Series 275

Mini-Convectron® Vacuum Gauge Module with DeviceNet® Digital Interface

GRANVILLE-PHILLIPS®

Installation, Operation and Service Instructions

Series 275

Mini-Convectron® Vacuum Gauge Module with DeviceNet® Digital Interface

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Instruction manual part number 275563, Revision 01, November 2006

This manual is for use only with the following part numbers:

275538 and 275553

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- Email: *co-csr@brooks.com*

Installation, Operation, and Maintenance Instructions

Table of Contents

Tables

Chapter 1 Before You Begin

1.1 Receiving Inspection

On receipt of the equipment, inspect all material for damage. Confirm that the shipment includes all items ordered. If items are missing or damaged, submit a claim as stated below for a domestic or international shipment, whichever is applicable.

If materials are missing or damaged, the carrier that made the delivery must be notified within 15 days of delivery, or in accordance with Interstate Commerce regulations for the filing of a claim. Any damaged material including all containers and packaging should be held for carrier inspection. Phone customer service at **1–303–652–4400** or **1–800–776–6543** for assistance if your shipment is not correct for reasons other than shipping damage.

1.2 International Shipment

Inspect all materials received for shipping damage and confirm that the shipment includes all items ordered. If items are missing or damaged, the airfreight forwarder or airline making delivery to the customs broker must be notified within 15 days of delivery.

If an airfreight forwarder handles the shipment and their agent delivers the shipment to customs, the claim must be filed with the airfreight forwarder.

If an airfreight forwarder delivers the shipment to a specific airline and the airline delivers the shipment to customs, the claim must be filed with the airline.

Any damaged material including all containers and packaging should be held for carrier inspection. Phone customer service at **1–303–652–4400** or **1–800–776–6543** for assistance if your shipment is not correct for reasons other than shipping damage.

1.3 Warranty

GRANVILLE-PHILLIPS CONDITIONS OF SALE ARE INCORPORATED BY REFERENCE HEREIN.

1.4 Certification

Granville-Phillips certifies that this product met its published specifications at the time of shipment from the factory. Granville-Phillips further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by the Institute's calibration facility.

1.5 Service Guidelines

Some minor problems are readily corrected on site. For customer service, phone **1–303–652–4400** or **1–800–776–6543** within the U.S.A., or email co-csr@brooks.com. If the product must be returned for service, request a Return Authorization (RA) from Granville- Phillips. See the Service Form at the end of *Chapter 6*. Do not return products without first obtaining an RA.

Shipping damage on returned products as a result of inadequate packaging is the Buyer's responsibility.

When returning equipment to Granville-Phillips, please use the original packing material whenever possible. Otherwise, contact your shipper or Granville-Phillips for safe packaging guidelines. Circuit boards and modules separated from the controller chassis must be handled using proper anti-static protection methods and must be packaged in anti-static packaging. Granville-Phillips will supply return packaging materials at no charge upon request.

1.6 FCC Verification

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

1.7 UL Listed

This product, when labeled, is listed to UL 3101 Standard for Safety, Laboratory Equipment by Underwriters Laboratories Inc. (UL).

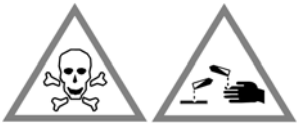
Chapter 2 Safety

WARNING

Read this instruction manual before installation, using, or servicing this equipment. If you have any doubts about how to use this equipment safely, phone customer service at **1–303–652–4400** or **1–800–776–6543**.

These symbols are associated with the handling of poisons and acids. Follow all local and state codes when working with caustic materials and liquids.

This symbol is associated with high voltage hazards. Follow all local and state codes when working with high voltage equipment.



This symbol is associated with handling of combustible materials. Follow all local and state codes when working with flammable materials and liquids.

These symbols are associated with situations that may cause equipment to burst violently due to excessive pressures. Make sure systems are depressurized before attempting to work on them.

WARNING

Do not use the gauge tube to measure the pressure of combustible gas mixtures. The sensing element normally operates at only 125° C but it is possible that momentary transients or controller malfunction can raise the sensor above the ignition temperature of combustible mixtures which may explode causing injury to personnel or equipment damage.

WARNING

Danger of injury to personnel and damage to equipment exists on all vacuum systems that incorporate gas sources or involve processes capable of pressurizing the system above the limits it can safely withstand.

For example, danger of explosion in a vacuum system exists during backfilling from pressurized gas cylinders because many vacuum devices such as ionization gauge tubes, glass windows, glass bell jars, etc., are not designed to be pressurized.

WARNING

Install suitable devices that will limit the pressure from external gas sources to the level that the vacuum system can safely withstand. In addition, install suitable pressure relief valves or rupture discs that will release pressure at a level considerably below that pressure which the system can safely withstand.

Suppliers of pressure relief valves and pressure relief discs are listed in Thomas Register under “Valves, Relief” and “Discs, Rupture.”

Confirm that these safety devices are properly installed before installing the Convectron Gauge. In addition, check that

1. The proper gas cylinders are installed,
2. Gas cylinder valve positions are correct on manual systems, and
3. The automation is correct on automated systems.

WARNING

All conductors in, on or around a vacuum system that are exposed to potential high voltage electrical discharges must either be shielded to prevent human contact, or be connected to earth ground for safe operation.

When high voltage is present in any vacuum system, a life threatening electrical shock hazard may exist unless all exposed conductors are maintained at earth ground. The power cord of this product should be connected only to a properly grounded outlet. However, grounding this product does not guarantee that other components of the vacuum system are maintained at earth ground.

Be aware that an electrical discharge through a gas may couple dangerous high voltage directly to an ungrounded conductor almost as effectively as would a copper wire connection. A person may be seriously injured or even killed by merely touching an exposed ungrounded conductor at high potential. This hazard is not peculiar to this product.

WARNING

Grounding, though simple, is very important! Please be certain that the ground circuits are correctly utilized, both on your ion gauge power supplies and on your vacuum chambers, regardless of their manufacturer, for this phenomenon is not peculiar to Granville-Phillips equipment. Refer to **Safety** Instructions and Chapter 4, for additional information. If you have questions, or wish additional labels or literature, please contact one of our service personnel.

Chapter 3 Introduction

3.1 General Description

The Model 275 Mini-Convectron Vacuum Gauge Module, shown in Figure 3-1, is a modular instrument that is capable of measuring vacuum pressures from less than 1 x 10^{-3} Torr to 1000 Torr N_2 equivalent (or air). The 275 Mini-Convectron Vacuum Gauge Module does not have external controls or adjustments and is available in RS-485 and DeviceNet digital interface and analog versions.

The DeviceNet digital interface version provides communication over networks. The DeviceNet digital interface can be used to read pressure, calibrate the gauge and configure the trip point relays.

The trip point relays can be used to control various devices such as; safety interlock, valve, digital input for a scanner, or programmable logic controller. The relay trip points can be set to customized pressure settings to turn power ON or OFF to the appropriate device.

The Model 275 Mini-Convectron Vacuum Gauge Module is a rugged device that is capable of many years of trouble-free service. However, there are conditions that may cause the gauge tube to fail and should be avoided:

- *Chemical Etching* - exposure to fluorine, chlorine or mercury causes the sensor wire to become chemically etched and damaged.
- *Too Much Power* - if the gauge electronics and gauge tube are connected while the gauge electronics are powered ON and the gauge tube is at vacuum, a spike in the bridge voltage can occur at initial contact and damage the sensor wire. Always turn power OFF or unplug the gauge tube before connecting the gauge to the module electronics.
- *Shock* - extreme shock, such as dropping a gauge, can cause a weld to fail.

3.2 Specifications

Figure 3-1 Dimensions

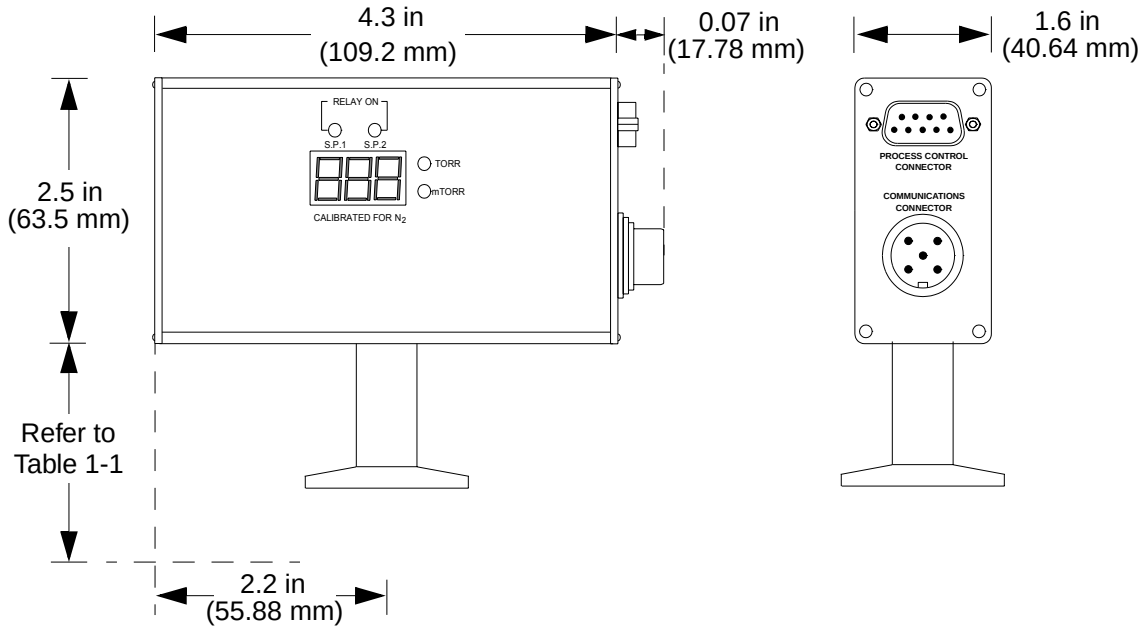


Table 3-1 Vacuum Connection Height Dimensions

Vacuum Connections	Height Dimensions inches (mm)
1/8 NPT Pipe Thread 1/2 inch Tabulation	0.9 (22.86)
1/4 inch 4VCR-Type Female	1.2 (30.48)
1/2 inch 8VCR-Type Female	1.5 (38.1)
1.33 inch (NW16CF) Conflat-Type	1.5 (38.1)
2.75 inch (NW35CF) Conflat-Type	1.5 (38.1)
NW16KF	1.2 (30.48)
NW25KF	1.2 (30.48)
NW40KF	1.5 (38.1)

Refer to Table 3-2 and Table 3-3 for performance and physical specifications of the 275 Mini-Convectron Vacuum Gauge.

Table 3-2 Performance Specifications

Parameter	Specification
Measurement Range	1 x 10^{-3} to 1000 Torr for N_2 or air.
Operating Voltage and Power	+24 VDC, nominal, 0.2 Amperes, 5 Watts maximum. **NOTE:** Customer supplied power supply as shown in Table 3-4.
Trip Point Relays	Single pole-double throw relays (SPDT) Silver alloy-gold clad contacts 1A, 30 VDC, resistive load or AC non-inductive

Table 3-3 Physical Specifications

Parameter	Specification
Vacuum Connections	1/8 NPT Pipe Thread 1/2 inch Tabulation 1/4 inch 4 VCR-Type Female 1/2 inch 8 VCR-Type Female 1.33 inch (NW 16 CF) Conflat-Type 2.75 inch (NW 35 CF) Conflat-Type NW16KF NW25KF NW40KF
Electrical Connection	DeviceNet Micro Connector
Weight	13 oz.
Case Material	Aluminum extrusion.
Gauge Tube Replacement	Field replaceable using only Phillips type screwdriver.
Operating Temp Range	0 ^{o}C to 40 ^{o}C.
Non-operating Temp Range	–40 ^{o}C to 70 ^{o}C

3.3 Power Supply Requirements

The customer supplied power supply should provide operating voltage and current to the 275 Mini-Convectron Vacuum Gauge Module as specified in Table 3-4. Surge current is the maximum momentary current when power is first applied. Operating current is the steady-state current during normal operation.

Current ratings for DeviceNet power are MAXIMUM. This is not an ISOLATED NODE.

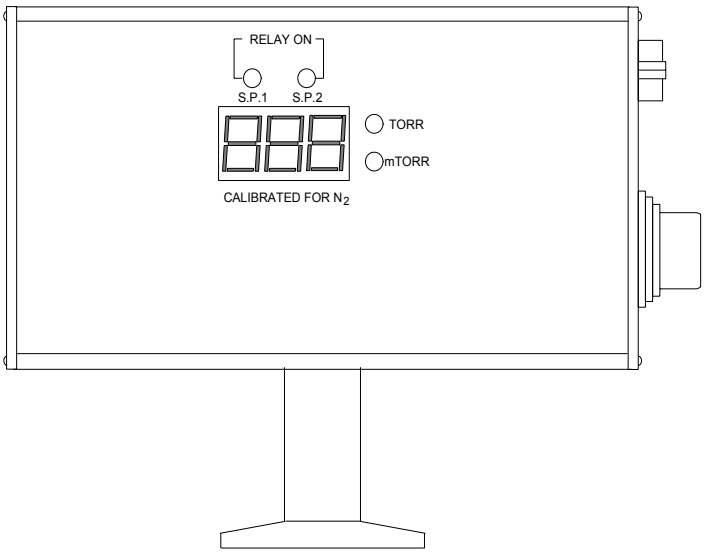
Table 3-4 Gauge Powered by DeviceNet

Connector	Surge Current	Operating Current	Input Voltage	Pin Connection
DeviceNet	1.5 A 8 ms	0.2 A	26 VDC	Pin 2, + VDC Pin 3, -VDC
DeviceNet	2.5 A 8 ms	0.5 A	11 VDC	Pin 2, + VDC Pin 3, -VDC

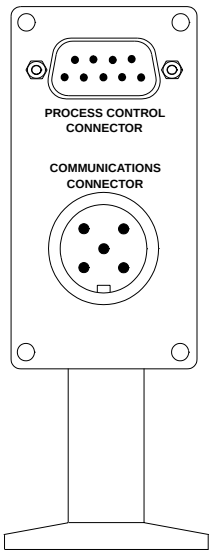
3.4 Component Description

The front, rear and side panels of the 275 Mini-Convectron Vacuum Gauge Module are shown in Figure 3-2 and described in the following paragraphs.

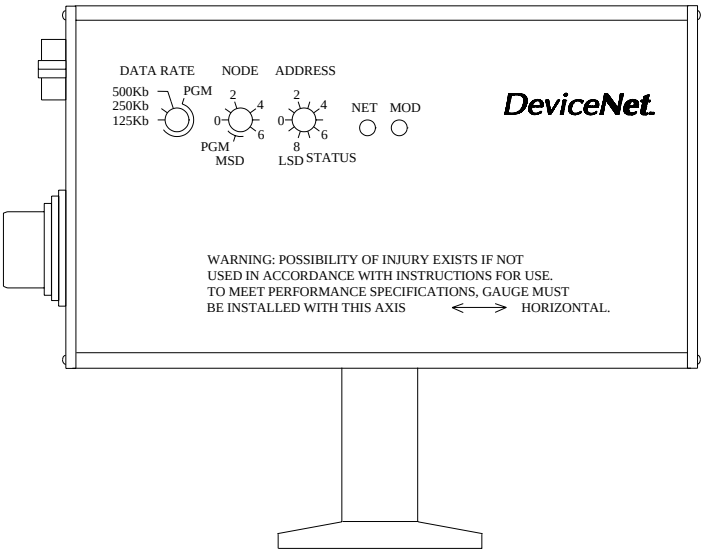
Figure 3-2 275 Mini-Convectron Vacuum Gauge Module End Plate



FRONT PANEL



SIDE PANEL



REAR PANEL

3.5 Front Panel

Digital Display

The 7-segment digital display on the side of the *275* Mini-Convectron Module provides a viewable pressure reading. Pressure can be displayed in Torr or mTorr. The two LEDs next to the display indicate whether the pressure reading is in Torr or mTorr. The lowest pressure resolution for the display is 1 mTorr. A reading of -0 indicates a below zero reading which has the same meaning as bit 3 of the Status Attribute in the S-Analog Sensor Object.

Relay ON LEDs

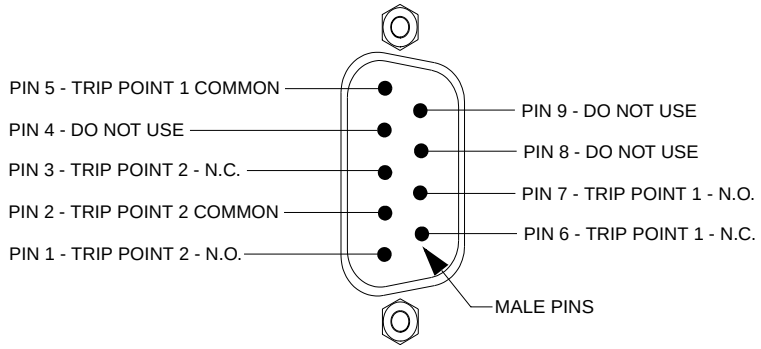
The Relay ON LEDs are illuminated when either the Trip Point 1 (S.P.1) or Trip Point 2 (S.P.2)control relays are energized.

3.6 Side Panel

Process Control Connector

The Process Control Connector provides a connection to the *275* Mini-Convectron Vacuum Gauge Module trip point relay contacts. Refer to Figure 3-3 for pin assignments.

Figure 3-3 Process Control Connector Pin Assignments

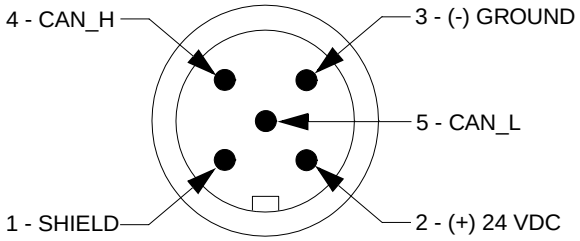


N.O. = NORMALLY OPEN N.C. = NORMALLY CLOSED

Communications Connector

The Communications Connector provides a connection to the 275 Mini-Convectron Vacuum Gauge Module for 24 VDC Input power and the DeviceNet network. Refer to Figure 3-4 for pin assignments.

Figure 3-4 Communications Connector Pin Assignment



3.7 Rear Panel

Data Rate Switch

The Data Rate Switches select the rate at which data is sent and received on the DeviceNet network. When the 275 Mini-Convectron Vacuum Gauge Module power is turned ON or reset by the network, the data rate switch position will be read by the gauge firmware. Available values are: 125 kbaud, 250 kbaud, 500 kbaud, or PGM. If the gauge power is turned ON while the Data Rate Switch is in the PGM position, the gauge reads the data rate from memory.

Table 3-5 DeviceNet/422 Communication Parameters

Parameter	Default Value	Range of Values
Baud Rate	500 kbaud	125, 250, or 500 kbaud
Address	63	0 to 63

Node/Address MAC ID Switches

The Node/Address MAC ID Switches sets the media access control identifier which the network master uses to address the 275 Mini-Convectron Vacuum Gauge Module. The addresses range from 0 - 63 (00x - 3Fx). The switch setting is read when power is applied or when the device is reset.

MOD/NET Status LEDs

The Status LEDs indicate whether or not the 275 Mini-Convectron Vacuum Gauge Module or DeviceNet network has power and is functioning properly. Refer to Table 3-6 and Table 3-7 for more information.

Table 3-6 275 Mini-Convectron Vacuum Gauge Module (MOD) LED States

Module State	LED State	Description
Power OFF	OFF	No power applied to module.
Self Test	Flashing Green-Red	Module is in self test.
Operational	Green	Module is operating normally.
Unrecoverable Fault	Red	Module has detected an unrecoverable fault.

Table 3-7 DeviceNet Network (NET) LED States

Network State	LED State	Description
Not Powered, Not On-Line	OFF	Module is not on-line • The module has not completed the DUP_MAC_ID test yet. • The module may not be powered, look at module status LED.
Self Test	Flashing Red/Green	Module is in self-test.
On-line, Not Connected	Flashing Green	Module has passed the Dup_MAC_ID test, is on-line, but has no established connections to other nodes. It means that the module has no established connections.
On-line, Connected	Green	The module is allocated to a Master. Device is operating normally.
Critical Link Failure	Red	Failed communication device. The module has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID or Bus-off).
Connection Time Out	Flashing Red	The I/O connection is in the timed-out state.

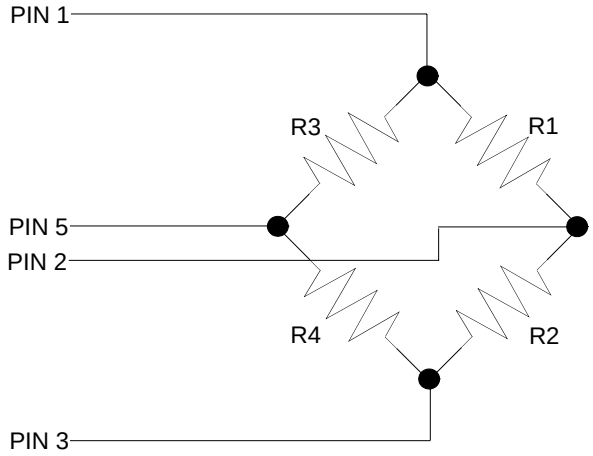
3.8 Mounting Flange

The *275* Mini-Convectron Vacuum Gauge Module can be equipped with a metal seal, O-ring, or VCR type mounting flange as listed in Table 3-1. The type of flange must be specified when ordering the *275* Mini-Convectron Vacuum Gauge Module.

3.9 Theory of Operation

The transducer is a convection enhanced Pirani gauge providing rapid response, six decades of pressure transduction, stable calibration and good accuracy. The R1 Pirani sensing element shown in Figure 3-5, is one leg of a Wheatsone Bridge.

Figure 3-5 Gauge Tube Schematic



A temperature compensating network R2, forms the second leg of the bridge. The temperature sensitive component of this network is mounted inside the gauge tube envelope with the sensor. All other resistors of the bridge are mounted upon the exterior electrical feed through pins of the gauge tube. Pin 4 serves as an electrical terminal for construction of the compensating network R2, but no connection is made from the controller.

All materials have been chosen for ultra high vacuum service, corrosion resistance and the gauge tube (without the electronics module) can be baked to 150º C. The gauge tube envelope is type 304 stainless steel. All metallic joints in the envelope are TIG welded. No solder is used within the envelope. The following materials are exposed to vacuum; Type 304 stainless steel, Carpenter Alloy 52, Kovar, Kapton, gold plated tungsten and borosilicate glass.

Chapter 4 Installation, Configuration

4.1 Introdution

This chapter provides you with the information required to install the *275* Mini-Convectron Vacuum Gauge Module.

The flowchart in Figure 4-1 highlights the major tasks for installing the *275* Mini-Convectron Vacuum Gauge Module (with DeviceNet digital interface) and refers to the appropriate installation procedures within this section.

4.2 Grounding

For safety, the outer housing of the gauge must be grounded to the vacuum chamber. This is accomplished by the use of a metal flange clamp for the NW type flanges. Due to the O-ring seal, grounding cannot be assumed through the fitting. The groove in the KF flange of the *275* Mini-Convectron Vacuum Gauge has been designed to prevent the use of a non-metallic type of flange clamp. Do not alter the groove or a non-metallic flange clamp to attempt usage.

4.3 Installation Precautions

⚠ CAUTION

Make sure the following installation precautions have been followed during the installation of the 275 Mini-Convectron Vacuum Gauge.

1. For readings below 1 Torr, the 275 Mini-Convectron Vacuum Gauge can be installed in any orientation.

   Although the gauge tube will read correctly below 1 Torr when mounted in any position, erroneous readings will occur at pressures above 1 Torr if the gauge tube is not horizontal.

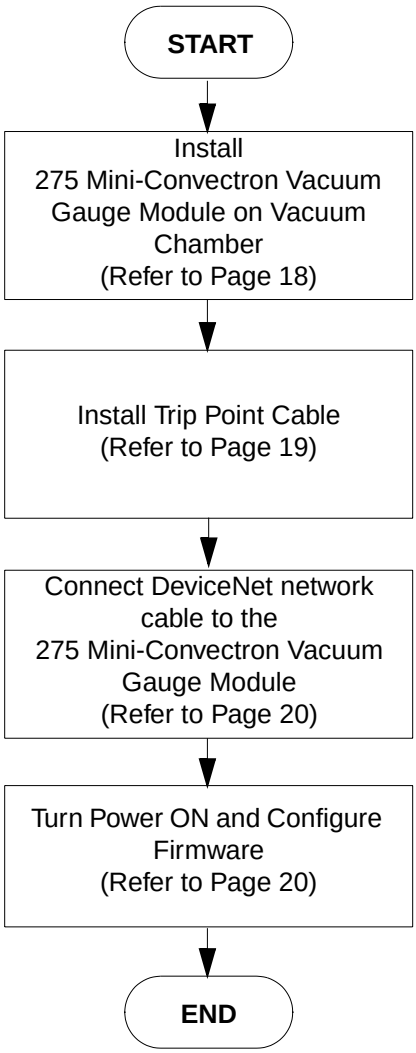
2. For readings above 1 Torr, the 275 Mini-Convectron Vacuum Gauge must be installed in a horizontal position.
3. It is recommended that the 275 Mini-Convectron Vacuum Gauge be installed with the port oriented vertically downward to ensure that no system condensates or other liquids collect in the gauge tube.
4. Do not use a compression mount (quick disconnect) for attaching the 275 Mini-Convectron Vacuum Gauge to the system in applications resulting in positive pressures in the gauge tube. Positive pressures might blow the tube out of a compression fitting and may injure personnel or damage equipment. Pipe thread or flange mounting systems should be used for positive pressure applications.

   The absolute pressure in the gauge tube should not exceed 1000 Torr.

5. Do not perform electrical continuity tests on the 275 Mini-Convectron Vacuum Gauge tube with instruments applying voltages in excess of one volt when the tube is at vacuum, or five (5) volts when at atmospheric pressure. Exceeding these voltages will damage the sensing element.
6. Keep the tube clean. Do not remove the mounting port cover until you are ready to install the tube.

7. Do not mount the 275 Mini-Convectron Vacuum Gauge in a manner such that the deposition of process vapors, upon the internal surfaces of the gauge tube, may occur through line-of-sight access to the interior of the gauge tube.
8. Do not install the 275 Mini-Convectron Vacuum Gauge Module where high amplitudes of vibration are present. Excessive vibration will cause forced convection at high pressure and provide erroneous readings.
9. Do not bake the 275 Mini-Convectron Vacuum Gauge electronics module at temperatures greater than 85° C.
10. Do not install the gauge tubes where they will be subject to corrosive gases such as mercury vapor or flourine which will attack the gold plated sensor.
11. For greatest accuracy and repeatability, the 275 Mini-Convectron Vacuum Gauge should be located in a suitable room temperature environment.
12. All connections to the 275 Mini-Convectron Vacuum Gauge are to be made with shielded cable(s). The shield(s) are to be connected to the connector shell.

Figure 4-1 275 Mini-Convectron Vacuum Gauge Module Installation (DeviceNet Digital Interface)



4.4 Installation

⚠ CAUTION

Reasonable care should be taken to install the *275* Mini-Convectron Vacuum Gauge Module where it is protected from physical damage.

Compression Mount

The *275* Mini-Convectron Vacuum Gauge is designed to fit a standard 1/2 inch compression (quick-disconnect) mount.

WARNING

A compression mount should not be used in positive pressure applications. Positive pressures may eject the gauge tube from a compression fitting and injure personnel or damage equipment.

1. Remove the plug from the 275 Mini-Convectron Vacuum Gauge tube port.
2. Insert the gauge tube port into the compression fitting and tighten the press ring by hand.

   If a seal is not achieved, apply a light coating of vacuum grease to the press ring.
3. Rotate the vacuum gauge in any direction for optimum routing of the cables.
4. Tighten the press ring hand tight.
5. Proceed with Trip Point Cable Installation.

1/8 NPT Mount

The 275 Mini-Convectron Vacuum Gauge is designed to fit a standard 1/8 NPT female fitting.

1. Remove the plug from the 275 Mini-Convectron Vacuum Gauge tube port.
2. Apply Teflon tape to the gauge tube threads.

⚠ CAUTION

Do not use a wrench to tighten the gauge tube port threads.

1. Insert the gauge tube port threads into the system and rotate the 275 Mini-Convectron Vacuum Gauge by hand to achieve a seal.
2. Proceed with Trip Point Cable Installation.

Other Mounts

Follow standard installation procedures for all other mount types.

WARNING

If an NW type flange is being used, ground the 275 Mini-Convectron Vacuum Gauge Module to the vacuum chamber by installing a metal flange clamp.

Trip Point Cable Installation

1. Install the supplied connector on the customer supplied trip point cable according to the pin assignments in Table 4-1.

   N.C. = Normally closed relay contact. N.O. = Normally open relay contact.

Table 4-1 Trip Point Connector Pin Assignments

Pin	Function
1	Trip Point Instance 2, N.O.
2	Trip Point Instance 2, Common
3	Trip Point Instance 2, N.C.
4	Do Not Connect
5	Trip Point Instance 1, Common
6	Trip Point Instance 1, N.C.
7	Trip Point Instance 1, N.O.
8	Do Not Connect
9	Do Not Connect

2. Connect the trip point cable to the connector on the *275* Mini-Convectron Vacuum Gauge Module.
3. Proceed with DeviceNet Digital Interface Installation.

4.5 DeviceNet Digital Interface Installation

Use the following procedure to install the *275* Mini-Convectron Vacuum Gauge (with DeviceNet digital interface) on the vacuum system and obtain a vacuum chamber pressure.

1. Set the MAC ID switches on the *275* Mini-Convectron Vacuum Gauge Module to the correct address position for the vacuum chamber on which it is installed.
2. Set the data rate switch to the appropriate setting.
3. Connect the DeviceNet network cable to the connector *275 Mini-Convectron* Vacuum Gauge Module.
4. Turn the DeviceNet power supply ON.

   Refer to the *Series MICRO-ION and Mini-Convectron Gauge Module DeviceNet Programmer's Guide*, P/N 354022, for additional information on firmware configuration.
5. Allocate a connection for the *275* Mini-Convectron Vacuum Gauge Module to the network master as listed in Table 4-2 and Table 4-3.

   An explicit message connection must be allocated to allow a polled connection to be allocated. They may be allocated simultaneously as shown in Table 4-2.

Table 4-2 Network Master Connection

Parameter	Service	Class	Instance	Allocation Choice	Master ID
Connection	$4B_{hex}$	3	1	3*	0 to 63

* Allocation Choice = 3 allocates a polled and explicit message connection.

Table 4-3 Allocation Choice Byte Contents

7*	6*	5*	4*	3*	2*	1	0
Reserved	Acknowledge Suppression	Cyclic	Change of State	Reserved	Bit Strobed	Polled	Explicit Message

* Not Supported, Value = 0 only.

6. Configure the expected packet rate for the explicit and polled connections, as listed in Table 4-4.

   The default explicit message expected packet rate is 2.5 seconds. If data is requested as a slower rate, this must changed to prevent the connection from expiring. See Table 4-4 to disable the expected packet rate

Table 4-4 Disabling the Expected Packet Rate

Parameter	Service	Class	Instance	Attribute	Data
Service	10_{hex}	5	1*	9	0

* 1 = Explicit connection 2 = Polled Connection

7. Proceed with **Configuring Polled I/O Data Format**.

4.6 Configuring Polled I/O Data Format

The *275* Mini-Convectron Vacuum Gauge Module can input data to the network in two data types and status information can be included. The default format inputs one byte of status data and floating point pressure. See Table 5-5 on Page 35 for status bit definitions.

Table 4-5 Configuring Polled I/O Data Format

Parameter	Service	Class	Instance	Attribute	Data
1 Byte Status and 4 Bytes Floating Point Pressure	10_{hex}	4	0	65_{hex}	5 (Default)
4 Bytes Floating Point Pressure	10_{hex}	4	0	65_{hex}	4
1 Byte Status and 2 Bytes Integer Pressure	10_{hex}	4	0	65_{hex}	2
2 Bytes Integer Pressure	10_{hex}	4	0	65_{hex}	1

* These parameters are non-volatile, the setting will remain after power is cycled.

4.7 Trip Point Relays

The default trip point relay configuration is disabled. The trip point value indicates the pressure that causes the trip point to change state as pressure is going down. The trip point will clear when pressure rises above Trip_Point_Value + (Hysteresis * Trip_Point_Value). For the default hysteresis of 20%, the trip point will clear when the pressure reaches 20% (hysteresis value = 0.2) over the trip point pressure value.

Table 4-6 Configuring Trip Point Relays

Parameter	Service	Class	Instance	Attribute	Data
Disable Trip Point Relay 1	10_{hex}	35_{hex}	01_{hex}	06_{hex}	0
Normal Polarity Trip Point 1	10_{hex}	35_{hex}	01_{hex}	08_{hex}	0
Reversed Polarity Trip Point 1	10_{hex}	35_{hex}	01_{hex}	8	1
Trip Point Pressure Trip Point 1 350 Torr	10_{hex}	35_{hex}	01_{hex}	5	00 00 AF 43 $_{hex}$
Set Trip Point 1 Hysteresis	10_{hex}	35_{hex}	01_{hex}	$0A_{hex}$	CD CC 4C 3E $_{hex}$ (default = 20%)
Enable Trip Point Relay 1	10_{hex}	35_{hex}	01_{hex}	6	1
Disable Trip Point Relay 2	10_{hex}	35_{hex}	02_{hex}	6	0
Normal Polarity Trip Point 2	10_{hex}	35_{hex}	02_{hex}	8	0
Reversed Polarity Trip Point 2	10_{hex}	35_{hex}	02_{hex}	8	1
Trip Point Pressure Trip Point 2 1.00 e-2 Torr	10_{hex}	35_{hex}	02_{hex}	5	0A D7 23 3C $_{hex}$
Set Trip Point 2 Hysteresis	10_{hex}	35_{hex}	02_{hex}	$0A_{hex}$	CD CC 4C 3E $_{hex}$ (default = 20%)
Enable Trip Point Relay 2	10_{hex}	35_{hex}	02_{hex}	6	1

* These parameters are non-volatile, the setting will remain after power is cycled.

4.8 Checking Module Status

Check the status if the *275* Mini-Convectron Vacuum Gauge Module will not read pressure due to a fault (alarm).

Table 4-7 Checking 275 Mini-Convectron Vacuum Gauge Module Status

Parameter	Service	Class	Instance	Attribute	Data
Check Status	$0E_{hex}$	31_{hex}	1	07_{hex}	Unsigned integer, 1 byte*

* Refer to the *Series Mini-Convectron and MICRO-ION Vacuum Gauge Module DeviceNet Programmers Guide*, P/N 354022, for more information.

4.9 Measuring N_2 or Air

Each Mini-Convectron gauge tube is individually calibrated for N_2 and temperature compensated prior to leaving the factory. Each controller is individually calibrated to provide accurate readout of N_2 or air pressure, therefore, initial calibration should not be necessary.

If the tube becomes contaminated or does not read correctly, the *275* Mini-Convectron Vacuum Gauge Module can be calibrated through DeviceNet by performing the following procedures.

Vacuum Adjustment

1. Evacuate the chamber.
2. If you know the pressure is less than $1x10^{-4}$ Torr, send zeroes with the Zero Adjust Service. If the base pressure is between $1x10^{-4}$ and $1x10^{-1}$, use another gauge or pump specifications to enter the data value for the Zero Adjust Service.

Table 4-8 Zero Vacuum Adjust Example

Parameter	Service	Class	Instance	REAL Data
Zero Adjust	$4B_{hex}$	31_{hex}	1	00 00 00 00

Table 4-9 $1x10_{-2}$ Vacuum Adjust Example

Parameter	Service	Class	Instance	REAL Data
Zero Adjust	$4B_{hex}$	31_{hex}	1	0A D7 23 3C $_{hex}$

Atmospheric Adjustment

1. Allow the chamber pressure to rise to atmospheric pressure.
2. Use Table 4-10 to determine the atmospheric pressure (Torr) for your altitude and enter the data value for the Atmospheric Adjust Service.

Table 4-10 Atmospheric Adjustment Parameters

Altitude Above Sea Level (feet)	Air or N_2 Pressure (Torr)
0	760
1,000	733
2,000	707
3,000	681
4,000	656
5,000	632
6,000	609
7,000	586
8,000	564
9,000	543
10,000	523

Table 4-11 760 Torr Example

Parameter	Service	Class	Instance	Data
Gain Adjust	$4C_{hex}$	31_{hex}	1	00 00 3E 44 $_{hex}$

Using Input Polled I/O

When a master polls the module for measured pressure, the format of the returned pressure value depends on the data type.

To configure the data format for input polled I/O, see Table 4-5.

Table 4-12 Input polled I/O for pressure values

Pressure values are transmitted in low byte to high byte order.

Instance	Typical device data	Data type	Description
1	23 79_{hex}	UINT	UINT vacuum pressure (760 Torr)
2	00 23 79_{hex}	STRUCT	BYTE exception status UINT vacuum pressure
4	00 00 3E 44_{hex}	REAL	REAL vacuum pressure
5 (default)	00 00 00 3E 44_{hex}	STRUCT	BYTE exception status REAL vacuum pressure (760 Torr)

Use Table 4-13 to convert UINT counts to pressure. The counts are proportional to voltage and non-linear with respect to pressure.

Table 4-13 UINT Counts versus Pressure

Pressure	UINT Count	Pressure	UINT Count
0.0001	453	6.5	5490
0.001	464	10	5986
0.01	566	15	6246
0.015	613	20	6523
0.02	660	30	6736
0.05	885	50	6912
0.075	1031	65	6995
0.1	1157	100	7060
0.2	1558	150	7118
0.35	1935	200	7172
0.5	2306	300	7311
0.65	2573	400	7473
0.85	2888	500	7622
1	3086	600	7747
2	4007	700	7851
3	4552	760	7909
5	5204	900	8019
		1000	8086

Use with Gases other than N_2 or Air

WARNING

Do not use the gauge tube to measure the pressure of combustible gas mixtures. The sensing element normally operates at only 125º C but it is possible that momentary transients or controller malfunction can raise the sensor above the ignition temperature of combustible mixtures which may explode causing injury to personnel or equipment damage.

Make sure the 275 Mini-Convectron Vacuum Gauge Module Gain adjustment is correctly set for measuring Air.

The indicated pressure on a 275 Mini-Convectron Vacuum Gauge depends upon the following parameters:

- Type of gas in the tube
- Tube axis orientation
- Gas pressure within the tube

275 Mini-Convectron Vacuum Gauges are calibrated for N_2 within the accuracy of the instrument. By observing certain safety precautions, the gauge tube may be used to measure the pressure of other gases.

Mini-Convectron Gauge tubes are thermal conductivity gauges. these gauges transduce gas pressure by measuring the heat loss from a heated sensor wire maintained at a constant temperature. For gases other than N_2 and air, the heat loss is different at any given true pressure and the indicated pressure will be different.

Indicated versus True Pressure Curves

The graphs in Figure 4-2, Figure 4-3, and Figure 4-4 show the true pressure versus indicated pressure for 11 commonly used gases. Table 4-14 will help to locate the proper graph for a specific application.

Table 4-14 Indicated Versus True Pressure Information

Range and Units	Gases	Figure Reference
1 - 100 mTorr	All	2-2
0.1 - 1000 Torr	Ar, CO_2, CH_4, Freon 12, He	2-3
0.1 - 1000 Torr	D_2, Freon 22, Kr, Ne, O_2	2-4

1 mbar = 100 Pa = 1.33 Torr, so the charts may be used for pascal and mbar units.

A useful interpretation of these curves is, for example, that at a true pressure of 2×10^{-2} Torr of CH_4 the heat loss from the sensor is the same as at a true pressure of 3×10^{-2} of N_2 as shown in Figure 4-2. The curves at higher pressure vary widely from gas to gas because the thermal losses at higher pressures are greatly different for different gases. If you must measure the pressure of gases other than N_2 or air, use Figure 4-3 or Figure 4-4 to determine the maximum safe indicated pressure for the other gas as explained below.

Example 1 – Maximum Safe Indicated Pressure

Assume a certain system will withstand an internal pressure of 1000 Torr or 19.3 psia. For safety, you wish to limit the maximum internal pressure to 760 Torr during backfilling. Assume you wish to measure the pressure of Argon (Ar).

On Figure 4-3, locate 760 Torr on the left hand scale, travel to the right to the intersection with the Argon curve, and then down to an indicated pressure of 24 Torr (N_2 equivalent). Thus, in this hypothetical situation, the maximum safe indicated pressure for Argon is 24 Torr.

For the sake of safety, it is prudent to place a warning label on the instrument face which under the assumed conditions would read "DO NOT EXCEED 24 TORR FOR ARGON".

Example 2 – Indicated To True Pressure Conversion

Assume you wish to determine the true pressure of Argon in a system when the Mini-Convectron is indicating 10 Torr. On Figure 4-3, read up from 10 Torr (N_2 equivalent) indicated pressure to the Argon curve and then horizontally to the left to a true pressure of 250 Torr. Thus 250 Torr Argon pressure produces an indication of 10 Torr (N_2 equivalent).

Example 3 – True To Indicated Pressure Conversion

Assume you wish to set a process control trip point at a true pressure of 20 Torr of $C0_2$. On Figure 4-3, locate 20 Torr on the true pressure scale, travel horizontally to the right to the $C0_2$ curve and then down to an indicated pressure of 6 Torr (N_2 equivalent). Thus the correct process control setting for 20 Torr of $C0_2$ is 6 Torr (N_2 equivalent).

Example 4 – True To Indicated Pressure Conversion

Assume you wish to obtain a helium pressure of 100 Torr in the system. On Figure 4-3, locate 100 Torr on the left hand scale, travel horizontally to the right to attempt to intersect the He curve. Because the intersection is off scale, it is apparent that this true pressure measurement requirement for helium exceeds the capability of the instrument.

For gases other than those listed, the user must provide accurate conversion data for safe operation. The Mini-Convectron Gauge is not intended for use above 1000 Torr true pressure.

Figure 4-2 Gas Pressures, 1 x 10^{-4} to 1 Torr

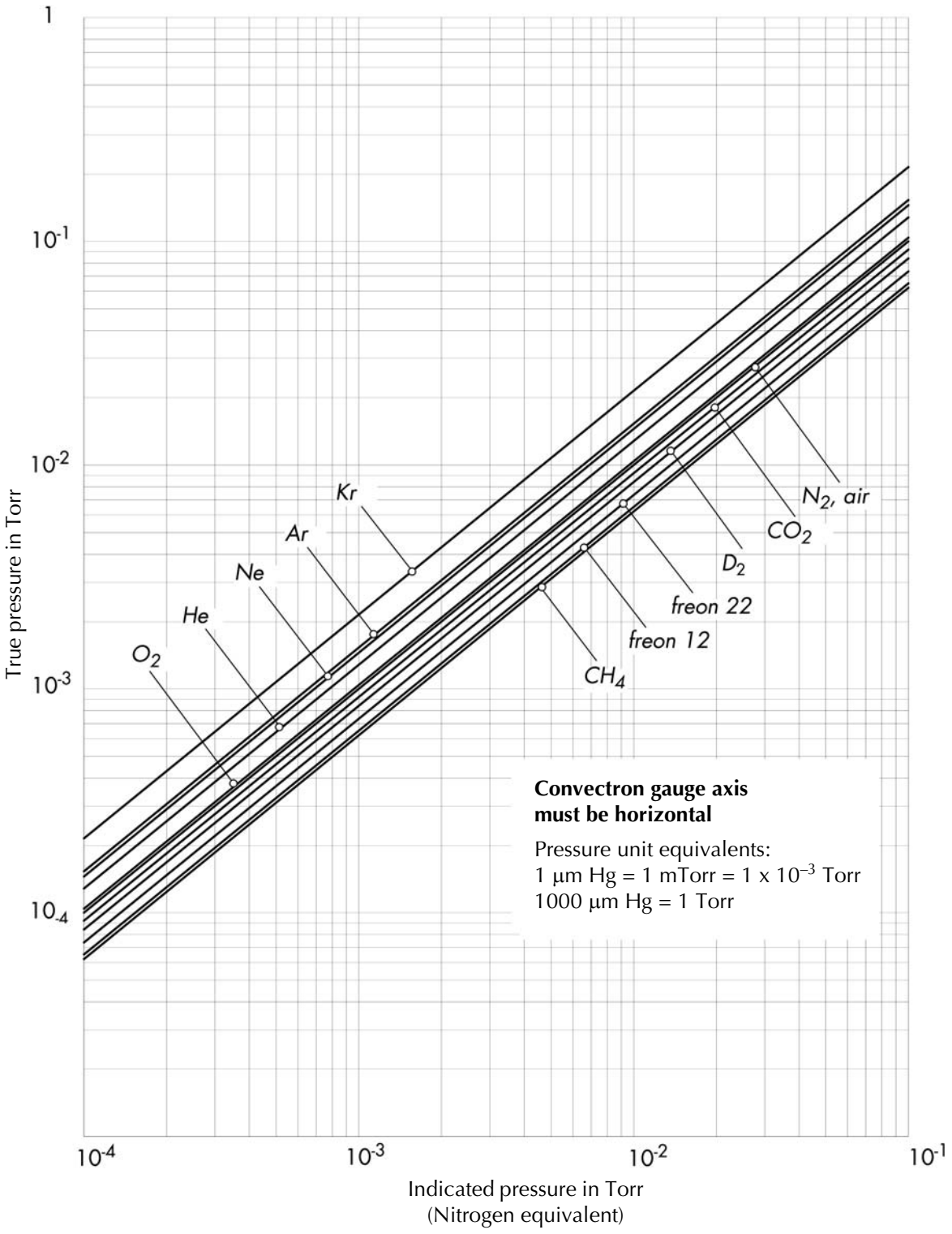


Figure 4-3 Gas Pressures, 1 x 10^{-2} to 1000 Torr, First Gas Set

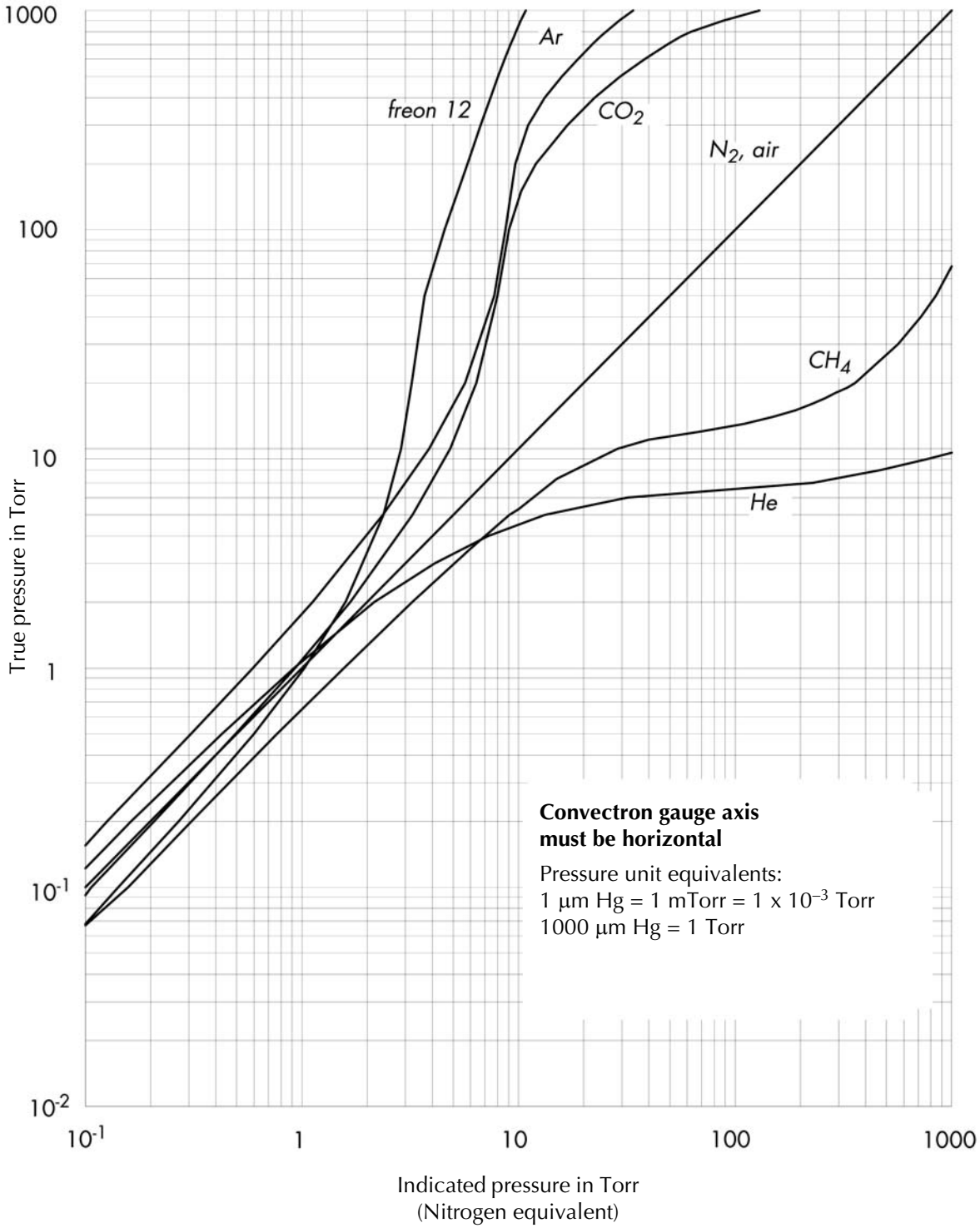
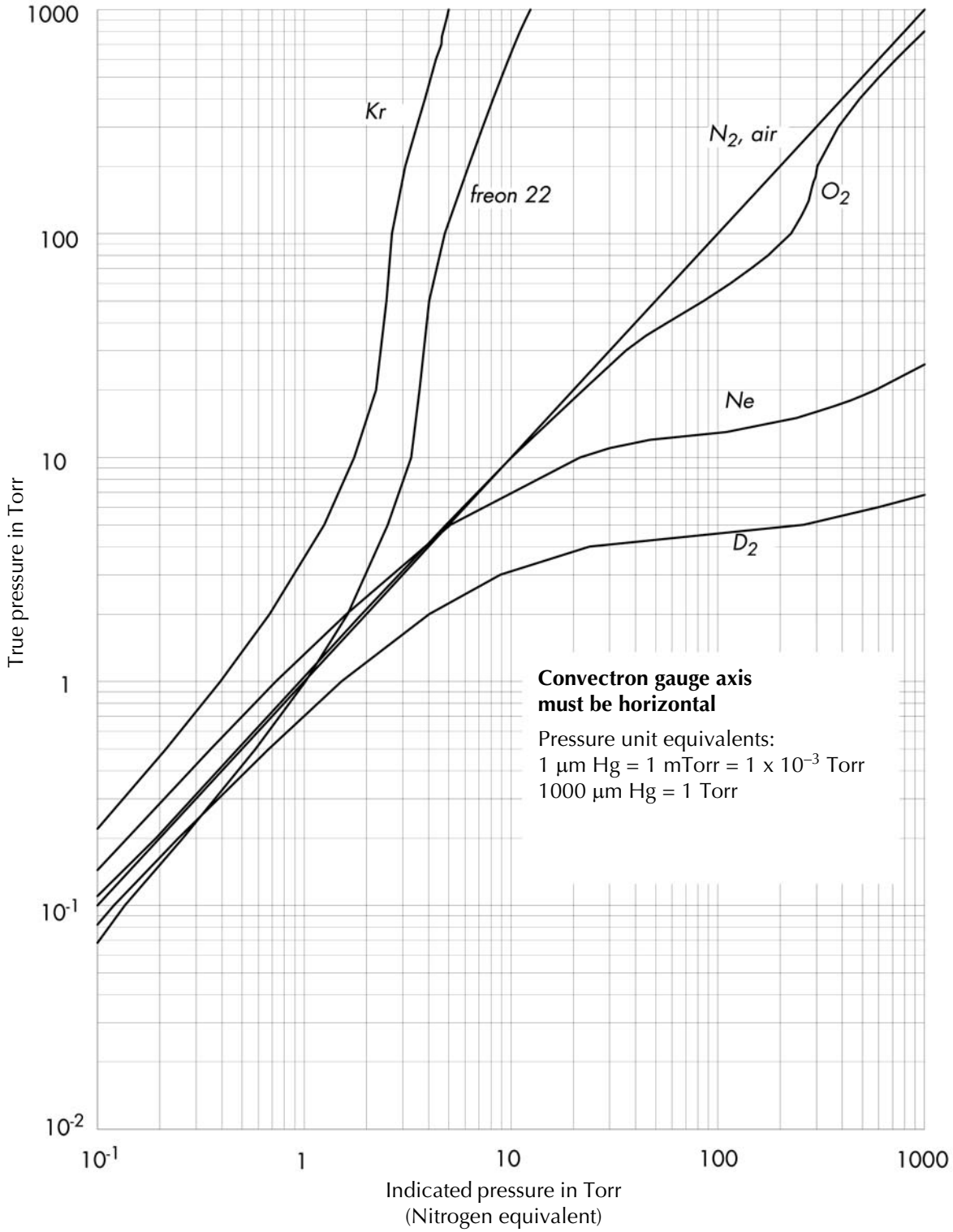


Figure 4-4 Gas Pressures, 1 x 10^{-2} to 1000 Torr, Second Gas Set



4.10 Vacuum Gauge Module Process Chamber Baking

The 275 Mini-Convectron Vacuum Gauge tube can be removed from the module electronics without interrupting the vacuum within the process chamber.

⚠ CAUTION

The temperature of the *275* Mini-Convectron Vacuum Gauge Module electronics cannot exceed 85º C. The electronics module must be removed from the process chamber before baking the chamber at temperatures higher than 85º C.

WARNING

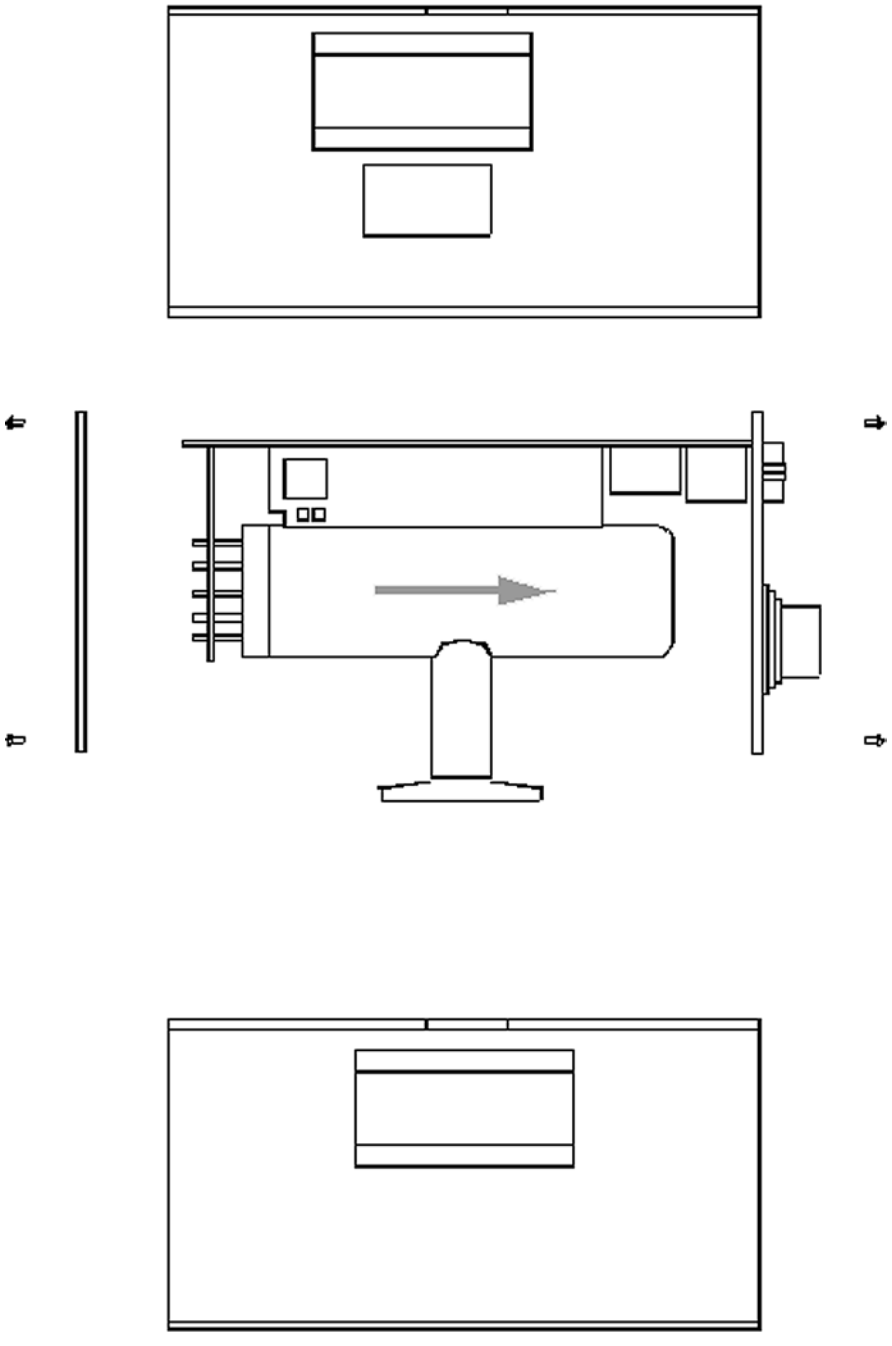
To prevent electrical shock, shut down electrical power before servicing the *275* Mini-Convectron Vacuum Gauge Module. Do not touch any gauge pins while the gauge tube is under vacuum or connected to a controller.

1. Disconnect the DeviceNet and Trip Point cable connectors.
2. Remove the eight screws holding the two end plates of the module as shown in Figure 4-5.
3. Remove the one side, front and rear cover plates from the PC board/ gauge tube assembly as shown in Figure 4-5.
4. Hold the PC board/gauge tube assembly and *carefully* remove the gauge tube from the tube socket in the direction of the arrow shown in Figure 4-5.

   The gauge tube should not exceed 150º C.
5. Bake the process chamber at the desired temperature for the specified period of time.
6. Allow the chamber to cool below 85º C (158º F).
7. Hold the PC board/gauge tube assembly and *carefully* push the end of the gauge tube into the tube socket until it stops.

   Make sure the PC boards are properly mounted in the front and rear cover slots.
8. Install the side, front and rear cover plates on the PC board/gauge tube assembly.
9. Install the eight end plate screws.
10. Connect the Trip Point and DeviceNet cable connectors.

Figure 4-5 Module Removal for Baking the Process Chamber



Chapter 5 Troubleshooting

5.1 Introduction

The problems presented in Table 5-1 are followed by possible causes and corrective actions.

5.2 Troubleshooting Procedures

Table 5-1 DeviceNet Digital Interface Troubleshooting Procedures

Problem	Possible Cause	Corrective Action
No Power Indication	No input power. Verify that there is + 11 VDC to + 26.5 VDC at pin 2 of the communication connector with respect to pin 3.	Correct reason for lack of power.
Unit does not respond to DeviceNet communication from a Master but the MOD Indicator is solid green:	1. Address rotary switches set to incorrect address positions. 2. Incorrect baud rate.	1. Set the address rotary switches to the correct address positions. 2. Set the baud rate switch in the correct position.
MOD indicator does not light:	DeviceNet power supply disconnected, off, or inadequate for load.	A switching supply may shut down from the current surge upon power up. If a switching power supply is used, size current limit to two times working load. Refer to Table 3-4 for power requirements.
275 Mini-Convectron Vacuum Gauge always reads 9.99e+09 via DeviceNet or MOD light turns red.	Fault condition indicated by reading response to status attribute.	1. Refer to Table 2-9 for DeviceNet command to check status. 2. Refer to Table 5-5 for status bit definitions.
Process control trip point does not function as expected.	1. The trip point connector may be wired incorrectly. 2. Wrong trip point values programmed. **NOTE:** The process control trip point will always have the COMMON contact connected to the N.C. contact when the 275 Mini-Convectron Vacuum Gauge is off or when the unit is not powered. 3. Trip point not enabled.	1. Refer to page 19. 2. Obtain programmed trip point values. If trip point values are incorrect, program the proper values. Refer to Table 4-6. 3. Refer to Table 4-6 for command to enable trip point.
Bridge analog output voltage reads less than +0.22 VDC or greater than +10 VDC.	1. Gauge Tube Failure. 2. Bridge Amplifier Failure.	1. Refer to page 40 to test the gauge tube. 2. Replace the module.

Table 5-1 DeviceNet Digital Interface Troubleshooting Procedures (Continued)

Problem	Possible Cause	Corrective Action
Readout cannot be calibrated to the specified value using Zero_Adjust or Gain_Adjust service.	1. Gauge incorrectly calibrated out of operating range. 2. Gauge tube contaminated with material from vacuum system. 3. The gold plating on sensor has been attacked by a gas such as flourine or mercury vapor.	1. Use restore factory calibration command (Service 32_{hex}, Class 31_{hex}, Instance 01_{hex}) to restore factory calibration. User calibration values can re-calibrated if desired. 2. Refer to page 37 and clean gauge tube. If not effective, replace gauge tube. 3. Refer to page 40 and replace gauge tube. Cleaning will not solve this problem.
Readout indicating a pressure in the system that is very different than being observed by supporting gauges.	1. Gas composition on system is not what the user believes it to be. This can be caused by selective gas pumping, process in use, outgassing of product, etc. 2. Gauge calibration incorrect.	1. Determine gas composition and refer to page 23 to calibrate the 275 Mini-Convectron Vacuum Gauge Module accordingly. 2. Use restore factory calibration command (Service 32_{hex}, Class 31_{hex}, Instance 01_{hex}) to restore calibration. User calibration values can be re-calibrated if desired.

5.3 Status Information

For status information, see Table 5-2 through Table 5-5.

Table 5-2 Analog Sensor Status, Class 31_{hex} Instance 1, Attribute 7

BIT	Definition
0	High Alarm – none
1	Low Alarm – bridge volts < 200 mV, sensor failure
2	High Warning – none
3	Low Warning bridge volts < 300 mV, calibration needed

Table 5-3 Analog Sensor Reading Valid, Class 31_{hex} Attribute 5

BIT	Definition
0	Reading Valid – indicate valid reading

Table 5-4 Identity Object Status, Class 1, Instance 1, Attribute 5

BIT	Definition
0	An object is allocated, unrelated to error condition
2	Configured, unrelated to error condition
8	Minor recoverable fault, same as bit 3, Analog Sensor Status
11	Major unrecoverable fault, same as bit 1, Analog Sensor Status

Table 5-5 I/O Status Byte and Device Supervisor Exception Status, Class 30_{hex} Instance 1, Attribute $0C_{hex}$

BIT	Definition
1	Alarm, same as bit I, Analog Sensor Status
5	Warning, same as bit 3, Analog Sensor Status

Chapter 6 Service

6.1 Introduction

The procedures in this section provide instructions for normal service issues that may be required during use of the 275 Mini-Convectron Vacuum Gauge Module.

Phone customer service at **1–303–652–4400** or **1–800–776–6543** if there are questions pertaining to the service of the 275 Mini-Convectron Vacuum Gauge Module.

6.2 Mini-Convectron Gauge Tube Cleaning

When the fine sensor wire within the gauge tube is severely contaminated with oil or other films, its emissivity or diameter can be altered causing a change in gauge tube calibration.

Cleaning the internal components of the gauge tube with trichloroethelyne, perchloroethelyne, toluene, or acetone is possible but must be done carefully to prevent damage to the sensor wire.

WARNING

Follow all product safety precautions for the solvent being used to prevent personal injury.

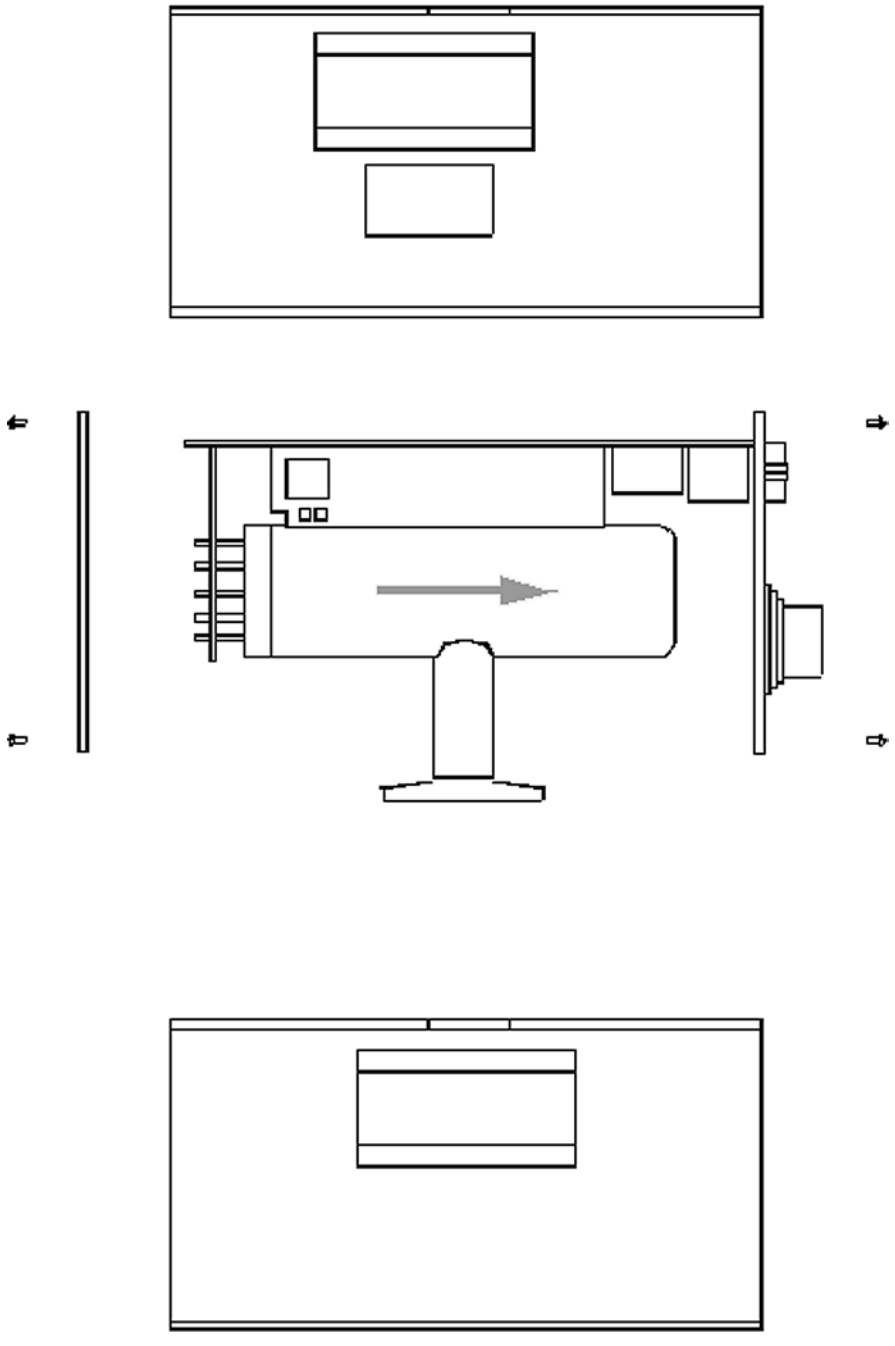
WARNING

To prevent electrical shock, shut down electrical power before servicing the *275* Mini-Convectron Vacuum Gauge Module. Do not touch any gauge pins while the gauge tube is under vacuum or connected to a controller.

Use the following procedure to clean the internal components of the gauge tube.

1. Disconnect the DeviceNet and Trip Point cable connectors.
2. Remove the eight screws holding the two end plates of the module as shown in Figure 6-1.
3. Remove the one side, front and rear cover plates from the PC board/ gauge tube assembly as shown in Figure 6-1.

Figure 6-1 Gauge Tube Removal from Module



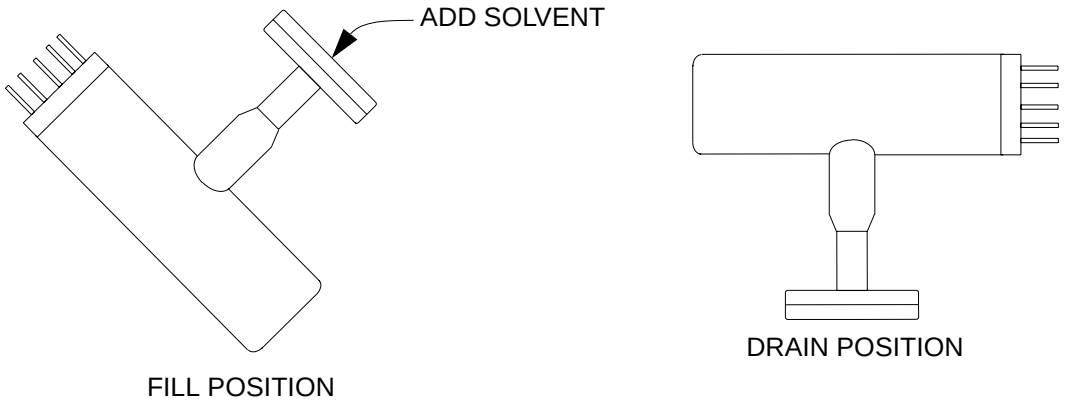
4. Hold the PC board/gauge tube assembly and *carefully* remove the gauge tube from the tube socket in the direction of the arrow shown in Figure 6-1.
5. Hold the gauge tube with body at a 45º angle as shown in Figure 6-2.

⚠ CAUTION

Do not shake the gauge tube while the solvent is in the tube. Calibration changes may occur.

6. Slowly add the solvent to fill the gauge tube through the port shown in Figure 6-2.

Figure 6-2 Adding and Draining Solvent



7. Allow the solvent to remain in the gauge tube for approximately 10 minutes.
8. After 10 minutes has elapsed, drain the solvent from the gauge tube by rotating the gauge tube so the port is facing down as shown in Figure 6-2. Allow all the solvent to drain from the gauge tube.
9. Allow the gauge tube to dry for 12 hours while pointing down.
10. Make sure the solvent odor has disappeared before installing the gauge tube in the module.
11. Hold the PC board/gauge tube assembly and *carefully* push the end of the replacement gauge tube into the tube socket until it stops. Make sure the PC boards are properly mounted in the front and rear cover slots.
12. Install the side, front and rear cover plates on the PC board/gauge tube assembly.
13. Install the eight end plate screws.
14. Connect the Trip Point and DeviceNet cable connectors.

6.3 Mini-Convectron Gauge Tube Test and Replacement

This procedure can be used to test and/or replace the gauge tube if you suspect it has failed.

WARNING

To prevent electrical shock, shut down electrical power before servicing the *275* Mini-Convectron Vacuum Gauge Module. Do not touch any gauge pins while the gauge tube is under vacuum or connected to a controller.

1. Disconnect the DeviceNet and Trip Point cable connectors.
2. Remove the eight screws holding the two end plates of the module as shown in Figure 6-1.
3. Remove the one side, front and rear cover plates from the PC board/ gauge tube assembly as shown in Figure 6-1.
4. Hold the PC board/gauge tube assembly and *carefully* remove the gauge tube from the tube socket in the direction of the arrow shown in Figure 6-1.

⚠ CAUTION

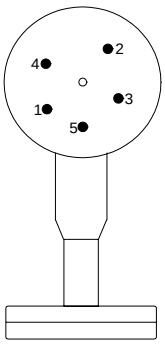
Make sure the volt/ohm meter being used in this procedure does not apply more than 10 mA to the gauge tube circuits. Damage to the gauge tube may result.

5. Using a volt/ohm meter, measure the gauge tube pins listed in Table 6-1 and as shown in Figure 6-3.

Table 6-1 Mini-Convectron Gauge Tube Pin Test Resistance Values

Pins to Test	Resistance Values (ohms)
1 to 2	17 to 22.5
3 to 4	27 to 45
2 to 3	45 to 54
1 to 5	180 to 185

Figure 6-3 Mini-Convectron Gauge Tube Pin Identification



6. If any of the resistance values in Table 6-1 are not within specification, the gauge tube should be replaced.
7. Phone customer service at **1–303–652–4400** or **1–800–776–6543** to order a new gauge tube.
8. Hold the PC board/gauge tube assembly and *carefully* push the end of the replacement gauge tube into the tube socket until it stops.

   Make sure the PC boards are properly mounted in the front and rear cover slots.
9. Install the side, front and rear cover plates on the PC board/gauge tube assembly.
10. Install the eight end plate screws.
11. Connect the Trip Point and DeviceNet cable connectors.

    Gauge tube failures are most frequently caused by one of the following conditions:

    - Chemical Etching – exposure to fluorine, chlorine or mercury causes the sensor wire to become chemically etched and damaged.
    - Overpower – if the gauge electronics and gauge tube are connected while the gauge electronics are powered ON and the gauge tube is at vacuum, a spike in the bridge voltage can occur at initial contact and damage the sensor wire. Always turn power OFF or unplug the gauge tube before plugging the gauge into the gauge electronics.
    - Shock – extreme shock, such as dropping a gauge, can cause a weld to fail.

Service Form

RA number _____ Model number _____

Serial number _____ Date _____

Name _____ Phone number _____

Company _____

Street address _____

City _____ State _____ ZIP _____

Please help Granville-Phillips provide the best possible service by giving us information that will help us determine the cause of the problem and protect our analysis and calibration equipment from contamination.

Problem description: _____

_____

_____

_____

Application description: _____

_____

_____

_____

Has this product been used with
high vapor pressure or hazardous materials? Yes ❑ No ❑

If Yes, please list the types of gas, chemicals (common names, specific chemical,) biological materials, or other potentially contaminating or harmful materials exposed to the product during its use.

_____

_____

_____

PRODUCTS EXPOSED TO RADIOACTIVE MATERIAL CANNOT BE ACCEPTED BY GRANVILLE-PHILLIPS UNDER ANY CIRCUMSTANCES.

Corporate officer signature _____

Contact name_____ Phone number _____

Series 275

Mini-Convectron® Vacuum Gauge Module with DeviceNet® Digital Interface

GRANVILLE-PHILLIPS®

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Installation, Operation and Service Instructions