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Commanding Officer
NSWC Crane

Development of Standardized Test Methods for Quantitative Small Arms Flash Measurements

Dr. David F. Dye (david.f.dye@navy.mil) and Jason M. Davis

April, 2016, NDIA Armament Systems Forum

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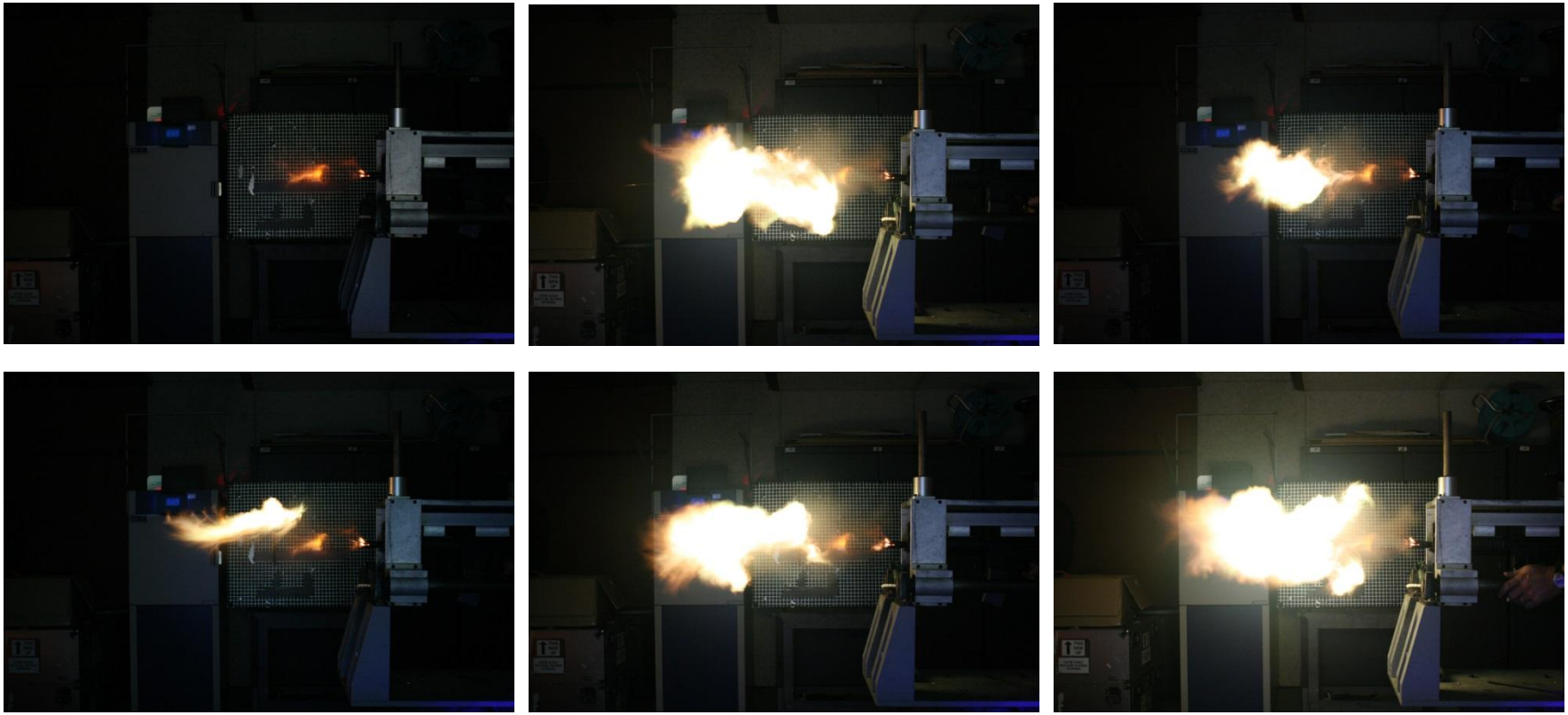
Project Objective

- Current flash measurement methods rely on still (long exposure) photography
  - Qualitative assessment of performance
  - Poor calibration/standardization
- Objective: Develop and evaluate quantitative small arms muzzle flash measurement methods—emphasis on suppressed weapons
  - Effort part of NATO Army Armaments Group (NAAG), Land Capability Group Dismounted Soldier Systems, Suppressor Team of Experts

Photographic Flash Characterization

- Currently preferred method for flash characterization
  - Quantification is difficult using uncalibrated cameras
  - Limited to visible flash (using consumer cameras)



Comparison of Available Methods

Critical Requirements:

- Reliable calibration
- High sensitivity
- Temporal resolution
- Multiple spectral bands

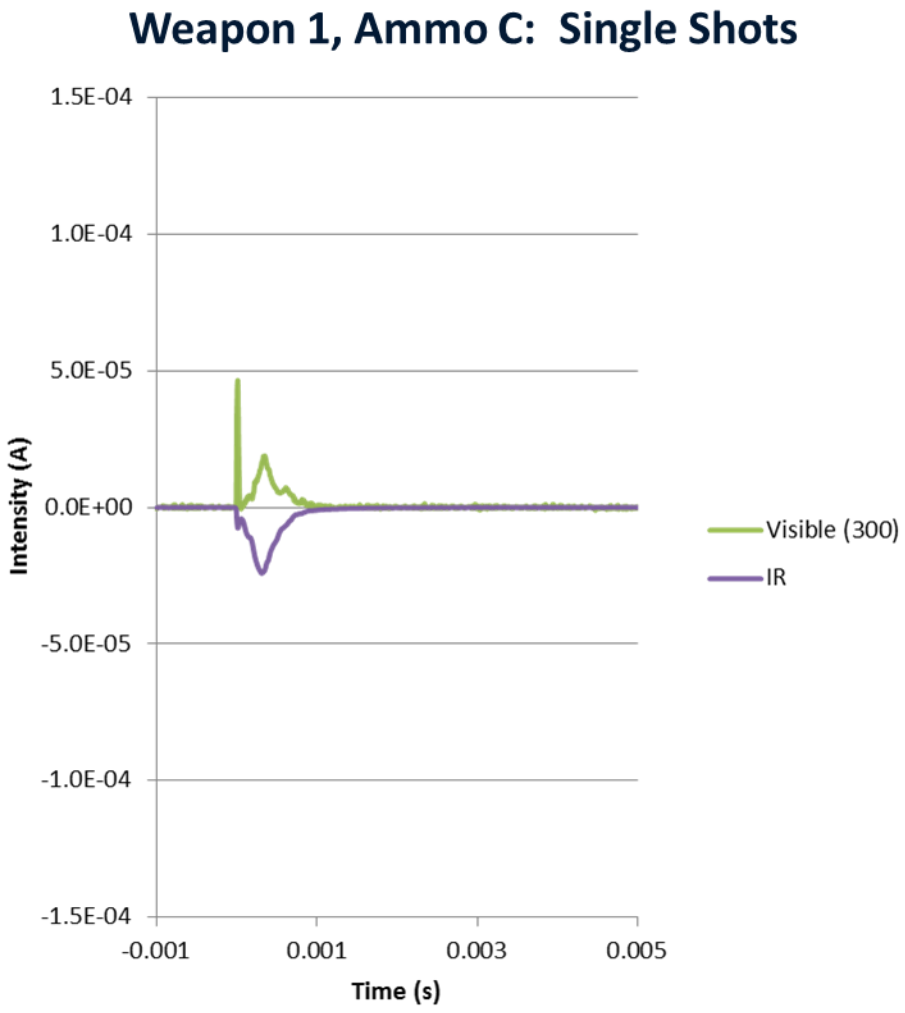
Secondary Concerns:

- Shape/size images
- Low cost (relative)
- Easy to use

	Still Photography	H.S. Photography	Radiometry	H.S. Spectrometers
Reliable intensity measurement	✓	?	✓	✓
High sensitivity	✓	X	✓	X
Large dynamic range	✓	✓	✓	✓
Temporal resolution	X	✓	✓	?
Multiple spectral bands	X	X	✓	✓
Shape/Size measurement	✓	✓	X	X
(Relatively) Low Cost	✓	X	✓	?
Ease of operation/maintenance	✓	?	✓	X

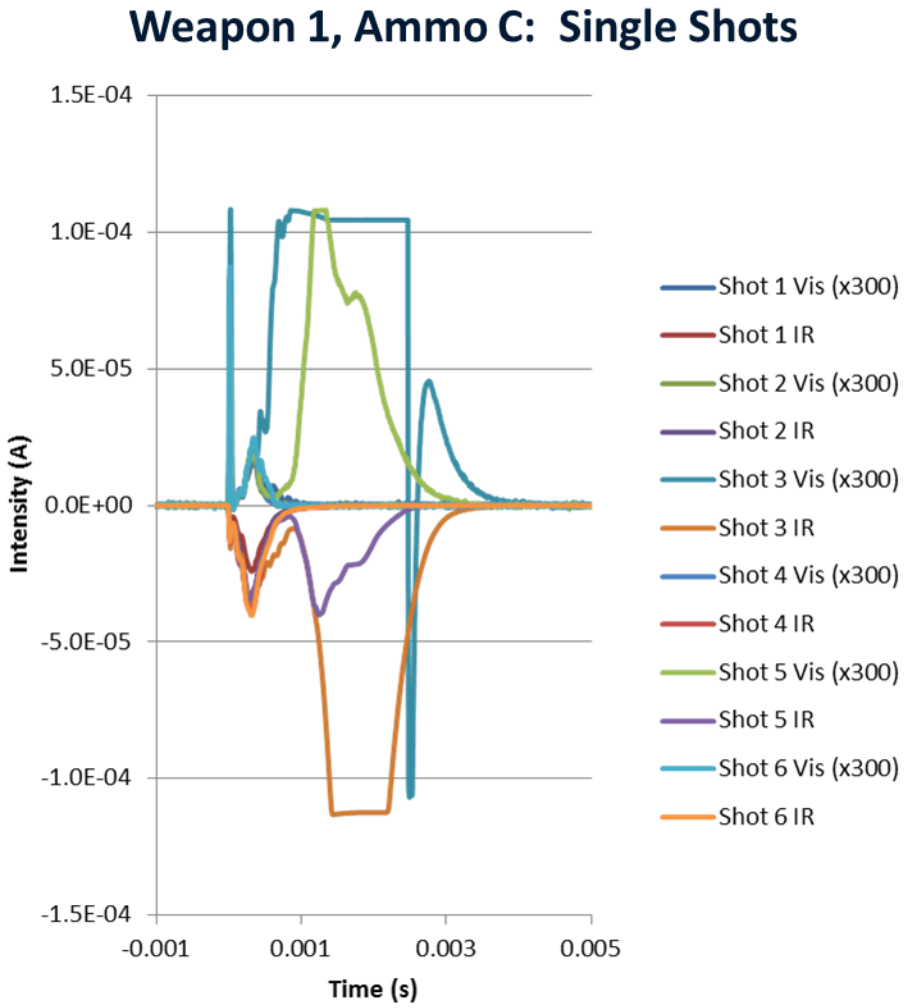
Temporal Flash Characterization

- Test Objectives:
  - Can instrumentation resolve fast features of the flash profile?
  - Can instrumentation quantitatively and repeatably measure intensity of flash profile?
    - Integration yields W/sr
- Notes:
  - Intensities plotted in amps to minimize apparent intensity differences due to amplifier gain settings



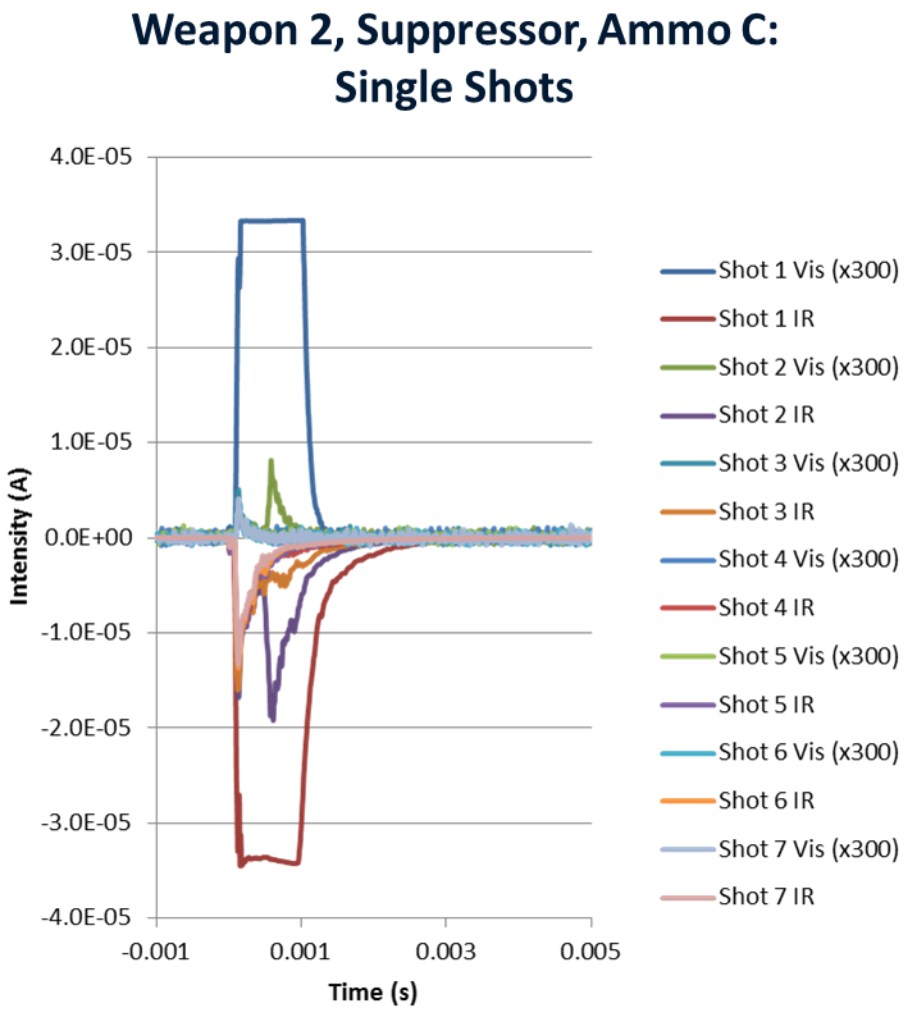
Temporal Flash Characterization

- Expected features observed
  - **Early: Pre-Flash**
    - Consistent profile
    - Bandwidth limiting feature
    - Small total energy emission
  - **Mid: Primary Flash**
    - Consistent duration & intensity
  - **Late: Secondary Flash**
    - Highly variable duration & intensity
- Large variability observed in flash intensities
  - Secondary flash is inconsistent
  - *Visible light level triggering is not reliable*
    - Recommend triggering from either IR or acoustic signal
    - IR triggering used successfully in these tests



Temporal Flash Characterization

- Addition of suppressors has a major impact on measured intensity
  - Infrared and visible signals both greatly reduced
  - “Cold” shots were much more intense than “warm” shots



Conclusions

- Photometers provide reliable muzzle flash measurement
  - Spectral radiant intensity measurements:
    - Visible, NIR, SWIR, and MWIR detectors available
    - Clearly defines measured intensity (W/sr)
  - Secondary flash creates dynamic range issues
    - “Bright” flashes saturate high-gain detectors/amplifiers
    - Possible solution is multiple detector/amplifiers
    - High sensitivity COTS solutions are being explored
  - Suppressed measurements pose sensitivity issues
    - Evaluation of alternate detectors is ongoing
  - Combination of photometry and photography is current path forward

- Documentation and validation of standards is ongoing
  - Final procedures established by Fall, 2016