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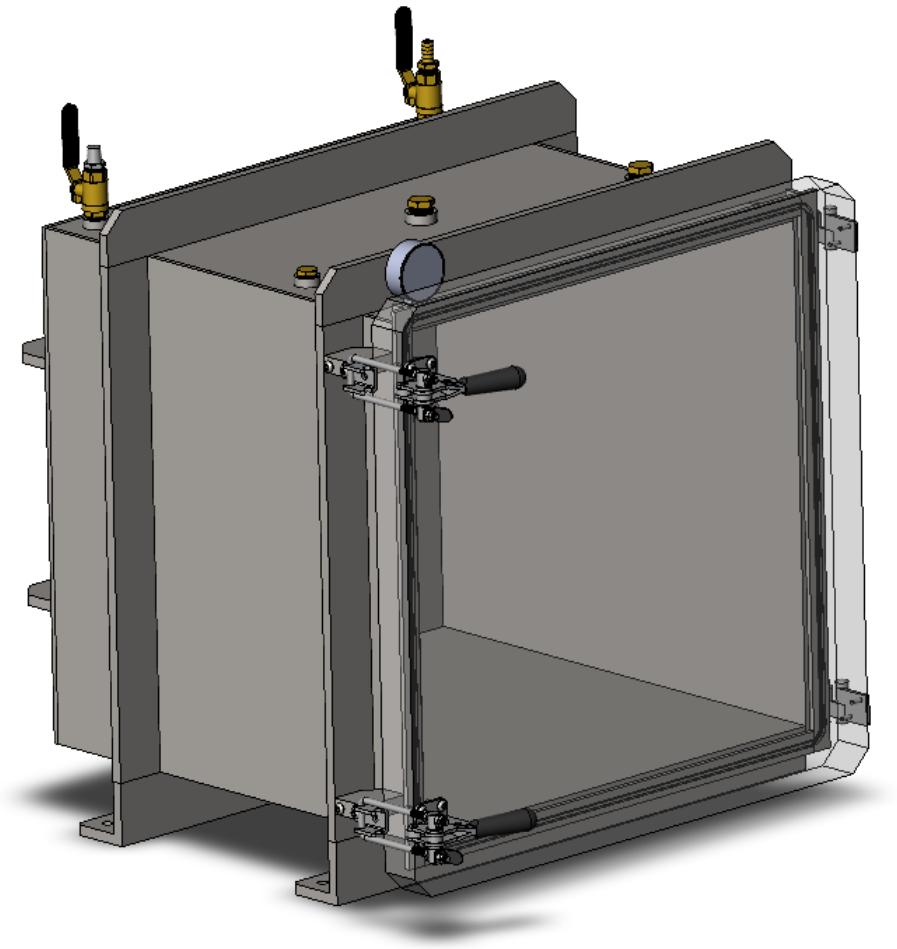
Vacuum Chamber Manual



Contents

1. SAFETY

CAUTION: This system is designed to create vacuum pressure inside the chamber. Chamber pressure should never exceed atmospheric pressure (unless stated otherwise). Using positive pressure (beyond what was stated) inside the chamber can result in an unsafe condition that may result in injury or death to individuals working with the system. It will also void the warranty as it could damage the system.

CAUTION: Care must be used when moving or lifting the system. Proper lifting equipment and safety devices must be used. Do not lift or move the chamber using the chamber ports, door/lid, or valves. Use lifting eyes (if provided) or lift the entire chamber as a properly secured unit.

CAUTION: Ensure that materials or objects placed in the system can be safely exposed to a vacuum environment. Never place objects or materials in a vacuum chamber that might create a hazard for people working in the vicinity of the system.

CAUTION: Ensure that all connections to the chamber are made in a safe manner and are made in compliance with standard code requirements. All electrical connections must be made in accordance with electrical codes, and all connections in or near the chamber must be properly grounded. All fluid connections should be either closed loop or, if open loop, should be properly vented/drained to ensure environmental safety and the safety of personnel operating the equipment.

CAUTION: For systems with viewports, DO NOT operate the system if the viewport material is cracked, damaged, or has deep scratches or gouges. Use under these conditions may cause failure of the viewport that could result in operator injury and/or damage to the articles inside the chamber. Contact Abbess immediately (see contact information at the end of this manual) to arrange for repair or replacement of the viewport before operating the system.

CAUTION: Observe the following operating conditions:

- Operate indoors only.
- Operate in a well-lit area.
- Operate with an ambient temperature of between 15°C and 30°C.
- Operate with an ambient humidity of between 20 and 65 percent.
- Ensure the system is on a stable floor, deck, or platform capable of safely supporting it and any chamber contents.
- Secure to the floor, deck or platform as necessary.
- Electrical power connections should be made by licensed professionals and in compliance with all applicable codes and ordinances.
- Ensure adequate ventilation for people, process, and equipment.

WARNING: Opening the chamber to room conditions with thermal elements at extreme temperature (hot or cold) can cause injury, damage to system components, and introduce debris and contaminants to the system. Always return the system to ambient temperature before venting.

2. OVERVIEW

The chambers are used to expose articles in the system to vacuum pressure (pressures below atmospheric). A vacuum cycle controller (VCC) and proportional-integral-differential (PID) controller are used to automate chamber cycling. The basic system consists of three parts:

1. The vacuum chamber, which is the sealable enclosure built to withstand pressures below atmospheric pressure.

3. UNPACKING AND INITIAL SETUP

3.1. System Installation

NOTE: It is important to inspect the system and any components for any damage immediately upon arrival and after unpacking. Failure to inspect the system for damage promptly after arrival can result in denial of damage claims. See section 3.3 below for details on how to report system damage.

All Abbess systems are packed in a shipping crate prior to leaving the manufacturing facility. Each crate is labeled with several indicators that track the shipping process to detect improper handling during shipping. There should be no indication of mishandling during shipment.

1. Inspect the Crate: Before opening, carefully examine the crate for any signs of damage during shipping. If there's visible damage, document it with photos before opening. Abbess recommends that customers take photos of all indicators on the outside of the crate as soon as the crate had been delivered in the event a claim is made against the shipper.

2. Prepare the Workspace: Choose a spacious area with enough room to maneuver around the crate. Ensure the surface is clean and free of debris to prevent scratching or damaging the system.

3. Gather Tools: Depending on the crate's fastenings, you may need tools like a screwdriver, box cutter, or pry bar to open it safely.

4. Lift with Care: If the crate is heavy, use proper lifting techniques or equipment to avoid injury. Enlist the help of others if needed.

5. Remove External Fastenings: Carefully remove any straps, bands, or nails securing the crate. Be cautious not to damage the system or yourself in

the process.

6. Open the Crate: Use appropriate tools to open the crate, such as a box cutter or pry bar. Cut along the seams or carefully pry open the lid; be careful not to damage the contents inside.

7. Inspect for Damage: Once the crate is open, visually inspect the system for any signs of damage or loose components. Check for any loose parts, cables, or accessories.

8. Remove Packing Materials: Carefully remove any packing materials such as foam, bubble wrap, or cardboard inserts. Dispose of them properly to avoid clutter and potential hazards.

9. Lift the System Out: Carefully lift the system out of the crate using appropriate lifting equipment. Do not risk physical injury or damage to the system.

10. Check Documentation: Look for any accompanying documentation, such as manuals, warranty information, etc. Keep these handy for reference. (Note: Abbess will also provide electronic copies of any documentation to the end user via email.)

11. Verify Contents: Verify that all items on the packing list are included in the crate. If items are missing, see “Report Missing Items” below.

12. Prepare for Setup: Place the system in its intended location, ensuring proper ventilation and accessibility to power outlets and peripherals.

13. Setup and Testing: Connect power to the system. Each power connector is labeled with its voltage and current requirement. Ensure that all connections are made in accordance with local requirements. Verify functionality of the system: See “System Operation” below.

14. Dispose of Packaging: When the system operation has been verified, dispose of the crate and packing materials responsibly, recycling where possible, and disposing of any waste appropriately. DO NOT dispose of the crate prior to validating system operation. In the unlikely event of a problem with the system it can be returned to Abbess using the original packing crate.

15. Enjoy Your New System: Once set up, enjoy using your new system!

3.2. Reporting Missing Items

Abbess Instruments makes every effort to ensure your purchase is properly packed and all items listed on the packing slip are included with the shipment. If your system is damaged or if any items are missing please

follow the procedures below. Retain all packaging material until the issue is resolved in case items need to be returned.

1. Thoroughly search all packing material for missing items.
2. Review the packing list included with the shipment to verify that items are not back ordered.
3. Contact Abbess Instruments immediately at 508-881-8811.

3.3. Reporting Shipping Damage

The shipping carrier is responsible for breakage that occurs in transit. Items shipped by Abbess Instruments are delivered to the carrier in good condition, appropriately packed for shipping using approved packaging methods.

If you receive damaged goods, please follow these steps so that we can ensure proper credit to you:

1. Immediately contact the carrier to report the damage. Retain the original carton and merchandise for the inspector.

2. Notify Abbess Instruments immediately at (508) 881-8811. Do not return damaged goods to Abbess Instruments without authorization. Do not return goods that have not been inspected by the carrier. Abbess will not accept return shipments without a return merchandise authorization (RMA).

We are willing to assist you in every possible manner, but please be aware that if you fail to follow the above procedure, the freight carrier or Abbess Instruments may not honor your damage claim.

If a determination is made that the system needs to be returned to Abbess follow the procedure described in “Service and Returns” below.

4. SYSTEM OPERATION

High vacuum systems require a pumping system that works to achieve and maintain vacuum inside the chamber. In most systems a roughing pump is used to lower the chamber pressure from atmospheric pressure to a modest intermediate pressure (typically about 1 Torr). When the intermediate pressure (called the “crossover pressure”) is reached, a high vacuum pump takes over and further evacuates the chamber to create high vacuum conditions (10^{-5} Torr or lower).

4.1. Basic Operating Guidelines

DO	DON'T
Always touch the chamber or any components that will go inside the chamber with clean, gloved hands.	Touch the inside chamber with bare hands or dirty gloves.
Clean all parts prior to placing into a vacuum chamber.	Use oil or grease inside the vacuum chamber unless they are high vacuum compatible. If vacuum compatible, use sparingly (dependent upon application).
Vent the vacuum chamber with dry nitrogen to prevent water vapor from absorbing on the clean walls of the chamber.	Leave the chamber open when not in use.
Minimize the time that your chamber is open to your lab space.	Use dirty tools inside the vacuum chamber.
Keep chamber (if applicable) closed when the system is not in use	Do not leave chamber open for extended periods

4.2. Check System Setup

- Ensure the vacuum pump is properly connected to the vacuum chamber.
- Confirm that the manual ball vent valve is closed.
- Ensure the vacuum valve to the chamber is also closed.

4.3. Verify Equipment Functionality

- Check that the vacuum pump is operational.
- Make sure that any necessary gauges or sensors are in place to monitor the pressure inside the chamber.
- Ensure that there are no leaks in the system or any equipment.

4.4. Close the Ball Vent Valve

- Make sure the manual ball vent valve (the valve that allows air to enter the chamber) is fully closed to prevent air from entering during the evacuation process.

4.5. Open the Vacuum Valve

- Open the vacuum valve that connects the vacuum pump to the chamber. This will start the pumping process.

- Ensure that the valve opens slowly to avoid any sudden changes in pressure that could potentially damage the chamber or equipment.

4.6. Monitor Pressure and Pump Down Process

- Monitor the pressure inside the vacuum chamber via the pressure gauge(s). The goal is to reduce the pressure as much as possible, depending on your process requirements.
- The pressure should gradually drop as the vacuum pump evacuates the air from the chamber.
- Continue this process until the desired vacuum level is reached.

4.7. Check for Leaks (if applicable)

- If the pressure is not decreasing as expected, check for leaks around the chamber, vacuum valves, and pump connections.
- Use a leak detector or an appropriate method to pinpoint and fix any leaks if necessary.

4.8. Shut the Vacuum Valve

- Once the desired vacuum pressure is reached, close the vacuum valve to isolate the chamber from the vacuum pump.

4.9. Monitor Stability

- Keep monitoring the chamber pressure for a few minutes to ensure that it remains stable at the desired vacuum level. If the pressure starts to rise, check for potential issues like a slow leak.

4.10. Open the Ball Vent Valve (If Needed)

- If you need to bring the chamber back to atmospheric pressure, open the manual ball vent valve very slowly to allow controlled admission of air.
- Monitor the chamber pressure as the vent valve opens to prevent sudden changes.

4.11. Post-Vacuum Procedures

- After the vacuum cycle is complete and the chamber is vented (if required), check the equipment once more to ensure everything is in good working condition.

5. SYSTEM MAINTENANCE AND TROUBLESHOOTING

1. Inspect the chamber door seal regularly to ensure no defects or excessive wear has occurred. If cracks begin to appear in the gasket replace it immediately.
2. To clean gaskets, wipe down gasket with a lint free wipe and distilled, deionized (DI) water or 99.99% (ultra-pure) isopropyl alcohol. Vacuum grease can be applied to the gasket to help enhance gasket life. Apply the grease sparingly to the gasket to achieve a smooth, thin film. Do not clean gaskets with any other solvents as this will shorten the gasket life.

- For chambers that have no acrylic utilize acetone followed by ultra-pure isopropyl.

3. Regularly clean your chamber to keep the system running at optimum performance. A dirty chamber will adversely affect the vacuum process and may decrease the life and performance of the pumping system. The vacuum pump, chamber door seal, chamber surfaces and other vacuum components should be cleaned regularly.
    - Always use lint free wipes when cleaning the chamber.

4. If using an oil-sealed pump, make sure to change the oil regularly.

5.1. Cleaning the Chamber

WARNING:

- **DO NOT** use tap water or commercial cleaning solvents. Clean only when surfaces are at ambient temperature and allow all surfaces to dry thoroughly.
- **DO NOT** rinse electrical equipment under running water.
- Ensure adequate ventilation when cleaning and handle all solvents in accordance with their safety data sheets.
- Use clean gloves (nitrile recommended) when touching any parts of the system that are exposed to vacuum.
- If uncertain, contact Abbess for clarification or advice.

1. Cleaning of all interior chamber environment surfaces and equipment elements involved in high vacuum processes should be performed by wiping down the surfaces using a lint free cloth and ultra-pure isopropyl alcohol (IPA) or high purity acetone (for metal parts only). Cleaning agents must not contain oil.
2. Cleaning exterior stainless steel components: Stainless steel components exterior to the chamber environment may be cleaned with a cleaner approved for use with stainless steel. Non-abrasive cleaners are recommended to preserve the surface finish. Non-abrasive scouring pads are also recommended. Scrapers and non-metallic scouring pads may be used on heavily soiled areas. If scrapers are used be careful not to damage the chamber surface. Rinse all areas using a lightly damp sponge or towel. Dry thoroughly.
3. Contaminants can build up in vacuum gauges, causing incorrect pressure readings that are often interpreted as degraded system performance. The vacuum gauge sensor should be cleaned any time pressure readings are suspect, or when “dirty” processes are performed in the chamber. See the appendix for information on how to clean the gauge sensor.

5.2. Decontamination

No hazardous materials are delivered with the system. In the event of a hazardous material spill by the user or outside source, immediately contact your laboratory safety officer or the manufacturer of the material for instructions on clean up or other decontamination procedures. Reference your Safety Data Sheets (SDS) for instructions on

proper clean-up and handling procedures. Ensure compliance with all local regulations.

5.3. Calibration

All gauges and instrumentation are factory adjusted and calibrated. No user adjustment should be needed.

For any supplied Pirani gauge, it may be necessary to adjust the Pirani sensor in the event of contamination, extreme temperature fluctuations, or aging. If gauge adjustment is necessary, contact Abbess for instructions or reach out to the gauge manufacturer.

5.4. Long Pump-Down Times

In a high vacuum system, the high vacuum pump primarily is pumping gases absorbed onto the walls of the chamber and other components. Long pump-down times can result from several factors, including:

- Gas loads from outgassing of components inside the chamber
- Gas loads from leaks or permeation
- Contamination inside the chamber
- Environmental effects

Each of these factors is discussed in greater detail below.

Longer-than-typical pump down times do not always indicate a problem with the system. Most of the time long pump times result from one of the issues above and the system will return to typical pump down times when the source of the trapped gas load is removed from the system or when the gas load is fully captured and evacuated from the system.

If a system problem is suspected, the system should be thoroughly cleaned. If equipped with thermal control, the chamber should also be baked out (heated to 100°C at 1 Torr or less pressure for at least 24 hours). A pump-down cycle should be run with a clean, dry, and empty chamber. Under these conditions the pump down time should return to its typical value (these values can be found on the attached Certificate of Conformance attached to this document). If pump down times remain significantly longer than typical contact Abbess for further support.

5.4.1. Environmental Effects

Water vapor is the primary contaminant in a vacuum system. The water vapor comes from the air and will adhere to the walls of the chamber. Removal of the layers of water vapor via the pumping system on a vacuum chamber is a very slow process. High humidity, low chamber temperature, high surface area inside the chamber, dirt/contamination all contribute to higher absorption of water vapor and poor vacuum performance. In general, vacuum baking of the system is recommended,

especially if vacuum levels below 1 x 10^{-6} Torr are required. Vacuum baking is performed by raising the internal chamber temperature to 100°C with pressure below 1 Torr for a minimum of 24 hours. Vacuum baking may only be required during initial system cycling (if the chamber is operated and protected from humidity) or may be required each vacuum cycle if operated in a high humidity environment.

5.4.2. Contamination / Outgassing

In addition to water vapor, other chemicals and materials may contribute to the gas load inside a vacuum chamber. Oils and lubricants, even from fingerprints, will limit vacuum performance. Some contaminants with low vapor pressures (such as oils) may take weeks or months to fully pump away. Prevent liquids, loose/volatile chemicals, oils, or any contaminants from entering the vacuum chamber.

5.4.3. Improper Use of Materials

Many materials contain chemical residues, fibers, or porous surfaces that will outgas under vacuum conditions. Most plastics and elastomers, for example, are not compatible with high vacuum systems. Minimize the use of plastics, porous materials, and materials with rough surfaces that can trap gas molecules and reduce system performance.

5.4.4. Virtual Leaks

Virtual leaks are a common problem that limit performance in high vacuum systems. Virtual leaks are usually introduced into a vacuum system by improper fixture design. A virtual leak is a small pocket or void that interacts with the vacuum system through a very small path. A common example of a virtual leak is a threaded screw installed into a blind, tapped hole. The dead space below the screw in the tapped hole is the pocket and the threads form the small path. The pocket of air must be evacuated through the threads each time the chamber is vented. This can significantly slow down the evacuation of the chamber. Venting the screw or eliminating the blind hole will eliminate the virtual leak in this case.

5.4.5. Leaks

Most often leaks are created in a vacuum system when a seal is broken (whether a door seal or a flange seal). If a leak is assumed, always check the item in the system that was last modified. Use a helium leak detector as a tool to locate leaks.

5.5. Troubleshooting

The troubleshooting table below can be used to address common vacuum problems.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Chamber will not pump down	Leak in vacuum line	Check hose, hose connections, and clamps
	Door and gasket not sealing flat (observed visually)	Adjust hinge – contact ABBESS for assistance
	Defect in door seal	Replace door seal gasket
	Vent or other valve left open	Ensure all valves are closed
Chamber evacuates slowly or will not achieve base pressure	Defective Vacuum Gauge	Check operation of high vacuum gauge
	Outgassing from chamber contents	Minimize outgassing effect or remove offending part (see “Virtual Leaks” above)
	Outgassing from vacuum chamber walls	Clean vacuum chamber and components
	Leak in system	Inspect all components of connections. Helium Leak test chamber system, if possible. Perform rate of rise test to see if you have a leak or outgassing problems (see below)*
	Poor Vacuum Pump Performance	Change pump oil (if pump uses oil). Pump may need rebuild.
		Pump needs rebuild. Contact Abbess for assistance.

*A rate of rise test can be performed by evacuating the chamber to the lowest pressure practical, then closing all valves and plotting the pressure rise over time until the pressure exceeds 1 Torr. If the pressure rise is linear then the cause is likely an external leak. If the pressure rise slows down at higher pressures (is non-linear), then the cause is likely outgassing.

6. SERVICE AND RETURNS

In the event a product purchased from Abbess Instruments needs service or must be returned please follow the outlined procedures below.

Contact Abbess Instruments Technical Support Department
Before returning any product to Abbess Instruments for any reason, please contact Abbess Instruments at +1 (508) 881-8811. Support is available

Monday through Friday from 8:30 AM to 5:00 PM EST. Support is available free of charge to customers of Abbess Instruments in good standing.

Pack the Product for Return Shipment

If Abbess determines that the system needs to be returned for service, a Returned Materials Authorization (RMA) number for the product will be issued. If possible, the product should be packaged in its original shipping carton or crate. If other packaging is required, use a suitable shipping container, which will allow a minimum of 2 inches clearance between the product and the walls of the shipping carton or crate. The system should be shipped with the chamber empty and the door closed and latched. The system must be packed to minimize damage caused by shifting during shipping. Peanuts, semi rigid foam, cardboard, and other items may be used inside the crate (not inside the chamber); Abbess recommends either reusing the crate supplied with the system or having a qualified packing company recrate the returned product. Extra care should be taken when packaging heavy systems. Some packaging materials (such as Styrofoam peanuts) will allow the system to shift in transit and may result in damage. The shipment must be clearly marked with the RMA.

Use an Abbess Recommended Shipper

Many shipping companies are not familiar with the requirements for shipping vacuum systems. Common carriers like FedEx and UPS will often offer shipping services for large items but are typically not as familiar with the correct transport of high sensitivity vacuum systems. Abbess works with several nationwide and international shipping companies and can help arrange for return shipping. Contact Abbess for details.

Insurance

Most common carriers offer insurance. It is highly recommended that you insure your product against damage that could occur during return shipping. Abbess Instruments is not liable for any return shipping damages.

Documentation

When returning items to Abbess Instruments, a copy of the RMA form (provided by Abbess) must be included inside the shipment. In addition, the shipment must have a packing slip or other document with the following information: contact person's name and phone number, return address (where the repaired system will be shipped), and any information about the problem (including what, if any, actions were taken to address the problem prior to the return).

How Will Your Return be Handled?

Abbess Instruments will evaluate the returned item for damage. If the return is a repair, the product will be examined for problems and a repair estimate will be made. The contact person will be contacted, at which time a Purchase Order will be requested. After the PO is issued, the product will be

repaired and returned shipped. The repair will be done in an expeditious manner. The contact person will be notified immediately in the event any shipping damage has occurred.

7. WARRANTY

Abbess Instruments' systems are carefully tested and inspected before leaving the factory. We warrant the product to be free from defects in material and workmanship under normal use and service for 12 months from the date of receipt, under the following terms:

1. Abbess acrylic lids and acrylic vacuum chambers are designed to be robust, however due to the nature of acrylic, they are not meant to withstand being dropped, to withstand sharp blows, or to have a point load placed of them. They are also prone to develop scratches and abrasions, especially when caustic samples are placed inside of the chamber or when solvents containing caustics or abrasives are used to clean the acrylic components of the chamber. For these reasons Abbess will only warranty these acrylic parts from defects in the workmanship and the material themselves, but not for any damage that results from mishandling or normal wear and tear.

2. The components of Abbess Vacuum Chamber Systems are, by their nature, delicate. Abbess Instruments strongly recommends that all systems containing electronics be shipped by air and/or air ride trucks. Abbess cannot be responsible for components becoming loose or damaged during transit. We have found through our experience that regardless of how well electronics are packed for shipping they are prone to damage. For that reason, we will only ship systems containing vacuum components and/or electronics via air ride truck or air using Abbess-preferred carriers unless specified otherwise by the customer. It is strongly recommended that customers use an Abbess-preferred carrier (contact Abbess for information on Abbess-preferred carriers). If a customer chooses to ship using a non-Abbess-preferred carrier or uses a shipping method not approved by Abbess the customer assumes full responsibility for any damage incurred in shipping. Abbess will automatically, without notice, void the warranty if systems containing vacuum components and/or electronics are not shipped as we recommend. Voiding of the warranty will be for all damage, including latent damage. Under no circumstances will Abbess warranty a product that has been shipped via hard-body truck or any other method which subjects the equipment to vibrations and/or shocks, including but not limited to ocean transit.

   DAMAGE IN SHIPPING: **It is the customer's responsibility to file an insurance claim with the shipper in a timely manner.** Any work done

by Abbess, including assistance in assessing damages, because of damage in shipping will be billed at our Abbess' usual labor rate. There will be additional charges for any travel or replacement parts and material. Abbess will not do any work without either a PO from the customer or written assurance from an insurance company that Abbess will be compensated for repairs. Damage in shipping in no way absolves the customer of its responsibility to pay Abbess Instruments as per agreed upon payment terms.

3. Warranties are null and void if vacuum chambers are kept in an environment that causes contamination to the chamber and/or its components. Operating difficulties or damage caused by dirt or contamination will not be covered by the warranty.

4. In the event of a defect in materials or workmanship, we will either repair or replace, at our option, any part which in our judgment shows evidence of such defect.

5. This warranty does not cover normal wear and tear, or expendable items such as gaskets, O-rings or oil.

6. The warranty is null and void if, in Abbess' opinion, the unit has been misused, abused, altered, tampered with, or used in life-cycle testing.

7. Abbess' liability is limited to the cost of the unit. In no event shall Abbess Instruments be liable for loss of profit, or incidental, indirect, special, consequential or other similar damages arising out of any breach of a contract resulting from this quotation, or obligations under a resulting contract. Except as provided in Abbess's standard warranty, the liability of Abbess for any claim arising out of or in connection with a resulting agreement, whether in contract or tort (including negligence or strict liability) shall not exceed the amount paid to Abbess by the customer with respect to any resulting contract. Abbess shall be under no further warranty obligation expressed or implied.

8. Abbess reserves the right to modify warranty terms for products that have been modified/customized at the customer's request.

9. Customers requiring service for their systems must first obtain a return material authorization (RMA) number from abbess by calling +1 (508) 881-8811. When an RMA has been issued, ship the unit, freight prepaid, to Abbess in the the original crating. If the original crating is not available, suitable crating must be used.

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8. APPENDIX

Customer satisfaction is a top priority at Abbess.

If you have any questions, comments, concerns about your system please contact us.

Constructive feedback is always welcomed!

Shipping Address:

Abbess Instruments and Systems, Inc.
75 October Hill Road.
Holliston, MA 01746 USA

Mailing Address:

Abbess Instrument and Systems, Inc.
PO Box 498
Ashland, MA 01721
USA

Phone : +1 (508) 881-8811
Fax : +1 (508) 881-4884

Email : abbess@abbess.com