

# The NIST/NIJ Technical Working Group on Biological Evidence Preservation: Best Practice Handbook in Progress

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Preservation

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# Technical Working Group on Biological Evidence Preservation

A partnership between the **National Institute of Standards and Technology**, Law Enforcement Standards Office and the **National Institute of Justice**, Office of Investigative and Forensic Sciences

Inaugural meeting took place in August 2010

Broad goal to “establish proper collection, storage, and preservation techniques throughout the forensic science disciplines”

We just had our 8<sup>th</sup> meeting (June 13,14 in Baltimore MD)

# Technical Working Group on Biological Evidence Preservation

The NIST/NIJ Technical Working Group on Biological Evidence Preservation (TWGBEP) is charged with:  
**creating best practices and guidance to ensure the integrity, prevent the loss, and reduce the premature destruction of biological evidence after collection through post-conviction proceedings.**

# 21 TWGBEP Members

# Initial Observations

Evidence can be found in a variety of places e.g.:

- Law Enforcement Property/Evidence Rooms
- Laboratory Property/Evidence Rooms
- Court Property/Evidence Rooms
- Prosecutor's Offices, Detective's Desk drawer,...
- Hospitals

Finding:

- Better methods need to be established to be able to track evidence across the different agencies.

# Handbook on Biological Evidence Preservation

## **Audience**

- All handlers of biological evidence (**emphasizing property and evidence custodians**)
- Challenge to encompass small to large agencies

# **5 Major Sections of the Handbook**

- I. Retaining Biological Evidence**
- II. Biological Evidence Safety & Handling**
- III. Packaging and Storing Biological Evidence**
- IV. Tracking Biological Evidence Chain of Custody**
- V. Biological Evidence Disposition**

# Additional Areas of the Handbook

## Additional Resources: Web page references for:

Packaging and Collection Guidance

Property and Evidence Associations

Biohazard Disposal Guidelines

## Appendix A:

Evidence Tracking and Management Systems

## Appendix B:

List of Evidence Retention Laws

## Appendix C:

Notification of Destruction Mechanisms

## Glossary

## Bibliography



# Handbook on Biological Evidence Preservation

## **Retaining Biological Evidence**

The purpose of this section is to provide guidance to prevent the premature destruction of biological evidence. To achieve that, this section includes:

- Guidance regarding biological evidence identification
- Recommendations on the retention of biological evidence for certain crime categories
- Recommendations on the retention of biological evidence for different case statuses

# Handbook on Biological Evidence Preservation

## **Biological Evidence Safety & Handling**

The purpose of this section is to provide guidance on biological evidence safety and handling concerns and includes:

- Discussion of universal Precautions
- Guidance regarding the use of personal protective equipment (PPE)
- Guidance regarding exposure control plans
- Guidance on the disposal of regulated waste

# Handbook on Biological Evidence Preservation

## **Packaging and Storing Biological Evidence**

The purpose of this section is to provide guidance on the proper packaging and storage of evidence containing biological material. To achieve that, this section includes:

- Guidance on packaging different types of biological evidence
- High and low tech methods to dry wet evidence
- Best practices regarding the use of containers and individual item packaging
- Guidance on the appropriate conditions for biological evidence storage
- A discussion on storage location considerations
- A list of references for further guidance and training

# Handbook on Biological Evidence Preservation

## **Tracking and Chain of Custody Section**

The purpose of this section is to provide guidance to improve both the chain-of-custody process and the tracking of evidence to enhance the integrity of the criminal justice system. To achieve that, this section includes

- Guidance on the importance of chain of custody
- Best practices on managing and tracking evidence
- A discussion comparing tracking systems and minimum requirements
- Best practices and sample procedures on securing biological evidence
- Best practices for evidence management in locations such as the courthouse or hospital
- Recommendations on communications and oversight

# Handbook on Biological Evidence Preservation

## Biological Evidence Disposition

The purpose of this section is to provide guidance to improve the administrative efficiency of the disposition of biological evidence. To achieve that, this section includes:

- Best practices for the process of evidence disposition
- Key elements to include in departmental manuals or policies regarding biological evidence disposition

Disposition is the ongoing process of determining what to do with evidence in a case. The process includes retention and disposal, destruction, auction, diversion to governmental agency use or returning to owner.

# Packaging and Storing Biological Evidence

## Drying Wet evidence



Metal lockers



Fiberglass  
Shower stall



Tiled room



Commercial  
Drying  
Cabinet

All enclosures must be decontaminated between uses

# Packaging and Storing Biological Evidence

**Frozen:** Laboratory freezer storage temperatures at or below  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ )

**Refrigerated:** Stored between  $2^{\circ}\text{C}$  ( $35^{\circ}\text{F}$ ) and  $8^{\circ}\text{C}$  ( $46^{\circ}\text{F}$ ) with less than 25% humidity

**Temperature Controlled:** Stored between  $15.5^{\circ}\text{C}$  ( $60^{\circ}\text{F}$ ) and  $24^{\circ}\text{C}$  ( $75^{\circ}\text{F}$ ) with less than 60% humidity

**Room Temperature:** No temperature or humidity control guidelines

# Temporary Storage

Type of Evidence	Frozen	Refrigerated	Temperature Controlled	Room Temp
Liquid Blood	Never	Best	≤24 hours	
Urine	Best	≤24 hours		
Dry Biological Stained Items			Best	Acceptable
Wet Bloody Items (dry ASAP)	Best	Acceptable	≤24 hours	
Bones			Best	Acceptable
Hair			Best	Acceptable
Swabs with Biological Material		Best (wet)	Best (dry)	
Vaginal Smears			Best	
Feces	Best			
Buccal Swabs			Best	≤24 hours

## DEFINITIONS:

Temporary Storage: refers to the period between the time when an officer submits an item with evidentiary value into a locker or other facility, and the time that it is removed and documented as received into the property room by property room personnel.

Frozen: Stored by freezing at a constant temperature at or below  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ )

Refrigerated: Stored between  $2^{\circ}\text{C}$  ( $35^{\circ}\text{F}$ ) and  $8^{\circ}\text{C}$  ( $46^{\circ}\text{F}$ ) with less than 25% humidity

Temperature Controlled: Stored between  $15.5^{\circ}\text{C}$  ( $60^{\circ}\text{F}$ ) and  $24^{\circ}\text{C}$  ( $75^{\circ}\text{F}$ ) with less than 60% humidity

Room Temperature: No humidity control

Dry: Evidence that has been fully dried so that no liquid (blood, semen, etc,) can drip from the object that it exists upon.



# Long Term Storage

Type of Evidence	Frozen	Refrigerated	Temperature Controlled	Room Temp
Liquid Blood	Never	Best		
Urine	Best			
Dry Biological Stained Items			Best	
Bones			Best	Acceptable
Hair			Best	Acceptable
Swabs with Biological Material			Best (dry)	
Vaginal Smears			Best	
Feces	Best			
Buccal Swabs			Best	
DNA Extracts	Best(liq) →	Acceptable(liq)	Acceptable (dry)	

## DEFINITIONS

Long-Term Storage of Biological Evidence: A long-term storage location must be designated to secure all biological evidence or property items in the custody of the agency for the duration of the time it is held in the property room, until the items are diverted, sold, released, or destroyed.

Frozen: Stored by freezing at a constant temperature at or below  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ )

Refrigerated: Stored between  $2^{\circ}\text{C}$  ( $35^{\circ}\text{F}$ ) and  $8^{\circ}\text{C}$  ( $46^{\circ}\text{F}$ ) with less than 25% humidity

Temperature Controlled: Stored between  $15.5^{\circ}\text{C}$  ( $60^{\circ}\text{F}$ ) and  $24^{\circ}\text{C}$  ( $75^{\circ}\text{F}$ ) with less than 60% humidity

Room Temperature: No humidity control

# Evidence for the Storage conditions

- Extensive literature search
- Review of the “newer” preservation materials, advances in technology
- Room temperature stability studies maturing
- On going experiments by the NIST Human Identity Project Team members

# Partial Reference list

Farkas, D. H., et al. "Specimen collection and storage for diagnostic molecular pathology investigation." *Arch.Pathol.Lab Med.* 120.6 (1996): 591-96; Austin, M. A., et al. "Guidelines of the National Heart, Lung, and Blood Institute Working Group on Blood Drawing, Processing, and Storage for Genetic Studies." *Am.J.Epidemiol.* 144.5 (1996): 437-41; Visvikis, S., A. Schlenck, and M. Maurice. "DNA extraction and stability for epidemiological studies." *Clin.Chem.Lab Med.* 36.8 (1998): 551-55; Gino, S., C. Robino, and C. Torre. "DNA Typing of Liquid Blood Samples Stored at 4 Degrees C for 15 Years". August 17, 1999: *Progress in Forensics.* Elsevier Science, 2000.V 476-78; Kobilinsky, L. "Recovery and stability of DNA in samples of forensic science significance." *Forensic Sci.Rev.* 4.1 (1992): 68-87; Steinberg, K. K., et al. "DNA banking in epidemiologic studies." *Epidemiol.Rev.* 19.1 (1997): 156-62. Gino, Robino, and Torre, op. cit.; Prinz, M., W. Grellner, and C. Schmitt. "DNA typing of urine samples following several years of storage." *Int.J.Legal Med.* 106.2 (1993): 75-79; Benecke, Mark. "Forensic DNA Samples - Collection and Handling." In J. Funchs & M. Podda (Eds.). *Encyclopedia of diagnostic genomes and proteomics 1*, 500-04. 2005. New York, Marrcel Dekker.

This category includes blood, semen, saliva, and vaginal swabs that are dry.

Gino, Robino, and Torre, op. cit.; Kobilinsky, op. cit.; Gill, P., A. J. Jeffreys, and D. J. Werrett. "Forensic application of DNA 'fingerprints'." *Nature.* 318.6046 (1985): 577-79; Lund, S. and J. Dissing. "Surprising stability of DNA in stains at extreme humidity and temperature." *International Congress Series*, 1261.0 (2004): 616-18; Benecke, op, cit.; Sjolholm, M.I., Dillner, J., Carlson, J. Assessing quality and functionality of DNA from fresh and archival dried blood spots and recommendations for quality control guidelines. *Clin Chem* 2007; 53:1401-7.; Aggarwal, R. K., J. W. Lang, and L. Singh. "Isolation of high-molecular-weight DNA from small samples of blood having nucleated erythrocytes, collected, transported, and stored at room temperature." *Genet.Anal.Tech.Appl.* 9.2 (1992): 54-57. Kanter, E., et al. "Analysis of restriction fragment length polymorphisms in DNA recovered from dried bloodstains." *Journal of Forensic Sciences*, 31 (1986): 403-08. Kobilinsky, op. cit. Steinberg, op. cit.; Gill, op. cit. Gill, op. cit.; Farkas, op. cit.; Benecke, op. cit.; Giusti, A., et al. "Application of deoxyribonucleic acid (DNA) polymorphisms to the analysis of DNA recovered from sperm." *Journal of Forensic Sciences*, 31 (1986): 409-17. Benecke, op. cit. Steinberg, op. cit.; Walker, A.H., Najarian, D., White, D.L., Jaffe, J.F., Kanetsky, P.A., Rebbeck, T.R.. Collection of genomic DNA by buccal swabs for polymerase chain reaction-based biomarker assays. *Environ Health Perspect* 1999;107:517-20

Liquid:

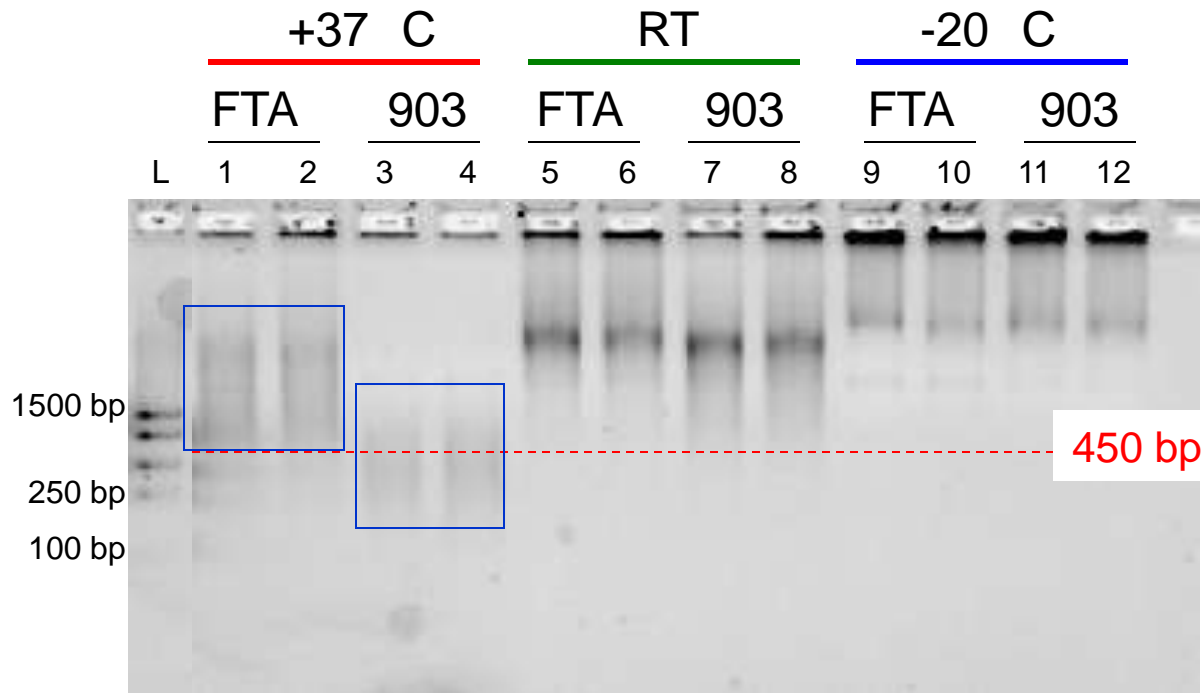
Yates, J. R., S. Malcolm, and A. P. Read. "Guidelines for DNA banking. Report of the Clinical Genetics Society working party on DNA banking." *J.Med.Genet.*, 26.4 (1989): 245-50; Benecke, op. cit. Dry: Yates, op. cit.

# DNA recovered from 10 year old bloodstains

Three different extraction methods used duplicated samples  
Stains on 903 paper

Sample Storage	Extraction Method A	Extraction Method B	Extraction Method C
Lab Ambient	52 ng	75 ng	11 ng
-20 °C	49 ng	43 ng	13 ng
-80 °C	42 ng	45 ng	9 ng
Liq N <sub>2</sub>	43 ng	37 ng	11 ng

# Quality of the Extracted DNA

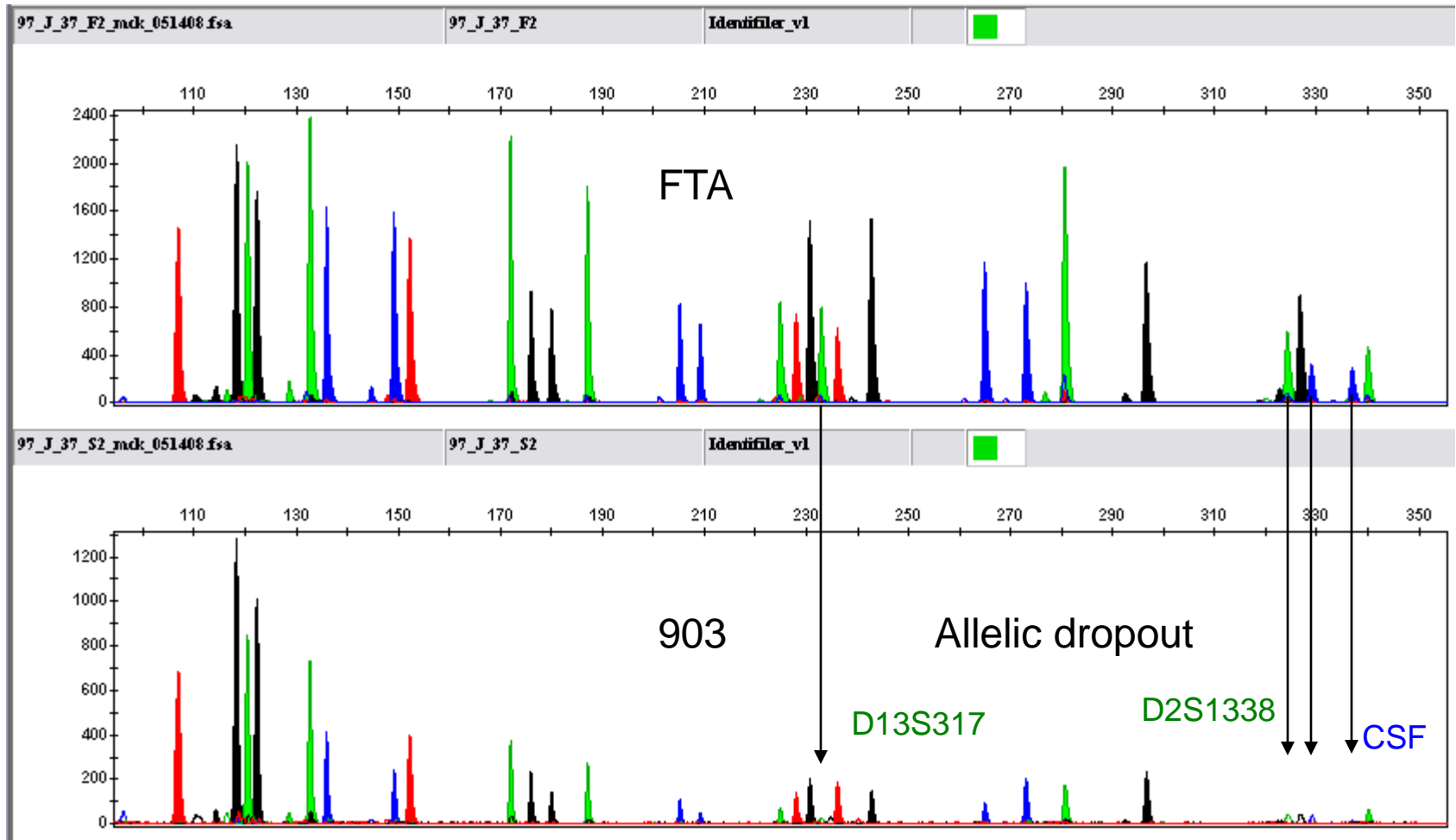


Most STR typing kits have products that are less than 450 bp

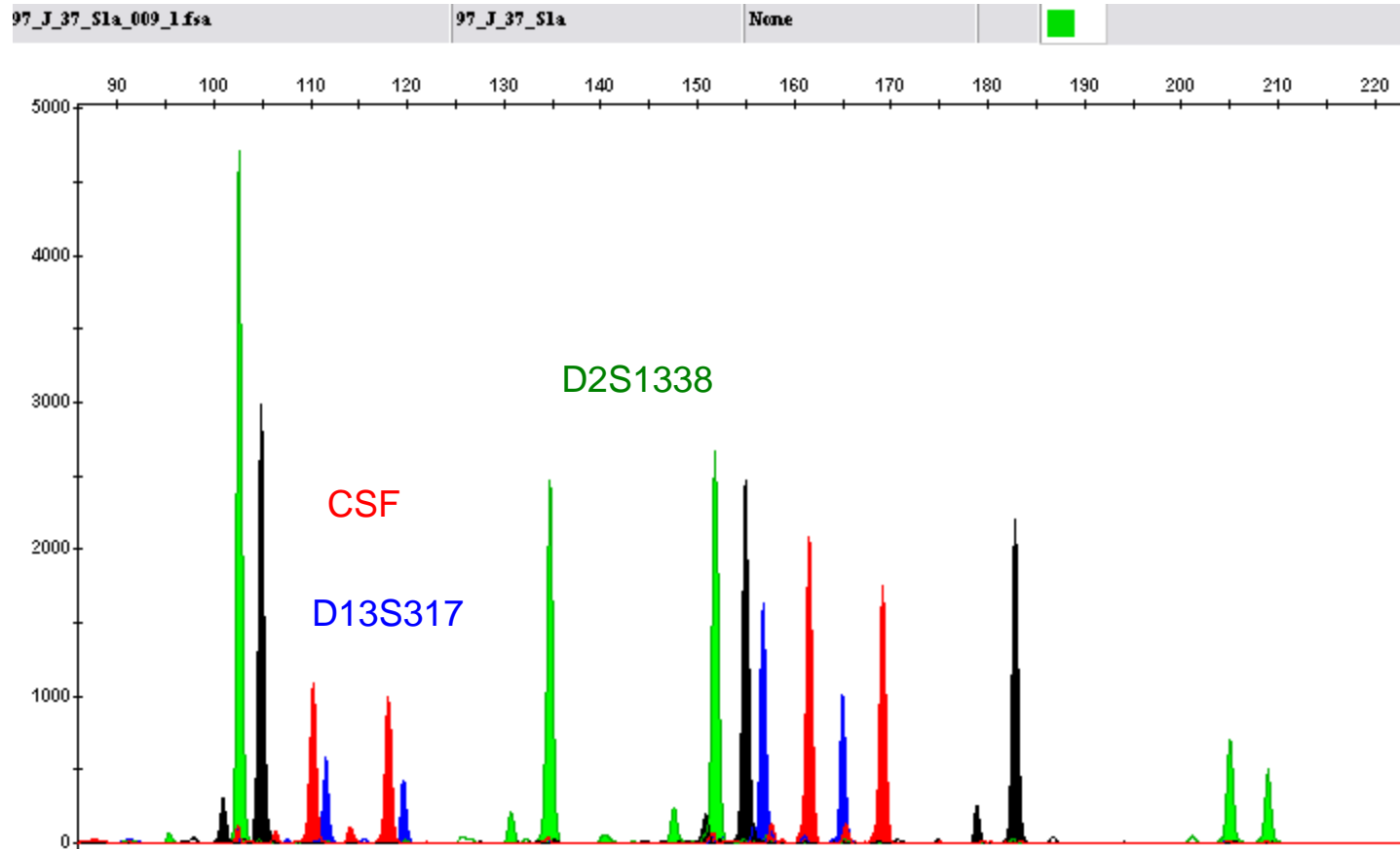
L ladder with 250 bp, 400 bp, 800 bp and 1500 bp bands visible  
Lanes 1, 2: + 37 °C FTA; Lanes 3, 4: + 37 °C 903;  
Lanes 5, 6: RT FTA; Lanes 7, 8: RT 903;  
Lanes 9, 10: -20 °C FTA; Lanes 11, 12: -20 °C 903;

After 11 years of storage at 37 °C both FTA and 903 show signs of degradation, the FTA samples exhibit DNA with slightly higher molecular weight than the 903 samples.

# FTA – 903 +37 C Storage Idfiler

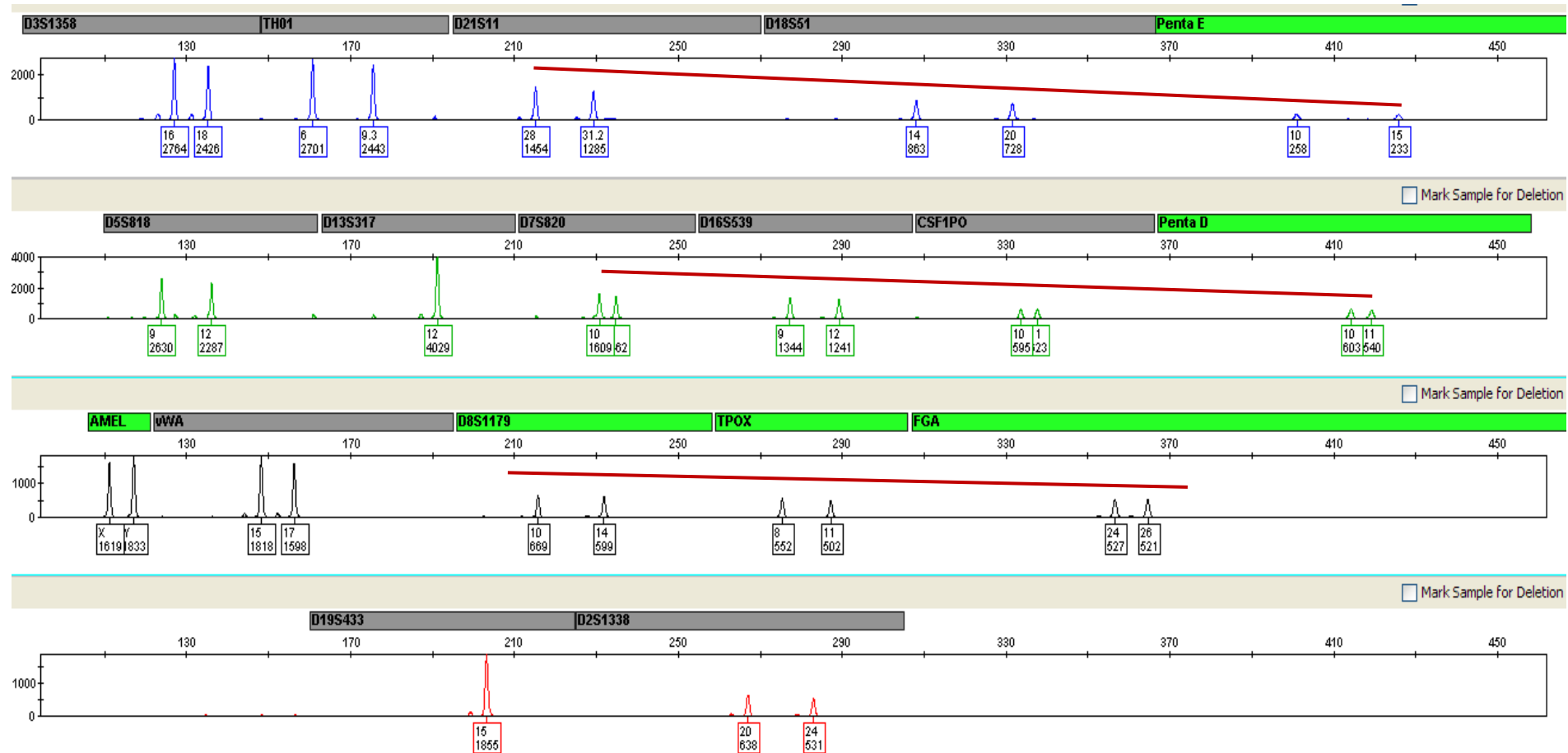


# 903 +37 C Storage Minifiler amp



Alleles dropping out with Idfiler amplification are recovered with Minifiler

# 25 year old Bloodstain(1986) PowerPlex 18D (903 paper)



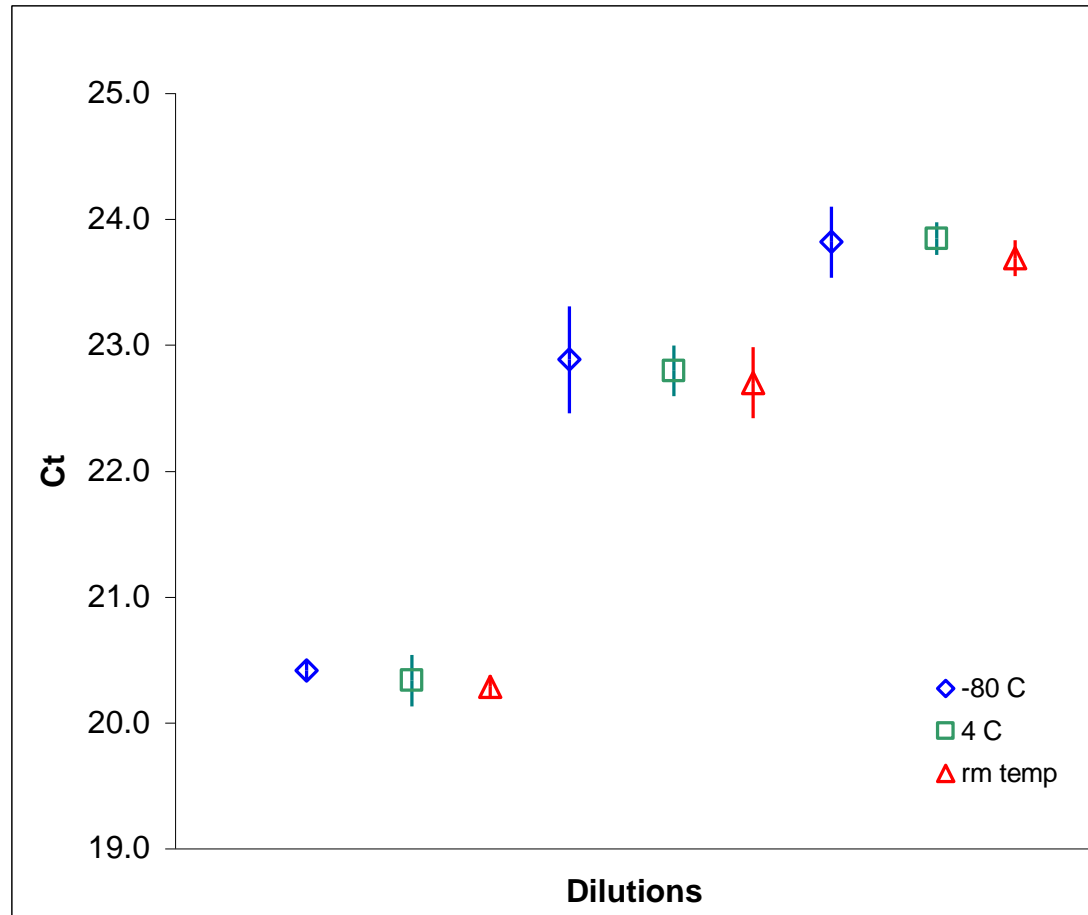
Single 1.2 mm punch stored at room temperature

No Extraction

Data from Pete Vallone and Erica Butts NIST Human Identity Project Team members



# 6 year Extracted DNA Stability in PFA Tubes



Data from DNA extracts stored in PFA tubes at -80 °C, 4 °C, and Lab ambient temperature for 6 years.

Each storage temperature had three DNA concentrations: neat, 1→5 dilution, and 1→10 dilution.

qPCR results of triplicate aliquots are displayed with error bars representing 2 sd. There is no difference as a result of temperature storage after 6 years.

# Tracking Biological Evidence

## Chain of Custody

Chain-of-custody documentation should include the following:

- Description of the evidence
- Unique case identifier (e.g. case number)
- Where the evidence was collected
- Where the evidence was stored
- Who was in possession of the evidence and for what purpose.
- What was done to the evidence (e.g., analysis)
- Date and time information

# Tracking Biological Evidence

## Electronic Evidence Management

- Reporting capabilities (including statistics)
- Tracking capabilities
- Alert Mechanisms (“Tickler File”)
- Integration with existing systems
- Security
- Inventory Management
- Communication (enhancing data sharing with other CJ agencies)
- Accessibility - web-based hosted solution vs server based
- Usability (ease of use)
- Customization (creating a system to meet your needs)
- Data Conversion
- IT and Hardware Support
- Training
- Appropriate Capabilities for the size of agency
- Electronic Signature Capabilities
- Cost benefit analysis for individual features considered (understand value added for each)

# Property Custodian Checklist for the Final Disposition of Biological Evidence:

- Review cases on a regular basis using a “tickler” system or evidence case tracking system. Also, any of the notification/authorization mechanisms discussed previously may initiate the disposition process.
- Notify the investigator or court to determine case status.
- Get final sign off from the designated authority to disposition evidence.
- Ensure compliance with any statutes, policies, and procedures that may require court orders or notifications before disposal.
- Actual disposition should be done in compliance with state and federal health and safety laws using certified biological disposal vendors.

# Thank you for your Attention!!



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NIST Law Enforcement Standards Office  
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TWGBEP members



# Forensics@NIST

Three day symposium on cutting edge  
forensic science research at NIST

# 2012

## SAVE THE DATES

**Date:** November 28-30<sup>th</sup>, 2012

**Time:** 9:00 am to 5:00 pm

**Location:** NIST (Gaithersburg, Maryland)

**For more information:**

[www.nist.gov/oles/forensics-2012.cfm](http://www.nist.gov/oles/forensics-2012.cfm)

Note: registration is required