ION Pump
Instruction manual

www.gammavacuum.com

900013_G

Original instructions

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Disclaimer

The content of this manual may change from time to time without notice. We accept no liability for any errors that may appear in this manual nor do we make any expressed or implied warranties regarding the content. As far as practical we have ensured that the products have been designed and constructed to be safe and without risks when properly installed and used in accordance with their operating instructions.

We accept no liability for loss of profit, loss of market or any other indirect or consequential loss whatsoever.

Product warranty and limit of liability are dealt with in our standard terms and conditions of sale or negotiated contract under which this document is supplied.

You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product.

Contents

1. Safety and compliance

1.1. Definition of Warnings and Cautions

NOTICE:

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use.

Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions. The equipment must only be operated and maintained by trained personnel in the proper condition and as described in this instruction manual.

Obey local and state requirements and regulations. If you have any questions about safety, operation or maintenance of the device, please contact our nearest subsidiary.

Important safety information is highlighted as warning and caution instructions. Obey these instructions.

WARNING:

If you do not obey a warning, there is a risk of injury or death. Different symbols are used according to the type of hazard.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the equipment.

We reserve the right to change the design and the stated data. The illustrations are not binding.

Keep the instructions for future use.

1.2. Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that we use on the product or in the product documentation have the following meanings:

	Warning/Caution An appropriate safety instruction must be followed or caution to a potential hazard exists.
	Warning - Dangerous voltage Identifies possible hazards from hazardous voltages.
	Warning - Flammable material The material is flammable. If exposed to sources of ignition it can cause a fire.
	Warning - Heavy object Identifies a possible hazard from a heavy object.
	Warning - Hot surfaces Identifies a potential hazard from a hot surface.
	Warning - Risk of explosion There is a risk of explosion when you do the task.
	Mandatory - Read the manual
	Warning - Use protective equipment Use appropriate protective equipment for the task.
	Warning - High magnetic field Strong magnetic field. No pacemakers or other devices allowed. Authorised personnel only.

1.3. Warnings

	WARNING: 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.	AVERTISSEMENT: Les unités de commande de Gamma Vacuum destinées aux pompes ioniques peuvent fournir 7 000 V c.c. dans des conditions de fonctionnement en circuit ouvert ou basse pression. Pour un fonctionnement sûr, l'unité de commande et la pompe ionique doivent disposer d'un connecteur de châssis commun raccordé à la terre du système d'alimentation.	警告: イオンポンプ用に設計されたガンマ真空コントロールユニットは、開回路または低圧動作条件で 7000 vdc の出力を供給します。安全に動作させるためには、コントロールユニットとイオンポンプに電源システムのグランドに接続された共通のシャーシコネクタが必要です。
	ADVERTENCIA: Las unidades de control Gamma Vacuum diseñadas para el funcionamiento de bombas de iones pueden suministrar 7000 V CC en un circuito abierto o en condiciones de funcionamiento a baja presión. Para un funcionamiento seguro, la unidad de control y la bomba de iones deben tener un conector de chasis común conectado a la toma de tierra del sistema eléctrico.	WARNUNG: Die Steuereinheit von Gamma Vacuum ist für den Betrieb von Ionenpumpen mit einer Kapazität von 7000 V DC unter Betriebsbedingungen im offenen Stromkreis oder Niederdruck ausgelegt. Für einen sicheren Betrieb sollten die Steuereinheit und die Ionenpumpe einen gemeinsamen Einbaustecker haben, der mit der Masse des Stromversorgungs - systems verbunden ist.	警告： 离子**泵**运行中所用的 Gamma Vacuum 控制**单**元在**开**路或低**压**运行条件下，能**够产**生 7000 V 直流**电**。出于安全起**见**，控制**单**元和离子**泵应该**有一个共用底**盘连**接器，并与**电**源系**统**接地点相**连**。

	WARNING: High magnetic field. Can cause implanted heart pacemakers and cardioverter Defibrillators to cease operation. Maintain 12 inch safe distance from ion pump.	AVERTISSEMENT : Champ magnétique puissant. Peut interrompre le fonctionnement des stimulateurs cardiaques et des cardio-défibrillateurs implantés. La distance de sécurité doit être d'au moins douze pouces par rapport à la pompe ionique.	警告: 高磁場。植え込み式ペースメーカおよび除細動器の動作を停止させる可能性があります。イオンポンプから 12 インチ以上離れた安全な距離を保ってください。
	ADVERTENCIA: Campo magnético elevado. El equipo puede interrumpir el funcionamiento de marcapasos y desfibriladores automáticos implantables. Mantenga una distancia de seguridad de aproximadamente 30 cm (12 pulgadas) respecto a la bomba de iones.	WARNUNG: Hohes Magnetfeld. Kann dazu führen, dass implantierte Herzschrittmacher und Kardioverter-Defibrillatoren nicht funktionieren. Halten Sie einen Sicherheitsabstand von 30 cm zur Ionenpumpe ein.	警告： 高磁场。植入的心脏起搏器和复律 除颤器可能会失效。必须与离子泵保持 12 英寸远的安全距离。

	WARNING: Heavy object. To avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing.	AVERTISSEMENT : Objet lourd. Pour éviter les blessures musculaires ou dorsales, utilisez des engins de levage et des techniques de levage appropriées lors du retrait ou du remplacement d'un objet lourd.	警告: 重量のある装置、部品。筋挫傷、背中や腰の怪我を避けるために、取り外しや交換はリフトを使用した適切な吊り上げ方法で行ってください。
	ADVERTENCIA: Objeto pesado. Para evitar distensiones musculares o lesiones en la espalda, utilice ayudas para la elevación y técnicas de elevación adecuadas durante la retirada o sustitución del equipo.	WARNUNG: Schwerer Gegenstand. Um Muskelverspannungen oder Rückenverletzungen zu vermeiden, verwenden Sie beim Entfernen oder Ersetzen Hebehilfen und geeignete Hebetechniken.	警告： 重物。为了避免肌肉劳损或背部损伤，执行卸除或更换操作时，应使用起重工具，并采用适当的起重技巧。

	CAUTION: Not for use with flammable gases.	ATTENTION : N'utilisez pas la machine avec des gaz inflammables.	注意: 可燃ガスには使用しないでください。
	PRECAUCIÓN: No utilice este equipo con gases inflamables.	VORSICHT: Nicht zur Verwendung mit zündfähigen Gasen.	注意： 不能用于易燃气体。

	CAUTION: Burn hazard. All ion pump surfaces are hot during bake. Do not touch pump unless bake is off and pump has cooled.	ATTENTION : Risque de brûlure. Toutes les surfaces de la pompe ionique sont chaudes pendant l'étuvage. Ne touchez pas la pompe tant que l'étuvage n'est pas terminé et que la pompe n'est pas froide.	注意: 火傷の危険性。ベーク中は、イオンポンプのすべての面が高温になります。ベークが終了しポンプが冷えるまで触らないでください。
	PRECAUCIÓN: Peligro de quemaduras. Todas las superficies de la bomba de iones están calientes durante su funcionamiento. No toque la bomba a menos que el horno esté apagado y la bomba se haya enfriado.	VORSICHT: Verbrennungsgefahr. Alle Ionenpumpen-oberflächen sind während des Ausheizvorgangs heiß. Die Pumpe nicht berühren, es sei denn, das Ausheizsystem ist ausgeschaltet und die Pumpe ist abgekühlt.	注意： 灼**伤**危**险**。所有离子**泵**表面在烘烤**过**程中温度都很高。必**须**等烘烤停止，**泵**凉下来后，才能触碰**泵**。

	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. Use wires that can withstand temperatures up to 600 °C to connect the pump terminals.	AVERTISSEMENT : Les éléments chauffants sont configurés pour 100-120 ou 200-240 volts, max. 16 A. Assurez-vous que le connecteur et la tension sont adaptés avant le raccordement. La tension ou le courant peuvent entraîner des blessures, voire la mort. Débranchez tous les cordons d'alimentation avant l'entretien. Utilisez des fils capables de supporter des températures pouvant atteindre 600 °C pour raccorder les bornes de la pompe.	警告: ヒーターは、100～120、または 200～240 ボルトのいずれか、16 アンペア（最大）で構成されています。接続する前に、適切なコネクタと電圧を確認してください。不適切な電圧や電流は怪我や死亡事故の原因になります。保守を行う前に、すべての電源コードを外してください。600°C までの温度に耐えられるワイヤを使用して、ポンプ端子を接続します。
	ADVERTENCIA: Los calentadores están configurados para 100-120 o 200-240 voltios, 16 A máx. Compruebe que el conector y la tensión sean los adecuados antes de realizar la conexión. La tensión o la corriente pueden provocar lesiones o incluso la muerte. Desconecte todos los cables de alimentación antes de realizar cualquier tarea de mantenimiento. Utilice cables que puedan soportar temperaturas de hasta 600 °C para conectar los terminales de la bomba.	WARNUNG: Die Heizungen sind konfiguriert für entweder 100–120 oder 200–240 Volt und max. 16 A. Überprüfen Sie vor dem Anschluss den entsprechenden Stecker und die Spannung. Spannung oder Strom können zu Verletzungen oder Tod führen. Trennen Sie vor Wartungsarbeiten alle Stromkabel. Verwenden Sie zum Anschluss der Pumpenklemmen Drähte, die Temperaturen bis 600 °C standhalten können.	警告： 加热器的配置规格为 100-120 或 200-240 V，最大电流 16 A。连接之前先确认连接器和电压是否正确。电压或电流不当可能导致人员伤亡。维护之前先断开所有电源线。连接泵端子所用电线必须能够耐受高达 600 °C 的温度。

	WARNING: Read and understand operator's manual before using this machine. Failure to follow operating instructions could result in injury or damage to equipment.	AVERTISSEMENT : Lisez et comprenez le mode d'emploi avant d'utiliser cette machine. Le non-respect des instructions d'utilisation peut entraîner des blessures ou endommager l'équipement.	警告: 本機械を使用する前に、取扱説明書をよく読み、十分に理解してください。操作手順に従わない場合、怪我や機器が損傷する原因となることがあります。
	ADVERTENCIA: Lea y comprenda el manual del operador antes de utilizar este equipo. Si no se siguen las instrucciones de funcionamiento, podrían producirse lesiones o daños en el equipo.	WARNUNG: Sie müssen diese Bedienungsanleitung lesen und verstehen, bevor Sie diese Maschine benutzen. Die Nichtbeachtung der Gebrauchsanleitung kann zu Verletzungen oder Schäden an der Anlage führen.	警告： 使用本**设备**之前，**请阅读**并理解操作**员**手册。不遵守操作手册**说**明可能**导**致人**员**受**伤**和**设备损**坏。

2. 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 0.2 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.

WARNING:

Do not use unauthorized parts. Such parts may compromise safety. Contact us if in doubt.

WARNING:

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

Table 1. *Models*

Small pumps	Low profile pumps	Tall profile pumps
Mini	100L	150T, 150TV, 150L
3S	200L	200T
10S,10ST, 10SW	300L	250T
20S	400L, 400LX	300T, 300TV
25S, 25SVT, 25SVW	600L, 600LX	500T
40S	800LX	600TV
45S	1200LX	
75S		

Individual model specification information is located on our website at: www.gammavacuum.com

2.1. 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

3. Technical data

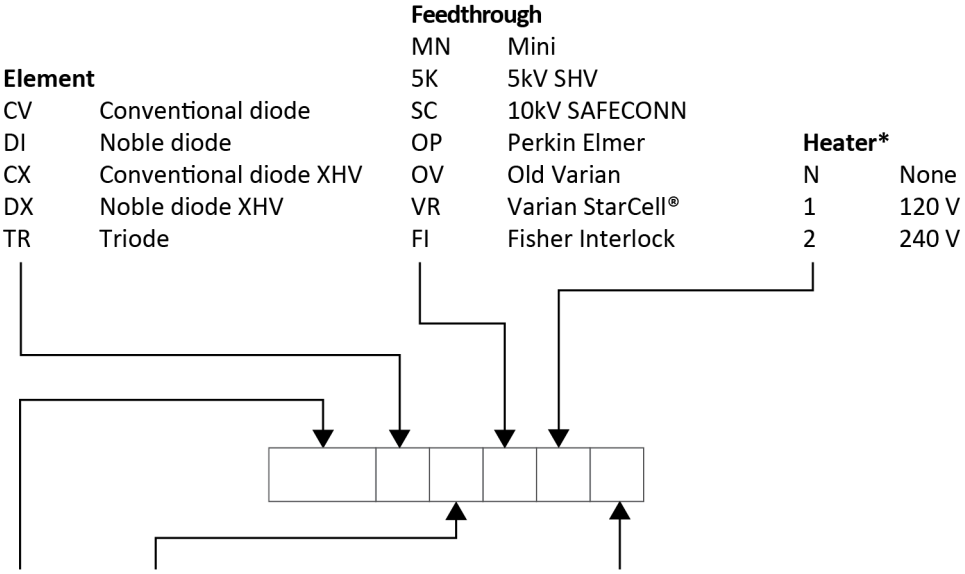
Table 2. *Technical data*

Pump	Pumping speed l/s	Weight kg (lbs)	Available elements	Available ports	Available Feed throughs	Option: Integrated TSP/NEG
MINI	0 2	0.35 (0.8)	DI	1V	MN	N
3S	3	0.45 (1.0)	CV / DI	CU /1V / 1H / 1D	5K / OV	N
5S	5	2.3 (5)	CV / DI	2V	5K / SC	N
10S	10	6 (13)	CV / DI	2H	SC / OV / FI	N
25S	25	9 (20)	CV / DI / TR / CX / DX	2V / 2H / 2D / 4V / 4D	SC / OP / OV / VR / FI	TSP / N0 / N1
45S	45	16 (34)	CV / DI / TR / CX / DX	2V / 2H / 2D / 4V / 4D	SC / OP / OV / VR / FI	TSP / N0 / N1 / N2
75S	75	22 (48)	CV / DI / TR / CX / DX	2V / 2D / 4V / 4D / 6S / 62	SC / OP / OV / VR / FI	TSP / N0 / N1 / N2 / N3
100L	100	29 (62)	CV / DI / TR	6S / 6D / 8S / 8D	SC / OP / OV / VR / FI	TA / NG
150T	150	32 (70)	CV / DI / TR	6S / 6D / 6P / 8S / 8D / 8P	SC / OP / OV / VR / FI	TC / TA / NG
150TV	150	32 (70)	CV / DI / TR	6S / 6D / 6P	SC / OP / OV / VR / FI	TC / TA / NG
200L	200	50 (112)	CV / DI / TR	6S / 6D / 8S / 8D	SC / OP / OV / VR / FI	TC / TA / NG
200T	200	50 (112)	CV / DI / TR	6S / 6D / 6P / 8S / 8D / 8P	SC / OP / OV / VR / FI	TC / TA / NG
300L	300	66 (145)	CV / DI / TR	8S / 8D	SC / OP / OV / VR / FI	TC / TA / NG
300T	300	66 (145)	CV / DI / TR	8S / 8D / 8P	SC / OP / OV / VR / FI	TC / TA / NG
300TV	300	66 (145)	CV / DI / TR	8S / 8D / 8P	SC / OP / OV / VR / FI	TC / TA / NG
400L	400	67 (148)	CV / DI / TR	8S / 8D	SC / OP / OV / VR / FI	TC / TA / NG
400LX	400	95 (210)	CV / DI / TR	8S / 8D / 8P	SC / OP / OV / VR / FI	TC / TA / NG

Pump	Pumping speed l/s	Weight kg (lbs)	Available elements	Available ports	Available Feed throughs	Option: Integrated TSP/NEG
500T	500	96 (212)	CV / DI / TR	8S / 8D / 8P	SC / OP / OV / VR / FI	TC / TA / NG
600L	600	103 (226)	CV / DI / TR	8S / 8D / 10 / 18	SC / OP / OV / VR / FI	TC / TA / NG
600LX	600	122 (270)	CV / DI / TR	8S / 8D / 8P / 10 / 18 / 19	SC / OP / OV / VR / FI	TC / TA / NG
600TV	600	109 (243)	CV / DI / TR	8S / 8D / 8P	SC / OP / OV / VR / FI	TC / TA / NG
800LX	800	127 (280)	CV / DI / TR	8S / 8D / 10 / 18	SC / OP / OV / VR / FI	TC / TA / NG
1200LX	1200	206 (452)	CV / DI / TR	8S / 8D / 10 / 18	SC / OP / OV / VR / FI	TC / TA / NG
XW	Xl/s	25 (56)	CV / DI	2D	SC / FI	

For the meaning of abbreviations, like CV, DI, 2H, SC, FI, NG, etc, refer to Ordering information.

Figure 1. *Ordering Information*



Element		Feedthrough		Heater*	
CV	Conventional diode	MN	Mini	N	None
DI	Noble diode	5K	5kV SHV	1	120 V
CX	Conventional diode XHV	SC	10kV SAFECONN	2	240 V
DX	Noble diode XHV	OP	Perkin Elmer		
TR	Triode	OV	Old Varian		
		VR	Varian StarCell®		
		FI	Fisher Interlock		

Pump	Flange		Integrated TSP/NEG	
MINI	CU	Copper Tube	N	None
3S	1V	Vertical DN16 (1.33'')	TSP	TSP single filament
5S	1H	Horizontal DN16	N0	50l/s NEG (25/45/75)
10S	1D	2 ports DN16	N1	100l/s NEG (25/45/75)
25S	2V	Vertical DN40 (2.75'')	N2	200l/s NEG (45/75)
45S	2H	Horizontal DN40	N3	300l/s NEG (75)
75S	2D	2 ports DN40	TC	TSP & Cryoshroud (not 100L)
100L	4V	Vertical DN63 (4.5'')	TA	TSP & Ambient Shield
150T	4D	2 ports DN63/40 (4.5''/2.75'')	NG	400l/s NEG
150TV	6S	Single DN100 (6'')		
200L	62	2 ports DN100/40 (6''/2.75'') perpendicular		
200T	6D	2 ports DN100/40 (6''/2.75'') inline		
300L	6P	2 ports DN160/100 (8''/6'') perpendicular		
300T	8S	Single DN160 (8'')		
300TV	8D	2 ports DN160 inline		
400L	8P	2 ports DN160 perpendicular		
400LX	10	Single DN200 (10'')		
500T	18	2 ports DN200/160 (10''/8'') inline		
600L	19	2 ports DN200/160 (10''/8'') perpendicular		
600LX				
600TV				
800LX				
1200LX				
XW				

** Option only for 10S and bigger, heater option not available (N) for MINI, 3S and 5S.*

Not all configurations are possible, refer to Table: Technical data.

Example: 200LDI8DSC2TA is a 200 l/s ion pump with a low profile and a noble diode element. It has two opposing flanges ('inline') with a diameter of DN 160 (8''). It uses the SAFECONN feedthrough and has an electrical heater with a supply voltage of 240 V. The ion pump contains an integrated TSP (=Titanium Sublimation Pump) with ambient sputtering shield.

4. Unpack the pump

Do not remove or damage the protective plastic cover 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.

4.1. Inspect for any obvious damage

If the pump is damaged in any way, a claim should be filed with the carrier immediately and notification given to Gamma Vacuum.

If equipment must be returned for inspection or repair, obtain authorization from Gamma Vacuum prior to shipping. Contact Gamma Vacuum for authorization and return instructions.

4.2. Check the equipment received

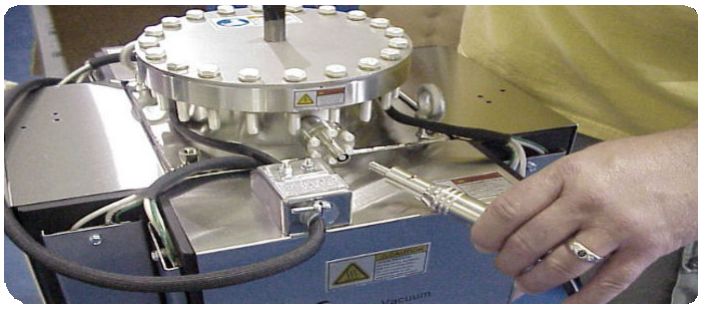
Ensure that all items shipped have been received. If any items are missing, notify the carrier and Gamma Vacuum. Save all packaging material for inspection.

5. Initial checkout

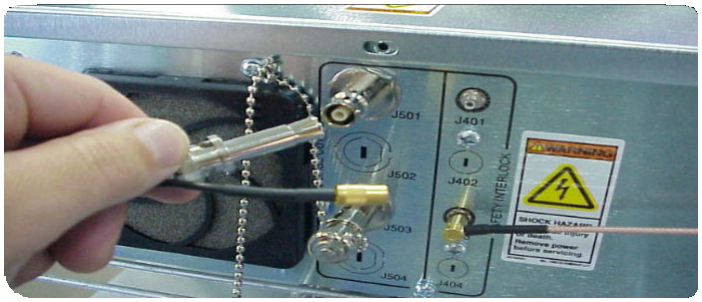
5.1. Pre-venting procedure

Ion pumps are shipped under vacuum to ensure ultra high vacuum cleanliness and to demonstrate the vacuum integrity of the ion pump.

1. Connect the high voltage cable to the ion pump. Use the supplied cable or a cable with the appropriate mating connector for your feedthrough.



2. Connect the high voltage cable to an ion pump controller with the correct polarity. Connect the SAFECONN SMB connector, if included.



3. Enable high voltage on the ion pump controller.
4. The ion pump should start immediately and follow the time, pressure, and current specifications recorded on the included certificate of conformance.

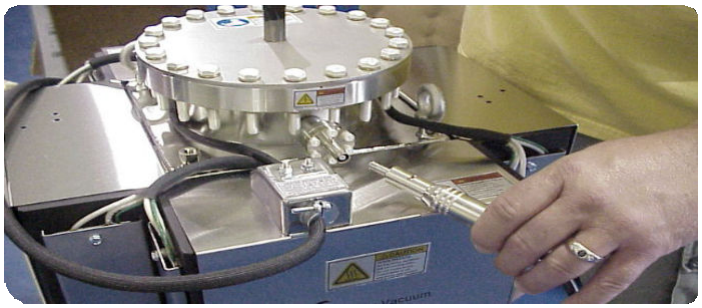
6. Installation

1. Remove the blank-off flange from the pump using dry nitrogen as a venting gas.
2. Bolt the ion pump to the system using the bolt set from the blank-off flange. Pumps up to the size of the 40S many 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).

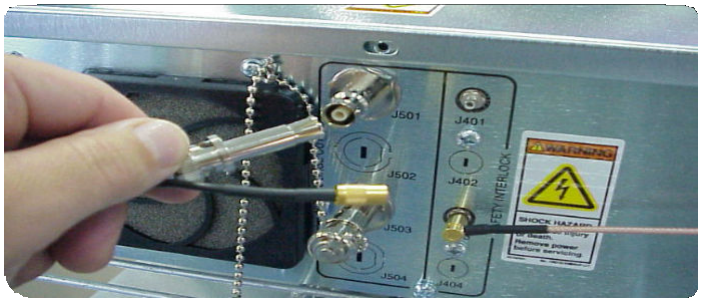
   Note:

   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.

3. Several styles of feedthrough connection systems are available, but SAFECONN connectors are standard.
4. To connect the SAFECONN connector, push the cable end connector onto the feedthrough and turn clockwise to lock in place.



5. Attach the other end of the cable to the 10 kV high voltage connector mounted on the rear of the power supply chassis.



   NOTE:

   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.

6. 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.

7. Operation

7.1. General recommendations

Read the following recommendations before operating ion pump:

- 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 downtime, flush the system with dry nitrogen to decrease water vapour 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.

7.2. Rough pumping

Rough pumping removes a high volume of gas load and achieves a pressure at which the ion pump will start. The ion pump will start quicker, achieve ultimate pressure faster, and last longer.

CAUTION:

Do not contaminate 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 x 10^{-4} torr or lower.

7.3. 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 x 10^{-2} torr. If the pump is still under vacuum, see Pump starting (isolated) on page 22.

1. Switch on the roughing pump and open the roughing valve.
2. On the ion pump controller, set the controller 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 x 10^{-4} torr (lower pressure is better).
4. The controller should read 300 to 500 V and slowly increase to full voltage (normally 5000 to 7000 V).
5. Close the roughing valve when the controller reads 2000 V or greater.
6. When the controller reads 3500 V, set the power unit switch to run, if so equipped. To determine ion pump pressure, set the controller 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.

7.4. 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 controller readout display to voltage. Set the ion pump controller switch to start, if so equipped.
4. When system pressure has reached 1 x 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 3000 V.
5. When voltage is greater than 3500 V, with the isolation valve fully open and the roughing valve fully closed, place the ion pump controller switch to run, if so equipped.

7.5. Ongoing operation

After the ion pump has started, it continues to reduce pressure in the system without further attention.

NOTE:

The ion pump can 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 and off
- setpoints-relays that can interlock equipment and processes, or control bakeout by ion pump current or calculated pressure
- computer interface for remote operation by computer.

Note:

Gamma Vacuum ion pump controllers have all the desired features of an ion pump controller.

7.6. Venting procedure

To enhance system performance:

- Minimize the time the ion pump is exposed to atmosphere.
- 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 x 10^{-6} torr.

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.

7.7. 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: the ion pump and magnet temperatures are held to acceptable limits without a thermostat. If ion pumps are covered or insulated during bakeout, then the temperature of the ion pump should be thermostatically controlled.

NOTE:

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

7.7.1. Before you begin

During bakeout, monitor system pressure so that it does not exceed 1 x 10^{-5} torr. It might 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.

7.7.2. 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.

8. Maintenance

CAUTION:

This equipment uses a high voltage, detachable power supply cord. Do not replace with inadequately rated supply cords.

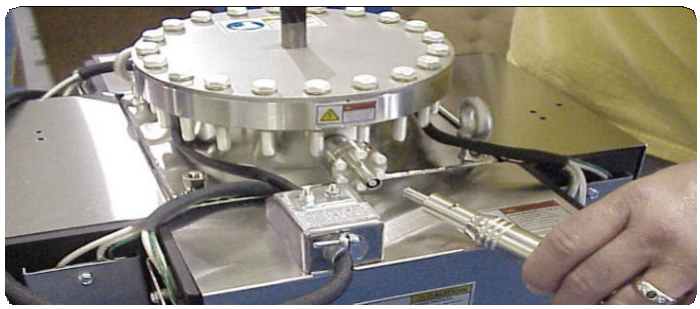
8.1. Performance checks

The ion pump operates on the cold cathode discharge principle, so 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.

8.1.1. 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 user 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 decrease in current as the pump pumps itself down. Voltage should read 7000 ± 10% and current of a few microamps after a short period of time.

8.1.2. Leakage current check

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

- Discharge current: is the sum of ion flow to and 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 because 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 or field emission:

1. Place the system under vacuum sufficient to produce an ion pump current of 1 mA or less. See Rough pumping on page 21.
2. Switch off the ion pump controller.
3. Remove the magnets from the ion pump, see Magnetic strength check on page 26.
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.

8.1.3. Magnetic strength check

NOTE:

To complete this process, you need a gaussmeter.

Magnetic field strength is one factor that determines the pumping speed of the ion pump. The magnets are magnetized prior to assembly at the factory, and there should not be a noticeable reduction in strength unless the magnets are heated above 350 °C or are badly damaged.

To check field strength:

- Remove a magnet assembly from one or more pumping elements.
- Set the gap between the assemblies at 1-1/2” (38 mm). Use a wooden spacer block where necessary.
- Check all components of the field in the gap. The field should be approximately 1000 to 1500 gauss depending on magnetic circuit design.

9. Fault finding

Table 3. *Fault finding*

Condition
Pump does not pump system down on page 27
Pump down is slow and base pressure higher than previous on page 27
Pump does not start on page 28
Pump becomes hot during starting on page 28
Pump becomes hot during operation on page 28
Pump current rises to higher level than previous on page 28
Pump current shows the zero but system pressure indicates higher pressure on page 28

Fault	**Pump does not pump system down**
Cause	**Large leak in system**
Remedy	Leak check system, repair leak.
Cause	**Gauge equipment or power unit malfunction**
Remedy	Check gauge and power unit operation.
Cause	**Pump has short circuit**
Remedy	Burn short out or return to factory for repair.
Cause	**Magnetic field strength is low**
Remedy	Check field strength, remagnetize if necessary.
Cause	**Pump is hot**
Remedy	Allow to cool at room temperature.

Fault	**Pump down is slow and base pressure higher than previous**
Cause	**Leak in the system**
Remedy	Check system for leaks, repair.
Cause	**Atmospheric contaminants on pump and system walls**
Remedy	Use low-temperature bakeout of system.
Cause	**Gassy material in system**
Remedy	Remove materials with high outgassing rate.
Cause	**Pump is hot**
Remedy	Allow to cool at room temperature.

Fault	Pump does not start
Cause	**Insufficient roughing vacuum**
Remedy	Check roughing pump for correct operation, check roughing gauge.
Cause	**Leak in the roughing system**
Remedy	Leak check roughing system, repair leak.
Cause	**Pump is contaminated from hydrocarbon source**
Remedy	Use RGA to determine if oil is present. Pump requires chemical cleaning.
Cause	**Pump is contaminated with inert gases**
Remedy	Rerough system with dry N_2 backfill.

Fault	Pump becomes hot during starting
Cause	**Insufficient roughing vacuum**
Remedy	Check the roughing pump operation.
Cause	**Leak in rouging system**
Remedy	Leak check of roughing system, repair the leak.

Fault	Pump becomes hot during operation
Cause	**Pressure too high, has load too heavy for pump to handle**
Remedy	Reduce the gas load and clean the system.

Fault	Pump current rises to higher level than previous
Cause	**System is contaminated with atmospheric contaminants**
Remedy	Use the low-temperature bakeout.
Cause	**Pressure in the system is higher**
Remedy	Reduce the gas load, outgas system, remove the gas materials.
Cause	**Pump has developed the high leakage current**
Remedy	Burn out the leakage paths. Replace the insulators.

Fault	Pump current shows the zero but system pressure indicates higher pressure
Cause	**Pump magnets are installed incorrectly**
Remedy	Verify magnets are installed correctly.
Cause	**Pump up to air**
Remedy	Confirm the ion pump is not at atmospheric pressure.

10. Corrective procedures

10.1. Leak testing

The most common cause of the slow pump down and high base pressure in any vacuum system is a leak. 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.

10.2. Low temperature bakeout

This procedure is very effective for improving the pump down 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 or pump with atmospheric water vapour.

This water vapour 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.

To remove water vapour and restore proper operation:

1. Place the system under vacuum with the system sealed and the ion pump in operation.
2. Bakeout temperatures of 200 °C to 250 °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 °C, remove the magnets from the pump, see Magnetic strength check on page 26. If there are any non-metallic (for example, Viton) seals in the system, the bakeout should be limited to 150 °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 2×10^{-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.

10.3. 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^{-2} torr), 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 in Performance checks on page 25.
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.

CAUTION:

These control units are capable of delivering 7000 V d.c. under open circuit conditions. Observe safety precautions listed in Safety symbols on page 6.

10.4. 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, turn 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. See Rough pumping on page 21 and the Pump starting (not isolated) on page 21.
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.

CAUTION:

These control units are capable of delivering 7000 V d.c. under open circuit conditions. Observe safety precautions listed in Safety symbols on page 6.

10.5. 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.

11. Warranty and service

11.1. Service

11.1.1. Cleaning procedure

Prior to any cleaning of the pump, the mains power should be disconnected. Once powered off, use a 50% distilled water and 50% isopropyl alcohol solution to clean the entire unit. A soft, non abrasive cloth will ensure no damage to the LCD screen and finish of the unit.

11.1.2. 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 info@gammavacuum.com.

11.1.3. 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 info@gammavacuum.com or contact our facility numbers.

11.2. Warranty

11.2.1. General terms

Gamma Vacuum warrants to the Buyer that the equipment sold is new, unless previously stated, and is, at the time of shipment to Buyer from Gamma Vacuum, free from defects in material and workmanship. As Buyer's sole exclusive remedy under this warranty, Gamma Vacuum agrees to either repair or replace, at Gamma Vacuum's 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 lifetime 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 thirty (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 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, labour, 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.

11.2.2. Warranty claims

Upon notification, Gamma Vacuum will investigate warranty claims. To initiate a warranty claim, please contact Gamma Vacuum or a representative of Gamma Vacuum directly. 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 info@gammavacuum.com.

11.3. Returning material

11.3.1. 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 Gamma Vacuum tollfree. 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 product description
- Product serial number

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

NOTE:

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

11.3.2. 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 labelled on all shipping information and packages.

12. Disposal

Dispose of the pump and any components and accessories safely and in accordance with all local and national safety and environmental requirements.

Particular care must be taken with any components that have been contaminated with dangerous process substances.

Take appropriate action to avoid inhalation of any particles that may be present in the pump.

P20010460A

EU Declaration of Conformity

Gamma Vacuum
Part of the Atlas Copco Group
2700 4th Ave E, Suite 100
Shakopee, MN 55379
USA

Documentation Officer
Jana Sigmunda 300
Lutín , 78349
Czech Republic
T: +42(0) 580 582 728
documentation@vt.atlascopco.com

The product specified and listed below

TiTan Ion Pumps:

PRO-EL-PO-FE-HV-TN

Where:

PRO= Product Type Pump Size
EL= Element Type
PO= Number and Type of Vacuum Port
FE= High Voltage Feedthrough Type
HV=Heater Voltage
TN= With TSP/NEG

Is in conformity with the relevant requirements of European CE legislation:

2014/35/EU	Low voltage directive (LVD)
2011/65/EU	Restriction of certain hazardous substances (RoHS) directive as amended by Delegated Directive (EU) 2015/863

Based on the relevant requirements of harmonised standards:

EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 1012-2:1996/A1:2009	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2021-07-14*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Ian Keech, VP Engineering
Scientific Vacuum Division
Burgess Hill, UK

Marcus Thierley
General Manager
Shakopee, USA

This product has been manufactured under a quality management system certified to ISO 9001:2015

P20010460A

Declaration of Conformity

Gamma Vacuum
Part of the Atlas Copco Group
2700 4th Ave E, Suite 100
Shakopee, MN 55379
USA

Documentation Officer
Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
documentation@vt.atlascopco.com

This declaration of conformity is issued under the sole responsibility of the manufacturer.

TiTan Ion Pumps:

PRO-EL-PO-FE-HV-TN

Where:

PRO= Product Type Pump Size
EL= Element Type
PO= Number and Type of Vacuum Port
FE= High Voltage Feedthrough Type
HV=Heater Voltage
TN= With TSP/NEG

The object of the declaration described above is in conformity with relevant statutory requirements:

Electrical Equipment (Safety) Regulations 2016

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Relevant designated standards or technical specifications are as follows:

EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 1012-2:1996/A1:2009	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2021-07-14*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Gamma Vacuum

Ian Keech, VP Engineering
Scientific Vacuum Division
Burgess Hill, UK

Marcus Thierley
General Manager
Shakopee, USA

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): Class A/B Industrial equipment

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

RoHS (EU, UK): Material Exemption Information

This product is compliant with no Exemptions

REACH (EU, UK)

This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance-based requirements.

Article 33.1 Declaration (EU, UK)

This product does not knowingly or intentionally contain Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

Additional Applicable Requirements

The product is in scope for and complies with the requirements of the following:

2012/19/EU	Directive on waste electrical and electronic equipment (WEEE)
TÜV SÜD marked	Certificate U8 16 04 60983 017
Product is certified to CAN/CSA-C22.2 No.61010-1:2012	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements

材料成分声明

China Material Content Declaration

表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。

Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

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