confirm. Repeat the step for the month and year.

#### 3.2.1.3. UV Timer

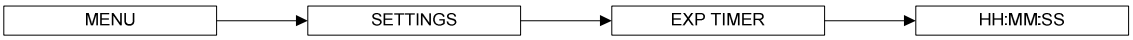
UV timer can be used to switch off the UV lamp automatically after a fixed period. The UV timer can be set up to 50:59:59. By default, the timer is set to 60 minutes, which is considered the most effective UV decontamination time. Without the UV timer, the lamp has to be switched off manually.


To set UV timer:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose UV TIMER.
6. Use UP / DOWN button to choose the hour (HH). Press SET button to confirm. Repeat the step for the minute and second.

#### 3.2.1.4. Experiment Timer

Experiment timer is a countdown timer that can be used for critical experiment. Experiment timer can be set between “00:00:00” and “50:59:59”. By default, the timer is set to 60 minutes.




To set experiment timer:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose EXP TIMER.
6. Use UP / DOWN button to choose the hour (HH). Press SET button to confirm. Repeat the step for the minute and second.

#### 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 20 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).


To set warm up time:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose WARM UP.
6. Use UP / DOWN button to choose the length of warm up time. Press SET button to confirm.

#### 3.2.1.6. Post-Purge Time

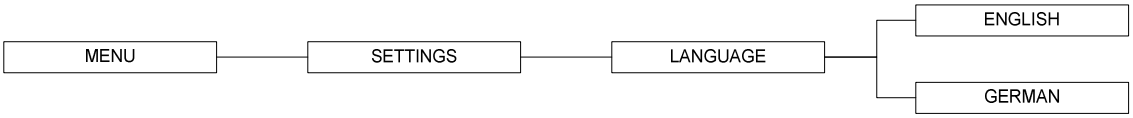
After the user switches off the BSC blower, there will be a post-purge period, to ensure that all contaminants are purged from the work zone. The default setting is zero minute (disabled) and user can set from 0 up to 20 minutes. It is recommended that BSC is purged for a minimum of 3 minutes after the 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).


To set post-purge time:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose POST PURGE.
6. Use UP / DOWN button to choose the length of post-purge time. Press SET button to confirm.

#### 3.2.1.7. Language

This option is used to change the language settings. There are two languages available on the system: English and German.




To set the language:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN/FAN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose LANGUAGE.
6. Use soft buttons to choose the ENGLISH/GERMAN.

#### 3.2.1.8. Illuminance

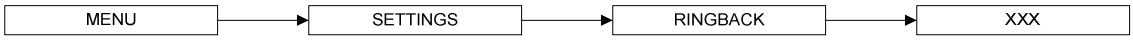
Illuminancefunction controls the brightness of the lamp in the BSC.


To set illumination:

1. Press MENU button to enter the menu display – if the BSC is secured by PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ILLUM.
6. Use UP / DOWN button to choose the illumination level. Press SET button to confirm.

#### 3.2.1.9. Alarm Ringback Time

For user's convenience, it is possible to mute the alarm in custom mode. When muted, the visual alarm will still be activated, but the buzzer will not sound. The audible alarm / buzzer will be re-activated after the set ringback time expires. The default setting is 30 seconds and user can set it between 0 to 999seconds.

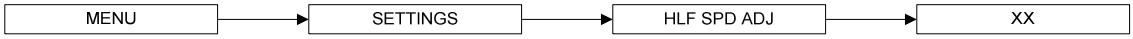



To set alarm ringback time:

1. Press MENU button to enter the menu display – if the BSC is secured by PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose RINGBACK.
6. Use UP / DOWN button to choose the ringback time duration. Press SET button to confirm.

#### 3.2.1.10. Half-Speed Adjustment

There is an option to set the blower to reduced speed operation to save energy when the cabinet is not being used but the user still desire to operate the cabinet. By default, the blower voltage (duty cycle) will be set to 80% from nominal.It can be adjusted between 0 to 99%.




To adjust the half-speed setting:

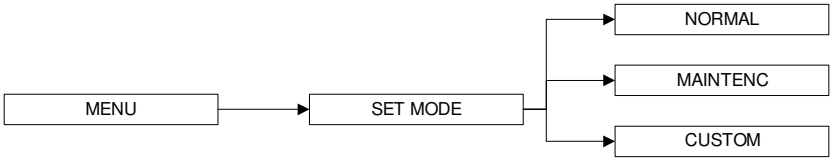
1. Press MENU button to enter the menu display – if the BSC is secured by PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SETTINGS.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose HLF SPD ADJ.
6. Use UP / DOWN button to adjust the half-speed setting. Press SET button to confirm.

### 3.2.2. Setting Mode

EC2 BSC has four working modes:

- Normal mode: used in the normal operation.

- Custom mode: used when alarm mute option is desired.
- Maintenance mode: used only by service engineer during BSC maintenance.




To set mode:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN and ADMIN PIN, then it will ask for the appropriate PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose SET MODE.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose between NORMAL, MAINTENANCE, CUSTOM,and DECON.

### 3.2.3. Diagnostic Readout

The diagnostic readout allows the user to know the condition of the BSC or help the service engineer during maintenance and troubleshooting.

| Category | On Screen | Explanation |
|---|---|---|
| FIRMWARE | UIB | Version number of the firmware in User Interface Board |
| | MCB | Version number of the firmware in Main Controller Board |
| INFLOW | ADC IF | ADC value of actual inflow |
| | ADC IF0 | ADC value of no inflow (blower off) |
| | ADC IFN | ADC value of nominal inflow |
| | VEL IFN | Velocity of nominal inflow |
| | BLOWER SPEED | Nominal Blower Speed |
| DOWNFLOW | ADC DF | ADC value of actual downflow |
| | ADC DF0 | ADC value of no downflow (blower off) |
| | ADC DFN | ADC value of nominal downflow |
| | VEL DFN | Velocity of nominal downflow |
| | BLOWER SPEED | Nominal Blower Speed |
| TEMP | ADC TEMPERATURE | ADC value of actual temperature |
| | TEMPERATURE | Actual temperature |
| SASH | SASH CYCLE | Actual sash cycle value |
| | MAXIMUM CYCLE | Maximum sash cycle allowed |

To check the diagnostic readout:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN and ADMIN PIN, then it will ask for the appropriate PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose DIAG.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose between FIRMWARE, INFLOW, DOWNFLOW,TEMP, and SASH.

### 3.2.4. Data Logging

EC2 BSCcomes with a data logging facility. The recoded data are alarms, BSC start and stop time, and airflow velocities. The data can only be displayed on screen.

### 3.2.5. Calibration

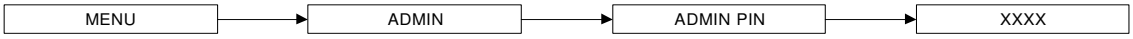

BSC needs to be calibrated / certified regularly (at least annually) to ensure the containment performance of the BSC. BSC calibration includes measuring airflow with reference instrumentation and establishing reference between airflow sensor(s) on the BSC to the standard reference. Calibration should only be carried out by qualified personnel. For more information, refer to factory test report and certification procedure.

### 3.2.6. Admin

The admin menu allows the user to change critical settings that should only be accessible to laboratory administrator.

#### 3.2.6.1. New ADMIN PIN (default 0009)

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




To Set New ADMIN PIN:

1. Press MENU button to enter the menu display – if the BSC is secured by anADMIN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN PIN.
6. Use UP / DOWN buttons to choose the first digit. Press SET button to confirm. Repeat the step for the rest 3 digits of the PIN.

#### 3.2.6.2. New FAN PIN (default 0001)

FAN PIN restricts access to fan control and some sections of the menu. 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.

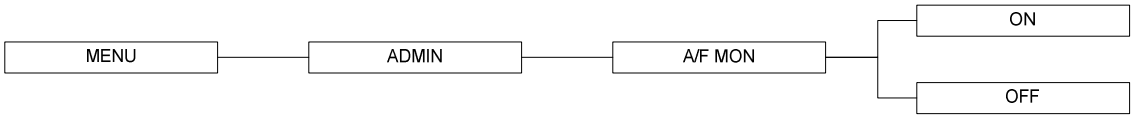
Setting the PIN to 0000 will disable this feature. When the FAN PIN is disabled, the BSC can be turned on and off without requiring PIN. However to access the menu, the user is still required to enter the FAN PIN (0000).


To Set New FAN PIN:

1. Press MENU button to enter the menu display – if the BSC is secured by anADMIN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose FAN PIN.
6. Use UP / DOWN buttons to choose the first digit. Press SET button to confirm. Repeat the step for the rest 3 digits of the PIN.

#### 3.2.6.3. Airflow Monitoring

Whenever the air velocity goes outside of the safe range, air fail alarm will be triggered. The airflow monitoring option is used to enable/disable this alarm. The alarm is enabled by default.




To Set Airflow monitor(ON/OFF):

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose A/F MON.
6. Use soft buttons to choose the ON/OFF. Press SET button to confirm.

#### 3.2.6.4. Certification Interval

The user can set the certification interval using this option. After each interval period, a reminder will be shown on the display to inform the user that calibration needs to be done.


To Set Certification Interval:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose CERT INT.
6. Use UP / DOWN buttons to choose how long period of the certification. Press SET button to confirm.

#### 3.2.6.5. Certification Date

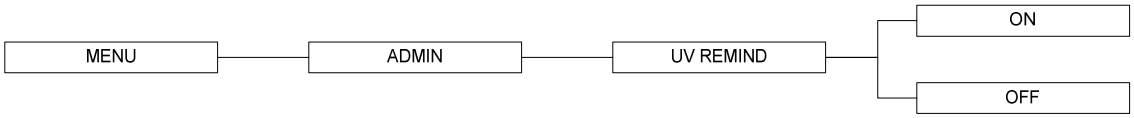
Using this option, the user can store information when the last certification date was.


To Set Certification Date:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose CERT DATE.
6. Use UP / DOWN buttons to choose the date of the last certification date. Press SET button to confirm.

#### 3.2.6.6. UV Life Reminder

This option allows the user to show or hide the UV life information on the display.



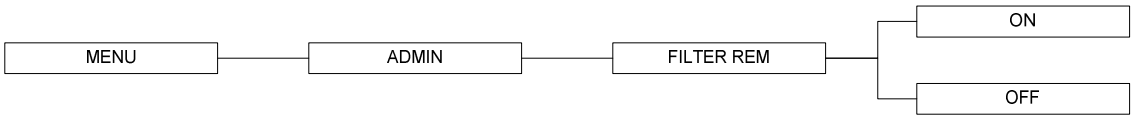

To Set UV life reminder(ON/OFF):

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then PIN will be asked, otherwise go to step 3.

2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose UV REMIND.
6. Use soft buttons to choose the ON/OFF. Press SET button to confirm.

#### 3.2.6.7. Filter Life Reminder

This option allows the user to show or hide the filter life information on the display.

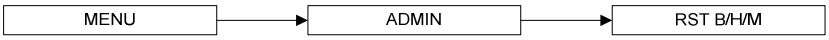



To Set Filter life reminder(ON/OFF):

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose FILTER REM.
6. Use soft buttons to choose the ON/OFF. Press SET button to confirm.

#### 3.2.6.8. Reset Blower-Hour-Meter

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

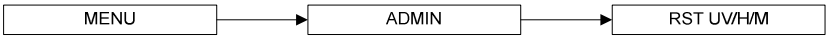



To reset blower-hour-meter:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose RST B/H/M.
6. Use SET button to reset the blower-hour-meter.

#### 3.2.6.9. Reset UV-Hour-Meter

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. Maximum counter is set at 2,000 hours (100%). Please reset the UV lamp hour meter after each UV lamp replacement.

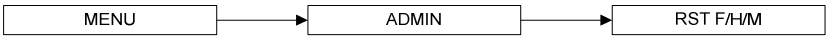



To reset UV-hour-meter:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose RST UV/H/M.
6. Use SET button to reset the UV-hour-meter.

### 3.2.6.10. Reset Filter-Hour-Meter

This option is used to reset the filter hour meter. The filter hour meter indicates how long the filter has been in operation. The value is determined by blower voltage (duty cycle). This would allow the system to monitor the true life of the filter and only indicate replacement need when airflow nominal setting requirement is no longer achievable due to the heavy loading of the filter. Maximum counter is set at 100%. The counter value can be seen in main screen. Please reset the filter hour meter after each filter replacement.



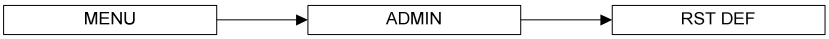

To reset filter-hour-meter:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose RST F/H/M.
6. Use SET button to reset the filter-hour-meter.

### 3.2.6.11. Reset Settings to Default

User can reset the settings of BSC by choosing this option. The features being reset are warm-up period (3 minutes), UV timer (60 minutes), certification interval (12 months), ringback time (30 seconds), Experiment timer (60 minutes), Illuminance (90%) and half-speed ratio (80%).

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.

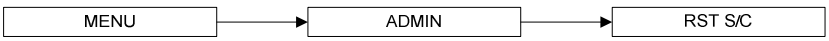



To reset settings to default values:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose RST DEF.
6. Use SET button to reset the settings.

### 3.2.6.12. Reset Sash Window Life Cycle

This option is used to reset the sash window life cycle. The sash window life cycle indicates how long the sash motor has been in operation. Maximum counter is set at 16,000 cycles based on the expected operational life of the motor. The counter value can be seen in the diagnostic – sash cycle screen. It is recommended that the sash motor is replaced when it has operated for15,000 cycles.




To reset filter-hour-meter:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then PIN will be asked, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN button to choose between screens. Use the soft buttons to choose ADMIN.
5. Use UP / DOWN button to choose between screens. Use the soft buttons to choose RST S/C.
6. Use SET button to reset the sash windows life cycle.

## 3.3. Experiment Timer

The experiment timer can be started by pressing the DOWN button while the sash is in the safe/ready position and air condition is safe. Pressing DOWN button while the experiment timer function is working will stop and resume the timer. Pressing the UP button will leave the experiment timer function and reset the timer. The timer in the experiment timer function is counting down and shown using the HH:MM:SS format. Operator can use the SETTINGS | EXP TIMER menu (refer to section3.2.1.4) to set the experiment timer.

## 3.4. Alarms and Warnings

Audio and visual alarms are activated when the condition inside the BSC is not safe for the operator. User should check the LCD display to understand the cause of these alarms. The most common alarm is the SASH ALARM that indicates that the sash is neither at the normal operating height nor at fully closed position (UV mode).This condition can easily be corrected by putting the sash at the designated sash height.

Another important warning that should be quickly responded to is AIRFLOW ALARM which indicates that there is airflow failure. The operator should check if there is any obstruction to the airflow, and correct it if possible. Should the alarm persists, the operator should stop working as the containment provided by the BSC may have been compromised. Call service or Esco's local distributor for guidance and support.

# Chapter 4 - Basic Cabinet Operation

## 4.1. Sash Window Operation

### 4.1.1. Sash Window State

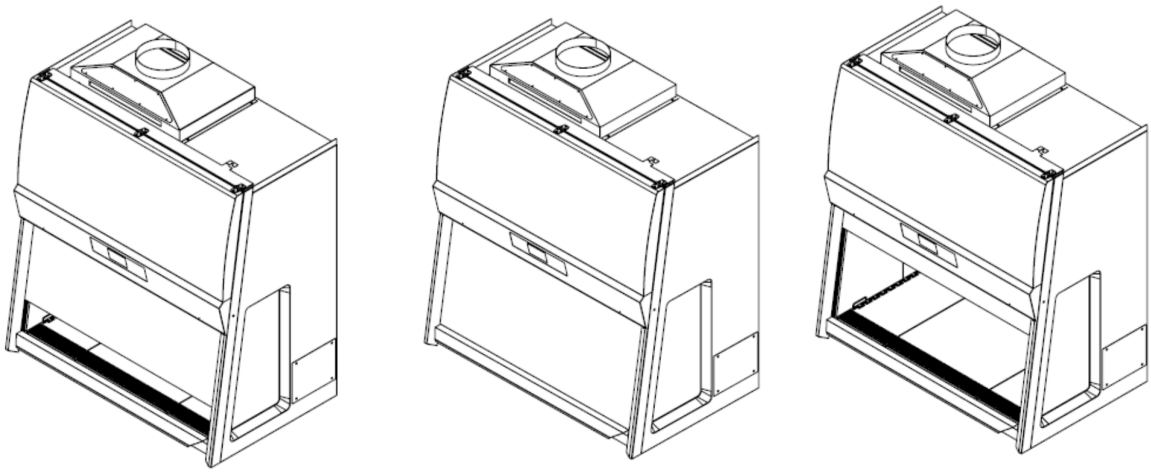


**Figure 4.1. Sash window positions.**

**Sash is fully open**

- ✓ Blower can be activated
- ✓ Fluorescent lights can be used
- × Unsafe working condition

**Sash is in safe position**

- ✓ Blower can be activated
- ✓ Fluorescent lights can be used
- ✓ Safe working condition

**Sash is fully closed**

- × Blower can't be activated
- × Fluorescent lights can't be used

### 4.1.2. Operating Motorized Sash Window

**Lower Sash from Fully Open Position (Push & Hold)**

When the sash is fully open, pressing the down button and holding it will cause the sash to descend to the Safe Height setting and stop. If the fluorescent lights are switched on as the sash moves away from the fully open position, they will switch off automatically. If you release the button before the sash has reached Safe Position / Safe Height the lights will not be switched off. The fluorescent lights switch on automatically when the sash reaches Safe Position.

**Lower Sash from Safe Height Position (Push & Hold)**

When the sash is at safe operating height, pressing the down button and holding it will cause the sash to descend to the fully closed position and stop. If the fluorescent lights are switched on as the sash descends, they will switch off automatically as the sash leavesSafe Position. If you release the button before the sash has reached the fully closed position the lights will remain not operational.

**Raise Sash from Fully Closed Position (One Touch)**

When the sash is fully closed, pressing the up button will prompt the user to input the PIN(FAN or ADMIN PIN) to turn on the fan. If thePIN is correct, fan will turn on and the sash will ascends to the Safe Height setting and stop.

**Raise Sash from Safe Height Position (One Touch)**

When the sash is safe operation position, pressing the up button will cause the sash to ascend to the fully open position and stop. If the fluorescent lights are switched on, they switch off automatically as the sash leaves Safe Position. If the sash is stopped midway, the lights will remain not operational. The fluorescent lights switch on when the sash reaches the fully open position.

### 4.1.3. Using Sash Window

- The sash window should be fully closed when the cabinet is not in use. This helps keep the work zone interior clean.
- The sash window should always be in the normal operating height at all times when the cabinet is in use. Even if the cabinet is left unattended, but the blower is on, the sash window should never be moved from the normal operating height, unless during loading or unloading of materials/apparatus into the cabinet.
- The alarm will be activated whenever the sash window is moved from the normal operating height.
- Whenever the sash window is moved to the correct height from a higher or lower position, the light will automatically be turned on as a signal to the user.
- The sash window may be opened to its maximum position for the purpose of loading/unloading of materials/apparatus into the cabinet. When the sash window is fully opened, the lightscan be turned on to facilitate cleaning.
- The fan should be turned off when the sash window at fully closed position, to turned off the fan system will required the user input the password, if the password not correct and after 2-3 minutes then the sash window will be bring to the safe position to prevent the glass smashed because of the high pressure.

## 4.2. Starting and Shutting Down the BSC

When the cabinet is turned on, the BSC will enter the warm-up period. In this period, the alarm will sound indicating that the BSC is not safe to use. However, the alarm can be muted by pressing the indicated soft button.

Should there be a power failure when the fan is operational, audible alarm will activate as awarning that the containment is lost unexpectedly.The alarm will sound until the capacitor is drained (for about 2 minutes). This event will also be logged such that when power is restored and the unit is operational, alarm will sound to indicate there has been a potential loss of containment due to immediate past power failure.

## 4.3. Working in the BSC

- Allow the BSC to purge any contaminant by allowing the blower to operate for at least 3 minutes before and after using the BSC (see Section 3.2.1.5 and 3.2.1.6 of this manual for more information).
- Wear appropriate personal protective equipment (PPE) determined by your risk assessment prior to working in BSC.
- Adjust stool height to achieve a comfortable working position.
- Perform surface decontamination on the work area (work surface, back and side walls, UV lamp, electrical outlets, service fixtures and the inner surface of the sash window) before and after using the BSC. When diffuser needs to be cleaned, damp cloth (not too wet) should be used to wipe and user has to be careful not to cause the filter to be wetted. Where bleach is used, a second wiping with sterile water should be carried out to remove any residual chlorine that may corrode stainless steel surfaces.
- Perform surface decontamination on the surfaces of any materials, containers or apparatus with appropriate disinfectant before entering or exiting the work area.
- Place the waste container (biohazard bag, pipette discard pans, etc.) inside the BSC work area.
- Place all items and apparatus in the safe working area.

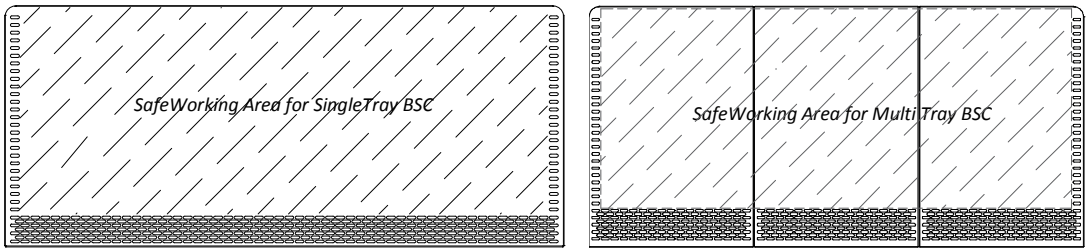



**Figure 4.2. Safe working area.**

- Minimize room activities (personnel movements, closing and opening of doors, etc.) since these external airflow disturbances may adversely affect the BSC's internal airflow, thereby possibly impairing the containment capabilities of the BSC.
- Ensure that the sash is at normal operating height (READY state) before starting any experiment.
- When the sash is fully closed, the blower should be turned off to prevent overheating. FAN PIN or ADMIN PIN would be needed for this. This is a safety feature to prevent unauthorized personnel from shutting down the cabinet.
- Ensure the front and back air grilles are not obstructed by your arms or any other objects.
- Work as far back in the BSC as possible - at least 150 mm (6 inches) behind the front air intake grille.
- Wait for around one minute after placing the hands into the cabinet prior to any manipulation.
- While working in the BSC, move your hands slowly and in a controlled manner. Rapid movements may disrupt the air barrier, allowing contaminants to escape or enter the BSC.
- The use of bunsen burner inside the work zone is not recommended. However if the use of bunsen burner is unavoidable, burner that is capable of being used on demand or enclosed electric microincinerator may be used but they must be placed towards the back of the work surface in the BSC.

  ⚠ Use of Bunsen burners within Esco biosafety cabinets is entirely at your own risk and Esco accepts no responsibility or liability for their use. Bunsen burner flames can disrupt the laminar airflow and will contribute to heat built up within the cabinet. However, if the use of a Bunsen burner is approved by a safety officer, it should be operated on the right side of the work zone. In Esco cabinets, the airflow sensor, when installed in the work zone, is mounted on the left side. Therefore operating the burner on the right side would not affect the cabinet airflow monitoring system. All gas installations must be carried out in accordance with current national, state and local safety regulations by qualified personnel.
- Place aerosol-generating instruments as far back in 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.
- It is recommended that post purge time is set to clear the work zone of contaminants after work in the BSC is completed. Air balance is an important consideration when determining the operation mode of the BSC since the air discharged through ducted BSC must be considered in the overall air balance of the laboratory.

## 4.4. Working Ergonomics

On most occasions, you would most likely be operating the BSC in sitting rather than standing posture. There are some obvious advantages of the sitting posture:

- The physiological energy cost and fatigue involved in sitting are relatively less.
- Sitting posture provides the body with a stable support.

However, sitting position has some drawbacks too:

- The working area available is fairly limited.
- There is a potential risk of being constrained in the same posture for a long time.

- Sitting posture is one of the most stressful postures for one's back.

Therefore you should pay careful attention to the following guidelines in order to achieve comfortable and healthy working conditions:

- Always ensure that your legs have enough legroom.
- Keep your lower back comfortably supported by your chair. Adjust the chair or use a pillow behind your back whenever necessary.
- You should place your feet flat on the floor or on a footrest. Don't dangle your feet and compress your thighs.
- You should keep varying your sitting position throughout the day at regular intervals so that you are never in the same posture for too long.
- Observe the following precautions with respect to your eyes:
    - Give your eyes frequent breaks. Periodically look away from the work area and focus at a distant point.
    - Keep your glasses clean.
- Arrange the items/apparatus frequently used in your work in such a way that you can minimize the physical strain involved in handling them.
- Exercise regularly.

The BSC's noise emission has been tested and found to be in compliance with EN 12469, ISO 4871 and NSF/ANSI 49 which is important to ensure health and comfort for the operator.

Ergonomics accessories available with Esco include:

- Armrest padding.
- Lab chair.
- Footrest.

Please contact your local distributor or Esco for more information.

## 4.5. UV Lamps (If Present)

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 type of decontamination agent, UV light doesn't 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 minimum 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 vapours).
- 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. Check the UV interlock regularly for correct operation.
- 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 BSC 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.
- Please note that the use of UV lamp in BSC has been explicitly discouraged in all major international standards and recommendations.

## 4.6. 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 Hydrochloric Acid
    - 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.
- Suggested general interior cleaning and disinfection procedures (does not apply to spills) are:
    - Spray cleaning cloth / tissue with 70% ethanol. This will reduce the aerosols generated from the area to be cleaned.
    - Wipe the interior to be cleaned with a slow circular motion from outer to inner (e.g. less contaminated area to more contaminated area).
    - *Note: This is just a simplified cleaning and disinfection procedure. Choice of cleaning of disinfection procedures should be made through risk assessment. All facilities need to have adequate spill clean up procedures.*
- There is no one disinfectant agent that works with all organisms. Therefore, user and the safety professionals should carry out risk assessment to ensure that appropriate disinfectant agent and validated decontamination procedures are used in decontaminating the BSC.

## 4.7. 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.

## 4.8. Further Information

- A Guide to Biosafety and Biological Safety Cabinets can be downloaded from http://escoglobal.com/resource.php?id=13
- An educational video on “Working Safely in your Biological Safety Cabinet” is available for viewing athttp://www.youtube.com/watch?v=ZnUW1N-JJz8

# Chapter 5 - Service and 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 retain the attractive factory finish.
- Ensure that the chemicals used are compatible to 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**

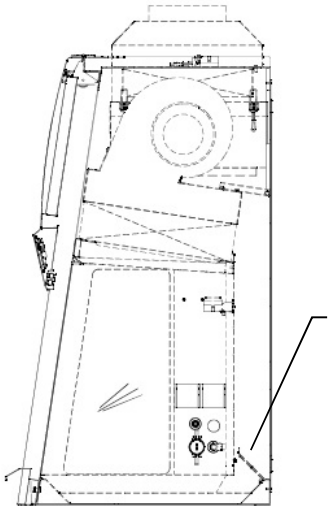
All BSC must be re-certified annually by qualified engineer. See certification procedures attached to the factory test report.

**Accessing the paper catch**

The purpose of accessing the paper catch is to remove any retained materials that might cause obstructions to airflow. Care must be taken as the area is contaminated.

Before opening the paper catch:

- Carry out risk assessment along with the safety professionals in your facility.
- Use appropriate personal protective equipment (PPE) as determined by your risk assessment.
- Wipe down the interior of the BSC including the top and bottom surfaces of the work tray(s) while airflow is operating.
- If the interior cannot be wiped down, the BSC should be decontaminated.




Accessing the paper catch

1. Turn off the blower then raise the sash to fully open position for easy access.
2. Remove the tray(s) to access the paper catch.
3. The figure next to this box points to the location of the paper catch (latched to the bottom section of back plenum). Locate and remove any material trapped. Be careful of any sharp objects that might be present. You might want to use a mirror to help you assess the presence of hazardous materials prior to accessing the paper catch.

**Figure 5.1. Accessing the paper catch.**

## 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.

## 5.3. Service Risk Considerations

There are risks that may affect the service personnel when servicing the bio safety cabinets. There for it is important that your service personnel are properly trained. Here are the list and the protective measures.

| No | Risk | Service Events | Protective Measures |
|---|---|---|---|
| 1. | Mild injuries, scratches, bruises | Mechanical parts replacement, relocate the cabinet position | Use proper personal protective equipment (PPE) when servicing |
| 2. | Electrical shock | Replacement of electrical parts | Use proper PPE when servicing. Detach the power supply cord before replacing any electrical parts. |
| | | Electrical trouble shooting | Use proper PPE when servicing. Follow closely the electrical trouble shooting guide explained on chapter 8. |
| 3. | Eye irritation or blindness | UV lamp replacement. | Use proper PPE when servicing. Always detach power supply cord before replacing the UV lamp. |
| 4 | Chemical hazard | Decontamination | Use proper PPE. Follow closely the decontamination procedure on section 7.9 |

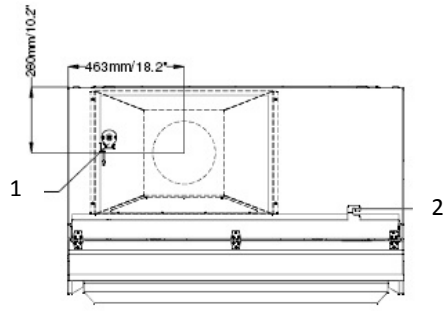
## 5.4. Safety Verification after Service

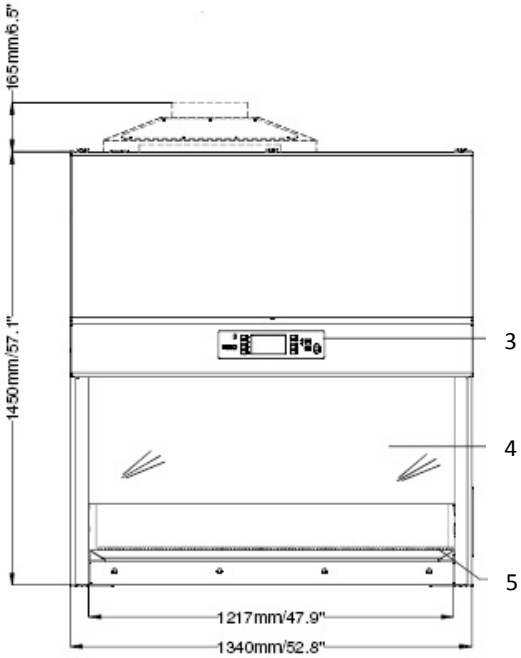
The below instructions are recommended and worth to be done each time finishing a service issue.

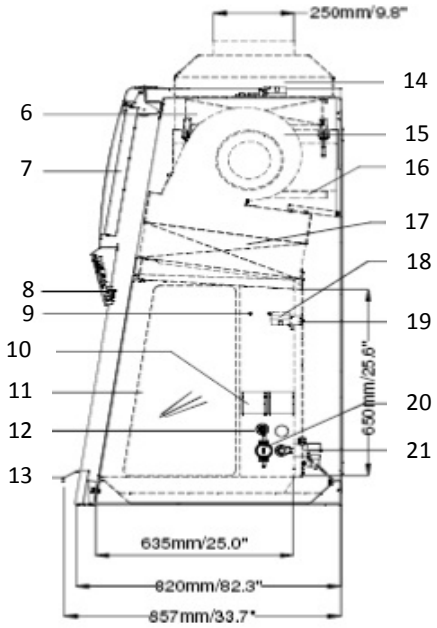
1. Do re-certification each time after new installation, replacing blower, replacing filter, replacing air flow sensor, replacing control board, or relocating this cabinet. Refer to chapter 7.
2. Conduct electrical safety test each time after replacing critical electrical components such as electronic control boards, blowers and SMPS.

# Chapter 6 - Engineering Details

## 6.1. Engineering Drawing




1. Exhaust Sensor& Mounting Bracket
2. Power Inlet
3. ECS G2 Microprocessor System
4. Sash Window
5. Multi Piece Work Tray
6. Exhaust ULPA Filter
7. Electrical/Electronic Panel
8. Fluorescent Lamp
9. IV Bar Retrofit Provision
10. Electrical Outlet Retrofit Kit Provision
11. Side Glass
12. Service Fixture Retrofit Kit Provision
13. Armrest
14. Exhaust Collar (Optional)
15. Downflow Blower
16. Exhaust Blower
17. Downflow ULPA Filter
18. Downflow Sensor
19. UV Lamp Provision
20. Optional Solenoid Valve
21. Steris VHP/Bioquell HPV Port

## 6.2. Technical Specification

| | | EC2-4L8<br>EC2-4S8 | EC2-5L8<br>EC2-5S8 | EC2-6L8<br>EC2-6S8 |
|---|---|---|---|---|
| **Nominal Size** | | 1.2 meters (4') | 1.5 meters (5') | 1.8 meters (6') |
| **External Dimensions (W x D x H)** | | 1340 x 820 x 1450 mm<br>52.8" x 32.3" x 57.1" | 1645 x 820 x 1450 mm<br>64.8" x 32.3" x 57.1" | 1950 x 820 x 1450 mm<br>76.8" x 32.3" x 57.1" |
| **Internal Work Area, Dimensions (W x D x H)** | | 1219 x 636 x 670 mm<br>48.0" x 25.0" x 26.4" | 1524 x 636 x 670 mm<br>60.0" x 25.0" x 26.4" | 1829 x 636 x 670 mm<br>72.0" x 25.0" x 26.4" |
| **Internal Work Area, Space** | | 0.63m² (6.8 sq.ft) | 0.78 m² (8.4sq.ft) | 0.95 m² (10.2sq.ft) |
| **Average Airflow Velocity** | **Inflow** | 0.50 m/s (99 fpm) at initial setpoint | | |
| | **Downflow** | 0.35 m/s (69 fpm) at initial setpoint | | |
| **ULPA Filter Typical Efficiency** | **Downflow** | >99.999% at 0.1 to 0.3 microns and MPPS as per IEST-RP-CC001.5 USA<br>with H14 rating per EN 1822, Europe | | |
| | **Exhaust** | | | |
| **Typical Sound Emission per EN 12469*** | | < 55 dBA | < 56 dBA | < 57 dBA |
| **Fluorescent Light Intensity At Zero Ambient** | | > 1,500 lux (> 139 foot-candle) | | |
| **Cabinet Construction** | **Main Body** | 1.5 mm (0.06") 16 gauge electrogalvanized steel with white oven-baked epoxy-polyester Isocide antimicrobial powder coated finish | | |
| | **Work Tray** | 1.5 mm (0.06") 16 gauge stainless steel, type 304, with BA finish | | |
| | **Back Wall** | 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 220-240 VAC, 50/60 Hz, 1Φ** | **Nominal Power** | 160 W | 270 W | 370 W |
| | **Maximum Current** | 10 A | 10 A | 10 A |
| | **Maximum total current of all outlets** | 5 A | 5 A | 5 A |
| | **BTU** | 546 BTU | 918 BTU | 1,258 BTU |
| **Weight** | | Max 296 kg | | |

** Noise reading in open field condition / anechoic chamber*

# Chapter 7 - Maintenance and Re-certification of the Cabinet

Esco products generally provide years of trouble-free operation however like all equipment they require maintenance and service. Maintenance and service should be carried out by trained personnel. Esco offers training courses to equip service providers with the latest skills, information and tools to successfully maintain and service Esco products. For more information on the nearest training course, please contact Esco.

Service providers should familiarize themselves with the basic operating principles of products before working on them. Suitable references include information in this Manual or brochures which may be downloaded from the Esco web site.

Biological safety cabinets generally require:

- Re-certification, when:
  - The cabinet is re-located.
  - Cabinet performance is suspect.
  - After filter or blower replacement.
  - At least once a year or based on your risk assessment.
  - During recertification:
    - Cabinet airflow velocities and flow patterns are verified against the manufacturer's specifications and relevant international standards
    - Filters are scan-tested to ensure they do not leak.
    - Operator comfort tests may be performed.
    - If airflow velocities are found to be off setpoint, adjustments are made as part of the certification process before final values are recorded.
- Airflow alarm calibration, when:
  - The cause of the airflow alarm cannot be determined.
  - Re-certification indicates the displayed airflow deviates by > 0.02 m/s (4 fpm) from actual measured velocities (only for products with airflow velocity displays).
- Decontamination before filter or fan replacement, or as specified.
- Filter replacement, when:
  - The filters are clogged and the fan(s) are unable to compensate for the filter loading.
  - Filter leaks which cannot be repaired are found during scan-testing.
    Note: Before filter replacement, the cabinet must be decontaminated.
- Fan replacement (typically rare) if failure occurs.
- Routine maintenance also includes:
  - Fluorescent lamp(s) replacement - typically once every 2 years.
  - UV lamp replacement - typically once every 1 year.

## 7.1. Installation Check

1. Check that the cabinet was installed away from air conditioning unit, heater, door, ceilinglamp, or any other equipment that affect cabinet airflow to ensure the sensor reading on top of cabinet is undisturbed.
2. Make sure the holes on the exhaust airflow sensor are not blocked, and the holes on the exhaust and downflow airflow sensors are perpendicular to the airflow path. If the airflow sensor is moved, then the microprocessor requires re-calibration.
3. Make sure the holes on the exhaust and downflow airflow sensors tube are perpendicular to the airflow path. If the airflow sensor tube is moved, then the microprocessor requires re-calibration.
4. Make sure that the exhaust filter is not blocked, and the downflow diffuser is properly installed.
5. Make sure that the downflow diffuser is properly installed.
6. Check that the fan duty cycle matches with the value given on the test report.

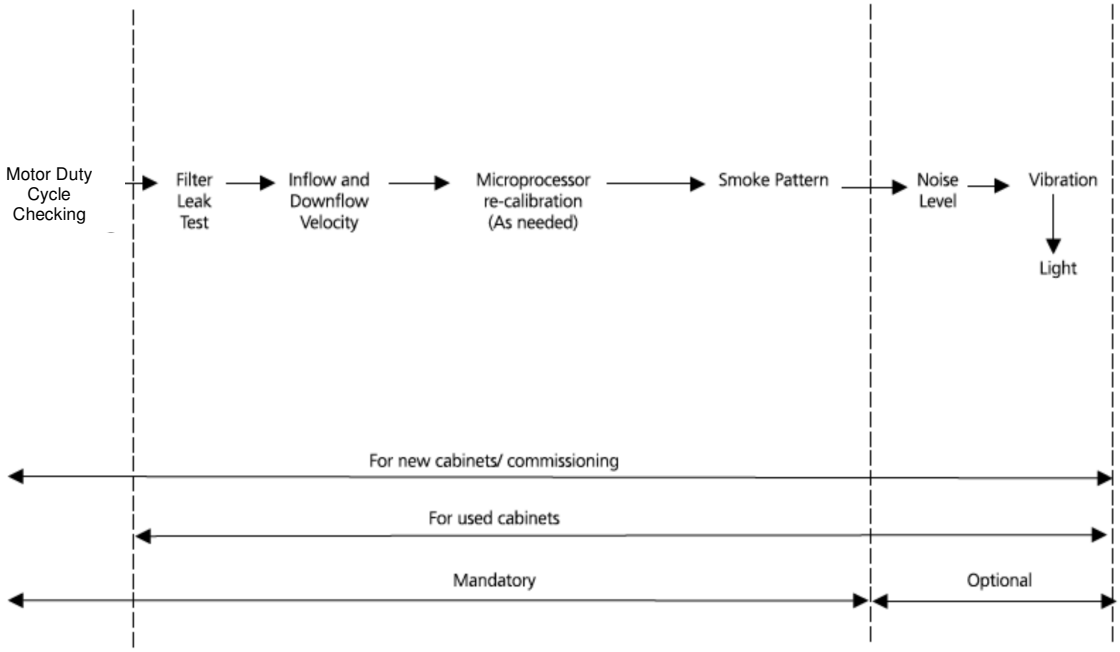
## 7.2. Cabinet Field Certification

Cabinet field certification must be performed on:

- New installation.

- Relocation of cabinet.
- Activation of airflow alarm with undetermined cause.
- When cabinet performance is suspect.
- At least once in a year or based on your risk assessment.

The steps to perform field certification:




## 7.3. Performing Calibration / Certification

### 7.3.1. Setting Cabinet in Maintenance Mode

In Maintenance Mode all alarms are defeated and the window can be moved without the light being switched off.

1. At NORMAL mode LCD display:


2. Press MENU button to access microprocessor menu.
   a. 'PASSWORD' with flashing '0' will be displayed. Enter the ADMIN PIN. Follow procedure below to enter the default ADMIN PIN of 0009.
   b. Press SET button. Flashing '00' will be displayed.
   c. Press SET button. Flashing '000' will be displayed.
   d. Press SET button. Flashing '0000' will be displayed.
   e. Press ▼ button to key in 9
   f. Press SET button


3. Alarm will sound, wait until alarm stops. Use the ▼or ▲button until the display as shown below:


4. Press the "SET MODE" button until the LCD displays MAINTENANCE. The cabinet is in maintenance mode the displayed to indicate unsafe condition.
5. Press the MENU button twice to exit from the menu tree.

### 7.3.2. Filter PAO Leak Test

The downflow (supply) and exhaust filters should be challenged with PAO aerosol of fixed concentration. The aerosol should be evenly distributed throughout the supply (positive) cabinet plenum. An aerosol photometer should be used to monitor aerosol penetration downstream of both filters, and to scan for the presence of leaks. Place the probe at distance of 0.5 to 1 cm from the area to be scanned, and move the probe with traverse speed of 5 cm/sec along the filter gasket and filter media. When scanning the filter media, move the photometer probe with slightly overlapping manner to ensure leak detection (if present)

Use the following table to assess the filter performance:

| **PAO Concentration** | **____ µg/L** | **NSF49recommends ≥ 10 µg/L for DOP and ≥ 7.5 µg/L for PAO but Esco recommends ≥ 15 µg/L for DOP and ≥ 20 µg/L for PAO to achieve the required concentration in the upstream.** | | |
|---|---|---|---|---|
| **Downflow Filter** | | **Exhaust Filter** | | Upstream concentration calculative method $\frac{13{,}500 \times N}{\text{Total Airflow in cfm}}$ |
| Leaks detected in media | Yes / No | Leaks detected in media | Yes / No | |
| Leaks detected in gasket | Yes / No | Leaks detected in gasket | Yes / No | |
| Particle penetration | % | Particle penetration | % | |

Notes:

- Always check background aerosol concentration in room, make sure it is not too high.
- Check the upstream aerosol concentration again after the test is completed to ensure the same value.
- When switching between upstream / clear / downstream, let the photometer purge for a minute.
- For field testing: to avoid accessing contaminated sampling tube, use calculative method shown in the table above.

- For the eSafe Series cabinets, the approximate total airflow is as shown in the following table. N= the number of laskin nozzles opened.

| Cabinet model number | EC2-4LX / EC2-4SX | EC2-5LX / EC2-5SX | EC2-6LX / EC2-6SX |
|---|---|---|---|
| Nominal width of the cabinet | 1.2 m (4') | 1.5 m (4') | 1.8 m (6') |
| Approximate total airflow | 1,314 $m^3$/h (773cfm) | 1,642 $m^3$/h (966cfm) | 1,970 $m^3$/h (1,159 cfm) |

### 7.3.3. Inflow Velocity Testing

#### 7.3.3.1. Direct Inflow Measurement (DIM)

Direct Inflow Measurement (DIM) is the most accurate method to measure inflow. It is to be performed using an 8" flow hood that measured the inlet volumetric flow rate on the front aperture.

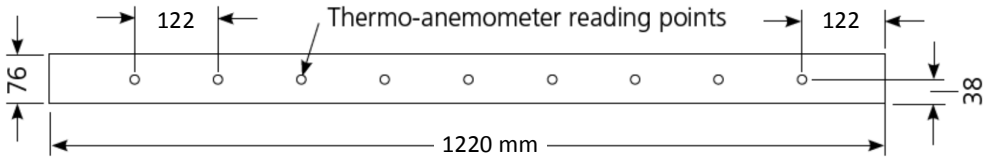
1. Remove armrest but install it back after testing is finished.
2. Attach the flow hood inlet to the front aperture, with the window lowered to touch the flow hood and the rest of the opening area covered by laminated paper and masking tape.
3. Take 5 readings and divide the volumetric inflow reading in liter/second by the opening area to get the inflow velocity in meter/second. The opening dimension (width x sash height), and the required nominal inflow velocity of various EC2 cabinets is as follows:

| Cabinet | EC2-4LX / EC2-4SX | EC2-5LX / EC2-5SX | EC2-6LX / EC2-6SX |
|---|---|---|---|
| **Width (m) (ft)** | 1.220 (4) | 1.524 (5) | 1.830 (6) |
| **Sash height (m)** | 0.175 | 0.175 | 0.175 |
| **Nominal inflow (m/s)** | 0.50 m/s | 0.50 m/s | 0.50 m/s |

#### 7.3.3.2. Secondary Inflow Measurement

In the event that flow hood is not available, a secondary inflow method to measure inflow can be performed.

1. Remove armrest, but install it back after testing. Hold the armrest by hand when the last capped nut is unscrewed.
2. Put the masking tape to cover the small gap between the tray and the cabinet. Mark the proper probe position on the masking tape as below (for example):




| Cabinet | EC2-4LX / EC2-4SX | EC2-5LX / EC2-5SX | EC2-6LX / EC2-6SX |
|---|---|---|---|
| **Width (m) (ft)** | 1.220 (4) | 1.524 (5) | 1.830 (6) |
| **Distance from walls (mm)** | 122 | 127 | 122 |
| **Distance apart (mm)** | 122 | 127 | 122 |

3. Put the gage block and lower the sash window until it consistently touches the window height template on the left and right side of the cabinet. REMOVE the gage block before taking airflow reading.
4. Mount the thermo-anemometer on the probe holder, which along with gage block, may be obtained by contacting biotech@escoglobal.com. Attach the probe holder to the cabinet by making the magnets

on the probe holder bonds to the EG steel part underneath the cabinet. Make sure the probe holder touch the front nosing of the cabinet. Adjust the probe height so that the center of the white tip is 38 mm (1.5 inches) below the sash window lower edge to take the reading at the center of the opening height.

5. Take the average of the readings. Multiply the average by the sash height conversion factor:

| Cabinet | EC2-4LX / EC2-4SX | EC2-5LX / EC2-5SX | EC2-6LX / EC2-6SX |
|---|---|---|---|
| **Conversion factor** | 0.442 | 0.442 | TBD |

Example:

If the average reading at 76 mm (3 inches) opening is 1.13 m/s then the inflow reading at normal window opening is: 1.13 m/s x 0.442 = 0.50 m/s.

**Note:** Calibration must be done with sash window at normal opening, not 3" (76 mm) opening

### 7.3.4. Downflow Velocity Testing

Downflow testing is performed using thermo-anemometer on a plane that is 10 cm above the lower edge of the sash window opening for EC2-xLy following the grid below:

| Cabinet | | EC2-4LX EC2-4SX | EC2-5LX EC2-5SX | EC2-6LX EC2-6SX |
|---|---|---|---|---|
| **Width (mm) (ft)** | | 1,220 (4) | 1,524 (5) | 1,830 (6) |
| **Left to Right** | Distance from walls (mm) (in) | 152.5 (6.0) | 191.2 (7.5) | 228.8 (9) |
| | Distance apart (mm) (in) | 305 (12.1) | 382.5 (15.1) | 457.5 (15.1) |
| **Front to Back** | Distance from walls (mm) (in) | 150 (5.9) | 150 (5.9) | 150 (5.9) |
| | Distance apart (mm) (in) | 300 (11.8) | 300 (11.8) | 300 (11.8) |
| **Nominal Downflow (m/s) (fpm)** | | 0.35 (70) | 0.35 (70) | 0.35 (70) |

### 7.3.5. Calibration of SentinelControl

The purpose of calibrating the microprocessor is to let the microprocessor record particular output voltages from the airflowsensor and correspond them to fail and nominal points of air velocity. Once the calibration has been completed, thecontrol will be able to show the air velocity whenever the fan is in operation. All Esco cabinets are factory-tested andcalibrated before being shipped.

The procedures detailed in this section should only be performed by a suitably qualified engineer familiar with the maintenance and calibration of Esco biological safety cabinets. In order to perform calibration you will need a copy of the factory test report. The data in the factory test report is specific to each cabinet - always check the serial number of the cabinet to be calibrated and ensure the correct test report is used for calibration base data.

Calibration is required in the following eventualities:

- When the cause of airflow alarm cannot be determined.
- At the time of annual re-certification, if displayed airflow velocity deviates by more than 0.02 m/s (4 fpm) than the measured velocity.
- When either of the cabinet blowers (main or exhaust) is changed.
- When the filter is changed.
- When the airflow sensor is changed.

- In any other circumstance that is likely to affect cabinet airflow velocities.

⚠ The calibration must be carried out in maintenance mode.

Before calibration is performed, set the cabinet to maintenance mode, this will allow you to lower the sash window without the lights being automatically shut off. This is important as the blower duty cycle will slightly increase if the lights are not on, resulting in a minor discrepancy in calibration. In maintenance mode the alarms will be disabled and you will not need to re-enter the PIN every time the menu or fan button is pressed, also, no fan warm up or post purge is required.

There are 3 steps to do standard field calibration:

1. Calibrating the Zero point.
2. Balance the Main Blower and Exhaust Blower to get Nominal Inflow and Downflow.
3. Calibrate the Nominal Inflow and Downflow Set Point.

Contact Esco for special calibration procedure when Airflow sensor, Main board, or Software is replaced.

#### 7.3.5.1. Calibrating the Zero point

The sensor must be calibrated at zero velocity first before you can proceed to sensor calibration. The microprocessor will retain the zero setting, so if the sensor has been zeroed before, you can skip this section. If the sensor is not zeroed before, the calibration must be performed.

For zeroing the sensor, make sure the fan has been turned off for at least 1 minute to let the sensor temperature warmed up due to absence of airflow. Please also make sure that the holes on the sensor housing are closed (e.g. by masking tape) to eliminate the external airflow disturbance such as room HVAC system.

1. Press MENU button. Use the ▼ button until the cursor is at “CALIBRATE”. Press the SET button. As shown below:


2. Choose “ZERO SENS” and press SET. The fan is automatically switched off if it was on.
3. The LCD will display:


4. Block the airflow sensor and press the SET button.
5. The LCD would then show:


6. The ADC values signify the airflow sensor output. Wait and observe these values until they stabilize and press the SET button to confirm the ZERO point. The microprocessor takes 3 minutes to record the sensor output voltage.
7. Return to the menu and turn on blower.

### 7.3.5.2. Balance the Main Blower and Exhaust Blower to get Nominal Inflow and Downflow

You will find the motor duty cycles that correlate to the Nominal Inflow and Downflow velocity. This is a prelude to calibrating the microprocessor.

**MAIN BLOWER (DOWNFLOW) SET POINTS**

1. Adjust the "MAIN BLW" duty cycle to Nominal Downflow by pressing ▲or ▼button.
2. After the fan has stabilized, use the thermo-anemometer to measure the downflow velocity. Please refer to Downflow Test for the downflow measurement procedures.
3. The cabinet main blower is then adjusted to obtain the three downflow set points. The duty cycle at each point were recorded below after the airflow was allowed to stabilize.

Downflow Nominal Point: 0.35 m/s

Actual main blower duty cycle for new filter: _____ %

Downflow Minimum Point: 0.30 m/s

Actual main blower duty cycle for new filter: _____ %

Downflow Maximum Point: 0.40 m/s

Actual main blower duty cycle for new filter: _____ %

**EXHAUST FAN (INFLOW) SET POINTS**

1. Set up the flowhood for inflow measurement.
2. Adjust the "EXH BLW" duty cycle to **Nominal Inflow** by pressing ▲or ▼button.
3. Check if the inflow velocity is **0.50** m/s and fine tune the fan to attain this velocity. Ensure that the main fan is at nominal duty cycle.
4. The cabinet's **exhaust blower** was then adjusted to obtain two inflow set points. The duty cycle at each point were recorded below after the airflow was allowed to stabilize.

*Inflow Nominal Set Point*

4ft : 0.50 m/s or 107 L/s (Flow Hood LOCAL DENS reading: 105 L/s)

Actual exhaust blower duty cycle for new filter : _____ %

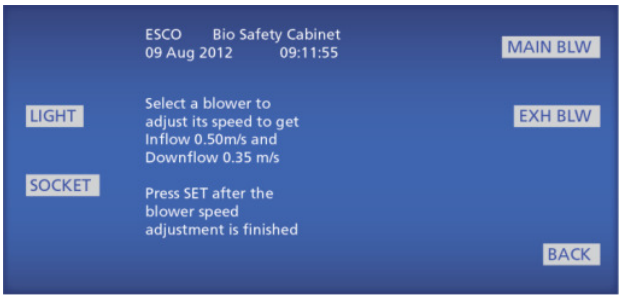
*Inflow Minimum Point*

4ft : 0.45 m/s 96 L/s (Flow Hood LOCAL DENS reading of 94 L/s)

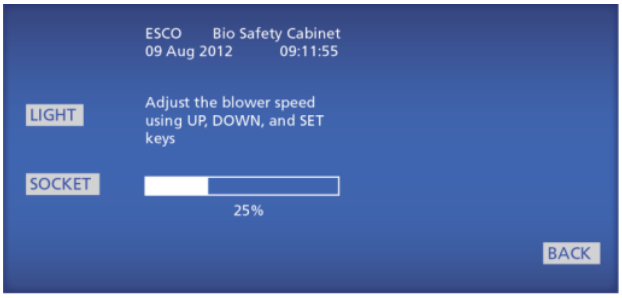
Actual exhaust blowerduty cycle for new filter : _____ %

### 7.3.5.3. Calibrating the Inflow Nominal and Downflow Nominal Set Point

1. Press MENU button to accessing microprocessor menu.
   a. 'PASSWORD' with flashing '0' will be displayed. Enter the ADMIN PIN. Follow procedure below to enter the default ADMIN PIN of 0009.
   b. Press SET button. Flashing '00' will be displayed.
   c. Press SET button. Flashing '000' will be displayed.
   d. Press SET button. Flashing '0000' will be displayed.
   e. Press ▼button to key in 9
   f. Press SET button
2. Use the ▲or ▼button to find "CALIBRATE" menu
3. Press SET and choose "EXH SENS" then press SET, fan will be automatically turned on if it's originally turned off. The LCD would display a warning as shown :




4. Keeping the "MAIN BLW" duty cycle at **nominal downflow** and adjust the "EXH BLW" duty cycle to **nominal inflow** by pressing ▲or ▼button.




5. Wait and observe the value of "ADC IFN" and "ADC DFN" to stabilize and press the SET button. The microprocessor takes 1 minute to record the sensor output voltage.


#### 7.3.5.4. Airflow Alarm Checking

- **Inflow min alarm checking:** Install the flow hood. Keep N1 (downflow) speed control at nominal duty cycle. Set the N2 (exhaust) speed control to the Inflow Minimum Set Point duty cycle. Check that inflow velocity is not lower than 0.45 m/s using flow hood. Check that the LCD displays the LOW INFLOW message, with the Red Warning LED and buzzer activated. After that, return N2 to nominal duty cycle.
- **Downflow min alarm checking:** Keep N2 speed control at nominal duty cycle. Go to calibration menu and adjust N1 speed. Set the N1 speed to the Downflow Minimum Set Point Duty Cycle. Putthe thermo-anemometer at the lowest downflow point and see that this lowest point is not less than 20% fromthe nominal downflow. If there is more than 1 point that has the same lowest value, then pick one of them. Forexample, if the nominal downflow velocity is 0.35 m/s, then the lowest individual point shall not be lower than 0.31 m/s.Return to the main screen, check that the LOW DOWNFLOW message is displayed, with theRed Warning LED and buzzer activated.
- Return the N1 to nominal duty cycle (calibration menu, adjust blower duty cycle), until the LCD displays the pre-set nominal downflow velocity, nominal pre-set inflow velocity and AIR SAFE status.Keep N2 speed control at nominal duty cycle.
- **Downflow max alarm checking:** Set the N1 speed control to the Downflow Maximum Set Point duty cycle (go to calibration menu and adjust blower duty cycle). Put thethermo-anemometer at the highest downflow point and see that this highest point is not more than 20% from thenominal downflow velocity. If there is more than 1 point that has the same highest value, then pick one of them. Thetarget nominal downflow is 0.35 m/s, therefore, the highest individual point shall not be higher than 0.40 m/s.Return to the main screen, check that the HIGH DOWNFLOW message is displayed on LCD,with the Red Warning LED and buzzer activated.
- Return the N1 to nominal duty cycle, until the LCD displays the pre-set nominal downflow velocity, nominal pre-set inflowvelocity and AIR SAFE status. Ensure that N2 speed control is at nominal duty cycle.

### 7.3.6. Power Failure Alarm

The test is designed to verify the performance of the power failure alarm installed on the cabinet

1. Disconnect power to cabinet.
2. Record the initial average inflow velocity and average downflow velocity.

Acceptance : Alarm is sounded indicating power loss has occurred.

### 7.3.7. Motor Control Verification

This test is designed to verify the capability of the motor to compensate for filter loading.

1. Ensure the cabinet airflow is now balanced.
2. Record the initial average inflow velocity, average downflow velocity and power consumption. Use power meter connected to the power inlet to the cabinet to measure the power consumption.

| Parameter | Value |
|---|---|
| **Initial average inflow velocity** | m/s \| fpm |
| **Initial average downflow velocity** | m/s \| fpm |
| **Initial power consumption** | W |

3. Lift up the front panel to enable you to observe the motor duty cycle. Record the initial motor duty cycle.

| Parameter | Value |
|---|---|
| **Initial motor duty cycle** | % |

4. Close the front panel.
5. Block 50% of the inflow grill for 2 minutes and record the average inflow velocity, average downflow velocity and power consumption.

| Parameter | Value |
|---|---|
| **Average inflow velocity when grill is blocked** | m/s \| fpm |
| **Average downflow velocity when grill is blocked** | m/s \| fpm |
| **Power consumption when grill is blocked** | W |

6. Unblock the inflow grill and let the cabinet stabilize for 2 minutes. Record the final average inflow velocity and average downflow velocity.

| Parameter | Value |
|---|---|
| **Final average inflow velocity** | m/s \| fpm |
| **Final average downflow velocity** | m/s \| fpm |
| **Final power consumption** | W |

Acceptance : Average inflow and downflow velocity when grill is blocked and after grill is unblocked must be within ± 0.025 m/s (± 5 fpm) of initial velocity. Power consumption increases when grill is blocked indicating the compensation by the motor.

### 7.3.8. Airflow Smoke Patterns Test

A suitable visible smoke generator was used to visualize cabinet airflow patterns.

**Downflow:**

- Spray smoke on work surface center line, 10cm (4") above sash window lower edge, left to right.
- Observation: Smoke flow should be smooth downward with no dead spots or reflux (upward blow).

**View Screen Retention:**

- Spray smoke 2.5cm (1") behind sash, 15cm (6") above sash lower edge, left to right.
- Observation: Smoke flow should be smooth downward with no dead spots, reflux (upward blow) or escape.

**Work Opening Edge Retention:**

- Spray smoke along entire aperture perimeter, 3.8cm (1.5”) outside cabinet.
- Observation: Smoke flow smooth, no reflux out once drawn in, no billowing or penetration over work surface.

**Sash Wiper Seal:**

- Spray smoke behind sash, 5cm (2”) from the sides and along the top of the work area.
- Observation: There should be no smoke escape from the cabinet.

**Downflow Diffuser Perimeter:**

- Spray smoke at 2.5cm (1”) underneath the diffuser perimeter (this is a non-NSF test).
- Observation: Smoke flow should be downward with no dead air corner or reflux.

**Notes:**

The sash Wiper Seal Test will require two persons to perform the test:

- One person to insert their hand into the cabinet and eject the smoke.
- One person to check for smoke escape from the cabinet, with the front panel lifted.

### 7.3.9. Mandatory Annual Inspection of Sash Mechanism

Checking of Motorized Tubular Motor:

1. Remove screws from the left and right side of blue panel. Lift up the front panel.
   Caution: The front panel is equipped with a gas spring which will open the front panel automatically.
2. Check mounting screws on both sides of the brackets, ensure there are no loose screws.
3. Check the plastic end caps for any sign of cracks. Do not operate sash if cracks are found.
4. Check suspension belts are securely fastened to the sash glass. Check for any sign of tearing on the belt.

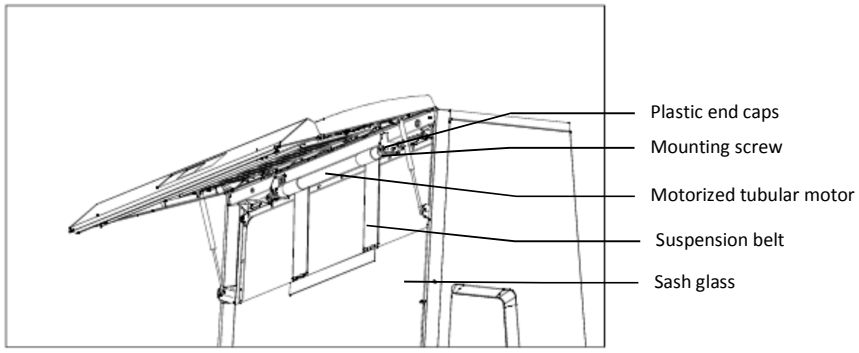



**Figure 7.1. Motorized tubular motor**

Checking of the Sliding Sash Mechanism

1. Remove screws from the left and right side of the sash cover.
2. Remove the sash covers for access to the sliding window mechanism.
3. Ensure Guide A is securely glued to the glass.
4. Check by lifting the glass out slightly and make sure Guide A does not detached from glass with finger force.
5. Check for the gap between the sash guides as per sketches shown above.
6. Check the position of switch to ensure it does not collide with the moving sash glass.
7. After all the above checks are done, install the sash cover and close the front panel.
8. Operate the sash and the glass should be moving smoothly up and down.
9. Ensure that the glass does not jam at any position and the suspension belt does not slack at any point in time.

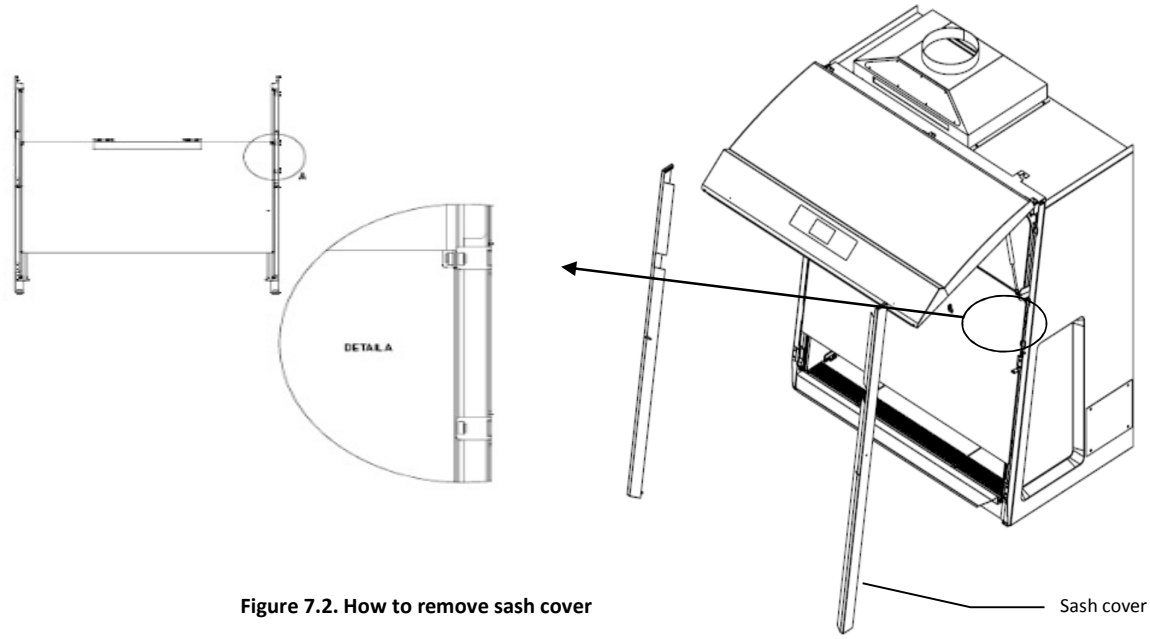



**Figure 7.2. How to remove sash cover**

## 7.4. Replacement of Filter

Instructions for filter replacement

1. Remove the screws located on the left and right side of the blue panel.
2. Open up the hinged front panel and put on the struts to support the front panel.
3. Remove filter/blower access panel, which are held in position by phillip panhead screws.
4. Unlatch the latch at the side of the supply plenum and lift up the supply plenum.
5. Carefully remove the supply filter from the front.
6. Replace new filters by reversing the above steps.

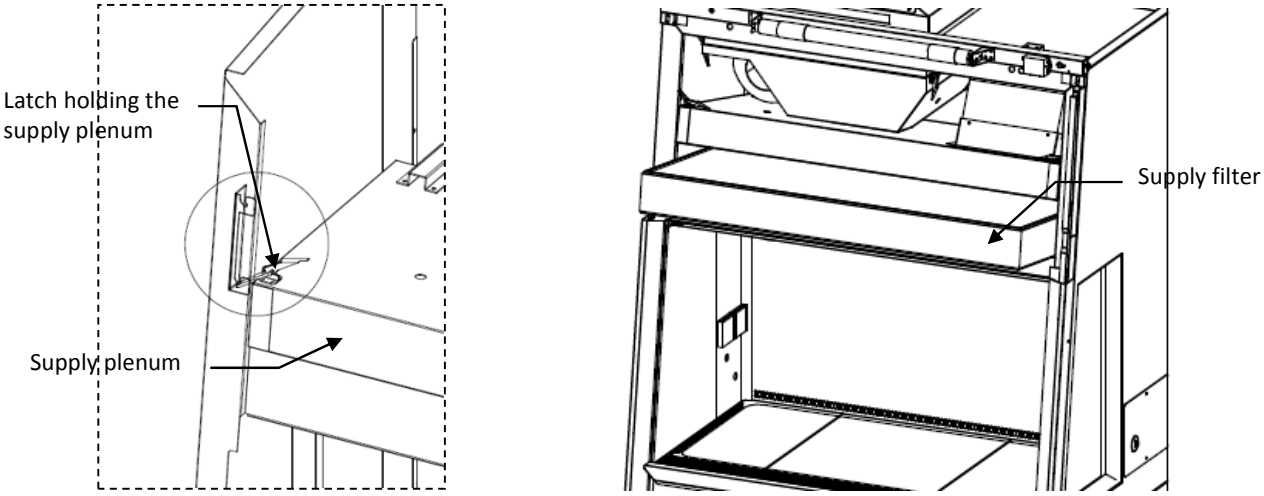



**Figure 7.3. Unlatching the supply plenum to remove supply filter**

Exhaust filter removal

1. Unlatch the latch at the side of the exhaust plenum to lower down the plenum until it is restingon top of the exhaust plenum.
2. Carefully remove the exhaust filter.
3. Replace new filters by reversing the above steps.

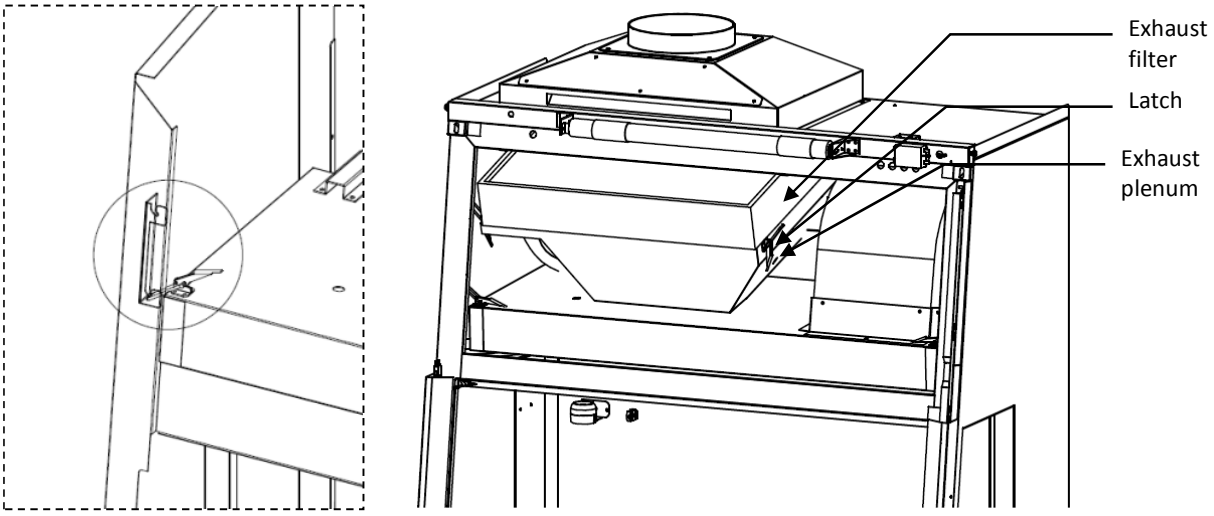



**Figure 7.4. Unlatching the exhaust plenum to remove exhaust filter**

Two persons may be required for changing the filter(s) of 5-feet and 6-feet cabinets

Under normal usage and barring any accident (example - puncture), the two HEPA/ULPA filters do not need replacement unless and until the inflow velocity cannot be maintained at the specifications required by the testing report even though the fan has been set to maximum speed.

The filters should not be replaced until the entire cabinet has been decontaminated.

1. Before the filters are removed from the cabinet, their contaminated faces should be taped off using plastic cardboard or some other suitable material. This would minimize the risk to personnel in the event of decontamination not being thorough.
2. Used filters should be disposed off in accordance with local regulations. They may have to be incinerated as medical waste. They should be double bagged and appropriately labeled after being removed from the cabinet. Refer to Limitation of Liability page vi.
3. Proper personal protective equipment (PPE) (may consist of a disposable gown, gloves and respiratory protection device and the choice should be determined by adequate risk assessment) should be worn while removing used filters. You should dispose the disposable PPE and decontaminate reusable equipment after the procedure. Finally you should properly wash your hands.
4. Before the new filters are installed, all surfaces should be thoroughly cleaned of silicon and/or adherent gasketmaterial. The new filter should be carefully handled and examined before being fitted. It is important that thefilters and the gaskets be checked for leaks prior to use.

The use of non-Esco parts and/or parts not supplied directly by Esco or our authorized distributors, including but notlimited to maintenance parts, spare parts, replacement parts, system components and/or system accessories shall voidall expressed or implied warranties.

## 7.5. Replacement of Blower

To replace the blower, follow the steps mentioned below:

1. Check the replacement parts list at the end of this manual.
2. Follow the steps that have been pictorially illustrated in the blower replacement diagram below.
3. Take out the blower housing and unscrew the bolts that secure the blower to the blower housing.
4. Repeat this procedure in reverse order with the new blower to complete the replacement.

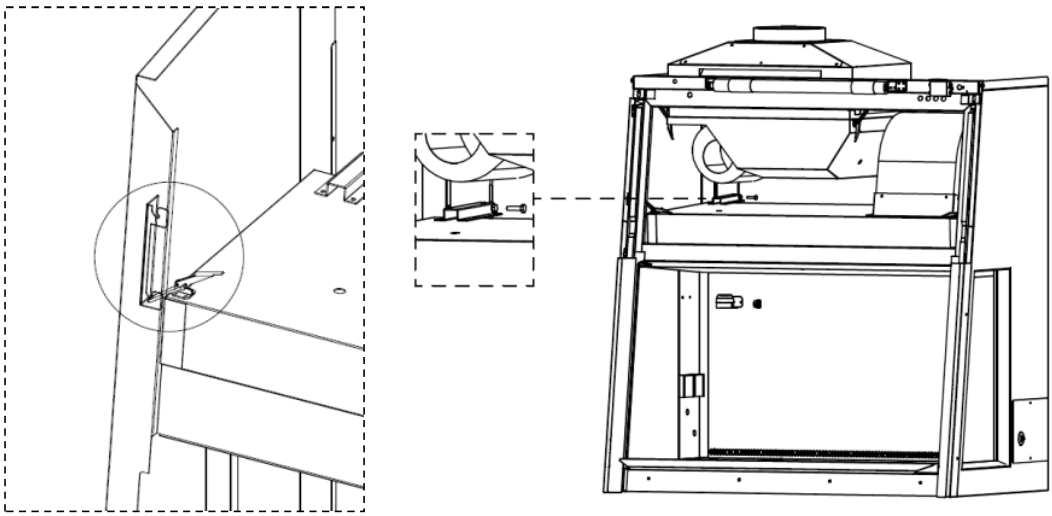


**Figure 7.5. Supply plenum removal**

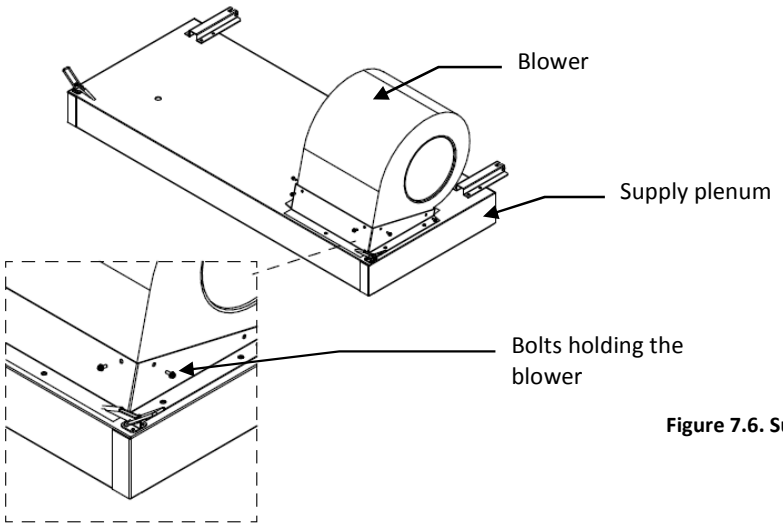



**Figure 7.6. Supply blower removal**

Supply blower replacement

1. All electrical connections must be disconnected while working with blowers to prevent electrical hazard.
2. Supply filter must be removed before the supply blower can be replaced.
    a. Unscrew the hinge holding the plenum onto the cabinet body.
    b. Remove the supply plenum box from the cabinet (at least 2 persons are required to carry out the supply plenum box).
    c. Remove the bolts securing the blower as shown.
    d. Remove the blower.
    e. Re-install new blower by reversing the above steps.

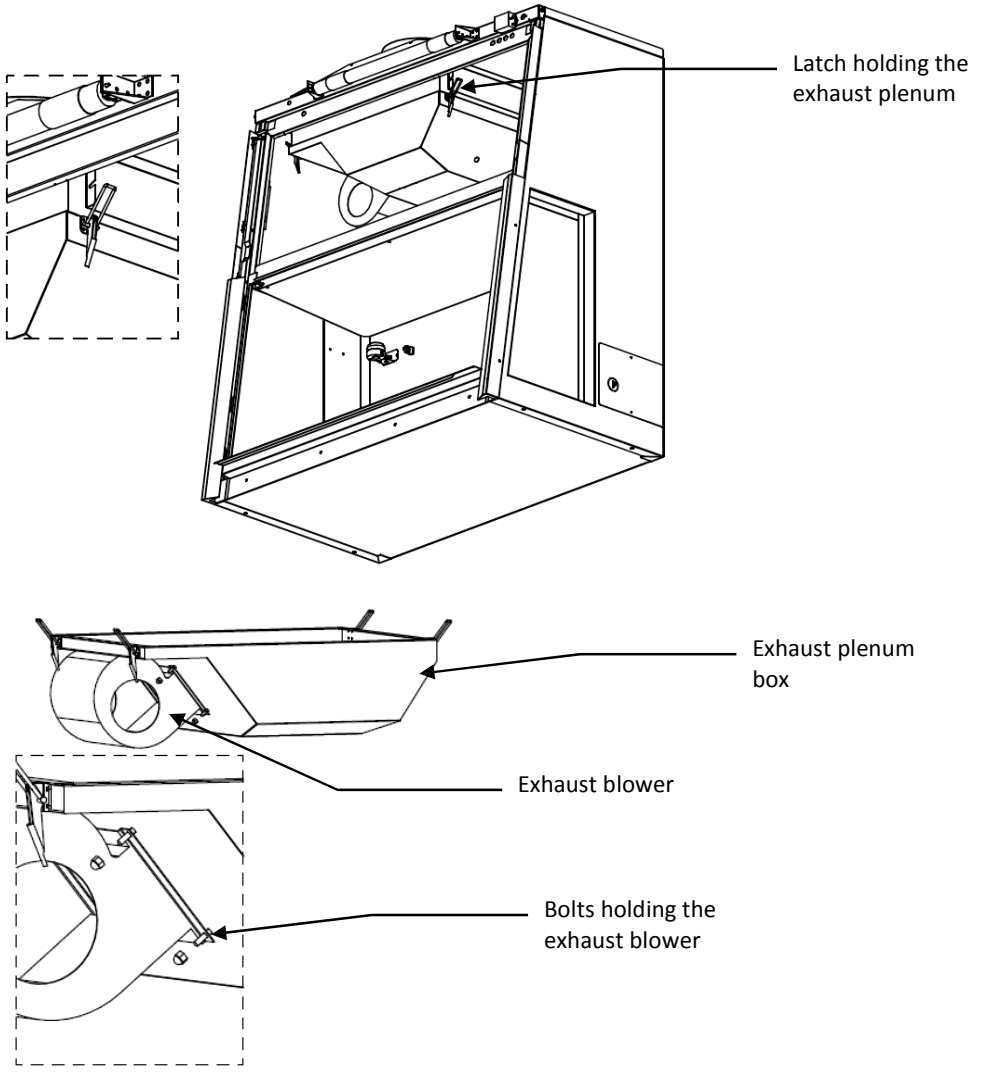



**Figure 7.7. Exhaust blower removal**

The exhaust plenum has to be removed before the blower can be removed.

1. Unlatch the exhaust plenum and lower the exhaust plenum slowly. Hold the exhaust blower while unlatching the plenum (at least 2 persons are required to carry out the supply plenum box – please note that the EC2-6LX uses two exhaust blowers).
2. Unscrew the bolts holding the exhaust blower and remove the blower.
3. Re-install new blower by tightening the bolts removed earlier.

## 7.6. Replacement of Airflow Sensor

1. There two airflow sensors installed on the cabinet. One is located on top of the cabinet while another one is on the inner liner. Start by disconnecting the airflow sensor cable connector.
2. For each of the sensor, unfasten the two screws that secure the sensor housing to the cabinet as shown below. Where downflow sensor is to be replaced or removed, the cabinet should be decontaminated before the sensor is serviced.
3. Lift the sensor housing, replace with new sensor and screw it on the cabinet.
4. Make sure the rounded end of the sensor housing faces towards the filters. Ensure that the axes of the sensor holes are parallel to the airflow direction as shown below.

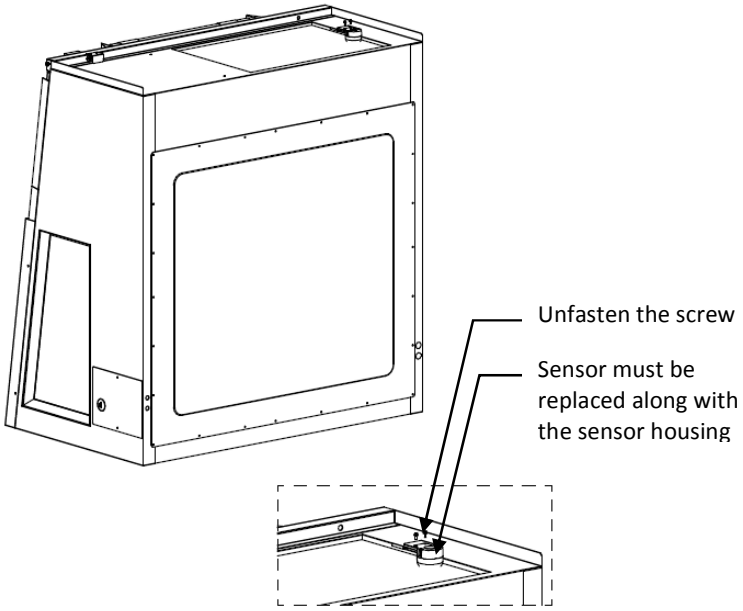



**Figure 7.8. Sensors replacement**

Please re-calibrate the control when sensor is replaced. The calibration should only be carried out by qualified personnel.

## 7.7. Replacement of Fluorescent Lamp

1. Check the replacement parts list at the end of this manual.
2. Disconnect the electrical connections prior to working with any electrical components.
3. Unfasten the two screws from the side of the blue panel and then lift up the front panel. Hold open the front panel with the struts.
4. The fluorescent lamp(s) are located behind the blue panel. Remove the old one(s) from their socket(s) andreplace back with the new one(s).

## 7.8. Replacement of UV Lamp

1. Check the replacement parts list at the end of this manual.
2. Disconnect the electrical connections prior to working with any electrical components.
3. Take out the old UV lamp by rotating it 90° in anti-clockwise direction before pulling it out.
4. Replace back with a new UV lamp by pushing it up in its socket and rotating it 90°clockwise tosecure the lamp in its socket.

## 7.9. Decontamination Procedure

A decontamination kit – complete with all materials, equipments and supplies (but excluding chemicals which should be acquired locally) required for carrying out decontamination of safety cabinets - is available from Esco.

Decontamination should be performed in any of the following eventualities:

- Before replacing the exhaust / downflow filters or blowers.
- Before accessing the contaminated plenum of the cabinet.
- In case of an accidental spillage that might have contaminated any of the inaccessible surfaces.
- Before performance validation and re-certification or as part of preventive maintenance.
- Before cabinet relocation.

In this section, gaseous decontamination by formalin is described.

Decontamination should only be performed by qualified personnel.

### 7.9.1. Warning on Formalin Exposure

Decontamination is often performed by means of formaldehyde fumigation or paraformaldehyde de-polymerization. Formalin exposure could have very dangerous implications on your health:

1. External contact can cause irritation to skin, eyes and mucous membranes.
2. Inhalation in small concentration can cause coughing, nausea and diarrhea.
3. Inhalation in large concentration can cause convulsions, coma and even death.
4. Long term exposure can cause cancer.

Care should be taken while working with formaldehyde as it can be "reasonably anticipated to be a human carcinogen" (IARC 1982, 1987, 1995).

According to OSHA [Occupational Safety and Health Administration (USA)], Formaldehyde exposure limits are as follows:

- Short Term Exposure Level (STEL): 2 ppm for 15 minutes exposure, 4 times a day, minimum of 60 minutes in between exposures.

Any additional local safety regulations should also be observed. Personnel should be given adequate training. The following links provide general guidelines on formaldehyde safety:

- Regulations (Standards - 29 CFR) Formaldehyde - 1910.1048, Occupational Safety and Health Standards, OSHA (Occupational Safety and Health Administration), U.S. Department of Labor: http://www.osha.gov
- OSHA Formaldehyde Fact sheet (PDF format) http://www.osha.gov/OshDoc/data_General_Facts/formaldehydefactsheet.pdf

Ammonia is used to neutralize Formaldehyde. OSHA prescribes the following exposure limit for Ammonia:

- STEL: 35 ppm for 15 minutes exposure, 4 times a day, minimum of 60 minutes in between exposures.

### 7.9.2. List of Equipment

1. Device to measure formaldehyde concentration: Formaldemeter® 400 has been found to be suitable and can be obtained from PPM Technology (UK) (http://www.ppm-technology.com).
2. Device to measure ammonia concentration: Dräger®-Tubes and Accuro® pumps have been found to be suitable:Drägerwerk AG (Germany) (http://www.draeger.com/index.html). Tubes with a measuring range of 0-100 ppm are recommended.
3. Hand-drill, screwdriver, and socket key (M4 and M5).
4. Measuring tape.

### 7.9.3. List of Consumables

1. Tape (3M-3939 is recommended).
2. Air-tight bag that can enclose the entire cabinet (can be ordered from Esco).
3. Biohazard waste bag.
4. Suitable chemical or biological indicators where required.

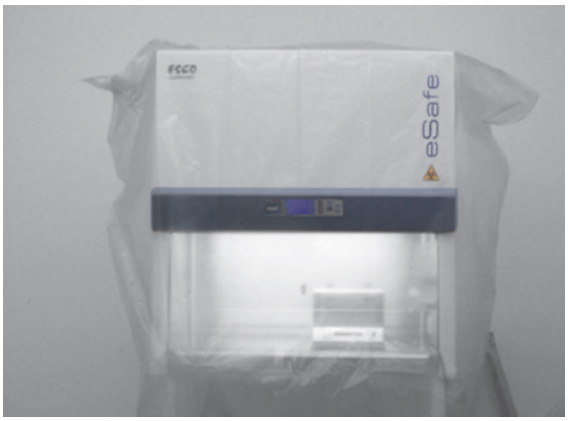
### 7.9.4. Appropriate Protective Clothing

1. A solid front-back closing, full body, long-sleeved disposable lab gown.
2. Disposable shoe covers.
3. Disposable surgical/PVC gloves for hand protection.
   **Caution:** Gloves should be pulled over the knitted wrists of the gown rather than being worn inside.
4. Gloves must be worn while handling formalin and ammonia solutions. Compared to latex gloves, Nitrile gloves exhibit higher resistance to formaldehyde and are less likely to cause allergic skin reactions. Hence Nitrile gloves should be preferred over latex gloves.

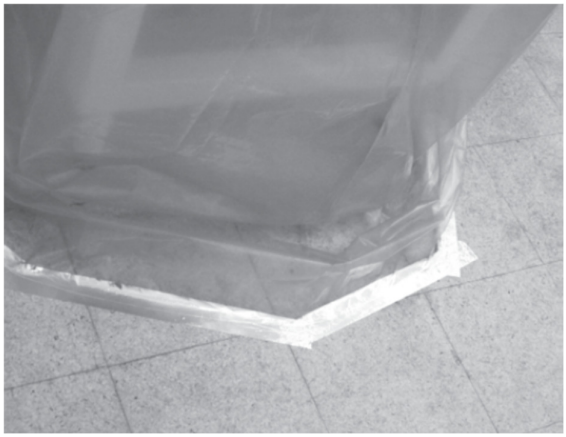
5. Respirator providing appropriate level of gas protection. Any face shield should be wiped clean with suitable cleaning materials each time after using it.

### 7.9.5. Common Preparatory Steps

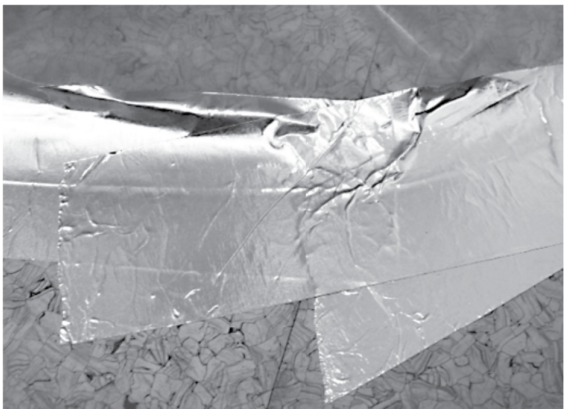
1. It is recommended that a safety briefing be conducted for all personnel in the laboratory where the cabinet hasbeen placed before carrying out the procedure.
2. Access to the laboratory should be restricted during the procedure. A warning sign should be pasted on the doorof the lab to warn all personnel (a suitable label is available from Esco). No personnel should enter the lab until theprocedure is complete and the formaldehyde (and other relevant hazardous chemical) concentration has been verified to be within safe limits.
3. Prior to starting the procedure, contingency plans should be drawn for possible incidences of breach in the cabinet seal, leading to leakage of formaldehyde into the room. You should properly study the ventilation design of the room and should keep appropriate equipment on standby so that formaldehyde can be vented in the event of a leakage. One way of doing this would be to connect a flexible hose to a small exhaust fan which can vent the contaminated air into an adjacent fume hood. Special care should also be taken in case the air in the laboratory isre-circulated to other parts of the building. In such a case, a formaldehyde leakage could even necessitate evacuationof other parts of the building.
4. Set the cabinet to maintenance mode (refer to section7.3.1). In this mode, the personnel doing thedecontamination is able to turn on the fan to pulse the airflow in the cabinet (to distribute the formaldehyde vapor)and also turn on the outlets to supply power to the vaporisers, even though the sash is fully closed.
5. Measure the length, width and height of the air tight bag that would be used to enclose the cabinet in order tocalculate its volume. If any ductwork is used, the extra volume must also be taken into account for calculating theamount of chemicals that would be needed for carrying out the decontamination.
6. Put the plastic tent to enclose the entire cabinet and support stand.




7. Use the 50 mm wide aluminium tape to seal the gap between the bottom plastic tent and the floor. The tape must be pasted on top of the straightened portion of the plastic tent. If the tape is pasted on top of crumpled, bent, of flipped plastic bag, it harder to achieve leaktightness. To compensate for areas where the plastic bag must turn, use multi section tape. Ensure that the two layers of tape overlap at the end points to prevent formalin leakage.



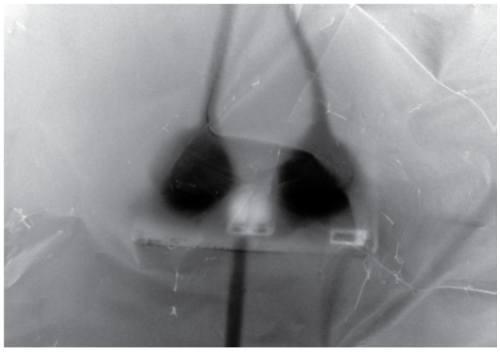
8. The overlapped tapes at the joints are shown here.



9. Be careful when there are some joints on the plastic bag. To ensure that there is no leak coming front the joints, flip the aluminium tape to half so that the adhesive portion is on both sides as shown below. Put this flipped aluminium tape underneath the joint as shown below:

10. After putting the flipped tape underneath the joint, put 3 extra layers of aluminium tape going inward, as shown here

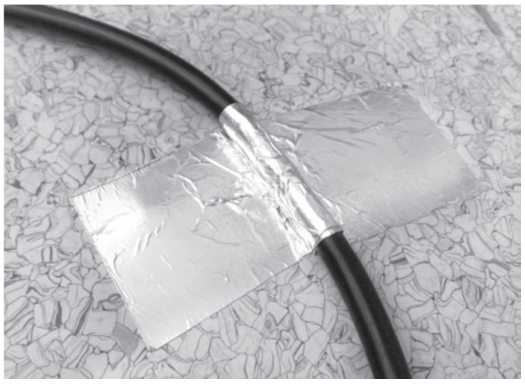
11. There are 2 power cables to be used: one for cabinet, and one for formalin vaporizer. Do not connect the vaporizer cable to the electrical outlet inside the work zone, because if the building power supply tripped, by the time the power is restored, someone has to press the electrical outlet button at the cabinet to turn ON the vaporizer. Therefore, the vaporizer must be connected directly to the building power supply. With this method, after power is restored, the vaporizer will resume the unfinished operation.These 2 cables should be



combined so that only 1 cable should come out from the plastic tent, tominimize chance of formalin leakage.

12. To seal the cable, first make an Ω-shape aluminium tape around the cable, and make a 5 cm flat portion going to both directions.

13. Then, paste the aluminium tape to the floor.



14. Put the bottom part of the plastic bag on topof the aluminium tape, then seal it with anotherlayer of aluminium tape. Use multiple layer ofaluminium tape (at least 2 layers) on both directionsto ensure leak tightness.

15. The cabinet is ready for decontamination.

### 7.9.6. Decontamination Process

There are two alternative combinations of decontaminants and their corresponding neutralizers that are commonly used:

1. 37% formalin solution (HCHO) with 25% ammonia solution ($NH_4OH$) being the neutralizer.
2. Paraformaldehyde with ammonium bicarbonate ($NH_4CO_3$) being the neutralizer.

The decontamination processes carried out using these two combinations are slightly different. Both these processes are discussed in details here.

There are other ways of cancelling out the effects of formaldehyde / paraformaldehyde than using the abovementioned neutralizers. They include:

- Connecting a temporary duct to the cabinet, with the gas being released into a fume cupboard.
- Connecting a temporary duct to the external atmosphere using a temporary connection.
- Using the existing duct connection of the cabinet to exhaust the gas (this is applicable only if the cabinet is itself ducted).

It is very important to ensure compliance with local laws and regulations with respect to the above mentioned techniques. Some countries have either put a limit on use of formaldehyde in gaseous decontamination or outright ban the use due to it being carcinogenic. User then needs to consider alternative gaseous decontamination process.

#### 7.9.6.1. Use of Formalin and Ammonia Solution

Esco has designed formalin vaporizer (FV-001) to simplify formalin decontamination process by using formalin and ammonia solution.

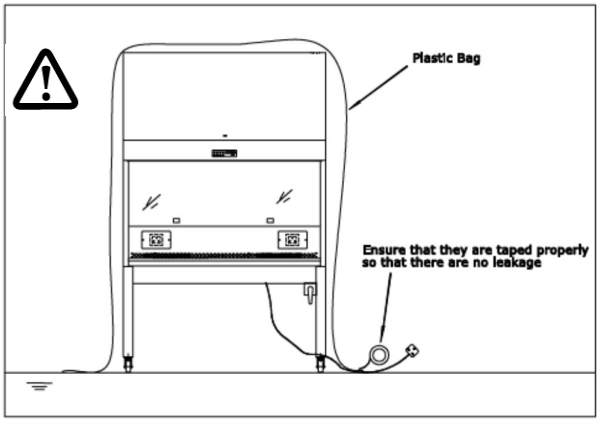
Calculate the amount of 37% formalin, 25% ammonia, and water required, which is 85 ml each, for every 1 $m^3$ volume to be decontaminated. Dispense the formalin and ammonia solution in a suitable environment (e.g. fume hood) to prevent undesired exposure to worker. The solution could be easily measured using measuring cylinder and poured into beakers. Formalin and ammonia solutions should not mix with each other to prevent neutralization.

Water is poured into the formalin tank to increase the decontamination area humidity to be above 60%. If the space humidity already exceeds 60%, then there is no need to add water. Please note that the water shall not be poured into the ammonia tank because it will not assist in the decontamination process.

To anticipate a “worst case scenario”, a relatively “large size” biological safety cabinet, with the body height of 1.7 m (67 inches) and width of 0.9 m (35 inches), mounted on a “tall” 90 cm (35 inches) standing height support stand, will have the volume enclosed by the air tight bag, and the corresponding required solution mixture, approximately as follows:

| Cabinet Width | 2 ft / 0.6 m | 3 ft / 0.9 m | 4 ft / 1.2 m | 5 ft / 1.5 m | 6 ft / 1.8 m |
|---|---|---|---|---|---|
| **Volume ($m^3$)** | 1 | 1.5 | 2 | 2.5 | 3 |
| **37% Formalin (ml)** | 85 | 128 | 170 | 213 | 255 |
| **25% Ammonia (ml)** | 85 | 128 | 170 | 213 | 255 |
| **Water (ml) - optional** | 85 | 128 | 170 | 213 | 255 |

Smaller size cabinets, especially when installed on a 70 cm (28 inches) sitting height support stand, require less formalin, ammonia, and water from the table above. The actual volume to be decontaminated must be measured on site, as it varies from one cabinet to another. The figures on the table above are given for comparative purpose only.




Please pay attention to electrical cables. Ensure they are adequately secured to prevent leakage.

**Figure 7.9. Cabinet enclosed with gaseous decontamination bag**

After approximately 25, 50, 75, and 100% of the formalin being evaporated, turn on the cabinet blower for 1 minuteto circulate the formalin throughout the cabinet. Below is the approximate time interval to turn on the blower, correspondingto the formalin and ammonia table for the "worst case scenarios" as previously discussed:

| Cabinet Width | 2 ft / 0.6 m | 3 ft / 0.9 m | 4 ft / 1.2 m | 5 ft / 1.5 m | 6 ft / 1.8 m |
|---|---|---|---|---|---|
| **Volume ($m^3$)** | 1 | 1.5 | 2 | 2.5 | 3 |
| **Blower ON interval** | 5 mins | 7.5 mins | 10 mins | 12.5 mins | 15 mins |

Notes:

- Allow the formalin vapor a minimum contact time of 8 hours inside the cabinet, preferably 10 hours, but overnightis better (CONTACT TIME).
- The ammonia vaporizer will automatically start after the "CONTACT TIME" is reached. If possible, it is desirable tocirculate the ammonia by turning on the cabinet blower at the same interval as the formalin vaporization. However,this is not mandatory, and not as important as circulating the formalin.
- Allow the ammonia vapor a minimum neutralization time of 2 hours inside the cabinet (NEUTRAL TIME). After the "NEUTRAL TIME" is finished, the equipment used will inform the user to open the plastic bag. Please be aware thatthe formalin and / or ammonia concentration inside the plastic bag may be above the Short Term Exposure Level(STEL) and appropriate respiratory protection when opening the plastic bag. Checking of chemical concentration (e.g. formaldehyde and ammonia) prior to opening the plastic bag is also strongly encouraged.

### 7.9.6.2. Use of Paraformaldehyde – Ammonium Bicarbonate Combination

Additional apparatus needed:

- Heating device (e.g. frying pan)
- Aluminium foil

Check temperature and humidity. The temperature inside the cabinet's work zone should be greater than 21 °C while the relative humidity should be in between 60% and 85%. Use a hot plate to heat a beaker of water until the desired temperature and humidity are achieved. Unless these temperature and humidity conditions are fulfilled, formaldehyde gas will not be effective. Formaldehyde enters living organisms through their cell walls by means of absorption of water. Please note that auto ignition temperature of paraformaldehyde is 300°C (572 °F).

Based on the volumeof the cabinet, calculate the amount of paraformaldehyde andammonium bicarbonate needed as follows:

1. Paraformaldehyde amount (gram): Total volume ($m^3$) x 11gram/$m^3$(per NSF49 Standard)
2. Ammonium bicarbonate amount (gram):

   Steps to determine the amount of Ammonium Bicarbonate required:

   a. Determine the stoichiometric amount of ammonium bicarbonate needed to produce the requisite amount ofammonia gas that would neutralize the resulting formaldehyde gas.
   b. To ensure completion of the reaction, make sure that the weight of ammonium bicarbonate is 10% greaterthan the weight of the paraformaldehyde used.
3. Completely enclose the cabinet using a plastic bag and ensure air-tightness inside the enclosure by using tapes atall appropriate places. Pay special attention to the power supply cables.
4. Wear appropriate protective clothing based on your risk assessment.
5. Thoroughly surface-decontaminate the work surface, side walls, inner back walls, recessed pan and interior surface of the window using appropriate disinfectant. Do not use any disinfectants containing chlorine-based substance. Surface decontamination should be carried out for the UVlights and electrical outlet as well.
6. Spread the Paraformaldehyde evenly over the surface of the heating device. Place another heating device is on the work tray for the Ammonium Bicarbonate. At this stage, the AmmoniumBicarbonate should be restricted from mixing with the air in the cabinet.

Following are two ways of restricting Ammonium Bicarbonate:

**Method 1:**

- Spread the Ammonium Bicarbonate evenly over the surface of the heating device and then cover the device with aluminum foil in such a way that Ammonium Bicarbonate cannot react with Formaldehyde while decontamination is in progress.
- The aluminium foil can be placed in such a way that it allows ammonia gas to escape when the device is heated. Alternatively, some provision can be made for removing the aluminium foil remotely at the beginning of the neutralization phase.
- Make sure that the deployment of such a removal mechanism doesn't lead to unsafe levels of Formaldehyde escaping out of the plastic bag enclosing the cabinet.

**Method 2:**

- Seal the cabinet using a special plastic sheet that has a pair of gloves built into it. The ammonium bicarbonate is placed in a sealed container inside the cabinet.
- Using the built-in gloves, the person performing the decontamination would be able to reach the work zone of the cabinet without having to break the seal. At the beginning of the neutralization phase, Ammonium Bicarbonate is removed from the sealed container and spread evenly over the surface of the heating device. The heating device is then switched ON so that ammonia is generated from ammonium bicarbonate.

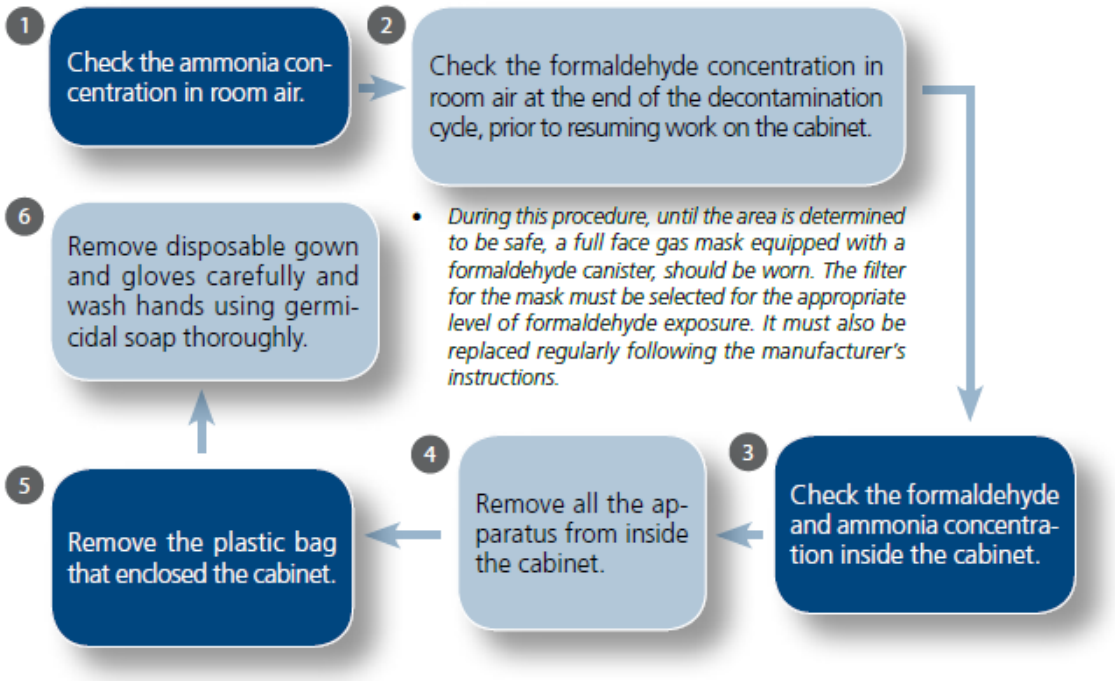
7. After approximately 25, 50, 75, and 100% of the formalin being evaporated, turn on the cabinet blower for 1 minute to circulate the formalin throughout the cabinet. Below is the approximate time interval to turn on the blower, corresponding to the formalin and ammonia table for the "worst case scenario" as previously discussed:

| Cabinet Width | 2 ft / 0.6 m | 3 ft / 0.9 m | 4 ft / 1.2 m | 5 ft / 1.5 m | 6 ft / 1.8 m |
|---|---|---|---|---|---|
| **Volume ($m^3$)** | 1 | 1.5 | 2 | 2.5 | 3 |
| **Blower ON interval** | 5 mins | 7.5 mins | 10 mins | 12.5 mins | 15 mins |

Notes:

- Allow the formalin vapor a minimum contact time of 8 hours inside the cabinet, preferably 10 hours, but overnight is better.
- Allow the ammonia vapor a minimum neutralization time of 2 hours inside the cabinet. After the neutralization time is completed, the plastic bag enclosure can be opened. Please be aware thatthe formalin and / or ammonia concentration inside the plastic bag may be above the Short Term Exposure Level(STEL) and full face mask with formalin and / or ammonia filter should be worn when opening the plastic bag.

### 7.9.7. Decontamination Completion Step




Before the filters are removed from the cabinet, their contaminated faces should be taped off using plastic film or cardboard or some other suitable material. This will minimize the risk of personnel in the event the decontamination was not thorough.

Used filters should be disposed following local regulations. They may have to be incinerated as medical waste. They should be double bagged and appropriately labeled following removal from the cabinet.

### 7.9.8. Validation of Decontamination Procedure

Validation of decontamination procedure must be carried out when the decontamination procedure is validated. Esco encourages the user to carry out periodic validation with biological indicator to ensure the successful performance of the decontamination process. The procedures below assume spore strips are used.

1. Place some spore strips of *Bacillus subtilis var. niger* inside the cabinet prior to decontamination. Suggested locations include:
    a. Work surface/table tray
    b. Recessed pan
    c. Downstream HEPA filter
2. Place similar strips outside the decontamination room for positive control (recommended).
3. Remove all the spore strips and place in Trypticase-soy broth and incubate for 2 days at 37 °C.
4. If there is no growth of bacteria inside the broth (the broth remains clear), the decontamination procedure has been successfully verified.

Where non-spore strips biological indicators are used, user must follow manufacturer's instructions to ensure appropriate performance.

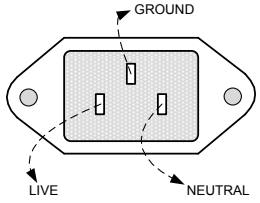
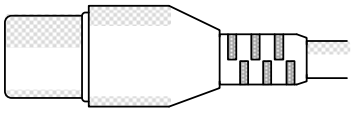
# Chapter 8 - Troubleshooting

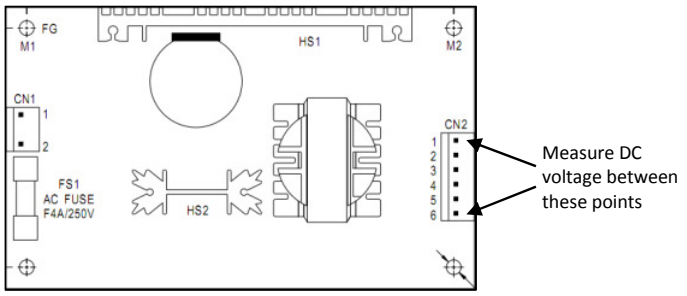
This section helps you troubleshoot some of the common problems you might face while operating this cabinet. This section should be done by trained service personnel. Should you have any queries left unanswered here, please feel free to contact Esco.

Please study the electrical circuit diagram carefully before you start using this cabinet. You can find the electrical diagram inside the electrical panel which in turn is behind the front panel.

This cabinet must be certified after installation and re-certified whenever it is moved, its performance is suspect or as frequent as warranted by your risk assessment.

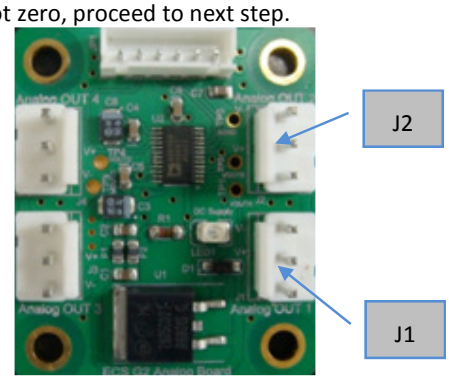
## 8.1. Electrical and Mechanical Troubleshooting

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| **Cabinet does not start** | Power failure | • Check if there is power at the wall / building socket.<br>• You can use voltmeter or test pen to check power on the wall / building socket. |
| | Power cord is faulty or not connected properly | • Check whether power cord has been connected properly into wall / building socket and also into the unit. Some cabinet has 2 power cords.<br>• Check whether the power cord is giving power by measuring the AC voltage between the live and the neutral terminal of the cord by using voltmeter (see figure below).<br>• If the voltage is NOT within ±2% of the wall socket voltage, replace the cord.<br>Make sure to use the same rating of the power supply cord as provided by the original. It is to prevent failure operation of the cabinet, electrical and fire hazard. Esco will not be responsible to any accidents or failures caused by fault rating of the power supply cord replacement.<br>• If the voltage is within ± 2% of the wall socket voltage, please proceed to the next step.<br>  <br>Cordset MALE<br>  <br>Cordset FEMALE |
| | Fuse has blown | • Cut the electrical power supply to the unit<br>• Check the continuity between the two ends of the fuse F1 in Power Distribution Board.<br>• If there is no continuity, then the fuse has blown. Call service person to replace with the correct fuse rating (T 8A H 250 VAC).<br>• Otherwise, proceed to the next step. |

<table>
<tr><th>Problem</th><th>Possible Cause</th><th>Corrective Action</th></tr>
<tr><td></td><td>Improper connection</td><td>• Lift-up the front panel and locate electrical box behind it.<br>• Open electrical box and switch on the unit.<br>• Carefully measure AC voltage between LIVE and NEUTRAL terminal block inside electrical box.<br>• The voltage should be 230 VAC or 115VAC± 10%.<br>• If the voltage is out of the range, check cable connection at connector A pin 1, 2 and 3 (for 230 VAC cabinet) or connector A pin 1, 3, and 5 (for 115 VAC cabinet).<br>• At connector A, confirm the voltage is present using the table below.<br>• See drawing Layout B at the end of this section to locate connector A and find pin numbering system of the connector.</td></tr>
<tr><td rowspan="4">Cabinet does not start</td><td>Defective power supply (SMPS)</td><td>• Check the SMPS (switching mode power supply Model PS-65-12 Mean Well)<br>• Input 230VAC or 115VAC± 10%.<br>• Output +12VDC ± 10% (Red-Black cable).<br>• Unit must be turned on to perform this test.<br>• See electrical drawing for SMPS connection.<br>• Checking SMPS output: measure the DC voltage between Red and Black cables on the SMPS side(CN2, see figure below).<br>• The voltage should be in range of +12VDC ± 10%.<br>• If out of range, please check incoming power to the SMPS(CN1, see figure below). The input of SMPS should be 230 VAC± 10% for 230 VAC cabinet or 115 VAC± 10% for 115 VAC cabinet. If input is correct but output is not, then replace the SMPS.</td></tr>
<tr><td colspan="2"> 

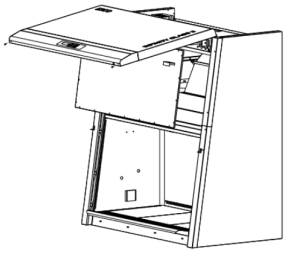
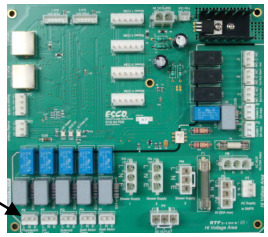
<table>
<tr><th>Part #</th><th>Description</th><th>I/O</th></tr>
<tr><td>CN1</td><td>AC Supply from PDB</td><td>I</td></tr>
<tr><td>CN2</td><td>DC Supply to PDB</td><td>O</td></tr>
</table></td></tr>
<tr><td>Power Connection problem, from SMPS to Power distribution board (PDB)</td><td>• See electrical drawing for locationpower distribution board (PDB) inside electrical panel.<br>• Measure the incoming voltage on the Power distribution board (PDB) at terminal PU. See electricaldrawing for pin out polarity<br>• Voltage should be +12VDC ± 10%.<br>• If voltage is out of range, check connection between SMPS and PDB.<br>• If voltage is correct, proceed to next step.</td></tr>
<tr><td>Power Connection problem, from Power</td><td>• Refer to theelectrical drawing for the location main control board (MCB) inside electrical panel.</td></tr>
</table>

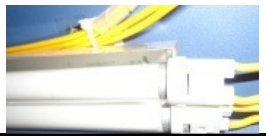
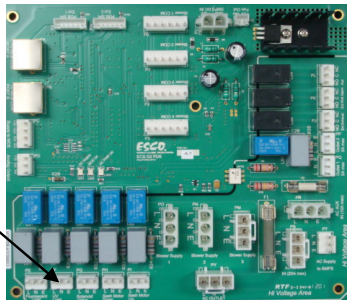
| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | Distribution Board (PDB) to Main Control Board(MCB) | • Measure the incoming voltage on the Power distribution board(PDB) at terminal PC (see Figure 8.2) and on the Main Control Board at terminal ME1 (see Figure 8.1). See electricalfor pin out polarity.<br>• Voltage should be +12VDC ± 10%.<br>• If voltage is out of range (at terminal PC), replace the power distribution board (PDB).<br>• If voltage is out of range (at terminal ME1), check connection between PDB and MCB.<br>• If voltage is correct, proceed to next step. |
| **Cabinet does not start** | Power connection problem from Main Control Board(MCB) to user Interface Board(UIB) | • See electrical drawing for locationuser interface board (UIB) inside electrical panel.<br>• Measure the incoming voltage on the Main Control Board at terminal MA1 (see Figure 8.1) and on the user interface board (UIB) at terminal UA1 (see Figure 8.3). See electricalfor pin out polarity.<br>• If voltage is out of range (at terminal MA1), replace the main control board (MCB).<br>• If voltage is out of range (at terminal UA1), check connection between PDB and MCB.<br>• If voltage is correct, proceed to next step. |
| | Broken Main Control Board (MCB) | • Restart the cabinet 2 to 4 times.<br>• The Main Control Board is defective if the Main ControlBoard incoming supplyis +12VDC ± 10% AND:<br>– "MCB OK" LED is off at the power distribution board (PDB).<br>– The LCD message "Starting up failed, watchdog failure"<br>– There is no Buzzer sound.<br>• If these conditions exist, replace the Main Control Board.<br>• If these conditions DO NOT exist, proceed to next step. |
| | BrokenUser Interface Board (UIB) | • Restart the cabinet 2 to 4 times.<br>• The User Interface Board is defective if the UIB board incoming supply is +12VDC ± 10% AND:<br>– the LCD is blank<br>– the Buzzer sound<br>• If these conditions exist, replace the User Interface Board.<br>• If these conditions DO NOT exist, proceed to next step. |
| | BrokenPower Distribution Board (PDB) | • Ensure the following are correct:<br>– Main Control Board is operational.<br>– User Interface Board is operational.<br>– Power Distribution Board has the correct incoming voltage (+12VDC ± 10%).<br>– All wiring connectionsare good.<br>• Turn the cabinet on, if the FAN, LIGHT, SOCKET and UV cannot be controlled, replace the power distribution board (PDB).<br>• If any of the components FAN, LIGHT, SOCKET or UV can be controlled, proceed to the next step. |
| **Power-failure alarmdoesn't work** | BrokenBackup Power Module(BPM) | • Switch off the cabinet. Switch on the cabinet.<br>• The Backup Power Module is defective if the LED 1 at BPM is off, replace the Backup Power Module.<br>• If LED 1 at BPM is on, proceed to next step. |

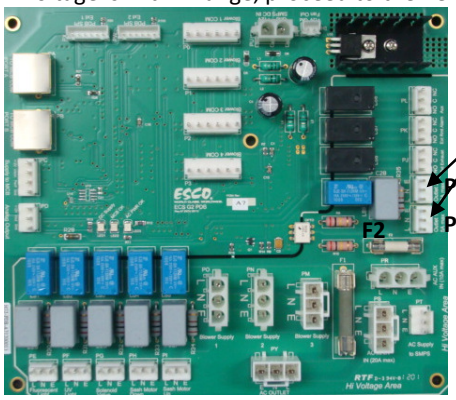
| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | |  Backup Power Module LED1 |
| | Broken buzzer | • Switch off the cabinet. Switch on the cabinet.<br>• If LED 1 at BPM is on, checkconnection between Main Control Board (MCB) to buzzer.<br>• If connection is fine, replace the buzzer.<br>  |
| **Motor is silent** | Fan is Off | • Switch on the Fan by pressing Fan button on control panel.<br>• Enter the Fan PIN number if required (default is 0001).<br>• The LED for FAN should illuminate and the FAN should start.<br>• If the LED does not illuminate, check connection from control panelto main board or replace the membrane.<br>• If the FAN does not come on, proceed to next step. |
| | Broken Digital to Analog Converter Board (DAC) | • Switch on the Fan by pressing Fan button on control panel.<br>• Enter the Fan PIN number if required (default is 0001).<br>• Measure the DC voltage between the V+ and V- terminals of both the connector J1 and J2 in the Analog Board<br>• If the voltage is zero, then the Analog Board is damaged.<br>• If the voltage is not zero, proceed to next step.<br>  J2 J1 |

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | BrokenECMS Motor Controller | • Switch on the Fan by pressing Fan button on control panel.<br>• Enter the Fan PIN number if required (default is 0001).<br>• If the seven segment display on the ECMS Motor Controller does not turn on, replace the ECMS Motor Controller.<br>ECMS Seven Segment Display  |
| **Blank LCD** | Connection problem | • Turn off the cabinet.<br>• Open the front panel and locate UIB and the LCD behind the panel.<br>• Check whether the LCD connector (20 pins) has been insertedproperly into its socket on the user interface board (UIB). Refer to electrical drawing for more information.<br>• If LCD has been connected properly to the UIB, proceed to next step. |
| | User Interface Board not yet programmed | • Turn on the cabinet.<br>• Open the front panel and locate UIB and LCD behind it.<br>• If the LED (MCB OK) on UIB is not blinking and buzzer does not sound, please re-program the User interface board.<br>• If these conditions DO NOT exist, proceed to next step. |
| | Broken LCD | • If the LCD does not show any information, while the membrane buttons and indicator LEDs are functional, then the LCD is damaged so pleasereplace it with new LCD. |
| **Inoperative buttons** | Broken membrane keypad | • Turn the cabinet on.<br>• If the unit does not respond to any membrane button press while no watchdog failure alarm is being sounded, then the membrane keypad is damaged.<br>• Replace the membrane. |
| **Airflow Failure – alarm is triggered (this could be due to either hardware or software)** | External air Interference | • Ensure that there is no external source of airflow disturbance like air conditioning vent, window or incidences of door opening or people walking fast near the cabinet.<br>• If there is no external air interference, proceed to next step. |
| | Blocked cabinet grill | • Ensure that the front and back air grilles inside the cabinet are not blocked and that the cabinet is not excessively loaded.<br>• If there is no blocked air grille, proceed to next step. |

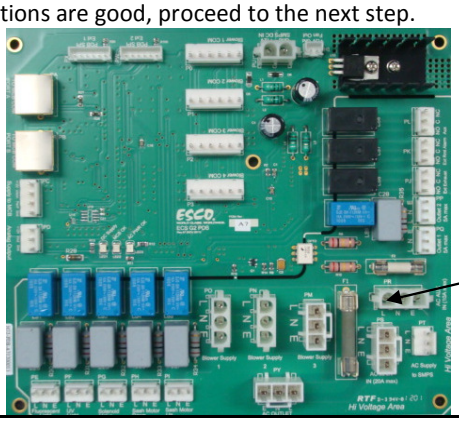
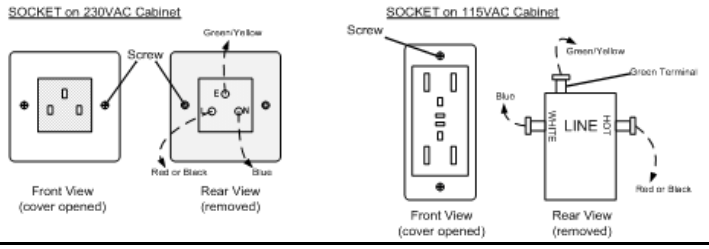
| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | Sensor Failure | • There are 2 pcs airflow sensor: exhaust and downflow. The sensors are installed inside the donuts chasing. See picture below.<br>– Exhaust airflow sensor is located on top of the unit, above exhaust filter.<br>– Downflow airflow sensor is located below the downflow filter, inside cabinet work zone.<br>– Important to check:<br>✓ Ensure that the sensors area is not blocked and that their through holes are perpendicular to the filter's surface.<br>✓ Exhaust sensor is attached tightly to the bracket.<br>✓ There is no gap between sensor chasing and filter surface.<br>✓ Sensor brackets are installed tightly to the cabinet.<br>✓ Note: the sensors operating temperature range is 5-35°C.<br>• Turn on the cabinet.<br>• Open the front panel and locate the electrical panel behind it.<br>• Referto electrical drawing layout and use multimeter to<br>– Check sensor's input voltage(+12 VDC) at channel MN1(red cable) for exhaust sensor and channel MO1(red cable) for downflow sensor on Main Control Board (MCB).<br>✓ Voltage should be +12VDC ± 10%.<br>✓ If thevoltage is out of range, replace the main control board (MCB).<br>– Check sensor's output voltage (DC) atchannel MN1(white cable(+), black cable(-)) for exhaust sensor and channel MO1 (white cable(+), black cable(-)) for downflow sensor on main control board (MCB).<br>✓ Voltage range should be 0-10 VDC.<br>– Increasing the blower speed will increase the sensor's output voltage while lowering the blower speed will reduce the sensor's voltage output.<br>✓ If your observation is different, the sensors connection for any bad/looseconnection.<br>✓ If connection is fine but sensor is still not working properly, replace the sensor.<br>✓ If airflow sensor is working properly, proceed to next step.<br>    |
| | Motor failure | • Check the motor. If motor is not running, refer to 'motor is silent' problem.<br>• If motor is working properly, proceed to next step. |
| **Airflow Failure – alarmis triggered (this couldbe due to** | Filter loaded | • Turn off the cabinet.<br>• See filter life at the main screen of the cabinet display, if the filter life is low(closed upon 10%), the filter should be replaced.<br>• If filter is not loaded, proceed to next step. |

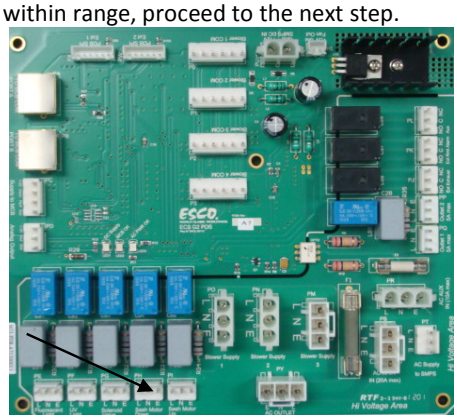
| Problem | Possible Cause | Corrective Action |
|---|---|---|
| **either hardwareor software)** | Faulty/ inaccurate calibration | • Re-calibrate the microprocessor. Follow the calibration procedureavailable in the certification procedure.<br>***Warning:****The recalibration is to be carried out only by an authorizedperson.*<br>• If calibration has been done properly, proceed to next step. |
| | Others | • Please refer to software troubleshooting section for moreinformation. |
| **Excessive fan noise** | Loose motor or impeller wheel mounting | ***Warning:****For next step, decontaminate the unit before accessing toblower. To be carried out only by an authorized person.*<br>• After docontamination, open the blower access panel (see picture below) and check if the blower mounting bolts have beenfully tightened.<br>• Also check whether the motor can rotate properly and not loose.<br>• If motor is physically damaged, replace it.<br>  |
| **Light always OFF** | Sash in SASH ALARM or UV state | • Move the sash to Ready position (normal operating height).<br>• Ready/Safe position is indicated by black dot mark on the right profilecover.<br>• Turn on the light by pressing LIGHT button on the membrane/keypad.<br>• Light can only be turned ON at Ready/Safe or Fully Open sash position.<br>• If light cannot be turned ON when sash at Ready/Safe position, proceed tonext step. |
| | Faulty relay | • Open front panel and refer to the electrical drawing.<br>• Turn on the cabinetand turn on the light by pressing the LIGHT button on the membrane.<br>• Please check relay LS1 on the power distribution board (PDB).<br>• On terminal PE, check AC voltagethe Life(L) and Neutral (N).<br>• Voltage should be 230VAC or 115VAC± 10%.<br>• If voltage is out of range, replace the power distribution board (PDB).<br>• If voltage is correct, proceed to the next step.<br>Measure AC voltage between these points(L and N)<br>  <br>**PE** |

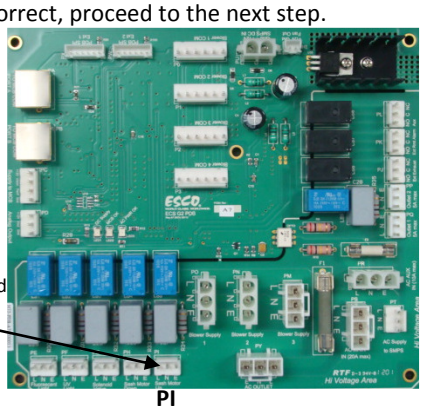
| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | Connection Problem | • Turn off the cabinet.<br>• Open front panel and refer to the electrical drawing.<br>• Check for any loose or bad connection between power distribution board (PDB),fluorescent lamp ballast, and analog output port(PD) at PDB board.<br>• Check also the connection of the lamp holder.<br>• If all connections are good, then proceed to the next step. |
| | Faulty fluorescent tube | • Replace the faulty fluorescent tube.<br>• Fluorescent tube is located inside the blue panel (see picture below).<br>  |
| | Faulty Fluorescent ballast | • Turn off the cabinet.<br>• Open electrical panel and refer toelectrical drawing.<br>• Turn on the cabinet, then turn on the light by pressing LIGHT buttonon membrane/keypad.<br>• Make sure the AC voltage at ballast input is 230VAC± 10% for 230V cabinet or 115VAC± 10%for 115V cabinet.<br>• If not, check the LS1/fluorescent relay (refer to faulty relay section).<br>• Check AC voltage at ballast output, it should be around 450-600VAC.<br>• Replace ballast if output voltage is much lower than this range. |
| **UV Light always OFF** | Sash not in UV state/ wrong sash position | • Make sure the sash position is in closed position and UV button option is displayed on the LCD.<br>• If UV mode is not displayed on the LCD, please refer to theMechanical Switch troubleshooting section.<br>• Switch ON the UV lamp by pressing the UV button.<br>• If UV light is not ON after pressing UVbutton, proceed to next step. |
| | Faulty relay | • Open front panel and refer to the electrical drawing.<br>• Turn on the cabinet and turn on the UV light by pressing the UV button on the membrane.<br>• Check relay LS2on the power distribution board (PDB).<br>• On terminal PF, check AC voltagethe Life(L) and Neutral (N).<br>• Voltage should be 230VAC or 115VAC± 10%.<br>• If voltage is out of range, replace the power distribution board (PDB).<br>• If voltage is correct, proceed to the next step.<br>Measure AC voltage between these points (L and N)<br>  <br>**PF** |

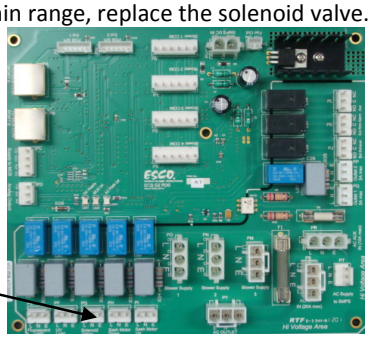
<table>
<tr><th>Problem</th><th>Possible Cause</th><th>Corrective Action</th></tr>
<tr><td></td><td>Faulty UV ballast</td><td>
• Turn off the cabinet.<br>
• Open front panel and refer to the electrical drawing.<br>
• Turn on the cabinet, then turn on the UV light by pressing UV buttonon membrane/keypad.<br>
• Make sure the AC voltage at ballast input is 230VAC± 10% for 230V cabinet or 115VAC± 10%for 115V cabinet.<br>
• If not, check the LS2/UV relay (refer to faulty relay section above).<br>
• Check AC voltage at ballast output, it should be around 10-25VAC for 230VAC cabinet or around 450-600VAC for 115VAC cabinet. See Table 4 below.<br>
• Replace ballast if output voltage is much lower than this range.
<table>
<tr><th>Cabinet Voltage</th><th>Connector</th><th>Pin</th><th>UV Ballast Output</th></tr>
<tr><td>230VAC ±10%</td><td>B</td><td>7 to 8</td><td>10-25VAC</td></tr>
<tr><td>115VAC ±10%</td><td>E</td><td>7 to 8</td><td>450-600VAC</td></tr>
</table>
</td></tr>
<tr><td></td><td>Faulty UV light</td><td>• Replace the faulty UV light or when the UV light life less than 10%.</td></tr>
<tr><td>Electrical Socket always OFF</td><td>Fuse has blown</td><td>
• Cut the electrical power supply to the cabinet.<br>
• Check the continuity between the two ends of the fuse F2 in Power Distribution Board (PDB).<br>
• If there is no continuity, then the fuse has blown.Call service person to replace with the correct fuse rating(T 5A H 250VAC).<br>
• If there is continuity, proceed to the next step.
</td></tr>
<tr><td></td><td>Faulty relay</td><td>
• Open electrical panel andrefer to electrical drawing.<br>
• Turn on the cabinet and turn on the socket by pressing the SOCKET button on the membrane.<br>
• Check relay LS9on the power distribution board (PDB).<br>
• On terminal PP/PQ, check AC voltagethe Life(L) and Neutral (N).<br>
• Voltage should be 230VAC or 115VAC± 10%.<br>
• If voltage is out of range, replace the power distribution board (PDB).<br>
• If voltage is within range, proceed to the next step.<br>


</td></tr>
</table>

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | Connection Problem | • Turn off the cabinet.<br>• Open electrical panel and refer to electrical drawing.<br>• Check for any loose or inadequate contact between power distribution board (PDB) and female connector PR(see picture below). Check also the tightness of cable connection.<br>• If all connections are good, proceed to the next step.<br>  |
| | Faulty electrical socket | • Socket is located inside the workzone.<br>• Check electrical socket connection. Refer to drawing below.<br>• If connection is correct but socket has no output, replace it.<br>  |
| **Sash Windows cannot MoveDown** | Sash in UV state/ wrong sash position | • Make sure the sash position is not in fully closed position and UV button option is not displayed on the LCD.<br>• If the sash is in fully closed position, moving the sash to the right position.<br>• If the sash is not in fully closed position, proceed to the next step. |
| | The system automatically lock the tubular motor | • Go to diagnostic option to see the current sash life cycle value.<br>• Make sure the sash life cycle value is less than 16,000 cycles.<br>• If the sash life cycle more than 16,000, replace the sash motor.<br>• If the sash life cycle less than 16,000, proceed to the next step. |
| | Connection Problem | • Turn off the cabinet.<br>• Open the front panel of the cabinet.<br>• Check for any loose or inadequate contact between power distribution board (PDB) terminal PH and tubular motor (refer to electrical drawing) also the cable tightness.<br>• If all connections are good, proceed to the next step. |
| | Faulty relay | • Open front panel and refer to the electrical drawing.<br>• Turn on the cabinet and move down the sash window by pressing the SASH DOWN button on the membrane. |

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | | • Check relay LS4on the power distribution board (PDB).<br>• On terminal PH, check AC voltagethe Life(L) and Neutral (N).<br>• Voltage should be 230VAC or 115VAC± 10%.<br>• If voltage is out of range, replace the power distribution board (PDB).<br>• If voltage is within range, proceed to the next step.<br>Measure AC voltage between these points (L and N)<br>  <br>**PH** |
| | Broken Tubular motor. | • Turn off the cabinet.<br>• Open the front panel of the cabinet.<br>• If the tubular motor looks faulty, replace the tubular motor.<br>• If not, turn on the cabinet then press SASH UP button to move up the sash windows.<br>• If the sash cannot move up, then the tubular motor may be broken, replace the tubular motor.<br>• If the sash is moving up, proceed to the next step. |
| | Incorrect setting of the tubular motor(for downward movement) | • Open the front panel of the cabinet.<br>• Turn on the cabinet.<br>• Press SASH DOWN button followed by pushing (forward) the tubular motor lock button.<br>*Note: You can find the lock button at the top right corner of the tubular motor.*<br>• Release the button if the sash window reaches the fully closed position. |
| **Sash Windows cannot MoveUp** | Sash in Fully Open position/ wrong sash position | • Make sure the sash position is not in fully open position and the cabinet is not in decontamination process.<br>• If the sash is in fully open position, move the sash to the right position.<br>• If the decontamination process is active, stop the decontamination process.<br>• If the sash is not in fully open position, proceed to the next step. |
| | The System automatically locked the tubular motor | • Go to diagnostic option to see the current sash life cycle value.<br>• Make sure the sash life cycle value less than 16,000 cycles.<br>• If the sash life cycle more than 16,000, replace the sash motor.<br>• If the sash life cycle less than 16,000, proceed to the next step. |
| | Connection Problem | • Turn off the cabinet.<br>• Open the front panel of the cabinet. |

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | | • Check for any loose or inadequate contact between power distribution board (PDB) terminal PI and tubular motor (refer to electrical drawing). Check also the tightness of cable connection.<br>• If all connections are good, proceed to the next step. |
| | Faulty relay | • Open front panel and refer to the electrical drawing.<br>• Turn on the cabinet and moving up the sash window by pressing the SASH UP button on the membrane.<br>• Check relay LS5on the power distribution board (PDB).<br>• On terminal PI, check AC voltagethe Life (L) and Neutral (N).<br>• Voltage should be 230VAC or 115VAC± 10%.<br>• If voltage is out of range, replace the power distribution board (PDB).<br>• If voltage is correct, proceed to the next step.<br>Measure AC voltage between these points (L and N)<br>  <br>PI |
| | Broken Tubular motor. | • Turn off the cabinet.<br>• Open the front panel of the cabinet.<br>• If the tubular motor looks failed/broken, replace the tubular motor.<br>• If not, turn on the cabinet then press SASH DOWN button to move down the sash windows.<br>• If the sash cannot moving down then the tubular motor is likely to be faulty, replace the tubular motor.<br>• If the sash is moving down, proceed to the next step. |
| | Incorrect setting the tubular motor(for moving up) | • Open the front panel of the cabinet.<br>• Turn on the cabinet.<br>• Press SASH UP button followedby pulling the tubular motor lock button.<br>*Note: You can find the lock button at the top right corner of the tubular motor.*<br>• Released the button if the sash window reaches the fully open position. |
| **Solenoid valve doesn't open/close** | Sash not in SAFE state/ wrong sash position | • Make sure the sash position is in safe position, the condition is "AIR SAFE" and GAS button option is displayed on the LCD.<br>• If sash window is in safe position and GAS button is not displayed on the LCD, please refer to theairflow failure alarm troubleshooting section.<br>• Open the solenoid valve by pressing the GAS button.<br>• If the Solenoid valve cannot open, proceed to next step. |
| | Connection Problem | • Turn off the cabinet.<br>• Open the front panel of the cabinet. |

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| | | • Check for for any loose or inadequate contact between power distribution board (PDB) terminal PG and Solenoid valve (see electrical drawing). Check also the tightness of cable connection.<br>• If all connections are good, proceed to the next step. |
| | Faulty relay | • Open electrical panel andrefer to electrical drawing.<br>• Turn on the cabinet and make sure the sash position is in safe position, air condition is “AIR SAFE” and GAS button option is displayed on the LCD.<br>• Open the solenoid valve by pressing the GAS button.<br>• Check relay LS3on the power distribution board (PDB).<br>• On terminal PG, check AC voltagethe Life (L) and Neutral (N).<br>• Voltage should be 230VAC or 115VAC± 10%.<br>• If voltage is out of range, replace the power distribution board (PDB).<br>• If voltage is within range, replace the solenoid valve.<br>Measure AC voltage between these points (L and N)<br>  <br>**PG** |
| **Contaminated samples** | Leaking downflow filter | • Decontaminate the cabinet and check the location of the leaking filter.<br>• Patch the leaking filter with 3M DP-100 glue. The patched area should not exceed 4% of the total filter area. Then check the filter for leakage again.<br>• If the filter is still leaking, decontaminate the cabinet and change the downflow filter.<br>• Re-certify the cabinet after the new filter has been installed. |
| | Low airflow | • Adjust the speed control (located inside the electrical panel, behind the front panel) and / or damper (if present, located on top of the unit, above exhaust filter) to get the optimum airflow as stated in the test report. |
| | Blocked air grille | • Make sure that the front and back air grilles are not blocked. |
| | Leaking exhaust filter | • Exhaust filter is located on top of the unit.<br>• Patch the leaking filter with 3M DP-100 glue.The patched area should not exceed 4% of the total filter area. Then check the filter for leakage again.<br>• If the filter is still leaking, decontaminate the cabinet and change the exhaust filter.<br>• Re-certify the cabinet after the new filter has been installed. |

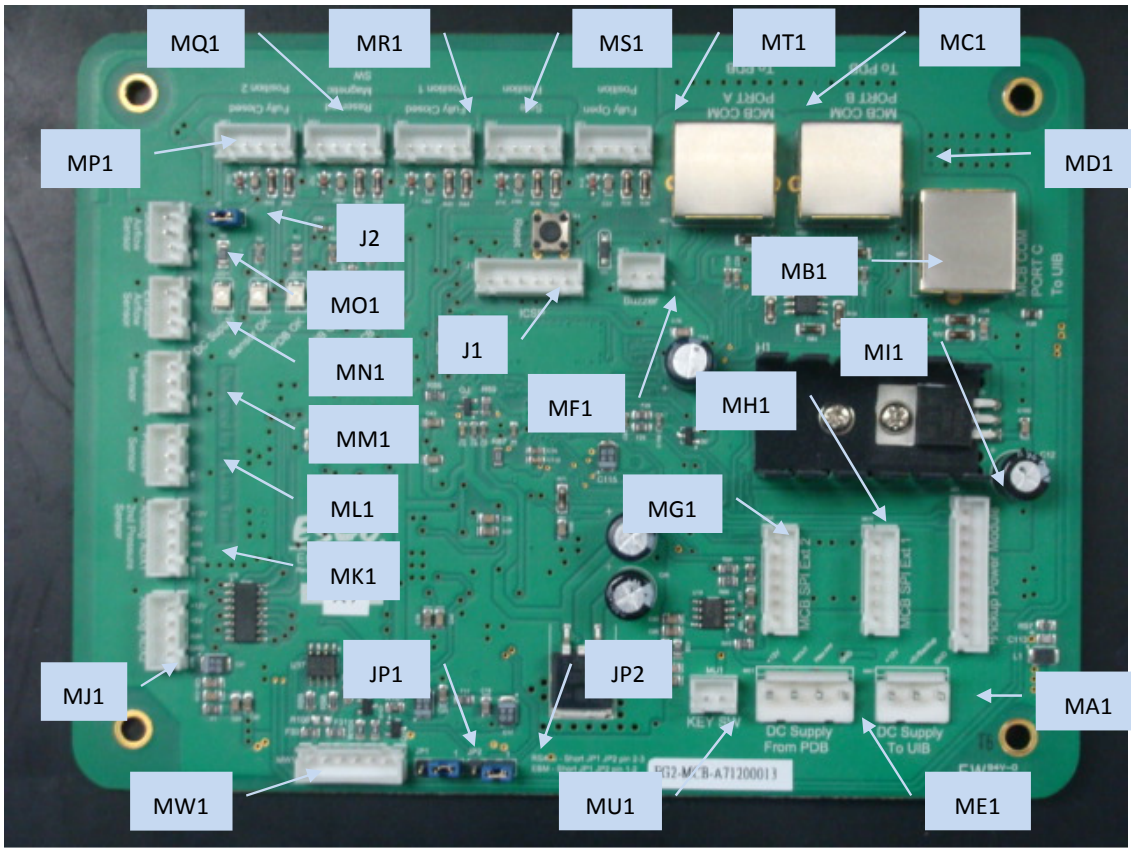



**Figure 8.1. Main controller board input / output**

| Part # | Description | I/O |
|---|---|---|
| MA1 | DC Supply to UIB | O |
| MB1 | Communication Port C | I/O |
| MC1 | Communication Port A | I/O |
| MD1 | Communication Port B | I/O |
| ME1 | DC Supply from PDB | I |
| MF1 | Buzzer | O |
| MG1 | MCB SPI Peripheral Port 2 | I/O |
| MH1 | MCB SPI Peripheral Port 1 | I/O |
| MI1 | Backup Power | I/O |
| MJ1 | Auxiliary Sensor 2 | I/O |
| MK1 | Auxiliary Sensor 1 | I/O |
| ML1 | Pressure Sensor | I/O |
| MM1 | Temperature Sensor | I/O |

| Part # | Description | I/O |
|---|---|---|
| MN1 | Exhaust Airflow Sensor | I/O |
| MO1 | Downflow Airflow Sensor | I/O |
| MP1 | Sash Fully Closed Switch 2 | I |
| MQ1 | Reserved Switch | I |
| MR1 | Sash Fully Closed Switch 1 | I |
| MS1 | Sash Safe Switch | I |
| MT1 | Sash Fully Open Switch | I |
| MU1 | Key Switch | I |
| MW1 | RS-485 Communication Port | I/O |
| J1 | ICSP Programming Interface | I/O |
| J2 | Fully Closed 2 Jumper | I |
| JP1 | UART Transmit Jumper | I |
| JP2 | UART Receive Jumper | I |

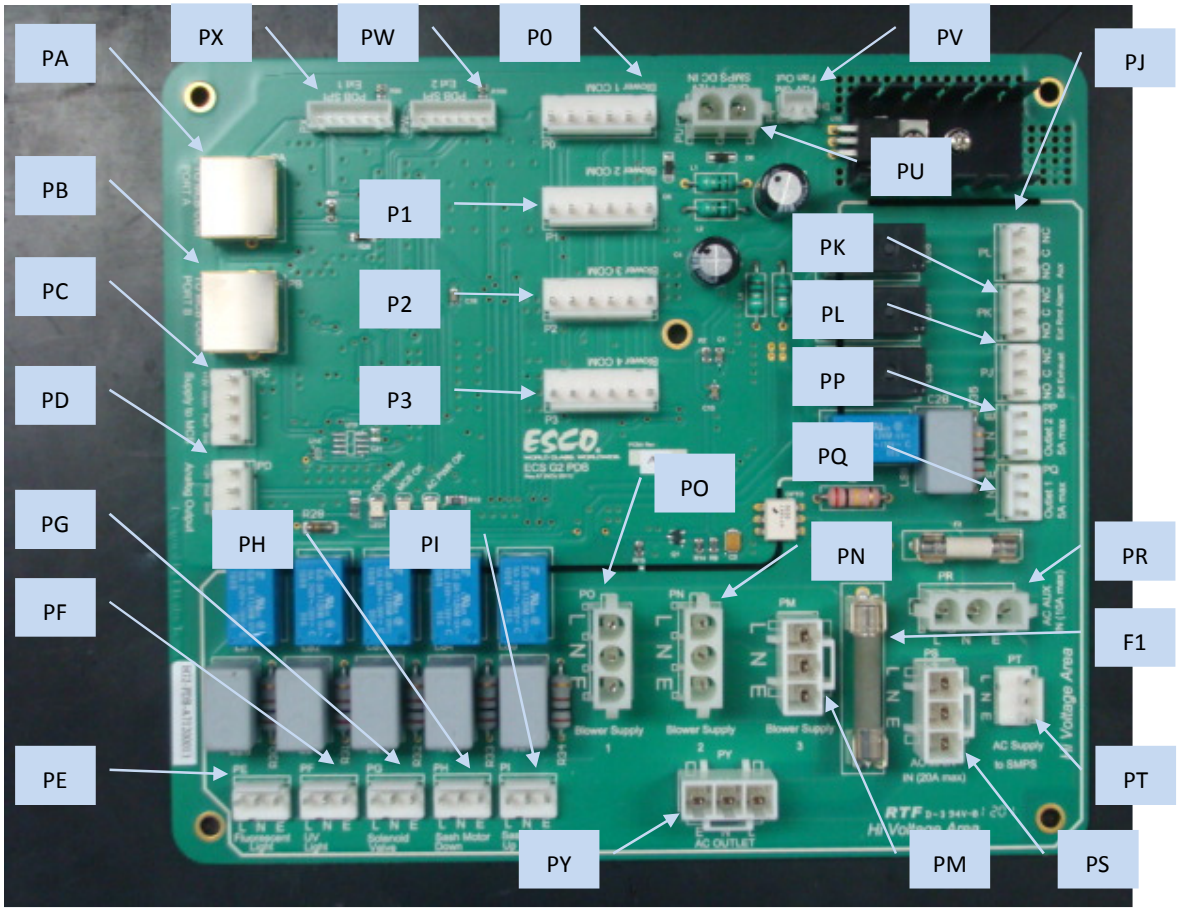



**Figure 8.2. Power distribution board input / output**

| Part # | Description | I/O |
|---|---|---|
| PA | Communication Port A | I/O |
| PB | Communication Port B | I/O |
| PC | DC Supply to MCB | O |
| PD | Analog Output | O |
| PE | Fluorescent Light | O |
| PF | UV Light | O |
| PG | Solenoid Valve | O |
| PH | Sash Motor Down | O |
| PI | Sash Motor Up | O |
| PJ | External Exhaust | O |
| PK | Remote Alarm | O |
| PL | Auxiliary Relay | O |
| PM | Blower Supply 3 | O |
| PN | Blower Supply 2 | O |
| PO | Blower Supply 1 | O |
| PP | Electrical Outlet 2 | O |

| Part # | Description | I/O |
|---|---|---|
| PQ | Electrical Outlet 1 | O |
| PR | Auxiliary AC Input | I |
| PS | Main AC Input | I |
| PT | AC Supply to SMPS | O |
| PU | DC Supply from SMPS | I |
| PV | Cooling Fan | O |
| PW | PDB SPI Peripheral Port 2 | I/O |
| PX | PDB SPI Peripheral Port 1 | I/O |
| PY | Main AC Outlet | O |
| P0 | Blower 1 Communication Port | I/O |
| P1 | Blower 2 Communication Port | I/O |
| P2 | Blower 3 Communication Port | I/O |
| P3 | Blower 4 Communication Port | I/O |
| PQ | Electrical Outlet 1 | O |
| PR | Auxiliary AC Input | I |
| PS | Main AC Input | I |

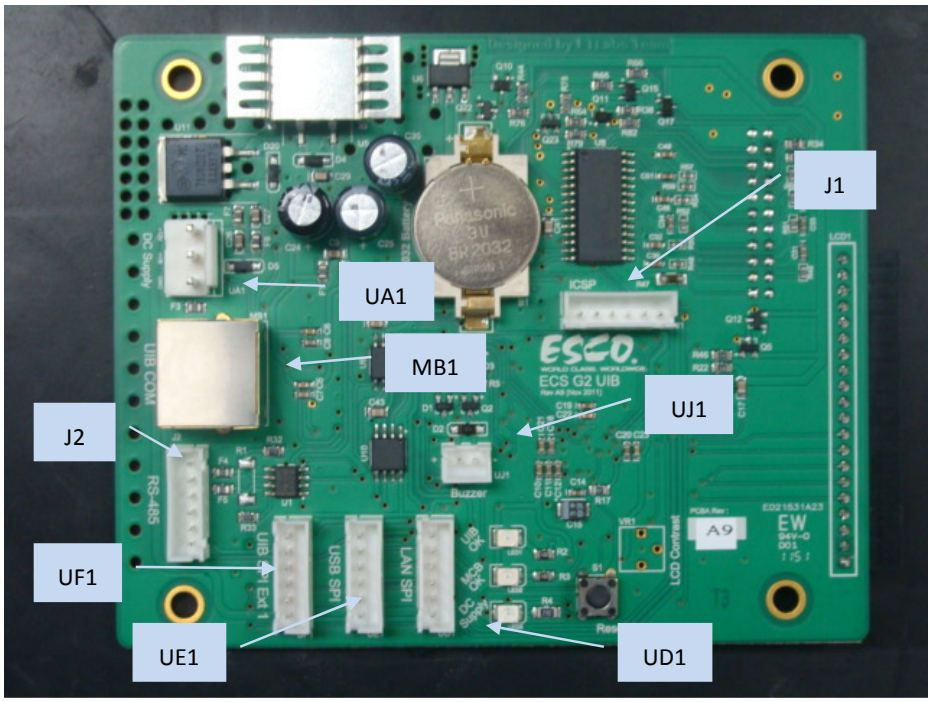



**Figure 8.3. User interface board input / output**

| Part # | Description | I/O |
|---|---|---|
| UA1 | DC Supply from MCB | I |
| UD1 | SPI Peripheral Port for LAN | I/O |
| UE1 | SPI Peripheral Port for USB | I/O |
| UF1 | UIB SPI Peripheral Port 1 | I/O |
| UJ1 | Buzzer | O |
| J1 | ICSP Programming Interface | I/O |
| J2 | RS-485 Communication Port | I/O |
| MB1 | UIB Communication Port | I/O |

## 8.2. Sash Detection Function

Esco cabinets use switches in order to help the control system keep track of the position of the sash window. The way this tracking is done can be better understood from the diagram and table below. The lower end of the sash window can be moved over the range indicated by the arrow on the left in the diagram below. The cabinet makes use of three switches which have been shown on the right.

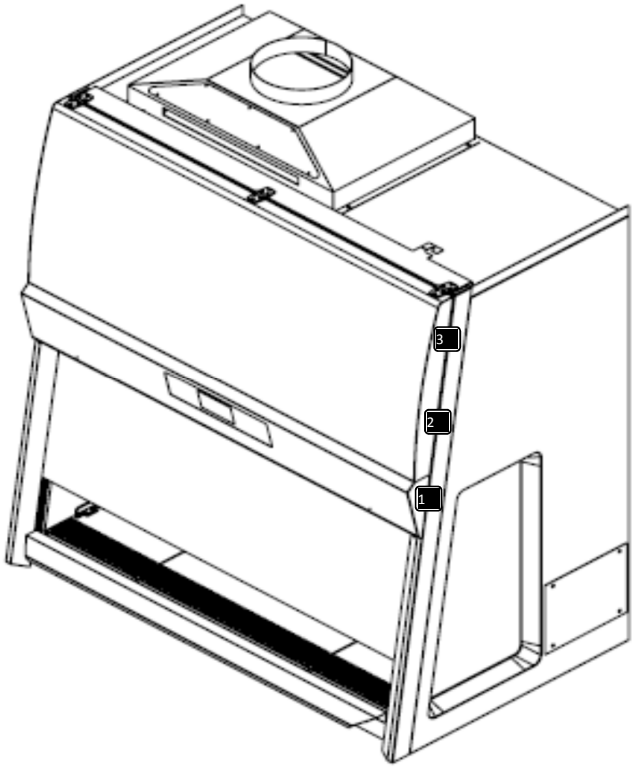



**Figure 8.4. Location of the switches**

**Table 8.1. Sash state detection**

| Switch 1 | Switch 2 | Switch 3 | Description |
|---|---|---|---|
| Close | Open | Open | Sash window is fully closed; UV lamp can be activated. |
| Open | Close | Open | Sash window is at normal operating height; Cabinet is ready for use. |
| Open | Open | Close | Sash window is fully opened. |
| Open | Open | Open | Sash window is either in between fully open position and normal operating height or it is in between fully close position and normal operating height; It is unsafe to operate the cabinet in this state; Sash alarm sounds. |
| Any other combination of the states of the switches | | | ERR.MCWITCH detected. |

The basic principle behind the sash position detection mechanism is that two switches cannot be closed at the same time. If such a condition arises, the user must check the condition of the switches. If the displayed message does not match the actual sash position, check the state of the switches by removing the sash profile.

## 8.3. Sash Operation Mode Summary

| Sash position | Function available | Normal mode and air fail alarm on | Normal mode and air fail alarm off | Maintenance mode |
|---|---|---|---|---|
| **READY/SAFE** | Sash position detection | Yes | Yes | Yes |
| | Fan control | Yes, with WARM UP & PURGING time, FAN PIN required | Yes, with WARM UP & PURGING time, FAN PIN required | Yes, with WARM UP & PURGING time, no PIN required |
| | Light control | Yes | Yes | Yes |
| | Socket control | Yes | Yes | Yes |
| | UV control | Interlocked | Interlocked | Interlocked |
| | MENU access | Yes, ADMIN/FAN PIN required | Yes, ADMIN/FAN PIN required | Yes, no PIN required |
| | Pressing SET button | Interlocked | Interlocked | Interlocked |
| | Timer | No | Yes | Yes |
| | Current time display | Yes | Yes | Yes |
| | Air velocity display | Yes | Yes | Yes |
| | Air fail check | Yes, alarm if air velocity falls below specification | Yes, no alarm if air velocity falls below specification | Yes, no alarm if air velocity falls below specification |
| **SASH ALARM /UNSAFE** | Sash position detection | Yes | Yes | Yes |
| | Message displayed | “SASH UNSAFE” | “SASH UNSAFE” | “SASH UNSAFE” |
| | Current time display | Yes | Yes | Yes |
| | Alarm | Yes, not mutable | Yes, not mutable | Not applicable |
| | Fan control | Yes, with WARM UP & PURGING time, FAN PIN required | Yes, with WARM UP & PURGING time, FAN PIN required | Yes, with WARM UP & PURGING time, no PIN required |
| | Light control | No | No | Yes |
| | Socket control | Yes | Yes | Yes |
| | UV control | Interlocked | Interlocked | Interlocked |
| **FULLY OPEN** | Sash position detection | Yes | Yes | Yes |
| | Message displayed | “FULLY OPEN” | “FULLY OPEN” | “FULLY OPEN” |
| | Current time display | Yes | Yes | Yes |
| | Alarm | Yes, mutable for 5 minutes (up to) | Yes, mutable for 5 minutes(up to) | Not applicable |
| | Fan control | Yes, with WARM UP & PURGING time, FAN PIN required | Yes, with WARM UP & PURGING time, FAN PIN required | Yes, with WARM UP & PURGING time, no PIN required |
| | Light control | No | No | No |
| | Socket control | Yes | Yes | Yes |
| | UV control | Interlocked | Interlocked | Interlocked |
| **UV mode** | Sash position detection | Yes | Yes | Not applicable |

| Sash position | Function available | Normal mode and air fail alarm on | Normal mode and air fail alarm off | Maintenance mode |
|---|---|---|---|---|
| | Switch off fan requested | Yes | Yes | Yes |
| | Message displayed | “FULLY CLOSED” | “FULLY CLOSED” | “FULLY CLOSED” |
| | Fan control | No | No | No |
| | Light control | No | No | No |
| | Socket control | Yes | Yes | Yes |
| | UV control | Yes | Yes | Yes |

## 8.4. Software Troubleshooting

| Error Codes | Explanation | Corrective Action |
|---|---|---|
| **Sash: Error position** | Switch error: this error occurs when two or more switches are activated at the same time. | **Step 1:**<br>Remove the connection from MR1, MS1, andMT1 (Figure 8.1) Switch on the system. If the LCD does not show “Sash:UnsafePosition”, the main board is faulty.<br>**Step 2:**<br>In case the main board is fine, then switches can be faulty or the wiring of the sensor can be faulty. To know which sensor is faulty,the steps below should be carried out:<br>• Bring the sash to the unsafe position and connect the nominal sensor connection to the points MS1.<br>• The display should show“Sash: Safe Position”. If it does not then it means that the switch for detection of normal operating height has malfunctioned.Do the same way with the other switches.<br>• Replace the switch/wiring for the malfunctioned switch. |
| **Wacthdog Failure** | There is a communication problem between Main Controller Board and User Interface Board. | • If the buzzer does not sound, please check the cable connection between MCB and UIB.<br>• If the buzzer not sound, please check the Main Control Board:<br>1. Reset the Main Controller Board (press the reset button on the MCB).<br>2. If after resetting the MCB, the watchdog failure message still appears at UIB, replace or re-flash the MCB board. |

# Chapter 9 - Replacement Parts List

The use of non-Esco parts and/or parts not supplied directly by Esco or our authorized distributors, including but not limited to spare parts, system components and/or system accessories, shall void all expressed or implied warranties.

| No | Item / Cabinet Model | Item Code | Description | Qty |
|---|---|---|---|---|
| **MECHANICAL REPLACEMENT PARTS** | | | | |
| **1** | **Filter** | | | |
| | EC2-4LX / EC2-4SX | 1100132 | Downflow filter (ULPA Filter No. 155) | 1 |
| | | 1100243 | Exhaust filter (ULPA Filter No. 272) | 1 |
| | EC2-5LX / EC2-5SX | 1100337 | Downflow filter (ULPA Filter No. 367) | 1 |
| | | 1100338 | Exhaust filter (ULPA Filter No. 368) | 1 |
| | EC2-6LX / EC2-6SX | 1100336 | Downflow filter (ULPA Filter No. 366) | 1 |
| | | 1100329 | Exhaust filter (ULPA Filter No. 359) | 1 |
| **2** | **Supply Blower** | | | |
| | EC2-4LX / EC2-4SX | 5070494 | Complete supply blower for EC2-4LX (flashed) | 1 |
| | EC2-5LX / EC2-5SX | 5070494 | Complete supply blower for EC2-5LX (flashed) | 1 |
| | EC2-6LX / EC2-6SX | 5070585 | Complete supply blower for EC2-6LX (flashed) | 1 |
| **3** | **Exhaust Blower** | | | |
| | EC2-4LX / EC2-4SX<br>EC2-5LX / EC2-5SX | 1110078 | Exhaust blower (Blower No. 76) | 1 |
| | EC2-6LX / EC2-6SX | 1110078 | Exhaust blower (Blower No. 76) | 2 |
| **4** | **Motorized window** | | | |
| | EC2-4L8/5L8/6L8<br>EC2-4S8/5S8/6S8 | EQR/ME-TBR-MOTOR-220V | Tubular motor complete set 220 V, 50/60 Hz | 1 |
| | EC2-4L9/5L9/6L9<br>EC2-4S9/5S9/6S9 | EQR/ME-TBR-MOTOR-115V | Tubular motor complete set 115 V, 50/60 Hz | 1 |
| **ELECTRICAL REPLACEMENT PARTS** | | | | |
| **1** | **Electrical module** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | | Complete Electrical Panel 220-240 VAC | 1 |
| **1.1** | **EMI Filter** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080256 | Filter for EMI | 1 |
| **1.2** | **UV Ballast** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080964 | UV Ballast | 1 |
| **1.3** | **Ballast** | | | |
| | EC2-4L8<br>EC2-4S8 | 1080995 | Fluorescent Ballast | 1 |
| | EC2-5L8/6L8<br>EC2-5S8/6S8 | 1080995 | Fluorescent Ballast | 2 |

| No | Item / Cabinet Model | Item Code | Description | Qty |
|---|---|---|---|---|
| | EC2-4L9<br>EC2-4S9 | TBD | Fluorescent Ballast | 1 |
| | EC2-5L9/6L9<br>EC2-5S9/6S9 | TBD | Fluorescent Ballast | 2 |
| **2** | **Airflow alarm and control system** | | | |
| **2.1** | **Membrane** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080951 | Sentinel Platinum Membrane | 1 |
| **2.2** | **Main Control Board (MCB)** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080918 | ECS-G2 Main Control Board | 1 |
| **2.3** | **User Interface Boar (UIB)** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080919 | ECS-G2 User Interface Board | 1 |
| **2.4** | **Power Distribution Board (PDB)** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080992 | ECS-G2 Power Distribution Board | 1 |
| **2.4.1** | **Fuse** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080922 | Over current protection | 2 |
| **2.5** | **ECMS Board/Torque Blower Control** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080917 | ECMS Board (Duty cycle control) | 1 |
| **2.6** | **Digital Analog Converter Board (DAC)** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080921 | Digital to Analog Converter Board | 1 |
| **2.7** | **LCD board** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080949 | Monochrome (Blue & White) LCD | 1 |
| **2.8** | **Backup Power Module Board (BPM)** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080920 | DC backup power system | 1 |
| **2.9** | **Buzzer** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080948 | KPEG960 buzzer kingstone 12V | 1 |
| **2.10** | **Switch Mode Power Supply (SMPS)** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080945 | SMPS | 1 |
| **2.11** | **Airflow sensors** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080876 | ESCO Custom High End Airflow Sensor | 2 |

| | | | | |
|---|---|---|---|---|
| **2.12** | **Temperature sensor** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | EQR/EL-SA-TEMP | Temperature Sensor | 1 |
| **3** | **Capacitor** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080106 | Capacitor 5uF | 1 |
| **4** | **Inductor** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080969 | Inductor 5 mH | 1 |
| **5** | **Fluorescent lamp** | | | |
| | EC2-4LX<br>EC2-4SX | 1080593 | Fluorescent Lamp 4FT | 2 |
| | EC2-5LX/6LX<br>EC2-5SX/6SX | 1080593 | Fluorescent Lamp 4FT | 4 |
| **6** | **UV lamp** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080223 | UV Lamp 4FT | 1 |
| **7** | **Mechanical switch** | | | |
| | EC2-4LX/5LX/6LX<br>EC2-4SX/5SX/6SX | 1080227 | Magnetic Switch Contact | 4 |