



**Cold Cathode Ionization Vacuum Gauge  
CCM502 Module  
*The Hornet™***



**User Manual**

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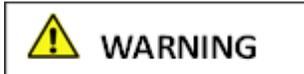
**Important User Information** There are operational characteristic differences between solid state equipment and electromechanical equipment. Because of these differences, and because there are a variety of uses for solid state equipment, all persons that apply this equipment must take every precaution 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.

No patent liability is assumed by InstruTech with respect to use of information circuits, equipment, or software described in this manual.

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

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 N<sub>2</sub>/air, etc.

The InstruTech® CCM502 Hornet™ module provides the basic signal conditioning required to turn a cold cathode vacuum gauge into a complete measuring instrument. The module provides a log-linear analog output for the measured pressure and requires a digital input to activate the sensor. Additionally, the instrument provides a sensor on/off status using an open collector transistor output as well as a status LED. The measurement range for the CCM502 cold cathode ionization gauge is  $7.6 \times 10^{-10}$  to  $7.6 \times 10^{-3}$  Torr.

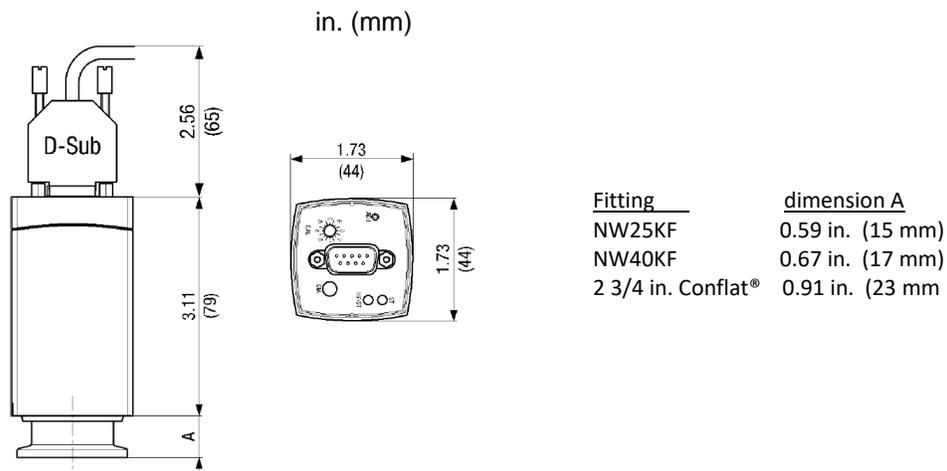
## 1.2 Specifications

measurement range	7.6 x 10 <sup>-10</sup> to 7.6 x 10 <sup>-3</sup> Torr / 1 x 10 <sup>-9</sup> to 1 x 10 <sup>-2</sup> mbar / 1 x 10 <sup>-7</sup> to 1 Pa	
accuracy - N2 (typical)	7.6 x 10 <sup>-9</sup> to 7.6 x 10 <sup>-3</sup> Torr: ± 30% of reading	
repeatability - (typical)	7.6 x 10 <sup>-9</sup> to 7.6 x 10 <sup>-3</sup> Torr: ± 5% of reading	
materials exposed to gases	anode: molybdenum    others: Ni alloy, Al <sub>2</sub> O <sub>3</sub> , stainless steel, glass	
internal gauge volume	1.391 in <sup>3</sup> (22.8 cm <sup>3</sup> )	
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)		
	7.6x10 <sup>-8</sup> ... 7.6 x10 <sup>-3</sup> Torr	0 to 95% relative humidity, non-condensing
	7.6x10 <sup>-9</sup> ... 7.6 x10 <sup>-3</sup> 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	
mounting orientation	any	
input signal	sensor enable (anode voltage turned on) is set by continuity to ground	
analog output	log-linear 0 to 8 Vdc, 1 V/decade	
output impedance	2 x 4.7 Ω, short-circuit proof	
load impedance	≥10 kΩ, short-circuit proof	
error signal	analog output switches to ≥ 10 V	
response time		
	p = 7.6 X 10 <sup>-9</sup> Torr	~1 sec
	p > 7.6 X 10 <sup>-7</sup> Torr	<100 msec
sensor status output	sensor on/off status is determined by open collector transistor (ground emitter) rated at 30 V max. V <sub>CE</sub> , 100 mA max. I <sub>C</sub> . Transistor off = Sensor off, Transistor on = Sensor on	
sensor status indication on gauge	sensor ON/OFF status indication via LED	

input power <sup>(1)</sup>	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	≤ 1AT
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: ≤ 100 μA high current collector version: ≤ 500 μA
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

<b>CCM502 Part Number</b>	<b>Spare Parts / Accessories Part Numbers</b>
<p style="text-align: center;">CCM502 S # # A</p> <p><b>Sensor Version</b> S= Standard</p> <p><b>Collector</b> H= High Current L = Low Current</p> <p><b>Fittings / Flanges</b> C= NW25KF D= NW40KF F= 2 3/4 in. CF / NW40CF Conflat®</p> <p><b>Electrical Connector</b> A= 9-pin D-sub male</p>	<p>CCM502 Spare Sensor, NW25KF                    CC5SC</p> <p>CCM502 Spare Sensor, NW40KF                    CC5SD</p> <p>CCM502 Spare Sensor, 2 3/4 in. CF / NW40CF Conflat    CC5SF</p> <p>Spare Ionization Chamber                            002588</p> <p>Sensor (anode) activation aid (set of 10 pcs)            002587</p> <p>Tool set for removing/installing sensor activation aid    002586</p> <p>Centering ring with fine filter, NW25KF                002585</p>

Example: CCM502SHDA (CCM502 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 CCM502 *Hornet™* 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 CCM502 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 CCM502 is mounted is electrically grounded.

Do not turn on the anode voltage and try to activate the sensor when pressure exceeds  $7.60 \times 10^{-3}$  Torr.

 **WARNING!** The power supply used in the Cold Cathode Gauge Module (CCM502) 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 CCM502 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 CCM502 with the CCM502 enclosure removed. Contact with exposed electrical circuits in the CCM502 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 bake-out 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 ion 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 CCM502 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, O<sub>2</sub>, CO and N<sub>2</sub>. For other gases, the measurements have to be corrected. Refer to [section 5](#) titled “Using the gauge with different gases” for a 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 CCM502 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 CCM502 too close to a gas source inlet may also cause measurement and control instability.

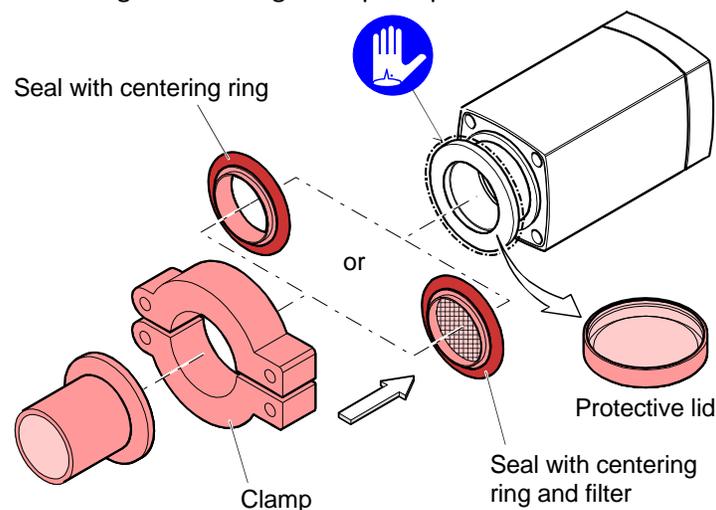
The CCM502 can be mounted in any orientation, however, if possible, mount the gauge with port down to help minimize the effect of any particles or condensation collecting in the gauge.

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.

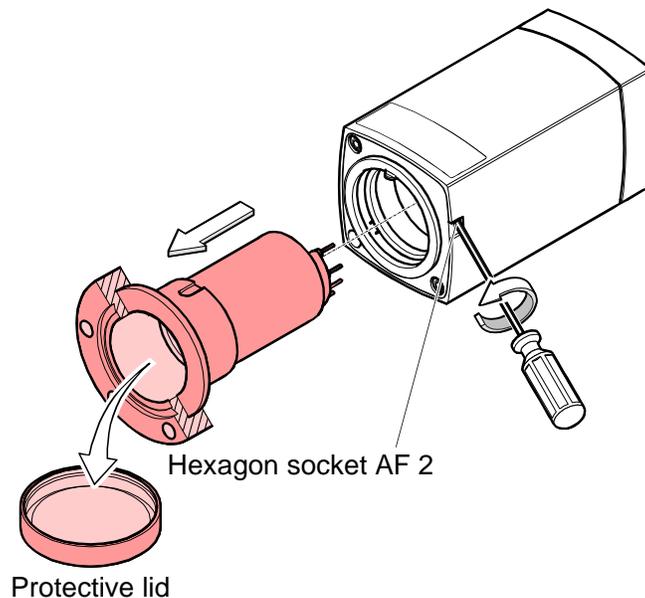
Use all metal vacuum fittings with metal seals when operating pressures are expected to be below  $1.00 \times 10^{-7}$  Torr ( $1.33 \times 10^{-7}$  mbar,  $1.33 \times 10^{-5}$  Pa).

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  $\leq 16$  V (overvoltage protection).

### 3.2.2 Connector

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

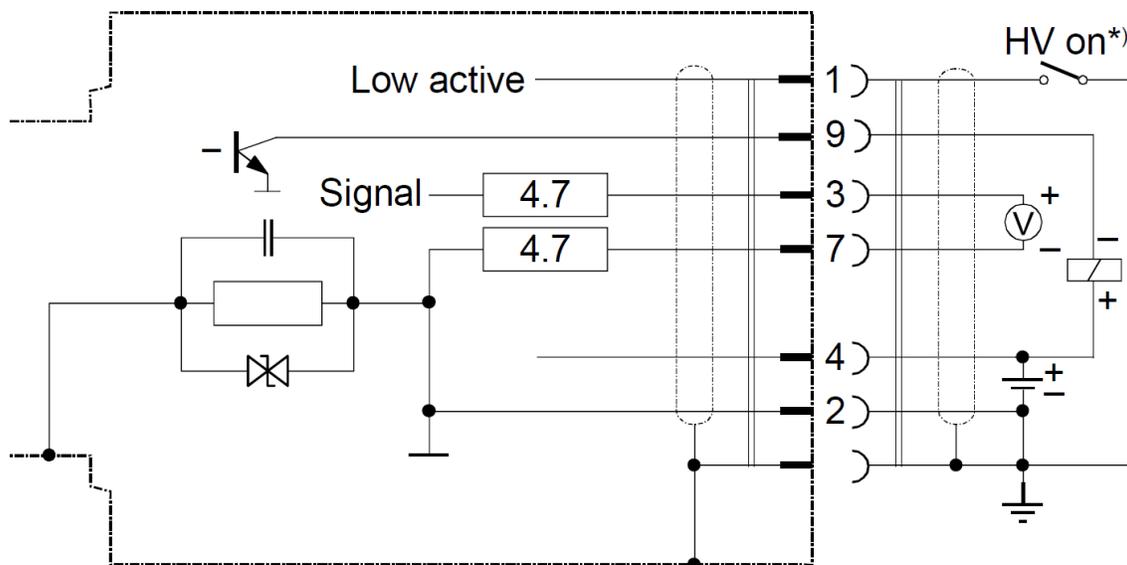
1) The CCM502 is provided with one 9-pin D-sub male connector used for the I/O interface. Fabricate a cable to connect to the vacuum gauge as shown below:

### 3.2.3 Connectors pin-out

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

PIN NUMBER	PIN DESCRIPTION
1	Sensor enable (HV On/Off) - Low active digital input The high voltage to anode is turned on and cold cathode sensor is activated by applying a continuous ground. The sensor is turned off by removing the ground. See <a href="#">section 4.3</a> for other methods of activating the sensor.
2	Power common GND
3	Analog output (Log-Linear 0 to 8 Vdc, 1 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	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



\* Applying continuous ground activates the cold cathode sensor.

## 4 Setup and Operation

### 4.1 Applying power

Connect power to the CCM502 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. Read this user manual in its entirety before activating the sensor. Refer to [section 4.3](#) titled "Activating the sensor" for further details.

### 4.2 Overpressure shut down

The user must turn off the high voltage to sensor before pressure rises above  $7.60 \times 10^{-3}$  Torr, otherwise the signal output will be erroneous with the sensor turned on above  $7.60 \times 10^{-3}$  Torr.

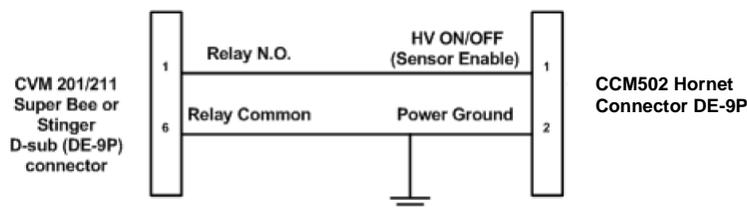
### 4.3 Activating the sensor

Before you turn on the anode high voltage and activate the sensor, make sure you understand all instructions and information provided in this manual. You can activate the sensor by one of the following methods:

1) Digital Input - See [section 3.2.3](#) Pin 1 (low active)

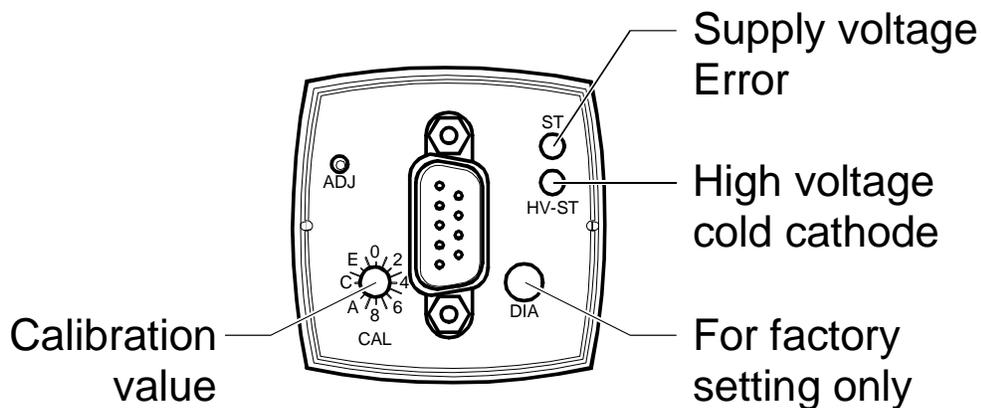
2) Using a Convection gauge relay to activate the cold cathode sensor

Because the useful operating range of the InstruTech's cold cathode CCM502 is from  $7.60 \times 10^{-10}$  Torr to  $7.6 \times 10^{-3}$  Torr, another vacuum gauge capable of measuring pressures above  $7.60 \times 10^{-3}$  Torr should be used to determine when to turn on the high voltage to anode voltage and activate the sensor. This can be implemented by using signals from another gauge such as an InstruTech convection enhanced Pirani (CG) gauge. For example, you may use an InstruTech CVM211 *Stinger™* or the CVM201 *Super Bee™* convection gauge to activate or deactivate the cold cathode sensor. The setpoint relay from the CVM211 or CVM201 can be physically wired to the cold cathode connector (see typical connection scheme below). The relays in the CVM211 or CVM201 can be configured to energize at the desired pressure at which the cold cathode sensor will be activated. The cold cathode sensor is activated (operational) by applying a continuous ground thru the relay connections of the CVM211 or CVM201. The sensor is deactivated when relay is de energized discontinuing the application of ground.



**⚠ CAUTION!** Activating the sensor at pressures higher than  $7.60 \times 10^{-3}$  Torr may result in contamination buildup and incorrect pressure measurement.

#### 4.4 Status Indication



LED		Condition
<ST>	<HV-ST>	
off	off	No supply voltage
lit solid green	off	Supply voltage = ok, 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

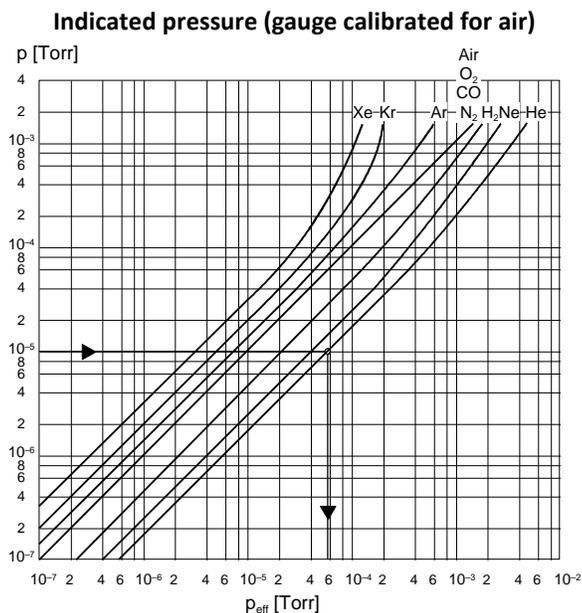
#### 4.5 Sensor activation delay

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
- $< 3.75 \times 10^{-9}$  Torr < 20 minutes

## 5 Using the gauge with different gases

The measurement value is gas dependent. The pressure reading applies to dry air, O<sub>2</sub>, CO and N<sub>2</sub>. For other gases, the measurements have to be corrected.



### Indication range below 1.0 x 10<sup>-5</sup> Torr

In the range below 10<sup>-5</sup> 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 <sub>2</sub> , O <sub>2</sub> , CO)	1.0
Xe	0.4
Kr	0.5
Ar	0.8
H <sub>2</sub>	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 CCM502 indicates a measured pressure of 7.6 x 10<sup>-6</sup> Torr,  
 $p_{\text{eff}} = 0.8 \times 7.6 \times 10^{-6} = 6 \times 10^{-6}$  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 CCM502 provides a 0 to 8 Vdc, 1 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**:

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

Where P is the pressure in Torr, 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 **mbar**:

$$P = 10^{(\text{volts} - 9.875)} \quad V = \log_{10}(P) + 9.875$$

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

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

$$P = 10^{(\text{volts} - 7.875)} \quad V = \log_{10}(P) + 7.875$$

Where P is the pressure in pascals, and V is the output signal in volts.

**The output voltage is +10 Vdc under the following conditions:**

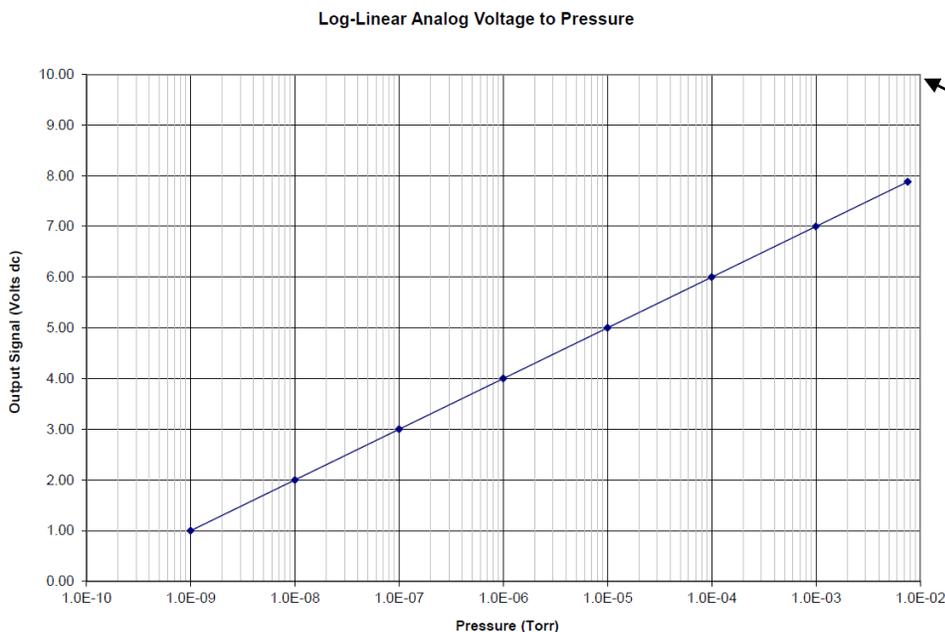
- 1) The sensor is turned off.
- 2) The gauge has not stabilized and no valid pressure signal is detected.

**Log-Linear Analog Output**

Pressure (Torr)	Voltage
1.00E-09	1.00
1.00E-08	2.00
1.00E-07	3.00
1.00E-06	4.00
1.00E-05	5.00
1.00E-04	6.00
1.00E-03	7.00
7.60E-03	7.88
Sensor is off	10.00

The following chart shows the graphical results of table and formulas above.

Pressure is plotted on the X-axis with a log scale; the output signal is plotted on the Y-axis on a linear scale.



+ 10 VDC  
See the [conditions](#) described above which cause the output to switch to +10VDC.

## 7 Service

### 7.1 Calibration

The gauge is factory-calibrated and the pressure reading applies to dry air, O<sub>2</sub>, CO and N<sub>2</sub>. 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 CCM502. 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  $7.6 \times 10^{-5}$  Torr ...  $7.6 \times 10^{-3}$  Torr can cause severe contamination as well as reduced up-time.

Contamination of the gauge generally causes a deviation of the measured values. In the low pressure range ( $p < 7.6 \times 10^{-4}$  Torr), the pressure indication is usually too low (as a consequence of the contamination of the cold cathode system). 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.

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.

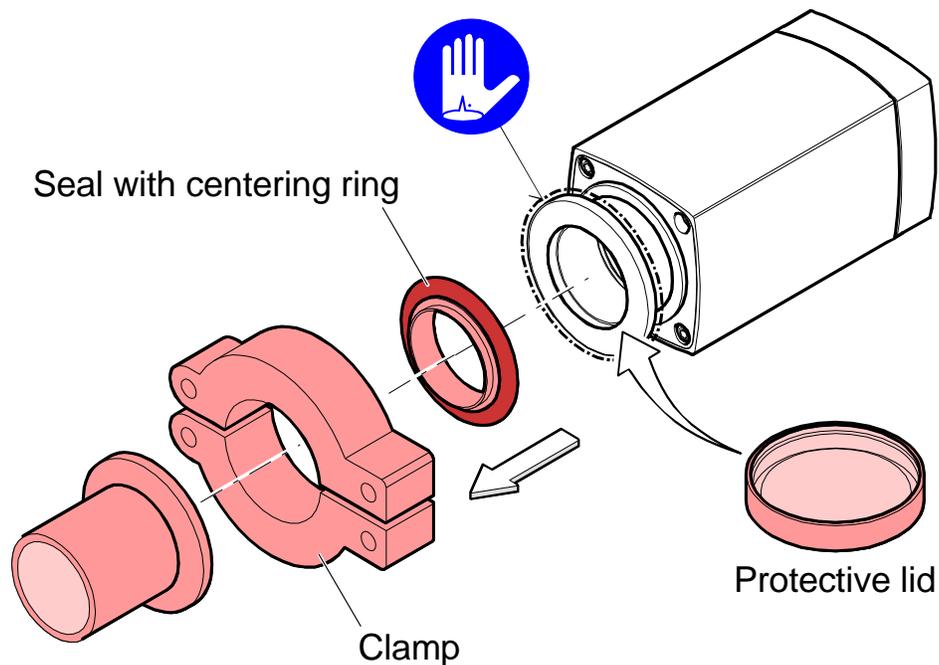
When using the gauge in gases containing contaminants, periodic replacement of ionization or measuring chamber maybe required.

## 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.

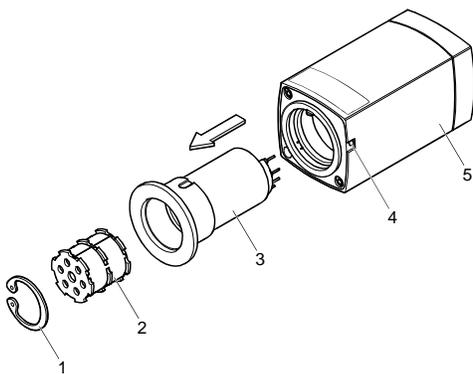


### 7.4.1 Inspecting the sensor

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

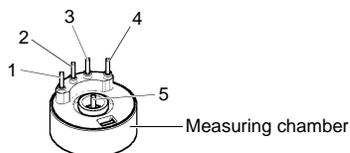
#### Tools / Material Required

- 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	$\infty$	$\ll \infty$	Contamination, short circuit cold cathode sensor

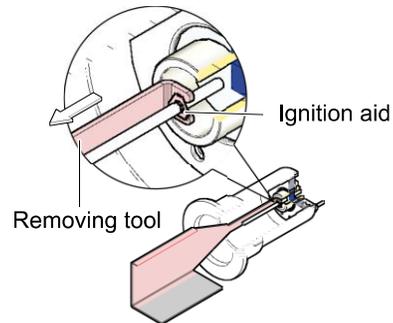


Replace measuring chamber if defective.

- 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.

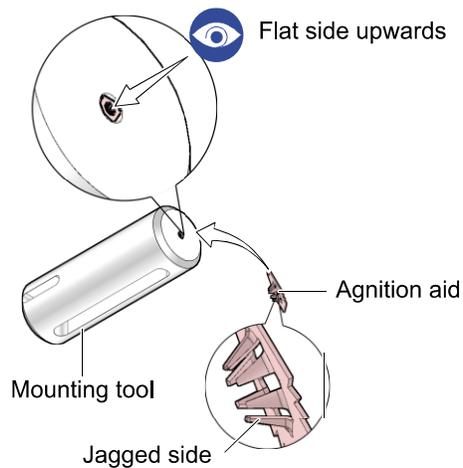


- ❷ We recommend to rub the inside walls of the measuring chamber up to the groove for the retaining ring to a bright finish using a polishing cloth.

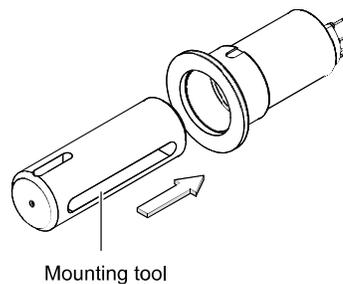


- The sealing surfaces must only be worked concentrically.
- Do not bend the anode.

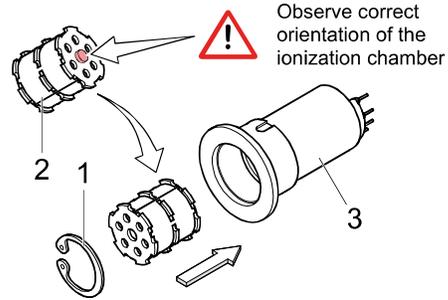
- ❸ Insert the new ignition aid into the mounting tool with the jagged side downwards ...



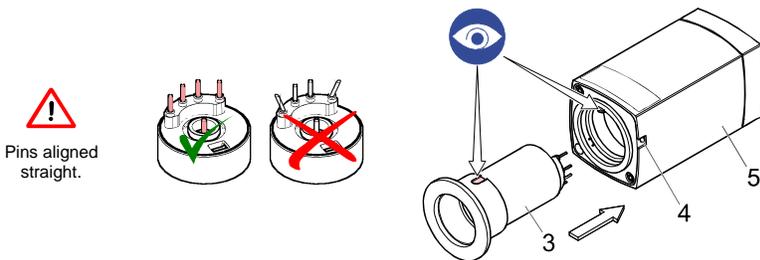
... and slide it onto the anode until the stop position is reached.



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



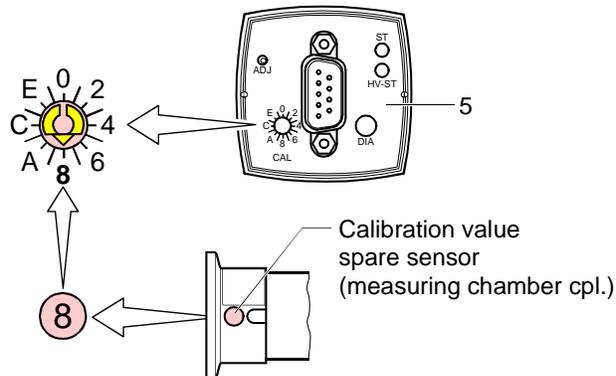
- ⑤ It is recommend to perform a leak test (leak rate  $<1 \times 10^{-9}$  mbar l/s).
- ⑥ Carefully slide the measuring chamber (3) (clean or new) into the electronics unit (5) until the mechanical stop is reached.



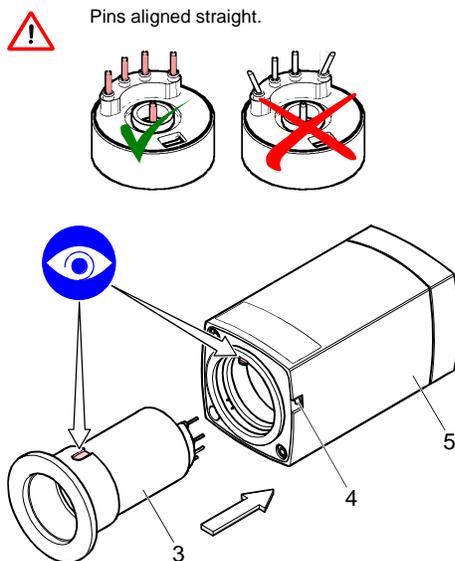
- ⑦ Fasten the measuring chamber (3) by means of the hexagon socket set screw (4).

### 7.4.3 Replacing the measuring chamber

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



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



- 3 Fasten the measuring chamber (3) by means of the hexagon socket set screw (4).
- 4 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 voltage at 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 at 10 V	lid solid green	off	off	No high voltage in the measuring chamber	Switch on the high Voltage
				Overpressure in the measuring chamber	Evacuate the vacuum system to $< 7.6 \times 10^{-3}$ Torr mbar and switch the gauge off and on again via "HV ON"
	lid solid green	blinking green	off	Gas discharge has not ignited	Wait, until the gas discharge has ignited (= 5 minutes at a pressure of $7.6 \times 10^{-10}$ Torr)
	blinking red	off	off	EEPROM error	Switch the gauge off and on again after 5 s Replace the gauge
Signal continually at approx. $3.8 \times 10^{-9}$ 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](mailto: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](http://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.



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