

Technology Overview

Raman and Fourier Transform Infrared (FTIR) spectroscopy are lab-proven, trusted analysis techniques that provide highly accurate analysis results:

- **Raman:** As a laser-based technique, Raman spectroscopy uses a single laser to interrogate a sample, measuring the light that is scattered by the sample of interest to develop the chemical fingerprint. Raman is uniquely able to scan through transparent or translucent containers, eliminating direct contact with the substance and providing significant tactical advantage.
- **FTIR:** Complementary to Raman, FTIR is an absorption technique. A broad-spectrum light is used to interrogate the sample, and the light that is absorbed provides the chemical fingerprint. FTIR is well suited for fluorescent or dark-colored substances which can be problematic for a Raman spectrometer.



Complementary technologies provide a broad range of identification techniques.

Thermo Scientific Portable Analytical Instruments Benefits at-a-Glance

- Fast, accurate chemical identification at ports of entry and borders
- High throughput for increased productivity and informed decision making
- Ease of use with menu-driven interface for fast training and proficiency
- Increased duty recovery through counterfeit and mislabeled drug identification

Meeting the Challenge of Customs and Border Protection

Customs organizations worldwide face a daunting challenge—detect and deter dangerous and hazardous substances while facilitating commerce and safe travel. From narcotics and explosives identification to anti-counterfeit inspection, the ultimate goal is to protect the public by ensuring the integrity of materials that reach our shores and borders. Thermo Scientific portable analytical instruments were specifically designed and engineered to help meet this challenge.

To discuss your particular application and requirements, please contact your local Thermo Scientific representative, email sales.chemid@thermofisher.com, or visit our website at www.thermoscientific.com/safety-chemID.

Application Note: 102

In addition to U.S. offices, Thermo Fisher Scientific maintains a network of representative organizations throughout the world.

Key Words

- Customs inspection
- Narcotics interdiction
- Chemical identification
- Duty recovery
- Raman spectroscopy
- FTIR spectroscopy

Thermo Scientific
Portable Analytical Instruments
2 Radcliff Road
Tewksbury, MA 01876
+1 978.642.1132
www.thermoscientific.com/safety-chemID
sales.chemid@thermofisher.com

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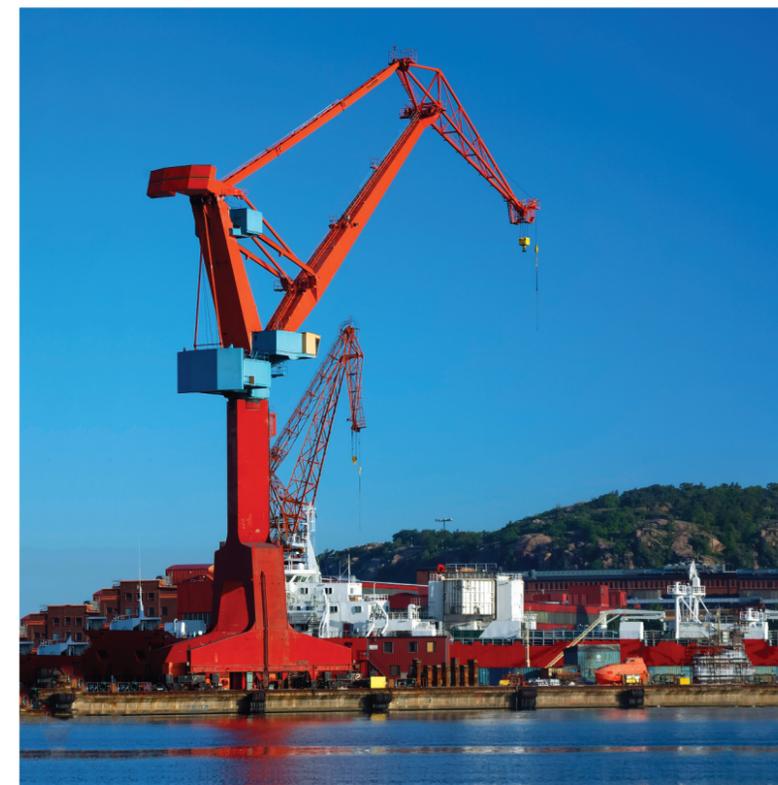
Customs and Border Protection

Keeping the Public Safe—and Commerce Moving—with Handheld Checkpoint Solutions

Customs and Border Protection—On the Front Line

By land, by sea, by air. Customs and Border Protection (CBP) organizations are charged with protecting public safety by serving as guardians of a nation's borders. They are expected to facilitate legitimate trade while stemming the overwhelming, constant flow of suspect shipments. Despite their constant vigilance, the world's ports of entry and borders can serve as gateways for illegal narcotics, new synthetic drugs, explosives, precursors, counterfeit pharmaceuticals, and unknown chemicals. In the United States alone in fiscal year 2011, 24.3 million containers come through the nation's ports of entry (POE), and CBP officers and agents seized nearly five million pounds of narcotics, a 20 percent increase from FY 2010.¹ The World Health Organization (WHO) estimates that "look alike" or counterfeit drugs comprise as much as 10 percent of pharmaceuticals worldwide (approximately \$30 billion USD), and in some countries up to 50 percent of the drug supply.² This can add up to millions of lost dollars in duties and taxes.

Understaffed CBP organizations are on the front lines, balancing the interdiction of suspicious shipments with keeping commerce moving. Handheld chemical identification instruments are available that can help agents and officers accurately analyze products at the port of entry, holding up only those shipments that potentially pose the greatest risk. Results are immediate for fast, informed decisions.



Portable Optical Analysis—Identifying the Suspects

Thermo Scientific portable analytical instruments are rugged, handheld spectrometers designed for rapid and precise chemical identification, authentication, and screening at the point of need. A user can hold the sample of interest against the instrument nosecone—through sealed containers in many cases—and easily conduct an analysis. Just like fingerprints are matched in a database of criminals, Thermo Scientific instruments can match chemicals to a database of known materials. Whether the need is for narcotics identification, explosives or precursor identification, or inspection for spurious/falsely-labeled/falsified/counterfeit (SFFC) pharmaceuticals, these instruments provide accurate results in seconds.

Using either Raman or FTIR spectroscopy (see back page), our tools provide Customs personnel with a broad chemical identification solution that can increase safety, save time, facilitate decision making, and help in the enormous benefit of duty recovery.

What You Need, When You Need It, Where You Need It

With a mission to safeguard the public by safeguarding the products and raw materials that enter through ports of entry and borders, Customs and Border Protection personnel can achieve success through international collaboration, targeted operations, and the deployment of innovative technology.

1 U.S. Customs & Border Patrol. *CBP's 2011 Fiscal Year in Review*, December 12, 2011. http://www.cbp.gov/xp/cgov/newsroom/news_releases/archives/2011_news_archive/12122011.xml

2 Cappiello, Nicholas D. "Counterfeit-Resistant Technology: An Essential Investment to Protect Consumers and to Avoid Liability." *Journal of Health & Biomedical Law*, 2 (2006): p. 279.

3 World Customs Organization. *WCO Publishes Its Three Annual Reports on IPR, Drugs and Tobacco*, July 4, 2012. <http://www.wcoomd.org/en/media/newsroom/2012/july/wco-publishes-its-three-annual-reports-on-ipr-drugs-and-tobacco.aspx>

4 Drug Enforcement Administration. "DEA Arrests Nine People throughout Florida during the First National Synthetic Drug Takedown as Port of Operation Log Jam." *Press Release*, July 31, 2012.

5 U.S. Immigration and Customs Enforcement. *Program Global Shield*. Pamphlet, June 2011.

6 U.S. Department of Homeland Security. *Cargo Screening*. <http://www.dhs.gov/cargo-screening>

Narcotics Identification



According to the World Customs Organization (WCO), both the number of drug seizures reported by WCO Members and the total amount of drugs intercepted in 2011 increased substantially compared to 2010.³

In addition to dealing with more well-known drugs such as cocaine, heroin, and MDMA (ecstasy), Customs personnel now also have to face the rapidly growing challenge of synthetic drugs. Synthetic cathinones — also called “bath salts” or “plant food”—and synthetic cannabinoids—often called “spice”—are broad categories of designer drugs that are pushing the capabilities of law enforcement worldwide. In July 2012 Operation Log Jam, the first U.S. nationwide law enforcement action against synthetic drugs, resulted in approximately 90 arrests and the seizure of more than 5 million packets of finished designer synthetic drugs.⁴

As quickly as countries make a certain drug type or derivative illegal, new alternatives appear on the market thereby circumventing the new laws. With drug targets evolving so rapidly, those agencies chartered to police such activities must keep pace by deploying the latest testing methods.

In some locations, if Customs officials suspect a package may contain drugs, it can be sent to a lab for analysis, which could take hours—even days. The result is that commerce is slowed and legal shipments can be delayed. A new field-deployed technology helps to eliminate this problem.

Our Solution

For rapid identification of suspected narcotics in the field, among the ships, at the airports, at the borders, the Thermo Scientific TruNarc analyzer offers a handheld Raman system that can scan through transparent/translucent containers, plastics bags, and bottles for most samples. A single test for multiple controlled substances provides enforcement officials with clear, definitive results for presumptive identification. Lightweight and easy to use, the TruNarc™ device delivers fast and accurate narcotics analysis anywhere it's needed.



This breakthrough instrument easily identifies narcotics, stimulants, depressants, hallucinogens and analgesics using lab-proven Raman spectroscopy. It can analyze key drugs of abuse as well as common cutting agents, precursors, and emerging threats such as cathinones and bulk cannabinoids—ensuring that Customs officials are always ahead of the curve.



Explosives & Unknown Chemicals



Improvised explosive devices (IEDs) are gaining traction due, in part, to the relative ease of production and widespread availability of raw materials. Because they are not fueled by traditional explosive materials like TNT, but are made in crude chemical labs using industrial chemicals like nitric acid, ammonium nitrate, diesel fuel and sugar, they avoid detection by traditional explosive detection technologies and trained canines.

In fact, they are considered the most prevalently used explosive device employed by criminals worldwide, and terrorist training manuals have been uncovered that detail how to easily assemble IEDs with a basic knowledge of chemistry.⁵

Formed as a collaborative effort in 2011 and now numbering more than 90 nations and international organizations, Program Global Shield is an unprecedented worldwide effort to counter the smuggling of chemical precursors that could be used to manufacture explosive devices. They monitor the import and export of 14 explosive precursor chemicals that have been identified as those most often used in IEDs. As of July 2012, Program Global Shield has accounted for 41 seizures of chemical precursors totaling more than 126 metric tons related to the illicit diversion of these chemicals.⁶



Global Shield Precursors

	Raman	FTIR
Acetic Anhydride	✓	✓
Acetone	✓	✓
Aluminum Powder	×	×
Ammonium Nitrate	✓	✓
Calcium Ammonium Nitrate	✓	✓
Hydrogen Peroxide	✓	×
Nitric Acid	✓	✓
Nitromethane	✓	✓
Potassium Chlorate	✓	✓
Potassium Nitrate	✓	✓
Potassium Perchlorate	✓	✓
Sodium Chlorate	✓	✓
Sodium Nitrate	✓	✓
Urea	✓	✓

NOTE: Metals, such as aluminum, are not amenable to Raman or FTIR analysis.

Our Solution

Together, the Thermo Scientific FirstDefender and TruDefender product families offer an ideal solution for identification of liquid and solid industrial chemicals, as well as numerous explosives and precursors. The FirstDefender® RM, based on Raman spectroscopy, and TruDefender® FT, based on FTIR spectroscopy, can quickly identify the contents of tankers, drums, bags, and bottles directly at ports of entry and borders. These highly accurate instruments are deployed globally by military and civilian responders for field-based assessment of a broad range of unknown chemicals. This unique set of tools helps equip Customs and Border Protection personnel in the fight against the IED threat.

Duty Recovery



A significant and costly consequence of counterfeit and intentionally mislabeled materials is that governments are deprived of much needed revenue in the form of lost duties that otherwise would have been paid on legitimate products. With a counterfeit pharmaceuticals industry estimated to be a billion-dollar industry and some estimates considerably larger, the amount of uncollected duties is noteworthy and should spur governments to do everything possible to recover these funds. What's more, some of the duty recovery itself could help pay for the very technology that can identify the spurious substances. Product safety is improved through supply chain management and public coffers receive the appropriate monies owed.

Our Solution

The FirstDefender and TruDefender product families provide valuable capabilities for duty recovery. The vast substance libraries include more than 11,000 individual chemicals, ranging from toxic chemicals and explosives to benign household materials. This wide range enables Customs personnel to identify materials intentionally mislabeled as less expensive product in order to avoid duties. For example, if a white powder is labeled as sugar but tests as a pharmaceutical compound, further analysis is warranted.