

TELEDYNE HASTINGS INSTRUMENTS



INSTRUCTION MANUAL

HPM 4/5/6 VACUUM GAUGE



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.

Revision A (Document Number 175-032014) March 2014
Revision B (Document Number 175-102014) October 2014



Visit www.teledyne-hi.com for WEEE disposal guidance.



Contact with harsh solvents and chemicals to any plastic parts of the HPM 4/5/6 Vacuum Gauge can damage the unit and may void the warranty.



Instrument repair should only be performed by Teledyne Hastings service technicians.



Disconnecting gauge tube by pulling on the cable may result in damage to the octal socket and/or cable. Always disconnect by pulling on the Octal Connector.

Hastings Instruments reserves the right to change or modify the design of its equipment without any obligation to provide notification of change or intent to change.

Table of Contents

1.0	GENERAL INFORMATION	4
1.1.	FEATURES	4
1.2.	SPECIFICATIONS	4
1.3.	SAFETY	5
1.4.	ACCESSORIES	5
1.4.1.	INSTALLATION ACCESORIES	5
1.4.2.	CALIBRATION REFERENCE TUBES	5
2.0	INSTALLATION	7
2.1.	RECEIVING INSPECTION	7
2.2.	BATTERY INSTALLATION/REPLACEMENT	7
2.3.	CABLE REMOVAL/INSTALLATION	7
3.0	OPERATION	9
3.1.	FRONT PANEL	9
3.1.1.	PRESSURE GRAPH	9
3.1.2.	BATTERY LEVEL	9
3.1.3.	TUBE TYPE	9
3.1.4.	CURRENT PRESSURE	9
3.1.5.	PRESSURE UNITS	9
3.1.6.	POWER/ENTER KEY	10
3.1.7.	DV SELECT/UP KEY	10
3.1.8.	UNITS SELECT/DOWN KEY	10
3.2.	ELECTRICAL CONNECTOR	10
3.3.	QUICK START	10
3.4.	USER OPTIONS/ADJUSTMENTS	11
3.4.1.	AUTO-SHUTOFF	11
3.4.2.	CONTRAST ADJUST	11
3.4.3.	CALIBRATION	11
3.4.4.	PREPARATION	11
3.4.5.	ENTER CALIBRATION MODE	11
3.4.6.	SELECT THE TUBE TYPE	11
3.4.7.	SELECT THE UNITS	11
3.4.8.	ADJUSTMENT	12
3.5.	THERMAL COEFFICIENT	12
4.0	WARRANTY	13
4.1.	WARRANTY REPAIR POLICY	13
4.2.	NON-WARRANTY REPAIR POLICY	13

1.0 General Information

This manual contains technical and general information relating to the installation, operation, and calibration of Teledyne Hastings Vacuum Gauges, and Gauge Tubes.

For best performance, Hastings vacuum gauges should be operated with the appropriate Hastings gauge tube. Attempting to use a Hastings vacuum gauge with other manufacturer's tubes may result in damage to both the gauge and tube.

1.1.Features

The HPM 4/5/6 is a battery-operated hand-held vacuum gauge supporting vacuum measurements using the Teledyne Hastings DV-4, DV-5 and DV-6 series vacuum gauge tubes. It is designed for portability and ease of use in applications where AC power is not readily available.

Digital circuitry is used to power the vacuum gauge tube and convert its signal output for display. The lightweight unit operates with a standard 9 volt battery, and can be user-configured to display in units of Torr, mbar, or Pascal.

The device can be calibrated from the front panel using an in-system vacuum tube at known vacuum or out-of-system using a Hastings Reference Tube. Front panel buttons enable switching between DV-4 (0.1 to 20 Torr), DV-5 (0.0001 – 0.1 Torr), and DV-6 (0.001 to 1 Torr) Hastings vacuum gauge tubes. These tubes are rugged, noble-metal sensors which are resistant to corrosion and can be ordered with a variety of system connections to meet your system's requirements such as VCR®, KF-16, KF-25, Glass, MiniConflat™ and 1/8" NPT, etc.

1.2.Specifications

RANGE.....	
DV-4.....	0.01 – 20 Torr
DV-5.....	0.1 – 100 mTorr
DV-6.....	0.001 – 1.0 Torr
ACCURACY	
CALIBRATED WITH TUBE.....	
With DV-6 tube (0.001 – 1 Torr)	± (15% of reading +.001 Torr) (Max)
With DV-4 tube (0.01 – 10 Torr)	± (20% of reading +.02 Torr) (Max)
With DV-5 tube (0.0001 – 0.1 Torr)	± (15% of reading +.0001 Torr) (Max)
CALIBRATED WITH REFERENCE TUBE.....	
With DV-6 tube (0.001 – 1 Torr)	± (15% of reading +.003 Torr) (Max)
With DV-4 tube (0.01 – 10 Torr)	± (20% of reading +.04 Torr) (Max)
With DV-5 tube (0.0001 – 0.1 Torr)	± (15% of reading +.0002 Torr) (Max)
OPERATING TEMPERATURE RANGE	
With alkaline battery (included).....	-18°C to 55°C
With lithium battery	-20°C to 60°C
Externally powered	-20°C to 70°C
STORAGE TEMPERATURE RANGE (without battery)	-20°C to 70°C
INPUT VOLTAGE.....	5.5 – 9.5 VDC, (9V Battery)
BATTERY LIFE (with included alkaline battery)	Greater than 30 hours operation

HPM 4/5/6 DIMENSIONS IN (mm)	3.35 X 5.66 X 1.40" (85 X 144 X 36 mm)
WEIGHT (Approx.)	0.7 lb (0.3 kg)
CABLES (Approx.)	2-ft. sensor cable included
PRESSURE UNITS.....	
DV-4.....	Torr, mbar, Pascal
DV-5.....	mTorr, μbar, Pascal
DV-6.....	mTorr, mbar, μbar, Pascal
CE COMPLIANCE	Refer to Following Table

CE STANDARD COMPLIANCE	
Test	Standard
EMC/EMI Family	EN61326
Radiated Emissions	EN55011
ESD	IEC 61000-4-2
Radiated Immunity	IEC 61000-4-3

1.3.SAFETY

The following symbols and terms may be found on THI products and/or in THI manuals and indicate important information.



When found on the device, this symbol indicates that the operator should refer to the manual for important instructions on the proper use of this device. When found in a manual, this symbol indicates that the reader should understand the implications contained in the text before operating the device.

1.4.ACCESSORIES

1.4.1. INSTALLATION ACCESORIES

Teledyne Hastings Instruments offers a complete line of system attachments that permit easy maintenance for contaminated operations. Gauge tubes are offered with various system fittings to match a wide range of configurations. Additionally, Teledyne Hastings' complete line of quick disconnect attachments allows customers to install these special fittings and easily replace sensors without vacuum sealant or Teflon® tape. For particularly dirty systems, Teledyne Hastings offers a particle dropout trap containing a series of nine separate baffles which prevent solid contaminants from having a direct path to the sensor's thermocouple.

1.4.2. CALIBRATION REFERENCE TUBES

Calibration Reference Tubes allow quick and easy instrument calibration. They provide a known vacuum (noted on the tube) for a given Gauge Tube family. The may be attached is calibrated to simulate a gauge tube at a given operating pressure. Simply plug into the instrument and adjust until the display reads the pressure noted on the reference tube.

Teledyne Hastings Instruments Calibration Reference Tubes employ the same Hastings metal thermocouples



used in all Teledyne Hastings Vacuum Gauge Tubes. The thermocouple is sealed in a glass capsule that has been evacuated, baked, out-gassed, and aged to ensure long-term stability. The sealed capsule is then housed in a protective metal shell to provide a rugged, trouble-free assembly

Vacuum Gauge Tubes

Vacuum Gauge Tubes 20Torr Range		
Stock #	Model #	Description
55-19	DV-4D	20 T Vac Gauge Tube (Purple Base)
55-19R	DV-4R	20 T Vac Gauge Tube/Rugged
55-258	DV-4D-KF-16	20 T Vac Gauge Tube/KF-16™
55-266	DV-4D-KF-25	20 T Vac Gauge Tube/KF-25™
55-227	DV-4D-VCR	20 T Vac Gauge Tube/VCR™
55-69	DV-34	20 T Vac Gauge Tube/316SS
55-101	DB-16D	Reference Tube (DV-4 Series)
Vacuum Gauge Tubes 100 mTorr Range		
67-6	DV-5M	1/8" NPT (Red Base)
55-230	DV-5M -VCR	VCR™
55-103	DB-18	Reference Tube (DV-5 Series)
Vacuum Gauge Tubes 1000 mTorr Range		
55-38	DV-6M	1000 mTorr (Yellow Base)
55-38R	DV-6R	1000 mT Vac Gauge Tube/Rugged
55-38S	DV-6S	1000 mT Vac Gauge Tube/Rugged w/ protective cup
55-139	DV-20	1000 mT Vac Gauge Tube/Glass
55-251	DV-6-KF-16	1000 mT Vac Gauge Tube/KF-16™
55-267	DV-6-KF-25	1000 mT Vac Gauge Tube/KF-25™
55-283	DV-6-VCR	1000 mT Vac Gauge Tube/VCR™
55-38R-CF	DV-6R-CF	1000 mT Vac Gauge Tube/Mini Conflat™
55-66	DV-36	1000 mT Vac Gauge Tube/316SS
55-104	DB-20	Reference Tube (DV-6 Series)



2.0 Installation

2.1. RECEIVING INSPECTION

Unpack and inspect all items for obvious signs of damage. Immediately advise Teledyne Hastings and the carrier of any suspected damage.

In the unlikely event that items need to be returned, first obtain an RMA (Return Material Authorization) number from our Customer Service Department at 1-800-950-2468 (757-723-6531).

2.2. BATTERY INSTALLATION/REPLACEMENT

The HPM 4/5/6 is shipped with a 9 volt alkaline PP3 transistor battery (IEC # 6LR61, ANSI # 1604A). Battery life specifications are given with respect to this battery at 20°C. If the HPM 4/5/6 is operated for a significant time at temperatures much lower than this, then the battery life will be reduced. Alkaline batteries have an operating temperature range of -18°C – 55°C (0°F – 130°F)

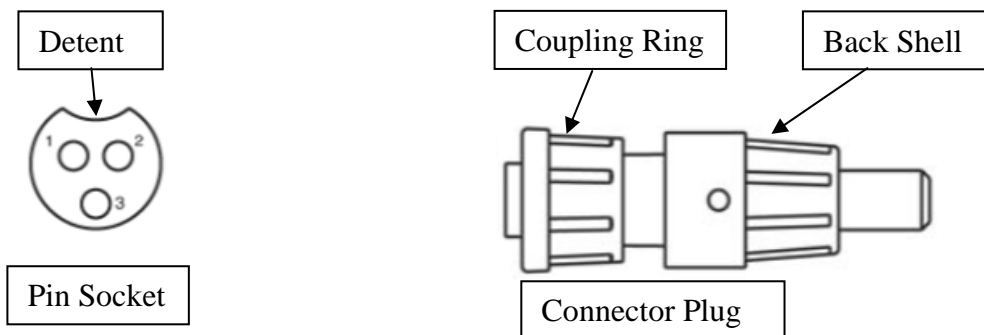
Lithium (not lithium ion) 9 volt batteries (ANSI # 1604L) are the recommended replacement when operating in cold temperatures or very warm temperatures. The operating temperature range for Lithium batteries is -20°C – 60°C (-4°F – 140°F). Lithium batteries have much better cold weather behavior and they will have much longer battery life at all temperatures. These batteries are available from Energizer, Rayovac and Duracell.

The battery compartment is located on the back of the instrument inside the rubber boot. To remove the boot, open the stand and push the instrument out of the boot from the bottom being careful not to bend the cable connector plug.

The battery compartment is located on the bottom rear of the case. Open the battery compartment by pressing in and sliding down at the top of the cover. Plug in a new 9-volt battery, place battery and cable into the battery compartment and reinstall cover by pressing down on the battery with the cover and sliding the cover until it snaps into the locked position. Insert the instrument back in the protective boot and reattach the cable assembly; turn the locking knob clockwise to lock in place.

2.3. CABLE REMOVAL/INSTALLATION

The cable shipped with the HPM 4/5/6 (Part # CB-HPM 4/5/6) is attached to the instrument using a locking-type connector. Refer to the following figures for the instructions below:

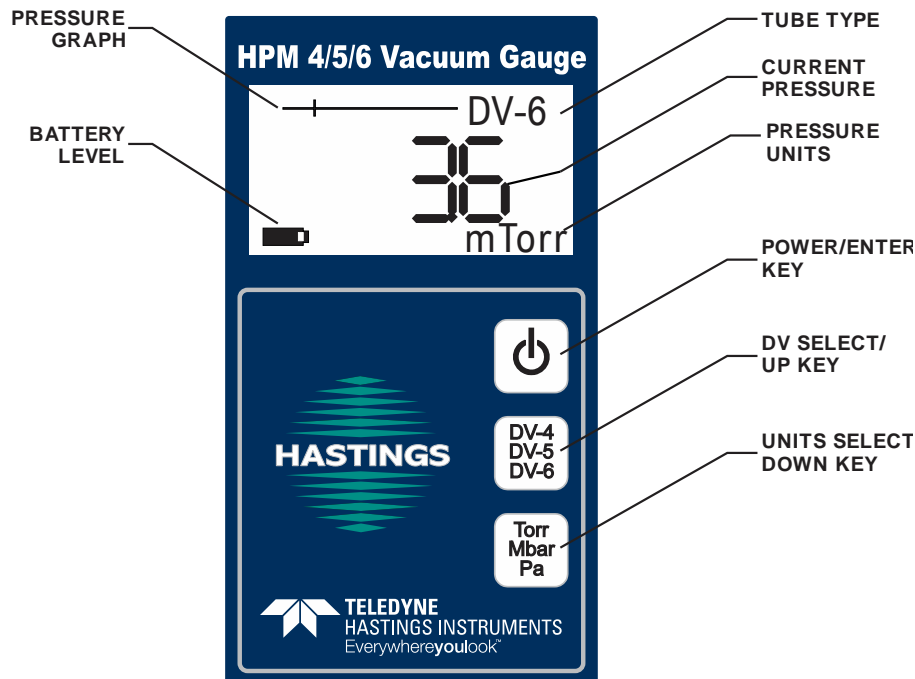


1. Remove the boot by opening the stand and pushing the instrument out of the boot from the bottom being careful not to bend the cable connector plug.
2. Thread the cable through the boot opening until you can easily grasp the Connector Plug.
3. Twist the Coupling Ring counter-clockwise about 120 degrees until you feel it hit the stop.
4. Pull the Connector Plug out of the Pin Socket and boot opening.
5. Discard the old cable assembly.
6. Thread the new cable assembly through the boot opening until you can easily grasp the Connector Plug.
7. While holding onto the Back Shell, gently push the Connector Plug into the Pin Socket while twisting until you feel the Connector Plug engage the detent in the Pin Socket.
8. Push the Connector Plug all the way in until you feel it bottom out.
9. Gently push the Coupling Ring over the Pin Socket. You may need to twist the Coupling Ring counter-clockwise to do this.
10. Gently twist the Coupling Ring clockwise about 120 degrees until you feel it latch.
11. Push the instrument back into the boot.

3.0 Operation

3.1.FRONT PANEL

The section describes the primary operation of the user interface. See section 3.4 USER OPTIONS/ADJUSTMENTS for operation in other modes.



3.1.1. PRESSURE GRAPH

Shows a general indication of the current pressure within the measurable range. The graph will flash and an arrow will be displayed on the right end when the pressure can no longer be measured. If under-range, the graph will flash and an arrow will be displayed on the left end.

3.1.2. BATTERY LEVEL

Indicates the amount of charge left in the battery. The battery should be changed when this indicator is flashing.

3.1.3. TUBE TYPE

It shows the type of gauge tube being measured. This is changed via the DV Select key.

3.1.4. CURRENT PRESSURE

A digital display of the current pressure. This will flash "999 Over Range" when the pressure is higher than the measureable range. If lower than the measureable range, this will flash "000 Under Range". The pressure will display negative numbers because indicated pressure will be lower when ambient temperature is lower than calibration temperature.

3.1.5. PRESSURE UNITS

Shows the currently-selected pressure units of the displayed pressure reading. This is changed via the Units Select key.

3.1.6. POWER/ENTER KEY

- Turns the unit ON or OFF.
- When held during power on, displays the software version.
- When held longer than 3 seconds during power on, temporarily disables Auto-Shutoff.
- Acts as an Enter key in adjustment modes.

3.1.7. DV SELECT/UP KEY

Changes the gauge tube type and functions as the up key in adjustment modes.

3.1.8. UNITS SELECT/DOWN KEY

Changes the pressure units and functions as the down key in adjustment modes.

3.2. ELECTRICAL CONNECTOR

The vacuum gauge tube interfaces with the HPM 4/5/6 Vacuum Gauge via the included octal connector. The Octal connector is “keyed” so that proper connection is assured. Always grip the connector by its cover and not the cable when plugging or unplugging the connector.

In some cases, corrosion may build up on the gauge tube pins; in order to ensure a good connection, use Scotch-Brite or equivalent to clean the pins when needed.



Disconnecting gauge tube by pulling on the cable may result in damage to the octal socket and/or cable. Always disconnect by pulling on the Octal Connector.

3.3. QUICK START

The HPM 4/5/6 is shipped from the factory fully calibrated, and will provide immediate and accurate vacuum measurements when used with good gauge tubes.

- Connect octal socket to a DV-4, DV-5, or DV-6 vacuum gauge tube.
- Turn unit on by pressing the “Power” button.
- If the tube type displayed in the upper right-hand corner of the LCD does not match the attached tube type, press the “DV-4, DV-5, DV-6” button until the correct tube type is displayed.
- If the units displayed in the lower right-hand corner of the LCD, does not match the desired units, press the “Torr, mbar, Pa” button until the desired units is displayed.
- Once the correct tube type and units have been selected, the display will indicate one of the following:
 - A pressure value within the measurable range of selected tube type.
 - Flashing “999 OVER RANGE” which indicates the vacuum gauge tube is either outside the measurable range, or not connected.
 - Flashing “000 UNDER RANGE” which indicates the vacuum gauge tube is at a pressure less than the measurable range.
- Press the “Power” button to turn the unit off; this will help prolong battery life.

NOTE: *If tube type and/or conversion units have been changed, the instrument will use these selections the next time it is turned on.*

3.4.USER OPTIONS/ADJUSTMENTS

3.4.1. AUTO-SHUTOFF

- In order to maximize battery life, the HPM 4/5/6 will automatically power down after about 5 minutes. To temporarily disable this behavior, hold the power button down at power up until “AUTO OFF DISABLED” is displayed.

3.4.2. CONTRAST ADJUST

If the LCD display is difficult to read, the user may adjust the contrast as follows:

- With the power off, press and hold the Units Select key.
- While holding the units select key, press and hold the power key until “Adjusting Contrast” is displayed.
- Release both keys.
- Use the Tube Select key to increase the contrast and the Units Select key to decrease the contrast.
- Press the power button to save the contrast and return to normal operation.

3.4.3. CALIBRATION

The instrument is calibrated for all three tube types (DV-4, DV-5, and DV-6) at the factory. This ensures that valid readings will be displayed for each tube type when delivered. The user may re-calibrate if desired using either a Reference Tube or a tube at a known vacuum.

3.4.4. PREPARATION

- Ensure the HPM 4/5/6 is turned off.
- Plug in a DV-4, DV-5 or DV-6 Reference tube or plug into a tube at a known vacuum within the valid range of the tube.

3.4.5. ENTER CALIBRATION MODE

The following procedure will allow the user to enter calibration mode.

- Push and hold both “TUBE SELECT” and “UNITS SELECT” buttons simultaneously.
- While holding down these buttons, press and hold the “Power” button.
- When the LCD displays “CALIBRATION MODE”, release all three buttons.
- The LCD will display “CAL MODE” at the top and will flash “Select Tube Type” while flashing the tube type in the upper right-hand corner.

3.4.6. SELECT THE TUBE TYPE

- Press the “TUBE SELECT” or “UNITS SELECT” buttons until the correct gauge tube type is displayed.
- Press the “POWER” button to accept the tube type selection.
- The LCD will flash “Select Units” while flashing the Pressure Units in the lower right-hand corner

3.4.7. SELECT THE UNITS

- Press the “TUBE SELECT” or “UNITS SELECT” buttons until the desired units is displayed.
- Press the “POWER” button to accept the Units selection.
- The LCD will now display the current pressure in the selected units.

3.4.8. ADJUSTMENT

- The user may now adjust the displayed pressure value to match the known vacuum level by pressing the “TUBE SELECT” button to increase or the “UNITS SELECT” button to decrease. While adjusting, a message may be displayed informing the user that they must wait before further adjustment is allowed.
- Allow time for the reading to settle, DV-5 tubes take about 3 minutes.
- When the desired pressure value has been reached, press the “POWER” button to set this selection and exit calibration mode.

NOTE: The following table specifies the TELEDYNE HASTINGS reference tube to be used in the calibration of a gauge based upon the type of gauge tube being used.

Reference Tube	Gauge Tube	Color Band
DB-16D	DV-4	Purple
DB-18	DV-5	Red
DB-20	DV-6	Yellow

3.5.THERMAL COEFFICIENT

The HPM 4/5/6 generates an AC heating voltage using an internal transformer. This heating voltage is supplied to the vacuum tube to warm up the thermocouples in order to measure the pressure. As the ambient temperature increases or decreases the internal resistance of the copper winding in the transformer also changes. This resistance change will change the AC heating voltage that the vacuum tube receives and changes the pressure reading slightly.

Increasing temperature will cause the pressure readings to increase and decreasing temperature will cause the pressure readings to decrease. The chart to the right shows the amplified output from the gauge tube as the ambient temperature changes from -25°C to 77°C. The instruments are initially adjusted at an ambient temperature of approximately 22°C. The dominant effect is the change in the zero pressure output of the tube. This effect can be corrected by adjusting the low pressure reading at the operating ambient temperature.

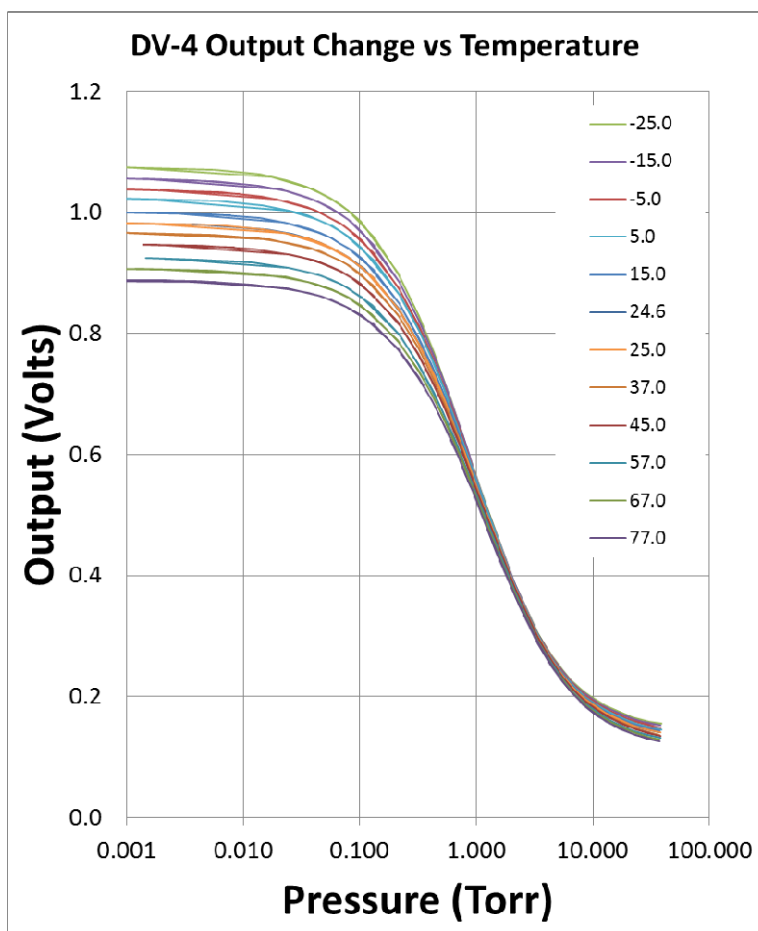
The mid-range of the tube is highly immune to temperature changes. A much smaller change will occur in the highest pressure area, but since the curve is quite flat through this region, a small change in output can cause a significant change in the indicated pressure reading.

The specified rate of change does not include actual changes in pressure that occur in a closed vacuum system during temperature excursions. The typical rate of change is as follows:

DV-4 (1.25% of reading + 2.2 mTorr)/°C

DV-5 (0.1% of reading + 0.08 mTorr)/°C

DV-6 (-.21% of reading + 0.2 mTorr)/°C



4.0 Warranty

4.1. 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.

4.2. 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

804 NEWCOMBE AVENUE

HAMPTON, VIRGINIA 23669 U.S.A.

ATTENTION: REPAIR DEPARTMENT

TELEPHONE (757) 723-6531
1-800-950-2468

FAX (757) 723-3925

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