INSTRUCTION MANUAL

Digivac Model 276

Digital Vacuum Gauge

Digivac Models
Model 276

276 Ranges
.001 to 760 Torr
.001 to 1013 milliBar

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1.0 DESCRIPTION AND PRINCIPLE OF OPERATION.

The DIGIVAC Model 276 gauge is a compact digital vacuum sensing instrument. It uses a thermocouple gauge tube in combination with a piezoelectric transducer element to sense vacuum and display the reading in Torr. The Digivac Model 276 sits on a bench top and has 2 optional SPDT controls, analog output, RS232 data and Ethernet available. If in doubt about what gauge sensor you have, consult the Digivac packing list that came with your instrument for positive identification.

Consult the Digivac website www.digivac.com for information about other Digivac vacuum controllers and gauges.

The Digivac Model 276 thermocouple circuitry operates by measuring the temperature rise of an electrically heated thermocouple exposed to a vacuum. As vacuum increases, or, more correctly, as absolute pressure decreases, fewer and fewer molecules of gas are available to cool the thermocouple. With less molecules the air temperature rises and the thermocouple gauge thus senses the vacuum. A precision reference inside the Digivac in conjunction with an integrated circuit amplifier controls the electrical excitation of the sensor filament. .

2.0 CONSTRUCTION.

The base model 276 consists of the indicating and controlling instrument, the sensing tube, the sensing tube cable and an AC power adapter.

The instrument is housed in a rugged vinyl clad metal enclosure. The gauge tube houses the various thermocouple sensing, heating and compensating elements, the transducer and terminates in an RJ45 connector. Regulating circuitry in the instrument provides constant current for gauge tube excitation, and thus compensates for resistance in the probe leads.

3.0 UNPACKING AND INSPECTION.

After the DIGIVAC is received, it should be carefully unpacked and inspected for damage during shipment and for completeness. The package should contain, as a minimum, the instrument, the thermocouple gage tube, the tube connecting cable, and an instruction manual. In the event of a loss during shipment, a claim should immediately be made to the common carrier or the postal service, as applicable. The Digivac warranty pertains only to the instrument, and does not cover losses in shipping.

4.0 INSTALLATION.

The instrument should be located in a clean, dry environment for best results. The unit can be placed on a desktop. The gauge tube cable should be identified by wire tags or markings specific to your environment.

Thermocouple gauge tubes must be installed in a thread-down orientation in a clean, dry vacuum system. While threading the gauge tube in to the manifold, the gauge tube cable should be disconnected to avoid damage. In this way, twisting of the cable and the octal socket on the tube is avoided. Care should be exercised to install the tubes in a dry part of the system. Since the instrument works on the principle of temperature rise, the probes will not work if they become filled with a liquid such as vacuum or diffusion pump oil. The gauge tube should be protected against oil and other contaminants by installing it in such a way to protect it. A good practice is to mount the gauge tube in the most vertically distant place from oil and other contaminants as applicable. The gauge tube should be mounted in the most stable pressure region of the vessel to be measured. For example, it would be better to install the gauge tube on a tank rather than on the pipe that is directly connected to a vacuum pump. In the event of contamination, see section 6.0 for gauge tube cleaning instructions.

If the gauge is used in a Neon sign processing facility, the following is recommended to protect the gauge from damage from bombarding:

- The gauge tube should be isolated from the system with a stopcock. The stopcock should be closed when bombarding.
- There should be at least 2 feet of tubing between the electrode and the Digivac. For best results, the tubing should be metal.
- In extreme cases, the gauge can be absolutely protected by installing a normally open solenoid valve between the gauge tube and the system. The solenoid valve coil should be in parallel with the bombarding transformer. In this way, the solenoid will be closed and the gauge tube will be positively protected whenever bombarding is done.
- If a gauge is damaged by bombarding, it can generally be brought back to operating condition by replacing the Op amp which controls the gauge tube current. Consult Digivac.

The set point connections are in the back of the unit. There are 2 rows of pins. The top row of pins is for set point 1, and the bottom row of pins is for set point 2. The top 3 pins are in the order:

1. common – The common line of a switch
2. N.C. – Normally closed. This means that above the set point value there is a current path between the common and the N.C. terminal. Put another way the switch is “ON” between these 2 terminals. At the set point value and below (higher vacuum, lower pressure) the connection is open. Put another way, the switch is “OFF” between the common and the N.C. connection at higher vacuum (a lower vacuum reading).
3. N.O. – Normally open. This means that above the set point value there is no current path between the common and N.O. connection. Put another way the switch is “OFF” between these 2 terminals. When the vacuum indication goes below the set point value (higher vacuum, lower pressure) the current path closes. Put another way the switch is “ON” between the N.C. and N.O. connections at absolute vacuum readings below the set point value.

Take care in insuring that the wire connections are made fast, and the voltage and current does not exceed 250V or 7A. If you need to control a device that draws more power, consider another relay in between the Digivac output and the device to be controlled

The Analog output is located in the center of the back panel, and should be connected to a high impedance input. The output impedance is 1KΩ.

The RS232 connection can be made to a PLC or computer via a male DB9 cable connection to the female DB9 connection on the Digivac. The Digivac acts as a DCE, so a straight serial connection is appropriate.

Please use the supplied 5V AC adapter with your Instrument. This adapter provides clean short protected power to protect and insure accuracy of the internal circuitry.

5.0 OPERATION.

After installation, the DIGIVAC is ready for immediate operation. The unit will normally provide accurate readings immediately, however occasionally a gauge tube will have absorbed material during storage and may require as much as 24 hours of operation before accurate readings are attained. It is recommended that the DIGIVAC be energized continuously during vacuum system operation so that the hot filament will not allow contaminants to condense.

In cases where the system has contaminants, as is often the case with metalizing and coating equipment, it is often effective to isolate the gauge tube with a solenoid or manual valve during periods when contamination is most active.

6.0 SERVICING - GAUGE TUBE CLEANING.

In many cases, a gauge tube may become fouled with oil or other foreign matter. It is often possible to restore the functionality of contaminated probes with cleaning. If the contaminant is known, the tube should be filled with a fluid that is known to be a solvent to that contaminant. As an example, ether is often effective in removing residues of some oils. Commercial carburetor cleaners are very powerful solvents and are highly effective against some contaminants.

After cleaning with solvents, the gauge tube should be completely dried or flushed with a volatile solvent to assure that it is dry prior to re-installing it. If this is not done, contamination of the system may result.

6.1 FACTORY REPAIR AND CALIBRATION.

The vacuum gauge assembly is designed to provide years of trouble-free service, and the liberal internal use of plug-in components make it easily repairable. No field servicing of the unit is recommended other than replacement of the gauge tube if onsight calibration facilities and knowhow exist, but factory servicing and calibration are available at a nominal cost and turn-around times of 24 hours are typical.

6.2 FIELD CALIBRATION.

Each Digivac vacuum gauge controller is calibrated to the particular vacuum gauge sensor that is shipped with the unit. While changing the sensor is possible, it will result in a slightly different reading as all gauge tubes are not created equal. Although it is preferable that all calibration be performed at Digivac, field calibration can be accomplished.

Before re-calibrating the instrument, it should be ascertained that the instrument is in fact incorrect. In many cases, the problem will be with a tube that is fouled, or a system that is operating improperly. It is recommended that a spare tube be kept on hand and stored in a clean, dry place. Then, in cases of suspect readings, the tube should be changed before proceeding further.

If adjustments are to be made, proceed as follows:

A) Acertain if you have the “button” calibration or the “no button Calibration” scheme. Unless otherwise noted on the packing slip, it is likely that you have the “button” calibration scheme.
B) Remove the Instrument from the panel.

C) Remove the front panel cover of the instrument and locate the two thermocouple calibration potentiometers. These 2 Potentiometers have either “ATM” or “Vac” etched into the circuit board to the right of the display. Also locate the transducer span potentiometer which is a taller potentiometer to the left of the display

D) Operate the vacuum system at the lowest attainable pressure, and allow the system and the gauge tube to stabilize for several minutes. Factory zero setting is done at a pressure of .1 milliTorr (.1 micron) or less.

E) Adjust the zero setting potentiometer so the unit reads zero. Make sure not to under span. Allow the measurement standard to rise to 1 milliTorr and make sure the gauge reading also reads 1 milliTorr.

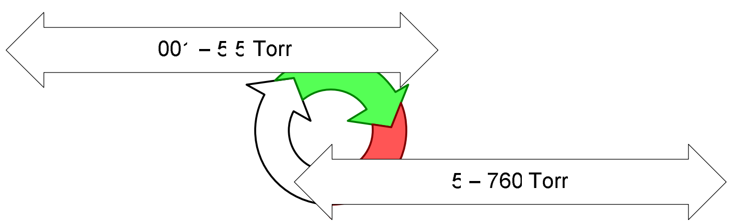
F) Check the operation of the gauge at other pressures below 1 Torr. Normally, adjustment of the zero will not be interactive with the readings of the instrument at higher pressures.

G) Note the Transition Region.

   a. For button calibration models: The transition region is between 3 and 8 Torr. When the pressure is rising from 1 milliTorr to 3 milliTorr, the unit is indicating vacuum based on the thermocouple sensor. From 3 to 8 milliTorr the unit is indicating vacuum based on a percentage blend between the thermocouple sensor and the transducer. At a measurement above 8 milliTorr, the unit is basing the vacuum level indication soley on the tranducer data. Note that the Thermocouple determines what region the unit is in.
      i. Set the vacuum level so the 276 indicates 7 Torr
      ii. Adjust the “ATM” potentiometer while holding the button down so the 276 reads what the standard reads, being careful that the 276 not go over 7.5.
      iii. If the unit goes over 7.5, bring the vacuum level so the 276 reads less than 2 Torr, and then go back to step i.
      iv. Repeat steps i-iii until the 276 matches the standard at 7 Torr within .5 Torr.

   b. For “no button” calibration models, the 276 is in the transition region from 5 Torr to 5.5 Torr. When the pressure is rising from 1 Torr through 5.5 Torr, the reading is being taken from the Thermocouple. At 5.5 Torr, the vacuum reading is being taken from the transducer.

Sensor Transition Region



Similarly as the pressure level is decreased from 760 Torr to 5 Torr, the vacuum reading is taken from the transducer. At 5 Torr, the vacuum reading transitions to being taken from the Thermocouple.
      i. Set the vacuum level so the standard reads 35 Torr.
      ii. Set the Transducer potentiometer so that th 276 reads the same as the standard at 35 Torr.
      iii. Slowly raise the vacuum level to below 2 Torr, then to approximately 4.5 Torr, making sure not to let the 276 go over 5 Torr, and adjust “atm” potentiometer so unit matches the standard.
      iv. Repeat D-G until no calibration is necessary with an accuracy of within 1 milliTorr near zero, and within 1 Torr near 5 Torr.

H) Bring the vacuum level to atmosphere (760Torr) and check that the 276 reading agrees to within 10 Torr.

7.0 NOTES ON CALIBRATION.

The DIGIVAC is calibrated in nitrogen, which has thermal properties virtually identical to air. Other gasses will affect the readings by an amount proportional to the thermal conductivity of the gases. In most cases, the gases present in a vacuum system will be air, nitrogen, or oxygen, and no appreciable errors will occur.

Certain other gases, however, have thermal conductivity significantly greater than air and will cause the instrument to read higher than the actual amount of pressure. Examples of such gasses are water vapor, fluorocarbon refrigerants, and acetone. Conversely, other gasses have thermal conductivity significantly lower than air and will cause the instrument to read lower than actual pressure. Examples of such gasses include helium, oxygen and to a lesser extent, CO_2.

When interpreting readings using gasses other than air, it should be borne in mind that the DIGIVAC reads Torr, which is a measure of absolute pressure - that is the opposite of vacuum. Thus, a lower numerical reading actually is a higher level of vacuum. For more information, refer to section 8.0.
When in doubt, consult Digivac.

8.0 UNDERSTANDING TORR.

The DIGIVAC and many similar instruments are calibrated in microns or "milliTorr." It is appropriate to discuss what microns are and to relate microns to other measures of pressure and vacuum.
Microns are not really a measure of vacuum at all, but rather of absolute pressure. It will be recalled that the pressure of the atmosphere is 14.696 or approximately 14.7 pounds per square inch at sea level. This pressure is due to the weight of all of the air in the earth's atmosphere above any particular square inch. This 14.696 psi is equivalent to the pressure produced by a mercury column of approximately 29.92 inches high or .76 meters (about 3/4 of a yard) or 760 millimeters of mercury. Atmospheric pressure varies greatly with altitude. It decreases approximately 1 inch of mercury per thousand feet of altitude. It also varies widely with local weather conditions. (Variations of one half inch in a single day are common.) The word vacuum means pressure lower than atmospheric or "suction," but, in describing negative pressure, the atmosphere is only a satisfactory reference if we are dealing with values of vacuum down to about 27 inches of mercury. Below that, it is much more useful to talk in terms of absolute pressure, starting from absolute zero. The DIGIVAC and all similar instruments do just this.

One TORR, a commonly used unit, is an absolute pressure of one millimeter of mercury. A milliTorr is equal to one thousandth of a TORR. A MICRON is the same as a milliTorr. The full scale reading of a DIGIVAC is 1999 microns and is equivalent to 1.999 TORR of approximately 2/760 of atmospheric pressure. This is less than .1 inches of mercury, and less than .05 PSI.

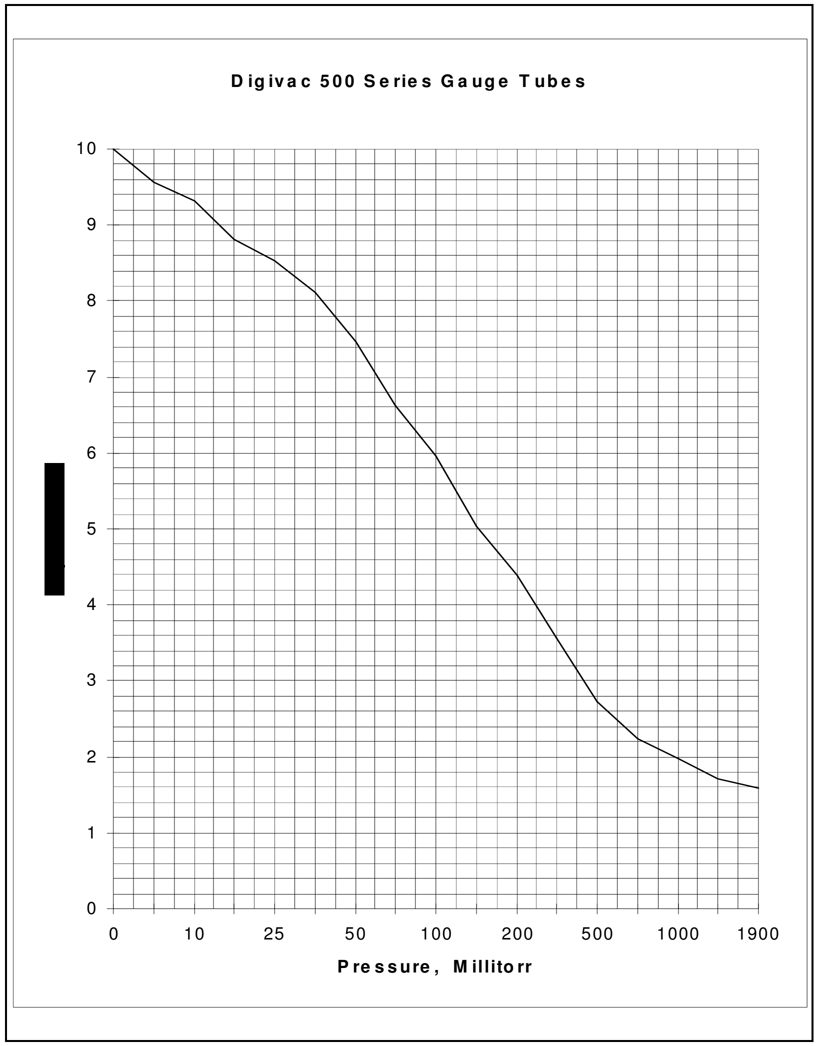
9.0 ACCESSORIES AND MODIFICATIONS.

The following are offered as accessory equipment or field-installed modifications.

Padded shoulder strap Case with Velcro closure- For instruments that will be used in the field, particularly in cryogenic applications, a padded shoulder strap case is available. This case holds a Digivac 100tc battery powered gauge in the optimal reading position. The operator can open the Velcro cover, pull out the gauge tube cable, plug it into the tube on the equipment, and see the reading. It was developed to assist in field service of cryogenic tank farms and vacuum jacketed piping.

Below is the typical response of a thermocouple vacuum gauge tube.
Digivac gauges which use pressure transducers are linear.

Milli-Torr	Milli-volts
0	10
5	9.57
10	9.32
20	8.81
25	8.54
35	8.11
50	7.46
75	6.63
100	5.96
150	5.04
200	4.38
300	3.56
500	2.72
750	2.24
1000	1.97
1500	1.71
1900	1.59



Typical response of a Hastings Dv-6 and Dv-36 tubes