



LasIR Tunable Diode Laser Technology Fact Sheet for Unisearch Associates Inc.

Performance Claim

The Unisearch Associates LasIR tunable diode laser (TDL) was tested away from major chemical sources, positioned outdoors adjacent to a lightly traveled road and directed to a multi-element retro-reflector module at a distance of 110 meters, producing a total light path of 220 meters. An optically transparent methane-containing gas cell was placed in the light path; and measurement by the LasIR was compared to the known concentration of the target gas. Performance claims for CH₄ are:

- (1) The LasIR detection limit is 1.21 ppm-m for methane at a path-length of 1.5 meters.
- (2) The LasIR showed a maximum deviation of 0.019 ppm at a path-average concentration of 0.454 ppm over 220 meters, over a 72 % reduction in source strength.
- (3) For concentration linearity, the LasIR has a response slope of 1.00 over a gas cell range of 40 to 800 ppm.
- (4) The relative accuracy of LasIR methane measurements is between 0.02% and 12.2% at a 1.5 m path-length.
- (5) The LasIR exhibited precision in repetitive measurements of 0.63% Relative Standard Deviation for methane using a path-length of 1.5 m.
- (6) Interference from ambient water vapour and carbon dioxide did not affect the LasIR.

The LasIR incorporates a Tunable Diode Laser (TDL) and a gas spectrometer for remote in-situ measurement of trace gases in stack exhaust. Two LasIR units (Serial # LAS 0006 and LAS 0007, Optics serial # SMPT 0001 and 0002), operated from 15 to 25°C, were laboratory tested and subsequently tested for three months in an aluminum smelting facility, for measurement of hydrogen fluoride (HF). Performance claims for HF measurement, verified at 95% confidence level, are:

- (1) The HF detection limit of the LasIR is 0.01 mg/m³ in the range of 0-5 mg/m³.
- (2) Identical LasIR instruments, measuring the same gas sample, give the same measurement.
- (3) LasIR absolute errors, for measurements in the range 0.05 to 5 mg/m³, are less than 6% of the Full Scale Deflection (FSD).
- (4) The zero point drift in the LasIR HF measurements is less than 0.08 mg/m³/month.
- (5) Changes in the temperature of the monitoring head cause the zero point of the LasIR to change by less than 0.002 mg/m³/K¹ and the gain to change by less than 0.004 mg/m³/K.

Technology Application

Unisearch LasIR instrument provides accurate measurements of a variety of atmospheric gaseous molecular pollutants such as HF, HCl, CH₄, H₂O, CO, CO₂, NH₃, C₂H₂, C₂H₄, NO, and NO₂. This verification is focused on the operation of the LasIR for the measurement of hydrogen fluoride (HF) and methane (CH₄). The measurement of these species gives industrial operators precise knowledge of their concentration allowing control measures used to limit the effluence of these gases if necessary.



Performance Conditions

The performance of the LasIR in measuring methane was investigated by Battelle (Columbus, Ohio) an approved verification authority under the US Environmental Protection Agency's (EPA) Environmental Technology Verification (ETV) program. The Battelle testing of the LasIR, performed in May of 2000, led to the issuing of an ETV Joint Verification Statement (EPA and Battelle).

Testing of the LasIR's performance in measuring HF concentrations in industrial gas phase effluent was conducted by Gesellschaft für Umweltschutz TÜV Nord mbH (The Society for Environmental Protection, SEP), Institut für Chemie und Umweltschutz (Institute for Chemistry and Environmental Protection), Hamburg. This testing involved an extensive set of tests carried out over a period of several months. Initially tests were conducted in the SEP laboratory; however the majority of the testing was conducted in an Aluminum smelting plant which had a suitable effluent gas which contained HF.

Technology Description

The Unisearch LasIR system is a tunable diode laser infrared spectrometer system designed for in-situ, non-invasive measurements of trace species in stack/duct emissions gases and ambient air. The system consists of 3 major components: the LasIR control analyzer module which contains the electronics and the reference cell, the telescope assembly with retro-reflector which is used to launch and return the laser emission through the desired path and a PC compatible computer which acts as the control interface and a data logger.

Verification

The US EPA ETV Report for Unisearch Associates LasIR Tunable Diode Laser Open-Path Monitor, and the US EPA ETV Test/QA Plan for Verification of Optical Open-Path Monitors. October 28, 1999 were used in support of the methane performance claims. A report prepared by the Society for Environmental Protection TÜV Nord mbH, Institute for Chemistry and Environmental Protection, Hamburg, Germany was used in support of the HF performance claims. The verification was completed by Arincon using ETV Canada's General Verification Protocol (March, 2000).

What is the ETV Program?

The Environmental Technology Verification (ETV) Program is a joint Environment Canada - Industry Canada initiative delivered by ETV Canada. The ETV Program is designed to support Canada's environment industry by providing credible and independent verification of technology performance claims.

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