

*Thank you for purchasing this Esco Biological Safety Cabinet. Please read this manual thoroughly to familiarize yourself with the many unique features and exciting innovations we have built into your new equipment. Esco provides many other resources at our website, [www.escoglobal.com](http://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](http://us.escoglobal.com) • [usa@escoglobal.com](mailto:usa@escoglobal.com)

**Rest of the World**

Esco Micro Pte. Ltd.  
21 Changi South Street 1 • Singapore 486777  
Tel +65 6542 0833 • Fax +65 6542 6920  
[www.escoglobal.com](http://www.escoglobal.com) • [mail@escoglobal.com](mailto:mail@escoglobal.com)

**Airstream®**  
Class II  
Biological Safety Cabinet

## Copyright Information

© Copyright 2013 Esco Micro Pte Ltd. All rights reserved.

The information contained in this manual and the accompanying product is copyrighted and all rights are reserved by Esco.

Esco reserves the right to make periodic minor design changes without obligation to notify any person or entity of such change.

Sentinel® and Airstream® are registered trademarks of Esco.

*“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

i	Table of Contents
iii	Warranty Terms and Conditions
v	Introduction
v	1. Products Covered
v	2. Safety Warning
v	3. Limitation of Liability
vi	4. European Union Directives on WEEE and RoHS
vii	Declaration of Conformity

### **1 Chapter 1 - Product Information**

1	1.1 Quick View
---	----------------

### **2 Chapter 2 - Sentinel Control System**

2	2.1 Sentinel Control System
3	2.2 Menu Options
4	2.2.1 Settings
5	2.2.2 Setting Mode
5	2.2.3 Field Calibration
6	2.2.4 Admin Settings
8	2.3 Stopwatch and Experiment Timer (Only for non-motorized sash BSC)
8	2.4 Alarms and Warnings
9	2.5 Diagnostic Mode
10	2.5 Standby Mode (Half Speed)

### **11 Chapter 3 - Basic Cabinet Operation**

11	3.1 Sash Window Operation
11	3.1.1 Sash Window State
11	3.1.2 Operating Motorized Sash Window (Only for BSC with motorized sash window)
12	3.1.3 Using Sash Window
12	3.2 Starting and Shutting Down the BSC
12	3.2.1 Turning on the BSC
12	3.2.2 Turning off the BSC
12	3.3 Working in the BSC
13	3.4 Working Ergonomics
14	3.5 UV Lamps (If Present)
14	3.6 Decontamination and Disinfecting Agents
15	3.7 Gaseous Decontamination
15	3.8 Further Information

### **17 Chapter 4 - Maintenance**

17	4.1 Scheduled Maintenance
19	4.2 Maintenance/Service Log

### **20 Chapter 5 - Maintenance and Re-certification of the Cabinet**

20	5.1 Installation Check
21	5.2 Cabinet Field Certification
21	5.3 Performing Calibration / Certification
21	5.3.1 Setting Cabinet in Maintenance Mode
22	5.3.2 Adjusting Airflow
23	5.4 Parts Replacement
23	5.4.1 Filter Replacement Procedure
26	5.4.2 Blower Replacement Procedure
27	5.4.3 Fluorescent Lamp(s) Replacement Procedure
27	5.4.4 UV Lamp Replacement Procedure
28	5.4.5 Airflow Sensor Replacement Procedure

---

<b>30</b>	<b>Chapter 6 - Decontamination</b>
30	6.1 Decontamination Agents
30	6.1.1 Formalin/Paraformaldehyde Decontamination
30	6.1.2 Chlorine Dioxide Decontamination
30	6.1.3 Hydrogen Peroxide Decontamination
322	6.2 Recommended Decontamination Sealing Method
<b>344</b>	<b>Chapter 7 - Troubleshooting</b>
344	7.1 Electrical and Mechanical Troubleshooting
51	7.2 Software Troubleshooting
<b>533</b>	<b>Chapter 8 - Engineering Details</b>
533	8.1 AC2-_E_ Engineering Drawing
54	8.2 AC2-_S_ Engineering Drawing
55	8.3 AC2-_E_ and AC2-_S_ General Specifications
56	8.4 AC2-_D_ Engineering Drawing
57	8.5 AC2-_G_ Engineering Drawing
58	8.6 AC2-_D_ and AC2-_G_ General Specifications
59	8.7 AC2-2N7 Engineering Drawing
61	8.8 AC2-2N7 General Specifications

## 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](http://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 6542 0833

Global Email Helpdesk: [support@escoglobal.com](mailto: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 for Ascent Max
Cleanroom Equipment	1 year limited
Laboratory Ovens and Incubators	1 year limited
CO <sub>2</sub> Incubators	2 years limited
Containment/Pharma Products	2 years limited
Ultra-low Temperature Freezer	5 years limited 5 years on compressor
Benchtop Incubator	2 years limited
Thermal Cyclers	3 years limited for MiniPro, MaxPro, Provocell 2 years limited for Spectrum 2 years on blocks and Peltier units 2 years on all electronic components 3 years on the housing and fans

Policy updated on 1<sup>st</sup> January 2012

Applies to all units ordered on and after 1<sup>st</sup> January 2012

# Introduction

## 1. Products Covered

Esco Class II Biological Safety Cabinet						
Model	Electrical Rating	0.6 meters 2 feet	0.9 meters 3 feet	1.2 meters 4 feet	1.5 meters 5 feet	1.8 meters 6 feet
Airstream	220-240 VAC, 50/60Hz, 1Φ	AC2-2E8	AC2-3E8	AC2-4E8	AC2-5E8	AC2-6E8
		AC2-2S8	AC2-3E8-M	AC2-4E8-M	AC2-5E8-M	AC2-6E8-M
			AC2-3S8	AC2-4S8	AC2-5S8	AC2-6S8
		AC2-3S8-M	AC2-4S8-M	AC2-5S8-M	AC2-6S8-M	
Airstream	110-130 VAC, 50/60Hz, 1Φ	AC2-2E9	AC2-3E9	AC2-4E9	AC2-5E9	AC2-6E9
		AC2-2S9	AC2-3E9-M	AC2-4E9-M	AC2-5E9-M	AC2-6E9-M
			AC2-3S9	AC2-4S9	AC2-5S9	AC2-6S9
		AC2-3S9-M	AC2-4S9-M	AC2-5S9-M	AC2-6S9-M	
	90-110 VAC, 50/60Hz, 1Φ	AC2-2N7	AC2-3N7	AC2-4N7	AC2-5N7	AC2-6N7
Airstream Duo	220-240 VAC, 50/60Hz, 1Φ			AC2-4D8 AC2-4G8		AC2-6D8 AC2-6G8

## 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.
- Before you process, you should thoroughly understand the installation procedures and take note of the environmental / electrical requirements.



- In this manual, important safety related points will be marked with the symbol.
- If the equipment is used in a manner not specified by this manual, the protection provided by this equipment may be impaired.

## 3. 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.

#### 4. 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)**

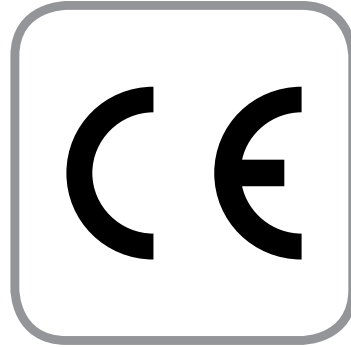
With respect to the directive on RoHS, please note that this cabinet falls under category 8 (medical devices) and category 9 (monitoring and control instruments) and is therefore exempted from requirement to comply with the provisions of this directive.



## 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** : Airstream  
**Model** : AC2-2E8, AC2-3E8, AC2-4E8, AC2-5E8, AC2-6E8, AC2-3E8-M, AC2-4E8-M,  
AC2-5E8-M, AC2-6E8-M, AC2-2S8, AC2-3S8, AC2-4S8, AC2-5S8, AC2-6S8,  
AC2-3S8-M, AC2-4S8-M, AC2-5S8-M, AC2-6S8-M

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 amending directives

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

**Low Voltage** : EN 61010-1:2001  
**EMC** : EN 61326-1:2006 Class B  
**Design/ Performance Criteria** : EN 12469 (2000) Class II Biological 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.

A handwritten signature in black ink, appearing to read 'XQ Lin', is positioned above a horizontal line.

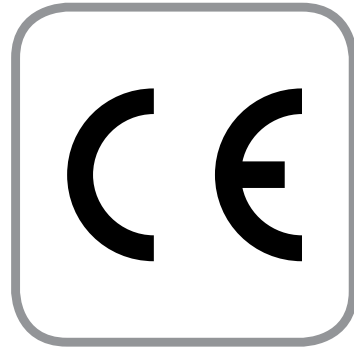
**XQ Lin**  
Group CEO, ESCO

This Declaration of Conformity is only applicable for 230VAC 50/60Hz units

## 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** : Airstream Duo  
**Model** : AC2-4D8, AC2-6D8, AC2-4G8, AC2-6G8

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 amending directives

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

**Low Voltage** : EN 61010-1:2001  
**EMC** : EN 61326-1:2006 Class B  
**Design/ Performance Criteria** : EN 12469 (2000) Class II Biological 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.

A handwritten signature in black ink, appearing to read 'XQ Lin', is written over a horizontal line.

**XQ Lin**  
Group CEO, ESCO

This Declaration of Conformity is only applicable for 230VAC 50/60Hz units

## Chapter 1 - Product Information

### 1.1. Quick View AC2 3G

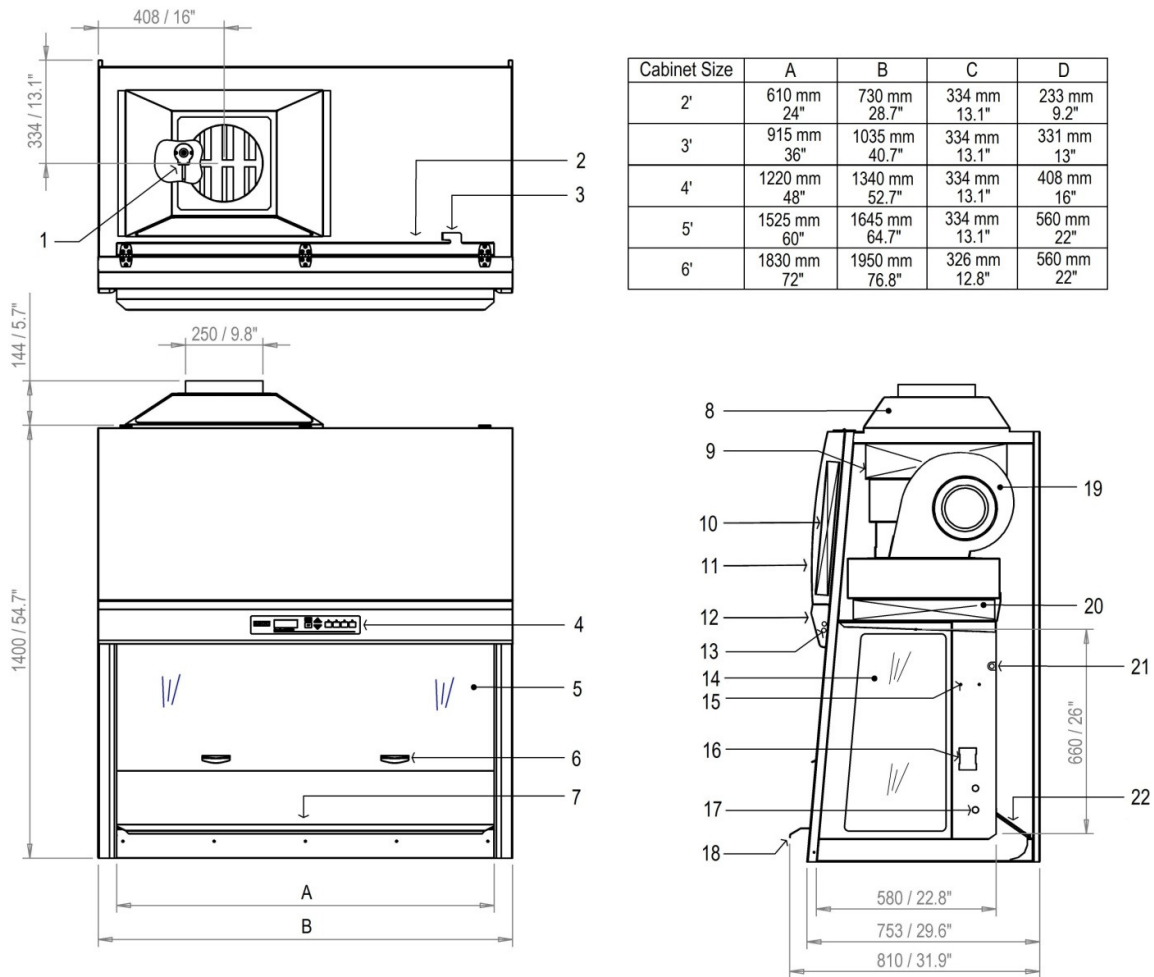


Figure 1.1. AC2 Gen 3 general parts.

- |                                 |                              |                                       |
|---------------------------------|------------------------------|---------------------------------------|
| 1. Airflow Sensor               | 8. Exhaust Collar (Optional) | 15. IV Bar Retrofit Kit Provision     |
| 2. RS232 Port                   | 9. Exhaust ULPA Filter       | 16. Electrical Outlet Kit Provision   |
| 3. Power Inlet                  | 10. Electrical Panel         | 17. Service Fixture Kit Provision     |
| 4. Sentinel Gold Control System | 11. Curved Front Panel       | 18. Stainless Steel Armrest           |
| 5. Sash Window                  | 12. Display Panel            | 19. ECM Blower                        |
| 6. Sash Handle                  | 13. Fluorescent Lamps        | 20. Downflow ULPA Filter              |
| 7. Work tray                    | 14. Side Window              | 21. UV Lamp                           |
|                                 |                              | 22. Paper Catch (optional pre-filter) |

## Chapter 2 - Sentinel Control System

### 2.1. Sentinel Control System

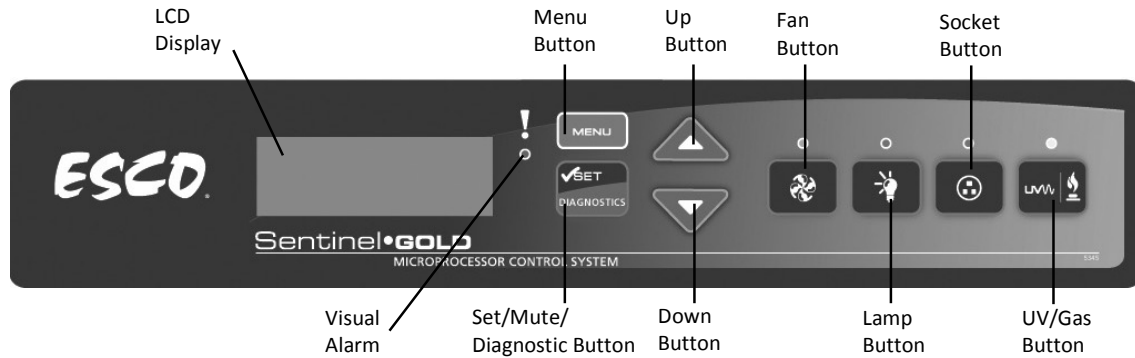


Figure 2.1. Sentinel Gold general parts.

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

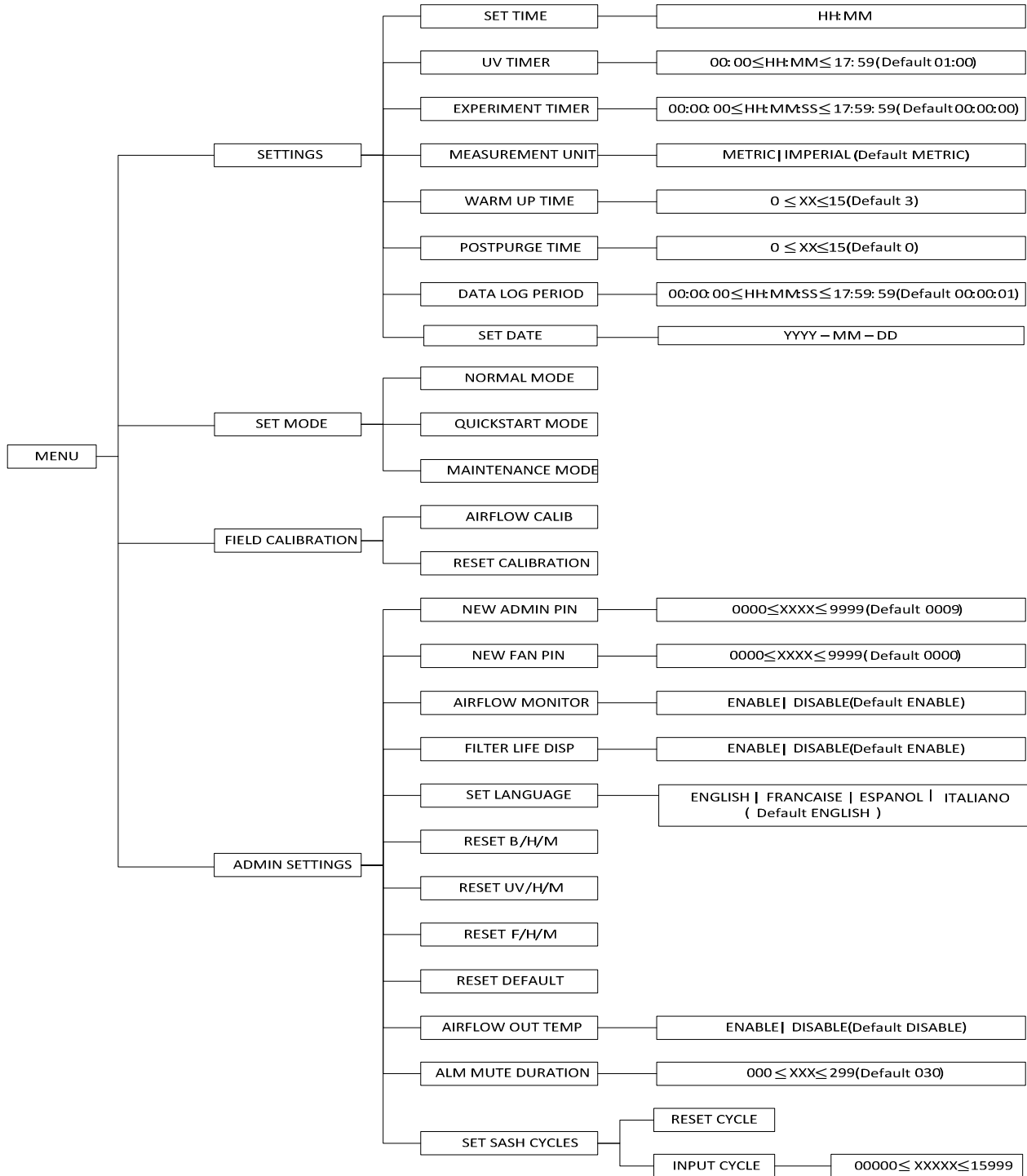
*When you are entering menu options, the alarm will sound to indicate that the microprocessor is not monitoring the operation of the cabinet. No further warnings will be given.*

- To enter and exit from the menu options.

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

## 2.2. Menu Options

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

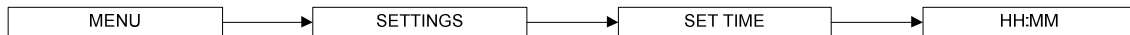


## 2.2.1. Settings

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

### 2.2.1.1. Set Clock (Time)

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



### 2.2.1.2. UV Timer (If UV present)

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



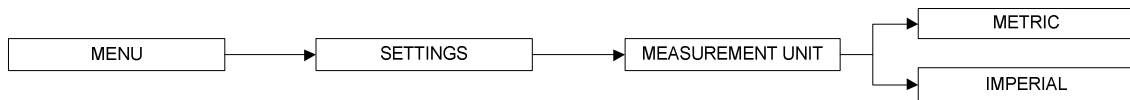
### 2.2.1.3. Experiment Timer (Not applicable to motorized sash BSC)

Experiment timer is a countdown timer that can be used for critical experiment. Experiment timer can be set between "00:00:00" and "17:59:59".



### 2.2.1.4. Measurement Unit

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



### 2.2.1.5. Warm Up Time

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

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



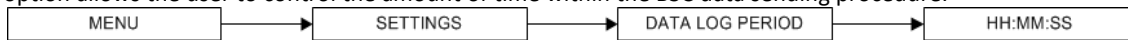
### 2.2.1.6. Post Purge Time

After the user switches off the BSC blower, there will be a post-purge period, to ensure that all contaminants are purged from the work zone. The default setting is zero minute (disabled) and user can set from 0 up to 15 minutes. It is recommended that BSC is purged for a minimum of 3 minutes after the work is complete. *(Note: Please note that WHO Laboratory Biosafety Manual (3<sup>rd</sup> edition) advocates 5 minutes post purging time after work is completed while US Biosafety in Microbiological and Biomedical Laboratories (5<sup>th</sup> edition) advocates 4 minutes).*



### 2.2.1.7. Data Log Period

Using RS232 communication port, the BSC can send data on the condition of the BSC to a PC. Data Log Period option allows the user to control the amount of time within the BSC data sending procedure.



### 2.2.1.8. Set Date

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

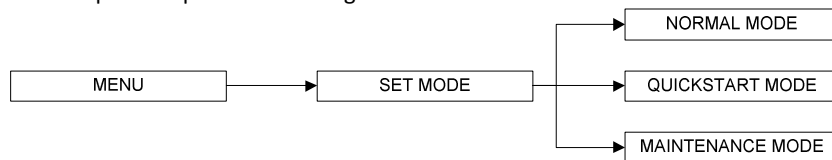


To Set Date:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the 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 buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose SET DATE. Press SET button to confirm.
6. The time is set in YYYY–MM–DD format. Use UP / DOWN buttons to choose the year (YYYY). Press SET button to confirm. Do the same for the month and day.
7. The display will show DATE SET for a few second and then return to SETTINGS.
8. Press MENU button twice to return to the main display.

## 2.2.2. Setting Mode

The BSC has three modes and two of which, normal mode and quickstart mode, can be used in daily activity. Both of these modes can be seen and accessed when you enter the FAN PIN. The last mode, maintenance mode is for the use of qualified personnel during maintenance.



### 2.1.2.1. Normal Mode

The Normal mode is activated by factory default except N series. In this mode, all alarms and interlocks are enabled.

### 2.2.2.2. Quickstart Mode

Quickstart mode allows the user to activate the blower by simply lifting the sash from fully closed position and the light by simply lifting the sash window to the operating position. In this mode, all alarms and interlocks are enabled. This mode is activated by factory default in N series.

### 2.2.2.3. Maintenance Mode

Maintenance mode should only be accessed by qualified personnel during maintenance. In this mode, all alarms are disabled and all interlocks are defeated.

## 2.2.3. Field Calibration

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



### 2.2.3.1. Airflow Calibration

This option allows proper calibration and operation of the airflow sensor alarm. There will be two points to be calibrated, namely inflow fail point and inflow nominal point.

### 2.2.3.2. Reset Calibration

This option allows the user to reset all values calibrated in the field and return it to the values obtained during factory calibration.

### 2.2.4. Admin Settings

The admin menu allows you to change both FAN and ADMIN PIN. The reset blower, filter and UV hour meter (if present) functions are usually used after the blower, filter or UV lamp is changed as they can easily serve as an indication to the user on when the BSC needs maintenance. The reset default function will return the options in the settings menu to their factory settings.

#### 2.2.4.1. New ADMIN PIN (Default 0009)

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

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

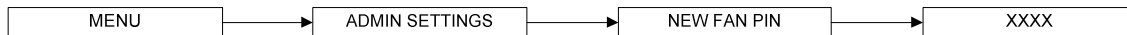


#### 2.1.4.2. New FAN PIN (Default 0000 - DISABLED)

FAN PIN restricts access to fan control and some parts of the menu, settings and set mode. User must enter the four-digit PIN before switching the fan on or off. This feature prevents unauthorized personnel from accessing critical control sections. It will also prevent unauthorized shutdown of the BSC when continuous operation is required. FAN PIN is also needed to disable the alarm when the sash is fully raised and cleaning needs to be performed.

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

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

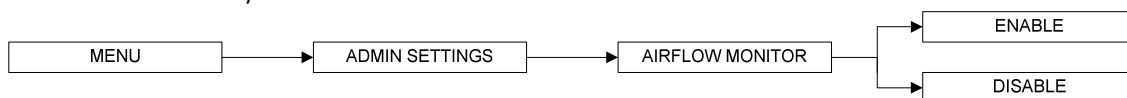


#### 2.1.4.3. Airflow Monitor

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

When the Airflow Monitor is disabled, the warm up period is removed but the airflow will not be displayed for the first three minutes.

If the ambient temperature is outside of 18-30°C (which is the cabinet working temperature), the Airflow Monitor is automatically disabled.

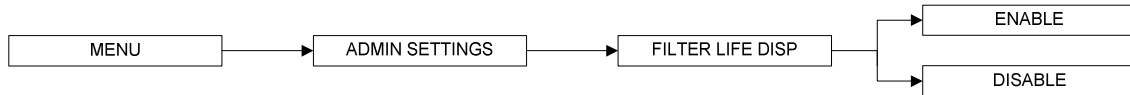




#### 2.1.4.4. Filter Life Display

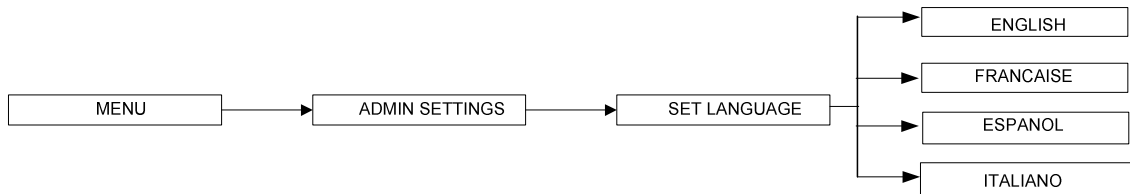
Using this option, the user can select whether the filter life is displayed or not.

Filter life is calculated based on the filter hour meter (F/H/M). The filter life display will count down according to the amount of hours left in the filter hour meter with respect to filter life expectancy of 10,000 hours. When the filter is changed, the F/H/M must be reset (*please see section 2.1.4.8 to reset the F/H/M*). Please note that the life of the filter is dependent on multiple factors which include environmental air cleanliness. A dirty / dusty environment will load the filter fast.



#### 2.1.4.5. Set Language

Using this option, the user can select the language of messages displayed on the LCD.



#### 2.1.4.6. Reset B/H/M

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



#### 2.1.4.7. Reset UV/H/M (If UV is present)

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%). The counter value can be checked while in the diagnostic mode. Please reset the UV lamp hour meter after each UV lamp replacement.



#### 2.1.4.8. Reset F/H/M

This option is used to reset the filter hour meter. The filter hour meter indicates how long the filter has been in operation. Maximum counter is set at 10,000 hours (100%). The counter value can be checked while in the diagnostic mode. Please reset the filter hour meter after each filter replacement.



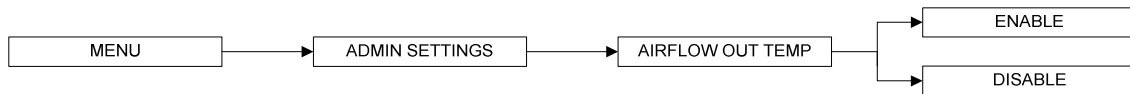
#### 2.1.4.9. Reset Default

User can reset default settings by choosing this option. The features being reset are warm up period (3 minutes), post-purge period (0 minute), UV timer (60 minutes) if present, measurement unit (metric), airflow monitor (enabled), ADMIN PIN (0009), filter life display (disabled) and FAN PIN (0000).

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 using this function either.

#### 2.1.4.10. Airflow Out Temp

Using this option, the user can select whether or not to display the airflow when the ambient temperature is out of the optimum temperature range, below 18°C (65°F) or above 30°C (86°F).



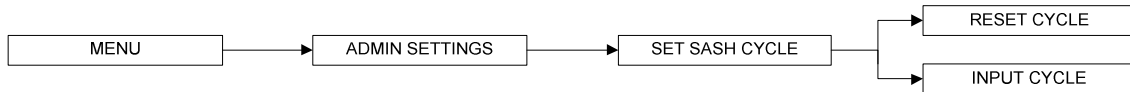
#### 2.1.4.11. Alarm Mute Duration

To mute unsafe sash height and airfail alarm for a certain period. The mute period can be set from 0 up to 299 seconds; the default value is 30 seconds. Alarm will be activated when sash is not in the working height and when the inflow velocity is below the value prescribed by the standard the cabinet is designed or certified to.



#### 2.1.4.12. Set Sash Cycle (Not applicable to non-motorized sash BSC)

To reset the sash cycles count to zero or to input the sash cycle count manually. The maximum value of sash cycles is 16,000 and after which the motor needs to be replaced (e.g. as part of the preventive maintenance program). The cycles will raise every sash move to up and down.



Warning message will be shown after the cycle value reaches 15,000.

- 1st warning: “Replace Sash Motor” – after sash reached 15,000 cycles.
- 2nd warning: “Stop Using Sash” - after sash reached 15,500 cycles.
- 3rd warning: “Sash Motor Locked” (sash motor cannot operate) - after sash reached 16,000 cycles.

#### 2.1.4.13. Date Certified

This option is used to input the date the cabinet was certified. The year can be adjusted from 2000 to 2099.

### 2.3. Stopwatch and Experiment Timer (Only for non-motorized sash BSC)

- The stopwatch function can be started by pressing the UP button while the sash is in the safe/ready position. Pressing UP button again while the stopwatch function is activated will stop and resume the timer. Use the DOWN button to exit the stopwatch function and reset the timer. The timer in the stopwatch function is counting up and is shown using the HH:MM:SS format.
- The experiment timer can be started by pressing the DOWN button while the sash is in the safe/ready position. Pressing DOWN button while the experiment timer function is activated will stop and resume the timer. Use the UP button to exit the experiment timer function and reset the timer. The timer in the experiment timer function is counting down and is shown using the HH:MM:SS format. Operator can use the SETTINGS | EXPERIMENT TIMER menu (*refer to section 2.2.1.3*) to set the experiment timer.

### 2.4. Alarms and Warnings

A BSC uses alarms to indicate that the condition inside the BSC is not safe for the operator, so check the LCD display to understand the cause of these alarms. The most common alarm is the SASH ALARM, which 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 appropriate operation position.

Other alarms that indicate a failure or an error in the BSC system:

- **AIRFLOW: NO!** will be displayed if there is an airflow failure.
- **SASH: ERROR POSITION** indicates a failure in the sash detection system.
- **SENSOR UNCALIBRATED** will be displayed if the airflow velocity sensor is not yet calibrated.

*Note: If the message "Call Service for re-certification" is displayed, it means the BSC certification has expired. Call service or Esco's local distributor for re-certification.*

## 2.5. Diagnostic Mode

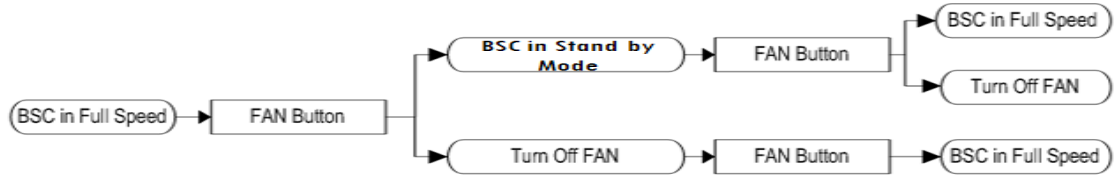
Diagnostic mode can be accessed by pressing the SET button. The diagnostic mode allows the user to know the condition of the BSC or help the service engineer during maintenance and troubleshooting.

On Screen	Explanation
MODE	Shows which mode is active: NORMAL MODE, QUICKSTART MODE or MAINTENANCE MODE
VERSION	Shows the version of the software; eg: CP104D V 1.0
TEMPERATURE	Shows the temperature inside the cabinet.
B/H/M	Blower Hour Meter – increase by the hour.
SASH CYCLE	Shows the cycle of sash moving. Maximum cycle is 16000.
FILTER LIFE	Shows percentage of filter life (based on Filter Hour Meter) and expected filter life of 10000 hours.
AF OUT TEMP	Velocity display status when temperature out of range
UV LIFE	Shows percentage of UV lamp life (based on UV Lamp Hour Meter).
UV TIMER	Shows the UV timer value – default is 60 minutes. Maximum value is 00 minutes (infinite on).
MUTE TIMER	Shows the mute timer value – default is 30 seconds. Maximum value is 299 seconds.
ADC IFF	ADC for Fail Point Inflow – calculated using offset based on Inflow Nominal Point.
ADC IFN	ADC for Nominal Point Inflow – based on field calibration.
ADC IFA	ADC for Actual Inflow – showing real time sensor reading.
ADC IF0	ADC for factory calibrated Zero Point Inflow (no inflow).
ADC IF1	ADC for factory calibrated Fail Point Inflow.
ADC IF2	ADC for factory calibrated Nominal Point Inflow.
DFN	Nominal of Downflow – keyed in during factory or field calibration.
CONSTANT	Airflow sensor constant. This value is needed when ordering a new sensor.
CALIB TEMP	Temperature when the factory calibration was performed.
ADC TEMP	ADC value for TEMPERATURE.
M_SWITCH1	Shows the condition of magnetic switch 1 – fully open position.
M_SWITCH2	Shows the condition of magnetic switch 2 – safe position.
M_SWITCH3	Shows the condition of magnetic switch 3 – fully closed position.
TYPE	Cabinet type

## 2.6. Standby Mode (Half Speed)

In Standby Mode, the blower speed is greatly reduced resulting in less power consumption. This mode is typically used during the night to maintain basic level of containment where the cabinet is not used by the operator.

The mode can be accessed by pressing the FAN button when the cabinet is in operation. In half speed mode, the airflow monitor is disabled and only the FAN button is operational, while other buttons are interlocked.



## Chapter 3 - Basic Cabinet Operation

### 3.1. Sash Window Operation

#### 3.1.1. Sash Window State

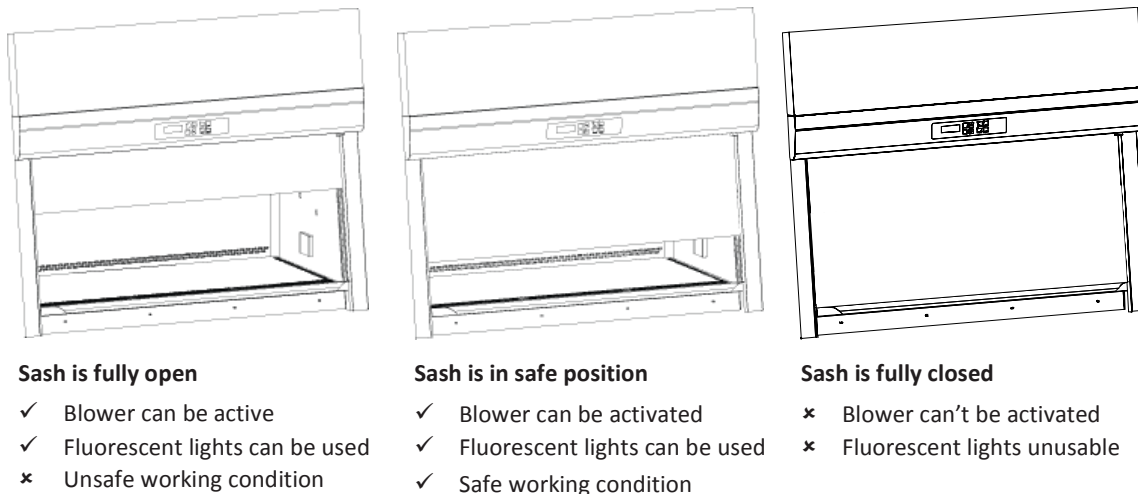


Figure 3.1. Sash window positions.

#### 3.1.2. Operating Motorized Sash Window (Only for BSC with motorized sash window)

The motorized sash uses a “push and hold” mechanism, so if you remove your finger from the button the sash will stop immediately – this is a safety feature to control the closure and prevent anything getting trapped in the aperture as the sash descends.

##### Lower Sash from Fully Open Position

When the sash is fully open, pressing the down button and holding it will cause the sash to move to the Safe Height setting and stop. If the fluorescent lights are on as the sash descends, they will stay on as long as the sash stops in the Safe Position. If you release the button before the sash has reached Safe Position the lights will switch off automatically.

##### Lower Sash from Safe Height Position

When the sash is at safe operating height, pressing the down button and holding it will cause the sash to move down to the fully closed position and stop. If the fluorescent lights are on as the sash descends, they will switch off automatically as soon as the sash is fully closed. If you release the button before the sash has reached the fully closed position, the lights will switch off automatically.

##### Raise Sash from Fully Closed Position

When the sash is fully closed, pressing the up button and holding it will prompt the user to input the password to turn on the fan. If the password is correct, the fan will turn on if it was on and the sash will move up to the Safe Height setting and stop.

### Raise Sash from Safe Height Position

When the sash is in safe operation position, pressing the up button and holding it will cause the sash to move up to the fully open position and stop. If the fluorescent lights are on as the sash rises, they will stay on as long as the sash is allowed to fully open. Stopping the sash midway will cause the lights to switch off automatically.

#### 3.1.3. Using Sash Window

- The sash window should be fully closed when the cabinet is not in use. This helps to keep the work zone interior clean.
- The sash window should always be at the normal operating height at all times when the cabinet is in use. Even if the cabinet is left unattended, while 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/from the cabinet. When the sash window is fully opened, the alarm sound may be muted by pressing MUTE button but the alarm will automatically sound again after 30 seconds (default is 30 seconds but can be set up to 5 minutes) to remind the user that it is not safe to work in the cabinet and the light will be turned on to facilitate cleaning.

## 3.2. Starting and Shutting Down the BSC

### 3.2.1. Turning on the BSC

1. Raise the sash to the indicated normal operational height (READY state). The lamp will turn on when this height is reached.  
**Note:** *When Quickstart mode is selected, fan will turn on as well, without pressing the fan button.*
2. Turn on the fan by pressing the FAN button. Input the Fan PIN if asked (if PIN ≠ 0000). This will start the warm up procedure (default: 3 minutes). All buttons are disabled during warm up period.
3. The BSC is ready for work.

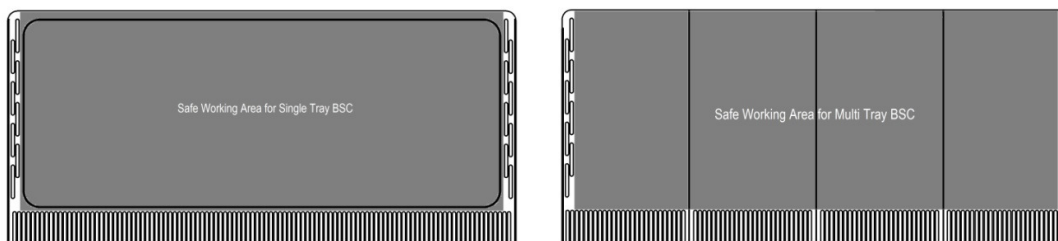
### 3.2.2. Turning off the BSC

1. Turn off the fan by pressing the FAN button. Input the Fan PIN if asked (if PIN ≠ 0000). This will start the post purge procedure (default: 0 minute). All buttons are disabled during post purge period.
2. Lower the sash to the fully closed position (the display will show UV MODE). The sash can be lowered immediately after turning off the fan as it will not interrupt the post purge procedure.  
**Note:** *When Quickstart mode is selected, fan will turn off without pressing the fan button.*
3. Turn on the UV lamp (when present) to decontaminate the work area by pressing the UV button. Leave the UV lamp on to make sure the decontamination is done effectively. The UV lamp can only be turned on after the post purge procedure is finished.

## 3.3. 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 2.2.1.5 and 2.2.1.6 of this manual for more information*).
- Wear appropriate personal protective equipment (PPE) determined by your risk assessment prior to working in a 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. Filter diffuser should not be wiped to prevent filter damage. 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 3.2. 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.
- 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, a burner that is capable of being used on demand or an enclosed electric micro incinerator may be used but they must be placed towards the back of the work surface in the BSC.
- 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 these equipment is in operation.
- As much as possible, it is recommended that the BSC be operated continuously in order to achieve optimal containment and cleanliness. Airflow studies have shown that once the fan has been switched off, air from the BSC may escape due to the thermal currents from inside the BSC. Therefore, 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.

### 3.4. Working Ergonomics

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

- The physiological energy cost and fatigue involved in sitting are relatively less.
- Sitting position 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 position 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 an appropriate support (e.g. 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 vary 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 from Esco include:

- Armrest padding
- Lab chair
- Footrest

Please contact your local distributor or Esco for more information.

### 3.5. 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 types of decontamination agent, UV light does not leave any residue. The decontamination action stops upon de-energizing of the lamp. However, the UVC spectrum does not penetrate well.

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

### 3.6. 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.
  - There is no one disinfectant agent that works with all organisms. Therefore, users and safety professionals should carry out risk assessment to ensure that appropriate disinfectant agents and validated decontamination procedures are used in decontaminating the BSC.

### 3.7. 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

### 3.8. 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 at <http://www.youtube.com/watch?v=ZnUW1N-JJz8>



## Chapter 4 - Maintenance

### 4.1. 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 with one another.
- Use appropriate personal protective equipment (PPE) when carrying out the activity.

#### Test the audible and visual alarm

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

#### Check the cabinet's functionality

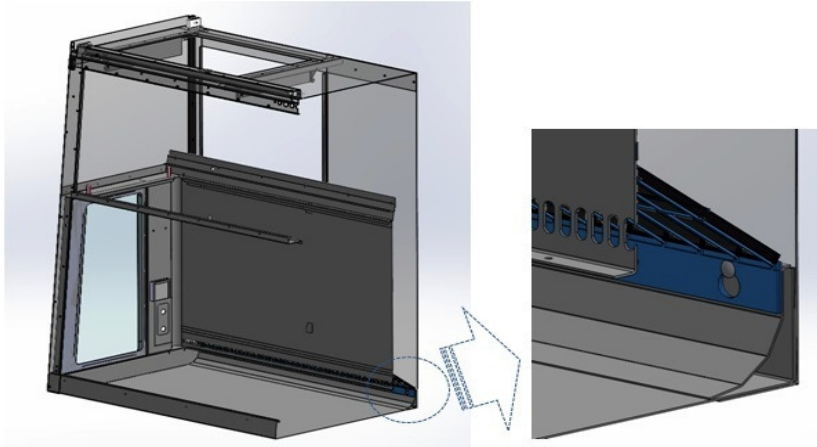
- Check the BSC's mechanical functionality (e.g. sash window – lubricate if necessary).
- Check the BSC's electrical functionality (e.g. fluorescent lamp – replace if necessary).
- Check the BSC for any defect and if any, repair immediately.

#### Recertification

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

### 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.



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. As detailed, the paper catch is being hooked into two hooking objects at the back of the carcass. Raise the paper catch initially up to 10mm until it feels like it disengages from those hooking objects, pull a bit to the front then do steps 1 to 3 below. Be carefull of any sharp objects that might be present. You might want to use a mirror to help you asses the presence of hazardous materials prior to accessing the paper catch. Removed any materials that have been trapped.

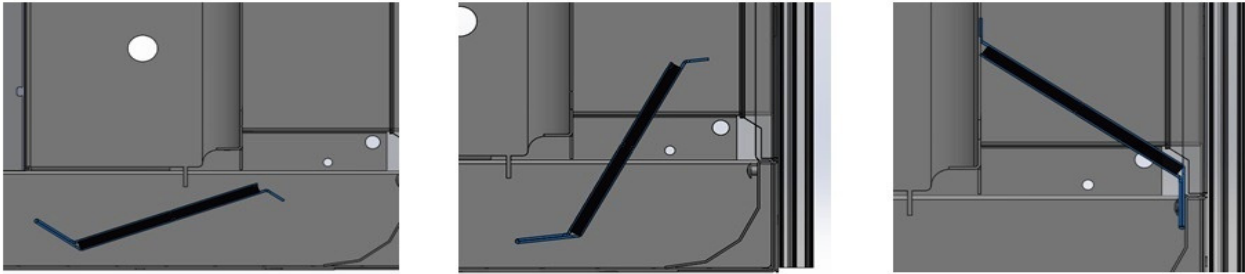


Figure 4.1. Paper catch access.

### Pre-filter Installation:

1. Insert the pre-filter to the opening of the paper catch as shown in image 1 above.
2. Push the pre-filter accordingly until it fits into the paper catch as shown in image 2 to 3.

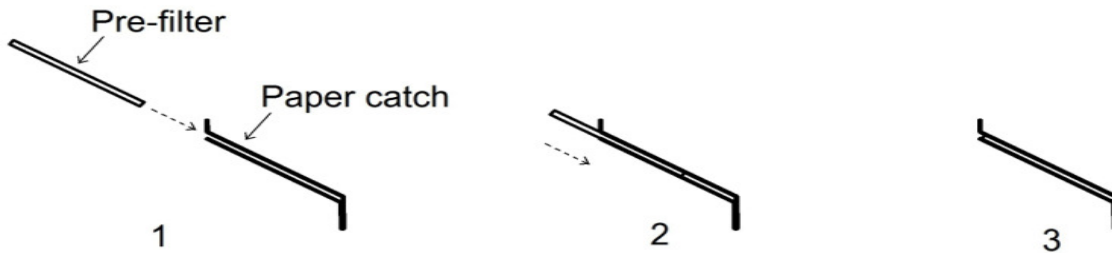
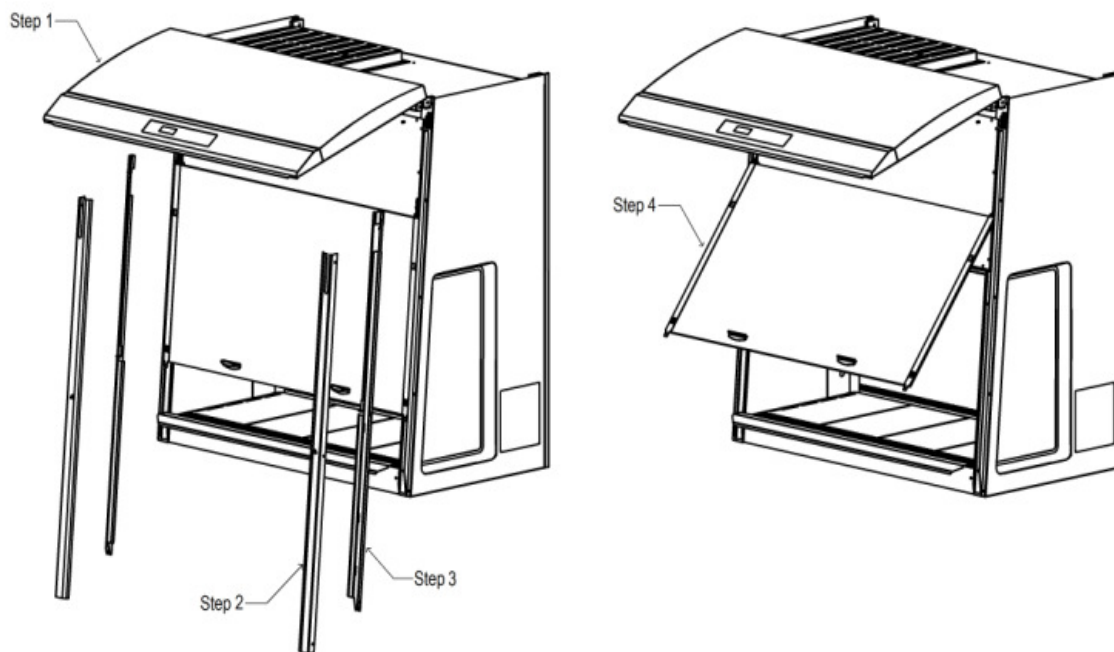


Figure 4.2. Installation of pre-filter.

### Sash Cleaning Procedure for Non-Motorized Sash BSC



#### Steps in Sash Cleaning Procedure:

1. Tilt up the front panel.
2. Unscrew the two aluminum covers using Philip head screw driver.
3. Unscrew the two aluminum switch brackets using the Philip head screw driver.
4. Tilt up the sash glass freely for cleaning.

#### 4.2. 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.

---

## Chapter 5 - 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.

### 5.1. Installation Check

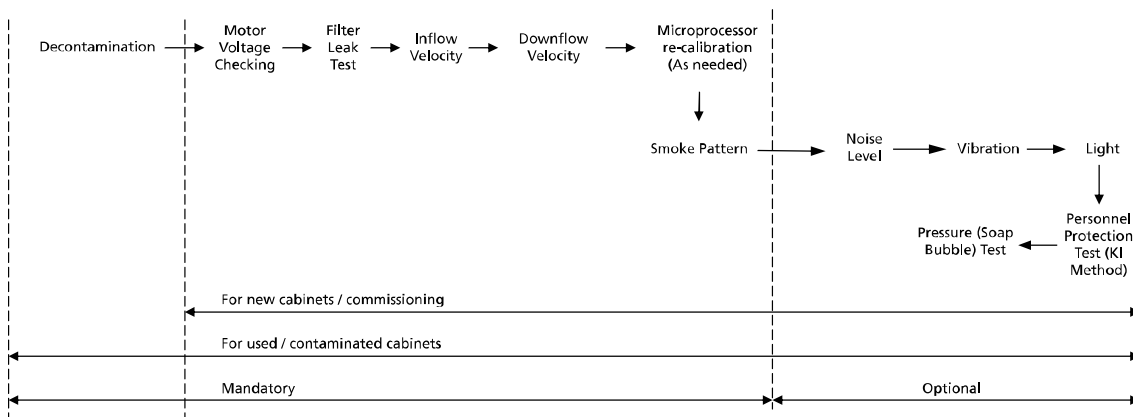
1. Check that the cabinet was installed away from air conditioning unit, heater, door, ceiling lamp, or any other equipment that affect cabinet airflow to ensure the sensor reading on top of cabinet is undisturbed.
2. Make sure the holes on the exhaust airflow sensor are not blocked, and the holes on 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.

## 5.2. 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:



## 5.3. Performing Calibration / Certification

### 5.3.1. Setting Cabinet in Maintenance Mode

To start the certification, ensure the fan and lamps are turned on. The cabinet should then be put to maintenance mode. In Maintenance Mode all alarms are defeated and the window can be moved without the light being switched off.

1. Press MENU button. Enter the ADMIN PIN (Default ADMIN PIN is 0009)
2. If SETTINGS is displayed the ADMIN code has been removed proceed to step 3
  - a. Press SET with 0 flashing
  - b. Press SET with 00 last digit flashing
  - c. Press SET with 000 last digit flashing
  - d. Press SET with 0000 last digit flashing
  - e. Press ▼ button to key in 9
  - f. Press SET
3. Alarm will sound, wait until alarm stops. Cabinet should read.

```

MENU OPTIONS XX:XX
→ SETTINGS
  SET MODE
  FIELD CALIB
  ADMIN SETTINGS
  
```

4. Use the ▼ button until the LCD displays SET MODE. Press the SET button and LCD would show :

```

MENU OPTIONS XX:XX
→ NORMAL MODE
  QUICKSTART MODE
  MAINTENANCE MODE
  
```

5. Use the ▼ button until the LCD displays MAINTENANCE message at the top most line of the LCD. Press the SET button. The cabinet is now in maintenance mode and the word "Maintenance" will blink continuously to indicate unsafe condition.
6. Press the MENU button twice to exit from the menu tree.
7. The word "MAINTENANCE" is displayed on the LCD as shown below.

```

MAINTENANCE XX:XX
Sash: OK
I:0.45 m/s D:0.30 m/s
  
```

OR

```

MAINTENANCE XX:XX
Sash: OK
I:90 fpm D:60 fpm
  
```

### 5.3.2. Adjusting Airflow

Carry out the steps below to adjust the airflow:

1. Remove the two screws holding the front panel (one screw located on the blue panel at each end on bottom edge).
2. Lift front panel. It will be held open by the front panel stick.
3. Locate speed controller positioned toward right side of electrical panel.
4. Plug the multimeter probes to the Motor Voltage Sampling Port.
5. Adjust the airflow by adjusting the speed controller.

#### 5.3.2.1. Initial Voltage Adjustment (only for AC2-D and AC2-G)

These AC2 BSCs are equipped with an exhaust fan below of the exhaust filter. This fan needs to be adjusted so that the correct balance between downflow velocity and inflow velocity is achieved.

No.	Main fan	Exhaust fan	Inflow	Downflow
1	+	+	++	+
2	+	=	+	+
3	+	-	++	++
4	=	+	-	-
5	=	=	=	=
6	=	-	+	+
7	-	+	--	--
8	-	=	-	-
9	-	-	--	-

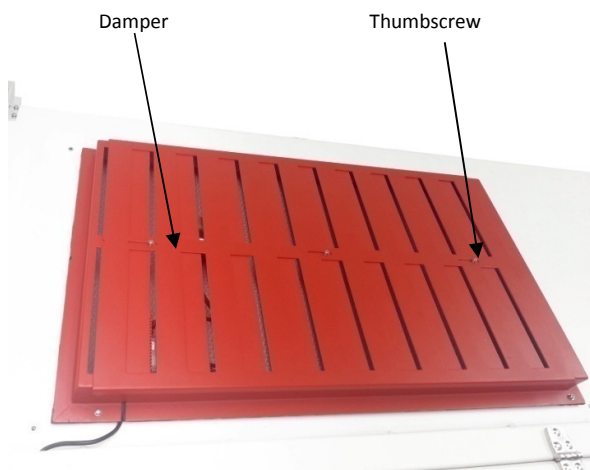
+ : Faster/increase in value  
 ++ : Increase greatly in value  
 = : Constant  
 - : Slower/decrease in value  
 -- : Decrease greatly in value

The BSC downflow and exhaust fan speed control need to be adjusted to get nominal downflow velocity of  $0.30 \pm 0.025$  m/s.



### 5.3.2.2. Damper Adjustment

The damper is used to balance the downflow velocity and exhaust velocity. The damper needs to be adjusted when the downflow velocity does not meet the accepted criteria (refer to the cabinet's technical specifications). Open the damper opening if the downflow velocity is too high; close the damper opening if the downflow velocity is too low.



**Figure 5.1. Adjustment of damper.**

Loosen the thumbscrew(s) to slide the damper left or right to increase or reduce the downflow velocity.

## 5.4. Parts Replacement

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

### 5.4.1. Filter Replacement Procedure

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

Under normal usage and barring any accident (example - puncture), the two filters do not need replacement unless and until the inflow and / or downflow velocity can no longer be maintained within the specifications.

1. Before the filters are removed from the BSC, their contaminated faces should be taped off using plastic, cardboard or some other suitable material. This will minimize the risk of personnel in the event the decontamination was not thorough.
2. Used filters should be disposed 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.
3. Proper PPE (based on your risk assessment) should be worn while removing used filters. You should dispose of these things 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 gasket material. The new filter should be carefully handled and examined before being fitted. It is important that the filters and the gaskets be checked for leaks prior to use.

*Two persons may be required to facilitate filter changing on 5' and 6' BSC.*

Two steps of tightening are necessary where the first round torque strength should be about one-third of the final torque required. Over tightening may cause filter damage and potential leak.

#### 5.4.1.1. Exhaust Filter Replacement for AC2- E\_ and AC2- S\_ Class II BSC

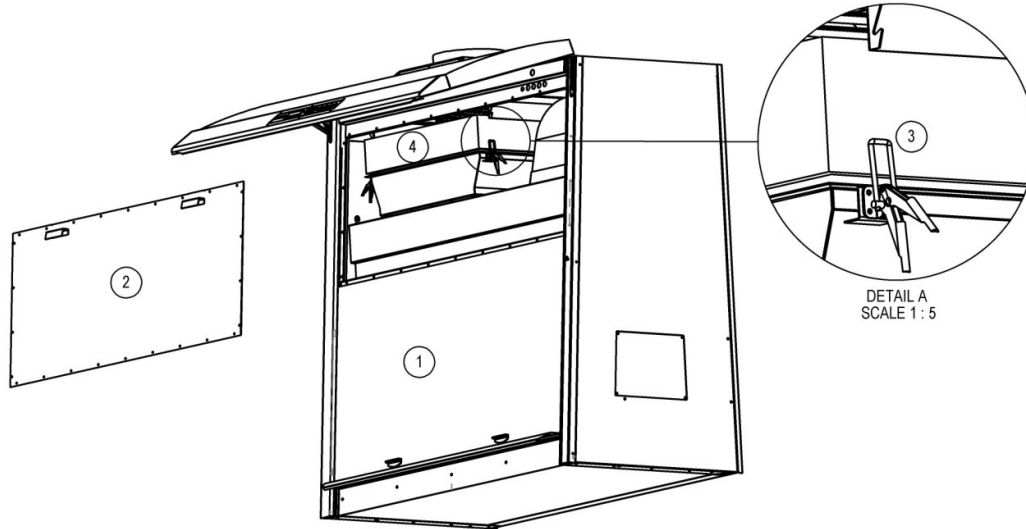


Figure 5.2. Filter Replacement for AC2- E\_ and AC2- S\_

1. Move the Sash Window down until it reaches the armrest.  
*Note:* For motorized sash BSC, remove the window straps after moving the sash window to the lowest position.
2. Remove red plenum cover using Phillips screwdriver.
3. Unclip those four red clips to lower down the sliding filter bracket.  
*Caution:* Be careful when lowering down the sliding bracket because it might damage the filter gasket
4. Take out the exhaust filter carefully.
5. To install new filter, just do a reverse procedure from Step 4 to Step 1.

#### 5.4.1.2. Exhaust Filter Replacement for AC2-\_D\_ and AC2-\_G\_ Class II BSC

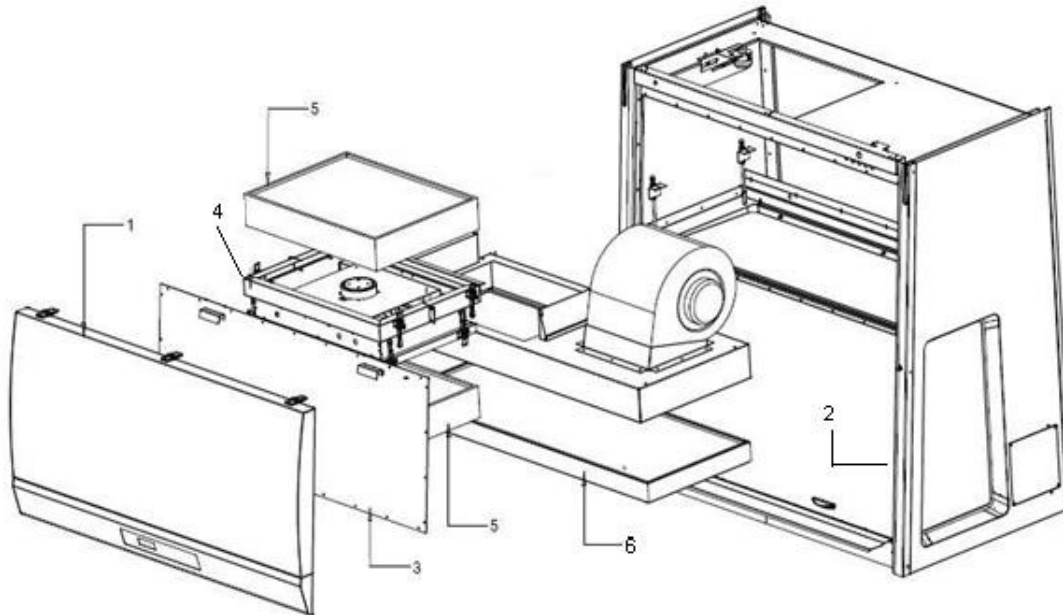


Figure 5.3. Filter Replacement for AC2-\_D\_ and AC2-\_G\_

1. Remove the screws from the bottom of blue panel and then lift up the front panel.  
**Caution:** Use the cylindrical struts to carefully hold open the front panel. Continue to work only after the front panel is secured.
2. Move sash window to the lowest position.  
**Note:** For motorized sash BSC, remove the window straps after moving the sash window to the lowest position.
3. Remove red plenum cover using Phillips screwdriver.
4. Remove the secondary exhaust filter mounting frame from the front.
5. Remove the secondary exhaust filter.
6. Remove the primary exhaust filter from the front.
7. To install the new filter, reverse Steps 1 to 6.
  - a. When blower housing onto new filter is secured, please ensure gasket compression is equal on both downflow and exhaust filter.
  - b. When the exhaust filter mounting frame is secured, please do not over-tighten the nuts, use the lowest torque if using a power tool.

### 5.4.1.3. Downflow Filter Replacement

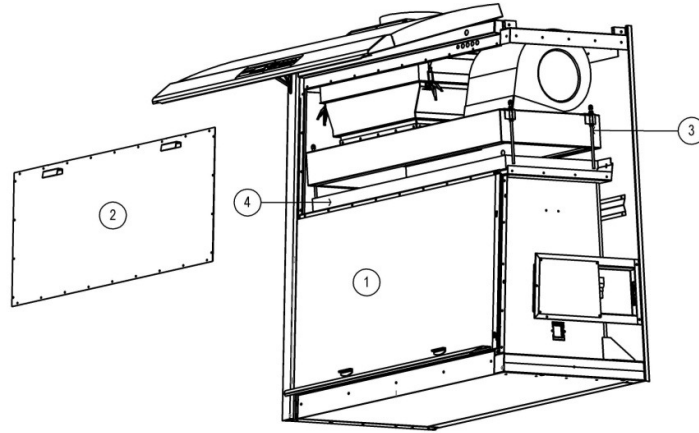


Figure 5.4. Downflow filter replacement

1. Move the sash window until it reaches the arm rest.  
*Note:* For motorized sash BSC, remove the window straps after moving the sash window to the lowest position.
2. Remove red plenum cover using Philip screw driver.
3. Loosen those four bolt adjusters to elevate the plenum from downflow filter.  
*Caution:* Be careful when adjusting the bolt adjusters. This might damage the filter gasket.
4. Take out the downflow filter carefully.
5. To install new filter, just do a reverse procedure from Step 4 to Step 1.

### 5.4.2. Blower Replacement Procedure

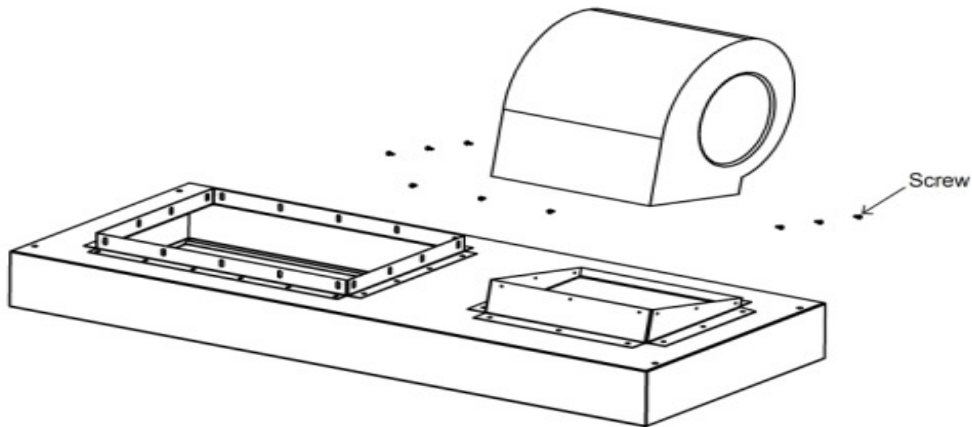


Figure 5.5. Blower replacement

To replace the blower, do the filter replacement steps until the blower plenum assembly can be removed from the cabinet, then do the following steps:

1. Unscrew all those screws on the front and sides as shown in the image above.
2. Take out the blower carefully.

#### 5.4.3. Fluorescent Lamp(s) Replacement Procedure

1. Disconnect the electrical connections.
2. Remove the screws from the bottom of blue panel and then lift up the front panel.  
**Caution:** Use the cylindrical struts to carefully hold open the front panel. Continue to work only after the front panel is secured.
3. The fluorescent lamp(s) is located behind the blue panel. Disconnect the old one(s) and replace with the new one(s).

#### 5.4.4. UV Lamp Replacement Procedure

1. Carry out necessary surface decontamination in the work zone prior to working on the UV lamp.
2. Disconnect the electrical connections.
3. Remove the old UV lamp by rotating it 90° counter clockwise and pull downward.
4. Install the new UV lamp by pushing it upward and rotating it 90° clockwise to secure the lamp in its socket.

## 5.4.5. Airflow Sensor Replacement Procedure

### 5.4.5.1. Airflow Sensor Replacement Procedure where Doughnut Sensor Housing is Used

Similar to the sensor box case, in AC2-\_E\_, AC2-\_S\_, AC2-\_D\_ and AC2-\_G\_, the airflow sensor is located on top of the cabinet. The sensor can easily be accessed in these cabinets.

1. Start by removing the damper (unscrew) on top of the cabinet (for AC2-\_E\_ & AC2-\_S\_ ; damper not applicable for AC2-\_D\_ and AC2-\_G\_).

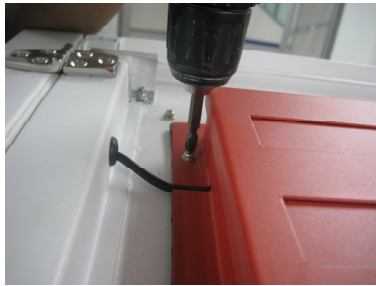


Figure 5.6. Unscrewing the Damper

2. Lift the damper to locate the airflow sensor.



Figure 5.7. Lifting & Removing the Damper

3. Disconnect the airflow sensor cable connector.



Figure 5.8. Disconnecting Airflow sensor Cable

4. Remove temperature sensor from the bracket.



Figure 5.9. Remove Temperature sensor

5. Remove the doughnut sensor housing from the bracket.



Figure 5.10. Remove doughnut sensor housing

6. Install the new sensor (it comes with the doughnut sensor housing) into the bracket and connect the sensor cable connector. Ensure the airflow direction described in the sensor housing is complied with during installation.



Figure 5.11. Airflow sensor direction

## Chapter 6 - Decontamination

---

BSC decontamination should be performed in any of the following eventualities:

- Before replacing the exhaust/downflow filters or blower.
- Before accessing the contaminated negative or positive plenum of the BSC.
- In case of an accidental spillage that might have contaminated any of the inaccessible surfaces.
- Before performance validation and re-certification.
- Before BSC relocation.
- Before any procedures mandated by user's risk assessment.

Appropriate Personal Protective Equipment (PPE) per user's risk assessment that may include gloves, gown, and respirator with filter suitable for the decontamination gas/vapor must also be used by the certifier or any other qualified personnel performing the decontamination.

Esco can provide the formalin vaporizer (FV-001) and decontamination bag needed for the decontamination procedure.

The information provided in this section does not construe a final advice on how decontamination must be carried out. Appropriate personnel including the safety personnel in the facility must be consulted and adequate risk assessment must be conducted to ensure the safety and efficacy of the decontamination procedures.

### 6.1. Decontamination Agents

#### 6.1.1. Formalin/Paraformaldehyde Decontamination

Typically the decontamination is performed using formalin gas by either vaporizing 37% formalin solution or by de-polymerization of solid paraformaldehyde.

Despite its widespread usage for decontamination, formalin gas presents the following health risks:

- External contact can cause irritation to skin, eyes, and mucous membranes.
- Inhalation in small concentrations can cause coughing, nausea, and diarrhea.
- Inhalation in large concentrations can cause convulsions, coma, and death.
- Long term exposure can cause cancer.

Although the Permissible Exposure Level (PEL) for formalin is 0.75 ppm, many scientists believe that there is no safe level of carcinogen exposure to humans. Therefore, typically the room must be evacuated when the decontamination process is performed, which leads to lab down time.

The use of formalin decontamination also has other disadvantages:

- The process is time-consuming.
- The certifier needs to pulse the BSC fan to circulate the formalin vapor. This can dislodge the tape holding the plastic sheet covering the exhaust filter.
- Due to excessive residue extensive cleaning must be done after decontamination and before use.

According to OSHA [Occupational Safety and Health Administration (USA)], formaldehyde Short Term Exposure Level (STEL) is 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). Available at: [http://www.osha.gov/OshDoc/data\\_General\\_Facts\\_formaldehydefactsheet.pdf](http://www.osha.gov/OshDoc/data_General_Facts_formaldehydefactsheet.pdf)



The time required to carry out formalin decontamination is outlined below:

No.	Process	Time
1	Set-up & sealing the BSC to make it air tight	1 hour
2	Formalin vaporization	½ hour
3	Formalin contact time to obtain target log of 4-6 kill	8 – 10 hours
4	Ammonia vaporization to neutralize formalin	½ hour
5	Ammonia contact time to neutralize formalin	2 hours
6	Exhausting the ammonia residue	1 hour
7	Tear-down & cleaning the (substantial) residue	1 hour
<b>TOTAL without ammonia neutralization</b>		<b>10½ – 12½ hours</b>
<b>TOTAL with ammonia neutralization</b>		<b>14 – 17 hours</b>

Ammonia is used to neutralize formaldehyde. OSHA prescribes the ammonia STEL is 35 ppm for 15 minutes exposure, 4 times a day, minimum of 60 minutes in between exposure.

Due to the adverse health effect of formalin gas, its use has been banned in some countries such as Germany, Austria, and Switzerland. Other European countries are expected to follow suit. Two primary candidates to replace formalin decontamination are chlorine dioxide gas and hydrogen peroxide vapor.

#### 6.1.2. Chlorine Dioxide Decontamination

Chlorine dioxide decontamination is performed by injecting chlorine gas ( $\text{Cl}_2$ ) into a cylinder filled with solid sodium chlorite ( $\text{NaClO}_2$ ), which generates the greenish-yellow chloride dioxide gas ( $\text{ClO}_2$ ). Chlorine dioxide decontamination is much faster than formalin. Being a true gas, it spreads quickly, without the need of pulsing the BSC's blower. It can rapidly kill the micro-organisms with high efficacy with just 1 hour contact time. User must note that the concentration of chlorine gas inside the cabinet must decrease to a safe level (e.g. by using scrubber system) before user should open the air tight seal. The Short-Term Permissible Exposure Limit (STEL) for Chlorine Dioxide gas is 0.3 ppm. The time required for the entire process of chlorine dioxide decontamination is as follows:

No.	Process	Time
1	Set-up & sealing the BSC to make it air tight	1 hour
2	Chlorine dioxide gassing	½ hour
3	Chlorine dioxide contact time	1 hour
4	Chlorine dioxide "scrubbing"	½ hour
5	Tear-down & cleaning the (minimal) residue	½ hour
<b>TOTAL</b>		<b>3½ hours</b>

Chlorine dioxide has the PEL of 0.1 ppm, compared to 0.75 ppm for formalin. In both processes airtight BSC sealing is required to protect personnel from the gas exposure.

#### 6.1.3. Hydrogen Peroxide Decontamination

Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) decontamination is performed by flash vaporization of an aqueous peroxide mixture, creating a vapor that is distributed throughout the inside the BSC.

STERIS and BIOQUELL are two major vendors of hydrogen peroxide generators. There are significant differences in operating principles.

- The STERIS principle is to avoid condensation on surfaces to minimize corrosion and optimize vapor distribution. The relative humidity inside the BSC must be lowered to 30% so that the remaining 70% relative humidity can be occupied by the hydrogen peroxide vapor.

- The BIOQUELL principle is to seek micro-condensation to achieve the kill. The generator releases tiny high-speed droplets inside the BSC.

Hydrogen peroxide vapor is non-carcinogenic, but highly effective against micro-organisms. Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) vapor breaks down under catalytic action to become air and water, making it environmentally friendly and it leaves no residues. The BSC is often aerated by ducting to speed up the breaking down of hydrogen peroxide vapor.

The time needed for the entire process is outlined below:

No.	Process	Time	
1	Set-up & sealing the BSC	½ hour	
2	Conditioning and decontamination cycle	½ - 1 ½ hour	
3	Ducting out H <sub>2</sub> O <sub>2</sub>	H <sub>2</sub> O <sub>2</sub> generator doing aeration	½ hour   8 hours
4	Tear-down	½ hour	
<b>TOTAL</b>		2 - 3 hrs   9½ - 10½ hrs	

For hydrogen peroxide decontamination, the BSC need to be equipped with two ports:

- One port located in front opening or side wall, penetrating the work zone area
- One port located on top of the exhaust filter.

The generator used defines the port function as described below:

	Steris	Bioquell
<b>Hydrogen peroxide source</b>	Injected into the BSC	Generated inside the BSC
<b>Bottom front / side port</b>	Hydrogen peroxide introduction	Hydrogen peroxide re-introduction
<b>Top port</b>	Hydrogen peroxide extraction	Hydrogen peroxide extraction

## 6.2. Recommended Decontamination Sealing Method

This section gives an example of how the cabinet can be sealed when FV-011 formalin vaporizer is used. However, similar principle can be applied for other gaseous decontamination method.



- Put the decontamination bag to enclose the entire BSC and support stand.
- Use the 50 mm wide aluminum tape to seal the gap between the decontamination bag and the floor. To compensate for areas where the decontamination bag must turn, use multi section tape. Ensure that the two layers of tape overlap at the end points to prevent leakage.



3. Overlap the tape at the joints.



4. These 2 cables (for BSC and for vaporizer) should be combined so that only 1 cable should come out from the decontamination bag, to minimize chance of formalin leakage.



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



6. Put the bottom part of the decontamination bag on top of the aluminum tape, and then seal it with another layer of aluminum tape. Use multiple layer of aluminum tape (*at least 2 layers*) on both directions to ensure leak tightness.



7. The BSC is ready for formalin decontamination.

## Chapter 7 - Troubleshooting

### 7.1. Electrical and Mechanical Troubleshooting

This guide addresses the most common service issues. Unless there is a note to limit the applicability of the points raised, the point applies to all AC2 series. For more troubleshooting or service information contact your local Esco Distributor.

#### Hardware:

- DVM (Digital Voltage Meter).  
**Note:** An analog meter can be used for troubleshooting, but cannot be used for motor voltage measurement.
- Phillips screwdriver.
- Insulated jumper cables.

#### The Electrical Panel and Component Layout:

Open the front panel, the electrical panel is located on the back of the panel. A red cover is used to cover the electrical panel located on the back of the front panel of AC2-xNy model. The component layout is as followed (please note that the layout is the same regardless of the power rating).

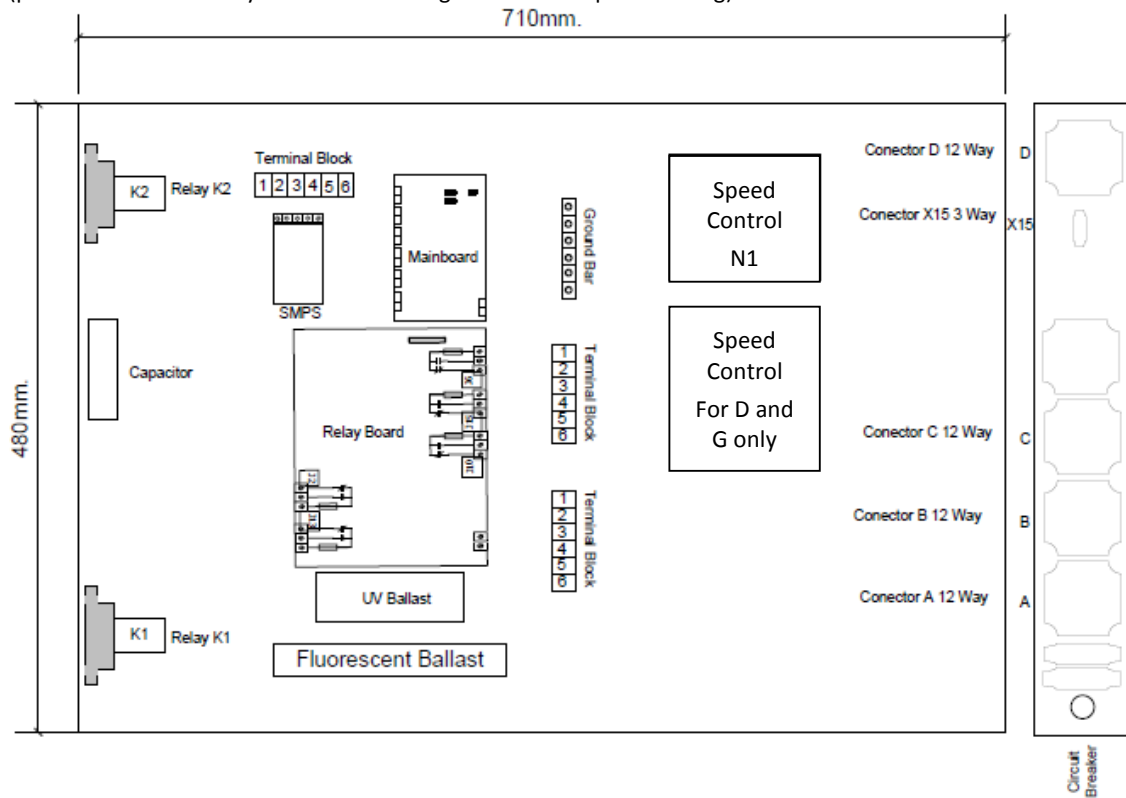


Figure 7.1. Layout Electrical Box in AC2-xEy, AC2-xSy, AC2-xGy and AC2-xDy

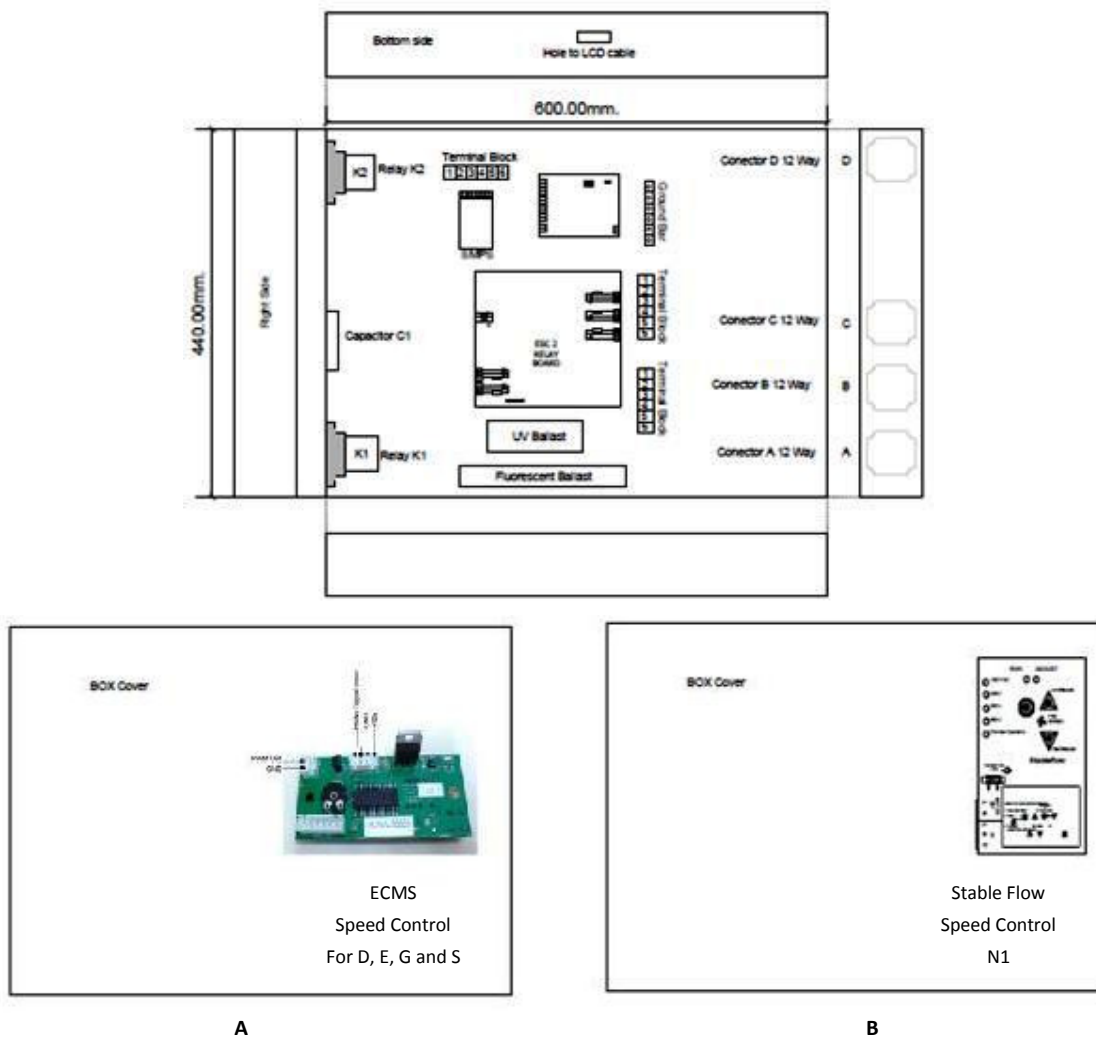
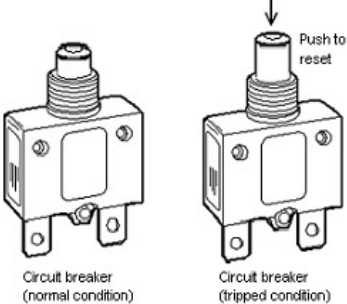
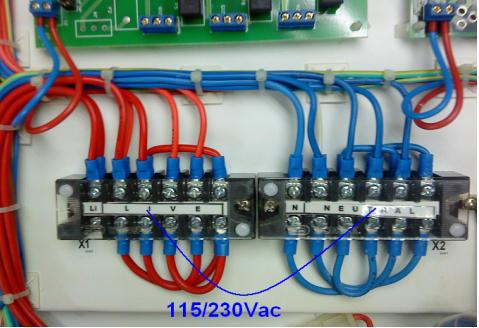
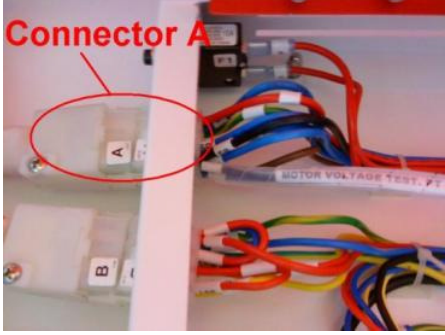
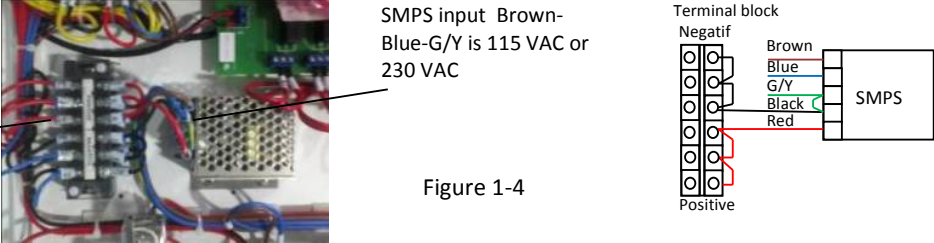
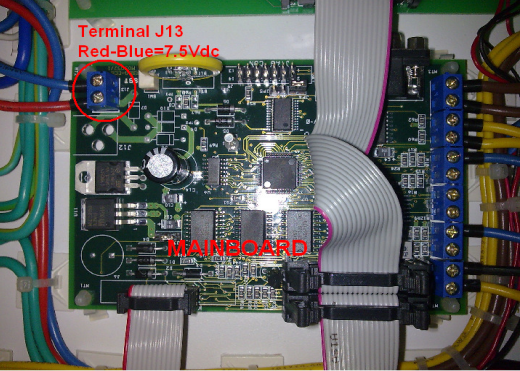


Figure 7.2. A - Layout Electrical Box AC2 D, E, G and S; B - Layout Electrical Box AC2 N

**Problem 1: Cabinet does not start (LCD, button, fan light, and socket are inoperative)**

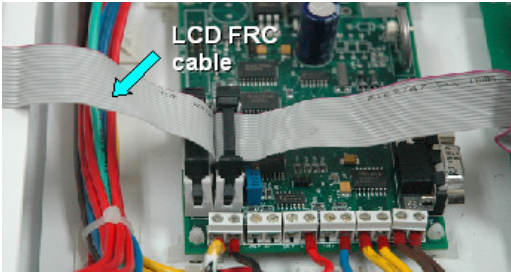
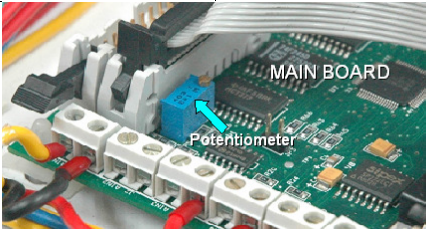
Cause	Corrective Action
Power Failure	<ul style="list-style-type: none"> <li>Check wall outlet for power.</li> <li>If the outlet has a switch make sure it is turned ON.</li> </ul>
Power cord is not connected properly or faulty	<ul style="list-style-type: none"> <li>Ensure the power cord is connected correctly to the wall outlet.</li> <li><b>NOTE:</b> Some cabinets have 2 cordsets.</li> <li>Disconnect the power cord at the cabinet and measure the AC voltage between the live and the neutral terminal of the cord.</li> <li>If the voltage is not within <math>\pm 2\%</math> of the wall socket voltage, replace the cordset; otherwise Proceed to the next step.</li> </ul>
Circuit breaker has tripped	<ul style="list-style-type: none"> <li>Check the circuit breaker inside the electrical panel.</li> <li><b>NOTE:</b> If circuit breaker has tripped, do not reset the breaker before checking all electrical components and wiring connections. (See Figure 1-1 in the next page).</li> </ul>

Cause	Corrective Action
	<ul style="list-style-type: none"> <li>Does the cabinet operate correctly after resetting the circuit breaker? If it does not Proceed to the next step.</li> </ul>
	<div style="text-align: center;">  <p>Figure 1-1</p> </div>
<p>Improper connection</p>	<ul style="list-style-type: none"> <li>Measure AC voltage between LIVE (RED) and NEUTRAL (BLUE) terminal blocks inside electrical box. See Figure 1-2.</li> <li>Voltage must be within <math>\pm 10\%</math> of the rated voltage.</li> <li>Refer to cabinet Serial Number Tag for required voltage.</li> <li>If the voltage is out of the range or there is no voltage, check cable connection on both sides of connector A. See Figure 1-3.             <ul style="list-style-type: none"> <li>230 VAC at Connector A pin 1 and 3. Pin 5 is ground.</li> <li>115 VAC Connector A pin 1 and 3. Pin 5 is ground.</li> </ul> </li> <li>If there is voltage at Connector A but no voltage is measured at the RED (LIVE) and BLUE (NEUTRAL) terminal blocks, the problem is between connector A and the terminal strips.</li> <li>If voltage is not present at connector A, but voltage is measured at the female connector for the line cord at the top of the cabinet that the power cord is plugged into, the problem is between the female connector and the pins on Connector A.</li> </ul>
<div style="text-align: center;">  <p>Figure 1-2</p> </div>	<div style="text-align: center;">  <p>Figure 1-3</p> </div>
<p>Defective power supply – Switch Mode Power supply (SMPS) (Only when SMPS (item code 1080945) is installed)</p>	<ul style="list-style-type: none"> <li>Locate the SMPS (Power Supply) and Terminal block.</li> <li>On the side of terminal block, measure the DC voltage between Red (pin 3) and Black (pin 4) Measure on the side away from the SMPS.</li> <li>The voltage should be in range of <math>+12\text{ VDC} \pm 10\%</math>.</li> <li>If you do not have voltage, measures the other side of terminal block.</li> <li>If out of range or no voltage, check incoming power to the SMPS – check terminal where the cord is connected. The input of SMPS should be <math>\pm 10\%</math> of the cabinet incoming voltage.</li> </ul>

Cause	Corrective Action
	<ul style="list-style-type: none"> <li>If input voltage exists but there is no output voltage, please replace the SMPS.</li> <li>If input and output voltage is correct, please Proceed to the next step.</li> </ul>
<p>SMPS output Red-Black/blue is 12 VDC</p>	 <p>SMPS input Brown-Blue-G/Y is 115 VAC or 230 VAC</p> <p>Figure 1-4</p>
<p>Connection problem to main board or from main board to display</p>	<ul style="list-style-type: none"> <li>Measure the incoming voltage on the main board at terminal J 13 (Note polarity, blue cable closest to edge is negative -). See Figure 1-5.</li> <li>Voltage should be between 6.75 – 8.25VDC, if 7.5 VDC SMPS (item code 1080328) is used.</li> <li>Voltage should be between 10.8 – 13.2VDC, if 12 VDC SMPS (item code 1080945) is used.</li> <li>If voltage is out of range or no voltage, ensure adequate connection between SMPS and main board.</li> <li>Ensure adequate connection between flat ribbon cable from main board to LCD/keypad membrane.</li> </ul> <p><b>NOTE:</b> There are two ribbon cables from the main board and the display and key pad. The larger flat cable is for the Display. The smaller flat cable is for the LEDs/keypad membrane.</p> <ul style="list-style-type: none"> <li>If the LCD Display is on, but not the LEDs in keypad membrane, check connection on the smaller Flat Ribbon cable.</li> <li>If the incoming voltage at J13 is of right voltage and flat ribbon cable are connected adequately but the LEDs on the keypad membrane and LCD display are still not turned on, please proceed to the next step.</li> </ul>
	<p>Figure 1-5</p>
<p>Defective main board</p>	<ul style="list-style-type: none"> <li>The main board is defective if the main board incoming supply is between 10.8 – 13.2VDC if 12 VDC SMPS is installed and: <ul style="list-style-type: none"> <li>All LED's on the control panel are off.</li> <li>The LCD is blank.</li> <li>No buzzer sound.</li> </ul> </li> <li>If these conditions exist replace the main board, otherwise Proceed to the next step</li> </ul> <p><b>Note:</b> when replacing main board, reconnect all wires correctly, any wrong wiring may result in</p>

Cause	Corrective Action
	<i>damage.</i>

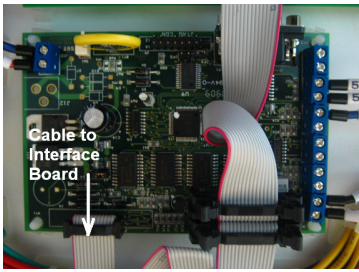
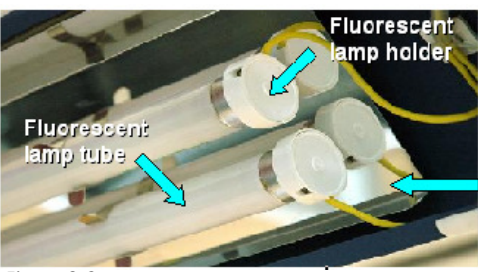
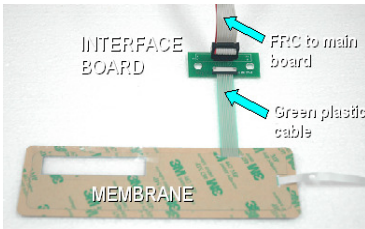
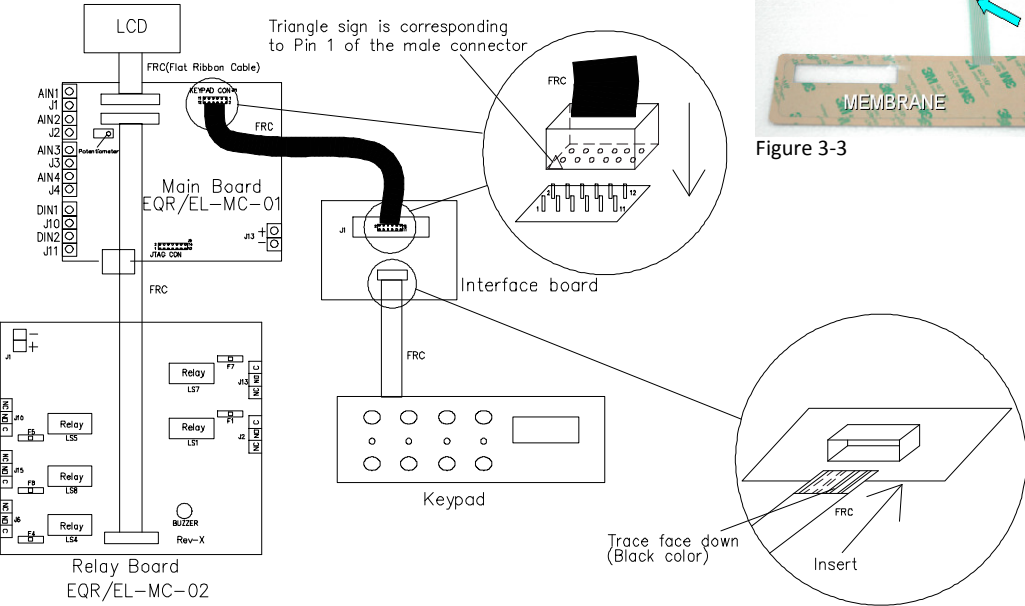
### Problem 2: Blank LCD

Cause	Corrective Action
Connection problem	<ul style="list-style-type: none"> <li>• Ensure LCD large Flat Ribbon Cable adequately connects the main board with the display at the main board end.</li> <li>• Ensure that the cable has been inserted adequately into its socket on the main board. This is a Keyed connector with locking arms. The arms should point to the same direction as the cable. See Figure 2-1 below.</li> <li>• If the LCD Display is not on, check power to main board as detailed in Problem 1.</li> </ul>
	Figure 2-1
Contrast problem	<ul style="list-style-type: none"> <li>• Adjust the potentiometer on main board by rotating the top metal part using flat screw driver to achieve the best LCD contrast. Rotating the part in the counter clockwise direction will increase the contrast. See Figure 2-2.</li> <li>• If the LCD remains blank, replace it.</li> </ul>
	Figure 2-2
Defective LCD	<ul style="list-style-type: none"> <li>• Connect a new LCD to the LCD port on main board.</li> <li>• If the new LCD functions properly, this indicates the old one is defective.</li> <li>• If the new LCD does not work, replace the large Flat Ribbon Cable.</li> <li>• If the LCD still does not work replace, the main board.</li> </ul>

### Problem 3: Inoperative buttons

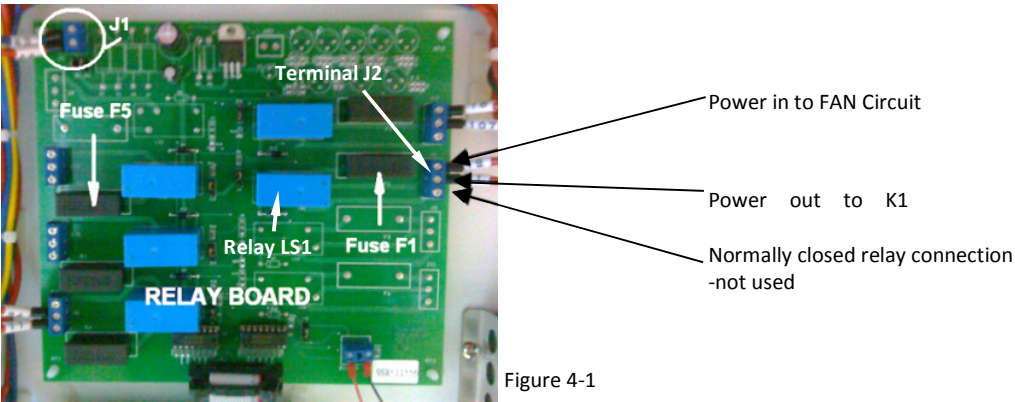
Cause	Corrective Action
Connection problem	<ul style="list-style-type: none"> <li>• Does the LCD display work? If it does not, please refer to Problem 1 and ensure that the main board is powered.</li> <li>• Ensure that the small Flat Ribbon Cable is connected to the main board – See figure 3-1. The triangle sign on the female connector of the cable indicates PIN number 1.</li> <li>• Interface board and membrane/keypad are located behind the blue panel, underneath the metal light deflector.</li> <li>• Turn off the cabinet and then remove the bulbs and the clips that hold the bulbs. See Figure 3-2.</li> <li>• Ensure adequate connections between the cable from the main board and the Interface board. See Figure 3-3.</li> <li>• Ensure adequate connections between the green plastic cable from the Interface</li> </ul>

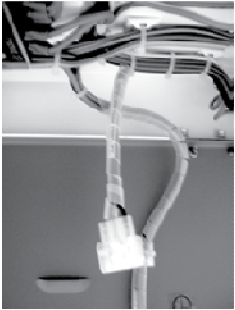
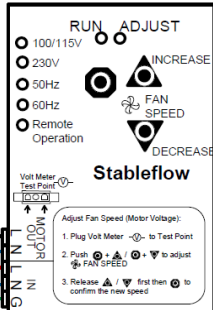
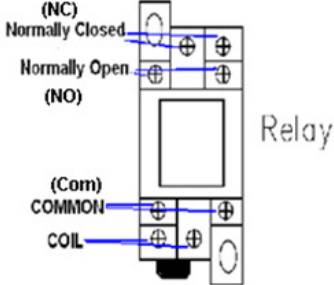
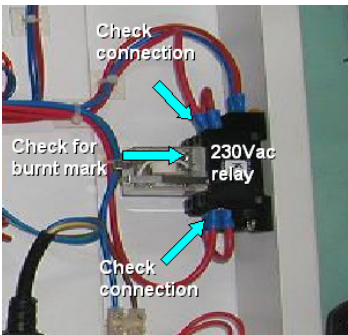

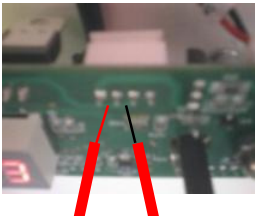



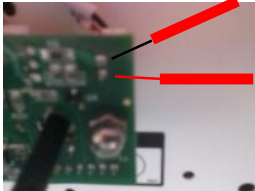
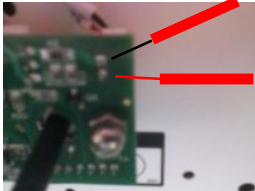
Cause	Corrective Action
 <p>Figure 3-1</p>  <p>Figure 3-2</p>  <p>Figure 3-3</p>  <p>Figure 3-4</p>	<p>board and the Display board. Figure 3-4.</p> <p>Fluorescent lamp holder</p> <p>Fluorescent lamp tube</p> <p>Metal deflector</p> <p>INTERFACE BOARD</p> <p>FRC to main board</p> <p>Green plastic cable</p> <p>MEMBRANE</p> <p>Triangle sign is corresponding to Pin 1 of the male connector</p> <p>Main Board EQR/EL-MC-01</p> <p>Interface board</p> <p>Keypad</p> <p>Trace face down (Black color)</p> <p>Insert</p>
<p>Defective Cable and / or Interface Board and / or keypad</p>	<ul style="list-style-type: none"> <li>• Replace them one by one, to check which one(s) is/are Defective.</li> <li>• Replace the Defective part(s).</li> </ul>

**Problem 4: Blower does not function**

Cause	Corrective Action
<p>Motor Blower Fan is not running</p>	<ul style="list-style-type: none"> <li>• Switch on the Fan by pressing Fan button on control panel.</li> <li>• Enter the Fan PIN number if required (default is 0001).</li> <li>• The LED for FAN should illuminate and the FAN should start.</li> <li>• If the FAN does not operate, Proceed to the next step.</li> <li>• If the LED on the cabinet front does not illuminate, please refer to Problem 1.</li> </ul>
<p>DC Voltage Connection problem to relay board</p>	<ul style="list-style-type: none"> <li>• Measure the incoming voltage on the Relay Board at terminal J 1 (Note polarity, BLUE cable closest to edge is negative -). See Figure 4-1.</li> <li>• Voltage should be between 6.75 – 8.25VDC, if 7.5 VDC SMPS (item code 1080328) is used.</li> </ul>

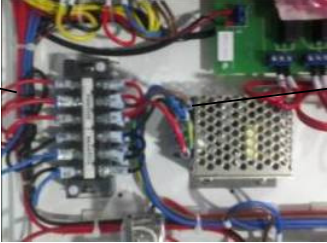
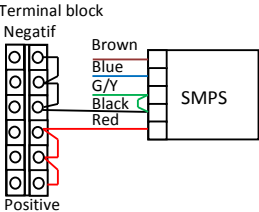
Cause	Corrective Action
	<ul style="list-style-type: none"> <li>• Voltage should be between 10.8 – 13.2VDC, if 12 VDC SMPS (item code 1080945) is used.</li> <li>• If voltage is out of range or no voltage, check connection between SMPS (power supply) and relay board.</li> <li>• If voltage is correct, Proceed to the next step.</li> </ul>
Fuse F1 is blown or circuit is not energized	<ul style="list-style-type: none"> <li>• Check that AC voltage is supplied to the Relay board.</li> <li>• Ensure the Motor Blower FAN button and LED is energized.</li> <li>• Locate LS1 circuit and measure AC voltage between large BLUE (Neutral) terminal block and the end terminal (with Red cable) on the three terminal strips (J2 on relay board). See Figure 4-1.</li> <li>• If there is voltage to the end terminal (Terminal with cable) check the central terminal (Normally Open Circuit) to the BLUE (Neutral) terminal block.</li> <li>• Should there be no voltage detected at the central terminal, the fuse could have been blown or the circuit is not energized.</li> <li>• Check Fuse F1 on relay board. See Figure 4-1.</li> <li>• If fuse F1 is blown, as temporary solution, use F5 (spare) to replace F1.</li> <li>• If fuse F1 is good, check the voltage between the BLUE (Neutral) terminal block and the end terminal on the LS1 circuit (J2 on relay board)</li> <li>• Detection of voltage at the end terminal with no cable indicates that the F1 fuse is good and the circuit is not energized.</li> </ul>
 <p data-bbox="748 1283 841 1308">Figure 4-1</p>	
K1 Relay not energized or faulty	<ul style="list-style-type: none"> <li>• Check voltage at the speed control on the motor voltage test points - Refer to Figure 4-2 (E/S series) and Figure 4-3 (N series).</li> <li>• If the voltage is correct at the speed control Proceed to the next step. No voltage at the speed control indicates that K1 relay is not energized or the wiring between the Relay board and K1 is open.</li> <li>• Check the voltage between the BLUE (Neutral) terminal block and NO terminal contact at K1 relay. Refer to Figure 4-4/4-5.</li> <li>• Ensure that the motor blower switch in front keypad membrane is on.</li> <li>• If voltage is present at K1, proceed to check the speed controller in next section. Otherwise, check all terminal connections to K1 relay.</li> <li>• If connections on K1 relay are OK, visually inspect K1 relay for any burnt or flash marks. Refer to Figure 4-5.</li> <li>• If burnt or flash marks are present, replace the relay.</li> </ul>

Cause	Corrective Action
 <p>Figure 4-2</p>	 <p>Figure 4-3</p>
 <p>Figure 4-4</p>	 <p>Figure 4-5</p>
<p>Defective ECMS motor speed controller</p>	<ul style="list-style-type: none"> <li>• Check Voltage supply to the ECMS, check from DC supply that one pin must be 12 volt.</li> <li>• If there is no voltage supplied to the ECMS, check the cable connection.</li> <li>• If cable connection is fine, check voltage output of the DC power supply.</li> <li>• If there is no DC Power supply output, the DC power supply is faulty and needs replacement.</li> <li>• If there is voltage supplied to ECMS, proceed to the next step.</li> <li>• Check the display of ECMS whether or not there is any reading.</li> <li>• If ECMS displays any value, try to turn the potentiometer to maximum and minimum to check for response.</li> <li>• If ECMS responds to the adjustment, check PWM output with the multimeter.</li> <li>• If ECMS produces PWM output, ECMS is likely not defective.</li> <li>• If ECMS does not produce PWM output, ECMS is defective and needs replacement.</li> <li>• If ECMS does not respond after adjustment attempt with the potentiometer, ECMS is defective and needs replacement.</li> <li>• If ECMS does not display any value, ECMS is defective and needs replacement.</li> <li>• When the standby mode is turned on, the ECM blower should work at a lower speed. If the ECM blower increases in speed (measured or through displayed value) or drops lower than the expected speed, the ECMS is defective and needs to be replaced.</li> </ul> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>Figure 4-6. ECMS</p>



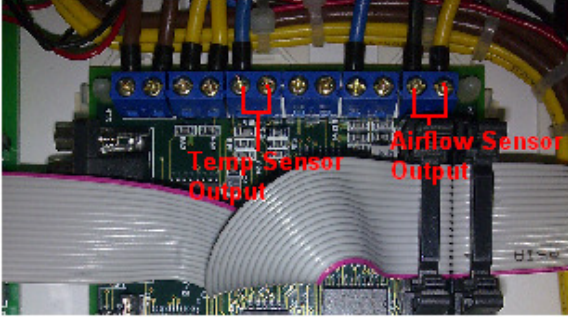
Cause	Corrective Action
	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Figure 4-8. ECMS no Display</p> </div> <div style="text-align: center;">  <p>Figure 4-7. Measure ECMS Supply</p> </div> <div style="text-align: center;">  <p>Figure 4-9. Measure PWM Output</p> </div> </div>
Defective motor speed controller (only applicable to Stable flow Speed control)	<ul style="list-style-type: none"> <li>• Switch on the blower on the cabinet.</li> <li>• Please refer to the component layout at the beginning of this section to locate the speed controller. This is indicated by N1 in the layout.</li> <li>• If the blower still does not work, Switch off the cabinet.</li> <li>• Disconnect the connector to the stableflow output.</li> <li>• Switch on cabinet. Check Voltage output of stable flow. If no voltage output / small output voltage is measured, try to adjust speed to maximum. When voltage output is not detected, the stable flow is defective.</li> <li>• Replace the defective stableflow. Proceed to the next step.</li> </ul>
Motor failure	<p><b>WARNING:</b> <i>The cabinet MUST be decontaminated before opening the plenum cover.</i></p> <ul style="list-style-type: none"> <li>• Check for physical damage.</li> <li>• Will the motor rotate?</li> <li>• Check wiring.</li> <li>• Replace the blower.</li> </ul>

#### Problem 5: Airflow Failure (AIRFAIL) – alarm is triggered

Cause	Corrective Action
External air interference	<ul style="list-style-type: none"> <li>• Ensure that there are no external sources of airflow disturbance close to the sensor. Check vents, lights, ceiling too close, etc.</li> <li>• If there is no external air interference, Proceed to the next step.</li> </ul>
Blocked cabinet grille	<ul style="list-style-type: none"> <li>• Ensure that the air grilles inside the cabinet are not blocked and that the cabinet is not excessively loaded.</li> <li>• If there is no blockage in air grilles, Proceed to the next step.</li> </ul>
Low building supply voltage (if new cabinet, check this first)	<ul style="list-style-type: none"> <li>• Refer to the electrical layout and find motor voltage Test Point shown in Figures 4-2 and 4-3.</li> <li>• <b>NOTE:</b> <i>The voltage adjustments should only be carried out by a qualified Certifier.</i></li> <li>• For a new cabinet, if the motor voltage is lower than the Nominal Voltage value recorded in the factory test report, adjust the speed controller to get output voltage to blower as specified in the Test Report – Test Conditions Documentation Sheet.</li> <li>• For cabinet that has been used for more than 1 year, refer to last motor Nominal Voltage from last certification report or if not available, measure the actual airflow on cabinet and increase motor voltage accordingly to achieve nominal airflow velocity.</li> <li>• If supply voltage is same as Nominal voltage, proceed to the next step.</li> </ul>
Defective airflow sensor power supply – Switch Mode Power supply (SMPS) (Only when SMPS (item code	<ul style="list-style-type: none"> <li>• Cabinet must be turned on to perform this test.</li> <li>• Locate the 5 pin connector.</li> <li>• On the BACK side of the 5 pin connector measure the DC voltage between Green (pin 5) and Black (pin 4). Measure on the side, away from the SMPS. See Figure 1-4 and 1-5.</li> <li>• The voltage should be in range of +12VDC <math>\pm</math> 10%.</li> <li>• Voltage on the other side of the 5 pin connector does not need to be measured.</li> <li>• If out of range, check incoming power to the SMPS Molded cord – check the terminal where the cord is connected. The input should be <math>\pm</math>10% of the cabinet voltage</li> </ul>

Cause	Corrective Action
1080328) is installed)	<ul style="list-style-type: none"> <li>If you have input voltage but no output voltage replace the SMPS.</li> </ul>
Defective airflow sensor power supply – Switch Mode Power supply (Only when SMPS (item code 1080945) is installed)	<ul style="list-style-type: none"> <li>Cabinet must be turned on to perform this test.</li> <li>Locate the terminal block.</li> <li>On the side of the terminal block, measure the DC voltage between red and black pins. Measure on the side, away from the SMPS. See Figure 5-1 and 5-2.</li> <li>The voltage should be in range of +12VDC <math>\pm</math> 10%.</li> <li>The voltage has to be measured on the other side of terminal block and SMPS.</li> <li>If out of range, check incoming power to the SMPS – check terminal where the cord is connected. The input of SMPS should be <math>\pm</math>10% of the cabinet incoming voltage</li> <li>If input voltage is measured, but no output voltage, then replace the SMPS.</li> </ul>
<p>SMPS output Red – Black/blue is 12VDC</p>  <p>Figure 5-1</p>	<p>SMPS input Brown-Blue-Green Yellow is 115V AC or 230V AC</p>  <p>Figure 5-2</p>
Cabinet requires the air flows to be set	<ul style="list-style-type: none"> <li>Refer to the Test Report for this model and set the air flow values to the required values. This information is also contained on the label at the bottom of the BLUE front panel.</li> </ul>
Filter loaded or wrong speed controller setting	<ul style="list-style-type: none"> <li>Plug in the voltmeter to the Motor Voltage Sampling Port.</li> <li>Measure the actual airflow velocity using anemometer or flow hood. If actual airflow is good but LCD still shows AIRFAIL, Proceed to the next step. If actual airflow is not good, please adjust motor speed controller accordingly until alarm is turned off and the LCD shows nominal airflow reading. After this, if LCD still shows AIRFAIL, Proceed to the next step.</li> <li>The sensor will take about 2-3 minutes before it can register a new airflow setting. <b>Note:</b> <i>The cabinet must be certified at least annually.</i></li> <li>If the blower is already operating at maximum voltage and the airflow alarm is still triggered due to filter loaded, it's time to change the filter.</li> <li>If filter is not loaded, Proceed to the next step.</li> </ul>
Faulty/inaccurate calibration	<ul style="list-style-type: none"> <li>Re-calibrate the microprocessor. Follow the calibration procedure in the test report. <b>Warning:</b> <i>To be carried out only by an authorized person.</i></li> </ul> <p><b>CHECKING CALIBRATION DATA</b></p> <ul style="list-style-type: none"> <li>After calibration is done, go to main display by pressing MENU button twice.</li> <li>Press SET/Diagnostic button, will display the mode and software version that is currently being used on the cabinet. Example: <b>DIAGNOSTIC</b> <b>MODE: NORMAL</b> <b>CP104D VERSION 1.5</b></li> <li>Press DOWN button until you find the following: <ul style="list-style-type: none"> <li><b>TEMPERATURE:</b> Shows actual ambient temperature</li> <li><b>ADC IFF:</b> ADC value for Fail Point Inflow – calculated using offset based on Inflow Nominal Point.</li> <li><b>ADC IFN:</b> ADC value for Nominal Point Inflow – set during sensor calibration.</li> <li><b>ADC IFA:</b> ADC value for Actual Inflow – showing real time sensor reading.</li> <li><b>ADC IF0:</b> ADC value for factory calibrated Zero Point Inflow (no inflow)-set during zero</li> </ul> </li> </ul>

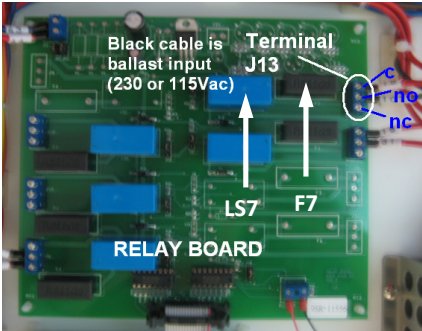
Cause	Corrective Action
	<p>calibration.</p> <ul style="list-style-type: none"> <li>- <b>ADC IF1:</b> ADC value for factory calibrated Fail Point Inflow.</li> <li>- <b>ADC IF2:</b> ADC value for factory calibrated Nominal Point Inflow.</li> <li>- <b>ADC DFA:</b> ADC value for Actual Downflow – showing real time sensor reading.</li> <li>- <b>ADC DFO:</b> ADC value for factory calibrated Zero Point Downflow (no downflow).</li> <li>- <b>ADC DFN:</b> ADC value for Nominal Point downflow – based on field calibration.</li> <li>- <b>CONSTANT:</b> value for Inflow sensor constant - keyed in during sensor calibration.</li> <li>- <b>CALIB TEMP:</b> Temperature when the factory calibration was performed.</li> <li>- <b>ADC TEMP:</b> ADC value for temperature.</li> </ul> <p><i>Note: Depending on preset unit at SETTINGS&gt;MEASUREMENT UNIT&gt; (Metric or Imperial), the units for temperature and velocity will change accordingly. For Metric-°C, m/s while for Imperial-°F, fpm. Factory setting is at Metric.</i></p> <ol style="list-style-type: none"> <li>1. In order to prevent any AIRFAIL or unstable velocity displayed on LCD problem, please ensure the following is done after the calibration: <ol style="list-style-type: none"> <li>a. CONSTANT value is correct. Check it with constant written on airflow sensor body or inside Replaceable Component Record List which comes with the test report.</li> <li>b. TEMPERATURE shows room temperature. If not, refer to next possible cause, part B.</li> <li>c. ADC IF0 &lt; ADC IF1 &lt; ADC IF2. If not please re-do calibration in correct sequence: SET CONSTANT → SET ZERO → CALIB. If CALIBRATION ERROR is encountered, please refer to next possible cause, part A.</li> <li>d. ADC DFO &lt; ADC DFN. If not please re-do calibration in correct sequence: SET CONSTANT → SET ZERO → CALIB. If CALIBRATION ERROR is encountered, please refer to next possible cause, part A.</li> </ol> </li> <li>2. Just after calibration, ADC IFA value should be close to ADC IFN value. If not, please adjust the speed controller to make both values closer by at least ± 20 units.</li> </ol>
Sensor Failure / Sensor Misalignment	<p><b>A. Air Flow Sensor failure / misalignment</b></p> <ul style="list-style-type: none"> <li>• Airflow sensor the top of the cabinet (E/S series model) or inside the unit below the top filter (D/G series model). Airflow sensor for D/G series models can be accessed from the back of the unit. See Figure 5-1 below. It is a stainless steel tube with 2 round holes facing up.</li> </ul> <p><b>Important to check:</b></p> <ol style="list-style-type: none"> <li>1. Ensure that the sensor area is not blocked at all and that its through-holes are perpendicular to the filter's surface.</li> <li>2. Exhaust sensor is attached tightly to the box / housing.</li> <li>3. If sensor box is used, there is no gap between sensor box and filter surface. If doughnut housing is used, the installation direction is in accordance with the airflow direction.</li> <li>4. Sensor box / housing is installed tightly to the cabinet.</li> </ol> <ul style="list-style-type: none"> <li>• Turn off the cabinet.</li> <li>• Open the front panel and locate electrical panel behind it.</li> <li>• Refer to the Component Layout at the beginning of this section to locate the main board in the electrical box.</li> <li>• Using multimeter, check the exhaust sensor's output voltage (DC) at channel AIN1(+) and J1(-) on main board (See Figure 5-2 below).</li> <li>• The airflow sensor voltage should increase if airflow is increased and decrease if airflow is decreased.</li> <li>• If your observations are different, check airflow sensor connection on top of the unit (see Figure 5-5) and at connector D pin 9, 10, 11, 12 on electrical panel for any bad/loose connection.</li> <li>• If connections are good but sensor is still not working properly, replace it.</li> </ul>

Cause	Corrective Action
	<ul style="list-style-type: none"> <li>If airflow sensor is working properly, Proceed to the next step.</li> </ul> <p><b>B. Temperature Sensor Failure</b></p> <ul style="list-style-type: none"> <li>Temperature sensor is located on top of the unit, close to exhaust airflow sensor. See Figure 5-4.</li> <li>Using multimeter, check the temperature sensor's output voltage (DC) at channel AIN4(-) and J4(+) on main board See Figure 5-3.</li> <li>0.01VDC should represent one degree Celsius. For example, if output is 0.25 VDC, it indicates temperature of 25 °C. Tolerance of <math>\pm 1^{\circ}\text{C}</math> is acceptable.</li> <li>Replace temperature sensor if the reading is wrong.</li> <li>If temperature sensor is working properly, Proceed to the next step.</li> </ul>
 <p data-bbox="290 846 386 869">Figure 5-3</p>	 <p data-bbox="1053 716 1179 764">Temperature Sensor</p> <p data-bbox="915 827 1008 850">Figure 5-4</p>
 <p data-bbox="850 1167 943 1190">Figure 5-5</p>	

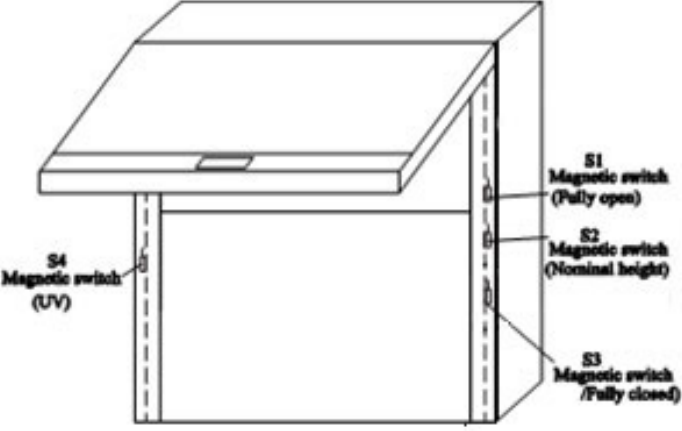
#### Problem 6: Excessive Blower Noise

Cause	Corrective Action
Resonance	<p><b>Note:</b> Requires a Certifier or qualified personnel</p> <ul style="list-style-type: none"> <li>Locate the motor speed controller.</li> <li>Measure the motor voltage and record this number</li> <li>Increase the motor speed by 5 – 10 VAC. Does the noise change or go away?</li> <li>If the noise is gone, measure the actual airflow velocity. Requires a Certifier <ul style="list-style-type: none"> <li>If the velocity is still in the acceptable range, maintain it.</li> <li>If velocity is out of acceptable range, or if noise persists, go to next step.</li> </ul> </li> </ul>
Loose motor or impeller wheel mounting	<p><b>Note:</b> Decontaminate cabinet first before accessing the blower</p> <ul style="list-style-type: none"> <li>Open the blower access panel and check if the blower mounting bolts are tight</li> <li>Does the motor rotate freely without noise?</li> <li>If motor is physically damaged, replace it.</li> </ul>

**Problem 7: Light always OFF**

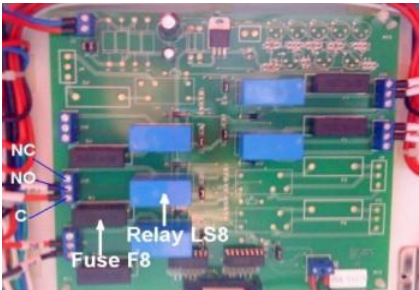
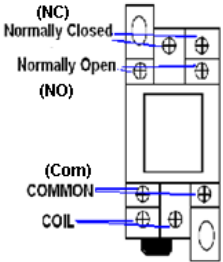
Cause	Corrective Action
Sash in SASH ALARM state	<ul style="list-style-type: none"> <li>• Is the Light LED on the front panel ON?</li> <li>• If the light does not turn on, press the Light button and make sure the sash is in the Normal operating position (Ready Position Normal Operating height). <b>Note:</b> <i>The sash must be at the Normal Operating position.</i></li> <li>• Is the cabinet in Warm Up period? <b>Note:</b> <i>The fluorescent light will not light if the cabinet is in Warm Up period unless the cabinet is in Quick Start Mode.</i></li> <li>• Move the sash to Ready position (normal operating height).</li> <li>• Switch on the light by pressing LIGHT button on the membrane.</li> <li>• If the LED is ON the keypad and main board are functioning correctly.</li> <li>• If fluorescent light does not light with the window in the proper position Proceed to the next step</li> <li>• If the LIGHT LED still does not light, skip to <b>Ready magnetic switch Issues</b> in this table.</li> </ul>
Burned out fluorescent tube	<ul style="list-style-type: none"> <li>• Replace the faulty fluorescent tube.</li> <li>• Fluorescent tubes are located inside the blue panel.</li> <li>• The white lamp holder can be pulled off from the tubes.</li> </ul>
Defective Fluorescent ballast or Relay Board issues	<ul style="list-style-type: none"> <li>• Check incoming voltage to the Relay board.</li> <li>• Locate LS7 circuit and measure AC voltage between BLUE (NEUTRAL) terminal block and the end terminal (with Red cable) on the three terminal strip (J13 on relay board).</li> <li>• If there is voltage to the end terminal (Terminal with cable), check the central terminal (Normally Open Circuit) to the BLUE (NEUTRAL) terminal block.</li> <li>• No voltage at the central terminal indicates a blown fuse or the circuit is not energized.</li> <li>• Check Fuse F7 on relay board. See Figure 7-1 below.</li> <li>• If fuse F7 is blown, as temporary solution, use F5 (spare) to replace F7.</li> <li>• If fuse F7 is good, check the voltage between the BLUE (NEUTRAL) terminal block and the end terminal on the LS7 circuit (J13 on relay board).</li> <li>• Voltage at the end terminal with no cable indicates the F7 fuse is good and the circuit is not energized.</li> <li>• Make sure the LIGHT LED is on.</li> <li>• If the ballast has power and the bulbs are new the problem is either connections or the ballast.</li> <li>• Check Connector C connections. If there are no loose terminals, replace the ballast.</li> </ul>
	<p>Figure 7-1</p>
Ready magnetic switch Issues	<ul style="list-style-type: none"> <li>• With the LIGHT LED ON and the sash at the Normal operating position (Ready)</li> <li>• Does the Display indicate “SASH: OK” or “SASH: NO!”</li> <li>• “SASH: NO!” indicates the sash is not at the proper position and the LIGHT LED should not be on. This indicates a main board problem or a magnetic switch detection problem.</li> </ul>



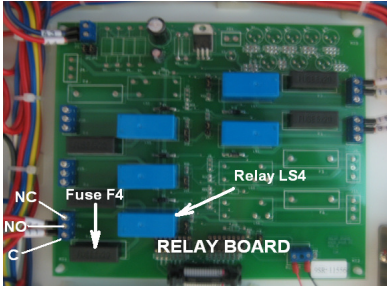
Cause	Corrective Action
	<ul style="list-style-type: none"> <li>To access the magnetic switches for the sash positions, remove the right sash window profile cover as you face the cabinet.</li> <li>There are 3 magnetic switches inside the right profile. See Figure 7-2 below. The one in the middle is for Ready position.</li> <li>There is a magnet attached to the glass to activate the magnet.</li> <li>Shift the switch or magnet position so the distance between them is between 10-13mm (3/8 to 1/2") as explained in Figure 7-2 below. If the distance is too far, the switch may not be able to detect the magnet.</li> <li>If the LCD still displays "<b>SASH: NO!</b>", the switch may be defective or there is a wiring connection problem. To check the connections proceed to the next step.</li> </ul>
 <p data-bbox="971 961 1065 982">Figure 7-2</p>	<p data-bbox="245 1041 363 1094">Connection Problem</p> <ul style="list-style-type: none"> <li>Locate Connector C and D and check male and female side for any bad connection.</li> <li>If the fluorescent lamp still does not light with the LIGHT LED ON return to start of Problem 7 and repeat the troubleshooting process.</li> </ul>

#### Problem 8: UV Light always OFF

Cause	Corrective Action
Sash not in UV state	<ul style="list-style-type: none"> <li>Lower the sash to UV mode position.</li> <li>If "<b>SASH FULLY CLOSED</b>" is not displayed on the LCD, please refer to the Magnetic Switch troubleshooting section.</li> <li>Switch on the UV lamp by pressing the UV button.</li> <li>If "<b>SASH FULLY CLOSED</b>" is displayed on LCD but UV is not ON after pressing UV button, refer to the Magnetic Switch troubleshooting section.</li> </ul>
Faulty UV tube	<ul style="list-style-type: none"> <li>Replace the faulty UV tube.</li> </ul>
Faulty UV ballast	<ul style="list-style-type: none"> <li>Check incoming voltage to the Relay board.</li> <li>Locate LS8 (J15 Terminal) circuit and measure AC voltage between large BLUE (Neutral) terminal block and the end terminal (with Red cable) on the three terminal strip (J15 on relay board).</li> <li>If there is no incoming voltage to the end terminal (Terminal with cable), refer to the next step <b>NO power to UV Relay circuit LS8</b>.</li> <li>If voltage to the end terminal (Terminal with cable) exists, check the central terminal (Normally Open Circuit) to the BLUE (Neutral) terminal block.</li> <li>Absence of voltage at the central terminal indicates a blown fuse or the circuit is not energized.</li> <li>Check Fuse F8 on relay board. See Figure 8-1 below.</li> <li>If fuse F8 is blown, as temporary solution, use F5 (spare) to replace F8.</li> <li>If fuse F8 is good, check the voltage between the BLUE(NEUTRAL) terminal block and</li> </ul>

Cause	Corrective Action
	<p>the end terminal on the LS8 circuit (on J15 terminal of relay board).</p> <ul style="list-style-type: none"> <li>• Voltage at the end terminal with no cable indicates the F8 fuse is good and the circuit is not energized.</li> <li>• Make sure the UV LED is on.</li> <li>• If the ballast has power and the UV lamp is new, the problem is either cable connections or the UV ballast.</li> <li>• Check Connector B cable connections. If there are no loose terminals, replace the UV ballast.</li> </ul>
No Power to UV Relay circuit LS8 and K2 relay	<ul style="list-style-type: none"> <li>• Absence of voltage at LS8 indicates K2 Relay is open.</li> <li>• Check magnetic UV interlock switch on Left side (as you face the cabinet) of sash.</li> <li>• Check the AC voltage to and from the K2 relay.</li> <li>• Absence of voltage indicates a wiring issue between the RED (Live) power in and the K2 relay.</li> <li>• If voltage to the K2 relay is present, but no voltage out of the K2 relay, this indicates the relay is not energized or defective.</li> <li>• Check the DC voltage to the coil of the K2 relay. Voltage should be 12VDC <math>\pm</math> 10%.</li> <li>• No voltage indicates the magnetic switch on the Left side is not closed. Check the wiring to the switch Connector D-6 and D-3.</li> <li>• To simulate a closed switch, set the jumper between connector D-6 and D-3 at Connector D.</li> <li>• If the relay does not energize, check the wiring from the K2 coil to Connector D and the neutral wiring from K2 to the DC Power supply.</li> <li>• If wiring connections are OK, visually inspect K2 relay for any burnt or flash marks.</li> <li>• If burnt or flash marks are present, replace the relay.</li> <li>• If no burnt or flash marks are found, turn off the cabinet.</li> <li>• Disconnect relay cables and check for the continuity at K2 relay terminals. See figure 8-2. NC to COM has continuity while, NO to COM does not have continuity. Replace the relay if any of the terminals are found with wrong continuity configuration.</li> </ul>
	 <p>Figure 8-2</p>
UV magnetic switch is defective or misaligned	<ul style="list-style-type: none"> <li>• Move sash to Fully Closed position. The LCD should show <b>SASH: FULLY CLOSED</b>.</li> <li>• If the LCD display shows "<b>SASH: NO!</b>" the sash is not fully closed.</li> <li>• Check the magnetic switches. There are 3 magnetic switches behind the right sash profile cover. See Figure 7-2 above. The bottom one is for UV Mode position.</li> <li>• There is a magnet attached to the glass to activate the magnetic switch.</li> <li>• Shift the switch or magnet position so the distance between them is between 10-13mm (3/8" to 1/2") as explained in Figure 7-2 above. If the distance is too far, the switch may not be able to detect the magnet.</li> <li>• If the LCD still showing "<b>SASH: NO</b>" check the connections at Connector D pins D-4 and D-5</li> <li>• To simulate a closed U/V Switch, connect the jumper between Connector D pins D-5 and D-4.</li> <li>• If this does not turn on the UV, return to the first step and repeat the procedures.</li> </ul>

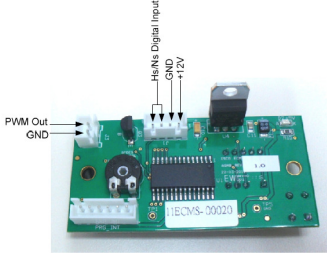

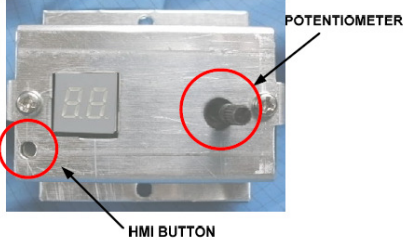
**Problem 9: Electrical socket always OFF**

Cause	Corrective Action
Connection Problem	<ul style="list-style-type: none"> <li>• Is the OUTLET LED illuminated? If not press the Outlet button at the keypad membrane in front panel.</li> <li>• Check voltage coming to the Relay board.</li> <li>• Locate LS4 (J6 Terminal) circuit and measure AC voltage between Large BLUE (Neutral) terminal block and the end terminal (with Red cable-COM) on the three terminal strip (J6).</li> <li>• If there is voltage to the end terminal (with Red cable-COM), check the central terminal (Normally Open circuit) to the BLUE (Neutral) terminal block.</li> <li>• No voltage at the central terminal (Normally Open circuit) indicates a blown fuse or the circuit is not energized.</li> <li>• Check Fuse F4 on relay board. See Figure 9-1 below.</li> <li>• If fuse F4 is blown, replace with F5 fuse.</li> <li>• If fuse F4 is OK, check the voltage between the BLUE (NEUTRAL) terminal block and the end terminal (COM) on the LS4 circuit (J6 on relay board).</li> <li>• Voltage at the end terminal (Normally Closed circuit) with no cable indicates the F4 fuse is good and the circuit is not energized. Make sure the OUTLET LED is on.</li> <li>• If there is power to the relay and it is energized Check voltage across Connector B pin 1 to 2 and pin 4 to 5.</li> <li>• If there is power through Connector B pins, remove socket outlets from wall.</li> <li>• Check incoming power to the plug in the cable to the outlet</li> <li>• No power indicates a wiring issue. Recheck voltage from Connector B pins.</li> <li>• Check for loose or faulty connection between the power cord, IEC inlet and Connector B.</li> </ul>
	Figure 9-1
Faulty electrical socket	<ul style="list-style-type: none"> <li>• Socket(s) is(are) located inside the work zone.</li> <li>• Check electrical socket connection.</li> <li>• If connection is correct but socket has no output, replace electrical socket.</li> </ul>

**Problem 10: Contaminated Sample/Lab**

Cause	Corrective Action
Blocked air grille/ Cabinet overloaded with too many items	<p><b>Note:</b> Contaminated samples are normally the result of any of the following:</p> <ul style="list-style-type: none"> <li>-Poor Technique of the user or lack of training.</li> <li>-Samples being contaminated in the incubator or somewhere other than the BSC.</li> </ul> <p>Items to check on the BSC:</p> <ul style="list-style-type: none"> <li>• Make sure that the front and back air grilles are not blocked.</li> <li>• Remove all equipment and other items from the cabinet and surface decontaminate the cabinet including the area under the work surface.</li> <li>• Surface decontaminate everything that is returned to the BSC.</li> <li>• If the contamination problem persists, recertify the cabinet.</li> </ul>

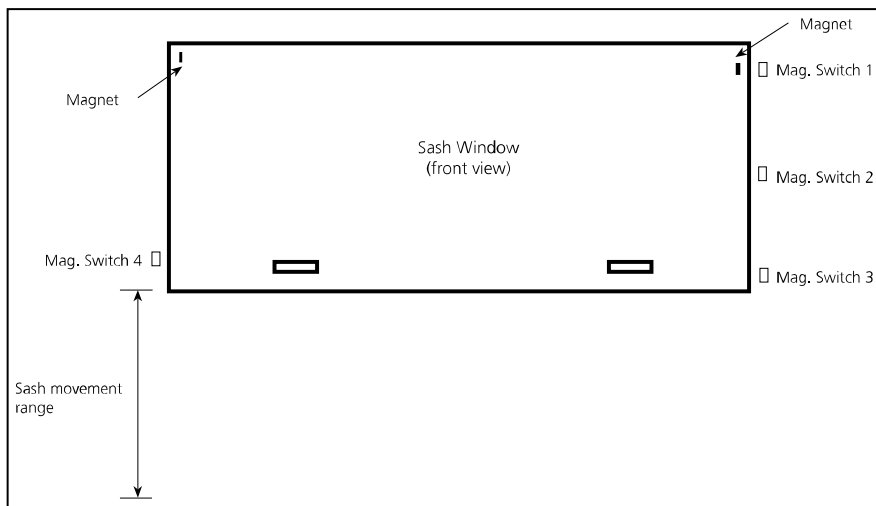
**Problem 11: DC Motor Speed Controller not functioning**

Cause	Corrective Action
No output, the power indicator LEDs Off	<ul style="list-style-type: none"> <li>• Turn the system on by supplying 12 VDC to the ECMS.</li> <li>• Replace the ECMS with a new one (Figure 11.1 )</li> </ul>  <p>Figure 11.1 ECMS</p>
No output, but the power indicator LEDs On	<ul style="list-style-type: none"> <li>• Make sure that the correct DC line voltage is connected properly and turned on.</li> <li>• Replace the ECMS with a new one.</li> </ul>  <p>Figure 11.2 ECMS showing the power indicator</p>
The output voltage cannot be adjusted by turning the potentiometer	<ul style="list-style-type: none"> <li>• Replace the ECMS with a new one.</li> </ul>  <p>Figure 11.3 ECMS showing potentiometer and HMI button</p>
The half speed mode cannot be activated	<ul style="list-style-type: none"> <li>• Make sure both of the digital input has been shorted. You can check the continuity of digital input by Multimeters.</li> <li>• Replace the ECMS with a new one.</li> </ul>

## 7.2. Software Troubleshooting

Error Code	Corrective Action
Sash: Error Position	<ul style="list-style-type: none"> <li>Magnetic switches are located inside right profile cover. See drawing B-1 below.</li> </ul>

B-1



B-2

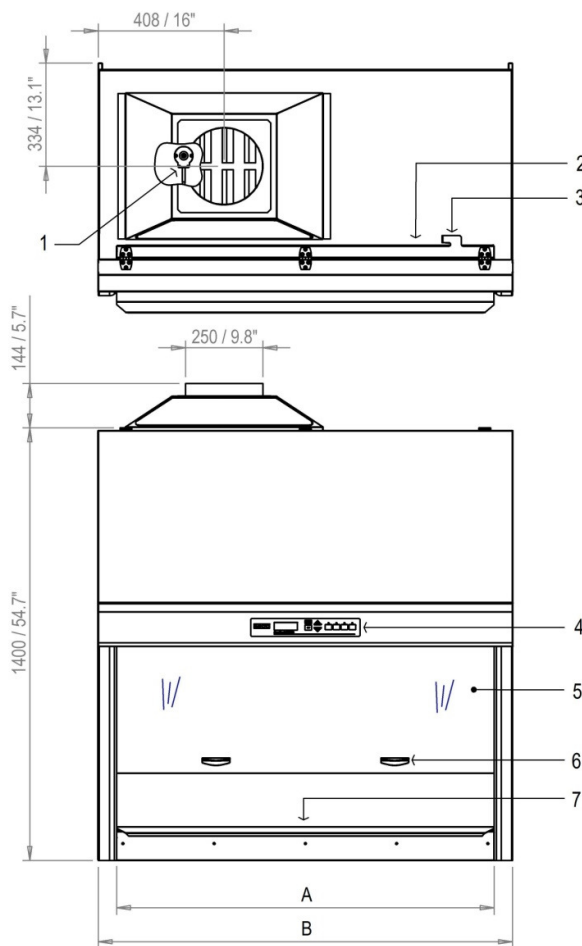
Table 2

Magnetic Switch 1	Magnetic Switch 2	Magnetic Switch 3	Magnetic Switch 4	Description
Close	Open	Open	Open	Sash is fully opened, ALARM is given. ALARM can be muted.
Open	Close	Open	Open	Cabinet sash is at nominal height, ready to use.
Open	Open	Close	Close	Sash is fully closed; UV can be operated.
Open	Open	Open	Open	SASH is at unsafe state, ALARM is given. ALARM cannot be muted.
Rest Conditions				SASH:ERROR POSITION detected

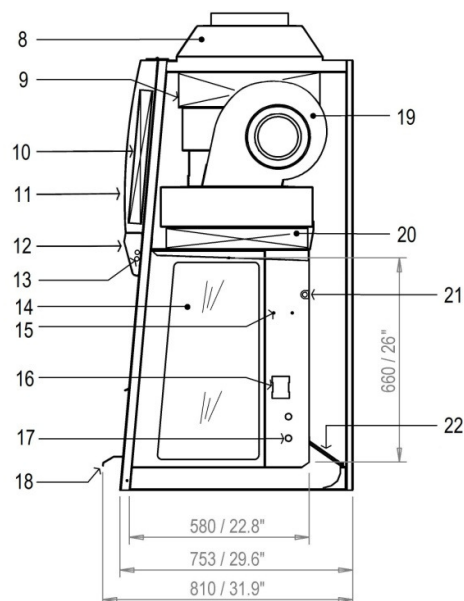
SENSOR UNCALIBRATED		• Calibrate the controller. Refer to test report to calibrate.		
Sash Position	Function Available	Normal Or Quickstart Mode and Airfail Alarm On	Normal Or Quickstart Mode and Airfail Alarm Off	Maintenance Mode
READY	Sash Position Detection	Yes	Yes	Yes
	Fan Control	Yes, with WARM UP & PURGING time, FAN PIN required	Yes, with WARM UP & PURGING time, FAN PIN required	Yes, without 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, USER or ADMIN PIN required	Yes, USER or ADMIN PIN required	Yes, no PIN required
	Pressing Set button	Complete Diagnostic Message	Complete Diagnostic Message	Complete Diagnostic Message
	Timer	Yes	Yes	No
	Current Time Display	Yes	Yes	Yes
	Air Velocity Display	Yes	Yes	Yes
	If not calibrated, displaying "Sensor Uncalibrated"			
Air Velocity Display Status	Yes	Yes	No	
Air Fail checking	Yes, Alarm and display alert if air fails	No	No	
SASH ALARM	Sash Position Detection	Yes	Yes	Yes
	Current Time Display	Yes	Yes	Yes
	Sash Alarm	Yes, not mutable	Yes, not mutable	Not Applicable
	Fan Control	Yes, without WARM UP & PURGING time, no PIN required	Yes, without WARM UP & PURGING time, no PIN required	Yes, without WARM UP & PURGING time, no PIN required
	Light Control	No	No	Yes
	Socket Control	Yes	Yes	Yes
	UV Control	Interlocked	Interlocked	Interlocked
	Air Velocity Display	Yes	Yes	Yes
	Air Velocity Display Status	Yes	Yes	No
Air Fail checking	Yes, display alert if air fails	No	No	
FULLY OPEN	Sash Position Detection	Yes	Yes	Yes
	Current Time Display	Yes	Yes	Yes
	Alarm	Yes, mutable for 5 minutes	Yes, mutable for 5 minutes	Not Applicable
	Fan Control	Yes, with WARM UP & PURGING time, FAN PIN required	Yes, with WARM UP & PURGING time, FAN PIN required	Not Applicable
	Light Control	Yes	Yes	Yes
	Socket Control	Yes	Yes	Yes
FULLY CLOSED	UV CONTROL	Interlocked	Interlocked	Interlocked
	Sash Position Detection	Yes	Yes	Yes
	SWITCH OFF Fan requested	Yes	Yes	No
	Fan Control	Interlocked	Interlocked	Yes
	Light Control	Interlocked	Interlocked	Yes
Socket Control	Yes	Yes	Yes	
UV Control	Yes	Yes	Interlocked	

## Chapter 8 - Engineering Details

### 8.1. AC2-\_E\_ Engineering Drawing



Cabinet Size	A	B	C	D
2'	610 mm 24"	730 mm 28.7"	334 mm 13.1"	233 mm 9.2"
3'	915 mm 36"	1035 mm 40.7"	334 mm 13.1"	331 mm 13"
4'	1220 mm 48"	1340 mm 52.7"	334 mm 13.1"	408 mm 16"
5'	1525 mm 60"	1645 mm 64.7"	334 mm 13.1"	560 mm 22"
6'	1830 mm 72"	1950 mm 76.8"	326 mm 12.8"	560 mm 22"

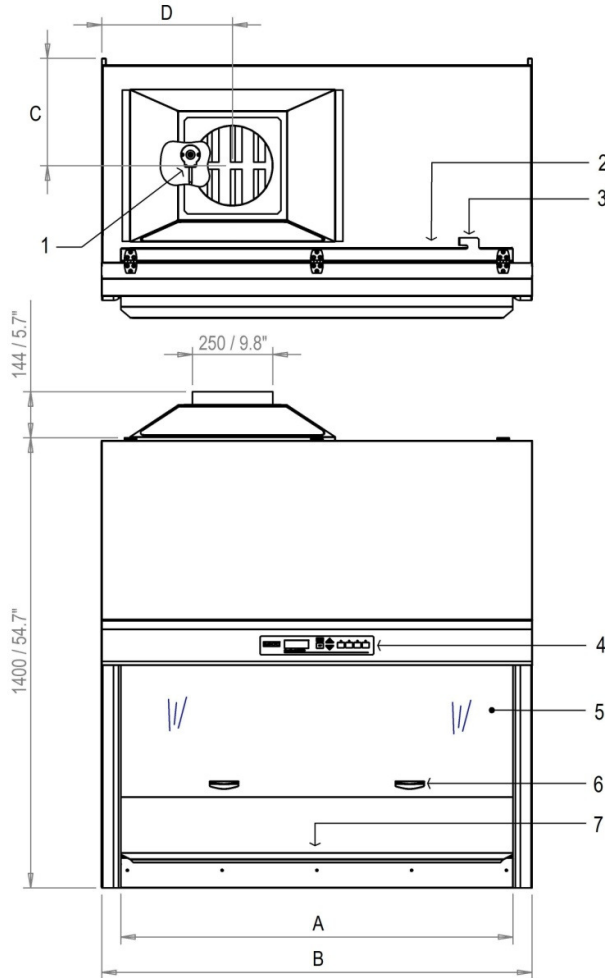


- 1 - Airflow Sensor
- 2 - RS232 Port
- 3 - Power Inlet
- 4 - Sentinel Gold Control System
- 5 - Sash Window
- 6 - Sash Handle
- 7 - Work tray

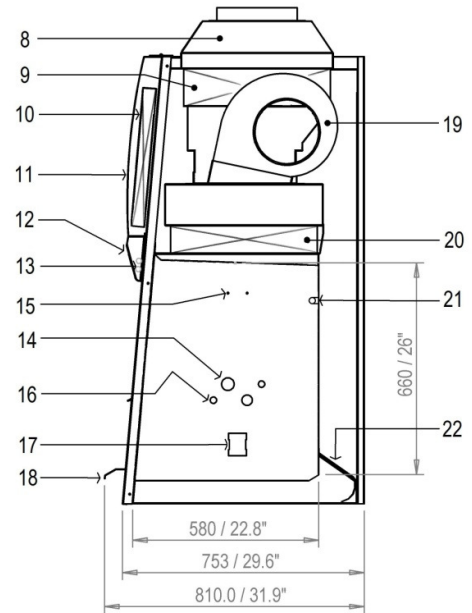
- 8 - Exhaust Collar (Optional)
- 9 - Exhaust ULPA Filter
- 10 - Electrical Panel
- 11 - Curved Front Panel
- 12 - Display Panel
- 13 - Fluorescent Lamps
- 14 - Side Window

- 15 - IV Bar Retrofit Kit Provision
- 16 - Electrical Outlet Kit Provision
- 17 - Service Fixture Kit Provision
- 18 - Stainless Steel Armrest
- 19 - ECM Blower
- 20 - Downflow ULPA Filter
- 21 - UV Lamp
- 22 - Paper Catch (optional pre-filter)

## 8.2. AC2-S\_Engineering Drawing



Cabinet Size	A	B	C	D
2'	610 mm 24"	730 mm 28.7"	334 mm 13.1"	233 mm 9.2"
3'	915 mm 36"	1035 mm 40.7"	334 mm 13.1"	331 mm 13"
4'	1220 mm 48"	1340 mm 52.7"	334 mm 13.1"	408 mm 16"
5'	1525 mm 60"	1645 mm 64.7"	334 mm 13.1"	560 mm 22"
6'	1830 mm 72"	1950 mm 76.8"	326 mm 12.8"	560 mm 22"



- 1 - Airflow Sensor
- 2 - RS232 Port
- 3 - Power Inlet
- 4 - Sentinel Gold Control System
- 5 - Sash Window
- 6 - Sash Handle
- 7 - Work tray

- 8 - Exhaust Collar (Optional)
- 9 - Exhaust ULPA Filter
- 10 - Electrical Panel
- 11 - Curved Front Panel
- 12 - Display Panel
- 13 - Fluorescent Lamps
- 14 - Steris VHP/ Bioquell HPV Port

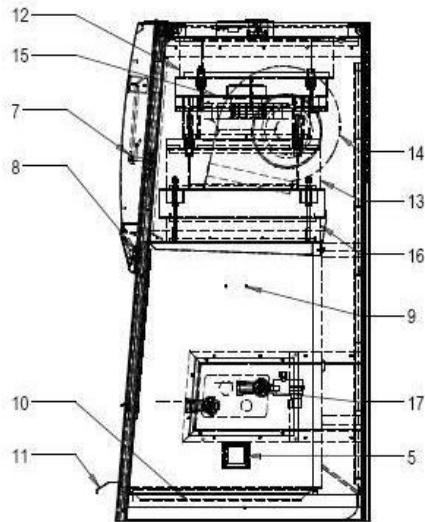
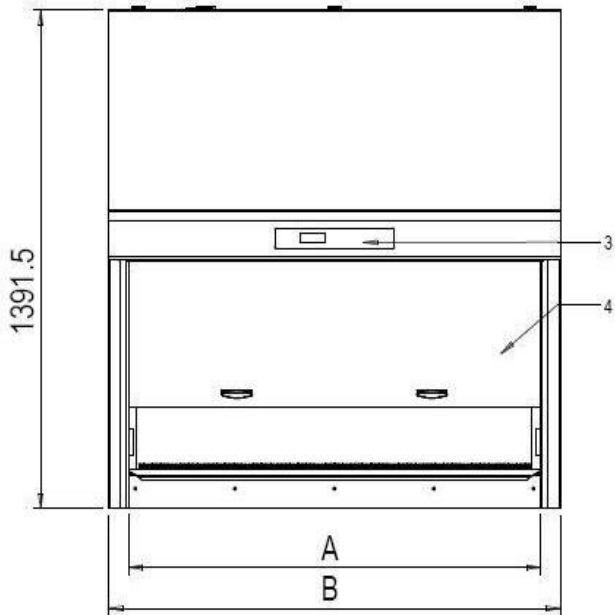
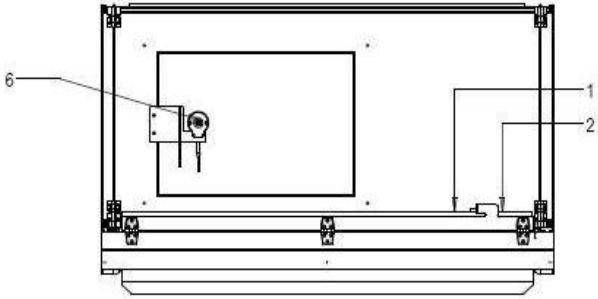
- 15 - IV Bar Retrofit Kit Provision
- 16 - Electrical Outlet Kit Provision
- 17 - Service Fixture Kit Provision
- 18 - Stainless Steel Armrest
- 19 - ECM Blower
- 20 - Downflow ULPA Filter
- 21 - UV Lamp
- 22 - Paper Catch (optional pre-filter)





#### **8.4. AC2-\_D\_ Engineering Drawing**

	A	B
4'	1220mm	1340mm
6'	1830mm	1950mm



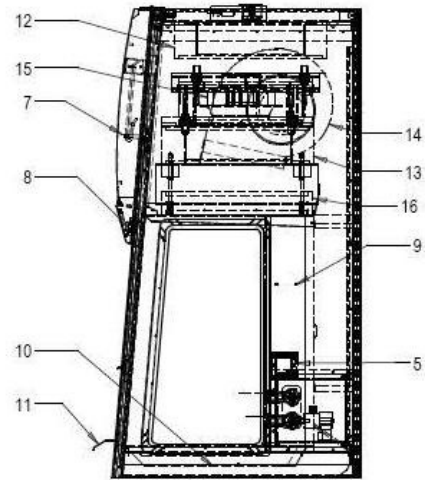
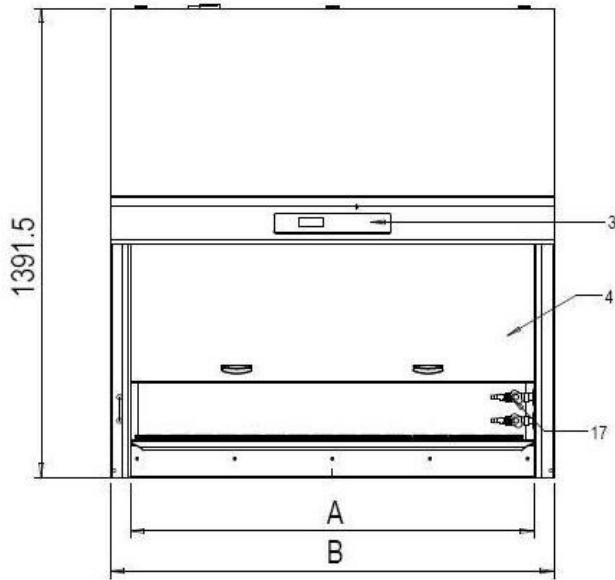
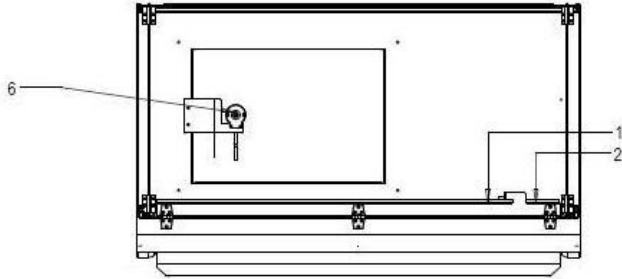
- 1.0 RS232 Port
- 2.0 Power Inlet
- 3.0 Sentinel Gold Controller
- 4.0 Sash Window
- 5.0 Electrical Outlet
- 6.0 AirFlow Sensor

- 7.0 Electrical Panel
- 8.0 Fluorescent
- 9.0 IV Bar Retrofit Kit Provision ( max 1 kg load)
- 10.0 Work Tray
- 11.0 Armrest
- 12.0 2nd Exhaust ULPA Filter

- 13.0 1st Exhaust ULPA Filter
- 14.0 Blower 1
- 15.0 Blower 2
- 16.0 Downflow ULPA Filter
- 17.0 Service Fixture

### 8.5. AC2-\_G\_ Engineering Drawing

	A	B
4'	1220mm	1340mm
6'	1830mm	1950mm



- 1.0 RS232 Port
- 2.0 Power Inlet
- 3.0 Sentinel Gold Controller
- 4.0 Sash Window
- 5.0 Electrical Outlet  
Retrofit Kit Provision
- 6.0 AirFlow Sensor

- 7.0 Electrical Panel
- 8.0 Fluorescent
- 9.0 IV Bar Retrofit Kit  
Provision ( max 1 kg load)
- 10.0 Work Tray
- 11.0 Armrest
- 12.0 2nd Exhaust ULPA Filter

- 13.0 1st Exhaust ULPA Filter
- 14.0 Blower 1
- 15.0 Blower 2
- 16.0 Downflow ULPA Filter
- 17.0 Service Fixture

## 8.6. General Specifications

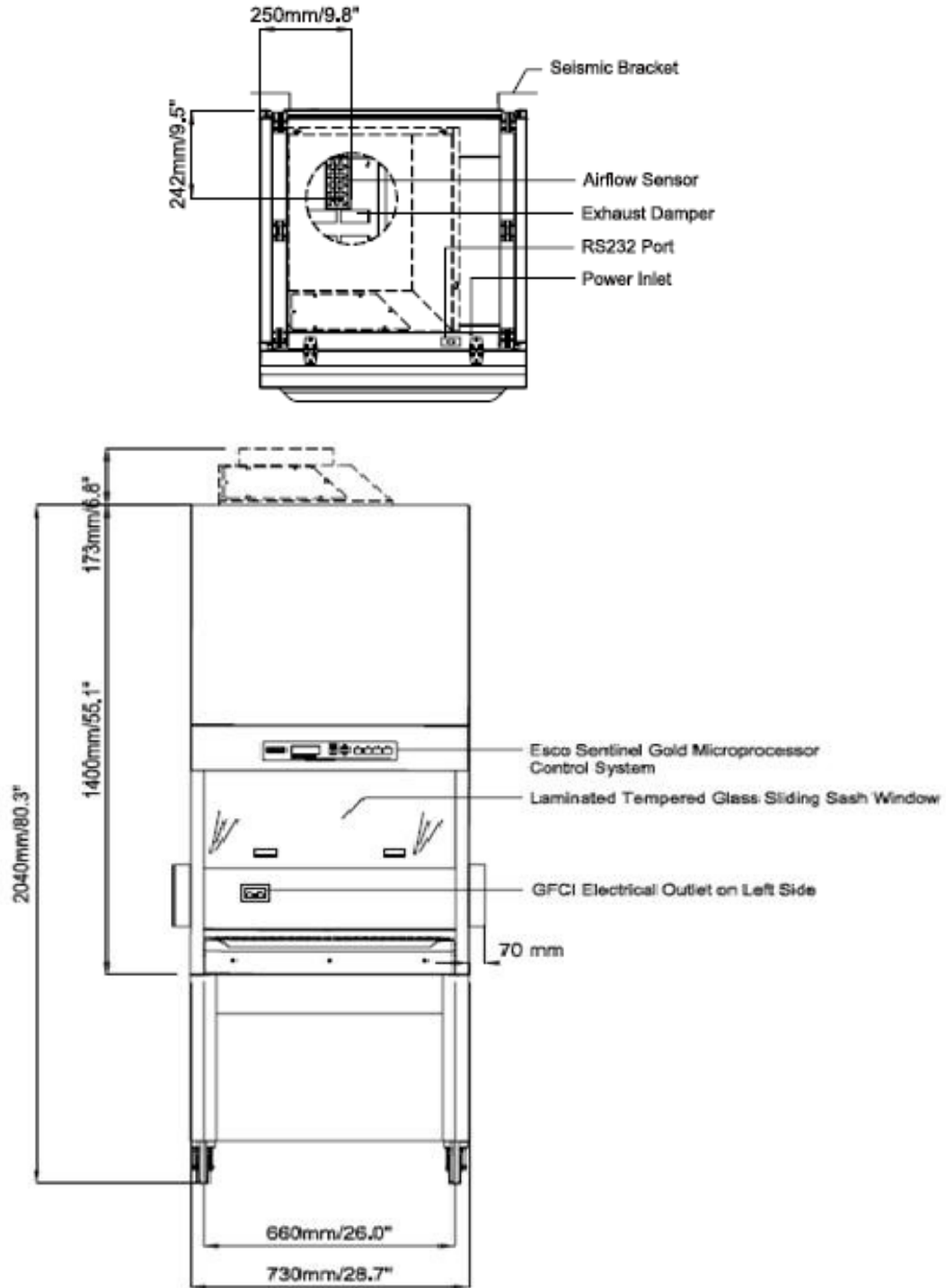
AIRSTREAM CLASS II TYPE A2 TECHNICAL SPECIFICATIONS			
Glass Slide: 230 V, 50/60 Hz		AC2-4D_	AC2-4G_
Stainless Steel Side: 230 V, 50/60 Hz		AC2-6D_	AC2-6G_
<b>Nominal Size</b>		4 ft/ 1.2m	6 ft/ 1.8m
<b>External Dimensions* (W x D x H)</b>	<b>Width</b>	1340 mm (52 ¾")	1950 mm (76 ¾")
	<b>Depth without arm rest</b>	753 mm (29 ½")	
	<b>Depth with arm rest</b>	810 mm (32")	
	<b>Height</b>	1400 mm (54 ¾")	
<b>Gross Internal Dimensions (W x D x H)</b>	<b>Width</b>	1220 mm (48")	1830 mm (72")
	<b>Depth</b>	580 mm (22 ¾")	
	<b>Height</b>	660 mm (26")	
<b>Usable Work Area</b>		0.56 m <sup>2</sup> (6.1 sq.ft)	0.85 m <sup>2</sup> (9 sq.ft)
<b>Tested Opening</b>		203 mm (8")	
<b>Working Opening</b>		215 mm (8 ½")	
<b>Ave. Airflow Velocity</b>	<b>Inflow</b>	0.45 m/s (90 fpm)	
	<b>Downflow</b>	0.30 m/s (60 fpm)	
<b>Airflow Volume</b>	<b>Inflow</b>	473 cmh (803 cfm)	709 cmh (1204 cfm)
	<b>Downflow</b>	726 cmh (1295 cfm)	1144 cmh (1943 cfm)
	<b>Exhaust</b>	473 cmh (803 cfm)	709 cmh (1204 cfm)
	<b>Required Exhaust With Optional Thimble Exhaust Collar</b>	538 m <sup>3</sup> /h (317 cfm)	823 m <sup>3</sup> /h (485 cfm)
	<b>Static Pressure For Optional Thimble Exhaust Collar</b>	31 Pa / 0.12 in H <sub>2</sub> O	47 Pa / 0.18 in H <sub>2</sub> O
	<b>ULPA Filter Efficiency</b>	>99.999% at 0.1 to 0.3 micron as per IEST-RP-CC001 USA	
	>99.999% at MPPS as per EN 1822 (H14) EU		
<b>Sound Emission**</b>	<b>NSF / ANSI 49</b>	62.3 dBA	65.5 dBA
	<b>EN 12469</b>	61.3 dBA	62.5 dBA
<b>Fluorescent Lamp Intensity (lux)</b>		1400 Lux	
<b>Fluorescent Lamp Intensity (ft-cd)</b>		130	
<b>Cabinet Construction</b>	<b>Main Body</b>	"1.2 mm (0.05") 18 gauge electro-galvanized steel with white oven-baked epoxy-polyester Isocide antimicrobial powder coated finish"	
	<b>Work Zone</b>	1.5 mm (0.06") 16 gauge Stainless steel Type 304 with No. 4B finish	
	<b>Side Walls (E series)</b>	UV absorbing tempered glass, 5 mm (0.2") colourless and transparent	
	<b>Side Walls (S series)</b>	0.9 mm (0.035") 20 gauge Stainless steel, type 304 and 1.2 mm (0.05") 18 gauge electro-galvanized steel	
<b>Electrical</b>	<b>Cabinet Full Load Amps (FLA)</b>	9.62A	11A
	<b>Heat load (BTU/Hr)</b>	905	1230
<b>Nnominal Power Consumption</b>		265W	360W
<b>Net Weight****</b>		230 Kg (507 lbs)	346 Kg (763 lbs)
<b>Shipping Weight****</b>		285 Kg (628 lbs)	428 Kg (944 lbs)
<b>Shipping Dimensions, Maximum (W x D x H) mm ****</b>		1450 x 820 x 1760	2050 x 820 x 1760
<b>Shipping Volume, Maximum****</b>		2.09 m <sup>3</sup>	2.96 m <sup>3</sup>

\* Depth includes the remove-able arm rest and front cover. When they are removed, depth is 790 mm (31.1").

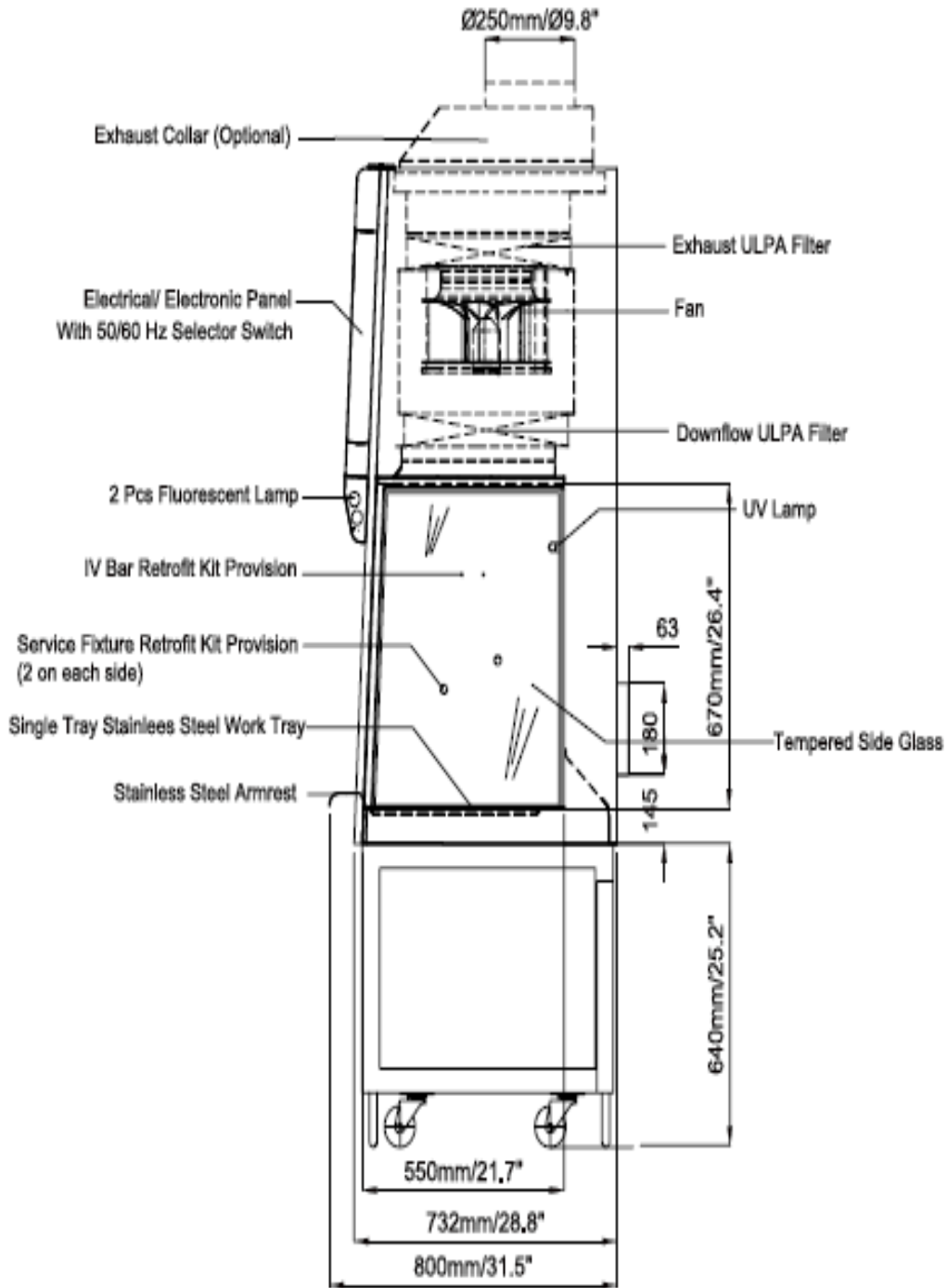
\*\* Noise reading in open field / anechoic chamber.

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

### 8.7. AC2-2N7 Engineering Drawing



i



## 8.8. General Specifications

		<b>AC2-2N7</b>
External Dimensions (W x D x H) (mm)		730 x 800 x 1400
External Dimensions (W x D x H) (")		28.7 x 31.5 x 55.1
Gross Internal Dimensions (W x D x H) (mm)		670 x 560 x 670
Gross Internal Dimensions (W x D x H) (")		26.4 x 22.0 x 26.4
Usable Work Area		0.29 m <sup>2</sup> (3.1 ft <sup>2</sup> )
Maximum Sash Opening		440 mm
Avg. Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than ± 20%
Airflow Volume	Inflow	185 m <sup>3</sup> /h (111 cfm)
	Downflow	385 m <sup>3</sup> /h (230 cfm)
	Exhaust	185 m <sup>3</sup> /h (111 cfm)
	Required Exhaust With Optional Thimble Exhaust Collar	260 m <sup>3</sup> /h (153 cfm)
	Static Pressure For Optional Thimble Exhaust Collar	28 Pa / 0.11 in H <sub>2</sub> O
ULPA Filter Efficiency	Downflow	≥99.999% at 0.1 to 0.3 micron as per IEST-RP-CC001 USA
	Exhaust	≥99.999% at MPPS as per EN 1822 (H14) EU
Sound Emission *	NSF / ANSI 49	<62 dBA
	EN 12469	<59 dBA
Fluorescent Lamp Intensity		>900 Lux (> 84 foot candles)
Cabinet Construction	Main Body	1.2 mm (0.05") 18 gauge electro-galvanized steel with white oven-baked epoxy-polyester Isocide antimicrobial powder coated finish
	Work Zone	1.5 mm (0.06") 16 gauge Stainless steel Type 304 No. 4 finish
	Side Walls	UV absorbing tempered glass, 5 mm (0.2"), colourless and transparent

\* Sound emission test is conducted in an open field condition/anechoic chamber

\*\* Cabinet only (excluding retrofit kit & support stand)



