



Cold Cathode Pirani Combination Vacuum Gauge
WGM701 Module
The Wasp™



User Manual

InstruTech
1475 S. Fordham St.
Longmont, CO 80503
USA

Phone: +1-303-651-0551
Fax: +1-303-678-1754
E-mail info@instrutechinc.com
www.instrutechinc.com

Important User Information

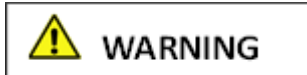
There are operational characteristic differences between solid state equipment and electromechanical equipment. Because of these differences, and because there are a variety of uses for solid state equipment, all persons that apply this equipment must take every precaution and satisfy themselves that the intended application of this equipment is safe and used in an acceptable manner.

In no event will InstruTech be responsible or liable for indirect or consequential damages that result from the use or application of this equipment.

Any examples or diagrams included in this manual are provided solely for illustrative purposes. Because of the many variables and requirements imposed on any particular installation, InstruTech cannot assume responsibility or liability for any actual use based on the examples and diagrams.

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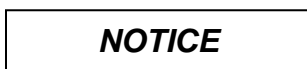
Throughout this manual we use notes, notices and apply internationally recognized symbols and safety messages to make you aware of safety considerations.



Identifies information about practices or circumstances that can cause electrical or physical hazards which, if precautions are not taken, could result in death or serious injury, property damage, or economic loss.



Identifies information about practices or circumstances that can cause electrical or physical hazards which, if precautions are not taken, could result in minor or moderate injury, property damage, or economic loss.



Identifies information that is critical for successful application and understanding of the product.



Labels may be located on or inside the device to alert people that dangerous voltages may be present.

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1 Introduction / General Information

1.1 Description


The WGM701 *Wasp™* vacuum gauge module combines the Cold Cathode Inverted Magnetron technology with a Pirani sensor to provide reliable and continuous pressure measurements from atmosphere to high vacuum. A cold cathode ionization gauge measures vacuum pressure by first ionizing gas molecules inside the vacuum gauge and then measuring the resulting ion current. A large potential between the sensor anode and cathode will cause ionization to occur. The amount of ion current generated from the ionized gas is proportional to the pressure in the vacuum system and is dependent on the type of gas used. As the pressure inside the vacuum system drops, the measured ion current drops. Two ion current collector options are available. The low current collector option is recommended for use in heavy gases such as argon to prevent self-sputtering while the high current version is recommended for gases such as N₂/air, etc. The Pirani sensor measures pressure indirectly by sensing the loss of heat from a sensor to the surrounding gases. The higher the pressure of the surrounding gas, the more heat is conducted away from the sensor. Pirani thermal conductivity gauges maintain a sensor (usually a wire) at some constant temperature, and measure the current or power required to maintain that temperature.

The WGM701 provides the basic signal conditioning required to turn the sensor into a complete vacuum pressure measurement instrument. The built-in controller provides a log-linear analog output for the measured pressure. The cold cathode sensor is automatically activated once the pressure measured by the Pirani sensor has indicated a low enough pressure level of 7.6×10^{-3} Torr. Additionally, the instrument provides a sensor on/off status using an open collector transistor output as well as several status LEDs. The measurement range for the WGM701 cold cathode Pirani combination gauge is 7.6×10^{-10} to 760 Torr.

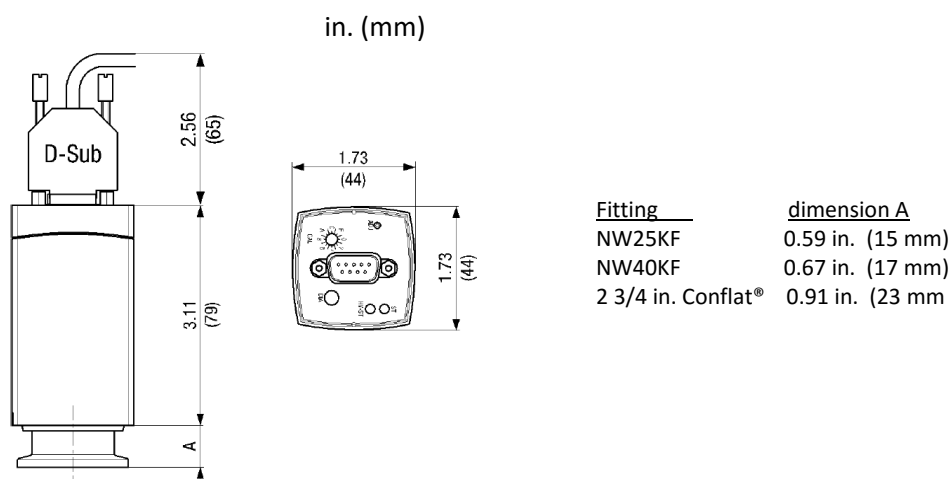
1.2 Specifications

| | | |
|---------------------------------|---|--|
| measurement range | 7.6×10^{-10} to 760 Torr / 1×10^{-9} to 1,000 mbar / 1×10^{-7} Pa to 101 kPa | |
| accuracy - N2 (typical) | 7.6×10^{-9} to 7.6×10^{-3} Torr: | ± 30% of reading |
| | 7.6×10^{-3} to 75 Torr: | ± 15% of reading |
| | 75 to 760 Torr: | ± 50 % of reading |
| repeatability - (typical) | 7.6×10^{-9} to 75 Torr: ± 5% of reading | |
| materials exposed to gases | Ni alloy, Al ₂ O ₃ , stainless steel, glass | |
| internal gauge volume | 1.391 in ³ (22.8 cm ³) | |
| admissible pressure | 145 psi, 10 bar absolute (limited to inert gases < 50 °C) | |
| temperature | operating: + 5 to + 55 °C storage: -40 to + 70 °C | |
| humidity (30 days a year) | 7.6×10 ⁻⁸ ... 7.6 ×10 ⁻³ Torr | 0 to 95% relative humidity, non-condensing |
| | 7.6×10 ⁻⁹ ... 7.6 ×10 ⁻³ Torr | 0 to 70% relative humidity, non-condensing |
| bakeout temperature (at flange) | 150 °C (sensor only - electronics removed) | |
| weight | 0.61 lb. (0.28 kg) with NW25 KF flange | |
| housing (electronics) | aluminum extrusion | |
| use | indoor only | |
| mounting orientation | any | |
| analog output | log-linear 0.5 to 7 Vdc, 0.5 V/decade | |
| output impedance | $2 \times 4.7 \Omega$, short-circuit proof | |

| | |
|-----------------------------------|--|
| load impedance | $\geq 10 \text{ k}\Omega$, short-circuit proof |
| error signal | analog output switches to $\geq 10 \text{ V}$ |
| response time | $p = 7.6 \times 10^{-9} \text{ Torr}$ ~1 sec $p > 7.6 \times 10^{-7} \text{ Torr}$ <100 msec |
| sensor status output | cold cathode sensor on/off status is determined by open collector transistor (ground emitter) rated at 30 V max. V_{CE} , 100 mA max. I_C . Transistor off = Sensor off, Transistor on = Sensor on |
| sensor status indication on gauge | sensor ON/OFF status indication via LED |
| input power ⁽¹⁾ | 14.5 to 30 Vdc, 2 W protected against power reversal and transient over-voltages (Minimum voltage of the power supply unit must be increased proportionally to the length of the cable) |
| fuse required | $\leq 1\text{AT}$ |
| supply voltage ripple | <1 Vp-p |
| high voltage in measuring chamber | operating voltage (anode): <3.3 KV sensor activation voltage (anode): <4.5 KV |
| current in measuring chamber | low current collector version: $\leq 100 \mu\text{A}$ high current collector version: $\leq 500 \mu\text{A}$ |
| connector | 9-pin D-sub male |
| altitude | 19,685 ft. (6,000 m) max |
| CE compliance | EMC (EN61000-6-2, EN61000-6-3, EN61010-1, EN61326-1) |
| environmental | RoHS compliant |

(1)  **WARNING!** The gauge may only be connected to power supplies, instruments, or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.

1.3 Dimensions



1.4 Part Numbers

| WGM701 Part Number | | Spare Parts / Accessories Part Numbers | |
|-----------------------------------|---------------|--|--------|
| | WGM701S # # A | WGM701 Spare Sensor, NW25KF | WG7SC |
| <u>Sensor Version</u> | | WGM701 Spare Sensor, NW40KF | WG7SD |
| S= Standard | | WGM701 Spare Sensor, 2 3/4 in. CF / NW40CF Conflat | WG7SF |
| <u>Collector</u> | | Spare Ionization Chamber | 002588 |
| H= High Current | | Sensor (anode) activation aid (set of 10 pcs) | 002587 |
| L = Low Current | | Tool set for removing/installing sensor activation aid | 002586 |
| <u>Fittings / Flanges</u> | | Centering ring with fine filter, NW25KF | 002585 |
| C= NW25KF | | | |
| D= NW40KF | | | |
| F= 2 3/4 in. CF / NW40CF Conflat® | | | |
| <u>Electrical Connector</u> | | | |
| A= 9-pin D-sub male | | | |

Example: WGM701SHDA (WGM701 with standard sensor, high current collector, NW40KF fitting, 9-pin D-Sub connector)

1.5 Options & Accessories

PS501-A

| | |
|----------------|---|
| Description: | Power supply |
| Compatibility: | Powers the WGM701 <i>Wasp™</i> vacuum gauge module |
| Power Input: | 100 - 240 Vac |
| Power Plug: | North American 115 Vac plug |
| Output: | 24 Vdc @ 750 mA (18 W) |
| Connector: | 9-pin D-sub female to mate with and power the WGM701 module |
| Cable length: | 6 ft. (2 m) |
| Note: | 9-pin D-sub connector backshell can be opened to enable connections to signals and relays |



2 Important Safety Information

InstruTech has designed and tested this product to provide safe and reliable service, provided it is installed and operated within the *strict safety guidelines provided in this manual*. **Please read and follow all warnings and instructions.**




To avoid serious injury or death, follow the safety information in this document. Failure to comply with these safety procedures could result in serious bodily harm, including death, and or property damage.


Failure to comply with these warnings violates the safety standards of installation and intended use of this instrument. InstruTech disclaims all liability for the customer's failure to comply with these instructions.


Although every attempt has been made to consider most possible installations, InstruTech cannot anticipate every contingency that arises from various installations, operation, or maintenance of the module. If you have any questions about the safe installation and use of this product, please contact InstruTech.

2.1 Safety Precautions - General

Hazardous voltages are present with this product during normal operation. The product should never be operated with the cover removed.

 **WARNING!** Do not modify this product or substitute any parts without authorization of qualified InstruTech service trained personnel. Return the product to an InstruTech qualified service and repair center to ensure that all safety features are maintained. Do not use this product if unauthorized modifications have been made.

 **WARNING!** Source power must be removed from the product prior to performing any servicing.

 **WARNING!** The gauge may only be connected to power supplies, instruments, or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.


After servicing this product, ensure that all safety checks are made by a qualified service person. When replacement parts are required, ensure that the parts are specified by InstruTech. Substitutions of non-qualified parts may result in fire, electric shock or other hazards. Use of unauthorized parts or modifications made to this product will void the warranty.


To reduce the risk of fire or electric shock, do not expose this product to rain or moisture. These products are not waterproof and careful attention must be paid to not spill any type of liquid onto these products. Do not use these products if they have been damaged. Immediately contact InstruTech to arrange return of the product if it is damaged.

Due to the possibility of corrosion when used in certain environmental conditions, it is possible that the product's safety could be compromised over time. It is important that the product be periodically inspected for sound electrical connections and equipment grounding. Do not use if the equipment grounding or electrical insulation has been compromised.

2.2 Safety Precautions - Service and operation

Ensure that the vacuum port on which the WGM701 is mounted is electrically grounded.

 **WARNING!** The power supply used in the Cold Cathode Gauge Module (WGM701) is subject to high voltages which could cause severe injury or death. In order to prevent electric shock and bodily harm, the user should wait 1 minute after power is removed before touching the WGM701 power supply components.

 **WARNING!** When the anode voltage is turned on and the sensor activated, 3,300 Vdc to 4,500 Vdc is present at the internal power supply and other components. DO NOT operate the WGM701 with the WGM701 enclosure removed. Contact with exposed electrical circuits in the WGM701 could result in death or serious injury.

Use an appropriate power source of 14.5 to 30 Vdc, 2 W minimum.

Turn off power to the unit before attempting to service the module.


Turn off power to the unit before detaching the electronics from the sensor for sensor replacement, sensor cleaning or bakeout purposes.

Turn off power to the unit if a cable or plug is damaged or the product is not operating normally according to this instruction manual. Contact qualified InstruTech service personnel for any service or troubleshooting condition that may not be covered by this instruction manual.


Do not use if the unit has been dropped or the enclosure has been damaged. Contact InstruTech for return authorization and instructions for returning the product to InstruTech for evaluation.

The most common cause of all vacuum gauge failures is contamination of the sensor. Noisy, abnormally low, or erratic readings and total gauge failure are possible indications of gauge contamination.

2.3 Electrical Conditions


 **WARNING!** When high voltage is present in any vacuum system, a life threatening electrical shock hazard may exist unless all exposed electrical conductors are maintained at earth ground potential. This applies to all products that come in contact with the gas contained in vacuum chambers. An electrical discharge within a gaseous environment may couple dangerous high voltage directly to any ungrounded conductor of electricity. A person could be seriously injured or killed by coming in contact with an exposed, ungrounded electrical conductor at high voltage potential. This condition applies to all products that may come in contact with the gas inside the vacuum chamber (vacuum/pressure containment vessel).

2.3.1 Proper Equipment Grounding

 **WARNING!** Hazardous voltages that could seriously injure or cause death are present in many vacuum processes. Verify that the vacuum connection port on which the gauge is mounted is electrically grounded. Consult a qualified Electrician if you are in doubt about your equipment grounding. Proper grounding of your equipment is essential for safety as well as intended operation of the equipment.

The WGM701 must be electrically connected to the grounded vacuum chamber. The connection must conform to the requirements of a protective connection according to EN 61010:


- VCR® connections fulfill this requirement.
- For gauges with a KF connection, use a conductive metallic clamping ring.

 **WARNING!** In order to protect personnel from electric shock and bodily harm, shield all conductors which are subject to potential high voltage electrical discharges in or around the vacuum system.


2.3.2 Electrical Interface and Control

It is the user's responsibility to ensure that the electrical signals from this product and any connections made to external devices, for example, relays and solenoids, are used in a safe manner. Always double check the system set-up before using any signals to automate your process. Perform a hazardous operation analysis of your system design and ensure safeguards and personnel safety measures are taken to prevent injury and property damage.


2.4 Overpressure and use with hazardous gases

 **WARNING!** Install suitable protective devices that will limit the level of pressure inside your vacuum chamber to less than what the vacuum chamber system components are capable of withstanding. For example, a quick-connect, O-ring compression fitting may forcibly release a mounted device from the vacuum chamber fitting with only a few psi over local uncorrected barometric (atmospheric) pressure.


In cases where an equipment failure could cause a hazardous condition, always implement fail-safe system operation. For example, use a pressure relief device in an automatic backfill operation where a malfunction could result in high internal pressures if the pressure relief device was not installed on the chamber.

 **WARNING!** Overpressure in the vacuum system > 14.5 psia (1 bar)


Injury caused by released parts and harm caused by escaping process gases can result if clamps are opened while the vacuum system is pressurized. Do not open any clamps while the vacuum system is pressurized. Use the type of clamps which are suited to overpressure.

 **WARNING!** Overpressure in the vacuum system > 29 psia (2.5 bar)

KF connections with elastomer seals (O-rings) cannot withstand such pressures. Process media can thus leak and possibly damage your health. Use O-rings provided with an outer centering ring.

 **CAUTION!** If the internal pressure of a vacuum measuring device is allowed to increase above local uncorrected barometric pressure (atmospheric pressure side), vacuum fittings may release and possible overpressure conditions may cause leaks that would allow the gas inside the tube to release into the atmosphere of the surrounding environment. Toxic, pyrophoric and flammable gases are examples of hazardous gases that if allowed to leak out of the vacuum/pressure containment vessel into the atmospheric environment, could cause bodily injury and possible damage to equipment. Never expose the vacuum measuring device internal volume to pressure above local atmospheric pressure when using hazardous gases.

2.5 Gas Dependency

 **WARNING!** The measurement value is gas dependent. The pressure reading applies to dry air, O₂, CO and N₂. For other gases, the measurements have to be corrected. Refer to [section 5](#) titled “Using the gauge with different gases” for more details.

3 Installation

3.1 Mechanical Installation

⚠ CAUTION! Dirt and damage can impair the function of the vacuum component. Take appropriate measures to ensure cleanliness and prevent damage. Touching the product or parts with bare hands increases the desorption rate. Always use clean, lint free gloves as well as clean tools when working with this product.

Mount the WGM701 as close as possible to the pressure you want to measure. Long or restricted, small diameter tubing will create a pressure difference between your process chamber and the gauge. This may cause a delay in response to pressure changes. Mounting the WGM701 too close to a gas source inlet may also cause measurement and control instability.

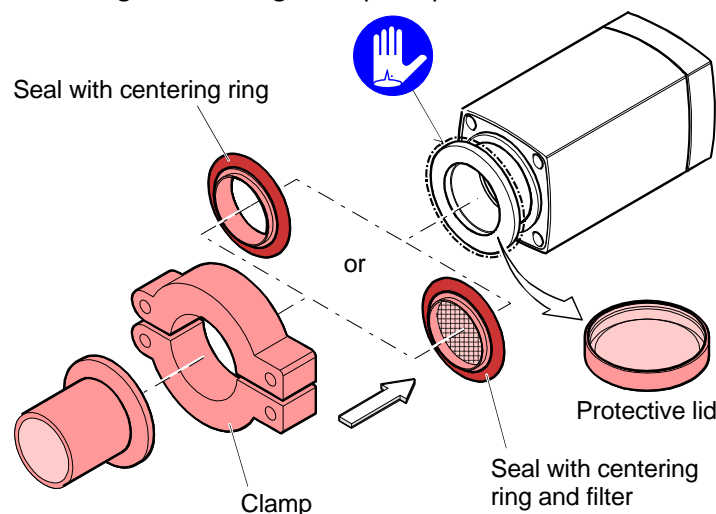
The WGM701 can be mounted in any orientation, however, if possible, mount the gauge with port down to help minimize the effect of any particles or condensation collecting in the gauge.

For electrical safety purposes the housing of the gauge must be grounded to the vacuum chamber. When using KF flanges, metal clamps must be used to ensure proper grounding. Do not attempt to modify your flange in order to use non-metallic-type flange clamps.

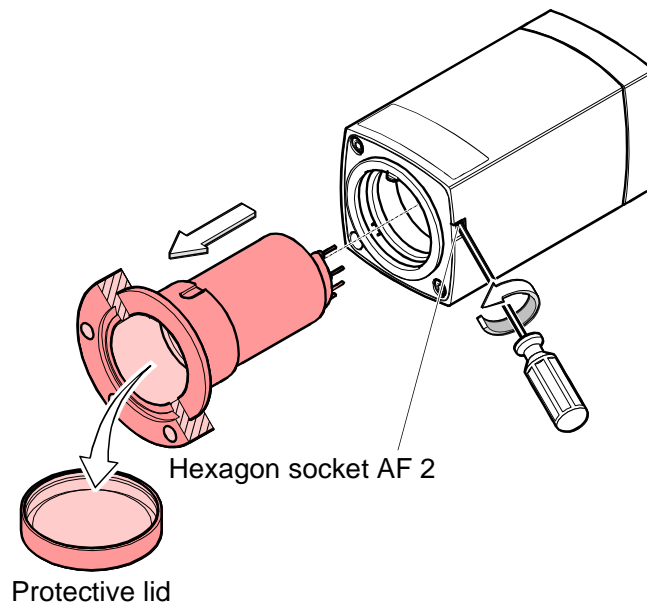
Use all metal vacuum fittings with metal seals when operating pressures are expected to be below 1.00×10^{-7} Torr (1.33×10^{-7} mbar, 1.33×10^{-5} Pa).

For potentially contaminating applications and to protect the measurement system against contamination, installation of the optional seal with centering ring and filter is recommended. See [section 1.4](#) for accessories part numbers.

Remove the protective lid and install the product to the vacuum system following manufacturer's recommendations for different flanges and fittings. Keep the protective lid for future maintenance.



When making a CF flange connection, it may be advantageous to temporarily remove the electronics unit as shown below.



⚠ WARNING! Helium may cause electric arcing with detrimental effects on the electronics of the product. Before performing any leak tests disconnect power and remove the electronics unit.

3.2 Electrical Installation

3.2.1 Grounding

⚠ WARNING! Be sure the vacuum gauge and the rest of your vacuum system are properly grounded for safety as well as intended operation of the equipment. When using KF flanges, metal clamps must be used to ensure proper grounding.

⚠ WARNING! The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.

Ground loops, differences of potential, or EMC problems may affect the measurement signal. For optimum signal quality, please do observe the following:

- Use an overall metal braided shielded cable. The connector must have a metal case.
- Connect the supply common with protective ground directly at the power.
- Use differential measurement input (signal common and supply common conducted separately).
- Potential difference between supply common and housing ≤ 16 V (overvoltage protection).

3.2.2 Connector

Good, recommended practice is to remove power from any cable prior to connecting or disconnecting it.

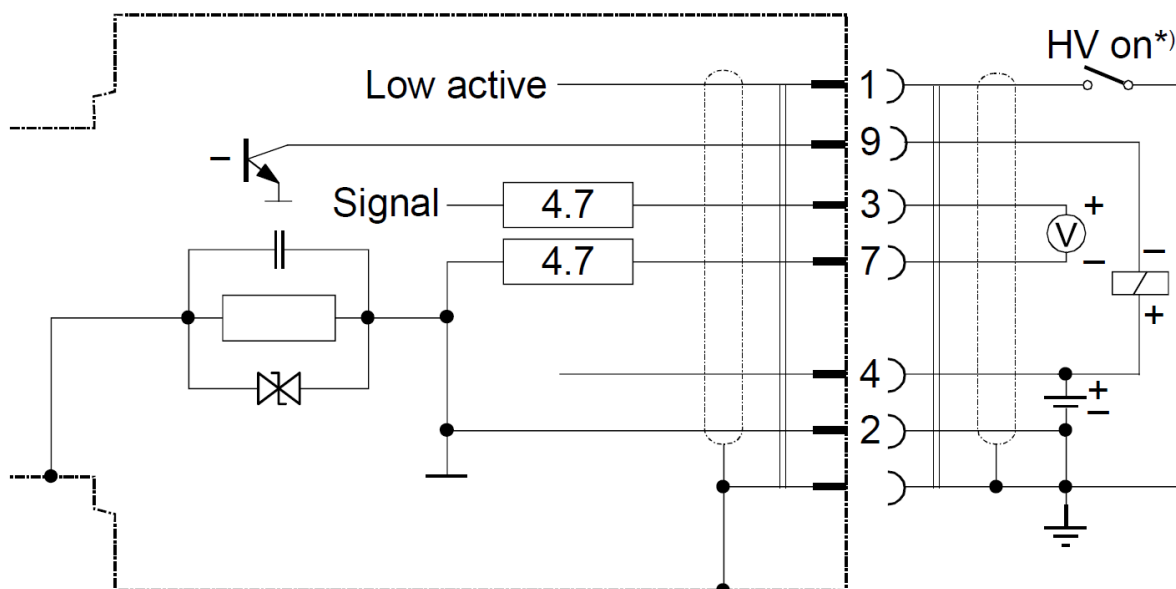
1) The WGM701 is provided with one 9-pin D-sub male connector used for the I/O interface. Fabricate a cable to connect to the vacuum gauge as shown below:

3.2.3 Connector pin-out

9-pin D-sub (DE-9P) male connector (used for analog output and digital I/O)

| PIN NUMBER | PIN DESCRIPTION |
|------------|--|
| 1 | Not assigned |
| 2 | Power common GND |
| 3 | Analog output (Log-Linear 0.5 to 7 Vdc, 0.5 V/decade) |
| 4 | Power Input (14.5 to 30 Vdc, 2 W) protected against power reversal and transient over-voltages |
| 5 | Not assigned |
| 6 | Do not connect |
| 7 | Analog output common (Do not use for sensor enable ground) |
| 8 | Not assigned |
| 9 | Cold cathode sensor on/off status is determined by open collector transistor (ground emitter) rated at 30 V max. V_{CE} , 100 mA max. I_C . Transistor off = Sensor off, Transistor on = Sensor on |

Wiring Diagram



* Does not apply to WGM701. Pin 1 is not assigned. Digital input to gauge is not required as high voltage for cold cathode sensor is turned on automatically once measurements from pirani has indicated low enough pressure level.

4 Setup and Operation

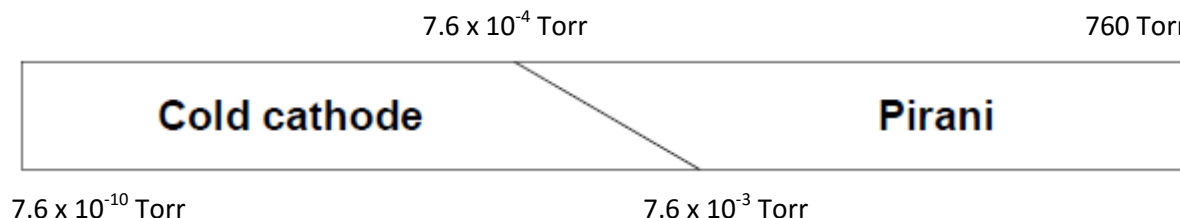
4.1 Gauge start up and operation

Read this user manual in its entirety before operating the instrument.

The signal output is available when power is applied to the gauge. Allow for a stabilizing time of approx. 10 min. Once the gauge has been switched on, it can remain in operation continuously regardless of the pressure.

Connect power to the WGM701 using the designated pins 4 and 2 of the 9-pin D-sub connector. Alternatively, you can power the device by connecting InstruTech's PS501-A power supply to the connector.

The gauge consists of two separate measuring systems (Pirani and cold cathode system based on the inverted magnetron principle). The two sensors are designed to operate as one combined measuring unit. The optimum measuring configuration for the particular pressure range, in which measurement is performed, is shown below:



4.2 Cold Cathode sensor activation delay

An ignition delay occurs when cold cathode gauges are switched on. The delay time increases at low pressures and is typically:

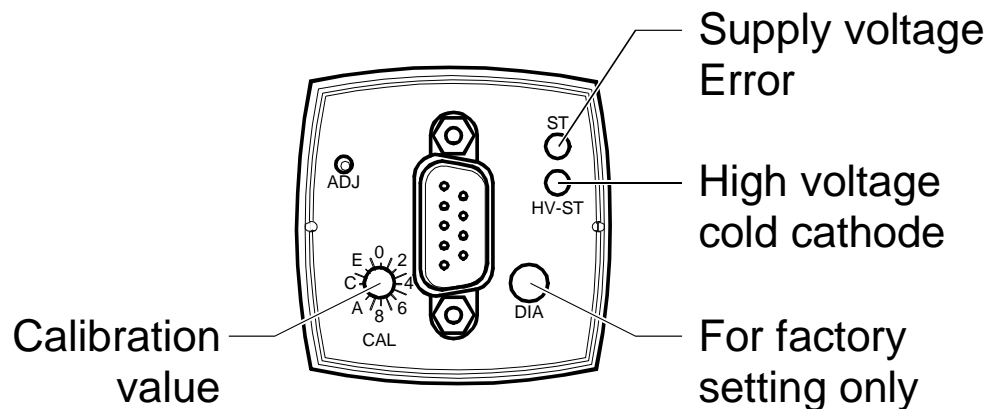
| | |
|--|--------------|
| $7.60 \times 10^{-6} \dots 7.60 \times 10^{-3}$ Torr | < 1 second |
| $7.6 \times 10^{-8} \dots 7.6 \times 10^{-6}$ Torr | < 20 seconds |
| $3.75 \times 10^{-9} \dots 7.6 \times 10^{-8}$ Torr | < 2 minutes |
| < 3.75×10^{-9} Torr | < 20 minutes |

As long as the cold cathode measuring circuit has not ignited, the output signal is provided by the Pirani measuring circuit.

If the cold cathode is activated at a pressure less than 2.25×10^{-10} Torr, the gauge cannot recognize whether the cold cathode sensor has ignited.

Once flanged on, permanently leave the gauge in the operating mode irrespective of the pressure.

4.3 Status Indication



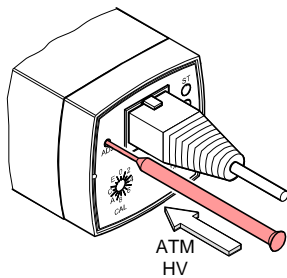
| LED | | Condition |
|-----------------|-----------------|---|
| <ST> | <HV-ST> | |
| off | off | No supply voltage |
| lit solid green | off | Supply voltage = ok, Pirani active, no high voltage in the measuring chamber |
| lit solid green | blinking green | Supply voltage = ok, pressure in the cold cathode range, cold cathode has not ignited |
| lit solid green | lit solid green | Cold cathode has ignited |
| blinking red | off | EEPROM error |

4.4 Gauge Adjustment

- The cold cathode measuring circuit, which is dominant for low pressures ($< 7.6 \times 10^{-4}$ Torr), is factory-calibrated and cannot be adjusted. The HV (zero) adjustment of the Pirani measuring circuit is carried out automatically by the gauge itself at pressures less than 7.6×10^{-6} Torr. A new zero point is saved in a non-volatile memory every 15 minutes. Any zero adjustment has a negligible effect on the pressure range between approx. 7.6×10^{-3} Torr and 7.5×10^2 Torr.
- The characteristic curve of the Pirani can be affected if used under different climatic conditions, through extreme temperatures, aging or contamination. If necessary the user can manually readjust the Pirani gauge as described below:

4.4.1 Pirani ATM (span) adjustment

- ❶ If you are using a seal with centering ring and filter, check that they are clean or replace them if necessary.
- ❷ Put the gauge into operation and operate it at atmospheric pressure for at least 10 minutes.
- ❸ Press the <ADJ> button with a pin (max. $\varnothing 1.1$ mm) to set the ATM. The Pirani sensor is adjusted to 760 Torr (duration ≈ 5 s).



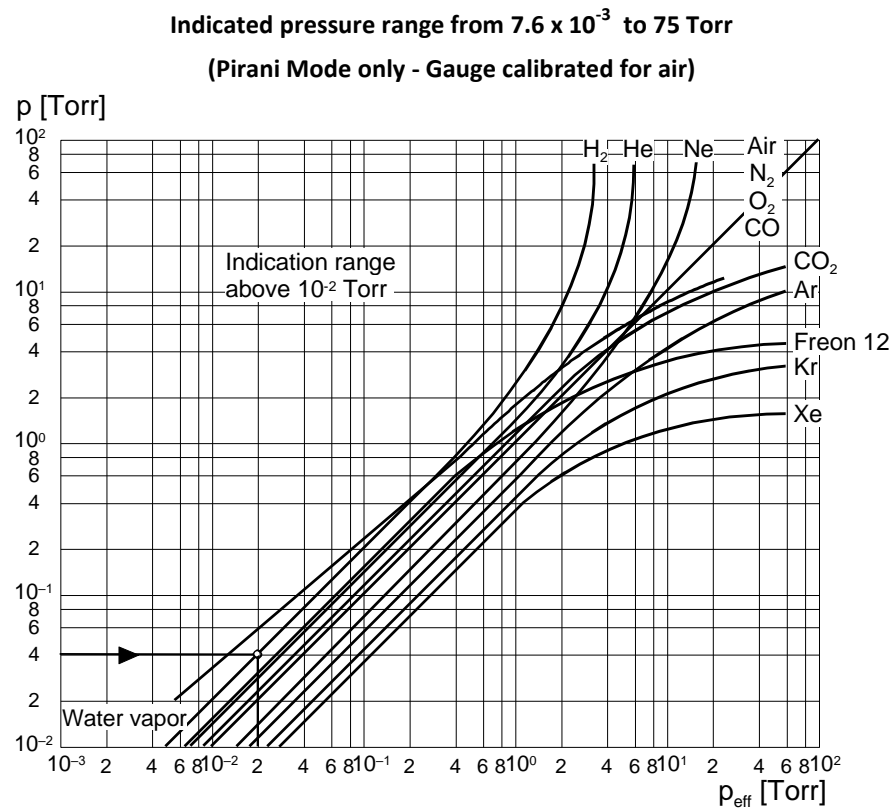
- ✓ If the output from the gauge corresponds to 760 Torr, the ATM adjustment has been successful. Otherwise, repeat the adjustment procedure.

4.4.2 Pirani HV (zero) adjustment

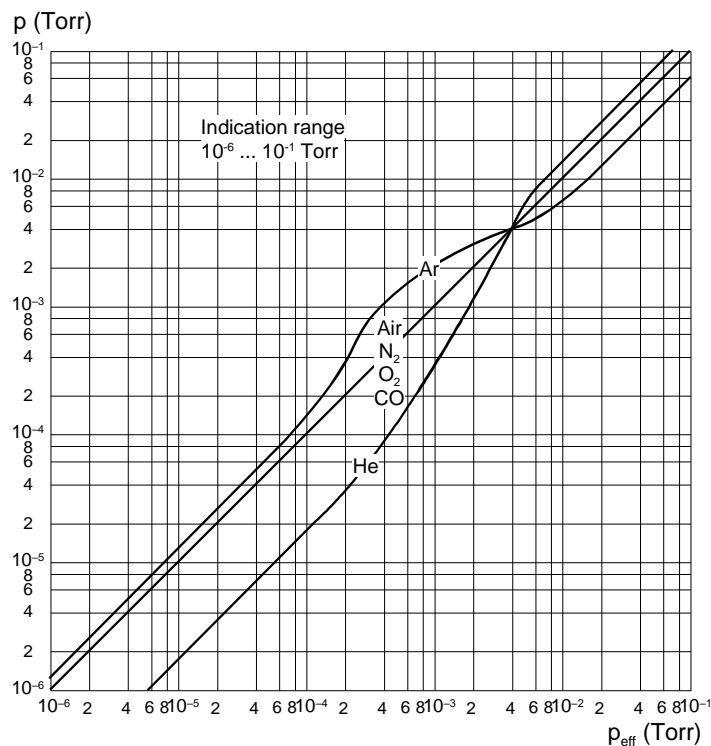
- For adjusting the zero, operate the gauge under the same constant ambient conditions and in the same normal mounting orientation.
- ❶ Evacuate the vacuum system to a pressure less than 7.6×10^{-6} Torr and wait at least 2 minutes.
 - ❷ Press the <ADJ> button with a pin and the HV adjustment is carried out (duration ≈ 5 s).
- ✓ If the output from the gauge corresponds to 7.6×10^{-6} Torr, the adjustment has been successful. Otherwise, repeat the adjustment procedure.

5 Using the gauge with different gases

The measurement value is gas dependent. The pressure reading applies to dry air, O₂, CO and N₂. For other gases, the measurements have to be corrected.



Indicated pressure range from 7.60×10^{-7} to 7.6×10^{-2} Torr
(Gauge calibrated for air)



Indication range below 7.6×10^{-6} Torr

In the range below 10^{-5} the pressure indication is linear. For gases other than air, the pressure can be determined by means of the following conversion formula:

$$p_{\text{eff}} = K \times \text{indicated pressure}$$

| | | |
|--------|---|-----|
| where: | Gas type | K |
| | Air (N_2 , O_2 , CO) | 1.0 |
| | Xe | 0.4 |
| | Kr | 0.5 |
| | Ar | 0.8 |
| | H_2 | 2.4 |
| | Ne | 4.1 |
| | He | 5.9 |

These conversion factors are average values.

Example: If the gas in use is argon (Ar) and the WGM701 indicates a measured pressure of $1.00 \times 7.6 \times 10^{-6}$ Torr,
 $p_{\text{eff}} = 0.8 \times 7.60 \times 10^{-6} = 8 \times 10^{-7}$ Torr true pressure of **argon** gas

A mixture of gases and vapors is often involved. In this case, accurate determination is only possible with a partial pressure measurement instrument, e.g. a quadrupole mass spectrometer.

6 Analog Output

The WGM701 provides a 0.5 to 7 Vdc, 0.5 V/decade log-linear signal proportional to pressure.

A) The log-linear output signal and pressure are related by the following formulas when units of measurement is in **Torr** and **mbar**:

$$P = 10^{(\text{volts} - 5.5)/(0.5)} \quad V = ((0.5 \times \log_{10}(P)) + 5.5)$$

Where P is the pressure in Torr or mbar, and V is the output signal in volts.

B) The log-linear output signal and pressure are related by the following formulas when units of measurement is in **pascals**:

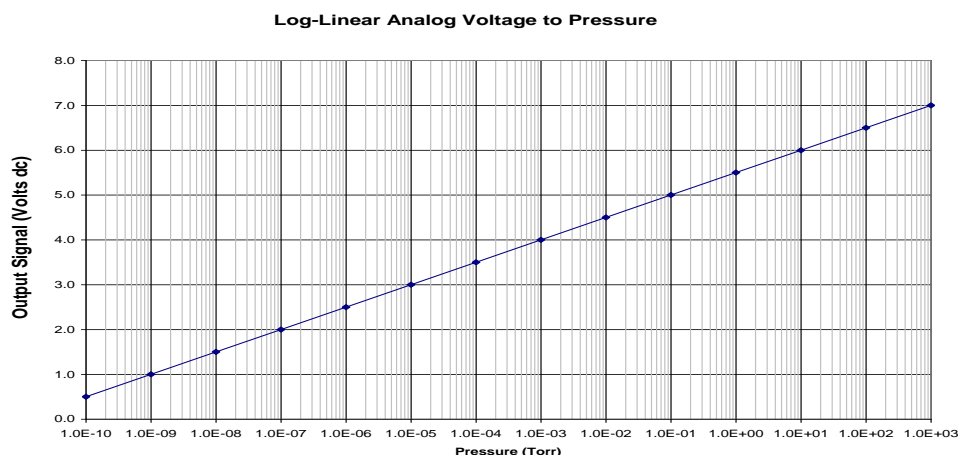
$$P = 10^{(\text{volts} - 4.5)/(0.5)} \quad V = ((0.5 \times \log_{10}(P)) + 4.5)$$

Note: The output voltage is +10 Vdc when pressure is in the cold cathode measurement but the cold cathode sensor has not ignited.

Log-Linear Analog Output (N₂ /air only)

| Pressure (Torr) | Voltage |
|-----------------|---------|
| 1.0E-09 | 1.0 |
| 1.0E-08 | 1.5 |
| 1.0E-07 | 2.0 |
| 1.0E-06 | 2.5 |
| 1.0E-05 | 3.0 |
| 1.0E-04 | 3.5 |
| 1.0E-03 | 4.0 |
| 1.0E-02 | 4.5 |
| 1.0E-01 | 5.0 |
| 1.0E+00 | 5.5 |
| 1.0E+01 | 6.0 |
| 1.0E+02 | 6.5 |
| 7.6E+02 | 6.94 |
| See Note | ≥10 |

The following chart shows the graphical results of table and formulas above for pressure measurements in Torr. Pressure is plotted on the X-axis with a log scale; the output signal is plotted on the Y-axis on a linear scale.



7 Service

7.1 Calibration

The gauge is factory-calibrated and the pressure reading applies to dry air, O₂, CO and N₂. For other gases, the readings have to be corrected as described in [section 5](#).

7.2 Maintenance

In general, under clean operating conditions, maintenance is not required for the WGM701. In case of a defect :

- Only replace the ionization chamber and ignition aid, or
- Replace the measuring chamber (spare sensor)

InstruTech assumes no liability and the warranty becomes null and void if any repair work other than replacing the sensor activation (ignition) aid, measuring or ionization chambers is carried out by the end-user or third parties.

7.3 Contamination

The most common cause of all vacuum gauge failures is contamination of the sensor. Noisy or erratic readings, gauge failures due to contamination or wear and tear, as well as expendable parts (e.g. ionization chamber, ignition aid) are not covered by the warranty.

Gauge contamination is influenced by the process media used as well as any existing or new contaminants and their respective partial pressures. Continuous operation in the range of 7.6×10^{-5} to 7.6×10^{-3} Torr can cause severe contamination as well as reduced up-time. Contamination can to a certain extent be reduced by:

- Geometric protection (e.g. screenings, elbows) against particles that spread rectilinearly
- Mounting the flange of the gauge at a place where the partial pressure of the pollutants is particularly low.

Special precautions are required for vapors deposited under plasma (of the cold cathode measuring system). While vapors occur it may even be necessary to:

- Temporarily switch off the gauge.
- Temporarily seal off of the gauge from the vacuum chamber using a valve.

If the pressure reading is too high when operating in the pressure range of 7.6×10^{-4} to 7.6×10^{-2} Torr, the Pirani sensor is most likely contaminated. See section [4.4.1](#) and [4.4.2](#) for readjusting the Pirani.

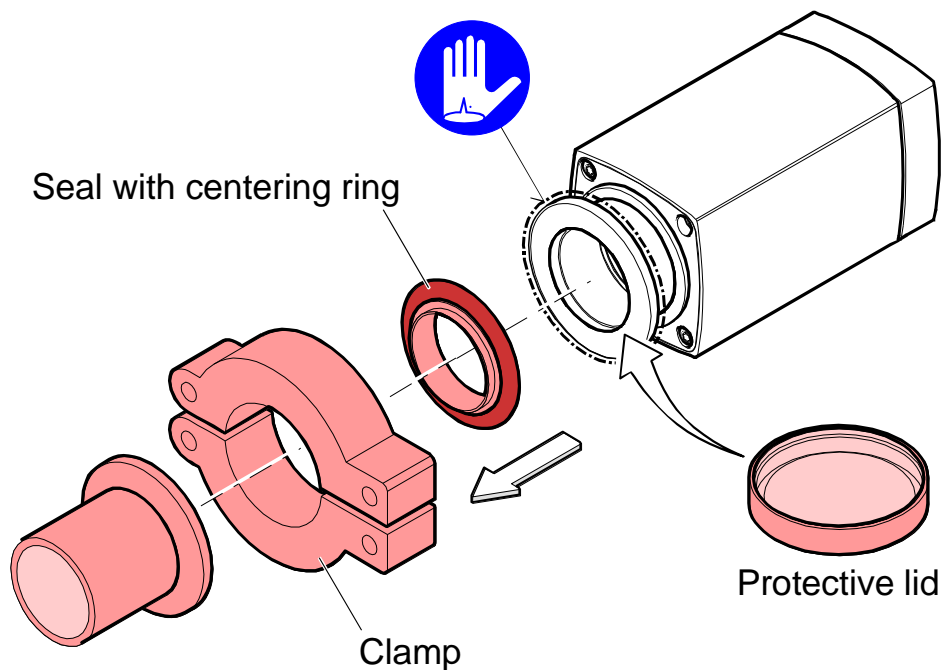
If the pressure reading is too low when operating in the pressures below 7.6×10^{-3} Torr, the cold cathode sensor is most likely contaminated. In case of severe contamination, instabilities can occur (layers of the measuring chamber peel off). Contamination due to isolating layers can even lead to a complete failure of the discharge. When using the gauge in gases containing contaminants, periodic replacement of ionization or measuring chamber maybe required. See the following sections for performing such task.

7.4 Removing the gauge from service

⚠ WARNING! Contaminated parts can be detrimental to health. Before beginning work, find out whether parts are contaminated and adhere to the relevant regulations and precautions for handling contaminated parts.

⚠ CAUTION! Dirt and damage impair the function of the vacuum component. Take appropriate measures to ensure cleanliness and prevent damage. Touching the product or parts with bare hands increases the desorption rate. Always use clean, lint free gloves as well as clean tools when working with this product.

- 1) Vent the vacuum system and turn off power to the gauge.
- 2) Unplug the cable and remove the gauge from the chamber.
- 3) Re-install the protective lid.

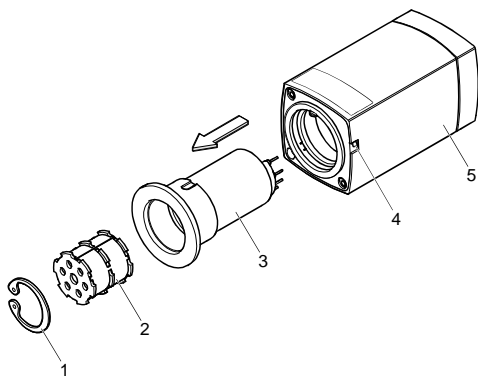


7.4.1 Inspecting the sensor

If the cause of the fault is suspected to be in the measuring chamber (sensor), the following checks can be made with an ohmmeter.

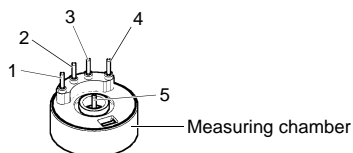
Tools / Material Required

- Allen wrench AF 2
- Pliers for retaining ring
- Ohmmeter



- 1 Unfasten the hexagon socket set screw (4) and remove the complete measuring chamber (3) from the electronics unit (5).
- 2 Remove the retaining ring (1) as well as the ionization chamber (2) from the measuring chamber (3).
- 3 Check the ionization chamber and the measuring chamber for contamination:
 - Ionization chamber is contaminated only: Replace ionization chamber.
 - Measuring chamber is severely contaminated: Replace complete measuring chamber.
- 4 Using an ohmmeter, make following measurements on the contact pins.

| Measurement between pins | | | Possible cause |
|--------------------------|----------|--------------|--|
| 5 + measuring chamber | ∞ | $\ll \infty$ | Contamination, short circuit cold cathode sensor |

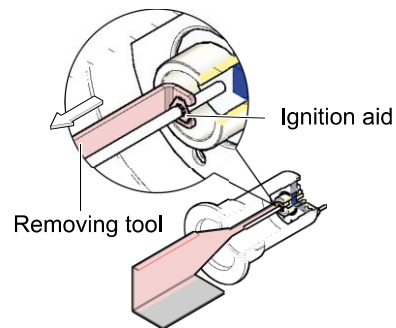


Replace measuring chamber if defective.

- 5 It is recommend to perform a leak test (leak rate $<1 \times 10^{-9}$ mbar l/s).

7.4.2 Replacing the ionization chamber and sensor activation aid

- ❶ Due to contamination remove the ignition aid with the removing tool.



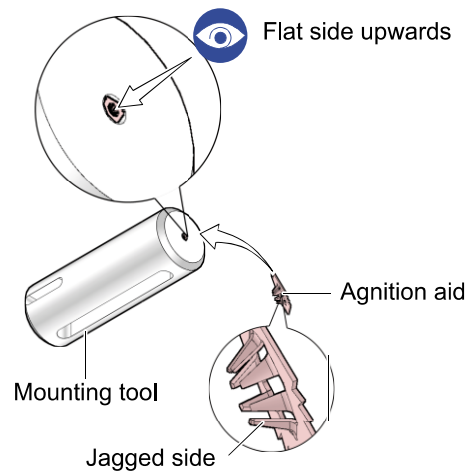
- ❷ We recommend to rub the inside walls of the measuring chamber up to the groove for the retaining ring to a bright finish using a polishing cloth.



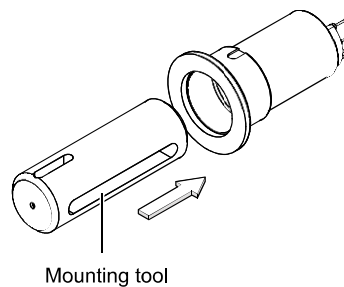
CAUTION!

- The sealing surfaces must only be worked concentrically.
- Do not bend the anode.

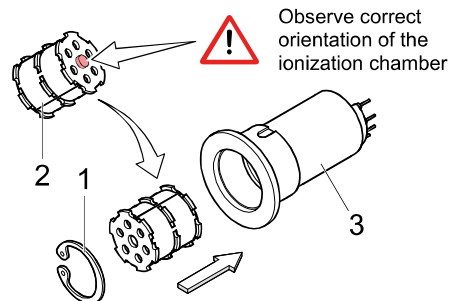
- ❸ Insert the new ignition aid into the mounting tool with the jagged side downwards ...



... and slide it onto the anode until the stop position is reached.

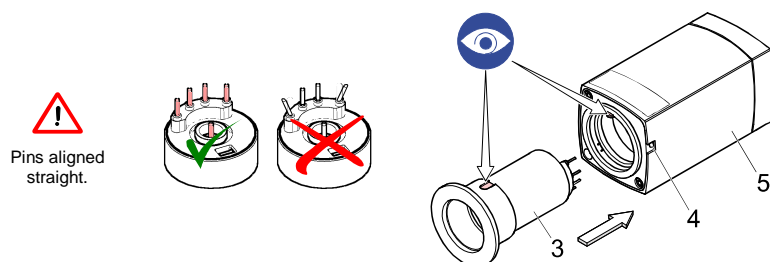


- ④ Slide a new ionization chamber (2) into the measuring chamber (3) until the mechanical stop is reached and mount the retaining ring (1).



- ⑤ It is recommended to perform a leak test (leak rate $<1 \times 10^{-9}$ mbar l/s).

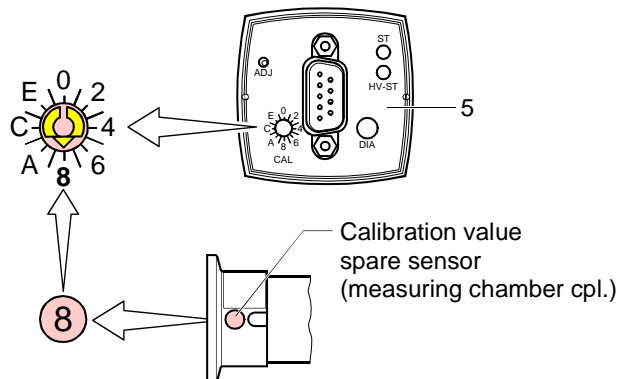
- ⑥ Carefully slide the measuring chamber (3) (clean or new) into the electronics unit (5) until the mechanical stop is reached.



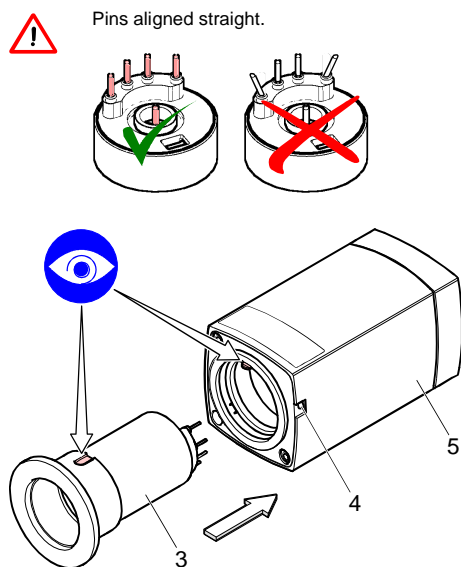
- ⑦ Fasten the measuring chamber (3) by means of the hexagon socket set screw (4).

7.4.3 Replacing the measuring chamber

- ❶ Set the calibration value of the spare sensor with the <CAL> switch on the electronics unit (5).



- ❷ Carefully slide the measuring chamber (3) into the electronics unit (5) until the mechanical stop is reached.



- ❸ Fasten the measuring chamber (3) by means of the hexagon socket set screw (4).
- ❹ Perform an ATM and HV adjustment of the Pirani using the <ADJ> button. See sections [4.4.1](#) and [4.4.2](#).
- ❺ It is recommend to perform a leak test (leak rate $<1 \times 10^{-9}$ mbar l/s) and a function test of the gauge on the leak detector.

⚠ WARNING! Helium may cause electric arcing with detrimental effects on the electronics of the product. Before performing any leak tests disconnect power and remove the electronics unit.


7.5 Troubleshooting

In case of an error, it may be helpful to just turn off the mains supply and turn it on again after 5 seconds.

| Problem | LED <ST> | LED <HV-STD> | Status Signal | Possible Cause | Possible Solution |
|--|---|--------------------|------------------|--|--|
| No signal output | off | off | off | No supply voltage | Turn on power supply |
| Measuring signal unstable | lid solid green | lid solid green | on | Gauge contaminated | Replace ionization chamber or measuring chamber |
| Signal output does not drop under below 10 V | lid solid green | blinking green | off | Gas discharge has not ignited. | Wait, until the gas discharge has ignited (= 5 minutes at a pressure of 7.6×10^{-10} Torr) |
| Signal output continually > 5.6 V | lid solid green | off | off | Pirani zero point shift | Perform a Pirani HV adjustment via ADJ button |
| Signal output continually > 9.5 V | lid solid red blinking red | off off | off off | Pirani defective EEPROM error. | Replace the measuring chamber Switch the gauge off and on again after 5 s Replace the gauge |
| Signal continually at approx. 3.8×10^{-5} Torr | lid solid green | lid solid green | on | Measuring chamber severely contaminated | Replace the measuring chamber |

8 Factory Service and Support

If you need help setting up, operating, troubleshooting, or obtaining a return materials authorization number (RMA number) to return the module for diagnosis, please contact us during normal business hours (8:00am to 5:00pm Mountain time) Monday through Friday, at 303-651-0551. Or e-mail us at support@instrutechinc.com.

 **WARNING!** Contaminated products (e.g. radioactive, toxic, caustic or microbiological hazard) can be detrimental to health and environment. Products returned to InstruTech should be free of harmful substances.

For the safety of our employees, you must download, complete and submit a material disclosure form from our website at www.instrutechinc.com. Please use this form to provide a history of the product detailing what gases have been used. We cannot accept products that have been exposed to hazardous materials.

9 Warranty

SELLER warrants that its products are free of defects in workmanship and material and fit for the uses set forth in SELLER's catalog or product specifications, under the normal use and service for which they are intended.

The entire warranty obligation of SELLER is for the repair or replacement, at SELLER's option, of products or parts (examination of which shall disclose to SELLER's satisfaction that it is defective) returned, to SELLER's plant, properly identified within twenty four (24) months (unless otherwise noted) after the date of shipment from InstruTech Plant. BUYER must obtain the approval of SELLER and a return authorization number prior to shipment.

Alteration or removal of serial numbers or other identification marks renders this warranty void. The warranty does not apply to products or components which have been abused, altered, operated outside of the environmental specifications of the product, improperly handled or installed, or units which have not been operated in accordance with SELLER's instructions. Furthermore the warranty does not apply to products that have been contaminated (user assumes the responsibility in conjunction with the process media used), or when the product or part is damaged during the warranty period due to causes other than ordinary wear and tear to the product including, but not limited to, accidents, transportation, neglect, misuse, use of the product for any purpose other than that for which it was designed.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY EXTENDS ONLY IN FAVOR OF THE ORIGINAL BUYER. THE BUYER'S SOLE REMEDY SHALL BE THE REPAIR OR REPLACEMENT, AS IS EXPRESSLY PROVIDED HEREIN, OF ANY WARRANTED DEFECTIVE PRODUCT OR PART, AND UNDER NO CIRCUMSTANCE SHALL SELLER BE LIABLE TO BUYER OR ANYONE ELSE FOR ANY CONSEQUENTIAL DAMAGES TO PERSONS OR PROPERTY, FOR INCIDENTAL DAMAGES OR LOSS OF TIME, FOR ANTICIPATED OR LOST PROFITS, OR ANY OTHER LOSS INCURRED BY THE BUYER RELATED TO THE PRODUCT COVERED BY THIS WARRANTY. THIS EXCLUSIVE REMEDY SHALL NOT BE DEEMED TO HAVE FAILED OF ITS ESSENTIAL PURPOSE SO LONG AS SELLER IS WILLING AND ABLE TO REPAIR OR REPLACE DEFECTIVE PARTS IN THE PRESCRIBED MANNER. THIS LIMITED WARRANTY MAY NOT BE MODIFIED BY SELLER UNLESS SUCH MODIFICATION OR WAIVER IS IN WRITING, EXECUTED BY AN AUTHORIZED OFFICER OF SELLER.



InstruTech®

1475 S. Fordham St.
Longmont, CO 80503
USA

Phone +1-303-651-0551

Fax +1-303-678-1754

E-mail info@instrutechinc.com
www.instrutechinc.com