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Agilent Technologies

Vacuum Products Division

860A and 860A-2 Cold Cathode Ionization Gauge Control

INSTRUCTION MANUAL

Manual No. 699908068
Revision A
July 2000

860A and 860A-2 Cold Cathode Ionization Gauge Control

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Preface

Hazard and Safety Information

This manual uses the following standard safety protocols:

WARNING



The warning messages are for attracting the attention of the operator to a particular procedure or practice which, if not followed correctly, could lead to serious injury.

CAUTION



The caution messages are displayed before procedures, which if not followed, could cause damage to the equipment.

NOTE



The notes contain important information.

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

Before operating or servicing equipment, read and thoroughly understand all operation/ maintenance manuals provided by Agilent. 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 Agilent office.

Check that your Ion Gauge Controller and vacuum n · system are SEPARATELY grounded to a common ground.

WARNING



Placement of a ground wire between the vacuum chamber and the controller chassis is NOT SAFE; large continuous currents could flow through it.

Personnel could 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.

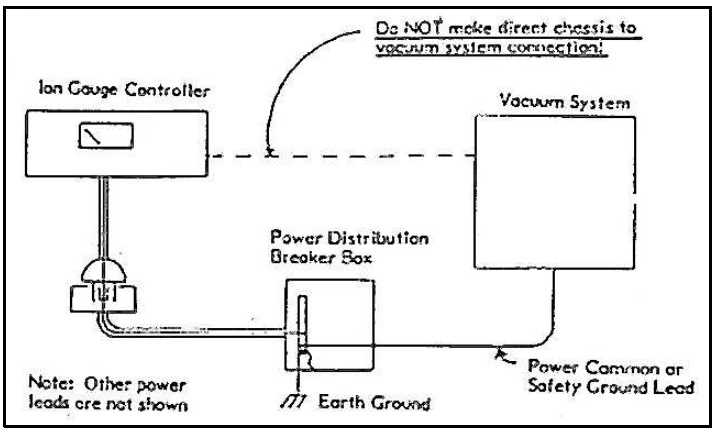


Figure 1 Grounding Schematic

WARNING

An independent agency has determined that ALL vacuum chambers, regardless of manufacture, can possibly become charged to lethal voltage levels, under certain conditions, if they are not grounded with a quality, common ground with the controller of their ionization tube.

After each maintenance/service procedure, and before operating the controller and vacuum system, verify the integrity of the ground of both units; FAILURE TO DO SO COULD COST YOU YOUR LIFE!

WARNING

This equipment contains high voltages (up to 3000 V), high enough to produce electric shock and cause death or serious injury. Equipment utilizing these controls should be designed to prevent personal contact with high voltages.

Always break the primary circuit when direct access to the control unit is required.

Contacting Agilent

In the United States, you can contact Agilent Customer Service at 1-800-882-7426. See the back cover of this manual for a listing of our sales and service offices.

Visit our web site at: http://www.chem.agilent.com/en-US/Products/Instruments/vacuum/pages/default.aspx.

General Information

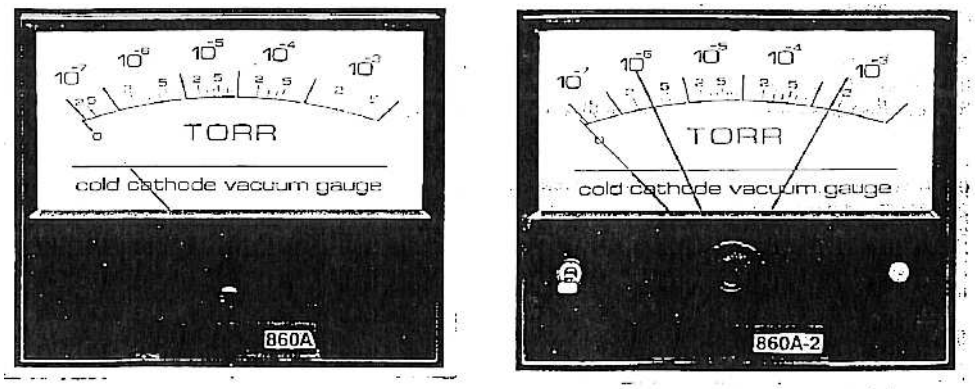
This manual contains operating instructions and maintenance information for the Agilent 860A and the 860A-2 Cold Cathode ionization Gauge Controls. These controls are used for industrial or scientific vacuum applications where pressures of 10^{-2} to 10^{-7} Torr are to be measured. The 860A is the non-set point model; the 860A-2 is the dual optical meter relay set point model used for process control applications, Both models can be used with the Agilent Model 524 (bakeable) and the Model 525 (non-bakeable) gauge tubes; both models can be supplied with meters capable of reading either in Torr or millibars (See Figure 1.)

Table 1 Cold Cathode Ionization Gauge Controls

Non-Set Point Models	Agilent Part Number
860A Cold Cathode ionization Gauge Control, 115 VAC, 60 Hz, complete with power and 524 gauge tube cables, with Torr meter	0860-L5796-301
860A Cold Cathode ionization Gauge Control, 230 VAC, 50 Hz, complete with power and 524 gauge tube cables, with Torr meter	0860-L5796-302
860A Cold Cathode ionization Gauge Control 115 VAC, 60 Hz, complete with power and 525 gauge tube cables, with Torr meter	0860-L5796-311
860A Cold Cathode ionization Gauge Control 230 VAC, 50 Hz, complete with power and 525 gauge tube cables, with Torr meter	0860-L5796-312
860A Cold Cathode ionization Gauge Control 230 VAC, 50 Hz, complete with power and 524 gauge tube cables, with Torr meter	0860-L5796-305
860A Cold Cathode ionization Gauge Control 230 VAC, 50 Hz, complete with power and 525 gauge tube cables, with Torr meter	0860-L5796-315
Dual Set Point Models	**Agilent Part Number**
860A-2 Cold Cathode ionization Gauge Control with dual set point-optical meter relay, power switch and indicator light, complete with power and 524 gauge tube cables, 115 VAC, 60 Hz, with Torr meter	0860-L5797-301
860A-2 Cold Cathode Ionization Gauge Control with dual set point optical meter relay, power switch and indicator light, complete with power and 524 gauge tube cables, 230 VAC, 50 Hz, with Torr meter	0860-L5797-302
860A-2 Cold Cathode Ionization Gauge Control with dual set point optical meter relay; power switch and indicator light, complete with power and 525 gauge tube cables, 115 VAC, 60 Hz, with Torr meter	0860-L5797-311
860A-2 Cold Cathode Ionization Gauge Control with dual set point optical meter relay, power switch and indicator light, complete with power and 525 gauge tube cables, 230 VAC, 50 Hz, with Torr meter	0860-L5797-312

Table 1 Cold Cathode Ionization Gauge Controls (Continued)

Non-Set Point Models	Agilent Part Number
860A-2 Cold Cathode Ionization Gauge Control with dual set point optical meter relay, power switch and indicator light, complete with power and 524 gauge tube cables, 230 VAC, 50 Hz, with millibar meter	0860-L5797-305
860A-2 Cold Cathode Ionization Gauge Control with dual set point optical meter relay, power switch and indicator light, complete with power and 525 gauge tube cables, 230 VAC, 50 Hz, with millibar meter	0860-L5797-315



No Set Point Model Dual Set Point Model

Figure 1 Agilent's 860A and 860A-2 Cold Cathode Ionization Gauge Controls

Table 2 Specifications

Item	Description
Power Required	❑ Non-Set Point Model: 115 VAC; 230 VAC; 50/60 Hz, 3 W ❑ Set Point Model: 115 VAC; 230 VAC; 50/60 Hz, 10 W
Pressure Range	1 x 10^{-2} to 1 x 10^{-7} Torr
Accuracy	Meter accuracy +/- 2% F.S.
Zero Drift	Negligible
Power Cord	6', 3-wire
Gauge Tube Cable	10'
Recorder Output	0 to 10 mV (non-adjustable)

Table 2 Specifications (Continued)

Item	Description
Weight	❑ Basic Model: 2 lbs ❑ Set Point Model: 3lbs
Set Points	❑ Contact Ratings: 5(2.5)A (resistive) 115(230) VAC or 24 VDC ❑ Repeatability: 0.5% F.S. ❑ Dead Band: 0.5% F.S.

Theory of Operation

The cold cathode gauge represents one of the most popular methods of high vacuum measurement through the use of ionization. Its simplicity, durability, and relatively low cost make this gauge an attractive choice for many high-vacuum gauging requirements. However, one should be aware of the operational characteristics and limitations of the cold -cathode gauge before using it in a system.

The gauge consists of a controller to provide the high voltage as well as a readout for the pressure and a sensor that is connected to the system where pressure is to be- monitored. The sensor can be of several types, a simple Penning type or a more complex magnetron structure. The latter type (Redhead magnetron type) is used as an illustration in this discussion.

An ionization chamber containing a cylindrical cathode with end caps is surrounded by a conducting metal wall. A high-voltage supply is connected in series with a meter and the ionization chamber. A magnetic field of about 1000 gauss is introduced with flux lines parallel to the axis of the cathode. Figure 2 illustrates the cross-section of the cold cathode gauge tube.

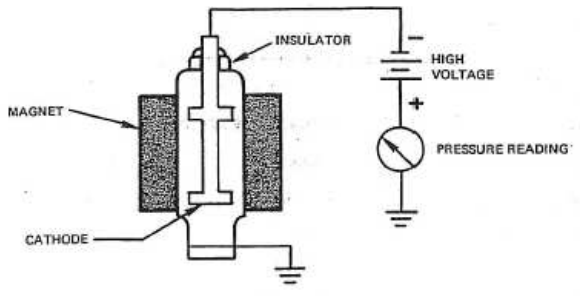


Figure 2 Cross-Section Drawing of Cold Cathode Gauge

When this tube is subjected to a total pressure below approximately10^{-1}Torr, an electron is removed from the cathode by the strong electrostatic field and finds itself in an orbit around the cathode perpendicular to the magnetic field. The electron will then collide with gas molecules present, thus ionizing them, producing positively charged ions and free electrons.

The resulting free electrons also travel in orbits about the cathode and ionize other gas molecules present. This *avalanche effect*, once started, takes milliseconds to arrive at a final value (dependent upon pressure). The positive ions are collected by the cathode and the resultant current, which is proportional to pressure, is observed in the meter in series with the high voltage supply. To determine the ion current at a given pressure, the sensitivity of the tube must be known. This is determined by the particular geometry of the tube. The 524 and 525 gauges have a sensitivity of approximately 5 A/Torr. This means at 1×10^{-1} Torr, the ion current will be 500 mA. At the usual 2 KV supply voltage, this results in a power dissipation of 1000 W within the tube! This, obviously, is not done and, in conventional controls, current limiting must be used so that the maximum current is approximately 1 mA, resulting in an upper pressure reading capability typically in the 10^{-3} Torr range.

In these new 860A and 860A-2 Barrel Cold Cathode Gauge Controls, pressure can be read to 1×10^{-2} Torr. This is accomplished by supplying ia pulsating DC current to the tube. In operation, a cold cathode gauge requires a minimum DC voltage to *fire*. This threshold voltage is dependent upon pressure and reduces in value as the pressure rises. The pulsating DC current is derived from a half-wave rectifier connected to the secondary of a high-voltage transformer. As the pressure rises, the tube will fire earlier on the rising side of the half-wave cycle, thus increasing the average current through the meter and producing a higher reading. At low pressures (below 10^{-5} Torr), the starting time may be longer than the period between successive cycles and the tube will not fire. To prevent this occurrence, a small capacitor is added across the power supply. The capacitor will charge to the peak value of the pulsating DC current waveform thereby firing the gauge tube at low pressure and sustaining its operation. At high pressure, the capacitor is discharged by the gauge tube during the half cycles of the waveform and has no effect. An exponentiating diode is added to provide the ability to read several decades on one logarithmic meter scale.

The set of five graphs (Figure 3) illustrate the manner in which the current and voltage change with the pressure in the tube. The shaded portions of the curves for 10^{-3} and 10^{-2} Torr show the amount of time that the tube is in the conducting mode. Note that at 10^{-2} Torr, the point at which the tube *fires* is earlier in the cycle therefore resulting in an increased rms current.

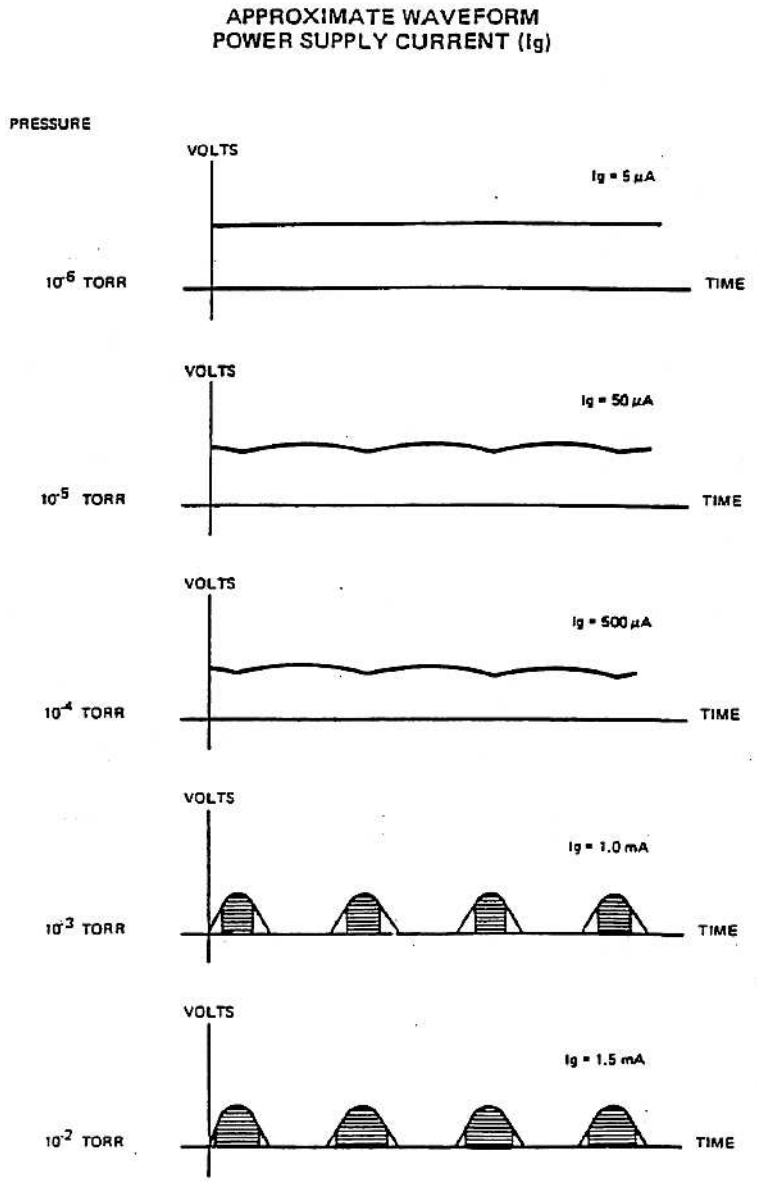


Figure 3 Current and Voltage Change Curves

This unique cold cathode gauge control is totally housed, within a 2-3/4″ diameter barrel behind an easy-to-read 4-1/2″ square meter. The indicating pressure range extends from 1 x 10^{-7} Torr to 1.x 10^{-2} Torr on a 5-decade logarithmic scale.

Gauge Tube Positioning

The cold cathode gauge tube will operate in any orientation. The user must keep in mind that there is a strong magnetic field around the tube; therefore, when near other magnetic material, the tube must be handled with great care.

Gauge tube positioning on a vacuum system is very important if dependable readings are to be obtained. The tube port should be located as close to the region as possible. If the port is near or facing cryogenic surfaces, the apparent pressure reading will be significantly lower than actual pressure. Locations near the inlets to high-vacuum pumps should be avoided.

Since the gas discharge in the tube will break down hydrocarbons causing contamination of the gauge tube, the tube should be protected from direct exposure to mechanical and diffusion pump fluids.

If further discussion on the theory and operation of cold cathode gauge vacuum measurement is desired, the following references should be consulted.

References:

1. Dushman. S., J.M. Lafferty, SCIENTIFIC FOUNDATIONS OF VACUUM TECHNIOUE, John Wiley & Sons, Inc., Second Edition, New York, 1962.

2. Guthrie, A., VACUUM TECHNOLOGY, John Wiley & Sons, Inc., 1963.

3. Lewin, G., VACUUM SCIENCE AND TECHNOLOGY, McGraw-Hill, New York, 1965.

4. Redhead, P.A. et al, ULTRAHIGH VACUUM Chapman and Hall, London, 1968.

5. Van Atta, C.M., THE DESIGN OF HIGH VACUUM SYSTEMS, Kirtney Mfg. Div., N.Y. Brake Co., 1955.

6. Van Atta. C.M., VACUUM SCIENCE AND ENGINEERING. McGraw-Hill, 1965.

Preparation for Use

Unpacking

Each control is inspected and carefully packed prior to shipment. Since the packing materials are designed specifically for this instrument, they should always be used when transporting the unit. The instrument is packed with the following contents:

Quantity	Item
1	Cold Cathode Ionization Gauge Control
1	High-Voltage Cable
1	AC Line Cord, Integral Ground Plug
1	Operating Instruction Manual

NOTE *The gauge tube must be ordered separately.*



Installation

All cables should be kept away from hot surfaces and/or moving parts such as pump heaters and/or roughing pumps.

Figure 14 on page 19 and Figure 15 on page 21 provide the dimensions for the panel cut-out. After cutting out the panel, mount the gauge control through the panel cut-out with the hardware furnished.

It is not recommended that the gauge control be shipped mounted in a panel since shipping vibration may cause excessive stress on the rear of the meter barrel.

The warranty does not cover breakage during transportation unless proper support is given to the rear of the meter barrel. If the control is subject to vibration in use, a support should be used particularly for the set point model.

WARNING *High voltage is present at some terminals.*



All connections to the cold cathode gauge control should be made with the power disconnected, because high voltage is present at the gauge tube connection.

The controls are supplied with separate high voltage cables for the proper models of the gauge tube. When, using the 860A Gauge Control, the ground wire must be attached to a screw on the gauge tube to ensure high voltage protection.

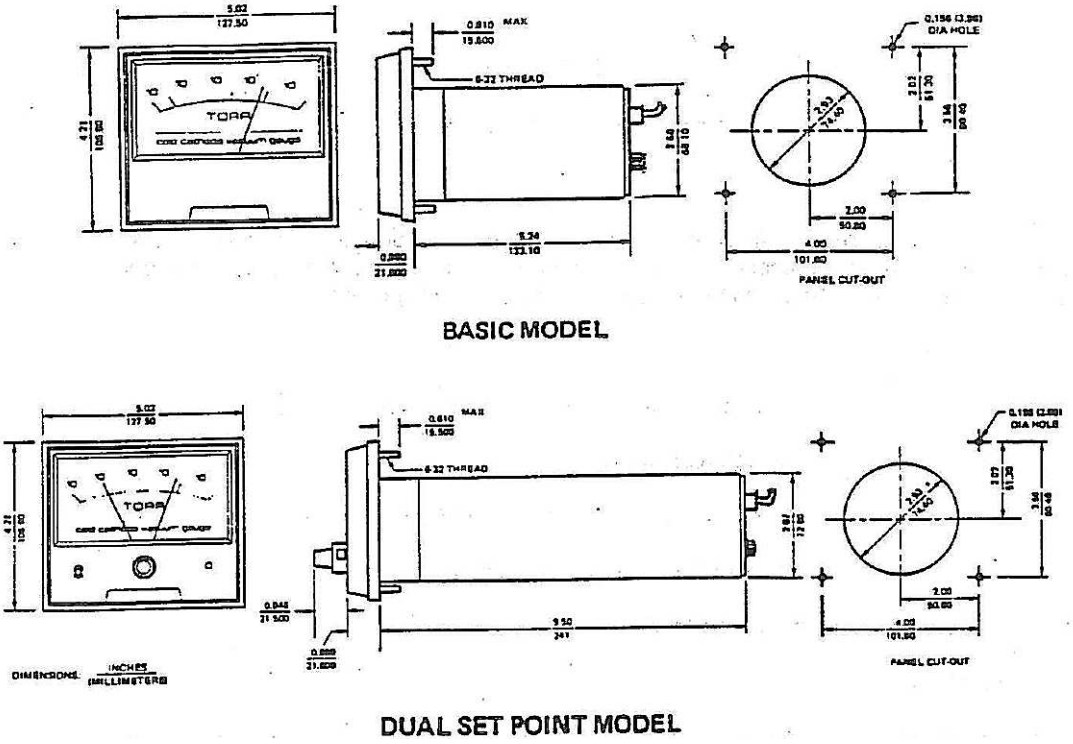


Figure 4 Panel Cutout Dimensions, Model 860 and 860A-2 Models

The basic model (860A) is not supplied with a separate on-off switch. It is necessary that you wire the power through an independent switch or an automatic turn-on relay preset to turn on at a set pressure. Further discussion of various ways of handling the turn on of the control is given in “Operation” on page 10.

A front panel on-off switch is provided on the set point model (860A-2); however, you may want to consider an independent turn-on turn-off mechanism that is better suited to the system.

The power and all other electrical connections are made through the connector P2. Figure 5 on page 9 shows the connector pin identifications.

Solder the power cord to the appropriate terminals. Check that the control is designed for the voltage which will be supplied so that the control is not damaged (Figure 6 on page 9).

The power cable connector is disassembled in the following manner to make these connections. Loosen the screws on the cable clamp so that there is sufficient room to slide the cable through. Next, remove the screws on the side clips by pulling back on the screws while turning the screw counterclockwise. The clips will slide off allowing the cover and clamp assembly to be pulled back on the cable exposing the terminal solder pins.

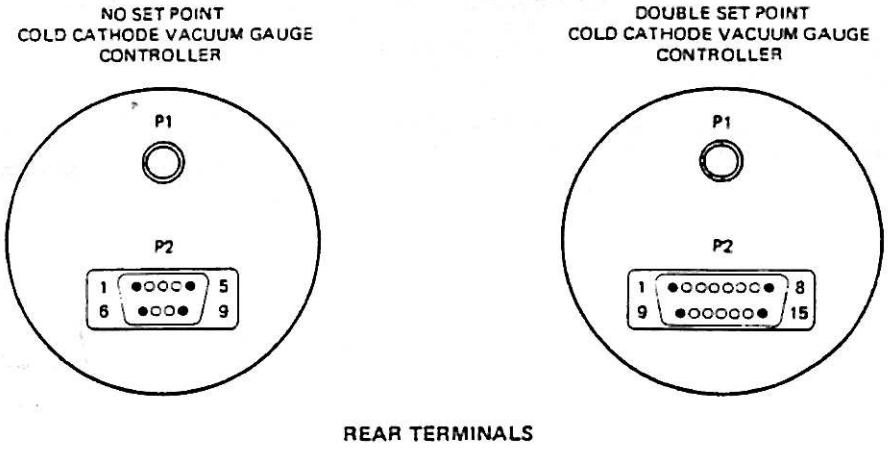


Figure 5 Connector Pin identifications

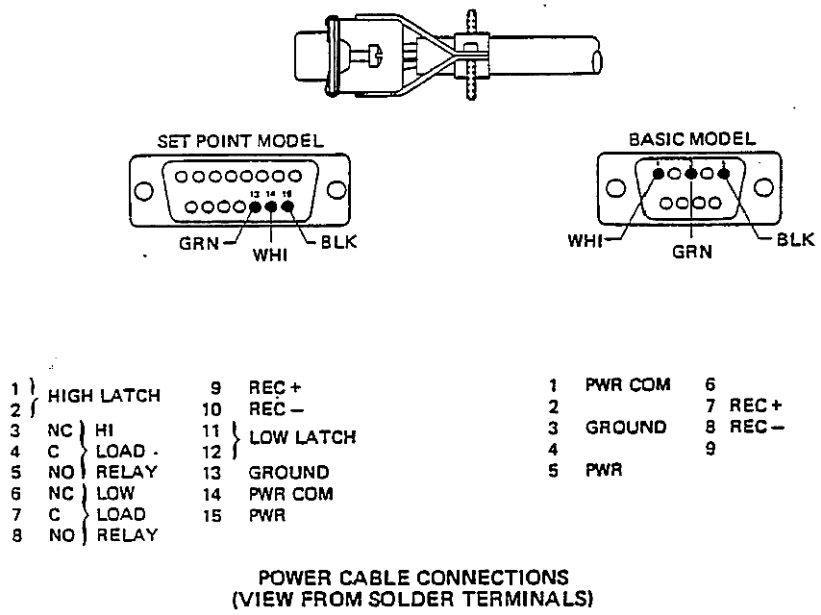


Figure 6 Power Cable Connections

When making the power and other external wiring connections, be careful when soldering wires to the connector pins. To prevent damage to the insulation, do not overheat the pin. After soldering has been completed, check that extra strands of wire have not shorted other terminals.

After all wires have been soldered to the connector, plug the assembly into the rear of the control. It is now ready for operation.

Operation

Gauge Control

Under normal operating conditions, no calibration is ever necessary. If erroneous pressure readings are observed, the problem can usually be traced to a dirty gauge tube. The gauge tube should be cleaned as outlined in “Service” on page 14. Should the problem persist after cleaning the gauge tube and checking all external wiring, then consult with the factory service department for assistance.

Set Points

The 860A-2 Control is supplied with two independent set points that are adjusted by two concentric knobs located on the front of the meter. The setting of each control point is indicated by the position of the set pointer. The outer knob controls the low set point and the inner knob the high set point. Control action occurs when the pressure indicating pointer coincides with the corresponding set pointer.

The set pointer(s) can be adjusted to any position from 10^{-7} to 10^{-2} Torr and does not interfere with the movement of the indicating pointer. The operation of the set points may overlap when the set points are set to their minimum spread. The terms *low* and *high* set points do not refer to a particular portion of the meter scale, but rather with respect to each other; i.e., the high set point can only be set at a pressure higher than that of the low set point. Since the set points operate from the movement of the meter needle, the speed of response to a pressure change is only as rapid as the inertia of the meter needle allows.

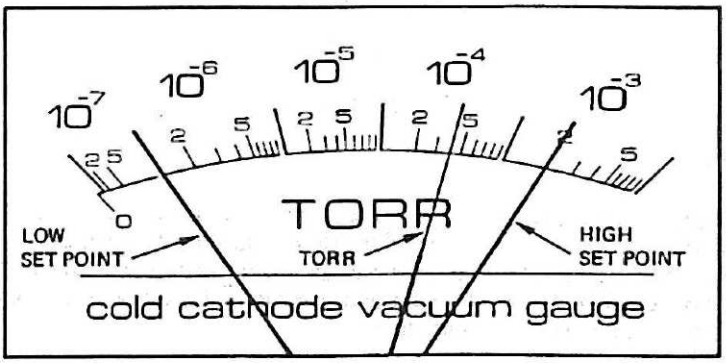
The set point relay terminals are isolated from the gauge control circuitry. The terminals are passive contacts of the relay which provide common, normally-open, and normally-closed functions. Figure 9 illustrates the set point mode of operation. The relay is in a de-energized condition when the pressure needle is at a higher pressure than the set point.

By properly interconnecting the relay contacts, a variety of operating modes can be, used.

For example, if the process requires control in a pressure band, the set point outputs can be wired as shown in Figure 9.

Each set point relay can be operated independently in a latched mode. The set point relay remains energized after being tripped when the latch terminals are jumpered. It is necessary to interrupt the latch jumper to de-energize (reset) the relay. The latching mode of operation can be selected by shorting pins 11 and 12 of P2 for the low set point and pins 1 and 2 for the high latch.

The latching mode can be used to control a process that requires turn-on at a low pressure e.g., 5×10^{-6} Torr) but must turn off if the pressure rises above a particular level (e.g., 5×10^{-3} Torr). Figure 9 illustrates the proper wiring to accomplish this. The low set point is operated in the latched mode.



Pointer	Pressure Setting	Relay Contacts	Relay State
With Meter Indicating 4×10^{-4} Torr	–	–	–
Low Set Point	1×10^{-6} Torr	NC – Closed NO – Open	De-energized
High Set Point	2×10^{-3} Torr	NC – Open NO – Closed	Energized

Figure 7 Setpoint Operation (Model 860A-2)

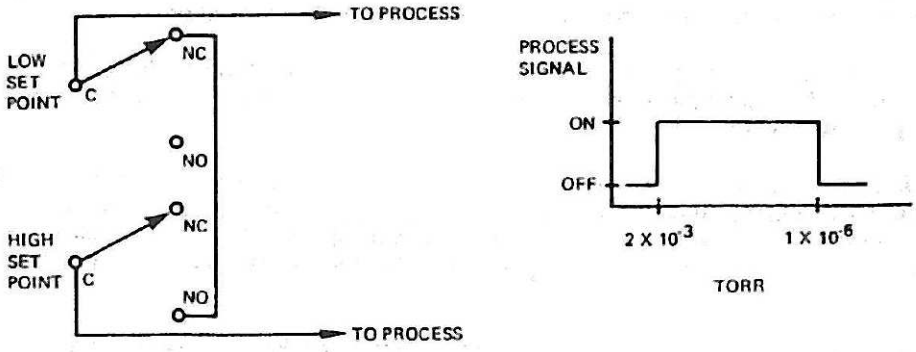


Figure 8 Set Point Wiring for Control in a Pressure Band (Model 860A-2)

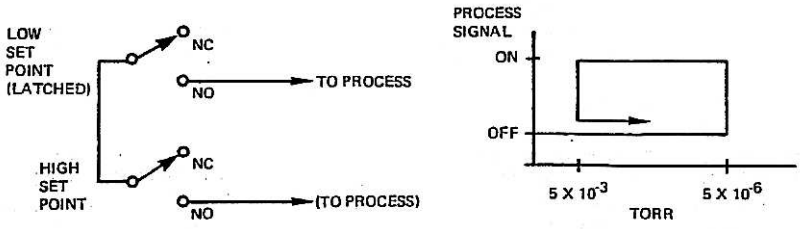


Figure 9 Set Point Wiring for Automatic Turn-off (Model 860A-2)

As the pressure is reduced, the high set point trips first and then the low set point trips when 5×10^{-6} Torr is attained. Since the low set point is latched, it remains closed. However, if the pressure rises above 5×10^{-3} Torr, the high set point trips, interrupting the process. The latch must be reset at the end of the process cycle to reactivate the low set point.

Recorder Output

All models have a recorder output that is 0- 10 mV. This corresponds to the full range of the meter indication. The output is designed for use with a recorder having a full scale range of at least 10 mV and an input impedance of greater than 2,000 Ohms.

Pin 8 is at ground, with Pin 7 going to 10 mV full scale in the basic model. In the set point model, Pin 10 is at ground while Pin 9 is a positive 10 mV full scale.

The recorder output is not adjustable. Correction for any error between the recorder output and the meter reading must be done by the measuring recorder. A reading of 1×10^{-7} Torr corresponds to 0 mV output (Figure 10). Since the meter needle can go lower than this (pegged to the left), the recorder output goes slightly negative.

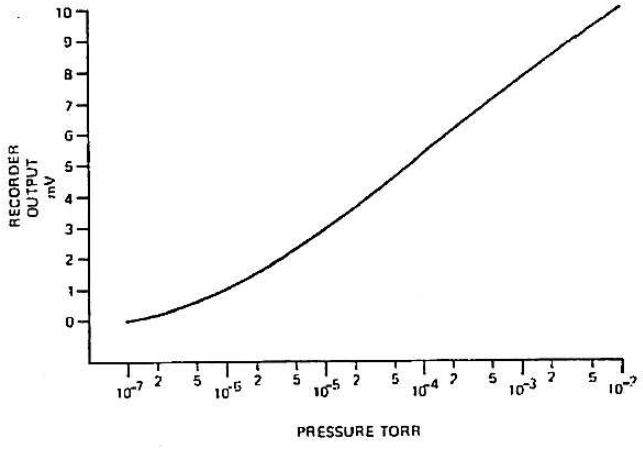


Figure 10 Recorder Output vs. Pressure

The response time of the recorder output is much faster than the meter indication. In some applications this fast response may result in unwanted oscillations at the output. A simple filtering circuit may be employed at the terminal to reduce these fluctuations.

Long Cable Operation

The control is supplied as standard with a 10′ long, high voltage cable. If it is desirable to position the tube a greater distance from the control; a longer cable must be assembled.

Using an RG-58 cable, the tube may be positioned up to 1000′ away. The cable leakage current is considerably less than the lowest reading on the control with cables up to this length.

Operating Guides

It is recommended that the cold cathode, gauge tube not be operated at pressures above 10^{-1} Torr for extended periods of time. Operation in this pressure range will result in rapid contamination of the gauge tube. For automatic operation, suitable interlocking of the gauge, control should be made. This can be obtained from a thermocouple type controller. high vacuum valve opening, or other system signal which is activated at 10^{-1} Torr.

Rapid venting of the tube to atmosphere will not cause damage to the tube or gauge control. The gauge tube discharge will extinguish at a pressure of several Torr. Exposure of the gauge tube to atmospheric pressure with the control on will not be harmful to the tube.

Service

WARNING



This equipment contains high voltages (up to 3000 volts), high enough to produce electric shock and cause death or serious injury. Equipment utilizing these controls should be designed to prevent personal contact with high voltages.
Always break the primary circuit when direct access to the control unit is required.

Control Unit

The control unit is basically a self-contained instrument. It should give trouble-free operation for many years., If problems do arise, consult “Service” on page 14 or contact the Agilent Service Department.

To clean the glass meter face, use soap and water. To remove grease or oil, use kerosene sparingly. It is recommended to wipe or blot the meter face periodically with a clean, damp soft cloth or chamois.

Return the instrument to the Agilent Service Department for repair, do not attempt repair of the sealed unit while it is under the warranty as the warranty will be voided.

Gauge Tube

The gauge tube requires periodic maintenance. Leaving the gauge unoperated for sustained periods of time or exposing it to system contaminants (pump oil, for example) can be a source of trouble. These conditions will cause gases to be absorbed into the metal surfaces of the gauge tube, thus causing faulty readings and slow starting. Also, a buildup of contaminants causes faulty or erratic readings.

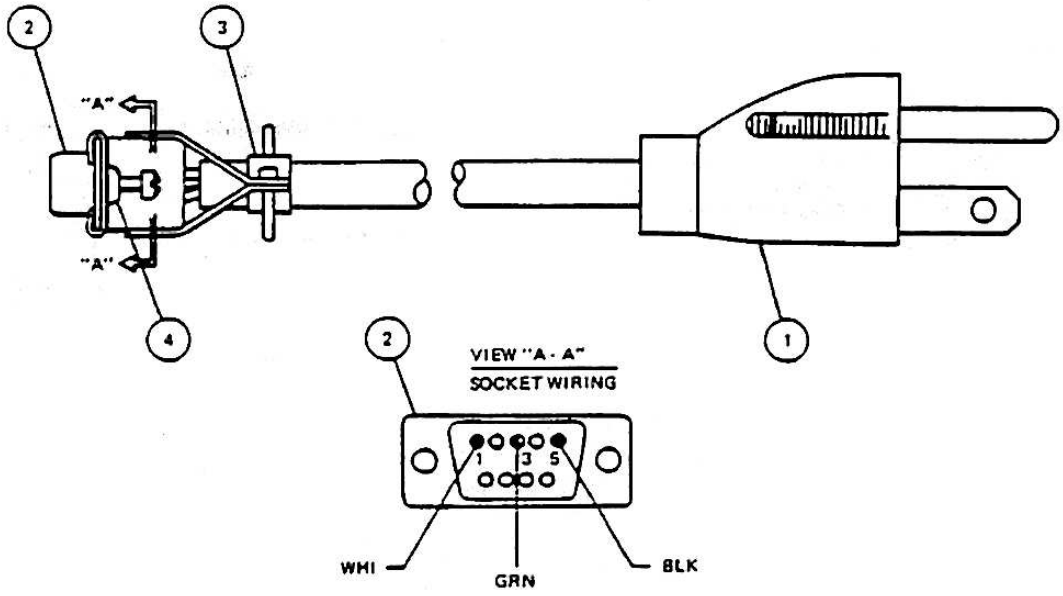
One method of *cleaning up* the gauge tube is to apply heat to the gauge. This process drives the absorbed gases off the walls and surfaces of the gauge. Care should be exercised not to overheat the O-ring seals in the 525 gauge tube (maximum temperature 100 °C or 212°F). The 524 tube is bakeable to 400 °C (752°F), assuming the connection to the vacuum system is also bakeable.

For best results and for removing built-up contaminants, a thorough cleaning of the gauge tube is necessary. Both the anode and the cathode surfaces must be cleaned. This can be accomplished by disassembling the gauge and cleaning each part. A wire brush, steel wool, or emery cloth are good surface cleaners. After brushing, the parts must be washed in soap and water (preferably Alconox), rinsed in plain water, and a final rinse in alcohol and hot-air dried if possible.

Replacement of the glass sleeve in the 524 tube may be necessary. If it appears brownish-black in color, it is heavily contaminated and must be replaced for proper operation. If a spare sleeve is not available, the old one can be used by installing it with the *clean end* facing the threaded portion of the anode.

Troubleshooting

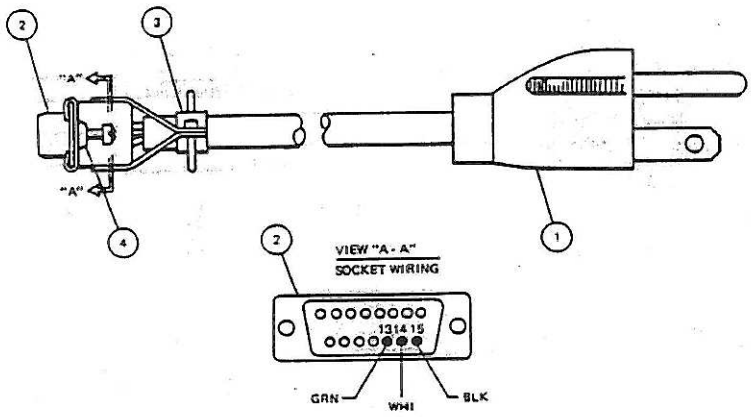
Fault	Possible Causes/ Remedy
Gauge control does not read above 1×10^{-7} Torr	Check that proper power is being supplied to the control. Check high voltage cable connection at tube and rear of control.
Gauge control reads full scale even when pressure is below 1×10^{-2} Torr	Check high voltage cable for a short to the center conductor. Inspect gauge tube for a low resistance from cathode to body. Insulator may be damaged.
Gauge tube won't strike a discharge.	Insure that the high voltage is being applied to the gauge tube. The time for the tube to strike will be longer at lower pressures. To reduce the turn on the control at a pressure of 10^{-2} Torr.
Reading on gauge control is erratic.	Gauge tube is contaminated. Follow procedure for disassembly and cleaning of tube.



POWER CABLE ASSEMBLY (BASIC MODEL)
PARTS LIST
PART NO. 0881-K3643-301

Item	Description	Part No.
1	Power Cord	0881-K3622-301
2	Connector, ITT Cannon DE-9S	0881-6480-72-509
3	Connector Shell, ITT Cannon DE-44994	0881-6700-60-009
4	Screw Lock Assembly, ITT Cannon D20419	0881-6480-72-503

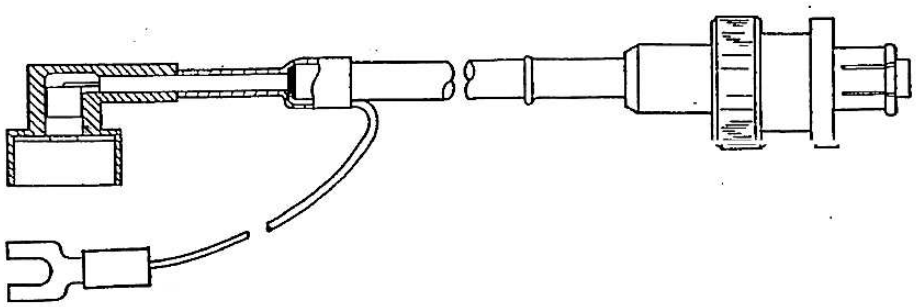
Figure 11 Power Cable Assembly (Basic Model)



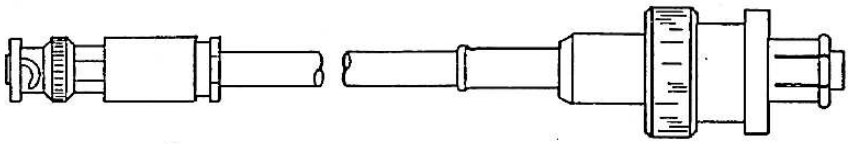
POWER CABLE ASSEMBLY (SET POINT MODEL)
PARTS LIST
PART NO. 0881-K3644-301

Item	Description	Part No.
1	Power Cord	0881-K3622-001
2	Connector, ITT Cannon DA-15S	0881-6480-72-505
3	Connector Shell, ITT Cannon DA-20961	0881-6700-60-006
4	Screw Lock Assembly, ITT Cannon D20419	0881-6480-72-503

Figure 12 Power Cable Assembly Set Point Model



HIGH VOLTAGE CABLE ASSEMBLY (524 GAUGE TUBE)
PART NO. 0881-L5571-310



HIGH VOLTAGE CABLE ASSEMBLY (525 GAUGE TUBE)
PART NO. 0881-L5572-310

Figure 13 Cable Assemblies

Accessories

Agilent 524-2 Cold Cathode Gauge Tube

The 524-2 Cold Cathode Ionization Gauge Tube, which is similar in configuration to the famous Redhead Magnetron Gauge, measures pressures down to 1 x 10^{-9} Torr with accuracy and reliability. When properly maintained, the 524-2 will start at very low pressures where ordinary cold cathode gauges are difficult to start. Excellent repeatability and improved stability are provided by the linear response below 1 x10^{-2} Torr.

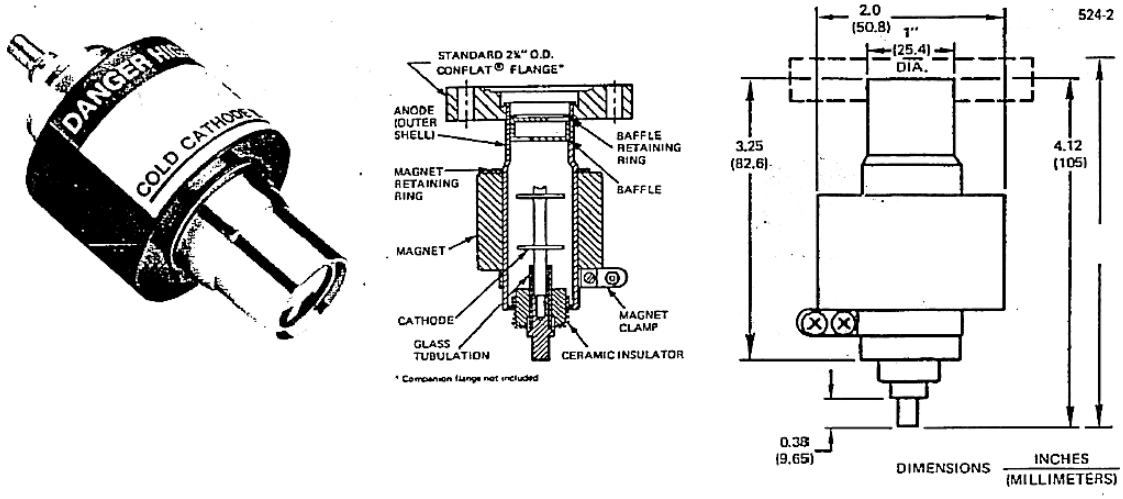


Figure 14 524-2 Gauge Tube Parts and Dimensions

Table 3 Specifications

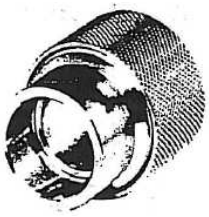
Item	Description
Range	1 X 10^{-9} to 1 x 10^{-2} Torr
Starting Time	From 5 X 10^{-3} to 10^{-7} Torr; not over 30 seconds
Response Time	Full-range pressure change, less than one second (tube only)
Materials	Aluminum cathode, stainless steel shell, brazed ceramic insulator
Temperature	Bakeable to 400 ℃ (752 ℉)
Tabulation	524-2: 1” OD smooth wall 524-2F: Con-Flat flange 2-3/4” OD

Ordering Information

Bakeable 524-2 Gauge Tubes	Order Number
524-2 Cold Cathode Gauge Tube with 1” tubulation	0524-F2817-301
524-2F Cold Cathode Gauge Tube with 2-3/4” ConFlat® flange	0524-F2818-301

Recommended Vacuum Seals

Model Number	Tubulation Size
1340-F0205-382	Stainless steel body O-ring for 1” tubing



Maintenance Kit, Model Number 0591-K4381-301

The Agilent 524-2MK maintenance kit provides all of the tools and replacement parts necessary to assure indefinite gauge life. The kit contains retaining ring pliers, a tube brush for cleaning the stainless shell, a screwdriver for easy cathode replacement, and a two year supply of grit for polishing the interior of the shell. A replacement cathode, baffle, retaining ring, and six Pyrex insulators are also supplied. The entire-kit is housed in a rugged, clear plastic, hinged case, 8-1/2 x 6 x 1-3/4”.

Agilent 525 Cold Cathode Gauge Tube

The 525 Cold Cathode ionization Gauge Tube, which is similar in configuration to the Redhead Magnetron Gauge, measures pressures down to 1 x 10^{-7} Torr with accuracy and reliability. When properly maintained, the 525 starts at very low pressures where ordinary cold cathode gauges are difficult to start. Excellent repeatability and improved stability are provided by the linear response below 1 x 10^{-2} Torr.

The 525 terminates in smooth-walled 1″ OD tubing. An O-ring compression seal allows easy mounting and servicing of the tube.

The tube may also be brazed or welded into place if desired.

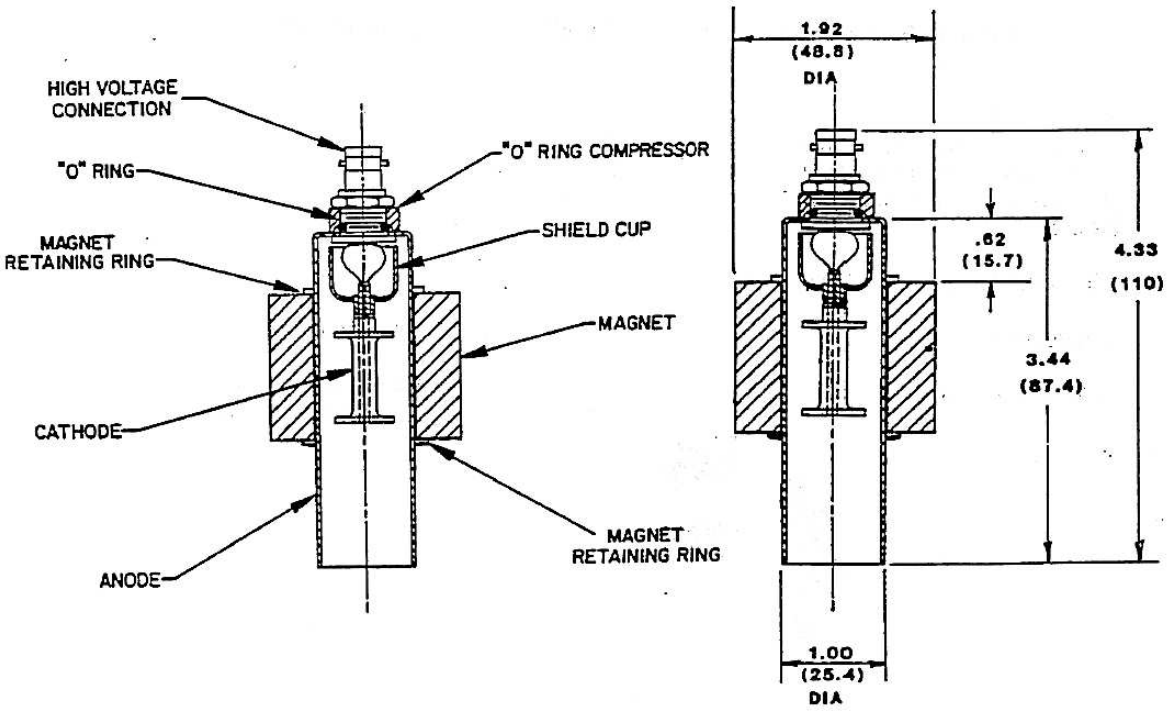


Figure 15 525 Cold Cathode Gauge Tube Parts and Dimensions

Table 4 Specifications

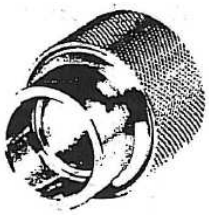
Item	Description
Range	Range 1 x 10^{-7} to 1 x 10^{-2} Torr
Starting Time	From 5 x 10^{-3} to 10^{-7} Torr: not over 30 seconds
Response Time	Full-range pressure change, less than one second (tube only)
Materials	Aluminum cathode, stainless steel shell, O-ring seal
Temperature	100℃ (212℉) maximum
Tabulation	1” OD smooth wall

Ordering Information

Non-Bakeable 525 Gauge Tubes	Order Number
525 Cold Cathode Gauge Tube with 1” inch tubulation	0525-K9234-301
525 Cold Cathode Gauge Tube with NW40 Flange	0525-K9234-302
525 Cold Cathode Gauge Tube with 2-3/4 inch ConFlat® Flange	0525-K9234-303
525 Spare Parts High-voltage cathode assembly consisting of: one. high-voltage connector, one assembled and two spare Parker O-rings, cathode, shield cup, O-ring compressor, and lock washer	0581-K9440-301

Recommended Vacuum Seals

Model Number	Tubulation Size
1340-F0205-382	Stainless steel body O-ring for 1” tubing



Agilent Technologies

Vacuum Products Division
Instructions for returning products

Dear Customer:

Please follow these instructions whenever one of our products needs to be returned.

1) Complete the attached Request for Return form and send it to Agilent Technologies (see below), taking particular care to identify all products that have pumped or been exposed to any toxic or hazardous materials.

2) After evaluating the information, Agilent Technologies will provide you with a Return Authorization (RA) number via email or fax, as requested.
Note: Depending on the type of return, a Purchase Order may be required at the time the Request for Return is submitted. We will quote any necessary services (evaluation, repair, special cleaning, eg).

3) **Important steps for the shipment of returning product:**
   - Remove all accessories from the core product (e.g. inlet screens, vent valves).
   - Prior to shipment, drain any oils or other liquids, purge or flush all gasses, and wipe off any excess residue.
   - If ordering an Advance Exchange product, **please use the packaging from the Advance Exchange to return the defective product.**
   - Seal the product in a plastic bag, and package product carefully to avoid damage in transit. You are responsible for loss or damage in transit.
   - Agilent Technologies is not responsible for returning customer provided packaging or containers.
   - **Clearly label package with RA number**. Using the shipping label provided will ensure the proper address and RA number are on the package. Packages shipped to Agilent without a RA clearly written on the outside cannot be accepted and will be returned.

4) Return only products for which the RA was issued.

5) **Product being returned under a RA must be received within 15 business days.**

6) **Ship to the location specified on the printable label, which will be sent, along with the RA number, as soon as we have received all of the required information.** Customer is responsible for freight charges on returning product.

7) Return shipments must comply with all applicable **Shipping Regulations** (IATA, DOT, etc.) and carrier requirements.

RETURN THE COMPLETED **REQUEST FOR RETURN** FORM TO YOUR NEAREST LOCATION:

EUROPE:	**NORTH AMERICA:**	**PACIFIC RIM:**
Fax: 00 39 011 9979 330		
Fax Free: 00 800 345 345 00	Fax: 1 781 860 9252	please visit our website for individual
Toll Free: 00 800 234 234 00	Toll Free: 800 882 7426, Option 3	office information
vpt-customercare@agilent.com	vpl-ra@agilent.com	http://www.agilent.com

Agilent Technologies

Vacuum Products Division
Request for Return Form
(Health and Safety Certification)

Please read important policy information on Page 3 that applies to all returns.

1) CUSTOMER INFORMATION

Company Name:	**Contact Name:**
Tel: **Email:**	**Fax:**
Customer Ship To:	**Customer Bill To:**
Europe only: **VAT reg. Number:**	USA/Canada only: ☐ **Taxable** ☐ **Non-taxable**

2) PRODUCT IDENTIFICATION

Product Description	Agilent P/N	Agilent S/N	Original Purchasing Reference

3) TYPE OF RETURN (**Choose one from each row** and supply Purchase Order if requesting a billable service)

3A. ☐ Non-Billable ☐ Billable ➡ New PO # (hard copy must be submitted with this form):

3B. ☐ Exchange ☐ Repair ☐ Upgrade ☐ Consignment/Demo ☐ Calibration ☐ Evaluation ☐ Return for Credit

4) HEALTH and SAFETY CERTIFICATION

AGILENT TECHNOLOGIES CANNOT ACCEPT ANY PRODUCTS CONTAMINATED WITH BIOLOGICAL OR EXPLOSIVE HAZARDS, RADIOACTIVE MATERIAL, OR MERCURY AT ITS FACILITY.
Call Agilent Technologies to discuss alternatives if this requirement presents a problem.

The equipment listed above (check one):

☐ **HAS NOT** pumped or been exposed to any toxic or hazardous materials. OR
☐ **HAS** pumped or been exposed to the following toxic or hazardous materials. If this box is checked, the following information must also be filled out. Check boxes for all materials to which product(s) pumped or was exposed:

☐ Toxic ☐ Corrosive ☐ Reactive ☐ Flammable ☐ Explosive ☐ Biological ☐ Radioactive

List all toxic/hazardous materials. Include product name, chemical name, and chemical symbol or formula:

_____

NOTE: If a product is received at Agilent which is contaminated with a toxic or hazardous material that was not disclosed, **the customer will be held responsible** for all costs incurred to ensure the safe handling of the product, and **is liable** for any harm or injury to Agilent employees as well as to any third party occurring as a result of exposure to toxic or hazardous materials present in the product.

Print Name: **Authorized Signature: .....** **Date:**

5) FAILURE INFORMATION:

Failure Mode (REQUIRED FIELD. See next page for suggestions of failure terms):
Detailed Description of Malfunction: (Please provide the error message)
Application (system and model):

I understand and agree to the terms of Section 6, Page 3/3.
Print Name: **Authorized Signature: .....** **Date:**

Agilent Technologies

Vacuum Products Division
Request for Return Form
(Health and Safety Certification)

Please use these Failure Mode to describe the concern about the product on Page 2.

TURBO PUMPS and TURBO CONTROLLERS

APPARENT DEFECT/MALFUNCTION		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	.....	OPERATING TIME:	

ION PUMPS/CONTROLLERS

- Bad feedthrough	- Poor vacuum
- Vacuum leak	- High voltage problem
- Error code on display	- Other

VALVES/COMPONENTS

- Main seal leak	- Bellows leak
- Solenoid failure	- Damaged flange
- Damaged sealing area	-Other

LEAK DETECTORS

- Cannot calibrate	-No zero/high backround
- Vacuum system unstable	- Cannot reach test mode
- Failed to start	- Other

INSTRUMENTS

- Gauge tube not working	- Display problem
- Communication failure	- Degas not working
- Error code on display	- Other

SCROLL AND ROTARY VANE PUMPS

- Pump doesn't start	- Noisy pump (describe)
- Doesn't reach vacuum	- Over temperature
- Pump seized	- Other

DIFFUSION PUMPS

- Heater failure	- Electrical problem
- Doesn't reach vacuum	- Cooling coil damage
- Vacuum leak	- Other

Section 6) *ADDITIONAL TERMS*

Please read the terms and conditions below as they apply to all returns and are in addition to the Agilent Technologies Vacuum Product Division – Products and Services Terms of Sale.

- Customer is responsible for the freight charges for the returning product. Return shipments must comply with all applicable **Shipping Regulations** (IATA, DOT, etc.) and carrier requirements.
- Customers receiving an Advance Exchange product agree to return the defective, rebuildable part to Agilent Technologies **within 15 business days**. Failure to do so, or returning a non-rebuildable part (crashed), will result in an invoice for the non-returned/non-rebuildable part.
- Returns for credit toward the purchase of new or refurbished Products are subject to prior Agilent approval and may incur a restocking fee. Please reference the original purchase order number.
- Units returned for evaluation will be evaluated, and a quote for repair will be issued. If you choose to have the unit repaired, the cost of the evaluation will be deducted from the final repair pricing. A Purchase Order for the final repair price should be issued within 3 weeks of quotation date. Units without a Purchase Order for repair will be returned to the customer, and the evaluation fee will be invoiced.
- A Special Cleaning fee will apply to all exposed products per Section 4 of this document.
- If requesting a calibration service, units must be functionally capable of being calibrated.

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