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# Project Summary

# Field Experience with Four Portable VOC Monitors

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**This report discusses the field operation problems associated with use of four portable volatile organic compound (VOC) detection instruments in conducting Reference Method 21 VOC screenings. The report presents the results of the field trials and summarizes the ease of use of each instrument. Information on operational problems and recommendations are provided. Also included are discussions of the features that would make all portable instruments more reliable, durable, or convenient to use. Based on the data collected for this study, three of the instruments report similar leak rates in the facility where they were used.**

**This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).**

## Introduction

The U S. Environmental Protection Agency (EPA) has issued performance standards and guidelines to limit emissions of volatile organic compounds (VOC) from several stationary source categories. These industries such as petroleum refineries, synthetic organic chemical plants, and natural gas processing plants emit significant quantities of VOCs from sources other than classical point sources into the workplace and surrounding atmosphere. These fugitive VOC emissions occur from valves, pumps, drains, pressure relief devices, etc.

As described in 40 CFR 60, Appendix A, Reference Method 21 (RM 21), *Determination of Volatile Organic Compound Leaks*, there are technically feasible devices suitable for monitoring fugitive VOC leaks. These devices can be placed near possible points of emissions and will respond to releases of the organic compounds. Specific instruments suitable for this purpose include, but are not limited to, catalytic oxidation, flame ionization, infrared absorption, and photoionization detectors.

Subsequent field use of portable VOC detectors has disclosed some instrument-specific problems such as undetected flame-outs, plugged orifices from dirt, high background readings due to chemical absorption on probe and tubing surfaces, high humidity effects, varying or lack of response, long response times, and calibration drift. To identify and document these types of problems, four monitors were used to conduct screening following RM 21 procedures.

This report provides basic information on each instrument, how they were used, what operational problems were encountered during and between screenings, and the ease of use of each instrument in relation to the other three. Special attention was given to documenting operational problems and ease of use.

## Field Trial Methods

The following VOC analyzers were used during the study:

- Foxboro Century Systems Portable Organic Vapor Analyzer Model OVA-108
- United Technology's Bacharach Instruments Model TLV Sniffer*
- Analytical Instruments Development, Inc., AID Model 712*
- HNu Systems, Inc., Model PI-101

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The instruments used represent three types of detectors. The OVA and Analytical Instruments Development, Inc., Model 712 (AID) are flame ionization detectors (FID). United Technology's Bacharach Instruments, Inc., Model TLV Sniffer (TLV) uses catalytic oxidation. The HNu Systems, Inc., Model PI-101 (HNu) uses a photoionization detector (PID).

A comparison of the manufacturers' published specifications was made with the RM 21 requirements. Although some of the instruments did not appear to meet the RM 21 requirements, all the instruments were used and their field experience reported. No attempt was made to make a rigorous evaluation of each instrument or of RM 21. However, where possible, the requirements of RM 21 were met.

Two types of operational tests were conducted with the equipment—a reliability check and field operations. In the reliability check the instruments were charged and allowed to operate for several 8-hour periods. This test provided some assurance that the instruments could operate over an 8-hour period. In the field operations all four instruments were used to screen a series of 200 to 300 sources. Following the screening, the instrument operator completed an evaluation sheet, reported any problems with the instrument, and provided general subjective comments on the instrument as a leak detection tool. Screening was conducted at two petroleum refineries, a chemical manufacturing plant, and a natural gas processing facility.

## Summary of Evaluations

The field trials were designed to provide subjective comments on the instruments' performances Table 1 summarizes the comments developed from the screenings.

All the instruments except the HNu were equipped with some kind of probe filter, and these filters were always installed. However, a 2-inch length of plastic tubing loosely stuffed with glass wool was added to protect the probe from contamination by the greases and oils present at many sources. The instruments' responses were the same with and without the plastic tubing in place. The tubing is easily replaced and reduces time spent in the field cleaning the metal sample probes. The tubing was normally replaced on an as-required basis which was fairly frequently. The replacement criteria was based on appearance of the tubing. If there was any visible contamination on it, it was replaced.

The TLV comes without a shoulder strap making it very awkward to use for screening. Also, since the zero knob is easily moved, a piece of tape was used to secure it. This prevented having to constantly check and reset the instrument zero.

The OVA comes with one strap. However, after several screenings it was realized that if worn as a backpack it would be easier to use, make the operator more mobile, and speed up the screenings. Therefore, a second strap was purchased from the manufacturer so that the OVA could be worn as a backpack, using the two carrying straps as a shoulder harness. Since the OVA has a readout on the hand-held probe, this did not create any problem. However, when the instrument flamed out, relighting it was a little awkward since the operator had to either get someone else to press the igniter button on the case or let the case slip forward on the shoulders and stretch around to reach it.

## Desirable Instrument Features and Recommendations for Future Studies

The desirable features that should be included in a field screening instrument are as follows:

- The strap should allow for carrying the instrument on the back, out of the way, leaving the hands free for climbing, handling log sheets, and manipulating the probe and readout (assuming the readout is attached to the probe).
- The calibration controls should be located in the backpack and protected by the instrument case cover. All controls should have locks to prevent unintentional movement.
- The readout should be analog and use a logarithmic scale that ranges from 10 to 100,000 ppm. RM 21 must be modified to accept the resulting scale divisions.
- The readout should have a lock-and-hold reading capability and/or hold-highest-reading function switch.
- There should be provisions to use the instrument as a go/no-go detector with indicator lights to show whether the reading is above or below the calibration point.
- An igniter button should be located on the probe/readout if the instrument uses an FID.
- A series of status indication lights should appear on the probe/readout assembly to show if the instrument has sufficient battery charge and if it is responding.
- The sample line connecting the backpack and probe/readout should be at least 4 feet long and very flexible.
- A holster should be provided for the probe/readout so that both hands can be free for climbing and handling data sheets.
- The probe assembly should have provisions for frequent cleaning because the probe becomes contaminated with grease and other materials during the screening process.
- The system should be protected from the elements and be able to operate in light rain, high humidity, and high ambient temperatures.
- The system should protect the rechargeable battery from overcharging and deep discharge. Provisions should be made for easy battery removal and replacement. Ideally, the charging system should be capable of being left on charge at all times. There should also be an indication of when the unit is within one hour of being too weak to operate effectively. This would provide time to check the instrument calibration before the unit required recharging.
- The calibration system should allow for easy calibration to multiple calibration gases

Available and additional data on leak rates, repeatability of screening values, and response factors for VOC instruments should be assembled in a screening handbook to present the kinds of information necessary for a proper screening program. Information should be included on how to screen various types of sources, how to prepare log and repair sheets, response factors of various instruments, lists of typical compounds encountered in various types of facilities, etc. Screening procedures should be developed for organic materials with response factors greater than 10.

**Table 1.** *Summary of Operating Problems*

| Item | OVA | TLV | HNu | AID |
|---|---|---|---|---|
| Carrying strap | The best arrangement of the instruments evaluated. | No strap; instrument was carried by a handle that was sometimes inconvenient | The strap was very narrow and after an hour of carrying was quite uncomfortable | The strap was unpadded and, although reasonably wide, the edge of the strap became very uncomfortable after an hour of carrying. |
| Battery | Acceptable during period of evaluation. | Acceptable during period of evaluation | Acceptable during period of evaluation | Acceptable during period of evaluation |
| Battery charger | Acceptable during period of evaluation | Acceptable during period of evaluation | Acceptable during period of evaluation. | Acceptable during period of evaluation |
| Instrument readout | The analog readout with logarithmic scale was conveniently located in the probe and very easy to use. | The readout in the control unit was less convenient to read than on the probe but was acceptable It required frequent scale changes that were somewhat inconvenient. | The readout in the control unit was less convenient to read than on the probe but was acceptable. It required frequent scale changes that were somewhat inconvenient | The digital readout was difficult to read from an angle, and the frequency with which it had to be updated made selection of a reading value difficult |
| Calibration knob or zero/span adjustment | The knob could not be secured. However, since it was located on the control module, which had a cover, it did not require securing. | The zero adjust knob (only adjustment) was located on the control module and could not be secured. It was easily and frequently bumped, requiring re-zeroing of the instrument, until it was secured with tape. | The zero knob was somewhat protected and was quite stiff to turn. It is located on the control module and did not require securing. | The calibration (zero and span) require a screwdriver to adjust The response and level knobs had locks to secure them. All were acceptable. |
| On/off and other controls | The controls are on the control module. The instrument and pump switches are easily moved (newer models have locking toggles). The handles on the hydrogen supply are too short (newer models have longer ones) The gas select knob was not used since span gases were used for calibration | The on/off/standby, battery, operate, and range switch caused no problems | The controls were acceptable. | The alarm, on/off switch, and the battery/AC/charge switch were frequently confused, which resulted in turning off the instrument instead of the audible alarm on several occasions. |
| Sample line and instrument umbilical | The sample line tends to kink after long use when the protective sleeve slips. The line could be longer. The electrical connector at the control module has been weakened and has shorted | The sample hose could be longer During the evaluation period, the hose developed a kink and would frequently pinch off, causing the pump to stall and the instrument to operate improperly | The umbilical was too short. | The umbilical was too short. |

**Table 1.** *(Continued)*

| Item | OVA | TLV | HNu | AID |
|---|---|---|---|---|
| *Probe contamination* | *Since all the plants had some sources where the probe could get dirty, all units were affixed with a 2-in. long piece of Tygon tubing with a glass wool plug as a primary filter.*<br><br>*This flexible tip was also helpful when screening because it made it easier to get the probe tip close to the source interface.* | *See OVA comments.* | *See OVA comments.* | *See OVA comments.* |
| *Probe assembly* | *The assembly was conveniently sized and not uncomfortably heavy. The alarm adjust knob on the back was broken off when the assembly was dropped.* | *The probe is very lightweight and easy to manipulate* | *The assembly was quite heavy and very difficult to manipulate.* | *The assembly had a comfortable feel. However, the plastic bezel damaged during the second screening falls off frequently.* |
| *Audible alarms* | *The alarm cannot be heard in most plant environments. The ear plug was very uncomfortable and the operators did not wear it.* | *See OVA comments* | *Not Applicable.* | *See OVA comments* |
| *Screening time* | *Very good; ~30 seconds per source.* | *Somewhat slow; ~45 seconds per source* | *Unknown; no response to sources.* | *Very good; ~30 seconds per source.* |



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*The complete report, entitled "Field Experience with Four Portable VOC Monitors," (Order No. PB 85-165 496/AS; Cost: $10.00, subject to change) will be available only from:*
*National Technical Information Service*
*5285 Port Royal Road*
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