Series 342

Granville-Phillips® Series 342 & 343 Mini-Ion Vacuum Gauge Modules

GRANVILLE-PHILLIPS®

Instruction Manual

Instruction manual part number 342030
Revision 101 - February 2013

Brooks

Series 341

Granville-Phillips® Series 342 & 343 Mini-Ion Vacuum Gauge Modules

This Instruction Manual is for use with Granville-Phillips Series 342 & 343 Mini-Ion Vacuum Gauge Modules listed below.

GRANVILLE-PHILLIPS®

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Catalog Numbers

20342034	20343021	20343037	342006	343004
20342047	20343024	20343041	342006-EU	343004-EU
20342048	20343027	20343046	342011	343005
20342049	20343028	342002	342011-EU	343005-EU
20342054	20343029	203420	342040	343014
20342056	20343030	342002-EU	342040-EU	343014-EU

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SEE WARNINGS ON NEXT 2 PAGES

RECEIVING INSPECTION

On receipt of your 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. Contact our Customer Service Department, 5675 Arapahoe Ave., Boulder, Colorado 80303, telephone (303) 443-7660, if your shipment is not correct for reasons other than shipping damage.

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. The following illustrates to whom the claim is to be directed.

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

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Any damaged material including all containers and packaging should be held for carrier inspection. If your shipment is not correct for reasons other than shipping damage, contact our Customer Service Department, 5675 Arapahoe Avenue, Boulder, Colorado 80303, U. S. A., telephone (303) 443-7660.

LIMITED WARRANTY

This Granville-Phillips Company product is warranted against defects in materials and workmanship for one year from the date of shipment provided the installation, operating and preventive maintenance procedures specified in this instruction manual have been followed. Granville-Phillips Company will, at its option, repair, replace or refund the selling price of the product if GPC determines, in good faith, that it is defective in materials or workmanship during the warranty period, provided the item is returned to Granville-Phillips Company together with a written statement of the problem.

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CIRCUMSTANCES SHALL GRANVILLE-PHILLIPS COMPANY BE LIABLE FOR CONSEQUENTIAL OR OTHER DAMAGES RESULTING FROM A BREACH OF THIS LIMITED WARRANTY OR OTHERWISE.

WARNING

READ THIS INSTRUCTION MANUAL BEFORE INSTALLATION, USING, OR SERVICING THIS EQUIPMENT. IF YOU HAVE ANY DOUBTS ABOUT HOW TO USE THIS EQUIPMENT SAFELY, CONTACT THE GRANVILLE-PHILLIPS CUSTOMER SERVICE DEPARTMENT AT THE ADDRESS LISTED ON THIS MANUAL.

DANGER, HIGH VOLTAGE

Voltages (up to 180 Vdc) capable of causing injury or death are present in the power supply. Avoid touching the connector sockets, tube pins, and other high voltage conductors. Servicing should be performed by qualified personnel only.

DANGER, EXPLOSIVE GASES

Do not turn on the ionization gauge when there is danger of explosion from explosive or combustible gases, or gas mixtures. Ionization gauge filaments operate at temperatures sufficiently high to cause ignition.

IMPLOSION AND EXPLOSION

Glass ionization gauges if roughly handled may implode under vacuum causing flying glass which may injure personnel. If pressurized above atmospheric pressure, glass tubes may explode. A substantial shield should be placed around vacuum glassware to prevent injury to personnel.

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.

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 Mini-Ion 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

Safe operation of ion producing equipment, including the Mini-Ion Gauge, requires grounding of both its power supply and the vacuum chamber. **LETHAL VOLTAGES** may be established under some operating conditions unless correct grounding is provided.

Research at Granville-Phillips has established that ion producing equipment, such as ionization gauges, mass spectrometers, sputtering systems, etc., from many manufacturers may, under some conditions, provide sufficient conduction via a plasma to couple a high voltage electrode to the vacuum chamber. If conductive parts of the chamber are not grounded, they may attain a potential near that of the high voltage electrode during this coupling.

Potentially fatal electrical shock could then occur because of the high voltage between these chamber parts and ground.

During routine pressure measurement, using ionization gauge controllers from any manufacturer, about 160 V may become present on ungrounded chambers at pressures near 10^{-3} Torr. All isolated or insulated conductive parts of the chamber must be grounded to prevent these voltages from occurring.

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 Section 1.2, Installation, for additional information. If you have questions, or wish additional labels or literature, please contact one of our service personnel.

CHAPTER 1 - THE 342/343 MINI-ION GAUGE

1.1 INTRODUCTION

General Description

The 342 Mini-Ion Gauge measures pressures from less than 1 x 10^{-6} Torr to 5 x 10^{-2} Torr, air equivalent, using a miniature triode style of ionization gauge. The 343 Mini-Ion Gauge measures pressures from less than 5 x 10^{-8} Torr to 5 x 10^{-3} Torr - air equivalent using a miniature B-A style of ionization gauge.

Pressure readout is via a logarithmic analog voltage on the I/O connector on all models and digital readout for models with that option.

The Mini-Ion Gauge is a modular instrument intended for computer control only with no external controls or adjustments. The power supply voltage required for operation is 24 Vdc, ±15%, 12 watts.

1.2 INSTALLATION

General

The Mini-Ion Gauge can be mechanically mounted anywhere in a system in any attitude. It should be mounted in a location with free air flow and ambient temperature less than 40 °C.

Mounting Configuration

The Mini-Ion Gauge is mounted to the vacuum system by the flange only. Reasonable care should be taken to install the device where it is protected from physical damage.

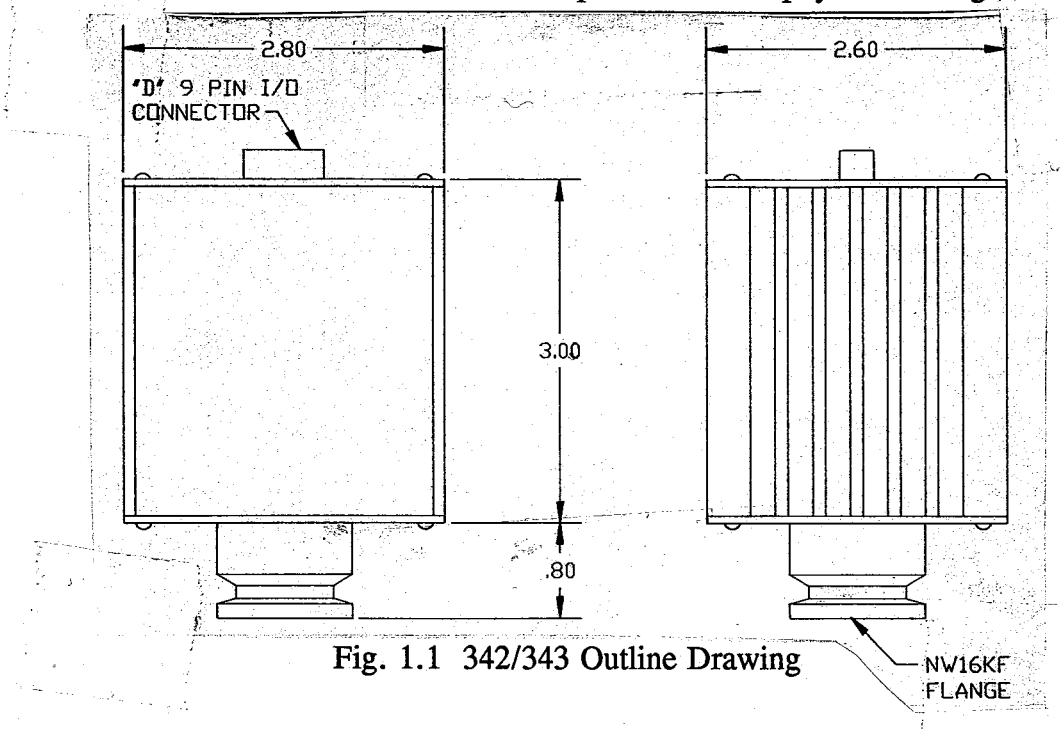

Fig. 1.1 342/343 Outline Drawing

Grounding

The Mini-Ion Gauge converts the input power to +180 Vdc for the grid supply. For safety the outer housing of the gauge must be grounded to the vacuum chamber. This is accomplished by the use of a metal clamp only for the NW16KF flange. Due to the "O" ring seal grounding cannot be assumed through the fitting. The groove in the flange of the 342 Mini-Ion Gauge has been designed to prevent the use of a non-metallic type of clamp. Do not alter the groove or a non-metallic clamp to attempt usage.

I/O Cable Connections

The I/O connector is used to operate the Mini-Ion Gauge and output the analog voltage corresponding to pressure.

Pin	Function
1	GAUGE ON/OFF. The application of a continuous ground is required for an "ON" condition. Removal of the ground turns the gauge off.
2	Power Ground. Use for input power return, IG On/OFF, Degas On/OFF, and status outputs.
3	Analog Output.
4	Input Power. +24 Vdc ±15%, 12 watts max. Protected against reversal and overvoltage.
5	Degas Status. Open collector transistor (grounded emitter) rated at 40 V max VCE, 50 mA max. Transistor off = degas off, transistor on - degas on.
6	Degas ON/OFF. Same as Gauge On/OFF.
7	Signal Ground. Use in conjunction with the analog output only.
8	Emission Current. Application of a ground increases emission current from 100 micro amps to 2 milliamps.
9	Gauge Status. Same as Degas Status.

1.3 OPERATION

Theory of Operation

The functional parts of a typical ionization gauge are the filament (cathode), grid (anode) and ion collector, which are shown schematically in Fig. 1.2. These electrodes are

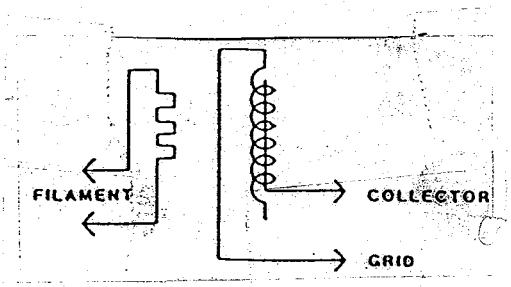

Fig. 1.2 Ion Gauge Schematic

maintained by the gauge controller at +30, +180, and 0 volts, relative to ground, respectively.

The filament is heated to such a temperature that electrons are emitted, and accelerated toward the grid by the potential difference between the grid and filament. Most of the electrons eventually collide with the grid, but many first traverse the region inside the grid one or more times.

When an energetic electron collides with a gas molecule an electron may be dislodged from the molecule leaving it with a positive charge. Most ions are then accelerated to the collector. The rate at which electron collisions with molecules occur is proportional to the density of gas molecules, and hence the ion current is proportional to the gas density (or pressure, at constant temperature).

The amount of ion current for a given emission current and pressure depends on the ion gauge design. This gives rise to the definition of ion gauge "sensitivity", frequently denoted by "K":

$$K = \text{ion current}/(\text{emission current} \times \text{pressure})$$

The triode type gauge typically has a sensitivity of 6.2/Torr when used with nitrogen or atmosphere. The B-A type gauge has a sensitivity of 5.2/Torr. Sensitivity ratios for some other gases are given in Table 1.1.

The ion gauge controller varies the heating current to the filament to maintain a constant electron emission, and measures the ion current to the collector. The pressure is then calculated from these data.

Ion gauge degas is accomplished by increasing the emission current to 10 mA resulting in an increased temperature of the grid to drive off contaminants.

Emission Current

There are two ranges of emission current available. Either 100 microamps or 2 milliamps is available as determined by the status of pin 8 of the I/O connector. While either range can be used continuously, the following guidelines are suggested. For operation in the higher pressure ranges with a clean system 100 microamperes emission is satisfactory. This will give a theoretical longer filament life and allows usage to where the gauge pressure reading overlaps with other type transducers such as the Convectron or Capacitance Manometer. For operation in the lower pressure ranges the 2 milliampere range can be used to give a more accurate pressure reading. Internal circuitry corrects the analog output voltage to pressure relationship curve for the emission current selected.

There is a problem with all ion gauges when used in systems which have the potential for diffusion pump oil vapor to enter the gauge tube. This oil vapor deposits on the grid forming an insulator and preventing emission resulting in higher and higher filament power being required and ultimate inability to control emission. In this situation the 2 milliamp position is recommended.

Table 1.1

Ion gauge sensitivity ratios, r, derived from data obtained by S. Dushman and A. H. Young, Phys, Rev. 68 278 (1945).

Gas	N_2	H_e	N_e	A_r	K_r	X_e	H_2
r	1	0.15	0.24	1.19	1.86	2.73	0.46

Analog Output

This signal is proportional to the logarithm of the pressure with 0 volts at 1 x 10^{-9} Torr. When the IG is turned off the output will switch to slightly over +10 Vdc. Refer to Fig. 1.3 for complete details.

Gas Sensitivity Correction

The 342 Mini-Ion Gauge is calibrated to read pressure for nitrogen or air. If used with gases other than this it will be required that the analog output voltage to pressure reading be corrected for the gas in use. Table 1.1 gives some typical sensitivity ratios. To correct the analog output to pressure curve reading, divide the indicated pressure reading by the sensitivity ratio.

Example

The analog output voltage is measured and found to be 4.69 Vdc which, for air or nitrogen, indicates a pressure of 5 x 10^{-5} Torr. If I know the gas type in the system is neon then

$$\frac{5x10^{-5}\ Torr}{.24} = 2.08\ x\ 10^{-4}\ Torr\ of\ neon.$$

Overpressure Shutdown

The 342 is preset by fixed component values to shut down the ion gauge should pressure rise above 5 x 10^{-2} Torr of nitrogen. The 343 is preset for a shutdown at 5 x 10^{-3} Torr of nitrogen.

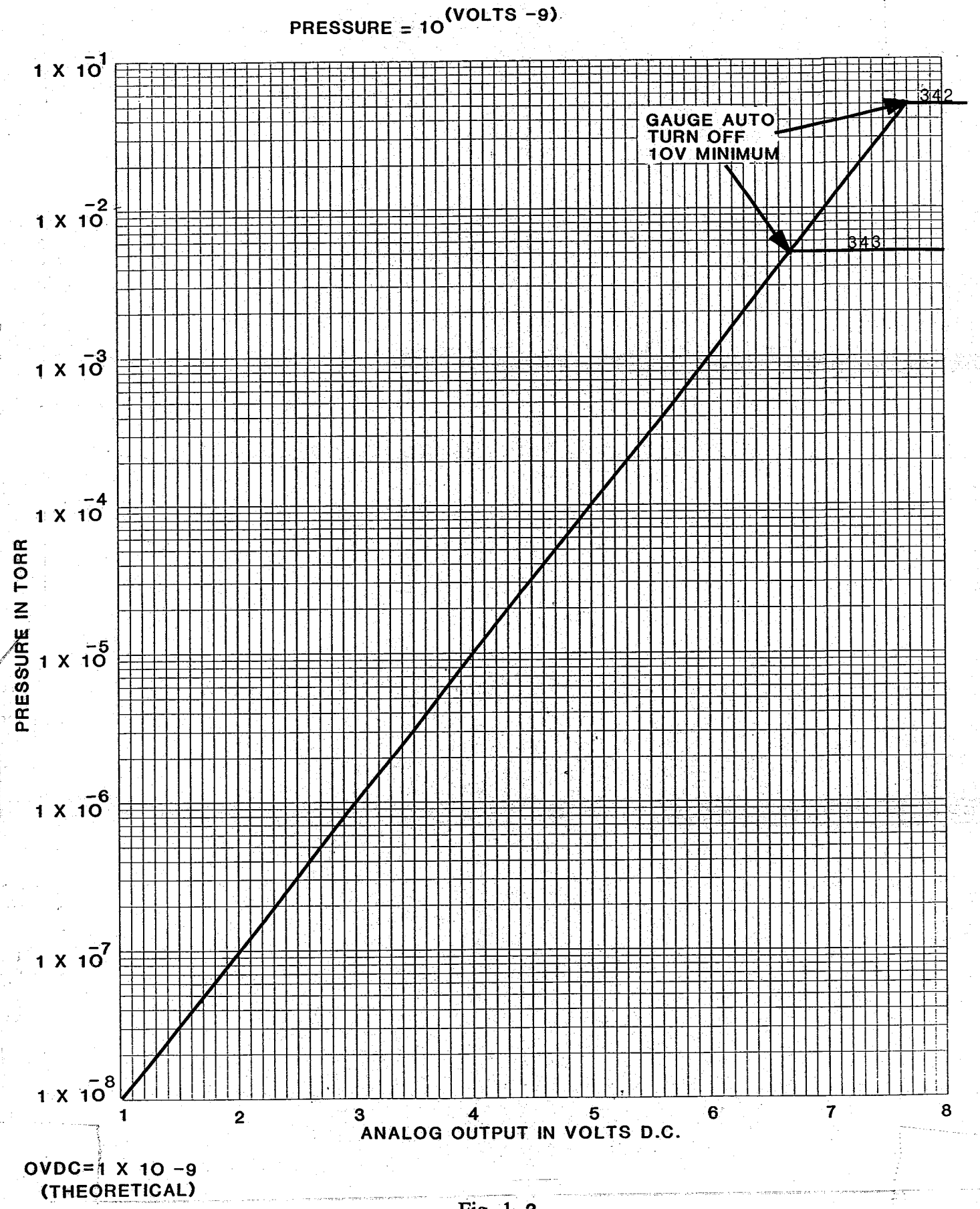
PRESSURE = 10^(VOLTS −9)
1 X 10^−1
1 X 10^−2
1 X 10^−3
1 X 10^−4
1 X 10^−5
1 X 10^−6
1 X 10^−7
1 X 10^−8
PRESSURE IN TORR
GAUGE AUTO
TURN OFF
10V MINIMUM
342
343
1
2
3
4
5
6
7
8
ANALOG OUTPUT IN VOLTS D.C.
0VDC=1 X 10 −9
(THEORETICAL)

Fig. 1.3

Gauge ON/OFF

To turn the gauge on it is required that pin 1 be grounded to pin 2 of the I/O connector. To turn the gauge off, remove the ground. Note that the application of the ground will only try to turn the gauge on once. If, for any reason, this is not successful, it will be required that the input be recycled back to off and then on again.

Possible reasons for this to happen include:

1. Initial application of power to the unit.

2. Attempt made to turn on the gauge at a pressure where emission could not be established.

3. An overpressure shutdown where system pressure exceeded the overpressure shutdown level.

Degas

Degassing of the gauge tube is accomplished by EB heating of the grid. Pressure reading during degas is allowable. Note that in order to activate the degas circuit the IG ON circuit must be first activated. This assures that there is a vacuum in the system prior to degas. Also note that the degas circuit shall turn off if the IG ON circuit is turned off. Since degassing is of limited value in the pressure range covered by this gauge, and due to the small size of the gauge, power during degas is approximately 3 watts above operating power and is turned off automatically after a two minute period.

SPECIFICATIONS
FOR MINI-ION GAUGES

PERFORMANCE

Measurement Range	-342	Less than 1×10^{-6} to 5×10^{-2} Torr for N_2.
	-343	Less than 5×10^{-8} Torr to 5×10^{-3} Torr for N_2. Operating below 1×10^{-7} Torr requires the use of a 1-5/16 inch Conflat flange.
Analog Output		Logarithmic, 1 Vdc/decade.
Overpressure Protection	-342	Gauge tube turns off if pressure rises above 5×10^{-2} Torr.
	-343	Gauge tube turns off if pressure rises above 5×10^{-3} Torr.
Emission Current		2 ranges: 0.1 mA, 2 mA.
Accuracy, Typical	-342	$\pm$15%.
	-343	+30%, -15%.
Operating Voltage & Power		+24 Vdc $\pm$15%, 12 watts max.
Degas		Electron bombardment, approximately 3 watts with 2 minute timer.

PHYSICAL

Vacuum Connection	NW16KF flange or 1-5/16 inch Conflat.
Electrical Connection	9 pin "D" connector.
Weight	13 oz.
Case Material	Aluminum extrusion.
Gauge Design	Based on proven triode or B-A designs with thoria coated iridium cathode operating at low emission for long gauge tube life.
Gauge Tube Replacement	Field replaceable using only Phillips type screwdriver.
Electrical Safety	Metal enclosure which houses 180 V supply will require use of a metal clamp to assure ground continuity to system.
Operating Temp Range	0 °C to 40 °C.
Non-operating Temp Range	-40 °C to 70 °C.

NOTES