

**Microenvironment
(Clean Dry Box)
Manual**

CDB-100

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1. Manual

This manual is intended for use by operators, application engineers, programmers, and technicians using the Eco-Snow CDB100 Clean Dry Box Microenvironment system.

The Operation and Maintenance Manual contains information about the system, facilities requirements, installation procedures, screen descriptions, operation, maintenance, and troubleshooting procedures.

2. Conventions

- NOTE:** A note contains a suggested action or other helpful information.
- CAUTION:** A caution contains information about actions that can cause equipment damage, data loss, or damage to the database.
- WARNING:** A warning contains information about actions that can cause loss of life, injury, or major equipment damage.
- BOLD:** Upper and lower case is used for menu selections.
- Bold Italics:*** Used for on screen messages, for example *Do you wish to delete recipe?*

3. Safety Summary

- Observe standard industrial safety practices when installing and operating automated equipment.
- Have power connections made by qualified personnel.
- Provide space for access and servicing.
- Perform recommended maintenance checks.
- Observe Lockout/Tag procedures when performing maintenance. See Section 4.

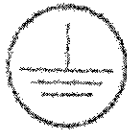
PRECAUTIONS



CAUTION: Hot surfaces inside. Remove electrical power and secure the supply in accordance with the appropriate lockout/tagout procedure before entry.



WARNING: Hazardous Voltage Enclosed. Voltage or current hazard sufficient to cause shock, burn, or death. Disconnect and lockout power before servicing.



Equipment grounding terminal.



Protective earth.

4. Dry Nitrogen Gas Lockout/Tagout Procedure

In any operation that would expose employees to the processing environment or upper enclosure, for routine maintenance or other purposes, the dry nitrogen gas supply to the equipment must be securely shut off. There must be no chance for the equipment to be accidentally resupplied with the dry nitrogen gas. This can be done in the most practical way by using the **dry nitrogen gas supply lockout/tagout procedure**.

Lockout procedures can be necessary in more than one location at the same time, and may need to be performed by more than one employee. Depending on the operation, for example maintenance or repairs, the dry nitrogen gas supply can be turned off at the main source or on the machine.

To perform a lockout procedure:

- Turn the dry nitrogen gas supply OFF at the source.

NOTE: The USER is responsible for supplying the appropriate shut off valve and lockout device.

- Place a Lockout device over the shut off valve and lock in place.
- Place an identification tag on the Valve Lockout device(s). When an employee has completed his task, he removes his tags and his locks.

In cases of more than one employee working on the equipment, the User is responsible for establishing a policy, which ensures that all employees are finished working on the machine prior to removal of the Valve Lockout devices. This will eliminate any chance of misunderstanding that might result in the energizing of the equipment while someone is working on it.

Whenever it is necessary for an employee to work in, clean, or make adjustments in the processing environment or upper enclosure, the dry nitrogen gas supply lock-out procedure must be used to prevent the employee from being exposed to a personal safety hazard.

5. Liquid Carbon Dioxide Lockout/Tagout Procedure

In any operation that would expose employees to the processing environment or upper enclosure, for routine maintenance or any other purpose, the liquid carbon dioxide supply to the equipment must be securely shut off and the lines inside the system vented. There must be no chance for the equipment to be accidentally resupplied with liquid carbon dioxide. This can be done in the most practical way by using the **liquid carbon dioxide lockout/tagout procedure**.

Lockout procedures can be necessary in more than one location at the same time, and may need to be performed by more than one employee. Depending on the operation, for example maintenance or repairs, the liquid carbon dioxide can be turned off at the main source or on the machine.

To perform a lockout procedure:

- Turn the liquid carbon dioxide supply valve **OFF**. All of the components and hoses downstream of the valve (including the hoses and components inside the system) will still be pressurized by liquid carbon dioxide trapped between the exterior valve and the snow valves.
- Bleed off the pressure remaining in the line by opening snow valves until all excess pressure dissipates (approximately 10 to 20 seconds). To be certain the line is no longer pressurized, make sure the liquid carbon dioxide pressure gauge next to the supply valve reads 0 psi.
- Place a Lockout device over the valve and lock in place.
- Place an identification tag on the Valve Lockout device(s). When an employee has completed his task, he removes his tags and his locks.

In cases of more than one employee working on the equipment, the User is responsible for establishing a policy, which ensures that all employees are finished working on the machine prior to removal of the Valve Lockout devices. This will eliminate any chance of misunderstanding that might result in the energizing of the equipment while someone is working on it.

Whenever it is necessary for an employee to work in, clean, or make adjustments in the processing environment or upper enclosure, the liquid carbon dioxide lock-out procedure must be used to prevent the employee from being exposed to a personal safety hazard.

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Facilities Requirements

The Eco-Snow™ Manual Cleaning System includes the basic Clean Dry Booth (CDB) supplied with an external 10' length of stainless steel hose and liquid CO₂ tank connector, and the W-2 Variable Orifice Gun. The system has the following dimensions:

Footprint	55" x 32"
Height	60"
Weight	Approx. 300 lbs.

In order to operate the system, the following facilities are required:

Table	The center of the glove openings is 19" from the bottom of the box. A table height of approx. 32"-36" provides a convenient height for working in the chamber. For reference, the system at Eco-Snow resides on a 35" high table.
Power	115V and 15 Amps
Dry Nitrogen	Nominal 25-30 psi capable of 1.5 CFM flow rate, supplied to the back right of CDB with a 1/4 or 3/8" O.D. plastic tube
Liquid Carbon Dioxide	BOC Pure Clean grade (99.995% purity) with siphon tube . (A 10' hose connected to the front left corner of the CDB will be supplied by Eco-Snow. Therefore the CO ₂ tank(s) must be located within 10' of the front left corner of the CDB.)
Disposable Gloves	Operators should wear latex or other thin disposable gloves to prevent perspiration buildup inside the CDB gloves.

1.0 Unpacking

Upon receipt of the CDB, examine the shipping container for broken or open packaging, distortion, or any other evidence of mishandling. If inspection indicates damage to the unit or any of its components, notify the carrier (within 15 days of delivery) and request an inspection.

Carefully move the container to a clean work area and unpack. The container you receive should contain the following:

1. Clean Dry Box
2. Installation and Operating Manual
3. Variable Orifice Gun, installed (not included with all orders)
4. Tank Connector

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2.0 System Description

The BOC Eco-Snow clean dry box (CDB) is a microenvironment used in precision cleaning applications. It is made up of a variety of subsystems that control airflow, humidity, and temperature within the main operating area and attached load lock. The CDB intended to be used in conjunction with the Eco-Snow CO₂ cleaning systems to create a conditioned cleaning environment. The CDB is often an integral and necessary part of the cleaning process for many CO₂ jet spray applications. The following subsystems make up the CDB:

2.1 *Recirculating Gasflow, Humidity, and Contamination Control*

The Eco-Snow CDB recirculating system produces a variable flow rate of highly filtered dry, inert gas within the main cleaning chamber. High flow rates are achieved using a patented ducting system and a high-capacity blower/filter combination. A positive pressure of dry, filtered purge gas reduces the humidity inside the cleaning vessel and reduces the possibility of contamination reaching the main cleaning chamber from outside sources. Parts are introduced to the main chamber via the load lock. Purge gas enters into the system through a common point at the back of the CDB and is distributed to the various sections of the CDB from user-controlled flow meters. A Swagelok connection brings purge gas into the CDB.

2.2 *Thermal Control System*

Increases in the ambient temperature within the main cleaning chamber result from heat added to the system by the blower and infrared (IR) lamps. Cooling of the environment is caused by the expansion of CO₂. The IR heat lamps are used for general warming of entire parts or collections of multiple parts.

2.3 *Electrostatic Discharge Control System*

Triboelectric charging induced by high-velocity airflow within the main cleaning chamber may cause static buildup to occur on non-grounded hardware placed within the CDB. The jet spray process may also add significant charge to hardware during the cleaning process. To counter these two effects, an ionization bar has been added to neutralize unwanted charge. In addition, all metal surfaces in the CDB, including the CO₂ jet spray delivery system, have been grounded to avoid complications stemming from charge buildup.

2.4 *Electrical System*

The CDB is designed for semi-automated control of all electrical subsystems via the timer. The internal outlet and IR lights can be singly or simultaneously set to operate for a specified length of time, allowing the operator to warm a part for a set time with minimal oversight. The timer is connected to a sonic alarm and LED to signal the operator that the preset time period has expired. Fine control of blower speed is achieved via variable voltage adjustment. A breaker for each electrical subsystem is located in the electrical box below the load lock. A 115-V cord supplies power to the system.

2.5 *CO₂ Delivery System*

The CDB is typically used in conjunction with the Eco-Snow line of CO₂ jet spray devices to form an integrated cleaning environment. The CO₂ jet spray delivery system is attached to the

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CDB via the bulkhead connector located on the lower right of the left side panel. The bulkhead is a VCR fitting. Blow-off valves relieve excess pressure inside the CDB.

3.0 Safety and Operational Guidelines

Safety is a key element in the Eco-Snow CDB design. To ensure operator safety and maximize the potential of the CDB, the following precautions and safety guidelines must be followed:

3.1 *Recirculating Gasflow and Contamination Control System*

1. Inert purge gases (i.e., GN₂, CO₂) should be used only in well-ventilated areas. Connecting the blow-off valves to a venting system can be used to exhaust the excess purge gas.
2. Periodically test the working environment surrounding the CDB for oxygen content. Adjust ventilation as required to ensure operator safety.
3. Do not attempt to inhale process chamber or load lock environment gases. Due to the use of inert gases these volumes are depleted of oxygen
4. Tighten all external fittings to specifications prior to starting the purge gas flow.
5. Purge gas pressure should not exceed **45 psi**.
6. Properly secure purge gas supply tanks.
7. Allow ample time for the process chamber to purge before beginning CDB operations.
8. Never operate the blower motor with the top assembly cover detached from the CDB.
9. Do not allow foreign objects to penetrate the HEPA filter. If the integrity of the HEPA filter is compromised, it must be replaced.

3.2 *Thermal Control System*

1. Do not allow the internal CDB temperature to exceed 40°C.
2. Do not leave the thermal control system (i.e. IR lamps, and user-supplied heaters) unattended.
3. Carefully monitor hardware temperature when using the IR lamps as a heating process.

3.3 *Electrostatic Discharge Control System*

1. Do not operate the pulse bar emitter/ionization system in an area where volatile chemicals or explosives are present.
2. Detach the pulse flow control module power cord from the power source when cleaning electrodes or manipulating the supply lines.
3. Do not touch the high-voltage electrodes protruding from the ion bar housing.
4. Do not sever the input lines leading to the ion bar.
5. Properly ground static-sensitive hardware.

3.4 *Electrical System*

1. Input power must be drawn from a properly grounded receptacle.
2. Do not deviate from the nominal input power specifications.

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3. Remove the input line to the CDB from the power source before removing the access panel to the CDB electrical box.
4. Properly ground all hardware and equipment placed within the CDB process chamber.

3.5 CO₂ Delivery System

1. The jet spray process should be conducted only in well-ventilated areas.
2. Do not allow the CO₂ nozzle to dwell on CDB surfaces or gloves for extended periods.
3. Closely monitor the temperature of sensitive hardware during the jet spray process.

3.6 General

1. Because the CDB is heavy, great care should be taken when transporting the assembly.
2. A strong table must be used to support the weight of the CDB (300 lb.).
3. A minimum of two people is required to remove the CDB top during routine maintenance. Do not attempt to manipulate the blower housing or filter without the help of an assistant.

This list of safety precautions is not complete. Your facility may have specific procedures for compressed inert gases, liquefied compressed gases, cryogenic liquids, ESD, and electrical equipment.

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4.0 Specifications

The system and range of operation specifications are as follows:

<u>System</u>	<u>Range of Operation</u>
Flow	0 to 450 LFPM inside process chamber
Humidity	<0.01% RH using inert purge gas
Cleanliness	Subclass 10 environment
Temperature	25° to 36°C operating temperature
Weight	300 lb.
Footprint	55" x 32"
Height	60"

In order to operate the system, the following facilities are required:

Table	The center of the glove openings is 19" from the bottom of the box. A table height of approx. 32"-36" provides a convenient height for working in the chamber. For reference, the system at Eco-Snow resides on a 35" high table.
Power	115V and 15 Amps
Dry Nitrogen	Nominal 25-30 psi capable of 1.5 CFM flow rate, supplied to the back right of CDB with a 1/4 OD plastic tube
Liquid Carbon Dioxide	BOC Pure Clean grade (99.995% purity) with siphon tube . (A 6' hose connected to the front left corner of the CDB will be supplied by Eco-Snow. Therefore the CO ₂ tank(s) must be located less than 6' of the front left corner of the CDB.)
Disposable Gloves	Operators should wear latex or other thin disposable gloves to prevent perspiration buildup inside the CDB gloves.

5.0 Startup Procedure

1. Remove all packing material associated with transportation of the CDB.
2. Turn all switch selections on the front panel to the "Off" position and all voltage controls to the minimum power position.
3. Install the two IR lamp bulbs.
4. Connect the CDB to a purge gas source. See section 6.1.1.

Warning: Do not exceed a purge pressure of 45 psi.

5. Connect the electrical line to a 115 VAC, 60 Hz, 15 Amp outlet.
6. Turn the blower voltage control to the 90% level.

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7. Turn the blower switch to the "On" position.
8. Allow the CDB to run with the blower set at the 90 percent level for approximately 8 hours.

Customer requirement and the ambient relative humidity level external to the CDB determine the actual length of time required to reduce the internal humidity level. In addition to reducing the humidity level of the internal CDB environment, the extended length high-flow purge will remove any particles that became dislodged in the shipping process.

The CDB is now fully operational.

5.1 Initial cleaning

All CDB surfaces have been precision cleaned prior to CDB arrival at the customer facility. Following the equilibration period discussed in the initial setup instructions above, no further cleaning is required except that described in the "Maintenance" section of this manual. If a CO₂ cleaning system is present, it may be used after the equilibration period to lightly clean interior CDB surfaces prior to initial use of the system. With the exception of the stainless steel floor and back wall inside the main chamber, care should be taken not to dwell on any internal CDB surfaces for extended periods.

6.0 Operation

6.1 Recirculating Gasflow, Humidity, and Contamination Control System

6.1.1 Purge Gas Supply and Regulation

Purge gas can be supplied to the CDB through various sources. The removal of humidity from the CDB is usually the main concern when choosing a purge gas. Nitrogen is an excellent choice under these circumstances because it is extremely dry, readily available, and cost effective. The preferred sources for nitrogen are:

1. *Facility supplied GN₂.* If a source of pressurized dry nitrogen is available as part of the normal facility utilities, then it should be used as the source of purge gas for the CDB. If this external source of GN₂ is pressurized beyond 45 psi, it must first pass through a regulator before entering the CDB. Clean tubing should be used to connect the source of purge gas to the CDB. The internal filter will remove particles from the purge gas during normal use.
2. *High Pressure Liquid Nitrogen.* Liquid nitrogen tanks may be used as a source of gaseous nitrogen for the CDB. **When using a LN₂ tank as a source of gaseous N₂, the gas use port on the tank must be used.** It is recommended that a high-pressure (250 psi) LN₂ tank, in conjunction with a regulator, be used to supply the CDB inlet gas. A low-pressure tank (22 psi) is usually insufficient to maintain a purge.
3. *GN₂ tank or tank farm.* A Grade 6, 1500-psi GN₂ tank or tank farm may supply the gaseous nitrogen. A regulator is required to step down the tank pressure from its nominal 1500-psi level to an outlet gas pressure of about **30 psi**. A standard single 1500-psi

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nitrogen tank will supply the CDB with nitrogen for approximately 3 hours at a CDB inlet pressure of 30 psi.

6.1.2 Purge Gas Connection

1. Connect a regulator to the inert gas source.
 - 1.1. Facility supplied GN2 may require special adapters to connect a regulator.
 - 1.2. For LN2 supplied nitrogen, use the "GAS" outlet of the tank. A normal nitrogen regulator is equipped with a male CGA 580 fitting; the gas port of the LN2 tank should have the mating fitting attached already. If it does not have a female CGA 580 fitting, contact your gas supplier to correct the problem.
2. Attach a ¼" flexible tube between the regulator and the gas inlet of the CDB.
3. Turn down the regulator to zero outlet pressure (counter-clockwise).
4. Open the supply valve. The regulator should now read the supply pressure
 - 4.1. Facility supplied GN2 usually has a pressure of 80 psi.
 - 4.2. High Pressure LN2 usually has a pressure of up to 250 psi.
 - 4.3. Gaseous Nitrogen cylinders vary between 1500 and 2000 psi.
5. Increase the outlet pressure of the regulator to 30 psi (clockwise).
6. Adjust each flow meter to the nominal setting listed below by turning the actuator knob on the meter clockwise and reading the level tangent to the bottom of the suspended ball.
7. Adjust the regulator output as necessary

Start-Up Flow Setting

"Make Up Gas"	50 SCFH
"Load Lock"	20 SCFH

Maintenance Flow Setting

"Make Up Gas"	20 SCFH
"Load Lock"	10 SCFH

The inlet gas flow system is now fully operational.

6.2 Thermal Control System

6.2.1 Blower

Increases in temperature of the ambient CDB environment result from the blower and IR lamps. Heat from the blower (500 W) is dissipated from the blower housing through convection. The heat added to the system by the blower motor elevates the temperature inside the CDB to approximately 36°C during normal operation.

6.2.2 IR Lamps

The second source of heat inside the CDB is the set of two IR lamps (150 W each). The IR lamps operate singly or together and can be timer activated. The IR lamp is typically used for

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large area heating of hardware after the CO₂ jet spray process is completed. Hardware may be placed in close proximity to the bulb to decrease warm-up time or, for more gentle heating, the IR lamp may be used to warm the entire process environment. The IR lamps are operated from the front panel using toggle switches. One toggle switch selects among non-operation of both lamps (“Off”), operation of one lamp (“Single”), and the operation mode of both lamps (“Both”). This switch is located on the front panel under the load lock and to the right of the blower speed control. A second switch, located above the timer box, controls the functioning mode of the IR lamps. When this switch is placed in the timer mode and the timer switch is placed in the “On” position, the IR lamp(s) (either single or dual depending on the placement of the lamp select switch) become activated. The timer “On/Off” switch can be toggled from the front panel or from inside the CDB. Once activated using the timer, the IR lamp(s) will remain on for the timer interval set by the operator.

The IR lamps are normally kept in the OFF position.

6.3 Electrostatic Discharge Control System

The CDB employs four different methods to control the level of static charge that may build up on surfaces within the process chamber and on hardware placed within the CDB main chamber. These methods include:

6.3.1 Grounding of internal CDB surfaces.

To reduce the potential for static buildup on internal metallic CDB surfaces, all conducting surfaces have been grounded. These surfaces include the stainless steel floor, stainless steel back plane, florescent lamp housing, and IR lamp housing.

6.3.2 Grounding of the CO₂ system.

A ground wire may be connected from the CO₂ tank to an appropriate ground plane. Grounding of the CO₂ device eliminates charge buildup that may occur when high-velocity CO₂ gas and solid CO₂ particles exit the jet spray nozzle.

6.3.3 Part grounding.

Grounding of process hardware is a viable technique to eliminate charge buildup on sensitive component surfaces within the CDB. When grounding delicate electronic components, care should be taken to ensure that the ground path is capable of handling the anticipated discharge. Grounding of customer hardware is left to the operator’s discretion and should be verified on test hardware before live components are used.

Ion bar

The ion bar located directly below the HEPA filter reduces charge buildup that may occur on dielectric materials. The ion bar floods the CDB process chamber with large quantities of positive and negative gas ions. These ions are formed from corona discharge using a tungsten electrode. Attracting negative ions from the charge rich gas stream neutralizes surfaces of positive charge accumulation. Surfaces that have become negatively charged attract positive ions from the gas stream and are neutralized. The function of the ion bar was optimized as part of the check-out procedure at Eco-Snow Systems.

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6.3.4.1 Ion Bar Configuration

Operation – Output Level Control

Use the independent output level controls to adjust the positive and negative ion emission level settings.

Timing Control

Adjust the “ON” time for ion emission with the 12 position switch according to the chart below.

Switch Position	1	2	3	4	5	6	7	8	9	10	11	12
ON Time (Sec)	0.2	0.4	0.6	0.8	1.0	1.2	1.6	2.0	4.0	6.0	8.0	10

Maintenance

WARNING!

These instructions are for use by qualified personnel only. To avoid personal injury or damage to the equipment, do not perform any maintenance other than that contained in these instructions.

CAUTION!

There are no user-serviceable parts inside the controller. Any unauthorized service will void the warranty and may result in additional repair charges.

Emitter Unit Maintenance

Maintaining a schedule for proper maintenance is necessary for optimum system performance. Emitter point cleaning and periodic replacement are the primary maintenance requirements for 5000 series equipment. The frequency of cleaning varies depending upon the environmental conditions of the installation. As a general rule, emitter points should be cleaned every 2 to 6 months. Replacement is suggested every 2 or 3 years, or more frequently if excessive erosion is evident.

Emitter Point Removal

Before removing the emitter points, disconnect power to the ionizer by turning off the 5024(e) Control Module. To replace the emitter point of an AeroBar or Emitter, grasp the emitter point with an appropriate tool and pull it out. If the emitter points are silicon (ultraclean), a soft jawed tool is strongly recommended. Silicon points are brittle and care must be taken during removal

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and insertion to avoid breakage. The exposed parts of the AeroBar or Emitter should be cleaned at this time. Cleaning instructions and materials are detailed in the CLEANING PROCEDURES section. The new emitter point is then gently pushed into its socket, taking care to avoid damaging the sharp point. Insert silicon (ultraclean) points using fingers only. Power may now be reconnected to the ionizer unit.

Cleaning Procedures

CAUTION!

Do not use solvents such as acetone or MEK which will damage the paint or plastic parts of the system components.

The frequency of cleaning will vary depending on the product and the individual installation. After the initial installation, system operation should be monitored closely and a regular cleaning schedule developed which meets the needs of the operating conditions. Acceptable cleaning materials are listed in Table 4.

Emitter Points

To clean emitter points without removing them, a lintless cloth or swab moistened with isopropyl alcohol will do an adequate job. Gently rotate the swab or cleaning cloth around the emitter point to clean. Particular care should be taken with silicon (ultraclean) emitter points.

MATERIALS	CHARACTERISTICS
Isopropyl Alcohol	This solvent is cleanroom compatible. Caution: IPA is flammable and poisonous if injected.
Cleaning Cloths	Almost any commercially available lint free cloths (such as Handi-wipes) are acceptable for cleaning ionization equipment. Special cloths approved for cleanroom use are available.

Table 4: Recommended Cleaning Materials

5024(e) Controller

The 5024(e) Controller should be cleaned as necessary to maintain its appearance. A cleaning cloth moistened with isopropyl alcohol is used for this process.

Ionizers

For non-cleanroom environments only: Moisten a cleaning cloth with isopropyl alcohol. Starting from one end, clean the entire ionizer. Wipe all areas thoroughly especially the area between the emitter points until all dirt is lifted. Take care that the solvent does not get on any adjacent painted surfaces.

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SYSTEM MAINTENANCE

Once installed, the 5024(e) System will require very little maintenance beyond that described above for the Emitter units. The 5024(e) Controller operation should be checked on a monthly basis to ensure it is continuing to operate as originally adjusted. Calibration on the controller is not required except as done during a periodic check of the entire system for balance and discharge certification. Ion Systems recommends quarterly or semi-annual calibration depending on usage and application of the system.

The 5024(e) System should be checked for proper operation whenever the emitter points are cleaned, or more often if desired. The model 210 Charged Plate Monitor (CPM) or equivalent is used to accomplish this. The procedure is described in the CPM Operating Instructions.

SYSTEM TEST

The test procedures that follow will ensure that the operation of all components of the 5024(e) System are within the published specifications. Before proceeding, one should become familiar with the controls, features, and operating instructions which have been provided in previous sections of this manual.

Test Equipment

Table 5 outlines a list of recommended test equipment required to complete the test procedures:

Model 210 Charged Plate Monitor	Available from Ion Systems
Stopwatch	Accurate to 0.1 seconds
Anemometer	Able to make accurate measurements (within 5%) in the range of 0-100 and 0-400 FPM

Table 5: Recommended Test Equipment

Test Procedures

Using an anemometer, verify that the airflow present in the area is at the value determined during the initial installation of the 5024(e) System.

Observe the indicator lights on the 5024(e) Control Module and verify with a stopwatch that the TIME value is the same value determined during the initial installation.

Set up the Model 210 Charge Plate Monitor directly underneath an ionizer. Use the procedure described in the appropriate manual to verify that the ionizer is producing the desired balanced swing in voltage as measured by the Model 210 CPM.

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Maintenance Service

A Maintenance Service Contract may be arranged with Ion Systems. Ion Systems' personnel will periodically come to your facility and perform the necessary cleaning operations. After cleaning, the system will be checked for proper operation and calibrated. At the time of initial installation by Ion Systems, a Certification Report is provided which documents the system performance. Ion Systems can provide a Re-certification Service for the system with or without a Maintenance Service Contract. For further information about the above services, please contact Ion Systems at (510) 548-3640 or ionsys@ion.com.

6.4 Electrical System

The CDB electrical system services the blower, control timer, IR lamps, florescent light, and interior outlet. Power enters the CDB through a 115-VAC, 60 Hz cord located at the base of the CDB below the load lock. The input line may draw up to 15 A during normal operation of the various subsystems.

The chamber below the load lock houses the breaker box and the majority of CDB electrical components.

Warning: The access panel to the electrical box should never be opened while the input lines are connected to a live power source.

6.4.1 Timer Operation

Each of the electrical systems within the CDB, with the exception of the blower and florescent light, may be operator activated for a preset interval using the timer relay system. The timer control panel is located at the front face of the CDB below the right glove port. (See Figure 1.) The relay timer may be used to control individual subsystems singly or user selected groups defined by the operator's process. The timer control relay may be set to "On" times that vary from 1 sec to 199 min. 59 sec. The minimum count interval is 1 sec. A simple procedure for timer control setup is given below:

1. Press the set key located on the timer control keypad. The digit control arrow keys are now active.
2. Chang individual digits by pressing the "up" or "down" arrows located below each digit. Pushing the "up" arrow increases an individual digit. Pushing the "down" arrow decreases an individual digit.
3. Change the LCD screen until the proper "on time" duration has been selected.
4. Press the enter key to lock in the time period selected in step 3.

Timer setup is complete.

The relay timer may be used to regulate the operation of the IR lamps or internal outlet. Timer control is very useful for regulating the heating times that may be necessary before or after the CO₂ jet spray cleaning processes. The timer allows the operator to quantify the use of CDB subsystems such that a repeatable experimental procedure may be generated. Timer regulation of a subsystem is conducted in the following manner:

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6.4.2 Timer Regulation

1. Set the timer for the desired interval by following the timer setup procedure.
2. Configure those systems that require timed operation (i.e. IR lamp single or dual operation, outlet hardware configuration).
3. Select subsystems for timer operation by toggling the "On/Timer" switch for each system to "Timer". The "On/Timer" switch for a particular system is located at the front CDB switch panel.
4. At operator discretion, initiate timed operation by selecting "On" from the timer "On/Off" switch select. Timed operation can be effected from the front panel switch select or the toggle switch located inside the CDB below the interior load lock access door.
5. Upon completion of the timer interval, the timer relay will close automatically.
6. Select "Off" at the timer toggle switch.
7. After the timer interval has expired, the sonic alarm located directly to the right of the timer control housing will sound. The sonic alarm produces a loud, penetrating signal that may be heard throughout a laboratory and despite elevated noise backgrounds.

6.5 CO₂ Delivery System

The CDB main process chamber is ideally suited for precision cleaning applications using the Eco-Snow™ CO₂ jet spray product line. Using a dry inlet gas such as GN₂, relative humidity values as low as 0.01 percent may be achieved. CDB construction and high flow rate filtration methods produce an internal CDB environment that is below **class 10** (FED STD. 209) at the highest flow rate available (greater than 450 LFPM). The Eco-Snow™ CO₂ jet spray device should be connected to a tank using the following procedure:

6.5.1 CO₂ Jet Spray Device Installation

1. Remove the tank connector from its shipping container.
2. Place a stainless steel gasket over the VCR bulkhead on the outside of the CDB.
3. Thread the VCR nut of the 6' hose onto the VCR bulkhead. Tighten the nut until finger tight.
4. Continue to tighten the female nut 1/16 of a turn using a 3/4-in. open-face wrench while holding the feedthrough motionless using another 3/4-in. open-faced wrench.
5. Place a Teflon gasket inside CGA 320 fitting
6. Thread the female nut onto a standard CO₂ tank or comparable source of CO₂ and tighten it firmly using a wrench.
7. Refer to the Eco-Snow™ CO₂ manual shipped with the CO₂ jet spray device before opening the supply tank valve. Follow precisely the usage procedure instruction listed in the Eco-Snow™ CO₂ manual.

Coupling of the Eco-Snow Jet Spray System to the CDB is complete.

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7.0 Repair and Customer Service

The Eco-Snow™ CDB has been designed with durability and dependability as foremost concerns. Each subsystem has been chosen with due regard for quality, simplicity, and long-term service. Under normal operating circumstances, the CDB will provide years of error-free service and reliable performance. If a malfunction does occur, the operator is advised to contact an Eco-Snow™ CDB engineer prior to any attempts to repair or replace system hardware. To obtain customer service, please contact one of the following CDB personnel

<u>Name</u>	<u>Telephone</u>	<u>e-mail</u>
Werner Brandt	(925) 605-1904	werner.brandt@boc.com

Each member of the Eco-Snow™ team listed above is available during normal working hours to take your calls regarding CDB technical information or questions. Hours of operation at the Livermore, CA, facility are Monday through Friday, 8:00 a.m. to 6:00 p.m. (Pacific Standard Time). If you prefer to write, correspondence may be directed to the address listed below:

Eco-Snow Systems, Inc.
4935A Southfront Road
Livermore, CA 94550

Fax messages are received 24 hours a day, 7 days a week at (925) 371-0798.

8.0 Maintenance

The Eco-Snow™ CDB requires very little maintenance during normal use. Interior surfaces of the system need not be cleaned upon receipt of the system. Prior to shipment, all interior surfaces are wiped with isopropyl alcohol to remove any organic film remnants of the fabrication process. The wiping also removes loose particulate matter that may have collected during assembly.

If a CO₂ jet spray system was purchased with this system, the operator may use it following the initial setup and equilibration period to thoroughly remove any particles that may have been dislodged during shipment. Care should be taken not to dwell for extended periods on surfaces within the CDB or the CDB glove material. The CO₂ jet spray process can lower the temperature of a surface significantly if dwell times are long. Surfaces may incur thermal damage and the operator may be injured if the CO₂ process is used improperly.

Depending on the contaminant level of the hardware being cleaned and the ultimate cleanliness level required for a particular hardware, periodic cleaning of interior CDB surfaces might be required. The recommended cleaning procedure for gross levels of particulate or organic contamination is listed below. This procedure is not recommended for minor amounts of mainly particulate contamination.

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8.1 *Light Cleaning*

Warning: This procedure can only be conducted in a well-purged chamber. A high oxygen concentration with solvent vapors may cause an explosion when the blower is operating.

1. Turn the blower to the "Off" position.
2. Clean the solvent dispenser using a lint-free cloth.
3. Transfer the solvent dispenser and several lint-free wipers to the process chamber.
4. Clean all accessible interior surfaces.
5. Remove the wipers and solvent dispenser from the process chamber.
6. Turn the blower to the "On" position. Rotate the voltage control for the blower to 90 percent. Allow the CDB to purge for 2 hours before resuming normal activities within the process chamber.

The CDB is now clean.

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8.2 *Gross Contaminant Removal*

1. Shut down all electrical systems by placing switch in the "Off" position.
2. Unplug the power line.
3. Rotate the actuator knob for each flow meter to the minimum flow position (fully counterclockwise).
4. Stop the purge gas flow to the CDB.
5. Exhaust the purge gas from the CDB main chamber and load lock by opening all doors, including the large side access door.
6. Remove the box top cover from the CDB and place it to the side

Warning: The box top is heavy and requires two to three people to remove.

7. Remove the cleanroom tape that connects the blower assembly to the HEPA filter.
8. Remove the blower assembly from the HEPA filter and place it on the box top cover.

Warning: The blower assembly is heavy and requires two people to remove it.

Important: The exposed pleats of the HEPA filter are very fragile and may be easily torn. The HEPA filter outer frame is not completely rigid and requires the support of two people when being moved.

9. Place the HEPA filter in a safe place.
10. Expose the entire assembly to ambient air for at least 30 minutes prior to cleaning inside the CDB.
11. Wipe interior surfaces of the CDB using a lint-less soft wipe soaked in isopropyl alcohol. If isopropyl alcohol is not available, ethanol may be substituted. Acetone is not recommended as a cleaning solvent because it will etch plastic CDB surfaces.

Danger: Small quantities of solvents (i.e., alcohol) may produce dizziness, nausea, and vomiting. Cleaning of CDB surfaces should only be attempted using the proper breathing equipment in a well-ventilated area.

12. Upon completion of the cleaning process, the CDB should be reassembled in the following manner:
13. Place the HEPA filter on top of the rubber gasket material that lines the top of the process chamber. Make sure that the flow arrow of the HEPA filter is pointing from top to bottom in the direction of circulation. Do not tear or puncture the pleats of the HEPA.

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14. Position the blower assembly on top of the HEPA filter such that the blower power cord hangs freely in the return duct.
15. Using 2" cleanroom tape, secure the blower assembly to the filter frame.
16. Attach the blower/filter combination to the CDB process chamber with 2" cleanroom tape.
17. Replace the box top cover such that the interior gasket strip faces the front of the CDB view panel.
18. Close all of the doors leading to the process chamber and load lock.
19. Start purge gas flow to the CDB
20. Set the inlet gas flow meters to their appropriate nominal settings by rotating each knob clockwise.
21. Plug the line cord into a live outlet.
22. Begin blower operation by toggling the blower "On/Off" switch to "On."
23. Allow the main process chamber to purge for at least 4 hours. Extended purge is required to regain the original low humidity, subclass 10 environment that existed before main process chamber breach.

The CDB is now operational.

In addition to internal cleanings, the HEPA filter should be inspected periodically. A visual inspection of the HEPA and a particle count inside the process chamber will determine if the high-capacity filter needs to be replaced. A filter may be ordered by calling a CDB engineer listed in the "Repair and Customer Service" section of this manual. The filter replacement procedure is listed below:

8.3 Filter Replacement

1. Shut down all electrical systems by placing switch in the "Off" position.
2. Unplug the power line.
3. Rotate the actuator knob for each flow meter to the minimum flow position (fully counterclockwise).
4. Stop the purge gas flow to the CDB.
5. Exhaust the purge gas from the CDB main chamber and load lock by opening all doors, including the large side access door.
6. Remove the box top cover from the CDB and place it to the side

Warning: The box top is heavy and requires two to three people to remove.

7. Remove the cleanroom tape that connects the blower assembly to the HEPA filter.
8. Remove the blower assembly from the HEPA filter and place it on the box top cover.

Warning: The blower assembly is heavy and requires two people to remove it.

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Important: The exposed pleats of the HEPA filter are very fragile and may be easily torn. The HEPA filter outer frame is not completely rigid and requires the support of two people when being moved.

9. Remove the HEPA filter and discard per appropriate Hazardous Waste disposal procedures.
10. Place the new HEPA filter on top of the rubber gasket material that lines the top of the process chamber. Make sure that the flow arrow of the HEPA filter is pointing from top to bottom in the direction of circulation. Do not tear or puncture the pleats of the HEPA.
11. Position the blower assembly on top of the HEPA filter such that the blower power cord hangs freely in the return duct.
12. Using 2" cleanroom tape, secure the blower assembly to the filter frame.
13. Attach the blower/filter combination to the CDB process chamber with 2" cleanroom tape.
14. Replace the box top cover such that the interior gasket strip faces the front of the CDB view panel.
15. Close all of the doors leading to the process chamber and load lock.
16. Start purge gas flow to the CDB
17. Set the inlet gas flow meters to their appropriate nominal settings by rotating each knob clockwise.
18. Plug the line cord into a live outlet.
19. Begin blower operation by toggling the blower "On/Off" switch to "On."
20. Allow the main process chamber to purge for at least 4 hours. Extended purge is required to regain the original low humidity, subclass 10 environment that existed before main process chamber breach.

The CDB is now operational.

8.4 Shutdown Procedure

The CDB has been designed to run continuously for extended periods. If the operator deems a shutdown period is required, the following simple procedure should be followed:

1. Place all front panel switches in the "Off" position.
2. If the purge gas source must be removed, adjust the flow rate at each flow meter to the minimum level. Turn the inlet gas valve to the "Off" position. Disconnect the source of the inlet gas.
3. Disconnect the electrical input line from the power source.

Shutdown is complete.

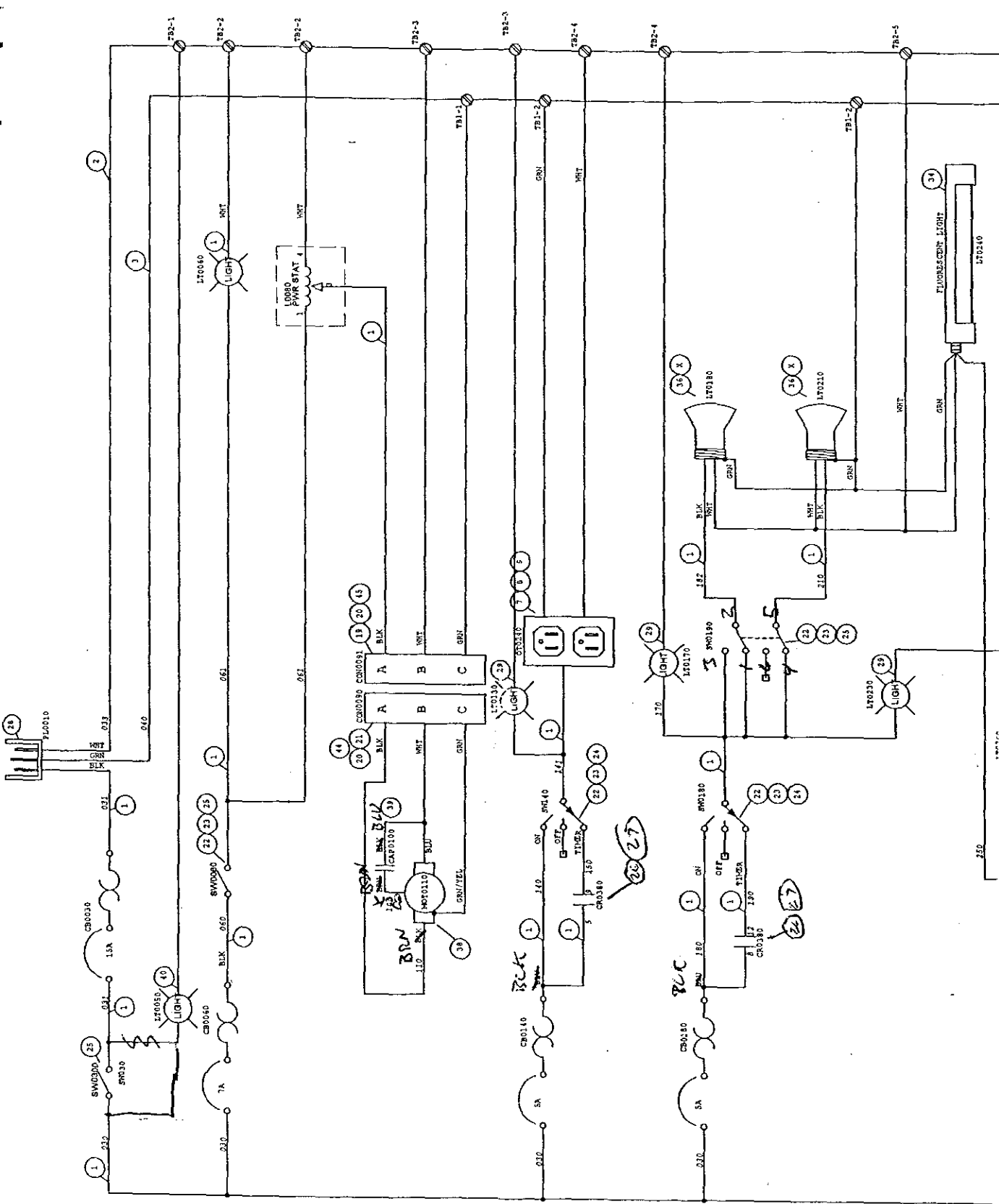
Rough Draft

9.0 Glossary

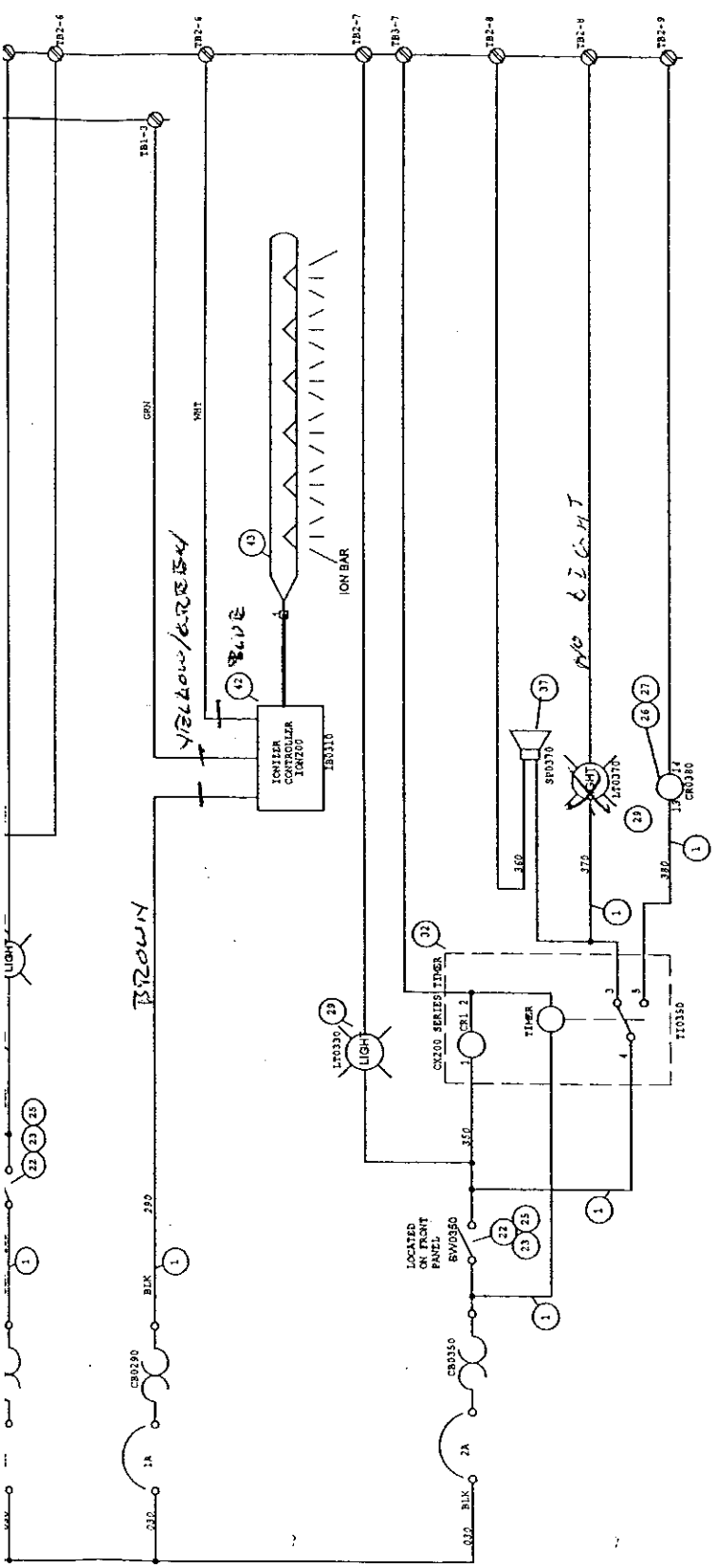
<u>Name</u>	<u>Description</u>
Main chamber	Cleanliness, humidity, and temperature-controlled environment for precision processing
Blower	Voltage controllable speed setting from 0 to 450 linear feet per minute (LFPM)
HEPA filter	High-efficiency HEPA filter removes 0.3- μm particles with 99.999 percent efficiency
Load lock	Allows parts to be transferred between the main chamber and exterior of the CDB with minimal disruption of the interior box environment through two sealed passage doors
Side access door	Sealed access door allows large parts to be introduced into the main chamber
Inlet filters	0.03- μm inlet gas filters with 99.999 percent efficiency
Flow meters	Controls inlet gas flow to blower (50 standard cubic feet per hour – SCFH) and load lock (15SCFH)
Electrical access box	Contains breaker box, instrument wiring, and inlet gas flow distribution manifold
Timer	Timer control of IR lamps, and outlet; 200-minute range with 1-second minimum intervals
Internal timer control switch	Allows activation of timer control sequence from inside the main chamber
Time interval completion indicator	LED signal turns on at the end of a timer interval
Internal outlet	Timer controllable; 115 VAC, 60 Hz

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IR lamps	Timer controllable and switch selectable; 150 W per bulb
Pulse flow controller	Controls operation of ion bar and sets level of ionic species in main chamber
Ion bar	Provides large flux of positive and negative ionic species



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- 0230
- 0240
- 0250



NOTE: NUMBERS IN ITALICS ARE WIRE NUMBERS

TIMER SETTINGS
1 = ON
1 2 3 4 5 6 7
1 1 1 0 0 1 0

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File	PLC SYSTEM AC POWER DISTRIBUTION
Size	Document Number
Date	Cust# MC3700502
Sheet	1 of 1
Date	Friday, March 05 1998