CONVIRON

CHAMBERS

MAINTENANCE AND TROUBLESHOOTING MANUAL

278881-ENG-R00

CHAMBERS

MAINTENANCE AND TROUBLESHOOTING MANUAL

Please read these instructions carefully and completely before operating the chamber.

Conviron Document Number 278881-ENG, Revision 00
Published by:

CONVIRON 590 Berry Street
Winnipeg, Manitoba
Canada, R3H 0R9
www.conviron.com

February 2018

EU declaration of conformity available upon request

Printed in Canada

PREFACE

Welcome to the Maintenance and Troubleshooting Manual for Conviron Chambers. This manual has been developed to assist with the basic operation and maintenance of Conviron's portfolio of reach-in and walk-in chambers.

The Manual has been designed to provide sufficient detail for the majority of chamber configurations. The format is structured to provide step-by-step instruction. Clients will find sufficient detail for typical chamber installations including figures, diagrams, and graphics for ongoing operation and maintenance. However, given that installations are specific to each facility and that facilities may have unique circumstances, additional information or assistance from Conviron may be required. In such cases, global contact information is provided.

This equipment is only to be used and maintained by authorized personnel – that is, personnel who have been trained on the proper operation and/or maintenance of the equipment and who have read this manual.

WEEE and RoHS Compliance Statements

CONVIRON is committed to meeting all requirements of the WEEE directive (2012/19/EU).

Products labeled with the WEEE symbol (a crossed out "waste bin") indicate that the final user should not discard this product along with other household waste, but that it must be collected and treated separately.

Please contact Conviron, or your Conviron distributor, for proper handling and disposal instructions.

CONVIRON is committed to meeting all requirements of the RoHS directive (2011/65/EU). The RoHS directive requires that manufacturers eliminate or minimize the use of lead, mercury, hexavalent chromium, cadmium, polybromated biphenyls, and polybromated biphenyl ethers in electrical and electronic equipment sold in the EU after July 1, 2006.

SERVICE & TECHNICAL SUPPORT

Before contacting Conviron, please check the following:

- Read this document and the accompanying control system manual in their entirety before attempting to operate the chamber.
- If you are having a problem using your chamber(s), pay particular attention to the relevant section and the pertinent information in this manual, and use the information to diagnose and correct the problem.
- If the problem persists and/or you require additional assistance, please collect the following information prior to contacting Conviron:
  - The serial number of the cabinet, located on the rating plate
  - The control system version. Instructions for obtaining the version of your control system are provided in the control system operator manual.
  - A description of the problem
  - A description of what you were doing before the problem occurred.

Head Office
Technical Services
Conviron
590 Berry St.
Winnipeg, Manitoba,
Canada R3H 0R9

Please visit www.conviron.com for global service contact information.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 PRECAUTIONS

1.1 Hazard Symbols

The following symbols are used throughout this manual and/or on your equipment to draw your attention to important warnings, guidelines, and product information. Please take note of their respective meanings.

Symbol	Description
	The "**HAZARD WARNING**" symbol is used whenever a hazard exists which could cause personal injury or potential equipment damage, and requires correct procedures/practices for prevention.
	The "**IMPORTANT INFORMATION**" symbol is used to identify operating procedures which must be followed to ensure smooth and efficient equipment operation.
	The "**PLEASE NOTE**" symbol is used to draw attention to additional information which may assist in the operation of the equipment.
	The "**ELECTRICAL SHOCK/ELECTROCUTION**" symbol is used to identify a source of potentially dangerous electrical current.
	The "**ELECTROSTATIC DISCHARGE**" symbol is used to identify equipment which is sensitive to electrostatic discharge.
	The "**BURN HAZARD/HOT SURFACE**" symbol is used to identify surfaces which are hot enough to cause personal injury.
	The "**SLIPPERY SURFACE**" symbol is used to identify a potential hazard caused by a slippery surface.
	The "**MOVING PARTS**" symbol is used to identify a potential hazard from moving parts inside the machine compartment.
	The "**HAND CRUSH/FORCE FROM BELOW**" symbol is used to identify a potential hazard from moving parts inside the chamber.

Symbol	Description
	The “**PROTECTIVE EARTH-GROUND-MANDATORY ACTION**” symbol is used to identify the protective earth connection.
	The “**PROTECTIVE EARTH-GROUND**” symbol is used to identify the protective earth connection.
	The “**WEAR EYE PROTECTION-MANDATORY ACTION**” symbol is used to identify areas where eye protection is mandatory.
	The “**OPTICAL RADIATION**” symbol is used to identify areas where exposure to ultraviolet (UV) and infrared radiation may be possible.
	The “**FALL HAZARD**” symbol is used to identify a potential hazard of falling from elevated surfaces.
	The “**READ THE OPERATOR MANUAL**” label is intended to remind the user to have a thorough understanding of the equipment BEFORE use.

1.2 Hazard Warnings

Please note the following hazard warnings before operating or maintaining this equipment.

This equipment is only to be operated and maintained by authorized personnel – that is, personnel who have read this manual, been trained on the proper operation and/or maintenance of the equipment and who are qualified tradespeople such as electricians, plumbers, and refrigeration mechanics.

If in doubt about safe operation and/or maintenance of the equipment, contact the responsible party immediately.

Before operating the chamber, conduct a visual inspection of the equipment and surrounding area by walking around the unit to ensure no debris or obstacles are present that could pose a safety hazard

Before starting, the operator should ensure that all electrical boxes are in the closed position and that no one is present in the chamber – either servicing or working within/on the unit.

Before connecting to main building services, inspect all connections. Shipping vibration can cause electrical and plumbing connections to loosen.

Ensure that no one is using, or could activate the room remotely, during operation or maintenance activities by temporarily disconnecting the Ethernet.

When a schedule is not running, alarms are disabled. No one other than a single, designated on-site service technician should be operating the chamber. Altering output parameters to troubleshoot a chamber, while others are handling mechanical or electrical systems within the chamber, *could be hazardous and may result in personal injury*. As such, manipulation of output parameters must be performed with either a qualified service technician present or by way of phone support with Conviron's Technical Services group.

Qualified trades-people such as electricians, plumbers, refrigeration mechanics, etc. should perform all work as required by local codes and regulations.

Refrigeration lines can be very hot when the chamber is operating. For safe operation, insulate hot gas lines on site to prevent inadvertent contact, i.e. exposed refrigeration lines.

Take all appropriate safety precautions when using and maintaining this equipment – including wearing appropriate safety apparel and using appropriate tools.

Use only original replacement parts when maintaining and servicing the equipment. If in doubt about safe operation and/or maintenance of the equipment, contact Conviron immediately.

Procedures in this manual involve working on or near high voltage equipment. *Do not* attempt them unless you have appropriate knowledge and experience.Take appropriate safety precautions.

Caution must be exercised when refrigerant is purged through hoses. Refrigeration charging should only be conducted by a licensed refrigeration technician.

Decibel readings of up to a maximum of 82 dBA can be expected inside your chamber. Actual decibel level will be dependent on your model configuration and system operation. Your chamber may come equipped with a decibel reduction feature, which should be used at all times while inside the chamber. If the decibel reduction feature is not provided, or is not utilized, appropriate hearing protection must be used instead.

Working with high voltage will be required when installing this equipment. *Do not* attempt this work unless you have the appropriate knowledge and experience.

Disconnect and lock out the main power before servicing the equipment.

The main terminal in the control panel has live voltage unless the external breaker is OFF. Use extreme caution when working on the control panel to prevent injury.

Water coming into contact with the electrical components presents a high voltage hazard. Avoid these conditions. If you have any doubt of safe watering practices, contact Conviron.

The control system may come equipped with an optional Uninterrupted Power Supply (UPS) and power will remain live for a period of time even if the power supply is turned OFF. Use extreme caution when working on the control panel to prevent injury. If you have any doubts as to whether your unit comes equipped with a UPS, contact Conviron.

Inside the control panel is an independent temperature shut-off device called the ir33. This ir33 acts as a secondary fail-safe protector that shuts off the chamber if its temperature limits are exceeded. The ir33 is set by Conviron and is factory protected (requires Access Level 3). The factory setting for the ir33 temperature limit is ten degrees beyond the chamber operating range. The standard operating range of a chamber is +4˚C to +45˚C while the standard ir33 shutdown settings are -6˚C to +55˚C, depending on the size of the chamber, size of the compressor, and other factors. The ir33 is located inside the control panel where there is live high voltage. Contact Conviron Client Services for more information or help if necessary.

Do not service the control panel without using proper ESD procedures, including the use of a grounding strap and/or anti-static mat.

	*Do not* look directly at the lamps while in operation. Use adequate UV eye protection when working under HID lamps. Also wear protective clothing and gloves.
	*Never* check evaporator fans for free movement while power remains ON. Perform visual and auditory checks to ensure circulating fans are operating.
	*Do not* touch the heaters. The hot surface presents a burn hazard. High Intensity Discharge (HID) lamps can cause serious skin burn and eye inflammation from short-wave ultraviolet radiation if the lamp envelope is punctured or broken. Do not use if individuals will remain inside the chamber for more than a few minutes unless adequate shielding or other safety precautions are used. The arc tube of Metal Halide lamps is designed to operate under high pressure at temperatures up to 900°C. If ruptured, the outer bulb may break causing very hot glass to be discharged into the surrounding area with a risk of property damage or personal injury. To reduce the possibility of arc tube rupture: • Operate lamps only at the recommended operating position. • Operate lamps with proper circuits and auxiliary equipment. • Use only in enclosed fixtures capable of withstanding particles of glass having temperatures up to 1000°C. • Do not scratch or subject the outer bulb to pressure. This causes it to crack or shatter. If the outer bulb is broken or shattered, turn off and replace the lamp to avoid possible injury. Protect lamp base, socket and wiring from moisture, corrosive atmospheres, and extreme heat. Be careful handling or disposing of these lamps. A partial vacuum in the outer bulb may cause glass to fly if struck. Avoid skin contact with any of the contents if the arc tube is broken. Lamps require 10 to 20 minutes to relight when power is interrupted. Let the lamps stabilize in color when turned on for the first time. This may require several hours and more than one start. Lamp color is also subject to excess vibration or shock. Color appearance may vary between individual lamps.
	Operators should note that water may accumulate on the floor which could be slippery and pose a safety hazard. Always ensure floors remain dry and operators wear non-slip footwear.
	Ensure that appropriate fall protection equipment and fall arrest system is in place before starting work on the roof of the chamber.

2 INTRODUCTION & DESCRIPTION

Thank you for choosing Conviron products. Building quality products and serving our customers well has earned our reputation as the world leader in controlled environment technology. Conviron manufactures a diverse lineup of reach-in chambers, walk-in rooms, and custom engineered solutions for a variety of applications where strict controls of temperature, humidity, lighting, and other parameters are required. This is a general Operations and Maintenance manual based on the commonalities of products within Conviron's diverse product line. For specific questions on product features not covered within the scope of this manual, please contact the Customer Service Department.

2.1 Warranty Service

In the event warranty work is required, contact the distributor in your area or visit www.conviron.com for global service contact information.

Conviron also offers extended warranties.

2.2 After Warranty Service

Conviron maintains a network of authorized service centers and can assist you in finding other reputable service providers in your area.

Alternatively, you may wish to use your own maintenance staff. Conviron provides technical support and runs regular service schools to provide additional training. For further details, contact the Customer Service Department.

When contacting Conviron, please be prepared with the model and serial number of the equipment. It is also helpful to have specific information as to program settings and ambient conditions.

2.3 Equipment Safety

Do not allow water to come into contact with the electrical components, as it presents the risk of water damage to both high and low voltage electrical components. If you have any doubt of safe watering practices, contact Conviron.

2.4 Static Sensitive Items

Your equipment may come equipped with static sensitive components, such as a CO_2 monitor. Static sensitive equipment require following proper Electrostatic Discharge (ESD) precautions. If you are unsure, please contact Conviron.

2.5 Work Station

The operators' workstation will either be at the control panel, mounted on the chamber, or remotely mounted in close proximity to the chamber. Managing the chamber controls is also possible through the Central Management™ (CM) System.

2.6 Installation

Contact Conviron if you need technical support during the installation of your chamber.

2.7 Conviron Testing Methods

After power is connected to the unit, the software is installed in the control system. The circuits are checked at this point to ensure they are functioning correctly. Initial check-off sheets are completed as the circuits are checked for correct operation.

The unit is charged with refrigerant, the operating pressures are set, and the pressure controls are set for safe operation of the chamber. Pull down temperature tests are conducted with a full lighting load to determine if the chamber performs correctly. Humidity tests are performed with both lights on and off. These tests are recorded along with temperature charts, and placed in the chamber's service file. These records are the actual recording instrument sheets used to verify equipment control and performance.

Before shutdown of the chamber, final checks are done on the circuits as well as visual inspection for refrigeration leaks, as per final test inspection. Each chamber has amperage draws recorded and the unit is signed off before being shipped.

Changes from standard ambient conditions (i.e. 21ºC and 50% RH) have a direct effect on the performance of each chamber. During periods of high ambient temperatures, the air-cooled units may experience high head pressures. High or low humidity in the building may produce unexpected results in the chambers having fresh air intakes.

2.8 Quality Standards

Conviron is registered to ISO 9001:2015. This internationally recognized quality standard was selected to guide us in providing world class service and products and to embrace continuous improvement.

Conviron products are designed using North American and European safety standards. For North America, Conviron products are CSA and TUV certified. For Europe, Conviron applies the CE mark.

3 START-UP & OPERATION

3.1 Factory Settings

All Conviron reach-in equipment is fully tested as a unit at the factory, while control panels and lamp canopies for walk-in units are factory tested. Before shipping, all switches and breakers are turned to OFF.

3.2 Chamber Operation and Maintenance Summary

Following these procedures help ensure your chamber responds properly to commands from the control system. This is not a complete maintenance schedule. Please refer to Chapter 4 CLEANING & MAINTENANCE for more details.

3.2.1 Start-up Procedures

If the chamber has been powered OFF for one hour or more, follow the chamber start-up procedure.

3.2.2 Setting Appropriate Alarm Levels

Protect your experiments from accidental over or under heating by adjusting the user settable high and low temperature tracking limit settings or the maximum/minimum temperature for your program.

Refer to the control system operator manual for further details.

3.2.3 Clean Equipment

- Clean the chamber drain pan and drain line regularly. Water backing up in the pan will damage chamber components. Clean the machine compartment, drain pan, and drain line regularly. Power off the unit prior to cleaning.
- Clean the condenser cooling fins regularly for efficient operation on chambers equipped with air-cooled refrigeration systems. Be careful not to fold fins over during cleaning.
- Clean chamber lamps, if necessary, for maximum lighting efficiency. Users can set a warning message to pop up at the control system display as a reminder.
- Clean the chamber internal walls regularly for maximum reflectance. Use a mild, nonabrasive, soap solution.

3.3 Safety

3.3.1 High Voltage Electrical Disconnect Switch

The main disconnect switch for walk-in chambers is located on the outside of the control panel. It turns off the high voltage electrical supply to all components within the unit and is used when performing maintenance.

Electrical power remains at the main terminals. Use extreme caution during maintenance procedures to prevent injury.

The control system may come equipped with an optional Uninterrupted Power Supply (UPS) such that power will remain live for a period of time even if the main power supply is disrupted or turned OFF. Use extreme caution to prevent injury. If you have any doubts as to whether your unit comes equipped with a UPS, contact Conviron.

3.4 Starting Your Chamber – DX Systems

3.4.1 Before Starting the Unit

- Check that the proper electrical power is connected to the main terminal beside the MAIN SERVICE CONNECTION label.
- Ensure all breakers are ON.

3.4.2 Visual Checks

Inspect the following before start-up:

1. Check the evaporator fan for free movement. Some chambers have a separate breaker for fans.

To avoid injury, never check evaporator fans for free movement while power remains ON.

2. Check that all lights function when turned ON.
3. Check that the doors are light tight. Inspect the doors with interior lights on, in a darkened room.
4. If your chamber has centrifugal atomizing humidifiers, program %RH to maximum. Check that mist is being generated.

3.4.3 Start-up Procedures

To start-up the chamber:

1. Ensure that all drain lines, water lines, or refrigerant lines on units with a remote or air-cooled condenser are connected.
2. Select and run a program. Refer to the control system manual for detailed instructions. Do not turn the control system OFF during boot up.

3. The Chamber is shipped with the refrigerant valves closed. For a water cooled condenser, open the manual bypass valve; if the chamber is equipped with variable water supply, close the valve.
4. With the control system powered up, set and run a program. Refer to the control system manual for further details.

Operate your Conviron equipment for a few days before introducing any plant material. This acquaints you with the equipment operation and ensures the equipment meets the requirements for your experiments.

3.5 Starting Your Chamber – Direct Cooled (GLY) Systems

Conviron recommends the following checks be performed before starting the chamber.

3.5.1 Before Starting the Unit

1. Check that the proper electrical power is connected to the main terminal beside the MAIN SERVICE CONNECTION label.
2. Ensure all breakers are ON.
3. Open all hand valves on the pump stand.
4. Open all manual air vents. Ensure automatic air vents are open.
5. Fill the system main lines with glycol.

3.5.2 Visual Checks

Inspect the following before start-up:

1. Check the evaporator fan for free movement. Some chambers have a separate breaker for fans.

Never check the evaporator fans for free movement while the power remains ON. Contact with moving fan blades could cause serious injury.

2. Check that all lights function when turned on.
3. Check that the doors are light tight. Inspect the doors with interior lights on, in a darkened room.
4. If your chamber has centrifugal atomizing humidifiers, program %RH to maximum. Check that mist is being generated.

3.5.3 Start-up Procedures

To start-up the chamber:

1. Ensure that all drain lines, water lines, or refrigerant lines on units with a remote air-cooled condenser are connected.
2. Turn main switch to ON.
3. With the control system powered ON, set and run a program. Refer to the control system operator manual for further details.
4. Turn the START/STOP selector switch to ON (where preset).
5. Purge air from the pump to avoid air locks in the line. Gradually open the valve to the coil (or circuit setter/flow regulating valve to first coil on multi-coil rooms). Purge air from the coil using the air vent located on the return line near the rear of the coil housing.
6. For multi-coil rooms, after air is purged from the first coil, slowly open circuit setter to subsequent coils in turn to purge air from them.

3.6 Lighting – Fluorescent and Incandescent

3.6.1 Fluorescent and Incandescent Combination

A typical lamp canopy includes fluorescent and incandescent lamps. However, other types of lamps and configurations are common. Lamps should be changed regularly, as intensity diminishes with use. Refer to the lamp manufacturer's specifications.

All control outputs including lighting are logged and it is possible to determine how long lights have been on. Users can set a "warning" message to pop up at the control system display as a reminder.

3.6.2 LIGHTRIGHT®

Some Conviron units feature a LightRight canopy which is counter balanced to provide easy height adjustment to compensate for aging lamps and growing plants. The LightRight canopy lets you maintain consistent lighting levels. Movable parts on these canopies are maintenance free.

Fluorescent lamps lose intensity over time although newer generation lamps are much better in this regard. Contact the lamp manufacturer for more information.

Fluorescent lamp intensity is affected by temperature. Chambers equipped with barriered lighting systems keep lamp temperature more constant regardless of setpoint and therefore are not significantly affected by chamber temperature.

3.6.3 Dimmable Lighting

With improvements in fluorescent lighting technology, a demand for dimmable lighting has emerged. Conviron has met this demand by providing either closed or open loop dimmable lighting on select chambers.

Prior to operating dimmable fluorescent lamps, you are required to run the lamps at full intensity for a period of 100 hours. New lamps contain impurities on the filaments (ends) of the lamps. The burn time burns off these impurities.

If a lamp is not burned in, it will reduce the life of the lamp. Running the lamps at 90% will burn the impurities off; however; it will take slightly longer than running at 100%. If run at 10% intensity, the impurities will have a greater effect on the lamp, such as blackened ends, reduced lamp life, and flickering. These effects vary between lamp manufacturers.

When the lamp is run at the lowest setting, the lamp life is reduced by half, which is 10,000 hours for a lamp that has a life of 20,000 hours.

Programmable settings are in micromoles and the maximum setpoint values will depend on the chamber.

3.7 Lighting – High Intensity Discharge Lighting (HID Option)

Do not look directly at the HID lamps while in operation.

The lamps are very bright and high intensity light can be harmful to your eyes. Use caution when working with high intensity light equipped chambers.

Use adequate UV eye protection and cover exposed skin when working under HID lamps. Alternatively, dim or turn off some or all banks of HID lamps depending on the lighting control option.

The three types of HID lamps commonly used are: high-pressure sodium (HPS), metal halide (MH), and more recently ceramic metal halide (CMH). HPS lamps are very efficient, but lack sufficient blue light, HPS and MH lamps are often used 50%/50% together to provide a balanced spectral blend. Ceramic metal halide HID lamps have a broad spectrum that more than covers the combined spectrum of HPS and MH lamps.

The HID lamp canopy may require a light barrier with several protective functions, including:

- Protecting the user and the plant material from injury in the rare event that a lamp shatters. Most often, this applies to MH lamps. The lamps *must* be rated for use in an *open* fixture for any HID lamp to be operated without a solid protective barrier.
- Screening out excessive levels of UV radiation that could occur if the protective glass envelope of the HID lamp was broken.

Immediately replace any HID lamp with a cracked or fractured outer glass envelope regardless of whether or not there is a protective glass barrier in the chamber design.

- While not a protective safety function, barriered lamp canopies (with separate cooling) are often used to minimze the amount of heat dissipated in the plant growth area. This enables higher relative humidity settings when the lights are on.
- Accommodating easy removal for cleaning, which should be done at regular intervals to maximize light levels.

Not every Conviron chamber using HID lamps has a solid tempered glass barrier included as part of the design. An open grid wire barrier may be used in some applications to prevent accidental contact with a hot lamp.

3.8 General Design

3.8.1 UNIFLOOR®

The Unifloor is a unique floor design that ensures uniform conditions throughout the entire growth area. Plant material is placed directly on the floor and does not need to be moved. This allows excess irrigation water to drain away, ensures the drainage area is clear of debris, and drain lines flow freely for accurate humidity control.

3.8.2 Aspirator

The aspirator is located inside the growth area and is shielded from radiant energy to prevent false readings caused by the chamber lighting.

3.8.3 Aspirator with Dry Humidity Sensor

If the chamber has an additive humidification option, a dry humidity sensor (Figure 3-1) reads the humidity level.

3.8.4 Portable Aspirator

A portable aspirator (Figure 3-1) is a metal container used in walk-in rooms and some reach-ins for all controlling and recording sensors for temperature, humidity, and optionally for CO_2 and light. The aspirator receives an air sample from the room to measure and control conditions. Place the aspirator in the growth area with the sensors (bottom) located at the same height of the plant leaves or by hanging it as centrally as possible relative to the lighting configuration. For improved chamber uniformity (for CMP control systems only), a second aspirator is possible.

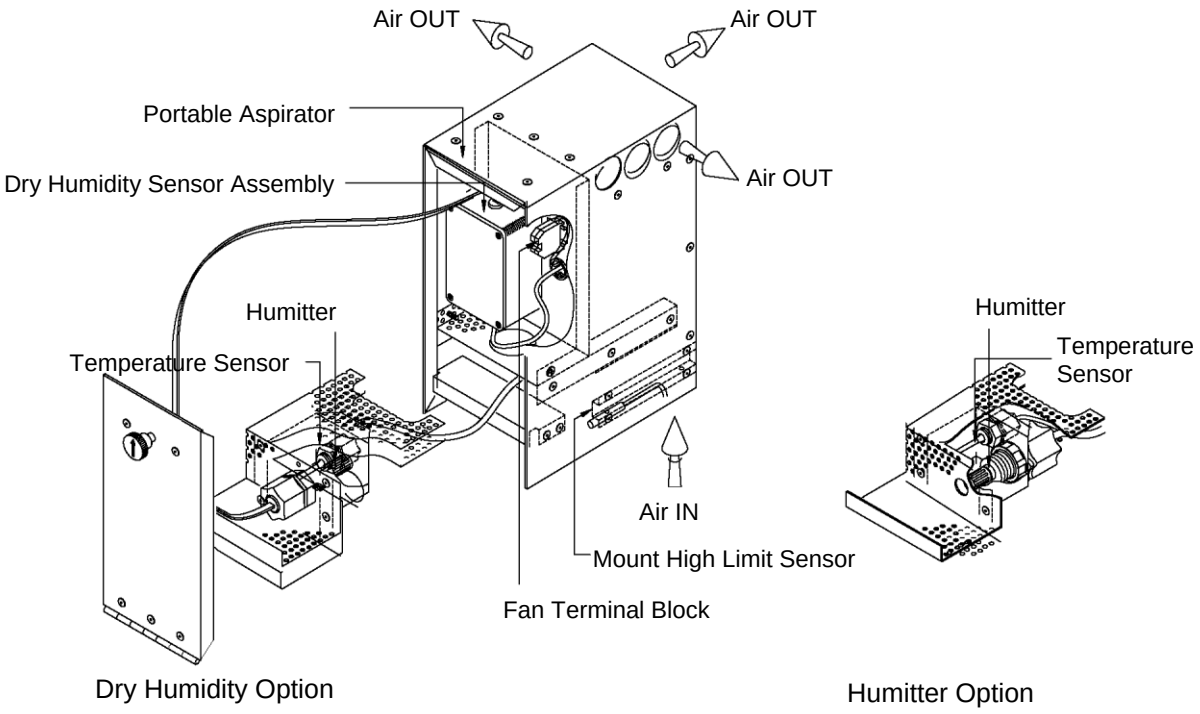

Figure 3-1 Portable Aspirator

Some chambers are equipped with a hanging portable aspirator (Figure 3-2) designed to hang by a chain from the light canopy. Reach-in chambers in the 15 and 20 Series aspirators may be mounted on a bracket (Figure 3-3) and attached to the pilasters on the walls of the chamber.

All controlling and alarm sensors are contained within.

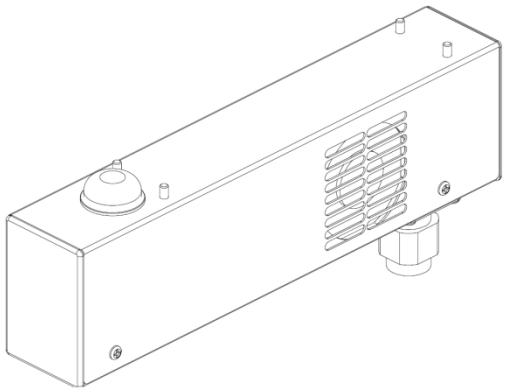

Figure 3-2 Hanging Portable Aspirator

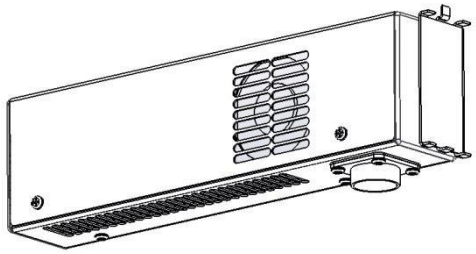

Figure 3-3 Track Mounted Portable Aspirator

3.9 Refrigeration

3.9.1 Single Evaporator Defrost System (DFT Option)

When a chamber operates near or below the freezing point of water, there is the danger of ice forming on the evaporator. To prevent this, Conviron uses an automatic defrost option as part of the control system software. This option is activated whenever the chamber temperature setpoint is set below a pre-programmed threshold and functions without the need for any further operator intervention.

The control system begins a defrost cycle when the actual temperature and setpoint is below the threshold temperature setpoint value (typically factory set at 8°C). The cycle consists of three phases:

1. Control Interval - The interval the unit cycles through to defrost. Every 180 minutes the unit defrosts.
2. Defrost Interval - During defrost, the time hot gas is circulated through the chamber evaporator coil to defrost the coil, until the coil temperature exceeds 4°C or a maximum of 10 minutes.
3. Fan Delay Interval - The amount of time the fan is shut off during the defrost interval to provide a cool down period after defrosting. Normally this interval is 2 minutes.

These three periods add up to the defrost cycle period. Refer to Table 3-1.

After the Control Interval has expired, the control system begins the defrost interval by switching off the circulating fans, chamber lights (or the lights can be set at the factory to be controlled during the defrost interval), and control heaters. The control system then switches to full heating (diverting hot gas through the evaporator and energizing electric defrost heaters, if so equipped).

After the Defrost Interval, the control system begins the Fan Delay Interval, switching from full heating to cooling (diverts liquid refrigerant to the evaporator and de-energizes any defrost heaters that may be on). The fans and chamber lights remain off, giving the evaporator time to reach its programmed temperature. The fans come on once the control system enters the next control period. The chamber lights are controlled during this period.

The chamber temperature may rise above the temperature setpoint and/or the threshold temperature setpoint during a defrost cycle. The control system will reset the defrost cycle timer (180 minutes) if this occurs during the control portion between defrost cycles. The control system will complete the cycle up to the end of the fan delay, and then terminate the defrost cycle if it occurs during the actual defrost or fan delay segments.

Table 3-1 Single Evaporator Defrost System

		Defrost Cycle Period [1]	
Components	Control Interval [2]	Defrost Interval	Fan Delay Interval
Fans	On	Off	Off
Burst Heaters	Controlled	Off	Controlled
Lights	Controlled	Off or Controlled (setting)	Controlled
Defrost Heaters (Optional)	Off	On	Off
Prop. Valve	Controlled	On/Heat	Controlled

NOTES:
1: Defrost Cycle Period = Defrost Interval + Fan Delay Interval
2: Controlled period indicates normal thermostatic or time line control

3.9.2 Optional Additive Humidity Control (with DFT Option)

Units provided with optional humidity control must have water drained from within the chamber when operating the unit below freezing temperatures. This is done automatically by a drain down system activated by the control system and purged by compressed air. (Compressed air must be supplied by the client.)

3.10 Shutdown

Should the chamber not be used for a period of approximately 2 weeks (or less), it is best to keep it running (temperature at/near ambient and fans running only). If experiments will not be run for a period of two weeks or longer, to minimize unnecessary electricity consumption, ensure all plants and soil are removed from the growth area, clean the unit as described in Section 4, CLEANING & MAINTENANCE.

Turn off the lights, and leave the chamber doors open slightly to reduce moisture buildup.

Contact Conviron if you are unsure.

4 CLEANING & MAINTENANCE

4.1 Cleaning

Prior to beginning a new experiment, thoroughly clean the exterior and interior of the cabinet. Repeat the thorough cleaning at three month intervals for long-term experiments.

- Clean the chamber and machine compartment drain pans and drain lines regularly.
- Clean the chamber lamps, if required, for maximum lighting efficiency.
- Clean the chamber internal walls regularly for maximum reflectance.
- On air cooled self-contained chambers, inspect to ensure the air cooled condenser fins are free of dust and debris. Use a fine brush and vacuum to clean the fins, or use nitrogen or low pressure compressed air to clean the fins.
- Avoid using high pressure washers or high pressure gases as this could cause damage to the aluminum fins (Max. pressure 60 psi).

4.1.1 Recommended Cleaning Solutions

- Soap and Water
  - Mix a solution of two teaspoons (10 milliliters) of liquid detergent in two quarts (2 liters) of warm water.
  - Wipe the surface with a soft cloth saturated in the solution.
- Vinegar and Water
  - Mix a solution of one part white vinegar to 20 parts warm water.
  - Wipe the surface with a soft cloth saturated in the solution.
- CLR®
  - Use either CLR Pro Metal Cleaner or CLR for Stainless Steel.
  - Always try a sample area that is not noticeable in case of an adverse reaction to some of the painted aluminum.
  - Always follow the instruction provided and safety guidelines with the product.

4.1.2 Clean the Plastic Light Barrier, Plexiglas® Doors & Tempered Glass

Light barriers, where applicable, must be cleaned often to allow maximum intensity. Clean the barrier after each experiment.

- Disconnect the power at the main breaker before cleaning inside the chamber.
- *Do not* spray water directly into the growth chamber while cleaning. The inside of the chamber contains sensors and other electrical components.

Do not touch the hot lamps. High lamp temperatures can cause severe burns. Allow the lamps to cool before cleaning.

- *Do not* rub vigorously. This solution will remove average dust and fingerprint.
- *Never* rub the plastic with a dry cloth, paper, or your hand to remove dust particles. Scratching or hazing will result if the plastic is rubbed while dry. In addition, dry rubbing sets up a static charge in the plastic, which attracts dust. Always use the detergent solution.
- Under extreme dust conditions, a light film of liquid wax will help protect the plastic from dust abrasion.
- Do not scratch the surface of the specular aluminum panels.

To clean plastic light barriers and Plexiglas doors:

1. Ensure the main disconnect switch is OFF.
2. Use the soap and water solution to clean the light barriers.
   a. Wipe the surface with a soft cloth saturated in the solution.
   b. Allow the mixture to set on the glass for a few minutes to penetrate any dirt and grime that may be present.
   c. After a few minutes, use a sponge or soft cloth to remove the mixture.
   d. Rinse with a soft cloth saturated in fresh, clean water.
   e. Buff with a soft cloth to restore the shine.

Any commercial spray cleaner specifically designed and approved for use on acrylic panels may be used in place of liquid solutions.

Under extreme dust conditions, a light film of liquid wax will help protect the plastic from dust abrasion.

To clean the tempered glass barriers:

1. Ensure the main disconnect switch is OFF.
2. Use the vinegar and water solution to clean glass barriers.
3. Wipe both sides of glass and wipe dry with a soft cloth or mild glass cleaner.

4.1.3 Baked Enamel Exterior Surfaces

The easy-to-clean baked enamel exterior surfaces should be wiped regularly with a damp cloth. Occasionally use a polish to restore the original luster.

Never use an abrasive or alkaline solution on the baked enamel exterior finish.

To clean the chamber baked enamel exterior walls and door surfaces:

1. Use the soap and water solution to clean the chamber exterior walls and doors.
2. Wipe the surface dry with a soft cloth.

4.1.4 Interior Surfaces

Ensure the main disconnect switch is OFF.
Do not spray water or cleaning solutions directly into the growth chamber while cleaning. The inside of the chamber contains sensors and other electrical components which could be damaged.

It is important that the interior of your cabinet be cleaned periodically beginning with the initial installation. Spillage of fertilizer solutions causes objectionable odors.

To clean chamber interior surfaces:

1. Use the soap and water solution to clean the interior surfaces, beginning with the initial installation.
2. Wipe the surface dry with a soft cloth.

Spillage of fertilizers, nutrients, or pesticides may cause objectionable odors. When this occurs, clean the entire interior with the soap and water solution, and wipe dry.

To clean the observation door panels:

1. Use the vinegar and water solution to clean glass doors and wipe both sides of the glass.
2. Wipe the surfaces dry with a soft cloth.

Stainless Steel

Clean frequently with a damp cloth.

To clean stainless steel panels:

1. Use the soap and water solution or a diluted isopropyl alcohol solution to clean the stainless steel panels.
2. Wipe the surface dry with a soft cloth.

Commercial glass cleaner will remove fingerprint smudges.

4.2 Maintenance

This equipment is only to be used and maintained by authorized personnel - that is, personnel who have been trained on the proper operation and/or maintenance of the equipment and who have read this manual.

Contact the responsible party, or Conviron, immediately if in doubt about safe operation and/or maintenance of the equipment.

Ensure that appropriate fall protection equipment and fall arrest system is in place before starting work on the roof of the chamber.

Electrical power remains at the main terminals. Use extreme caution during maintenance procedures to prevent injury.

The control system may come equipped with an optional Uninterrupted Power Supply (UPS) such that power will remain live for a period of time even if the main power supply is disrupted or turned OFF. Use extreme caution to prevent injury. If your unit comes equipped with a UPS, it will be located in the control panel.

Contact Conviron if in doubt.

To avoid injury, only perform visual and auditory checks to ensure circulating fans are operating.

The chamber requires regular maintenance in order to continue performing to specifications.

To ensure that you have reliable performance from your Conviron equipment, the following the recommended maintenance schedules will minimize the need for service.

4.2.1 Maintenance Schedules

Table 4-1 identifies the frequency of required maintenance to be completed by users and administrators.

Table 4-1 User & Administrators Maintenance Schedules

Standard Features	Before New Experiments	Daily	Monthly	Semi-annually
Temperature, Humidity, CO_2 Processes, & Lamps	•	•		
Circulating Fans, Intake and Exhaust Ports, Fresh Air Inlet Filter, and Aspirator Fans*	•		•	
Interior	•		•	
Sight Glass			•	
Drain Pan & Strainer, Canopy Cables	•			•
Refrigeration Faults, Water Supply & Drain, Door Gaskets				•

* Aspirator fans typically fail due to exposure to dirt and water splash. Relocation of the aspirator may also create problems with controllability of the chamber.

Optional Equipment	Before a New Experiment	Daily	Monthly	Semi-annual
SNH Additive Humidity System	•		•	
Separate Coil Dehumidifier	•		•	
Air Cooled Condenser	•		•	
CO_2 System	•		•	
Humidity Sensing Unit, Dry Humidity Sensor, Humidity Transmitter Calibration, Additive CO_2 System				•

Maintenance personnel:

- Visually inspect the lamps and replace where necessary.
- Ensure the temperature in the chamber is as programmed.

Monthly

In addition to the regular daily maintenance:

- Inspect the sight glass, Section 4.4 Sight Glass starting on page 26.
- Inspect the circulating fans, Section 4.5 Circulating Fans starting on page 27.
- Clean the air intake filter, Section 4.6 Fresh Air Inlet and Exhaust Port starting on page 27.

Each a New Experiment

In addition to the regular daily and monthly maintenance:

- Check the sensor calibration, Section 4.11 Sensor Calibration staring on page 31 to ensure the readings are within the programmed parameters.
  - Humidity, Section 4.12 Humidification Systems starting on page 32.
  - $C0_2$ control, if so equiped, Section 4.16 Additive Carbon Dioxide Control (CO2 Option starting on page 38.
- Monitor the humidity spray nozzles to ensure they are performing at 100%. If there is an oil fillter in the air line into the humidity system, regular filter maintenance should be performed at the end of each experiment.

Semi-Annually

In addition to the regular daily and monthly maintenance:

- Contact Conviron, or have a refrigeration service technician check the unit to prevent any small fault developing into a major breakdown. Ask the technician to report operating pressures, which the factory will review if necessary. Refer to Section 4.10 Refrigeration starting on page 31.
- Check door hinges and latches, Section 4.7 Doors starting on page 28.
- Clean the water strainer, if so equipped and all drain traps, Section 4.8 Water Supply & Drain starting on page 29.
- Clean the water-cooled condenser, Section 4.15 Cooling Tower Option (CTO Option) - Bypass starting on 37.
- Check the chamber Vaisala™ humidity sensor against an independent humidity sensor, Section 4.12.1 Maintenance starting on page 32.
  Calibration is recommended every two years. Refer to Section 4.12.1.1 Calibration Checks starting on page 33.

- Check the chamber Vaisala CO_2 sensor against independent CO_2 sensor, Section 4.16.4 Maintenance starting on page 40.
  Calibration is recommended every two years. Refer to Section 4.16.5 Calibration starting on page 40.
- Inspect the canopy cable, if so equipped, Section 4.13 Canopy Cables starting on page 37.

4.3 Machine Compartment Access – Reach-in Chambers

The top mounted machine compartment on the 20 Series reach in chambers is open to allow access to the refrigeration, electrical, and optional humidity control components.

Figure 4-1 shows an example of the top view of the machine compartment on reach-in chambers.

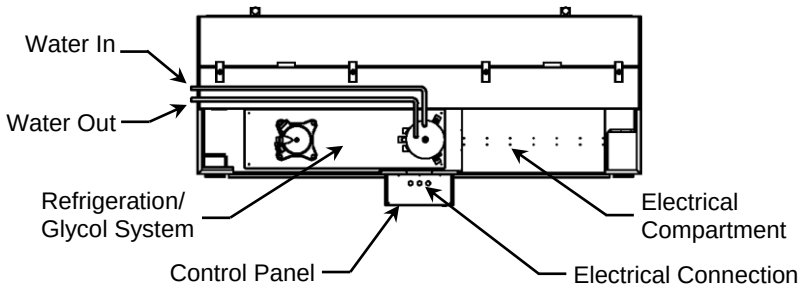

Figure 4-1 Top Mounted Machine Compartment

The bottom mounted machine compartment on the 15 Series reach in chambers is enclosed for protection. Access to the refrigeration and optional humidity control components is covered by a removable panel at the rear of the chamber.

Figure 4-2 Bottom Mounted Machine Compartment

4.4 Sight Glass

The sight glass visually indicates the presence of excessive moisture in the refrigerant, or if the refrigerant level is low. The sight glass (Figure 4-3) is located near the condenser in the machine compartment of reach-in chambers. Table 4-2 lists the locations for walk-in chambers.

Table 4-2 Sight Glass Locations for Walk-In Chambers

Walk-In Chamber	Sight Glass Location
Outdoor Air Cooled Units (OACU)	Located with the condensing unit
Remote Air Cooled Units (RAC) Water Cooled Units (W/C)	Located close to the chamber, either on top or beside

To inspect the sight glass:

1. A solid green dot indicates the refrigerant is dry. A yellow dot indicates the refrigeration contains moisture.
2. There should be no bubbling during the COOL cycle. Bubbles in the sight glass indicate the refrigerant level is low.
3. Contact Conviron, or a Conviron approved refrigeration service technician, if the dot is yellow or there are bubbles in the sight glass.

Figure 4-3 Sight Glass Example

4.5 Circulating Fans

Ensure the circulating fans are operating smoothly.

A fan speed setting of 0% on the control system display does not stop the circulating fans. The fans must operate at a minimal rate at all times to ensure the refrigeration system has adequate airflow over the evaporator coil.

The unit must be ON for this check. To avoid injury, only perform visual and auditory checks to ensure circulating fans are operating.

4.6 Fresh Air Inlet and Exhaust Port

During regular operation the fresh air inlet filter should be inspected once per month and cleaned as required.

To clean the fresh air inlet filter:

1. Remove foam filter from threaded air intake port.
2. Clean the filter by vacuuming to remove and rinsing with warm tap water (Wash the filter with the soap and water solution, if necessary, and rinse the filter thoroughly in fresh running water).
3. Allow filter to dry completely.
4. Re-insert the completely dry foam filter back into the threaded air intake port.
5. Inspect and clean the exhaust port, as required.

4.7 Doors

The door gaskets must seal completely and the door hinges must be properly aligned to maintain conditions within the chamber. Figure 4-4 shows an example of a poor door seal.

To test the door gasket seal:

1. Close the door(s) on a piece of light paper at the intervals of approximately six inches around the perimeter of each door. Adjustments can be made to the door catches or hinges.

Figure 4-4 Door Seal Test

2. When the seal is proper, a substantial drag should be felt when attempting to remove the paper with the door completely closed.
3. Contact Conviron if the door seal appears to leak.

Each hinge is provided with slotted mounting holes on the hinge side of the door.

To adjust the door gasket:

Adjust the strike assembly by either tightening or loosening the screws.

If it becomes necessary to remove the complete door assembly, remove the screws that secure the hinge to the cabinet exterior. In doing so, the gasket pressure originally applied will not be disturbed. To remove doors equipped with cam-lift hinges, simply open doors and lift off. Reach-in doors are fastened with screws and would require unscrewing.

4.8 Water Supply & Drain

Clean the water strainer, if so equipped, to prevent a build-up of contaminants, or water deposits in areas with hard water. A Y-strainer (Figure 4-5) filters out particulate matter in the water supply before the water enters the additive humidity components.

To clean the water inlet strainer:

1. Turn off the water supply at the chamber.
2. Remove the plastic cap on the Y-strainer.
3. Remove the filter cartridge from the Y-strainer fitting.

Figure 4-5 Water Inlet Strainer

4. Rinse the filter cartridge under running water until clean. Use the vinegar and water solution, or CLR, on stubborn deposits. Replacement filter cartridges can be ordered from Conviron, part number 76110.
5. Re-assemble the Y-strainer.

Do not over tighten the cap during re-installation. The plastic threads on the cap will be stripped if over tightened, causing a leak.

6. Inspect and clean the floor drain as required.

4.9 Lighting

The frequency of lamp changes will be determined by application. The height adjustable lamp fixture (not available on all models) lets you maintain consistent lighting levels.

Inspect the lamps daily to ensure that all lamps are functioning properly and replace poorly lit or flickering lamps to ensure unit performance. The frequency of lamp changes will be determined by application.

Dispose of used lamps following the requirements in your area. Contact local authorities for more information regarding disposal procedures.

Ensure the main disconnect switch is OFF before replacing any lamps inside the chamber.

Do not touch the hot lamps. High lamp temperatures can cause severe burns. Allow the lamps to cool before replacement.

To replace a fluorescent lamp:

1. Turn off the chamber.
2. Wait until the canopy and bulb are completely cool before touching either of them.
3. Remove the protective barrier, if so equipped.
4. Rotate the lamp ¼ turn in its socket, and remove it with care.
5. Install the new lamp, and ensure it is locked in its socket by rotating it ¼ turn.
6. Replace the protective barrier, if so equipped.

To replace an incandescent lamp:

1. Turn off the chamber.
2. Wait until the canopy and bulb are completely cool before touching either of them.
3. Remove the protective barrier, if so equipped.
4. Turn the old bulb counterclockwise to remove it from the socket.
5. Check the wattage and type of new bulb to ensure it is equivalent to the old bulb.
6. Turn the new bulb clockwise to install in the socket.
7. Replace the protective barrier, if so equipped.

To replace a high pressure sodium, metal halide, or ceramic metal halide lamp:

1. Turn off the chamber.
2. Wait until the canopy and bulb are completely cool before touching either of them.
3. Wear protective gloves when handling the bulbs.
4. Remove the protective barrier, if so equipped.
5. Turn the old bulb counterclockwise to remove it from the socket.
6. Check the wattage and type of new bulb to ensure it is equivalent to the old bulb.
7. Turn the new bulb clockwise to install in the socket.
8. Replace the protective barrier, if so equipped.

4.10 Refrigeration

Contact Conviron, or a Conviron approved refrigeration service technician, to check the unit to prevent any small fault developing into a major breakdown.

- Refrigeration Fault Check and Operating Pressures

  Ask the technician to report operating pressures, which the factory will review if necessary.
- Water Cooled Condenser

Contact Conviron, or a Conviron approved refrigeration service technician, to clean the water-cooled condenser if the head pressures are higher than normal. Normal conditions will vary depending on the customer supply fluid temperature.

Condensers should be inspected yearly, and cleaned if they are the cleanable type.

Contact Conviron or a refrigeration service technician if head pressures are higher than normal.

4.11 Sensor Calibration

Ensure the humidity, temperature, and CO_2 control (if so equipped) readings are within the programmed parameters. Calibrate by comparing a handheld temperature/humidity meter placed next to the aspirator to ensure the sensors are within specification.

It is recommended that the independent sensor be:

- Shielded from the radiant energy of the lamps.
- Exposed to a flow of air at the rate of 5.99m/s (1189 fpm) for aspirated sensors.

Contact Conviron if the readings of the test instruments do not match the settings of the chamber control system.

4.12 Humidification Systems

The dry humidity sensor (DHS) is included in all humidity systems (except systems for G1000, DR rooms, and the I24L), but can be ordered separately if only monitoring is required.

If your chamber is equipped with optional additive humidification, follow instructions to ensure proper control.

Monitor nozzles to ensure they are performing at 100%. If there is an oil filter hooked up to the air line into the humidity system, regular filter maintenance should be performed at the end of each experiment.

4.12.1 Maintenance

Do not use high pressure compressed air or solvents. *Do not* touch the humidity sensor or sensor surface.

The humidity sensor is protected against mechanical damage by a plastic guard and a membrane filter.

To clean the humidity sensing unit;

1. Remove the humidity-sensing unit by unplugging it from the multi-pin cord connector (Figure 4-6).

- Do not touch the face of the sensing element. Hold it by its edges only.
- Do not expose the sensing element to organic solvents, water, or ionic-laden liquids.
- Ensure the numbered pins are inserted into the connector holes of the same number when reinstalling the sensing unit.

Figure 4-6 Humidity Sensing Unit Removal & Disassembly

2. Remove the protective cover (Figure 4-6) to expose the sensing element.

3. Gently blow off any soot, dust or other particles deposited on the sensor surface with a clean, oil free blast of low pressure air. If dirt remains, brush lightly with a clean camelhair brush.

Do not wash the sensor. If the sensor is very dirty, gently clean the sensor head with a clean, damp, soft cloth.
Dry by blowing gently. *Do not* use high pressure compressed air.

To replace a humidity sensor:

1. Remove the sensor guard.
2. Pull out the defective sensor from the socket.
3. Holding the socket by the connector, insert the new sensor into the socket.
4. Replace sensor guard and membrane filter.
5. Recheck sensor calibration.

4.12.1.1 Calibration Checks

Regular calibration checks are very important. Checking the Vaisala humidity sensor is recommended twice a year. Intervals can be altered later to suit operating conditions.

To check the calibration of a humidity sensor:

1. Check the chamber Vaisala™ humidity sensor against an accurate, independent, preferably NIST traceable, humidity sensor.
2. Simply place the independent humidity sensor in the same location of the chamber humidity sensor and compare readings.
3. If a discrepancy is found, contact Conviron to order a replacement sensor tip, Conviron part number 79828. The sensing tip will drift after a year of operation, typically 2 % a year upward.
4. The membrane should also be changed yearly with Conviron part number 72058.

Refer to www.vaisala.com for further calibration information.

4.12.1.2 Spray Nozzle Humidification (SNH Option)

The frequency of cleaning depends on local water conditions. Use humidity water that meets Conviron published service bulletin SBRH001B specifications.

To clean the spray nozzle humidification system:

1. Turn off water supply.
2. Remove stainless steel spray nozzle head from adapter.
3. Disassemble the nozzle head and remove the slotted core.
4. Clean the orifice in the head by soaking in citric acid solution, ultrasonic cleaner, or CLR for eight hours. Sight through the orifice to see if it is clean.
5. Re-assemble the nozzle head; ensure that the core is securely fastened.
6. Replace the nozzle head in the adapter, turn on the water supply, and check operation.

Do not over tighten the nozzle head when replacing it in the adapter. Damage to the nozzle could occur from overtightening during installation.

Tighten the nozzle head finger firm tight.

A minimum of 60 psi is required to operate spray nozzles.

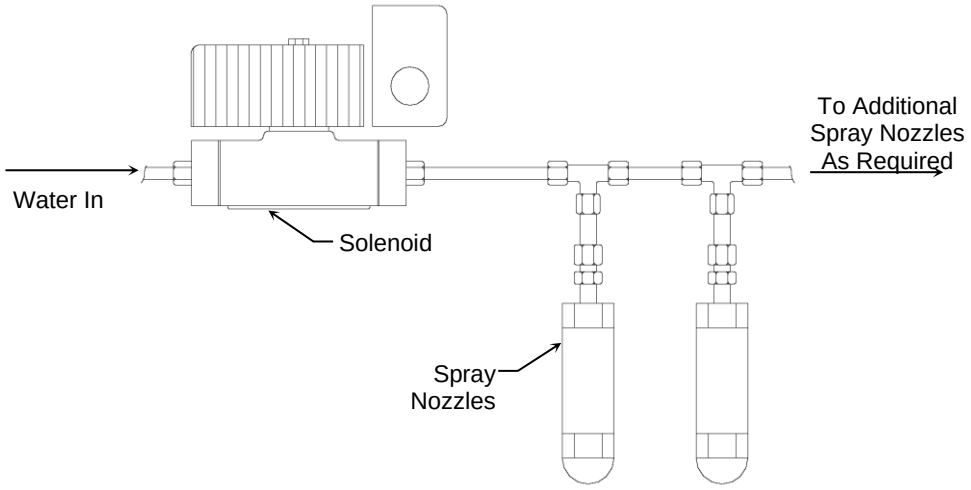

Figure 4-7 Spray Nozzle Humidifiers(s)

4.12.1.3 Air Assisted Spray Nozzle Humidification (ASNH Option)

The frequency of cleaning depends on local water conditions. Use humidity water that meets Conviron published specifications.

To clean the air assisted spray nozzle humidification system:

1. Turn off water and air supply at the inlet valve. It is advisable also to turn off the power to the chamber.
2. Disassemble the nozzle by twisting the fluid/air cap ¼ turn to the left.
3. Look in the air/fluid cap and body. If there is a buildup of oil in any of those parts, then wipe them out with a degreaser. It is not necessary to disconnect the nozzles for this procedure. If the nozzle parts are worn in any way, replace nozzle assembly.

It is a good practice to monitor the nozzles to ensure they are performing at 100%. If there is an oil filter installed in the air line into the humidity system, perform regular filter maintenance at the end of each experiment.

4.12.1.4 Ultrasonic Humidification (USH Option)

USH uses the principle of high frequency vibration to atomize water to develop humidity.

Contact Conviron for maintenance practices.

4.12.1.5 Centrifugal Atomizer Humidification (CAH Option)

To clean the centrifugal atomizer humidification system:

1. Turn off the water supply at the inlet valve.
2. Disconnect the power supply to the humidifier.
3. Referring to Figure 4-8, lift out the discharge dome **A** and the atomizing section **B**. Check to see if the water level is at least 1½“ (35mm) deep in base pan. If not, adjust the float **C** by bending the float arm down if the water level is too high, or up if the water level is too low.
4. Look through the impeller pump **D** slot. Ensure that the six holes at the top of the impeller tube are open. Use pipe cleaners for cleaning out the holes. Twist and pull out the pump **D** to remove the impeller pump. The pump is a press fit. If the pump is difficult to remove, place the assembly under hot water for two to three seconds. The plug will then twist out easily. Flush water through the impeller after cleaning.
5. If necessary, disconnect the water line and remove the bottom pan **E** for cleaning.
6. Reassemble the unit according to Figure 4-8.

Carefully rotate the impeller, making sure it turns freely before starting up humidifier. The hole in the side of the bottom pan next to the water connection is for water overflow. Keep hole open.

7. Reconnect the water and power supply.

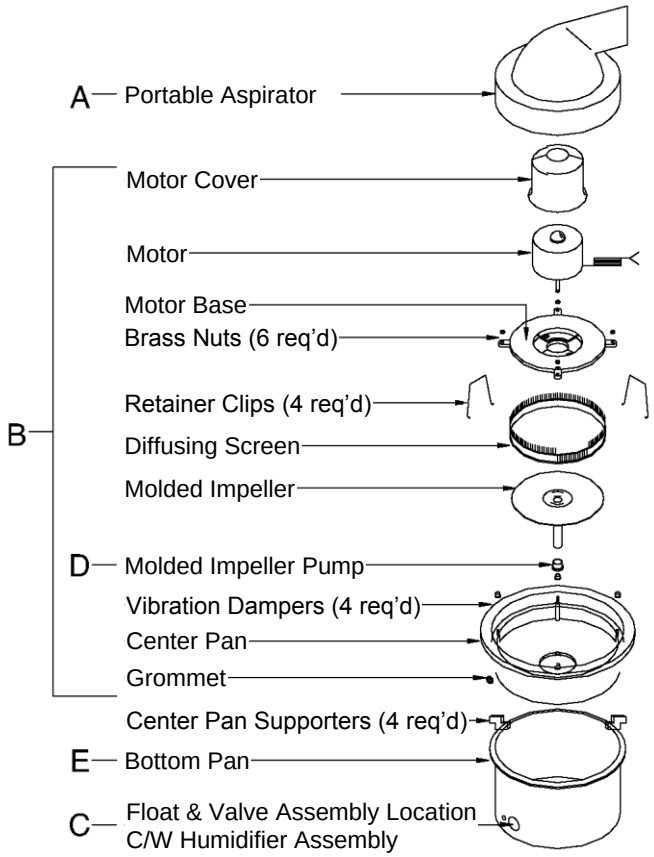

Figure 4-8 Centrifugal Atomizing Humidifier Maintenance

Service bulletin SBRH00 is available in 120V only. For the 240V application use part #232288 hydro fogger.

4.13 Canopy Cables

Inspect the cables supporting the canopy for signs of wear, especially near the motor.

Contact Conviron if wear or damage to the cable is found.

4.14 Air Cooled Condenser – ACSC, RAC & OACU Options

Regularly remove accumulated dirt on the condenser. Obstruction lowers the efficiency of the system. Clean the air-cooled condensers with a soft bristle brush and vacuum cleaner, or low-pressure compressed air.

Changes from standard ambient conditions (i.e. 21°C and 50% RH) have a direct effect on the performance of chamber. During periods of high ambient temperatures, air-cooled units may experience high head pressures. High or low humidity in the building may result in deviation from the setpoint in chambers with fresh air intakes.

4.15 Cooling Tower Option (CTO Option) - Bypass

All Conviron water cooled units are equipped with control valve and bypass line. Both the control valve and by-pass line are required to permit continuous operation of the cooling tower system supplying condenser water.

When only one condenser is connected to the system, the by-pass line hand valve must be adjusted for a water flow sufficient to provide the minimum recommended flow in the cooling tower.

The adjustment is made with the compressor shut down and the cooling tower pump operating. When several condensers are connected to the cooling tower system, all the by-pass hand valves must be adjusted for equal flow and for a total flow from all bypasses sufficient to provide the minimum recommended nozzle pressure.

Improperly adjusted by-pass hand valves in a multiple condenser system can cause cooling water starvation to some condensers with resulting compressor shut down on high head pressure. The bypass valve is used to regulate the flow of water in the bypass line of a three way water valve used in a cooling tower condenser water supply system.

All water cooled units are shipped from the factory with the manual bypass valve shut off. Onsite adjustment is required. In the event that service becomes necessary, contact Conviron.

Mechanically Cleanable Condenser (MCC Option)

Mineral scale and sludge deposits seriously reduce heat transfer in any condenser and affect system performance unless removed. However, deposits can be safely cleaned mechanically from water-cooled condensers to quickly restore efficiency without risking acid damage to condensers, cooling towers, and pumps (if so equipped).

The end plates (Figure 4-9) can be moved quickly and easily to provide complete access to the water tubes. A simple, spiral wire-cleaning tool is inserted and powered by an ordinary electric drill to remove the internal buildup.

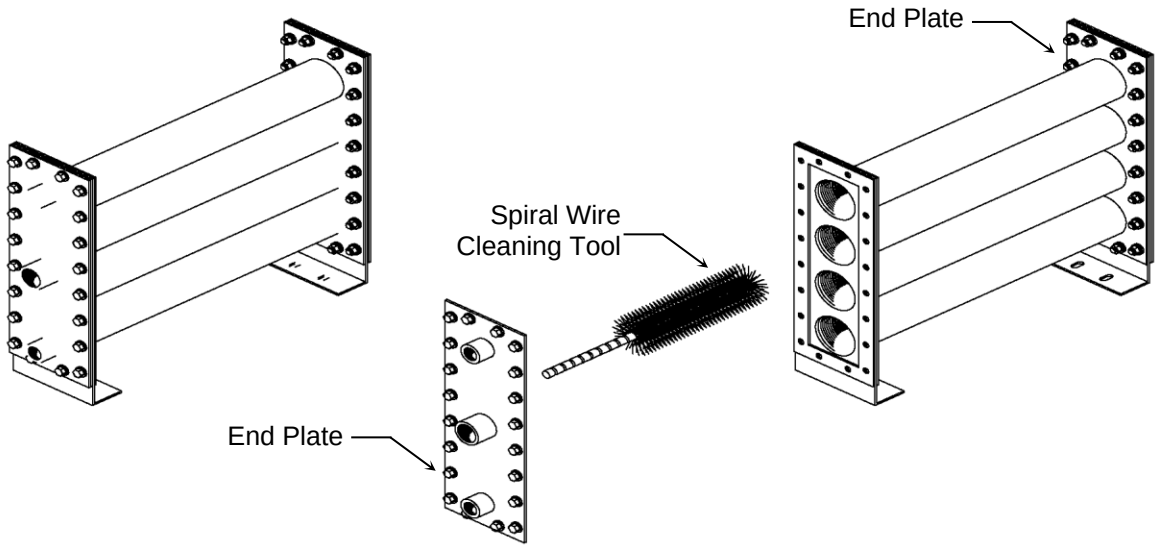

Figure 4-9 Mechanically Cleanable Condenser

For coaxial water cooled condensers, replacement rather than cleaning is recommended.

4.16 Additive Carbon Dioxide Control (CO_2 Option)

The carbon dioxide control option provides additive control of CO_2. The option is available for most models. It includes a sensor and monitor connected to the control system and includes a solenoid controlled injection system to elevate CO_2 in the chamber.

4.16.1 Major Components

Major components of the CO_2 option include the following:

- Component board
- Sensor, sensor cable, and power module
- Injection system
  - Pressure regulator
  - Solenoid valve
  - Tubing for CO_2 injection

The CO_2 Vaisala™ transmitter module supplies a 4-20 mA signal to the control system for CO_2 control. The placement of the module and probe varies according to the machine and options. The CO_2 sensor is powered at all times when mains power is connected and the controlled breaker is in the on position. Power and signal output wiring are shown on the schematics provided with each chamber.

The level of CO_2 in the chamber is displayed in parts per million (PPM) on the control system and is programmed the same way as temperature and humidity. CO_2 is monitored continuously as long as the control system is active. Close the main valve on the CO_2 tank when it is not in use. Do not adjust the regulator on the CO_2 tank once it has been set up.

4.16.2 Set-up

CO_2 control requires a high-pressure and a low-pressure regulator. In most chambers, the low-pressure regulator and the solenoid assembly are located in the machine compartment and are factory set at two pounds per square inch (psi). Do not adjust this setting unless there is difficulty reaching higher concentrations of CO_2 in larger chambers.

The high-pressure regulator is located on the customer supplied CO_2 tank. This regulator comes in two styles, a dial gauge, or a glass tube and ball style. In North America, Conviron provides the high-pressure regulator. Outside North America, the customer supplies the high-pressure regulator due to different thread size on the CO_2 tanks.

To ensure leak free connections, apply Teflon® tape onto the threads of the CO_2 tank outlet. Thread the high-pressure regulator onto the CO_2 tank. Connect the outlet of the high pressure regulator on the CO_2 tank(s) to the low-pressure regulator using ¼” polyethylene tubing. Hard copper may be used as an alternative. Ensure all connections are tight.

Open the main valve on the CO_2 tank approximately 3/4 of a turn. Program and run a CO_2 setpoint in the chamber that is above actual conditions in order to open the CO_2 solenoid. You should hear a click when the solenoid opens.

Set the flow meter. With one tank only, set the high-pressure regulator for 15 cubic feet per hour (CFH). If two or more tanks are used, set the first for 15 CFH and the rest for 10 CFH. The tube and ball style should be set to just lift the ball off its seat for one or multiple tanks.

4.16.3 Programming & Control

There are two variables to consider: programming desired CO_2 concentration and control of air flow through the chamber.

Programming the CO_2 setpoint is as easy as programming temperature or relative humidity. Values are entered in parts per million (PPM) in the CO_2 zone on the Main Status Program Screen of the control system. The Vaisala™ CO_2 monitor operates to 3000 ppm.

Ambient CO_2 levels are usually at least 350 ppm and can be higher depending on proximity to other CO_2 sources such as human beings or automobiles. If increased CO_2 levels are required, additive CO_2 can raise the concentration to required levels.

Controlling fresh air into and exhausting air out of the chamber is important to achieving desired CO_2 concentrations. Failure to consider this will lead to undesired results. Most chambers with CO_2 control are equipped with an automated damper to control airflow. These units will also typically have a manual fresh air inlet and exhaust outlet for running programs without CO_2 control. Some chambers are only equipped with the manual inlet and outlet.

For CMP control systems, the CO_2 Exhaust Damper option allows the automatic or manual control of an exhaust damper.

The exhaust damper option comes pre-configured from the factory. Once enabled, the damper will require a digital output for control.

Refer to the CO_2 Scrubber Manual for more detailed information.

The exhaust damper also serves to purge CO_2 in the event of a high level CO_2 alarm. If the high CO_2 limit is set below the CO_2 setpoint, the exhaust damper will open to purge CO_2 to the surrounding space.

4.16.4 Maintenance

Check the chamber Vaisala™ CO_2 sensor against an accurate, independent, preferably NIST traceable, CO_2 sensor. Checking the Vaisala CO_2 sensor is recommended twice a year. Simply place the independent CO_2 sensor in the same location of the Chamber CO_2 sensor and compare readings.

4.16.5 Calibration

Do not service the CO_2 sensors without observing proper ESD procedures, including the use of a grounding strap and/or anti-static mat.

Calibration is recommended every two years.

Remove the CO_2 sensor probe from the cable and return it to Vaisala for calibration. Conviron recommends that a spare, new or recently calibrated sensor probe be purchased in order to keep the CO_2 function operational while the first probe is away being calibrated. Vaisala can provide NIST traceable calibration certificates.

The Vaisala CO_2 system is a control board (Figure 4-10) located in the control panel and a sensor (Figure 4-11) in the aspirator.

Figure 4-10 Vaisala CO_2 Control Board

Figure 4-11 Vaisala CO_2 Sensor

Refer to www.vaisala.com for calibration information and a calibration kit for further information.

4.17 PM Contract Service

Contact Conviron to arrange for scheduled preventive maintenance service.

5 TROUBLESHOOTING

Conviron manufactures a diverse lineup of reach-in chambers, walk-in rooms, and custom engineered solutions for a variety of applications where strict control of temperature, humidity, lighting, and other parameters is required. This is a general troubleshooting guide, based on the commonalities of products within Conviron's diverse product line.

For specific questions on specific product features not covered within the scope of this manual, please contact Conviron's Technical Services group.

5.1 Overview

For general troubleshooting, please check the following:

- Power failures
- Water failures
- Tripped circuit breakers or blown fuses
- Incorrect safety control settings
- Burnt out lamps - check first for faulty lamps or faulty fits in the sockets, then check for defective ballasts

For more specific problems, check the following subsections:

- Refrigeration (DX systems)
- Refrigeration (Direct Coolant from Central Chiller Systems)
- Electrical (DX systems)
- Electrical (Direct Coolant from Central Chiller Systems)

5.1.1 Warranty Service

In the event of equipment failure, contact our distributor in your area or our Customer Service Department. Please visit www.conviron.com for global service contact information.

5.1.2 After Warranty Service

This equipment is only to be repaired by authorized personnel - that is, personnel who have read this manual, have been trained on the proper repair of the equipment, and who are qualified trades-people such as electricians, plumbers, and refrigeration mechanics.

Conviron provides technical support, runs regular service schools to provide additional training as well as can assist you with finding an authorized service provider or other reputable service organization in your area that will be able to look after the service needs of your equipment. For further details, contact the Customer Service Department.

When contacting Conviron, please be prepared with the model and serial number of the equipment. It is also helpful to have specific information as to program settings and ambient conditions.

5.1.3 Factory Settings

Conviron reach-in equipment is fully tested as a unit at the factory while control panels, air handling unit (AHU), and lamp canopies for walk-in units are factory tested. A setup sheet providing chamber test specification results is included with the unit prior to installation or for the customer to fill out if self-installed. Before shipping, all switches and breakers are turned to OFF.

5.2 Refrigeration – DX Systems

Refrigeration equipment is only to be repaired by authorized personnel – that is, personnel who have read this manual, have been trained on the proper repair of the equipment, and who are qualified and authorized refrigeration mechanics.

5.2.1 Compressor Protection

The compressor motor has inherent protection, which automatically cuts off the unit in the event of overload due to overheating or an over draw of amperage. This cut off is monitored by the control system and an alarm will be triggered. The compressor will automatically attempt to start up again three times after it has sufficiently cooled down. If the compressor cannot successfully restart after three tries, it will shut down the refrigeration system. If this happens, call Conviron.

If further troubleshooting is necessary with the refrigeration system, install refrigeration gauges on service valves. Typical operating head and suction pressures are located on the setup sheet and refrigeration schematic provided.

5.2.2 Safety Auxiliary High Temperature Limit

Set at 140°F or 158°F (60°C or 70°C), as indicated on the electrical schematic. This setting is non-adjustable.

5.2.3 Operating Pressures for R404A

- Suction pressure, measured at the crankcase pressure regulating valve, set in full heating for standard systems: 85 psig (586 kPa, 5.9 Bar).

Some systems are factory set below 85 psig (586 kPa, 5.9 Bar). Check the schematics to ensure the correct setting.

- Discharge pressure, set in full cooling with lighting load: 250 psig (1724 kPa, 17.3 Bar).
- Superheat, value should be set in a range of 10°F to 15°F or 5.6°C to 8.3°C measured at the expansion valve bulb with chamber in full cooling. The setting here is an interval rather than an absolute temperature.

5.2.4 Refrigeration Control Setpoints

Table 5-1 shows the control setpoints for standard and low temperature chambers with either R404A or 134A refrigerant. The R404A refrigerant is gradually being phased out and replaced with 448A. R134A is used in chambers with condensing units with Danfoss SC15G compressor, used in the Adaptis reach-in chambers. Older equipment R22 may also use refrigerant.

The operating pressures depend on the chamber specifications (conventional temp, LT, ULT, water-cooled, air-cooled, etc.) Generally, a condensing unit with R448A refrigerant undergoes smaller pressures compared with that with R404A. For Conviron's typical applications (i.e., 40F evaporator temperature and 105F condenser temperature), R448A has 245 psig condenser pressure and 80 psig evaporator pressure.

Table 5-1 Chamber Control Setpoints

		R404A	134A
Standard Temperature Chambers	High Pressure	Cut out: 350 psig (2413 kPa., 23.8 Bar)	Cut out: 240 psig (1655 kPa., 16.6 Bar)
		Cut in 275 psig (1896 kPa., 19 Bar)	Cut in 182 psig (1255 kPa., 12.6 Bar) 58 psig (fixed differential) (400kPa., 4.0 Bar)
	Low Pressure	Cut out: 15 psig (103 kPa, 1.0 Bar)	Cut out: 5 psig (35 kPa, 0.3 Bar)
		Cut in: 40 psig (276 kPa, 2.7 Bar)	Cut in: 55 psig 241 kPa, 2.4 Bar)

	R404A		134A
Low Temperature Chambers	High Pressure	Cut out: 350 psig (2413 kPa, 23.8 Bar) Cut in: 275 psig (1896 kPa, 19.0 Bar)	n/a
	Low Pressure, Reciprocating or Hemetic Compressors	Cut out: 5 psig (35 kPa, 0.3 Bar) Cut in: 35 psig (241 kPa, 2.1 Bar)	n/a
	Low Pressure Compressors	Cut out: 15 psig (103 kPa, 1.0 Bar) Cut in: 40 psig (276 kPa, 2.7 Bar)	n/a

5.2.5 Scroll Compressor Module

By monitoring and analyzing data from the scroll compressor and the thermostat demand, the diagnostics module can accurately detect the cause of electrical and system related failures and protect the compressor. An LED indicator communicates the alarm condition.

Green LED means no alarm, a red LED means an alarm, the ICM401 is a phase monitor only.

Compressor model numbers from ZB58K5E and above do not have an ICM401 module and discharge thermostat. CoreSense modules are used instead.

5.2.6 Slight Shift in Controlling Temperature

A stuck proportional valve - force the valve from 0 to 100% from the Service screen.

5.2.7 Temperature Wide Cycling

Incorrect Level

Compressor may be cutting out on overload, low pressure, or high-pressure cutout. Contact a refrigeration service technician

Control Setting

Look for:

- Compressor cycling at incorrect level
- Portable aspirator fan not running
- Loosened or disconnected aspirator piping
- Air not passing properly over sensing element

- Location of aspirator body
- Sensor element not facing air stream at inlet next to aspirator body

5.2.8 Chamber Temperature Too High (Above Setpoint)

- Insufficient refrigerant in system - check for leaks. Repair and add the refrigerant. Refer to the setup sheet provided with your chamber for correct refrigerant charge.
- Restricted filter/drier – replace.
- Restricted strainer or expansion valve - clean the strainer, and adjust or replace the expansion valve.
- Dirty evaporator – clean the evaporator.
- Fans not working.
- Frosted evaporator – check the following:
  - The fan motor(s) is running.
  - The chamber is designed to run below freezing. If so, check length of defrost cycle and time delay.
  - The hot gas flows through the evaporator during defrost and the defrost heaters are energized, if so equipped.
- Compressor malfunctioning - refer to Electrical troubleshooting.
- Proportional Valve malfunctioning – refer to Electrical troubleshooting.

5.2.9 Chamber Shuts Off on Low Temperature Limit

Proportional Valve - Ports 1 and 2 are open when the valve is de-energized. In the event of disruption of power to the valve, hot gas is discharged directly to the condenser thus lowering the temperature below the setpoint of the chamber and shutting off on low limit.

Refer to electrical troubleshooting.

5.2.10 Compressor Noisy or Vibrating

Contact Conviron Service.

5.2.11 High Discharge Pressure

- System overcharged with refrigerant - contact Conviron.
- Non-condensable in system - purge, evacuate, and recharge.
- Restriction in discharge line (before receiver only) - check to see that discharge service valve is wide open.
- Condenser fan(s) not running - check the electrical circuit.
- Air-cooled condenser plugged. Water-cooled condenser fouled - clean chemically or mechanically, depending on make of condenser.

- Insufficient water or condenser water too warm – the condenser fan has failed, check electrical circuit.
- Check the electrical operation of the solenoid (magnetic) valves.
    - The cooling solenoid should open and hot gas solenoid should close on cool cycle.
    - Smaller valves will magnetically attract a steel object (e.g. screwdriver) when they open. Place a hand on the larger valves. You will feel them open. Replace the solenoid coil if inoperative. The solenoid coil can be changed without replacing the entire valve.

5.2.12 Low Discharge Pressure

- Insufficient refrigerant in system - check for leaks. Repair and add the refrigerant. Refer to the setup sheet for correct charge.
- Low ambient temperature (air-cooled condenser without discharge pressure regulation) and/or improperly adjusted head pressure control.
- Low airflow across evaporator - frosted coil - defective fan motor.
- Suction shut off valve (if so equipped) partially closed - open the valve.
- Low suction pressure - determine the cause of low suction pressure.
- Damaged valves or rods in compressor - repair or replace the compressor.

5.2.13 High Suction Pressure

Check for incorrect crankcase pressure setting at the regulator.

5.2.14 Low Suction Pressure

- Insufficient refrigerant in system - check for leaks. Repair and add the refrigerant. Refer to the Setup sheet for correct charge.
- Expansion valve malfunctioning - check and reset for proper superheat.
- Dirty liquid line filter/drier - replace.
- Dirty evaporator - clean.
- Failed circulating fan motor - check the electrical circuit.
- Frosted coil from operating cabinet too long at a low temperature - operate only in designed temperature range.
- Frosted coil, designed for below 39°F (4°C) - check the following:
    - Frost is completely removed from the coil after the defrost period. If not, check the length of the defrost cycle and fan delay.
    - Hot gas flows through the coil during defrost and the defrost heaters are energized, if so equipped.
- Faulty pump down solenoid.
- Defective coil.

5.2.15 Little or No Oil Pressure (Semi-hermetic Compressors)

Excessive liquid in crankcase - reset the expansion valve for higher superheat. Check the liquid line solenoid valve operation.

- Low oil level - add oil.
- Loose fitting on oil lines - check and tighten.
- Pump housing gasket leaks - replace the gasket.
- Worn oil pump - replace.
- Defective low oil pressure safety switch - replace.
- Worn bearings - replace the compressor.

5.2.16 Compressor Loses Oil

- Shortages of refrigerant - check for leaks and repair. Add the refrigerant. Refer to the Setup sheet for correct charge.
- Excessive compression ring blow-by - replace the compressor.

5.2.17 Procedures for Charging the System

Follow this procedure when charging the system, once properly evacuated.

1. Check the gauge calibration. Use a standard screwdriver to adjust a small setscrew to set the gauge to zero initially.
2. Hook up the gauge hoses to the unit.
3. For certain compressor models, set the dual pressure control. Set the low side to cut in at 55 psig, for an R404A system.
4. Put an amp probe on the compressor electrical line to measure the start-up current.
5. Purge hoses of air by loosening the hose fitting at the manifold and opening the valve slightly on the tank until refrigerant comes through the hose.
6. Program the chamber for constant cooling, typically 39°F (4°C).
7. Switch the **CB1** circuit breaker to ON.
8. Run the program.
    - Watch the amp probe reading and compare the reading to the Conviron setup sheet supplied with the chamber.
    - Ensure the evaporator fan is running.
9. Charge the liquid refrigerant into the liquid side of system.
    - Charge the system with the quantity specified in the refrigeration schematic. Charging liquid into liquid line can continue as long as the system pressure is lower than the tank pressure.

- Slowly add liquid into the suction line, preferably before the suction accumulator. This should be done using a metering tool that can meter in liquid into suction to prevent compressor damage. If a metering tool is not available, carefully use your gauge manifold to meter the liquid into the line.
- Charge until there are no bubbles in the sight glass while operating in full cooling.

10. Adjust the head pressure regulating the valve located in the discharge line.

For an R22 system:

- Stabilize the high pressure at 210 psi for cooling.
- Set the low pressure at 68 psi on heating.
- Return to desired program.

For an R404A system:

- Stabilize the high pressure at 250 psi for cooling.
- Set the low pressure at 85 psi on heating, or the value shown on the refrigeration schematic.

For an R448A system:

- Stabilize the high pressure at 245 psi for cooling.
- Set the low pressure at 85 psi on heating.

Use caution when purging refrigerant through hoses. Refrigerant charging should only be conducted by a licensed refrigeration technician.

5.3 Refrigeration - Direct Coolant from Central Chiller System

5.3.1 Circulating Pump Protection

The circulating pump motor has inherent protection (either built-in thermal protection or impedance protection, depending on pump model), which automatically cuts off the unit in the event of overload due to overheating, or amperage over draw. When the unit has cooled down, it will automatically start up again. Call your local refrigeration technician if this happens.

5.3.2 Incorrect Temperature Wide Cycling Level

The circulating pump may be cutting out on overload. Find the cause and repair or replace.

5.3.3 Chamber Temperature above Setpoint

- Chiller fluid temperature is too warm - find the cause and correct.
- Air lock in circulating pump - bleed the pump.
- Dirty cooling coil - clean the cooling coil.
- Frosted evaporator - check the following:
  - The fan motor(s) are running.
  - The room is designed to run below freezing. If so, check the length of the defrost cycle and the time delay.
  - Water circulation heater energizes during defrost.
- Circulating pump malfunctioning – refer to Electrical troubleshooting - glycol system.
- Proportional valve malfunctioning – refer to Electrical troubleshooting - glycol system.
- If system is supplied with an in-line strainer - check the screen for obstruction.
- Loss of glycol in system - ensure all air vents and drain valves are closed.

5.4 Electrical - DX Systems

5.4.1 Run Program Selected, Unit Off, and Alarm Light On

- Check the chamber temperature to see if cutout has been due to the high or low temperature limit being exceeded.
- Set high limit alarms to highest and/or low limit alarms to the lowest and unit should automatically restart.

5.4.2 Unit Shut Off on Low Limit

- Proportional valve - Check for loose electrical connections at the valve. Program the control system so that it is in a full heating mode. There should be 24VAC at valve and 10 VDC at control valve module.
  - If there is 24VAC at the valve and 10VDC at the valve and it does not energize, replace the valve.
  - If there is not 24VAC at valve, check 10VDC. Check secondary of 24V transformer.
  - If there is no voltage, then check for 120VAC on primary of transformer.
- If 120VAC is at the primary of transformer, check the fuse, and then replace the transformer.
  - If 120VAC is not present on primary of transformer, check to make sure CB1 15 Amp breaker has not tripped.
  - If breaker has not tripped, check voltage between Y1 and X2 at CMP control system hardware.

- If there is no voltage at Y1 and X2, defective output on control system hardware. Replace hardware.

- Defective temperature sensor - replace.
- Refer to Refrigeration troubleshooting.

5.4.3 Unit Shut Off on High Limit

Proportional valve - program the control system so that it is in a full cooling mode. Check voltage at valve, if 24VAC is present at valve, you should have 0VDC between Y1 and X2 if voltage is present.

- If reprogramming does not correct the problem, replace the control system hardware.
- Circulating fan(s) not running - check for tripped circuit breaker. Determine the cause and reset.
- Defective circulating fan motor - replace the motor.
- Compressor malfunction - refer to Refrigeration trouble-shooting.

5.4.4 Compressor Will Not Run (No Hum)

- Open disconnect switch and tripped circuit breaker - close disconnect switch if open.
- Check electrical circuits and motor windings for short or open circuits. Reset the breaker after fault is corrected. Defective transformers in control panel, or compressor electrical box - check line side and load side for voltage.
- Defective contactor coil, relay or transformer - single-phase compressors have a 24-volt contactor, and three phase compressors have a 24-volt relay in series with the contactor coil. Check the contactor or relay coil for 24VAC - if present, replace the contactor coil or relay.
    - If not, check for 24VAC at secondary of transformer in control panel or compressor electrical box.
    - If present, check for broken wire between control panel and condensing unit.
    - If not present, check for defective transformer.
- Thermal overload tripped - overload resets automatically. Check unit closely when it comes back on.
- Loose wiring - check all wire junctions. Tighten all screws.
- System shut down by safety devices - determine the type and cause of shutdown and correct.

Voltages may differ depending on the utility.

5.4.5 Compressor is Energized, But Will Not Start

- Low line voltages - find the fault and correct it.
- Defective run or start capacitor – replace the capacitor (1∅ only).
- Defective start relay – replace the relay (1∅ only).
- Shorted or grounded motor windings - replace the compressor.
- Internal compressor mechanical damage - replace the compressor.
- Check the wiring from the control panel to the compressor unit.

The preceding applies to a single-phase system. If it is a three-phase, system, there will be no capacitor or relays.

5.4.6 Compressor Starts, But Trips on Overload Protection

- Low line voltages - find the fault and correct it.
- Excessive suction or discharge pressure - find the fault and correct it.
- Mechanical damage in the compressor - replace the compressor.
- Shorted or grounded motor windings - replace the compressor.
- Defective run or start capacitor – replace the capacitor.
- Defective start relay – replace the relay.
- Defective overload protector - repair or replace the compressor.

5.4.7 Starting Relay Burns Out

Single phase:

- Low or high line voltage - find the fault and correct it.
- Incorrect running capacitor - replace with the correct capacitor.
- Incorrect relay - replace with the correct relay.

5.4.8 Starting Capacitor Burn Out

Single phase:

- Relay contacts sticking - replace the relay.
- Incorrect capacitor - replace with the correct capacitor.

5.4.9 Running Capacitor Burn Out

Single phase

- Excessive high line voltage - find the fault and correct it.
- Capacitor voltage rating too low - replace with the correct capacitor.

5.4.10 Circuit Breaker Tripped

- Defective breaker – check the following for overload:
  - Receptacles
  - Fan motor
  - Circulating pump
  - Compressor
  - Shorted heater
- Defective ballast – check the following:
  - Determine which circuit breaker has been tripped
  - Check the appropriate circuit

5.4.11 Load Off (Lights, Heaters, Fans)

Check the circuit breaker. Check digital or analog output status on CMP control system. If output is programmed on and there is no power to output, then check for loose connections on the control system hardware and terminal blocks. If no problems are found in the wiring, check relays or contactors for load, replace the control system hardware.

5.4.12 Glycol Circulation Heater Does Not Engage During Defrost

Check the following:

- Circuit breaker - reset
- Faulty thermostat on water circulation heater, if so equipped - repair or replace
- Defective output on CMP control system hardware – replace hardware
- Loose or broken wire connections on the control system hardware and terminal blocks – tighten or repair

5.4.13 Glycol Circulation Heater Remains Energized

Check for sticky (welded) contactor - replace the Triac and Triac driver.

There are no Triacs in the CMP control systems.

5.5 Electrical - Direct Coolant from Central Chiller Systems

5.5.1 Unit Shuts Off On Low Limit

- Belimo valve (Staefa™).
  - Program the control system so that it is in a full heating mode, with 0 volts at the control valve.
  - Check the voltage at the valve between X1 and X2, or black and red wires on the Belimo valve, refer to schematic.
- Defective control system hardware – replace the hardware.
- Defective temperature sensor – replace the sensor.
- Refer to Refrigeration troubleshooting.

5.5.2 Unit Shuts Off On High Limit

- Check for loose electrical connection at the valve – tighten the connections.
- Program the control system so that it is in a full cooling mode.
  - If 24VAC is present at the valve and it does not energize - replace the valve.
  - If 24VAC is not present at the valve, check for 24VAC at the output of the bridge rectifier.
  - If 24VAC is present at the output of the bridge rectifier - check for a broken wire between the bridge rectifier and the proportional valve.
  - If 24VAC is not present at the output of the bridge rectifier - check if 24VAC is present at the secondary of the transformer.
  - If 24VAC is present at the secondary of the transformer - replace the bridge rectifier
  - If 24VAC is not present on the secondary of the transformer - check for 120VAC at the primary of the transformer (bridge rectifier for control systems prior to CMP models).
  - If 120VAC is on the primary of transformer - replace the transformer.
  - If 120VAC is not present on primary of transformer - check for 120VAC on load side of the Triac for the proportional valve.
  - If 120VAC is not present on load of the Triac for proportional valve - replace the Triac and Triac driver.
  - Check for 120VAC on the line side of the Triac - If 120VAC is not present, check (#50) circuit breaker at panel for Triacs used on control systems prior to CMP models.
- Defective control system hardware – replace the hardware.
- Circulating fan(s) not running - check for tripped breaker, determine the cause and reset.

- Defective circulating fan motor - replace the motor. On rooms running below 39°F (4°C), check Triac(s), or relays/contactors, for circulating fan(s). Fan(s) should run continuously except during defrost. Replace the relay or contactor where required.
- Glycol circulation heater - on rooms running below 39°F (4°C). The heater should be energized during defrost period.
- Check for defective Triac(s) or relays - replace the Triac(s) and Triac driver(s) or relays where necessary.

5.5.3 Circulating Pump Not Running

- Open disconnect switch or tripped circuit breaker - close the disconnect switch or breaker.
- Electrical circuits and motor windings for short or open circuits – repair or replace.
- Stuck pump – correct fault and reset circuit breaker.
- Check for low or high line voltage.
- Thermal overload, depending on the pump model, the motor has either built-in, automatic resetting thermal protection, or is impedance-protected. If motor trips on overload, check for low voltage at the motor or defective overload.
- Defective motor, check for open or shorted windings - repair or replace.
- Defective capacitor (depending on pump model) – replace the capacitor.
- Loose wiring - check all wire junctions and tighten all screws.
- Glycol supply.

5.5.4 Motor Hums and Cuts Off

- Check for stuck pump or defective capacitor (depending on pump model).
- Refer to Refrigeration troubleshooting (Glycol systems).

5.6 Optional Equipment

Not all optional equipment listed in this section will be present on every chamber. Similarly, not every option is described in this section.

Contact Conviron for information regarding troubleshooting a non-listed option.

5.6.1 Air Spray Nozzle Humidification (ASNH Option)

5.6.1.1 Intermittent, No Spray, or Poor/Low Water Spray with Constant Compressed Airflow

Less than perfect spray is almost always caused by partial blockage of the center water orifice. Even a tiny bit of grit or debris that got through in the water supply can severely limit the spray, or make the desired symmetrical cone spray misshaped. This is usually a constant condition as long as the air is flowing and water is available in the float reservoir.

- Remove the spray head and sight through the center hole with a bright light behind (Figure 5-1). A partial blockage will be readily visible as the light shines through the hole. Any grit or debris will cause the hole to appear not perfectly round.
- Clean the orifice in the spray head by soaking in citric acid solution or ultrasonic cleaner for eight hours. Sight through the orifice to ensure it is clean (Figure 5-2) before reinstalling the spray head.

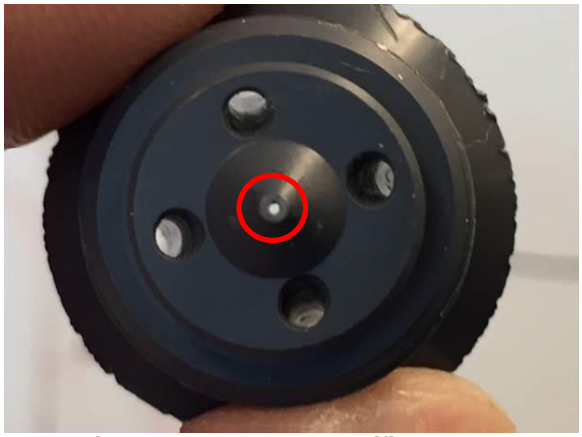

Figure 5-1 Water Orifice - Front

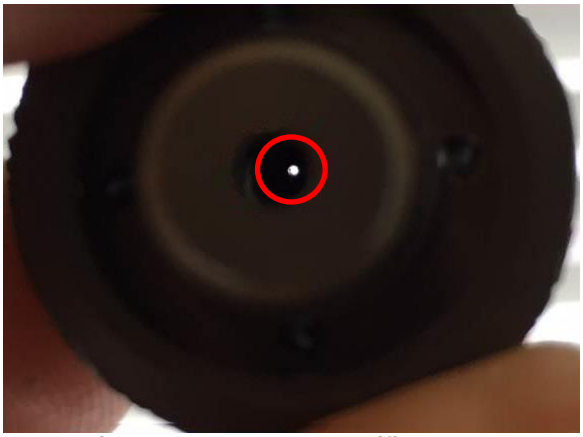

Figure 5-2 Water Orifice - Rear

5.6.1.2 Intermittent Spray, No Spray, or Air Bubbles in the Water Reservoir:

This is almost always due to a leakage of the compressed air from the outer body cavity into the center water cavity across the yellow highlighted faces (Figure 5-3) of the stainless steel body or PVC water cap. Air leakage is usually caused by a poor center seal of the gasket.

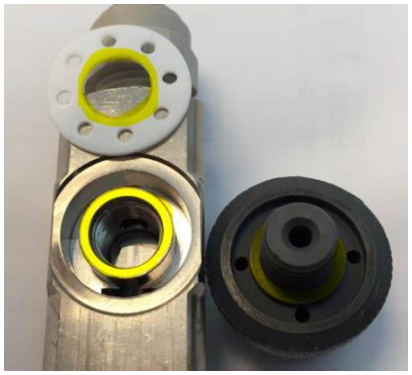

Figure 5-3 Gasket Mating Surfaces

The mating surfaces between the soft gasket and the rigid body and cap are very narrow and if this seal leaks even a bit, the spray will be intermittent or spitting, even though the air is running constantly.

If it leaks more seriously across that path, there may be no spray and air bubbles will back up into the water reservoir.

Any scratch, or other flaw, in the stainless steel body flange, the center flange of the PVC water cap, or the inner perimeter of the gasket will allow high pressure air to leak into the water siphon path and cause reduced spray efficiency.

- Dis-assemble the spray nozzle.
- Replace the existing rubber gasket with a Teflon gasket. Tighten the assembly finger firm tight.

5.6.1.3 Consistent No Spray, Misshaped Spray Pattern, or Air Bubbles in the Water Reservoir:

This is usually caused by misalignment between the orifice tip and the spray head cap (Figure 5-4) or damage to the center tip of the water orifice tip (Figure 5-5).

Inspect the nozzle for damage or misalignment – replace, or adjust as required.

Figure 5-4 Misaligned Orifice Tip

Figure 5-5 Damaged Orifice Tip

The water orifice tip must protrude bit past the surrounding spray head with an even annular air gap (Figure 5-6).

Figure 5-6 Correct Annular Air Gap

Conviron Head Office
Winnipeg, Canada
conviron.com

Conviron Europe Ltd.
Cambridgeshire, UK
conviron.co.uk

Conviron China
Shanghai, China
conviron.cn

Conviron US
Pembina, USA
conviron.com

Conviron Germany GmbH
Berlin, Germany
conviron.de

Conviron Australia
Melbourne, Australia
conviron.com.au

WWW.CONVIRON.COM
info@conviron.com

ISO9001

278881-ENG-R00, February 2018