UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, D.C. 20460

ETV

ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM
VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**FIELD PORTABLE GAS CHROMATOGRAPH/MASS SPECTROMETER**
APPLICATION:	**MEASUREMENT OF VOLATILE ORGANICS IN SOIL, WATER, AND SOIL GAS**
TECHNOLOGY NAME:	**EM640™**
COMPANY:	**BRUKER-FRANZEN ANALYTICAL SYSTEMS, INC.**
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The U.S. Environmental Protection Agency (EPA) has created a program to facilitate the deployment of innovative environmental technologies through performance verification and information dissemination. The goal of the Environmental Technology Verification (ETV) Program is to further environmental protection by substantially accelerating the acceptance and use of improved and more cost effective technologies. The ETV is intended to assist and inform those involved in the design, distribution, permitting, and purchase of environmental technologies. This verification statement provides a summary of the demonstration and results for the Bruker-Franzen Analytical Systems, Inc. EM640™ field portable gas chromatograph/mass spectrometer (GC/MS) system.

PROGRAM OPERATION

The EPA, in partnership with recognized testing organizations, objectively and systematically evaluates the performance of innovative technologies. Together, with the full participation of the technology developer, they develop plans, conduct tests, collect and analyze data, and report findings. The evaluations are conducted according to a rigorous demonstration plan and established protocols for quality assurance. The EPA's National Exposure Research Laboratory, which conducts demonstrations of site characterization and monitoring technologies, selected Sandia National Laboratories, Albuquerque, New Mexico, as the testing organization for field portable GC/MS systems.

DEMONSTRATION DESCRIPTION

In July and September 1995, the performance of two field transportable GC/MS systems was determined under field conditions. Each system was independently evaluated by comparing field analysis results to those obtained using approved reference methods. Performance evaluation (PE), spiked, and environmental samples were used to independently assess the accuracy, precision, and comparability of each instrument.

The demonstration was designed to detect and measure a series of primary target analytes in water, soil, and soil gas. The primary target analytes at the U.S. Department of Energy's Savannah River Site in Aiken, South Carolina, were trichloroethene and tetrachloroethene. The primary analytes at Wurtsmith Air Force Base in Oscoda, Michigan, were

benzene, toluene, and xylenes. Secondary analytes at the Michigan site included a variety of chlorinated organic solvents. The sites were chosen because they exhibit a wide range of concentrations for most of the analytes and provided different climatic and geological conditions. The conditions at each of these sites represent typical, but not all inclusive, conditions under which the technology would be expected to operate. Details of the demonstration, including a data summary and discussion of results may be found in the report entitled "Environmental Technology Verification Report, Field Portable Gas Chromatograph/Mass Spectrometer, Bruker-Franzen Analytical Systems, Inc. EM640™." The EPA document number for this report is EPA/600/R-97/149.

TECHNOLOGY DESCRIPTION

GC/MS is a proven laboratory analytical technology that has been used in environmental laboratories for many years. The combination of gas chromatography and mass spectrometry enables the rapid separation and identification of individual compounds in complex mixtures. The gas chromatograph separates the sample extract into individual components. The mass spectrometer then ionizes each component which provides the energy to fragment the molecules into characteristic ions. These ion fragments are then separated by mass and detected as charged particles, which constitutes a mass spectrum. This spectrum can be used in the identification and quantitation of each component in the sample extract. For nontarget or unknown analytes the mass spectrum is compared to a computerized library of compounds to provide identification of the unknown. Field transportable GC/MS is a versatile technique that can be used to provide rapid screening data or laboratory quality confirmatory analyses. In most systems, the instrument configuration can also be quickly changed to accommodate different inlets for media such as soil, soil gas, and water. As with all field analytical studies, it may be necessary to send a portion of the samples to an independent laboratory for confirmatory analyses.

The EM640™ is a commercially available GC/MS system that provides laboratory-grade performance in a field transportable package. The instrument is ruggedized and may be operated during transport. It weighs about 140 lbs and can be transported and operated in a small van. The EM640™ used in the demonstration used a Spray-and-Trap Water Sampler, direct injection for soil gas, and heated headspace analysis for soil samples. The minimum detection limit is 1 ppb for soil gas, 1μg/L for water, and 50 μg/kg for soil. The instrument requires a skilled operator; recommended training is one week for a chemist with GC/MS experience. At the time of testing, the baseline cost of the EM640™ was $170,000 plus the cost of the inlet system.

VERIFICATION OF PERFORMANCE

The observed performance characteristics of the EM640™ include the following:

- **Throughput:** The throughput was approximately 5 samples per hour for all media when the instrument was operated in the rapid analysis mode. Throughput would decrease if the instrument were operated in the analytical mode.

- **Completeness:** The EM640™ detected greater than 99 percent of the target compounds reported by the reference laboratory.

- **Precision:** Precision was calculated from the analysis of a series of duplicate samples from each media. The results are reported in terms of relative percent difference (RPD). The values compiled from both sites generally fell within the range of 0 to 40 percent RPD for soil and 0 to 50 percent for the water and soil gas samples.

- **Accuracy:** Accuracy was determined by comparing the Bruker GC/MS analysis results with performance evaluation and spiked samples of known contaminant concentrations. Absolute percent accuracy values from both sites were calculated for five target analytes. For soil, most of the values are scattered in the 0-90 percent range with a median of 39 percent. For water, most of the values fall in the 0-70 percent range with a median of 36 percent. The soil gas accuracy data generally fall in the 0-70 percent range with a median of 22 percent.

- **Comparability:** This demonstration showed that the EM640™ produced water and soil gas data that were comparable to the reference laboratory data (median absolute percent difference less than 50 percent). The soil data were not comparable. This was due, in part, to difficulties experienced by the reference laboratory and other problems associated with sample handling and transport.

- **Deployment:** The system was ready to analyze samples within 60 minutes of arrival at the site. The instrument was operated in a van. Warmup and calibration checks were completed in transit to the site.

The results of the demonstration show that the Bruker-Franzen EM640™ can provide useful, cost-effective data for environmental problem-solving and decision-making. The deviation of EM640™ and reference laboratory results for the soil samples, while statistically significant, is not so great as to preclude the effective use of the EM640™ GC/MS system in many field screening applications. We were unable to determine whether the Bruker GC/MS soil data or that of the reference laboratory or both were problematic. Undoubtedly, this instrument will be employed in a variety of applications, ranging from serving as a complement to data generated in a fixed analytical laboratory to generating data that will stand alone in the decision-making process. As with any technology selection, the user must determine what is appropriate for the application and the project data quality objectives.

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