

# Ion Pump Users Manual

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PN 900013, Rev C

Including Models:

Small Pumps

Mini  
3S  
10S, 10ST, 10SW  
20S  
25S, 25SVT, 25SVW  
40S  
45S  
75S

Low Profile Pumps

100L  
200L  
300L  
400L  
400LX  
600L  
600LX  
800LX  
1200LX

Tall Profile Pumps

150T, 150TV  
200T  
250T  
300T, 300TV  
500T  
600TV

Individual model specification information is located on our website at:

[www.gammavacuum.com](http://www.gammavacuum.com)

Read this entire manual and follow installation instructions. Failure to do so may cause injury and/or may void warranty.

ISO 9001:2008 Certified

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## General Information

Gamma Vacuum ion pumps provide clean, contamination free operation and have long operating lives, with no moving parts, no requirement for water cooling or liquid nitrogen for operation and little energy consumption. They provide high pumping speeds and feature fast starting and stability.

There are 29 standard models of ion pumps in the 3 L/S to 1200 L/S range available from Gamma Vacuum. Most pump sizes are available in differential ion or conventional pumping configurations.

All pumps are fully enclosed by pole pieces and stainless steel covers which cover the magnets and pumping pockets where appropriate.

## Approvals

Gamma Vacuum ion pumps are shown to meet CE and TUV/NRTL approvals:

- EN 1012-2
- EN 61010-1
- UL 61010-1
- CAN/CSA C22.2 No 61010-1



# Installation

## ***Receiving and Unpacking***

Unpack the pump carefully. Do not remove or damage the protective plastic tube on the copper punch-off tube or the pump may be vented to atmospheric pressure. The pump should be kept under vacuum until it is ready to be installed on the system.

Inspect for any obvious damage. If the pump is damaged in any way, a claim should be filed with the carrier (one copy to Gamma Vacuum). If equipment must be returned for inspection or repair, authorization must be obtained from Gamma Vacuum Prior to reshipping. Instructions for return will be provided at that time.

Check the equipment received against the packing list enclosed to insure that all items shipped have been received. If there are any shortages, notify the carrier and Gamma Vacuum. Save all packaging material for inspection.

## ***Initial Checkout***

Gamma Vacuum ships ion pumps under vacuum to insure ultra high vacuum cleanliness and to demonstrate the vacuum integrity of the ion pump vessel. After initial unpacking and before venting the ion pump, connect the ion pump to the ion pump controller and switch on high voltage. The ion pump should start immediately with no arcing and after 15 minutes of operation, ion pump current should be less than 1  $\mu$ A.

## ***Installation Procedure***

Remove the blank-off flange from the pump using dry nitrogen as a venting gas.

Bolt the ion pump to the system using the bolt set from the blank-off flange. Pumps up to the size of the 40S may be cantilevered during operation. Given proper support, other pumps can be mounted in any position with respect to the inlet flange. M8 mounting bosses are supplied on larger pumps for mounting purposes (use ISO 3266 compliant eye-bolts).





**NOTE:** If the vacuum system is to be cycled often, it is recommended that an isolation valve be installed between the ion pump and the vacuum chamber.

Several styles of feedthrough connection systems are available; however, the SAFECONN connectors are standard. To connect the SAFECONN connector, push the cable end connector onto the feedthrough until an audible click is heard and the connector is flush with the feedthrough. Attach the other end of the cable to the high voltage SHV 10kv connector mounted on the rear of the power supply chassis.

Although the high voltage cable has a grounded shield, we recommend that a separate wire be connected from the pump body to the safety ground on the rear of the control unit chassis. The wire should have a ring lug or other connector that can be inserted with one of the flange bolt washers. A wire is provided with cables provided by Gamma Vacuum.

The power unit is equipped with a three prong grounding power plug. This plug must be inserted into a similar three-wire receptacle which is a connection to system ground. If such a receptacle is not available, a separate ground must be provided.

## Warning Labels

	<p><b>WARNING:</b></p> <p>GAMMA VACUUM CONTROL UNITS DESIGNED FOR ION-PUMP OPERATION ARE CAPABLE OF DELIVERING 7000 VDC UNDER OPEN CIRCUIT OR LOW PRESSURE OPERATING CONDITIONS. FOR SAFE OPERATION, THE CONTROL UNIT AND ION PUMP SHOULD HAVE A COMMON CHASSIS CONNECTOR WHICH IS TIED TO THE POWER SYSTEM GROUND.</p>	<p><b>ALERTE:</b></p> <p>LES UNITES DE CONTROLE DE GAMMA VACUUM POUR L'OPERATION DES POMPES IONIQUES SONT CAPABLES DE FOURNIR 7000 VOLTS CONTINUS DANS UN CIRCUIT OUVERT OU EN TRAVAILLANT SOUS BASSE PRESSION . POUR OPERER EN TOUTE SECURITE , L'UNITE DE CONTROLE ET LA POMPE IONIQUE DOIVENT AVOIR UN CONNECTEUR DE CHASSIS EN COMMUN QUI EST LIE A LA TERRE DU SYSTEME D'ALIMENTATION.</p>	<p><b>警告 :</b></p> <p>イオンポンプ用ガンマ製真空制御装置は通電、もしくは低圧の状態でも運転した場合直流7000V供給可能です。安全運転のため、制御装置とイオンポンプはアースに接続された共通の等級配線を使用する必要があります。</p>	<p><b>安全警告:</b></p> <p>伽玛真空（公司）为离子泵运行所设计的控制单元在开路或低压运行条件下可输送7000伏直流电压。为确保安全运行，控制单元与离子泵应有一个共同的底盘连接器，和电源接地相连。</p>	<p><b>ADVERTENCIA:</b></p> <p>LAS UNIDADE DE CONTROL DE VACÍO GAMMA DISEÑADAS PARA LA OPERACIÓN DE BOMBAS TIPO IÓNICAS, SON CAPACES DE ALCANZAR 7,000 VDC BAJO OPERACION DE CIRCUITO ABIERTO O EN CONDICIONES DE OPERACION A BAJA PRESIÓN. PARA UNA OPERACIÓN FUERA DE RIESGO Y PELIGRO, LA UNIDAD DE CONTROL Y LA BOMBA IÓNICA, DEBEN TENER UN CONECTOR COMÚN A UN CHASIS EL CUAL ESTARÁ A SU VEZ, ENLAZADO A LA TIERRA DE LA FUENTE DE PODER.</p>	<p><b>ACHTUNG:</b></p> <p>GAMMA VACUUM STEUERGERÄTE FÜR IONENGETTERPUMPEN KÖNNEN HOCHSPANNUNGEN BIS ZU 7000 VOLT GLEICHSPANNUNG ERZEUGEN BEIM HOCHVAKUUMBETRIEB ODER OFFEN LIEGENDEN ANSCHLÜSSEN. FÜR DEN SICHEREN BETRIEB MUSS EIN GEMEINSAMER SCHUTZLEITER DIE GEHÄUSE VON PUMPE UND STEUERGERÄT MIT DEM SCHUTZLEITER DES NETZANSCHLUSSES VERBINDEN.</p>
	<p><b>WARNING:</b></p> <p>HIGH MAGNETIC FIELD. CAN CAUSE IMPLANTED HEART PACEMAKERS AND CARDIOVERTER DEFIBRILLATORS TO CEASE OPERATION. MAINTAIN 12 INCH SAFE DISTANCE FROM ION PUMP.</p>	<p><b>ALERTE:</b></p> <p>CHAMP MAGNÉTIQUE INTENSE. PEUT CAUSER DES PANNES D'OPERATION SUR DES PACEMAKERS ET DES DEFIBRILLATEURS CARDIAQUES. MAINTENIR UNE DISTANCE DE SECURITE DE 30 CM A PARTIR DE LA POMPE.</p>	<p><b>警告 :</b></p> <p>高磁場の為、心臓脈拍調整器や心臓除細動器が止まる危険性があります。イオンポンプから最低でも30cm離れたところでご使用ください。</p>	<p><b>安全警告:</b></p> <p>強磁場。強磁場会导致埋藏式心脏起搏器和复律除颤器停止运行。请务必使之和离子泵保持12英寸的安全距离。</p>	<p><b>ADVERTENCIA:</b></p> <p>ALTO CAMPO MAGNÉTICO. EL ALTO CAMPO MAGNETICO GENERADO PUEDE CAUSAR EL CESE DE LA OPERACION DE MARCADORES DE PASO Y DESFIBRILADORES CARDÍACOS.</p>	<p><b>ACHTUNG:</b></p> <p>STARKE MAGNETISCHE FELDER. HERZSCHRITTMACHER UND DEFIBRILLATOREN KÖNNEN IN IHRER FUNKTION BEEINTRÄCHTIGT WERDEN. MINDESTABSTAND VON 30 CM VON DER IONENGETTERPUMPE EINHALTEN.</p>
	<p><b>WARNING:</b></p> <p>HEAVY OBJECT. TO AVOID MUSCLE STRAIN OR BACK INJURY, USE LIFTING AIDS AND PROPER LIFTING TECHNIQUES WHEN REMOVING OR REPLACING.</p>	<p><b>ALERTE:</b></p> <p>OBJET LOURD. POUR EVITER UNE TENSION MUSCULAIRE OU UN MAL DE DOS, UTILISER DES AIDES ET DES TECHNIQUES DE LEVAGE APPROPRIÉES POUR L'ENLEVEMENT OU LE DEPLACEMENT.</p>	<p><b>警告 :</b></p> <p>大変重い装置です。筋挫傷、背部損傷等を防ぐ為、移動や移設の際は適切な技術や補助機器等を使用してください。</p>	<p><b>安全警告:</b></p> <p>重物。为避免肌肉拉伤或背部受伤，当移动或归位时请使用起重设备以及适当的起重技术。</p>	<p><b>ADVERTENCIA:</b></p> <p>OBJETO PESADO. PARA EVITAR UN SOBRE-ESFUERZO MUSCULAR O DAÑO FÍSICO, UTILIZE LA AYUDA DE ELEVADORES Y TÉCNICAS APROPIADAS PARA EL MANEJO DE OBJETOS PESADOS, CUANDO LO TRANSPORTE, DESPLAZE O CONSIDERE REEMPLAZARLO.</p>	<p><b>ACHTUNG:</b></p> <p>SCHWERES OBJEKT. ZUR VERMEIDUNG VON MUSKELZERRUNGEN ODER RÜCKENSCHÄDEN BEIM TRANSPORT GEEIGNETE HUBVORRICHTUNGEN UND HEBETECHNIKEN VERWENDEN.</p>
	<p><b>CAUTION:</b></p> <p>NOT FOR USE WITH FLAMMABLE GASES.</p>	<p><b>ATTENTION:</b></p> <p>NE PAS UTILISER AVEC DES GAS INFLAMMABLES.</p>	<p><b>危険 :</b></p> <p>可燃性ガスには使用しないでください。</p>	<p><b>安全警告:</b></p> <p>请勿与易燃气体同用。</p>	<p><b>PRECAUCION:</b></p> <p>NO DEBE USARSE CON GASES FLAMABLES O INFLAMABLES.</p>	<p><b>VORSICHT:</b></p> <p>NICHT GEEIGNET FÜR DEN EINSATZ MIT BRENNBAREN GASEN.</p>


**CAUTION:**

BURN HAZARD. ALL ION PUMP SURFACES ARE HOT DURING BAKE. DO NOT TOUCH PUMP UNLESS BAKE IS OFF AND PUMP HAS COOLED.

**ATTENTION:**

RISQUES DE BRULURE . TOUTES LES SURFACES DE LA POMPE IONIQUE SONT CHAUDES PENDANT L'ETUVAGE . NE PAS TOUCHER LA POMPE SAUF SI L'ETUVAGE EST ARRETE ET LA POMPE REFROIDIE.

**危険 :**

運転中、イオンポンプの表面は大変熱くなります。運転が止まり、ポンプが冷えるまで触れないでください。

**安全警告:**

烫伤危险。所有离子泵的表在烘烤时均十分灼热。请勿在烘烤结束前，离子泵冷却之前触摸。

**PRECAUCION:**

PELIGRO DE QUEMADURA. TODAS LAS SUPERFICIES DE LAS BOMBAS IONICAS ESTÁN CALIENTES DURANTE SU FUNCIONAMIENTO. NO TOQUE LA BOMBA A MENOS QUE ESTA HAYA SIDO DESCONECTADA Y SE HAYA ENFRIADO.

**VORSICHT:**

VERBRENNUNGSGEFAHR. DIE GESAMTE OBERFLÄCHE DER IONENGETTERPUMPE WIRD BEIM AUSHEIZEN SEHR HEIß. NICHT BERÜHREN BEVOR DIE HEIZUNG AUSGESCHALTET UND DIE PUMPE ABGECÜHLT IST.


**WARNING:**

HEATERS ARE CONFIGURED FOR EITHER 100-120 OR 200-240 VOLTS, 16 AMPS MAX. VERIFY APPROPRIATE CONNECTOR AND VOLTAGE PRIOR TO CONNECTION. VOLTAGE OR CURRENT CAN CAUSE INJURY OR DEATH. DISCONNECT ALL POWER CORDS BEFORE SERVICING. 600°C WIRING REQUIRED AT PUMP TERMINALS.

**ALERTE:**

LES ELEMENTS CHAUFFANTS SONT CONFIGURES POUR 100-120 OU 200-240 VOLTS, 16 AMPS MAX. VERIFIER LES CONNECTEURS ET LES VOLTAGES AVANT LA CONNECTION. VOLTAGE OU COURANT PEUVENT CAUSER DES BLESSURES OU LA MORT. DECONNECTER TOUS LES CORDONS AVANT LE SERVICE. CONNECTIONS A 600°C NECESSAIRE AU NIVEAU DE LA POMPE.

**警告 :**

加熱器の電圧値は100-120もしくは200-240V、最大電流値は16Aに設定されています。接続前に必ず、コネクタと電圧が適切であることを確認してからご使用ください。不適切な電圧値、電流値での使用は使用者が死亡、または重傷を負う原因になります。修理前は全ての電源コードを取り外してください。またポンプ端子は600度の配線が必要です。

**安全警告:**

发热器有100-120伏或200-240伏两种电压设置，电流最大值为16安培。请于连接之前预先检验连接器和电压是否合适。电压及电流可致伤或致死。请在维修前断开所有的电源线。泵的终端必须...（此处的600安培 WIRING不明，是乱码，要和发部件者重新核实）

**ADVERTENCIA:**

LOS CALEFACTORES ESTAN CONFIGURADOS PARA AMBOS 100-120 Ó 200-240 VOLTS, 16 AMP MÁXIMO. VERIFIQUE LA APROPIADA CONEXIÓN Y VOLTAJE PREVIO AL ENCHUFE Y PUESTA EN MARCHA U OPERACION. UN INCORRECTO VOLTAJE O CORRIENTE, PUEDE CAUSAR DAÑO O INCLUSO LA MUERTE. DESCONECTE TODA ALIMENTACION ELÉCTRICA ANTES DE DAR SERVICIO DE MANTENIMIENTO, REPARACION O REVISIÓN INTERNA. EL CABLEADO TIPO 600°C ES REQUERIDO EN LAS TERMINACIONES DE LA BOMBA.

**ACHTUNG:**

DIE AUSHEIZELEMENTE SIND GEEIGNET FÜR DEN BETRIEB MIT 100-120 V ODER 200-240 V WECHSELSPANNUNG, MAX. 16 AMPERE. VOR DER INBETRIEBNAHME DIE KORREKTE BETRIEBSSPANNUNG SICHERSTELLEN. ELEKTRISCHE SPANNUNGEN ODER STRÖME KÖNNEN VERLETZUNGEN ODER DEN TOD VERURSACHEN. TRENNEN SIE ALLE ELEKTRISCHEN ANSCHLÜSSE VON DER SPANNUNGSVERSORGUNG BEVOR SIE ARBEITEN AN DEM GERÄT AUSFÜHREN. DIE KABELVERBINDUNGEN AN DER PUMPE MÜSSEN FÜR EINE TEMPERATUR VON 600°C GEEIGNET SEIN.


**WARNING:**

READ AND UNDERSTAND OPERATOR'S MANUAL BEFORE USING THIS MACHINE. FAILURE TO FOLLOW OPERATING INSTRUCTIONS COULD RESULT IN INJURY OR DAMAGE TO EQUIPMENT.

**ALERTE:**

LIRE ET COMPRENDRE LE MANUEL D'OPERATION AVANT D'UTILISER CETTE MACHINE . NE PAS SUIVRE LES INSTRUCTIONS D'OPERATION PEUT CAUSER DES BLESSURES OU DES DEGATS A L'EQUIPEMENT.

**警告 :**

この装置を使用される前に必ず取扱説明書を熟読し理解した上でご使用ください。取扱説明書の通り操作をしなかった場合、装置が損傷、破壊することがあります。

**安全警告:**

在使用这台机器前，请务必阅读并理解“操作员手册（指南）”。如果未能遵循操作步骤说明，将可能导致设备的损坏。

**ADVERTENCIA:**

LEA, ESTUDIE, Y ENTIENDA BIEN EL MANUAL DE OPERACION, ANTES DE USAR ESTA MAQUINARIA. UNA FALLA POR NO SEGUIR LAS INSTRUCCIONES OPERATIVAS, PUDIERA RESULTAR EN DAÑO O PERJUICIO DEL EQUIPO.

**ACHTUNG:**

LESEN UND VERSTEHEN SIE DIE BEDIENUNGSANLEITUNG BEVOR SIE DAS GERÄT IN BETRIEB NEHMEN. FEHLBEDIENUNGEN KÖNNEN ZU VERLETZUNGEN FÜHREN ODER DIE AUSRÜSTUNG BESCHÄDIGEN.

# Operation

## **General Recommendations**

Before operating your ion pump, please read the following recommendations:

- Ensure that the air and environment are free from contaminants.
- Hands should be gloved and free from oils. Use UHV practices when working with ion pumps.
- For better starting and pump down time, flush the system with dry nitrogen to decrease water vapor and noble gas quantities.
- Check to see that the ion pump controller is properly connected and that the system is tightly sealed.
- To increase ion pump life and shorten time to ultimate pressure, use the full extent of the roughing system and start the ion pump at the lowest possible pressure.

## **Pump Roughing**

Rough pumping is performed in order to achieve a pressure at which the ion pump will start and to remove a high volume of gas load.

**CAUTION:** Care must be taken to avoid contaminating the ion pump with hydrocarbons from oils used to seal mechanical pumps.

Rough pump the system after you install the ion pump on the system. Refer to the roughing pump manufacturer's manual for instructions on roughing procedures, proper operation, and venting. Rough pumping must reduce system pressure to  $1 \times 10^{-4}$  torr or lower. Lower roughing pressure enables the ion pump to start quicker, reduces the time required to achieve ultimate pressure, and increases ion pump life.

## **Pump Starting (Not Isolated)**

This procedure is used when the ion pump is started after exposure to atmospheric pressure or any pressure above  $2.5 \times 10^{-2}$  torr.

1. Switch on the roughing pump and open the roughing valve.
2. On the ion pump controller, set the meter readout display to voltage. Set the ion pump controller switch to start, if so equipped.
3. Switch on the ion pump controller when system pressure has reached  $1 \times 10^{-4}$  torr (lower pressure is better).
4. The meter should read 300 to 500 volts and slowly increase to full voltage (normally 5000 to 7000 volts).
5. Close the roughing valve when the meter reads 2000V or greater.
6. When the meter reads 3,500 volts, set the power unit switch to run, if so equipped. To determine ion pump pressure, set the meter readout display to a current range, and calculate pressure by means of the current to pressure equation.

**NOTE:** Gamma Vacuum ion pump controllers have a selection for pressure readout.

## ***Pump Starting (Isolated)***

This procedure is used if the ion pump is under vacuum and isolated with a high-vacuum isolation valve. In this case, the ion pump is kept in operation while the remainder of the system is opened to atmosphere.

1. Check to see that the ion pump is operating properly.
2. Switch on the roughing pump and open the roughing valve.
3. On the ion pump controller, set the meter readout display to voltage. Set the ion pump controller switch to start, if so equipped.
4. When system pressure has reached  $1 \times 10^{-4}$  torr (lower pressure is better), begin closing the roughing valve and opening the isolation valve. Do not let ion pump voltage drop below 3 kV.
5. When voltage is greater than 3.5 kV, with the isolation valve fully open and the roughing valve fully closed, place the ion pump controller switch to run, if so equipped.

## ***Ongoing Operation***

Once the ion pump has started, it continues to reduce pressure in the system without further attention. The ion pump may be kept in permanent operation. The ion pump controller should provide overload protection to turn off the ion pump if system pressure rises above ion pump operating pressure. Other desirable features of an ion pump controller are:

- ion pump over-current protection
- safety interlocks • voltage, current, and pressure display
- analog outputs that correspond to ion pump voltage and current
- remote control on/off
- setpoints - relays that can interlock equipment and processes, or control bakeout by ion pump current or calculated pressure
- computer interface for complete remote operation by a computer

## ***Venting Procedure***

To enhance system performance, minimize the time the ion pump is exposed to atmosphere and use dry nitrogen gas when venting the ion pump to atmospheric pressure. NOTE: If an isolation valve is included, close it (with ion pump in operation) before opening the system. When venting the system to atmosphere, ion pump current may rise. This is not a problem if pressure remains below  $1 \times 10^{-6}$ .

1. Switch off the ion pump controller.
2. Connect a source of clean dry nitrogen to the up-to-air valve.
3. Open the up-to-air valve slowly to prevent dry nitrogen from entering the system too quickly.
4. Open the roughing isolation valve, gradually.

**CAUTION:** When venting, do not pressurize the ion pump or vacuum system above atmospheric pressure.

## ***Bakeout Procedure***

Bakeout reduces high gas loads. Gamma Vacuum bakeout heaters heat ion pumps above 150°C in free air (without covers or blankets). They heat the ion pump to a high enough temperature to adequately degas pump surfaces while preventing loss of magnetic flux. In free air, element heater temperature is self-limiting; ion pump and magnet temperatures are held to acceptable limits without a thermostat. If ion pumps are covered or insulated during bakeout, then ultimate temperature of the ion pump should be thermostatically controlled.

**NOTE:** When connecting heaters to a power source, ensure that power disconnects are readily available.

### Before You Begin

During bakeout, monitor system pressure so that it does not exceed  $1 \times 10^{-5}$ . Initially, it may be necessary to switch the heaters off periodically and allow pressure to drop, then switch the heaters back on as the gas load is reduced.



**WARNING:** Heaters are extremely hot to the touch. To avoid severe injury, isolate the pump so that no one is able to touch it.



**CAUTION:** Temperatures above 350 °C can cause irreversible loss of magnetic field strength. When operating the system at 350 °C or above, remove the ferrite magnets from the ion pump.



**CAUTION:** Heater must be wired to a disconnect and over-current protection device.

### Bakeout Operation Procedure

1. Switch on the heaters.
2. Monitor system pressure until system is heat-soaked and system pressure begins to decline.
3. If bakeout temperatures near 250°C, shut off the ion pump and use an auxiliary pump for bakeout.
4. Do not cut the bakeout period short. In most cases, a minimum of eight hours is recommended. Longer bakeout periods are often advisable.

**NOTE:** In a few cases, the ion pump is so badly contaminated that bakeout is not sufficient and it may be necessary to use chemical cleaning, which is a difficult procedure. If this is the case, contact your local service for details.

# Maintenance

## ***Performance Checks***

Since the pump operates on the cold cathode discharge principle, it does not include any moving parts. The pump is a sealed trapping device and all gaseous material pumped is retained inside the pump in the form of solid-state compounds. For these reasons the pump requires only minimum maintenance to provide trouble-free operation for extended periods of time.

### Operation Check

With the pump under vacuum, verify as follows:

1. Check that the ion pump control unit is in proper operating condition. (Refer to Control Unit Manual)
2. Connect the high voltage connector to the ion pump high voltage lead-through (ceramic insulator).
3. Turn on the control unit. Observe the current decrease as the pump pumps itself down. Voltage should read  $7000 + 10\%$  and current of a few microamps after a short period of time.

### Leakage Current Check

Total current in an ion pump is comprised of a combination of the following four currents:

- Discharge current is the sum of ion flow to/from the cathode plates, which consists of ion collisions with cathode plates and ions liberated from cathode plates. This current is almost proportional to ion pump pressure.
- Secondary electron current occurs when electrons are ejected from cathode plates or ion pump walls by colliding ions. This current increases with increasing ion energy (operating voltage).
- Leakage current flows across a resistive element such as high voltage cable insulation, high voltage feedthrough, or insulating ceramics. This current increases as the ion pump ages when sputtered deposits coat the ceramic insulators with a conductive film.
- Field emission current is caused by a high voltage gradient. This current depends on the voltage, distance to adjacent surfaces, and the geometry of the field emission point. Sharp edges and needle points exhibit higher emission currents since the electric field gradient is greater around them.

To determine whether ion pump current increase is due to an increase in system pressure or leakage current/field emission, follow these steps:

1. Place the system under vacuum sufficient to produce an ion pump current of 1 mA or less.
2. Switch off the ion pump controller.
3. Remove the magnets from the ion pump (see Removing the Magnets procedure).
4. Switch on the ion pump controller. Current should be negligible on the ion pump controller at full ion pump controller voltage.
5. If leakage current is present, maintenance may be required. NOTE: Leakage current causes errors in pump pressure reading, however, it does not necessarily affect actual pumping speed.

## Magnetic Strength Check

Magnetic field strength determines the pumping speed of the ion pump. Prior to assembly at the factory, the magnets are magnetized and the strength in the pumping pods is checked. Unless these magnets are heated above 350 degrees C or are badly damaged, there should not be a noticeable reduction in strength for several years.

Check field strength as follows:

1. Remove a magnet assembly from one or more pumping elements.
2. Set the gap between the assemblies at 1 ½ " (38mm). Use a wooden spacer block where necessary.
3. Check all components of the field in the gap. The field should be approximately 1700 gauss. Below 1500 gauss will affect pumping speed.

**NOTE:** In the majority of cases, the procedures outlined in paragraphs 1 and 2 above are sufficient to remedy problems encountered with vacuum systems. Always utilize these procedures in the order given before assuming that other remedies may be applicable.

## **Troubleshooting**

Symptom	Possible Cause	Recommended Corrective Action
Pump does not pump system down.	<ol style="list-style-type: none"> <li>1. Large leak in system.</li> <li>2. Gauge equipment or power unit malfunction.</li> <li>3. Pump has short circuit.</li> <li>4. Magnetic field strength low.</li> <li>5. Pump hot.</li> </ol>	<ol style="list-style-type: none"> <li>1. Leak check system, repair leak.</li> <li>2. Check gauge and/or power unit operation.</li> <li>3. Burn short out or return to factory for repair.</li> <li>4. Check field strength, remagnetize if necessary.</li> <li>5. Allow to cool to room temperature.</li> </ol>
Pump down is slow and base pressure higher than previously.	<ol style="list-style-type: none"> <li>1. Leak in system.</li> <li>2. Atmospheric contaminants on pump and system walls.</li> <li>3. Gassy material in system.</li> <li>4. Pump hot.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check system for leaks, repair.</li> <li>2. Use low temperature bakeout of system.</li> <li>3. Remove materials with high outgassing rate.</li> <li>4. Allow to cool to room temperature.</li> </ol>
Pump does not start.	<ol style="list-style-type: none"> <li>1. Insufficient roughing vacuum.</li> <li>2. Leak in roughing system.</li> <li>3. Pump contaminated from hydrocarbon source.</li> <li>4. Pump contaminated with inert gases.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check roughing pump for correct operation, check roughing gauge.</li> <li>2. Leak check roughing system, repair leak.</li> <li>3. Use RGA to determine if oil is present. Pump requires chemical cleaning.</li> <li>4. Rerough system with dry N2 backfill.</li> </ol>
Pump becomes hot during starting.	<ol style="list-style-type: none"> <li>1. Insufficient roughing vacuum.</li> <li>2. Leak in roughing system</li> </ol>	<ol style="list-style-type: none"> <li>1. Check roughing pump operation.</li> <li>2. Leak check roughing system, repair leak.</li> </ol>
Pump becomes hot during operation.	<ol style="list-style-type: none"> <li>1. Pressure too high, has load too heavy for pump to handle</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce gas load and/or clean system.</li> </ol>
Pump current rises to higher level than previously.	<ol style="list-style-type: none"> <li>1. System contaminated with atmospheric contaminants.</li> <li>2. Pressure in system is higher.</li> <li>3. Pump has developed high leakage current.</li> </ol>	<ol style="list-style-type: none"> <li>1. Use low temperature bakeout.</li> <li>2. Reduce gas load, outgas system, remove gassy materials.</li> <li>3. a. Burn out leakage paths. b. Replace insulators</li> </ol>
Pump current shows zero but system pressure indicates higher pressure.	<ol style="list-style-type: none"> <li>1. Pump magnets installed incorrectly.</li> <li>2. Pump up to air</li> </ol>	<ol style="list-style-type: none"> <li>1. Verify magnets are installed correctly</li> <li>2. Confirm ion pump is not at atmospheric pressure</li> </ol>

## **Corrective Procedures**

### **Leak Testing**

The most common cause of the slow pumpdown and high base pressure in any vacuum system is due to a leak in the system. Even an extremely small leak which would be undetectable in a pressure system can be very serious in an ultra-high vacuum system. Using a mass spectrometer or equivalent type leak detector, spray the outside surface of the system at suspected leak points with a probe gas through a fine muzzle. If a leak detector is not available, a less desirable method of leak detection is to monitor the pump current in conjunction with using a probe gas such as helium. Any leak should be fixed permanently.

### **Low Temperature Bakeout**

This procedure is very effective for improving the pumpdown speed and base pressure of a system which does not appear to be performing as well as it has previously. The principal reason for decreased performance is the contamination of the system and/or pump with atmospheric water vapor. This water vapor enters an open system and adheres to the system walls. Although this contamination does not physically harm the pump or "load it up," it is not removed by subsequent roughing cycles and forms a significant additional gas source in the system, particularly in moist climates. Removal as outlined below will restore the system to proper operation.

1. Place the system under vacuum with the system sealed and the ion pump in operation.
2. Bake out temperatures of 200 degree C to 250 degree C are sufficient to obtain pressures in the UHV range. Bakeouts at higher temperatures must be done into an auxiliary pump since the pumping speed of an ion pump is very low at these temperatures due to the reduced field strength of the magnets at elevated temperatures. To prevent irreversible loss of magnetic field strength at temperatures above 350 degree C the magnets should be removed from the pump. If there are any viton seals in the system the bake out should be limited to 150 degree C. If the ion pump is equipped with a bakeout heater, use it in place of the heat lamps on the pump.
3. Adjust the heat to prevent pressure in the system from rising above approximately  $2 \times 10^{-5}$  torr.
4. Generally an overnight bakeout of this sort will be sufficient, but longer bakeouts may be required for contaminated systems.

This procedure may be repeated as many times as it provides beneficial results. In the majority of cases, it will greatly improve system performance without additional work being required.

### **High Electrical Leakage**

High leakage current does not appreciably affect the operation of the pump, but it does render the pump incapable of giving accurate pressure readings. However, pressure can be read by determining the total leakage current after removing the magnets, and subtracting this value from the total current drawn by the pump. To reduce electrical leakage:

1. Connect the Gamma Vacuum control unit to the ion pump.
2. With the pump pressure in the low micron range (10-20torr), turn on the control unit.
3. Several applications of this technique may be necessary. Be sure to allow the control unit to discharge completely between each application.
4. If this procedure does not eliminate the leakage current, check the feedthrough for leakage as described under Performance Checks.



**CAUTION:** THESE CONTROL UNITS ARE CAPABLE OF DELIVERING 7000VDC UNDER OPEN CIRCUIT CONDITIONS. OBSERVE SAFETY PRECAUTIONS DISCUSSED PREVIOUSLY.

5. If the feedthrough is not the cause of the leakage current, the pumping element ceramic insulators are the conduction path and should be replaced.

### Pump Short Circuits

On infrequent occasions the pump may develop a short circuit after extended operation because a flake of deposited material is shorting across the pump element anode-cathode units.

1. Check for shorts by measuring resistance between the feedthrough tip and the pump body. Resistance should be infinite.
2. If a short is indicated, first try to remove it electrically by turning on the control unit with the pump in the low micron range (10-3 torr).
3. If several applications of this technique do not remove the short, let the pump up to atmosphere and repeat the procedure.
4. If this procedure does not remedy the short, remove the pump from the system and remove and inspect the connector straps and pumping elements. Connect each pumping element individually to the control unit and check for shorts by turning on the control unit.
5. Replace all ceramics.
6. Remove all loosely adhering material from the part including the pump envelope.
7. Degrease parts and reassemble with new ceramics.
8. Vacuum flakes and loose material out of pump body.
9. Reassemble and turn on power supply at atmosphere to check for shorts or leakage.



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### Chemical Cleaning

In a few instances, a system and pump may be so badly contaminated by a source other than atmospheric contamination that a moderate bakeout is not sufficient for improving performance. In these cases, it may be necessary to use chemical cleaning. This procedure is difficult and requires special equipment and chemicals. Gamma Vacuum provides this service. Contact the factory for details.

# Warranty & Service

## ***Service***

### Service Requests

Upon notification, Gamma Vacuum will identify the level of service required. To assist in this process, please provide the following information in as much detail as possible:

- Part Number
- Serial Number
- Detailed Description of the Vacuum System Hardware
- Detailed Description of the Vacuum System Process (gas species introduced, ultimate pressure, operational pressure)
- Reason for Service Request
- Required Documentation

To expedite this process, please forward this information to [service@gammavacuum.com](mailto:service@gammavacuum.com).

### Direct Support

Prior to recommending replacement parts or service at our facility, Gamma Vacuum can assist with general vacuum issues via e-mail or by telephone at no charge. It is our goal to have vacuum systems functional with minimal time and financial investment. To do this, our service technicians require as much information as possible about the vacuum system in need of support. To assist in this process, please provide the following information in as much detail as possible:

- Part Number
- Serial Number
- Detailed Description of the Vacuum System Hardware
- Detailed Description of the Vacuum System Process (gas species introduced, ultimate pressure, operational pressure)
- Reason for Support Inquiry

To expedite this process, please forward this information to [service@gammavacuum.com](mailto:service@gammavacuum.com) or contact our facility directly at the numbers below.

## ***Warranty***

### General Terms

Gamma Vacuum warrants to the Buyer that the equipment sold is new equipment, unless previously stated, and is, at the time of shipment to Buyer from Gamma Vacuum, free from defects in material and workmanship. As Buyers sole exclusive remedy under this warranty, Gamma Vacuum agrees to either repair or replace, at Gamma Vacuums option and free of parts charge to Buyer, and part or parts which, under proper and normal conditions of use, prove to be defective within twelve (12) months from the date of receipt by buyer. As expendable items may

have a life time of less than one year, their warranty is subject to reasonable service and will be replaced as determined by Gamma Vacuum. All warranty claims must be brought to the attention of Gamma Vacuum within 30 days of failure to perform.

This warranty does not cover loss, damage, or defects resulting from transportation to the buyer's facility, improper or inadequate maintenance by buyer, buyer supplied software or interfacing, unauthorized modifications of misuse, operation outside of environmental specifications for the equipment or improper site preparation and maintenance.

In-Warranty repaired or replacement parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the parts which have been repaired or replaced. After expiration of the applicable warranty period, the Buyer shall be charged at Gamma Vacuum's then current prices for parts, labor, and transportation.

Reasonable care must be used to avoid hazards. Gamma Vacuum expressly disclaims responsibility for any loss or damage caused by the use of its products other than in accordance with proper operating and safety procedures.

EXCEPT AS STATED HEREIN, GAMMA VACUUM MAKES NO WARRANTY, EXPRESSED OR IMPLIED (EITHER IN FACT OR BY OPERATION OF LAW), STATUTORY OR OTHERWISE: AND, EXCEPT AS STATED HEREIN, GAMMA VACUUM SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR FROM ANY CAUSE ARISING OUT OF THE SALE, INSTALLATION, OR USE OF ANY OF ITS PRODUCTS.

Statements made by any person, including representatives of Gamma Vacuum, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Gamma Vacuum unless reduced to writing and approved by an officer of Gamma Vacuum.

Gamma Vacuum may at any time discharge its warranty as to any of its products by refunding the purchase price and taking back the products.

## Warranty Claims

Upon notification, Gamma Vacuum will investigate Warranty Claims. To initiate a Warranty Claim, please contact Gamma Vacuum directly or a representative of Gamma Vacuum. To assist in this evaluation, please provide the following information in as much detail as possible:

- Part Number
- Serial Number
- Detailed Description of the Vacuum System Hardware
- Detailed Description of the Vacuum System Process (gas species introduced, ultimate pressure, operational pressure)
- Detailed Reason for the Warranty Claim

To expedite this process, please forward this information to [service@gammavacuum.com](mailto:service@gammavacuum.com).

## ***Returning Material***

### **Return Procedure**

In the event a product requires service, exchange, or return, a Return Material Authorization (RMA) number must be obtained from Gamma Vacuum prior to shipment. RMA numbers can be obtained by calling the Gamma Vacuum toll-free number. The RMA process will be expedited if any of the following information can be provided:

- Original Purchase Order Number
- Gamma Vacuum Sales Order Number
- Product Order Number and/or Product Description
- Product Serial Number

All products received for repair or replacement shall be prepaid. Items not labeled with an RMA number will be accepted; however substantial delay in process may result. A standard restocking fee may apply.

**Note:** Prior to issuance of an RMA, the required documents must be submitted to Gamma Vacuum.

### **Required Documentation**

During a lifetime of system operation, it is possible that certain contaminants, some of which could be hazardous, may be introduced into the vacuum system, thus contaminating the components. Please complete the form on the next page to identify any known hazardous substances that have been introduced into the vacuum system. This will enable us to evaluate your equipment and determine if we have the facilities to make the repair without risk to employee health and safety. Return, repairs, or credit will not be authorized until this form has been signed and returned.

**Note:** Prior to returning any materials, Gamma Vacuum must issue an RMA. The RMA number should be clearly labeled on all shipping information and packages.

## Return Material Authorization Form

Thank you for taking the time to complete this form. Please complete this form in word and return to Gamma Vacuum in word, Adobe Acrobat format (.pdf), or via fax. The "tab" key moves between fields. Digital signatures are acceptable.

<b>Assigned RMA:</b>		<b>Your Reference:</b>	
<b>Company Information</b>			
Company Name:		Date:	
Address:			
<b>Contact Information</b>			
Name:		Phone:	
Primary E-mail:		Fax:	
Web Site Address:			
<b>Return Information</b>			
Type of Product:	<input type="checkbox"/> ION PUMP <input type="checkbox"/> ION PUMP CONTROLLER <input type="checkbox"/> OTHER	Part Number:	
		Description:	
		Serial Number:	
Contaminant Status*:	<input type="checkbox"/> HAS NOT BEEN EXPOSED <input type="checkbox"/> HAS BEEN EXPOSED	Original Purchase Order:	
Claim Status:	<input type="checkbox"/> WARRANTY CLAIM <input type="checkbox"/> SERVICE REQUEST <input type="checkbox"/> SHIPPING ERROR <input type="checkbox"/> EVALUATION <input type="checkbox"/> OTHER	Your Reference:	
Reason for Return:			
Additional Information:			
Signature of Certifying Official		Name and Title of Certifying Official	

\* Contaminants to vacuum systems are defined as: any substance that, because of its properties, is not compatible with ultra-high vacuum (UHV) operation. Some of these are: silicon (in the form of silicones), sulfur, cadmium, fluorine and chlorine. Contaminants have been determined by vapor pressure curves and/or properties that are detrimental to the operation of UHV products.

\*\* "Hazardous substance" means a chemical or substance, or mixture of chemicals or substances, which:

- a. is regulated by the Federal Occupational Safety and Health Administration under Code of Federal Regulations, title 29, part 1910, subpart Z;
- b. is either toxic or highly toxic, an irritant, corrosive, a strong oxidizer, a strong sensitizer, combustible, either flammable or extremely flammable, dangerously reactive, pyrophoric, a carcinogen, a teratogen, a mutagen, a reproductive toxic agent, or that otherwise, according to generally accepted documented medical or scientific evidence, may cause substantial acute or chronic personal injury or illness during or as a direct result of any customary or reasonably foreseeable accidental or intentional exposure to the chemical or substance. (Common examples: arsenic, cadmium, gallium, cesium, mercury, radiation, etc.)