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Agilent Technologies

CE

UHV-24/UHV-24p Ionization Gauge

INSTRUCTION MANUAL

Manual No. 699905505
Revision E
July 2004

UHV-24/UHV-24p Ionization Gauge

Warranty

Products manufactured by Seller are warranted against defects in materials and workmanship for twelve (12) months from date of shipment thereof to Customer, and Seller's liability under valid warranty claims is limited, at the option of Seller, to repair, replace, or refund an equitable portion of the purchase price of the Product. Items expendable in normal use are not covered by this warranty. All warranty replacement or repair of parts shall be limited to equipment malfunctions which, in the sole opinion of Seller, are due or traceable to defects in original materials or workmanship. All obligations of Seller under this warranty shall cease in the event of abuse, accident, alteration, misuse, or neglect of the equipment. In-warranty repaired or replaced parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced parts. After expiration of the applicable warranty period, Customer shall be charged at the then current prices for parts, labor, and transportation.

Reasonable care must be used to avoid hazards. Seller expressly disclaims responsibility for loss or damage caused by use of its Products other than in accordance with proper operating procedures.

Except as stated herein, Seller makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except as stated herein, Seller shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise. Statements made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Seller unless reduced to writing and approved by an officer of Seller.

Warranty Replacement and Adjustment

All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto, and must be received within the applicable warranty period by Seller or its authorized representative. Such claims should include the Product serial number, the date of shipment, and a full description of the circumstances giving rise to the claim. Before any Products are returned for repair and/or adjustment, written authorization from Seller or its authorized representative for the return and instructions as to how and where these Products should be returned must be obtained. Any Product returned to Seller for examination shall be prepaid via the means of transportation indicated as acceptable by Seller. Seller reserves the right to reject any warranty claim not promptly reported and any warranty claim on any item that has been altered or has been returned by non-acceptable means of transportation. When any Product is returned for examination and inspection, or for any other reason, Customer shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect or non-conformity in the Product. In all cases, Seller has the sole responsibility for determining the cause and nature of failure, and Seller's determination with regard thereto shall be final.

If it is found that Seller's Product has been returned without cause and is still serviceable, Customer will be notified and the Product returned at Customer's expense; in addition, a charge for testing and examination may be made on Products so returned.

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Contents

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Declaration of Conformity
Konformitätserklärung
Déclaration de Conformité
Declaración de Conformidad
Verklaring de Overeenstemming
Dichiarazione di Conformità

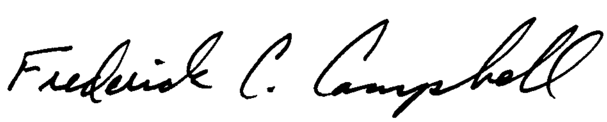
We	
Wir	Varian, Inc.
Nous	Vacuum Technologies
Nosotros	121 Hartwell Avenue
Wij	Lexington, MA, 02421-3133 USA
Noi	

declare under our sole responsibility that the product,
erklären, in alleniniger Verantwortung, daß dieses Produkt,
déclarons sous notre seule responsabilité que le produit,
declaramos, bajo nuestra sola responsabilidad, que el producto,
verklaren onder onze verantwoordelijkheid, dat het product,
dichiariamo sotto nostra unica responsabilità, che il prodotto,

UHV-24/UHV-24p Ionization Gauge

to which this declaration relates is in conformity with the following standard(s) or other normative documents.
auf das sich diese Erklärung bezieht, mit der/den flogenden Norm(en) oder Richtlinie(n) übereinstimmt.
auquel se réfère cette déclaration est conforme à la (auz) norme(s) ou au(x) document(s) normatif(s).
al que se refiere esta declaración es conforme a la(s) norma(s) u otro(s) documento(s) normativo(s).
waamaar deze verklaring verwijst, aan de volende norm(en) of richtlijn(en) beantwoodt.
a cui se rifersce questa dichiarazione è conforme alla/e sequente/I norma/o documento/I normativo/i.

EN 55011
1991 . . . . Group 1 Class A ISM emission requirements
EN 61010-1
1993 . . . . Safety requirements for electrical equipment for measurement, control, and laboratory use incorporating Amendments Nos 1 and 2.
EN 50082-2
1995 . . . . EMC heavy industrial generic immunity standard



Frederick C. Campbell
Operations Manager
Vacuum Technologies
Varian, Inc.
Lexington, Massachusetts, USA

October 2003

Preface

Hazard and Safety Information

This product must only be operated and maintained by trained personnel.

This manual uses the following standard safety protocols:

WARNING

Warnings indicate a particular procedure or practice, which if not followed correctly, could lead to serious injury.

CAUTION

Cautions indicate a particular procedure or practice, which if not followed, could cause damage to the equipment.

NOTE

Notes contain important information.

Before operating or servicing equipment, read and thoroughly understand all operation/maintenance manuals provided by Vacuum Technologies. Be aware of the hazards associated with this equipment, know how to recognize potentially hazardous conditions, and how to avoid them. Read carefully and strictly observe all cautions and warnings. The consequences of unskilled, improper, or careless operation of the equipment can be serious.

In addition, consult local, state, and national agencies regarding specific requirements and regulations. Address any safety, operation, and/or maintenance questions to your nearest Vacuum Technologies office.

Grounding the Multi-Gauge and senTorr Controllers

Be certain that your UHV-24/UHV-24p Ion Gauge Controller and vacuum system are separately grounded to a common ground.

WARNING

- *Do not place a ground wire between the vacuum chamber and the controller chassis; large continuous currents could flow through it.*
- *Personnel can be killed by high voltages (160 to 900 V may be present in an improperly grounded system).*
- *Make absolutely sure that your vacuum system is grounded as shown in Figure 1.*
- *Test the system ground to be sure that it is complete and capable of supporting at least 10 A.*

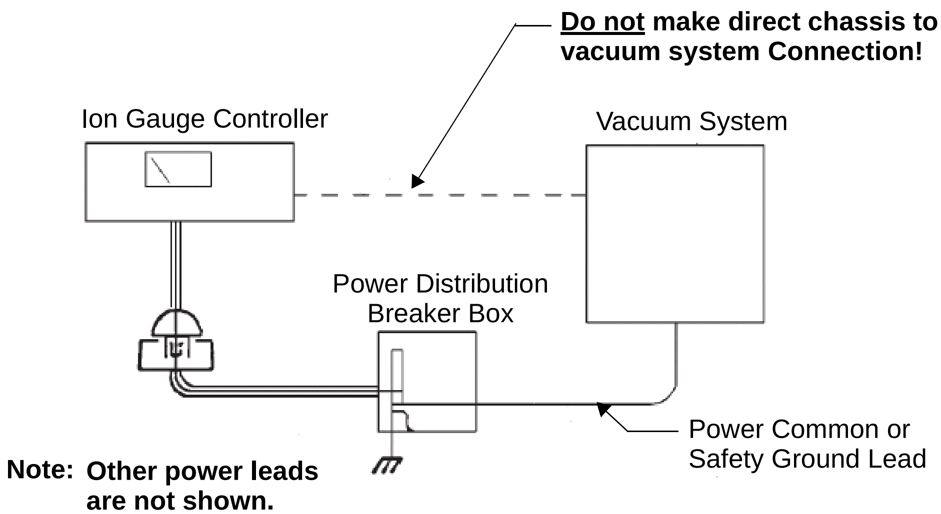


Figure 1 Ion Gauge and Vacuum System Connections

Use with Combustibles and Mixtures

WARNING

As with all ionization gauges, this device is not intrinsically safe. Exercise extreme care when using this vacuum gauge while pumping or backfilling a system or in any other system condition which contains combustible gases or mixtures. The filament, the end of a hot filament ion gauge and the high voltage discharge of a cold cathode gauge can be ignition sources.

When such a gas or mixture is present, do not turn on any such vacuum gauge. Failure to follow this instruction could result in serious injury to personnel and damage to equipment.

Vacuum Equipment and Cleanliness

Cleanliness is vital when servicing any vacuum equipment.

CAUTION

Do not use silicone oil or silicone grease.

Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

Do not clean any aluminum parts with Alconox. Alconox is not compatible with aluminum and will cause damage.

NOTE

Normally, it is unnecessary to use vacuum grease. However, if it must be used, do not use silicone types, and use it sparingly. Apiezon L grease is recommended (Vacuum Technologies Part Number 695400004).

Contacting Vacuum Technologies

In the United States, you can contact Vacuum Technologies Customer Service at 1-800-8VARIAN.

Internet users:

- ❑ Send email to Customer Service & Technical Support at vpl.customer.support@varianinc.com
- ❑ Visit our web site at www.varianinc.com/vacuum
- ❑ Order on line at www.evarian.com

See the back cover of this manual for a listing of our sales and service offices.

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UHV-24/UHV-24p Ionization Gauge

The UHV-24 Nude Ionization Gauge, with an x-ray limit of $2x10^{-11}$ Torr, provides reliable pressure measurement from 1 mTorr down to $2x10^{-10}$ Torr, with reduced performance at pressures lower than $2x10^{-10}$ Torr.

The UHV-24p Nude Ionization Gauge utilizes an extremely thin collector which lowers its x-ray limit to $5x10^{-12}$ Torr. As a result, it can measure pressure from 1m Torr down to $5x10^{-11}$Torr, with reduced performance at pressures lower than $5x10^{-11}$ Torr.

Properly mounted nude gauges, where the grid structure protrudes into the vacuum chamber, offer the lowest error in terms of the local vacuum pressure being the same as the chamber pressure. Both gauges are available with either dual tungsten or thoriated iridium filaments, which are field replaceable.

Nude gauges are recommended for bakeable, all-metal, ultra-high vacuum systems where maximum exposure to the vacuum gives the highest possible accuracy. The gauges are designed with replaceable dual filament assemblies.

Principles of Operation

The UHV-24/UHV-24p Nude Ionization Gauge contains three elements:

- ❑ Filament – The filament serves as a source of electrons.
- ❑ Grid – The grid functions as the electron collector operating at a positive potential (typically +150 V) with respect to the filament.
- ❑ Collector wire – Along the center of the cylindrical grid structure is a very small diameter ion collector wire operating at a negative potential (typically 28 V) with respect to the filament.

The process is s follows:

1. Electrons from the filament pass through the grid several times, on average, before being collected at the grid. While passing through the interior of the grid structure, the electrons ionize gas molecules at a rate which is proportional to the gas density.
2. The positive ions produced on the inside of the grid structure are accelerated toward and are neutralized at the collector by electrons from the external circuit. The number of ions produced per electron is proportional to gas density, and the positive ion current to the ion collector is used as an indication of pressure. Thus, for a constant value of accelerating voltage in excess of the ionization potential of the gas, the number of positive ions formed should vary linearly with pressure and with electron current. This is described by the relation:

$$I_c = S \cdot P \cdot I_e$$

where:

- ❑ I_c is the ion current in amperes to the collector,
- ❑ I_e is the electron current in amperes to the grid, and
- ❑ P is the pressure in Torr.

The sensitivity, S, of a given ion gauge is the proportionality constant in the basic ionization gauge equation above. Thus,

$$S = \frac{1}{P} \cdot \frac{I_c}{I_e}$$

For UHV-24 gauges, S for air (nitrogen) is 25 $(\text{Torr})^{-1}$. For the UHV-24p, S for air (Nitrogen) is 20 $(\text{Torr})^{-1}$. The normal operating electron current is 4 mA. For the UHV-24, the ion current at a pressure of 10^{-9} Torr is 10^{-10} A.

Installation

Vacuum Technologies ionization gauges can be operated with any ion gauge control unit capable of supplying the necessary operating voltages and currents. Degassing of this gauge is by electron bombardment of the grid.

To install the gauge:

1. Remove the metal sleeve protecting the collector wire.
2. Mount the nude ionization gauges in any position.

NOTE

Install the gauge in a relatively open space to reduce wall outgassing due to localized heating by the filament.
When the gauges are mounted horizontally, position the filaments to the side of the grid rather than below or above it so that a slight vertical movement of the grid or filament does not change their relative spacing.

Operating Specifications

Table 1-1 Normal Operating Requirements

Item	Requirement
Filament Voltage	3 to 4.5 V (AC or DC) - Varies with pressure and emission current
Filament Current	2.5 to 3.5 A - Varies with pressure and emission current
Element Voltages	Collector voltage: $V_c = 0$ Filament voltage: $V_{fil} = 28$ VDC Grid voltage, $V_g = +180$ VDC
Degas Power Requirements (40 W)	Grid Voltage: +600 VDC max Emission Current (total): 67 mA DC Filament Voltage: 7 V
Measurement Specifications	Sensitivity: ❑ 25/Torr (UHV-24), nominal ❑ 20/Torr (UHV-24p), nominal Emission Current: ❑ 4 mA for widest measurement range $5x10-^{10}$ Torr to $1x10^{-4}$ Torr ❑ 10 mA for pressures lower than 5x10-10 Torr ≤ 0.1 mA for pressure over $1x10^{-4}$ Torr
Materials	Filament: Tungsten or thoria-coated Iridium Filament Supports: SST Collector - tungsten: ❑ 0.007" diameter for UHV-24 ❑ 0.002" for UHV-24p Grid: SST Feedthrough: SST, Alumina, Nickel Alloy

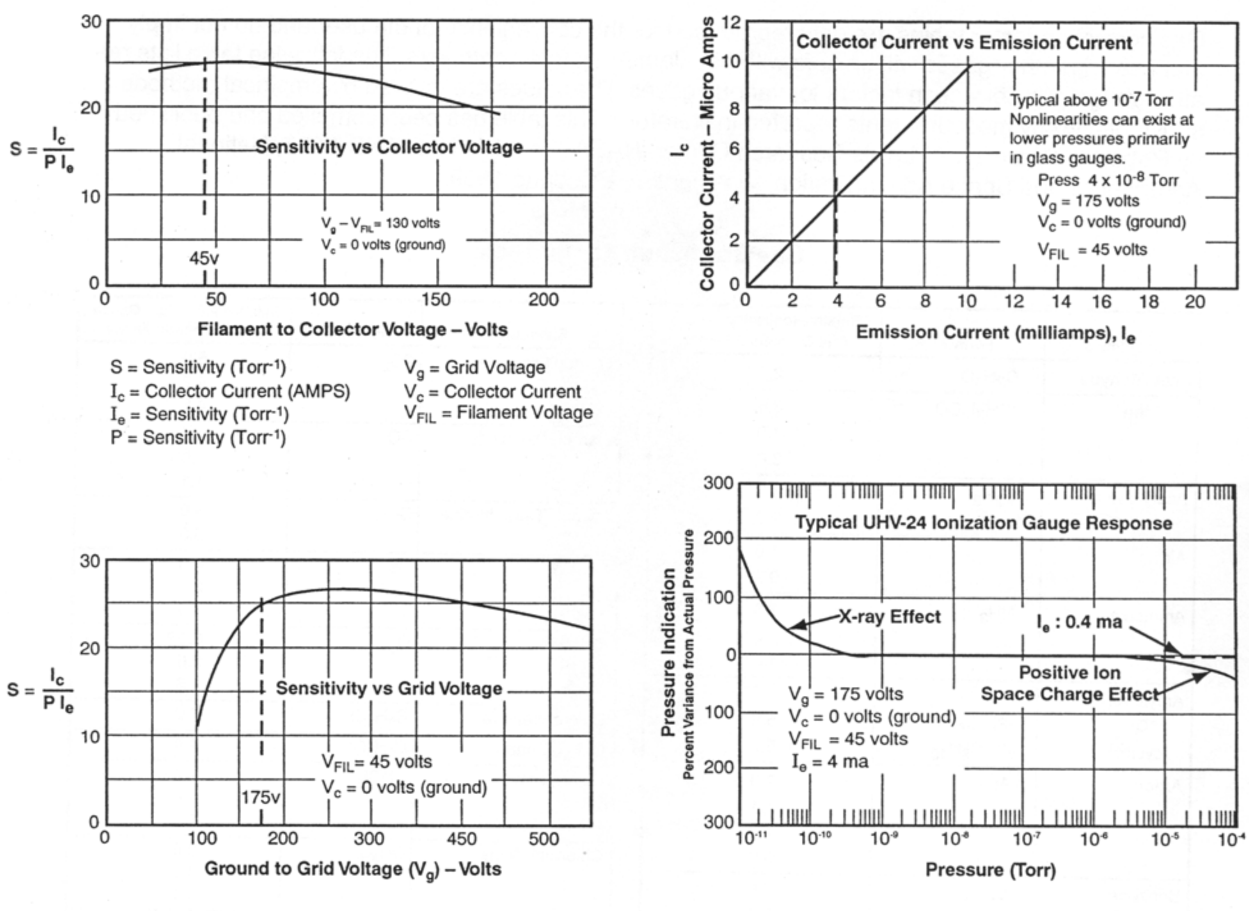

Figure 1-1 Typical Gauge Characteristics Graphs

Application Notes

Measurement of ultra-high vacuum is not a trivial undertaking. There are many factors that contribute to measurement problems. Some other concerns include that:

- The gauge sensitivity factor is based on nitrogen and very little, if any, nitrogen is present in UHV systems that are leak tight
- There are no convenient primary pressure standards that exist for UHV calibration.
- A grounded conductive wall near the tube raises the sensitivity by as much as 30%. This is typical of gauges mounted in tubulations attached to the system.

However, these three concerns are usually theoretical in nature and most problems fall under the following areas:

- All ion gauges are pumps, (likewise, all ion pumps are gauges). The difference is that gauges are designed primarily to measure pressure and have relatively small pumping speeds. However, given the right conditions it is possible for the gauge to pump the gas that being measured, especially if the chamber pump is small.

Pumping speed for a nude ion gauge is typically around 0.5 litres/sec. The pumping speed is affected by the emission current. The higher the emission current the higher the pumping speed.

- Ion gauge out-gassing occurs by virtue of operating the filament. Even after the gauge is *degassed* the filaments continue to generate gas when on. The major component is carbon-monoxide, though other gasses may also be liberated. This gas concentration tends to be higher in the vicinity of the gauge and can lead to higher than expected pressure readings. The hotter the filament, the more it out-gasses. Therefore, to minimize out-gassing use thoriated-iridium filaments, which run significantly cooler than their tungsten counterparts, and run them at the lowest emission current that gives good readings. However, it is necessary to determine if the benefits of the thoriated filaments overcome the drawback of higher particle generation and shorter life when exposed to hydrogen and halogen gases. There is a tradeoff between the gauge pumping and the gauge out-gassing that may compensate one for the other.
- Leakage currents are extremely difficult to avoid when using cables of 100 ′ or longer. Obviously, the longer the cable the worse the leakage. Teflon is the recommended insulator, but at $5x10^{-11}$ Torr with a UHV-24p operating with 10 mA of emission current, the ion current is only 10 pA. And that assumes that the gauge sensitivity factor of 20/Torr is somewhat accurate; most likely, it is lower than that. Only rarely is the sensitivity factor higher than expected, such as when mounted in a tubulation. But then the out-gassing and self-pumping issues get worse.
- When cables move, the capacitance between the shield and the conductor changes. This forces a current to flow either into or out of the electrometer circuit, depending upon the change in capacitance. With a long cable the capacitance is fairly large, and because the impedance is very high (the collector is a virtual current source) this current may take quite some time to settle out. Factors that can cause cable to move are:
  - Air movement from blowers
  - Handling
  - Temperature changes

  If the cable is in continuous vibration due to running near a pump or other actuator, there may be a continuous current flowing in the collector lead.
- Noise pick-up is also made worse by long cable lengths. A shielding system that works fine at 25′ may be inadequate at 150′. The cable is an antenna, the longer it is the more signal it picks up. In addition, the ion gauge has wires sticking out into the vacuum chamber, which also act as antennas. However, even if the cable shielding is adequate, noise inside the vacuum chamber is transmitted to the electrometer due to the high source impedance. This causes errors in the measurement as most electrometer amplifiers used in commercial controllers use logging transistors that tend to rectify high frequency noise into DC offsets. Judicious use of ferrite beads on the cable may help.

- Ground loops can be formed because the chambers are grounded and the controllers are grounded. For safety reasons, never float any controllers that can be touched during operation. Because of the low magnitude of ion currents being measured, it is possible for a ground loop current to overcome the ion gauge signal, sometimes resulting in a current flowing into the gauge collector. This often happens when the ion pumps are running on one phase of the AC power system and the instrumentation is operating off another phase. Experimentation is usually the only answer to find and fix this kind of problem.

Degas

All UHV-24 and UHV24p gauges are operated and degassed at the factory before shipment. Whether to degas the gauge after installation depends upon the application. In large systems that take a long time to pump down, such as several days, or will be baked for an extended period of time, degassing the gauge has a negligible affect. Considering that the e-beam degas system used runs at a high emission current, it may not be worth the theoretical reduction in filament life that results from the small reduction in gas load. In small systems, where the gauge is a larger percentage of the system surface area and gas load, there may be benefits to using degas after installation.Gauge degassing is not generally needed unless the goal is to reach pressures below $1x10^{-8}$ Torr. Degas is not intended to *clean* tube contamination.

If using degas, a 15 minute e-beam degas duration, using Vacuum Technologies Multi-Gauge and senTorr controllers, is all that is needed. Extending the degas interval only serves to heat up the surrounding chamber walls and increases the out-gassing rate from those surfaces. Bakeout is a better way to degas the chamber walls.

Bakeout

A temperature of +450 °C is a safe maximum for repeated or extended bakeout of the nude gauge.

Do not:

- Exceed +450 °C
- Expose the gauge to thermal shock

Maintenance: Filament Replacement

Vacuum Technologies’s nude gauges are equipped with dual filaments. The filament assembly is easily replaced if it is damaged or broken. The replacement filament kit contains two filament assemblies and an Allen wrench.

Tungsten Filament Replacement

This procedure replace the tungsten filament (Part No. 9710018).

To remove and change the damaged filament:

1. Carefully loosen all six set screws and pull the old filament support brackets out.

CAUTION *Handle the gauge only by its ceramic base to prevent damage to the delicate wires. Wear nylon gloves to prevent placing fingerprints on the gauge. The oil from fingerprints extends pumpdown time.*

2. Insert the long filament support bracket into its collar so that the filament is located 0.050 to 0.070" from the grid structure.
3. Tighten the set screws.
4. Insert the short filament support brackets into their collars, pushing them in as far as they will go before tightening the set screws. This ensures proper tension on the filament.

Thoria-Coated Iridium Filament Replacement

This replacement filament kit (Part No. 9710028) contains two thoria-coated iridium filaments stapled to a cardboard backing and packed in a foam-lined plastic box. Each filament also has a stabilizing bar soldered to the base of the filament for rigidity.

To remove and change the damaged filament:

1. Carefully loosen all six set screws and pull the old filament support brackets out.

CAUTION *Handle the gauge only by its ceramic base to prevent damage to the delicate wires. Wear nylon gloves to prevent placing fingerprints on the gauge. The oil from fingerprints extends pumpdown time.*

2. Carefully remove the stabilizing bar by very carefully cutting between the posts of the thoria-coated iridium filaments.
3. Cut the staples affixing the assembly to the cardboard backing.
4. Insert the long filament support bracket into its collar so that the filament is located 0.050 to 0.070" from the grid structure.
5. Tighten the set screws.
6. Insert the short filament support brackets into their collars, pushing them in as far as they will go before tightening the set screws. This ensures proper tension on the filament.
7. Carefully trim the remainder of the stabilizing bar from each filament post.

Appendix A. Gas Correction Factor Table

Table A-1 on page A-2 lists the relative gauge gas correction factors for various gases.

WARNING *Do not assume that the use of the gases listed in this table are safe with hot filament gauge controllers.*

The values in *Table A-1* are derived by empirical methods substantiated by measurements reported in literature. This table has been compiled and published by Robert L. Summers of Lewis Research Center, NASA Technical Note TND-5285, National Aeronautics and Space Administration, Washington, DC, June 1969.

To automatically convert the UHV-24/UHV-24p readings (normally calibrated for nitrogen):

- ❑ Enter the relative gas correction constant through the front panel key function **F GAS CORR**.

When the gas constant is entered, the gauge divides the result by the gas correction constant and displays the correct adjusted value.

A proper understanding for the transformation of the result is still, however, required. The correction for different gas species is purely mathematical. The tube sensitivity tube is affected by different gases which, in turn, is responsible for the tube output being manipulated by the pressure equation. In addition, There is loss in resolution of the instrument when gas correction constants are used. The loss in resolution becomes more apparent as the correction constants approach 0.5 from either direction. When the correction constants are 0.1 or 10, the tube output is 1/10 or 10 times normal. This causes the instrument to lose the high vacuum decade or the near atmosphere decade, respectively.

NOTE *Some gases have several correction factors listed. In such cases, the top number is the most commonly-used value.*

Table A-1 Gas Correction Factor Table

Substance	Formula	Relative Ionization Gauge Gas Correction Factor
Acetaldehyde	C_2H_4O	2.6
Acetone	$(CH_3)_2CO$	3.6 4.0 3.6
Acetylene	C_2H_2	1.9 2.0
Air		1.0 0.98
Ammonia	NH_3	1.3 1.2 1.3
Amylene:		
ISO·	ISO·C_5H_{10}	5.9
cyclo·	CY·C_5H_{10}	5.8
Argon	Ar	1.3 1.1 1.2 0.9
Benzene	C_6H_6	5.9 5.8 5.7 5.9 6.0
Benzoic Acid	C_6H_5COOH	5.5
Bromine	Br	3.8
Bromomethane	CH_3Br	3.7
Butane:		
n·	n·C_4H_{10}	4.9 4.7
ISO·	ISO·C_4H_{10}	4.6 4.9
Cadmium	Cd	2.3 3.4
Carbon Dioxide	CO_2	1.4 1.4 1.5 1.5 1.4

Substance	Formula	Relative Ionization Gauge Gas Correction Factor
Carbon Disulfide	CS_2	5.0 4.7 4.8
Carbon Monoxide	CO	1.05 1.05 1.1
Carbon Tetrachloride	CCl_4	6.0 6.3
Cesium	Cs	4.3 2.0 4.8
Chlorine	Cl_2	0.68 2.6 1.6
Chlorobenzene	C_6H_5Cl	7.0
Chloroethane	C_2H_5Cl	4.0
Chloroform	$CHCl_3$	4.7 4.8 4.8
Chloromethane	CH_3Cl	2.6 3.2 3.1
Cyanogen	$(CN)_2$	2.8 3.6 2.7
Cyclohexylene	C_6H_{12}	7.9 6.4
Deuterium	D_2	0.35 0.38
Dichlorodifloromethane	CCl_2F_2	2.7 4.1
Dichloromethane	CH_2Cl_2	3.7
Dinitrobenzene	$C_6H_4(NO_2)_2$	
o·		7.8
m·		7.8
p·		7.6
Ethane	C_2H_6	2.6 2.8 2.5
Ethanol	C_2H_5OH	3.6 2.9
Ethyl Acetate	$CH_3COOC_2H_5$	5.0

Table A-1 Gas Correction Factor Table (Continued)

Substance	Formula	Relative Ionization Gauge Gas Correction F5tor
Ethyl ether	$(C_2H_5)_2O$	5.1 5.1
Ethylene	C_2H_4	2.3 2.4 2.2 2.2 to 2.5
Ethylene oxide	$(CH_2)_2O$	2.5
Helium	He	0.18 0.15 0.13 0.12
Heptane	C_7H_{16}	8.6
Hexadiene: 1.5· cyclo·	 $1.5{\cdot}C_5H_{10}$ $CY{\cdot}C_6H_{10}$	 6.4 6.0
Hexane	C_6H_{14}	6.6
Hexene: 1· cyclo	 $1{\cdot}C_6H_{12}$ $CY{\cdot}C_6H_{10}$	 5.9 6.4
Hydrogen	H_2	0.46 0.38 0.41 0.45 0.44
Hydrogen Bromide	HBr	2.0
Hydrogen Chloride	HCl	1.5 1.6 2.0 1.5
Hydrogen Cyanide	HCN	1.5 1.6
Hydrogen Floride	HF	1.4
Hydrogen Iodide	HI	3.1
Hydrogen Sulfide	H_2S	2.2 2.2 2.3 2.1
Iodine	I_2	5.4
Iodomethane	CH_3I	4.2
Isoamyl Alcohol	$C_5H_{11}OH$	2.9
Isobutylene	C_4H_8	3.6
Krypton	Kr	1.9 1.7 1.7
Lithium	Li	1.9
Mercury	Hg	3.6
Methane	CH_4	1.4 1.5 1.6 1.4 to 1.8 1.5 1.5
Methanol	CH_3OH	1.8 1.9
Mehtyl Acetate	CH_3COOCH_3	4.0
Mythyl ether	$(CH_3)_2O$	3.0 3.0

Substance	Formula	Relative Ionization Gauge Gas Correction Factor
Naphthalene	$C_{10}H_8$	9.7
Neon	Ne	0.30 0.31
Nitrobenzene	$C_6H_5NO_2$	7.2
Nitrogen	N_2	1.0
Nitrotoluene (o·, m·, p·)	$C_6H_4CH_3NO_2$	8.5
Nitric Oxide	NO	1.3 1.2 1.0
Nitrous Oxide	N_2O	1.5 1.7 1.7 1.3 to 2.1
Oxygen	O_2	1.0 1.1 0.9 0.9
Pentane n· ISO· neo·	 $n{\cdot}C_5H_{17}$ $ISO{\cdot}C_5H_{17}$ $(CH_3)_4C$	 6.2 6.0 5.7 6.0 5.7
Phenol	C_6H_5OH	6.2
Phosphine	PH_3	2.6
Potassium	K	3.6
Propane	C_3H_8	4.2 3.7 3.7 to 3.9 3.6
Propene oxide	C_3H_6O	3.9
Propene: n· cyclo·	 $n{\cdot}C_3H_6$ $cy{\cdot}C_3H_6$	 3.3 3.2 to 3.7 3.6
Rubidum	Rb	4.3
Silver perchlorate	$AgClO_4$	3.6
Sodium	Na	3.0
Stannic iodide	SnI_4	6.7
Sulphur Dioxide	SO_2	2.1 2.3
Sulphur Hexafloride	SF_6	2.3 2.8
Toluene	$C_6H_5CH_3$	6.8
Trinitrobenzene	$C_6H_3(NO_2)_3$	9.0
Water	H_2O	1.1 1.0 0.8
Xenon	Xe	2.9 2.2 2.4
Xylene: o· p·	 $o{\cdot}C_6H_4(CH_3)_2$ $p{\cdot}C_6H_4(CH_3)_2$	 7.8 7.9

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Request for Return
Health and Safety Certification

ISO 9001 REGISTERED

1. Return authorization numbers (RA#) **will not** be issued for any product until this Certificate is completed and returned to a Varian, Inc. Customer Service Representative.
2. Pack goods appropriately and drain all oil from rotary vane and diffusion pumps (for exchanges please use the packing material from the replacement unit), making sure shipment documentation and package label clearly shows assigned Return Authorization Number (RA#) VVT cannot accept any return without such reference.
3. Return product(s) to the nearest location:

North and South America	**Europe and Middle East**	**Asia and ROW**
Varian, Inc. Vacuum Technologies 121 Hartwell Ave. Lexington, MA 02421 Fax: (781) 860-9252	Varian S.p.A. Via F.lli Varian, 54 10040 Leini (TO) – ITALY Fax: (39) 011 997 9350	Varian Vacuum Technologies Local Office

For a complete list of phone/fax numbers see www.varianinc.com/vacuum

4. If a product is received at Varian, Inc. in a contaminated condition, **the customer is held responsible** for all costs incurred to ensure the safe handling of the product, and **is liable** for any harm or injury to Varian, Inc. employees occurring as a result of exposure to toxic or hazardous materials present in the product.

CUSTOMER INFORMATION

Company name: ....

Contact person: Name: .... Tel:..

Fax: .... E-mail: ....

Ship method: Shipping Collect #: .... P.O.#: ....

Europe only: VAT Reg Number: .... *USA only:* ❒ Taxable ❒ Non-taxable

Customer ship to: .... Customer bill to: ....

....

....

PRODUCT IDENTIFICATION

Product Description	Varian, Inc. Part Number	Varian, Inc. Serial Number

TYPE OF RETURN (check appropriate box)

❒ Paid Exchange	❒ Paid Repair	❒ Warranty Exchange	❒ Warranty Repair	❒ Loaner Return
❒ Credit	❒ Shipping Error	❒ Evaluation Return	❒ Calibration	❒ Other

HEALTH and SAFETY CERTIFICATION

VACUUM TECHNOLOGIES CANNOT ACCEPT ANY BIOLOGICAL HAZARDS, RADIOACTIVE MATERIAL, ORGANIC METALS, OR MERCURY AT ITS FACILITY. CHECK ONE OF THE FOLLOWING:

❒ I confirm that the above product(s) has (have) **NOT** pumped or been exposed to any toxic or dangerous materials in a quantity harmful for human contact.

❒ I declare that the above product(s) has (have) pumped or been exposed to the following toxic or dangerous materials in a quantity harmful for human contact (Must be filled in):

Print Name... Signature .... Date ....

PLEASE FILL IN *THE FAILURE REPORT SECTION* ON THE NEXT PAGE

Do not write below this line

Notification (RA) #: .... Customer ID #: .... Equipment #: ....

VARIAN

Request for Return
Health and Safety Certification

ISO 9001 REGISTERED

FAILURE REPORT

(Please describe in detail the nature of the malfunction to assist us in performing failure analysis):

TURBO PUMPS AND TURBOCONTROLLERS

Claimed Defect		**Position**	**Parameters**	
❒ Does not start	❒ Noise	❒ Vertical	Power:	Rotational Speed:
❒ Does not spin freely	❒ Vibrations	❒ Horizontal	Current:	Inlet Pressure:
❒ Does not reach full speed	❒ Leak	❒ Upside-down	Temp 1:	Foreline Pressure:
❒ Mechanical Contact	❒ Overtemperature	❒ Other	Temp 2:	Purge flow:
❒ Cooling defective	❒ Clogging	....	Operation Time:	
Describe Failure:				
Turbocontroller Error Message:				

ION PUMPS/CONTROLLERS

❒ Bad feedthrough	❒ Poor vacuum
❒ Vacuum leak	❒ High voltage problem
❒ Error code on display	❒ Other ....
Describe failure:	
Customer application:	

VALVES/COMPONENTS

❒ Main seal leak	❒ Bellows leak
❒ Solenoid failure	❒ Damaged flange
❒ Damaged sealing area	❒ Other ....
Describe failure:	
Customer application:	

LEAK DETECTORS

❒ Cannot calibrate	❒ No zero/high background
❒ Vacuum system unstable	❒ Cannot reach test mode
❒ Failed to start	❒ Other ....
Describe failure:	
Customer application:	

INSTRUMENTS

❒ Gauge tube not working	❒ Display problem
❒ Communication failure	❒ Degas not working
❒ Error code on display	❒ Other ....
Describe failure:	
Customer application:	

ALL OTHER VARIAN, INC.

❒ Pump doesn't start	❒ Noisy pump (describe)
❒ Doesn't reach vacuum	❒ Overtemperature
❒ Pump seized	❒ Other ....
Describe failure:	
Customer application:	

DIFFUSION PUMPS

❒ Heater failure	❒ Electrical problem
❒ Doesn't reach vacuum	❒ Cooling coil damage
❒ Vacuum leak	❒ Other ....
Describe failure:	
Customer application:	

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