



B162 Trace Vapor Generator for Explosives and Narcotics (TV-Gen): An Overview

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Learning Overview: After attending this presentation, attendees understand about the Trace Vapor Generator for Explosives and Narcotics (TV-Gen), a system designed by the U.S. Naval Research Laboratory to produce continuous and stable vapor streams for the purpose of validation of trace vapor detectors. They will learn about the system and the characterization of a suite of contraband vapors.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by showing a method for evaluation of novel sensors and instrumentation using validated vapor streams.

Trace vapor detection of hazardous materials including explosives and narcotics is critical to the protection of military and civilian personnel both in the United States and abroad. The ability to detect trace vapors can enhance identification of explosive devices as well as border protection by preventing smuggling of narcotics or other illegal cargo. Researchers and instrument developers continue to advance trace vapor detection technology through the development of new materials and sensors for hazardous chemicals and vapors. However, uniform, reliable methods of evaluation for new detection systems are limited, making assessments and comparison across the field challenging. Additionally, the generation of explosive and narcotic vapors at reproducible, measurable rates is extremely difficult due to their low vapor pressures.

The U.S. Naval Research Laboratory has designed and constructed the TV-Gen to evaluate new materials, sensors, and instrumentation for hazardous vapor detection. The TV-Gen was developed to generate trace levels (parts per million to parts per quadrillion) of explosive or narcotic vapor. It provides a single output with a dual manifold that can be easily and efficiently switched between clean air and trace hazardous chemicals. Humidity and analyte introduction is made using the custom Pneumatically Modulated Liquid Delivery System (PMLDS) coupled to a perfluoroalkoxy (PFA) total-consumption microflow nebulizer that reproducibly and accurately generates trace vapors of low vapor pressure compounds. TV-Gen also consists of a custom oven capable of being heated up to 130°C, ensuring minimal analyte adsorption to the surfaces of the dual manifold. The manifold can be completely disassembled for thorough cleaning, and the custom control box utilizes computer control for standardized vapor delivery. An online validation system then provides near real-time verification of each analyte over a wide range of concentrations and relative humidities. The TV-Gen has been fully characterized with the following explosives: nitromethane, nitroglycerine, ethylene glycol dinitrate, 2,4,6-trinitrotoluene, pentaerythritol tetranitrate, and hexahydro-1,3,5-trinitro-1,3,5-triazine, as well as with the narcotic methamphetamine. Preliminary work has been completed with cocaine and 3,4-methylenedioxyamphetamine. This presentation will discuss the development of the TV-Gen as well as the characterization of certain explosive vapor streams. The method development process for generating vapors of the three low vapor pressure narcotics mentioned previously will also be presented in detail. These narcotic compounds were selected for initial testing based on vaporization temperature and vapor pressure. Parameters to be discussed include: nebulizer liquid and air flow rates and temperature, manifold temperature, liner type, sample volume, and trapping temperature. For example, using these optimized parameters, vapor generation efficiency for methamphetamine was $93 \pm 3.3\%$.

Trace Vapor Detection, Hazardous Vapor Generation, Explosives