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Trace Contraband Detection Field- Test by the South Texas Specialized Crimes and Narcotics Task Force

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Abstract

This report describes the collaboration between the South Texas Specialized Crimes and Narcotics Task Force (STSCNTF) and Sandia National Laboratories (SNL) in a field test that provided prototype hand-held trace detection technology for use in counter-drug operations. The National Institute of Justice (NIJ)/National Law Enforcement and Corrections Technology Center (NLECTC)/Border Research and Technology Center (BRTC) was contacted by STSCNTF for assistance in obtaining cutting-edge technology. The BRTC created a pilot project for Sandia National Laboratories (SNL) and the STSCNTF for the use of SNL's Hound, a hand-held sample collection and preconcentration system that, when combined with a commercial chemical detector, can be used for the trace detection of illicit drugs and explosives.

The STSCNTF operates in an area of high narcotics trafficking where methods of concealment make the detection of narcotics challenging. Sandia National Laboratories' (SNL) Contraband Detection Department personnel provided the Hound system hardware and operational training. The Hound system combines the GE VaporTracer2, a hand-held commercial chemical detector, with an SNL-developed sample collection and preconcentration system.

The South Texas Task force reported a variety of successes, including identification of a major shipment of methamphetamines, the discovery of hidden compartments in vehicles that contained illegal drugs and currency used in drug deals, and the identification of a suspect in a nightclub shooting. The main advantage of the hand-held trace detection unit is its ability to quickly identify the type of chemical (drugs or explosives) without a long lag time for laboratory analysis, which is the most common analysis method for current law enforcement procedures.

This work was performed through the NLECTC-Border Research and Technology Center, a program of the National Institute of Justice and part of the National Law Enforcement and Corrections Technology Center (NLECTC) system

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The author thanks the South Texas Specialized Crimes and Narcotics Task Force for their tireless efforts in rigorously field-testing the Hound hand-held contraband detection system and providing valuable feedback on its performance.

We also thank the National Institute of Justice and the Border Research Technology Center for initiating, guiding, and funding this trace contraband detection technology research project. The Hound trace drug and explosives detection system has proven to be valuable tool in the war on illicit drug smuggling into the United States.

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Executive Summary

The National Institute of Justice (NIJ)/National Law Enforcement and Corrections Technology Center (NLECTC)/Border Research and Technology Center (BRTC) was contacted by the South Texas Specialized Crimes and Narcotics Task Force (STSCNTF) to request assistance in obtaining hand-held trace detection technology for use in its counter-drug operations. The BRTC responded by creating a pilot project for Sandia National Laboratories (SNL) and the STSCNTF for the use of SNL's Hound, a hand-held sample collection and preconcentration system that, when combined with a commercial chemical detector, can be used for the trace detection of illicit drugs and explosives.

The STSCNTF operates in an area of high narcotics trafficking where methods of concealment make the detection of narcotics challenging. Sandia National Laboratories' (SNL) Contraband Detection Department personnel provided the Hound system hardware and operational training. The Hound system combines the GE VaporTracer², a hand-held commercial chemical detector, with an SNL-developed sample collection and preconcentration system.

The South Texas Task force reported a variety of successes, including the following:

- Identifying a major shipment of methamphetamines, thereby preventing a hazardous materials situation from becoming a crisis.
- Discovering a hidden compartment of heroin in a vehicle during a traffic stop.
- Identifying a suspect in a nightclub shooting.
- Helping a young drug abuser seek rehabilitation.
- Seizing currency because of the identification of illicit drugs on the currency.

The anecdotal information revealed that the Hound system is an effective tool that enabled the Task Force to respond quickly and agilely to local law enforcement requests for help. An advantage of a hand-held trace detection unit is its ability to quickly identify the type of chemical (drugs or explosives) without a long lag time for laboratory analysis, which is the most common analysis method for current law enforcement procedures.

The Hound system has been utilized successfully in major drug seizures during the past two years. NIJ, STSCNTF, and SNL have benefited from real-world testing in an operational environment of the Hound contraband detection system.

Acronyms

BRTC	Border Research and Technology Center
CT	computed tomography
DOE	Department of Energy
FBI	Federal Bureau of Investigation
GC	Gas chromatography
GE	General Electric
IMS	ion mobility spectrometry
ITMS	Ion Trap Mobility Spectrometry
LSD	lysergic acid diethylamide
NIJ	National Institute of Justice
NLECTC	National Law Enforcement and Corrections Technology Center
PCP	Angel dust, or phencyclidine
PETN	Pentaerythritol tetranitrate
RDX	Research and development explosive, or cyclo-trimethylene trinitramine
SFS	Spectral Fluorescence Signature
SNL	Sandia National Laboratories
STSCNTF	South Texas Specialized Crimes and Narcotics Task Force
THC	Tetrahydrocannabinol, the intoxicant in marijuana
TNT	Trinitrotoluene

1 Introduction

1.1 Background

The South Texas region is a primary corridor for the transportation of illegal drugs entering the United States from Mexico. Two major routes (US 77 from the Matamoros/Brownsville port of entry and US 281 from the Reynosa/McAllen port of entry) travel north through the Kingsville, Texas area and connect with Interstate 37, which runs from Corpus Christi to San Antonio. Major drug trafficking organizations that operate in the region and across the border in Mexico plague South Texas with their activities. Based on its location on the Mexican/United States border and its connectivity to the transportation infrastructure, the South Texas region is a nationally significant transportation and transshipment hub for drugs destined for the rest of the nation. Over time, drug smugglers have become more sophisticated in smuggling efforts, which requires law enforcement to seek new techniques and tools to combat the smugglers.

Technical solutions to law enforcement and border security challenges have emerged as a method for responding to global terrorism and illicit trafficking of narcotics and explosives. One tool in this effort is the Hound™, a hand-held sample collection and preconcentration system that, in combination with a commercial detector, can be used in the detection of contraband. The front-end sample collection and preconcentration device was developed by Sandia National Laboratories to enhance existing trace chemical detection technology, which can augment current law enforcement efforts for the screening of individuals, vehicles, and packages for explosives and narcotics. The Department of Energy (DOE) and Federal Bureau of Investigation (FBI) provided initial funding for the development of the Hound sample collection and preconcentration technology.

1.2 Overview

In July 2003, the National Institute of Justice (NIJ) / National Law Enforcement and Corrections Technology Center (NLECTC) / Border Research and Technology Center (BRTC) was contacted by the South Texas Specialized Crimes and Narcotics Task Force (STSCNTF), based in Kingsville, Texas, to request assistance in obtaining hand-held trace detection technology for use in its counter-drug operations in the Kingsville, Texas area.

BRTC Director Chris Aldridge responded by facilitating the transfer to the task force of the Hound system, a front-end sample collection and preconcentration technology developed by Sandia National Laboratories for use with commercial, off-the-shelf drug and explosives detectors. Sandia loaned the Hound system (with the commercial detector) to the South Texas task force in exchange for feedback on the system's operations in the field. Sandia also trained the task force and was available for troubleshooting any problems.

1.2.1 Past Applications of the Hound in a Law-Enforcement Application

The BRTC also used the Hound for a “jail mail” project at the jail in Pima County, Arizona. The Hound system was used to sample incoming mail to screen incoming letters and packages for illegal drugs.

1.3 Purpose

The purpose of the field test was to help the South Texas Task Force identify chemicals (i.e., illicit drugs or explosives such as gun powder) on the spot during police investigations. Another purpose of the project was to expose law enforcement personnel to technology options for law enforcement applications. The task force also provided a real-world test bed for Sandia by using the Hound in its daily operations.

1.4 Field Test Objectives

The STSCNTF field test evaluated the performance of trace detection equipment under real-world law enforcement operational conditions. The objectives of the test were to use the Hound in routine operations to determine its ability to identify drugs or explosives, its ruggedness, its user-friendliness, and its ability to work in a hot, humid environment.

2 Contraband Detection Technologies

2.1 Categories

Drug detection systems typically fall into two categories: bulk detectors and trace detectors. Both types can be used for nonintrusive drug testing of packages and containers.

Bulk detectors use X rays, computed tomography (CT) scans, and other imaging techniques to detect large quantities (such as a pound) of contraband substances. An operator must examine the resulting image and make a judgment about whether or not to examine the item further. Bulk systems do not identify the type of explosive or drug: they alarm on anomalous images. Bulk detectors typically have high nuisance alarm rates, cannot be used to test humans (except for some back-scatter imagers), and are suitable for fixed-location interrogation. Most of these detectors are large and bulky, and cannot be carried into the field.

Trace detectors perform a chemical analysis of a sample (either vapor or particulate) and can identify the chemical compound, such as heroin or cocaine. Trace detectors can determine if items have been contaminated by drugs or touched by individuals who have been handling drugs. If a trace system detects drug residue on the exterior of a package or vapors emanating from the inside of the package, it generates an alarm. Most trace detection systems are based on ion mobility spectrometry (IMS) technology. IMS technology has been used to make rugged, portable equipment available for use in the field. Trace detectors can operate in two sample modes: contactless vapor collection or surface swipe. Using a collection medium, the operator swipes the surface of the item of interest. The sample is then inserted into the detector so that the collected particles can be extracted, analyzed, and identified. If drugs are present, the detector identifies the substance and automatically alerts the operator. Trace detectors have been used in a variety of applications, including hand-held devices that can be taken into the field, providing a mobile chemical identifier.

2.2 The Hound™ System

The Hound™ (Figure 1), developed by Sandia National Laboratories, is a hand-portable sample collection and preconcentration device that, when combined with a commercial chemical detector, is capable of detecting vanishingly faint odors (parts per trillion) of explosives, drugs, and other chemicals. Its features include portability, high sensitivity, a low false alarm rate, and ease and speed of operation. The device allows the user to perform both swipe and vapor collection with a single portable unit. For vapor collection, a blower draws in a large volume of air, collects explosives and other chemicals from the air stream onto a metalized screen, and then vaporizes these compounds into a smaller parcel of air that is then delivered to a detector. The Hound sample collection and preconcentration unit can be detached to allow easier sample collection. The Hound enhances the detection capabilities of the commercial IMS, a GE Vapor-Tracer², by delivering the sample to the detector in a concentrated form.



Figure 1. Hound™ Contraband Detection System

2.2.1 Characteristics

The following table lists the characteristics of the combined Hound and the GE VaporTracer².

Table 1. Hound and GE VaporTracer² System Characteristics

Characteristic	Value
Technology	Ion Trap Mobility Spectrometry (ITMS) (GE VaporTracer ²)
Drugs Detected	The GE VaporTracer ² detects cocaine, heroin, PCP, THC, methamphetamine, LSD, marijuana, and other substances to sub-nanogram levels.
Explosives Detected	Gun powder, TNT, RDX, and PETN-based explosives
Warm-up Time	Less than 50 minutes
Analysis Time	4 to 10 seconds
Calibration	Menu-driven upon start-up
Size	29" x 5" x 5" (73cm x 12cm x 12cm)
Weight	24 lb (11 kg)
Usage	Portable, hand-held, or benchtop applications
Modes of Operation	Swipe and vapor

3 Additional Explosives Detectors

This section describes other trace chemical detectors that are currently commercially available.¹

Table 2. Commercial Chemical Trace Detection Systems

Manufacturer	Trace Detector Model	Cost*	Detector Type	Advertised Sensitivity ^a	Approx. Size /Weight	Use
Smiths Detection	SABRE 4000	Low	Ion Mobility Spectrometry	pg	13"x4"x4.5" under 6 lb	Personnel, package, and vehicle search
GE Security	VaporTracer ²	Low – Medium	Ion Trap Mobility Spectrometry	pg	8"x5"x16" 7 lb	Personnel, package, and vehicle search
Scintrex Trace Corp.	NDS-2000	Low	Gas Chromatography/surface ionization	ppb	5.5"x5"x20" Under 6 lb	Personnel, package, and vehicle search
NARTest	NARTest	Medium	Spectral Fluorescence Signature	ppb to pg	12"x3"x4" under 3 lb	Benchtop applications

(*Cost Column: Low cost is ≤ \$25,000; Medium cost is \$25,000 to \$50,000; High cost is > \$50,000)

^a vendor-advertised sensitivity (amount of explosives detected)

pg = picogram = 1×10^{-12} grams

ppb = one part per billion (1 ppb)

3.1 Ion Mobility Spectrometry (IMS) and Ion Trap Mobility Spectrometry (ITMS) Systems

IMS-based technology is the most common technique used for commercial applications of trace detection. IMS instruments can operate in swipe (particulate) and/or vapor detection modes. IMS detection is based on how fast ions move under the influence of an electrical field and reach the detector.

The operator collects a sample either by drawing in air near the object or by swiping a surface to collect particles. The system delivers the sample to the ionization region of the IMS detector, where electrons interact with the incoming molecules to form ions (drugs form positive ions and explosives form negative ions). The ions next move into the drift region of the IMS. The time required for the ions to travel the length of the drift region is called the *drift time* and is a complex function of the charge, mass, and size of the ion. The drift time is used to identify a material as a potential drug or explosive. Typical drift times are on the order of a few milliseconds (1 millisecond = 0.001 second.) IMS is one of the most widely used techniques for trace detection of contraband materials. IMS systems operate under ambient conditions and are priced moderately.

¹ Theisen, Lisa; Hannum, David W.; Murray, Dale W.; and Parmeter, John E., *Survey of Commercially Available Explosives Detection Technologies and Equipment 2004*, written for The National Law Enforcement and Correction Technology Center, a Program of the National Institute of Justice, U.S. Department of Justice, currently unpublished, available as a PDF at <http://www.ncjrs.gov/pdffiles1/nij/grants/208861.pdf> and other Internet resources.

3.1.1 IMS System Features

1. **Ease of Use**—Most units can be successfully operated by a person with only a few hours of training.
2. **Throughput Rate**—Approximately two to three samples per minute, but throughput can be higher depending on the system.
3. **Sample Collection**—Most units have vapor and particle collection abilities.
4. **Power Requirements**—Battery and AC-powered systems
5. **System Setup**—Warm-up time is approximately 15 to 45 minutes.
6. **Cost**—Ranges from \$19,000 to \$30,000

IMS instruments normally contain a small quantity of radioactive material as an ionizing source. This radioactive source does not pose any health risks if the system is operated properly, but simply having such a source may lead to extra paperwork and regulatory oversight. The drift time associated with a given ion is dependent on atmospheric pressure, and can thus change during inclement weather or when the spectrometer is moved more than a few hundred feet in elevation. These conditions require little more than routine, periodic recalibration, but users need to be aware of this issue. Another drawback of IMS technology is peak resolution in mixtures or “real-world samples”. Two different materials that form ions of similar size and mass may appear as a single broad peak rather than two distinct peaks in an IMS spectrum.



Photos furnished by Smiths Detection and GE Security

Figure 2. Sabre 4000 hand-held contraband detection unit (IMS-based) manufactured by Smiths Detection at left and the VaporTracer² hand-held instrument (ITMS-based, without a Hound attachment) at right

3.2 Spectral Fluorescence Signature (SFS)

The vendor literature² from NARTest states that SFS technology is used to image the substance under test. The image of the suspect substance is compared to a database of images of contraband materials. SFS has been used for analysis of organic compounds in various environments, including the analysis of water. SFS technology measures a target’s full-spectrum fluorescent response, excited with a set of scanned laser lines. The image is recorded as a multi-dimensional matrix of intensity and spectral parameters.³ Many compounds produce a unique image that can be matched to a database of target substances, such as illegal drugs.

² http://www.nartest.com/NarTest_Sales%20Sheet_WEB.pdf

³ http://www.idswater.com/water/us/Laser_Diagnostic_Instruments/Laser_Fluorescence_Remote_Sensing/99_0/g_supplier_1.html

3.2.1 System Features

1. **Portability**—Table-top unit in police stations and lab facilities.
2. **Ease of Use**—Most units can be successfully operated by a person with only a few hours of training.
3. **Throughput Rate**—One result per three minutes.
4. **Sample Collection**—Particle collection (surface swipe).
5. **Power Requirements**—AC-powered.
6. **System Setup**—Not applicable.
7. **Cost**—\$30,000

3.3 Gas Chromatography/Surface Ionization Detection

Scintrex Trace Corporation produces the NDS-2000⁴ for hand-held drug detection. These detectors do not utilize a radioactive ionizing source and thus users can avoid some of the paperwork and possible regulatory oversight that may be associated with detectors that use radioactive sources, such as IMS-based detectors.

Gas chromatography (GC) can be used to separate the molecules in a vapor sample by affecting the material's speed as it travels through the GC column. When vapors exit the GC section, they are trapped selectively on the surface of the surface ionization detector, which allows identification of the substance.

3.3.1 System Features

1. **Portability**—Hand-held systems weigh under 7 lb.
2. **Ease of Use**—Most units can be successfully operated by a person with only a few hours of training.
3. **Throughput Rate**—One sample per three minutes (40-second analysis time).
4. **Sample Collection**—Swipe particulate collection.
5. **Power Requirements**—Rechargeable batteries, vehicle adapter, and AC power.
6. **System Setup**—Ready within 20 minutes of power-up.
7. **Cost**—Not known

⁴ <http://www.scintrextrace.com/brochures/nds2000.pdf>

4 Laboratory Assessment of Cocaine Indicators

Drug particulate sampling was performed using the Hound hand-held contraband detection system. Personnel from Sandia National Laboratories analyzed field measurements using standard test protocol. Comparison with the calibration curves allows approximate quantification of the amount of drug residue collected. Figure 3 shows an SNL-derived calibration curve for the Hound using cocaine.

The Hound system has primarily been used for explosives detection and its preconcentration system was designed for that purpose. However, since the drugs exhibit similar vapor pressures and molecular weights, this system is also effective for drug detection. Initial laboratory tests showed the following lower limits of detection using the Hound and GE VaporTracer² detector:

1. Marijuana (THC) 40 nanograms
2. Heroin 50 nanograms
3. Cocaine 2 nanograms
4. Methamphetamine 5 nanograms

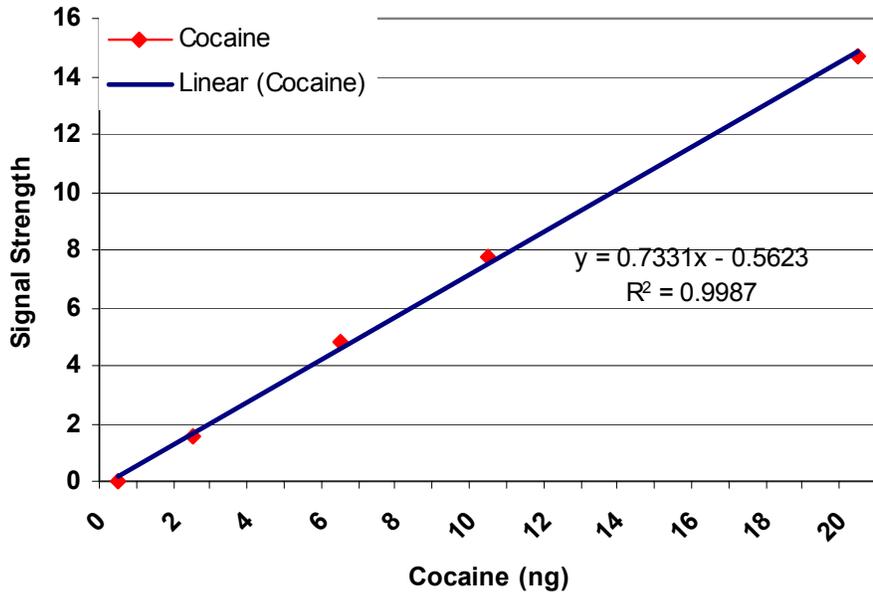


Figure 3. Sandia National Laboratories drug calibration data for the Hound

5 Project Activities

At the beginning of the project, David Hannum of Sandia National Laboratories trained several members of the Task Force on the use of the Hound II and how it interfaced to the VaporTracer² detector, including calibration, setup, operational considerations, storage, and battery charging. Richard Kirkpatrick of the South Texas Task Force had previously been trained for three days on the Itemizer (a benchtop chemical detector) and the technical principles of ion mobility spectrometry. The earlier training was presented by the Itemizer's vendor (the same company that produces the VaporTracer²). Kirkpatrick was one of the main users of the system and also trained other Task Force members in its operation and use. Other Hound users included Jason McGee and Edward Ruiz.

The equipment was available for use for a variety of applications. The system could be used as the primary or secondary means for identifying illicit drugs or the presence of gunpowder. For example, the system was also used as a secondary tool after a canine had alerted officers to the presence of illicit drugs. While the canine offers a quick way to check for the presence of drugs, the Hound II enhanced the commercial detector's ability to identify faint traces of the drugs, which was particularly helpful in the identification of currency used in trafficking drugs. Often, the officers would discover a hidden compartment used to store money, drugs, weapons, or all three. In Texas, such items can be deemed contraband and confiscated if the state can prove that the items have been used to commit a felony. For example, if the hidden compartment contains only currency, but a swipe of the compartment reveals trace amounts of illicit drugs, the currency can be deemed contraband.

The Hound and VaporTracer² were often placed in the back of a squad car for quick access in the field. Kirkpatrick reported that the technology is actively used and it can be employed to test materials 5 to 10 times per month, depending on the situation.

6 Applications of the Hound Technology

In several instances, the Hound was used effectively by the South Texas Task Force, as described in this section.

6.1 Checkpoint Screening

In early December 2003, SNL trained South Texas Task Force personnel and US Customs agents in the use of the Hound, which was used as a secondary screening device. At the Falfurrias, Texas checkpoint, agents use dogs to perform a 100% initial screening of all vehicles passing through the checkpoint. While dogs provide excellent trace detection capabilities, the dog cannot identify the type of drug or its exact location. When the Hound was used to sniff steering wheels and door handles in one inspection, traces of heroin were found and the main shipment was located eventually in half of a renovated oil pan.

6.2 Fast Assessment of Methamphetamines

On Saturday, August 7, 2004, the Texas Department of Safety initiated a routine traffic stop in Kleberg County. The officers decided to search the vehicle for contraband. A large quantity of unknown substances was found in a hidden modified compartment in the frame under the seats.

(See Appendix A for the complete letter from Jose R. Ibarra, Assistant Commander, that describes this incident.) The local law enforcement agency suspected what the contents could be, but could not be sure without a chemical analysis. They contacted the Task Force, which used the Hound to identify liquid methamphetamines, which is highly toxic and flammable. They were able to dispatch a HazMat response immediately, which would not have been possible with standard chemical testing labs, which normally require days or weeks for an analysis. “The Task Force is very grateful to have received this system for testing,” Ibarra wrote. “Our officers were able to detect a very toxic material which could have had dire effects. Because of this tool, we were able to detect the hazardous material and handle it with all the necessary precautions... I feel that on August 7, 2004, it truly saved the lives of several officers.”

6.3 Helping Troubled Families

The South Texas Task Force also has a mission to perform intervention in drug cases. Richard Kirkpatrick, a South Texas Task Force member, reported in February 2004 that he made an unusual house call. A single mother had called the task force for help: her son had been caught with a small amount of marijuana, but he denied any involvement in drugs, claiming that a friend had dropped the drugs on the floorboard of his truck. Kirkpatrick brought the Hound to the family’s house and tested the young man’s driver’s license for the presence of drugs. Traces of cocaine were found. Initially the young man protested to his mother that he had never had contact with illegal drugs. After about 30 minutes, the young man broke down and cried and told his mother that he has a serious addiction to cocaine. Kirkpatrick noted that the young man entered a drug rehabilitation program. Kirkpatrick stated, “...we strongly believe the South Texas Specialized Crimes and Narcotics Task Force using the Hound system saved a life that day.”

6.4 Identifying Shooting Suspects

Kirkpatrick said that another request for the Hound involving a night club shooting. A male suspect entered a night club and opened fire on another man, then fled the scene. After two and half hours the male suspect was arrested at his home. The suspect reportedly showered three times before being brought to the police station for questioning. Kirkpatrick took several swipes of the suspect’s clothing and firearms and used the Hound in explosives detection mode and was able to obtain hits of nitro—indicating the presence of gun powder.

6.5 Drug-related Currency Seizures

Another area of concern for law enforcement is the seizure of large amounts of money that has been used in drug-related transactions. The Hound was used in several cases to establish the presence of illicit drugs (such as cocaine) on the currency to allow its seizure. Various cases have resulted in seizures totaling more than \$465k. Documented incidents included:

- On 10/17/2005, at approximately 2:11 PM, S/A Augustine Ruiz, Jr. conducted a traffic stop on a southbound 2000 Jeep Cherokee. As a result, two Hispanic males were arrested and \$174k and the vehicle were seized. The defendants were traveling from Houston. The currency was hidden in a compartment in the firewall of the vehicle.
- On 10/18/2005, at approximately 11:04 AM, S/A Jason McGee conducted a traffic stop on a 1999 Jeep Cherokee. As a result, one Hispanic male was arrested and \$75k was

seized. The currency was located in a hidden compartment inside the firewall of the vehicle.

- On 08/31/2005, at approximately 2:21 PM, S/A Jason Mc Gee conducted a traffic stop on a southbound 2004 Ford F150 pickup. The defendants were traveling from Houston to Edinburg. As a result, two Hispanic males were arrested and \$60k and the vehicle were seized. The currency was hidden in a false compartment located in the passenger air bag. ON the same date and same case, a 2005 Ford F250 pickup was seized from a Hispanic male later that day with the same hidden compartment.
- On 11/23/2005, at approximately 5:30 PM, S/A Augustine Ruiz, Jr. conducted a traffic stop on a southbound 2002 Cadillac Escalade. As a result, a Hispanic male was arrested and \$156k and the vehicle were seized. The defendant was a resident of Roma, Texas.

6.5.1 Court Case Applications

The evidence gathered by the Hound II system has been used once in a court case. In the State of Texas vs. Manuel Cantu and Araveli Cantu, in the 105th Judicial Court in Kleberg County, Texas, the identification of trace amounts of illegal drugs were used to successfully convict defendants of money laundering. On December 13, 2003, Officer Edward Cruz found a hidden compartment in a vehicle that contained more than \$48,000 dollars. Cruz swabbed the packaging materials around the money as well as the male defendant's hands. The analysis showed the presence of cocaine, heroin, and methamphetamines. A conviction was obtained in 2004, and the confiscated currency was awarded to law enforcement.

6.6 Feedback from South Texas Task Force Personnel

The South Texas Task Force noted the following in their use of the Hound:

Limitations Discovered During the Hound Field test

- **Difficult to calibrate the GE instrument**—Kirkpatrick noted that we have experienced some downtime in selecting the correct calibrate peak time, even when the instrument was calibrated to a particular substance. Using the V-check vial was sometimes the only way to calibrate the instrument properly.
- **Detector warm-up time was too long**—Sometimes, the instrument warm-up time was not responsive enough to the immediate need. The VaporTracer detector requires a 45-minute warm-up time, which is typical of systems that use IMS technology.
- **Battery Life for the sample collector/preconcentrator was too short**—The Hound sample collection and preconcentration system given to the South Texas Task Force has a battery life of approximately 20 minutes of continuous operation. This limitation has been addressed in later versions of the Hound by using a blower motor that requires less amperage. This issue was also addressed by changing the method in which the batteries were discharged and recharged.
- **Downtime to switch modes**—When changing from explosives detection mode to drug detection mode, the operator was required to perform a time-consuming process that required tools to complete. The hand-held technology still has this limitation.
- **Difficult to display detailed results**—Data from the VaporTracer² can be downloaded to graphs on a laptop for printing at a later time, but the process can be cumbersome. The South Texas Task Force also evaluated the Sabre 2000 from Smiths Detection and the

data displays were easier to obtain via printed plasmagrams than the equivalent process on the VaporTracer².

- ***Requires technical expertise***—The calibration process requires some technical expertise. The Task Force noted that the calibration process was simpler for the Sabre 2000 than the equivalent process on the VaporTracer².

Positive outcomes of the Hound Field test

- ***Provides Evidence***—The evidence from the Hound (i.e., the identification of specific drugs) has been used to prosecute money launderers using trace evidence.
- ***Performs Drug and Explosives Identification Well***—The task force provided numerous examples of when the Hound was able to quickly and accurately identify chemicals, and, in some cases, save lives (Appendices A and B.)

Operational Considerations

- ***No breakdowns***—The Hound II and Vapor Tracer did not break down during the field test. After more than three years in the field, both units are still performing.
- ***Consumables***—Dopants, swipes, drying materials, and so on, were provided by Sandia. In the future, such costs will be borne by the South Texas Task Force.

7 Conclusions

Through routine operational use, the South Texas Task Force was able to use the technology offered by the Hound system to detect drugs and explosives (particularly gunpowder) during investigations to identify substances and potential suspects.

While the South Texas Task Force saw the value of using technology to help with law enforcement applications, the cost of the detector and prototype Hound may be prohibitive for local law enforcement entities. However, if the Hound were commercialized or the agencies received special additional stipends for technology, the cost might be affordable.

The task force also provided a real-world test bed for Sandia by using the Hound in its daily operations. The Hound demonstrated its ability to immediately identify methamphetamines, cocaine, ecstasy, and heroin. The system was able to perform well under field conditions and was user friendly with some limitations (see section 6.6). The system performed well in the local environment and was not affected by heat or humidity.

Trace contraband detection equipment has proven itself to be very useful in the day-to-day detection, location, and identification of illicit drugs and explosives when used by properly trained law enforcement officials. The type of equipment used in this test would be extremely valuable to local, state, and federal law enforcement officials throughout the nation.

8 Recommendations

Recommendations from South Texas Task Force:

- Adapt the Hound so it can work with any portable IMS instrument
- Incorporate sample collection, preconcentration, and detection into one instrument. (Sandia is developing the MicroHound, which performs all three functions in one instrument. The latest iteration of the MicroHound technology is due in May 2006.)

9 Additional Technology Options

Several manufacturers produce trace drug detection equipment. A survey of the commercially available equipment was written in 2000, "Guide for the Selection of Drug Detectors for Law Enforcement Applications," NIJ Guide 601-00 by J.E. Parmeter, D.W. Murray, and D.W. Hannum. This guide is available at no charge through:

The National Law Enforcement and Correction Technology Center
P.O. Box 1160
Rockville, MD 20849-1160
e-mail: asknlectc@nlectc.org
<http://www.nlectc.org>

10 Project Points of Contact

The following persons were the points of contact for the project:

Person	Role	Contact Information
Chris Aldridge	BRTC Director	(619) 232-1726
Dave Hannum, SNL Org. 6418	Test Engineer	(505) 844-6926

Appendix A—Letter from Jose Ibarra

AUG-26-2004 13:14 FROM:STSCNTF

3615955781

TO:18886602782

P.2



**SOUTH TEXAS SPECIALIZED CRIMES
AND NARCOTICS TASK FORCE**
P. O. BOX 213
KINGSVILLE, TEXAS 78364
tejasnar@intcomm.net
(361) 595-5778
Fax (361) 595-5781



August 16, 2004

Mr. Chris Aldridge
Border Research and Technology Center
1010 Second Avenue, Suite 1920
San Diego, CA 92101

Re: Hound II Detection System

Dear Mr. Aldridge:

On Saturday afternoon, August 7, 2004, the Texas Department of Public Safety initiated a traffic stop in Kleberg County. With the use of the Hound II Detection System, a large quantity of unknown substances, both liquid and powder was found in a unique hidden modified compartment in the frame under the seats.

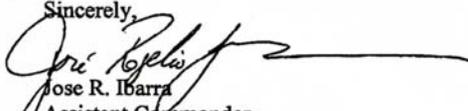
An opening was made in the compartment that punctured a plastic bottle. When the probe was extracted from the opening, the substance appeared to be a liquid that reacted when it came in contact with air and began to crystallize. At this point, our task force was contacted. Our officer conducted a swipe, and it was determined that the liquid contained high amounts of methamphetamines, and also bundles that resembled shaved ice. It also contained a small amount of nitrates. I was contacted and suggested that the vehicle be towed by a wrecker service to a safer location.

Throughout this area, law enforcement agencies are not too familiar with the properties of methamphetamines, both liquid and powder, and have only had simplified basic training in hazmat situations. With this tool, our officers were able to determine the contents of this compartment, and therefore, treated the incident as a Type 1 hazmat incident, preventing cross-contamination. The Kingsville Fire Department Hazmat Group was then contacted for precautionary measures.

The Task Force is very grateful to have received this system for testing. It has been very beneficial to our officers. In this particular instance, our officers were able to detect a very toxic material which could have had dire effects. Because of this tool, we were able to detect the hazardous material and handle it with all the necessary precautions. With continued feedback from our officers, and others like us, I am very confident that this technology will soon exceed its expectations.

Again, I would like to stress how very grateful we are that you have allowed us the use of the Hound II System for testing purposes. I feel that on August 7, 2004, it truly saved the lives of several officers.

Sincerely,


Jose R. Ibarra
Assistant Commander

Appendix B—Email from Richard Kirkpatrick

Hound Field Test progress report from the South Texas Specialized Crimes and Narcotics Task Force (Richard Kirkpatrick, 2/26/04)

The Hound system is performing very well.

During this time we continue to operate and implement the detector with our main focus on drug detection.

We have been able to use the device and with great success in detecting trace narcotics in vehicles. Most recently seizures of vehicles have been possible with the Hound system, including one commercial motor vehicle with a false compartment.

Approximately one week ago, we had received a phone call from a concerned parent. This parent, a single mother, having received news her son was caught at school with a small amount of marijuana in his vehicle, asked us to speak to her and her son. She explained to us she had a hard time believing her son was involved in any type of drug activity. The son told his mother and us it was his friend's drugs and not his that happen to fall on the floorboard of his truck.

We explained to the mother we could use the Hound system to check his hands and wallet to detect illegal drugs and identify that substance.

Our first test using the swipe method of the young man's driver's license revealed significant peak for cocaine. Initially the young man protested to his mother he had never been around illegal drugs or used them. After about thirty minutes the young man broke down, cried and told his mother he has a serious addiction to cocaine.

In short, gentleman we strongly believe the South Texas Specialized Crimes and Narcotics Task Force using the Hound system saved a life that day.

This young man is now in a drug rehabilitation program.

We also received another request recently for the Hound involving a night club shooting. A man suspect entered a night club and opened fire on another man then fled the scene. After two and half hours the male suspect was arrested at his home. The suspect reportedly showered three times before being brought to the police station for questioning. I utilized the Hound II (swipe method) in explosives mode and still was able to obtain hits of nitro on the clothing of the suspect as well as the fore arms.

We currently report significant levels of nitro, heroine, cocaine discovered in middle school and high schools. More local police agencies as well as US customs were recently briefed on the Hound II system and are excited as we are to discover other possibilities as well as limitations.

The pre-concentrator and air collection device both work very well with no problems.

As for cons, sometimes it is difficult to calibrate the GE instrument. We have experienced some downtime in selecting the correct calibrate peak time, even when the instrument was calibrated to a particular substance. We have found that the V-check vial sometimes is the only way to get the instrument to cal properly. At no point have we been successful in allowing the instrument to "cal on internal". Subsequent tests have resulted in alarms to inconsistent substances.

Suggest possible implementation of Hound II to adapt to any portable IMS instrument or build the hound II instrument to incorporate the detector all together.

Richard Kirkpatrick

Appendix C—Hound Contraband Sample Results

The following sample results were obtained by the South Texas Specialized Crimes and Narcotics Task Force (STSC&NTF) officials in their efforts to reduce the passage of contraband (specifically drugs) through the state of Texas. These spectra were downloaded from the GE VaporTracer² to a laptop computer.

Contraband Detection Field Test by the South Texas SCNTF

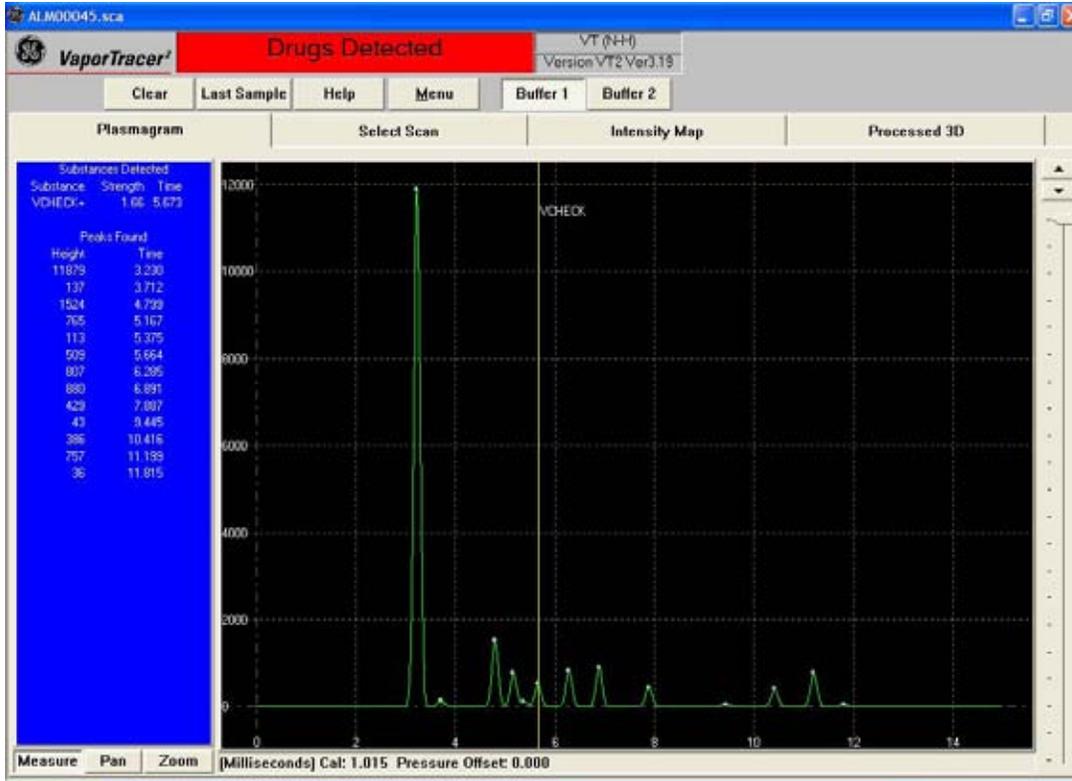


Figure A-1—Daily calibration check

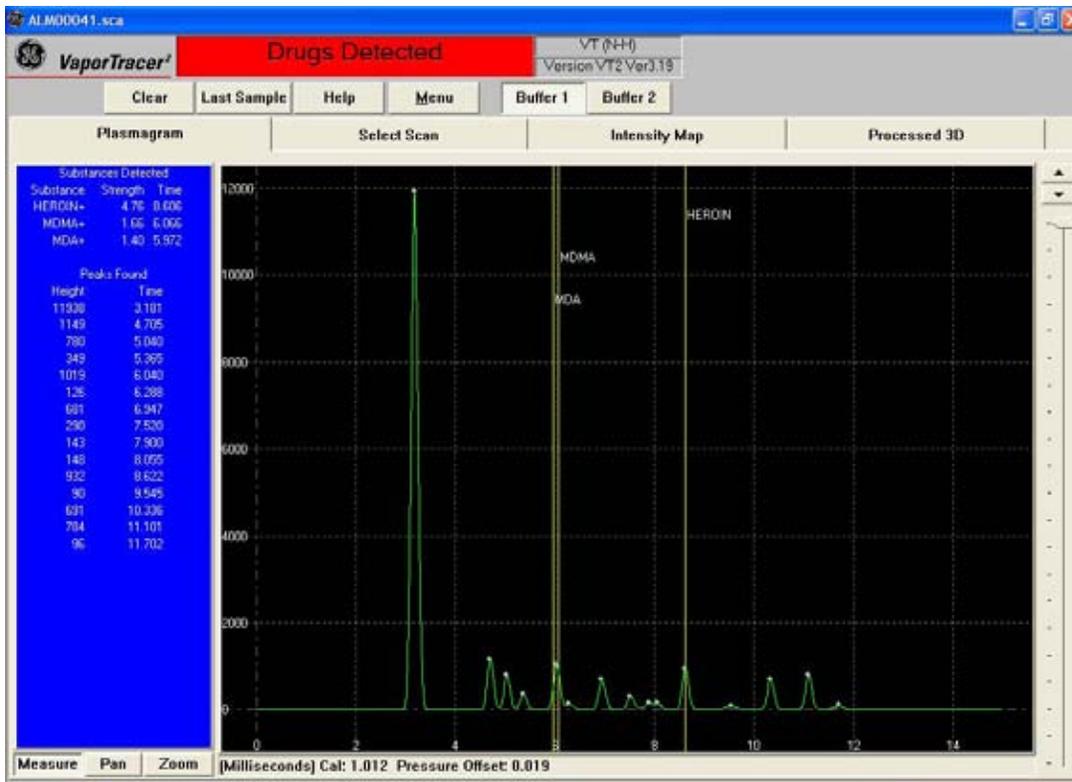


Figure A-2—Sample analysis showing methamphetamines and heroin

Contraband Detection Field Test by the South Texas SCNTF

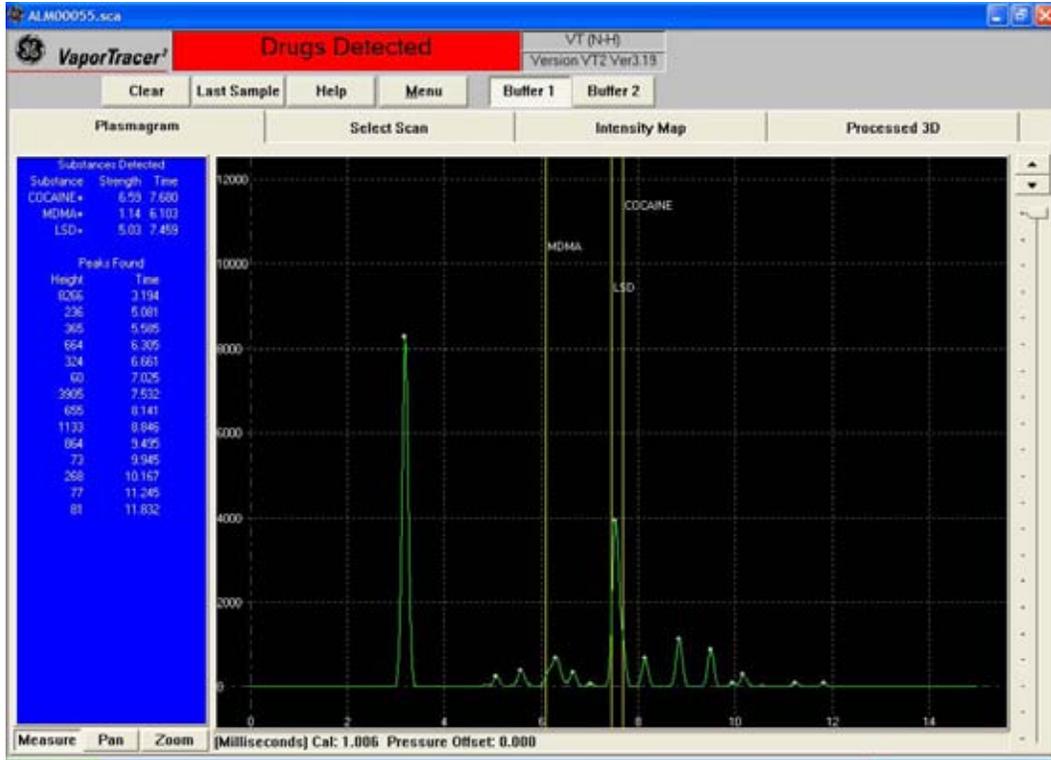


Figure A-3. Single sample analysis showing multiple drugs, including methamphetamine, LSD and cocaine traces

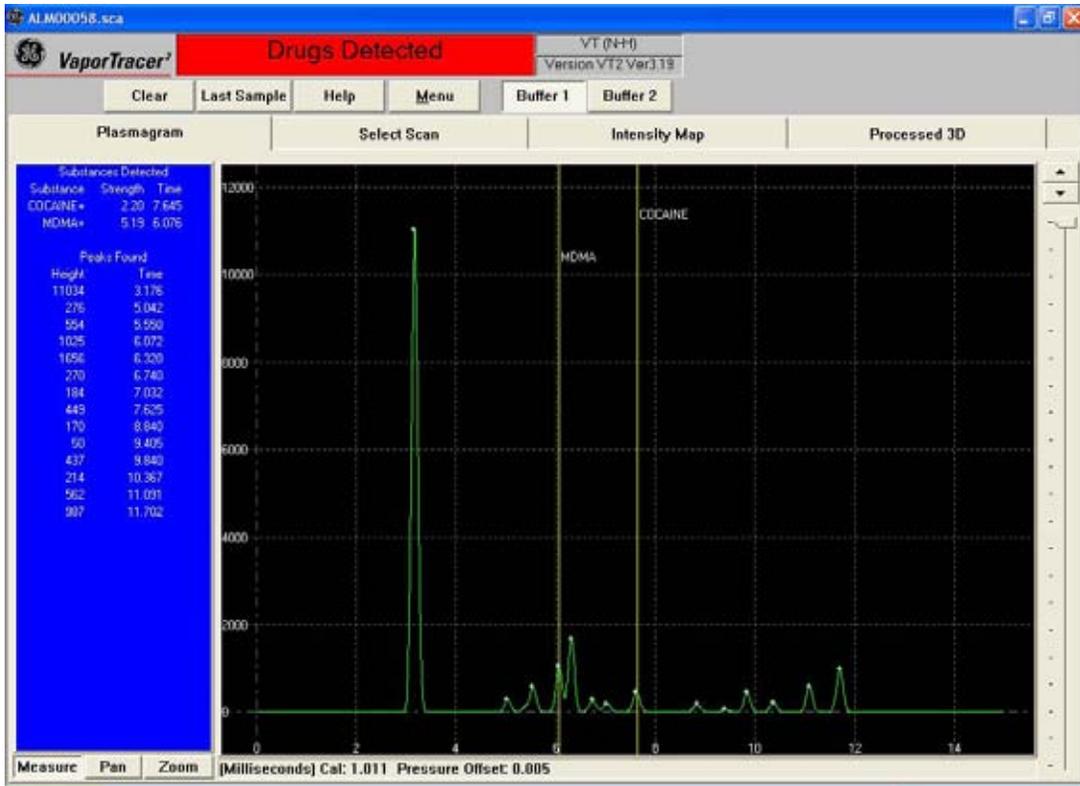


Figure A-4. Single sample analysis showing methamphetamine and cocaine

Distribution

1	MS0782	D.W. Hannum, 06418
1	MS0966	G.W. Shannon, 05744
12	MS0757	C.D. Aldridge, 06441
2	MS9018	Central Technical Files, 8944
2	MS0899	Technical Library, 04536