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THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

Battelle
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ETV Joint Verification Statement

TECHNOLOGY TYPE:	**PORTABLE EMISSION ANALYZER**		
APPLICATION:	**DETERMINING NITROGEN OXIDES EMISSIONS**		
TECHNOLOGY NAME:	**A-Plus Portable Emission Analyzer**		
COMPANY:	**ECOM America LTD.**		
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The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high quality, peer reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations; stakeholder groups which consist of buyers, vendor organizations, and permitters; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Advanced Monitoring Systems (AMS) program, one of 12 technology areas under ETV, is operated by Battelle in cooperation with EPA's National Exposure Research Laboratory. AMS has recently evaluated the performance of portable nitrogen oxides monitors used to determine emissions from combustion sources. This verification statement provides a summary of the test results for the ECOM A-PLUS Portable Emission Analyzer.

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VERIFICATION TEST DESCRIPTION

The verification test described in this report was one of a series of tests conducted in early 1999 on commercial portable nitrogen oxides analyzers at Battelle's facilities in Columbus, Ohio. Verification testing of the analyzers involved (1) a series of laboratory tests in which certified NO and NO_2 standards were used to challenge the analyzers over a wide concentration range and (2) tests using realistic combustion sources, in which data from the portable analyzers undergoing testing were compared to simultaneous measurements of NO and NO_x obtained with two chemiluminescent analyzers.

Verification testing lasted three to four days, of which two days were required for laboratory testing and the remainder for source emissions testing. To assess inter-unit variability, two identical analyzers were tested simultaneously in all tests, and results from the two analyzers were kept separate. The analyzers were operated at all times by a representative of ECOM and supervised at all times by Battelle staff.

Verification testing focused on measurement of NO and NO_2, the sum of which is denoted as NO_x. Laboratory testing included a linearity test over the entire nominal ranges of the analyzers for both NO and NO_2; estimation of detection limits and response times; interference testing; assessment of sample pressure and ambient temperature effects on analyzer response; and evaluation of zero and span drift during the various laboratory tests. Tests with combustion sources assessed the accuracy of NO, NO_2, and NO_x measurements, relative to the chemiluminescent NO/NO_x approach that is the basis of EPA Method 7E. Sources used in the testing were a gas-fired rangetop burner, a gas-fired water heater, and a diesel-powered electrical generator operated at both idle and at high RPM. These sources produced NO_x emissions ranging from less than 10 to over 400 ppm. Zero and span drift resulting from exposure to source emissions were assessed, and analyzer stability was monitored during one hour of uninterrupted sampling of diesel emissions.

Quality assurance (QA) oversight of verification testing was provided by both Battelle and U.S. EPA. Battelle QA staff conducted a technical systems audit, a performance evaluation audit, and a data quality audit of 10 percent of the test data. EPA QA staff conducted an independent on-site technical system audit.

TECHNOLOGY DESCRIPTION

The ECOM A-PLUS is a portable, microprocessor controlled, electrochemical sensor-based emission analyzer. The ECOM A-PLUS can be fitted with up to five separate gas sensors to measure oxygen, carbon monoxide, oxides of nitrogen (NO and NO_2), and sulfur dioxide. Only the NO and NO_2 measurement capabilities were verified in the tests reported here. The A-PLUS measures 21" x 10" x 11.8" and weighs 30 pounds. An on-board printer allows hard copy printing of vital stack parameters, while an RS232 interface provides the option to store the data to a computer. The A-PLUS incorporates a sample conditioning system that includes a heated sample line, heated probe head, peltier cooler, and moisture removal assembly. Designed for semi-continuous operation, the ECOM A-PLUS is not recommended for continuous gas emission measurement.

VERIFICATION OF PERFORMANCE

Linearity: The ECOM A-PLUS analyzers provided linear response, but not over their full nominal ranges of 0 to 4,000 ppm for NO and 0 to 500 ppm for NO_2. The actual linear ranges for the ECOM analyzers were about 0 to 3,500 ppm for NO, and about 0 to 450 ppm for NO_2.

Detection Limit: Combustion source tests indicated detection limits comparable to the 1 ppm measurement resolution of the analyzers. Detection limits estimated from the linearity test data were 1.2 ppm for NO_2 and about 4 ppm for NO. These values may have been influenced by the relatively high analyte levels used in the linearity test.

Response Time: Estimated response times were 11 to 37 seconds for NO and about 100 seconds for NO_2.

Zero/Span Drift: Drift in zero and span readings obtained before and after source combustion and laboratory tests were almost always less than 4 ppm, and span drift was always less than 5 percent of the span concentration provided. Shutting the analyzer off completely overnight had no significant additional effect on the drift observed.

Interferences: No interference was found from any of the following: 496 ppm CO; 5.03 percent CO_2; 494 ppm NH_3; 590 ppm of total hydrocarbons; 501 ppm of SO_2; and 451 ppm of SO_2 in the presence of 388 ppm NO.

Pressure Sensitivity: Over the tested range of -10 to +10 inches of water (relative to ambient pressure), the sample gas pressure had no significant effect on the zero or span readings of the ECOM analyzers.

Ambient Temperature: Ambient temperature over the range 45 to 105°F had little impact on zero and span readings of the ECOM analyzers. NO span values differed by 3 percent or less due to temperature effects over this range, using a 700 ppm span gas; and NO_2 span values differed by 7.5 percent or less, using a 140 ppm span gas.

Relative Accuracy: The relative accuracy of the ECOM A-PLUS analyzers for NO_x ranged from 1.5 to 12.1 percent in testing with sources emitting from 7 to 450 ppm NO_x.

Inter-Unit Repeatability: The performance of the two ECOM A-PLUS analyzers in the verification test was essentially the same in all respects. Unit-to-unit agreement of the two ECOM analyzers was within 4.2 percent on combustion sources emitting between 7 ppm and 450 ppm NO_x and was actually better than the agreement between the two reference analyzers.

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NOTICE: EPA verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. EPA and Battelle make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Mention of commercial product names does not imply endorsement.

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