THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

Battelle
. . . Putting Technology To Work

ETV Joint Verification Statement

TECHNOLOGY TYPE:	**PORTABLE EMISSION ANALYZER**		
APPLICATION:	**DETERMINING NITROGEN OXIDES EMISSIONS**		
TECHNOLOGY NAME:	**LANCOM Series II Portable Emissions Analyzer**		
COMPANY:	**Land Combustion**		
ADDRESS:	**10 Friends Lane**	**PHONE:**	**215-504-8000**
	Newtown, PA 18940	**FAX:**	**215-504-1346**
WEB SITE:	**http://www.landinst.com**		
E-MAIL:	**sales@land-combustion.com**		

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) Center, 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 Land LANCOM Series II Portable Emission Analyzer.

VERIFICATION TEST DESCRIPTION

The verification test described in this report was one of a series of tests conducted in April and May 2000 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 Land 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 about 350 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 Battelle. Battelle independent QA staff conducted a technical systems audit, a performance evaluation audit, and a data quality audit of 10% of the test data. Battelle testing staff conducted a performance evaluation audit, which was reviewed by independent QA staff.

TECHNOLOGY DESCRIPTION

The LANCOM Series II weighs 13.2 pounds, has the dimensions of a standard laptop computer, and measures up to seven flue gases (O_2, NO, NO_2, CO (low), CO (high), SO_2, and hydrocarbons). Analyzer options include semi-continuous monitoring (pre-determined timed sampling intervals), printing, data logging (1,000 records), and serial communications, plus various probe lengths. All gas measurements can be stored, downloaded, or printed. The LANCOM Series II offers on-board diagnostics, accessible filters and water catchpot, and a "semi-continuous" operating mode. It provides ppm conversions (mg/m^3, lb/mBTU. etc.), oxygen normalization, and total NO_x, on a wet or dry basis.

The LANCOM Series II systems components are mounted on molded PVC and sheathed in corrosion-resistant plastic. The analyzer can be operated when worn on a shoulder strap or free-standing on the ground. All controls are on the top of the instrument. The batteries are mounted at the bottom of the case, which provides enhanced stability when the instrument is on the floor. The large capacity water catchpot is mounted on the side of the instrument on a hinged assembly. The particulate and chemical filters are also mounted on the side of the instrument. All measured parameters and operator interface are displayed on a full function alphanumeric/graphic liquid crystal display. The LANCOM Series II contains two 6V batteries capable of powering the instrument for eight hours in the field.

VERIFICATION OF PERFORMANCE

Linearity: The Land Combustion LANCOM Series II analyzers provided linear response for NO and NO_2 over the tested ranges of 0 to 2,000 ppm and 0 to 512 ppm, respectively. One of the LANCOM units did exhibit a slightly low response to NO_2 above about 250 ppm, perhaps as a result of an older sensor used in that unit.

Detection Limit: Detection limits estimated from these wide-range linearity tests were about 2.5 ppm for NO and 1.5 to 2.3 ppm for NO_2.

Response Time: Response times of the two LANCOM Series II analyzers were 35 and 39 seconds for NO and 77 and 90 seconds for NO_2, respectively.

Zero/Span Drift: Drift in LANCOM Series II NO and NO_2 zero readings before and after laboratory and combustion source tests was within ± 2 ppm in nearly all circumstances. In laboratory tests, span drift for NO was within about 2%, using 1,400 to 2,000 ppm NO span levels. For NO_2, span drift was within 1%, using 350 to 512 ppm NO_2 span levels. In sampling gas combustion and diesel sources, absolute NO and NO_2 span drift was usually within 1 ppm, and span drift exceeded 2% of the span gas value only at span gas values of 10 to 20 ppm, reflecting the ± 1 ppm resolution of the analyzers.

Interferences: No interference was found from any of the following: 496 ppm CO; 5.03% CO_2; 494 ppm NH_3; 605 ppm of total hydrocarbons; 501 ppm of SO_2; or 451 ppm SO_2 in the presence of 393 ppm NO.

Pressure Sensitivity: Over the tested range of + 10 to - 10 in. H_2O, sample gas pressure had no significant effect on LANCOM Series II zero or span readings.

Ambient Temperature: Variations in ambient temperature over the range of 7 to 39° C (45 to 103°F) had no effect on the LANCOM Series II zero readings for NO_2, but a small effect was seen for NO, with higher temperature increasing zero readings by a few ppm. Over that entire temperature range, span response increased with increasing temperature by 7 to 10% for NO, and by about 4% for NO_2.

Relative Accuracy: The relative accuracy of the LANCOM Series II analyzers for NO_x ranged from 1.8 to 17.5% over both analyzers with natural gas and diesel combustion sources. At NO and NO_2 levels of 6 ppm or less, the LANCOM Series II analyzers were accurate to within about their 1 ppm measurement resolution.

Inter-Unit Repeatability: Comparison of verification results from the two LANCOM Series II analyzers showed some slight unit-to-unit differences, primarily in relative accuracy; but overall the performance of the two analyzers was essentially the same. Unit-to-unit agreement for NO_x in source sampling ranged from 0.5 to 7.7%, and was comparable to that of the reference analyzers.

Gabor J. Kovacs Date
Vice President
Environmental Sector
Battelle

Gary J. Foley Date
Director
National Exposure Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency