



TELEDYNE HASTINGS INSTRUMENTS
Everywhereyoulook™

HPM 4/5/6

Vacuum Gauge

INSTRUCTION MANUAL



TELEDYNE
HASTINGS INSTRUMENTS
Everywhereyoulook™

ISO 9001
CERTIFIED

Use and Disclosure of Data

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Manual Print History

The print history shown below lists the printing dates of all revisions created for this manual. The revision level letter increases alphabetically as the manual undergoes subsequent updates. 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
Revision C (Document Number 175-102022)	October 2022



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

Description of Symbols and Messages used in this manual



WARNING: indicates a hazardous situation, which, if not avoided, could result in death or serious injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood.



CAUTION: indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.



NOTICE: calls attention to a procedure or practice that if not correctly performed or adhered to, could result in equipment damage, loss of data, or inaccurate data.



NOTE: is used for tips and other digressions.

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.

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1. General Information

This manual contains technical and general information relating to the installation, operation, and calibration of vacuum gauges and gauge tubes manufactured by Teledyne Hastings Instruments (THI).

For best performance, THI vacuum gauges should be operated with the appropriate THI gauge tube. Attempting to use a THI vacuum gauge with another manufacturer's tube may result in damage to the gauge and/or tube.



NOTICE: 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.



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



NOTICE: Disconnecting the gauge tube by pulling on the cable may result in damage to the device. Always disconnect by pulling directly on the octal connector.



CAUTION: There are no operator serviceable parts or adjustments inside the product.



CAUTION: If this equipment is used in a manner other than that specified, the protection provided by the equipment may be impaired.

1.1. Features

The HPM 4/5/6 is a battery-operated hand-held vacuum gauge that supports 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 powers the vacuum gauge tube and converts its output for display. The lightweight unit operates with a standard 9-volt battery and can be 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, DV-5, and DV-6 tubes. These tubes are rugged, noble-metal sensors which are resistant to corrosion and can be ordered with a variety of system connections such as VCR®, KF-16, KF-25, Glass, MiniConflat™ and 1/8" NPT, etc.

Gauge Tube	Pressure Range
DV-4	0.2-20 Torr
DV-5	0.1-100 mTorr
DV-6	1-1000 mTorr

1.2. Specifications



WARNING: Do not operate instruments exceeding the specifications listed below. Failure to heed this warning could result in serious personal injury and/or damage to the equipment.

HPM 4/5/6 Vacuum Gauge:

Range	DV-4 - 0.01 – 20 Torr DV-5 - 0.1 – 100 mTorr DV-6 - 1 – 1000 mTorr
Accuracy (w/ calibrated tube)	DV-4 (0.01–10 Torr), ± (20% of Reading + 0.02 Torr) DV-5 (0.1–100 mTorr), ± (15% of Reading + 0.1 mTorr) DV-6 (1–1000 mTorr), ± (15% of Reading + 1 mTorr)
Accuracy (w/ calibrated reference tube)	DV-4 (0.01–10 Torr), ± (20% of Reading + 0.04 Torr) DV-5 (0.1–100 mTorr), ± (15% of Reading + 0.2 mTorr) DV-6 (1–1000 mTorr), ± (15% of Reading + 3 mTorr)
Operating Temperature Range	With alkaline battery (standard) -18 to 55°C With lithium battery (standard) -20 to 60°C Externally powered -20 to 70°C
Storage Temperature (without battery)	-20 to 70°C
Input Voltage	5.5 - 9.5 VDC, (9V Battery)
Battery Life (with included battery)	> 30 hours
Outline Dimensions in inches (mm)	3.35” by 5.66” by 1.40” (85 by 144 by 36)
Weight (Approx.)	0.7 lbs. (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	See table below

CE Standard Compliance	
TEST	Standard
EMC/EMI Family	EN61326
Radiated Emissions	EN55011
ESD	IEC 61000-4-2
Radiated Immunity	IEC 61000-4-3

See tube product bulletin for available tube connection configurations.



NOTICE: Use of an underpowered or under-voltage supply could result in equipment damage.

1.3. Accessories

1.3.1. Installation Accessories

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 almost any system requirement. 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.

1.3.2. Calibration Reference Tubes

Reference Tubes employ the same metal thermopiles used in all THI Vacuum Gauge Tubes. The thermopile is sealed in a glass capsule that has been evacuated, baked, outgassed, and aged to ensure long-term stability. The sealed capsule is housed in a rugged metal shell to provide a trouble-free assembly. The reference gauge tube is calibrated to simulate a gauge tube at a given operating pressure (noted on the shell), and provides quick and easy adjustment.



DAVC Compatible Reference Tubes			
Hastings #	Model Name	Hastings Tube	Color Band
55-101	DB-16D	DV-4	Purple
55-103	DB-18	DV-5	Red
55-104	DB-20	DV-6	Yellow

1.3.3. Accessories Index

Vacuum Gauge Tubes

Gauge Tubes - 20 Torr Range

Stock #	Model #	Description
55-19	DV-4D	1/8" MNPT Standard (Purple Base)
55-19R	DV-4R	1/8" MNPT Ruggedized
55-258	DV-4D-KF-16	KF-16™
55-266	DV-4D-KF-25	KF-25™
55-227	DV-4D-VCR	VCR™
55-69	DV-34	1/8" MNPT 316SS
55-101	DB-16D	Ref Tube (DV-4)

Gauge Tubes - 100 mTorr Range

67-6	DV-5M	1/8" MNPT (Red Base)
55-230	DV-5M -VCR	VCR™
55-103	DB-18	Ref Tube (DV-5)

Gauge Tubes - 1000 mTorr Range

55-38	DV-6M	1/8" MNPT (Yellow Base)
55-38R	DV-6R	1/8" MNPT Ruggedized
55-38RS	DV-6	1/8" MNPT Ruggedized RoHS
55-38S	DV-6S	1/8" MNPT Ruggedized/Vibration
55-139	DV-20	Glass
55-251	DV-6-KF-16	KF-16™
55-267	DV-6-KF-25	KF-25™
55-283	DV-6-VCR	VCR™
55-38R-CF	DV-6R-CF	Mini Conflat™
55-66	DV-36	1/8" MNPT 316SS
55-104	DB-20	Ref Tube (DV-6)



2. 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 a Return Material Authorization (RMA) number from our Customer Service Department at 1-800-950-2468 (757-723-6531).

2.2. Cable Removal/Installation

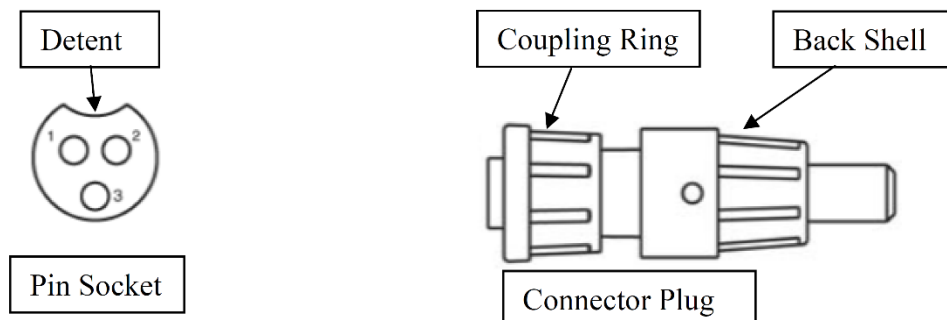
The cable shipped with the HPM 4/5/6 (Part # CB-HPM 4/5/6) is attached to the instrument using a locking-type connector. This cable will need to be removed when replacing the instrument's battery or when replacing a damaged cable. Refer to the following figures and instructions below:

2.2.1. Removal

1. Remove the instrument from the rubber boot (easier to reach the cable lock).
 - a. Open the stand and push the bottom portion of the instrument out of the boot.
 - b. Pull the rest of the instrument out of the boot.
 - c. Be careful not to bend the cable connector plug.
2. Pull the cable through the boot opening until you can easily grasp the Connector Plug.
3. Twist the coupling ring counterclockwise about 120 degrees until you feel it unlock and hit the stop.
4. Pull the connector plug out of the pin socket and boot opening.
5. Leave off the cable assembly for maintenance or discard it if damaged.

2.2.2. Installation

1. Remove the rubber boot if not already off (see 2.2.1)
2. Thread the new cable through the boot opening and onto the pin socket
3. Align the detent and push the connector plug until it bottoms out (all the way in).
4. Push the coupling ring over the pin socket connection (you may need to twist the coupling ring slightly counterclockwise to do this).
5. Twist the coupling ring clockwise about 120 degrees until it locks.
6. Push the instrument back into the boot.



2.3. Battery Installation/Replacement

The HPM 4/5/6 is shipped with a 9-volt alkaline PP3 battery (IEC # 6LR61, ANSI # 1604A). The battery compartment is on the back of the instrument inside the rubber boot.

1. See 2.2.1 to remove the instrument from the boot and disconnect the cable.
2. Locate the battery compartment on the bottom rear of the case.
3. Open the battery compartment by pressing in and sliding the compartment cover down
4. Disconnect the old battery (if present)
5. Plug in a new 9-volt battery and place battery and wires into the compartment.
6. Reinstall the battery compartment cover by pressing down on the battery with the cover and sliding the cover until it snaps into position
7. See 2.2.2 to put the cable back on and re-insert into the boot

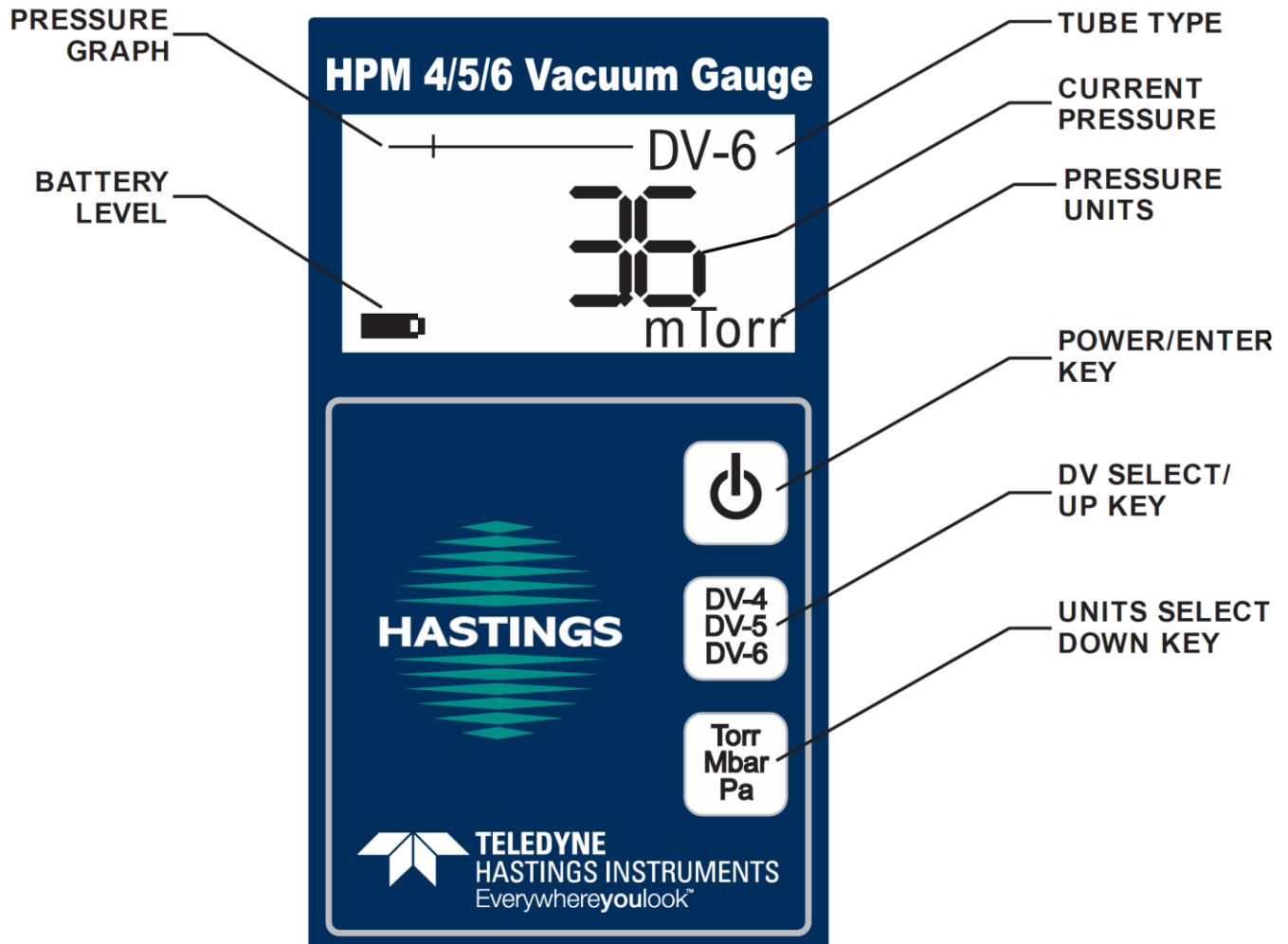
2.3.1. Battery Life Notes

Battery life specifications are given at 20°C. If the HPM 4/5/6 is operated for a significant time at temperatures much lower than this, 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 or very warm temperatures. The operating temperature for Lithium batteries is -20°C – 60°C (-4°F – 140°F). Lithium batteries have better cold-weather behavior and longer battery life than alkali batteries at all temperatures.

3. Vacuum Gauge Operation

3.1. Front Panel

This section describes the primary operation of the user interface. See section 3.4 for operation in other modes.



3.1.1. Pressure Graph

This shows a general indication of current pressure within the measurable range. If the pressure is higher than the measurable range, the graph flashes and displays an arrow on the right end. If the pressure is lower than the measurable range, the graph flashes and displays an arrow on the left end.

3.1.2. Battery Level

Displays battery life (charge). The battery should be changed when this indicator flashes.

3.1.3. Tube Type

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

3.1.4. Current Pressure

Digital display of the current pressure. This flashes “999 Over Range” when pressure is higher than the measurable range. If lower than the measurable range, this flashes “000 Under Range”.



NOTE: When ambient temperature is lower than calibration temperature, the display can show negative numbers within limited ranges.

3.1.5. Pressure Units

Shows the 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

Teledyne Hastings vacuum gauge tubes interface with the HPM 4/5/6 via the included octal connector. The connector is “keyed” so that proper connection is assured (only fits the correct orientation). Always grip the connector by its cover and not the cable when plugging or unplugging. In some cases, corrosion may build up on the gauge tube pins. To ensure a good connection and accurate readings, use Scotch-Brite or an equivalent abrasive to clean the pins when needed.



NOTICE: Disconnecting the 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 directly.

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.

Quick Start Instructions

1. *Connect the octal socket to a DV4, DV5 or DV6 gauge tube.*
2. *Turn the HPM 4/5/6 on using the power button.*
3. *Check that the tube type displayed in the upper right-hand corner of the display matches the attached tube type.*
If not, press the “DV-4, DV-5, DV-6” button until it does
4. *Check that the units displayed in the lower right-hand corner of the display are set appropriately.*
If not, press the “Torr, mbar, Pa” button until they are
5. *Once the correct tube type and units have been selected, the display will indicate one of the following:*
 - i. *A pressure value within the measurable range of selected tube type.*
 - ii. *Flashing “999 OVER RANGE” which indicates the vacuum gauge tube is either outside the measurable range, or not connected.*
 - iii. *Flashing “000 UNDER RANGE” which indicates the vacuum gauge tube is at a pressure less than the measurable range.*
6. *Press the power button to turn the unit off. This will help prolong battery life.*

**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 and 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 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 contrast, and the Units Select key to decrease contrast.
- Press the power button to save the contrast and return to normal operation.

3.5. Calibration

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

3.5.1. 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 (see 1.2 for tube ranges).

3.5.2. Enter Calibration Mode

- Push and hold “TUBE SELECT” and “UNITS SELECT” simultaneously.
- While holding 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.

3.5.3. Select Tube Type and Units

- Press “TUBE SELECT” or “UNITS SELECT” until the correct gauge tube is displayed.
- Press “POWER” to accept the tube type selection.
- The LCD will flash “Select Units” while flashing the Pressure Units in the lower right-hand corner
- Press “TUBE SELECT” or “UNITS SELECT” until the desired pressure units are displayed.
- Press “POWER” to accept the unit selection.
- The LCD will now display the current pressure in the selected units.

3.5.4. Adjustment

- The user may now adjust the displayed pressure value by pressing “TUBE SELECT” (Up) to increase or “UNITS SELECT” (Down) to decrease.
- Use the buttons to match the displayed pressure to the known vacuum level.
- 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 table in 1.3.2 specifies which Teledyne Hastings reference tube to be used in calibration.

3.6. 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.

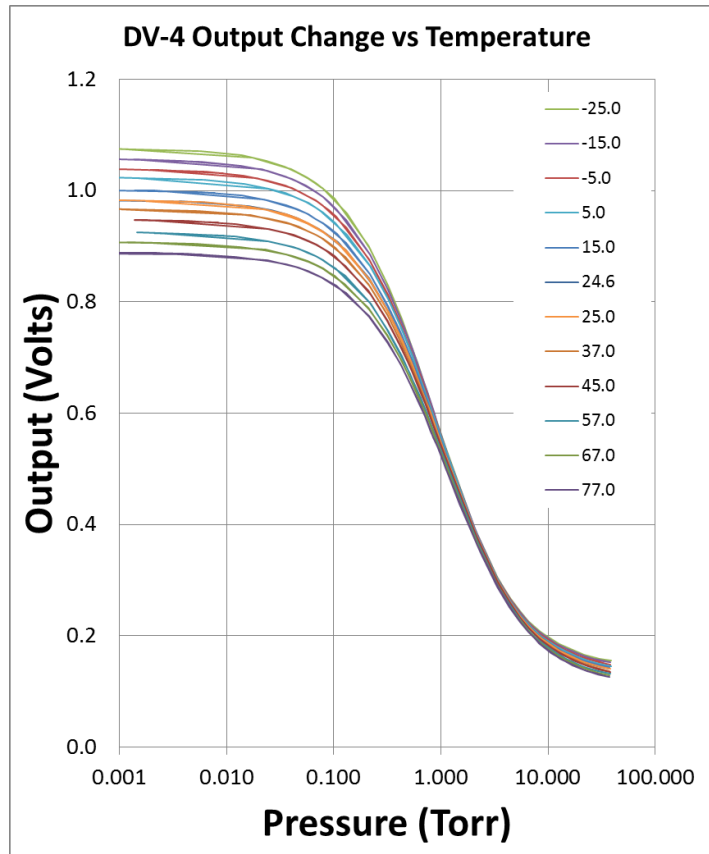
The specified rate of change does not include actual changes in pressure that occur in a closed vacuum system during temperature excursions.

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 (-0.21% of reading + 0.2 mTorr)/°C



4. Warranty and Repair

4.1. Warranty Repair Policy

See the company website for warranty information at:

<http://www.teledyne-hi.com/terms&conditions.htm>

4.2. Return Policy

See the company website for return information at:

<http://www.teledyne-hi.com/terms&conditions.htm>

Any product returned for either warranty or non-warranty repair must have been issued a Return Material Authorization (RMA) form.

RMA Forms may be obtained from the Information section of the Hastings Instruments website:

<http://www.teledyne-hi.com/inforeq.htm>



WARNING: Contaminated parts can be detrimental to health and environment. Ensure instruments are free of hazardous contamination prior to shipment.

Company contact information

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 mailto:hastings_service@teledyne.com

INTERNET ADDRESS <http://www.teledyne-hi.com>

5. Outline Drawings

The following section(s) show the outline dimensions for the HPM 4/5/6.

