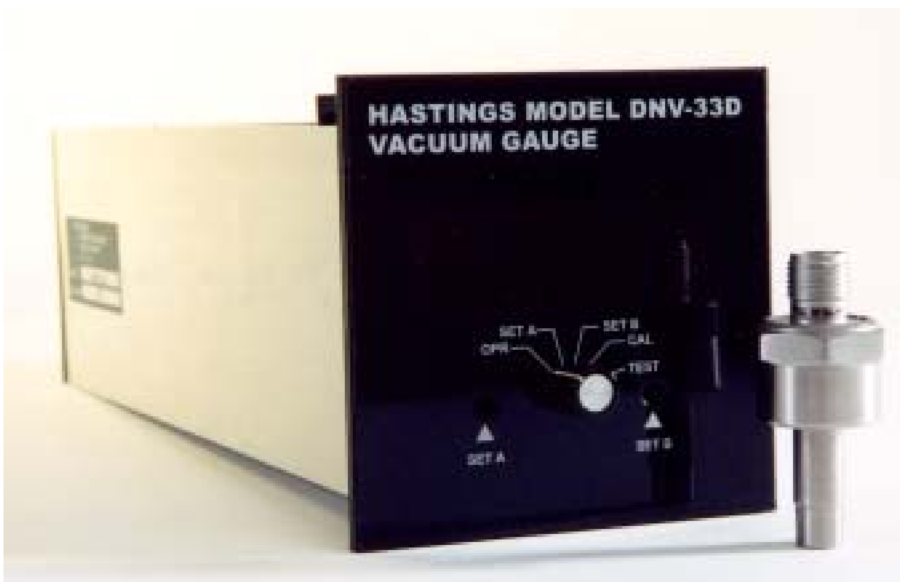
TELEDYNE HASTINGS

INSTRUCTION MANUAL

INSTRUMENTS

HASTINGS MODEL DNV-33D VACUUM GAUGE



TELEDYNE INSTRUMENTS
Hastings Instruments
A Teledyne Technologies Company

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Manual Print History

The print history shown below lists the printing dates of all revisions and addenda created for this manual. The revision level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new revision is created, all addenda associated with the previous revision of the manual are incorporated into the new revision of the manual. Each new revision includes a revised copy of this print history page.

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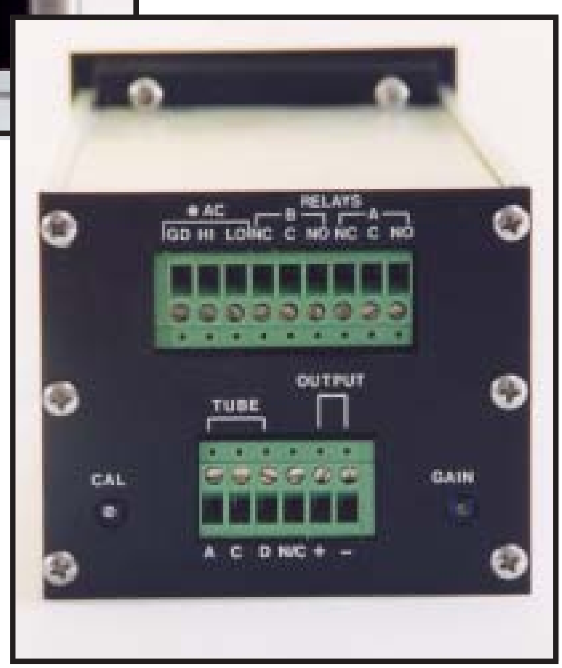
SECTION I

General Description

The Hastings Digital Vacuum Gauge, Model DNV-33D, incorporates proven Hastings thermopile technology to produce a linear vacuum gauge that covers the range of 1-1000 mTorr. The digital display reads directly in mTorr. The instrument provides an analog output signal which may be used to drive a remote indicator for recording, data logging, etc. The output is scale is 1 volt for 1000 mTorr.

The DNV-33D also includes dual set points (A set and B set) with LED indicators located on the front panel. Relay contacts are also provided for remote switching.

The rear panel of the instrument provides access to terminal blocks for AC power cord, gauge tube, relays and analog output connections. The calibration adjustment potentiometers may also be accessed through the back panelof the unit. The instrument is factory calibrated on a standard average curve for DNV-33 vacuum gauges.



Operating Principle

The operation of Hastings vacuum gauges uses a patented noble metal thermopile circuit. The hot junctions of the thermopile are heated directly by an AC current while an equal number of cold junctions are kept at ambient temperature by heavy mounting studs. Thus a DC voltage is then generated between the hot and cold junctions. As the pressure decreases, the lowering of the thermal conductivity of the gas surrounding the hot junction tends to increase the temperature of the hot junctions, thus increasing the output of the thermopile. This change in output is then amplified, linearized, and calibrated as a function of pressure.

1.0 SPECIFICATIONS

Indicator Model DNV-33D

Case Dimension .... Front Panel 96mm SQ. Depth 10 ¾”

Gauge Tube Type DV-33D-1, DV-33D-2, DV-33D-3*

Gauge Tube Shell .... Welded stainless steel shell

Overpressure .... 1500 PSIG max.

Panel Cut-out .... 3-1/16” (77.5 mm) H x 3-5/8” (92mm)W

Range .... 1-1000 mTorr

Readout .... Digital Meter

Power .... 115 VAC, less than 6 watts

Outputs .... Linear 0-1 VDC analog @ 4 ma. Max.

Calibration .... Calibrated for air or nitrogen

*Dash number Defines System Fitting Differences:

-1 Weld Fitting
-2 Cajon #SS-4 VCR Male Gland
-3 Cajon #SS-4 VCR Female Gland

2.0 INSTALLATION

QUICK START

- Install DV-33D gauge tube in vacuum system (see section 2.4). Ensure system is leak free.
- Connect the tube to the DNV-33D power supply/display and apply 115 VAC. Allow 30 minutes for warm-up (see section 3.1).
- Set the switch on the DNV-33D to the “OPR” position for normal operation (factory calibration).
- Set the switch on the DNV-33D to the “Set A” position. The relay will now be energized when the pressure is less than the set point. The set point LED will be on when the relay is energized. The set point may be set by adjusting the appropriate potentiometer on the front panel.
- Set the switch on the DNV-33D to the “Set B” position. The relay will now be energized when the pressure is less than the set point. The set point LED will be on when the relay is energized. The set point may be set by adjusting the appropriate potentiometer on the front panel.
- Set the switch on the DNV-33D to the “CAL” position. This is to be used when zeroing the gauge with the tube at a pressure less than 0.1 mTorr.
- Set the switch on the DNV-33D to the “TEST” position. Use this position to check the DNV-33D and to set the gain for individual tubes.

2.1 Panel Mounting

The DNV-33D instrument package can be mounted in a 3-1/16 inch high by 3-5/8 inches wide hole. Secure the gauge with the mounting brackets provided.

2.2 Connect the Gauge Tube wire to the gauge as follows:

REAR PANEL “TUBE”	GAUGE TUBE PIN #	WIRE COLOR
A	A	BLACK
C	C	WHITE
D	D	GREEN

2.3 Connect other wires to relay contacts and output terminals.

2.4 Gauge Tube Installation

Install the gauge tube in a clean, dry vacuum system with the open end pointing down so as to be self-draining should any vapors condense within the tube (See Sec. 5.1). For maximum accuracy, it is recommended that the tube be outgassed in the vacuum system for a minimum of 4 hours.

3.0 OPERATION OF VACUUM GAUGE

3.1 Powering of Vacuum Gauge

Plug the 8 ft. power cable into a single phase 115 VAC (DNV-33D) or 230 VAC (ENDV-33D)line. A line frequency of either 50 or 60 Hz is satisfactory. Allow 30-40 minutes for warm-up.

Plug the gauge tube cable onto the gauge tube. When the tube is exposed to a pressure greater than1000 mTorr, the analog output will be over 2 volts, and the display will read "1".

The relay will energize when the pressure is below the trip points. "Normal" relay position is de-energized (ATM pressure side of set point.)

3.2 Switch Position

"OPR" Normal operating position. Display reads pressure. Output on back panel reads 0-1 volt.

"SET A; SET B" Displays the trip point of the appropriate relay. If the pressure is below the trip point the relay is energized and the LED will be lit. The trip points can be set from 0-950 mTorr. The relay trip points are set by adjusting the appropriate pot located on the front panel.

"CAL" Used when zeroing the vacuum gauge tube at hard vacuum. Adjust the Cal pot on the rear panel for 000 on the display.

"Test" A voltage is injected into the 2nd stage AMP so that the GAIN of the gauge can be set on the average curve. Adjust 'GAIN' pot on rear panel for "400" on the display. NOTE: The signal output will change when the switch is put in this position and the set points may trip. See section 4.2.1 Reference Check.

4.0 CALIBRATION AND TROUBLESHOOTING GUIDE

All Hastings vacuum gauges and tubes have been carefully checked and calibrated at the factory before shipment. If a calibration check is desired the methods in the following sections may prove helpful.

4.1 Check of Tube Accuracy

The simplest and quickest method of checking the operation and calibration of power supply/ display and gauge tube is to keep a new, clean gauge tube on hand as a "standard". To check operation, install both of the gauge tubes together in the same clean, dry vacuum system, and pump until a steady pressure is obtained. Plug the gauge onto both tubes alternately and check reading. Be sure to allow time for readings to settle. If the tube reads a considerably higher pressure than the tube being used as a standard, a calibration shift in the old tube has occured. This is most likely resulting from tube contamination. The tube calibration can possibley be restored by gently rinsing the interior of the tube with a solvent such as trichlorethylene. After cleaning, thoroughly dry the tube and degas it before reinstallation into a vacuum system. This is done to avoid system contamination by the solvent. If calibration cannot be restored by this precedure, replace the old tube with a new gauge tube.

CAUTION: Do not attempt to measure the resistance of the gauge tube element while it is under vacuum. Some ohmmeters apply measuring voltages sufficient to burn out the thermo-pile while under vacuum. The resistance of the gauge tube can be measured safely at atmo-spheric pressure. This measurement is made between pins 3, 5 and 7 counting clockwise from the key looking at the base of the gauge tube. A measuring device such as the Triple Model 630 Test Set with ohms switch on the "X10" range, is suitable for this purpose.

4.2 DNV-33 Calibration

All calibration voltages are factory set and will rarely change. The methods for checking gauge calibration are detailed below:

4.2.1 Reference Check

The DNV-33D incorporates a quick reference check reading. To utilize this feature the front panel switch must be in the TEST position. In this position the digital display should read "400" (+3). If it does not read this the calibration GAIN pot should be adjusted to bring the reading back to "400". This will bring the gauge back on the standard average calibration curve. NOTE: The signal output will change when the switch is put in this position and the set points may trip.

Pump the gauge tube down to hard vacuum. Set the front panel switch to the 'CAL' position. Adjust the 'CAL' pot in the rear of the unit for 000 on the display. If there is a midscale reference available to the system, see section 4.2.3 on recalibration. Calibration is complete for use with the standard average curve.

4.2.2 Recalibration for Different Length Gauge Tube Cables

A maximum of 100 feet of gauge tube cable can be utilized by the DNV-33D. If the cable length or size (18 gauge) is changed, the unit must be recalibrated. The procedure for recalibration is described in section 4.2.1.

4.2.3 Optimizing Gauge Tube Accuracy

Individual tubes can be trimmed for best fit upscale on the curve by performing a calibration adjustment of the gain pot vs. tube output against an accurate reference standard, to do this:

Pump the gauge tube down to hard vacuum. Set the front panel switch to the "CAL" position. Adjust the "CAL" potentiometer in the rear of the unit until the display reads 000.

Pump the system to a known pressure using a reference in the system. At this pressure, adjust the gain potentiometer until the display reading matches the reference reading. The unit should now be calibrated. Best average fit to the curve will occur if 700 mTorr is used for this setting. Do not use this instrument with another tube unless resetting the gain to "400" per 4.2.1 or performing the above procedure for the specific tube.

5.0 Notes on Vacuum Measurements

5.1 Effects of Condensable Vapors

If the readings of Hastings gauges are to be compared with readings of other types of gauges, consideration must be given to the possible effects of condensable vapors on other gauges. For example, none of the many types of McLeod gauges, give correct readings if condensable vapors such as water, alcohol, acetone, etc., are present in the gauge. The McLeod gauge operates by compressing residual gases and vapors to obtain a reading, and this compression will tend to compress vapors that are present. This usally results in pressure reading that is lower than the actual pressure. Furthermore two different McLeod gauges could be used and both may have different readings. Both of these readings however could be incorrect if vapors are present. Hastings thermopile gauges however, have the useful property of responding to the total pressure of all gases and vapors that are present in the gauge tube.

To exclude vapors from a vacuum system, it is necessary to employ a trap of some kind that will absorb or condense vapors. Water vapor is by far the most common source of this difficulty. A cold trap cooled by liquid nitrogen is an effective means in removing vapors.

It may be necessary to keep McLeod gauges constently under vacuum for several hours, or days with a trap before it will read correctly. The use of rubber or Tygon tubing connecting the gauge to the vacuum system can lead to gross errors due to excessive outgassing and or adsorbtion by the tube. It is recommended that only glass or metal tubing be used. Reference should be made to the instructions furnished by the manufacturer of the McLeod gauge to be sure that it is provided with a suitable trap.

5.2 Outgassing

Hastings gauge tubes are fabricated from materials which have been proven by years of usage to be relatively free from outgassing. However; all surfaces of glass and metal that are exposed to the vacuum system may liberate gases and vapors that were previously adsorbed during exposure to the atmosphere. If the surfaces are contaminated with foreign matter, this outgassing may be much more persistent than if the surfaces are clean. The possibility of outgassing must be considered in checking the accuracy of Hastings gauges or in checking for leaks. This is especially important when working with pressures of less than 10 mTorr where atmospheric gases are likely to flood the enclosure due to leaks.

Also, if the system is being pumped continuously, gauges spaced at different distances from the pump will register different pressures. For a reliable comparison of different vacuum gauges, it is necessary then to insure that the vacuum system be free of any outgasses or other sources of apparent leaks. This can best be determined by closing off the system from the pumps and observing if there is any rise in pressure within the range of interest.

5.3 Ingassing

Ingassing is an effect opposite to outgassing and may also lead to erroneous readings. Ionization gauges exhibit a kind of pumping action that tends to clean up residual gasses in certain ranges of pressure and thereby lower the pressure. Also, if a cold trap is in a closed system, the total pressure may change considerable while condenseble vapors such as water, carbon dioxide and mercury and being condensed.

5.4 Effects of Thermal Conductivity

All Hastings vacuum gauges are originally calibrated in dry air. Since this calibration is a function of thermal conductivity, any gas having a thermal conductivity different from that of air will also have a different calibration. Contact factory for calibration in gases other than air.

5.5 Effects of System Conductance

Each element that makes up a vacuum system has associated with it a certain conductance (that is the opposite of resistance). For example, baffles, connecting tubing, and sharp turns may cause pressure drops throughout the system during pumping and during the time in which the system is reaching static equilibrium. It is not an uncommen occurence to measure different pressures at different locations in a vacuum system. In checking the calibration of a vacuum gauge, care must be taken to insure that the gauge and the reference are at the same pressure.

SECTION 6

Warranty

6.1 Warranty Repair Policy

Hastings Instruments warrants this product for a period of one year from the date of shipment to be free from defects in material and workmanship. This warranty does not apply to defects or failures resulting from unauthorized modification, misuse or mishandling of the product. This warranty does not apply to batteries or other expendable parts, nor to damage caused by leaking batteries or any similar occurrence. This warranty does not apply to any instrument which has had a tamper seal removed or broken.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty as to fitness for a particular use. Hastings Instruments shall not be liable for any indirect or consequential damages.

Hastings Instruments, will, at its option, repair, replace or refund the selling price of the product if Hastings Instruments determines, in good faith, that it is defective in materials or workmanship during the warranty period. Defective instruments should be returned to Hastings Instruments, **shipment prepaid,** together with a written statement of the problem and a Return Material Authorization (RMA) number. Please consult the factory for your RMA number before returning any product for repair. Collect freight will not be accepted.

.2 Non-Warranty Repair Policy

Any product returned for a non-warranty repair must be accompanied by a purchase order, RMA form and a written description of the problem with the instrument. If the repair cost is higher, you will be contacted for authorization before we proceed with any repairs. If you then choose not to have the product repaired, a minimum will be charged to cover the processing and inspection. Please consult the factory for your RMA number before returning any product repair.

TELEDYNE HASTINGS INSTRUMENTS

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E MAIL	hastings_instruments@teledyne.com
INTERNET ADDRESS	http://www.teledyne-hi.com/

Repair Forms may be obtained from the “Information Request” section of the Hastings Instruments web site.