Damaged Device Forensics

An update on a U.S. Department of Homeland Security R&D Project

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Acknowledgement & Disclaimer

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Customer Need

- Law enforcement agencies receive electronic devices as evidence that have endured physical damage to the device.
- Most agencies do not receive damaged devices frequently enough to develop expertise in how to address damaged devices.
- Limited research has been focused on data acquisition from damaged devices.
- Data retrieval from devices still needed.

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Approach (Part 1)

Introduce physical damage to the device along four damage methodologies that agencies are receiving.

1. Liquid Damage
2. Thermal Damage
3. Ballistics Damage
4. Impact Damage

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Approach (Part 2)

- Damage will be inflicted on devices in similar ways to real-world scenarios.
- Effect of the damage on devices will be identified.
- Scientific instruments and protocols will be used to measure the effects of damage on the devices.

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Approach (Part 3)

- Methods for addressing each stage of a damaged device will be identified.
- Methods to achieve data acquisition from damaged devices will be identified.
- Identification of catastrophic damage where data acquisition is no longer possible will be sought.

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Benefits

- Baseline scientific research on all exhaustive methods for data acquisition from damaged devices.
- Protocols to be developed and shared for successfully dealing with damaged devices across multiple damage methodologies.
- Support for law enforcement to incorporate damage device protocols into their existing standard operating procedures.

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Process

- Each damage modality includes a series of individual studies that complement or build upon each other.
- All studies are focused on the viability of data acquisition.
- Results from each discreet study are written to capture results.
- Practice based outcome will identify best practices.

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Competition

- Existing industry practices:
  - Many industry practices are anecdotal at best with no identified science backing the ‘best practice’ claims.

- Research:
  - Disparate protocols exist across numerous industries but has not been reconciled for digital forensics and data recovery.

  - Damaged Device project builds on last few years of PI’s work in this space.

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Liquid Damage

1. Hygroscopic Capacity of Integrated Circuit Packages and Printed Circuit Boards.
2. Submersion Longevity Study.
3. Efficacy of Cleaning Techniques.
4. Efficacy of Drying Techniques.

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Liquid Damage

5. Biohazard Protocol Definition.

6. Flammable Liquid Protocol Definition.

7. Application of Liquid Recovery Plan Against CONUS Water Samples.

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Liquid Damage

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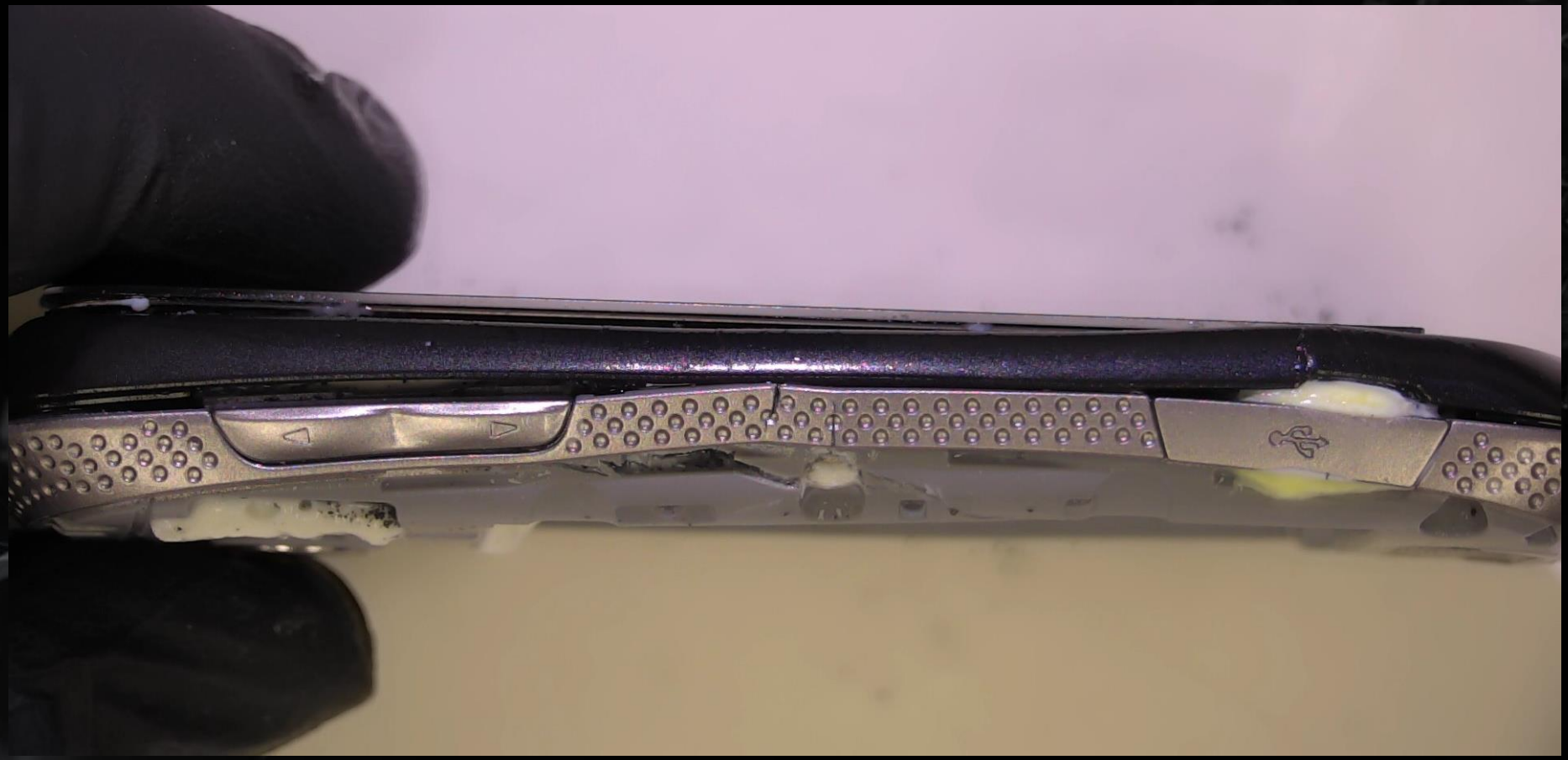
Recent Test



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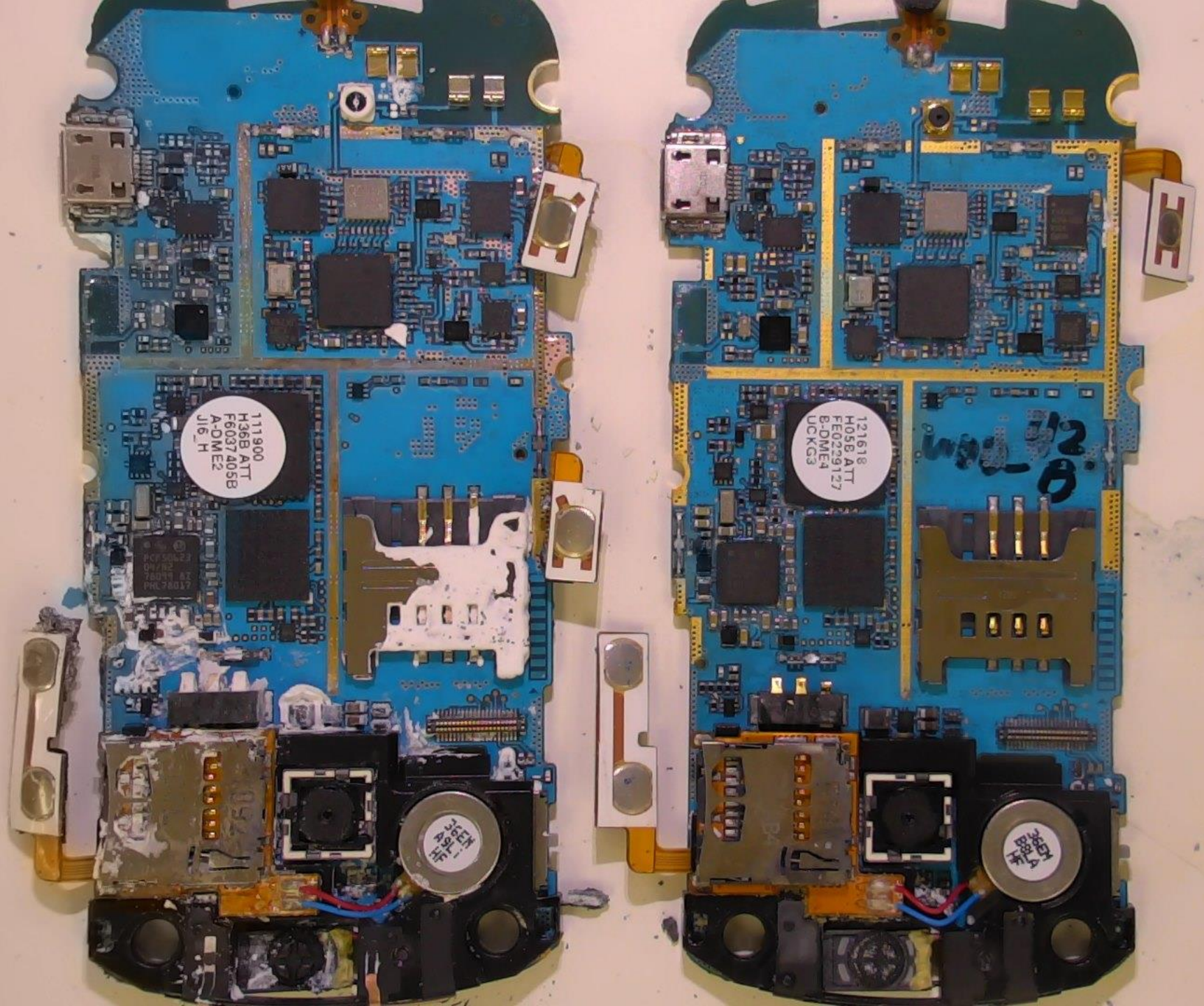
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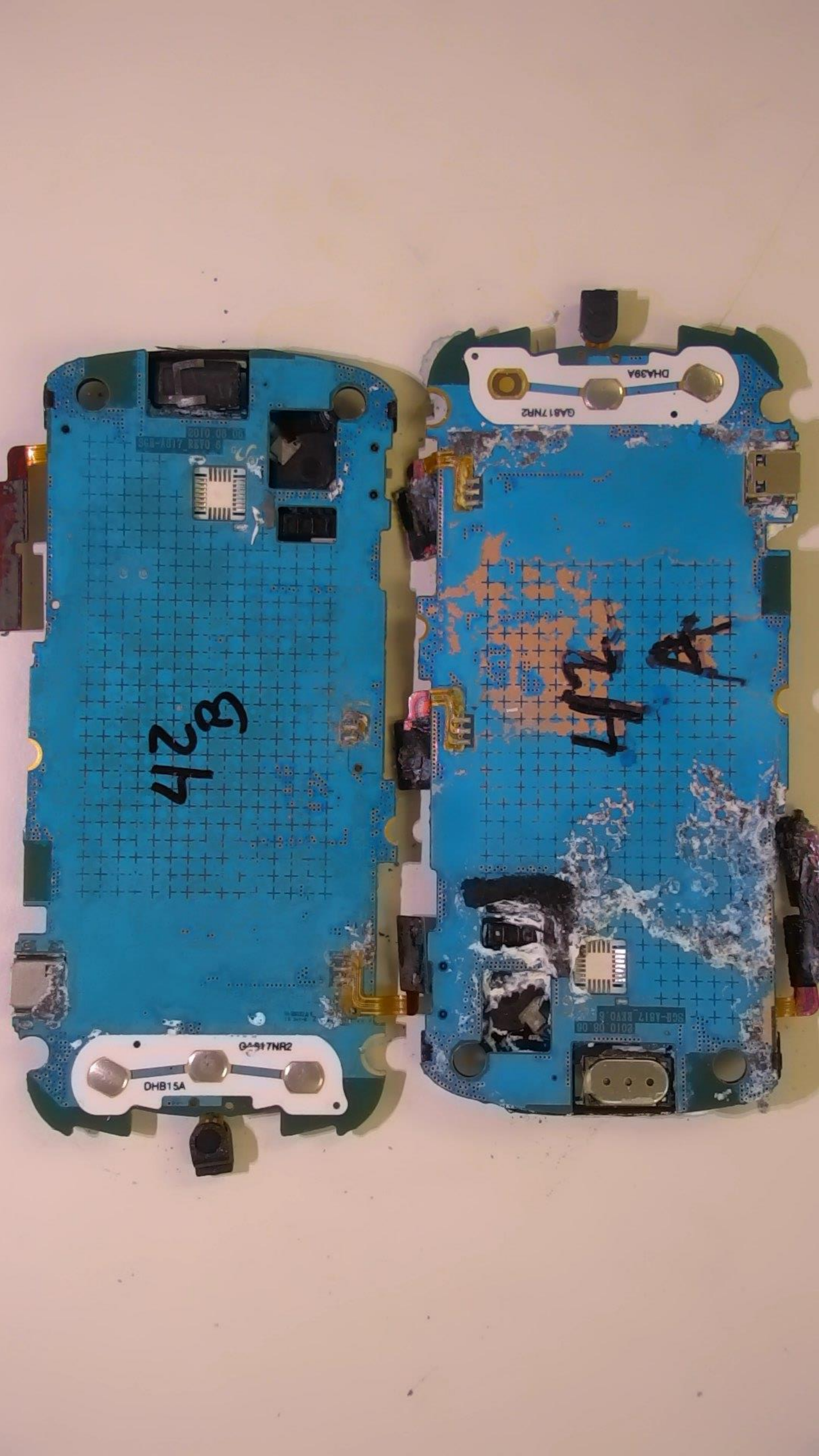
428
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DHA39A
GA817NR2

Hygroscopic Capacity of Integrated Circuit Packages and Printed Circuit Boards

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Terms

- integrated circuit packages
- circuit boards
- hygroscopic capacity
- hygroscopic coefficient

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Hypothesis

- Will chips and circuit boards exposed to liquids absorb an increasing amount of liquid?

- Can a maximum absorption level be identified?

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Results – 10 hour median and mean

Chips	0 % RH		20% RH		66% RH	
	% weight change	% moisture content	% weight change	% moisture content	% weight change	% moisture content
Mean	0.1787%	0.1780%	0.1228%	0.1225%	0.1275%	0.1265%
Median	0.1252%	0.1250%	0.1035%	0.1034%	0.0576%	0.0575%

PCBs	0 % RH		20% RH		66% RH	
	% weight change	% moisture content	% weight change	% moisture content	% weight change	% moisture content
Mean	1.3114%	1.2693%	0.6167%	0.6073%	0.5755%	0.5636%
Median	0.8329%	0.8260%	0.4343%	0.4324%	0.5612%	0.4851%

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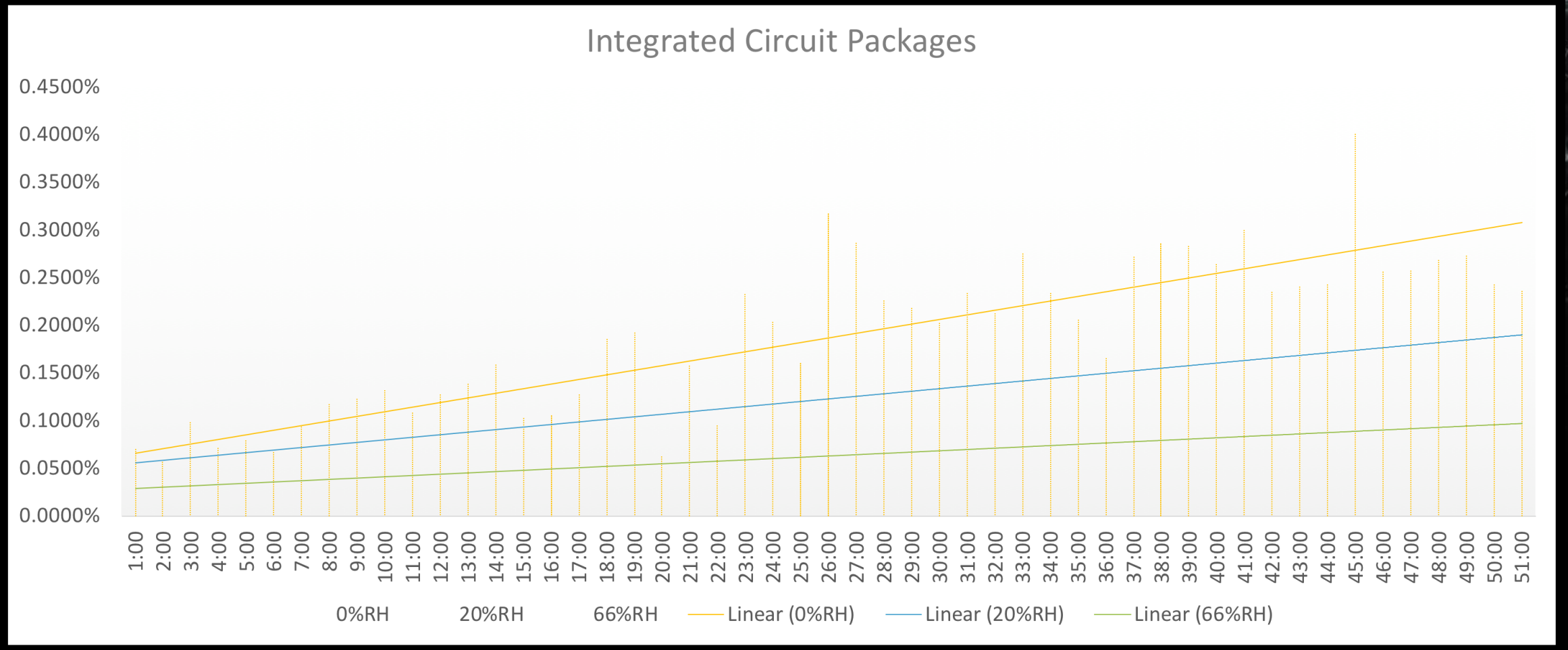
Results – Duration Absorption



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Conclusion

- Hygroscopic capacity of integrated circuit packages and printed circuit boards confirmed through methodical observation.
- Understanding that device components can absorb liquid should inform practitioners when addressing devices exposed to liquid.
- Pre-submersion humidity levels may have previously unrecognized effects as well.

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Liquid Takeaways

- The makeup of the liquid has a significant impact on damage to device.
- Devices should be transported in liquid from scene to lab.
- Devices should be addressed as soon as possible.
- Wet devices need to be dried before any work begins.

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Thermal Update

1. Thermal Damage (Baseline). Completed.
2. Thermal Damage (Expansion). Scheduled.
3. Microwave Damage. Completed. Paper in draft.
4. Potential damage from fire suppression foams. Completed. Paper finalized.

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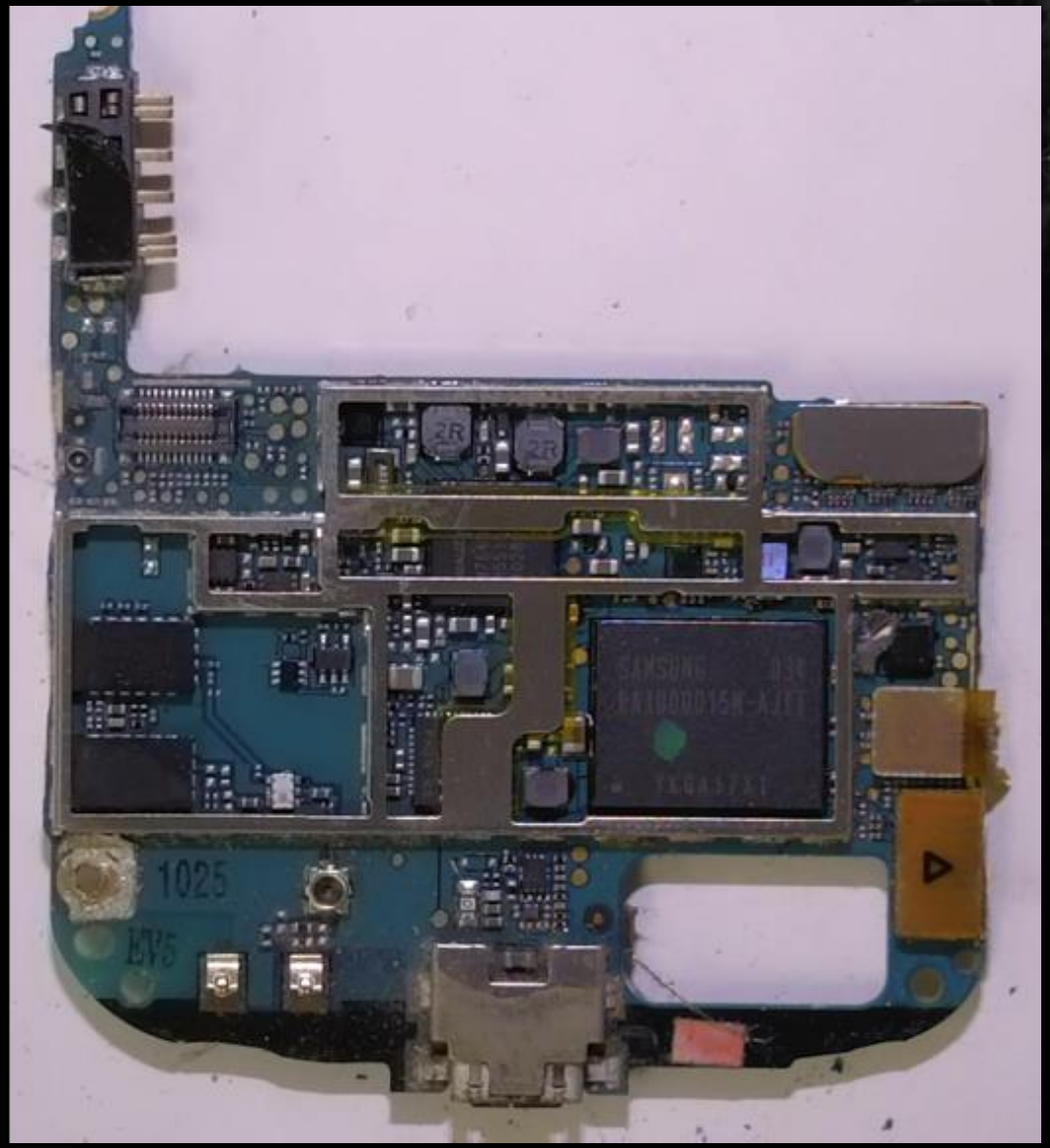

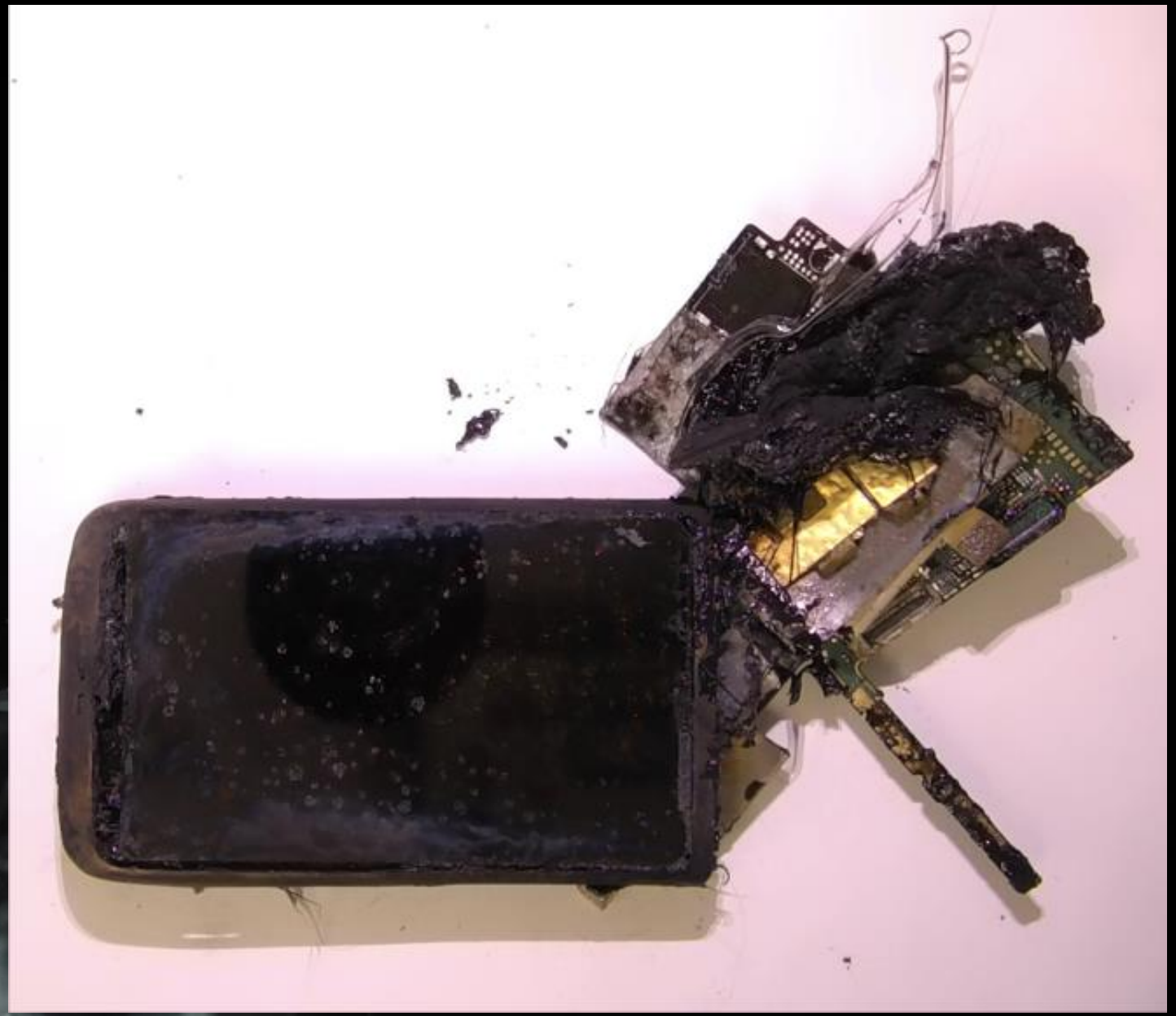

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DAMAGED MOBILE DEVICE FORENSICS
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Thermal Takeaways

- Devices are far more resilient than most agencies realize.
- Temperatures so far 900-1000 degrees with successful acquisitions.
- Expect challenges open up melted devices.
- Expect chips to be desoldered from the board.

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Impact Update

1.Impact Damage. Completed. Paper finalized.

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Impact Damage Paper

1. Samsung Solstice II (SGH-A817)
   - 70 grams (2.47 ounces) w/o battery; 91 grams (3.21 ounces) w/ battery

2. Terminal Velocity
   - Weight / Gravity / Air Density / Atmospheric Pressure / Temperature / Area of the object / Drag Coefficient
   - 34.51 mph

3. Impact
   - G-Force: **157 G's**
   - Equivalent of 36,110 lbs hitting 230 lb body for 0.1 second

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Ballistics Update

1. Firearms Damage (Sidearm Calibers) Completed.

2. Firearms Damage (Long gun Calibers) Completed. Paper in draft.

3. Explosive Damage (Baseline). Local agency collaboration identified.

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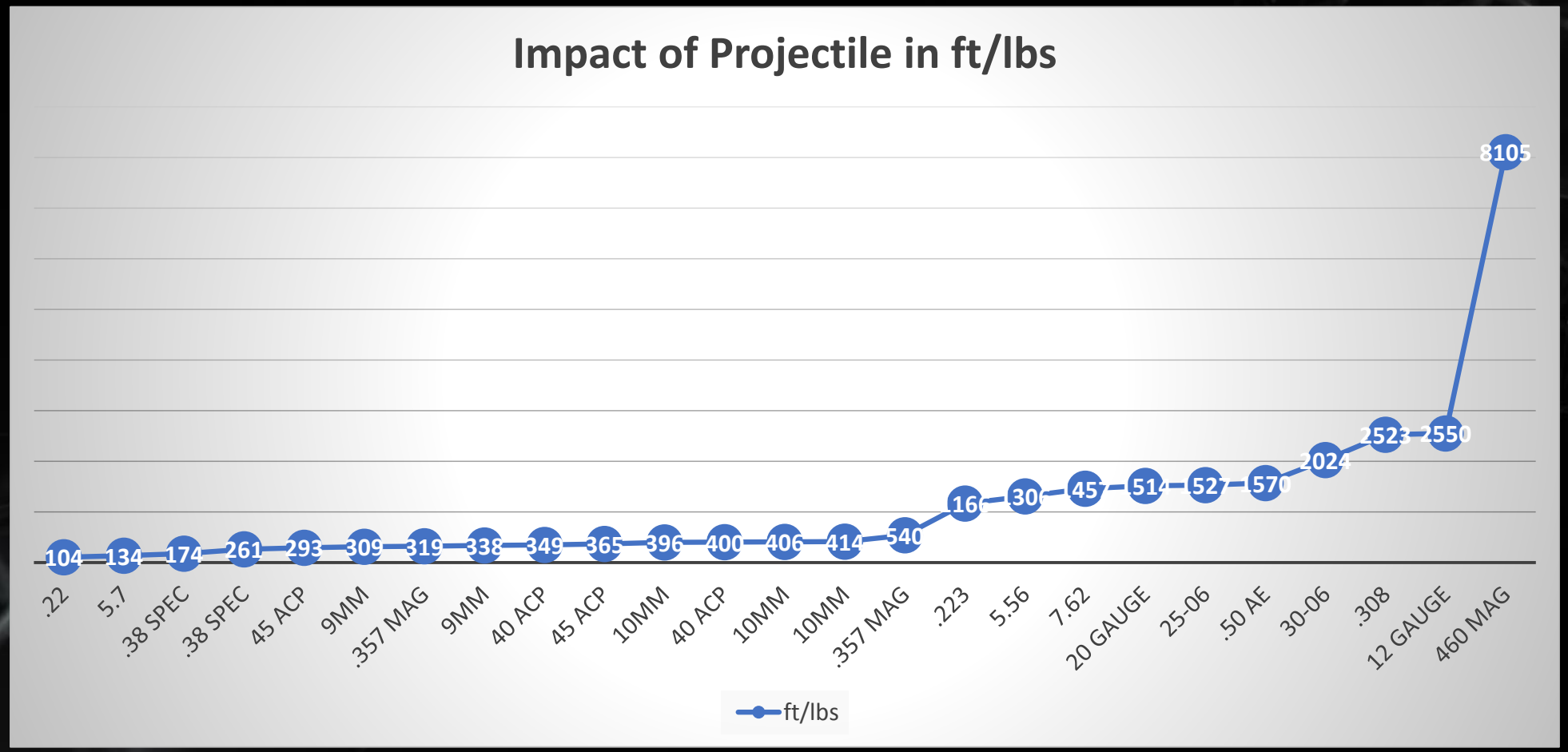
Ballistics Damage Paper



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Ballistic Takeaways

- If the projectile goes through the flash, the possibility of data retrieval is gone.
- If the projectile hits somewhere else on the board, the likelihood of retrieving data via chip-off increases.
- We have not yet identified a ballistics impact that damaged inside the chip.

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Summary

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Further Research Questions

- Intra IC Package Data Acquisitions via Bond Wire and Die
- Understanding the Efficacy of IC Package Removal and Successful Acquisition by Standard Labs
- The Application of Failure Analysis Techniques to Determine the Acquisition Failure from IC Packages

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