Labgard ES Energy Saver
Class II Laminar Flow
Biological Safety Cabinet

Models
NU-437-300E/400E/500E/600E
Bench/Console

Operation & Maintenance Manual

Australian Test Method

July, 2013
(Series 61 and higher)
Revision 2

Manufactured By:
NuAire, Inc.
2100 Fernbrook Lane
Plymouth, MN  55447
Toll-Free: 1-800-328-3352
In Minnesota:  (763)-553-1270
Fax: (763)-553-0459
Congratulations!

You have just purchased one of the finest Laminar Flow Biological Safety Cabinets available. With proper care, maintenance (certification), and laboratory procedure, this cabinet will give you years of product and personnel protection from particulate contaminants as prescribed in National Sanitation Foundation (NSF) Standard No. 49 and EN 12469. Please read this manual carefully to familiarize you with proper installation, maintenance, and operation of the cabinet.

Acknowledgment

NuAire, Inc. acknowledges that some material in this manual reflects information supplied by the National Institutes of Health personnel both in verbal and written specifications. In particular, NuAire acknowledges that information in Section 8 was obtained from the following sources:


3. Anderson R.W., Director of Pharmacy, University of Texas, M.D. Anderson Hospital and Tumor Institute at Houston.
ABOUT THIS OPERATION & MAINTENANCE MANUAL

The information contained in this manual is intended to reflect our current production standard configuration model along with the more frequently purchased options. Any unique additions/modifications/shop drawings are appended in the back flap of this manual, along with any modifications and/or additions to procedures as outlined in this manual. A copy of the original factory test report is also appended to this manual. In case this manual and/or test report is lost or misplaced, NuAire retains a copy in our files. A replacement copy can be obtained by calling or writing NuAire, Inc. stating the model number and serial number and a brief description of the information desired.
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1.0 General Description

The Labgard Model NU-437 Laminar Flow Biological Safety Cabinet (LFBSC) is a bench/table top model, optionally available with a base support stand, for operation as a console model.

The Laminar Flow Biological Safety Cabinet, (LFBSC) is a product resulting from the development of the "laminar flow" principle (see airflow schematic) and the application of environmental controls as required in the field of biological research or chemical containment. The LFBSC, when used with proper technique, is an effective laboratory aid in obtaining the optimum control over product quality while reducing the potential for exposure of both product and personnel to airborne biological or particulate chemical agents in low to moderate risk-hazard research and drug preparation or product operations, as prescribed by the Center for Disease Control (CDC) Atlanta, Georgia.

The NU-437 bench LFBSC meets the requirements of a Class II, since the cabinet conforms to the following requirements:

- Maintains an average inflow velocity of 135 LFPM (.68 M/S) through the work access opening.
- Has HEPA filtered downflow air that is mixed with the inflow air from a common exhaust plenum.
- Discharges a percentage of air to the outside atmosphere after HEPA filtration.
- Has all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure.
2.0 Models & Features
The model NU-437, Class II Laminar Flow Biological Safety Cabinet is manufactured in four sizes: 3 ft., 4 ft., 5 ft., and 6 ft.
3.0 Warranty

NuAire, Inc. warrants that it will repair F.O.B. its factory or furnish without charge F.O.B. its factory a similar part to replace any material in its equipment within 36 months after the date of sale if proved to the satisfaction of the company to have been defective at the time it was sold provided that all parts claimed defective shall be returned, properly identified to the company at its factory, charges prepaid. Factory installed equipment or accessories are warranted only to the extent guaranteed by the original manufacturer, and this warranty shall not apply to any portion of the equipment modified by the user. Claims under this warranty should be directed to NuAire, Inc. setting forth in detail the nature of the defect, the date of the initial installation and the serial and model number of the equipment.

This warranty shall not apply to any NuAire product or part thereof which has been subject to misuse, abuse, accident, shipping damage, improper installation or service, or damage by fire, flood or acts of God. If the serial number of this product is altered, removed or defaced as to be illegible, the Warranty shall be null and void in its entirety.

The warranty is for the sole benefit of the original purchaser and is not assignable or transferable. Prior to returning any item, for any reason, contact NuAire for a Return Authorization Number. This number must accompany all returns. Any product shipped to NuAire without this number will be returned refused shipment or collect freight.

4.0 Shipments

NuAire takes every reasonable precaution to assure that your Labgard ES cabinet arrives without damage. Motor carriers are carefully selected and shipping cartons have been specially designed to insure your purchase. However, damage can occur in any shipment and the following outlines the steps you should take on receipt of a NuAire Labgard ES cabinet to be sure that if damage has occurred, the proper claims and actions are taken immediately.

4.1 Damaged Shipments

4.1.1 Terms are factory, unless stated otherwise. Therefore, it is important to check each shipment before acceptance.

4.1.2 If there is visible damage, the material can be accepted after the driver makes a notation on the consignee's copy of the freight bill. Then an inspection must be made to verify the claim against the carrier. This inspection is the basis of your filing the claim against the carrier.

4.1.3 If concealed damage is found, it is absolutely necessary to NOTIFY THE FREIGHT AGENT AT ONCE, and request an inspection. Without this inspection, the transportation company may not accept a claim for loss or damage. If the carrier will not perform the inspection, an affidavit must be prepared stating that he was contacted on a certain date and that he failed to comply with the request. This along with other papers in the customer's possession will support the claim.
5.0 Installation Instructions

5.1 Location
Within the laboratory, pharmacy, etc., the ideal location of the biological safety cabinet is away from personnel traffic lanes, air vents (in or out), doors and/or any other source of disruptive air currents.

THE EXHAUST FILTER AREA IS ESPECIALLY SUSCEPTIBLE TO DISRUPTIVE AIR CURRENTS FROM AIR VENTS. The Electronic Airflow Control System's exhaust probe is located just above the exhaust HEPA filter and if disruptive air currents are present, the exhaust probe could be influenced by them, and indicate disruptive readings on the front panel display. If drafts or other disruptive air currents exceed the inflow velocity of the cabinet through the access opening, the potential exists for contaminated air to exit or enter the work zone area of the cabinet. It depends on the severity of the air current. REMEMBER: A BIOLOGICAL SAFETY CABINET IS NO SUBSTITUTE FOR GOOD LABORATORY TECHNIQUE.

Where space permits, a clear 6" (152mm) area should be permitted on each side of the cabinet for maintenance purposes. The electrical outlet into which the cabinet is connected should be readily accessible for maintenance purposes. Do not position the cabinet to prevent access to the power cord. The power cord plug serves as the disconnect and should remain readily accessible. If the outlet is inaccessible, such as a conduit (hardwired) connection, then an appropriate warning label should be applied near the cabinets on/off switch to indicate the circuit breaker on the power distribution panel should be used. A MINIMUM CLEARANCE OF 6" (152MM) IS REQUIRED FROM THE TOP OF THE CABINET TO THE CEILING FOR PROPER VENTILATION OF THE EXHAUST EFFLUX.

If this cabinet is used in a pharmacy application, Per OSHA, NIOSH, and ASHP, it is strongly recommended that the cabinet be exhausted to the outside. In addition, if this cabinet is used in microbiological application with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides, Per CDC/NIH and NSF it is strongly recommended that the cabinet be exhausted to the outside. NuAire offers two general categories of exhaust transitions, which will capture the exhaust efflux from the cabinet. These are: Canopy, Thimble or Air Gap Exhaust Transitions (with and without integral fan)

NOTE: THE EXHAUST SYSTEM SHOULD BE FITTED WITH A BACKDRAFT DAMPER TO PREVENT REVERSING OF AIRFLOW IN THE SYSTEM.

NuAire strongly recommends a canopy or thimble exhaust for most applications.
See separate instruction sheets for a discussion of exhaust transitions and installation requirements.

NOTE, some countries (i.e. Germany) only allow canopy or thimble type transitions. Verify requirements per Local, State and Federal code laws.
5.2 Set-Up Instructions

Remove outer shipping protection (carton or crating). The cabinet is fastened to the base skid and it is usually the best procedure to leave the skid in place until the cabinet is located in its approximate position to facilitate ease in handling. It can then be removed from the skid by removing the banding, bolts and screws holding the cabinet to the skid. It may be necessary to remove the Control Center in order to gain passage through a doorway. It may easily be removed by following the instructions on drawing BCD-11817.

5.2.1 Base Stand Assembly

The base stand is shipped knocked down in a separate carton and is assembled per drawing BCD-05147 if accompanied with the unit. Remove the banding holding the cabinet to the base skid. Lift the cabinet from the base skid and place on the floor. Now lift the cabinet on top of the base and bolt the base stand to the cabinet using two 3/8" - 16 x 3/4" bolts and washers provided for the front base stand tabs and two 1/4" acorn nuts for the rear weld studs. Place the cabinet in its desired location.

The base stand storage cabinets will usually be shipped according to customer requirements. If it is shipped unassembled, it can be assembled per drawing BCD-05146. It is recommended that the upper and lower base stand braces be installed first, then the rear and bottom panels (the end panels are always prefastened). Once assembled, fasten the cabinet per the above instructions.

5.2.2 Leveling

Using a level placed on the work tray, adjust the leg levelers, first, end to end, then, front to back. The NSF approved leg levelers provide a ± 3/4" (20mm) adjustment.

5.2.3 Bench/Security Drain Valve Installation (BCD-12634)

Place the cabinet on the bench with approximately a 2" (51mm) overhang clearance for the drain SST cap or security drain valve. If the security drain valve is not desired, leave the SST cap in place and place the cabinet in its desired location and using RTV caulk, seal all around the base of the cabinet and the bench. This provides a tight seal to prevent bench spills from migrating under the cabinet.

If a security drain valve is desired, (NOTE, CHECK WITH YOUR SAFETY PERSONNEL FOR REGULATORY REQUIREMENTS (i.e. LOCKING TYPE) OF DRAIN VALVE INSTALLATION) remove the handle from the valve stem with security tool provided to gain clearance for valve body rotation. Add Loctite 242 (furnished) to the threads and rotate valve body until secure, with the valve stem (for handle) on the left side. Re-install handle to valve stem. Adjust the cabinet on bench to provide a 2" (51mm) overhang and seal the interface of the bench and cabinet, using RTV caulk as above.
THE NUaire BIOLOGICAL SAFETY CABINET HAS A DRAIN PAN BELOW THE WORKTRAY DESIGN TO SUBSTANTIALLY DRAIN SPILLS THAT ACCIDENTALLY OCCUR IN WORK ZONE.

A 3/8 DRAIN COUPLING IS LOCATED ON THE FRONT OF THE CABINET. THE DRAIN COUPLING CAN EITHER BE CAPPED OR HAVE A DRAIN VALVE WITH SECURITY SCREWS ATTACHED AS DESIRED.

3. REMOVE HANDLE USING SPECIAL TOOL PROVIDED TO REMOVE (2) SECURITY SCREWS FROM VALVE STEM TO GAIN CLEARANCE FOR VALVE BODY ROTATION FOR INSTALLATION OF DRAIN VALVE.

4. ADD LOCTITE 242 (PROVIDED) TO THREADS AND ROTATE SST CAP OR VALVE BODY UNTIL SECURE WITH VALVE STEM ON LEFT SIDE AS SHOWN.

5. RE-INSTALL HANDLE WITH (2) SECURITY SCREWS TO VALVE STEM.

6. ADJUST THE CABINET ON THE BENCH WITH A 2" OVERHANG AND SEAL INTERFACE WITH BENCH TOP USING RTV SILICONE SEALANT.

FIGURE - 3

1. PLACE THE CABINET ON A BENCH WITH APPROXIMATELY 2 INCHES OF OVERHANG CLEARANCE FOR INSTALLATION OF SST CAP OR SECURITY DRAIN VALVE.

2. REMOVE CARTON A AND CONTENTS FROM WORK AREA, AND INSTALL THE SECURITY DRAIN VALVE AS SHOWN IN FIGURE 2.
5.2.4 Gas Service

NuAire doesn't recommend the use of natural gas within the BSC, but if gas service is determined to be necessary for the application, appropriate safety measures must take place. All NuAire BSC's have precautionary warning labels that say the following:

Use of explosive or flammable substances in this Cabinet should be evaluated by your appropriate safety personnel.

Once the determination has been made by the appropriate safety personnel, the application of natural gas must be performed in accordance to national, state and local codes. IT IS ALSO STRONGLY RECOMMENDED THAT AN EMERGENCY GAS SHUTOFF VALVE BE PLACED JUST OUTSIDE THE BSC ON THE GAS SUPPLY LINE.

The gas valve, when this option is installed, will only operate or flow gas when the cabinet blower is on and no alarm is present. A solenoid valve is installed on the gas supply line for this purpose.

NOTE, some countries (i.e. Germany) only allow certain types of certified valves to be used for natural gas (i.e. Germany DVGW Certified). Verify requirements per Local, State and Federal codes/laws.

As previously stated NuAire doesn't recommend the use of natural gas within the BSC and ASSUMES NO RESPONSIBILITY FOR ITS USE. USE AT YOUR OWN RISK. The Bunsen burner flame within the BSC not only contributes to heat build-up; it also disrupts the laminar air stream, which must be maintained for maximum efficiency. IF THE PROCEDURE DEMANDS USE OF A FLAME, A BUNSEN BURNER WITH ON DEMAND IGNITION IS STRONGLY RECOMMENDED. DO NOT USE CONSTANT FLAME GAS BURNERS. During use, the Bunsen burner should be placed to the rear of the workspace where resulting air turbulence will have a minimal effect.

5.2.5 Plumbing Services

Service ball valves with the type of service specified by the removable button on the handle are located in the work zone. The service ball valves are not recommended for pressure over 75 p.s.i. (5.2 BAR). Reducing valves should be installed external to the cabinet if necessary. Service ball valves should never be used for oxygen service. A special needle valve for oxygen service is required and available upon request.

External connection is to 3/8 inch NPT coupling in the inner sidewalls. Connection to plant utilities should be made with proper materials for the individual service and according to national and/or local codes. Observe all labels pertaining to the type of service and operating pressure.

5.2.6 Electrical Services

The NU-437E series Biological Safety Cabinets may be "hardwired" (optional) or plugged into an outlet with protective earthing connection with the standard power cord. The unit requires 230VAC, 50/60 Hz, single phase (current rating varies per cabinet size, reference Electrical/Environmental Requirements). It is recommended that power to the cabinet, whether hardwired or plug connected, be on its own branch circuit, protected with a circuit breaker at the distribution panel. A surge protector is strongly recommended if you are experiencing power related faults.
5.2.7 Final Assembly

Remove the protective cardboard cover over the exhaust HEPA filter, located under the protective screen if in place. Attach the exhaust sensor shroud over the exhaust sensor. The shroud should be placed as close as possible to the exhaust HEPA filter without coming in contact. The probe gasket should be tightly against the sensor shroud to prevent sneak airflow paths. The exterior surface and viewing glass are easily cleaned with any mild household detergent cleaner using a soft cloth. Harsh chemicals, solvent-type cleaners and abrasive cleaners should not be used.

Do not attempt to clean the HEPA filter media. Cabinet interior walls or work surface are easily cleaned with any mild household detergent cleaner using a soft cloth. Turn the cabinet on and let it operate for 60 minutes before using it as a LFBSC.
5.3 Certification Testing Methods and Certification

After installation and prior to use, NuAire recommends that the cabinet be certified or commissioned to factory standards. At a minimum, the following tests should be performed.

- HEPA filter leak test
- Downflow velocity test
- Inflow velocity test
- Airflow smoke patterns

The testing methods and equipment required are specified on the factory inspection report included with this manual (see insert in back cover).

**IT IS RECOMMENDED THAT THESE TESTS BE PERFORMED BY A QUALIFIED TECHNICIAN WHO IS FAMILIAR WITH THE METHODS AND PROCEDURES FOR CERTIFYING BIOLOGICAL SAFETY CABINETS. SEE INSERT.**

**AFTER THE INITIAL CERTIFICATION, NUAIRE RECOMMENDS THAT THE CABINET BE RECERTIFIED AT A MINIMUM ON AN ANNUAL BASIS AND AFTER EVERY FILTER CHANGE OR MAINTENANCE ACTION OR ANY TIME THE OPERATOR FEELS IT IS NECESSARY.**

Note that the Labgard cabinets, filters and seals provide premium performance; Quality Control in both design and manufacturing assure superior reliability. However, protection to both product and operator is so vital that certification to the performance requirements should be accomplished as stated to ensure biological safety established by the factory standards.
# Labgard ES Energy Saver

## Class II Laminar Flow

### Biological Safety Cabinet

Models NU-437-300E/400E/500E/600E

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>NU-437-300E Nominal 3 foot (0.9m)</th>
<th>NU-437-400E Nominal 4 foot (1.2m)</th>
<th>NU-437-500E Nominal 5 foot (1.5m)</th>
<th>NU-437-600E Nominal 6 foot (1.8m)</th>
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<tbody>
<tr>
<td><strong>Performance Specifications</strong></td>
<td>NSF / ANSI 49 EN12469</td>
<td>NSF / ANSI 49 EN12469</td>
<td>NSF / ANSI 49 EN12469</td>
<td>NSF / ANSI 49 EN12469</td>
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<td><strong>Class</strong></td>
<td>Class II</td>
<td>Class II</td>
<td>Class II</td>
<td>Class II</td>
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<tr>
<td><strong>Style of Cabinet</strong></td>
<td>Bench top/console with base stand/ storage cabinet</td>
<td>Bench top/console with base stand/ storage cabinet</td>
<td>Bench top/console with base stand/ storage cabinet</td>
<td>Bench top/console with base stand/ storage cabinet</td>
</tr>
<tr>
<td><strong>Cabinet Construction</strong></td>
<td>All welded stainless steel 16GA, Type 304 pressure tight design</td>
<td>All welded stainless steel 16GA, Type 304 pressure tight design</td>
<td>All welded stainless steel 16GA, Type 304 pressure tight design</td>
<td>All welded stainless steel 16GA, Type 304 pressure tight design</td>
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<tr>
<td><strong>Diffuser for Air Supply (Metal)</strong></td>
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<td>Non-flammable</td>
<td>Non-flammable</td>
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<tr>
<td><strong>HEPA Filter Seal Type:</strong></td>
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<td>Non-flammable</td>
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<td><strong>Supply Filter:</strong></td>
<td>HEPEX Seal</td>
<td>HEPEX Seal</td>
<td>HEPEX Seal</td>
<td>HEPEX Seal</td>
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<tr>
<td><strong>Exhaust Filter:</strong></td>
<td>HEPEX Seal, Spring loaded</td>
<td>HEPEX Seal, Spring loaded</td>
<td>HEPEX Seal, Spring loaded</td>
<td>HEPEX Seal, Spring loaded</td>
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<tr>
<td><strong>Fumigation per EN 12469, Annex J</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td><strong>Standard Services:</strong></td>
<td>One, Right Sidewall</td>
<td>One, Right Sidewall</td>
<td>One, Right Sidewall</td>
<td>One, Right Sidewall</td>
</tr>
<tr>
<td><strong>Gas Valve/Service Coupling (3/8 inch NPT):</strong></td>
<td>One, Backwall Center</td>
<td>One, Backwall Center</td>
<td>One, Backwall Center</td>
<td>One, Backwall Center</td>
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<tr>
<td><strong>Optional Services:</strong></td>
<td>Up to 3 ea. Sidewall</td>
<td>Up to 3 ea. Sidewall</td>
<td>Up to 3 ea. Sidewall</td>
<td>Up to 3 ea. Sidewall</td>
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<tr>
<td><strong>Ultraviolet Light:</strong></td>
<td>Left or Right</td>
<td>Left or Right</td>
<td>Left or Right</td>
<td>Left or Right</td>
</tr>
<tr>
<td><strong>Standard/Cup Sinks:</strong></td>
<td>Work Surface</td>
<td>Work Surface</td>
<td>Work Surface</td>
<td>Work Surface</td>
</tr>
<tr>
<td><strong>Cabinet Size Inches (mm):</strong></td>
<td>63 (1600)</td>
<td>63 (1600)</td>
<td>63 (1600)</td>
<td>63 (1600)</td>
</tr>
<tr>
<td><strong>Height (Fully Assembled):</strong></td>
<td>1320</td>
<td>1937</td>
<td>2220</td>
<td>2435</td>
</tr>
<tr>
<td><strong>Height (Minimum for Transport):</strong></td>
<td>1320</td>
<td>1937</td>
<td>2220</td>
<td>2435</td>
</tr>
<tr>
<td><strong>Work Zone Inches (mm):</strong></td>
<td>282</td>
<td>370</td>
<td>456</td>
<td>546</td>
</tr>
<tr>
<td><strong>Work Access Opening Inches:</strong></td>
<td>282 (717)</td>
<td>370 (940)</td>
<td>456 (1160)</td>
<td>546 (1380)</td>
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<tr>
<td><strong>Viewing Window:</strong></td>
<td>Fully closed to 19 1/2 inches</td>
<td>Fully closed to 19 1/2 inches</td>
<td>Fully closed to 19 1/2 inches</td>
<td>Fully closed to 19 1/2 inches</td>
</tr>
<tr>
<td><strong>Required Exhaust CFM/(CMH):</strong></td>
<td>8’ (240mm) Opening</td>
<td>8’ (240mm) Opening</td>
<td>8’ (240mm) Opening</td>
<td>8’ (240mm) Opening</td>
</tr>
<tr>
<td><strong>Canopy Fixed Flow Thimble (NU-916/926):</strong></td>
<td>225-450 (389-785)</td>
<td>295-520 (502-884)</td>
<td>365-590 (621-1003)</td>
<td>436-681 (741-1124)</td>
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<tr>
<td><strong>Plant Duct Static Pressure Eng/Metric:</strong></td>
<td>0.05-0.1’/1.27-2.54mm H2O</td>
<td>0.05-0.1’/1.27-2.54mm H2O</td>
<td>0.05-0.1’/1.27-2.54mm H2O</td>
<td>0.05-0.1’/1.27-2.54mm H2O</td>
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<tr>
<td><strong>Heat Rejected, BTU, Per Hour:</strong></td>
<td>1442</td>
<td>1937</td>
<td>2220</td>
<td>2435</td>
</tr>
<tr>
<td><strong>(non-vented)</strong></td>
<td>865</td>
<td>1162</td>
<td>1320</td>
<td>1460</td>
</tr>
<tr>
<td><strong>Electrical:</strong></td>
<td>230</td>
<td>230</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td><strong>Volts, AC 50Hz / 60Hz:</strong></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Amps: Outlets:</strong></td>
<td>14 GA - 3 Wire, 15A</td>
<td>14 GA - 3 Wire, 15A</td>
<td>14 GA - 3 Wire, 15A</td>
<td>14 GA - 3 Wire, 15A</td>
</tr>
<tr>
<td><strong>Amps: Total:</strong></td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td><strong>12 ft. Power Cord (one):</strong></td>
<td>340 lbs./754 kg.</td>
<td>490 lbs./222 kg.</td>
<td>640 lbs./290 kg.</td>
<td>680 lbs./308 kg.</td>
</tr>
<tr>
<td><strong>Net Weight:</strong></td>
<td>305 lbs./138 kg.</td>
<td>441 lbs./200 kg.</td>
<td>590 lbs./268 kg.</td>
<td>598 lbs./271 kg.</td>
</tr>
<tr>
<td><strong>Sound Pressure Level per ISO 4871:</strong></td>
<td>Not to Exceed 62 db</td>
<td>Not to Exceed 62 db</td>
<td>Not to Exceed 62 db</td>
<td>Not to Exceed 62 db</td>
</tr>
</tbody>
</table>

***Uncertainty is K = 2 db.

**** Crated Shipping Weight does not include weight for accessories or options.

Reference the customer test report for procedure and results.

+ These values are standard for EN12469 or NSF 49. These will be different if cabinet is operating to AS2252.2-2004

OM0202
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6.0 Operating the NU-437E

6.1 Electronic Control System

6.1.1 Overview

The electronic control system is designed to service the control requirements of the NU-437E Biological Safety Cabinet. The control system consists of two electronic modules that will perform the following functions:

- Control blower via solid state switch.
- Control lights via solid state switch.
- Control outlets via solid state switch.
- Control blower DC ECM Motor with solid-state DC Motor Controller that provides automatic compensation (constant volume control) for both filter loading and line voltage variances.
- Monitor and display airflow system performance via Flow Gard monitor.
- Airflow system alarm setpoints high/low via Flow Gard monitor.

The NU-437E incorporates the use of two electronic modules that improves the cabinet's performance. The Flow Gard monitor uses a dual thermistor airflow probe located in the exhaust airflow to monitor the cabinet system function. The Flow Gard monitor indicates through LED’s normal operation, as well as high alarm status (HEPA filter loading) and low alarm status (low airflow). The main control module, through the use of the front panel, controls the on/off functions of the blower, fluorescent and ultraviolet (optional) lights, and outlets. The main control module also monitors the sliding window position with a micro switch for both window high and closed (interlocks optional UV light) positions. Lastly, the main control module includes fan relay contact closures for interaction with HVAC systems to optimize environmental performance. All the above functions are shown in a system block diagram (see Figure 1).

![System Block Diagram](image-url)
6.1.2 Front Panel
The control system front panel contains the following functions described in detail (see Drawing BCD-08550).

6.1.2.1 Blower Keys
The blower keys indicate and control ON/OFF power to the blower.

6.1.2.2 Light Keys
The light keys indicate and control ON/OFF power to the fluorescent and optional ultraviolet lights

6.1.2.3 Outlet Keys
The outlet keys indicate and control ON/OFF power to the outlets.

6.1.2.4 Window Alarm LED
The window alarm LED indicates when the sliding window is raised above or below its proper operating height. The window alarm LED will blink when the sliding window is fully closed *

*The blower LED will also blink when both the sliding window is fully closed and the blower "on" switch has been depressed

6.1.2.5 Cleaning Key
The cleaning key may be pressed to silence the audible alarm for cleaning/loading purposes only.

6.1.2.6 Flow Gard Arrow Adjustment Keys
The arrow adjustment keys allow user interaction for various functions.

6.1.2.7 Flow Gard LED Display
The Flow Gard LED display indicates the system running condition. Green is normal; yellow is caution and red is alarm.

6.1.2.8 Flow Gard Reset Key
The Flow Gard reset key allows various user interactions for various functions.

6.1.2.9 Audible Alarm
The audible alarm is provided per EN 457, tested at one frequency to a loudness of 13 db over the cabinet’s normal running db level. The audible alarm will activate on all alarm conditions as long as they are present. The audible alarm will activate for 30 seconds full on, then ring back once every 10 seconds thereafter until the alarm condition is cleared.
6.1.3 Run Mode Operation
Operation of the cabinet is initiated by plugging the power cord into the appropriate line power. In the power off condition (cabinet is unplugged); all calibration and running parameters will be stored in the microprocessor's EEPROM memory. During the power on condition (cabinet is plugged in), the cabinet's blower, lights, and outlet may be turned on. The Flow Gard monitor will automatically turn on when the blower is on.

6.1.3.1 Airflow Control
The operating airflows within the cabinet (i.e. 85 LFPM (.43 m/s) downflow and 120 LFPM (.61 m/s) air inflow barrier) are controlled by a potentiometer and an exhaust damper. The potentiometer, located on the main control module, controls the operating voltage applied to the motor/blower. The potentiometer is adjustable over 270 degrees with a slotted screwdriver, which varies the applied voltage from 140 to 230 VAC. THIS ADJUSTMENT SHOULD ONLY BE MADE BY A QUALIFIED TECHNICIAN EMPLOYING THE PROPER INSTRUMENTS IN ORDER TO INSURE PROPER AIRFLOWS.

6.1.3.2 Sliding Window Operation
The cabinet has a full counter-balanced and removable sliding glass window with two operational features. As the window is raised above its specified operating height, an audible and visual alarm alerts the operator of possible compromised personnel protection. NOTE, for "E" Series, the cabinet also contains a low window alarm, which will activate both audible and visual alarms if the window is below its specified operating height. If the window is closed, it will perform an interlock function that will automatically turn off the blower or prevent it from being turned on. In addition, will allow the Ultraviolet light, if installed, to be turned on.

6.1.3.3 Blower Password Protection/Night Setback Mode
The blower is operated by using a password (a sequence of 3 key strokes) in combination with or without the night setback mode. The night setback mode allows the DC ECM motor to continue to run at a lower rate with the sliding window closed allowing the work zone interior to be continually HEPA filtered. If the night setback mode is selected (JP3), the blower switch must be on and the window closed for it to be activated. In other words, if JP3 is on, the night setback mode will indicate when the window is closed, (or with about 1/4” gap between the bottom of the window and the armrest). If JP3 is off the motor will shut off when the window is closed.

A combination of 3 jumpers on the control board will activate either the password and/or the night setback mode operation. The jumpers are located and labeled J1, J2, and J3 on the control board. The key stroke password sequence is a selected combination of the hidden key (blower symbol), blower on and blower off. The table below indicated the jumper combinations and their associated password with or without the night setback mode.

<table>
<thead>
<tr>
<th>Password JP1</th>
<th>Password JP2</th>
<th>Night Setback Mode JP3</th>
<th>Password Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>NO PASSWORD</td>
</tr>
<tr>
<td>On</td>
<td>Off</td>
<td>Off</td>
<td>on off hidden</td>
</tr>
<tr>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>on hidden off</td>
</tr>
<tr>
<td>On</td>
<td>On</td>
<td>Off</td>
<td>off on hidden</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>hidden on</td>
</tr>
<tr>
<td>On</td>
<td>Off</td>
<td>hidden</td>
<td>on off</td>
</tr>
<tr>
<td>Off</td>
<td>On</td>
<td>hidden</td>
<td>off On</td>
</tr>
<tr>
<td>On</td>
<td>On</td>
<td>hidden</td>
<td>NO PASSWORD</td>
</tr>
</tbody>
</table>

(Default in bold)
6.1.4 Flow Gard Operation

6.1.4.1 Overview
The Flow Gard monitor uses a dual thermistor airflow probe located in the exhaust airflow to monitor the cabinet system function. The Flow Gard monitor indicates through LED's normal operation (green), as well as high alarm status (red) (Hepa filter loading) and low alarm status (red) (low airflow). All user interaction is accomplished through the arrow and reset keys. **IT IS RECOMMENDED THAT THE FLOW GARD BE CALIBRATED ANNUALLY DURING THE TESTING PROCESS.**

6.1.4.2 Power-Up Sequence
On power up, the digital display is initialized and every segment of the display turned on for two seconds. The three LEDs and the audible alarm are also activated. The firmware version number is then displayed for two seconds.

6.1.4.3 Audible Alarm
The audible alarm will be activated whenever the Low or High Alarm zone is reached. Once the audible alarm is activated, it will stay on until the alarm condition is cleared.

6.2 Operating Guidelines
The intent herein is to present general operational guidelines that will aid in the use of the Laminar Flow Biological Safety Cabinet (LFBSC) to control airborne contaminants of low to moderate risk as stated in Technical Report No. FPS 56500000001 prepared by Dow Chemical U.S.A. for the National Cancer Institute, May 1, 1972.

Procedure protocols defined in terms of the barrier or control concepts unique to LFBSC must be developed in order to obtain a maximum potential for safety and protection. The pre-planning necessary to develop these protocols is based on several fundamental considerations, each of which will contribute to optimum benefits from the equipment:

- Know your "safe working area"
- Minimize disruption of "air curtain"
- Minimize room activity
- Utilize unidirectional air flow
- Employ aseptic techniques

6.2.1 Know Your "Safe Working Area"
The LFBSC safe working area is basically the work tray or depressed area. All work should be performed on or above the work tray. The area on or above the front grill is a non-safe working area.

**NOTE:** It is important to maintain an air gap on both sides of the work tray before fastening in place.
6.2.2 Minimize Penetration of "Air Curtain"

The minimum number of items necessary should be placed into the cabinet to prevent overloading, but the work should also be planned to minimize the number of times an operator's hands and arms must enter and leave the air curtain at the open face. The ideal situation is to have everything needed for the complete procedure placed in the hood before starting, so that nothing need pass in or out through the air barrier at the face until the procedure is completed. This is especially important in working with moderate risk agents.

Unnecessary rising of the hands inside the cabinet above the level of the work opening should be avoided. This presents an inclined plane from hands to elbows along which the downflow of air may run to, and possibly out, the open face.

Note: When working with agents of lower risk, it is not as important for all materials to be placed in the cabinet before starting, or for the procedure to be completely finished before materials are removed. Also, the time period for a unit may be continued over a more extended period during which entries and withdrawals from the cabinet may be made.

6.2.3 Minimize Room Activity

Activity in the room itself should be held to a minimum. Unnecessary activity may create disruptive air currents as well as interfere with the work of the operator. A person walking past the front of a cabinet can cause draft velocities up to 175 fpm (.89 m/s), which are sufficient to disrupt the air balance of the laminar flow unit.

6.2.4 Utilize Unidirectional Air Flow

The operator must keep two important facts in mind: (1) The air, as supplied to the work area through filters from the top, is contaminant free and (2) Airborne contamination generated in the work area is controlled by the unidirectional flow of parallel air streams in a top-to-bottom direction.

A solid object placed in a laminar air stream will disrupt the parallel flow and consequently, the capability of controlling lateral movement of airborne particulates. A cone of turbulence extends below the object and laminarity of the air stream is not regained until a point is reached downstream, approximately equal to three to six times the diameter of the object. Within the parameters of this cone, particles may be carried laterally by multidirectional eddy currents.

Transfer of viable materials and manipulations which may generate aerosols should not be performed above sterile or uninoculated materials. Items should be localized on the work surface in "clean" and "dirty" groups.

6.2.5 Employ Aseptic Technique

The operator must not assume an attitude of "let the cabinet do it" when performing procedures within a LFBSC. Properly balanced and properly used cabinets will do an excellent job of controlling airborne contamination and containing viable agents, but the cabinet will not eliminate contact transmission of contamination. Normal laboratory contamination control procedures and basic aseptic techniques are necessary to obtain maximum benefit from the cabinet. For example, open bottle, tube or flask mounts should be kept as parallel as possible to the downflow to minimize capture of chance particulates. This precaution is merely an extension of good aseptic technique as practiced on open bench tops. The good laboratory practices designed to minimize creation and/or release of aerosols to the environment should not be discontinued.

Items of equipment in direct contact with the etiologic agent must remain in the cabinet until enclosed or until surface-decontaminated. Trays of discard pipettes must be covered before removal from the cabinet (aluminum foil may substitute for fabricated covers).
If an accident occurs which spills or splatters suspensions of etiologic agent around the work area, all surfaces and items in the cabinet must be surface-decontaminated before being removed.

Applying a burner flame to flask and tube necks when mating surfaces of sterile assemblies is a conventional method of minimizing chance contamination. However, the efficiency of this operation is usually related to the removal of airborne contamination occurring while the item is uncovered. If the manipulation is carried out in an environment free of airborne particulates, then the need for the flaming operation is essentially removed. This is one of the additional advantages of the LFBSC - use of the gas burner is seldom necessary. The gas burner flame in one of these units not only contributes significantly to the heat build-up, it also disrupts the laminar air streams which must be maintained for maximum efficiency. If the procedure demands use of a flame, **A BUNSEN BURNER WITH ON DEMAND IGNITION IS RECOMMENDED. DO NOT USE CONSTANT FLAME GAS BURNERS.** It should also be placed to the rear of the workspace where resulting air turbulence will have a minimal effect. If cabinet air is inadvertently turned off, the flame could damage the HEPA filters.

### 6.3 Operating Sequence

#### 6.3.1 Start Up

Turn on cabinet blower and lights, check air intake and exhaust portals of the cabinet to make sure they are unobstructed.

Note: Some cabinets are equipped with ultraviolet (UV) lights. Good procedure includes the decontamination or wipe down of cabinet surfaces with chemical disinfectant before work commences. This practice eliminates the need for UV lights, whose primary utility in this application is inactivation of surface contamination since the filters effectively remove all airborne contaminants. UV lights, therefore, are not recommended in the LFBSC.

Allow blowers to operate for a minimum of 15 minutes before aseptic manipulations are begun in the cabinet. If the filtered air exhausted from the unit is discharged into the room, as in some installations, an additional advantage is obtained from purification (filtration) of the room air circulated through the equipment. Because of this characteristic contributing to the quality of the laboratory environment, some owners of LFBSC leave them in operation beyond the time of actual use.

#### 6.3.2 Wipe down

The interior surfaces of the work space should next be disinfected (see Cleaning Procedures section) by wiping them thoroughly with 70% alcohol or similar non-corrosive anti-microbial agents. **USE OF CHLORINATED OR HALOGEN MATERIALS IN THE CABINET MAY DAMAGE STAINLESS STEEL.**

#### 6.3.3 Materials & Equipment

The apparatus and materials should next be placed into the cabinet. Care must be exercised that no items be placed over the front intake grills. Materials should be arranged so that clean, dirty (used), and virus materials are well separated. Passage of contaminated materials over uninoculated cultures or clean glassware should be avoided and transfer of viable materials should be performed as deeply into the cabinet (away from open face) as possible.
6.3.4 Air Purge
Additional purging of the workspace without user activity should be allowed for 2-3 minutes after materials and apparatus have been placed in it. This will rid the area of all "loose" contamination that may have been introduced with the items.

6.3.5 Perform Work
The work can now be performed. The technician performing the work is encouraged to wear a long-sleeved gown with knit cuffs and rubber gloves. This will minimize the shedding of skin flora into the work area and concurrently protect the hands and arms from viable agent contamination. At a minimum, the hands and arms should be washed well with germicidal soap before and after work in the cabinet. For the preparation of antineoplastic drugs, the following procedures summarize those contained in OSHA Technical Manual TED 1-0.15A, Section VI, Chapter 2 “Controlling Occupational Exposure to Hazardous Drugs”. The above document should be thoroughly studied / reviewed prior to drug preparation in the cabinet. It may be found at this website, www.osha.gov/dts/osta/.

   a. A sterile plastic-backed absorbent drape should be placed on the work surface during mixing procedures. The drape should be exchanged whenever significant spillage occurs, or at the end of each production sequence.

   b. Vials should be vented with a filter needle to eliminate internal pressure or vacuum.

   c. Before opening ampoules, care should be taken to insure that no liquid remains in the tip of the ampoule. A sterile gauze sponge should be wrapped around the neck of the ampoule while opening.

   d. Final drug measurement should be performed prior to removing the needle from the stopper of the vial.

   e. A non-splash collection vessel should be available in the biological safety cabinet to discard excess drug solutions.

6.3.6 Terminal Purging & Wipe down
Following completion of work, allow the cabinet to run for 2-3 minute period without personnel activity to purge the unit. A surface disinfection of the interior surfaces (see Cleaning Procedures section) should be repeated after removal of all materials, cultures, apparatus, etc. A careful check of grills and diffuser grids should be made for spilled or splashed nutrients which may support fungus growth and resulting spore liberation that contaminates the protected work environment.

6.3.7 Paper Catch/Prefilter
A permanent paper catch is installed behind the rear divider panel of the work zone. This area forms the return air path to the motor/blower; and if the airflow is blocked, it could seriously affect the performance of the cabinet. Therefore THE PAPER CATCH SHOULD BE CHECKED AND CLEANED NO LESS THAN ON A WEEKLY BASIS and a daily basis if procedures dictate the use of paper products. Any paper removed must be properly disposed of as Contaminated Hazardous Waste. The above procedures also apply to all units configured with a prefilter.

6.3.8 Shut Down
Turn off blowers and lights. Do not use cabinet as a depository for excess lab equipment during periods of non-operation. If antineoplastic agents are being prepared in the cabinet, it is recommended to let the cabinet run 24 hours per day. This lessens the possibility that contaminants may escape.
6.4 Ergonomics

Ergonomics, the study or accommodation of work practices is extremely important for proper cabinet usage and user health and safety. An evaluation of normal work practices should be performed with each user when working in a cabinet. Evaluation criteria should be at a minimum:

- Proper user posture
- Effective work zone layout for work practice
- Vision or sightlines

For each of the above evaluation criterion, several work aids may be supplied to accommodate the user.

- Ergonomic chair - A six-way articulating seat and back control for personalized adjustment to assure proper user posture. Be sure feet are resting on the floor, chair foot support or foot rest. Also be sure back is fully supported with proper chair adjustments.
- Forearm/elbow support - The cabinet is provided with a non-metallic forearm support on the work access opening. Periodic mini-breaks during work practice should be taken resting forearm to avoid stress and fatigue. Elbow rests are optional that can provide support for particular work practices, such as pipetting. Also available as an option, closed cell foam disposable forearm pads to reduce pressure points and add comfort.
- Effective workzone layout - Always prepare your work procedure to minimize reach to avoid neck and shoulder stress and fatigue. Rotating tables are optional to maximum workzone and minimize reach.
- Vision and sightline - Always prepare your work procedure to eliminate glare and bright reflections on the window. Keep your window clean and sightlines clear to your effective workzone.

6.5 Cleaning Procedures

Cleaning the cabinet is an important function in terms of both containment and sterility. Use the following procedure to effectively clean or surface disinfect the cabinet workzone surfaces.

a. Raise the sliding window to a full-open position, if desired.

b. Press the cleaning key on the front control panel to silence the audible alarm during the cleaning process.

c. Apply appropriate disinfecting solution (i.e. coverage plus (Calgon Corp. ™)) or similar disinfectant to cabinet surfaces. Most surface disinfectants require a specific contact time depending upon the microbiological agents used within the cabinet. CONSULT APPROPRIATE DISINFECTANT DOCUMENTATION FOR PROPER APPLICATION AND SAFETY PRECAUTIONS.

NOTE: DISINFECTANTS THAT USE CHLORIDES AND HALOGENS WILL CAUSE DAMAGE TO THE STAINLESS STEEL SURFACES IF LEFT ON FOR LONG PERIODS OF TIME.

d. After the specified contact time, wipe up excess disinfectant. IF THE DISINFECTANT USED CONTAINS CHLORIDES OR HALOGENS, RE-WIPE ALL SURFACES WITH 70% ALCOHOL OR SIMILAR NON-CORROSIVE ANTI-MICROBIAL AGENT TO PREVENT DAMAGE TO STAINLESS STEEL SURFACES.
6.6 Hazardous Drug Decontamination Procedures
This procedure is intended to provide guidance following a spillage and/or periodic maintenance, testing or relocation of the cabinet. Additional guidance can be provided by the CETA document CAG-005-2007 found at the CETA website: www.CETAinternational.org.

6.6.1 Preparation
Prior to beginning decontamination activity, personnel should wear proper personnel protection equipment (PPE) i.e. Tyvek\(^1\) isolation gown, 2 pair of Nitrile gloves and a full-faced HEPA filtered respirator. All protective garments should be contained in 4 mil plastic bags and labeled for disposal as chemotherapy waste after completion of the procedure. For the purpose of this procedure, detailed procedures for cleaning a Class II BSC can be found in the 1990 ASHP Technical Assistance Bulletin *Guidelines on Handling Cytotoxic and Hazardous Drugs*.\(^2\)

6.6.2 Procedure
a. Make sure that the cabinet remains in operational mode with internal blower on.
b. Open the hinged or sliding view screen and secure in the full open position. With the view screen in the full open position, personnel protection is compromised and a full faced HEPA filtered respirator must be worn.
c. Clean all readily accessible surfaces of the cabinet.
d. Remove perforated metal diffuser screen from the underside of HEPA filter and place on the cabinet work tray.

\(\text{Note:}\) Depending on the model, the diffuser screen is secured to the cabinet by #8-32 screws or 1/4" - 20 acorn nuts, 3 places. It is purposely a tight fit and is secured to the back wall with projecting threadless studs.
e. Clean both sides of the perforated metal diffuser screen and remove it from the cabinet.
f. Lift the cabinet work tray, clean both sides and remove it from the cabinet.
g. Remove the front perforated grill, place on the cabinet floor and clean both sides. Remove from cabinet.
h. Clean work tray supports.
i. Working from top to bottom, clean all inside surfaces of the cabinet. Take care not to wet the HEPA filter. If liquid has collected in the plenum drain, aspirate it using IV tubing into an evacuated container. Label the evacuated container for disposal as chemotherapy waste.
j. Clean the plenum drain area and wipe dry.
k. If the cabinet requires maintenance and/or replacement of the HEPA filters, the operation should be halted at this point to allow trained personnel to complete replacement of the HEPA and/or maintenance action required.

6.6.3 Assembly
a. Replace front (if removed) grill.
b. Replace the work tray and carefully tighten the thumbscrews.
c. Replace perforated metal diffuser screen over the underside of the supply HEPA filter.
d. Wipe down all exposed surfaces of the work area with 70% isopropyl alcohol.
e. Prepare for aseptic operation.

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1 Available from Lab Safety Supply, Janesville, WI 53547-1368, or other laboratory, industrial, or hospital supply distributors.

7.0 General Maintenance

All maintenance actions on this equipment must be performed by a qualified technician who is familiar with the proper maintenance procedures required for this equipment. This includes both testing as well as repair.

7.1 Decontamination

No maintenance should be performed on the interior of the LABGARD ES cabinet (area behind access panels) unless the cabinet has been microbiologically decontaminated, is known to biologically clean, or known to be chemically inert. Surface disinfection is performed as specified in the Cleaning Procedures section.

Hazardous Gases! Personal Protection Equipment Required.

A disinfection using formaldehyde must be performed in accordance with the specifications of NSF 49/1992, Annex G or EN 12469, Annex J.

This procedure presents considerable risks and must be performed only by specially trained and authorized service personnel in accordance with applicable national safety regulations (e.g. Germany: TRGS 522).

The formaldehyde is vaporized within the tightly sealed sample chamber. The quantity of the applied formaldehyde depends on the volume of the sample chamber in the safety cabinet that is to be disinfected. The formaldehyde evaporates immediately after reaching its boiling point; the minimum reaction time is 6 hours. Therefore, the formaldehyde should be neutralized after the specified reaction time by vaporizing ammonia.

Flammable Hazard!

Formalin is flammable.

The auto-ignition temperature of formalin is 430°C (820°F).

With a volume percentage of 7.75% in dry air, formaldehyde vapor may explode.

For vaporization, do not use heating devices reaching temperatures above 250°C (477°F).

Chemical Hazard!

Formalin in reaction with hydrogen chloride will form BCME which is a hazardous chemical.

When using formalin, all residues of hydrogen chloride in the work chamber of the cabinet must be removed.

If microbiological decontamination is necessary, use the following procedure:

1. Disconnect power to the cabinet. Remove screws at each upper side of the control center and allow the control center to rotate down, resting on the safety straps. Disconnect electrical connectors on left side. Disconnect electrical from right side. (Be sure to note the location of the supply and exhaust sensor wires before disconnecting them from the main board).

Loosen safety plate next to left hinge. Remove control center by disconnecting safety straps and moving control center to the left off the slip hinges. Fold and pinch tubing to seal.
2. Remove the front decorative panel via top/front fasteners.
3. Remove left and right window farings via upper, middle, and top fasteners. At this point, the sliding window can be removed or allowed to hang from its top position. If the window is allowed to hang, use duct tape to secure to the cabinet during the remaining process.
4. Remove armrest via fasteners.
5. Remove downflow and exhaust probe shrouds. Remove only the downflow probe by turning the locking ring counter clockwise.
6. Remove the diffuser screen and window wiper seal.
7. Place decontamination equipment inside the work area. Reference decontamination procedure, per EN 12469, Annex J, using the following chart to calculate chemical requirements.

<table>
<thead>
<tr>
<th>Cabinet Size</th>
<th>300E</th>
<th>400E</th>
<th>500E</th>
<th>600E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabinet Dimensions</td>
<td>60 x 28 x 34-3/8 in.</td>
<td>60 x 28 x 46-3/8 in.</td>
<td>60 x 28 x 58-3/8 in.</td>
<td>60 x 28 x 70-3/8 in.</td>
</tr>
<tr>
<td>Volume</td>
<td>33.4 cu. ft.</td>
<td>45.1 cu. ft.</td>
<td>56.8 cu. ft.</td>
<td>68.4 cu. ft.</td>
</tr>
</tbody>
</table>

Note: the outlets in the work area are energized as long as the cabinet is plugged in and switched on the front panel. Unplug the cabinet before decontamination equipment is plugged into these outlets. The control centers electrical connectors may be re-attached to utilize the cabinet's interior outlets and fan during the decontamination. (See step 8)

8. Set control center on its side (with the ballast end down and the blower capacitor end up) on the left side of cabinet. Then plug in the 16-pin connector cable from the cabinet to the control center. In order to activate the blower, a jumper wire must be used to bridge the B/UVT and B/UV - contacts on the main board. Reconnect power to the cabinet. The outlets and blower can then be activated.

9. Seal front and top openings using pressure plates.
   a. The front plate is attached using the following steps:
      1) Remove screws in SST header just above work zone opening.
      2) Place front seal plate over bottom row of studs with the plate gasket next to the work access opening and the remaining holes should line up.*
      3) Fasten the plate using the fastening screws and nuts provided.
   b. The top seal plate is attached using the following steps:
      1) Remove filter guard above exhaust HEPA filter.
      2) Remove exhaust sensor shroud via fasteners.
      3) Place top seal plate over the studs and attach fastening nuts provided.

   NOTE: front and top seal plates are obtained by contacting NuAire Representative or Distributor

*Electrical service can be provided to the inside of the cabinet via the electrical bulkheads on the front pressure plate. Access to the neutralizing plate can be obtained through the liquid tight fitting on the front pressure plate.

10. Perform decontamination procedure per EN 12469, Annex J.

Normally, no preventive maintenance is required on the interior of the cabinet (i.e., the area behind the access panel containing the HEPA filters and motor (blower assembly). All required adjustments in order to maintain proper cabinet airflows are external to the cabinet interior. The motor is lubricated for life and is thermally protected with automatic reset.

1 Available from Lab Safety Supply, Janesville, WI 53547-1368, or other laboratory, industrial, or hospital supply distributor
7.2 Fluorescent Lamp, Bulb Replacement
The two (T8) fluorescent bulbs are cool white, rapid start and placed external to the cabinet to aid maintenance and minimize heat build-up within the cabinet. The life rating of the bulb is 9000 hours based on three hour burning cycles.

To replace a bulb, it is necessary to remove the lamp assembly.
- First, switch Cabinet Light Switch off.
- Second, remove the screws at each upper side of the Control Center and allow the Control Center to rotate down, resting on the safety straps.
- The bulb is now directly exposed for replacement.
- The bulb is removed by displacing the bulb to one side against the compressible lamp holder and lifting out the bulb.
- Reverse the procedure to reinstall the lamp assembly being careful not to pinch the safety straps, cable or tubing during closure of the control center.

7.3 HEPA Filter/Motor Replacement (Drawing BCD-11819)
The HEPA Filters under normal usage and barring an accident (a puncture), do not need replacement until the efflux velocity cannot be maintained or the access inflow velocity cannot be maintained at 115 LFPM (.58 m/s) (min.). This may permit the average downflow velocity to be as low as 80 LFPM (.41 m/s).

The HEPA Filters should not be replaced until the entire cabinet has been decontaminated or known to be biologically "clean".

7.3.1 Procedure (see Drawing BCD-11819)

![CAUTION]

Disconnect electrical power from the unit before attempting any maintenance action.

Step 1: Remove screws at each upper side of the control center and allow the control center to rotate down, resting on the safety straps. Second, remove the front decorative panel, which is held into position by (3) knurled nuts on the top edge and snap fit bullet catches on the bottom.

Step 2: Place sliding window into lowest position and remove front filter panel, which is held into position by Phillip pan head screws. Once the screws are removed, the panel is held into position by smooth weldstuds located on the top corner of the front filter panel. Use the window stop brackets as handles to remove the panel.

CAUTION: Screws are used in lieu of acorn nuts, and lock washers. The screws have O-rings and should be replaced if damaged or badly deformed.

The interior of the cabinet is now fully exposed for replacement of the filters and/or motor/blower.
Step 3: Filter Removal

It is not always necessary to replace both the supply and exhaust filters at the same time. If during the course of certifications, the downflow falls off while the exhaust increases the supply filter is "loading" faster than the exhaust filter and only the supply filter may need replacement. The opposite might also happen depending upon many factors.

a. To remove the supply filter:
   1. Unlatch the three filter clamps. (In front of the supply HEPA filter)
   2. Loosen three black hand knobs (about 3 turns) in back of permanent plenum.
   3. Lift the permanent plenum and hold up with wire strap.
   4. Carefully remove the supply filter. Direct exposure should be avoided.

   **CAUTION:** Dispose of spent HEPA filters properly. Avoid direct contact to "dirty side" of the filters. Label toxic waste.

b. To remove the Exhaust HEPA:
   1. Relax the exhaust filter seal loading mechanism by turning the four threaded bolts counterclockwise until one can see a definite release of the loading springs.
   2. Pull the exhaust choke tray free and remove the filter. It is not necessary to remove the tray, although it is free to move forward several inches, if necessary, to free the HEPA filter.

Step 4: Filter Installation

When installing new filters,

**USE ONLY NUaire SPECIFIED FILTERS FOR REPLACEMENT.**

(Filters shall conform to EN13091 and EN 1822-1 Class H14)

<table>
<thead>
<tr>
<th>Description</th>
<th>Supply HEPA Filter</th>
<th>Exhaust HEPA Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>99.995% @ 0.3 Micron</td>
<td>99.995% @ 0.3 Micron</td>
</tr>
<tr>
<td>Airflow Rating</td>
<td>100 fpm @ .60 ± .05″ w.g. per sq. ft.</td>
<td>250 fpm @ .70 ± .05″ w.g. per sq. ft.</td>
</tr>
<tr>
<td>Frame Type</td>
<td>Metal</td>
<td>Metal</td>
</tr>
</tbody>
</table>

**NU-437-300E**
- NuAire Part Number: A-980087-43
- Filter Size: 21″ x 32″ x 5 7/8″
- Filter Manufacturer: Filtration Group Inc.
- NuAire Part Number: A-980088-01
- Filter Size: 12″ x 24″ x 11 1/2″
- Filter Manufacturer: Filtration Group Inc.

**NU-437-400E**
- NuAire Part Number: A-980087-44
- Filter Size: 21″ x 44″ x 5 7/8″
- Filter Manufacturer: Filtration Group Inc.
- NuAire Part Number: A-980088-02
- Filter Size: 18″ x 24″ x 11 1/2″
- Filter Manufacturer: Filtration Group Inc.

**NU-437-500E**
- NuAire Part Number: A-980087-46
- Filter Size: 21″ x 56″ x 5 7/8″
- Filter Manufacturer: Filtration Group Inc.
- NuAire Part Number: A-980088-04
- Filter Size: 24″ x 24″ x 11 1/2″
- Filter Manufacturer: Filtration Group Inc.

**NU-437-600E**
- NuAire Part Number: A-980087-45
- Filter Size: 21″ x 68″ x 5 7/8″
- Filter Manufacturer: Filtration Group Inc.
- NuAire Part Number: A-980088-03
- Filter Size: 30″ x 24″ x 11 1/2″
- Filter Manufacturer: Filtration Group Inc.
a. To install the supply filter, simply reverse the procedure outlines in Step 3a, above.

**Note:** Be sure to open the choke plate fully before inserting the filter into the tray. This will assist in adjusting the airflow.

b. To install the exhaust filter, apply a thin layer of silicone grease to the top and bottom gaskets of the filter and carefully insert into the exhaust choke tray. Position the filter frame within the outside walls of the exhaust opening on the top of the hood. Tighten the spring loaded bolts, 4 places, depressing the gasket material by 1/8 inch (3mm).

### Step 5: Motor/Blower Assembly Removal

a. It is recommended that the motor/blower to be removed as a single unit. To remove, disconnect electrical connections to the motor, remove the HEPEX pressure plenum and unbolts the motor/blower assembly from the roof of the cabinet (4 places). Always inspect the rubber isolation motor mounts and replace those that are cracked or visibly show stress.

b. Replace the motor exactly as originally installed in the blower housing, paying particular attention to the correct electrical connections (see Electrical Schematic).

c. Re-install the new motor/blower assembly.

### 7.4 Sliding Window Replacement & Adjustment

The sliding window replacement is accomplished by removing the front decorative panel, control center, and window glide assemblies. The sliding window adjustment may be required due to everyday use over the life of the cabinet. The left window glide is stationary since it contains the micro switches that monitor window height. The right window glide is adjustable by a set screw and tension screw method (see Drawing BCD-11818). When adjusting the sliding window, be sure to verify proper micro switch operation. If the sliding window is too loose, the sliding window will not properly activate the micro switches, thus causing potential operational malfunctions to occur. In addition, the sliding window retention, or ability to slow the rate of fall, if a window counter balance experiences a fault. It is also required to assure proper window function (see Sliding Window Retention Verification in the Inspection Report).

### 7.5 Airflow Calibration

The NU-437 airflow calibration consists of adjustments to balance the airflow within the cabinet. **THIS WORK SHOULD BE DONE ONLY BY A QUALIFIED TECHNICIAN WHO CAN MEASURE THE AIRFLOW FROM THE FILTERS WITH A SUITABLE VELOMETER.** NuAire provides two adjustments to balance the airflow within the cabinet. These are:

a. PWM signal adjust via DC motor speed control.

b. exhaust filter choke

The PWM signal adjustment establishes the motor speed controls curve starting point of the programmed internal reference performance curve while the choke adjusts or balances the exhaust airflow as well as makes up for filter resistance tolerances. Since it has been NuAire's experience that the filters may not "load" evenly, choke adjustments may be necessary for proper cabinet performance.
Stored Curve Versus Fixed Duty Cycle Running Mode

Normally for the NU-437 application, a stored motor loading curve is used for each size of cabinet established by setting manual jumpers on the main control board (as referred to on the Electrical Schematic). A fixed duty cycle is also available for special application cabinets where the stored motor loading curve performance doesn’t meet the special application cabinet requirements,

The stored curve versus fixed duty cycle running mode can be accessed through the following designated key stroke sequence.

- Press and hold the ALARM SILENCE key
- Press OUTLET ON, OUTLET OFF and release the ALARM SILENCE key. (If the sequence is properly entered, either the fluorescent light LED would blink for stored curve running or UV LED would blink for fixed duty cycle running. Pressing either key will change modes.)
- Press the ALARM SILENCE key to enter the desired running mode. The calibration process and key strokes are the same for both modes.

DC ECM motor PWM signal DC voltage should also be monitored and recorded upon final calibration. The DC voltage may be measured using a digital voltmeter. The two test points to measure DC ECM motor voltage are located on the DC motor connector on the main control board.

The cabinet is considered to be certifiable if the following airflow measurements are present:

a. Downflow average: 85 LFPM ± 5 LFPM (.43 m/s ± .025 m/s).

b. Inflow average: 120 LFPM ± 5 LFPM (.61 m/s ± .025 m/s) using the direct inflow measurement method or constricted 3 inch (76mm) high access opening measurement method.

The airflow calibration mode is accessed through the following designated key stroke sequence.

- Press and hold the alarm silence key
- Press light on, light off and release the alarm silence key
  (If the sequence is properly entered, the outlet LED will blink at 1 second intervals and the blower will turn on.)

Once in airflow calibration mode the PWM signal/DC voltage can be increased (increase airflow) by pressing the UV light key. The PWM signal can also be lowered (decrease airflow) by pressing the FL light on key. During the process of pressing these keys the associated LED will indicate a change is being made. When a minimum or maximum PWM signal/DC voltage is reached the associated LED will remain lit indicating that no further adjustment in that direction is possible.
NOTE: Once at the desired airflow setting (after the last increase or decrease key change), the cabinet must run an additional 60 seconds at this airflow setting for the system to gather averaging data before exiting the calibration mode that enters the calibration setpoint into the system.

NOTE: It is possible to return the PWM signal to its original default setting. While in airflow calibration mode press and hold both FL light on and FL light off keys simultaneously for 3 seconds, an audible alarm will beep on each of the 3 seconds. Upon completion of the process, both the FL light on and UV light LED’s will blink 3 times indicating a successful reset has occurred.

Once the airflow calibration is complete, exit the airflow calibration mode by pressing the alarm silence key.

7.5.1 Downflow Calibration

Step 1:  
- Place a Vane Anemometer in the cabinet work zone on the horizontal plane 6 inches (152mm) below the diffuser screen. Spot check several points on the recommended downflow velocity test grid found in table 7.0.

Step 2:  
- If necessary, enter the airflow calibration mode, as stated above and adjust the PWM signal/DC voltage to achieve desired airflow.

Step 3:  
- Proceed to inflow calibration.

7.5.2 Inflow Calibration

Step 1:  
- Measure the inflow velocity using the recommended procedure found in Table 7.0. If necessary, adjust the exhaust filter choke, located under the front decorative panel, to achieve the correct average inflow velocity within the stated range of 120 ± 5 LFPM (.61 ± .025 m/s).

- Less than 125 LFPM (.63 m/s);
  First, open the choke plate or make sure it is open. If this is insufficient, then increase the PWM signal/DC voltage.

- Greater than 125 LFPM (.63 m/s);
  First, adjust the PWM signal/DC voltage to achieve 1/2 the exhaust excess, then close the choke plate to achieve the balance. In this fashion, the downflow should remain nearly constant (i.e. what the reduced speed took away, the choke plate restores).

The choke plate adjustment requires a standard blade screwdriver. To adjust, loosen the liquid-tight fitting around the choke adjustment shaft. While monitoring the exhaust flow to check position, turning the choke adjustment shaft clockwise will open the choke while turning counter clockwise close the choke.

Note:  
- The choke plate adjustment requires a standard blade screwdriver. To adjust, loosen the liquid-tight fitting around the choke adjustment shaft. While monitoring the exhaust flow to check position, turning the choke adjustment shaft clockwise will open the choke while turning counter clockwise closes the choke.

Step 2:  
- Once exhaust adjustment is complete, return the downflow calibration and then check average downflow velocity. If the downflow average remains within the correct range, the calibration is complete. If not, readjust as necessary to obtain the correct calibration range. Once entire cabinet has been balanced, tighten liquid-tight fastener around choke adjustment shaft.
7.5.3 Flow Gard Calibration Password

To enter into calibration mode, a 5 keystroke code must be entered.

- Press the [] [] [RESET] [] [] in sequence.
  The keypad will stay unlocked until the same 5 keystroke code is entered again. A single audible beep will confirm the 5 keystroke code sequence was entered correctly.

To calibrate the Flow Gard monitor, the cabinet must first be certified or set to nominal airflow values. Once the cabinet nominal airflows are set, perform the following procedure:

- Press and hold the [RESET] key for 10 seconds until the display indicates "CAL".
- Press the [RESET] key again. Display should indicate ".61" and "PGM".
- Press the [] or [] key to match the actual calculated inflow velocity.
- Press the [RESET] key to enter the calibration sequence. The monitor will perform the following sequence:
  1) 2 short beeps
  2) 20 second averaging countdown
  3) 2 short beeps, end of sequence
  4) Display will indicate "CAL" if successful or "Err" if not successful.
- If the calibration is successful, press and hold the [RESET] key for 2 seconds, the display should indicate normal readings.
- If the calibration is not successful, press the [RESET] key to acknowledge the error and re-enter the "CAL" mode. Below, is the calibration error code, along with the cause and correction. Once reviewed, try to recalibrate using the above sequence.
- Alarm limits are set at the factory to the following specifications.
  1. Supply air high velocity limit shall alarm before any airflow reading is 20% above the average velocity.
  2. Supply air low velocity limit shall alarm before any airflow reading is 20% below the average velocity.
  3. Alarm shall also activate before the corrected inflow velocity is 105 fpm (.53m/s) or lower

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Cause and Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ErL</td>
<td>Airflow below the instrument's calibration range. Check exhaust probe shroud position, verify airflow.</td>
</tr>
<tr>
<td>ErH</td>
<td>Airflow above the instrument's calibration range. Check exhaust probe shroud position, verify airflow.</td>
</tr>
<tr>
<td>Err</td>
<td>Too much variation in airflow. Check exhaust probe shroud position, probe gasket or room air currents in the exhaust airflow area.</td>
</tr>
</tbody>
</table>

The incorrect values will not be stored in memory. The monitor will continue to use the previous calibration values until a correct calibration is successfully completed.

7.5.3.1 Alarm Setpoint Display

The alarm setpoints may be viewed during calibration mode. Press the [] key, the display will toggle between the current reading and the High alarm setpoint. Press the [] key, the display will toggle between the current reading and Low Alarm setpoint. Note; only hold the keys down for 2 seconds at a time.
7.5.3.2 Alarm Setpoint Calibration
If desired, the Flow Gard high or low alarm limit may be adjusted. During the calibration mode, perform the following sequence:

- Press and hold either [↑] or [↓] key for 5 seconds, display will indicate "PGM" and the current high or low alarm setpoint.
- Using the [↑] or [↓] keys, adjust to the desired alarm limit value.
- Press the [RESET] key to enter the new alarm setpoint value. Monitor will give 2 quick beeps to acknowledge the saved value and return to run mode.

7.5.3.3 Parameter Configuration Mode
The parameter configuration mode allows limited user interaction for the following table items.

**Configuration Parameters**
The following table shows the factory default settings for the monitor's various programmable parameters. A default reset restores these settings.

<table>
<thead>
<tr>
<th>Configuration Parameter</th>
<th>Factory Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL</td>
<td>105 fpm (.53 m/s)</td>
</tr>
<tr>
<td>P01 - Digits enabled/disabled</td>
<td>Enabled</td>
</tr>
<tr>
<td>P02 - Units of measure</td>
<td>Metric (m/s)</td>
</tr>
<tr>
<td>P03 - Temporary horn disable timer</td>
<td>0 (infinite)</td>
</tr>
<tr>
<td>P04 - Warning-to-alarm transition delay timer</td>
<td>1 second</td>
</tr>
<tr>
<td>P05 - Alarm-to-warning transition delay timer</td>
<td>5 seconds</td>
</tr>
<tr>
<td>P06 - Low alarm warning offset</td>
<td>(display will read 2 fpm (0.01m/s))</td>
</tr>
<tr>
<td>dEF - Default reset</td>
<td>Resets P01 - P11 parameters to factory defaults</td>
</tr>
</tbody>
</table>

To access the parameter configuration mode, perform the following:

- Press and hold [RESET] key for 10 seconds until the display indicates "CAL".
- Press the [↑] or [↓] keys to scroll through the menu selections.
- Once the menu selection is found, press [RESET] key to open parameter for change.
- Press the [↑] or [↓] keys to alter the parameter value.
- Press the [RESET] key to enter the parameter value desired. The display will flash "PGM" once, and monitor will give 2 quick beeps to acknowledge the parameter value. The monitor will then return to the menu.

To exit the Configuration menu, press and hold the Test/Reset button for two seconds. The monitor will also time out and exit the Parameter Configuration menu after one minute without keypad activity.

โน่: Remember to enter the Password again to lock the keypad.
P01  Digits Enabled/Disabled
Digits can be enabled or disabled by entering this configuration. The PGM descriptor will turn on and by pressing either the Up or Down button toggles between the two settings. The status indicators and icons will not be turned off. After selection, press Test/Reset button to save. Monitor will give 2 quick beeps to acknowledge save and return to the P01 Configuration menu. Advance to another configuration or exit by holding Test/Reset button for 2 seconds.

P02  Units of Measure
Velocity can be displayed in feet per minute (fpm) or meters per second (m/s). After entering this Configuration menu selection, the monitor will turn on the PGM descriptor and display current units. Press the Up or Down Button to change setting. Press Test/Reset button to save. The monitor will give 2 quick beeps to acknowledge save and return to the P02 Configuration menu. Advance to another selection or exit by holding Test/Reset button for 2 seconds.

P03  Temporary Horn Disable Timer
During an alarm condition, the alarm can be temporarily silenced by pressing the Test/Reset button. Normally, the alarm will be silenced for the duration of the current alarm condition. Using the Horn Disable Timer, the monitor can be configured to enable the horn to come back on after a specified number of minutes. It can also be configured so that the horn cannot be silenced at all (0), which is the default condition for E and G models.

After entering this Configuration Parameter, the time can be set to any value from 0-255. If set at 255 and alarm temporarily silenced by pressing the Test/Reset Button, the alarm will not come on again until this alarm condition clears and another alarm event occurs. If it is desired to not be able to silence the alarm, set to 0. Any value between 0-255 indicates in minutes the time in which the horn will alarm again if the alarm condition is not corrected. Make any changes and press Test/Reset Button. Monitor will give two quick beeps to acknowledge save and go back to Configuration Menu.

P04  Warning-to-Alarm Transition Delay Timer
The yellow warning to red alarm transition time is the delay period, in seconds, that a given airflow condition must remain present before the monitor will go into the appropriate alarm zone. This feature prevents the monitor from toggling back and forth between zones when a condition is on the border.

This Configuration Parameter sets the warning-to-alarm transition timer. After this configuration menu selection is entered, the monitor will turn on the program mode PGM descriptor and display the current value for the warning-to-alarm transition timer. This timer can be set from 0 to 255 seconds.

When desired setting is displayed, press Test/Reset Button. The horn will give two quick beeps to acknowledge save and return to the Configuration Menu.

P05  Alarm-to-Warning Transition Delay Timer
The red alarm to yellow warning transition time is the delay period in seconds that an airflow condition must remain present before the monitor will go into the appropriate warning zone. This feature prevents the monitor from toggling back and forth between zones when a condition is on the border.

This Configuration Parameter sets the alarm-to-warning transition timer. After this configuration menu selection is entered, the monitor will turn on the program mode PGM descriptor and display the current value for the alarm-to-warning transition timer. This timer can be set from 0 to 255 seconds. Once the desired setting is displayed, press the Test/Reset button. The horn will give two quick beeps to acknowledge save and return to the Configuration Menu.
**P06 Low Alarm Warning Offset**

The low warning offset defines the starting point of the low warning zone. It is a value (in the current unit of measure) that is added to the low alarm setpoint. It determines when the yellow low warning light comes on.

Example: If the low alarm is set at 700 fpm and the low alarm warning offset is set at 50 fpm, the yellow low warning light will come on at 750 fpm.

This Configuration Parameter sets the low alarm warning offset. After this configuration menu selection is entered, the monitor will turn on the program mode PGM descriptor and display the current value for the low alarm warning offset. When the desired setting is displayed, press the Test/Reset button. The horn will give two quick beeps to acknowledge save and return to the Configuration menu.

<table>
<thead>
<tr>
<th>P07</th>
<th>P08</th>
<th>P09</th>
<th>P10</th>
<th>P11</th>
<th>P12</th>
</tr>
</thead>
<tbody>
<tr>
<td>None of these are in use at this time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**dEF Reset Configuration Parameters to Factory Default Settings**

All the parameters configurable by the user can be reset to the factory defaults located in the memory of the Biological Safety Cabinet monitor. After this configuration menu selection is entered, the monitor will turn on the program mode PGM descriptor and the display will show: rES

Press the Test/Reset button. The PGM descriptor will flash once and the horn will give two quick beeps to acknowledge that the configuration settings have been set to their factory default settings.

The monitor will return to the dEF Configuration menu selection. Press the Up and Down buttons to advance to another Configuration Parameter. Press and hold the Test/Reset button for 2 seconds to exit the Configuration menu.

**7.6 HEPA Filter Leak Test**

In order to check filter and filter seal integrity, the HEPA filter media and seals must be directly accessible, by the measuring instrument. The challenge material (i.e. PAO) should be supplied in the rear center of the work zone over the intake slots. The upstream challenge port being common for both filters in located on top of the cabinet.

**7.6.1 Supply Filter**

The diffuser plate placed below the HEPA to protect the filter during normal usage may be removed as follows: The diffuser is secured to the cabinet shell by #1/4-20 acorn nuts located immediately behind the front viewing window. After removing the fasteners, drop the front of the diffuser plate several inches and pull forward gently. Note that the diffuser is purposely a tight fit - it is held to the back wall of the cabinet interior by a light push - fit with projecting studs.
7.6.2 Exhaust Filter

The exhaust filter is typically more difficult to check since protective grills, charcoal filters, or exhaust transitions could cover the filter. Access panels are usually provided and should be removed. If an air gap exhaust transition is provided, the air gap must be sealed with duct tape or other suitable means to prevent contaminated air from migrating into the exhaust efflux. All exhaust blowers/fans should be turned off during the check.

**NOTE:** if the upstream challenge port is deemed contaminated and not accessible, use both downflow and exhaust volume for determining challenge concentrations. Use following area information below with average downflow velocity and spot-check exhaust velocities as measured to determine volume (CFM) (CMH).

<table>
<thead>
<tr>
<th>Model Size</th>
<th>*Supply Area (ft²)(m²)</th>
<th>Exhaust Area (ft²)(m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300E</td>
<td>5.61 (.159)</td>
<td>1.64 (.046)</td>
</tr>
<tr>
<td>400E</td>
<td>7.57 (.214)</td>
<td>2.58 (.073)</td>
</tr>
<tr>
<td>500E</td>
<td>9.53 (.270)</td>
<td>3.52 (.100)</td>
</tr>
<tr>
<td>600E</td>
<td>11.48 (.325)</td>
<td>4.45 (.126)</td>
</tr>
</tbody>
</table>

* Measured 4 inches above the bottom edge of the window.

**Laskin Nozzle Concentration Formula**

\[
\text{# Nozzles} \times 135 \text{ CFM} \times 100 \text{ ug/L} = \text{Challenge Downflow (CFM)} + \text{Exhaust (CFM)}
\]

\[
\text{# Nozzles} \times 229 \text{ CMH} \times 100 \text{ ug/L} = \text{Challenge Downflow (CMH)} + \text{Exhaust (CFM)}
\]

7.7 Airflow Smoke Pattern Test

The airflow smoke pattern test is performed using a smoke source (i.e. smoke tubes) in and around the cabinet work zone and access opening to determine a visual representation of the cabinet’s containment performance. To perform the test, the smoke source should be passed through the following areas:

1. A smoke source shall be passed from one end of the cabinet to the other, along the center line of the work surface, at a height of 4 inches (102mm) above the top of the access opening.
2. A smoke source shall be passed from one end of the cabinet to the other, 1 inch (25mm) just inside the view screen, at a height 6 inches (152mm) above the top of the access opening.
3. Pass a smoke source along the edges of the entire perimeter of the work opening approximately 1.5 inches (38mm) outside the cabinet, with particular attention paid to corners and vertical edges.
4. Pass a smoke source 2 inches (51mm) from the sides up inside of the window at the side channel seals, and along inside of the cabinet along the top of the work area or immediately below the wiper gasket.

The criteria used to evaluate the smoke patterns is the following:

1. The smoke inside the cabinet shall show smooth downward flow with no dead spots or reflux.
2. No smoke shall escape from inside the cabinet.
3. No smoke reflexes out of the cabinet once drawn in, nor does smoke billow over the work surface or penetrate onto it.
4. No smoke shall escape from the cabinet.
7.8 Cleanliness Classification Test for Pharmacy Application

If this cabinet is going to be used within pharmacy, per USP797¹, the cabinet must be tested to assure compliance to ISO 14644-1:1999, Cleanrooms and Associated Controlled Environments, Part 1: Classification of Air Cleanliness². The cleanliness classification test is performed using a particle counter to measure particle counts within the cabinet work zone. Turn on cabinet and let warm up for several minutes. Turn on particle counter and flush out sample tubing line to remove latent particles. Set the particle counter to measure 0.5 micron or larger particles at the appropriate measuring rate.

“Operational Particle Count Test”³
Position the particle counter isokinetic probe at a point 6 inches (152mm) upstream of the aseptic manipulation area (hand convergence point) and mounted so as not to interfere with the operator’s hand movement. The pharmacy operator will simulate IV manipulation during the particle count test using non-hazardous materials. A minimum of three (3) 1-minute particle counts shall be sampled and recorded while the user simulates aseptic compounding manipulations.

“At Rest Particle Count Test”
Take 5 test points in 1-minute intervals on a grid, in a horizontal plane as measured approximately 6-inches (152mm) above the work surface. The grid location is designed as the work zone center point and each corner measured 6-inches (152mm) from the inside perimeter.

Record the 5 particle count values for each of the test points over the 1-minute sample time. All final count particle concentrations and calculated 95% upper confidence limit shall not exceed 3520 particles per cubic meter (ppcm) or (100 particles per cubic feet (ppcf).

² ISO 14644-1:1999 Cleanrooms and Associated Controlled Environments-Classification of Air Cleanliness, International Organization for Standardization, Case Postale 56, CH-1211 Geneve 20, Switzerland
Table 7.0
Recommended Measurement Methods for Cabinet Downflow & Inflow.

A. Downflow Measurement

a. Instruments: Alnor RV-6 Vane Anemometer

b. Procedure: Supply filter efflux is measured on a grid, in a horizontal plane 6 inches (152mm) from the supply filter diffuser. The grid should start 4 inches (102mm) from the work zone perimeter. The grid intervals should be 8 to 9 inches (203 to 229mm) maximum for both side to side and front to back dimensions.

c. Test Data - Inches (mm):

<table>
<thead>
<tr>
<th>300E</th>
<th>4 (102)</th>
<th>12.792 (325)</th>
<th>21.584 (548)</th>
<th>30.375 (772)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400E</td>
<td>4 (102)</td>
<td>11.675 (297)</td>
<td>19.350 (492)</td>
<td>27.025 (686)</td>
</tr>
<tr>
<td>500E</td>
<td>4 (102)</td>
<td>12.396 (315)</td>
<td>20.792 (528)</td>
<td>29.188 (741)</td>
</tr>
<tr>
<td>600E</td>
<td>4 (102)</td>
<td>11.797 (300)</td>
<td>19.594 (498)</td>
<td>27.391 (696)</td>
</tr>
<tr>
<td></td>
<td>4 (102)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11.75 (298)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19.5 (495)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Readings:</th>
<th>Average Velocity ft./min.</th>
<th>m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d. Acceptance Criteria:

1. Average downflow velocity = **80 to 90 fpm (.41 to .46 m/s)**
2. Individual readings must be within ± 20% of the average downflow velocity.
Exhaust Air CFM/Access Opening Inflow Velocity

A. Instrument: Shortridge Flowhood ADM-870 or Alnor 8500 or TSI 8355 Thermo anemometer.
B. Procedure:
   The inflow velocity is measured by using a Direct Inflow Measurement (DIM) Instrument (i.e. shortridge flowhood). The DIM Instrument can be used directly on the cabinet with NO CORRECTION FACTORS REQUIRED since NSF has tested the cabinet using the same technique. The DIM Instrument should be equipped with a flowhood that is as close as possible to the width of the cabinet (i.e. NU-425-400 should use 1 x 4 foot flowhood). The DIM Instrument should also be duct taped to the cabinet to prevent any sneak air paths from occurring.

   The DIM Instrument will read inflow volume (i.e. CFM). Use the window access opening area to calculate inflow velocity.
C. Test Data - Inches (mm):

<table>
<thead>
<tr>
<th>DIM Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow Volume</td>
</tr>
<tr>
<td>Access Opening</td>
</tr>
<tr>
<td>Inflow Velocity</td>
</tr>
</tbody>
</table>

D. Acceptance Criteria:
   Access Opening inflow velocity = **115 to 125 ft. /min. (.58 to .63 m/s)**

<table>
<thead>
<tr>
<th>Cab. Size</th>
<th>Exhaust Filter Area ft² (m²)</th>
<th>8 Inch (203mm) Window Access Opening Area ft² (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300E</td>
<td>1.56 (.144)</td>
<td>1.91 (.177)</td>
</tr>
<tr>
<td>400E</td>
<td>2.44 (.226)</td>
<td>2.58 (.239)</td>
</tr>
<tr>
<td>500E</td>
<td>3.36 (.312)</td>
<td>3.24 (.300)</td>
</tr>
<tr>
<td>600E</td>
<td>4.28 (.397)</td>
<td>3.91 (.363)</td>
</tr>
</tbody>
</table>

7.10 Main Control Board Description & Replacement

The main control board consists of one Printed Circuit Board (PCB) assembly. The assembly consists of a power supply, relay logic and an independent motor speed control.

**Disconnect electrical power from the unit before attempting any maintenance action.**

The main control board is fastened to the control center with (6) 6-32 studs, lock washers and nuts. All electrical connections are made with removable terminals and/or Faston connectors. All AC circuits are fuse protected and when replacement is necessary, **USE ONLY FUSES OF SAME TYPE AND RATING FOR PROTECTION AGAINST RISK OF FIRE.**

<table>
<thead>
<tr>
<th>DESCRIPTION:</th>
<th>BLOWER FUSE</th>
<th>OUTLET FUSE</th>
<th>LIGHT FUSE</th>
<th>TRANSFORMER FUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUSE TYPE:</td>
<td>TIME-LAG</td>
<td>TIME-LAG</td>
<td>TIME-LAG</td>
<td>TIME-LAG</td>
</tr>
<tr>
<td>FUSE SIZE:</td>
<td>1/4 X 1-1/4 INCH</td>
<td>5 X 20MM</td>
<td>5 X 20MM</td>
<td>5 X 20MM</td>
</tr>
<tr>
<td>NU-437-300E</td>
<td>5 AMPS</td>
<td>3 AMPS (2)</td>
<td>1 AMP</td>
<td>1/4 AMP (2)</td>
</tr>
<tr>
<td>NU-437-400E</td>
<td>6.3 AMPS</td>
<td>3 AMPS (2)</td>
<td>1 AMP</td>
<td>1/4 AMP (2)</td>
</tr>
<tr>
<td>NU-437-500E</td>
<td>8 AMPS</td>
<td>3 AMPS (2)</td>
<td>1 AMP</td>
<td>1/4 AMP (2)</td>
</tr>
<tr>
<td>NU-437-600E</td>
<td>8 AMPS</td>
<td>3 AMPS (2)</td>
<td>1 AMP</td>
<td>1/4 AMP (2)</td>
</tr>
</tbody>
</table>
The main control board has several configuration jumpers used for different purposes. J1, J2, and J3 are used for the blower password and night setback mode selection/configuration. J4 and J9 are not used for this application and J6 & J7 are used to configure the ECM motor curve for the appropriate size of cabinet (see chart below).

<table>
<thead>
<tr>
<th>Cabinet Jumper Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>J6</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Off</td>
</tr>
<tr>
<td>On</td>
</tr>
<tr>
<td>Off</td>
</tr>
<tr>
<td>On</td>
</tr>
</tbody>
</table>

The DC ECM motor PWM signal/DC voltage can be measured and monitored. The DC voltage may be measured using a digital voltmeter. The two test points to measure the PWM signal/CD voltage are located on the DC motor connector on the main control board. PWM signal/DC voltage will range between 2.5 and 8.0 Vdc during normal operation and approximately 2.0 Vdc during night setback mode.
8.0 Error Indicators & Troubleshooting

Audible alarms and error indicators occur for a variety of reasons. Whenever an alarm condition is present, the audible alarm and error indicator will be presented and stay on until the error is cleared. When presented with an error indicator, please perform the following:

Step 1: NOTE ALL ERROR INDICATORS. When the cabinet is running, any and all red indicators display an error.

Step 2: VERIFY ERROR INDICATORS. Error indicators can be verified by turning the errored function on/off.

Step 3: MONITOR RE-OCCURRENCE OF ERROR INDICATORS. If re-occurrence of the error indicator is immediate or daily, use guide below to correct the situation.

<table>
<thead>
<tr>
<th>Error Indicator</th>
<th>Indicator</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window alarm</td>
<td>Sliding window is above or below its standard working height or microswitch is not operating properly.</td>
<td>Verify standard working height and window microswitch operation.</td>
</tr>
<tr>
<td>Cabinet fluorescent lights won't turn on.</td>
<td></td>
<td>Check light fuse on main control board in center. Check fluorescent lamps. Check voltage to light ballasts. Check ballast. Check light switch.</td>
</tr>
<tr>
<td>Cabinet blower won't turn on.</td>
<td></td>
<td>Check sliding window for correct operational height. Check blower fuse on main control board in the control center. Check voltage to blower on main control board in the control center. At motor voltage regulator and at bulkhead connector. Check wiring to blower. Check sliding window blower cutoff microswitch. Check blower motor. (Note: blower motor has internal thermal protector. Let blower motor cool off for a minimum of 30 minutes to assure thermal protector is not open.)</td>
</tr>
<tr>
<td>Error Indicator</td>
<td>Indicator</td>
<td>Correction</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cabinet outlets won't turn on.</td>
<td></td>
<td>Check outlet fuse on main control board in control center. Check voltage to outlets.</td>
</tr>
<tr>
<td>Cabinet ultraviolet light won't turn on.</td>
<td></td>
<td>Check light fuse on main control board in control center. Check ultraviolet lamp. Check voltage to ultraviolet ballasts. Check ballast. Check light switch.</td>
</tr>
<tr>
<td>Blower/lights/outlet fuses continue to blow.</td>
<td></td>
<td>Check for short on main control board. Isolate output of circuit by disconnecting control center connectors, light circuit, motor voltage regulator, etc. to isolate the short.</td>
</tr>
</tbody>
</table>

9.0 Remote Contacts

9.1 Fan Relay
The fan relay contacts are single pole normally open contact closure outputs which are activated whenever the blower is turned on. The contact points are located on the main control module. Contact ratings are 250 VAC maximum at 2 Amps.
10.0 Optional Equipment

10.1 Ultraviolet Lamp

Ultraviolet light will injure your eyes. Avoid direct viewing at all times. Personnel should not be present when ultraviolet lamp is on.

10.1.1 Overview
The germicidal ultraviolet is primarily intended for the destruction of bacteria and other microorganisms in the air or on directly exposed surfaces. Approximately 95% of the ultraviolet radiations from germicidal tubes are in the 253.7 nanometer region. This is a region in the ultraviolet spectrum which is near the peak of germicidal effectiveness. The exposure necessary to kill bacteria is the product of time and intensity. High intensities for a short period of time, or low intensities for a longer period are fundamentally equal in lethal dosage on bacteria (disregarding the life cycle of bacteria). The intensity of light falling on a given area is governed by the inverse law; that is the killing intensity decreases as the distance increases from the tube.

The germicidal tube is placed in the cabinet to provide an average intensity of 100 microwatts per centimeter (for a new tube) falling on a horizontal plane defined by the bottom of the work surface. The minimum requirement per paragraph 5.12 of NSF Standard 49 is 40 microwatts per square centimeter (ref. NSF Std. #49, June, 1976).

Since ultraviolet rays will not penetrate ordinary glass, it is recommended that the sliding window be closed while the ultraviolet light is on within the cabinet; or that personnel leave the cabinet face area.

10.1.2 Operation
The operation of the ultraviolet lamp is accomplished by closing the sliding window and pressing the UV switch located on the front panel.

10.1.3 Precaution
The rays from germicidal tubes may cause a painful but temporary irritation of the eyes and reddening of the skin, if of sufficiently high intensity, or if exposure covers a prolonged period of time. For this reason, one should avoid direct eye and skin exposure to ultraviolet light. If exposure cannot be avoided, it is necessary for personnel to wear eye goggles or face shields, and long sleeve gowns with rubber gloves.

Since ultraviolet rays will not penetrate ordinary glass, it is recommended that the sliding window be closed while the ultraviolet light is on within the cabinet; or that personnel leave the cabinet face area.

10.1.4 Maintenance
The output of an ultraviolet lamp deteriorates with burning age. The useful life of the lamp is approximately 7000 hours under specific test conditions.

Note: Before testing with lamp off, the light may be cleaned with a lint-free cloth dampened with alcohol or ammonia and water.

It is recommended that either a time schedule is established or the tube's output is measured periodically and the tube replaced when its output falls below 40 microwatts per square centimeter or exceeds 7000 hours of operation. Lamps should be allowed to operate approximately 5 to 10 minutes (longer when the lamp is in low temperatures) to warm up sufficiently and wiped clean of dust or dirt before reading the output with a meter. Even minute amounts of dust will absorb ultraviolet energy.
### Energies Required to Destroy Some Microorganisms by Ultraviolet Radiations(e)

<table>
<thead>
<tr>
<th>Mold Spores</th>
<th>Microwatt seconds per cm/2</th>
<th>Protozoa</th>
<th>Microwatt seconds per cm/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillium roqueforti</td>
<td>26,400</td>
<td>Paramecium</td>
<td>200,000(a)</td>
</tr>
<tr>
<td>Penicillium expansum</td>
<td>22,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillium digitatum</td>
<td>88,000</td>
<td>Nematode Eggs</td>
<td>40,000(b)</td>
</tr>
<tr>
<td>Aspergillus glaucus</td>
<td>88,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspergillus flavus</td>
<td>99,000</td>
<td>Algae</td>
<td>22,000(c)</td>
</tr>
<tr>
<td>Aspergillus niger</td>
<td>330,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhizopus nigricans</td>
<td>220,000</td>
<td>Virus</td>
<td></td>
</tr>
<tr>
<td>Mucor racemosus A</td>
<td>35,200</td>
<td>Bacteriophage (E. Coli)</td>
<td>6,600</td>
</tr>
<tr>
<td>Mucor racemosus B</td>
<td>35,200</td>
<td>Tobacco Masaic</td>
<td>440,000</td>
</tr>
<tr>
<td>Oospora lactis</td>
<td>11,000</td>
<td>Influenze</td>
<td>3,400(d)</td>
</tr>
</tbody>
</table>

#### Yeasts

| Saccharomyces              | 13,200                     |              |                            |
| ellipsoides               | 17,600                     |              |                            |
| Saccharomyces cerevisiae  | 13,200                     |              |                            |
| Brewers' yeast            | 6,600                      |              |                            |
| Baker's yeast             | 8,800                      |              |                            |
| Common yeast cake         | 13,200                     |              |                            |

#### Bacteria

| Streptococcus lactis      | 8,800                      |              |                            |
| Strep. hermolyticus (alpha type) | 5,500                   |              |                            |
| Staphylococcus aureus     | 6,600                      |              |                            |
| Staphylococcus albus      | 5,720                      |              |                            |
| Micrococcus sphaeroides   | 15,400                     |              |                            |
| Sarcina lutea             | 26,400                     |              |                            |
| Pseudomonas fluorescens   | 7,040                      |              |                            |
| Escherichia coli          | 7,040                      |              |                            |
| Proteus vulgaris          | 7,480                      |              |                            |
| Serratia marcescens       | 6,160                      |              |                            |
| Bacillus subtilis         | 11,000                     |              |                            |
| Bacillus subtilis spores  | 22,000                     |              |                            |
| Spirillum rubrum          | 6,160                      |              |                            |

### References:

(b) Hollaender (1942) Aerobiology, A.A.A.S. (for 90% inactivation), pp 162  
(e) This table, "Energies Required to Destroy Some Microorganisms by Ultraviolet Radiations" comes from Westinghouse brochure entitled - "Westinghouse Sterilamp Germicidal Ultraviolet Tubes"
11.0 Electrical/Environmental Requirements

11.1 Electrical (supply voltage fluctuations not to exceed +/- 10%)

*NU-437-300E  230 VAC,  50/60 Hz, 1 Phase, 6 Amps
*NU-437-400E  230 VAC,  50/60 Hz, 1 Phase, 10 Amps
*NU-437-500E  230 VAC,  50/60 Hz, 1 Phase, 11 Amps
*NU-437-600E  230 VAC,  50/60 Hz, 1 Phase, 11 Amps

*CE Certified

11.2 Operational Performance (for indoor use only)
Environment Temperature Range:  60°F-85°F (15°C - 30°C)
Environment Humidity:  20% - 60% Relative Humidity
Environment Altitude:  6562 Feet (2000 meters) Maximum

11.3 Light Exposure
Standard Fluorescent Lighting @ 150 ft. candles (1614 LUX) maximum intensity.

11.4 Installation Category: 2.0
Installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II, which is the category used for instruments in installations supplied from a supply comparable to public mains such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 2500 V for a 230 V supply and 1500 V for a 120 V supply.

11.5 Pollution Degree: 2.0
Pollution degree describes the amount of conductive pollution present in the operating environment. Pollution degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

11.6 Chemical Exposure
Chemical exposure should be limited to antibacterial materials used for cleaning and disinfecting. CHLORINATED AND HALOGEN MATERIALS ARE NOT RECOMMENDED FOR USE ON STAINLESS STEEL SURFACES. Chamber decontamination can be accomplished by paraformaldehyde, vapor phased Hydrogen Peroxide or Chlorine Dioxide without degradation of cabinet materials.

11.7 EMC Performance (classified for light industrial)
Emissions:  EN61326
Immunity:  EN61326

Class A equipment is intended for use in an industrial environment. In the documentation for the user, a statement shall be included drawing attention to the fact that there may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.
12.0 Disposal and Recycle

Cabinets that are no longer in use and are ready for disposal contain reusable materials. ALL components with the exception of the HEPA filters may be disposed and/or recycled after they are known to be properly disinfected.

Note: Follow all local, state and federal guidelines for disposal of HEPA filter solid waste.

Prior to any disassembly for disposal the cabinet must be decontaminated.

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Cabinet</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Front Grill</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Work Surface</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Window Faring</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Window Glides</td>
<td>HDPE</td>
</tr>
<tr>
<td>Window</td>
<td>Safety Glass</td>
</tr>
<tr>
<td>Window Frame</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Front Service Panel</td>
<td>Painted Steel</td>
</tr>
<tr>
<td>Front Decorative Panel</td>
<td>Painted Steel</td>
</tr>
<tr>
<td>Control Center</td>
<td>Painted Steel</td>
</tr>
<tr>
<td>Supply Diffuser</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Exhaust Filter</td>
<td>Aluminum</td>
</tr>
<tr>
<td>HEPA Filter Frames</td>
<td>Painted Steel</td>
</tr>
<tr>
<td>Hepex Bag</td>
<td>PVC</td>
</tr>
<tr>
<td>Blower Wheel &amp; Housing</td>
<td>Steel</td>
</tr>
<tr>
<td>Motor</td>
<td>Various Steel/Copper</td>
</tr>
<tr>
<td>Printed Wiring Assembly</td>
<td>Lead Free Electronic</td>
</tr>
<tr>
<td>Wire</td>
<td>PVC Coated Copper</td>
</tr>
<tr>
<td>Ballasts</td>
<td>Various Steel, Electronic</td>
</tr>
<tr>
<td>Armrest</td>
<td>PVC</td>
</tr>
<tr>
<td>Connectors</td>
<td>Nylon</td>
</tr>
<tr>
<td>Hardware</td>
<td>Stainless Steel and Steel</td>
</tr>
</tbody>
</table>

NOTE: Material type can be verified with use of a magnet with stainless and aluminum being non-magnetic.
CONTROL CENTER REMOVAL PROCEDURE

CAUTION
DISCONNECT ALL ELECTRICAL SERVICE TO UNIT BEFORE STARTING PROCEDURE

1. REMOVE (2) #8-32 SCREWS FROM TOP OF CONTROL CENTER AND GENTLY LET CONTROL CENTER OPEN ON SAFETY STRAPS.
2. REMOVE MINIHELIC GAUGE HOSES (IF PRESENT)
   (HOSE CLAMP/MAG GAUGE)
3. DISCONNECT ELECTRICAL ConnectORS AND CABLE CLAMPS SO THEY ARE LOOSE TO THE MAIN CABINET (BOTH SIDES)
4. LOOSEN NUT (HINGE STOP) AND MOVE METAL TAB 90°
5. REMOVE A 1/4-20 NUT FROM CONTROL CENTER HOLDING THE SAFETY STRAP (BOTH ENDS)
6. SLIDE CONTROL CENTER TO LEFT UNTIL FREE
7. ATTACH CONTROL CENTER REVERSE THE ABOVE STEPS.

FRONT DECORATIVE PANEL REMOVAL PROCEDURE

1. REMOVE (2) #8-32 SCREWS FROM TOP OF CONTROL CENTER AND GENTLY LET CONTROL CENTER OPEN ON SAFETY STRAPS.
2. REMOVE (3) NUTS FROM TOP LINE OF PANEL
3. REMOVE (6) KNUCKLED SCREWS FROM FRONT OF PANEL (IF PRESENT)
4. TO ATTACH FRONT DECORATIVE PANEL REVERSE THE ABOVE STEPS