INSTRUCTION MANUAL HIGH THROUGHPUT ION PUMP

PERKIN-ELMER
ULTEK

INSTRUCTION MANUAL

P/N 112-129-100

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GENERAL DESCRIPTION

The Ultek High Throughput Ion Pump (Figure 1) is a multiple discharge, cold cathode type ion pump, operating on the Penning discharge principle. It utilizes a discharge in a strong magnetic field to sputter reactive metal from a cathode plate. This reactive metal combines with gas particles in the system to form stable solid state compounds, thus removing a gas from the system and reducing the pressure. Operating entirely from electric power and using water as a coolant, the pump also serves as its own vacuum gauge (see Pressure Measurement section) and requires no oil or refrigerants.

The pump is designed for a wide variety of high vacuum applications including electronic vacuum tube processors, mass spectrometers, particle accelerators, research studies and environmental simulation.

It incorporates the important features of all Ultek ion pumps including freedom from hydrocarbon contamination of the system, invulnerability to power failure, low maintenance and the capability of producing ultrahigh vacuum.

EQUIPMENT SUPPLIED

The ion pump is shipped under vacuum completely assembled and can be installed on the vacuum system after connecting the water-cooling and high voltage cables. It is supplied with a 1-5/8" O.D. rotatable CFF flange and requires Ultek Model 222-0365 Ion Pump Control Unit (Figure 2).

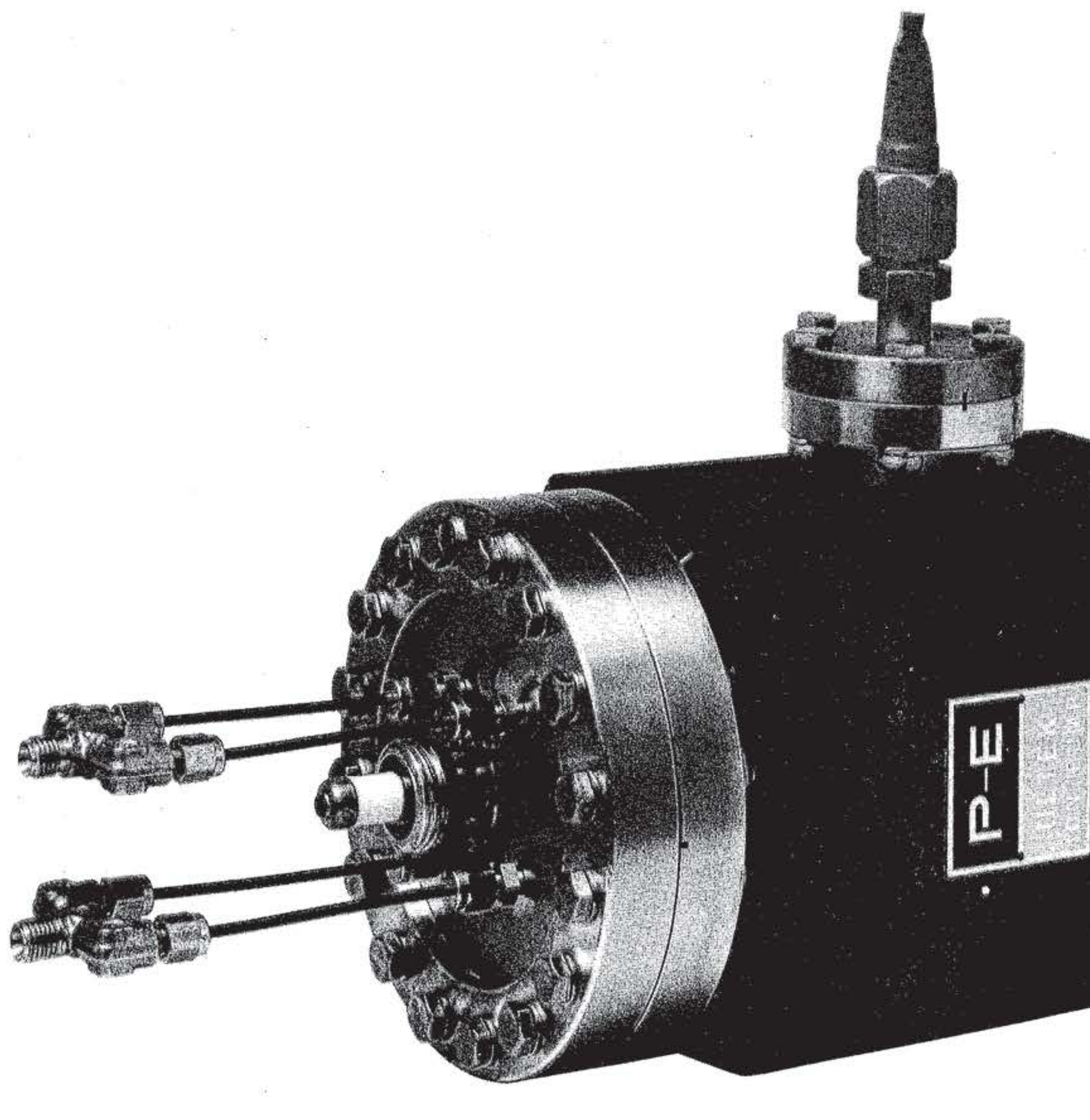

FIGURE 1. HIGH THROUGHPUT ION PUMP

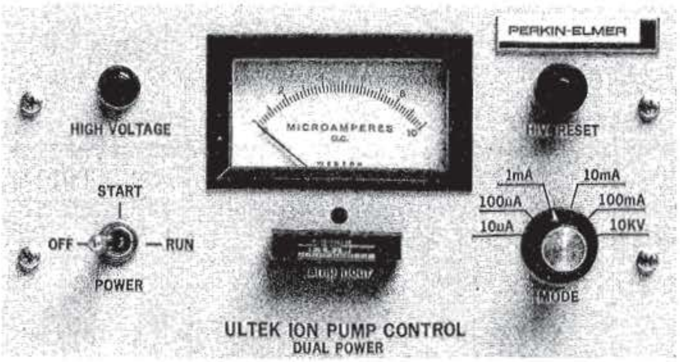

FIGURE 2. DUAL POWER ION PUMP CONTROL UNIT

SPECIFICATIONS

Pumping Speed

The rated nitrogen and hydrogen pumping speeds are given in Figure 3. These ratings apply when the pump is used with the Model 222-0365 ion pump control unit, which has a 5.5 kV, 100 mA power output when used in the higher power mode. Pumping air, speed is maintained at pressures between 3 X 10^{-4} Torr and 10^{-11} Torr and below.

Pressure Range

The pump will operate in the pressure range between 1 X 10^{-2} Torr (10 microns) and 10^{-11} Torr and below. Continuous long-term operation above 3 X 10^{-4} Torr is not recommended because the high currents drawn will result in overheating of the pump.

Starting Pressure

A roughing pressure of 1 X 10^{-2} Torr (10 microns) or below is required before starting the pump. Starting time at 5 microns, for example, averages four to five minutes. When mechanical roughing is used, a molecular sieve foreline trap is recommended to prevent backstreaming of mechanical pump oil. Sorption roughing is recommended where absolute cleanliness is required. After roughing, the roughing pumps must be valved off from the system and can be shut down.

Operating Temperature

Operating temperatures may rise up to 150°C for continuous periods of time. While not physically damaged by temperatures above 150°C, the ferrite type magnets will decrease irreversibly in strength, thus reducing pump efficiency. With magnets removed, bakeout temperatures to 250°C are possible.

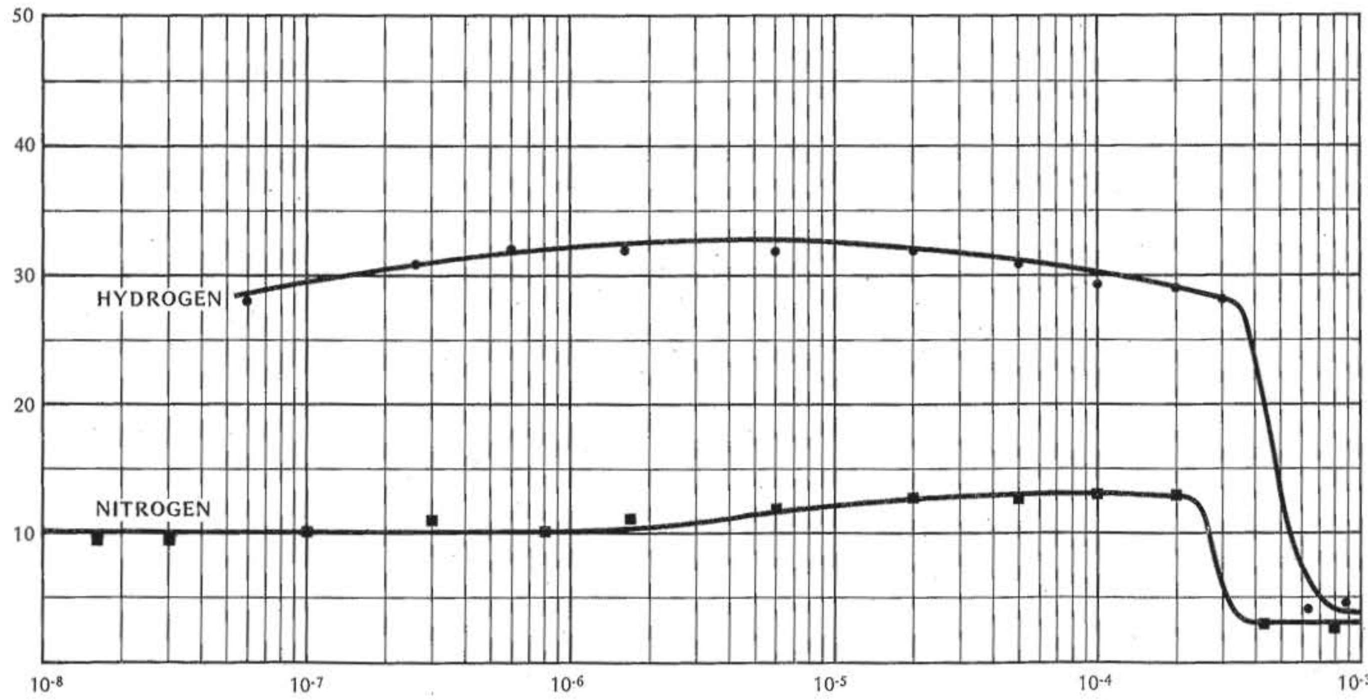

FIGURE 3. PUMPING SPEED AS A FUNCTION OF PRESSURE FOR NITROGEN AND HYDROGEN

Pressure Measurement

The current drawn by an ion pump during operation is directly proportional to the pressure in the system. Thus, the ion pump may be used to measure vacuum in the 10^{-4} Torr range and below, eliminating the need for additional high vacuum gauges in the system. Pressure can be determined by reading the pump current on the front panel meter and checking the pump current-pressure calibration curve (Figure 4).

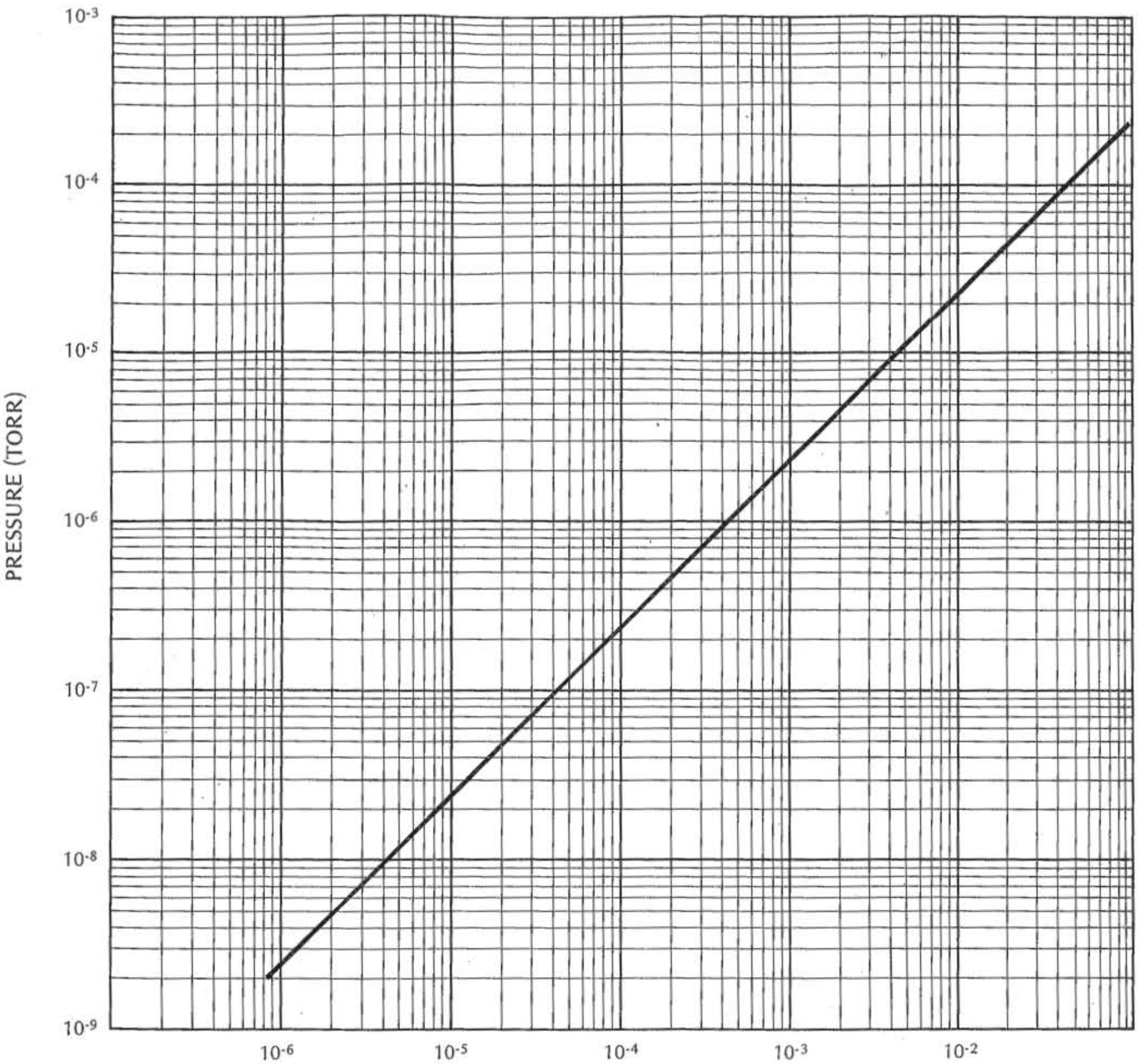

FIGURE 4. CALIBRATION CURVE

Operating Life

All Ultek pumping elements use a patented cylindrical anode with cathode plates and have a conservatively rated life in excess of 32,000 hours at 10^{-6} Torr. Pumping element life is inversely proportional to pressure during operation and will be 320,000 hours at 10^{-7} Torr or longer at still lower pressures.

Design and Materials

Parts exposed to vacuum (the pump body, anode structures and connecting flanges) are type 304 stainless steel. Cathode plates are titanium and magnets are ferrite type ceramic material. All pumps are thoroughly leak checked and shipped under vacuum (flange sealing gaskets are OFHC).

Stray Magnetic Field

Typically, the field at the pump inlet flange is 4 gauss or less. Detailed information on stray field characteristics for each pump is available on request.

2 INSTALLATION

RECEIVING AND UNPACKING

Unpack the pump carefully. Do not remove or damage the plastic tube on the copper pinch-off tube or the pump may inadvertently come up to atmospheric pressure. The pump should be kept under vacuum at all times and should not be opened until it is to be installed on the system.

The pump is shipped in a special packing case that should be saved if reshipment is planned. As it is unpacked, care should be exercised to prevent damage to the finished surfaces. It should be inspected for evidence of damage during shipping and, if damage is evident, a claim should be filed with the carrier with one copy forwarded to Perkin-Elmer Ultek. If equipment must be returned for inspection or repair, authorization must be obtained from Ultek in Palo Alto prior to reshipping. Instructions for return will be provided.

Check the equipment received against the enclosed packing list to ensure that all items shipped have been received. If there are any shortages, notify the carrier and your local Perkin-Elmer Ultek sales office.

After unpacking, but before installation in the system, check pump operation by connecting it to the ion pump control unit as described in the Installation Procedures section. With the ion pump control unit turned on and the pump still under vacuum, the voltage should be about 5.5 kV and the current a few microamps.

INSTALLATION PROCEDURES

Water-Cooling Connection

The pump is shipped with two stainless steel Swagelok fittings that connect it to a 1/4" line. Water pressure of 60 lbs/in^2 and a flow of 1/2 gal/min is required.

Mounting of the Pump

The pump can be installed and will operate in any position but the flange connection cannot provide support. Tapped holes are provided in the pump body to bolt it in place. Use a new copper gasket in the flange connection and draw the flange bolts to about 25 ft/lb torque. This is approximately the torque which will be obtained by pulling the bolts up as tightly as possible with a 10-inch wrench.

Ion Pump Control Unit Connection

The Model 222-0365 control unit requires a maximum of 4 amps of 115 vac (±10%) 60 Hz single-phase power. It will operate also on 50 Hz power without difficulty. A standard three-pin outlet must be provided.

> **WARNING**
>
> The ion pump control unit is capable of delivering 5500 volts dc under open circuit or operating conditions. For safe operation, the ion pump control unit and ion pump should have a common chassis connection which is tied to the power system ground.

Make the system power and grounding connection as follows:

a. Connect the high voltage cable from the ion pump control unit to the ion pump. The connector has a ground built into it. To make this connection, remove the threaded bushing from the end of the high voltage connector on the power unit. Slip it over the high voltage leadthrough (ceramic insulator) on the ion pump, threaded end out and tighten the two small set screws. Then slip the connector over the high voltage leadthrough and tighten it to finger tightness.

b. Insert the three-pin connector on the ion pump control unit cable into the system outlet, which has a connection to the system ground. If such a receptacle is not available, a separate ground must be devised and installed.

> **WARNING**
>
> Wait at least 30 seconds after turning off the ion pump control unit before disconnecting the high voltage connector to allow the filter capacitor to discharge completely.

Leak Checking

When installation is complete, the system should be leak checked to ensure it is completely sealed. Even a very small leak will prevent the system from achieving the high ultimate vacuum the ion pump can produce.

STARTING PROCEDURES

In the following paragraphs two different methods are outlined for starting the ion pump. The method to be used depends on whether or not an isolation valve is installed between the ion pump and the system. The cold (or open system) start procedure applies when the ion pump is to be started from the pressure that exists in the system. The hot (or isolated) start procedure is to be used when an isolation valve is included.

Once the pump has been started by either method, it will continue to reduce the pressure in the system without further attention. Figure 3 gives pumping speeds of nitrogen and hydrogen at various pressures and Figure 4 shows the calibration curve for the ion pump.

Cold Start (Open System)

This procedure is used when the pump is always open to the system and, therefore, must be started from the pressure existing in the system.

a. Check that the ion pump control unit is properly connected, water flow is unobstructed and the system has been leak checked. The Model 222-0365 power supply operates at a HIGH POWER and a LOW POWER setting. When using the power supply in conjuction with the High Throughput Ion Pump, optimum performance will be achieved in the HIGH POWER mode.

b. Turn on the roughing pump and open the roughing valve.

c. Set the ion pump control unit RANGE SELECTOR switch at 10 kV and the mode switch at START.

d. When the system pressure reaches 5 microns (5×10^{-3} Torr) or lower, turn on the ion pump control unit. At this time, voltage will be about 300-500 volts and current approximately 65 mA. A blue glow will be visible in the pump at this time.

e. The point at which the roughing valve can be closed depends on the nature of the system. Generally, it may be closed immediately after the power unit is turned on. However, if the ion pump does not start within a few moments, the roughing pump should be valved back into the system to evacuate gas liberated by the glow discharge which may have raised the pressure above 5 microns. The valve may be closed again after the pressure has dropped below 5 microns.

f. Within a few moments, the pump will start. This is indicated by a rise in voltage and a decrease in current. The blue glow will flicker and go out.

g. After the pump has started (voltage above 5000 volts), set the ion pump control unit RANGE SELECTOR switch to one of the current ranges and the mode switch to RUN.

h. If the system is to be left unattended for some time, set the RANGE SELECTOR switch to either 100 mA or 10 kV position, thus preventing the meter from reading off scale if a pressure rise should occur.

Hot Start (Isolated)

This procedure is used when there is an isolation valve between the ion pump and the system. In this case, the ion pump can be started even while the system is open to atmosphere.

a. Check the ion pump control unit connection, the water-flow connections and be sure the system has been leak checked. The Model 222-0365 power supply operates at a HIGH POWER and a LOW POWER setting. When using this power supply in conjunction with the High Throughput Ion Pump, optimum performance will be achieved in the HIGH POWER mode.

b. Turn on the roughing pump and open the roughing valve.

c. Set the ion pump control unit RANGE SELECTOR switch at 100 mA and the mode switch to START.

d. When the system pressure has reached about 5 microns (5×10^{-3} Torr), close the roughing valve.

e. Open the isolation valve slowly, keeping the ion pump at a pressure below 5×10^{-3} Torr. The current through the pump should not exceed 50 mA.

f. As soon as the isolation valve is completely open, set the RANGE SELECTOR switch at the current range in which the pump is operating and the mode switch to RUN.

g. If the system is to be left unattended for some time, the ion pump control unit RANGE SELECTOR switch should be left on either the 100 mA or 10 kV position to prevent the meter from reading off scale if a pressure rise should occur.

Bringing the System Up to Atmospheric Pressure

This procedure is recommended for opening the system to atmospheric pressure. It should be followed regardless of whether it is being opened for only a few moments or for an extended time period.

a. Connect a source of dry gas, preferably dry nitrogen, to the up-to-air valve on the system. Do not use an inert gas such as helium or argon.

b. If there is an ion pump isolation valve, close the valve and leave the ion pump in operation.

c. If there is no isolation valve, turn off the ion pump control unit.

d. Open the up-to-air valve quickly, letting dry gas into the system.

e. Keep the system closed as much as possible in order to retain dry gas in the system and keep atmospheric air out.

Dry gas is used to let the system up to atmospheric pressure in order to exclude as many atmospheric contaminants (particularly water vapor) as possible. Contaminants do not physically harm the pump or system, but they do form gas sources which may have considerable effect on the pumpdown time and base pressure of the system.

MEASURING PRESSURE

The ion pump is essentially a large Penning type cold cathode gauge, in which the current drawn is a function of the pressure in the system. This relationship is illustrated in the calibration curve (Figure 4). This indication of system pressure has proven extremely accurate and repeatable and is, therefore, an excellent means of gauging system pressure.

The pressure may be determined by reading the pump current and comparing it with the calibration curve.

OVERLOAD PROTECTION CIRCUIT

The ion pump control unit is equipped with an overload protection device. It is a switch actuated by a thermocouple which will turn off the ion pump control unit if the current output rises above a preset value. In operation, the current drawn by the ion pump is a function of the pressure in the system with higher currents being drawn at higher pressures. If the current drawn by the pump rises to about 5×10^{-4} Torr, and remains at this level for about two minutes, the overload protection device will turn off the ion pump control unit. This prevents the pump from overheating and being damaged by the high currents drawn at these pressures. The pump control unit is designed for operation at short circuit conditions for extended periods and will not be damaged by such operation.

The overload protection can be bypassed during starting by turning the mode switch to START so full current can be drawn for rapid starting.

GENERAL INFORMATION

The High Throughput Ion Pump is designed to operate for extended time periods without any maintenance other than occasional bakeout. Replaceable parts are listed in Section 5. An ion pump is a sealed trapping device and all gaseous material is retained inside the pump in the form of solid state compounds. Quantities of gases pumped and their level of contaminant content determine frequency of bakeout and other corrective maintenance procedures.

PERFORMANCE CHECKS

Operation Check

This procedure can be used to verify proper operation of the pump at pressures below 10^{-4} Torr. The pump must be isolated from the vacuum system and an ion pump control unit known to be in good operating condition should be used.

a. Connect high voltage connector to ion pump high voltage leadthrough.

b. Turn on ion pump control unit. The voltage should read about 5.5 kV and the current a few microamps on the lowest current scale.

c. Tap pump body with a metallic instrument. A momentary jump by the meter needle will indicate a pressure increase caused by gas being driven from the pump walls. The gas will be pumped immediately and the pressure will drop again to the previous level.

Leak Current Check

The ion pump includes a number of ceramic insulators which are shielded to minimize build up of conduction paths. However, in time, some of the insulators may become slightly coated and provide conduction paths that show up as higher current readings. To determine if an increase in pump current is caused by an increase in system pressure or by leakage current, follow these steps:

a. Pump down the system to a level giving a significant pump current reading (e.g. 1 X 10^{-6} Torr or 450 microamps).

b. Remove magnet assembly from the pump as described on page 9. The current reading should then be less than 1 microamp and preferably zero on the power unit scale. Voltage should be about 5500 volts.

Magnetic Strength Check

Pumping speed of the ion pump is a function of the magnetic field strength. The magnets are magnetized at the factory and field strength across the pumping element spacing is checked prior to assembly. It is quite unlikely that this strength will drop appreciably for several years, unless the magnets are heated above 250°C or are damaged. Field strength can be checked as follows:

a. Remove magnet assembly from the pump (see page 9).

b. Set the gap at 1-1/2" by tightening pole piece assembly screws. If necessary, use a wooden spacer block.

c. Check all components of the field in the gap. The field should be at least 1700 gauss.

Water-Flow Check

With an inlet pressure of 60 lbs/in^2, the water-flow should be in excess of 1/2-gal/min.

CORRECTIVE MAINTENANCE

Leak Testing

The most common cause of slow pumpdown and high base pressure in any vacuum system is leakage from atmosphere. Even an extremely small leak, which would be undetectable in a pressure system, can be very serious in an ultrahigh vacuum system.

Using the mass spectrometer type leak detector (such as Ultek Model 607-1000) spray through a fine nozzle the outside surface of the system at suspected leak points with a probe gas. Fix any leaks. If the system cannot be repaired immediately, the leak can be patched temporarily with epoxy.

High Electrical Leakage

High leakage current does not appreciably affect pump operation but it does make the pump incapable of giving accurate pressure readings. The following procedure may correct the condition by unit burning our the leakage paths.

a. Completely discharge ion pump control and connect it to ion pump.

b. With the magnets removed and the pump pressure in the low micron range (10^{-2} Torr) turn on ion pump control unit.

c. If several applications of power do not remove leakage, use a higher voltage power supply (up to 10 kV) and repeat the procedure.

d. If this procedure does not reduce leakage current sufficiently, either the leadthrough or the pumping element insulators are badly coated with material which provides a conduction path. The pump should then be returned to Ultek for repair.

Pump Short Circuits

Occasionally, the pump may develop a short circuit after a long period of operation because a flake of deposited material shorts across the pumping element anode-cathode assembly.

a. Check for a short by measuring resistance between the tip of the high voltage leadthrough and the pump body. Resistance should be infinite.

b. If there is a short, first try burning it out electrically by turning on the ion pump control unit with the pump in the low micron range (10^{-2} Torr).

c. If several applications of power do not remove the short, let the pump arc more than four or five times at atmospheric conditions.

d. If this procedure does not remedy the short circuit, the pump should be cleaned ultrasonically or returned to Ultek for repair. Contact your Perkin-Elmer Ultek sales engineer for assistance.

Low Temperature Bakeout

Low temperature bakeout is a simple and effective procedure for improving pumpdown speed and base pressure of a system. The principle reason for a decrease in performance is contamination of the system and/or pump with atmospheric water vapor. Water vapor enters the system and adheres to the walls when the system is open to atmosphere. It is not removed by subsequent roughing cycles and it forms a significant additional gas source in the system, particularly in moist climates. The water vapor contamination can be removed by the following procedures:

a. Pumpdown the system and leave the ion pump in operation.

b. Arrange infrared heat lamps and/or heater tape around the vacuum chamber and the ion pump and proceed to heat them. The ion pump and the ion pump magnets are not to be heated above 250°C. This temperature is approximated by a 500 watt heat lamp at a three-inch distance.

c. Adjust heat to prevent pressure in the system from rising above 5×10^{-5} Torr (about 20 mA).

d. Continue heating the system for as long as possible with only the ion pump in operation. Generally, an overnight bakeout will be sufficient, but longer bakeouts result in cleaner systems.

The above procedure may be repeated as many times as needed to provide beneficial results.

Replacement of High Voltage Leadthrough

On rare occasions, the high voltage leadthrough can become damaged. It can be replaced using the following procedure.

a. Removal

Disconnect high voltage leadthrough after turning off ion pump control unit and allowing filter capacitor to discharge. Remove water-cooling lines.

Remove the six flange bolts from high voltage leadthrough flange. Rotate high voltage leadthrough flange counter-clockwise, unscrewing it from the pump. Do not use excess force. If leadthrough cannot be rotated, the 6" flange with the water-cooling feedthroughs has to be removed (see Replacement of Pumping Element section) to determine cause of binding.

b. Installation

NOTE: If pumping element is also being replaced, the replacement element should be attached to the water-cooling feedthrough flange first, before installing the high voltage leadthrough.

Place a new gasket over the high voltage leadthrough. Rotate leadthrough clockwise, screwing it into pumping element, until feedthrough is snug against the gasket. Do not exert force on gasket. Make sure that the gasket is centered. Line up holes in flanges, replace bolts and tighten with a wrench.

Replacement of Pumping Element

When the pumping element (Figure 5) has reached the end of its operating life or if it has become contaminated excessively, it can be replaced by using the following procedure:

a. Removal

Remove high voltage leadthrough as described previously. Loosen the bolts holding the 6" water-cooling feedthrough flange to the pump and remove it with the pumping element from the body.

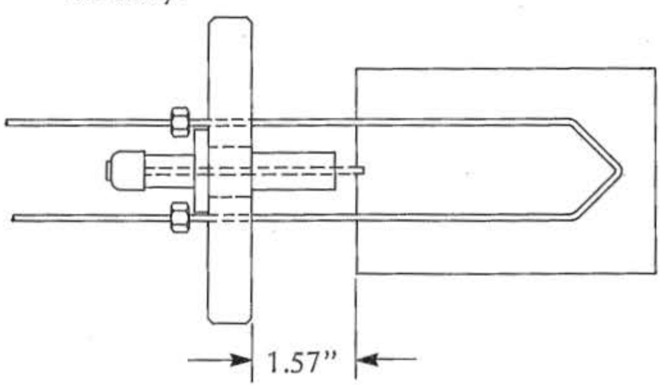

FIGURE 5. PUMPING ELEMENT

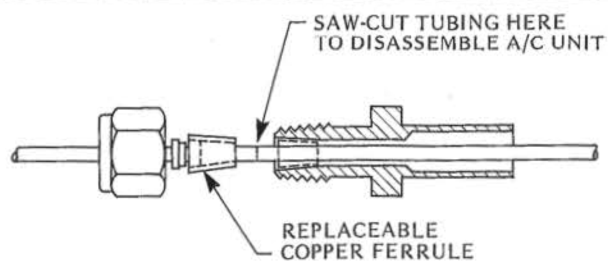

FIGURE 6. DETAIL WATER-COOLING LINE

Loosen ferrule nuts holding the water-cooling lines to the flange.

Push the pumping element toward the flange until the ferrule is free from the fitting (Figure 6).

Saw through water-cooling lines between ferrule and fitting (Figure 6).

Do not distort tubing.

Pull pumping element back from the flange until it is free.

b. Installation

Insert water lines from the new pumping element through the fittings in the flange until the distance between the element and the flange is 1.57" (see Figure 5).

Place new ferrules and nuts over water-cooling lines and hand tighten. Make sure that the dimension of 1.57" between element and flange is maintained. Insure that the element is not tilted with respect to the flange and the distance of 1.57" is the same at all four corners of the pumping element. Tighten ferrule nuts with a wrench.

Replace high voltage leadthrough as described previously. Mount flange with the pumping element in the pump body.

Magnet Removal

Use the following procedure to remove magnets from the pump. Do not remove them unless it is absolutely necessary.

a. Insert a 1/8"-wide steel rod in the space between the pump body and the aluminum spacer between the pole piece and the magnets. Using the rod as a lever, move the spacer at right angles from the pump body until the distance between the pole pieces is at least 1/2". Then insert the rod on the other side of the magnet between the pump body and the aluminum spacer. Again using the rod as a lever, move the spacer at right angles from the pump body until the distance between the pole pieces is at least 2". Due to magnetic attraction, the magnets will adhere to the pole pieces.

b. The pole pieces with magnets can now be rotated by hand until they are at right angles to the pump body and then removed.

The other pole piece and magnet can be removed in a similar manner.

c. Handle the magnet blocks carefully because they are strongly attracted to each other and are broken easily.

d. If remagnetizing is necessary, the magnets must be returned to Ultek because of the special magnetizing equipment required.

e. To install magnets, arrange the blocks so that the magnetic field is directed in a circular path around the pump.

Table 1. TROUBLESHOOTING CHART

Sympton	Possible Cause	Recommended Corrective Action
Pump does not pump system down.	1. Pump has a short circuit.	1. Burn out, or return to factory for repair.
	2. Large leak in system.	2. Leak check system, repair leak.
	3. Magnetic field strength low.	3. Check field strength, remagnetize if necessary.
Pumpdown is slow and base pressure higher than normal.	1. Leak in system.	1. Check system for leaks, repair.
	2. Volatile material in system.	2. Remove materials with high outgassing rate.
	3. Atmospheric contaminants on pump and system walls.	3. Use low-temperature bakeout procedure.
Pump does not start.	1. Insufficient roughing vacuum.	1. Check roughing pump for correct operation, check roughing gauge.
	2. Leak in roughing system.	2. Leak check roughing system, repair leak.
	3. Pump contaminated.	3. Bake out to 250°C with 5 micron or better vacuum to remove contamination.
Pump becomes hot during starting.	1. Insufficient roughing vacuum. 2. High gas load.	1. Check roughing pump operation.
Pump becomes hot during operation.	1. Pressure too high, gas load too heavy for pump to handle.	1. Reduce gas load, clean system.
Pump current rises to higher level than normal.	1. Pressure in system has increased.	1. Reduce gas load, outgas system, remove volatile materials.
	2. Pump has developed high leakage current.	2. Burn out leakage paths, replace insulators.
	3. System contaminated with atmospheric contaminants.	3. Use low temperature bakeout procedure.

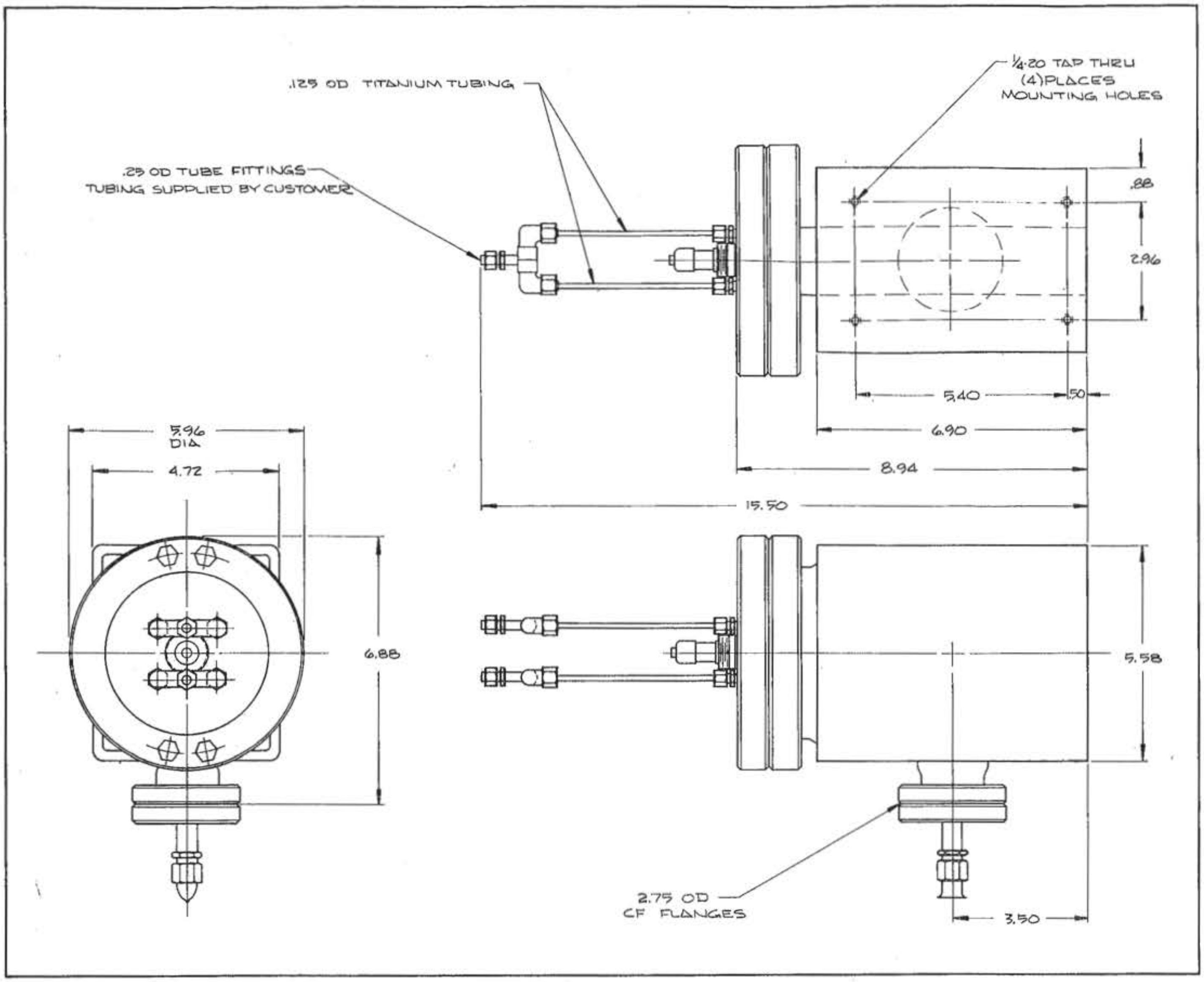

FIGURE 7. SCHEMATIC DIAGRAM—WATER-COOLED PUMP D221-390-600

REPLACEABLE PARTS 5

The following replaceable parts list specifies only those parts that are field-replaceable. When ordering parts please specify the model number and the serial number of the pump.

Description	Part Number
Pump inlet gasket, OFHC copper, Conflat	121-992-600
Water-cooling feedthrough flange gasket, OFHC copper, Conflat	221-385-500
Assembly bolt set, inlet flange. (Set is one bolt with nut and washer; 25 sets/box)	040-050-000
Assembly bolt set, water cooling feedthrough flange	040-010-000
Ion Pump Control Unit	221-312-200
HV Cable and Connector	138-462-010
HV Mounting and Bushing	061-015-000
HV Leadthrough	221-384-800
Pumping Element	221-378-500
Magnets	300-059-600

WARRANTY

Products manufactured by Perkin-Elmer Ultek Inc. (hereinafter referred to as "Ultek") are warranted against defects in materials and workmanship for a period of twelve (12) months from date of shipment thereof from Ultek to the buyer. Liability under this warranty is expressly limited to replacement or repair (at Ultek's option) of defective parts. This warranty applies only to parts manufactured, and labor provided, by Ultek under valid warranty claims, which must be received by Ultek within the applicable warranty period and shall be subject to the terms and conditions hereof. Expandable items such as tubes, heaters, sources, bonded targets, etc., by their nature, may not function one year; if such items fail to give reasonable service for a reasonable period of time, as determined solely by Ultek, Ultek will, at its election, repair or replace them. All warranty replacement or repair of parts shall be limited to equipment malfunctions which, in the sole opinion of Ultek, are due or traceable to defects in original materials or workmanship. Malfunctions caused by abuse or neglect of the equipment are expressly not covered by this warranty. 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 Ultek's then current prices for parts, labor or transportation.

Reasonable care must be used to avoid hazards. Ultek 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.

Where Ultek specifically agrees in writing to provide installation and on site acceptance testing of its products, the warranty period may be extended, if agreed to in writing by Ultek, to twelve (12) months from date of acceptance, but in no event more than fifteen (15) months from date of shipment of the products. Warranties given by suppliers of equipment or proprietary components not manufactured by Ultek but incorporated by Ultek into its products shall be passed on to the customer, provided that in no event shall Ultek have any liability for failure of any such supplier to perform on its warranty.

EXCEPT AS STATED HEREIN, ULTEK MAKES NO WARRANTY, EXPRESS OR IMPLIED (EITHER IN FACT OR BY OPERATION OF LAW), STATUTORY OR OTHERWISE: AND, EXCEPT AS STATED HEREIN, ULTEK SHALL HAVE NO LIABILITY UNDER ANY WARRANTY, EXPRESS OR IMPLIED (EITHER IN FACT OR BY OPERATION OR LAW), STATUTORY OR OTHERWISE. ULTEK 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 Ultek, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Ultek unless reduced to writing and approved by an officer of Ultek.

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

WARRANTY REPLACEMENT AND ADJUSTMENT

Before any products are returned for repair, replacement and/or adjustment, written authorization from Ultek for the return and instructions as to how and where the products should be shipped must be obtained. Any products returned to Ultek shall be sent prepaid via the means of transportation indicated as acceptable in the written authorization. Ultek reserves the right to reject any warranty claim on any product that has been shipped by unauthorized means of transportation. When any item is returned for examination and inspection, buyer and its shipping agency must assume responsibility for damage resulting from improper packing or handling, and for loss in transit.

When any product is returned, customer shall provide Ultek with data on operating conditions and any other pertinent information which will enable Ultek to determine the cause of claimed warranty defects. In all cases, Ultek has sole responsibility for determining the cause and nature of failure, and Ultek's determination with regard thereto shall be conclusive.

In the event it is determined by Ultek that a product has been returned without cause, buyer will be notified and the product returned at buyer's expense; in addition, a charge for testing and examination may, in the sole discretion of Ultek, be made on certain products so returned.

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