National Ballistics Imaging Comparison

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Disclaimer

Certain commercial equipment, instruments, or materials are identified in this report in order to specify the experimental procedure adequately. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the materials or equipment identified are necessarily the best available for the purpose.

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Project Goal and Motivation

- Establish traceability and quality assurance for U.S. ballistics identification using NIST's Standard Reference Material (SRM) 2460/2461 bullets and cartridge cases.
- Ensure that each ballistic lab has access to a unified standard as well as a statistical control limit. This promotes interoperability and quality assurance.
- Enable each ballistic lab to satisfy ISO lab accreditation requirements.

ASCLD/LAB-International

MEASUREMENT TRACEABILITY POLICY
The laboratory or calibration provider must document the measurement process or system used to
demonstrate traceability and provide a description of the chain of comparisons/calibrations that were used
to establish a connection **to a particular stated reference**.

To support traceability, the laboratory records for each step in the chain shall include:

- A clear description of the quantity being measured
- Specific information pertaining to the equipment subject to traceability
- A complete description of the measurement equipment or working standard used to perform the measurement
- A complete specification of the stated reference at the time the measurement system or working standard was compared to it
- A stated measurement result or value, with reference to International System of Units (SI) where possible
- **A documented uncertainty of measurement** and a description of the process used to develop it
- Appropriate intervals for re-calibration or calibration checks
- Information establishing the competence of the calibration laboratory and/or in-house personnel involved.

Three Steps Towards Traceability

1) **Establish a reference standard:**

   NIST SRM 2460/2461 bullets and cartridge cases and the "Golden Images";

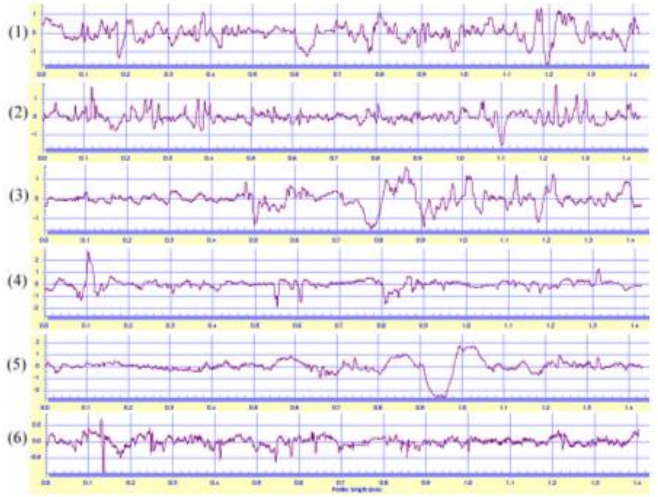
2) **Establish an unbroken chain of calibrations:**

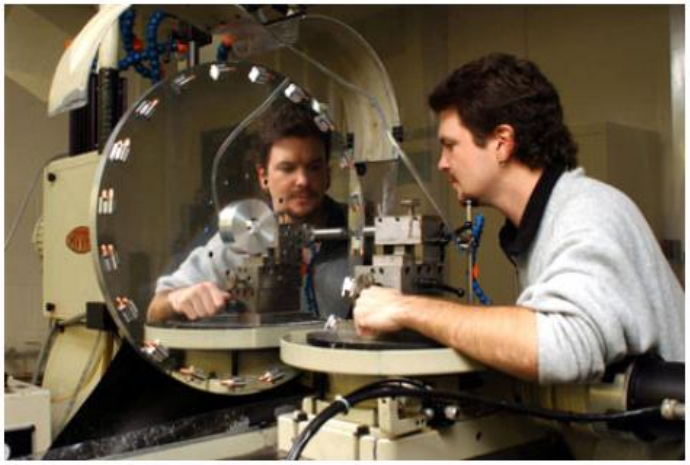
   For both the topography signature measurements at NIST and ballistics image acquisitions in U.S.;

3) **Uncertainty statement:**

   Control chart and control limit

NIST SRM2460 Standard Bullet





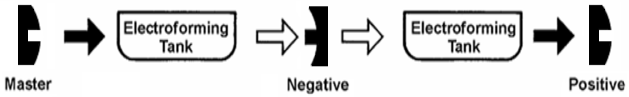
2D Correlation Software

NIST SRM2461 Standard Casing

Master 9 mm Casing

Courtesy of Etsy User: Artie

Electroforming Process



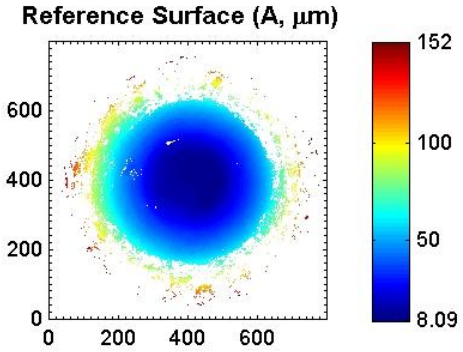
SRM2461 Standard Casing

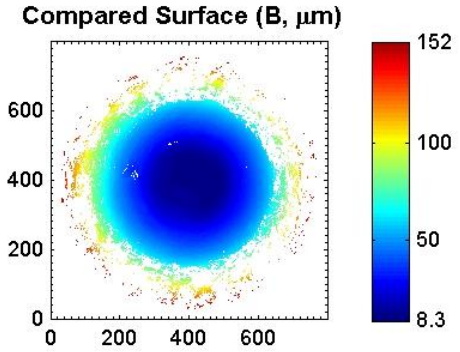
3D Correlation Software

Reference Surface (A)	Compared Surface (B)
SRM2461-153 Pin	SRM2461-242 Pin

X data spacing: 1.5625 µm
Y data spacing: 1.5625 µm

Gaussian Filter: Long Cutoff X: 0.15 mm
Long Cutoff Y: 0.15 mm





Date comparison: Aug 03, 2012

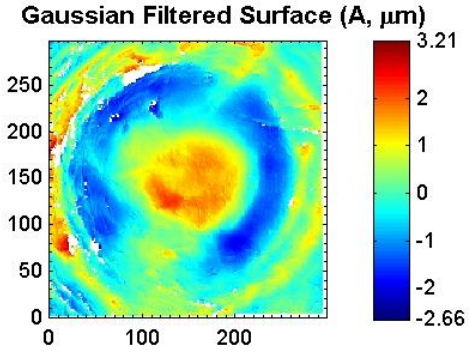
$ACCF_{max}$: 98.91 %

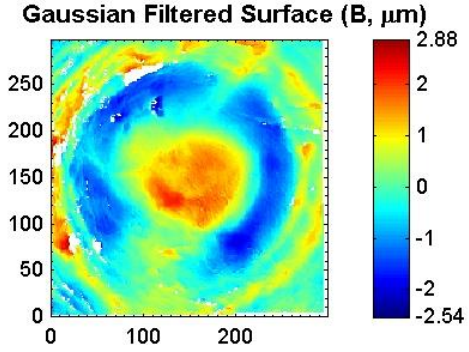
Sq(A): 0.8622 µm

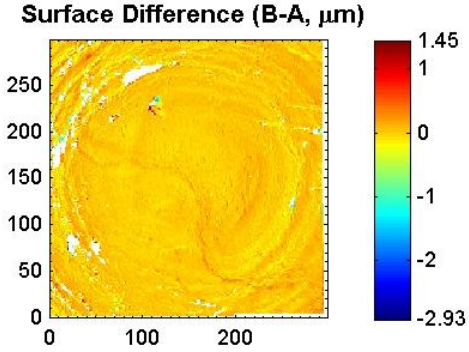
Sq(B): 0.8431 µm

Sq(B-A): 0.1273 µm

Sign. Diff. D_s: 2.18 %







NIST CasingCorrelator, 12.01.17

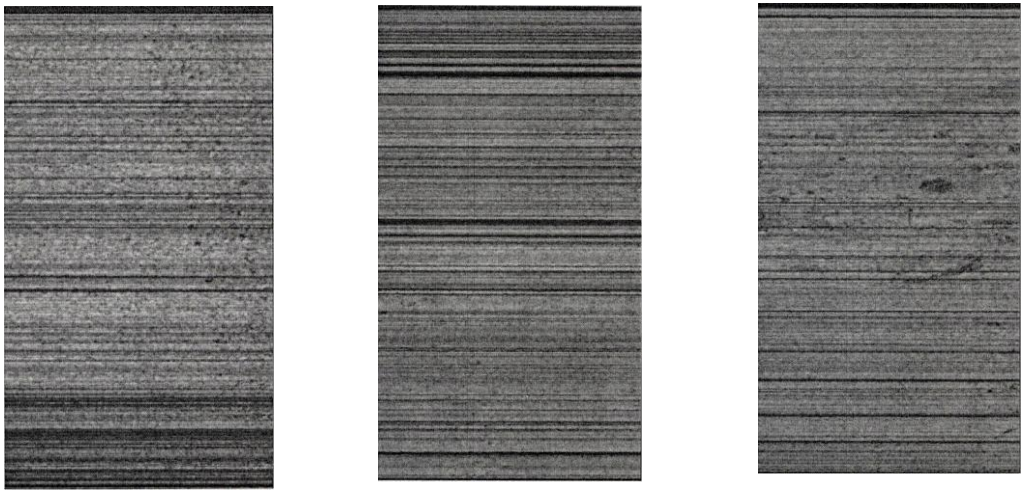
Heritage Integrated Ballistics Identification System (IBIS)

Courtesy of Forensic Technology Incorporated

There are approximately 200 IBIS stations around the country. It utilizes digital image acquisitions of ballistics signatures and a proprietary correlation algorithm to sort through a database of test fires and evidence.

IBIS Golden Images – SRM2460 Standard Bullet

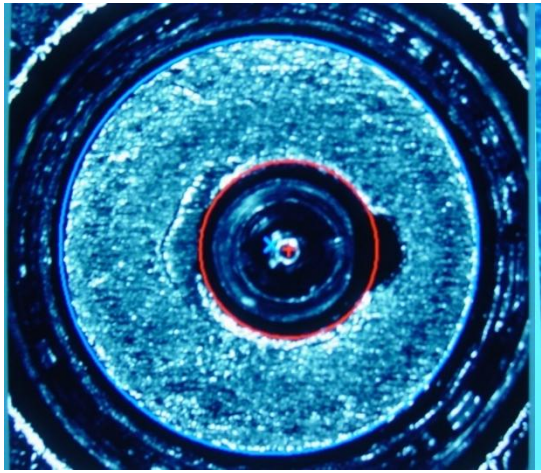
Land 1 to 3



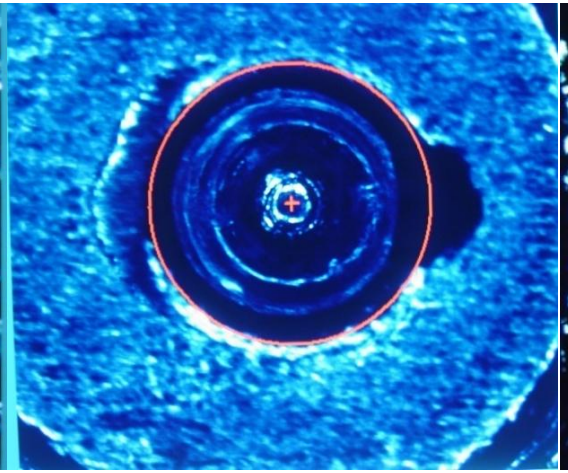
Land 4 to 6

IBIS Golden Images – SRM2461 Standard Casing

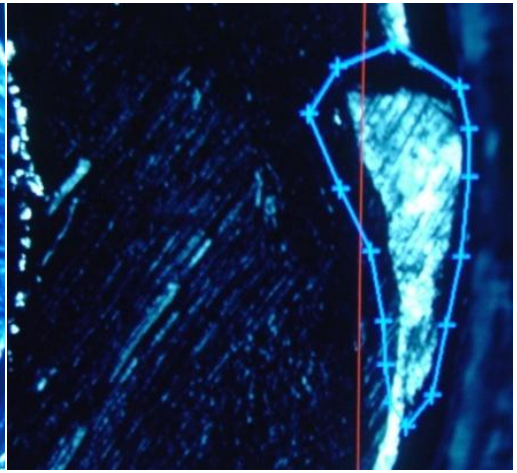
Breech Face



Firing Pin

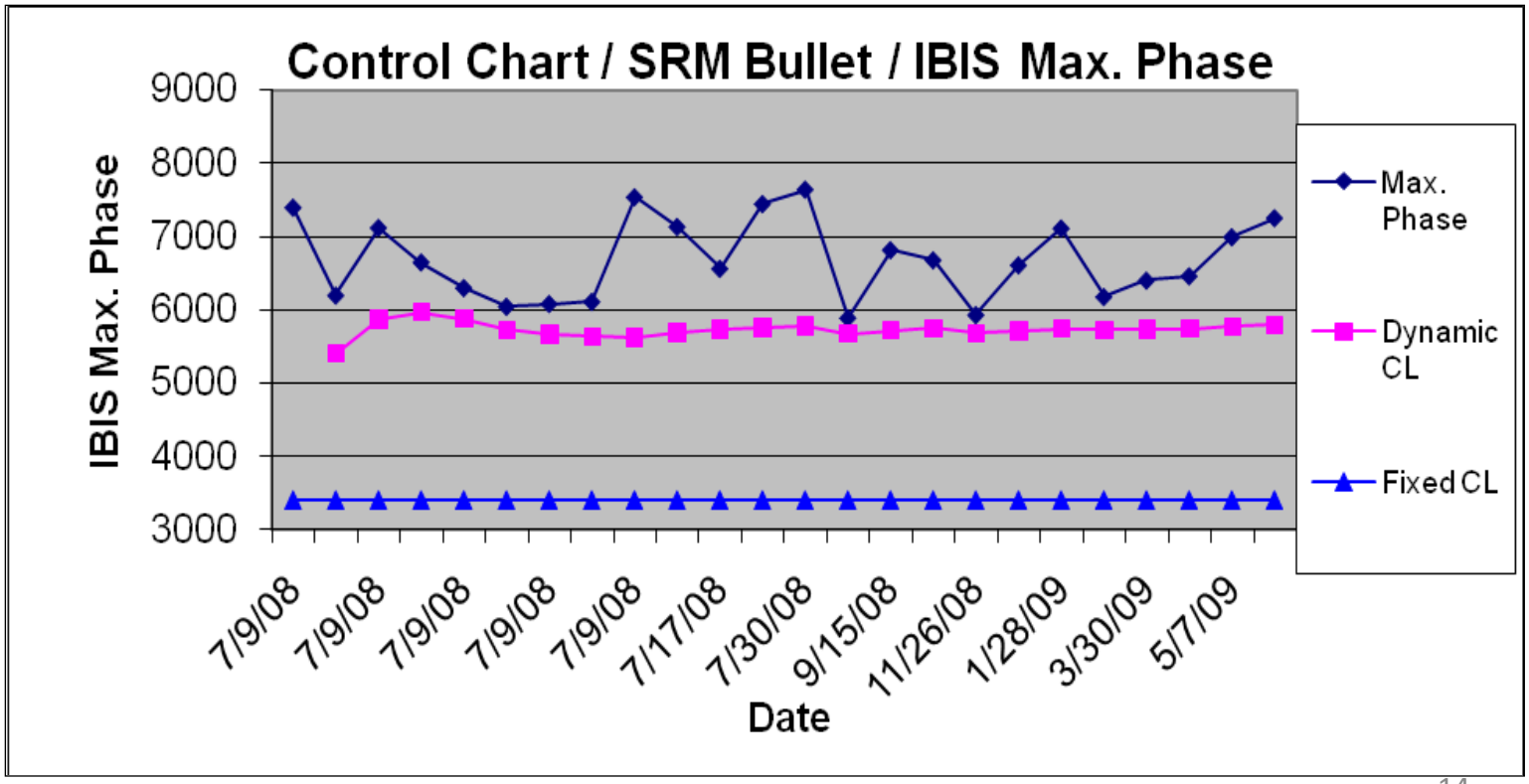


Ejector Mark



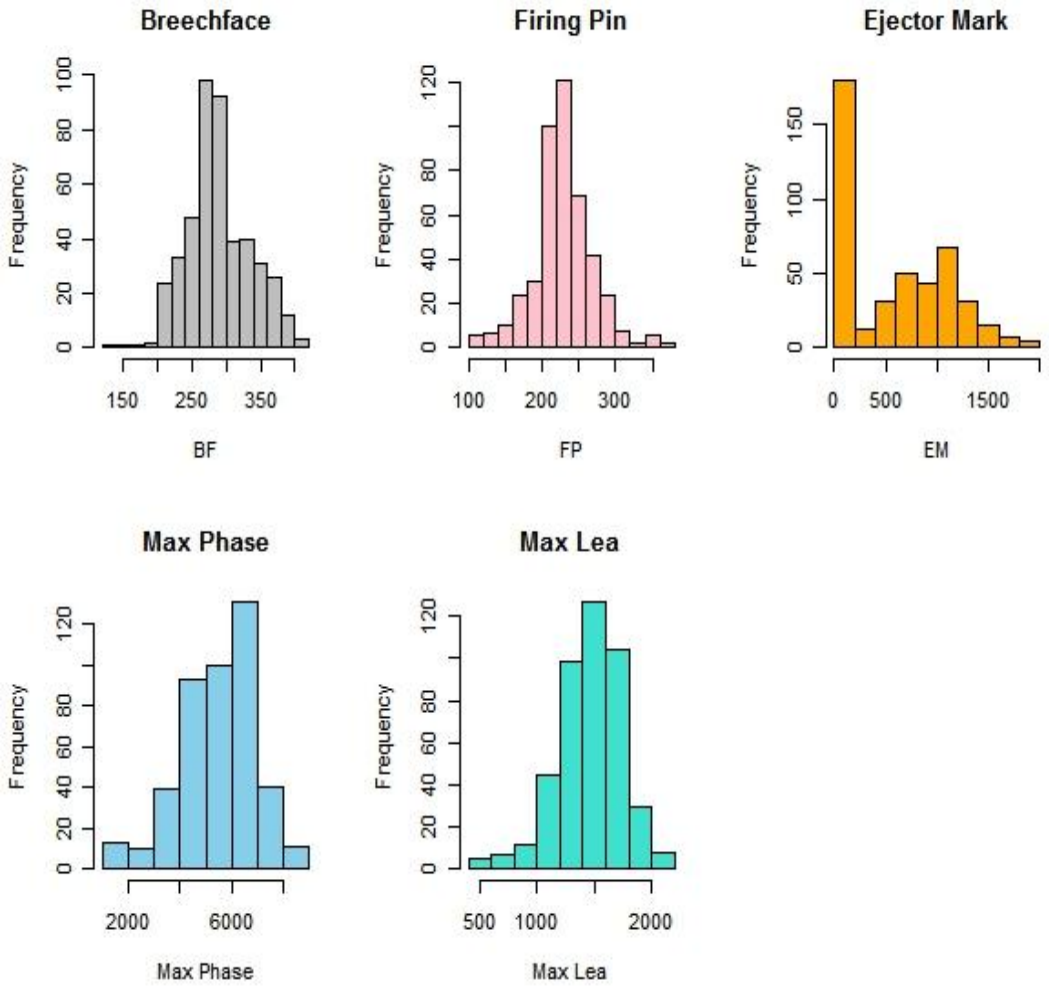
Project Plan

- Divided into three phases for a total of 24 data points.
- Phase 1: Ten consecutive measurements within a day.
- Phase 2: Four measurements once per week.
- Phase 3: Ten measurements once per month.

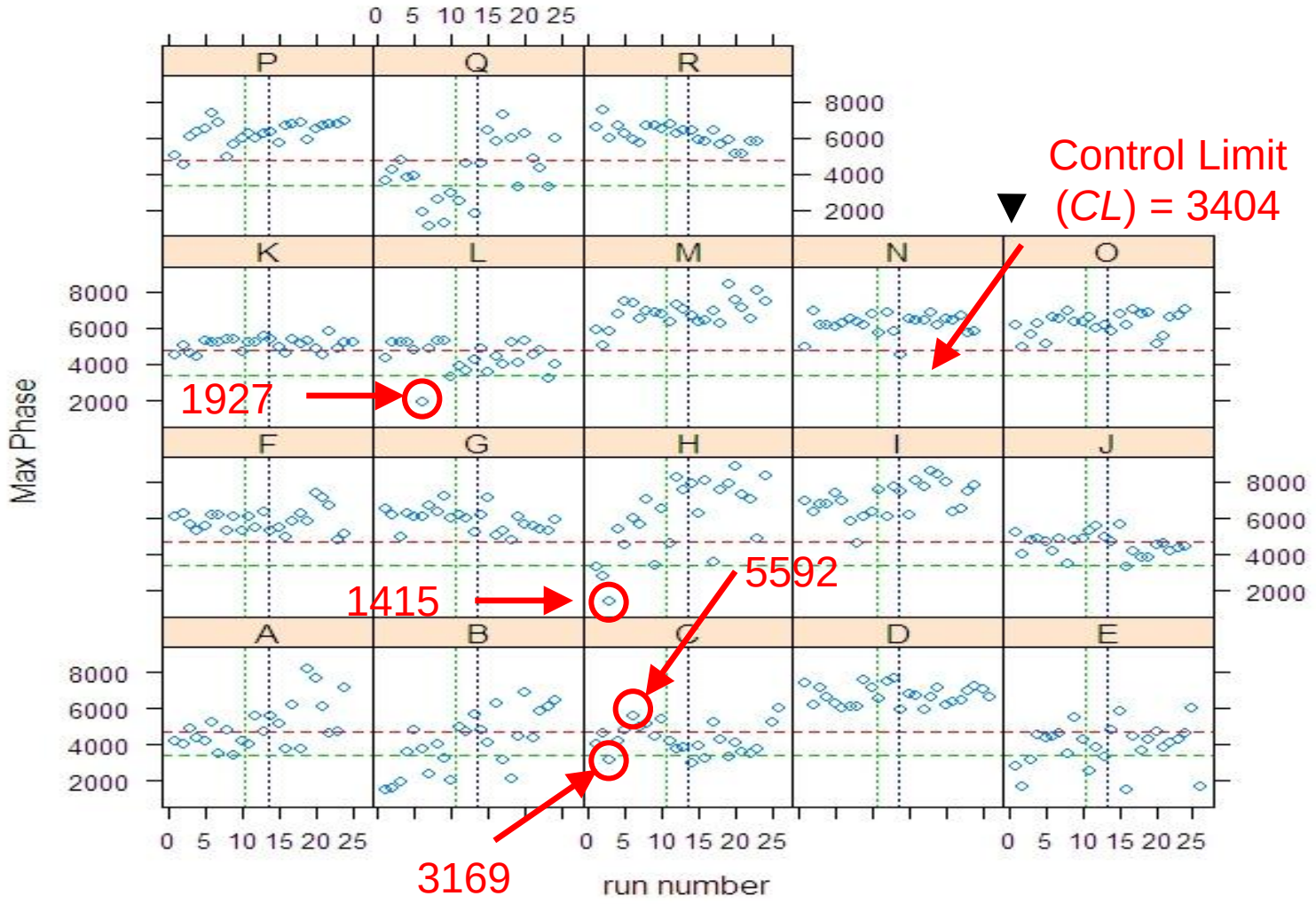


Histogram of Results

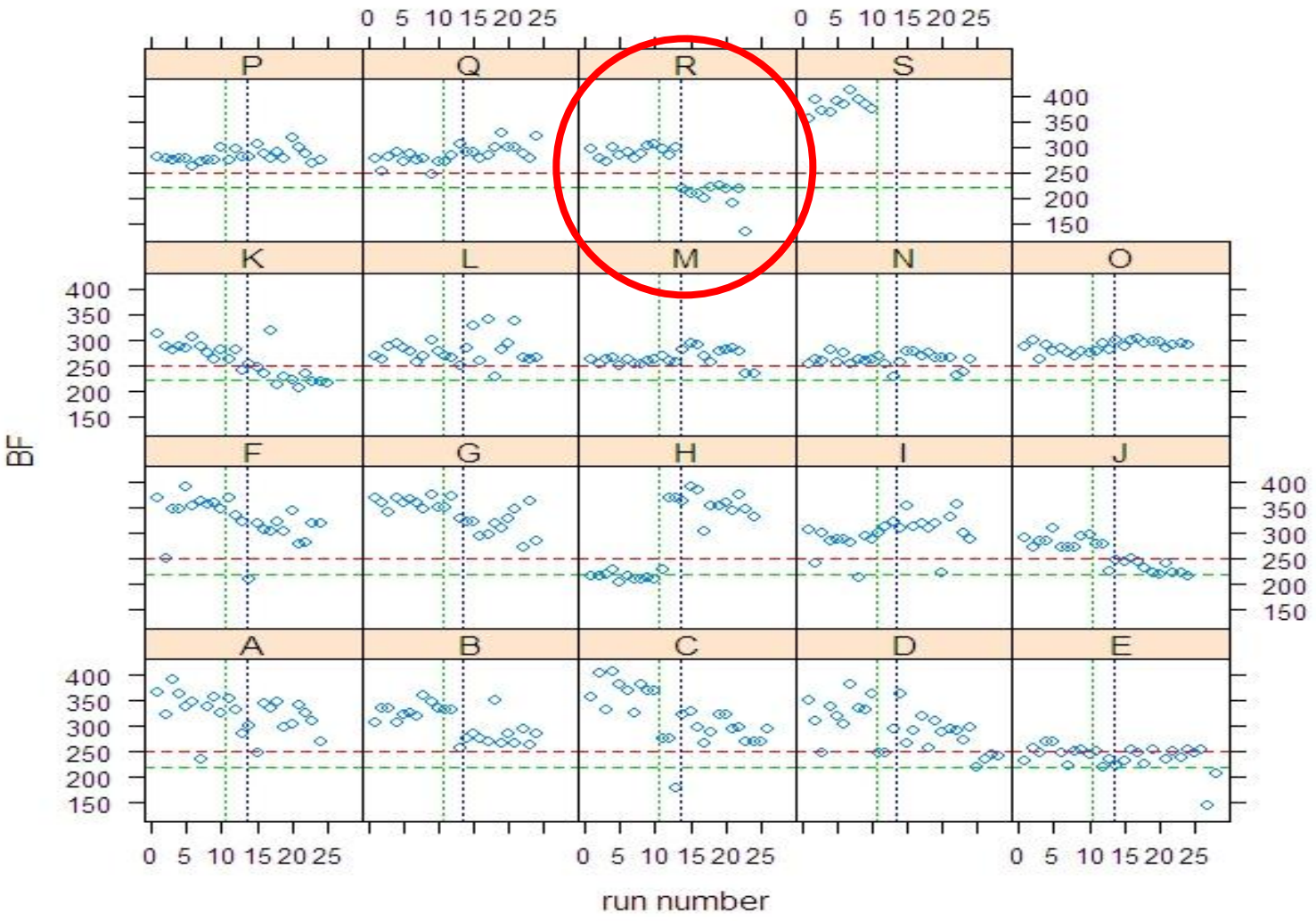
- All participants combined
- Peak phase is not included. It is almost identical to max lea
- Ejector mark scores are not unimodal
- Some skew in distributions may be present



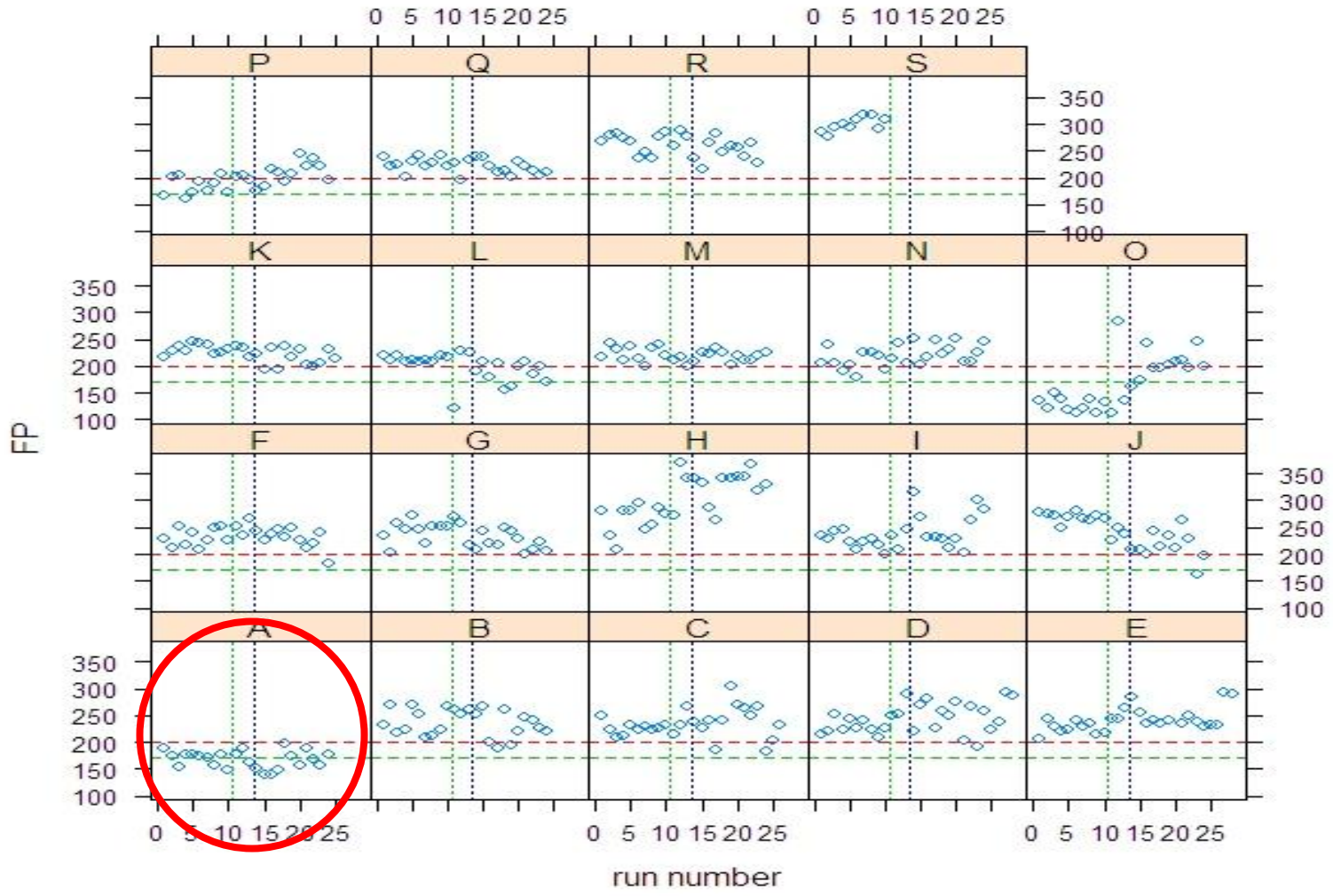
Bullet Max Phase Results for all 19 Examiners



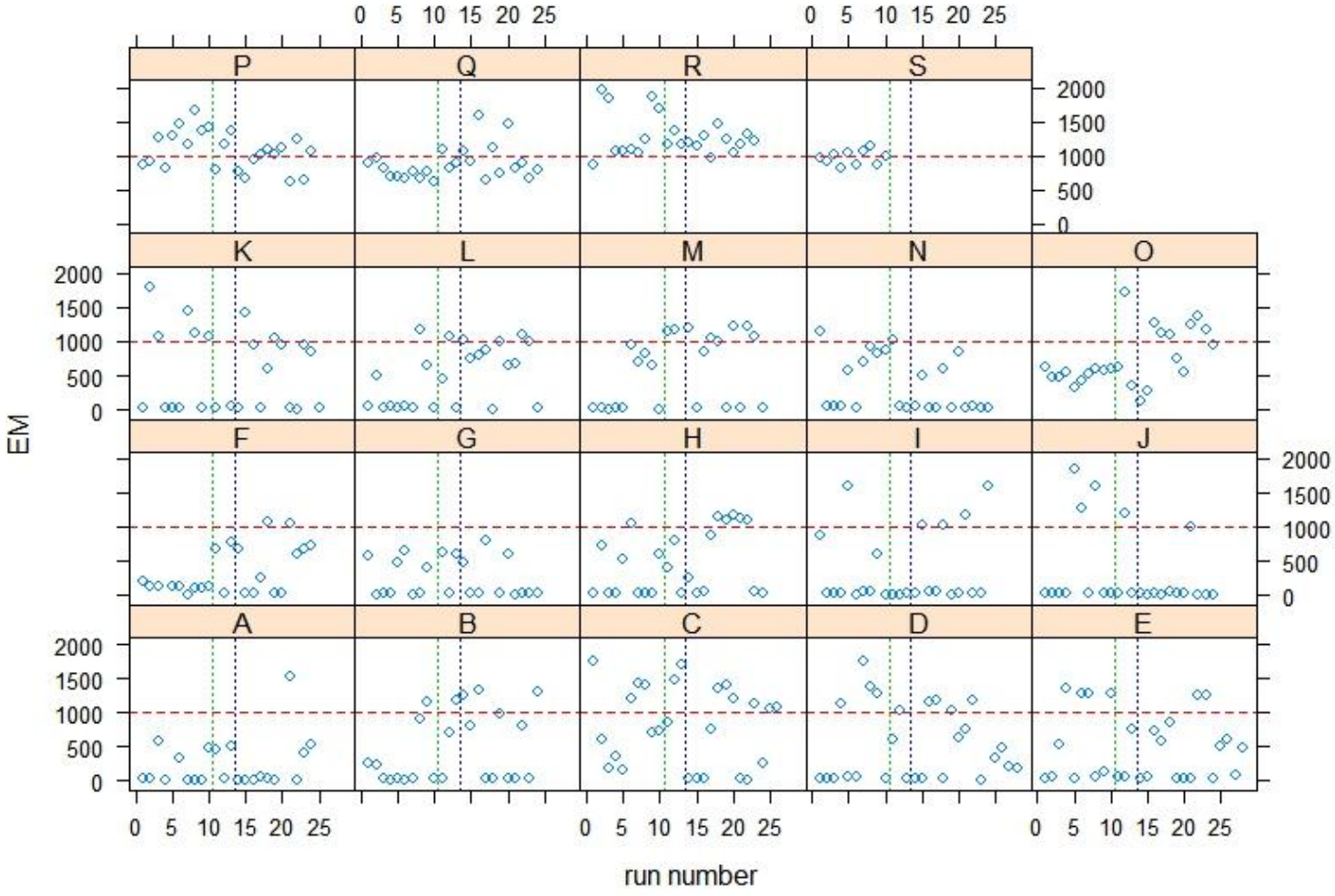
Casing Breechface Results for all 19 Examiners



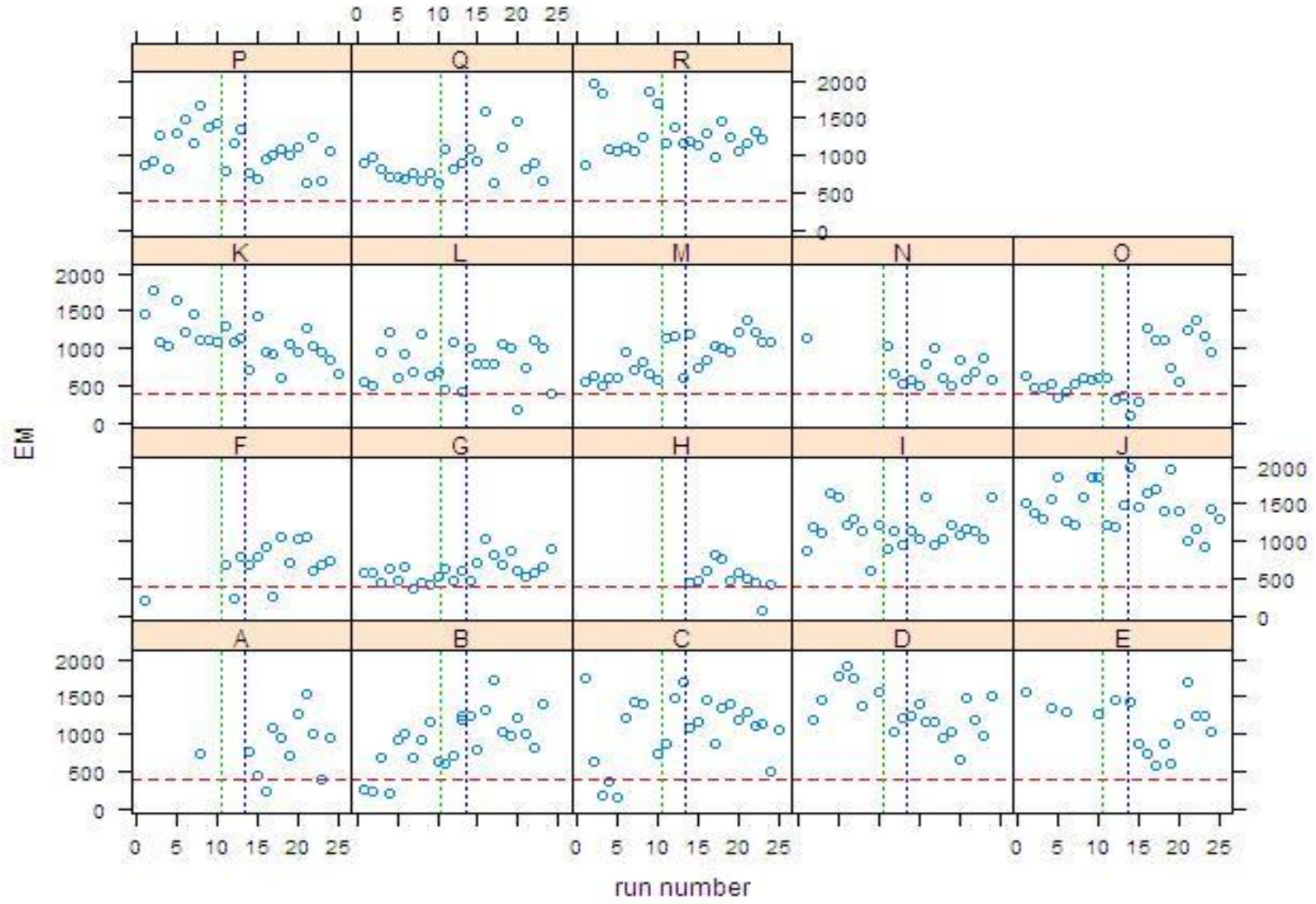
Casing Firing Pin Results for all 19 Examiners



Erratic Ejector Mark Results for 19 Examiners



Ejector Mark Correlation Results after FTI Patch



Heritage IBIS Control Limits

	Mean	Standard deviation	95% Control limit
Maximum phase	5662	1373	3404
Maximum LEA	1498	273	1049
Breech phase	276	38	214
Firing pin	233	38	171
Ejector mark	968	345	400

IBIS Brasstrax Measurement System

Courtesy of Forensic Technology Inc.

- Currently being rolled out to all NIBIN labs across the United States replacing the heritage IBIS system. Improved automation and image resolution.

- Comparisons of images taken with the Brasstrax versus Heritage system showed differences in the correlation scores.

NBIC 2

Problem:

- The new IBIS Brasstrax system has no reference golden image for the SRM2461 Standard Cartridge Casing.
- There are no established control limits for the three regions of interests on the SRM2461 Standard Cartridge Casing.

Solution:

- Run a shortened 6 month study with volunteer crime labs.
- Study will consist of 5 consecutive measurements of the SRM2461 Standard Catridge Case within one day.
- Two measurements per month measurements for six months.
- Total number of data points: 17 Data Points

NBIC 2 Status

- Measurements of all 175 Standard Cartridge Cases have been completed using the IBIS Brasstrax.
- A set of Golden Images have been established by ATF.
- Data collection from participating crime labs have been completed.
- Statistical analysis will be conducted to establish a set of control limits for Breech Face, Firing Pin, and Ejector Mark.

Acknowledgement

34 U.S. Ballistics Examiners in 17 crime labs of the U.S. NIBIN (National Integrated Ballistics Information Network) participated in the NBIC project:

NBIC - 1 Participants

Ashleigh Vogel – Michigan State Police
Edward Jachimowicz – CT Dept. of Public Safety
Caryn Tucker – IL State Police Forensic Science
Daryl Smith– IL State Police Forensic Science
Calvin Box– IL State Police Forensic Science
Jennifer Perry – Arkansas State Crime Lab
Steve Hargis– Arkansas State Crime Lab
Jill Errickson – Miami Dade Police Dept.
Nikki Mincey-McCall – ATF Atlanta
Charles Fancey – Jefferson Co. Sheriff's Dept.
Brandy Harrington– Jefferson Co. Sheriff's Dept.
Nanette Rudolph – FDLE Orlando
Linzee Willette – FDLE Orlando
Darrel Stein – Houston PD Crime Lab
John Ward – VA Div. of Forensic Science Lab
Helen Schumacher – VA Div. of Forensic Science Lab
Allison Milam – VA Div. of Forensic Science Lab
Susan Landen – VA Div. of Forensic Science Lab
Bill Mori – ATF CA
Martin Ols – ATF MD
Erich Smith - FBI

NBIC - 2 Participants

William Best – Allegheny County PD
Tammy Lyons – Houston PD
Megan Shaw – ATF CA
Erica Lawton-McWhite – Broward Sheriff's Office
Allen Greenspan – Broward Sheriff's Office
Jon Flaskamp – ISP Forensic Science Center
Mark Rennie – LAPD County Sheriff
Erik Osbeck – Columbus Crime Lab
Linzee Willette – FDLE Orlando
Michael Schoonover – FDLE Orlando
Kasi Lancaster – FDLE Tampa
Stephen Garten – ATF Atlanta
Martin Ols – ATF MD
Allison Northrop – ATF MD
Erin Hine – ATF MD

Thanks for your attention!

Questions?

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