

NATO Weapons and Sensors Working Group Panel Discussion

2017 ARMAMENT SYSTEMS FORUM

May 3, 2017



Barton H. Halpern, Ph.D.

Chairman, NATO LCG DSS W&S Sub Group



Agenda

1. NATO Organization
2. W&S Structure/ Terms Of Reference
3. NATO Panel- Participants



NATO Structure to LCGDSS groups



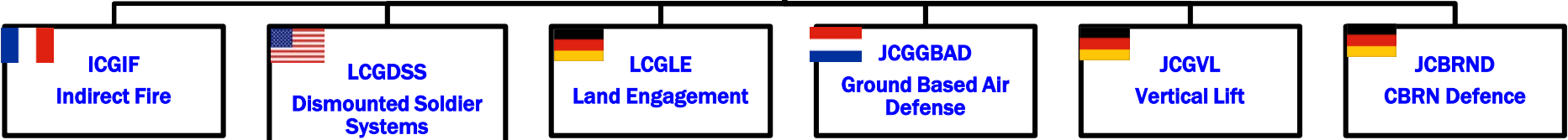
North Atlantic Council (NAC)

Conference of National Armament Directors (CNAD)
(AT&L)

 **AC/225 - NATO Army Armaments Group (NAAG)**

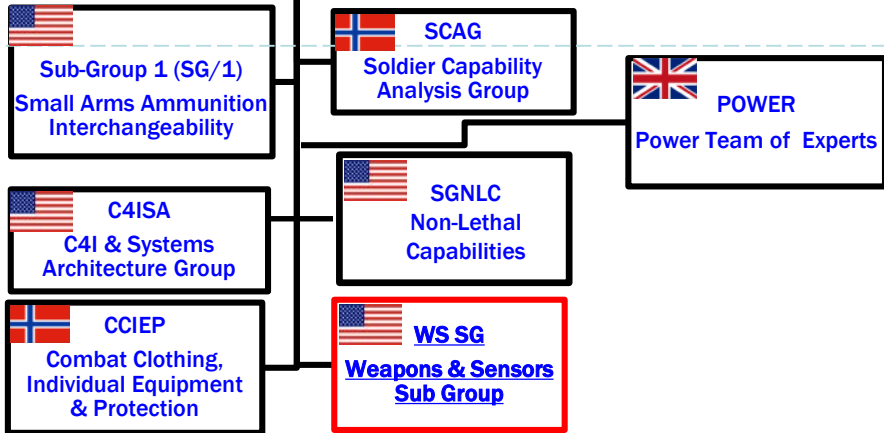
Level 2 Groups

LCG = Land Capability Group J/ICG = Joint/Integrated Capability Group



Level 2

Level 3



Meets as Level 2 Plenary only in March (Chairmen attend)
 Meets as Level 2&3, all Groups & Plenary in October

Land Capability Group Dismounted Soldier Systems

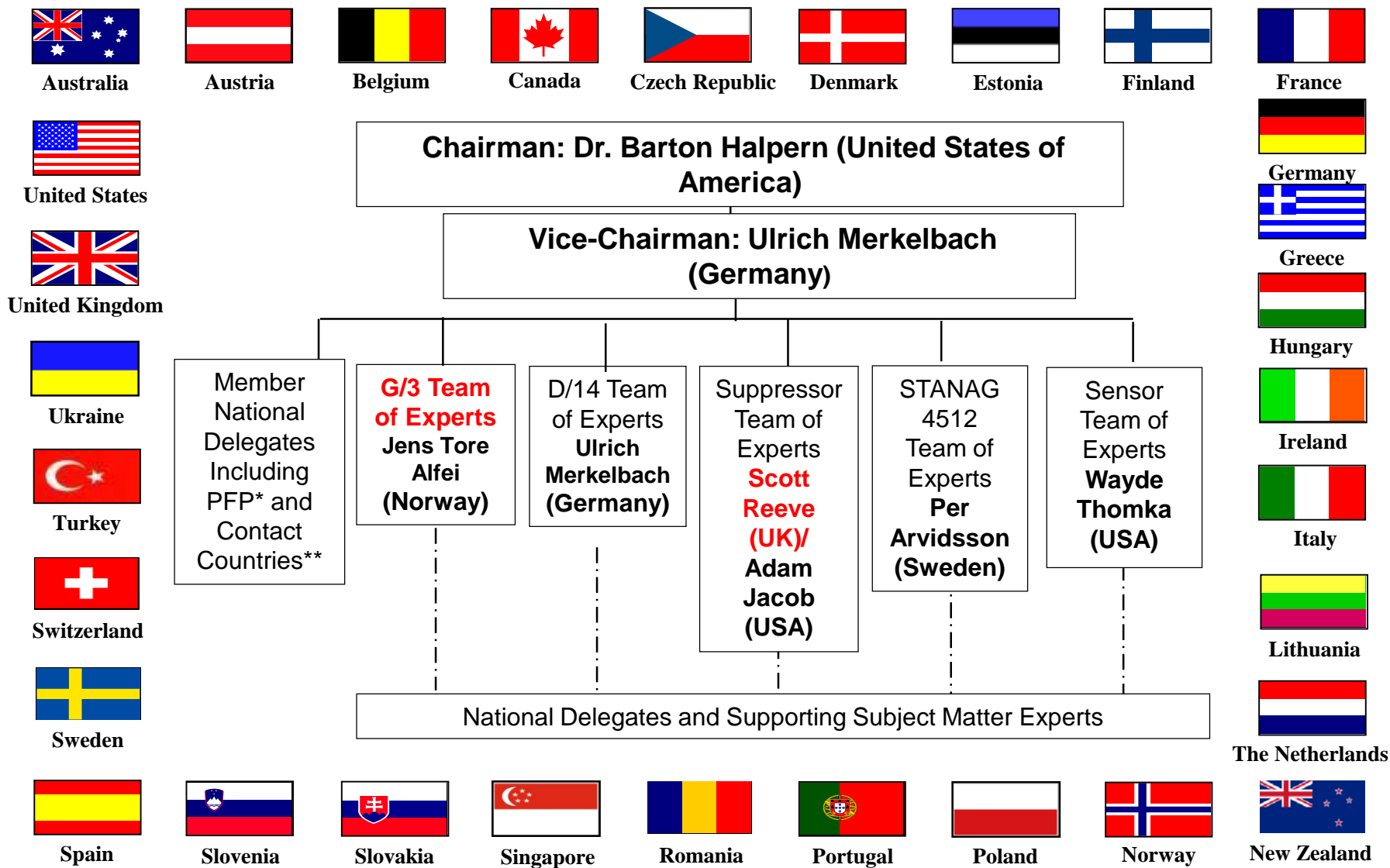
Sub-Groups & Working Groups meet alone in Spring

NATO Main Armament Group Handbook Level 3 Groups
Sub-Groups - indefinite, subjected to regular reviews
Working Groups -for specific tasks per ToR and PoW

Source: NATO Main Armament Group Handbook



Sub Group Weapon & Sensor Structure





ToR for Weapons & Sensors WG

- The group is responsible for all issues related to dismountable soldier's weapon systems, grenades and shoulder launched and guided anti-tank weapons, as well as dedicated sensors (including, but not limited to day and night sights, laser designators, tactical lights and fire control systems).
- **The group is responsible for training equipment as associated with our ToR equipment**
- The weapon system includes the weapon itself, different types of ammunition and the dedicated accessories.
- The group is also responsible for the interface of the weapons and sensors with the various other parts of the soldier system.

Three Levels of Standardization

AAP-6

Standardization: The development and implementation of concepts, doctrines, procedures and designs in order to achieve and maintain the compatibility, interchangeability or commonality which are necessary to attain the required level of interoperability, or to optimise the use of resources, in the fields of operations, materiel and administration

Three Levels

- **Compatibility**: The suitability of products, processes or services for use together under specific conditions to fulfil relevant requirements without causing unacceptable interactions (04 Oct 2000).
- **Interchangeability**: The ability of one product, process or service to be used in place of another to fulfil the same requirements (04 Oct 2000).
- **Commonality**: The state achieved when the same doctrine, procedures or equipment are used (04 Oct 2000).

Goal

- **Interoperability**: is the ability to act together coherently, effectively and efficiently to achieve Allied tactical, operational and strategic objectives (03 Dec 09)



The Panelists are :

1. **Mr. Mark McFadden, Program Management Engineer, JSSAP, U.S. Army ARDEC**
2. **Mr. Adam Jacob, U.S. Army ARDEC**
3. **Mr. David Long, Technical Warrant Holder Small Arms and Weapons, Naval Surface Warfare Center, Crane Division**
4. **Dr. David Dye, Naval Surface Warfare Center, Crane Division**
5. **Mr. Wayde Thomka, Technology Management Director, Project Manager Soldier Sensors and Lasers, U.S. Army**
6. **Kapitein-Commandant IMM (OF-3) Hendrik Vercruyssen, Belgian Defence**
7. **CWO John Yoshida, Senior Technical Authority Small Arms Director Soldier Systems Program Management (DSSPM) Canadian Armed Forces**

I have asked each of the panelists to describe their involvement and responsibilities

US Support of NATO Dismounted Soldier Systems (DSS) - Weapons & Sensors Sub Group

2017 NDIA Armament Systems Forum

May 03, 2017

Fredericksburg, VA



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UNPARALLELED
**COMMITMENT
& SOLUTIONS**

Act like someone's life depends on what we do.

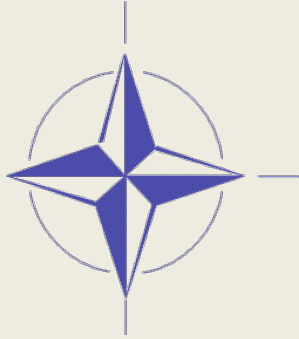


U.S. ARMY
RDECOM

U.S. ARMY ARMAMENT
RESEARCH, DEVELOPMENT
& ENGINEERING CENTER



CHAIRMAN VS US HoD ROLES



Chairman



- Plan & manage W&S
 - Establish Teams of Experts (ToEs) and work directives
 - Coordination with 28 nations
 - Conduct bi-annual W&S Meetings
 - Support bi-annual LCGDSS Plenary Meetings

Weapons & Sensors Sub Group (WS SG)

US HoD



- Support & coordinate W&S US resources
 - Support ToEs and work directives
 - US resources: ARDEC, ARL, ATC, CERDEC, JSSAP, NSWC Crane, PM-IWS (USMC), PM MAS, PM SSL, PM SW
 - US resources includes “permanent” delegates and “temporary” SMEs
 - Support bi-annual W&S Meetings



US HEAD OF DELEGATION

US HoD since October 2016 in Prague October 2016 (then Arnhem in Feb 2017)

- Represent the US position on all topics under WS
- US Participants: ARDEC (IW and CSW, Munitions, Fire Control), ARL, JSSAP, US Navy NSWC-Crane, PM-IWS (USMC), PM-SW, PM-SSL, USMC Systems Command, CERDEC
- Due to the nature of the WS charter and mission and its varied topics and directives, it is critical to ensure appropriate US expertise is available to participate, in order to validate relevant agreements and procedures that emerge and to ensure that the US tech base and current production base are properly represented
- S&T Briefs, upgrades, etc.
- Former NATO NARTC Superintendent – so know the SG/1 mission (Per Arvidsson from Sweden as well)



W&S is Custodian to 15 Plus STANAGs/STANRECs/Documents

ItemNo	Doc.Type	Short Title	Title	Status	Remark
4498	Cov + AP	STANREC4498Ed: 2/ AEP-87	SOLDIER SYSTEMS REPRESENTATIVE TARGETS, HELICOPTERS AND UNARMORED VEHICLES	PROMULGATED	
4512	Cov + Std	STANAG4512Ed: 1	DISMOUNTED PERSONNEL TARGET	PROMULGATED	Under Update
4513	Cov + Std	STANREC4513Ed: 1/AEP-4513	INCAPACITATION AND SUPPRESSION		Under Silence
4536	Cov + AP	STANREC4536Ed: 2/AEP-88	REPRESENTATIVE TARGET - UNFORTIFIED AND FORTIFIED STRUCTURES	PROMULGATED	
4694	Cov + Std	STANAG4694Ed: 1	NATO ACCESSORY RAIL	PROMULGATED	
4740	Cov + AP	STANAG4740Ed: 1/ AEP-90	NATO POWERED ACCESSORY RAIL	PROMULGATED	
4785	Cov + AP	STANREC4785Ed:1 / AEP-4785	SUPPRESSOR TESTING PROTOCOL ON ACOUSTIC SIGNATURE MEASUREMENT	PROMULGATED	
4796	Cov + AP	STANREC4796Ed:1 / AEP-4796	STANDARD INFANTRY SUPPORT WEAPONS MECHANICAL INTERFACE	STUDY	Under Silence
	No Cover	AEP-37Ed. 1 (no cover)	CATALOGUE OF RANGE TARGETS FOR DIRECT FIRE ANTI-ARMOUR AMMUNITION TESTS	PROMULGATED	LCGLE transfer on- going
	Doc	D/1- AC/225(DSS) D(2016)0001	NATO Infantry Small Arms Post 2025 - AC/225(DSS)D(2016)0001	Published	
	Doc	D/14 - AC/225 (LG/3- SG/1)D/14	Evaluation procedures for future NATO Small Arms Weapon Systems		Team of experts Ongoing efforts.
4785	Cov + AP	New Vol Under AEP 4785	Test protocols for flash intensity measurements in the visible and infrared spectrum for Small Arms		Team of experts Ongoing efforts.
4785	Cov + AP	New Vol Under AEP 4785	Test protocols for the measurement of thermal signature of Small Arms suppressors		Team of experts Ongoing efforts.
4785	Cov + AP	New Vol Under AEP 4785	Test protocols for the kinematic measurement of suppressed automatic and semi-automatic Small Arms		Team of experts Ongoing efforts.
4785	Cov + AP	New Vol Under AEP 4785	Test protocols for the kinematic measurement of suppressed automatic and semi-automatic Small Arms		Team of experts Ongoing efforts.
4785	Cov + AP	New Vol Under AEP 4785	Test protocols for the measurement of blowback resultant of Small Arms suppressors		Team of experts Ongoing efforts.

WS SG REPORTING TOOL MALFUNCTION INCIDENT REPORTS

Incidents/Accidents with Small Caliber Weapons (Sample)

- **With 12.7 mm FN M2 QCB**
- Outside chamber explosion;
- No injuries;
- Unlocked barrel.



- **BMG .50 M2 QCB**
- Fired from remote weapon station FLW 200 on ATF Dingo
- Investigations ongoing, cause still open





WEAPONS AND SENSORS SUB GROUP TEAMS OF EXPERTS (TOEs)

- Suppressor TOE
- D/14 TOE
- STANAG 4512 TOE
- Sensors TOE
- G3 Cone TOE
- STANAG 4513 UPDATE
- **New D1 finalized and released on 14 Mar 2016 - NEW NATO INFANTRY SMALL ARMS POST 2025**



SUPPRESSOR TOE

US PARTICIPATION

United Kingdom/United States (NOW) - Lead

- Produce test methodologies/protocols for evaluating Acoustic, Flash, Visible, IR, LWIR, and Mirage signatures of suppressors and suppressed weapons; also investigating Cyclic Rate/Cadence effects on weapon from suppressors; also Vapor and Particulate by-products and effect on operator in confined space, indoor range training (toxicity/blowback), expected to be completed in October 2017.
- NATO Acoustic Suppressor Testing Methodology STANAG (AEP-4785) was finalized in Dec 2015.
- Flash and Thermal started in Feb 2015. A new STANREC/AEP for measurements in the Visible and Infrared Spectrums for Small Arms expected in late 2016/early 2017. **Huge breakthrough discovering MidWave IR signatures (not visible) from weapons/suppressors – will lead to improved propellants, more likely improved suppressor designs, and NV technologies**
- Mirage, LWIR signature efforts as well as Cyclic Rate/Cadence effects from suppressor will be addressed at the next TOE meeting.
- US Participants: ARDEC, ARL, ATC, JSSAP, NSWC Crane, PM-IWS (USMC), PM-SW, USMC Systems Command



D/14 (Evaluation Procedures for Future NATO Small Arms Weapon Systems) ToE **US PARTICIPATION**

Germany – Lead

- Development of a new structure of D/14, previous update 2001.
- Divide the team into two sub teams: "weapon system" responsible for Chapters 2,3 and Annex B "accessories and miscellaneous" responsible for Chapters 1,4,5,6, Annexes A,C
- Numerous proposals, updates have been completed and briefed, accepted, and incorporated into new draft
- Revision of final drafts by ToE before final release
- "Test drive" with the final drafts at test facilities (Certified NTCs or other appropriate facilities)
- Completion of D14-update: 2018
- D/14 is the "gold standard" for NATO weapon system evaluation, allows for standardized test and evaluation methods for national acceptance of small arms weapon systems
- US HoD is a member of this TOE, previous role in NATO SG/1 had him assigned to assist in the 2001 D/14 update, attended TOE in Koblenz, GE in June 2016 and October 2016 in Prague, CZ, Arnhem, Netherlands in Feb 2017
- US Participants: ARDEC, ATC, CERDEC, JSSAP, PM-SW, PM-SSL, USMC Systems Command, PM-IWS (USMC)



SENSOR TEAM OF EXPERTS (ToE) US PARTICIPATION

USA Lead (Wayde Thomka, PM-SSL)

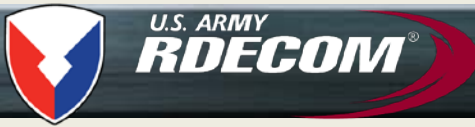
- Initiated Feb 2016
- 12 nations will participate
- Weapon centric sensors only.
- Initial efforts will focus on standardizing symbology and display format/layout.
- US Participants: CERDEC, JSSAP, PM SSL, PMSW, ARDEC Fire Control



D/1 - INFANTRY SMALL ARMS POST 2025

Aim of Paper - AC/225(DSS)D(2016)0001, 14 March 2016

The aim of this paper is to briefly describe the evolution of the technological developments that will affect the use of small arms in future conflicts and to provide a focus for further development of NATO small arms. This paper will also describe the possible applications of technology that can improve the ability of the infantry to survive future conflicts. Future requirements will be evaluated for infantry small arms (beyond the year 2025) identifying specific areas of technology with a potential for materiel standardization and interoperability.



Additional Efforts and Benefits

- National Updates from US Army (PM-SW, PM-SSL) and USMC (USMC Systems Command, PM-IW), USN (NSWC - Crane) and all other nations (**share** of information, technological thrusts, procurements, issues, initiatives, etc. with ammo, fire control, weapon and sensor configurations, fieldings, modifications, etc.)
- Special presentations on relevant topics are given at the WS SG meetings which are of great value to all and elicits excellent discussion on germane topics and furthers national and coalition progress in various areas
- NATO WS Reporting Tool – national delegates update the macro tool to share a wealth of information and ensure all information is valid with current fielded systems as well as future initiatives for weapons, ammunition, fire control, sensors, etc.
 - Reporting Tool is briefed at each bi-annual meeting, and updated as part of proceedings
 - Nations use the tool to surface malfunctions (ammunition, weapons, etc.) of their fielded systems (may be common to other nations, may lead to quicker diagnosis and resolution)
 - T&E background will serve well in this area, opportunity to ensure terms (malfunctions, case casualties) are standardized – D/14 connection
 - *SG/1 uses tool to ensure their NATO Nominated Weapon Systems are well represented in the Function and Casualty section of the Multi-Caliber Manual of Proof and Inspection (ensures representation of weapons with varying principles of operation – further discriminators, and optimizes battle interchangeability of their qualified ammunition designs)*



Additional Efforts and Benefits (Cont'd)

- Once per year, joint meeting with DSS and all SGs (TOEs often meet then as well), results in cross-fertilization of efforts and ideas, allows high level networking of experts in their functional areas, encourages checks and balances with NATO, and creates further promotion of standardization across dismounted soldier systems
- Foreign Military Sales – nations desire to purchase weapons, ammunition, optics, sensors, etc. that have been developed, tested and fielded by other member nations and/or NATO Test Centers
- Recent examples
 - Lethality testing, standardized detailed procedures for making gel blocks, calibrating them, and assessing temporary and permanent wound cavities as well as entry yaw into blocks, as part of overall assessment. UK developing procedures (D/14) which will be leveraged off ARDEC METC work/experience/analysis (TPM model for pistols (others in future) as well)
 - Tracer firing and barrel wear, mixed ammo effects
 - M2 receiver/parts/conversion kit quality exchange of information
 - Proof firing – relevant, process, directives



Additional Efforts and Benefits (Cont'd)

- Fielding of new mounts (Denmark, LW tripod)
- Blank Firing Attachment issues, exchange
- Simulation use in various nations, how it is used, saves on testing costs
- Noise emission of night vision tubes
- 80° night vision goggle
- Fire Control involvement in WS emerging
- Small Arms Gages – TMDE/Calibration procedures/necessity
- Temperature Effects on Ammunition
- D/14 replacement of Recoil by Ballistic Pendulum
 - WRSS (Knights Armament System, discovered felt recoil damaging devices) and CA (DRDC) developed jointly with UK recoil mount – felt recoil a huge discovery for devices! – this development will lead to better weapon system designs, suppressors designs, criteria for weapon/suppressor/device acceptance, improved thermal/NV/various devices technologies (robust) will also emerge as a result
- **WS SG members routinely ask for guidance to the entire SG distribution, which quickly provides vast expertise and recommendations**



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QUESTIONS?

NATO W&SWG Panel

Suppressor Test Methodologies Team of Experts

03 May 2017

NDIA Armament Systems Forum



Adam M. Jacob

Chairman, Suppressor Team of Experts

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Suppressor ToE

Background and Structure

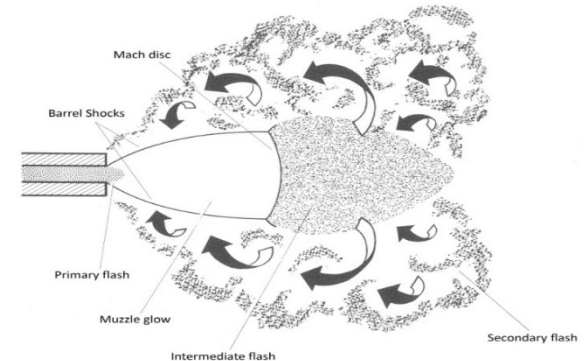
- NATO interest in standardizing test methods
 - Increase in suppressor use beyond specialized Users
 - No standardized methods to test or compare suppressors from different manufacturers
 - No quantifiable method to measure many suppressor attributes beyond acoustic signature
- Suppressor Test Methodologies Team of Experts structure
 - Formed in October 2012
 - Members of ToE are all W&SWG members, active in suppressor development and testing in their respective countries
 - ToE takes advantage of test methods and results across the NATO member countries
 - ToE meets at least twice a year, with standardization efforts taking place at various locations between meetings.



Suppressor ToE Goals

Goals

- Develop, test, and validate a series of test methodologies to characterize the performance of small arms suppressors, including aspects of signature, system performance and degradation, and hazardous effects.
- Publish and standardize test methods in the form of a series of Allied Engineering Publications (AEPs) which will eventually be volumes under AEP 4785





Suppressor ToE Scope and Status

Signature

- **Test Protocols for Acoustic Signature Measurement of Small Arms Suppressors (NATO Suppressor ToE) – Complete - STANREC 4785 and AEP 4785 V1**
- **Test Protocols for Flash Intensity Measurements in the Visible and Infrared Spectrum for Small Arms (NATO Suppressor ToE) – In progress – NEW Volume to AEP - to be provided Fall 2017**
- **Test Protocols for the Measurement of Thermal Signature of Small Arms Suppressors (NATO Suppressor ToE) – To begin - NEW AEP Volume**
- **Muzzle blast (NATO D14 effort) – Suppressor ToE to review**

System Performance

- **Accuracy & Consistency (NATO D14 effort) – Suppressor ToE to review**
- **Test Protocols for the Kinematic Measurement of Suppressed Automatic and Semi-Automatic Small Arms (NATO Suppressor ToE) – NEW AEP Volume**
- **Test Protocols for the Measurement of Mirage From Suppressed Small Arms (NATO Suppressor ToE) - NEW AEP Volume**

Hazardous effects

- **Test Protocols for the Measurement of Blowback Resultant of Small Arms Suppressors (US effort ongoing) - NEW AEP Volume, Army TOP**

A collage of military-related images: a soldier in full combat gear on the left, a large naval ship at sea in the center, a fighter jet in flight in the upper right, and a missile launch with a large plume of fire on the right side. A blue and yellow curved graphic element is at the bottom.

HARNESSING THE POWER OF TECHNOLOGY for the **WARFIGHTER**

NDIA Armaments Conference
NATO Panel

Presented By: David Long, Small Arms Weapons Division

Date: May 2017

CAPT JT Elder, USN
Commanding Officer
NSWC Crane

Dr. Brett A Seidle (SES)
Technical Director
NSWC Crane

Why Participate in the ToE


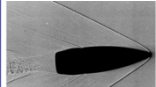

Technical Warrant Holder Responsibility:

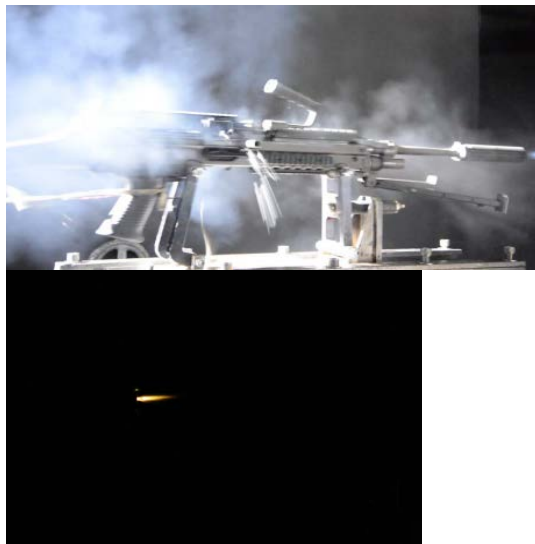
In accordance with NAVSEAINST 5400.97, and within their warranted technical areas, TWHs are responsible for **Setting Technical Standards:** Establish technical policy, standards, tools, requirements, and processes, including certification requirements, ensuring consistency with higher authority policy, requirements, architectures, and standards.

Technical Need

I

CAPABILITY PRODUCTION DOCUMENT
For
Family of Muzzle Brakes and Suppressors (FMBS)
Increment II, III (III A, III B), IV, and V Version 1.0

<p>Val Appl Milestone Decisio Pri</p>	 <p>S&T Opportunity Relevant Weapon Signature Evaluations</p>	<p>S. XXXX Pl. Owen Cramer NIISE Category Basic/Applied Research</p>
<p>Project Description: Developing effective sound and flash suppression for small arms weapons is critical for warfighter survivability. Often, however, visual and acoustic weapon signatures are evaluated subjectively or using potentially irrelevant parameters. Even when quantitative measurements are obtained, well-defined comparison measurements and standardized techniques are lacking. This leads to difficulty in comparing suppression systems. In this project, we'll methodically develop a set of relevant and quantitative parameters and testing procedures to evaluate the efficacy of visual and/or acoustic suppressors in small arms weapons.</p>		 <p>Shadowgraph of bullet above Mach 1</p>
		 <p>A subjective flash measurement technique</p>



Hazardous Effects?

Mirage?

Acoustics?

Visible/IR Flash?

LWIR Signature?

What Does the Navy Gain

- Collaboration with doctoral level expertise across NATO



Australia



Canada



Netherlands



Norway



Sweden



United Kingdom



United States (Army, Marine Corps, Navy)

The Result

Repeatable, quantitative methods

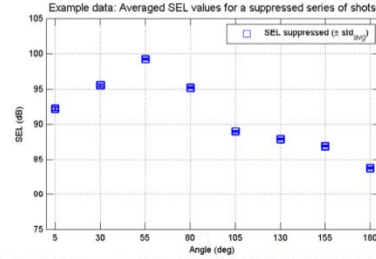
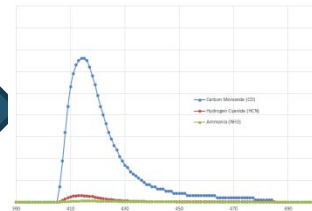
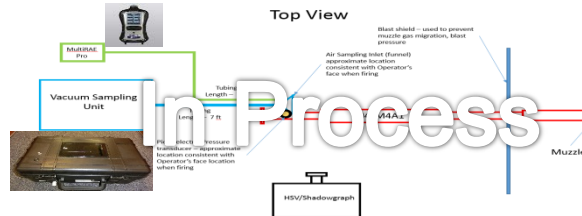
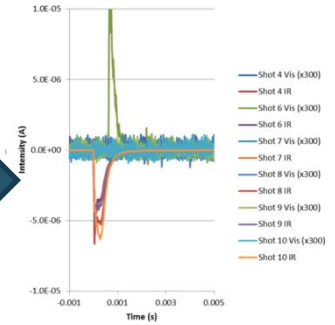
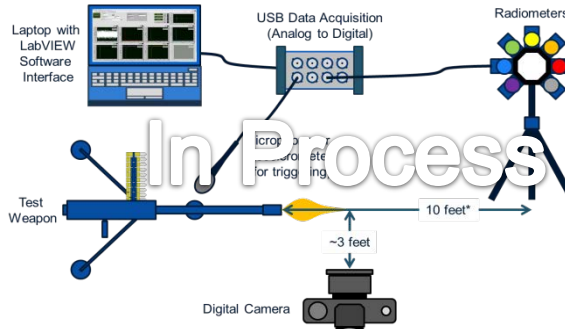


Figure A.1. Averaged SEL values for a suppressed series of shots as a function of the angle (for 8 microphones). Error bars are also given (\pm the standard deviation of the average based on 20 shots).





Contact Information

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HARNESSING THE POWER OF TECHNOLOGY for the **WARFIGHTER**

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*Dr. Brett Seidle
Technical Director
NSWC Crane*

***Development of Standardized Test Methods for
Quantitative Small Arms Signature Characterization***

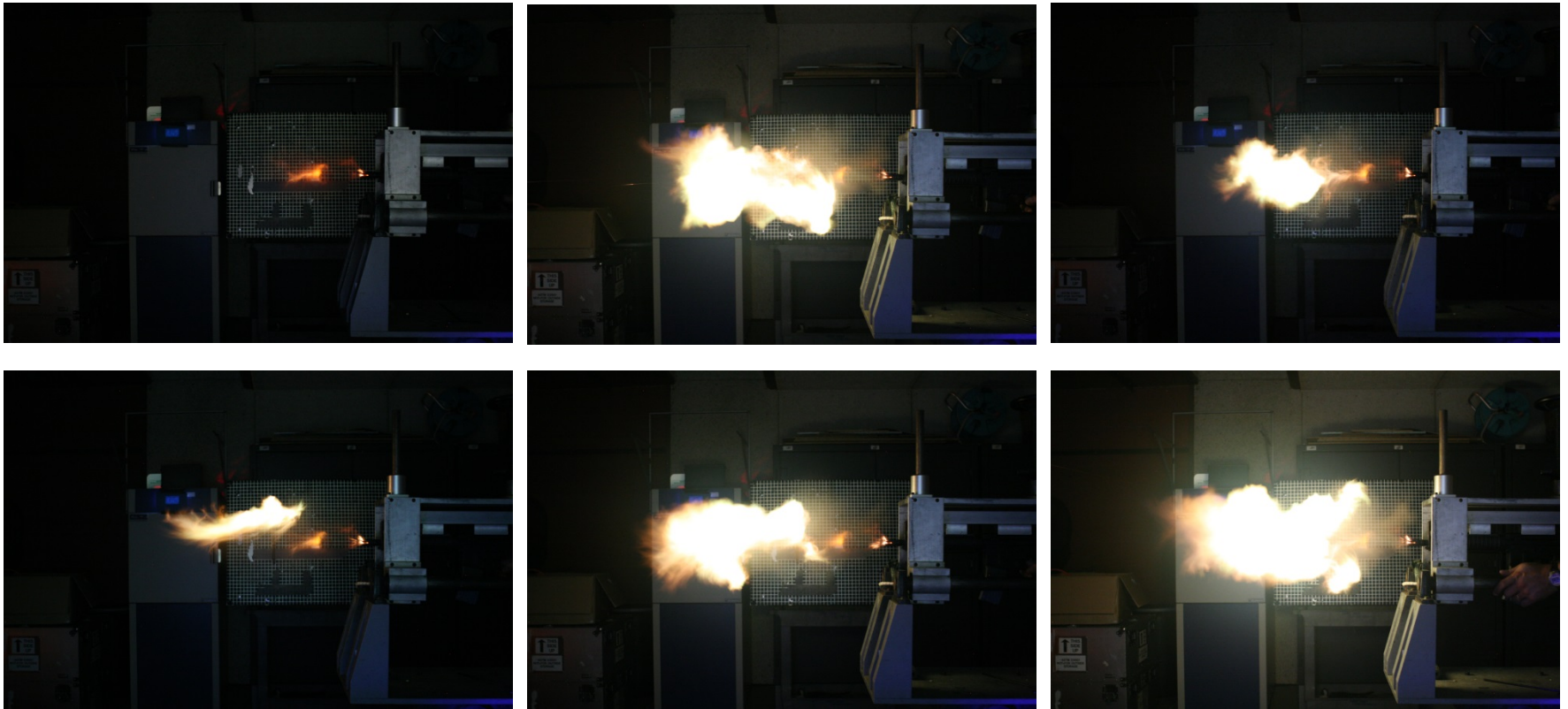
Dr. David F. Dye* david.f.dye@navy.mil, +1 (812) 854-6616

Project Objective: Flash Signature

- 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)



Proposed Quantitative Method

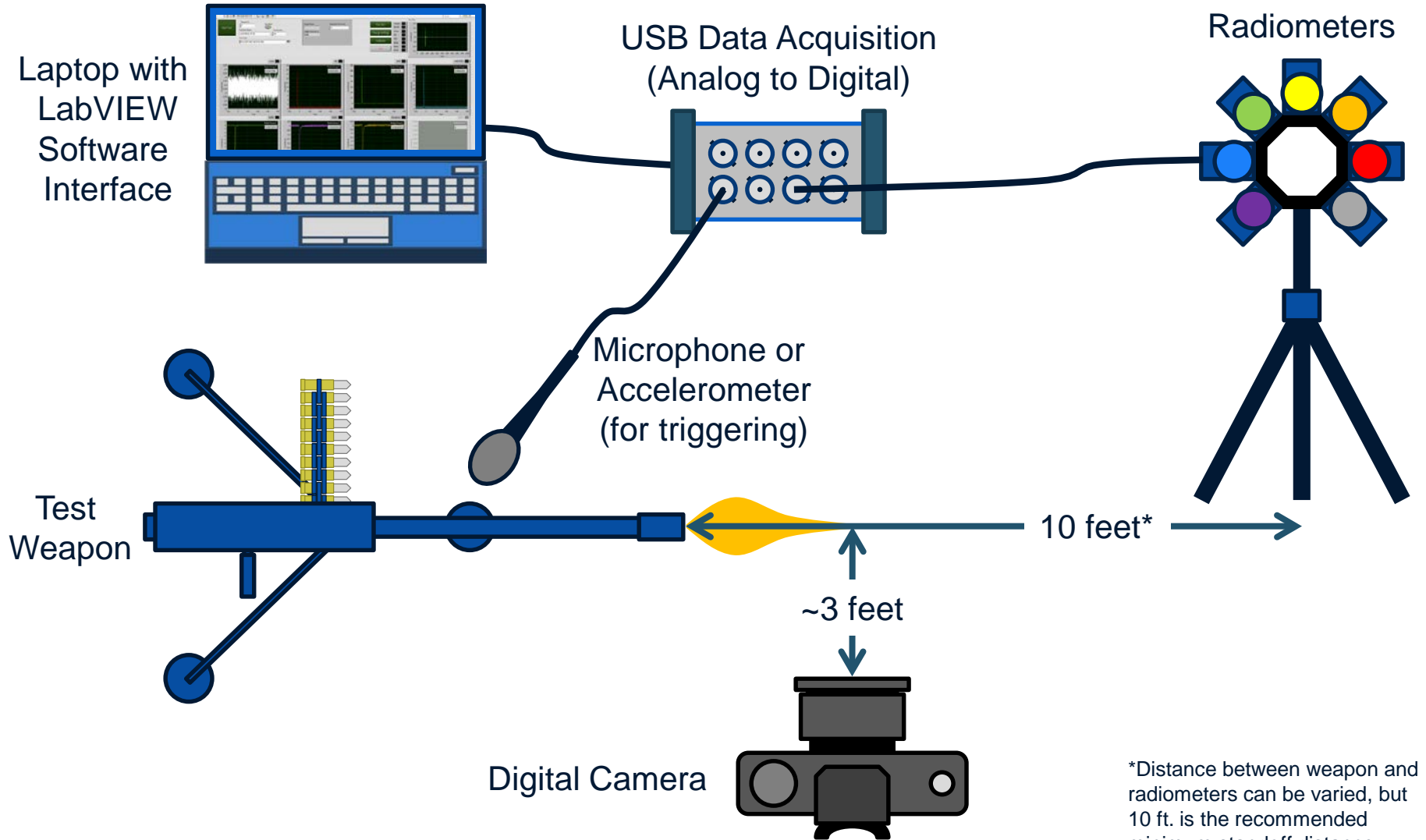
Proposed Quantitative Flash Intensity Measurement Method:

- Measure brightness using calibrated radiometers
 - Record instantaneous radiant intensity using photodiodes & DAQ module
 - Calculate total in-band energy from temporal response
 - For fast events like muzzle flash, this is the most important value
- Record long-exposure picture of flash event
 - Will be used for comparison with historical data & quality control, but not quantification of flash intensity

Benefits:

- Enables quantitative vs. subjective performance metrics
- Instrumentation independent intensity values
 - Improves comparison between different test results from different labs
- Simultaneous measurement in multiple bands is possible
 - Invisible emission occurs during firing, even when no visible flash is apparent
 - Proliferation of electro-optics makes non-visible bands increasingly important
- Consistent with upcoming NATO STANREC procedures

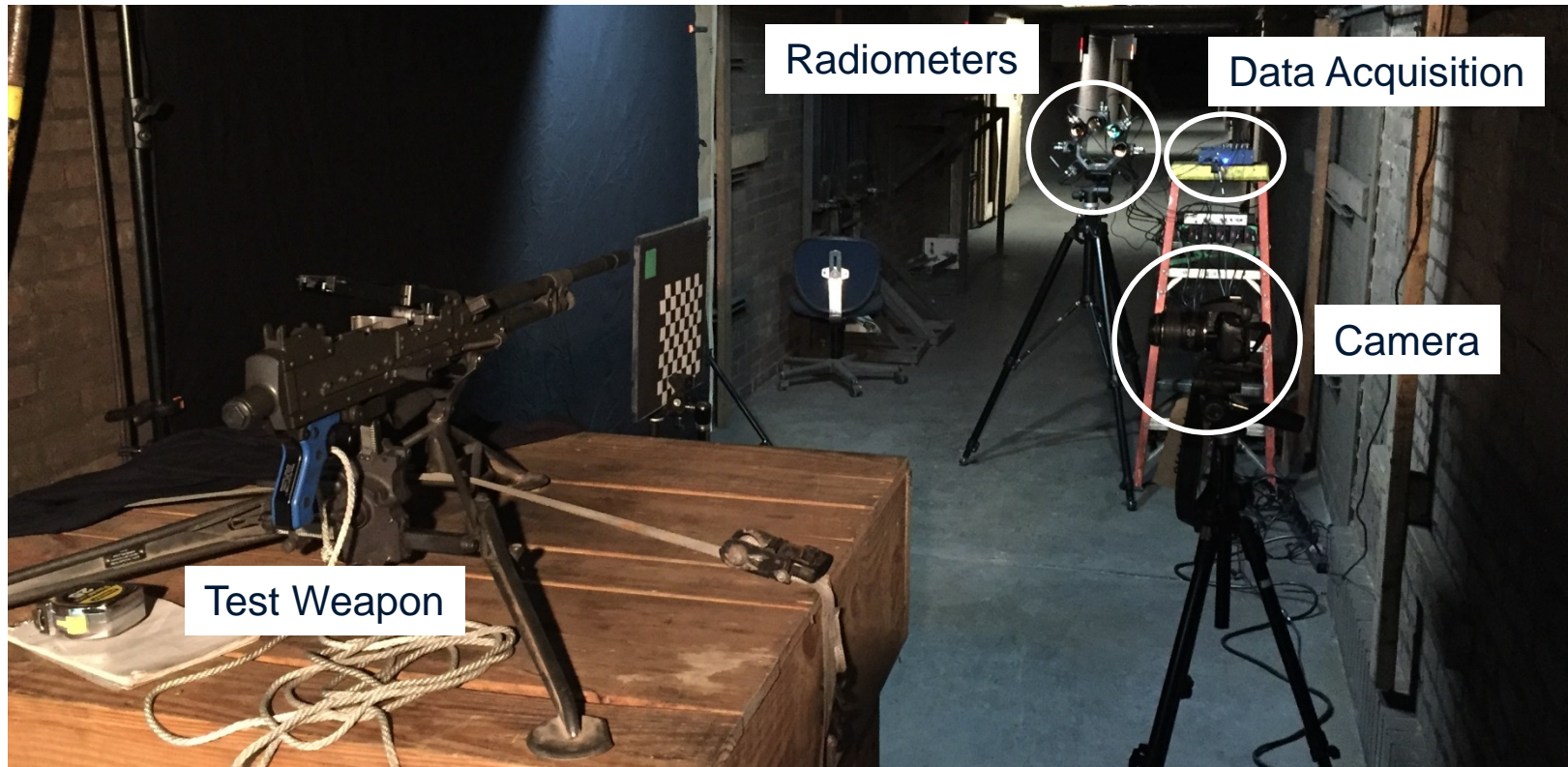
Simplified Instrumentation Diagram



*Distance between weapon and radiometers can be varied, but 10 ft. is the recommended minimum standoff distance.

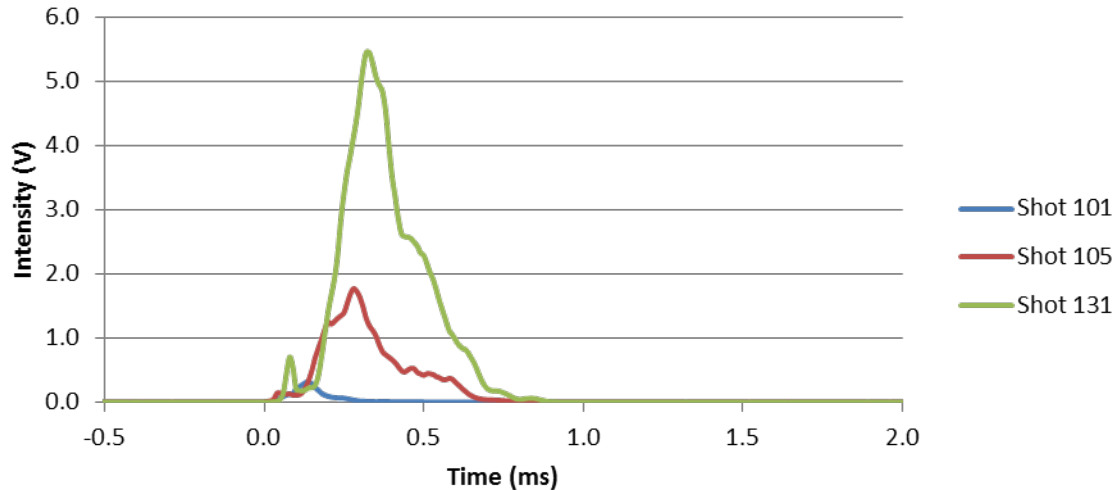
LCAAP Demonstration

- Radiometers: 10' from the muzzle, $\sim 5^\circ$ right of the weapon's line of fire
- Camera: $\sim 1'$ in front of the muzzle, $\sim 1'$ right of the weapon's line of fire
- Instrumentation was controlled remotely from outside of the firing tunnel



Quantification of Flash Brightness

Visible (Photopic) Flash Intensity Contractor B, M62A1, Lot 001



- Perceived visible brightness can be described as luminous energy (cd^*s) for short flashes
 - Repeatable measurement
 - Calibratable
 - Instrumentation independent



*Uncalibrated sample data is shown in volts vs. time for public release. Meaningful data will be reported in cd^*s for visible light and Joules for invisible light.

Project Objective: Thermal Signature

- Capability Gap: No internationally standardized test methods currently exist for quantification of small arms thermal signature
 - Inexpensive long-wavelength infrared (LWIR) imagers are readily available
 - Suppressors are of high concern
- Objective: Develop and evaluate quantitative small arms thermal signature measurement methods—emphasis on suppressed weapons
 - Utilize IR/RF Countermeasures Division imaging expertise
 - Effort part of NATO Army Armaments Group (NAAG), Land Capability Group Dismounted Soldier Systems, Suppressor Team of Experts



FLIR ONE, \$275



FLIR VUE, \$1499

Proposed Thermal Signature Measurement Method:

- Image “hot” weapons using long-wavelength infrared (LWIR) imagers
 - Focus on “inexpensive,” microbolometer-based, calibratable imagers
- Analyze images to measure radiant intensity
 - Images must have sufficient fidelity to allow quantification
 - Concentration on suppressors due to size and temperature
 - Adapt methods currently in use for IRCM analysis

Benefits:

- Enables quantitative performance metrics
- Instrumentation independent intensity values
 - Improves comparison between different test results from different labs
- Consistent with upcoming NATO STANREC procedures

Thermal Imager Evaluation



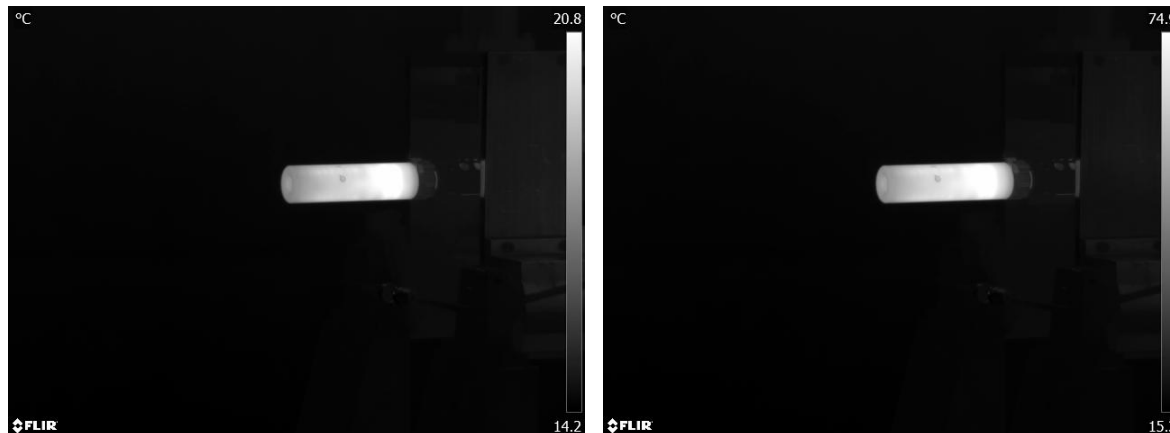
- Continuation of radiometer evaluation
 - Improved acoustic triggering demonstrated

- Thermal imaging capabilities evaluated
 - Microbolometers
 - Dual-band InSb



Quantitative Thermal Imaging

- Radiometrically accurate thermal images can be taken with “moderately” priced hardware





Acknowledgements

- NAAG LCG-DSS Suppressor Team of Experts
 - Scott Reeve & Ross Colbourne (DSTL, UK)
 - Dr. Morten Huesby (FFI, Norway)
 - Dr. Thomas Svensson (FOI, Sweeden)
 - Adam Jacob (ARDEC)
 - Dr. Rogério Pimentel (DRDC) & CWO John T. Yoshida (DSSPM, Canada)
 - Jason Davis & Dave Long (NSWC Crane)
- Salvatore A. Fanelli (USMC SYSCOM)
- Dr. Barton H. Halpern (Development and Engineering Center Joint Service Small Arms Program, Picatinny Arsenal)
- Financial support
 - NSWC Crane Naval Innovative Science and Engineering Program
 - USMC SYSCOM

Sensors ToE

February 2017



Wayde Thomka
US Army

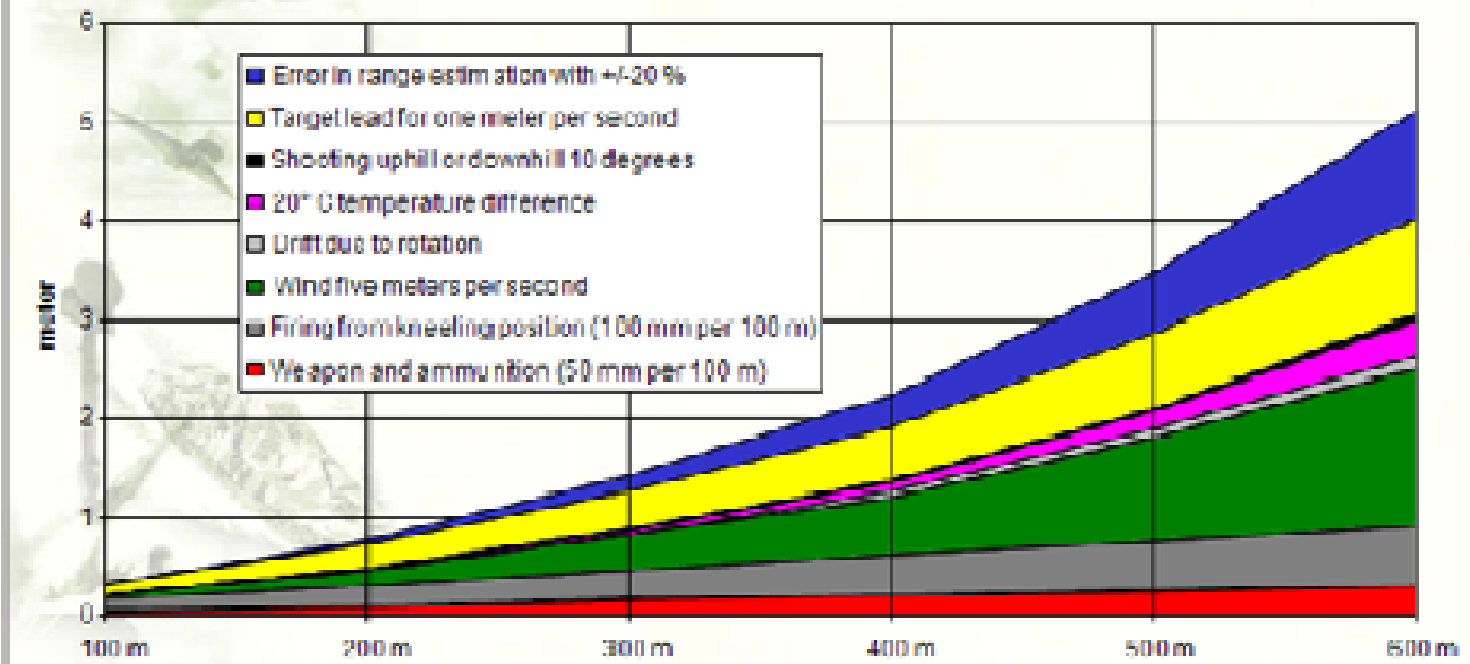


Sensors ToE

- First Meeting Spring 2017
- Topics included
 - ToE Administration
 - I² Performance
 - Laser Rangefinder Performance
 - Detect, Recognize, Identify Definitions
 - Small Arms Fire Control Topics
- 20 Individuals; 9 nations



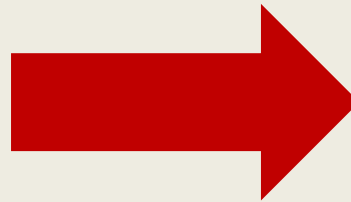
5.56 NATO Error Budget



Borrowed from Scott Reeve presentation to NATO in 2012 – who further referenced Per Arvidsson for this chart



Military Vehicle Identification:
M1A1 or T-72?



Human/Weapon Identification:
Combatant or Non-combatant?
Weapon or non-weapon?
AK-47 or broom, RPG or pipe?

The new threat has led to an increased risk of collateral damage and civilian casualties

Band / Illumination

- Visible
- Passive/Active SWIR
- MWIR/LWIR

Format

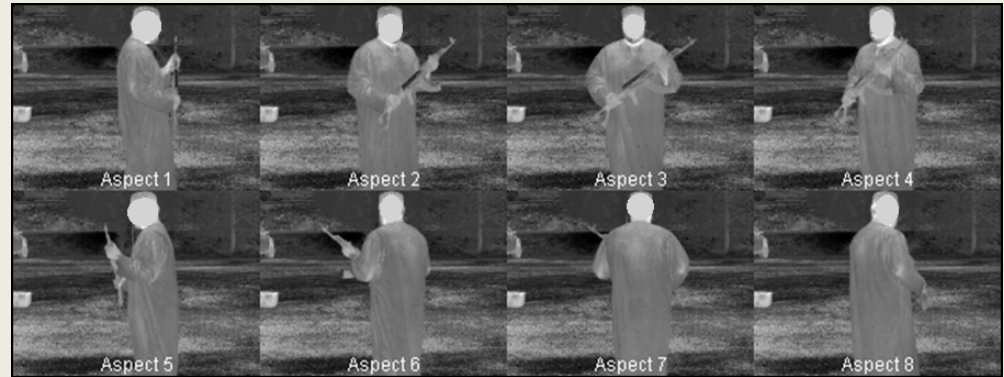
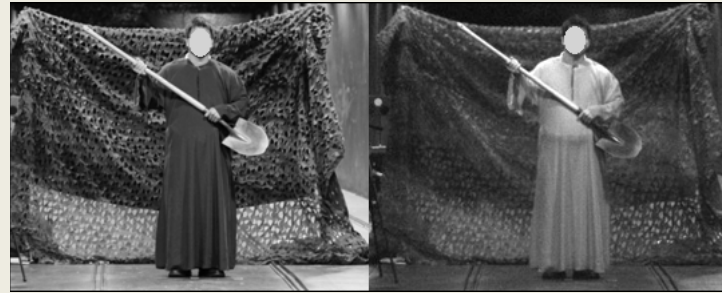
- Video
- Static

Aspects

- Front/Side
- Multiple

Choices

- Number
- Similarity/Diversity
- Grouping



Highly Dependant on Experimental Parameters



Fire Control Topics

- Range
- Targeting Error
- Wind Sensing
- Sensor Fusion
- Weapon/Fire Control integration
- Total system accuracy [P(h)] and time-to-engage performance
- Weapon /Fire Control/ Ammunition integration
- Current COTS solutions
- Human Factors



**DEFENSIE
LA DÉFENSE**

**BELGIUM – HoD NATO LCG
DSS - W&S SG**

Hendrik VERCRUYSEN
Cdt IMM (OF-3)

2017 NDIA Armament Systems Forum



Integrated Management

- As a Material Manager in the Belgian Armed Forces, you are responsible for a certain type of equipment during ALL phases of its life cycle



NATO LCG DSS – W&S SG

- Business case = translate requirements into Operational-Technical specifications
 - International network allows follow-up of current and future technologies in order to inform the decision makers on equipment that would improve combat effectiveness of our troops
 - Avoid expensive “trial & error”

NATO LCG DSS – W&S SG

- Acquisition = Public tendering
 - International network allows knowledge of different solutions to the requirements from several companies that have delivered to other NATO partners
 - Belgian policy to buy COTS/MOTS = NO prototypes
 - Aim for interoperability with Allies
 - Wherever possible : look for international collaboration opportunities (scale effect)

NATO LCG DSS – W&S SG

- Operate & Maintain
 - Share experiences on similar equipment
 - Positive feedback
 - Improvement opportunities
 - Upgrade potential
 - Negative feedback
 - Avoid technical problems
 - Learn from each other's mistakes
 - Adapt maintenance policies
 - Mutual support : spare parts

NATO LCG DSS – W&S SG

- Disposal = End of Life or replacement
 - Our own equipment
 - Verify other nation's interest in buying it
 - Equipment from NATO partners
 - Verify opportunity to acquire affordable equipment

Conclusion

- NATO LCG DSS – W&S SG allows:
 - Creation of and access to an international network of specialized individuals in a niche field of expertise : weapons & sensors
 - Honest and informal valuable information exchange on current and future technologies, experiences with equipment in use and possible collaboration opportunities
- = Improvement of quality delivered to the troops +
Cost savings for the Armed Forces**

Questions ?

Hendrik VERCRUYSEN, Kapitein-commandant IMM (OF-3)

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A Canadian Perspective

Chief Warrant Officer (Master Gunner) John Yoshida

3 May 2017



Participants

- **Materials Group**
 - Technical Authorities for small arms and fire control systems
- **Directorate of Land Requirements (DLR)**
 - Small Arms Project Authority
- **Defence Research and Development Canada (DRDC)**
 - Small arms scientists



Involvement and Benefits

- Collaboration
 - DSTL and DRDC
 - Sharing reports to and from other nations
 - Ability to ask questions to a wide audience
 - Most recently – shot counters
- Canadian voice as we update NATO standards



Questions

