ATF
National Laboratory Center

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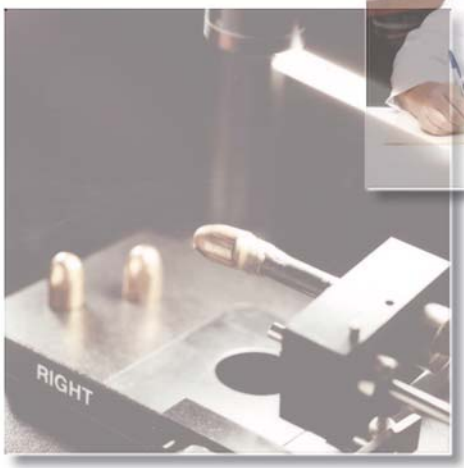


U.S. Department of Justice
Bureau of Alcohol, Tobacco, Firearms and Explosives

Welcome to the National Laboratory Center, ATF's state-of-the-art facility for utilizing science to support the Bureau's mission to reduce violent crime and protect the American public.

As you visit the center, or just read this pamphlet, we hope you get a better understanding of all the scientific resources and expertise that ATF brings to bear in support of its law enforcement mission.

The center has three basic components:

- National Forensic Laboratory, which evaluates evidence obtained in crimes involving firearms, at bomb scenes and from debris collected in suspected arson incidents.
- Fire Research Laboratory, the first facility in the world dedicated to fire scene investigations, including the ability to reconstruct fire scenes to determine how fires begin and spread.
- Alcohol and Tobacco Laboratory, which conducts chemical, physical and instrumental analyses to support illicit alcohol and tobacco trade investigations.

The ATF laboratories have provided invaluable services to the Federal government in the areas of law enforcement, industry regulation and tax collection for more than 100 years. ATF's National Laboratory Center follows in that tradition, tracing its roots back to 1886, when Congress created the first Treasury laboratory.

We hope you enjoy your visit.

ORGANIZATION

The National Laboratory Center is run by ATF's Office of Laboratory Services, which provides analytical and advisory services on matters of a scientific nature. Laboratory Services is made up of four organizational groups: the Forensic Science Laboratories in Atlanta, San Francisco and Washington, and the Fire Research Laboratory (FRL). The National Laboratory Center houses the FSL in Washington and the FRL and serves as the administrative center for Laboratory Services. Laboratory Services are part of ATF's Office of Science and Technology.

STAFFING, CERTIFICATION AND ACCREDITATION

The ATF laboratories are composed of more than 100 personnel, including chemists, scientists, engineers, fingerprint specialists, firearm and toolmark examiners, questioned document examiners and administrative support personnel. ATF laboratory personnel hold leadership positions in numerous professional scientific organizations and are considered among the most highly qualified specialists in their individual fields.

Certification

ATF actively supports and encourages certification for individual scientists and examiners. Our specialists are, first of all, professionals; certification by their peers is the highest endorsement of that professionalism. Although not every discipline in the laboratory has a certification program, where one exists virtually all of our senior examiners have sought and attained this important credential. Certifying bodies include the:

- American Board of Forensic Document Examiners
- American Board of Criminalistics
- International Association for Identification (fingerprint specialists)
- Association of Firearm and Toolmark Examiners
- Professional Engineer Certification Program (fire research engineers).

A typical certification program will require that the incumbent be recommended by a professional peer and undergo an application process that evaluates their training and qualifications. They must complete a written test and practical examination, and they must complete an oral board that is usually a presentation of a complex technical problem. Recertification on a three- to five-year cycle will require documentation of a minimum set of accomplishments that includes points for continuing education, active participation in professional organizations, scientific presentations and publications.

Accreditation

The ATF laboratories were one of the pioneers in the creation of a national program for the accreditation of forensic laboratories. The ATF Laboratories followed through with this support by being the first federal laboratories to achieve accreditation by the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB). The ATF laboratories were first accredited in 1985 and have continued to maintain accreditation since.

ASCLD/LAB was created in 1982 with the objectives of improving the quality of laboratory services, developing criteria to assess laboratory performance, provide independent and impartial laboratory reviews, and to establish a means for the public to identify laboratories that meet high standards[1].

To maintain its accreditation, the ATF laboratories undergo a rigorous on-site inspection every five years that evaluates all aspect of the laboratory including:

- The qualifications of personnel and standards for evaluation
- Employee development and training to proficiency
- Space, safety and security
- Evidence control, security, handling and preservation techniques
- Management organization, planning, budget and administrative practices
- Quality programs for methods and procedures, including an internal audit program

[1] Paraphrased. For additional information go to www.ascld-lab.org .

- Internal and external communications
- Instrument maintenance, calibration and the use of comparison standards
- Administrative and technical reviews of work products
- Internal and external proficiency testing

ASCLD/LAB currently accredits more than 300 forensic laboratories nationally and internationally. ATF is proud that its laboratories were among the leaders in this important effort.

SERVICES PROVIDED

Firearm and Toolmark Examination

The ATF laboratories are among the few forensic laboratories in the world that provide full service in all areas of firearm and toolmark examinations. These include examination of firearms, comparison and identification of bullets and cartridge casings, restoration of obliterated numbers, determination of firing distances, identification of toolmarks related to bombing and arson incidents and caused by a variety of hand and machine tools, and crime scene reconstruction in shooting incidents.

Firearms examiner fires a bullet from a pistol into a retrieval tank

This expertise, for example, allowed ATF to connect the dots in the investigation into the October 2002 sniper shootings that terrorized the metropolitan Washington, D.C., area.

Identification of toolmarks to a specific tool includes identification of fired bullets and cartridge casings to a specific firearm. Underlying these examinations is the premise that tools (firearms) leave distinct, reproducible and unique marks when in contact with a

softer metal used to manufacture bullets, cartridge casings, wires, locks, pipes and other components generally used to make an explosive device. These marks can then be categorized, classified and, if a suspected tool or a firearm is recovered, microscopically compared to test marks produced in the laboratory by that tool or a firearm.

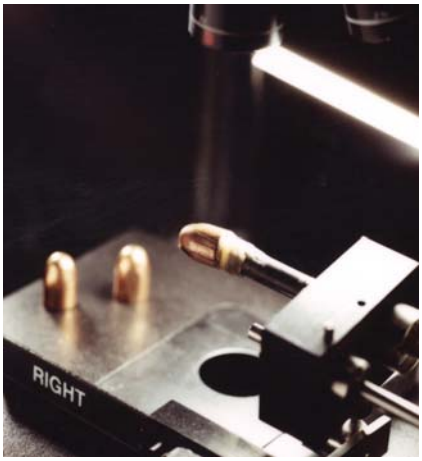
Bullet comparison for NIBIN

Restoration of firearm serial numbers that have been obliterated in an effort to conceal their identity often leads to the discovery of their origin. These restored numbers are searched through the National Crime Information Center (NCIC) providing investigators with valuable information tracing the firearms to the points of distribution and sale.

ATF Firearm and Toolmark Examiners are members of the Association of Firearm and Toolmark Examiners (AFTE) and were instrumental in developing a comprehensive nationwide certification program in three main specialty areas: Firearms Examination and Identification, Toolmark Examination and Identification and Gunshot Residue – Distance Determination. The first three AFTE certified examiners came from within ATF's ranks.

ATF Firearm and Toolmark Examiners conduct research in all specialty areas and often publish their results in internationally recognized professional journals such as *AFTE Journal* and the *Journal of Forensic Sciences* (a publication of the American Academy of Forensic Sciences). They also conduct research in the development of standards accepted by the legal profession and the courts to comply with the latest legal developments in admissibility of physical evidence and expert witness testimony.

ATF examiners provide expert testimony in all levels of state and federal courts in all specialty areas of this profession, and often assist other examiners from the state and local crime laboratories in preparations for expert witness testimony.



Bullet analyzed in the ballistics lab

National Integrated Ballistic Information Network (NIBIN) Program

The ATF laboratories are an integral part of NIBIN, a nationwide program using the Integrated Ballistics Identification System (IBIS). This computer system, combined with microscopy and digital imaging, quickly searches databases for matching toolmarks left by a firearm on fired bullets and cartridge casings. This search allows trained specialists to associate evidence in crimes committed with firearms in multiple locations throughout a geographical region. Without the system it would virtually take years to comb through evidence in many locations and be able to identify fired ammunition components to a particular firearm.

The country has been divided into 12 multistate regions where approximately 235 law enforcement sites operate IBIS systems. When a crime is committed with a firearm, fired bullets and/or cartridge casings are entered into the system and a database search performed to find any link between this evidence and evidence in other shooting incidents. Once the system identifies a potential candidate, a Firearm and Toolmark Examiner collects and microscopically compares the actual evidence. Numerous crimes have been solved that, if not for this system, would most likely have stayed unsolved.

Highly skilled IBIS Specialists located in all three ATF Forensic Laboratories review potentially matching images and determine whether a Firearm and Toolmark Examiner should compare the actual evidence. IBIS Specialists also test-fire weapons for entry into IBIS, conduct refresher-training sessions with their local and state counterparts, and assist in data entry when an individual site develops sizable backlogs.

ATF Firearm and Toolmark Examiners conduct research studies using IBIS to develop a statistical base for toolmark identification

criteria. They also work in concert with the National Institute for Standards and Technology (NIST) to develop a “standard bullet” that would be used for all NIBIN sites to calibrate and test the accuracy of the instruments and the computer program.

Pipe bomb

Since ATF and its partner agencies began using this technology, they have recorded thousands of “hits,” many of which have provided critical investigative leads that could not have been obtained by any other means.

Close up of analysis of bomb fragment

Explosives Examinations

The ATF forensic laboratories perform more explosives examinations than any laboratory in the world, and played key roles in the investigation of the 1993 World Trade Center bombing, Sept. 11, 2001, terrorist attacks and other major criminal and industrial explosions. ATF’s forensic chemists are specially trained in the identification of explosives and components of explosive devices. Evidence collected at scenes of explosions is examined to identify the type of explosive used and to identify all the parts of the explosive device. These can include blasting caps, leg wires, fuses, timing mechanisms, batteries, radio controlled components, igniters, containers, wire, tapes and any other parts that may have been used to make the device. The forensic chemists work closely with investigators to find device components that will help link a suspect to the crime.

When looking for the explosive used, the chemists look for intact particles that may have survived the blast when low explosives such as smokeless powder or black powder are used. If a high explosive was used, such as dynamite, water gels, or plastic explosives, the explosive is usually consumed in the blast. The forensic chemist must find evidence that was close to the blast, and recover any explosive residues by rinsing the evidence with water or a solvent. A variety of instrumental methods are then used to identify both low and high explosives.

Scientist using a microscope to examine a pipe bomb

Physical evidence recovered in the course of explosives-related investigations may be essentially intact or may consist entirely of debris recovered from the scene of an explosion.

Examiner uses microscope to analyze bomb fragment

The laboratory examination of intact explosive materials and device components is relatively straightforward. Frequently, the laboratory can provide a definitive identification of all of the components, including the type and possibly the brand of explosive. In the examination of post-blast debris, the ability of the laboratory to provide definitive information is dependent primarily on the quality and quantity of the evidence submitted. In either case, the identification of the device components and the characterization of trace evidence such as hairs, fibers and toolmarks can:

- Assist the investigator in the search for suspects
- Associate a suspect with a device
- Associate devices from separate incidents

It is therefore essential that the evidence be recognized, collected and properly packaged if the laboratory examination is to provide meaningful information and assistance to the investigator.

Types of Explosives

Explosives are generally characterized as high explosives or low explosives, and high explosives can be further classified as commercial, military and improvised. Low explosives are materials that burn rapidly or deflagrate; they generally require confinement to function as an explosive. Examples of low explosives include black powder, Pyrodex and smokeless powder. High explosives undergo nearly instantaneous chemical decomposition; they detonate. Typical examples of high explosives include dynamite, TNT (trinitrotoluene), ANFO (Ammonium Nitrate and Fuel Oil) and Composition C-4.

Devices made with low explosives are far more commonly observed than those involving high explosives. Low explosives, such as black and smokeless powder, are relatively inexpensive, easily purchased and function upon application of a spark or flame. In contrast, high explosives have limited availability and require a shock-producing detonator for their initiation.

Fire Investigation, Research and Education

The Fire Research Laboratory (FRL) is the only facility of its kind in the world to provide the necessary facilities, equipment and staff to work on important fire investigation issues such as fire scene reconstruction, flashover studies, validation of fire pattern analysis indicators, impact of accelerants on fire growth and spread, ignition studies and electrical fire cause analysis. Until the development of the FRL, there were no fire measurement facilities in the United States, or elsewhere, dedicated to the specific needs of the fire investigation community.

The initial concept of the FRL and Fire Research Center (FRC) facility arose from a demonstrated need identified by ATF's Certi-

fied Fire Investigators (CFIs). As they applied fire science theories to their investigations, they realized that there were a number of questions they could not answer. To better understand the fire scene, they wanted to be able to reconstruct fire scenes under controlled conditions in order to apply more sophisticated tools to fire ignition and development issues.

Large hood in the NLC Fire Research Lab large burn room

The FRC, completed in April 2003, houses the fire test cells and measurement equipment to support the FRL forensic examinations. Using a variety of fire measurement techniques and computer modeling tools, FRL staff assist ATF's Certified Fire Investigators both in the field and the laboratory. The fire modeling illustration to the right, one of the FRL tools, shows smoke movement under the FRC's largest test hood. Laboratory fire scene reconstruction helps to solidify scientific-based theories for fire ignition and development in any given case.

The FRC provides a controlled environment where fire investigation theories can be evaluated and fire cause scenarios can be reconstructed. The 60' by 60' hood, shown above, in the final stages of construction, is the largest calorimetry hood in the world. The FRC provides fire scientists, engineers, researchers and investigators with the capability to perform a wide range of standard and unique tests. These potential tests range from small-scale fire tests to full-scale testing of two-story structures.

The FRC has several test cells, or rooms, where full-scale test fires are conducted. This unique capability provides ATF the versatility necessary to reconstruct and test key aspects of most of the fire scenarios encountered by fire investigators in the field.

Using these test cells, the FRL has the ability to evaluate a wide variety of fire scenarios ranging from a simple burning trashcan to a completely furnished room or a full-scale structural mock-up. The FRL is equipped with state-of-the-art hood/exhaust systems, data acquisition systems and instrumentation to facilitate the measurement of heat release rate (HRR), burning rate, heat flux and temperatures of burning materials.

The work products developed by the FRL staff provide a bridge from theoretical fire research and testing knowledge to practical training and education to benefit the fire investigation.

The FRL staff provides training that supports the professional development of ATF Certified Fire Investigators (CFIs). The FRL conducts forensic applied research on behalf of ATF CFIs, prosecutors and the fire investigation community at large. The work supports investigations, as well as broader fire investigation research needs. Often the work is done in partnership with others, such as the National Institute of Standards and Technology (NIST) Building and Fire Research Laboratory and the University of Maryland.

The FRL is an active participant in the worldwide community of fire research laboratories and serves as an international model in the training of personnel, developing investigative research, testing protocols and in fostering technical partnerships.

The FRL also maintains a program for visiting scientists/professors who may be able to help FRL staff expand their knowledge and expertise, while working on mutually beneficial research that might not otherwise be possible in the academic world. The FRL works in cooperation with the National Institute of Standards and Technology (NIST), International Association of Arson Investigators (IAAI), United States Fire Administration (USFA), National Fire Academy (NFA) and the National Fire Protection Association (NFPA) to develop enhanced investigative, prosecutorial and training methodologies and other initiatives designed to improve fire scene investigation, reconstruction and analysis.

Fire Debris Analysis

ATF's forensic laboratories have specialized in supporting fire investigations and have examined the vast majority of evidence

Gas chromatograph used in analyzing arson evidence

involving fire investigations of federal interest for more than 35 years. The primary role of the fire debris chemist is the examination of fire debris evidence for the recovery and characterization of any ignitable liquid residues in the debris sample. Commonly, these residues would be from gasoline, kerosene or perhaps charcoal lighter fluid. After the analysis is complete, the chemist generates a report as to their findings and is subject to testifying in federal, state and local courts as an expert witness. As an expert witness, the chemist's role is to explain his findings to the jury and judge.

Evidence is typically submitted to the laboratory in clean unused paint cans. Upon receipt of the evidence by the analyst, the evidence is inventoried and each can is briefly opened and physically examined. While the can is open, the analyst inspects the debris for any obvious odors and considers how to preserve any potential evidence that may be irreversibly damaged by the sample preparation technique. For example, a Molotov cocktail (containing a glass bottle filled with an ignitable liquid and some type of wick) recovered intact may contain latent fingerprints or a cigarette butt bearing DNA evidence.

Examiner using solution in tray to bring up fingerprints on evidence

Fingerprint comparison

Based on this initial assessment, the analyst will choose one of several sample preparation techniques designed to recover ignitable liquids from fire debris samples. In the ATF laboratory, charcoal adsorption is the technique of choice for most fire debris samples. Most often, a strip impregnated with activated charcoal is suspended inside the can and the can is placed in a laboratory oven at 65½C for up to 16 hours after which the can is removed from the oven and allowed to cool. The strip is then removed from the can, placed in a screw cap vial and extracted with a solvent for analysis by Gas Chromatography-Mass Spectrometry (GC-MS). If an ignitable liquid is found in the debris, an investigator might conclude that sufficient physical evidence has been collected to establish arson. Even when coupled with the facts of the investigator's origin and cause determination, this may be far from sufficient evidence to successfully develop or convict a suspect.

Gas chromatograph used in analyzing arson evidence

Occasionally, the laboratory is asked to make a specific brand identification of an accelerant, especially gasoline. Gasoline is commonly used in arson because it is readily obtained, relatively inexpensive and easy to ignite. Successful comparisons of liquid samples have been undertaken. Liquid accelerants remaining at the scene (in containers or malfunctioned Molotov cocktails) have been associated with liquid samples found in a suspect's possession (from a gasoline can or vehicle) or samples from a gas station in the vicinity of the crime. Liquid samples are required for such a comparison. When the sample for comparison is from a gas station, the sample must be collected from the gas pump before another delivery of gasoline is made to the gas station.

Alcohol Diversion

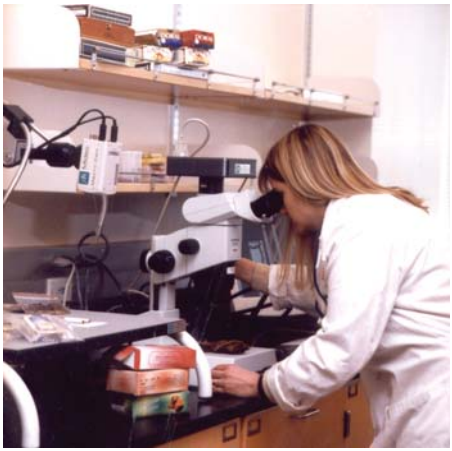
Alcohol diversion and smuggling is an ongoing illegal activity. Illicit alcohol trade involves moonshine, refilling, misbranding, counterfeit, smuggling, interstate diversion, and potable alcohol diversion as nonbeverage alcohol.

The Alcohol and Tobacco Laboratory (ATL), which was one of the five ATF laboratories before ATF split into two agencies – one moving to the Department of Justice and the other remaining at the Department of the Treasury – has the specialized expertise to support illicit alcohol trade investigations. With the Memorandum of Agreement between ATF and the Alcohol and Tobacco Tax and Trade Bureau (TTB), ATL will continue to support illicit alcohol trade investigations.

The primary role of ATL chemists is to examine evidence submitted by ATF investigators, generate a report on laboratory findings, and submit it to the field investigator to assist in arrest and indictment of illicit alcohol trade operators.

Typically laboratory examinations include physical and chemical examination and/or organoleptic evaluation for excise tax classification and product authenticity. The most modern instrumental techniques are employed in the analysis and in product profiling. The instruments utilized include: a Gas Chromatograph coupled with Flame Ionization Detector or Mass Spectrometer, a High Performance Liquid Chromatograph, a Gas Chromatograph coupled with Isotope Ratio Mass Spectrometer, a Inductively Coupled Plasma Mass Spectrometer and a Digital Density Meter. ATL specialists use organoleptic evaluation, where deemed necessary, along with analytical profile for class and type designation and product authenticity. The ATL also maintains an extensive database on various beverage and nonbeverage alcohol products to assist in identifying the alcohol product.

Tobacco Diversion



Diversion, smuggling and counterfeiting tobacco products in the market place are ongoing illegal activities. Illicit tobacco trade, including counterfeit state excise tax stamps, has skyrocketed since the November 1998 tobacco settlement between the states and tobacco companies, and the significant increase in state excise tax on cigarettes. Illicit tobacco trade investigations may involve tracking of tobacco shipments, counterfeit cigarettes and/or cigars, counterfeit state excise tax stamps, Internet sales, native and non-native enforcement, mail fraud, wire fraud, tax avoidance, money laundering, Jenkins's Act violations, and/or inter-state diversion.

Under the Memorandum of Agreement between ATF and Treasury's Alcohol and Tobacco Tax and Trade Bureau (TTB), ATL will continue to support illicit tobacco trade investigations.

The primary role of the ATL tobacco chemist is to examine evidence submitted, generate a report on laboratory findings and submit it to the field investigator to assist in possible arrest and indictment of illicit tobacco trade operators.

Typically laboratory examinations include physical and chemical examination for excise tax classification, physical examination of tobacco product, carton and state excise tax stamps of codes, markers and security features for authenticity, and inorganic and organic profiling for origin and/or common source of illicit product.

For chemical analysis a small quantity of tobacco from the evidence is pulverized and the pulverized sample is either extracted in solvents or digested in nitric acid prior to analysis. Analysis is performed utilizing various instrumental techniques such as High Performance Liquid Chromatography, Ion-Chromatography, Capillary Electrophoresis, Gas Chromatography coupled with Mass Spectrometer and Inductively Coupled Plasma Mass Spectrometer. Physical examination involves evidence examination under ultra-violet and infrared light source, photographic capabilities coupled with microscopic examination, equipment and comparison with established authentic markers.

Looking for clues in the Trace Evidence Section

The final task of the ATL tobacco chemist is to maintain an electronic imaging system and an inorganic-organic profile database to assist an investigation by linking evidence submitted to common origin or a common source.

Artist rendition of the ATF National Laboratory Center