PID/FID Combo

Model TVA-1000B
March 2010

NOTE: Guides are to be used by trained personnel only and DO NOT replace the manufacturer's operations or technical manuals. These guides were developed by field personnel for utilization by EPA and their contractors and are helpful in quick start-up and operations. Various limitations have been identified through the experience of the development group. Different makes, models, and updates to this equipment may change the limitations. It is recommended that calibration, maintenance, and use be recorded in a log book. If you have any changes or revisions please email one of the following: stevenson.peter@epa.gov, boykin.michael@epa.gov, chong.margaret@epa.gov, kroone.janice@epa.gov, zintak.leonard@epa.gov.

Uses:

The TVA-1000B is a portable, over-the-shoulder vapor analyzer that offers both the flame-ionization detector (FID) and photo-ionization detector (PID) in one instrument. This instrument can be used to detect both organic and inorganic vapors in the air. When used as an FID, the TVA-1000B has high sensitivity to hydrocarbons including methane and the dilutor kit can be used to reduce concentrations and increase dynamic range for volatile organic compounds. When used as a PID, it is very sensitive to aromatic and chlorinated compounds and can measure some inorganic compounds that the FID cannot (i.e., ammonia, carbon disulfide). Additionally, the sample can be recovered. With dual detectors, the user is able to make decisions regarding the type of compound present and which detector reading to use. This instrument can be used for exposure assessments when the identity of the contaminant is unknown. The instrument can also be used to screen samples. The response can be used to make analysis decisions.

Limitations:

- The FID requires > 16% oxygen to maintain the hydrogen flame. If there is not sufficient oxygen, the flame will go out.
- Neither detector is compound specific. PID is calibrated to isobutylene. The FID is calibrated to methane. Other compounds have different response factors for each detector.
- Low oxygen can also effect the characteristics of the flame, causing false elevated readings.
- If the ionization potential of a compound is higher than the lamp energy, the compound may not be detected.
- PID has a smaller dynamic range, and is not the best choice for measuring high concentrations of vapors.
- PID is susceptible to interference from water vapor more so than the FID.
- As the unit ages, the PID lamp energy may decrease, so compounds near the lamp energy may not be detected.
- PID lamp requires periodic cleaning depending on operating conditions.
- Detection of CW agent vapors are unreliable, even if calibrated.

Quick Start-up and Operation:

1. Install hydrogen tank (screws counterclockwise), attach probe/readout assembly (cable and air line), press [ON] button to turn on analyzer and turn on red hydrogen supply valve.
2. **Note: Requires high purity (99.997%) hydrogen.**
3. Wait 4 to 5 minutes for proper hydrogen flow, then press **Control**. Press **3** to ignite the hydrogen flame. The unit will ignite and display readings. If flame out message appears, clear the message (press **Exit**), wait another minute and repeat step 2. If the unit has not been properly calibrated, a bad calibration parameter error appears.
4. To shut OFF
   - Press the [**OFF**] button, close the hydrogen valve and remove the hydrogen cylinder**.**

Calibration:

1. Press **Exit** until the Main Menu appears. Calibration can now be performed. For best results, allow unit to warm up for 20 minutes, then press 2 = **Setup**.
2. Press **1 = Calibrate**.
3. Press **2 = Span Concentration**
4. Enter the Span Concentration for calibration gas being used and press **Enter**.
5. **Note:** If FID only, enter concentration of methane. If both, enter (PID) concentration of isobutylene, (FID) enter concentration of methane
6. Select the detector that the span concentration is for, then press the up or down arrow to select the correct unit of measure for the span gas. Enter the span calibration value, and press the **Enter** key. Repeat steps 5 & 6 for the second detector.
7. Next zero the instrument by pressing **3 = Zero**.
8. Press **1=Both** for dual detector units, or **Enter** for single detector units.
9. Fill Tedlar bag and introduce zero gas (<1 ppm total hydrocarbon) into the analyzer through the probe.
10. Press **Enter** to start (this assumes manual mode, the factory default)
11. Wait for minimal changes in values (about 15 seconds). Typically, the sample is stable when the first 2 digits of the reading do not change for 4-5 seconds.
12. Press **Enter** to accept, then press **1** to save.
13. Next calibrate with the span gas, fill Tedlar bags, use methane for FID and isobutylene for PID . Press **4 = span**.
14. Select the detector to be calibrated, and press **Enter** to start. Follow the screen prompts. Wait for the readings to stabilize (typically 10-15 seconds). Enter **1** to save and repeat steps 13 & 14 for the second detector.
15. Press **5 = RF** to verify proper response factor.
16. Confirm that response factor says “RF0: DEFAULT”. IF not, set to this value.
17. Press **Exit** twice to return to MAIN MENU.
18. Press **1 = Run**.

This completes the primary calibration, and the instrument is in the survey mode.

Additional Operation Information:

- The PID portion of the instrument works off the principle of ionization. The ionization potential of the lamp utilized by the PID will determine what compounds it will be able to detect. Below are some common compounds listed with their ionization potentials**.**

Chemical	IP (eV)
Hydrogen Chloride	12.7
Chlorine	11.5
Hydrogen sulfide	10.5
Ammonia	10.1
Trichloroethylene	9.45

- There are various lamp energies available for a PID. Each lamp is meant to detect particular types of compounds.

Lamp Energy	Compounds Detected
11.7 **eV**	Halocarbons**,** Methanol**,** Other Single **C** Compounds
10.6 eV	Vinyl chloride**,** MEK**,** MIBK**,** TCE**,** Other 2-4 **C** Compounds
9.5 **eV**	Aromatics, Large Molecules

- **A 10.6 eV lamp is factory installed standard.** An 11.7eV lamp wears out much faster than a 10.6 lamp. It is also more expensive and susceptible to humidity. A 10.6 eV lamp provides better responses to chemicals it can detect.
- The following compounds produce little or no response in the FID:
- He, Ar, O_2, H_2O, H_2S, SO_2, N_2, NO, NO_2, N_2O, NH_3, HCN, HCHO, CO, CO_2, CS_2, Ethanolamine
- Always remember to check that the hydrogen tank has enough hydrogen in it to run the FID.

Action Levels:

A response between 0-5 units either with the FID or PID function would require an upgrade to Level C protection. A response between 5-500 units from either the FID or PID would require an upgrade to Level B protection.

Principle of Operation:

The Flame Ionization Detector (FID) portion of the instrument measures organic compounds with a flame produced by the combustion of hydrogen and air. When hydrocarbons are introduced into the detection zone, a reaction occurs that forms ions. The ions produced are attracted to a collector electrode also found in the detector zone. As the ions move toward the collector, a current is produced. The current produced is directly proportional to the

concentration of hydrocarbons introduced to the flame. The current is then amplified, and sent to a readout device.

A Photoionization Detector (PID) is comprised of an ultraviolet (UV) lamp with a specific energy and ionization chamber. Compounds that pass through the chamber are excited by the UV photons, and ionized. The ions are attracted to a collector electrode, and produce a current as they migrate towards it. This current is directly proportional to the concentration of the compound. (Refer to Diagram below)

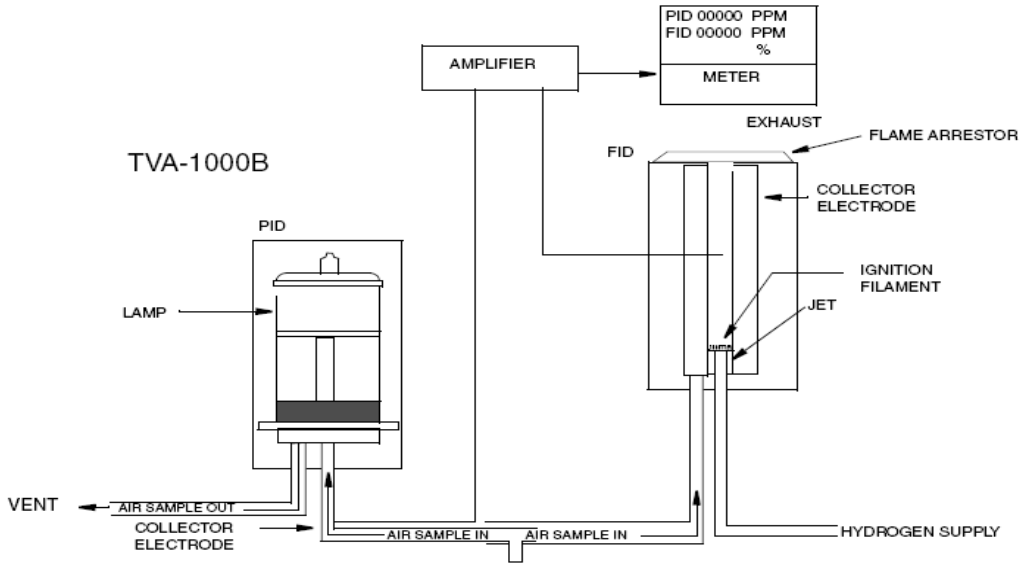


Figure 4. TVA-1000B Dual Detector Configuration

Battery Information:

The TVA-1000B operates on a rechargeable nickel cadmium battery. Fully charged, the battery will last a minimum of eight hours of continuous use at 20°C. Extreme temperatures, hot or cold, and use of the backlight will shorten the run time. The battery does not need to be removed from the instrument to be charged. A fully discharged battery should take approximately 16 hours to recharge completely. Do not leave the battery on charge for extended periods (greater than 96 hours).

NOTE: It is recommended that due to the many types of rechargeable battery configurations, that Equipment Managers verify proper battery charging and operation through monthly equipment operation until battery is discharged prior to recharging.

Main Inventory Items/Accessories:

- PID
- FID
- Enhanced Probe
- Battery - Rechargeable NiCad
- Battery Charger

- Hydrogen Tank
- Shoulder Strap
- Watertrap

Replacement of Auxiliary Equipment/Supplies:

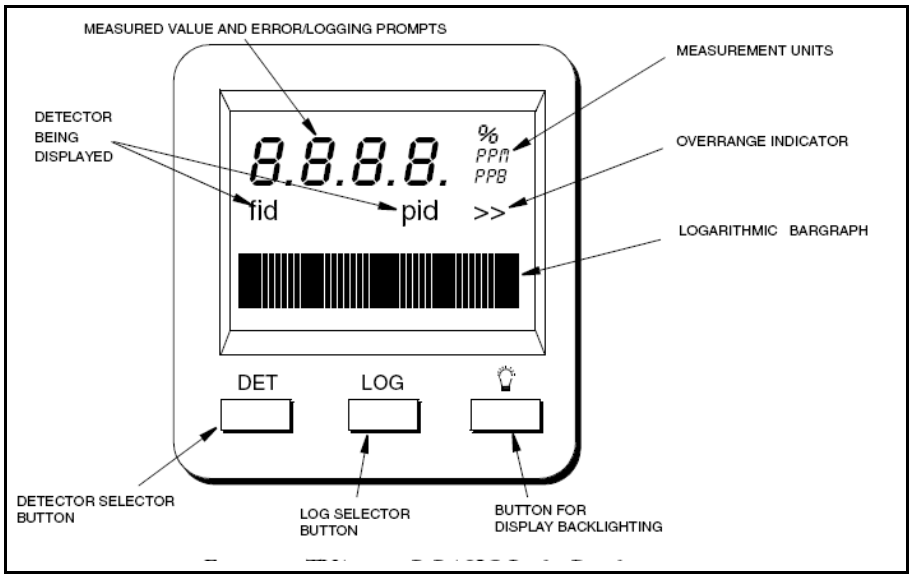
It is recommended that certain spare parts be kept in stock. (Refer to Instruction Manual for specific parts) Replacement parts are to be purchased from the manufacturer to ensure a maintenance schedule is followed.

Shipping Information:

The hydrogen storage tank needs to be shipped as dangerous goods. Air Cargo Only UN1049 “Hydrogen, Compressed.”

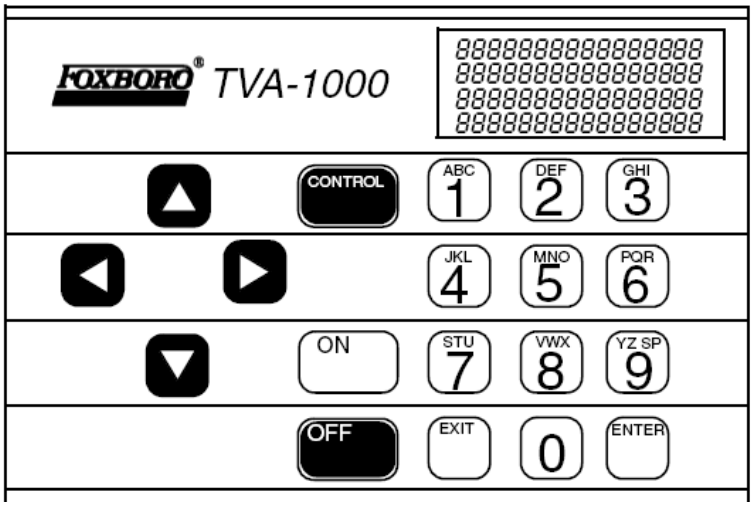
Contact Information (Technical Support):

http://www.thermo.com
Thermo Environmental Instruments, Inc.
8 West Forge Parkway
Franklin, Massachusetts 02038
Phone: 508-520-0430

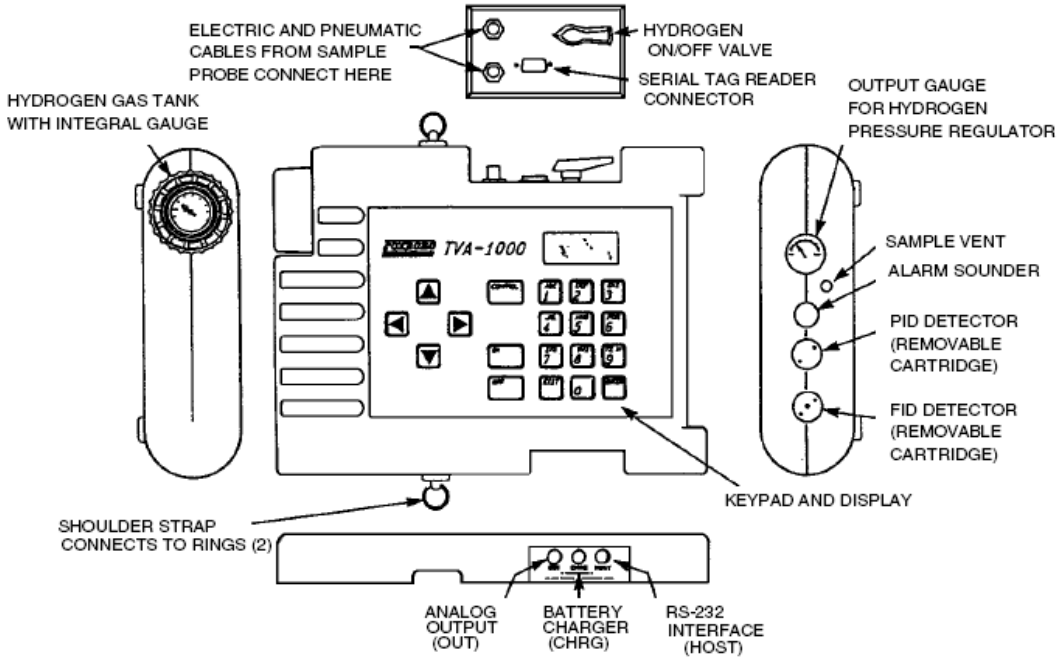


Basic Probe Display

Sidepack Keypad



Instrument Connections



Routine Maintenance / Daily TVA-1000B Maintenance Procedure Checklist:

I.D. Number; _____ Date: _____

- ❑ With pump off, orient analyzer so that sample line connections face down.
- ❑ Remove from sidepack and visually inspect sample line fitting for blockage.
- ❑ Check sidepack filter cup and probe filter cup or WATERTRAP Probe membrane. Replace as necessary and clean debris from sample line adapter fitting.
- ❑ Check sample line and readout cable tor visible damage and contamination.
- ❑ Calibrate analyzer in the manual mode and record the following after warm up (or calibrate in the Auto mode and return to manual mode to record data):
  FID: Zero Counts _____ (should be <5000 counts)
  Span Counts _____ (must = 175-250 counts/PPM Methane)
  PID: Zero Counts _____ (should be < 2000 counts)
  Span Counts _____ (must = 3500 - 6000 counts/PPM Isobutylene)

Example= Span Counts - Zero Counts = 25500 - 4100 = 210 Counts/ppm
Span Concentration (PPM) 102(PPM)

***NOTE:* If TVA-1000 is used in logging mode, this data is also included in header information. Retain this data for trend analysis. Although the values may change daily, the data can be a valuable resource for trend analysis.**

At the End of the Day or Shift:

- ❑ Remove the FID endcap. Blow-out with dry air and replace insert if discolored.
- ❑ Remove FID capsule. If visibly wet, shake-out excess water and let air-dry overnight.
- ❑ Perform visual inspection for signs of damage.

Weekly Maintenance Check:

- ❑ Replace sidepack and probe filter cups and clean sample line adapter fitting
- ❑ For all PID lamps except the 11.8eV: Remove the PID capsule according to the instructions in the Maintenance section of the manual. Clean the lamp with a cotton swab and isopropyl alcohol. Reinstall the cartridge and cap. *Note: Refer to M1 611-183 in the instruction book on cleaning techniques for the 11.8 eV lamp.*
- ❑ Check and tighten strain-relief screws on readout assembly and screws securing three connectors on sidepack.
- ❑ If possible, store the unit is a dry environment when not in use.