

**CELLGARD ES Energy Saver Class II,  
Type A2 Laminar Flow  
Biological Safety Cabinet**

**Models  
NU-475-300/400/500/600  
Bench/Console**

**Operation & Maintenance Manual**

**May, 2013  
Revision 1  
Series 5**



NU-475-400/500/600 Only

**Manufactured by:**  
NuAire, Inc.  
2100 Fernbrook Lane  
Plymouth, Minnesota USA 55447  
Toll Free: 1-800-328-3352  
In MN: 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 NSF/ANSI 49. Please read this manual carefully to familiarize you with proper installation, maintenance and operation of the cabinet. Other reference and guideline materials are available through the following web sites.

[www.hc-sc.gc.ca](http://www.hc-sc.gc.ca)  
[www.cdc.gov/od/ohs/](http://www.cdc.gov/od/ohs/)  
[www.absa.org](http://www.absa.org)  
[www.absa-canada.org](http://www.absa-canada.org)  
[www.ebsa.be](http://www.ebsa.be)  
[www.inspection.gc.ca](http://www.inspection.gc.ca)  
[www.who.int](http://www.who.int)  
[www.biosafety.be](http://www.biosafety.be)  
[www.hse.gov.uk](http://www.hse.gov.uk)  
[www.nsf.org](http://www.nsf.org)  
[www.cetainternational.org](http://www.cetainternational.org)  
[www.osha.gov/dts/osta/](http://www.osha.gov/dts/osta/)  
[www.nuaire.com](http://www.nuaire.com)

## **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.

**CELLGARD ES Energy Saver Class II, Type A2**  
**Laminar Flow Biological Safety Cabinet**  
Models NU-475-300/400/500/600  
Operation & Maintenance Manual

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**CELLGARD ES Energy Saver Class II, Type A2  
Laminar Flow Biological Safety Cabinet  
Models  
NU-475-300/400/500/600  
MANUFACTURED BY:  
NuAire, Inc. - Plymouth, Minnesota, U.S.A.**

## **1.0 General Information**

### **1.1 Description**

The CELLGARD ES Model NU-475 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 CELLGARD ES model NU-475 utilizes an Energy Saver DC ECM motor optimally determined forward curved fan for each model size/width to maximize both energy efficiency and filter loading capacity. The Energy Saver ECM motor is controlled via a solid-state DC motor controller that provides automatic compensation (constant volume control) for both filter loading and line voltage variances.

The Laminar Flow Biological Safety Cabinet, (LFBSC) is a product resulting from the development of the "laminar flow" principle 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-475 bench LFBSC is known as a Class II, Type A2 Biological Safety Cabinet. This is possible since NuAire's cabinet conforms to the following requirements:

1. Maintains inflow velocity of 100 LFPM (.51m/s) through the work access opening.
2. Has HEPA filtered downflow air that is mixed with the inflow air from a common exhaust plenum.
3. Exhaust airflow can either be room re-circulated or exhausted outside using a canopy exhaust transition.
4. Has all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure. (Type A1 permits positive pressure contaminated ducts and plenums).

Cabinets used for work with minute quantities of volatile toxic chemicals and traces amounts of radionuclides required as an adjunct to microbiological studies must be exhausted through properly functioning exhaust canopies.

### **1.2 Safety Instructions**

These safety instructions describe the safety features of the CELLGARD ES Model NU-475 LFBSC.

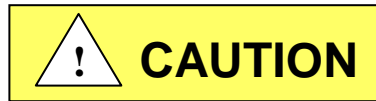
The safety cabinet has been manufactured using the latest technological developments and has been thoroughly tested before delivery. It may, however, present potential hazards if it is not used according to the intended purpose or outside of operating parameters. Therefore, the following procedures must always be observed:

- The safety cabinet must be operated only by trained and authorized personnel.
- For any operation of this unit, the operator must prepare clear and concise written instructions for operating and cleaning, utilizing applicable safety data sheets, plant hygiene guidelines, and technical regulations, in particular.
  - which decontamination measures are to be applied for the cabinet and accessories,
  - which protective measures apply while specific agents are used,
  - which measures are to be taken in the case of an accident.
- Repairs to the device must be carried out only by trained and authorized expert personnel.
- Keep these operating instructions close to the unit so that safety instructions and important information are always accessible.
- Should you encounter problems that are not detailed adequately in the operating instructions, please contact your NuAire Representative of NuAire technical Services.

### 1.3 Explanation of Symbols



Safety alert symbol indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

#### CAUTION:

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.



Potential electrical hazard, only qualified person to access.

#### NOTE:



Used for important information.

Biohazard



Ground, Earth



Lead Free



Flammable Hazard

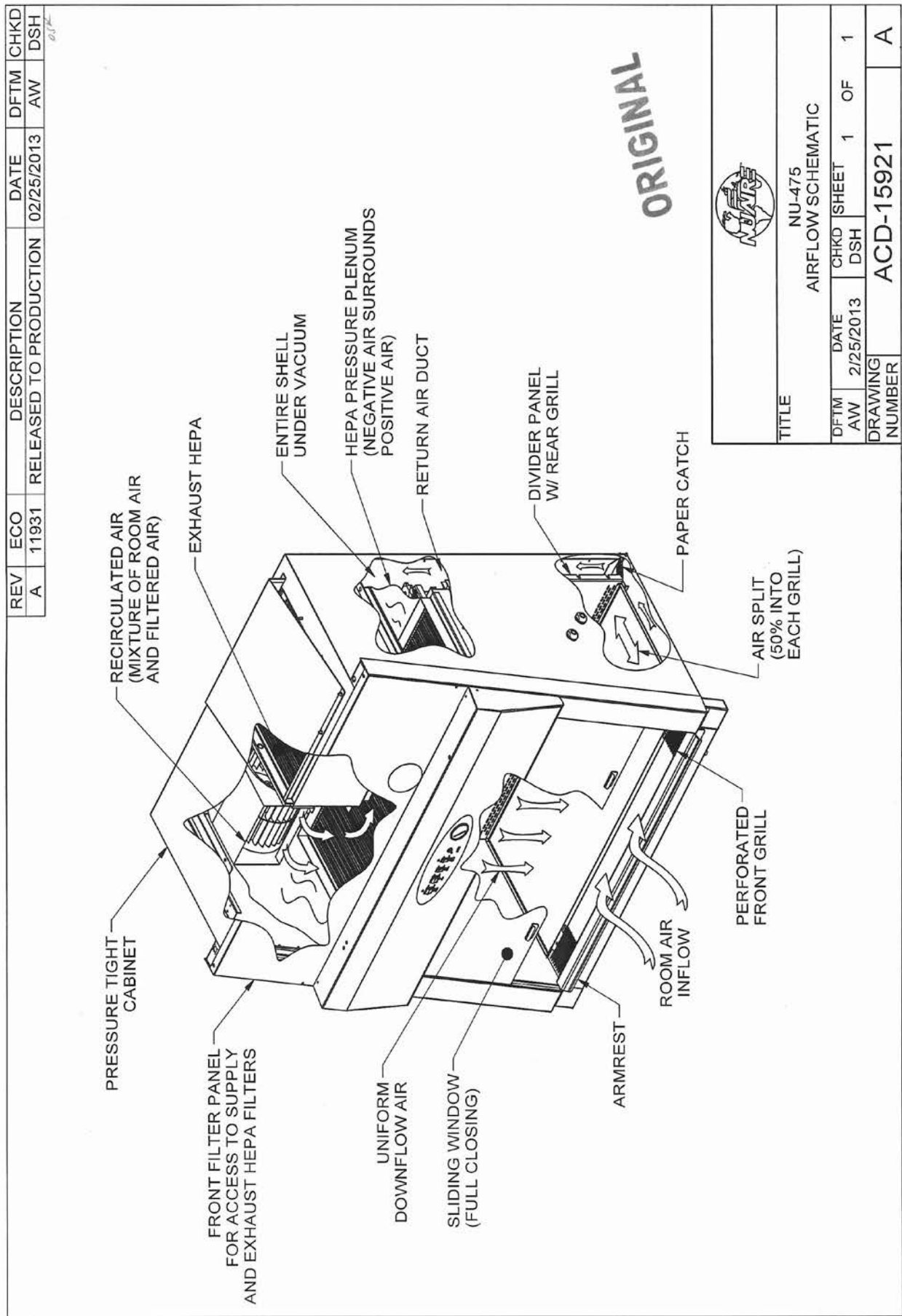


Hazardous Gases! Personal Protection Equipment Required.



Chemical Hazard

REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
A	11931	RELEASED TO PRODUCTION	02/25/2013	AW	DSH



NU-475  
AIRFLOW SCHEMATIC

DFTM	DATE	CHKD	SHEET	1	OF	1
AW	2/25/2013	DSH				
DRAWING	NUMBER	ACD-15921				
		A				

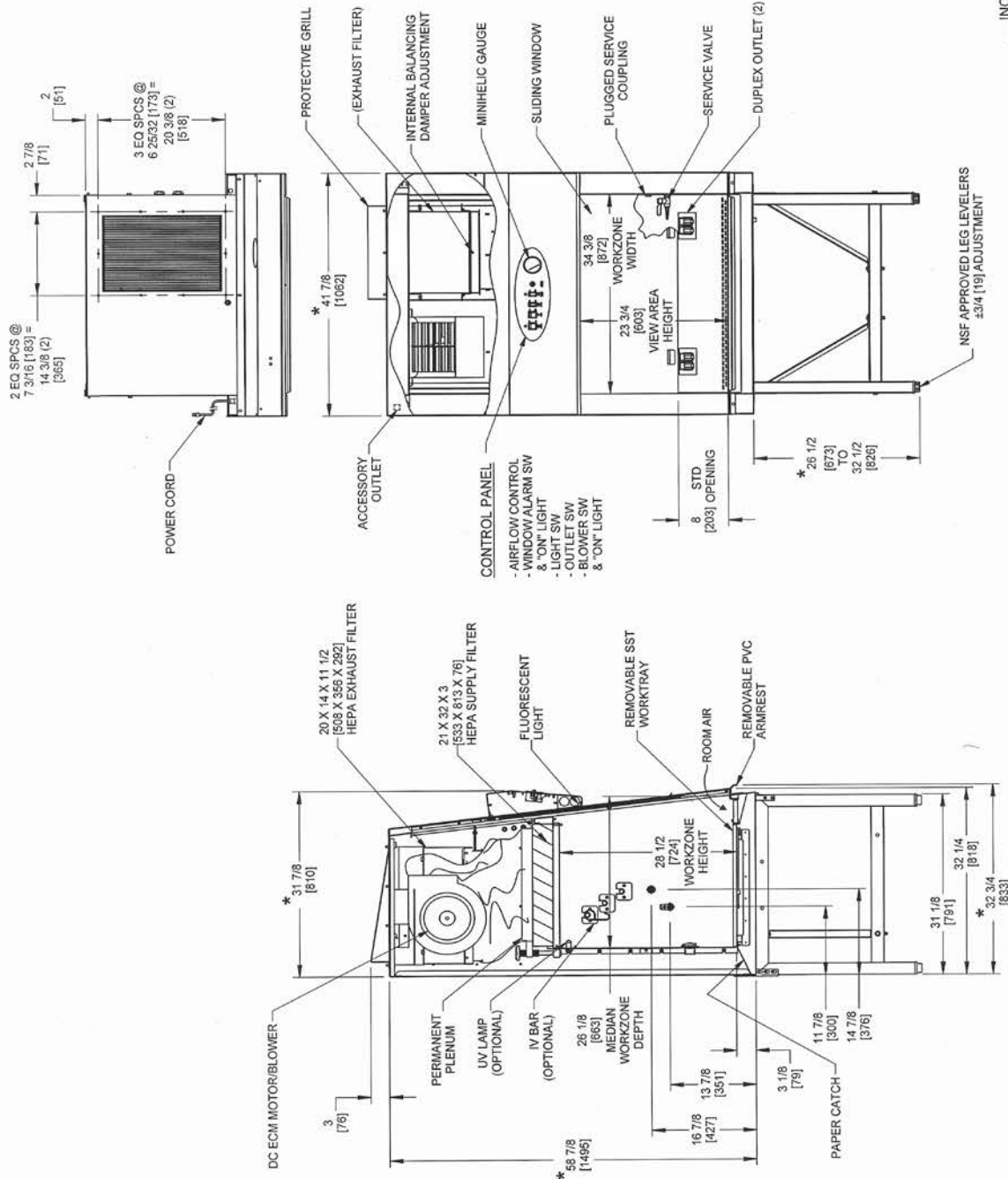
## **2.0 Models & Features**

The model NU-475, Class II, Type A2 Laminar Flow Biological Safety Cabinet is manufactured in four sizes: 3 ft., 4 ft., 5 ft., and 6 ft.



REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
A	11931	RELEASED TO PRODUCTION	2/25/2013	AW	DSH

4/4/13

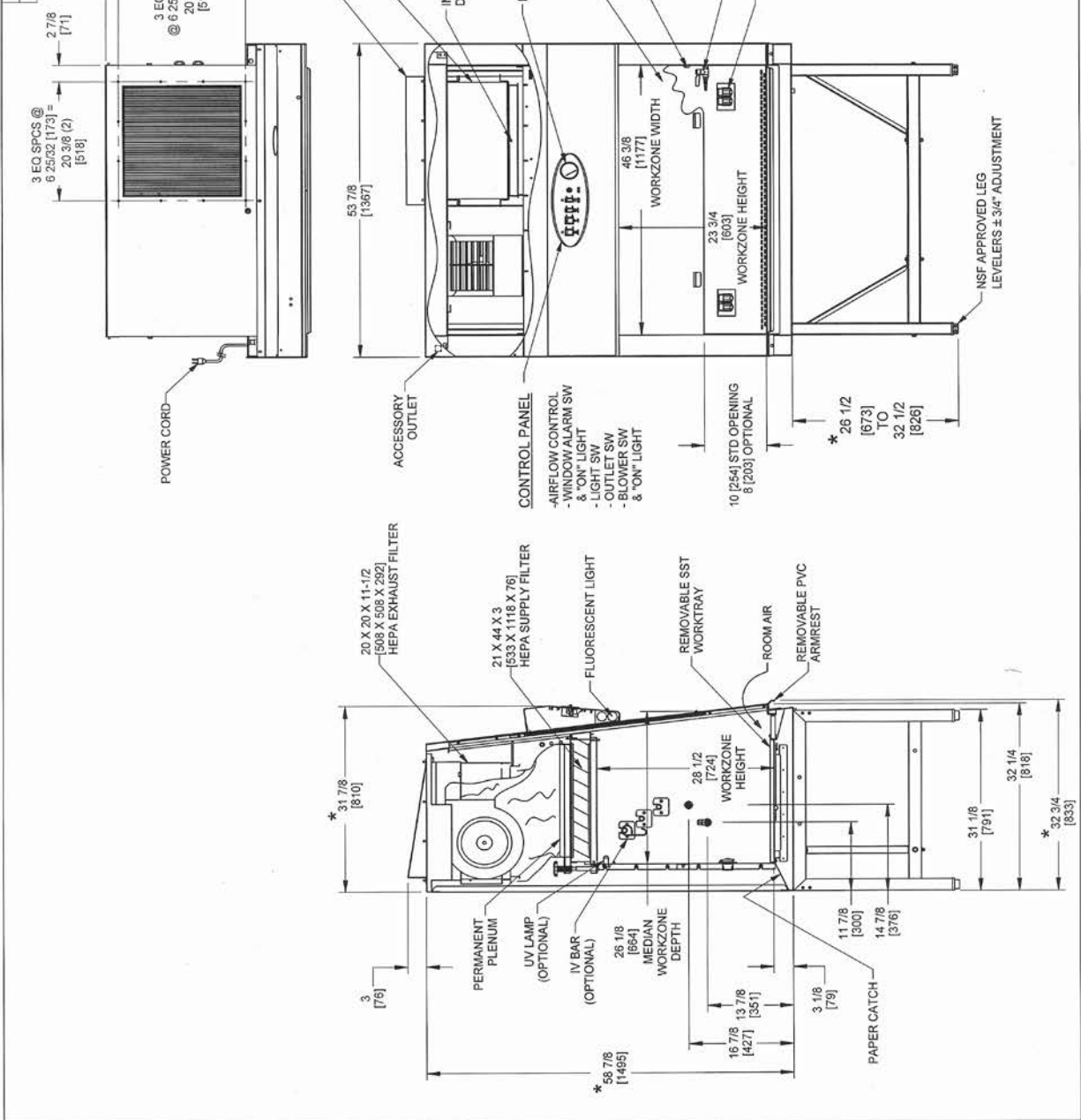


\* OVERALL DIMENSIONAL TOLERANCE ±1/4" [6.35]  
ALL OTHER DIMENSIONS ±1/8" [3.17]

ORIGINAL	
NU-475-300	
CLASS II, TYPE A2 (ENERGY SAVER)	
BIOLOGICAL SAFETY CABINET	
DFTM	DATE
AW	2/25/2013
CHKO	1
DSH	1
OF	1
DRAWING NUMBER	
BCD-15922	
A	

INCH  
MILLIMETER

REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
A	11931	RELEASED TO PRODUCTION	02/25/2013	AW	DSH

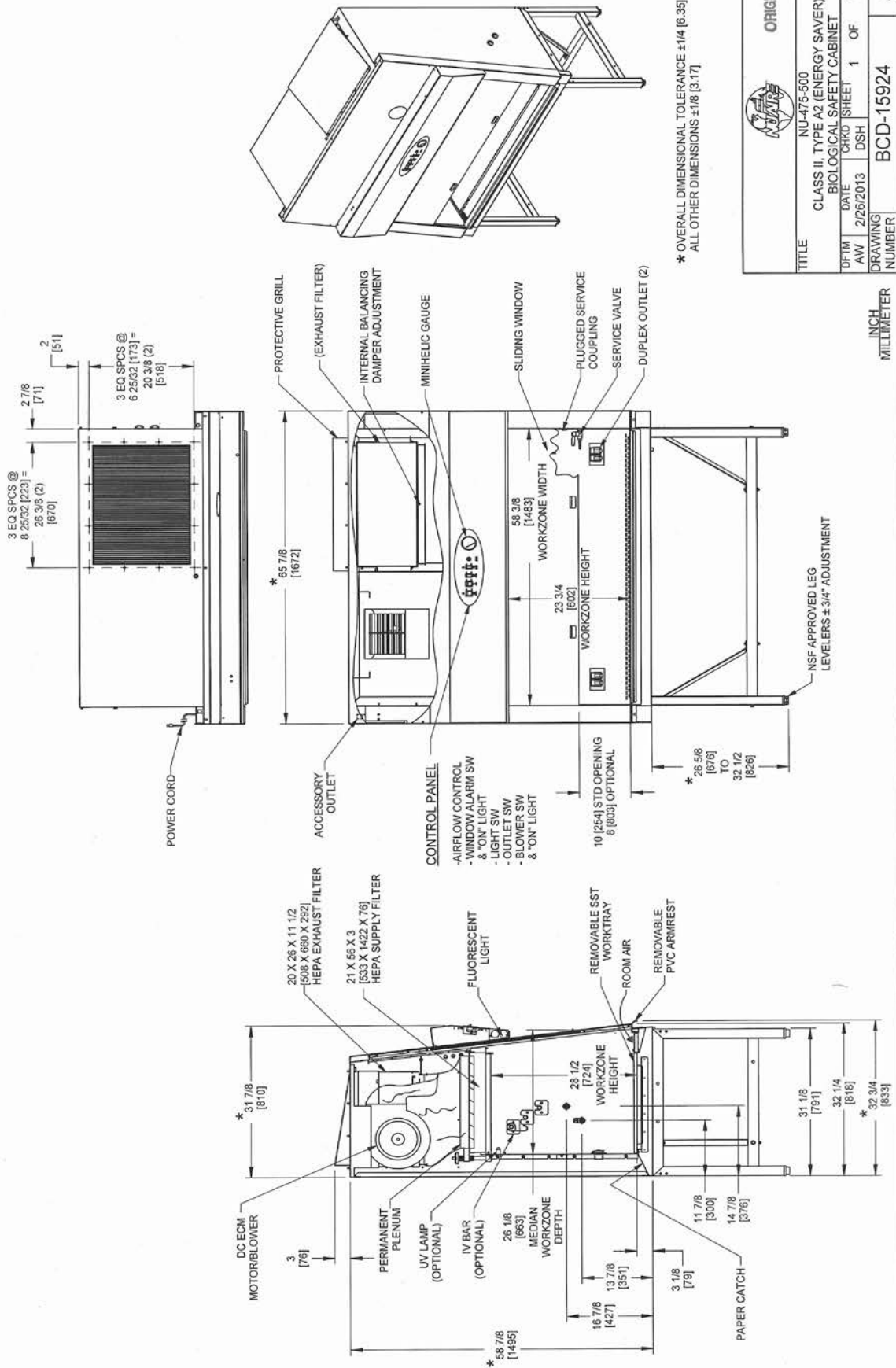


\* OVERALL DIMENSIONAL TOLERANCE  $\pm 1/4$  [6.35]  
ALL OTHER DIMENSIONS  $\pm 1/8$  [3.17]

TITLE		NU-475-400		ORIGINAL	
CLASS II, TYPE A2 (ENERGY SAVER)		DATE		2/25/2013	
BIOLOGICAL SAFETY CABINET		CHKD		DSH	
DFTM		1		OF 1	
DRAWING		NUMBER		BCD-15923	
INCH		MILLIMETER		A	

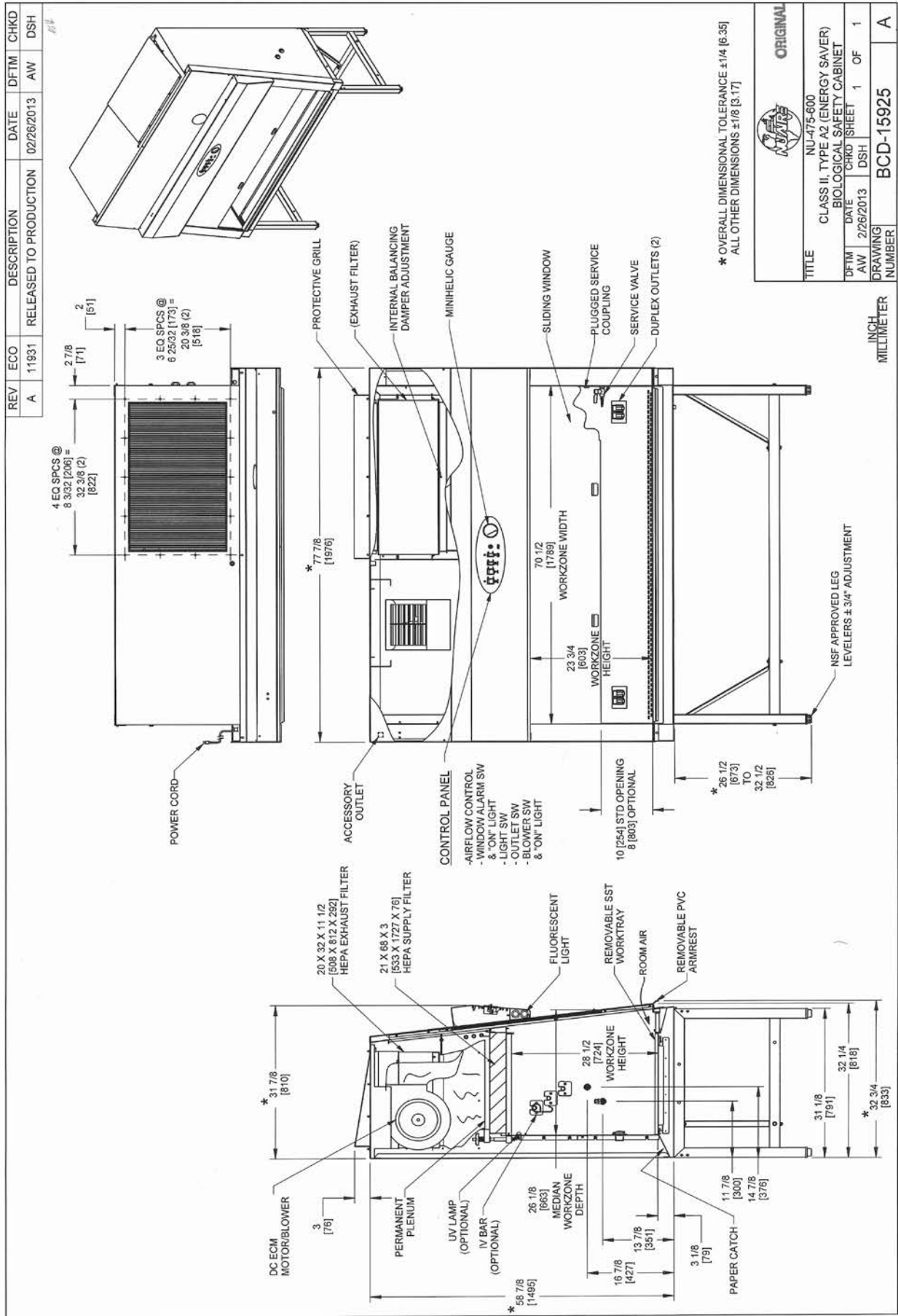
REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
A	11931	RELEASED TO PRODUCTION	02/26/2013	AW	DSH

1/2



\* OVERALL DIMENSIONAL TOLERANCE ±1/4 [6.35]  
ALL OTHER DIMENSIONS ±1/8 [3.17]

ORIGINAL	
TITLE	NU-475-500
CLASS II, TYPE A2 (ENERGY SAVER)	
BIOLOGICAL SAFETY CABINET	
DFTM	DATE
AW	2/26/2013
CHKD	DSH
SHEET 1 OF 1	
DRAWING NUMBER	BCD-15924
INCH	A
MILLIMETER	



### **3.0 Warranty**

NuAire, Inc. warrants Class II, Type A2 w/ECM Motor (CELLGARD ES) 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 including HEPA Filters within 60 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 CELLGARD 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 CELLGARD ES cabinet to be sure that if damage has occurred, the proper claims and actions are taken immediately.

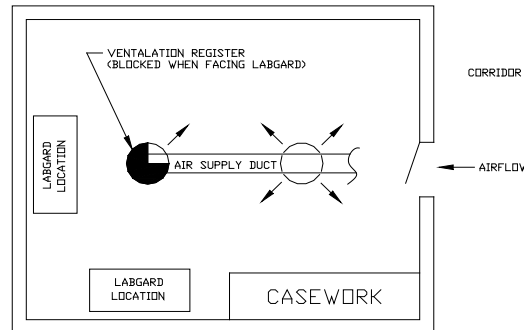
#### **4.1 Damaged Shipments**

- 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 a 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.



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 to 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 a canopy type of exhaust transition, which will capture the exhaust efflux from the cabinet.

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.

### 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.

Remove the plastic cap protecting the drain valve threads and install the drain valve, on the bottom right front of the cabinet using Loctite 242 furnished to the threads and rotate the valve body until it is secure (see BCD-11815).

#### 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  $\pm 3/4"$  (19mm) adjustment.

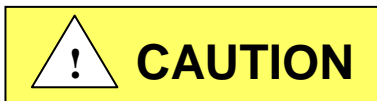
#### 5.2.3 Bench Installation (BCD-11815)

Place the cabinet on the bench with approximately a 2" (51mm) overhang clearance for installation of the drain valve. If the drain valve is not desired, place the cabinet in its desired location and using RTV sealant 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 drain valve is desired, remove the handle from the valve stem 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 sealant as above.

#### 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.**

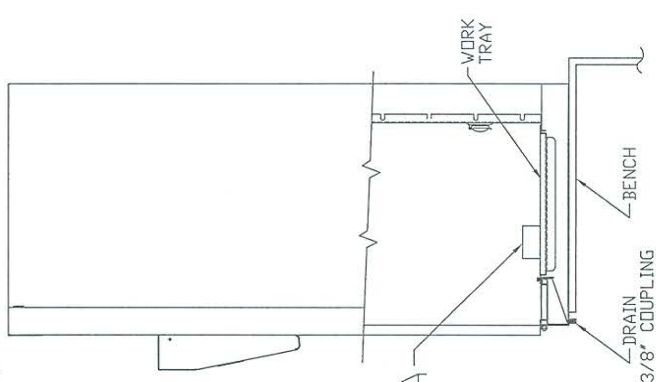
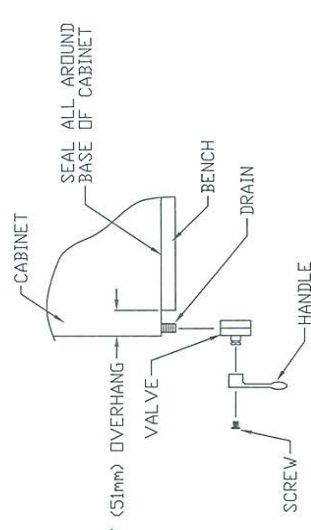
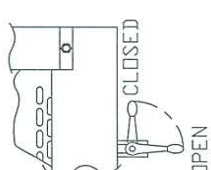



All NuAire BSC's meet the safety requirements of UL and CSA for Laboratory Equipment. To comply with these safety requirements, NuAire uses only certified gas valves. In addition, if external piping is required, only black pipe is used for this application.

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; is 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 flammable gasses or oxygen service. A special needle valve for oxygen service or certified valve 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.

THE NUAIRE BIOLOGICAL SAFETY CABINET HAS A DRAIN PAN BELOW THE WORK TRAY DESIGNED TO SUBSTANTIALLY DRAIN SPILLS THAT ACCIDENTIALLY OCCUR IN THE WORK ZONE. A 3/8" BALL DRAIN VALVE IS LOCATED ON THE FRONT OF THE CABINET FOR CONVENIENCE. THE CABINET BASE MEETS THE NSF OBJECTIVE WITH THE CAPABILITY OF BEING SEALED TO THE BENCH UPON WHICH IT RESTS.						<table><tr><td>REV</td><td>ECO</td><td>DESCRIPTION</td><td>DATE</td><td>DRFT</td><td>CHKD</td></tr><tr><td>C</td><td>11089</td><td>ADDED NU-475/477 MODELS</td><td>12/17/10</td><td>DHH</td><td>DSH</td></tr></table>						REV	ECO	DESCRIPTION	DATE	DRFT	CHKD	C	11089	ADDED NU-475/477 MODELS	12/17/10	DHH	DSH						
REV	ECO	DESCRIPTION	DATE	DRFT	CHKD																								
C	11089	ADDED NU-475/477 MODELS	12/17/10	DHH	DSH																								
<p>FIGURE - 1</p>  <p>1.) PLACE THE CABINET ON A BENCH WITH APPROXIMATELY 2 (51mm) INCHES OVERHANG CLEARANCE FOR INSTALLATION OF DRAIN VALVE.</p> <p>2.) REMOVE CARTON - A AND CONTENTS FROM WORK AREA, AND INSTALL THE DRAIN VALVE AS SHOWN IN FIGURE 2.</p>						<p>FIGURE - 2</p>  <p>3.) REMOVE HANDLE FROM VALVE STEM TO GAIN CLEARANCE FOR VALVE BODY ROTATION. FOR INSTALLATION OF DRAIN VALVE.</p> <p>4.) ADD LOCTITE 242 FURNISHED TO THREADS AND ROTATE VALVE BODY UNTIL SECURE WITH VALVE STEM ON LEFT SIDE AS SHOWN.</p> <p>5.) RE-INSTALL HANDLE TO VALVE STEM.</p> <p>6.) ADJUST THE CABINET ON THE BENCH, WITH A 2" (51mm) OVERHANG AND SEAL INTERFACE WITH BENCH TOP, USING RTV SILICON SEALANT.</p> <p>FIGURE - 3</p> 						<table><tr><td colspan="2"></td><td colspan="2">NU-425/427/430/435/437/440/475/477/480 DRAIN VALVE INSTALLATION</td></tr><tr><td>DFT/VCV</td><td>2/16/07</td><td>CHKD/BP</td><td>SHEET 1 OF 1</td></tr><tr><td colspan="2">DRAWING NUMBER</td><td colspan="2">BCD-11815</td></tr></table>								NU-425/427/430/435/437/440/475/477/480 DRAIN VALVE INSTALLATION		DFT/VCV	2/16/07	CHKD/BP	SHEET 1 OF 1	DRAWING NUMBER		BCD-11815	
		NU-425/427/430/435/437/440/475/477/480 DRAIN VALVE INSTALLATION																											
DFT/VCV	2/16/07	CHKD/BP	SHEET 1 OF 1																										
DRAWING NUMBER		BCD-11815																											



### 5.2.6 Electrical Services

The NU-475 series Biological Safety Cabinets may be "hardwired" (optional) or connected via an electrical power cord which is standard. The unit requires 115 VAC, 60 Hz, single phase (current rating varies per cabinet size, reference Electrical/Environmental Requirements). It is recommended that power to the unit be on its own branch circuit, protected with a circuit breaker or fuse at the distribution panel.

**PLEASE NOTE, THIS UNIT CONTAINS ELECTRONIC BALLASTS FOR THE FLUORESCENT LIGHTING. ELECTRONIC BALLASTS OPERATE WITH HIGH INRUSH CURRENT. IT IS NOT RECOMMENDED TO USE THIS PRODUCT WITH GROUND FAULT CIRCUIT INTERRUPTERS (GFCI'S) BECAUSE THE BALLASTS MAY CAUSE THE GFCI TO TRIP.**

### 5.2.7 Final Assembly

#### **NOTE: REMOVE THE PROTECTIVE CARDBOARD COVER OVER THE EXHAUST HEPA FILTER.**

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 Equipment

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.

1. HEPA filter leak test
2. Downflow velocity test
3. Inflow velocity test
4. Airflow smoke patterns
5. Site installation assessment tests

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 CELLGARD ES 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.

**Cellgard ES Energy Saver**  
**Class II Type, A2**  
**Laminar Flow Biological Safety Cabinet**  
**Models NU-475-300/400/500/600**

Catalog Number	Catalog Number			
	NU-475-300 Nominal 3 foot (0.9m)	NU-475-400 Nominal 4 foot (1.2m)	NU-475-500 Nominal 5 foot (1.5m)	NU-475-600 Nominal 6 foot (1.8m)
Performance Specifications 1. Personal Protection 2. Product Protection	NSF/ANSI 49	NSF/ANSI 49	NSF/ANSI 49	NSF/ANSI 49
NSF/ANSI 49	Class II, Type A2	Class II, Type A2	Class II, Type A2	Class II, Type A2
Style of Cabinet	Bench top/console w/base stand / storage cabinet	Bench top/console w/base stand / storage cabinet	Bench top/console w/base stand / storage cabinet	Bench top/console w/base stand / storage cabinet
Cabinet Construction	All welded stainless steel 16GA, Type 304 pressure tight design	All welded stainless steel 16GA, Type 304 pressure tight design	All welded stainless steel 16GA, Type 304 pressure tight design	All welded stainless steel 16GA, Type 304 pressure tight design
Diffuser for Air Supply (Metal)	Non-flammable	Non-flammable	Non-flammable	Non-flammable
HEPA Filter Seal Type: Supply Filter-99.995% Eff. on 0.3 microns Exhaust Filter-99.995% Eff. on 0.3 microns	HEPEX Seal Neoprene, Spring-loaded	HEPEX Seal Neoprene, Spring-loaded	HEPEX Seal Neoprene, Spring-loaded	HEPEX Seal Neoprene, Spring-loaded
Fumigation : per NIH/NSF Procedures	Yes	Yes	Yes	Yes
Standard Services: Service Coupling (3/8 inch NPT) Gas Valve/Service Coupling (3/8inch NPT) Duplex Outlet	One, Right Sidewall One, Right Sidewall Two, Backwall	One, Right Sidewall One, Right Sidewall Two, Backwall	One, Right Sidewall One, Right Sidewall Two, Backwall	One, Right Sidewall One, Right Sidewall Two, Backwall
Optional Services: Gas Cocks 3/8" NPT Ultraviolet Light Standard/Cup Sinks	Up to 3 ea. Sidewall One, Backwall Left or Right Work Surface	Up to 3 ea. Sidewall One, Backwall Left or Right Work Surface	Up to 3 ea. Sidewall One, Backwall Left or Right Work Surface	Up to 3 ea. Sidewall One, Backwall Left or Right Work Surface
Cabinet Size Inches (mm): Height (Fully Assembled) Height (Minimum for Transport) Width Depth (with Control Center) And Armrest Removed	61 7/8 (1572) 59 (1499) 41 5/8 (1057) 33 (838)	61 7/8 (1572) 59 (1499) 53 5/8 (1362) 33 (838)	61 7/8 (1572) 59 (1499) 65 5/8 (1669) 33 (838)	61 7/8 (1572) 59 (1499) 77 5/8 (1972) 33 (838)
Work Access Opening Inches (mm): Standard Opening Height/Optional Standard Inflow Velocity	8 (203) 105 FPM (.53 m/s)	10 (254) / 8 (203) 105 FPM (.53 m/s)	10 (254) / 8 (203) 105 FPM (.53 m/s)	10 (254) / 8 (203) 105 FPM (.53 m/s)
Work Zone Inches (mm): Height Width Depth measured at 10 inches (254mm) window height	28 1/2 (724) 34 3/8 (873) 26 (660)	28 1/2 (724) 46 3/8 (1178) 26 (660)	28 1/2 (724) 58 3/8 (1483) 26 (660)	28 1/2 (724) 70 3/8 (1788) 26 (660)
Viewing Window Inches (mm): Standard is safety plate sliding glass	Fully closed to 18 (457) open	Fully closed to 18 (457) open	Fully closed to 18 (457) open	Fully closed to 18 (457) open
Required Exhaust CFM/CMH Standard/Optional: Canopy Variable Flow Thimble (NU-911)  Canopy Fixed Flow Thimble (NU-907)	8 (203) opening CFM (CMH) 225-450 (383-765)  269 (457)	10(254) / 8(203) opening CFM (CMH) 363-588 (617-1000) / 295-520 (502-884) 426 (724) / 359 (610)	10(254) / 8(203) opening CFM (CMH) 451-676 (766-1149) / 365-590 (621-1003) 531 (902) / 445 (756)	10(254) / 8(203) opening CFM (CMH) 538-763 (915-1297) / 436-661 (741-1124) 634 (1077) / 532 (904)
Plant Duct Static Pressure Eng./Metric	0.05-0.1"/1.27-2.54mm H2O	0.05-0.1"/1.27-2.54mm H2O	0.05-0.1"/1.27-2.54mm H2O	0.05-0.1"/1.27-2.54mm H2O
Heat Rejected, BTU, Per Hour (non-vented) (vented)	8 (203) opening 826 120	10(254) / 8(203) opening 1140/1020 157	10(254) / 8(203) opening 1768/1611 198	10(254) / 8(203) opening 1884/1768 198
Electrical: Volts, AC 60 Hz +Amps: Blower/Lights (10/8 openings) Amps: Duplex Rated Amps: 12 ft. Power Cord (one)	U.L./U.L.-C Listed 115 2.1 3 10 14 GA - 3 Wire, 15A	U.L./U.L.-C Listed 115 2.9/2.6 12 14 GA - 3 Wire, 15A	U.L./U.L.-C Listed 115 4.5/4.1 3 14"/12 *12/14 GA-3 Wire, 20A Std., 15A Optional	U.L./U.L.-C Listed 115 4.8/4.5 3 14"/12 *12/14 GA-3 Wire, 20A Std., 15A Optional
Crated Shipping Weight:*** Net Weight	475 lbs. /215 kg. 425 lbs. /193 kg.	550 lbs. /249 kg. 500 lbs. /227 kg.	650 lbs. /295 kg. 600 lbs. /273 kg.	730 lbs. /331 kg. 680 lbs. /308 kg.

\*15A Configuration does not include accessory outlet.

\*\*\*Crated shipping weight does not include weight for accessories or options

+ Based on cabinet with new filters running at 115VAC.

## **6.0 Operating the NU-475**

### **6.1 Operator Controls & Indicators**

The following is a description of the controls and indicators found on both the front panel (See Drawing BCD-11816) and cabinet.

#### **6.1.1 Circuit Breaker-Blower (Top of Control Center)**

The motor/blower is protected with a circuit breaker.

The circuit breaker in conjunction with the motor's thermal protector is designed to open under locked rotor or half-wave power conditions.

Should the circuit breaker open (pop-out button will appear) merely depress to reset.

If the circuit breaker continually opens, a failure has occurred in the motor or solid-state speed controller.

Consult a qualified repair technician or NuAire, Inc. for replacement.

#### **6.1.2 Circuit Breaker-Outlets (Top of Control Center)**

The duplex outlet located in the sidewall of the work area is protected with a 3 amp circuit breaker.

The circuit breaker may trip at 110% of load rating but will trip at 145% of load rating in less than 2 seconds.

Should the circuit breaker open, (pop-out button will appear), unplug the appliance plugged into the outlet and merely depress the pop-out button to reset.

#### **6.1.3 Fluorescent/U.V. Light Switch**

This switch provides on/off control for the fluorescent light and/or the ultraviolet (U.V.) light if present (optional). With the U.V. light option, the switch provides for on-center off-on operation so that both the fluorescent light and the U.V. light cannot be energized at the same time.

The UV light is also interlocked, so it will only operate if the sliding window is closed.

Proper care should be exercised when the U.V. light is on.

#### **6.1.4 Outlet Switch**

This switch provides on/off control for the 115 VAC power available in the outlet(s) within the cabinet workzone.

#### **6.1.5 Blower Switch**

The blower switch applies power to the internal motor/blower when in the ON position.

The blower switch also has a second set of poles, which are available for use as a contact closure for an exhaust system.

In addition, power can be applied to the accessory outlet located on the upper left corner of the cabinet, behind the front window assembly.

The purpose of the outlet is to provide "switched" power for the following:

- 1) Exhaust transition with integral blower
- 2) To power a low power appliance, such as the low airflow alarm.

The rating of the outlet is 115 VAC at 2 amp maximum.

#### **6.1.6 Indicator Light**

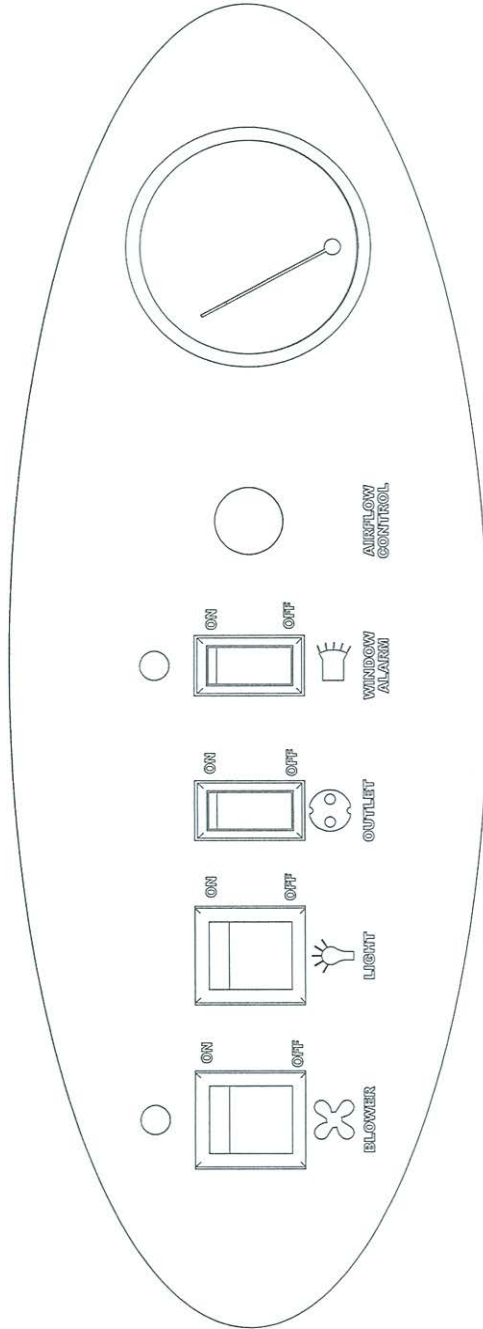
An indicator light is located above the Blower on/off switch and indicates when power is applied to the blower.

#### **6.1.7 Audible Alarm Enable**

As the sliding window is raised above its normal working height, a micro switch located in the glide channel activates both an audible and visual alarm.

This switch disables the audible alarm but will not disable the red indicator visual alarm.

REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
B	11089	ADDED 475 TO TITLE	12/17/2010	DHH	DSH



			
TITLE			
FRONT PANEL			
NU-425/475			
DFTM	DATE	CHKD	SHEET
CV	2/16/2007	BP	1 OF 1
DRAWING NUMBER			BCD-11816
			B

### 6.1.8 Airflow Calibration Potentiometer

The operating airflows within the cabinet (i.e. 60 LFPM (.30 m/s) downflow and 105 LFPM (.53 m/s) air inflow barrier) are controlled by the DC motor speed control and an exhaust damper. The DC motor speed control controls the ECM motor by providing a Pulsed Width Modulation (PWM) signal of 2.5 to 8.0 Vdc that is sent to the ECM motor. The ECM motor also sends back a Revolution Per Minute (RPM) signal to the DC motor speed control. The RPM signal is monitored for changes in comparison to a reference stored motor loading curve of RPM versus PWM and adjusts as needed to maintain a constant volume of air.

The airflow calibration potentiometer provides a means of adjusting the stored curve starting point, if necessary, at any point of the filter loading process. The airflow calibration potentiometer was manufactured in (2) versions. The first version, once adjusted with a small screwdriver, causes the speed control to go into calibration mode. The second version provides more feedback to the Service Technician in that there is a calibration mode push button next to the potentiometer that when pushed activates the calibration mode. There is also an LED to indicate you are in calibration mode. In either case, it will then remain in calibration mode until no potentiometer adjustment is made for 1 minute or the LED indicator is off. At that point the current RPM and PWM values will be stored as the starting point and the calibration mode will be exited.

**THIS ADJUSTMENT SHOULD ONLY BE MADE BY A QUALIFIED TECHNICIAN EMPLOYING THE PROPER INSTRUMENTS IN ORDER TO INSURE AIRFLOWS PER NSF/ANSI 49.**

### 6.1.9 Minihelic Gauge

The unit is equipped with a minihelic gauge. The minihelic gauge displays the static pressure within the pressure plenum supplying the downflow and exhaust filters. The gauge is calibrated in "inches of water gauge" pressure. As the HEPA filters load with particulate matter, the amount of static pressure will increase, giving an indication of the "health" of the cabinet. The initial pressure reading will be approximately .3" w.g.  $\pm$  .2" w.g. depending on altitude from sea level. At each 0.1" w.g. increment increase, the cabinet airflow should be checked by a qualified technician, unless certified on a yearly (or sooner) basis.

### 6.1.10 Sliding Window Operation

The cabinet has a full counter balanced and removable sliding tempered glass window with two operational features. As the window is raised above its specified operating height, an audible alarm alerts the operator of possible compromised personnel protection. At the same time, an audible and visual alarm is activated. The audible alarm may be switched off while the visual alarm remains until lowered to the safe operating position. When the window is lowered below 2 inches (50mm), the motor/blower automatically shuts down, to prevent stress on the motor/blower in the form of overheating. The maximum window height is 19 1/2 inches (495mm).

### 6.1.11 Convenience/Accessory Outlet

A convenience/accessory outlet is located in the upper left hand corner in back of the window assembly. The outlet is normally wired "hot" through the motor/blower circuit breaker. If an accessory is purchased, the outlet is defined as an accessory outlet supplying 115 VAC at 2.0 Amp maximum, and is wired to the blower switch (see electrical schematic).

## 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:

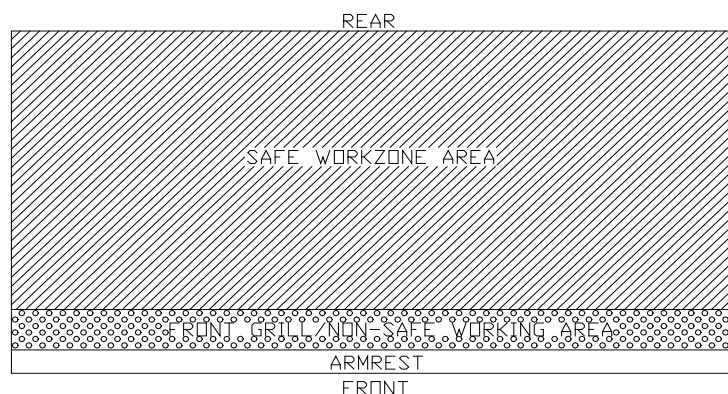
- a. Know your "safe working area"
- b. Minimize disruption of "air curtain"
- c. Minimize room activity
- d. Utilize unidirectional airflow
- e. Employ aseptic techniques

### 6.2.1 Know Your "Safe Working Area"

The LFBSC safe working area is basically the worktray or depressed area.

All work should be performed on or above the worktray.

The area on or above the front grill is a non-safe working area.



### 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 raising 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 workspace should next be disinfected (see cleaning procedures) 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.

<http://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. The decontamination of the interior surfaces 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; 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:

- a. Proper user posture
- b. Effective workzone layout for work practice
- c. Vision or sightlines

For each of the above evaluation criterion, several 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/armrest support –  
The cabinet is provided with a forearm support on the work access opening. Periodic mini-breaks during work practice should be taken resting forearm to avoid stress and fatigue.
- 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 effect 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 audible alarm silence or cleaning key on the front control panel to silence the audible alarm during the cleaning process.
- c. Apply appropriate disinfecting solution 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.**

**CAUTION: 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

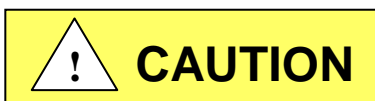
This procedure is intended to provide guidance following a spillage and/or periodic maintenance, testing or relocation of the cabinet. Additional guidance can be provided by the CETA document CAG-005-2007 found at the CETA website: [www.CETAinternational.org](http://www.CETAinternational.org).

### 6.6.1 Preparation

Prior to beginning decontamination activity, personnel should wear proper personnel protection equipment (PPE) i.e. Tyvek<sup>1</sup> 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*<sup>2</sup>.

### 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 the supply HEPA filter and place on the cabinet work tray



**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 plenums 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.

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

<sup>2</sup>American Society of Hospital Pharmacists. 1990.

ASHP Guidelines on Handling Cytotoxic and Hazardous Drugs *Am. J. Hosp. Pharm.* 47:1033-49

## 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 certification as well as repair.

### 7.1 Decontamination

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



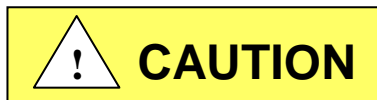
**Hazardous Gases! Personal Protection Equipment Required.**

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



This procedure presents considerable risks and must be performed only by specially trained and authorized service personnel in accordance with applicable safety regulations.

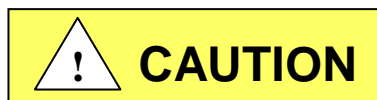
The formaldehyde is vaporized within the tightly sealed sample chamber. The quantity of the applied formaldehyde depends on the volume of the sample chamber in the safety cabinet that is to be disinfected. The formaldehyde evaporates immediately after reaching its boiling point; the minimum reaction 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. Remove screws at each upper side of the control center and allow the control center to rotate down, resting on the safety straps.  
Remove control center by disconnecting safety straps and moving control center to the left off the slip hinges.
2. Remove the front decorative panel via top/front fasteners.
3. Remove left and right window farings via fasteners.
4. Remove armrest via fasteners.
5. Place decontamination equipment inside the work area.  
Reference decontamination procedure, per NSF Standard 49, Annex G, using the following chart to calculate chemical requirements.

Cabinet Size	300	400	500	600
<b>Cabinet Dimensions</b>	58-7/8 x 28 x 34-3/8 in. (1.50 x .711 x .873 m)	58-7/8 x 28 x 46-3/8 (1.50 x .711 x 1.18 m)	58-7/8 x 28 x 58-3/8 (1.50 x .711 x 1.48m)	58-7/8 x 28 x 70-3/8 (1.50 x .739 x 1.88 m)
<b>Cabinet Volume</b>	32.79 cu. ft. (.929 cu. m)	44.24 cu. ft. (1.25 cu. m)	55.69 cu. ft. (1.58 cu. m)	67.14 cu. ft. (1.90 cu. m)

 **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 or run the decontamination power cords under the front seal area.

6. Use duct tape and plastic to seal the front and exhaust area.



**BE SURE CABINET IS TOTALLY SEALED TO PREVENT ANY LABORATORY EXPOSURE TO DECONTAMINATION GAS.**

7. Perform decontamination procedure per NSF Standard 49, Annex G.

If the cabinet has been used to prepare hazardous drugs, (chemotherapy), or other toxic chemicals, decontamination of the cabinet *cannot* be accomplished by the above procedure. (See section 6.6 for guidelines)

Please consult with NuAire, Inc. about any unique contamination problems.

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.

## 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.

1. Switch Cabinet Light Switch off.
2. Remove the screws at each upper side of the Control Center and allow the Control Center to rotate down, resting on the safety straps.
3. The bulb is now directly exposed for replacement.
4. The bulb is removed by displacing the bulb to one side against the compressible bulb holder and lifting out the bulb.
5. 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 100 LFPM (.51 m/s) (min.). This may permit the average downflow velocity to be as low as 55 LFPM (.28 m/s) as long as no point falls below 20% or +/-16fpm of the average downflow velocity, whichever is greater.

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)



**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 (6) knurled screws on the front.

**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.



**NOTE: 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 (i.e. greater than 110 LFPM) (.56 m/s), 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. Unscrew the 3 hand knobs (about 3 turns away from the filter) located behind the supply HEPA filter. This will relieve the pressure to the rear of the plenum.
  2. Relax the 4 plenum screws in front of the supply HEPA filter.
  3. Left 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 all waste containers/cartons based on the type of hazard.**

- 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.**

Description:	Supply HEPA Filter	Exhaust HEPA Filter
Efficiency:	99.99% @ 0.3 Micron	99.99% @ 0.3 Micron
Airflow Rating:	100 fpm @ .48 ± .05" w.g. per sq. ft.	250 fpm @ .48 ± .05" w.g. per sq. ft.
Frame Type:	Metal	Metal

##### NU-475-300

NuAire Part Number:	A-980962-01	A-980962-05
Filter Size:	21" (533mm) x 32" (813mm) x 3" (76mm)	20" (508mm) x 14" (366mm) x 11 1/2" (292mm)
Filter Manufacturer:	Camfil Farr	Camfil Farr

##### NU-475-400

NuAire Part Number:	A-980957-06	A-980957-09
Filter Size:	21" (533mm) x 44" (1118mm) x 3" (76mm)	20" (508mm) x 20" (508mm) x 11 1/2" (292mm)
Filter Manufacturer:	Camfil Farr	Camfil Farr

##### NU-475-500

NuAire Part Number:	A-980957-07	A-980957-10
Filter Size:	21" (533mm) x 56" (1422mm) x 3" (76mm)	20" (508mm) x 26" (660mm) x 11 1/2" (292mm)
Filter Manufacturer:	Camfil Farr	Camfil Farr

##### NU-475-600

NuAire Part Number:	A-980957-08	A-980957-11
Filter Size:	21" (533mm) x 68" (1727mm) x 3" (76mm)	20" (508mm) x 32" (813mm) x 11 1/2" (292mm)
Filter Manufacturer:	Camfil Farr	Camfil Farr

- 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



**Note:** Removal and replacement of the motor/blower may best be performed with the supply HEPA filter/HEPEX removed to reduce the chance of damage to the fragile HEPA filter media.  
Perform step 3.a. and place the supply in a secure location where it will not get damaged.

- 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 unbolt 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 and perform step 4 "Filter Installation" if the supply HEPA Filter was removed.

## 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 right window glide is stationary since it contains the micro switches that monitor window height.

The left window glide is adjustable by a set screw and tension screw method (see Drawing BCD-15926).

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.

## 7.5 Airflow Calibration

The NU-475 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 adjustment 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.

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

- a. Downflow average: 60 LFPM  $\pm$  5 LFPM (.30 m/s  $\pm$  .025 m/s).
- b. Inflow average: 105 LFPM  $\pm$  5 LFPM (.53 m/s  $\pm$  .025 m/s)  
using the direct inflow measurement method or  
constricted 3 inch (76mm) high access opening measurement method.  
Both values are published in the NSF or NuAire listing.

**BEFORE STARTING AIRFLOW CALIBRATION PROCEDURE, LET THE CABINET RUN FOR AT LEAST 10 MINUTES.**

### 7.5.1 Downflow Calibration

**Step 1:** Place a velometer in the cabinet workzone on the horizontal plane 4 inches (102mm) above the bottom edge of the viewing window.

Spot check several points on the recommended downflow velocity test grid found in Table 7.0.

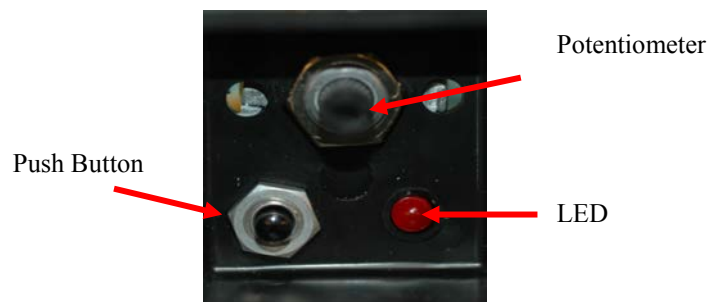
**Step 2:** If necessary, adjust airflow calibration potentiometer, located under the removable cap plug on front panel, to achieve the above stated airflow requirements.



**Note:** The airflow calibration potentiometer was manufactured in (2) versions.

The first version, once adjusted with a small screwdriver, causes the speed control to go into calibration mode. The second version (see photo below) provides more feedback to the Service Technician in that there is a calibration mode push button next to the potentiometer that when pushed activates the calibration mode. There is also an LED to indicate you are in calibration mode. In either case, it will then remain in calibration mode until no potentiometer adjustment is made for 1 minute or the LED indicator is off. At that point, the current RPM and PWM signal values will be stored as the starting point and the calibration mode will be exited. The calibration mode can be accessed as needed to achieve the stated airflow requirements. Be sure to allow cabinet to run 1 minute before any blower on/off action is taken.


**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  $105 \pm 5$  LFPM ( $.53 \pm .025$  m/s)
- Less than 100 LFPM (.51 m/s)  
First, open the choke plate or make sure it is open.  
If this is insufficient, then increase the motor speed control
- Greater than 110 LFPM (.56 m/s);  
First, adjust the motor speed control to achieve  $\frac{1}{2}$  the exhaust excess, and 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).

 **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.

**Step 3:** Perform the airflow or pressure alarm test (when installed) as part of the Site Installation Assessment Test in section 7.8.

 **Note:** The minihelic gauge should be periodically checked for its zero reading.  
If the zero reading has drifted, re-zeroing is accomplished by unscrewing the front cover counterclockwise using a small sheet of rubber between the cover and the palm of the hand.  
Once the cover is removed, the zero-adjust screw is located behind the scale at the pair marked "zero".  
Use the hex Allen wrench provided (located in control center) and adjust until pointer is on zero.  
This must be done with the cabinet blower off and the control panel in its normal position.  
Once adjusted, replace cover.



## 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 workzone over the intake slots. The upstream challenge port being common for both filters is 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).

<u>Model Size</u>	<u>*Supply Area (ft<sup>2</sup>)(m<sup>2</sup>)</u>	<u>Exhaust Area (ft<sup>2</sup>)(m<sup>2</sup>)</u>
300	6.33 (.588)	1.61 (.150)
400	8.53 (.792)	2.38 (.221)
500	10.74 (.998)	3.15 (.293)
600	12.95 (1.203)	3.92 (.364)

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

### Laskin Nozzle Concentration Formula

# Nozzles x 135 CFM x 100 ug/L  
Downflow (CFM) + Exhaust (CFM) = Challenge  
Concentration (ug/L)

# Nozzles x 229 CMH x 100 ug/L  
Downflow (CMH) + Exhaust (CMH) = Challenge  
Concentration (ug/L)

## 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 workzone 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 refluxes out of the cabinet once drawn in, nor does smoke billow over the worksurface or penetrate onto it.
4. No smoke shall escape from the cabinet.

## 7.8 Site Installation Assessment Tests

These tests are performed to verify the sash position, airflow or pressure setpoint where an audible and/or visual alarm will activate to signify unfavorable operating conditions within the biological safety cabinet and/or the remote exhaust blower, and canopy connection performance.

### 7.8.1 Sash Alarm

- Step 1: With sash alarm switch enabled, raise the sliding sash 1" (2.5cm) above the manufacturer's designated sash height for normal operation. Verify that the audible/visual alarm activates/sounds.
- Step 2: Return the sash to its normal operating height.

### 7.8.2 Airflow or Pressure Alarm (when installed)

- Step 1: Measure and record the speed control operating voltage at the speed control test points using a voltmeter.
- Step 2: Using the primary or secondary inflow test method, lower the speed control voltage to reduce the inflow by 20% from the certified testing value.
- Step 3: Verify that the alarm activates when the inflow is dropped to this point.
- Step 4: Adjust alarm setpoint as necessary as instructed by the alarm manufacturer procedures.
- Step 5: Return the speed control to its certified operating voltage as measured by the voltmeter.


### 7.8.3 Exhaust System Performance

This test is broken up into two groups based on the external venting configuration of the exhaust connection. Canopy, Thimble or Air Gap Exhaust Transitions

- Step 1: Using a visible smoke source, verify negative pressure at the gap. No smoke shall escape into the room from the canopy once it enters the exhaust system.
- Step 2: Measure the duct static pressure between the air gap and any duct-mounted balancing dampers. The gap should be adjusted to under a slight negative pressure (approx. -0.02 to -0.04"W.C. (-5 to -10 Pa)) in relation to outside air.

Gas-Tight Exhaust Transition

- Step 1: Measure the duct static pressure between the exhaust HEPA filter and any duct-mounted balancing dampers. The transition should be adjusted to be under a slight negative pressure (approx. -0.02 to -0.04"W.C. (-5 to -10 Pa)) in relation to outside air.

 **NOTE:** Positive pressure ductwork conditions are strongly discouraged. Positive pressure ductwork conditions should be reviewed and evaluated by a cognizant Safety Officer of Industrial Hygienist as part of their Laboratory Ventilation Management Program and Chemical Hygiene Plan.

## 7.9 Cleanliness Classification Test for Pharmacy Application

If this cabinet is going to be used within pharmacy, per USP797<sup>1</sup>, the cabinet must be tested to assure compliance to ISO 14644-1:1999, Cleanrooms and Associated Controlled Environments, Part 1: Classification of Air Cleanliness<sup>2</sup>.

The cleanliness classification test is performed using a particle counter to measure particle counts within the cabinet workzone. 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”<sup>3</sup>**

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 worksurface. The grid location is designed as the workzone 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)).

<sup>1</sup> USP28-NF23: United States Pharmacopeial Convention, Inc., 12601 Twinbrook Parkway, Rockville, MD 20852, USA, [www.usp.org](http://www.usp.org).

<sup>2</sup> 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

<sup>3</sup> CAG-002-2006: CETA Compounding Isolator Testing Guide, Controlled Environment Testing Association, 1500 Sunday Drive, Suite 102, Raleigh, NC 27607, USA, [www.cetainternational.org](http://www.cetainternational.org)

**Table 7.0**  
**Recommended Measurement Methods for Cabinet Downflow & Inflow**

**A. Downflow Measurement**

- a. Recommended Instruments: TSI 8355 Thermo anemometer
- b. Procedure:  
 Supply filter efflux is measured on a grid, in a horizontal plane 4 inches (102mm) above the bottom edge of the window. No reading should be taken closer than 6 inches (152mm) from the inside perimeter.
- c. Test Data - Inches (mm):

(Access Opening)

8"	10"											
300	300	6 (152)	11.594 (295)	17.188 (437)	22.782 (597)	28.375 (721)						
400	400	6 (152)	11.729 (298)	17.458 (443)	23.187 (589)	28.916 (735)	34.645 (880)	40.375 (1026)				
500	500	6 (152)	11.797 (300)	17.594 (447)	23.391 (594)	29.188 (741)	34.985 (889)	40.782 (1036)	46.579 (1183)	52.375 (1330)		
600	600	6 (152)	11.838 (301)	17.676 (449)	23.514 (597)	29.352 (746)	35.190 (894)	41.028 (1042)	46.866 (1190)	52.704 (1339)	58.542 (1487)	64.375 (1635)
6 (152)	6 (152)											
10.540 (268)	10.460 (266)											
15.080 (393)	14.920 (379)											
19.620 (498)	19.380 (492)											

Number of Readings:	Average Velocity	ft./min.(m/s)
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- d. Acceptance Criteria:
  1. Average downflow velocity = **55 to 65 fpm (.28 to .33 m/s)**
  2. Individual readings must be within  $\pm 20\%$  or  $\pm 16\text{fpm}$  ( $\pm 0.08\text{m/s}$ ) whichever is greater(factory test)  
 or  $\pm 25\%$  or  $\pm 16\text{fpm}$  ( $\pm 0.08\text{m/s}$ ) whichever is greater (field test) from the average downflow velocity.

**B. Inflow Measurement**

- a. Recommended Instrument: Shortridge Flowhood ADM-870 or TSI 8355 Thermo anemometer.
- b. Primary Procedure:  
 The primary procedure to determine inflow velocity uses 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 if operated in the local density default mode.  
 NSF has tested the cabinet and established listed air velocities expressed in local density.  
 The DIM Instrument should be equipped with a flowhood that is as close as possible to the width of the cabinet (i.e. NU-475-400 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.

**Alternate Procedure:**

The alternative procedure to determine inflow velocity uses a thermo anemometer in a constricted window access opening of 3 inches (76mm) with the armrest removed. Inflow air velocity is measured in the center of the constricted opening 1-1/2 inches (38mm) below the top of the work access opening on the following specified grid. Use the correction factor table to calculate the inflow velocity.

## c. Test Data - Inches (mm):

## 1. Dim Measurement

Inflow Volume ft. <sup>3</sup> /min.(m <sup>3</sup> /s)	Access Opening ft. <sup>2</sup> (m <sup>2</sup> )	Inflow Velocity fpm(mps)
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## 2. Constricted 3 inch (76mm) high access opening measurement - Inches (mm):

300	4 (102)	8.396 (213)	12.792 (325)	17.188 (437)	21.584 (548)	25.980 (660)	30.375 (771)										
400	4 (102)	8.264 (210)	12.528 (318)	16.792 (426)	21.056 (535)	25.320 (643)	29.584 (751)	33.848 (860)	38.112 (968)	42.375 (1076)							
500	4 (102)	8.198 (208)	12.396 (315)	16.594 (421)	20.792 (528)	24.990 (635)	29.188 (741)	33.386 (848)	37.584 (955)	41.782 (1061)	45.980 (1168)	50.178 (1274)	54.375 (1381)				
600	4 (102)	8.158 (207)	12.316 (313)	16.474 (418)	20.632 (524)	24.790 (630)	28.948 (735)	33.106 (841)	37.264 (946)	41.422 (1052)	45.580 (1158)	49.738 (1263)	53.896 (1369)	58.054 (1475)	62.212 (1580)	66.375 (1686)	

Number of Readings:	Average Velocity of Constricted Area fpm(mps)
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Average Velocity of Constricted Area	fpm(mps) X Constricted Area	ft <sup>2</sup> (m <sup>2</sup> ) = Constricted Area Volume	CFM(m <sup>3</sup> /s)
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Constricted Area Volume	CFM(m <sup>3</sup> /s) ÷ 8" or 10" Access Window Area	ft <sup>2</sup> (m <sup>2</sup> ) = Average Velocity of 8" or 10" Access Window Area	fpm(mps)
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Average Velocity of 8" or 10" Access Window Area	fpm(mps) X Correction Factor	=Average Inflow Velocity	fpm(mps)
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## d. Acceptance Criteria:

## 1. Access Opening Inflow Velocity = 100 to 110 fpm (.51 to .56 m/s)

## Areas/Correction Factors for Calculations

Cabinet Size	3" (76mm) Constricted Window Access Area	8" (203mm) Window Access Opening	10" (254mm) Window Access Opening	Correction Factor for 8" (203mm) Window	Correction Factor for 10" (254mm) Window
300	.72 (.067)	1.91 (.177)	-	1.22	-
400	.97 (.090)	2.58 (.240)	3.22 (.299)	1.22	1.21
500	1.22 (.113)	3.24 (.301)	4.05 (.376)	1.22	1.20
600	1.47 (.137)	3.91 (.363)	4.89 (.454)	1.18	1.15

## 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.

### Error Indicator Troubleshooting Guide

<u>Error Indicator</u>	<u>Indicator</u>	<u>Correction</u>
Window alarm	Sliding window is above its standard working height or micro switch is not operating properly.	Verify standard working height and window micro switch operation.
Cabinet fluorescent lights won't turn on.		Check blower/light circuit breaker on top of control center. Check fluorescent lamps. Check voltage to light ballasts. Check ballast. Check light switch.
Cabinet blower won't turn on.		Check sliding window for correct operational height. Check blower/light circuit breaker on top of control center. Check AC voltage to blower. Check DC motor speed control PWM DC voltage. Check wiring to blower. Check sliding window blower cutoff micro switch.
Cabinet blower runs at a high level.		Check DC motor speed control PWM DC voltage. RPM signal from ECM motor at issue.
Cabinet outlets won't turn on.		Check outlet circuit breaker on top of control center. Check voltage to outlets.
Cabinet ultraviolet light won't turn on.		Check blower/light circuit breaker on top of control center. Check ultraviolet lamp. Check voltage to ultraviolet ballasts. Check ballast. Check light switch.
Blower/lights circuit breaker continues to trip after reset.		Check for short on output of circuit breaker. Replace circuit breaker. Isolate output of circuit breaker by: disconnecting control center connectors, light circuit, motor voltage regulator, etc. to isolate the short.
Minihelic gauge	Minihelic gauge reads "NO" or "LOW FLOW"	Check minihelic gauge operation. Check for pinched tubing in control center. Make sure airflow is not too low.

## 9.0 Remote Contacts

### 9.1 Exhaust System Contacts

The exhaust system contacts are single pole normally open contact closure outputs which are activated whenever the blower switch is turned on.

The contact points are located on the blower switch.

Contact ratings are 250 VAC maximum at 2 Amps.

## 10.0 Optional Equipment

### 10.1 Ultraviolet Light



**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 square centimeter (for a new tube) falling on a horizontal plane defined by the center 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 light is accomplished by closing the sliding window and pressing the UV switch location on the front panel. The sliding window is interlocked to the ultraviolet light so, when the sliding window is raised, the ultraviolet light will turn off.

#### 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 light deteriorates with burning age. The useful life of the light 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 be established or the tube's output be measured periodically and the tube replaced when its output falls below 40 microwatts per square centimeter or exceeds 7000 hours of operation. Lights should be allowed to operate approximately 5 to 10 minutes (longer when the light is in low temperatures) to warm up sufficiently before reading the output with a meter.

### Energies Required to Destroy Some Microorganisms By Ultraviolet Radiations(e)

<b>Mold Spores</b>	<b>Microwatt seconds per cm/2</b>	<b>Protozoa</b>	<b>Microwatt seconds per cm/2</b>
Penicillium roqueforti	26,400	Paramecium	200,000(a)
Penicillium expansum	22,000		
Penicillium digitatum	88,000	<b>Nematode Eggs</b>	40,000(b)
Aspergillus glaucus	88,000		
Aspergillus flavus	99,000	<b>Algae</b>	22,000(c)
Aspergillus niger	330,000		
Rhizopus nigricans	220,000	<b>Virus</b>	
Mucor racemosus A	35,200	Bacteriophage (E. Coli)	6,600
Mucor racemosus B	35,200	Tobacco Mosaic	440,000
Oospora lactis	11,000	Influenza	3,400(d)
<b>Yeasts</b>			
Saccharomyces	13,200		
Ellipsoideus	17,600		
Saccharomyces cerevisiae	13,200		
Brewers' yeast	6,600		
Baker's yeast	8,800		
Common yeast cake	13,200		
<b>Bacteria</b>			
Streptococcus lactis	8,800		
Strep. hemolyticus (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:

- (a) Luckiesh, Matthew (1946) Application of Germicidal, Ethymal and Infrared Energy, D. Van Nostrand o., New York, New York, pp 253
- (b) Hollaender (1942) Aerobiology, A.A.A.S. (for 90% inactivation), pp 162
- (c) Ellis, C. and Wells, O.O. (1941) The Chemical Action of Ultraviolet Rays, Reinhold Publishing Corp., pp. 713-714
- (d) Hollaender, A., Oliphant, J.W. (1944) The inactivation effect of monochromatic ultraviolet. Radiation on Influenza Virus (for 90% inactivation) Jour. of Bact. 48, pp. 447-454
- (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-475-300	115V,	60Hz,	1 Phase,	12 Amps
*NU-475-400	115V,	60Hz,	1 Phase,	12 Amps
*NU-475-500	115V,	60Hz,	1 Phase,	14 Amps
*NU-475-600	115V,	60Hz,	1 Phase,	14 Amps

\*UL/UL-C Listed

### 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.

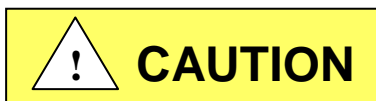
## 12.0 Disposal and Recycle

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.



BIOHAZARD



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



RECYCLE


LEAD FREE

### **Component**

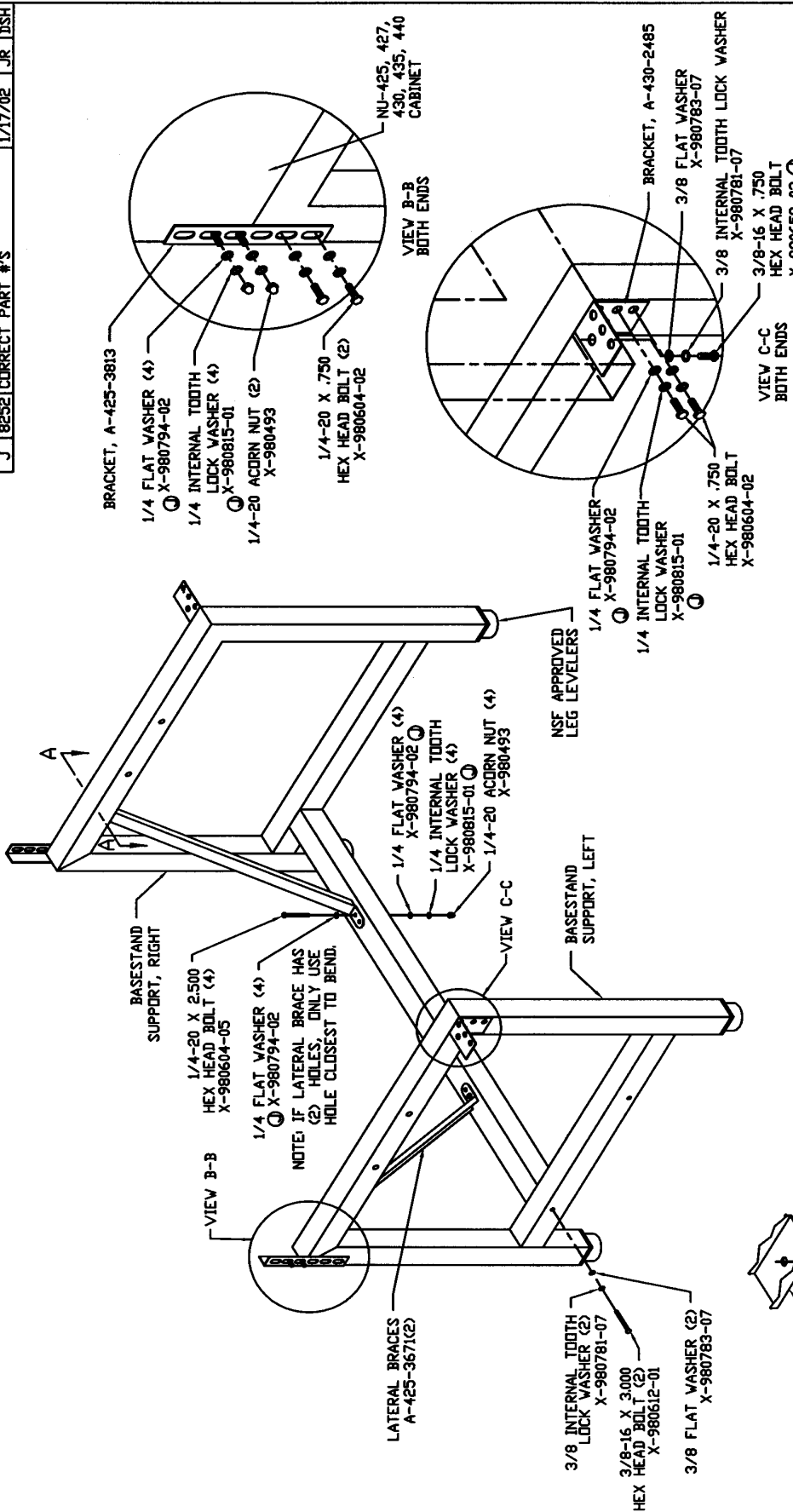
Base Cabinet  
Front Grill  
Worksurface  
Window Faring  
Window Glides  
Window  
Window Frame  
Front Service Panel  
Front Decorative Panel  
Control Center  
Supply Diffuser  
Exhaust Filter  
HEPA Filter Frames  
Hepex Bag  
Blower Wheel & Housing  
Motor  
Printed Wiring Assembly  
Wire  
Ballasts  
Armrest  
Connectors  
Hardware

### **Material**

Stainless Steel  
Stainless Steel  
Stainless Steel  
Stainless Steel  
HDPE  
Safety Glass  
Stainless Steel  
Painted Steel  
Painted Steel  
Painted Steel  
Aluminum  
Aluminum  
Painted Steel  
PVC  
Steel  
Various Steel/Copper  
Lead Free Electronic  
PVC Coated Copper  
Various Steel, Electronic  
PVC  
Nylon  
Stainless Steel and Steel

 **Note:** Material type can be verified with use of a magnet with stainless and aluminum being non-magnetic.

REV	ECD	DESCRIPTION	DATE	BY	CHKD
J	18252	CORRECT PART #'S	1/17/02	JR	DSH



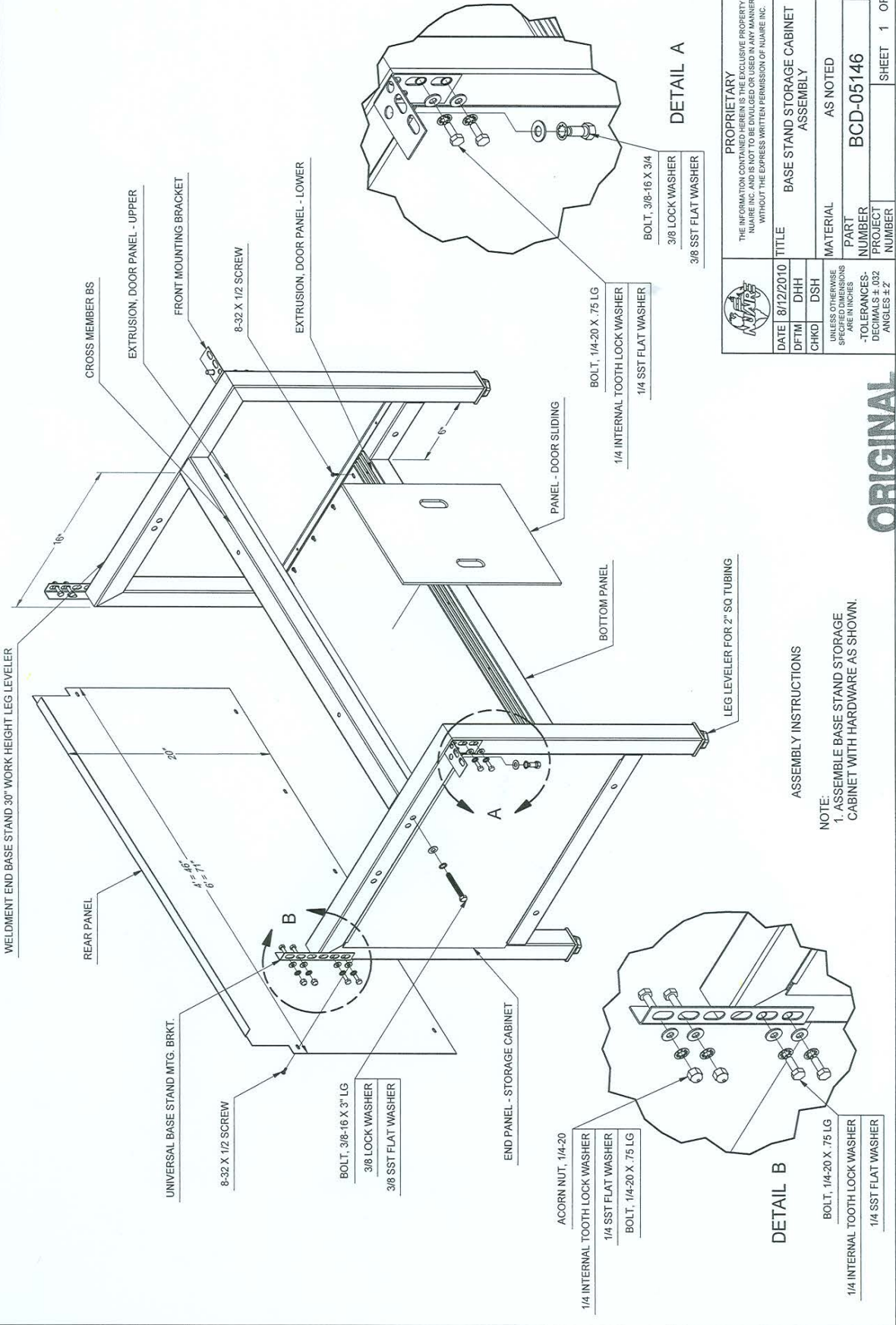
		PROPRIETARY THE INFORMATION CONTAINED HEREIN IS THE EXCLUSIVE PROPERTY OF HANSON INC. AND IS NOT TO BE REPRODUCED OR USED IN ANY MANNER WITHOUT THE EXPRESS WRITTEN PERMISSION OF HANSON INC.	
DATE	2/5/99	TITLE	BASE STAND ASSEMBLY
BY	TV	CHKD	JR
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES -TOLERANCES- DECIMALS .002 ANGLES .2°		MATERIAL	AS NOTED
		NUMBER	BCD-05147
		DO NOT SCALE DRAWING	SHEET 1 OF 1

# ASSEMBLY INSTRUCTIONS:

- 1.) ASSEMBLE BASE STAND WITH HARDWARE SHOWN.

REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
G	10958	MODELED IN INVENTOR	6/9/2010	DHH	DSH

6/14



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DATE	8/12/2010	TITLE	BASE STAND STORAGE CABINET ASSEMBLY
DFTM	DHH	MATERIAL	AS NOTED
CHKD	DSH	PART NUMBER	BCD-05146
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		PROJECT	G
-TOLERANCES-		NUMBER	SHEET 1 OF 1
DECIMALS ± .032			
ANGLES ± 2°			

#### ASSEMBLY INSTRUCTIONS

NOTE:  
1. ASSEMBLE BASE STAND STORAGE CABINET WITH HARDWARE AS SHOWN.

DETAIL A

- BOLT, 3/8-16 X 3/4
- 3/8 LOCK WASHER
- 3/8 SST FLAT WASHER

- BOLT, 1/4-20 X .75 LG
- 1/4 INTERNAL TOOTH LOCK WASHER
- 1/4 SST FLAT WASHER

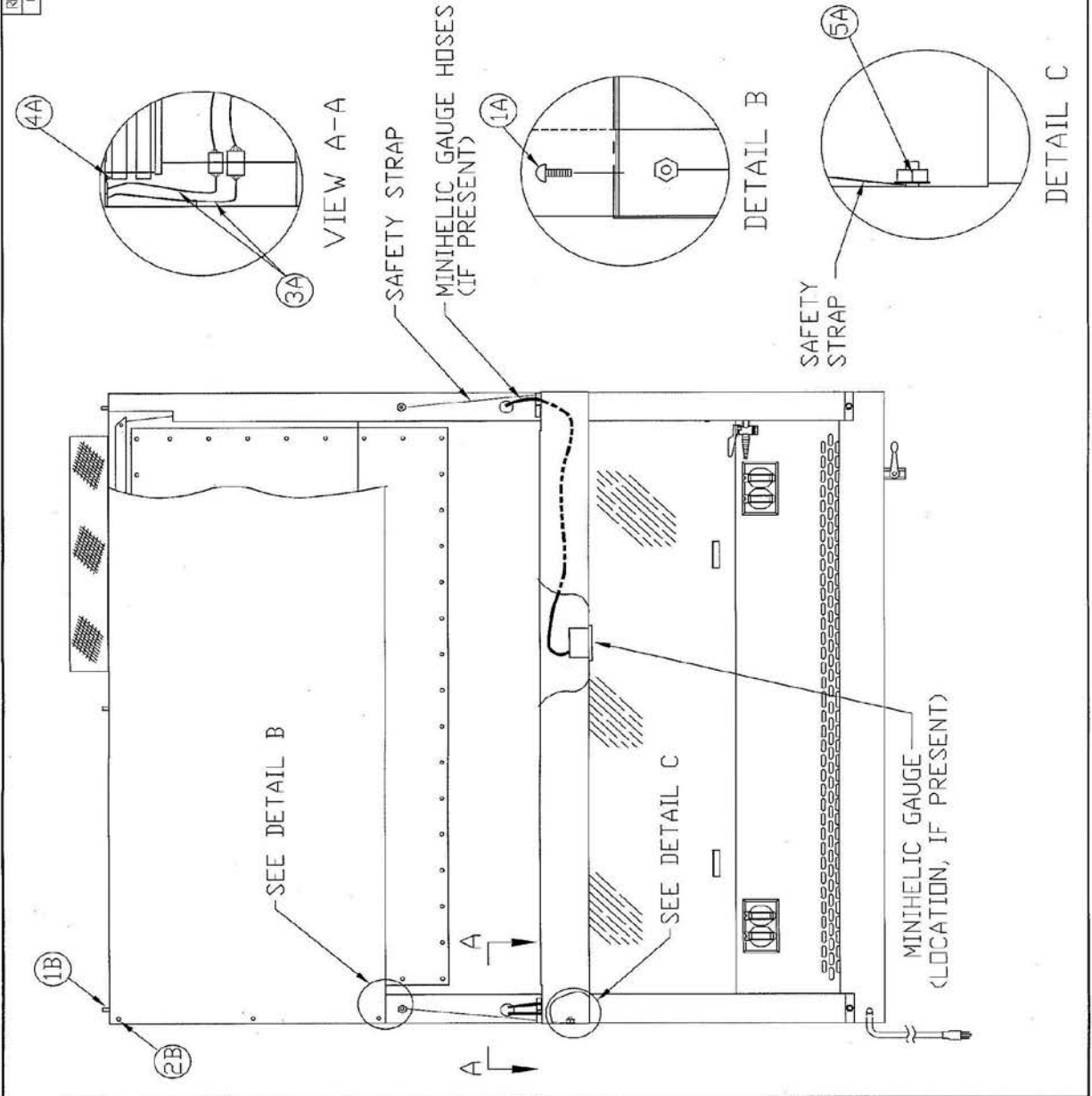
DETAIL B

- ACORN NUT, 1/4-20
- 1/4 INTERNAL TOOTH LOCK WASHER
- 1/4 SST FLAT WASHER
- BOLT, 1/4-20 X .75 LG

- BOLT, 1/4-20 X .75 LG
- 1/4 INTERNAL TOOTH LOCK WASHER
- 1/4 SST FLAT WASHER

ORIGINAL

REV	ECO	DESCRIPTION	DATE	DRFTCHKG
C	11608	ADDED NU-481/677 MODELS	4/16/12	DHH/JP



# CONTROL CENTER REMOVAL PROCEDURE

## CAUTION

DISCONNECT ALL ELECTRICAL SERVICE TO UNIT BEFORE STARTING PROCEDURE

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

## FRONT DECORATIVE PANEL REMOVAL PROCEDURE

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

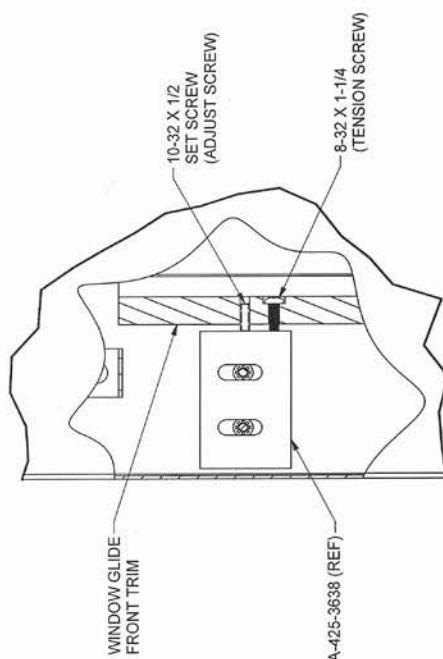
ORIGINAL



NU-425/427/430/435/437/440/454/477/480/481/629/677 CONTROL CENTER & FRONT DECORATIVE PANEL	
DFTM/CV	2/16/07
CHKD/JP	SHEET 1 OF 1
DRAWING NUMBER	BCD-11817
	C

REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
A	11931	RELEASED TO PRODUCTION	02/26/2013	AW	DSH

3/02



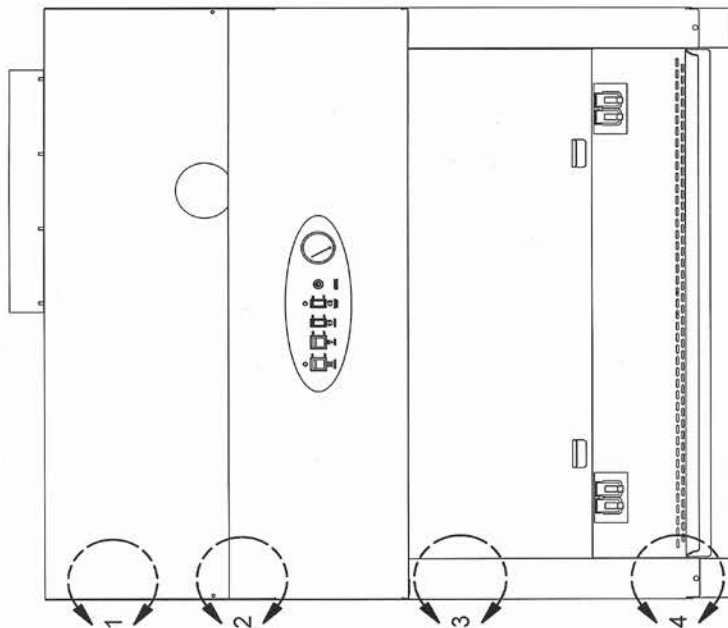
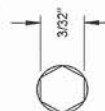
DETAIL A  
(4 PLACES)

**WINDOW GLIDE ADJUSTMENT:**

THE WINDOW GLIDES HAVE ADJUSTMENTS THAT ARE LOCATED AT THE CIRCLED POSITIONS 1 THRU 4. TO ACCESS POSITIONS 1 AND 2, REMOVAL OF THE FRONT COVER PANEL IS NECESSARY. IF THE WINDOW IS TOO LOOSE AT ANY OF THE FOUR POSITIONS, LOOSEN THE PHILLIPS HEAD TENSION SCREW AND TURN THE ALLEN HEAD SET SCREW CLOCKWISE A FULL TURN OR UNTIL YOU ACHIEVE THE POSITION THAT IS MOST COMFORTABLE FOR THE WINDOW TO SLIDE. THEN RETIGHTEN THE TENSION SCREW. TURN THE ADJUST SCREW COUNTERCLOCKWISE IF THE WINDOW IS TOO TIGHT.

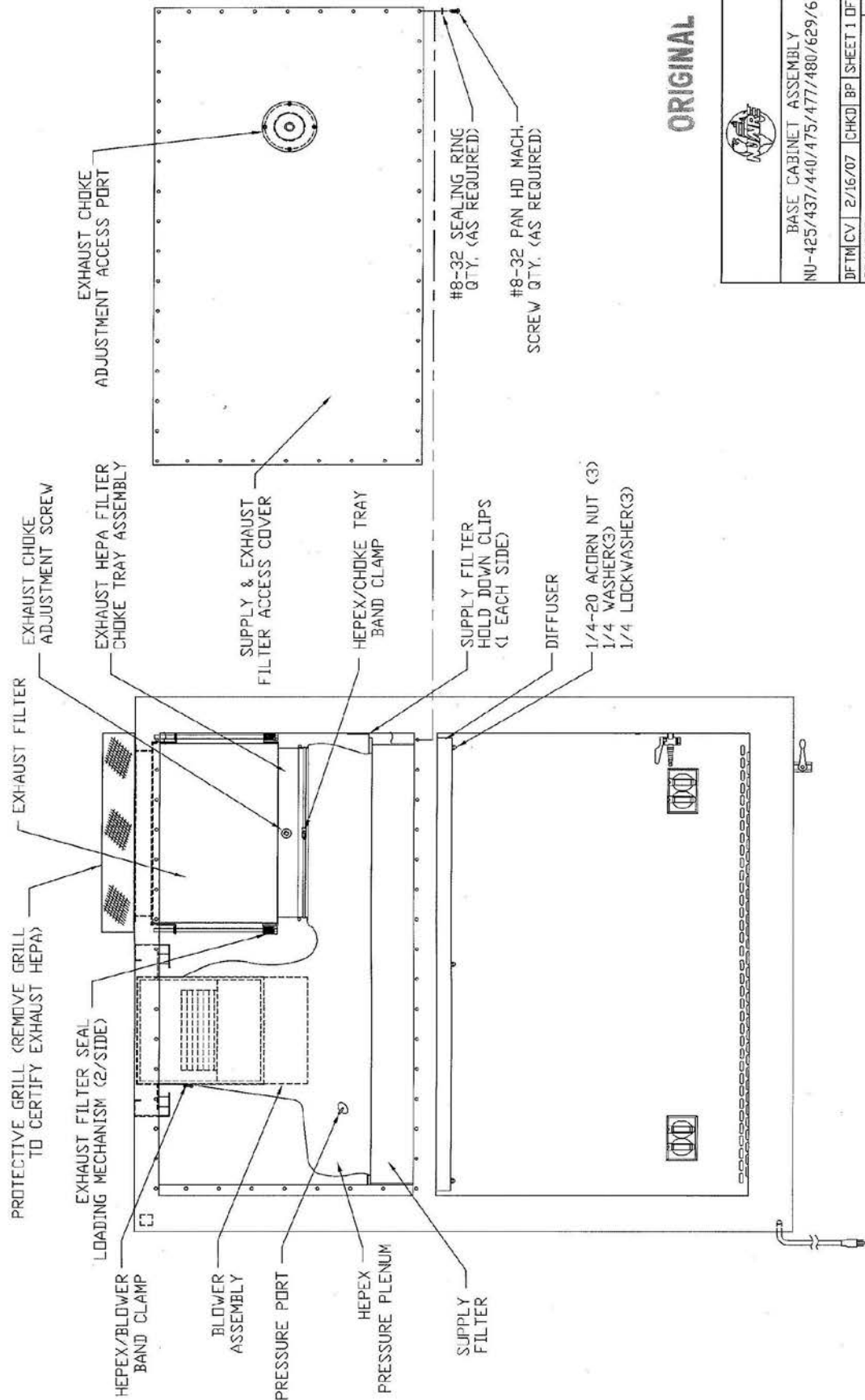
**TOOLS REQUIRED:**

1. 3/32" ALLEN WRENCH
2. PHILLIPS SCREWDRIVER



TITLE		NU-475477		ORIGINAL	
SLIDING WINDOW ASSY		8 ADJUSTMENT			
DFTM	DATE	CHKD	SHEET	1	OF 1
AW	2/26/2013	DSH			
DRAWING NUMBER		BCD-15926		A	

REV	ECO	DESCRIPTION	DATE	DRFT	CHKD
C	11608	ADDED NU-677 MODEL	4/23/12	DHH	BP



ORIGINAL



BASE CABINET ASSEMBLY	
NU-425/437/440/475/477/480/629/677	
DFTM/CV	2/16/07
CHKD	BP
SHEET	1 OF 1
DRAWING NUMBER	BCD-11819
	C



