

Feasibility of a California Ballistics Identification System

**Assembly Bill 1717 (Hertzberg)
(Stats. 2000, ch. 271)**

Report to the Legislature



*Attorney General Bill Lockyer
California Department of Justice
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Technical Evaluation: Feasibility of a Ballistics Imaging Database for All New Handgun Sales
Fredric A. Tulleners, Laboratory Director,
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Ballistic Imaging and Comparison of Crime Gun Evidence by the Bureau of Alcohol, Tobacco and Firearms, May 13, 2002
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AB 1717 Independent Review, December, 2002
Dr. Jan De Kinder, Ballistics Section, Head,
National Institute for Forensic Science, Belgium

EXECUTIVE SUMMARY

Assembly Bill 1717 (Hertzberg), (Stats. 2000, ch. 271), was signed into law by Governor Davis on August 31, 2000. This bill directed the Department of Justice (DOJ) to conduct a study to evaluate ballistics identification systems to determine the feasibility and potential benefits to law enforcement of utilizing a statewide system capable of maintaining a database of ballistic images and information from test-fired and sold firearms. Such a statewide ballistics identification system would be designed to allow law enforcement agencies to query a database to compare crime scene ballistics evidence with ballistics information from handguns sold in the state. Two states, Maryland and New York, have implemented statewide ballistics imaging databases for new handguns sold in those states. This type of system is often referred to as a reference ballistic imaging database (RBID), or a legislative database.

In compiling this report, the DOJ study has identified many issues that need further study and resolution before an RBID system can be implemented in California. While an operable RBID would assist law enforcement agencies in solving crimes, further refinement and maturing of the technology will need to occur before this capability is realized for the size of the system needed in California. The report raises questions that must be addressed, including the potential use of emerging technologies as an alternative to an RBID that may provide a simpler and more economical means of matching a gun to cartridge cases found at crime scenes. The DOJ study also highlights the need for this issue to be tackled at the federal level for several reasons: To be the most successful, any RBID must include ballistics information from all states; the federal government has the financial and structural resources to ensure the database is comprehensive; and federal agencies already have years of experience in dealing with an existing database of more than 560,000 ballistics images.

The RBID “beta” sites in New York and Maryland currently contain only handgun information. In 2002, there were approximately 12,400 handguns sold in Maryland that were subject to the ballistics imaging requirements. New York ballistically imaged 20,973 handguns in 2002. To date, New York and Maryland have made no matches, or “hits,” with these programs. Significantly greater numbers of handguns are sold in California each year than in Maryland or New York. The extreme size of any such database in California greatly increases the technical difficulty of establishing of an RBID here.

DEVELOPMENT OF THIS REPORT

A stakeholders meeting was held by the DOJ in April 2001 to discuss the feasibility of a statewide ballistics identification system in California. Attendees included representatives from firearms manufacturers; laboratories; local, state, and federal law enforcement agencies; providers of ballistics imaging technology; and special interest organizations. Subcommittees were formed during this meeting to identify industry and technical issues. Members of the subcommittees subsequently submitted their identified issues to the DOJ. As a result of the stakeholders meeting, Fredric A. Tulleners, Laboratory Director, DOJ, Bureau of Forensic Services (BFS), developed and conducted limited study performance tests of ballistics imaging

systems. His findings, contained in the *Technical Evaluation: Feasibility of a Ballistics Imaging Database For All New Handgun Sales* (hereinafter Technical Evaluation), reported the results of the studies conducted. The Technical Evaluation was distributed to stakeholders for review and comment in October 2001.

Comments on the Technical Evaluation were received from various stakeholders, including law enforcement agencies, private testing laboratories, handgun manufacturers, providers of ballistics imaging technology, firearm owner advocacy organizations, and the gun safety community. Extensive comments were received from the Bureau of Alcohol, Tobacco and Firearms (ATF) via the report *Ballistic Imaging and Comparison of Crime Gun Evidence by the Bureau of Alcohol, Tobacco and Firearms, May 13, 2002*, and from Forensic Technology, Inc. (FTI), currently the only provider of ballistics imaging technology worldwide. Stakeholder comments varied greatly, leading the DOJ to seek an external independent review.

The BFS contracted with Dr. Jan De Kinder, a recognized expert in the field, of the National Institute for Forensic Science in Belgium to conduct an independent review of the Technical Evaluation and the rebuttal reports from the ATF and FTI. Dr. De Kinder's report, *AB 1717 Independent Review* (hereinafter Independent Review), was received in December 2002. This report was a limited study based on information in the Technical Evaluation and the comments received from ATF and FTI. The Independent Review analyzed the current technologies discussed in those reports and comments. It was not meant to be an overall assessment of ballistics imaging technology. It did, however, confirm many of the findings contained in the Technical Evaluation.

In addition to the reports and comments mentioned above, to assist with the development of this report additional background and technical information was reviewed and obtained from *The Methods and Technology for "Ballistics Fingerprinting" and Their Practical Applications December 2000, First Edition* prepared by Forensic Technology 2000 and the *Ballistic Identification Capability Modeling – A Guide for State Program Establishment* (hereinafter Capability Modeling), prepared by Mitretek Systems.

A BRIEF OVERVIEW OF BALLISTICS IMAGING

The recent sniper attacks in the Washington D.C. area brought ballistic imaging to the public's attention. Questions were raised regarding whether an RBID would have assisted in the solving of that case. In the sniper case, firearms ballistics examiners used imaging technology to link cartridge cases to each sniper attack and, ultimately, to the weapon found in the suspects' possession. This technology also enabled investigators to link cartridge cases from a crime scene in one state to the weapon used in the sniper attacks. Even though this application is different than an RBID, it does demonstrate the value of ballistics imaging.

As bullets and cartridge cases are expelled from a firearm, microscopic markings are left on the bullets and the cartridge cases from the firing pin, ejector, barrel and other internal mechanisms of the firearm. These marks are unique to each firearm and are substantially reproduced each time the firearm is fired. The size, shape and location of these marks can be used to establish a smaller pool of firearms that share characteristics for comparison purposes. The individual nature of these marks can be used to conclusively identify a specific firearm as having fired a particular bullet or cartridge case. Ballistics imaging is often referred to as “ballistic fingerprinting” or “ballistic DNA.” Unlike DNA, which cannot be altered, some markings made by firearms may change over time with normal wear and tear of a firearm. Some preliminary studies suggest that some firearms marks may change rapidly during a “break-in” period of unknown length. Others state that marks on cartridge cases do not change, but that marks on bullets, especially lead bullets, do. However, even then there still may be marks that can be used for comparison purposes. Current law enforcement experience with ballistics imaging indicates that it is extremely rare for firearms to be purposely altered. It also is unknown what effect normal wear and tear may have on the correlation rate of an RBID, and further study is recommended. Maryland’s RBID only images cartridge cases due to the belief that bullets recovered from crime scenes may be too damaged for analysis. Ammunition from different manufacturers may be marked differently by the same firearm, and certain makes/models of handguns leave more distinguishing marks than others. Maryland and New York currently do not require a standard ammunition for the test-fired cartridge cases submitted to their RBID. The DOJ recommends further study to determine which types of ammunition should be used as protocol for a California RBID.

The ATF and the Federal Bureau of Investigation (FBI) have implemented an automated ballistics imaging system, the National Integrated Ballistics Information Network (NIBIN), in which state and local law enforcement agencies participate. This crime gun evidence system can be used to link ballistics information between two or more crimes. However, federal law, the Treasury and General Government Appropriations Act, 2002, Pub. L. 107-67, 115 Stat.519, prohibits agencies from using the NIBIN database to search for information on purchased firearms. Unlike NIBIN, RBIDs are intended to be used to link crime scene evidence with information about handguns that have been purchased or manufactured, but not yet linked to any crime. An RBID is used as an investigative tool to “point” investigators to the firearm associated with ballistics evidence. The systems do not identify matching images on their own, rather they generate automated initial comparisons that can result in a list of several potential match candidates. Trained personnel would then need to visually examine and compare these match candidates to identify an actual match.

As previously mentioned, only Maryland and New York have implemented RBIDs for new handguns sold in those states. Maryland’s system became operational in October 2000. New York’s system, the Combined Ballistic Identification System, or CoBIS, became operational in March 2001. Both systems image only cartridge cases. Both systems require firearms manufacturers to submit two cartridge cases in a specified manner with each new handgun imported into the state for sale. The firearms dealers forward the cartridge cases to a

state center for imaging. In instances in which a cartridge is not included, firearms dealers may go to state-authorized sites to test-fire handguns in order to obtain cartridge cases for imaging.

As of December 2002, neither Maryland nor New York had identified a hit with their RBID. The so-called "time-to-crime" factor may explain why. The "time-to-crime" is defined as the length of time from the first retail sale of a firearm to its recovery as a crime gun, regardless of the number of subsequent sales. *The Crime Gun Trace Reports (1999) National Report*, published by the ATF, identifies the median "time-to-crime" as three years for 32 percent of recovered guns. However, the latest *Trace Reports (2002)* indicates that an RBID is considered operable if it generates a hit rate of approximately 15% after two years of new-gun entries.

A CALIFORNIA BALLISTICS IDENTIFICATION SYSTEM

In recent years, semi-automatic handguns have been the predominant type of firearm used in crimes nationwide. As indicated in Mitretek Systems' Capability Modeling, bullets recovered from crime scenes are sometimes too damaged to successfully analyze ballistics information. Expert opinions differ as to whether or not bullets are suitable for imaging for an RBID. It should be noted that hit rates for bullets in NIBIN databases are negligible. Cartridge cases found at crime scenes are generally not damaged and can be more easily analyzed. The Maryland and New York RBIDs contain ballistics images only from cartridge cases. Cartridge cases from revolvers are rarely recovered from crime scenes, thus collecting ballistic images of cartridge cases from semi-automatic pistols may be preferable for developing a California RBID. However, there is no agreement among experts regarding the suitability of .22-caliber cartridge cases for analysis. The DOJ recommends further study to determine the feasibility of imaging bullets from new firearms sold and the suitability of imaging .22-caliber cartridge cases for a California RBID.

Under current California law, about 670 models of semi-automatic pistols have been approved for sale by dealers as new handguns. However, there are approximately 80,000 new semi-automatic pistols sold each year in California. That raises concern that the limited variety of handguns populating an RBID may adversely affect the database. When querying the system, for example, a user could potentially have such a large number of possible hits that it would be impractical to manually review all potential hits. This was the situation encountered in the Technical Evaluation with a database size of less than 800 guns. That concern may be eliminated by continued advancements in technology, such as improvements in algorithms and protocols that users could employ to limit the number of potential hits identified. The DOJ recommends further study to determine what impact improving technologies may have on this concern.

The DOJ believes federal agencies should look to RBIDs implemented in Maryland and New York and work collaboratively with other interested states to develop a standard protocol

throughout the country. Development of a standard protocol would improve the ability of states to share resources and ballistics imaging data.

Any RBID program created in California should be based on further study of systems implemented in Maryland and New York to determine whether there are aspects that can be used in California to ensure greater compliance from firearms manufacturers. For example, firearms manufacturers could be required to include two cartridge cases in a specified manner with each new handgun, as currently required in both Maryland and New York. Those cartridge cases would be submitted by firearms dealers to the DOJ for imaging before the handgun is sold. DOJ staff could review and enter the ballistics image and corresponding information into the RBID. As an alternative to the DOJ capturing the ballistics images, the California Legislature could require:

- Manufacturers and importers to obtain the necessary equipment to acquire ballistics images and forward such information electronically to the California database. The original cartridge cases would be submitted by firearms dealers to the DOJ prior to the sale of the handgun. Standards would need to be implemented to ensure the control and quality of the images and data and to prevent chain-of-custody concerns regarding the cartridge cases.
- Independent laboratories to be certified to acquire the ballistics images. The DOJ or manufacturers and importers could contract with these laboratories to ensure that the ballistics images are sent electronically to the California database. Standards would need to be implemented to ensure the control and quality of the images and data and to prevent chain-of-custody concerns regarding the cartridge cases.
- An independent entity to assume the responsibility for acquiring ballistics images and maintaining the ballistics image database. Again, standards would need to be implemented to ensure the control and quality of the images and data and to prevent chain-of-custody concerns regarding the cartridge cases.

An RBID is intended to provide law enforcement with another tool to assist in solving crimes. An important component of an RBID is to provide law enforcement agencies (LEAs) with the ability to query a California RBID on demand for potential hits to crime scene evidence in their possession. Under federal law there are severe restrictions on the use of federal ballistics databases. Federally-funded crime evidence systems currently cannot be used to query a statewide database of sold handguns. Options available for LEA access to the data include:

- Change federal law to allow LEAs to use NIBIN data to query a state RBID.
- Develop an infrastructure to allow local agencies to query the state database. Appropriate equipment and technical staff would be needed at the local level for

this application. Once potential matches have been identified, the LEA could submit the crime scene evidence to the DOJ firearms examiners for final determination of matching cartridge cases. Alternatively, the DOJ could send potential matches to the LEA for final determination to be made by the firearms examiners at the LEA. Chain-of-custody issues may be of concern with either approach.

- Submission of crime scene evidence by LEAs to the DOJ for imaging and subsequent query of the RBID. DOJ firearms examiners would make the final determination of matching cartridge cases. Again, chain-of-custody issues may be of concern.

An intriguing alternative is an emerging technology involving virtual serial numbers, or micro serial numbers. In this technology, the firearm “microstamps” a unique number on cartridge cases as they are fired from firearms equipped with the specialized stamping mechanism. The stamping mechanism is installed by firearms manufacturers. The unique number could be forwarded to the DOJ prior to the sale of a firearm. No special ballistics imaging equipment would be needed to image cartridge cases to populate a database. Since no special ballistics imaging equipment would be needed, this technology may be an economical alternative for use in California. This technology may be worthy of further study for possible use in California.

IMPLEMENTATION COSTS

Many issues surrounding a California RBID must be addressed before developing cost estimates for implementing and maintaining such a system. The DOJ recommends that further study include the feasibility of the following:

- Imaging bullets versus cartridge cases;
- Imaging all caliber handguns versus specific caliber handguns;
- Imaging all firearms, all handguns or only semi-automatic pistols;
- Imaging one or two cartridge cases and/or bullets for each firearm;
- The use of alternative technology;
- Imaging to be performed by DOJ, manufacturers/importers or independent laboratories; and
- LEA query methods.

It would be premature to estimate costs for a California RBID without determining the above parameters through further study.

Maryland's RBID implementation cost was \$1,800,000 including equipment and personnel. Their system is designed to capture approximately 30,000 ballistics images per year for five years. The initial equipment costs for the New York CoBIS system was \$2,397,775. That system was designed to meet New York's needs for 15 years. Personnel costs for New York are unavailable. It is reasonable to assume that any such system implemented in California would have much higher costs given the significantly greater number of handguns sold in California than in Maryland and New York.

RECOMMENDATIONS

It is apparent that existing research is too limited and that further study of current and emerging technologies is needed before creating an RBID in California. The DOJ believes that further study would be most comprehensive if conducted at the federal level. Federal agencies have access to an existing database consisting of more than 560,000 ballistics images and years of experience with the database. In addition, federal agencies employ numerous firearms experts with the knowledge and expertise in this area. Federal agencies also have the means to effectively communicate with all states regarding the ballistics information.

California recognizes the value of studying the performance of the RBID sites in Maryland and New York. However, California sells a significantly greater number of handguns than those states. In 2002, approximately 12,400 handguns met the ballistics imaging requirements in Maryland, and New York imaged 20,973 handguns. In California during the same period, more than 80,000 new semi-automatic pistols were sold. The extreme size of any such database in California greatly increases the technical difficulty of establishing of an RBID here.

Dr. De Kinder's Independent Review recommends that further studies be conducted prior to the implementation of a California RBID. Those studies include, but are not limited to:

- Conducting further correlation performance tests of the ballistics imaging system using handguns from additional manufacturers. Correlation performance tests of the database have been conducted with automatic pistols manufactured by Glock and Smith and Wesson to determine the ability of the database to identify matching cartridge cases. Glock semi-automatic pistols leave more identifiable markings on the cartridge cases, which result in a higher correlation rate. Further study using handguns from another manufacturer would provide an understanding of the range of correlation rates that could be expected with current technology.

- Researching the benefit and potential costs of imaging more than one cartridge from each handgun. Imaging two cartridge cases could account for variations in the markings on cartridge cases resulting in a higher correlation rate. The study could result in the development of a protocol to image one or multiple cartridge cases from each handgun. If multiple cartridge cases are imaged, the protocols should address whether the cartridge cases should be consecutively fired or be from specifically-spaced firings.
- Researching the effects that different types of ammunition have on an RBID. The study would involve firing different caliber ammunition from additional manufacturers to determine which ammunition and firing procedures work best for developing protocol.
- Evaluating the possibility of having a serial number/bar code imprint transferred to the breech face of a cartridge as it is fired from a firearm. In this emerging technology, a unique number is imprinted on cartridge cases as they are fired from firearms equipped with a specialized stamping mechanism.
- Developing an accurate “time-to-crime” statistic for California firearms. The “time-to-crime” (time of initial sale to involvement in crime) indicated by the ATF reflects a national median not necessarily representative of California’s time-to-crime. This established California “time-to-crime” could reflect transactions subsequent to the initial sale. This study would determine the retention time for ballistics images in the database and estimate the potential size of a database. It would also provide a window of time as to when a hit could be realistically expected.
- Creating a pilot project for a single caliber of handguns using current technology.

Many of the additional studies necessary to validate such a ballistics imaging system in California are beyond the capabilities of the DOJ. These studies would further evaluate the technology and assist with development of necessary protocols needed to implement a California RBID. Development of protocols through this process could save valuable time and effort if RBID were implemented in California. With appropriate funding, however, the BFS is poised to conduct the following tests:

- “Break-in Period and Consecutively Manufactured Slides,” to study the impact of repeatedly firing handguns. This study would allow for the observation of the impact that changes associated with the normal wear and tear of a firearm would have on the hit rate. In addition, study would analyze similarities of several slides made consecutively to determine if problems may arise when images from very similarly marked cartridge cases populate the database. This study could be conducted for an estimated cost of \$17,000.

- “Primer Hardness,” to determine which ammunition would be best suited for imaging. Ammunition differs in composition and construction. It would be necessary to determine which ammunition should be used for cartridge cases submitted for imaging. This study could be conducted for an estimated cost of \$12,000.
- “Micro Serial Number” In collaboration with the developer of this technology and other law enforcement agencies, determine the feasibility of this technology. This study could be conducted for an estimated cost of \$20,000.

CONCLUSION

Although this report raises several issues and questions concerning current technology, the DOJ believes that emerging or alternative technologies are likely to have the potential to develop ballistic imaging into a powerful crime-solving tool. The DOJ believes it is crucial that further study be conducted, that more resources be directed into this developing field and that more forensic scientists be trained to identify and compare ballistics fingerprints to assist law enforcement agencies throughout the country.

The DOJ strongly recommends that the federal government embrace the idea of further study on a national scope. Not only would further study and additional resources help provide answers to the many outstanding issues surrounding ballistics imaging, it would hasten the improvements in this technology. A national RBID could be an extremely valuable tool for law enforcement in generating leads and solving crimes.

Further study also should be made of alternative technologies, such as the possibility of using virtual serial numbers as a way to stamp a unique number on cartridge cases as they are fired from firearms.

In the meantime, the DOJ believes that studies should be undertaken to develop protocols in anticipation of a California RBID.

ATTACHMENT A

***Technical Evaluation: Feasibility of a Ballistics Imaging
Database for All New Handgun Sales***

**Fredric A. Tulleners, Laboratory Director,
Department of Justice, Bureau of Forensic Services**

ATTACHMENT D

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December, 2002*

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