INTERNATIONAL INFANTRY & JOINT SERVICES SMALL ARMS SYSTEMS SYMPOSIUM, EXHIBITION & FIRING DEMONSTRATION

"Enhancing Small Arms Effectiveness in Current and Future Operations"

Las Vegas, NV

18 - 21 May 2009

Agenda

TUESDAY, MAY 19, 2009

CONFERENCE KEYNOTE ADDRESS
- Mr. Anthony Melita, OUSD, (Acquisition, Technology, & Logistics) Land Warfare & Munitions

SESSION I- JOINT SERVICE SMALLARMS SYNCHRONIZATION TEAM (JSSAST) - 8501
Session Chair: COL Karl Scott Flynn, Chairman, JSSAST
Panel Members:
- LTC Thomas Henthorn, USA
- Col Patrick Lopardi, USAF
- Col Andrew Bianca, USMC
- CAPT Scott Genovese, USCG
- Mr. Nyle Wilcock, SOCOM
- Mr. Kevin Swenson, Joint Non Lethal Weapons Directorate
- CDR Thomas Gajeweski, USN

KEYNOTE ADDRESS
- Mr. Bill Sanville, PM Non-Standard Ammunition

SESSION II - PM MANEUVER AMMUNITION
- Mr. Chris Grassano, PM MAS

SESSION III - SMALL ARMS AMMUNITION AND TECHNOLOGY
- **8356 - FACTORS INFLUENCING DISPERSION OF SMALL CALIBER AMMUNITION,** Mr. Jeff A. Siewert, Arrow Tech Assoc., Inc.
- **8519 - U.S. ARMY SOLDIER WEAPONS AMMUNITION DEVELOPMENT,** Mr. Robert Zienowicz, U.S. Army, Picatinny Arsenal
- **8512 - ENHANCED FORCED ENTRY - THE RHEINMETALL ARGES 40MM X 46 DOOR BREACHING CARTRIDGE,** Mr. Brian T. Sullivan, American Rheinmetall Munitions, Inc.
- **8524 - U.S. NAVY SMALL ARMS AMMUNITION ADVANCEMENTS**, Mr. Charles Marsh, Mr. Jarod Stoll, NSWC & Mr. David Leis, Federal Cartridge Company
- **8527 - THE M200 HEDP , A NEW GENERATION RIFLE GRENADE,** Mr. Steve Dart, Mecar USA
- **8550 - LIGHTWEIGHT AMMUNITION DESIGN,** Mr. Vincent Battaglia, COLTS DEFENSE LLC & BML Tool & Mfg. Corp

WEDNESDAY, MAY 20, 2009

KEYNOTE SPEAKER
- LTC Thomas Henthorn, U.S. Army

SESSION IV - JSSAP
- **8525 - MODELING AND SIMULATION THROUGHOUT THE SMALL ARMS AQUISITION LIFE CYCLE ,** Mr. Timothy Fargus, U.S. Army ARDEC

- **8513 - MODELING OF GAS FLOW AND HEAT TRANSFER IN SMALL ARMS WEAPON SYSTEMS,** Dr. Laurie A. Florio, U.S. Army ARDEC
- **8514 - ADVANCED SMALL ARMS FIRE CONTROL TECHNOLOGY (ATO),** Mr. Terence F. Rice, U.S. Army ARDEC
- **8537 - ADVANCED SMALL ARMS LETHAL ARMAMENT TECHNOLOGY (ATO),** Mr. Shawn P. Spickert-Fulton, U.S. Army ARDEC
- **8536 - LIGHTWEIGHT SMALL ARMS TECHNOLOGIES**, Mrs. Kori Phillips, JSSAP, U.S. Army ARDEC

SESSION V - SMALL ARMS AS A SUBSYSTEM OF NATO DISMOUNTED SOLDIER SYSTEM OF SYSTEMS PROGRAMMES - 8502

Session Chair: LTC Mike Bodner, Chairman, NATO LCG 1, Directorate of Land Requirements (DLR) Department of National Defence, Government of Canada

- Weapons & Sensors, Per G. Arvidsson, Swedish Defence Materiel Administration
- Swedish Small Arms Programs, Per G. Arvidsson, Swedish Defence Materiel Administration
- Small Arms Replacement Project 2, MAJ B. Gilchrist, DLR 5-5
- Interoperability and Integration of Dismounted Soldier System, MAJ B. Gilchrist
- Powered Rail, Torbjoern Eld, Chairman, Powered Rail Team, NATO

DIVISION REPORT AND ACTIVITY

- Mr. Dave Broden, Chair, Armaments Division; Broden Resource Solutions, LLC

SESSION VI - SOLDIER WEAPONS - (PANEL)

Session Chair: COL Douglas Tamilio, PM Soldier Weapons

THURSDAY, MAY 21 2009

KEYNOTE SPEAKER

- Col Richard Eric Burns, OUSD, Advanced Systems and Concepts, Comparative Testing Office, DoD

LUNCHEON SPEAKER - *"The Modernization and Expansion of Ballistic Test Capabilities at the Lake City Army Ammunition Plant"*, Ms. Stefana Reilly, ATK

SESSION VIII - FIRE CONTROL SYSTEMS

- **8419 - CREW SERVED WEAPONS ACCESSORIES: INTEGRATED TARGETING AND ILLUMINATION**, Mr. Michael H. Jones, NSWC Crane
- **8473- USING 40MM AGL AS A PRECISION WEAPON AT LONG RANGES**, Dr. Daniel Corriveau, Defence R&D Canada
- **8389 - A NEW INTEGRATED DAY AND NIGHT FIRE CONTROL SYSTEM FOR 40MM GRENADE WEAPONS,** Mr. Bill Dunnill, Vectronix, Inc.
- **8539 - RAZAR: RAPID ADAPTABLE ZOOM FOR AUTOMATIC RIFLE**, Dr. Brett E. Bagwell, Sandia National Laboratories

SESSION IX - FIRE CONTROL PANEL - 8556

Session Chair: Mr. John Edwards, U.S. Army ARDEC

- Lennart Ljungfelt, Aimpoint
- Bruce Lerner, Battelle Labs
- Dr. Blaise Canzian, L-3 Communications Brashear
- Torgrim Jorgensen, VINGTEC
- Jim Teetzel, Wilcox Industries

SESSION X - NATIONAL SMALL ARMS CENTER UPDATE - 8479

Session Chair: Frank Puzycki, U.S. Army ARDEC

SESSION XI - WEAPONS

- **8272 - TIME FOR A CHANGE - US "INCREMENTAL" SMALL ARMS FIELDING - STATUS REPORT 2009**, Mr. Jim Schatz, Time4ChangeTeam
- **8478 - M2 BARRELL EXTENSION IMPROVEMENTS**, Mr. Jonathan Piazza, Principal Project Engineer, General Dynamics Armament & Technical Products
- **8583 SHRIKE 5.56 – ADVANCED WEAPONS SYSTEM™** , Mr. Geoffrey A. Herring, President and CEO, Ares Defense Systems, Inc.
- **8423 - ROTARY WING CREW SERVED WEAPON INTEGRATION**, Mr. Nigel Wasil, NSWC Crane
- **8503 - THE 20MM ANTI-MATERIAL RIFLE: A NEW USE FOR UNUSED AMMUNITION**, Mr. David P. Armstrong, NSWC Crane
- **8469 - USSOCOM WEAPON SHOT COUNTER (WSC): PROVIDING MORE THAN ROUND COUNT,** Mr. Jason M. Davis, NSWC Crane
- **8453 - SOUND SUPPRESSOR SPECIFICATION AND SOUND MEASUREMENT**, Mr. Owen Cramer, SAIC/Naval Surface Warfare Center

SESSION XII - 40MM GRENADE IMPROVEMENTS PANEL

Session Chair: Mr. Dave Broden, Broden Resource Solutions, LLC

Panelists: Mr. James Grassi, U.S. Army ARDEC

- Mr. Christopher Summa, U.S. Army ARDEC
- Mr. Adam Sorchini, U.S. Army ARDEC
- Mr. Jason Wasserman, U.S. Army ARDEC

NDIA
National Defense Industrial Association

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INTERNATIONAL INFANTRY & JOINT SERVICES

SMALL ARMS SYSTEMS

SYMPOSIUM, EXHIBITION & FIRING DEMONSTRATION

"Enhancing Small Arms Effectiveness in Current and Future Operations"



MAY 18-21, 2009

BALLY'S LAS VEGAS HOTEL ▸ LAS VEGAS, NEVADA

WWW.NDIA.ORG/MEETINGS/9610

EVENT #9610

OVERVIEW

The International Infantry & Joint Services Small Arms Systems Symposium, Exhibition & Firing Demonstration, "Enhancing Small Arms Effectiveness in Current and Future Operations," will be held at Bally's Las Vegas Hotel in Las Vegas, Nevada, May 18-21, 2009.

This symposium is a premier event where the Small Arms communities come together for technical paper presentations, informational speakers and exhibits of the hardware used by current and future defense organizations. A firing demonstration is scheduled for May 20, 2009 at Nellis Air Force Base, Nevada. The symposium is expected to draw government, industry, law enforcement and international participants, in addition to a strong representation from all branches of the military.

OBJECTIVE

Facing terrorist forces from MOUT to the open battlefield, American forces — both military and law enforcement alike — require the best equipment available. Only through the efforts of government and industry working together on a wide range of technology focus areas will the tools necessary to support our soldiers, sailors, airmen and marines now and in the future be realized. These focus areas range from incremental enhancements to fielded legacy small arms systems to enabling technologies, such as fire control improvements, use of robotics, and digitalization of small arms systems on the battlefield, to name a few. This symposium seeks to bring together government and industry, manufacturers and users to support this objective for the military and law enforcement communities.

PROMOTIONAL PARTNERS

Increase your company or organization's exposure at this premier event by becoming a Promotional Partner! With a Promotional Partnership, you will receive your organization's name on the back cover of the onsite brochure, a 350-word organization description in the onsite brochure, main podium recognition throughout the symposium, signage at all events and a hotlink on the symposium website to your organization's website. For more information, please contact Sam Campagna, NDIA, at (703) 247-2544 or scampagna@ndia.org.



AWARD INFORMATION

CHINN AWARD

The Chinn Award is presented annually to honor a government or industry individual who, in the opinion of the Small Arms Committee Executive Board, has made significant contributions to the field of small arms and/or infantry weapons systems. A significant contribution is considered to be a creative invention, new design or innovative concept in small arms weapons, ammunition or ancillary equipment that provides an advancement in the state-of-the art or capability enhancement that clearly benefits the warfighting or general military capability of the U.S. The Chinn Award may also be conferred as recognition to an individual who has performed sustained superior service in a career field of science, engineering, test and evaluation, manufacturing program management, academic study and research, publishing or maintenance relating to military small arms or infantry weapons.

The Chinn Award is named in honor of LtCol George M. Chinn, USMC, a career Marine who dedicated his life to the study, development and refinement of machine gun mechanisms. LtCol Chinn is remembered for his work as a gun designer and for having compiled a five volume reference work entitled, "The Machine Gun."

HATHCOCK AWARD

The Hathcock Award is presented to recognize an individual who, in the opinion of the Small Arms Committee Executive Board, has made significant contributions in operational employment and tactics of small arms weapons systems which have impacted the readiness and capabilities of the U.S. military or law enforcement. A significant contribution is considered to be a superior performance of duties in an operational environment or the development of tactics or training.

The Hathcock Award is named in honor of Gunnery Sergeant Carlos N. Hathcock, II, USMC, a career Marine who dedicated his life to the service of this country in both the military and law enforcement communities. He was honest, tactful, considerate, courageous, quietly proud and determined in all things and all places from the range to the battlefield. "The Gunny" not only distinguished himself in combat as a scout-sniper, but also as a competitive marksman and trainer. In his capacity as a trainer, he not only significantly impacted the current United States Marine Corps Scout-Sniper Program, but also influenced the sniper programs of the other military services and similar law enforcement programs nationwide.

AMBROSE INDUSTRY AWARD

The Ambrose Award is established and presented periodically to recognize an Industrial Firm which, in the opinion of the Small Arms Committee Executive Board, has made outstanding contributions to the field of small arms systems. An outstanding contribution is characterized by exemplary commitment and contribution to the Armed Forces by delivering superior materiel that meets required operational capabilities and supports a high level of force readiness in the conduct of warfighting activities or homeland defense. Such contributions may be shown through a record of continual demonstration of emerging technologies, development of products and systems, establishment of enhanced production capabilities and integration of innovative weapons systems and supporting products and services required by the DoD and Allied countries. Such contributions would be easily recognized as "excellence" in industry leadership and responsiveness in cases where National security priorities require attention to meet urgent needs in either peace or war time.

The Industry Award is named in honor of former Under Secretary of the Army, James R. Ambrose because of his recognition of the value and contribution of industry in meeting the needs of our National Defense. This was made unmistakably clear during his tenure from 1981-1988 as Under Secretary of the Army during the Presidency of Ronald Reagan. He was a major force in the post Vietnam modernization of all small arms weaponry where new and improved versions of the M16, M249 and M9 were purchased in large quantities as a result of industry competitions. Under Secretary of the Army Ambrose was a strong supporter of investing in the Future Rifle Program, later known as the Advanced Combat Rifle (ACR) Program. His emphasis on the need for competition could not be clearer here, as there were as many as six contractor systems in various phases of the program and 4 firms ultimately participated in the 9-month long ACR Field Experiment, the premier rifle evaluation of all time. For his support of small arms development and procurement and his strong emphasis and actions in involving industry at every step of the way, the NDIA Small Arms Committee believes it entirely appropriate to name this award in his honor.

MONDAY, MAY 18, 2009

12:00 PM - 6:00 PM — **CONFERENCE REGISTRATION**

5:00 PM - 6:00 PM — **RECEPTION IN EXHIBIT HALL**

TUESDAY, MAY 19, 2009

7:00 AM - 7:55 AM — **CONTINENTAL BREAKFAST**

7:00 AM - 6:00 PM — **CONFERENCE REGISTRATION**

7:55 AM — **WELCOME AND ADMINISTRATIVE REMARKS**
- Mr. Sam Campagna, *Director, Operations, NDIA*
- Mr. Brian Berger, *Chairman, Small Arms Committee, Vice President and General Manager, GD-OTS Simunition Operations*

8:10 AM — **CONFERENCE KEYNOTE ADDRESS**
- Mr. Anthony Melita, *OUSD, (Acquisition, Technology, & Logistics) Land Warfare & Munitions*

8:30 AM — **CONFERENCE KEYNOTE ADDRESS**
- Brigadier General Peter N. Fuller, *Program Executive Officer, Program Executive Office (PEO) Soldier*

8:50 AM - 10:10 AM — **SESSION I - JOINT SERVICE SMALL ARMS SYNCHRONIZATION TEAM (JSSAST) - 8501**
- Session Chair: COL Karl Scott Flynn, *Chairman, JSSAST*
- Panel Members:
- LTC Thomas Henthorn, USA
- CAPT Pat Sullivan, USN
- Col Patrick Lopardi, USAF
- Col Andrew Bianca, USMC
- CAPT Scott Genovese, USCG
- COL Kevin Noonan, SOCOM
- COL Douglas Tamilio, PMSW
- Mr. Kevin Swenson, Joint Non Lethal Weapons Directorate

10:10 AM — **BREAK IN EXHIBIT HALL**

10:40 AM — **2009 SMALL ARMS SECTION AWARDS**

Chinn Award
Recipient: Mr. Joel Goldman
Presented by: Mr. Brian Berger

Hathcock Award
Recipient: Mr. R.J. Thomas
Presented by: Mr. Jim Kauber and Mr. Gus Taylor

Ambrose Award
Recipient: Otis Technology, Inc.
Presented by: Mr. Brian Berger and Mr. Charles Buxton

NDIA Professional Service Awards
Recipient: Mr. Hays Parks
Presented by: Mr. Richard Audette

NDIA Professional Service Awards
Recipient: Mr. Volker Kurtz
Presented by: Mr. Jim Schatz and Mr. Charles Buxton

11:20 AM	**PLANS FOR JOINT 2010 GUN & MISSILE AND SMALL ARMS SYSTEMS SYMPOSIUM - Dallas, TX** ▸ Mr. Greg Hill, Director of Marketing, Ordnance Systems Meggitt Defense Systems, Inc.
11:40 AM - 1:10 PM	**LUNCHEON WITH SPEAKER** ▸ Hall Breechloaders: "A long Step From The Beaten Path - 8287 Dr. Stephen C. Small, *JSSAP/ARDEC*
1:10 PM - 1:30 PM	**KEYNOTE ADDRESS** ▸ Mr. Bill Sanville, *PM Non-Standard Ammunition*
1:30 PM - 2:10 PM	**SESSION II - PM MANEUVER AMMUNITION SYSTEMS** ▸ Mr. Chris Grassano, *PM MAS* ▸ Mr. Ben Harris, *Deputy PM Small Calliber*
2:10 PM - 5:00 PM	**SESSION III - SMALL ARMS AMMUNITION AND TECHNOLOGY** ▸ Session Chair: Mr. James Taylor, *ATK*
2:10 PM	**FACTORS INFLUENCING DISPERSION OF SMALL CALIBER AMMUNITION - 8356** ▸ Mr. Jeff A. Siewert, *Arrow Tech Assoc., Inc.*
2:30 PM	**U.S. ARMY SOLDIER WEAPONS AMMUNITION DEVELOPMENT - 8519** ▸ Mr. Robert Zienowicz, *U.S. Army, Picatinny Arsenal*
2:50 PM	**MAKING BULLETS GLOW IN DARK: INVENTING HYBRID ILLUMINESCENT AMMUNITION - 8455** ▸ Dr. William A. Hollerman, *University of Louisiana at Lafayette*
3:10 PM	**ENHANCED FORCED ENTRY - THE RHEINMETALL ARGES 40MM X 46 DOOR BREACHING CARTRIDGE - 8512** ▸ Mr. Brian T. Sullivan, *American Rheinmetall Munitions, Inc.*
3:30 PM	**BREAK IN EXHIBIT HALL**
4:00 PM	**U.S. NAVY SMALL ARMS AMMUNITION ADVANCEMENTS - 8524** ▸ Mr. Charles Marsh, Mr. Jarod Stoll, Mr. Graham Endris, *NSWC* ▸ Mr. David Leis, *Federal Cartridge Company*
4:20 PM	**THE M200 HEDP, A NEW GENERATION RIFLE GRENADE - 8527** ▸ Mr. Steve Dart, *Mecar USA*
4:40 PM	**LIGHTWEIGHT AMMUNITION DESIGN - 8550** ▸ Mr. Vincent Battaglia, *COLTS DEFENSE LLC & BML Tool & Mfg. Corp*
5:00 PM - 6:00 PM	**RECEPTION IN EXHIBIT HALL**

WEDNESDAY, MAY 20, 2009

7:00 AM - 1:30 PM	**CONFERENCE REGISTRATION**
7:00 AM - 7:45 AM	**CONTINENTAL BREAKFAST**
7:45 AM	**ADMINISTRATIVE REMARKS** ▸ Mr. Sam Campagna, *Director, Operations, NDIA* ▸ Mr. Brian Berger, *Chairman, Small Arms Committee; Vice President and General Manager, GD-OTS Simunition Operations*

7:50 AM	**KEYNOTE SPEAKER** ▸ LTC Thomas Henthorn, *US Army*
8:10 AM - 9:50 AM	**SESSION IV - JSSAP** ▸ Session Chair: Mr. Joel Goldman, *JSSAP, ARDEC*
8:10 AM	**MODELING AND SIMULATION THROUGHOUT THE SMALL ARMS AQUISITION LIFE CYCLE - 8525** ▸ Mr. Timothy Fargus, *US Army ARDEC*
8:30 AM	**MODELING OF GAS FLOW AND HEAT TRANSFER IN SMALL ARMS WEAPON SYSTEMS - 8513** ▸ Dr. Laurie A. Florio, *US Army ARDEC*
8:50 AM	**ADVANCED SMALL ARMS FIRE CONTROL TECHNOLOGY (ATO) - 8514** ▸ Mr. Terence F. Rice, *US Army ARDEC*
9:10 AM	**ADVANCED SMALL ARMS LETHAL ARMAMENT TECHNOLOGY (ATO) - 8537** ▸ Mr. Shawn P. Spickert-Fulton, *US Army ARDEC*
9:30 AM	**LIGHTWEIGHT SMALL ARMS TECHNOLOGIES - 8536** ▸ Mrs. Kori Phillips, *JSSAP, US Army ARDEC*
9:50 AM	**BREAK IN EXHIBIT HALL**
10:20 AM	**DIVISION REPORT AND ACTIVITY** ▸ Mr. Dave Broden, Chair, Armaments Division; *Broden Resource Solutions, LLC*
10:40 AM - 12:10 PM	**SESSION V - SMALL ARMS AS A SUBSYSTEM OF NATO DISMOUNTED SOLDIER SYSTEM OF SYSTEMS PROGRAMMES - 8502** ▸ Session Chair: LTC Mike Bodner, *Chairman, NATO LCG 1, Directorate of Land Requirements (DLR) Department of National Defence, Government of Canada*
12:10 PM - 1:40 PM	**SESSION VI - SOLDIER WEAPONS - (PANEL)** ▸ Session Chair: COL Douglas Tamilio, *PM Soldier Weapons* Mr. Richard Audette, *Deputy PM Soldier Weapons* LTC Michael Ascura, *PM Crew Served Weapons* TBD, *PM Individual Weapons*
1:50 PM	**BOARD BUSSES FOR FIRING DEMONSTRATION AT NELLIS AIR FORCE BASE**
3:00 PM - 5:30 PM	**SESSION VII - CONTRACTOR FIRING DEMONSTRATION** ▸ Session Chair: Mr. Sal Fanelli, *US Marine Corps*
4:30 PM	**FIRST BUS RETURNS TO HOTEL**
5:45 PM	**LAST BUS RETURNS TO HOTEL**

THURSDAY, MAY 21, 2009

7:00 AM - 4:00 PM	**CONFERENCE REGISTRATION**
7:00 AM - 7:30 AM	**CONTINENTAL BREAKFAST**
7:30 AM	**CALL TO ORDER AND REMARKS** ▸ Mr. Sam Campagna, *Director, Operations, NDIA* ▸ Mr. Brian Berger, *Chairman, Small Arms Committee; Vice President and General Manager GD-OTS Simunition Operations*
7:40 AM	**KEYNOTE SPEAKER** ▸ Col Richard Eric Burns, *OUSD, Advanced Systems and Concepts, Comparative Testing Office, DoD*
8:00 AM - 9:40 AM	**SESSION VIII - FIRE CONTROL SYSTEMS** ▸ Session Chair: Mr. John Edwards, *ARDEC*
8:00 AM	**CREW SERVED WEAPONS ACCESSORIES: INTEGRATED TARGETING AND ILLUMINATION - 8419** ▸ Mr. Michael H. Jones, *NSWC Crane*
8:20 AM	**USING 40MM AGL AS A PRECISION WEAPON AT LONG RANGES - 8473** ▸ Dr. Daniel Corriveau, *Defence R&D Canada*
8:40 AM	**CONTROL AND GUIDANCE OF 40MM SPIN STABILIZED PROJECTILES - 8517** ▸ Dr. Tomas Svitek, *Stellar Exploration*
9:00 AM	**A NEW INTEGRATED DAY AND NIGHT FIRE CONTROL SYSTEM FOR 40MM GRENADE WEAPONS - 8389** ▸ Mr. Bill Dunnill, *Vectronix, Inc.*
9:20 AM	**RAZAR: RAPID ADAPTABLE ZOOM FOR AUTOMATIC RIFLE - 8539** ▸ Dr. Brett E. Bagwell, *Sandia National Laboratories*
9:40 AM	**BREAK IN FOYER**
10:10 AM - 11:10 AM	**SESSION IX - FIRE CONTROL PANEL - 8556** ▸ Session Chair: Mr. John Edwards, *ARDEC*
11:10 AM - 11:25 AM	**SESSION X - NATIONAL SMALL ARMS CENTER UPDATE - 8479** ▸ Session Chair: Frank Puzycki, *ARDEC* ▸ Mr. Karl Lewis, *Lewis Machine & Tool Company*
11:25 AM - 11:40 AM	**LIGHTWEIGHT SMALL CALIBER AMMUNITION - UPDATE** ▸ Mr George Feghali, *General Dynamics OTS Canada*
11:40 AM - 3:10 PM	**SESSION XI - WEAPONS** ▸ Session Chair: Mr. Jeffrey D. Johnson, *NSWC Crane*

11:40 AM

TIME FOR A CHANGE - US "INCREMENTAL" SMALL ARMS FIELDING - STATUS REPORT 2009 - 8272
- Mr. Jim Schatz, *Time4ChangeTeam*

12:10 AM

M2 BARRELL EXTENSION IMPROVEMENTS - 8478
- Mr. Jonathan Piazza, *Principal Project Engineer, General Dynamics Armament & Technical Products*

12:30 PM - 1:30 PM

LUNCHEON WITH SPEAKER
- The Modernization and Expansion of Ballistic Test Capabilities at the Lake City Army Ammunition Plant
  Ms. Stefana Reilly, *ATK*

1:30 PM

SHRIKE 5.56 – ADVANCED WEAPONS SYSTEM™ - 8583
- Mr. Geoffrey A. Herring, *President and CEO, Ares Defense Systems, Inc.*

1:50 PM

ROTARY WING CREW SERVED WEAPON INTEGRATION - 8423
- Mr. Nigel Wasil, *NSWC Crane*

2:10 PM

THE 20MM ANTI-MATERIAL RIFLE: A NEW USE FOR UNUSED AMMUNITION - 8503
- Mr. David P. Armstrong, *NSWC Crane*

2:30 PM

USSOCOM WEAPON SHOT COUNTER (WSC): PROVIDING MORE THAN ROUND COUNT - 8469
- Mr. Jason M. Davis, *NSWC Crane*

2:50 PM

SOUND SUPPRESSOR SPECIFICATION AND SOUND MEASUREMENT - 8453
- Mr. Owen Cramer, *SAIC/Naval Surface Warfare Center*

3:10 PM

SESSION XII - 40MM GRENADE IMPROVEMENTS PANEL
- Session Chair: Mr. Dave Broden, *Broden Resource Solutions, LLC*
- Mr. James Grassi, *ARDEC*
- Mr. Christopher Summa, *ARDEC*
- Mr. Adam Sorchini, *ARDEC*
- Mr. Jason Wasserman, *ARDEC*

3:50 PM

CLOSING REMARKS
- Mr. Sam Campagna, *Director, Operations, NDIA*
- Mr. Brian Berger, *Chairman, Small Arms Committee, Vice President and General Manager, GD-OTS Simunition Operations*

REGISTRATION

Register online by visiting the symposium website at www.ndia.org/meetings/9610. Online registration will close at 5pm EST on May 8, 2009. You must register onsite after this date. You may also fax the registration form to (703) 522-1885 or mail to National Defense Industrial Association, Event #9610, 2111 Wilson Boulevard, Suite 400, Arlington, VA 22201. Payment must be made at the time of registration, and registrations will not be taken over the phone. In order for your name to appear in the onsite attendee roster, you must register for the symposium by May 8, 2009.

	Early	Regular	Late/Onsite
	Before 04/07/09	04/08/09 - 05/08/09	After 05/08/09
Government/ Academia	$680	$750	$825
Industry NDIA Member and Affiliates	$780	$860	$950
Industry non-NDIA Member	$830	$915	$1010

CANCELLATIONS

Cancellations received by April 7, 2009 will receive a full refund. Cancellations received between April 8, 2009 and May 8, 2009 will receive a refund minus a $75 cancellation fee. Please note that no refunds will be given for cancellations received after May 8, 2009. Substitutions are welcome in lieu of cancellations. Cancellations and substitutions must be made in writing to eagnew@ndia.org

ATTIRE

Appropriate dress for this symposium is business casual for civilians and Class B uniform or uniform of the day for military personnel.

LODGING

A block of rooms has been reserved at Bally's Las Vegas Hotel. To make your reservation, please call the hotel directly. In order to ensure the discounted NDIA rate, you must make your reservations early and ask for the "NDIA Small Arms" room block.

Bally's Las Vegas Hotel
3645 Las Vegas Blvd. S
Las Vegas, NV 89109
Tel: (702) 967-4111

Government Rate: $126.00* (Single/Double)
Industry Rate: $149.00 (Single/Double)

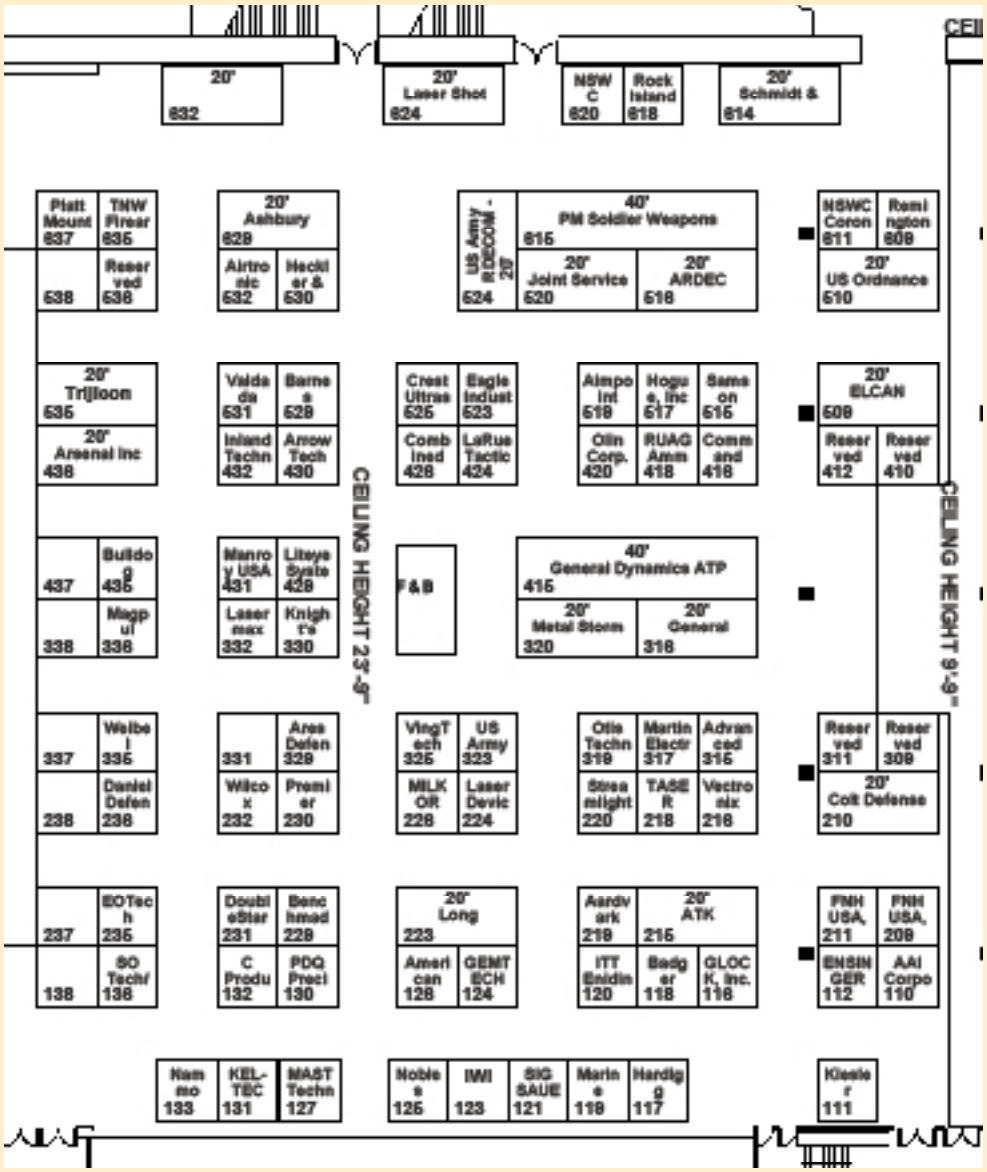
**Or the prevailing government per diem. The government per diem rate is available only to active duty or civilian government employees. ID will be required upon check-in. Retired military IDs do not qualify.*

EXHIBITS

NDIA invites you to exhibit at the International Infantry & Joint Services Small Arms Systems Symposium, Exhibition & Firing Demonstration at the Bally's Las Vegas Hotel in Las Vegas, NV. This is an excellent forum for the Small Arms community to display first-class hardware used by current and future defense organizations! Suppliers involved in the areas of training, modeling and simulation technologies, makers of small arms, ammunition and body armor are welcome to exhibit.

Cost to Exhibit:
NDIA Corporate Members*: $24.00/sq. ft.
Non-member: $29.00/sq. ft.
*rate applies to government agencies

For more exhibit information please visit the exhibits webpage at: www.ndia.org/exhibits/9610. For questions, contact Dennis Tharp, Exhibits Manager, at (703)247-2584 or via email at dtharp@ndia.org.



EVENT #9610 ▸ NDIA REGISTRATION FORM

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SMALL ARMS SYSTEMS SYMPOSIUM & EXHIBITION
BALLY'S LAS VEGAS ▸ LAS VEGAS, NV ▸ MAY 18-21, 2009

3 WAYS TO SIGN UP:

1. **Online with a credit card at www.ndia.org**
2. **By fax with a credit card - Fax: (703) 522-1885**
3. **By mail with a check or credit card**

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CONFERENCE REGISTRATION FEES

	Early *(Through 4/7)*	Regular *(4/8-5/8)*	Late *(5/9 and later)*
Government / Academia[1]	☐$680	☐$750	☐$825
Industry NDIA Member and Affiliates (AFEI, NTSA, PSA, WID)	☐$780	☐$860	☐$950
Industry Non-NDIA Member[2]	☐$830	☐$915	☐$1010

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[1] *Includes a free three-year NDIA membership and subscription to* National Defense *magazine for military and government employees.*

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Signature _____ Date _____

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PRIMARY OCCUPATIONAL CLASSIFICATION. Check ONE.
- ▷ Defense Business/Industry
- ▷ R&D/Laboratories
- ▷ Army
- ▷ Navy
- ▷ Air Force
- ▷ Marine Corps
- ▷ Coast Guard
- ▷ DOD/MOD Civilian
- ▷ Government Civilian (Non-DOD/MOD)
- ▷ Trade/Professional Assn.
- ▷ Educator/Academia
- ▷ Professional Services
- ▷ Non-Defense Business
- ▷ Other _____

CURRENT JOB/TITLE/POSITION.
Check ONE.
- ▷ Senior Executive
- ▷ Executive
- ▷ Manager
- ▷ Engineer/Scientist
- ▷ Professor/Instructor/Librarian
- ▷ Ambassador/Attaché
- ▷ Legislator/Legislative Aide
- ▷ General/Admiral
- ▷ Colonel/Navy Captain
- ▷ Lieutenant Colonel/Commander/ Major/Lieutenant Commander
- ▷ Captain/Lieutenant/Ensign
- ▷ Enlisted Military
- ▷ Other _____

Year of birth _____
(optional)

FOR QUESTIONS, PLEASE CONTACT:

KELLY SEYMOUR
MEETING PLANNER

PHONE: (703) 247-2583

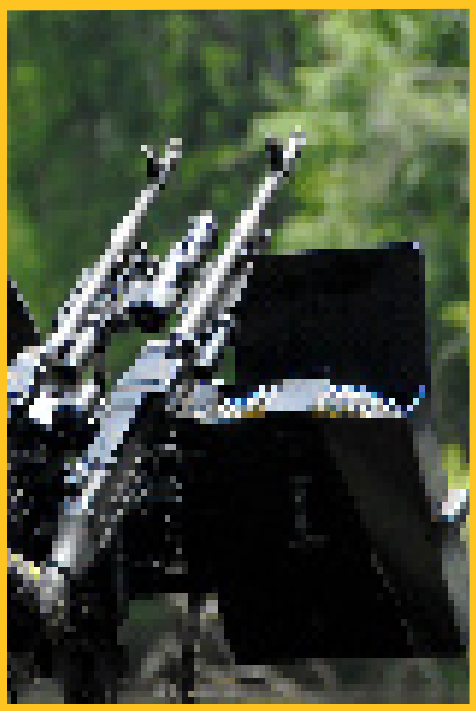
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SUITE 400
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ARLINGTON, VA 22201-3061
(703) 247-2566
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INTERNATIONAL INFANTRY & JOINT SERVICES

SMALL ARMS SYSTEMS

SYMPOSIUM, EXHIBITION
& FIRING DEMONSTRATION

TO REGISTER, VISIT:
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NDIA
Armaments Division
2009
Activity and Status Report

Small Arms Systems Committee

18-21 May 2009
Bally's Las Vegas Hotel
Las Vegas, Nevada

Armament Division

Dave Broden --Chairman

Broden Resource Solutions LLC

National Defense Industrial Association

Vision

America's leading Defense Industry association promoting National Security

Mission

ADVOCATE: **Cutting-edge technology and superior weapons, equipment, training, and support for the War-Fighter and First Responder**

PROMOTE: **A vigorous, responsive, Government - Industry National Security Team**

PROVIDE: **A forum for exchange of information between Industry and Government on National Security issues**

"If I were inviting a colleague to join, I'd say the most compelling reason is the prestige of NDIA membership." *-- NDIA member*

AFEI nsa PSA WIDS

Armament Division

- **Committees:**
  - **Gun and Missile Systems**
  - **Small Arms Systems**
- **Division/Committee Leadership:**
  - **Armament Division:** **Dave Broden--Chair**
    Broden Resource Solutions LLC
  - **Gun and Missile Systems:** **Brian Tasson**
    ATK-Mission Systems
  - **Small Arms Systems:** **Brian Berger**
    GD-OTS-Canada

NDIA Armaments Division Scope

Armament Division Committees and Related Scope:

- **Gun and Missile Systems**
  - Integrated Armament/Weapon Systems
  - Direct and Indirect Fire Weapon Systems
    - Cannon Caliber (Weapons and Ammo)
      - Vehicle, Helicopter, Aircraft etc.
    - Tank Cannons and Ammunition
    - Artillery/Mortar (Weapons and Ammo)
    - Shipboard Cannons (Weapons and Ammo)
  - Tactical Missiles
  - Integration Systems (Fire Control etc.)
  - Platform Interface and Integration
  - Training Systems

- **Small Arms Systems**
  - Integrated Small Arms Systems
  - Individual Weapons
  - Crew Served Weapons
  - Ammunition
  - Fire Control
  - Training Systems

Armament Division
Conference Themes 2009

- **Gun and Missile Systems:**
  - **Shaping the Future in Weapon Systems Development, Deployment and Reset**

- **Small Arms Systems:**
  - **Enhancing Small Arms Effectiveness in Current and Future Operations**

- **Theme Purpose and Focus:**
  - **Relevant to DOD Thrusts/Trends**
  - **Linked to Programs and Technology**
  - **Strengthening Government and Industry Partnership**
  - **Confirming Innovative Industry Response to:**
    - **Evolving Needs**
    - **Ensuring Readiness**

National Defense Industrial Association

Armament Division
Joint Conference Theme 2010

• **Joint Theme:** 21st Century Weapon Systems--
--Providing the Right Response

Committee Focus Themes

• **Gun and Missile Systems:**
  • Precision and Lethality in Medium and Large Caliber Systems

• **Small Arms Systems:**
  • Technology and Systems Sustaining and Evolving Small Arms Capability

Linking Armament Community Personnel, Systems, and Technology
• Leveraging Commonality--- Enabling Capability
• Ensuring Readiness

Armament Division
2010 Joint Conference Objectives

- A ***Single Common Conference*** for the Entire Armament Community
  - Government
  - Industry

- Discussion of Key Armament Policy, Requirements, Technology, Systems And Industrial Base Topics ***Relevant to Both Committees***

- ***Expanded Networking*** Opportunities

- ***Leveraging of Common*** Technology, Subsystems, Components, Processes, and Capabilities

- Conference Synergism ***Efficiencies***
  - Travel Once vs. Twice for Many Attendees--Economies

- ***Flexibility of Session Attendance*** (Move from one to another)
  - Expand Awareness of Technology and Systems

NDIA Plans --Repeat Every Three Years

National Defense Industrial Association

Armament Division

2010 Joint Conference Opportunities

- Expanded ***Networking*** Among Government and Industry

- ***Exhibits*** Addressing Technology, Systems, and Services Applied in Both Gun and Missile Systems and Small Arms Systems

- ***Expanded*** Scope and Variety of ***Presentations***

- Opportunities for ***"Poster" Session Presentation***--Expanding the Number And Format of Presentations

- Committee Goal: Larger and Broader Group of Attendees---
  - Opportunity for ***Focus on Keynote Speakers*** etc.

- Program Format Enabling Attendee ***Dialogue*** with Key Speakers Panels and Forums

- ***Expanded Firing Demo***--Technology and Systems Beyond Small Arms

Committee Welcomes Suggestions for Topics And Format Which Add Value and Opportunity

National Defense Industrial Association

Armament Division
2010 Joint Conference Benefits

- **Armament Community Communications**
- **Networking**
- **Single Conference Integrating Armament Companies, Resources, Capabilities, and Personnel**
- **Enabling Opportunities (New Programs, Partnerships, Cooperation)**
- **Awareness of Innovation in Technology and Services**
- **Communications and Understanding of Evolving DOD Trends, Thrusts, Budgets, Program Guidelines etc.**
- **Impact Discussions Regarding Industrial Base "Soft Landing"**

Armament Division
2009 Activity Highlights

- Conference Interest, Participation, and Attendance Strong in Economic Change
- Strategic Initiative Actions Focused to "Continuous Improvements"
  - Program Content
  - Keynote Speakers
  - Joint Programs (Linking Divisions/Committees/Topics)
- Science, Technology, Engineering, and Mathematics (STEM)--Human Capital Objectives--Confirmed in Member Companies
- Attention to Education and Training at Conferences
- Membership Attention to NDIA "Top Issues"
  - "Input--Impact--Results"
- Input to Industrial College of Armed Forces Re: Industry Perspective

Armament Division
2009 Activity Highlights

- Small Arms Systems Membership Supporting OSD Small Arms Study
  - Internal DOD Assessment
  - Industry Comments and Assessment
- Plans for Future Conference Collaboration
- Discussion of DOD Study Support
- Executive Committee Operation Improvements
- Conference Participation Opportunities Initiatives
  - Updated Call for Papers
  - Panels
  - Joint Conferences
  - Poster Sessions
  - Member Initiatives

- Ensuring "Value Added" Addressing Attendee and Member Interests
- Executive Committee Actions

Armament Division

2009 Strategic Thrust Initiatives

- **Continue Strategic Focus Thrusts--*"Continuous Improvement"***

- **Conference Content, Format, and Presentation *Quality Improvements***

- ***Executive Committee Operation and Membership***
  - **Active Participation**
  - **Uniformed Membership**

- **Seeking *DOD "Value Added Study"* Initiatives**
  - **Ensuring Member Participation**
  - **Completing Objectives**

- ***Expand Joint and Shared Conference Agendas*** **with Other NDIA Committees/Divisions**

- **Strengthen *Industry Conference Participation***
  - **Keynotes**
  - **Panels**
  - **Presentations**
  - **Exhibits**

Armament Division

2009 Strategic Thrust Initiatives

- **Conferences and Agendas Focused to Enabling Opportunities Which Ensure Continued Strength thru Innovation, Application of Resources, and Personnel during Economic Adjustment**
  - ***Provide for Capability Superiority and National Defense Readiness***

- **Ensure *"Life Cycle System and Technology Focus*" in all Conferences**

- **Communicate and Support *Industrial Base "Soft Landing"* Capabilities**

- **Membership *Engagement in STEM Initiatives and Division***
  - **Education**
  - **Mentoring**

- **Increased Active Input and Links to *"Top Issues"***

- **Seek Expanded On-Going *Member/Attendee Input and Impact***
  - **Direct to Committees/Division**
  - **Via Chapter Interface**

Armament Division
Response to DOD Adjustments

- Conferences and Agendas Addressing Adjustments
  - National Defense Objectives
  - Budget Trends
  - Procurement Changes
  - Special Topic Conferences where Appropriate
- Ensuring Member Interests--Topics--Issues are Addressed
- "Top Issue" Input and Impact
- Effective Communication
  - National Defense Magazine
  - Website
  - Chapter Meetings
  - Armament Division Feedback

Communicate and Inform Members
Respond to Challenges

Armament Division
Attendee Support and Input

- Comments and Suggestions Regarding Conference Program
  - Locations
  - Content and Format
  - Format--Single vs. Concurrent Sessions
  - Exhibits
  - Presentations, Keynotes, Panels etc.

- 2010 Joint Conference Focus Topics and Activities
  - Topics
  - Format

- "Top Issue" Topics Benefiting Industry and Government

- Strengthening Networking

- Highlighting Topics to be Included

Member Input Ensures Responsive "Value Added" Conferences

Human Capital Status, Development and Utilization

• **Objective: Ensure the Human Capital Resources are Available, And Have the Skills and Subject Matter Expertise to Support Armament System Technology, Development, and Production**

1. **Support for *STEM Initiatives* in Education and in Industry**

2. ***Manufacturing Personnel Training* Including Tool Design and Machine Operators**

3. **Enable *Expanded Mentoring* and Links of Senior Subject Matter Expertise(SME's) with Entering Employees--Need to Build Armament Engineering and Manufacturing Capability by Mentoring etc.**
   - ***NDIA STEM Division--Organized to Focus on Manpower Readiness***

4. **Provide for Challenging and Innovative Jobs and Tasks**

Human Capital Status, Development and Utilization

- Opportunities for NDIA Members:
  - Expand Activity in STEM Initiatives
    - Within Companies
    - In Communities
    - With NDIA
  - NDIA Conferences Regarding Workforce etc.
    - Manufacturing Workforce Symposium
    - 16-17 June 2009
    - Crown Plaza-O'Hare Airport
    - Chicago
  - Top Issue Focus and Actions

Recommend Participation And Support

NDIA Top Issue Topics 2009

- **NDIA Top Issue Objectives:** Guide Association's Advocacy and Educational Activities Throughout Each Year

- **Top Issue Focus Approach:** Broad Topics --Essential to Maintaining Strong Viable Defense Industry Capable of Meeting US National Security Requirements

- **Developed by:** Senior NDIA Industry Leadership--Approved by Board of Directors
  - Input from Divisions and Committees-- *Opportunity for Impact*

- **Distributed to:** Congress, Key Decision Makers with Executive Branch, Allied Governments, Industry Leaders, and Association Membership.

→ *Consideration of Topics and Action by Appropriate Government Officials*

Armament Division

"Top Issue Topics"--Member Input

- **Participation in Identifying and Developing Annual "Top Issues":**
  - **Attendees/Members Indentify Issue Topics**
  - **Executive Committee Submit Topic, Rationale, and Benefits to Legislative Affairs Committee**

- **"Top Issue" Communication to Members**
  - **"Top Issue" Annual Document**
  - **Conference And Symposium Briefings Updates**
  - **National Defense Magazine**
  - **NDIA Website**

- **"Top Issue"--Action Impact Awareness**
  - **To Policy**
  - **To Programs**
  - **To Procurement (Contract Type, FAR etc.)**
  - **To Regulations (e.g. ITAR, FAR, etc.)**
  - **Small Business**
  - **"Soft Landing"**

Issue 1:
Improve The Workforce Advantage To Ensure US National Security

- **Strengthen Science, Technology, Engineering, and Math (STEM) Educational Opportunities for US Citizens**

- **Improve Education, Training, and Retention of the Federal Acquisition Workforce**

- **Relieve Industrial Security Clearance Backlog And Ensure Timely Processing of Industrial Security Clearances**

Issue 2:
Maintain A Responsive and Capable Defense Industrial Base

- **Develop and Implement Advanced Manufacturing Technology**

- **Attract And Retain a Skilled Manufacturing Workforce**

- **Modernize Defense Manufacturing Facilities**

- **Environmental Protection**

- **Increase Funding for Ground Robotics Research , Development, and Engineering**

Issue 3:
Ensure The Integrity and Responsiveness of the Acquisition Process

- **Support Existing Laws and Regulations Concerning Contractor Voluntary Disclosure**

- **Contractor Ethical Conduct**

- **Ensure The Government Has Full Access to Commercial Products and Services**

- **Ensure The Integrity and Accessibility of the Interagency Contracting Process**

Issue 4:
Increase Government Contract Usage of All Small Businesses

- The Role of Women Owned Small Businesses

- Support Legislative Reforms to Increase Women Owned Small Business Access to All Industry Categories

- Improve Intellectual Property Protection for Small Business

- Permanently Reauthorize the Small Business Innovative Research Program (SBIR)

- Repeal the Three Percent Withholding on All Government Contracts

- Create Benefit Parity for Service Disabled Veteran Owned Small Businesses (SDVOSB)

Issue 5:
Sustaining Military Readiness While Providing For the Future

- **Increase Funding for Modeling and Simulation (M&S) Research, Development, and Procurement**

- **Evolve Enterprise Information Environments and Security**

- **Enhance Readiness: Training, Simulations, and Education**

- **Partner with Industry In Efforts to Streamline Policies, Programs, and Business Practices Relative to Transformation**

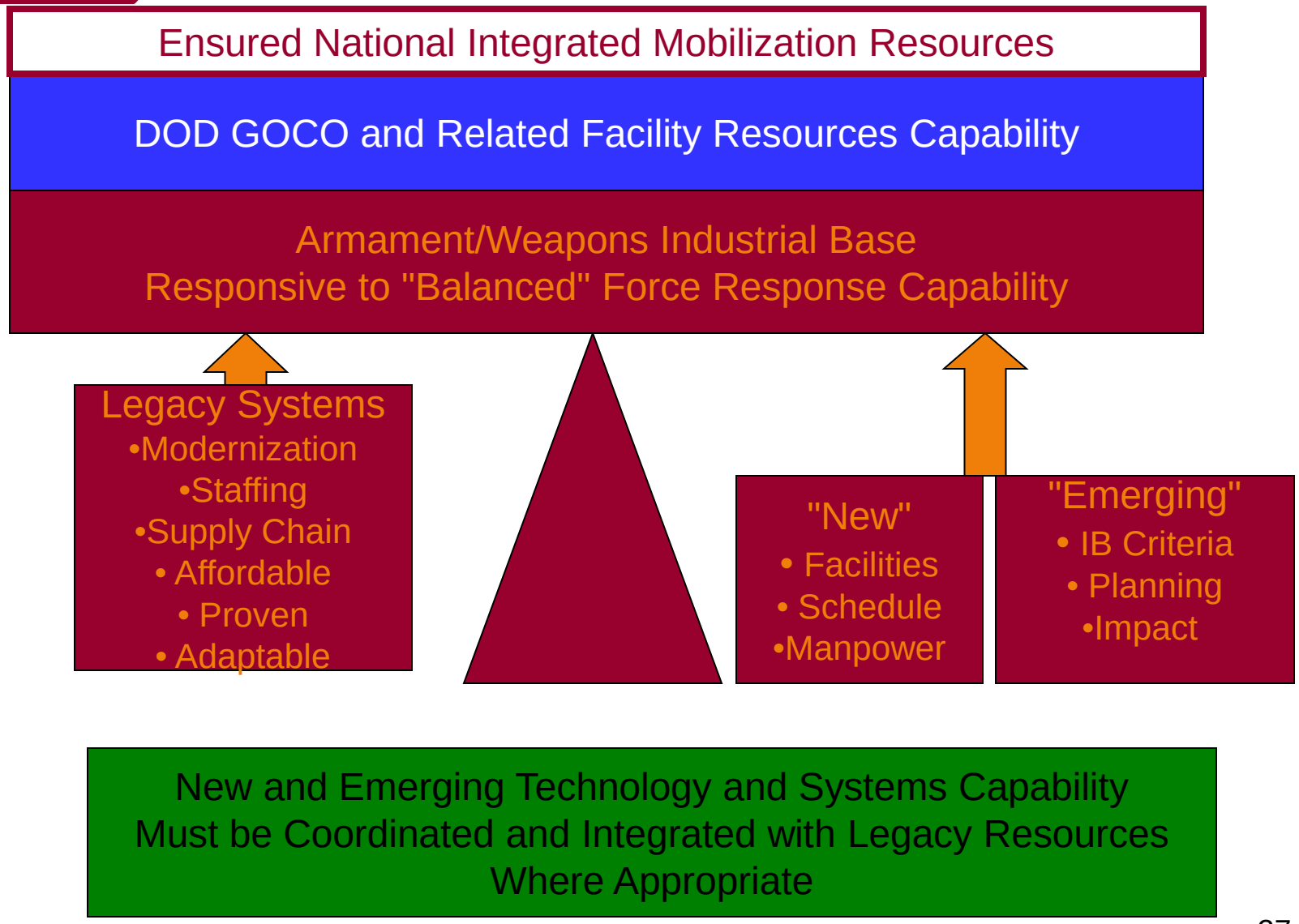
Issue 6:
Ensure International Competitiveness of US Defense Industrial Base

- **ITAR Broker Registration/Requirements of ITAR Part 129 for Foreign Nationals**
- **United States Army Security Assistance Command**
- **Support the Coalition for Security and Competitiveness**
- **Reinforce U.K. And Australian Defense Cooperation Treaties**
- **Supplement or Revise The Foreign Assistance Act and Export Controls Act**
- **Train and Equip Foreign Partners in The Global War on Terrorism**

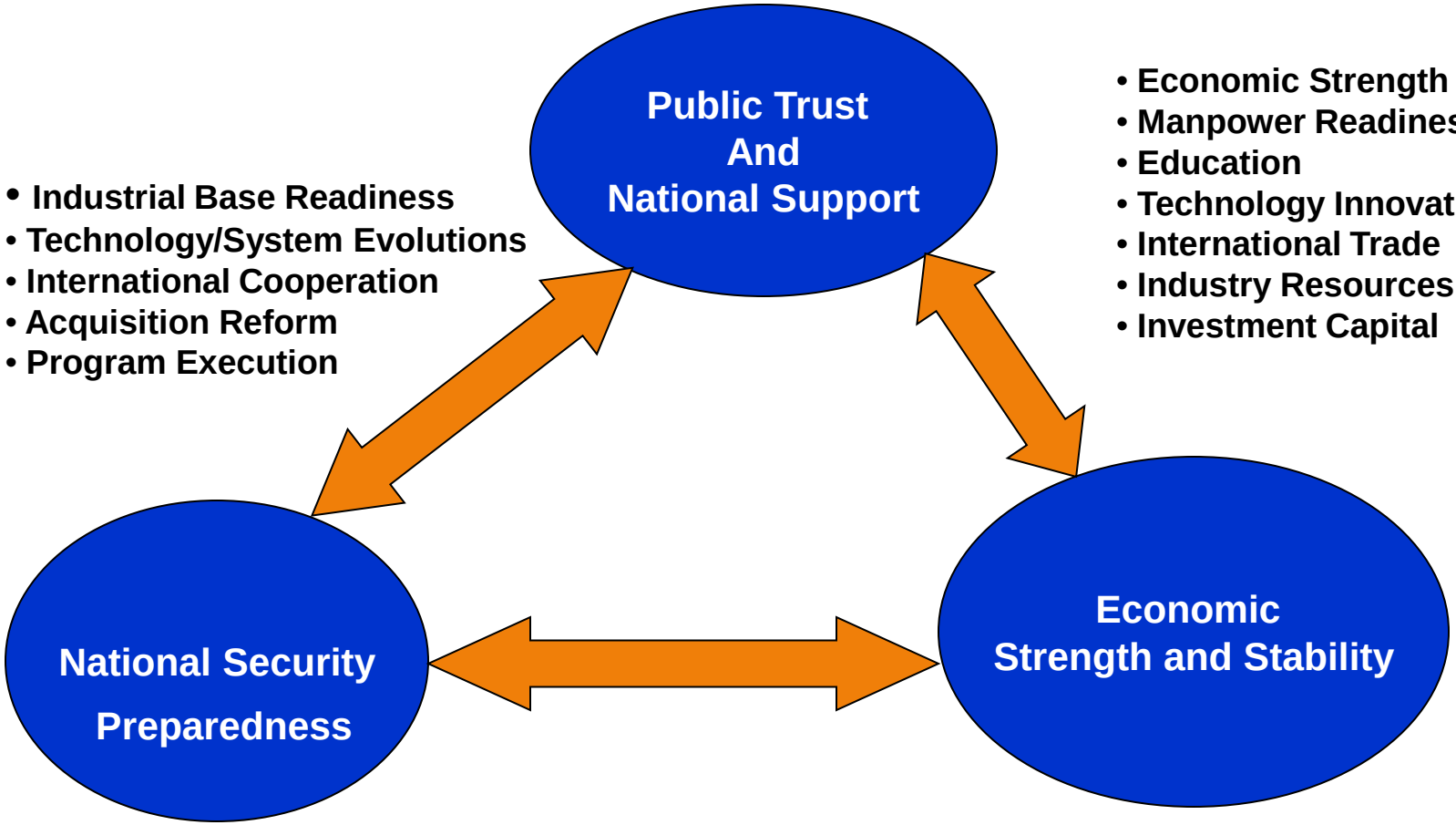
Issue 6:
Ensure International Competitiveness of US Defense Industrial Base

- **Expand Section 506 Draw Down Authority**
- **Increase Congressional Notification Threshold**
- **Establish Defense Coalition Support Account**
- **Support the Blue-Lantern-Golden Sentry Education Program**
- **Improve Defense Technology Transfers Among US Partners and Allies**
- **Resolve Dual National Issues While Protecting US Interests.**

Evolving Industrial Base Vision



Readiness Assured Integrity="Soft Landing"



Linking "Stakeholders" for National Security Readiness Enables a Responsive, Innovative, and Evolving Industrial Base Capability

Armament Division
2009 Challenges

- ***Maintaining Armament Division Strength*** **Thru Active Participation During Economic Adjust**

- **Structuring Conferences With *Topics Focused and Relevant* to DOD Adjustments and Plans Related to Industrial Base "Soft Landing"**

- **Establishing Industry Response to: *"Balanced Capability and Assured Readiness--"*Balancing Legacy with Evolving and New Capability"**

- **Strengthening *Partnerships***
  - **Government and Industry**
  - **US and International Community**

- **Ensuring that Conferences Integrate *Innovative and Visionary* Capability Complementing Legacy Resources**

- **Membership/Attendee Participation in *"Top Issues"***

Armament Division Leadership Vision

- A ***Relevant Voice and Forum-***--Enabling Government/Industry Impact to Issues/Topics

- NDIA Mission Statements Shape Armament Division--***Strategic Focus***

- A ***Forum for Response to DOD and Industry Challenges***

- A Forum Enabling ***Response to "Lessons Learned" and Evolving Needs***

- Supporting National Defense through ***People, Resources, Networking, and Conferences.***

- ***Transforming to Ensure Relevance*** to Changing Military, Geopolitical, Technology, Systems and Industrial Base Capabilities

NDIA is Resource of Choice for Excellence and Leadership National Defense Topics/Communications

Armament Division
Seeking Conference Attendee Suggestions/Recommendations

- **Armament Division Leadership is Committed to Quality, "Value Added" Conferences that Are Responsive to Attendee Interests**
- **Attendee Suggestions are Welcomed throughout the Year**
- **Response to NDIA Conference Questionnaire**
- **Comments to Leadership (Discussions, email, telecom etc.)**
- **Comments Regarding: Conference Location, Length, Format, Speaker Topics, Presentation Topics, Presentation Approach, Panels, Exhibits, Poster Sessions, Demos, New Approaches, etc.**

Continuous Improvement Strengthens Network Communications And Enables Innovation In Technology and Systems--Building Preparedness and Readiness Response

Armament Division
Take-Away Thoughts

- NDIA ***Mission is Focused*** to Strength, Responsiveness, Readiness, and Human Resources

- NDIA Strategic Focus Committed to Continuous Improvement------
  - ***"Value Added", Responsive, Adaptable, and Impacting Issues, and Ensuring Resources and Skilled Human Capital***

- ***Collaboration and Joint Conference Activity*** Offers Efficiency and Expanded Scope and Depth Available to Members

- ***Member/Attendee Input/Interests*** is Key Conference Planning Focus

- NDIA Conferences, Communications, and ***Networking Enables Adaptability*** During DOD and Economic Adjustment

- ***Training and Education*** Segment Increases Awareness of Trends and New DOD Program, Budgeting, and Contract Initiatives

Summary-Wrap Up

- ***Armament/Weapons Industrial Base*** **has an Strong, Responsive and Proven Structure and Capability**

- ***"New" and "Emerging" Technologies and Systems*** **Must be Integrated into Industrial Base on Timely and Effective Basis**

- **Industrial *"Soft Landing"* Focus is Critical to Maintaining Readiness for a *"Balanced"* Capability of Legacy and "New"**

- ***International Cooperation*** **has been a key element of Armament/Weapons Capability--Cooperation and International Sales Opportunities must be Maintained.--** ***Industry Supports and Encourages Trade.***

- **Acquisition and Program Management Topics Must Continue to be a Focus--*Contract Reform, JCIDS, Execution, Collaboration etc.***

- ***Manpower Resources*** **for Must Evolve to Support Industrial Base--*STEM***

- ***Innovation*** **Must be a Central Theme in Industrial Base and Government Activities.**

- ***Economic Conditions*** **must not divert National Security Preparedness--Enabler for Economic Recovery**

Weapons Comparative Testing

NDIA International Infantry and Small Arms Systems Symposium

May 2009



Col. Eric Burns

Director

Comparative Testing Office (CTO)

Office of the Deputy Under Secretary of Defense (Advanced System & Concepts)

Email: richard.burns@osd.mil

Website: www.acq.osd.mil/cto

Phone: (703) 602-3740

Overview

- **Defense Acquisition Challenge (DAC) and Foreign Comparative Testing (FCT) Overview**
- **Projects**
  - **Training, Weapons, Ammo, Enablers**
- **Items of interest**
  - **Training, Weapons, Ammo, Enablers**
- **Summary**

What We Do

Fund Testing of World-Class Items that Solve Warfighter's Problems

- **Find & Test "Here & Now" Solutions**
  - Projects begin within a year, end within 2 years (ammo 3 yrs.)
  - Testing at U.S. or foreign ranges
  - Project value: Range of $200K - $2M; average of $800K
- **OSD Selects & Funds Projects**
  - Clear Goal: "Test to Procure"
- **Services & USSOCOM Execute Our Programs**
  - Nominate & prioritize their projects
  - Service/USSOCOM Program Managers manage the tests

DAC – Testing Innovative Products for the Warfighter

The FY 2003 National Defense Authorization Act directed the Defense Acquisition Challenge Program to provide opportunity for:

- **"Increased introduction of innovative and cost-saving technologies into current acquisition programs of the DoD"**
- **"Any person or activity within or outside the DoD to**
  - **Propose alternatives, to be known as challenge proposals at the component, subsystem, or system level of an existing DoD acquisition program ...**
  - **that results in improvements in performance, affordability, manufacturability, or operational capability of that acquisition program"**
- **Focus on mature technologies ... TRL 7-9!**

DAC Metrics

Since Program Inception (FY 2003)

- Over 1975 proposals submitted
- 445 proposals endorsed / supported by Service/USSOCOM Programs
- 119 projects awarded, $196M invested (2003-2009)

Results: 60 projects completed to date

- 35 projects have procurements totaling $364M
- 22 projects have yielded capabilities currently deployed to our warfighters
- 5-to-1 average ROI based on cost avoidance (RDT&E, Procurement, Operations & Support)
- 60% of Projects awarded to Small or Mid Sized Businesses
- 26% of Projects Awarded to Companies indicating “First Time Participation” with DoD

FCT – Testing Coalition Products for the Warfighter

Established in 1980 by 10 USC, Section 2350a(g), to determine ability of NATO & friendly foreign countries to satisfy U.S. requirements or operational deficiencies

- **Authorizes side-by-side testing of - -**
  - **Foreign Non-developmental, or**
  - **Commercial Off-the-Shelf Equipment**
- **DoDI 5000.02 (Integrated Test & Evaluation)-**
  - **Testing of allied & friendly foreign countries' equipment**
  - **"The USD(AT&L) shall centrally manage FCT ..."**
- **Focus on mature technologies ... TRL 7-9!**

Global Defense Industry

- Only 46 of the top 100 defense contractors, by revenues, are U.S. companies
- 24 of the top 50 defense contractors are foreign
- 3 of the top 10 defense contractors are foreign
  - #3: BAE Systems (United Kingdom)
  - #7: EADS (Netherlands)
  - #9: Finmeccanica (Italy)
- But 86% of the proposals we receive represent foreign contractors smaller than the top 100

FCT Metrics

Over Last 29 Years



601 Projects Started, 514 Completed

279 Projects Met Service Requirements

200 Projects - Procurements Worth $9.0B

- Tested Products from 28 Countries
- OSD Investment: $1.17 Billion (constant FY09 $)
- Estimated RDT&E Cost Avoidance: $7.58 Billion
- Accelerated Fielding Averages 5-7 years
- Procurement Rate ~ 80% in the Past 6 Years
- Foreign Vendor Teaming with U.S. Industry in 33 States

Small Arms Projects

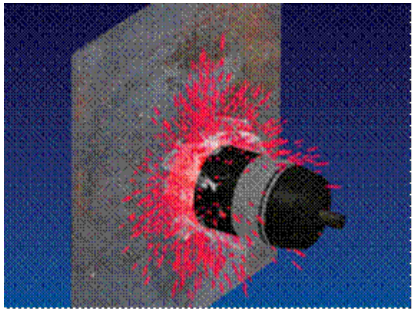
Training	8
Weapons	11
Ammunition	12
Enablers	13
TOTAL	44

Note: Not all Projects depicted

Training Projects



M4/M16 Training Bolt



40mm Tactical Marking, Day/Night Training Cartridges

Special Effects Small Arms Marking System for M249 SAW









Individual Serviceman Non-Lethal System



7.62 mm Short Range Training Ammo



Sub-caliber Trainer for M72 Light Anti-Tank Weapon





MK47 Crew-Served Weapon Trainer



Dismounted Infantry Virtual Simulation for Military Operations in Urban Terrain

Weapon Projects



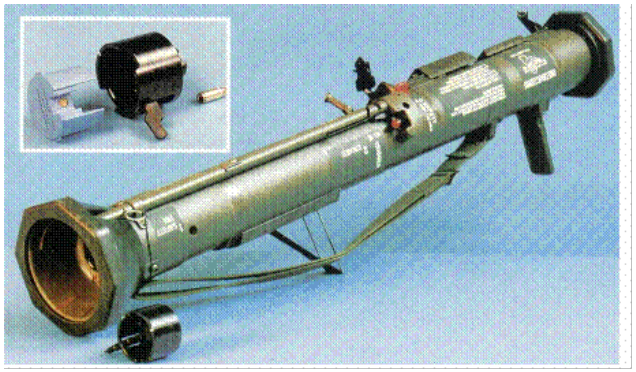
20mm Anti-Material Rifle



AT-4 CS



AT-4CS (Confined Space) Enhanced Blast Tandem Warhead



Advanced Demolition Weapons



High Rate-of-Fire .50 Caliber Machine Gun

Small Arms Projects



Close Quarter Battle Pistol





SOF (Special Operations Forces) Combat Assault Rifle (SCAR)



Joint Service Combat Shotgun



40mm Enhanced Grenade Launcher Module for M4 Carbine



5.56mm Lightweight Machine Gun





7.62mm Lightweight Machine Guns and Semi-Rigid Ammo Container

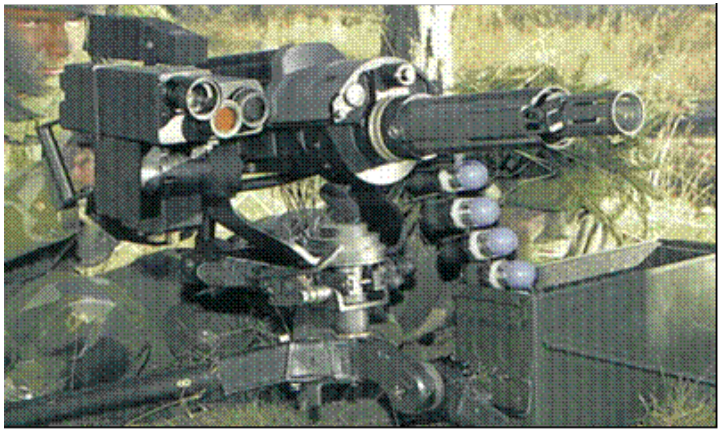
Ammunition Projects



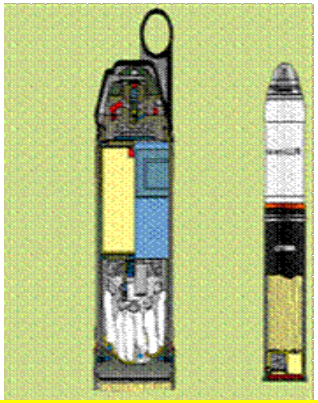
Joint Ranger Anti-armor, Anti-personnel Weapon System Ammunition Upgrades



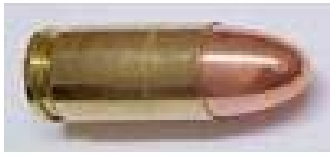
30mm Programmable Air Burst Munitions



Advanced Lightweight Grenade Launcher Ammunition



Multi-Role Anti-Armor Anti-Personnel Weapon System - MAAWS

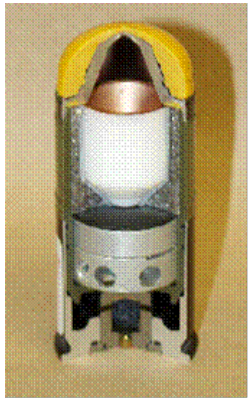


9mm Reduced Environmental Hazard Ammunition (REHA)

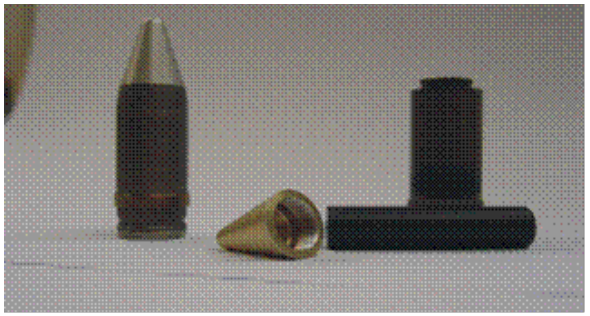


30mm APFSDS-Tracer

Enabler & Ammunition Projects



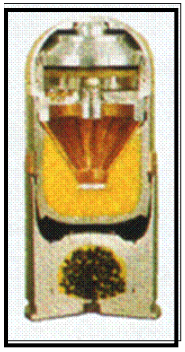
40mm Low Velocity,
High Explosive Dual Purpose



20mm Replacement Round



40mm High Explosive Dual Purpose



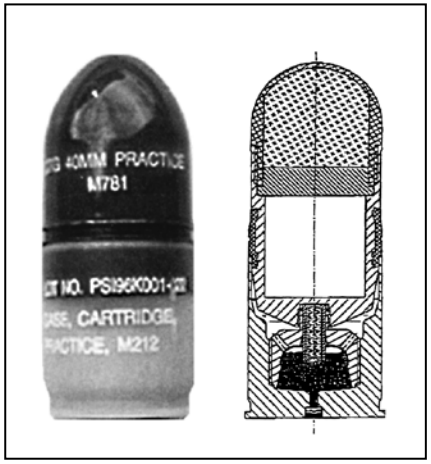
40mm Dud-Reducing M430A1E1 Cartridge



Lightweight Hand Grenade



Muzzle Break Sound Suppressor
for MK48 and M240



40 mm Practice Grenade

FY10 Draft Proposals

Significant interest this year in optics and aiming devices: 7 of the 14 enabler proposals

Training	**1**
Weapons	**0**
Ammunition	**6**
Enablers	**14**
TOTAL	**21**

Note: Not all proposals depicted

Current Proposal Trends

1. Training: more realistic
2. Weapons: lighter, more compact with less recoil
3. Sniper Weapon System: longer range capability
4. Ammunition: extended range and “green” (lead free)
5. Aiming Devices:
   a. Enhancing operators capabilities at longer ranges
   b. Greater interest for crew-served weapons
   c. Continued interest in night vision capabilities, especially digital imaging
   d. Emerging interest in sensor fusion (merging night vision & thermal capabilities)

Items of Interest

TRAINING





Autonomous Roving Robot Systems

- **Free-ranging robotic targeting system used for live-fire training**
- **Facilitates challenging, realistic training**
- **Executes complex pre-planned scenarios**

Items of Interest

WEAPONS



5.56mm Combat Assault Rifle
- Integral Optic
- Built-in Laser Aiming Device
- Factory zero'd

5.56mm Light-weight Machine Gun
- 10.78 lbs. (4.9kg)
- Short-stroke gas piston operating system
- 100 round drum or 30 round magazine fed





9mm Compact Personal Weapon
- Lightweight 3.3 lbs (1.5kg) and compact

Items of Interest



20mm X 110 Anti-material Sniper Rifle

20mm Hand-held,
Semi-automatic Infantry Weapon





40mm Less-lethal, Riot Control, Infantry Support and Special Operations Weapons Systems.



SOF 12 Gauge Shotgun

Items of Interest

AMMUNITION

40mm Soldier Parachute Aerial Reconnaissance Camera System







40mm Enhanced Blast Ammunition

- Blast, Heat and Fragmentation

5.56 mm Extended Range Ammunition

5.56 mm Green Ammunition

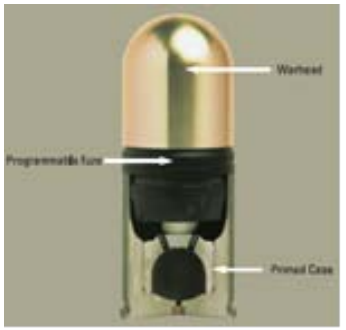




40mm Infrared Illumination

40mm Air Burst Munitions

- Programmable time based fuze technology



Items of Interest

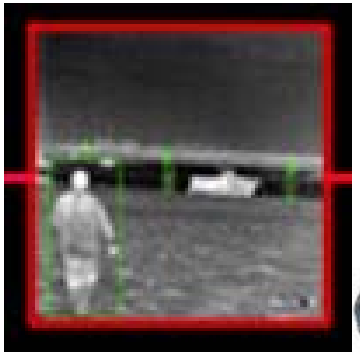
ENABLERS



Micro Adjustable Eyepiece

- Compatible with most optical devices
- Adjusted between 40 ~ 90

Enhanced Thermal Sighting System







Red Dot Sight Laser Range Finder

Items of Interest

NIGHT VISION ENABLERS



Night Vision –Laser Rifle Scope

Night Vision Laser Range Finder





Night Vision –Laser Monocular Range Finder

Summary

- **Actively engaged in testing for the small arms community**
- **Expect to continue supporting small arms well into the future**

- **Got any good products? See Bob…**

CTO - - Key Points of Contact

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https://cto.acqcenter.com

Questions?



Higher Fidelity Operational Metrics

LTC Tom Henthorn
Chief, Small Arms Branch
SRD, USAIC

$$35 \neq 35$$

$$35 = ??$$

Small Arms CBA

Priority Findings

Requirements for improving small arms analyses

- **Adopt an effects based standard** (Probability of Incapacitation, P_i)
- **Develop higher fidelity, operationally relevant metrics** to enable effective analysis of the performance of specific current (and projected) non-materiel and materiel combinations

- **Develop the modeling and simulation base** that enables sensitivity analyses of Soldier and small unit performance to add quantitative and qualitative value to threshold and objective requirements

Effects Based Standard

- “Stopping” or “Knockdown” Power are ambiguous and not measurable
- Hits on a target do not guarantee an inability to shoot back
- A human target is complex and requires an understanding of
  - **Where** a hit occurs
  - **What** part of the body is impacted by bullet / fragment
  - **How** much damage is produced by the bullet / fragment
  - **Whether** the damage is relevant to the target’s task performance
  - **When** effect occurs or is realized
- Must consider both delivery and terminal performance
- ***Probability of Incapacitation*** facilitates evaluating Soldier System performance from bullet delivery through terminal effect

Soldier + Training + Weapon + Enablers (Optics) + Ammo = Effect

Assessment / Evaluation Facilities

- **Maneuver Battle Lab** (POC: Mr. Jerry Barricks, jerry.w.barricks@us.army.mil)
  - *US Army Infantry Center, Ft Benning, GA*
  - Weapon and Systems capabilities assessment
  - Weapon Assessments with Soldiers in an operational context
- **Gruntworks Facility** (Mr. Mark Richter, mark.richter@usmc.mil)
  - *US Marine Corps, Quantico, VA*
  - Provide configuration management of current Marine Rifle Squad equipment
  - Determine optimum integration of all Marine Rifle Squad equipment
  - Determine best areas to modernize the Marine Rifle Squad for the future
- **Asymmetric Battle Lab** (POC: Mr. Joe Vega, joe.vega@us.army.mil)
  - *Asymmetric Warfare Group, Ft Meade, MD*
  - Rapid Asymmetric Non-Materiel and Materiel Solution Development

Individual Performance Assessment

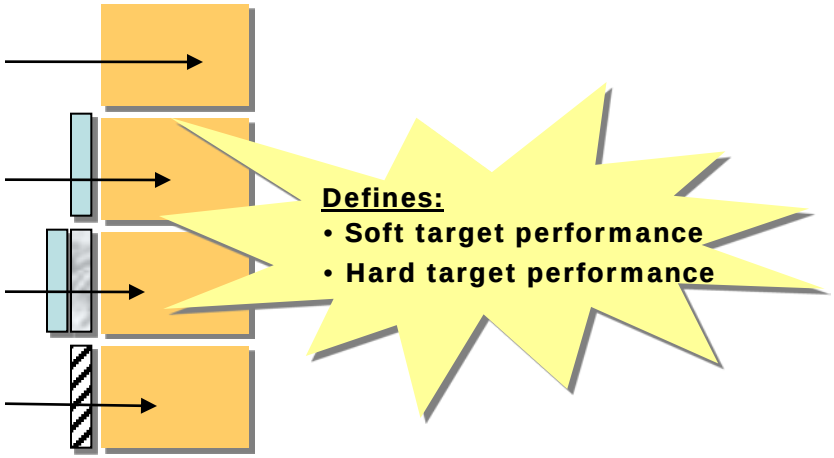
Soldier Weapon Evaluation and Test (SWEAT)

- Generate capability comparisons
- Any Soldier + Training + Weapon + Optic + Ammo combo
- Performance as a function of time and range
- Relevant operational framework



Soldier Weapon Evaluation and Test Course
SWEAT

Understand terminal performance through barrier at range….



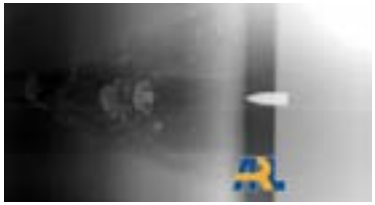
Static Dynamic Framework evaluates target performance based on system launch considering factors that influence terminal effect….

….and ORCA model translates shot location and damage into incapacitation of target based on ammo and weapon system used

- ✓ Simple
- ✓ Measurable
- ✓ Repeatable

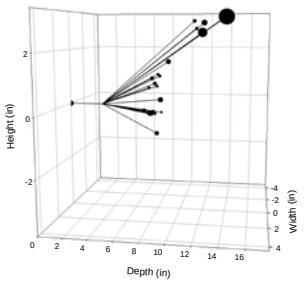
Small Caliber Evaluation

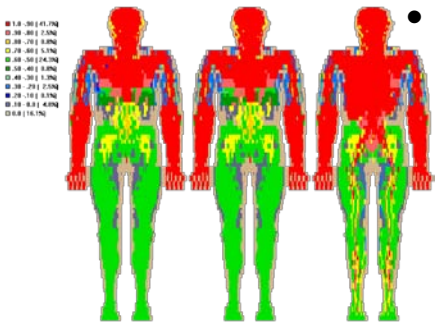


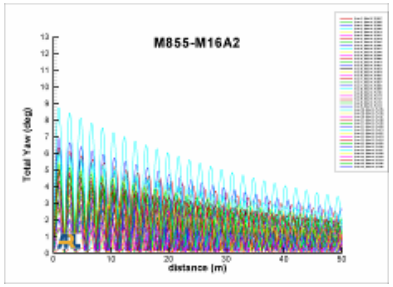




- **Replaced outdated assessment methodologies**
  - **Energy deposit methodology**
  - **Gelatin block “damage” evaluation**
  - **Methods do not account for spatial damage**
- **New evaluation methodology**
  - **Joint ARL SLAD/WMRD effort**
  - **End to end look at weapon/bullet performance evaluation**
  - **Includes statistical variation in systems performance “fleet” yaw**
  - **Can be applied to body armor and other types of barrier evaluation**
- **First study performing comparative P(I) analysis for M855, MK262, and M80 (among others)**
  - **Assessments including yaw effects and other considerations**
  - **Incapacitation predictions produced by ORCA**
- **Currently being used for LFT&E of M855LFS (Green Bullet Program)**





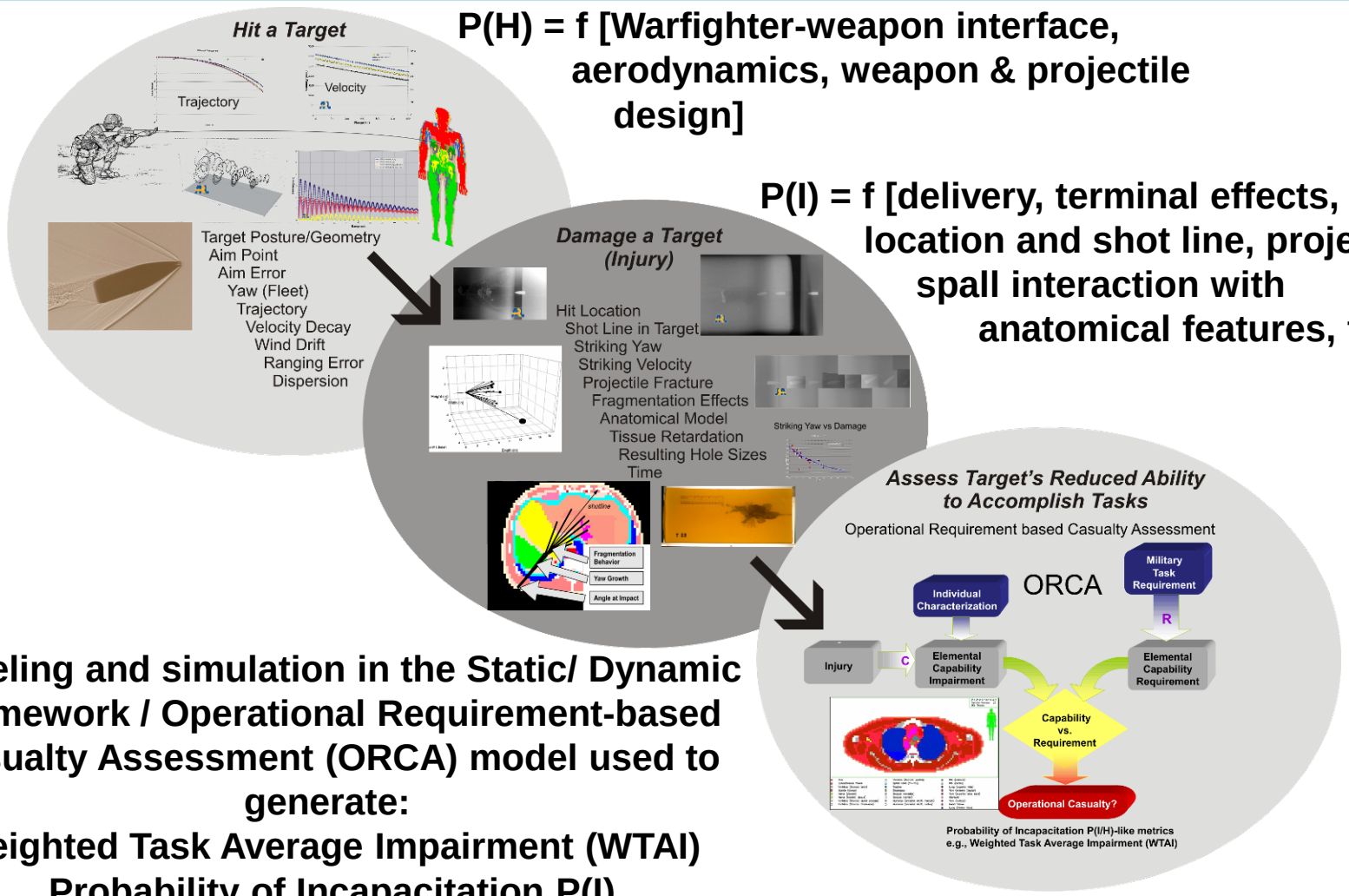


Slide courtesy of the U.S. Army Research Laboratory

Static/Dynamic Framework

P(H) = f [Warfighter-weapon interface, aerodynamics, weapon & projectile design]

P(I) = f [delivery, terminal effects, hit location and shot line, projectile/ spall interaction with anatomical features, time]



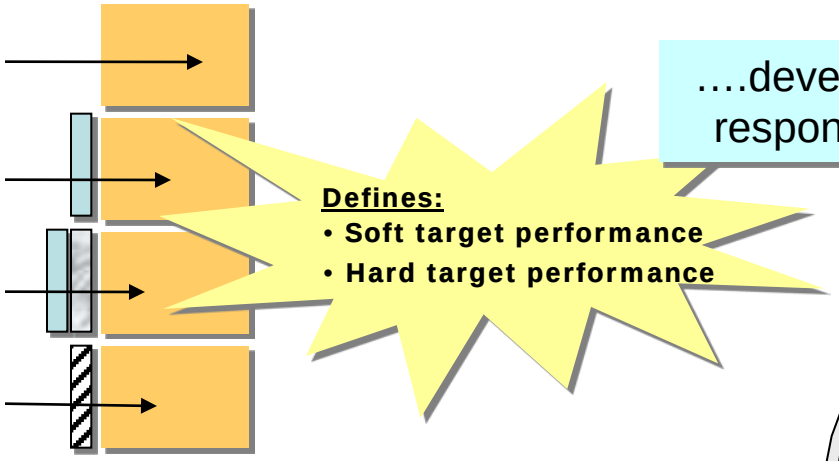
Modeling and simulation in the Static/ Dynamic Framework / Operational Requirement-based Casualty Assessment (ORCA) model used to generate:
Weighted Task Average Impairment (WTAI)
Probability of Incapacitation P(I)

Empirically Driven System Effectiveness Models

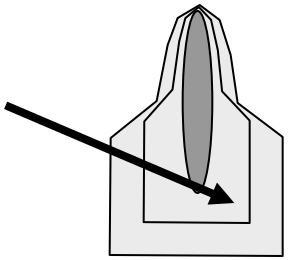
Slide courtesy of the U.S. Army Research Laboratory

Soldier Weapon Evaluation and Test Course
SWEAT

Understand terminal performance through barrier at range….



….develop incapacitation zones on targets that respond to the weapon and threat posture….



Static Dynamic Framework evaluates target performance based on system launch considering factors that influence terminal effect…

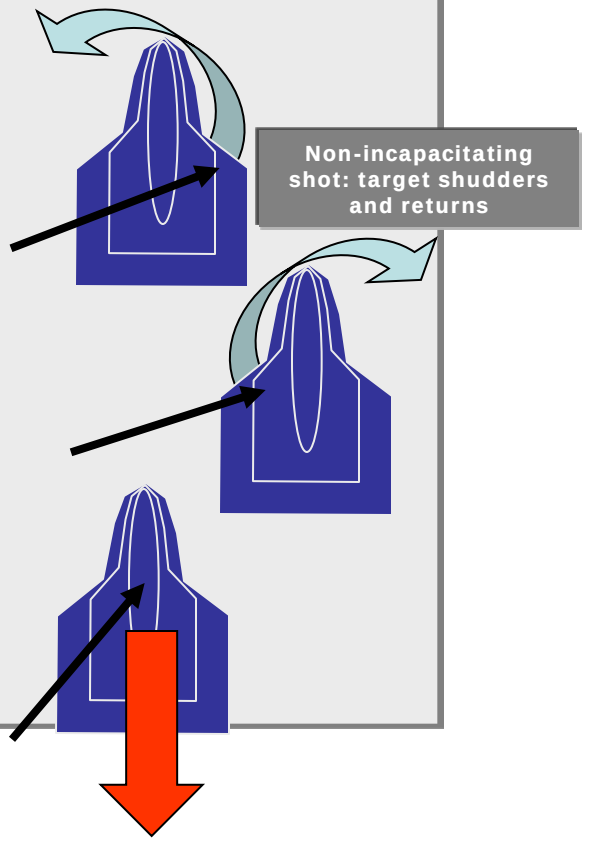
….and ORCA model translates shot location and damage into incapacitation of target based on ammo and weapon system used

- ✓ Simple
- ✓ Measurable
- ✓ Repeatable

Target Response

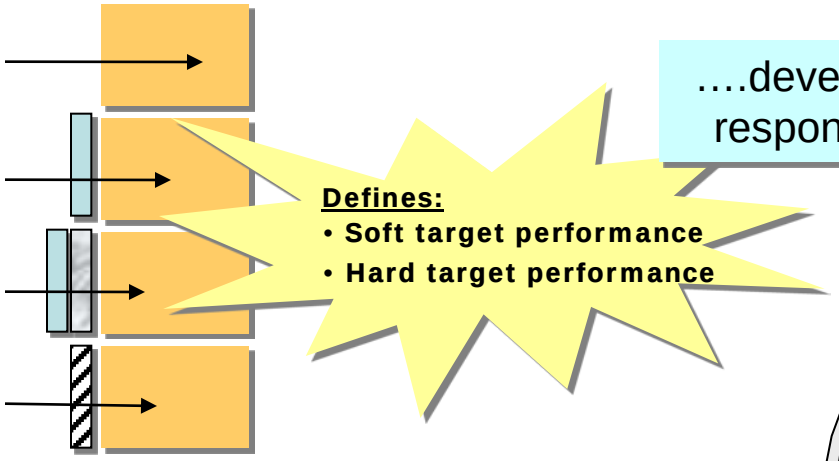
Overview: Require targets that ‘understand’ adjustable quality of hit metrics and provide target feedback given differences in target posture, location of hit and caliber of round

- ❑ Adjustable target zones (size)
- ❑ Quality of hit scoring
- ❑ Variable time responses
- ❑ Real-time feed-back to Soldier
- ❑ Multiple degrees of freedom for target response
- ❑ Adjustable software
- ❑ Wireless to 1200m (reduce digging on range)
- ❑ Thermal signature (O) for future use
- ❑ Durable to .50 cal
- ❑ Rapid target switch-out
- ❑ Moving targets



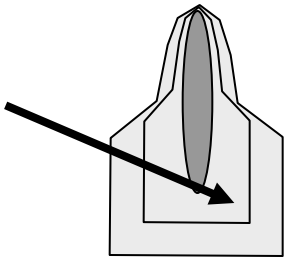
Soldier Weapon Evaluation and Test Course
SWEAT

Understand terminal performance through barrier at range….



….develop incapacitation zones on targets that respond to the weapon and threat posture….

….evaluate Soldier performance in an operationally realistic environment driven by system influence and target response



Static Dynamic Framework evaluates target performance based on system launch considering factors that influence terminal effect…

….and ORCA model translates shot location and damage into incapacitation of target based on ammo and weapon system used

Weapon

Soldier	A	B	C	D
1	10	15	25	15
2	50	60	75	50
3	55	55	70	60
4	30	40	50	35

- ✓ Simple
- ✓ Measurable
- ✓ Repeatable

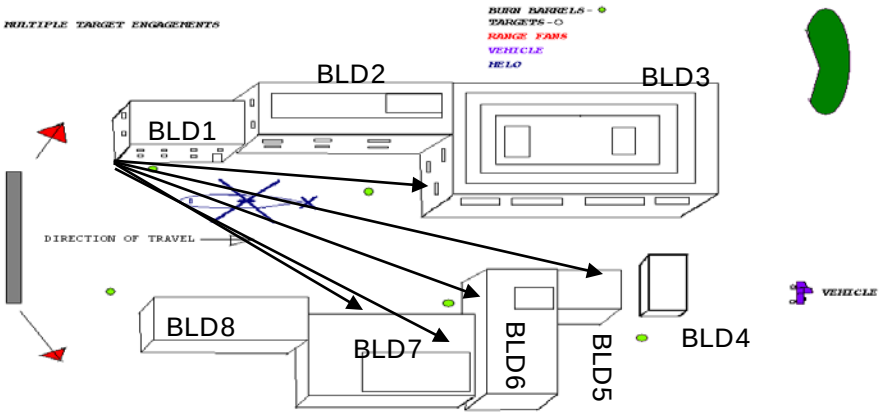
Soldier in the loop performance evaluates under operational conditions the weapon and ammunition influence

Course Layout: 1 of 22



- Position: 1
- Represents: Right handed engagements
- Firing position: standing
- Number of engagements: 5
- Number of target locations: Bldg 3, 5, 6 and 7
- Type of engagements: 2 window, 1 roof

Range	CQB-3-10m	15m-50m	75m-200m	300m-600m	800-1000m
Time	1.2 sec	3 sec	4 sec	10 sec	15 sec
P(i)	0	5	0	0	0



SWEAT Scoring Methodology

Produces two results

Overall Score
for comparison of capability

741

where score is a function of

- **quality hits**
- **time burden**
- **rounds fired**

Given a Soldier, Training, Weapon, Optic Ammo combination

Range	CQB	50m	200m	600m	1000m
Time	1 sec	2 sec	4 sec	7 sec	10 sec
Raw Score	12/15	10/15	6/15	2/12	0/10
P(i)	80	67	40	17	0

Incapacitation Profile
for comparison of standards

Comparison of System Performance

Soldier + Training + Weapon + Optic + Ammo = Effect

S	T	W	O	A	CQB 2sec	50m 3sec	200m 5sec	600m 8sec	1000m 10sec
11B	SS	M4	Iron	M855					
11B	SS	M4	CCO	M855					
11B	SS	M4	RCO	M855					
92Y	SS	M4	Iron	M855					
11B	B4	M110	x10	**118LR**					
11B	B4	M24	x10	**118LR**					

Relevant comparisons of capability based on Effect produced

Closing

Excellent. More Fact. Less Opinion.

- SGM Pete Gould

- Develop and maintain tools for improved capability evaluation
  - SWEAT (Individual)
  - SWEAT (Sniper)
  - SWEAT (Support by Fire)

- Share and leverage evaluation capability across Joint Services and Industry

- Develop understanding of Soldier System Effect…

….what is required?

2009 NDIA International Infantry & Joint Services Small Arms Systems Symposium

OSD Perspective

Anthony J. Melita

OUSD (Acquisition, Technology & Logistics)

Deputy Director, Portfolio Systems Acquisition,

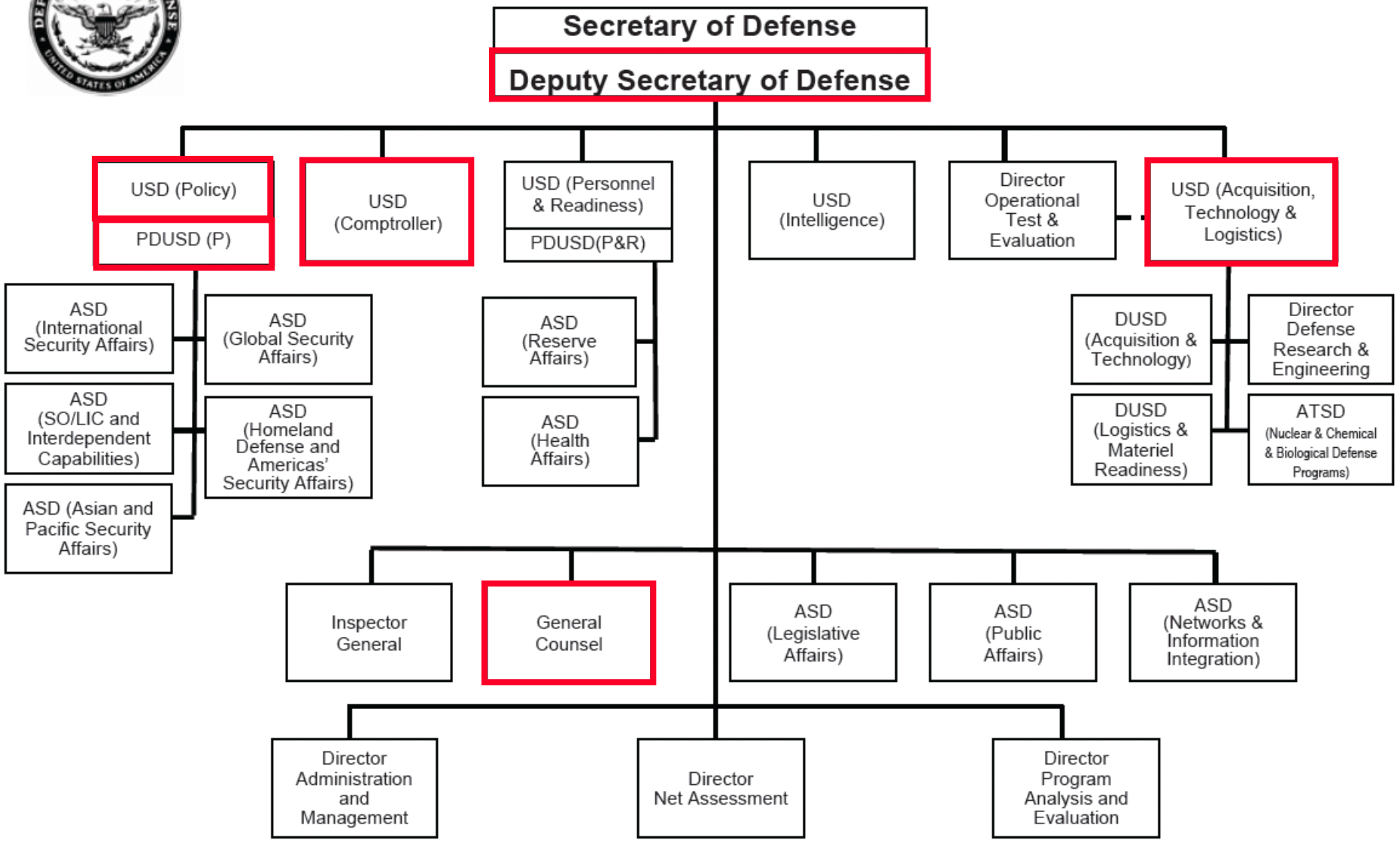
Land Warfare and Munitions

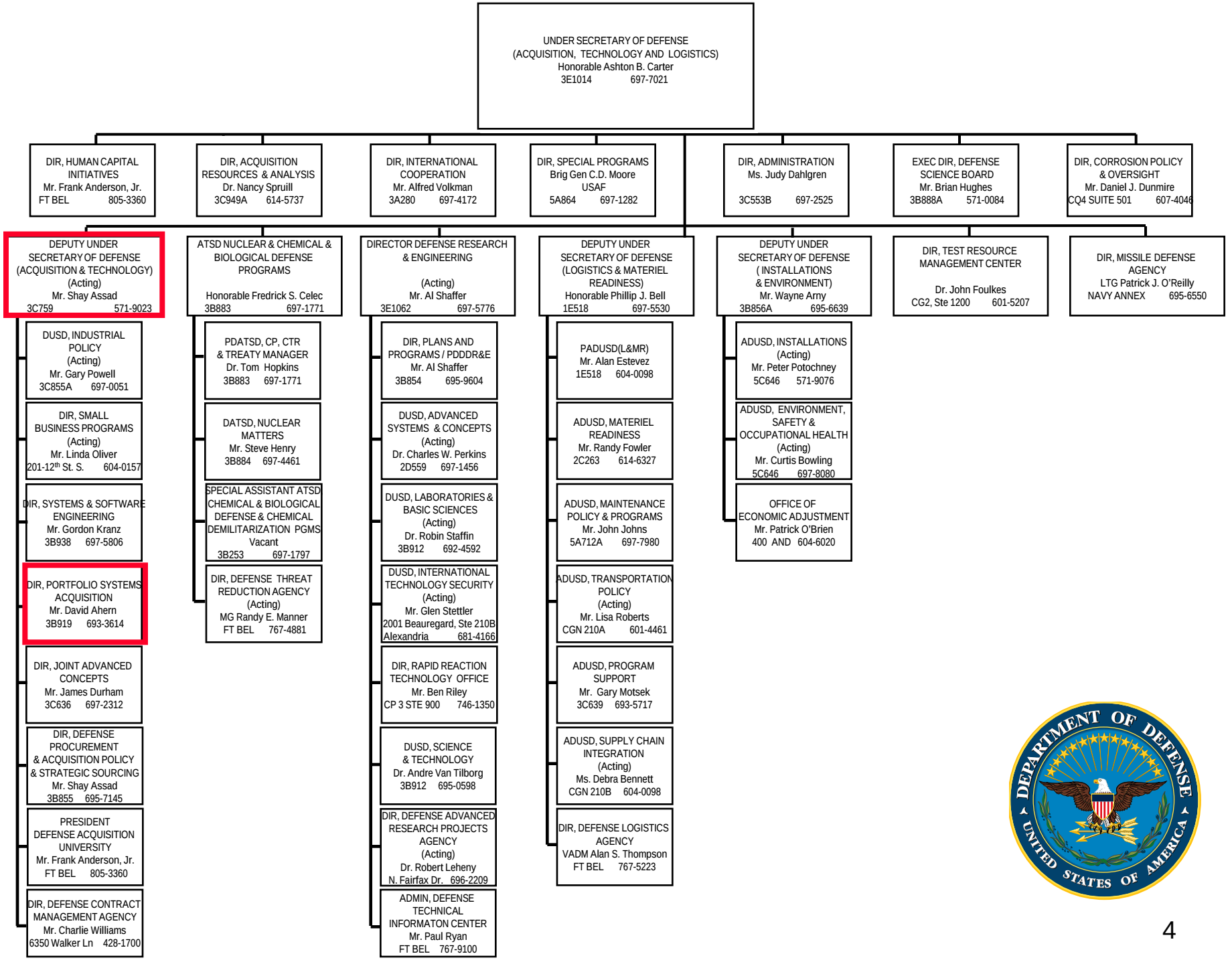


Discussion Topics

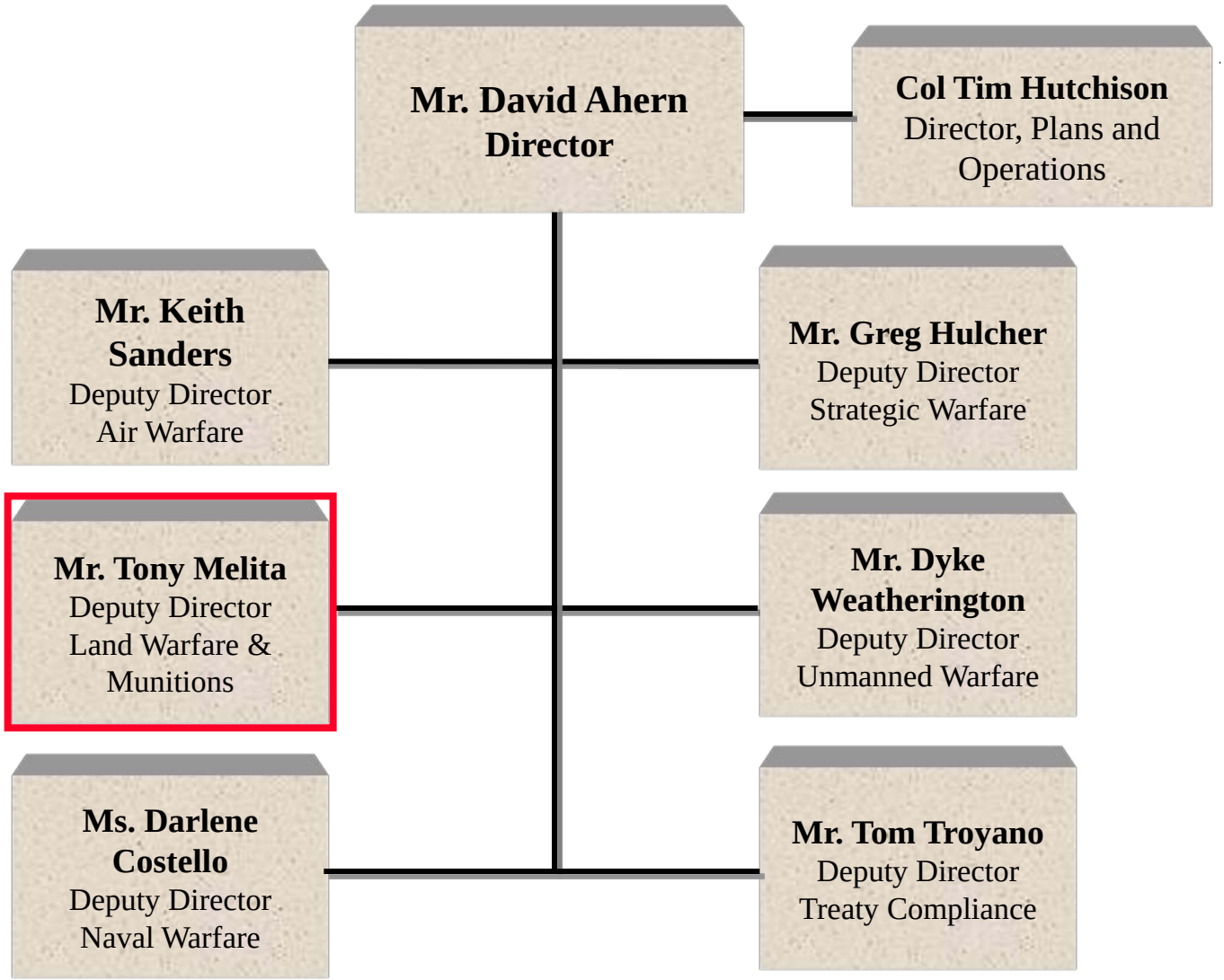
- OSD / AT&L Organization
- Budget Trends
- Small Arms Joint Assessment Team

Office of the Secretary of Defense



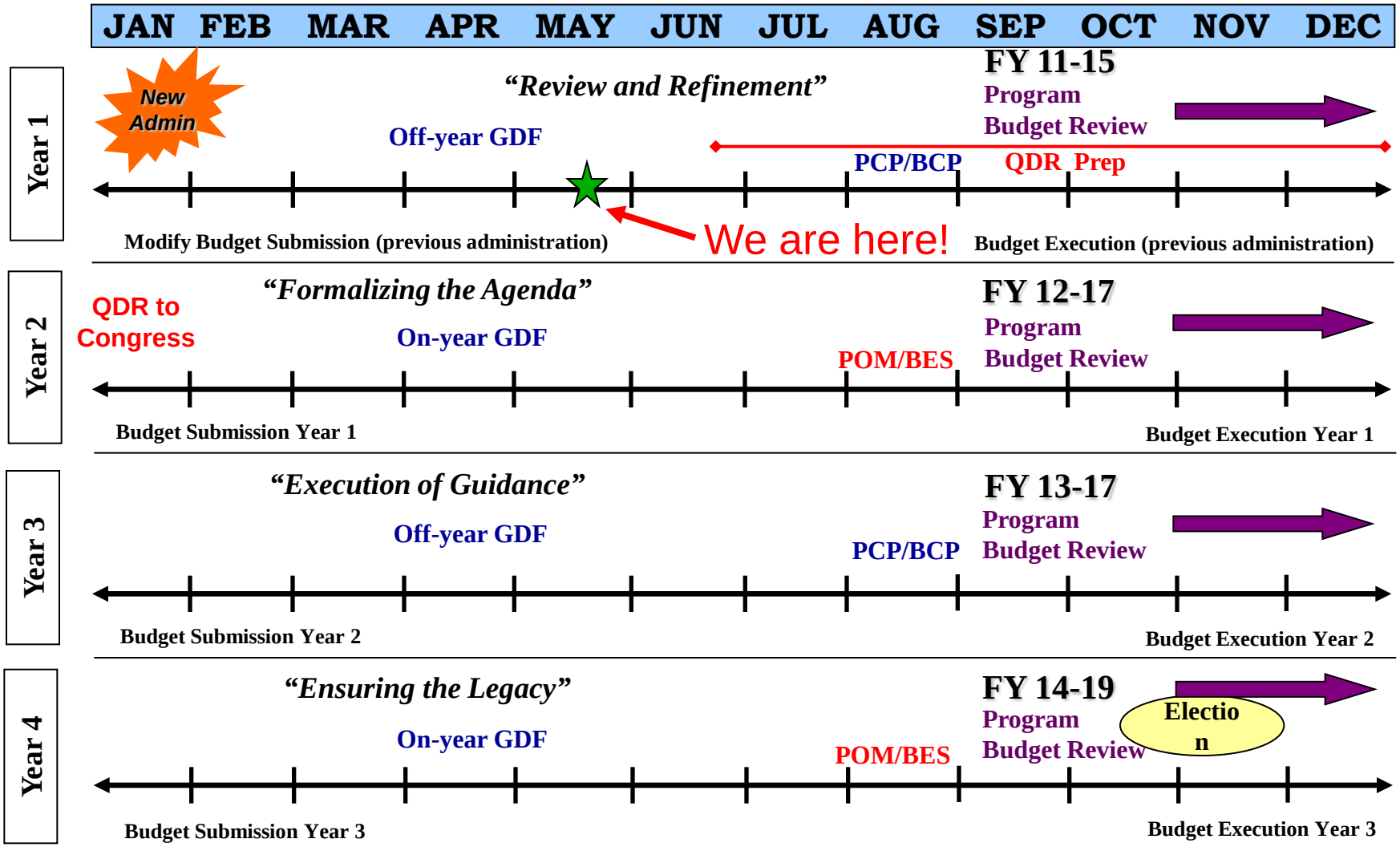

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Mr. Patrick O'Brien
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PORTFOLIO SYSTEMS ACQUISITION (PSA)



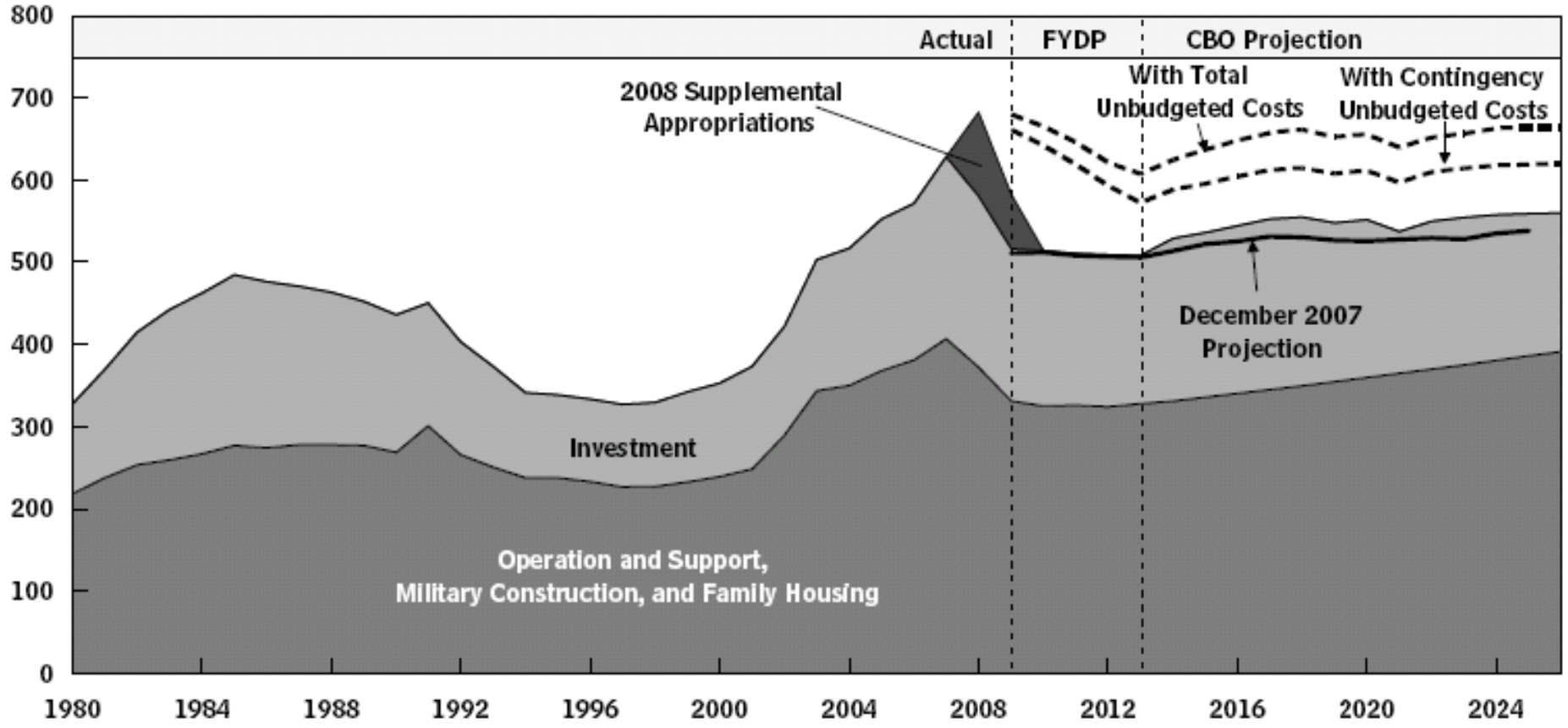
Budget Trends

Planning, Programming, Budgeting, and Execution



4 Administration Years with 2-year PPBE Cycle

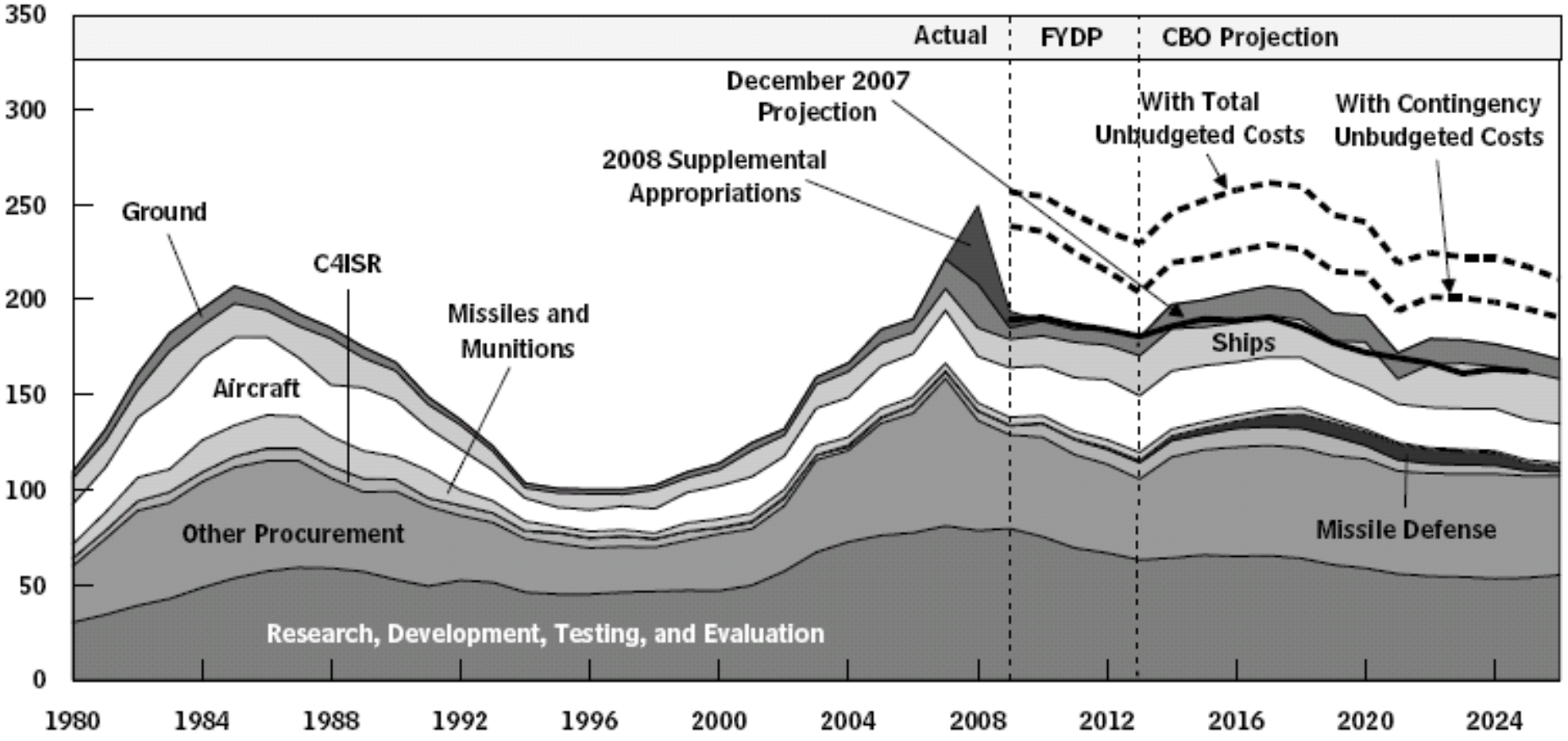
Past and Projected Resources for Defense



Source: Congressional Budget Office, “LONG-TERM IMPLICATIONS OF THE FISCAL YEAR 2009 FUTURE YEARS DEFENSE PROGRAM,” January 2009

Past and Projected Resources for Defense Investment

(Billions of 2009 dollars)



Source: Congressional Budget Office, "LONG-TERM IMPLICATIONS OF THE FISCAL YEAR 2009 FUTURE YEARS DEFENSE PROGRAM," January 2009

Small Arms & Ammunition Joint Assessment Team









- Objective – Conduct an objective assessment of the Department's approach to satisfying small arms and ammunition capability requirements

- Tasking – review current and projected Small Arms and Ammunition (SAA) requirements; assess performance of current SAA against requirements; establish acquisition and life-cycle costs; determine cost premium drivers on current and future weapons; evaluate cost and capability of current development and procurement plans; and consider future requirements and capabilities that can be acquired today, and that which requires R&D

- Membership – All DoD stakeholders

JAT Membership

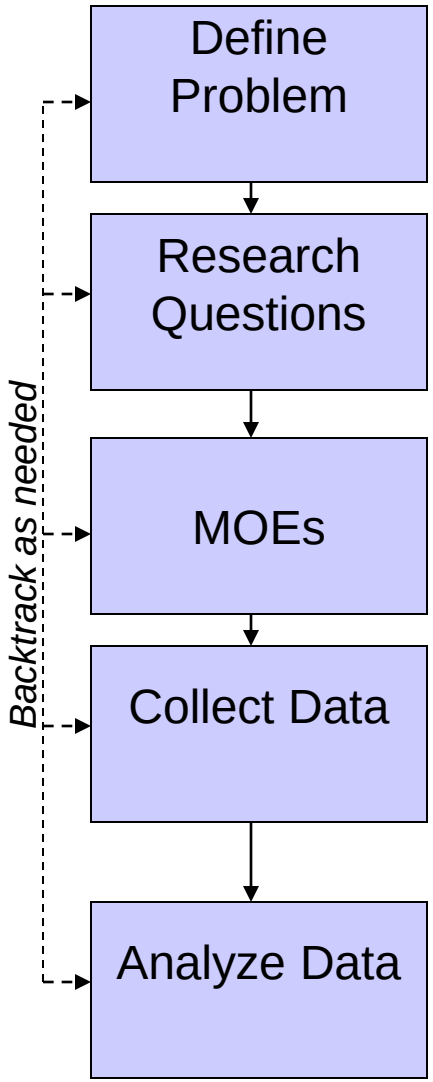
OSD AT&L (4)	**USSOCOM**	**OPNAV, N86**
OSD Policy	**JSSAP**	**NSWC, Crane**
OSD Comptroller	**SAF/AQ**	**DUSA (T&E)**
OSD PA&E	**DASN (ExW)**	**HQDA, G-3**
OSD DOT&E	**ASA (ALT)**	**HQDA, G-8**
Joint Staff, J-8	**HQMC, MCCDC**	**USA Infantry Center**

- Definitions of Small Arms & Ammunition

  - Small Arms: Man portable, individual, and crew-served weapon systems used mainly against personnel and lightly armored or unarmored equipment. *(JP 1-02)*

  - Small Arms Ammunition: Ammunition for small arms, i.e., all ammunition up to and including 20 millimeters (.787 inches). *(JP 1-02)* and 40mm grenades.

Small Arms Joint Analysis Approach



Which weapons systems and munitions acquisitions are most needed to improve Joint Force capabilities?

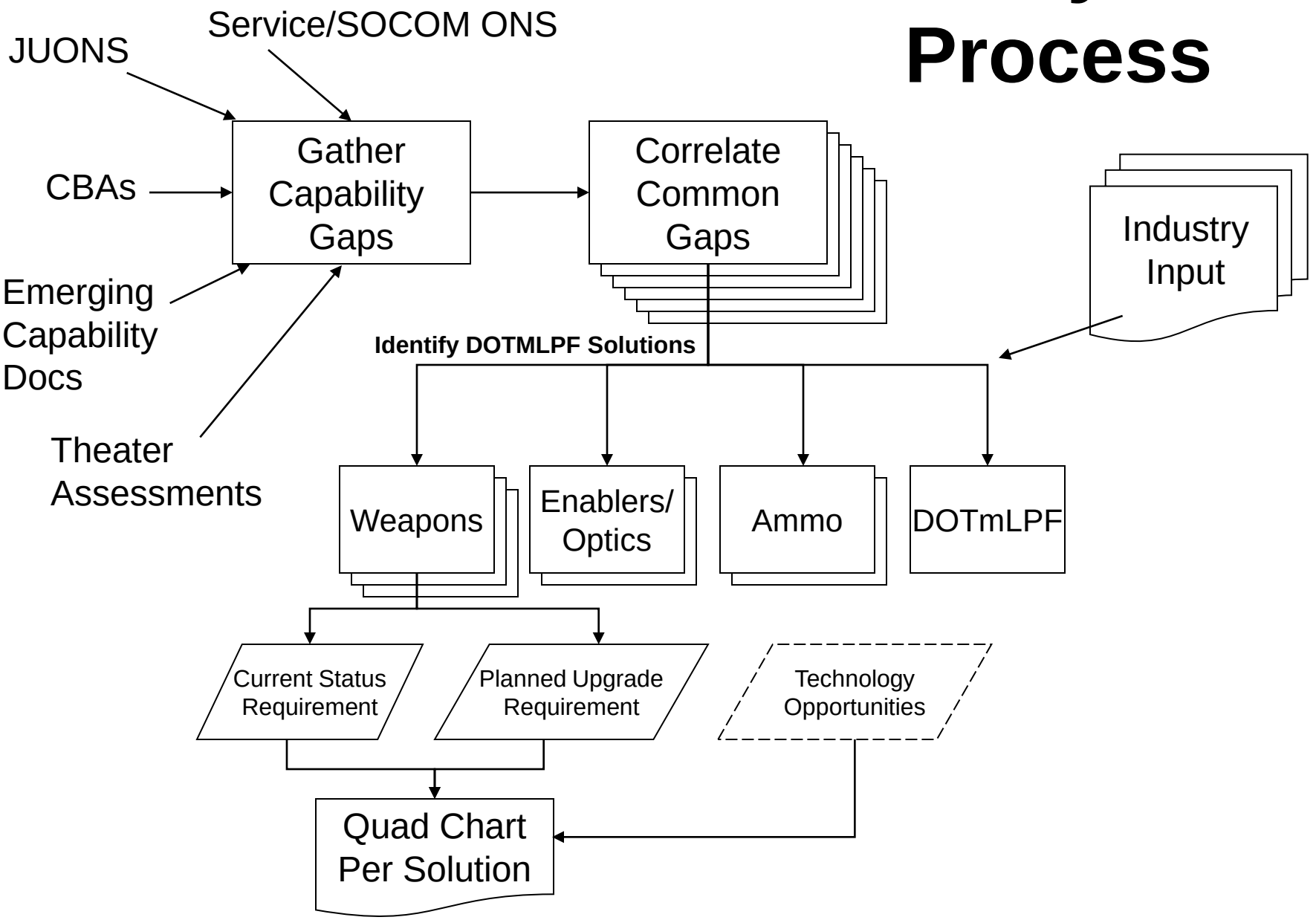
What weapon systems and munitions acquisitions are planned? What improvements are expected? What are the expected costs? How are we buying presently?

Assess current MOEs: Lethality, Range, Maintainability, Reliability, Sustainability, Human Systems Integration, Cost. Additional MOEs can be added as needed.

Leverage existing analysis: Rand Commonality Study, Family Engineering Study System Configuration Study, and 2006 Joint Small Arms Capability Assessment/Functional Area Analysis. Research ammunition configurations and weapons system interfaces.

Apply combat models and simulations to a broad spectrum of scenarios to assess the operational effectiveness and logistics implications of alternatives. Examine alternatives for alleviating the capability gaps and determine their efficacy as joint solutions.

Analysis Process



Quad Chart Example

Improved Night/Day Observation/Fire Control Device (INOD Block 2) (AN/PVS-26)



Description: Provides the SOF sniper with a light weight, low signature, fire control and observation device which allows the sniper to detect, acquire, and engage targets out to the weapon's maximum effective range under day/night conditions.

Capability / Performance

- Single Weapon mounted for heavy sniper and crew served weapons (INOD Block 2 - .50 caliber and crew served weapons).
- The INOD allows the sniper to go from day to night operations without re-zeroing.
- Clip-on design with dedicated day optics.

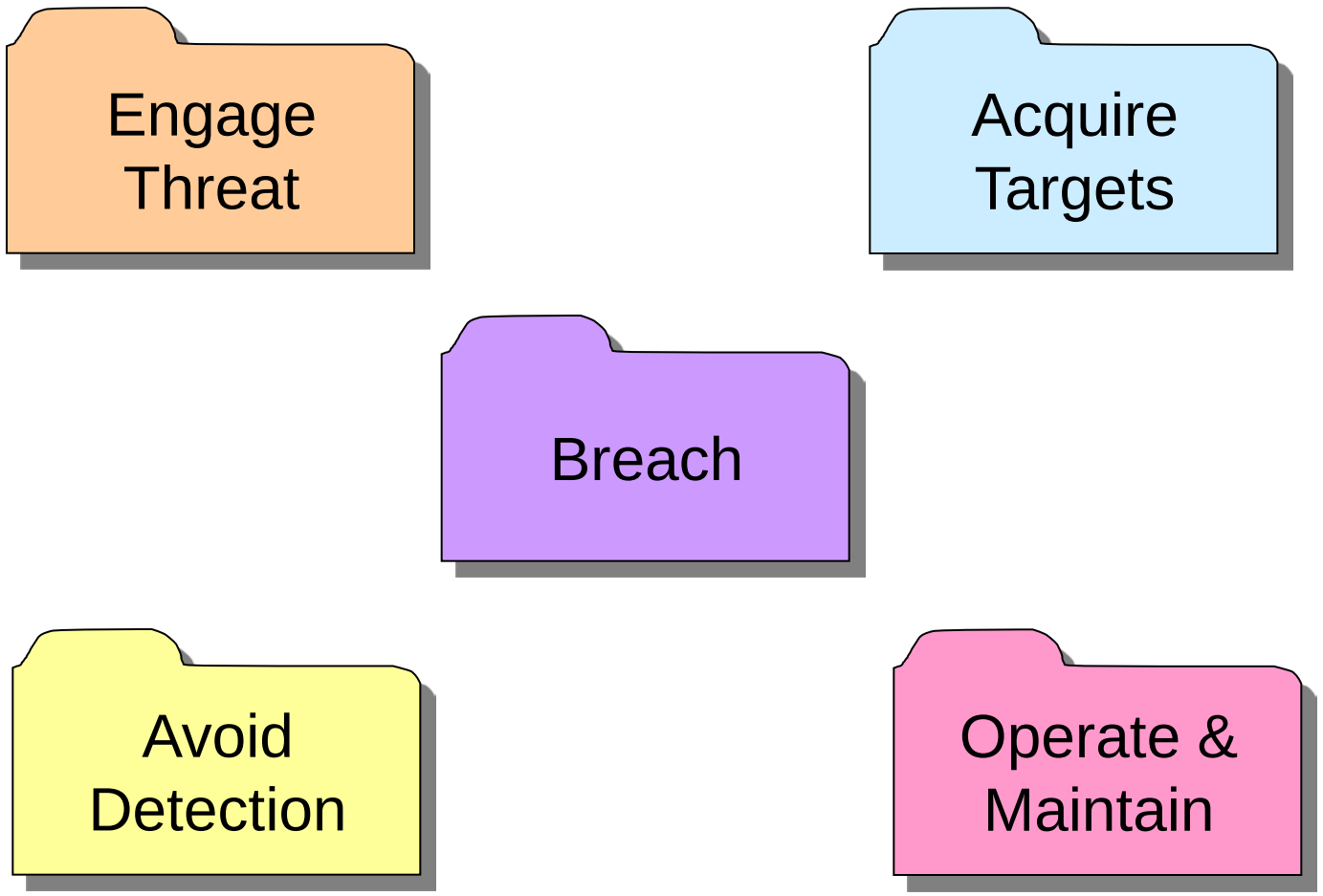
Schedule

- **Authorization/Validation: USSOCOM INOD ORD 25 June 2003**
- **LRIP Deliveries: 3rd QTR FY06**
- **Production Delivery: 4th QTR FY07**
- **LRIP Fielding: 2nd QTR FY07**
- **IOC: FY09 (1875)**
- **FOC: FY11 (2018)**

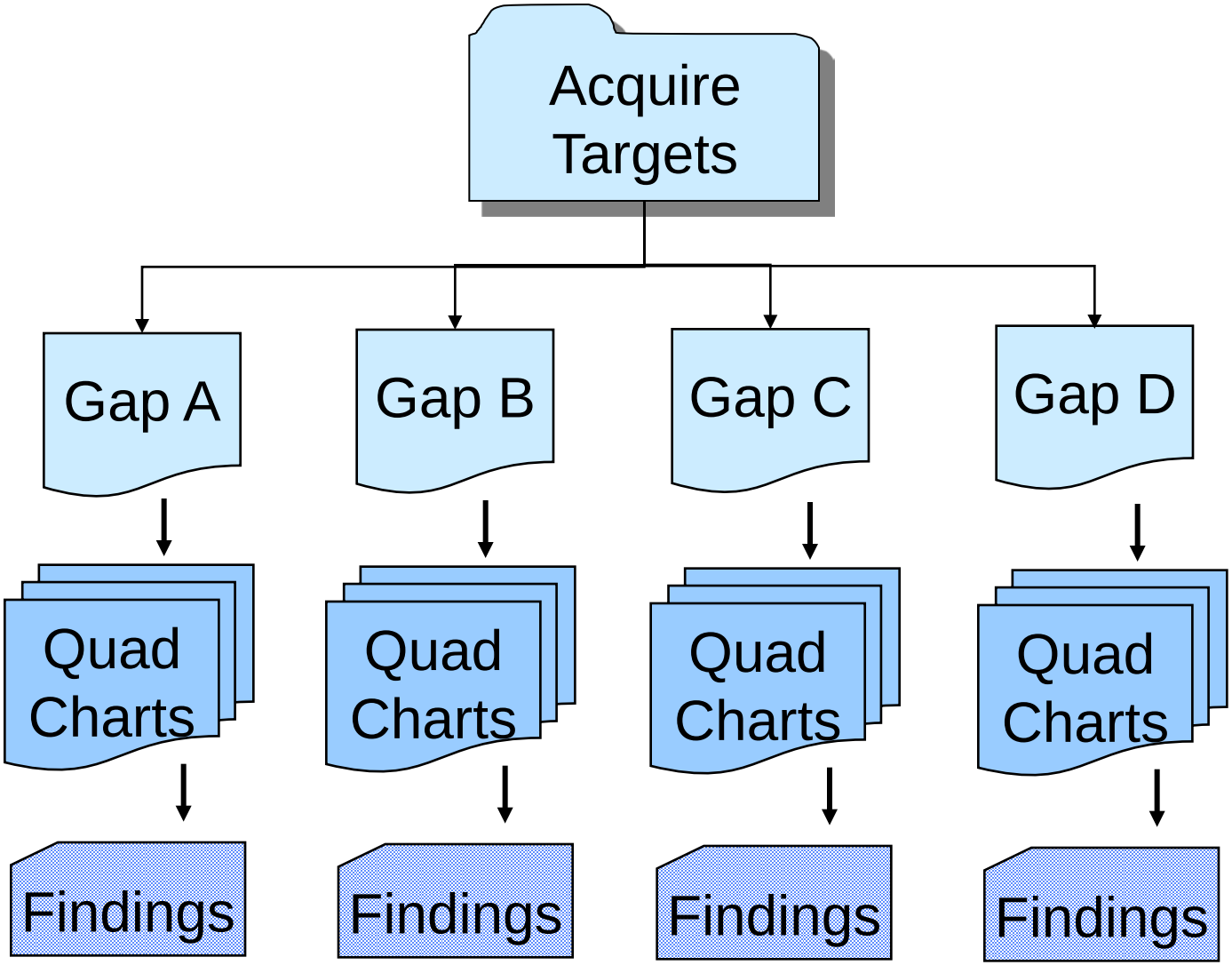
Cost / Affordability

- **Authorization: INOD**
- **Unit Cost: $8,000.**
- **BOI: 1875**

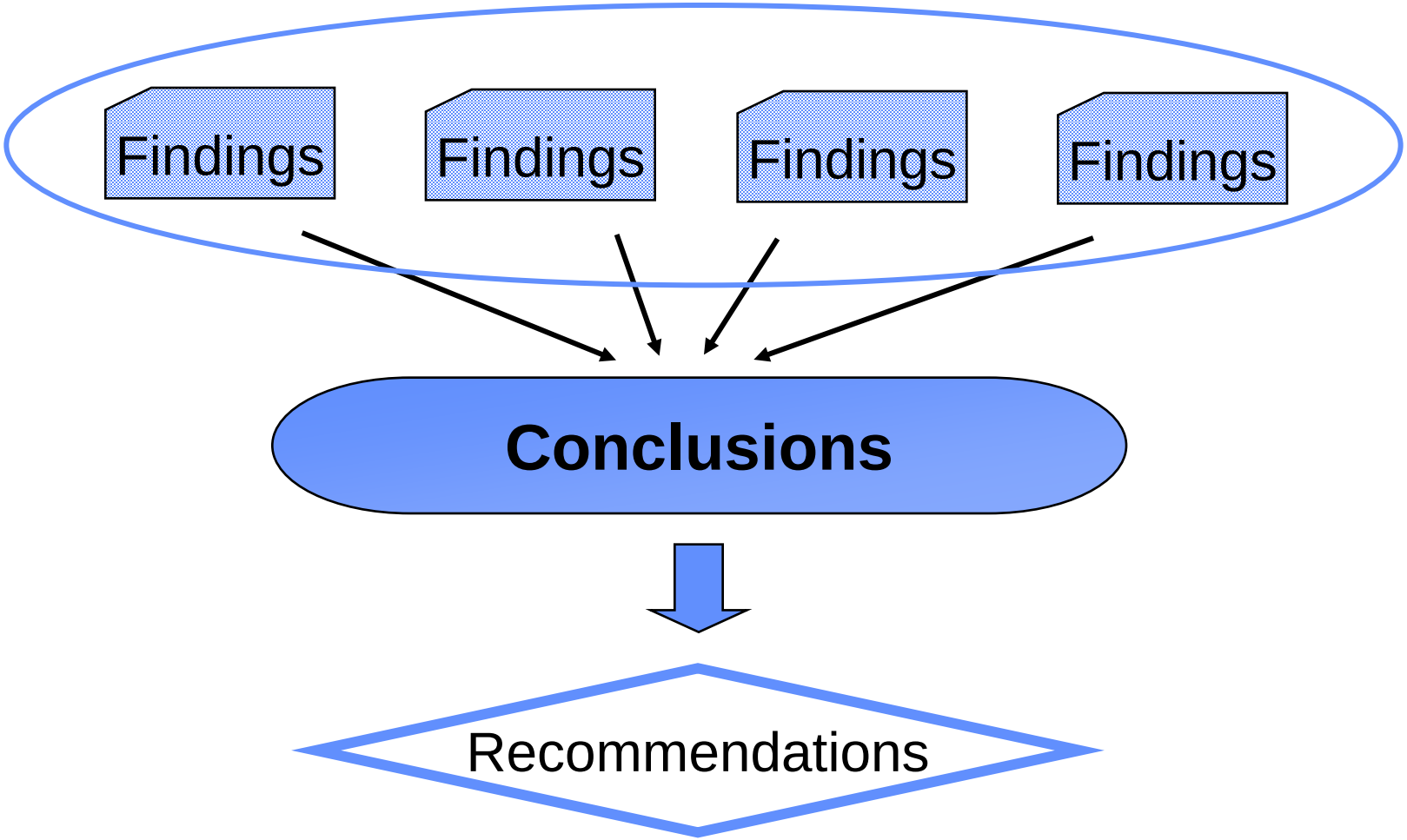
Small Arms Capability Gap Areas



JAT Analysis Process



JAT Analysis Process (cont.)



Small Arms JAT Conclusions – Themes

- **Measurable standards to support requirements definition**
- **Factors and challenges that impact system optimization and decisions regarding potential materiel and non-materiel solutions**
- **The impact of training on small arms effectiveness**
- **Availability of COTS/NDI materiel solutions**



Questions?



Project Director

International Infantry & Joint Services Small Arms Systems Symposium

18 – 21 May 2009

William Sanville

Project Director

Nonstandard Ammunition

Distribution Statement A:
Approved for Public Release; distribution is unlimited

DESTRUCTION NOTICE: **Destroy by any method that will prevent disclosure of contents or reconstruction of documents**

Non-Standard Ammunition

Nonstandard Ammunition Producers & Suppliers

Nonstandard Ammunition…

…is not in the US Army supply base

…is not type classified or safety certified for use by US Army

…is not produced using technical data packages managed by US Army

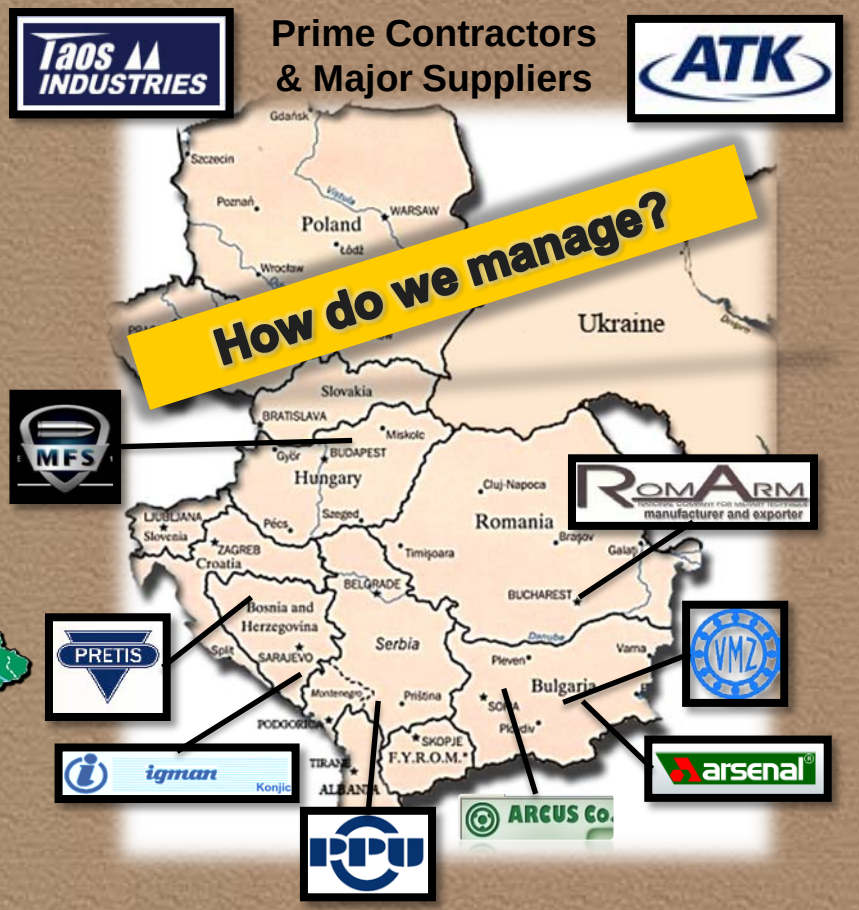






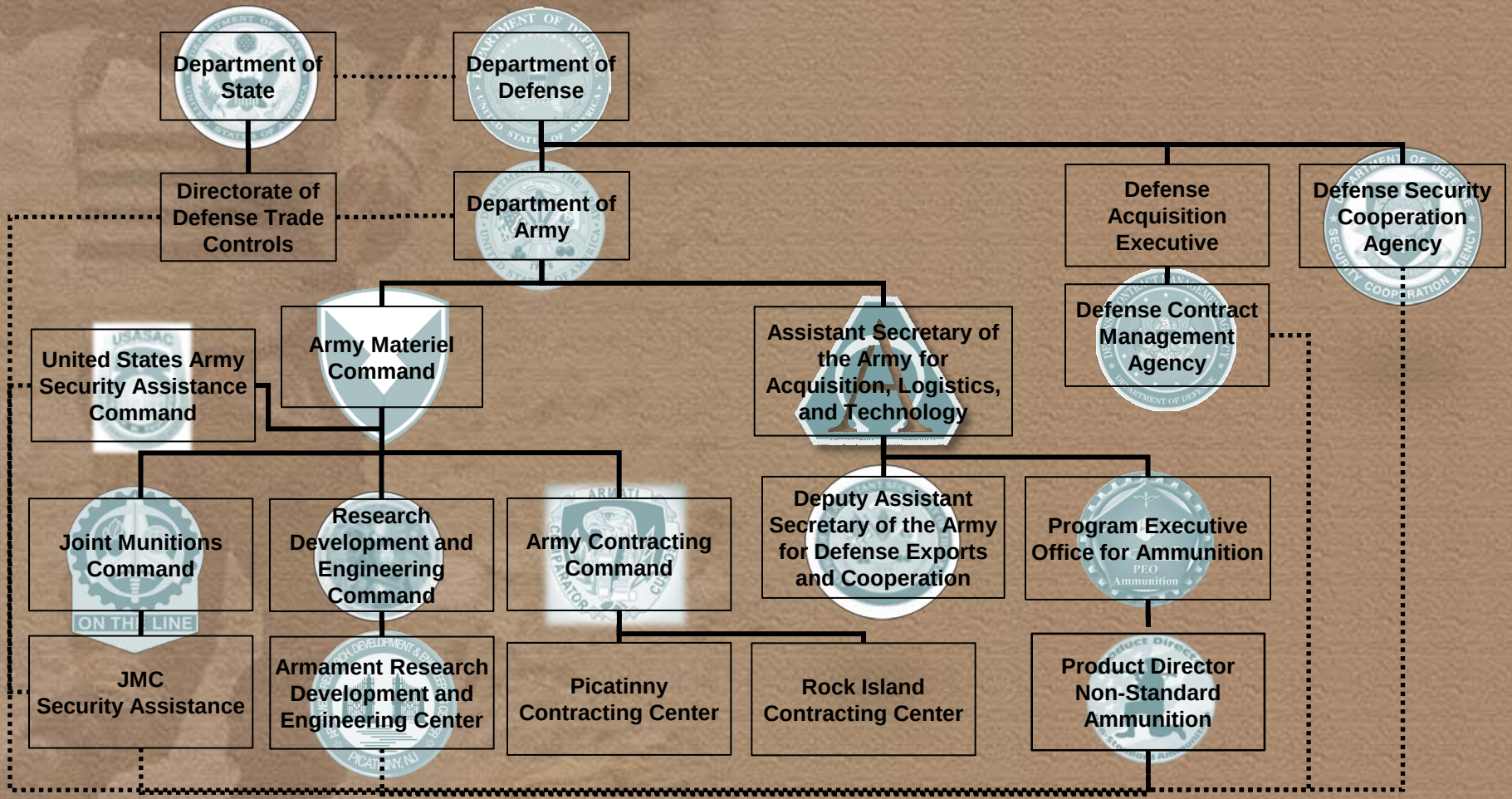


Prime Contractors & Major Suppliers



DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition Organizations



DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition Program Management

- Establish program management similar to standard US ammunition
- Establish and maintain knowledge base of items and producers/suppliers
- Coordinate efforts with State Department
- Apply general technical specifications to ammunition
- Review and approve producer/supplier specific top-level assembly drawings and Lot acceptance criteria and results for each ammunition item
- Execute source inspection of all shipments using critical QAR support from DCMA

Verifying compliance to quality standards prior to delivering to Theater



Enterprise approach in implementing requirements that are reasonable, understandable, & executable

DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition Support to Afghanistan & Iraq

Shipped / Ordered | **Ordered / Shipped**

Small Caliber



139M / 206M | 459M / 330M

Medium Caliber



2.5M / 1.8M

Rocket Propelled Grenades



20K / 52K | 635K / 230K

Large Caliber



9.2K / 7.2K

Other



9K / 40K | 244K / 181K

37% of FMS ammunition for Iraq



5 FMS Cases Implemented or Pending

14 Pseudo FMS Cases Implemented or Pending



36% of FMS ammunition for Afghanistan

DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition
Future Support to Afghanistan & Iraq

CSTC-A Forecast for ANA & ANP
*** Increase not factored into forecast yet**

Afghanistan Three-Year Plan	
Small Caliber	330M
RP / Launched Grenades	1.2M
Med & Large Caliber Direct	1.5M
Mortars & Artillery	625K
Aviation Rockets	29K
ATGM	2K
Misc Links, Belts, Flares	340K

ANP – Afghan National Police
ANA – Afghan National Army



Iraq Sustainment	
Small Caliber	16.5M
Rocket Propelled Grenades	32K
Mortars	125K



Current FMS Case Workload & Theater Input

DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition Support to US Forces

Supporting US Forces with validated NSA requirements by:

- **Procuring NSA**
- **Arranging for delivery of NSA procured in CONUS**
- **Facilitating testing and evaluation of procured NSA**
  1. **Validation of physical characteristics**
  2. **Electronic Pressure, Velocity, and Action Time Testing (EPVAT)**
  3. **Function and Casualty testing (F&C)**

- Consolidating procurements under PD NSA
- Coordinating Transportation for CONUS Deliveries
- Supporting other customer requirements





DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition
Change to Termination Notification

- **Problem – performance reports only required for DoD contracts >$5M so termination information for all contracts not readily available for competitive source selections**
- **Policy changed by USD(AT&L) on 23 Jul 08**
- **Revised policy requires reports for all terminated contracts**
- **Reports must be submitted to OSD within 10 days of termination for default or cause**
- **DoD website will now provide information on all terminations**
  - ✓ **Available for source selection officials**
  - ✓ **Available for Contracting Officers for responsibility determinations**

DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition Coordination with State Department



- **NSA anticipated to involve export of controlled items**
- **DFARS 252.204.7008, Requirements for Contracts Involving Export-Controlled Items**
- **"Defense Items" defined in the Arms Export Control Act, 22 U.S.C. 2778(j)(4)(A)**
  - ✓ Subject to regulation under International Traffic in Arms Regulations (ITAR)
- **Activities subject to regulation include, but are not limited to, brokering**
- **Full contract statement will be located on NSA website at: http://www.aschq.army.mil/ac/aais/ioc/**

DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition Executing NSA Mission





We are proud of our partnership with the ANA and the ANP. We cherish the trusted relationships that we maintain. And we remain committed to our mission to build sustainable capacity and capability for the ANSF in order to bring stability and security to the Afghan people.
– Richard P. Formica, Major General, US ARMY Commanding







DISTRIBUTION STATEMENT A:
Distribution is unlimited

Nonstandard Ammunition Going Forward

Managing Large & Changing Requirements…

Supporting Complex Worldwide Supply Chain…

Successfully Delivering Ammunition to US and Allied Forces

Anticipate Final RFP Release 29 May 09
Website: http://www.aschq.army.mil/ac/aais/ioc/

DISTRIBUTION STATEMENT A:
Distribution is unlimited

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Ballistic Test Facilities and Systems Modernization at the Lake City Army Ammunition Plant

Ms. Stefana Reilly
Project Manager
ATK Small Caliber Systems

Mr. Danny Huang
US Army, ARDEC
Picatinny Arsenal

Approved # OSR 09S-1471



Indoor & Outdoor Ballistic Test Ranges

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2400 Yard Outdoor Ballistic Test Range

- 22 Firing Bays
- 4 Down Range Firing Houses



Indoor Ballistic Test Range

- 14 Velocity & Pressure Bays
- 14 Function & Casualty Bays
- 2 Sub-Ranges 200 Yards

Where We Were In The 1940's

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After A Few Upgrades 1970-1980's

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- Testing Only The Ammunition
- MSDOS Based Oehler System
- Labor Intensive Paper Targets
- Personnel In Line of Fire
- Subjective Determination
- Single Point Of Failure
- At Maximum Testing Capacity
- No Flexibility
- Redundant Data Entry
- Long Test Cycle Times

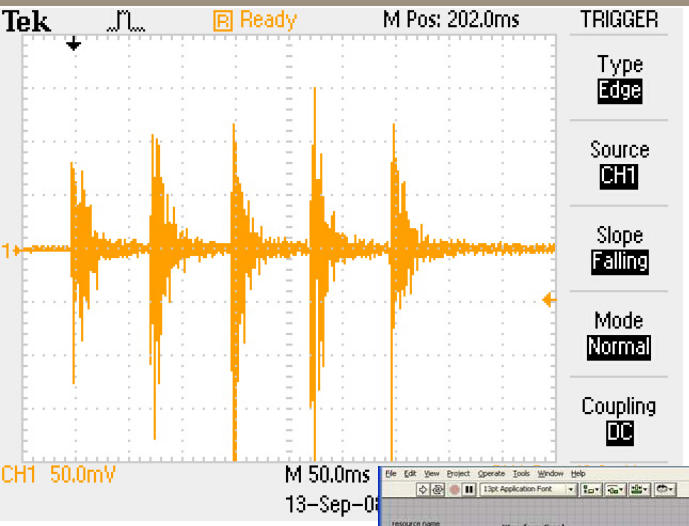


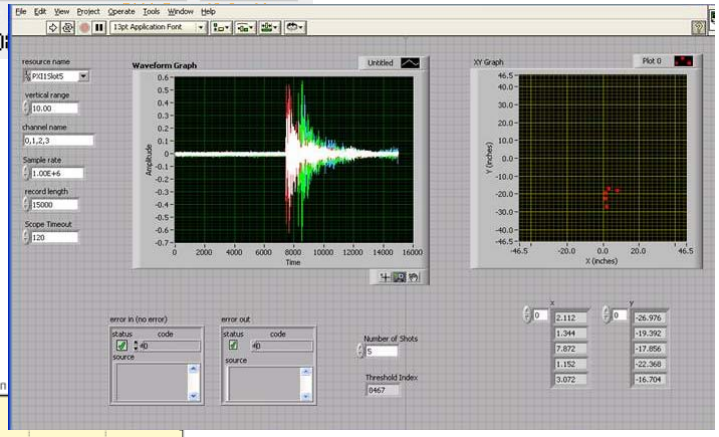


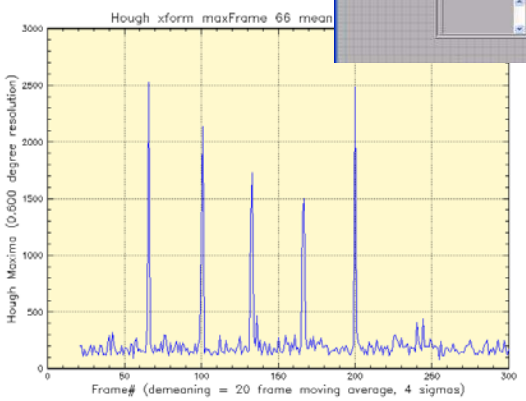


Where We Are Going: 2008 and Beyond

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- Systematic Approach
- Automation
- Real Time Data
- Quantitative Analysis
- State Of The Art Technology
- Increased Testing Capacity
- Eliminate Need For Data Entry
- Eliminate Single Point Failures
- No Downrange Personnel

How We Are Getting There

Replace the obsolete data collection and analysis systems currently used in the indoor and outdoor ballistic acceptance testing facilities, with a modern system that is compatible with current industry and government standards. Implement key projects as identified in the Ballistics QFD analysis. Automate the test range measurement systems to increase the availability of the ballistics testing functions, and to enhance efficiency, accuracy, and consistency

16 Total Projects

Automation

- **Trace Performance**
- **Accuracy**
- **Function & Casualty**
- **Range Conditions**
- **Water "Proofness"**

Upgrade/Rehab

- **EPVAT**
- **Bullet Pull**
- **Linker**
- **Velocity Screen**
- **Transducer Calibration**

Facility/Infrastructure

- **Hand Loading**
- **Accuracy Mount**
- **Mercury Lab**
- **Communications**
- **Gun Air Cooling**
- **Observation Houses**

Legacy Trace Performance Testing

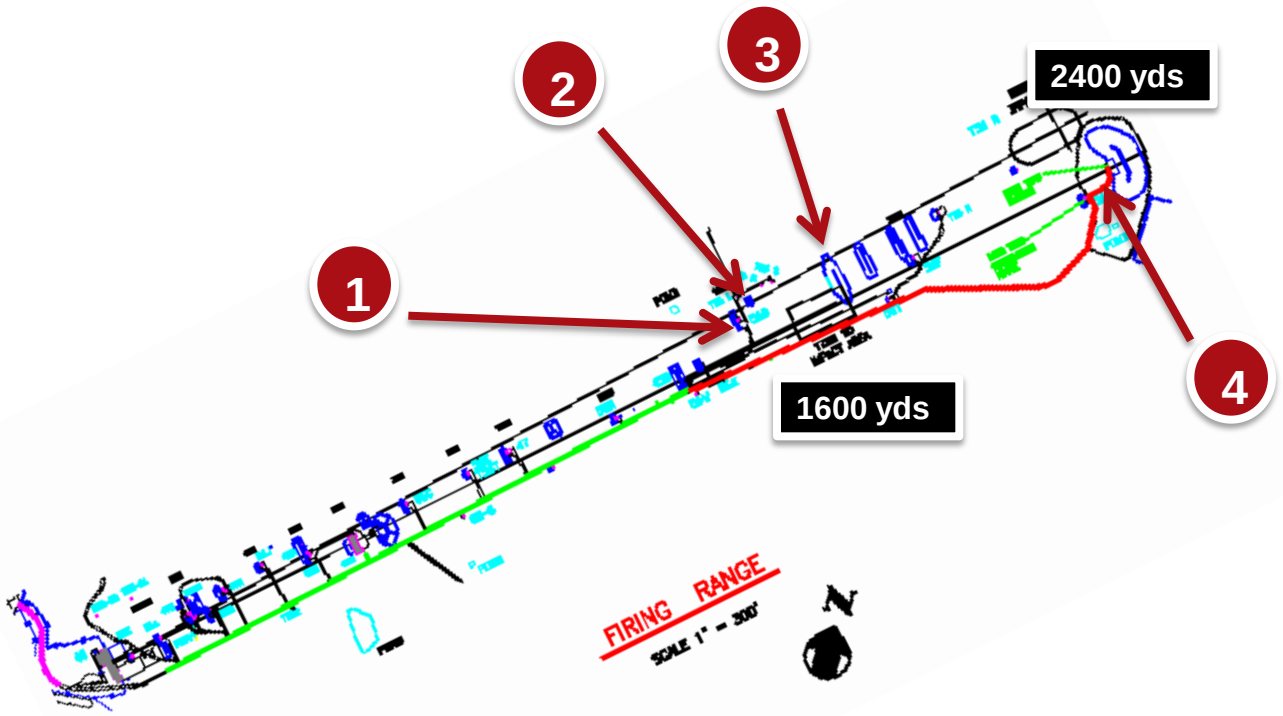
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Weapons, Ammunition, & Personnel Transport



Observation House



Legacy Trace Performance Testing Not Ideal!

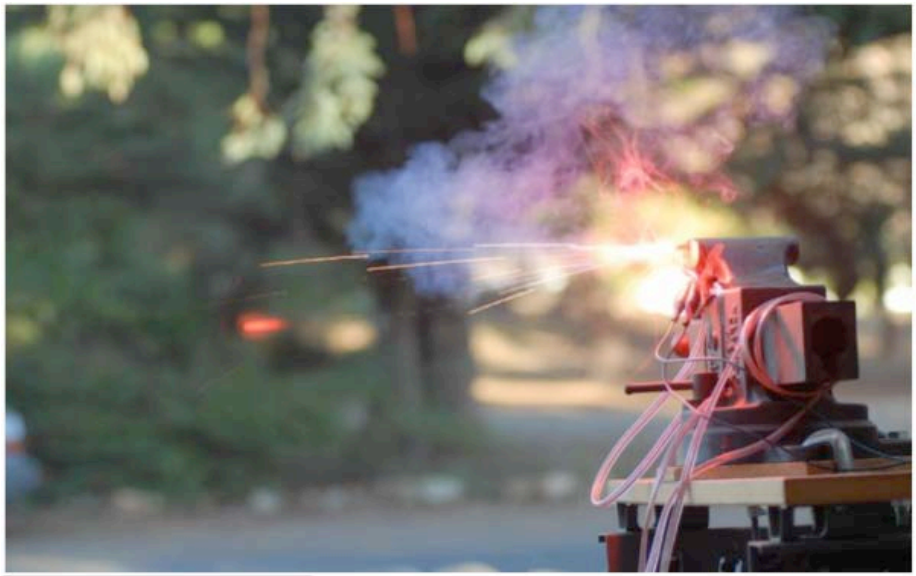
Trace Observation & Evaluation System

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Objectives

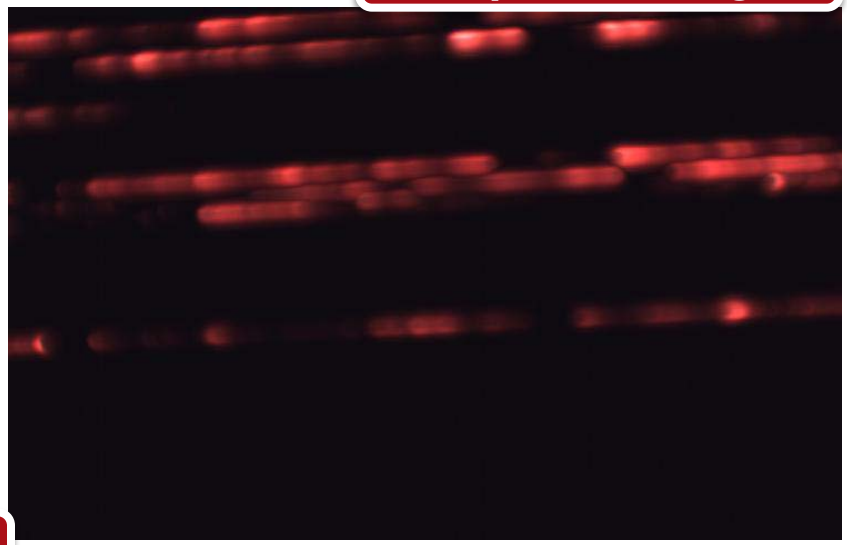
- Eliminate Downrange Observers
- Automate Pass/Fail Determination
- Retain Video
- Make Test Data Immediately Available
- Process Data In Real Time





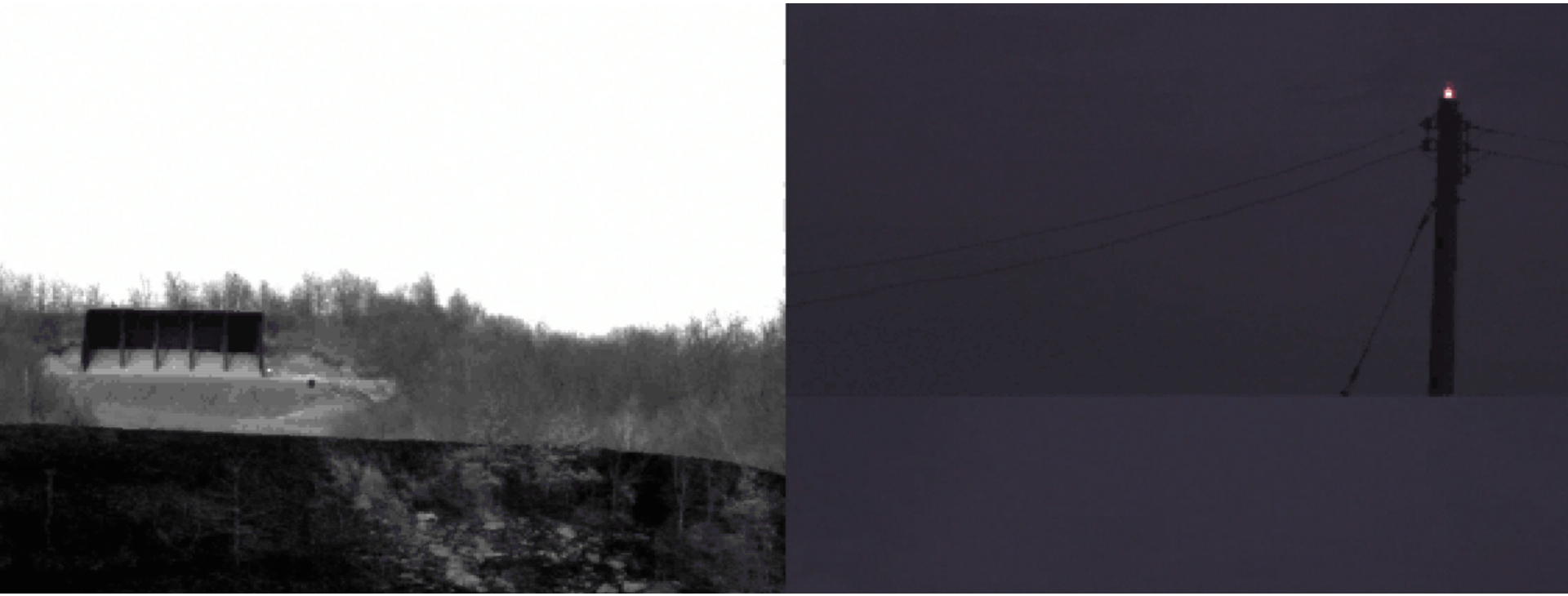
Tracer Spectral Characteristics Measured

Composite Image



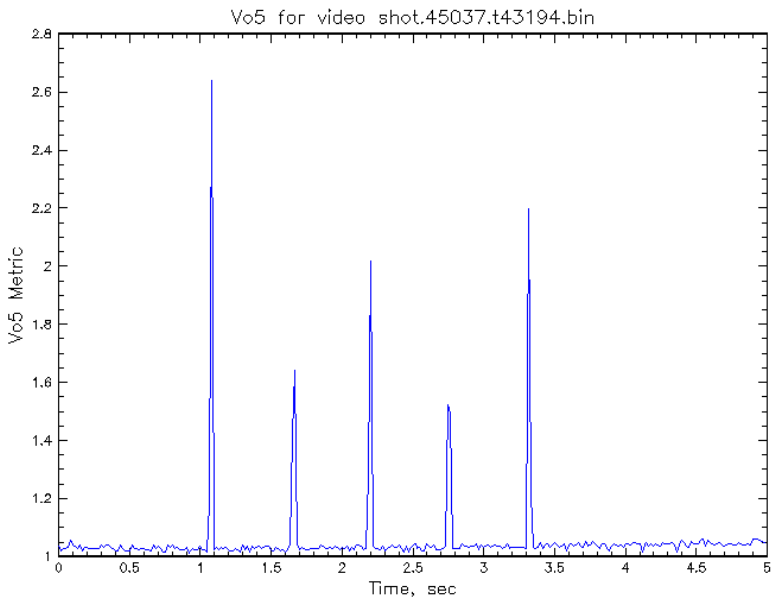
Video From 7.62mm Trace Testing

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TOES Challenges

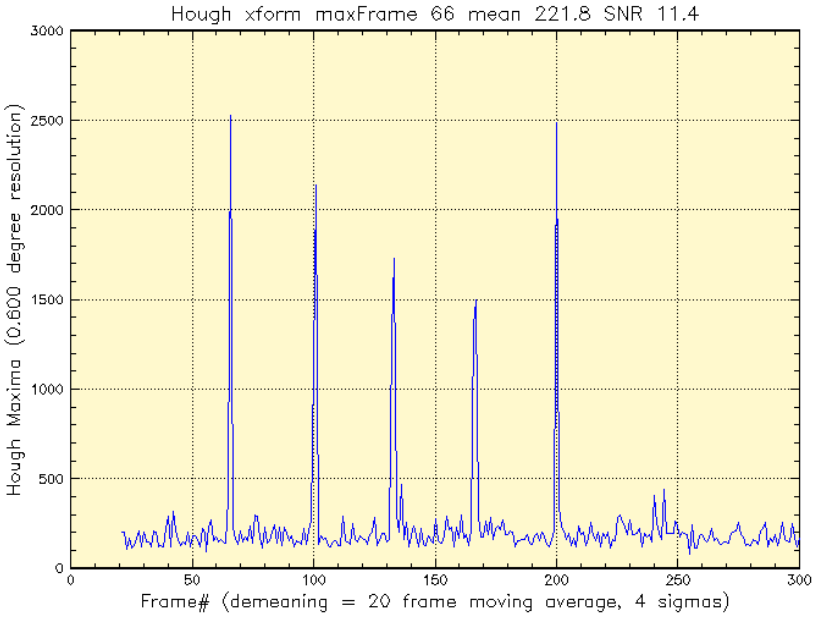
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Challenges

- Make Real Time Processing Possible
- Eliminate False Triggers
- Capture Blind Tracer Events

- Step One (Vo5 Algorithm)
  - Measures Structure
- Step Two (Hough Transform)
  - Discriminates Linear Events

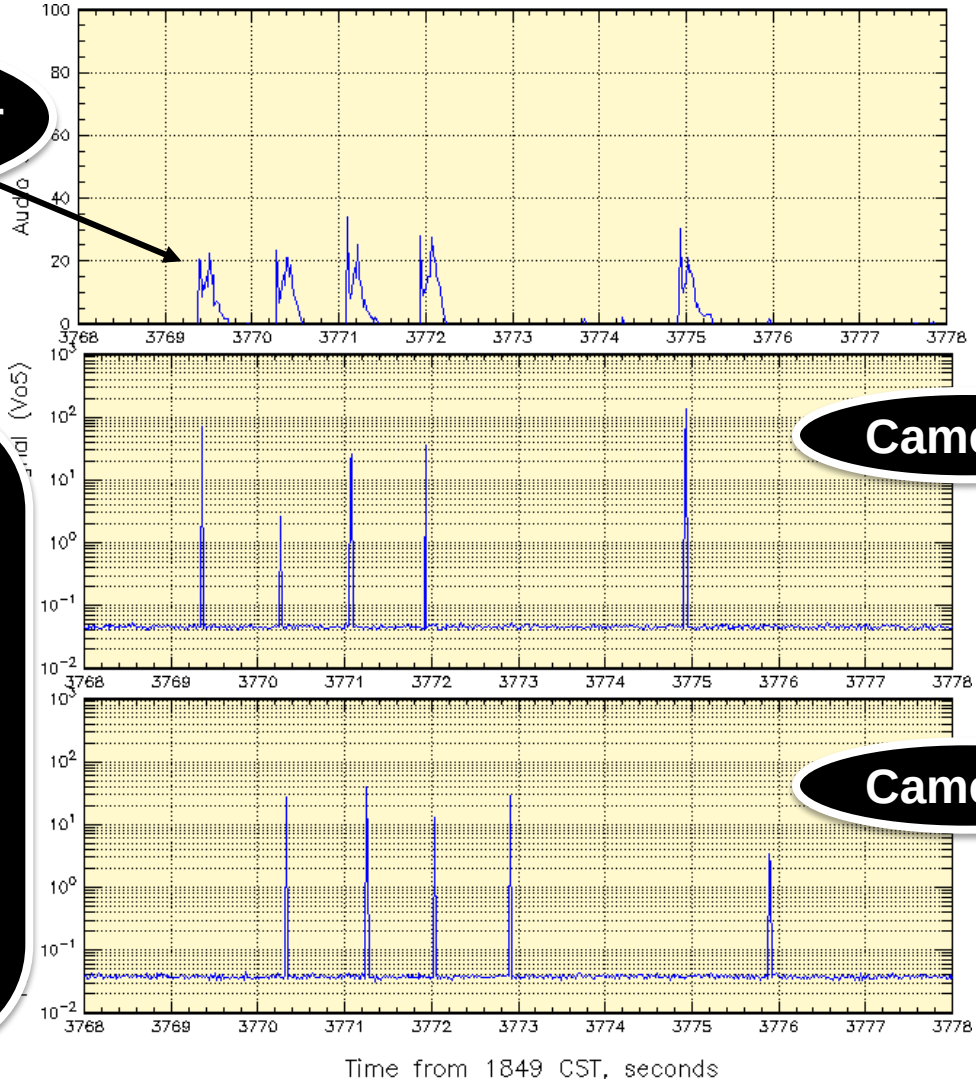


TOES Challenges

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How To See A “Blind”

Acoustic Trigger



Benefits

- Fully Automated
- No Downrange Observers
- Real Time Data
- Quantitative Analysis
- Increased Test Capacity

Legacy Accuracy

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- Operator Staples Target To Wood Frame
- Gunner Tries To Locate Center Of Target
- Gunner Fires Through Target
- Target Cut Down
- Operator Digitizes Target
- Clerk Enters Data Into Spreadsheet

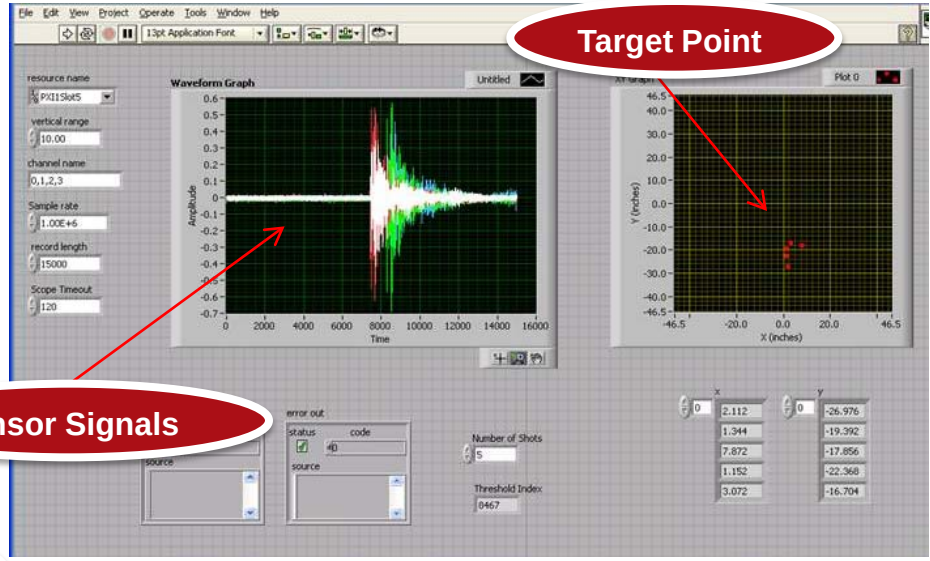


Legacy Accuracy Testing Not Ideal!

Range Accuracy Target System (RATS)

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- Projectile Passes Through Target Area
- Wave Is Induced On Aluminum Rod
- AE Sensors Receive Signals
- XY Coordinate Recorded
- Calculation Of Dispersion Characteristics
- Data Automatically Entered



RATS Results

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Paper System

- Rotational Error
- Wave Error
- Target Movement Error
- Digitizing Error
- Personnel In Line Of Fire

RATS

- Gunner Centered Easily
  - Spec Requirement
- Actual (x,y) Coordinates
- No Personnel Downrange
- Est. Accurate To 0.1” At 600 Yards

Greater Accuracy, Greater Precision

Horizontal SD

5.56mm	Mean	StD	P-Value
Paper	1.326	0.302	0.247
RATS	1.304	0.293	

Vertical SD

5.56mm	Mean	StD	P-Value
Paper	1.104	0.151	0.688
RATS	1.112	0.159	

Mean Radius

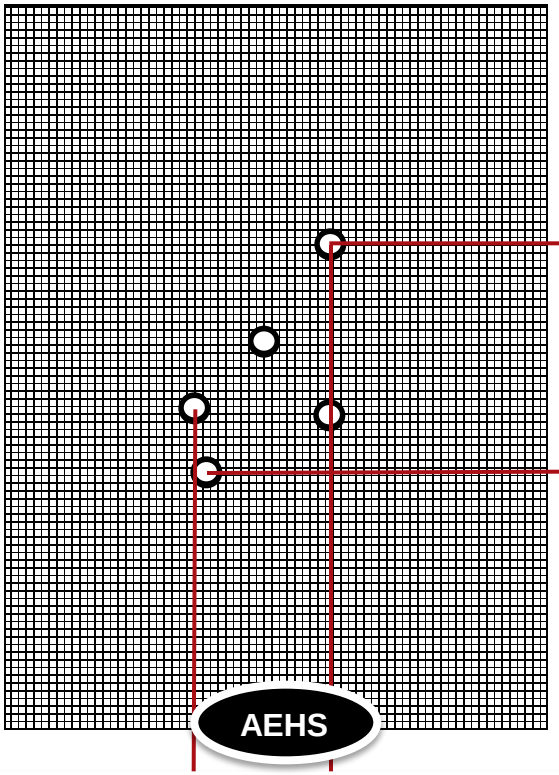
7.62mm	Mean	StD	P-Value
Paper	4.012	0.916	0.130
RATS	3.992	0.899	

50 Caliber	Mean	StD	P-Value
Paper	5.191	1.037	0.612
RATS	5.198	1.048	

Accuracy Sub-Sonic

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- Screen Type Material As A Target
- Camera Takes Images Of Fired Shots
- Coordinate Recorded, Dispersion Characteristics Calculated
- Data Is Transmitted To Server And Display Application
- Target Is Mechanically Indexed By Gunner From Firing Location

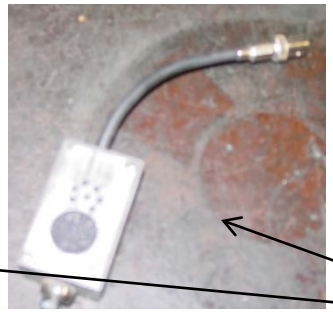
Legacy Function & Casualty

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- Acoustic Sensor Adjacent Bay Cross Talk
- Blank Rounds Measured
- Water Trap Causes Wet Environment
- Various Weapon Systems
- MSDOS Based Oehler System
- Cadence Controlled By Operator
- Excessive Manual Gain Adjustment







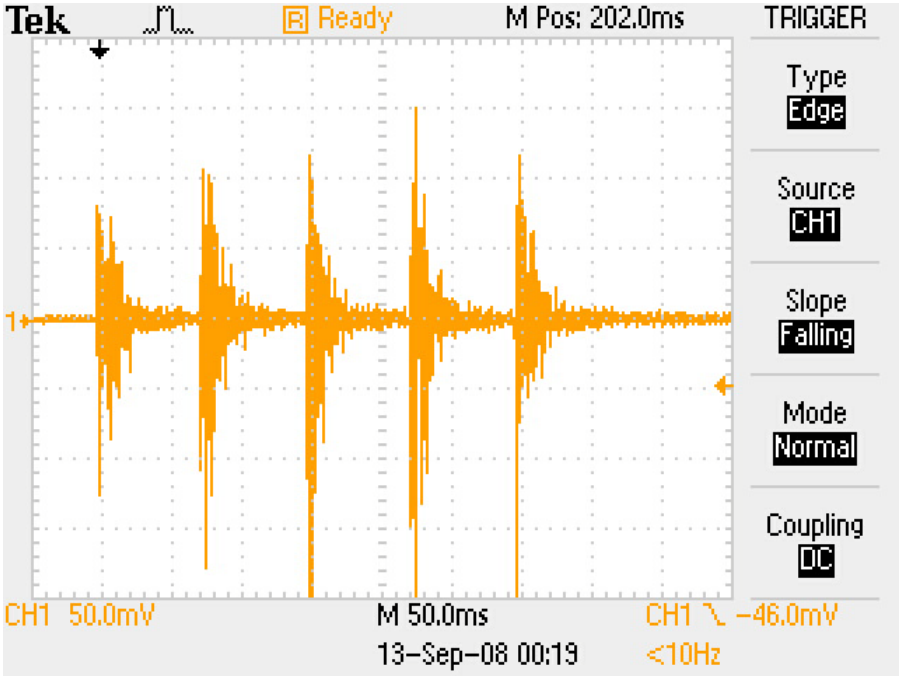
Legacy Cyclic RateTesting Not Ideal!

Not Designed For Gun Blast

Cyclic Rate Calculator (CRaC)

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- Senses Pressure Blast
- Up To 1500 RPM
- +/- 2% Of True Rate Of Fire
- Functional Weapons
- Cadence Controlled





Impact

- Systematic Approach
- Reduction In Test Cycle Time
- Quantitative Analysis
- Reduction In Personnel
- Increased Testing Capacity
- Improved Efficiency
- Significant Reduction In Data Entry
- Elimination Of Single Point Failures
- Elimination Of Downrange Personnel

Approved # OSR 09S-1471

NDIA
National Defense Industrial Association

PROMOTING NATIONAL SECURITY SINCE 1919

INTERNATIONAL INFANTRY & JOINT SERVICES

SMALL ARMS SYSTEMS

SYMPOSIUM, EXHIBITION & FIRING DEMONSTRATION

"Enhancing Small Arms Effectiveness in Current and Future Operations"



MAY 18-21, 2009

BALLY'S LAS VEGAS HOTEL ▸ LAS VEGAS, NEVADA

WWW.NDIA.ORG/MEETINGS/9610

EVENT #9610

OVERVIEW

This symposium is a premier event where the Small Arms communities come together for technical paper presentations, informational speakers and exhibits of the hardware used by current and future defense organizations. A firing demonstration is scheduled for May 20, 2009 at Nellis Air Force Base, Nevada. The symposium is expected to draw government, industry, law enforcement and international participants, in addition to a strong representation from all branches of the military.

OBJECTIVE

Facing terrorist forces from MOUT to the open battlefield, American forces — both military and law enforcement alike — require the best equipment available. Only through the efforts of government and industry working together on a wide range of technology focus areas will the tools necessary to support our soldiers, sailors, airmen and marines now and in the future be realized. These focus areas range from incremental enhancements to fielded legacy small arms systems to enabling technologies, such as fire control improvements, use of robotics, and digitalization of small arms systems on the battlefield, to name a few. This symposium seeks to bring together government and industry, manufacturers and users to support this objective for the military and law enforcement communities.



AWARD INFORMATION

CHINN AWARD

The Chinn Award is presented annually to honor a government or industry individual who, in the opinion of the Small Arms Committee Executive Board, has made significant contributions to the field of small arms and/or infantry weapons systems. A significant contribution is considered to be a creative invention, new design or innovative concept in small arms weapons, ammunition or ancillary equipment that provides an advancement in the state-of-the art or capability enhancement that clearly benefits the warfighting or general military capability of the U.S. The Chinn Award may also be conferred as recognition to an individual who has performed sustained superior service in a career field of science, engineering, test and evaluation, manufacturing program management, academic study and research, publishing or maintenance relating to military small arms or infantry weapons.

The Chinn Award is named in honor of LtCol George M. Chinn, USMC, a career Marine who dedicated his life to the study, development and refinement of machine gun mechanisms. LtCol Chinn is remembered for his work as a gun designer and for having compiled a five volume reference work entitled, "The Machine Gun."

The 2009 Chinn Award will be presented to Mr. Joel Goldman on Tuesday, May 19, 2009.

HATHCOCK AWARD

The Hathcock Award is presented to recognize an individual who, in the opinion of the Small Arms Committee Executive Board, has made significant contributions in operational employment and tactics of small arms weapons systems which have impacted the readiness and capabilities of the U.S. military or law enforcement. A significant contribution is considered to be a superior performance of duties in an operational environment or the development of tactics or training.

The Hathcock Award is named in honor of Gunnery Sergeant Carlos N. Hathcock, II, USMC, a career Marine who dedicated his life to the service of this country in both the military and law enforcement communities. He was honest, tactful, considerate, courageous, quietly proud and determined in all things and all places from the range to the battlefield. "The Gunny" not only distinguished himself in combat as a scout-sniper, but also as a competitive marksman and trainer. In his capacity as a trainer, he not only significantly impacted the current United States Marine Corps Scout-Sniper Program, but also influenced the sniper programs of the other military services and similar law enforcement programs nationwide.

The Hathcock Award will be presented to Mr. R.J. Thomas on Tuesday, May 19, 2009.

AMBROSE INDUSTRY AWARD

The Ambrose Award is established and presented periodically to recognize an Industrial Firm which, in the opinion of the Small Arms Committee Executive Board, has made outstanding contributions to the field of small arms systems. An outstanding contribution is characterized by exemplary commitment and contribution to the Armed Forces by delivering superior materiel that meets required operational capabilities and supports a high level of force readiness in the conduct of warfighting activities or homeland defense. Such contributions may be shown through a record of continual demonstration of emerging technologies, development of products and systems, establishment of enhanced production capabilities and integration of innovative weapons systems and supporting products and services required by the DoD and Allied countries. Such contributions would be easily recognized as "excellence" in industry leadership and responsiveness in cases where National security priorities require attention to meet urgent needs in either peace or war time.

The Industry Award is named in honor of former Under Secretary of the Army, James R. Ambrose because of his recognition of the value and contribution of industry in meeting the needs of our National Defense. This was made unmistakably clear during his tenure from 1981-1988 as Under Secretary of the Army during the Presidency of Ronald Reagan. He was a major force in the post Vietnam modernization of all small arms weaponry where new and improved versions of the M16, M249 and M9 were purchased in large quantities as a result of industry competitions. Under Secretary of the Army Ambrose was a strong supporter of investing in the Future Rifle Program, later known as the Advanced Combat Rifle (ACR) Program. His emphasis on the need for competition could not be clearer here, as there were as many as six contractor systems in various phases of the program and 4 firms ultimately participated in the 9-month long ACR Field Experiment, the premier rifle evaluation of all time. For his support of small arms development and procurement and his strong emphasis and actions in involving industry at every step of the way, the NDIA Small Arms Committee believes it entirely appropriate to name this award in his honor.

The 2009 Ambrose Industry Award will be presented to Otis Technologies, Inc. on Tuesday, May 19, 2009.

MONDAY, MAY 18, 2009

12:00 PM - 6:00 PM — **CONFERENCE REGISTRATION**

5:00 PM - 6:00 PM — **EXHIBIT HALL OPENS - BALLY'S EVENT CENTER**
RECEPTION IN EXHIBIT HALL - BALLY'S EVENT CENTER

TUESDAY, MAY 19, 2009

7:00 AM - 7:55 AM — **CONTINENTAL BREAKFAST - GRAND SALON**

7:00 AM - 6:00 PM — **CONFERENCE REGISTRATION**

7:55 AM — **WELCOME AND ADMINISTRATIVE REMARKS - PLATINUM BALLROOM**
- Mr. Sam Campagna, *Director, Operations, NDIA*
- Mr. Brian Berger, *Chairman, Small Arms Committee, Vice President and General Manager, GD-OTS Simunition Operations*

8:10 AM — **CONFERENCE KEYNOTE ADDRESS**
- Mr. Anthony Melita, *OUSD, (Acquisition, Technology, & Logistics) Land Warfare & Munitions*

8:30 AM — **CONFERENCE KEYNOTE ADDRESS**
- Brigadier General Peter N. Fuller, *Program Executive Officer, Program Executive Office (PEO) Soldier*

8:50 AM - 10:10 AM — **SESSION I - JOINT SERVICE SMALL ARMS SYNCHRONIZATION TEAM (JSSAST) - 8501**
- Session Chair: COL Karl Scott Flynn, *Chairman, JSSAST*
- Panel Members: LTC Thomas Henthorn, USA
  CAPT Pat Sullivan, USN
  Col Patrick Lopardi, USAF
  Col Andrew Bianca, USMC
  CAPT Scott Genovese, USCG
  Mr. Nyle Wilcock, SOCOM
  COL Douglas Tamilio, USA
  Mr. Kevin Swenson, *Joint Non Lethal Weapons Directorate*

9:30 AM — **EXHIBIT HALL OPENS**

10:10 AM — **BREAK IN EXHIBIT HALL - BALLY'S EVENT CENTER**

10:40 AM — **2009 SMALL ARMS SECTION AWARDS**

Chinn Award
Recipient: Mr. Joel Goldman
Presented by: Mr. Brian Berger

Hathcock Award
Recipient: Mr. R.J. Thomas
Presented by: Mr. Jim Kauber and Mr. Gus Taylor

Ambrose Award
Recipient: Otis Technology, Inc.
Presented by: Mr. Brian Berger and Mr. Charles Buxton

NDIA Professional Service Awards
Recipient: Mr. Hays Parks
Presented by: Mr. Richard Audette

NDIA Professional Service Awards
Recipient: Mr. Volker Kurtz
Presented by: Mr. Jim Schatz and Mr. Charles Buxton

11:20 AM
PLANS FOR JOINT 2010 GUN & MISSILE AND SMALL ARMS SYSTEMS SYMPOSIUM - Dallas, TX
- Mr. Greg Hill, *Director of Marketing, Ordnance Systems Meggitt Defense Systems, Inc.*

11:40 AM - 1:10 PM
LUNCHEON WITH SPEAKER - GOLD BALLROOM
- Hall Breechloaders: "A Long Step From The Beaten Path" - 8287
  Dr. Stephen C. Small, *JSSAP/ARDEC*

1:10 PM - 1:30 PM
KEYNOTE ADDRESS
- Mr. Bill Sanville, *PM Non-Standard Ammunition*

1:30 PM - 2:10 PM
SESSION II - PM MANEUVER AMMUNITION SYSTEMS
- Mr. Chris Grassano, *PM MAS*
- LTC Christopher Seacord, *Product Manager, Medium Caliber Ammunition*
- LTC Jeffrey Woods, *Product Manager, Small Caliber Ammunition*

2:10 PM - 5:00 PM
SESSION III - SMALL ARMS AMMUNITION AND TECHNOLOGY
- Session Chair: Mr. James Taylor, *ATK*

2:10 PM
FACTORS INFLUENCING DISPERSION OF SMALL CALIBER AMMUNITION - 8356
- Mr. Jeff A. Siewert, *Arrow Tech Assoc., Inc.*

2:30 PM
U.S. ARMY SOLDIER WEAPONS AMMUNITION DEVELOPMENT - 8519
- Mr. Robert Zienowicz, *U.S. Army, Picatinny Arsenal*

2:50 PM
MAKING BULLETS GLOW IN DARK: INVENTING HYBRID ILLUMINESCENT AMMUNITION - 8455
- Dr. William A. Hollerman, *University of Louisiana at Lafayette*

3:10 PM
ENHANCED FORCED ENTRY - THE RHEINMETALL ARGES 40MM X 46 DOOR BREACHING CARTRIDGE - 8512
- Mr. Brian T. Sullivan, *American Rheinmetall Munitions, Inc.*

3:30 PM
BREAK IN EXHIBIT HALL - BALLY'S EVENT CENTER

4:00 PM
U.S. NAVY SMALL ARMS AMMUNITION ADVANCEMENTS - 8524
- Mr. Charles Marsh, Mr. Jarod Stoll, Mr. Graham Endris, *NSWC*
- Mr. David Leis, *Federal Cartridge Company*

4:20 PM
THE M200 HEDP, A NEW GENERATION RIFLE GRENADE - 8527
- Mr. Steve Dart, *Mecar USA*

4:40 PM
LIGHTWEIGHT AMMUNITION DESIGN - 8550
- Mr. Vincent Battaglia, *COLTS DEFENSE LLC & BML Tool & Mfg. Corp*

5:00 PM - 6:00 PM
RECEPTION IN EXHIBIT HALL - BALLY'S EVENT CENTER

*6:*00 PM
EXHIBIT HALL CLOSES

WEDNESDAY, MAY 20, 2009

7:00 AM - 1:30 PM
CONFERENCE REGISTRATION

7:00 AM - 7:45 AM
CONTINENTAL BREAKFAST - GRAND SALON

7:45 AM
ADMINISTRATIVE REMARKS - PLATINUM BALLROOM
- Mr. Sam Campagna, *Director, Operations, NDIA*

7:50 AM	**KEYNOTE SPEAKER** ▸ LTC Thomas Henthorn, *U.S. Army*
8:10 AM - 9:50 AM	**SESSION IV - JSSAP** ▸ Session Chair: Mr. Joel Goldman, *JSSAP, ARDEC*
8:10 AM	**MODELING AND SIMULATION THROUGHOUT THE SMALL ARMS AQUISITION LIFE CYCLE - 8525** ▸ Mr. Timothy Fargus, *U.S. Army ARDEC*
8:30 AM	**MODELING OF GAS FLOW AND HEAT TRANSFER IN SMALL ARMS WEAPON SYSTEMS - 8513** ▸ Dr. Laurie A. Florio, *U.S. Army ARDEC*
8:50 AM	**ADVANCED SMALL ARMS FIRE CONTROL TECHNOLOGY (ATO) - 8514** ▸ Mr. Terence F. Rice, *U.S. Army ARDEC*
9:10 AM	**ADVANCED SMALL ARMS LETHAL ARMAMENT TECHNOLOGY (ATO) - 8537** ▸ Mr. Shawn P. Spickert-Fulton, *U.S. Army ARDEC*
9:30 AM	**EXHIBIT HALL OPEN - BALLY'S EVENT CENTER**
9:30 AM	**LIGHTWEIGHT SMALL ARMS TECHNOLOGIES - 8536** ▸ Mrs. Kori Phillips, *JSSAP, U.S. Army ARDEC*
9:50 AM	**BREAK IN EXHIBIT HALL - BALLY'S EVENT CENTER**
10:20 AM - 11:50 AM	**SESSION V - SMALL ARMS AS A SUBSYSTEM OF NATO DISMOUNTED SOLDIER SYSTEM OF SYSTEMS PROGRAMMES - 8502** ▸ Session Chair: LTC Mike Bodner, *Chairman, NATO LCG 1, Directorate of Land Requirements (DLR) Department of National Defence, Government of Canada*
11:30 AM	**EXHIBIT HALL CLOSES**
11:50 AM	**DIVISION REPORT AND ACTIVITY** ▸ Mr. Dave Broden, Chair, Armaments Division; *Broden Resource Solutions, LLC*
12:10 PM - 1:40 PM	**SESSION VI - SOLDIER WEAPONS - (PANEL)** ▸ Session Chair: COL Douglas Tamilio, *PM Soldier Weapons* ▸ Panelists: Mr. Richard Audette, *Deputy PM Soldier Weapons* LTC Michael Ascura, *PM Crew Served Weapons* TBD, *PM Individual Weapons*
1:50 PM	**BOARD BUSSES FOR FIRING DEMONSTRATION AT NELLIS AIR FORCE BASE (LOAD BUSES AT BALLY'S HOTEL NORTH DOOR/FLAMINGO ENTRANCE)**
3:00 PM - 5:30 PM	**SESSION VII - CONTRACTOR FIRING DEMONSTRATION** ▸ Session Chair: Mr. Sal Fanelli, *U.S. Marine Corps*
4:30 PM	**FIRST BUS RETURNS TO HOTEL**
6:30 PM	**LAST BUS RETURNS TO HOTEL**

THURSDAY, MAY 21, 2009

7:00 AM - 4:00 PM — **CONFERENCE REGISTRATION**

7:00 AM - 7:30 AM — **CONTINENTAL BREAKFAST - GRAND SALON**

7:30 AM — **CALL TO ORDER AND REMARKS - PLATINUM BALLROOM**
- Mr. Sam Campagna, *Director, Operations, NDIA*
- Mr. Brian Berger, *Chairman, Small Arms Committee; Vice President and General Manager GD-OTS Simunition Operations*

7:40 AM — **KEYNOTE SPEAKER**
- Col Richard Eric Burns, *OUSD, Advanced Systems and Concepts, Comparative Testing Office, DoD*

8:00 AM - 9:40 AM — **SESSION VIII - FIRE CONTROL SYSTEMS**
- Session Chair: Mr. John Edwards, *U.S. Army ARDEC*

8:00 AM — **CREW SERVED WEAPONS ACCESSORIES: INTEGRATED TARGETING AND ILLUMINATION - 8419**
- Mr. Michael H. Jones, *NSWC Crane*

8:20 AM — **USING 40MM AGL AS A PRECISION WEAPON AT LONG RANGES - 8473**
- Dr. Daniel Corriveau, *Defence R&D Canada*

8:40 AM — **CONTROL AND GUIDANCE OF 40MM SPIN STABILIZED PROJECTILES - 8517**
- Dr. Tomas Svitek, *Stellar Exploration*

9:00 AM — **A NEW INTEGRATED DAY AND NIGHT FIRE CONTROL SYSTEM FOR 40MM GRENADE WEAPONS - 8389**
- Mr. Bill Dunnill, *Vectronix, Inc.*

9:20 AM — **RAZAR: RAPID ADAPTABLE ZOOM FOR AUTOMATIC RIFLE - 8539**
- Dr. Brett E. Bagwell, *Sandia National Laboratories*

9:40 AM — **BREAK - GRAND SALON**

10:10 AM - 11:10 AM — **SESSION IX - FIRE CONTROL PANEL - 8556**
- Session Chair: Mr. John Edwards, *U.S. Army ARDEC*

11:10 AM - 11:25 AM — **SESSION X - NATIONAL SMALL ARMS CENTER UPDATE - 8479**
- Session Chair: Frank Puzycki, *U.S. Army ARDEC*
- Mr. Karl Lewis, *Lewis Machine & Tool Company*

11:25 AM - 11:40 AM — **LIGHTWEIGHT SMALL CALIBER AMMUNITION - UPDATE**
- Mr George Feghali, *General Dynamics OTS Canada*

11:40 AM - 3:10 PM — **SESSION XI - WEAPONS**
- Session Chair: Mr. Jeffrey D. Johnson, *NSWC Crane*

11:40 AM

TIME FOR A CHANGE - US "INCREMENTAL" SMALL ARMS FIELDING - STATUS REPORT 2009 - 8272
- Mr. Jim Schatz, *Time4ChangeTeam*

12:10 AM

M2 BARRELL EXTENSION IMPROVEMENTS - 8478
- Mr. Jonathan Piazza, *Principal Project Engineer, General Dynamics Armament & Technical Products*

12:30 PM - 1:30 PM

LUNCHEON WITH SPEAKER - GOLD BALLROOM
- The Modernization and Expansion of Ballistic Test Capabilities at the Lake City Army Ammunition Plant
  Ms. Stefana Reilly, *ATK*

1:30 PM

SHRIKE 5.56 – ADVANCED WEAPONS SYSTEM™ - 8583
- Mr. Geoffrey A. Herring, *President and CEO, Ares Defense Systems, Inc.*

1:50 PM

ROTARY WING CREW SERVED WEAPON INTEGRATION - 8423
- Mr. Nigel Wasil, *NSWC Crane*

2:10 PM

THE 20MM ANTI-MATERIAL RIFLE: A NEW USE FOR UNUSED AMMUNITION - 8503
- Mr. David P. Armstrong, *NSWC Crane*

2:30 PM

USSOCOM WEAPON SHOT COUNTER (WSC): PROVIDING MORE THAN ROUND COUNT - 8469
- Mr. Jason M. Davis, *NSWC Crane*

2:50 PM

SOUND SUPPRESSOR SPECIFICATION AND SOUND MEASUREMENT - 8453
- Mr. Owen Cramer, *SAIC/Naval Surface Warfare Center*

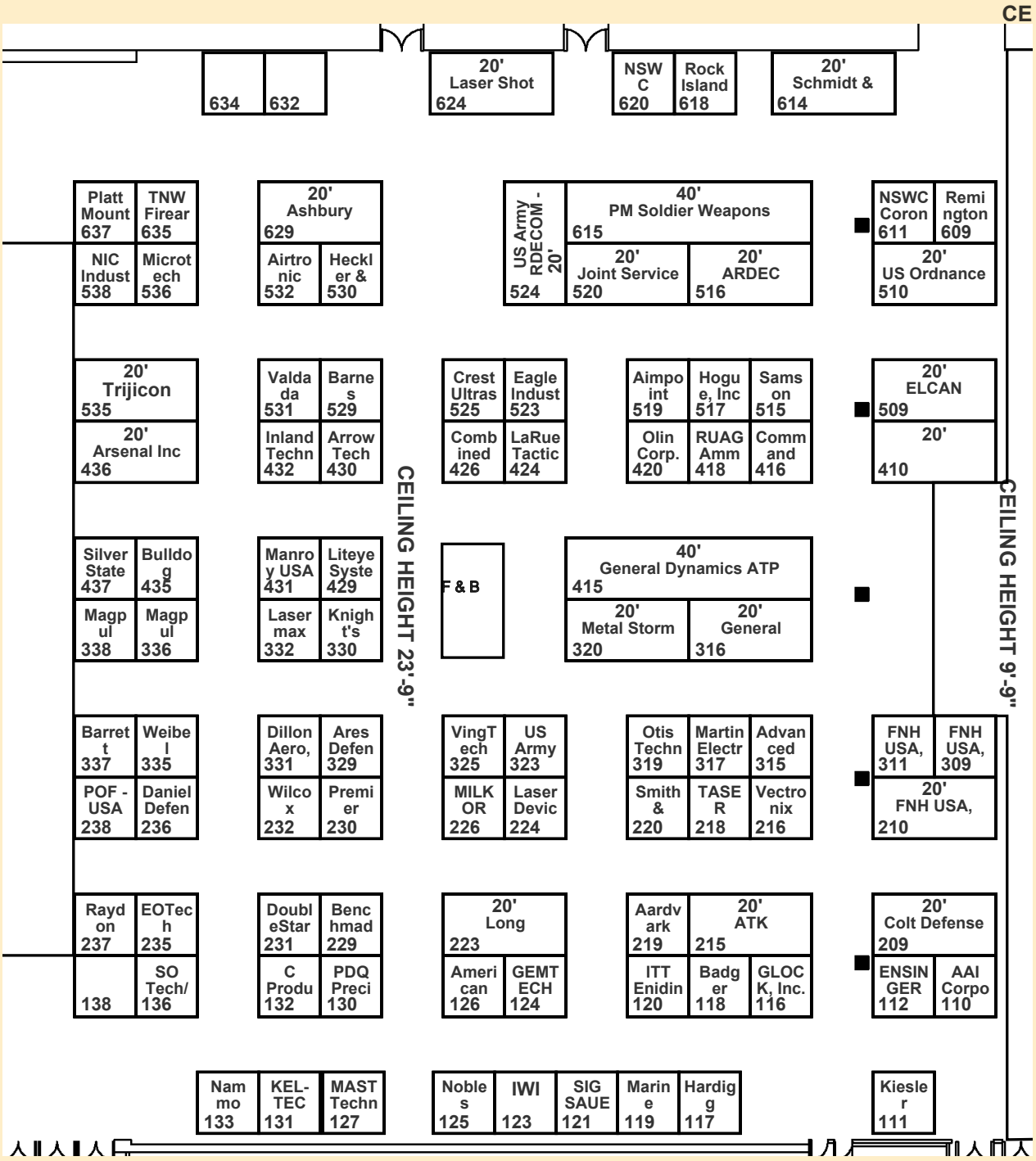
3:10 PM

SESSION XII - 40MM GRENADE IMPROVEMENTS PANEL
- Session Chair: Mr. Dave Broden, *Broden Resource Solutions, LLC*
- Panelists: Mr. James Grassi, *U.S. Army ARDEC*
  Mr. Christopher Summa, *U.S. Army ARDEC*
  Mr. Adam Sorchini, *U.S. Army ARDEC*
  Mr. Jason Wasserman, *U.S. Army ARDEC*

3:50 PM

CLOSING REMARKS
- Mr. Sam Campagna, *Director, Operations, NDIA*
- Mr. Brian Berger, *Chairman, Small Arms Committee, Vice President and General Manager, GD-OTS Simunition Operations*

EXHIBITOR FLOOR PLAN (as of 5/11/09)



ADDITIONAL AUTHORS

ABSTRACT ID	TITLE	SALUTATION
8272	Time for a Change - U.S. “Incremental” Small Arms Fielding - Status Report 2009	Mr. Jim Schatz
8356	Factors Influencing Dispersion of Small Caliber Ammunition	Mr. Tim Janzen
8389	A New Integrated Day and Night Fire Control System for 40mm Grenade Weapons	Mr. James Teetzel and Mr. Jos van Seeters
8455	Making Bullets Glow in the Dark: Inventing Hybrid Luminescent Ammunition	Mr. Brady Broussard, Mr. Noah Bergeron and Mr. Ross Fontenot
8479	NSAC Progress Report	Mr. Frank Puzycki and Mr. Karl Lewis
8502	Small Arms as a Sub-system of NATO Dismounted Soldier System of Systems Programmes	Mr. Mark Richter
8504	Lightweight Small Caliber Ammunition - Update	Mr. Lucian Sadowski and Mr. Mark Leng
8507	Development of a 40mm High Velocity Single Chamber Cartridge Case	Mr. Peter Martin
8517	Control and Guidance of 40mm Spin Stabilized Projectiles	Mr. Brian J. Riskas
8524	US Navy Small Arms Ammunition Advancements	Mr. Jarod Stoll, Mr. Graham Endris and Mr. David Leis
8525	Modeling and Simulation Throughout the Small Arms Acquisition Lifecycle	Mr. Alexander Lee and Mr. Michael Wilson
8527	The M200 HEDP - A New Generation Rifle Grenade	Mr. Simon Haye and Mr. Christophe Soleil
8529	The Modernization and Expansion of Ballistic Test Capabilities at the Lake City Army Ammunition Plant	Mr. Daniel Huang
8536	Lightweight Small Arms Technologies - Annual Update	Mr. Paul Shipley
8539	RAZAR - Rapid Adaptive Zoom for Automatic Rifles	Dr. David Wick, Mr. John Edwards and Dr. Robert Batchko
8540	Advantages of a Multi-Caliber Infantry Weapon for the Military	Mr. Gwinn Mack

Thank You to Our Promotional Partners!

ATK



SCHULER

ATK is a premier aerospace and defense company with $4.5 billion in annual sales, more than 17,000 employees, and operations in 21 states. We bring non-traditional approaches to the market, with speed and innovation. ATK has signature expertise in delivering timely, advanced and affordable capabilities with reliable performance – in many cases economically upgrading current inventories with force multiplier affect.

ATK continues to expand its business as a leading provider of enhanced lethality and survivability solutions with core competencies in facility and supply chain management; small-and medium-caliber ammunition design and manufacture, medium-caliber gun system design and manufacture, and advanced propellant and energetics production. We are the technology leader in law enforcement, hunting and shooting sports ammunition, accessories and reloading supplies.

Our product line spans the breadth of individual and crew-served applications, from conventional and special-mission pistol and rifle ammunition, to 30mm and large-caliber for air, land and sea platforms. We have extended our supply chains to include not only U.S. and NATO specification ammunition, but non-standard product as well. We are pioneering the development of enhanced tactical ammunition, including air bursting munitions, next generation energetics, and advanced propellants that will increase performance. ATK continues to enter new international markets supporting U.S., NATO, and allied forces with affordable, interoperable solutions in support of freedom.

ATK brings unmatched reliability and lethality in integrated weapon systems. We offer added value with fully integrated electronics and fire control capabilities supporting our innovative chain gun technology and medium-caliber ammunition systems, presenting a complete lethality package for today's ground and air platforms. We manufacture the well-known Bushmaster line of chain gun systems for ground, naval and air armament applications, which includes the M242 25mm cannon for the Bradley Fighting Vehicle, the MK44 30/40mm cannon selected by the U.S. Marine Corps for the Expeditionary Fighting Vehicle, and the 30mm M230 cannon for the AH-64 Apache and Apache Longbow helicopters. We now also produce the Mk19 Grenade Machine Gun and the Palletized Autonomous Weapon System (PAWS).

Additional ATK news and information can be found at www.atk.com.

Almost 25 years ago in Upstate New York's Black River Valley, Otis Technology, Inc. was founded by Doreen Williams Garrett. At that time the 16 year old entrepreneur patented her first compact gun cleaning kit and it was carried in a shoe polish tin. The company and the product were known as The Whole Kit & Caboodle. The company that began at the kitchen table of the Williams home is family owned and operated still today. Within the community and the industry, Otis remains supportive and loyal, leaving a large positive mark on a small community. The Management maintains a family oriented structure for its employees. Otis is involved with the AUSA, the American Heart Walks, Relay for Life, Bowl for Kids Sake, and holds an annual Invitational Golf Outing for Charity. Jerry Williams, former Director of Military Sales and father of the CEO and the VP's of Otis, spent many years as an instrumental member of the NDIA board while aiding in the growth of the company. Currently, Otis' Director of Military Sales, Brad McIntyre sits on the NDIA Executive Board.

Today, Otis Technology, Inc. is the manufacturer of the most advanced gun cleaning systems in the world. Otis believes in staying on the cutting edge of technology, and listening to the voice of the customer to create state of the art, high quality products. As the creator of Breech-to-Muzzle ™ cleaning systems, Otis Technology is highly regarded by experts as the industry leader in firearm maintenance products. Otis offers many gun cleaning advancements and refinements developed for the military, as well as and competitive marksmen and hunters. By cleaning Breech-to-Muzzle ™, dirt and fouling is pulled out the muzzle, not pushed back into the action, gumming the trigger or causing malfunctions.

Among the many awards that Otis Technology, Inc has received are the 2008 DSCC Silver Award for quality performance as a government contractor and the 2008 Fast track 50 Award for being the number one fastest growing business in Central New York. All Otis products and components are USA made, with ninety-eight percent manufactured in house at their Lyons Falls, NY facility. Each Otis cleaning system comes with detailed information on how to properly clean and care for your firearm. A firearm is an investment, and should be treated as such. The Otis System will last a lifetime! You'll spend more time shooting and less time cleaning!

To learn more about Otis Technology, Inc. and their products visit www.otisgun.com or call 1-800- OTIS-GUN.

NDIA Fire Control Panel
2009 May 21

L-3 Communications

Integrated Optical Systems

Brashear Division

Brashear Fire Control Legacy

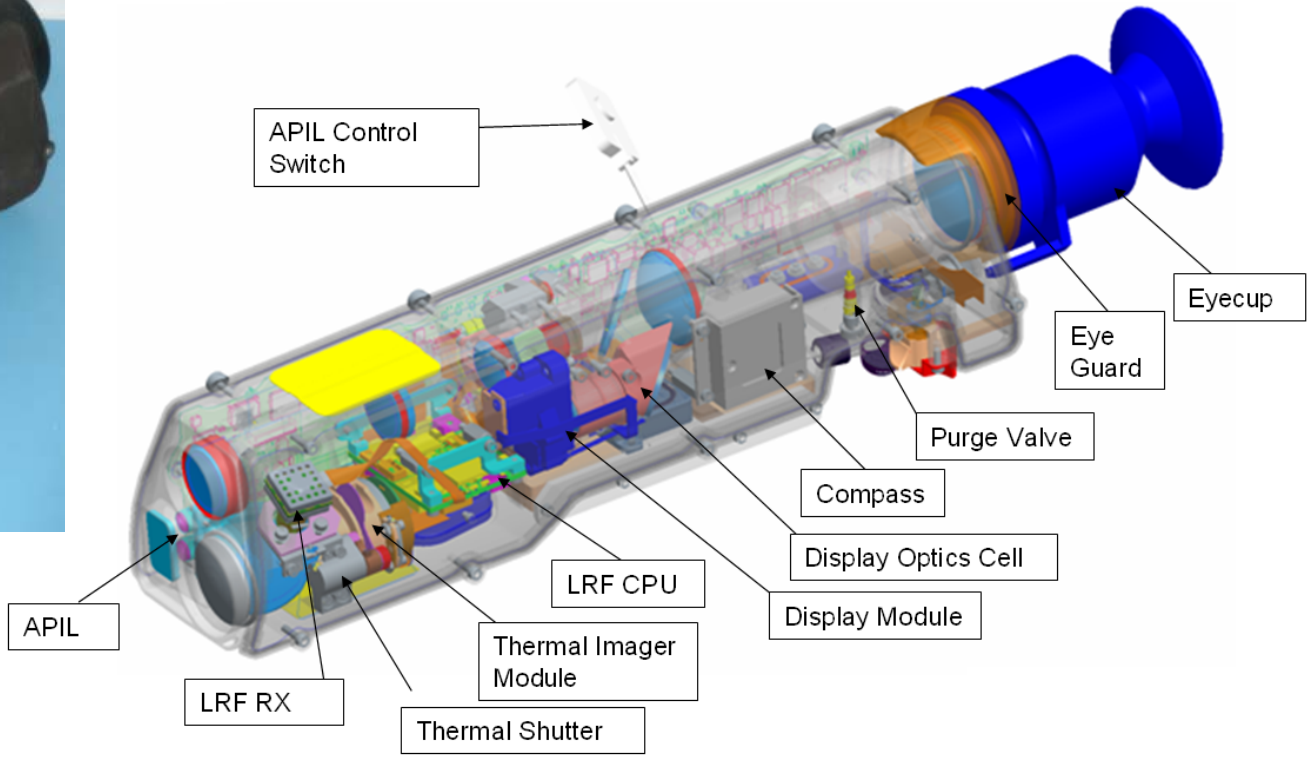












Thought-Provoking Question #1 (part 1)

What potential unique functionality will be available to the ground warfighter that offers paradigm breakthrough?

- *Integrated day / night / "all weather" combat sight*
  - Enabled by dual band sensor and color display of fused imaging.
  - For example, fused SWIR & LWIR, or selectable integrated direct-view optic & LWIR.
  - Eliminate added weight and unfavorable weight distribution of "clip-ons" by designing compact system for dual-band use from the start.
  - Provides seamless ease of use by soldier and increased DRI performance against targets.

Thought-Provoking Question #1 (part 2)

- Digital battlefield connectivity and information flow
  - **Expect more frequent cooperative, handoff, and NLOS style engagements**
    - *Scouts send back info to small group via network*
    - *Expect overhead imaging keyed to map info and absolute targeting coordinates*
    - *Enabled by fire control (rangefinder) integrated with GPS & northseeking unit*
  - **The soldier needs more INFO, not more DATA**
    - *The answer is not moving more video pixels around a network*
    - *Instead, provide targeting info and target cueing info fused with situational awareness view*
  - **Use limited-range transceivers to create a self-organizing network**
    - *Share local targeting information and target cueing information*
    - *My buddy is engaging a target…where is his target in my FOV?*

Thought-Provoking Question #3 (part 1)

What Doctrine or Operations alterations could be enabled through enhanced capabilities of small arms fire control?

- *Tactical fire control system improvements*
  - Counter-defilade capability of airburst weapon system with fire control (IAWS / “XM25”)
  - Add to this - Automated target tracking and lasing for accurate range to evasive targets.
    - *Results in increased P(h) for airburst / counter-defilade weapon system.*

Thought-Provoking Question #3 (part 2)

- *More pervasive deployment of tactical fire control systems (for example, on M4)*
  - Compact, simple to use (“unthinking use”) fire control to increase long range accuracy of every soldier using M4 while maintaining CQB capability of combat optic.
  - Results in increased P(h) and increased effective range of weapon.

Thought-Provoking Question #8

Any comments relative to projection for full spectrum warfighter capable systems encompassing CCO like capability (CQB) with added capability of advanced fire control (extend range)?

- *Rapid, accurate engagement without needing time for cheek weld and sight picture acquisition*
  - Near-to-eye display of virtual reticle.
  - Enabled by small lightweight low power cameras and heads-up transparent display module.
  - Results in decreased time to put effects on target.
  - Combat optic with adjusted aimpoint increases P(h) at extended range.

Backup

Other Issues

- Pervasive use of RWS with crew-served weapons
- Robotic “dog” with enhanced senses
  - Sniper detection?
  - House clearing?
- Need to improve efficiency of house clearing ops
- Wide FOV foveated NVG
- Higher fidelity, all-at-once thru-the-wall viewing could change tactics
- NLOS and handoff engagements face doctrinal issues because soldier who pulls the trigger did not ID the target

1. What potential unique functionality will be available to the ground warfighter that offer paradigm breakthrough.
2. Crew served fire control on and off vehicles and the standalone fire control vs vehicle fire control.
3. What Doctrine or Operations alterations could be enabled through enhanced capabilities of small arms fire control.
4. Describe complexity challenges for seemless ease of use operations by the warfighter.
5. What are the prime areas for miniaturization.
   1. Smaller pixel sensors, lower power electronics,
6. Comment on the advantages and disadvantages of Common module approach.
7. Where are specific investments needed for the Advanced Fire Control capability for the warfighter with boots on the ground?
8. Share comments relative to projection for full spectrum warfighter capable systems encompassing CCO like capability (CQB) with added capability of advanced fire control (extend range).
9. With the DOD review of major programs on-going, what is your view of ground warfighters affordably increasing battlespace influence with small arms fire control, including performance and timeliness.

2009 National Defense Industrial Association's

International Infantry & Joint Services Small Arms Systems Symposium

2009 NDIA Small Arms Fire Control Panel

Panel Members

Lennart Ljungfelt – Aimpoint
Bruce Lerner – Battelle Labs
Dr. Blaise Canzian – L-3 Comm. Brashear
Torgrim Jorgensen, VingTech
Jos van Seeters – Vectronix
Jim Teetzel Wilcox Industries

2009 NDIA Fire Control Panel

- Request that panel not present a marketing approach, rather consider examples of topics below;
  - Operational Capability Improvements
    - Increased Probability of Hit
    - Increased Effective Range
    - Decrease time to put effects on target
    - All environment weather capability
  - Total Ownership Characteristics
    - Lifecycle Cost
    - Reliability
    - Maintainability-complexity
    - Durability
    - Weight
  - Target Acquisition
    - Detection
    - Recognition
    - Classification
    - Identification
  - Network Enabled
    - Data Gathering
    - Soldier as a Sensor
- Thought provoking topics to lead the community and audience to an increased awareness to <u>emerging technology, designs and application</u> for Small Arms Fire Control <u>is the objective</u>.

2009 NDIA Fire Control Panel

- Questions Suggestions:

1. What potential unique functionality will be available to the ground warfighter that offer paradigm breakthrough.
2. Crew served fire control on and off vehicles and the standalone fire control vs vehicle fire control.
3. What Doctrine or Operations alterations could be enabled through enhanced capabilities of small arms fire control.
4. Describe complexity challenges for seemless ease of use operations by the warfighter.
5. What are the prime areas for miniaturization.
6. Comment on the advantages and disadvantages of Common module approach.
7. What are the challenges to maintainability and reliability in a field environment.
8. Where are specific investments needed for the Advanced Fire Control capability for the warfighter with boots on the ground?
9. Share comments relative to projection for full spectrum warfighter capable systems encompassing CCO like capability (CQB) with added capability of advanced fire control (extend range).
10. With the DOD review of major programs on-going, what is your view of ground warfighters affordably increasing battlespace influence with small arms fire control, including performance and timeliness.

VINGTECH
Simrad Optronics Group

A GLOBAL MILITARY SUPPLIER

Crew Served Weapon Sight and Fire Control System

Vingmate FCS



Scope

- Improve first hit probability
- Fast handling and target engagement
- Improve range performance
- Reduce ammunition consumption
- Modular design
- Prepared for future requirements



Functionality

- Ballistic Compensation
  - MET compensation (temp, pressure, wind)
- Night Vision interface
- Airburst programming
- Interface to BMS systems
- Target Acquisition
- Indirect Fire



Night Vision Capabilities

- Full operability using night-vision GN goggles
- Several Thermal Night Vision sights have been integrated.
- No re-alignment needed when switching from day to night.

Integrated Thermal Sensors

- Heavy Weapon Thermal Sight from BAE
- VIPIR from Qioptiq
- Hunter from AIM



Dedicated for 40mm AGL's and .50 cal HMG's

Vingmate on H&K GMG



Vingmate on MK 47

Vingmate on MK 19



Vingmate on M2

Can be adapted to other weapons and calibers

torgrim.jorgensen@vingtech.com

Battelle
The Business of Innovation

Future Fire Control – Beyond Line of Sight Targeting and Engagement

Bruce Lerner, Charles Holmes
Battelle Memorial Institute
Columbus, OH

Postulate

- In the future, the individual warfighter must be able to attack targets in an “indirect fire” manner – engaging without line of sight visibility by using a ballistic firing solution.

Combat Assumptions and *Current Trends*

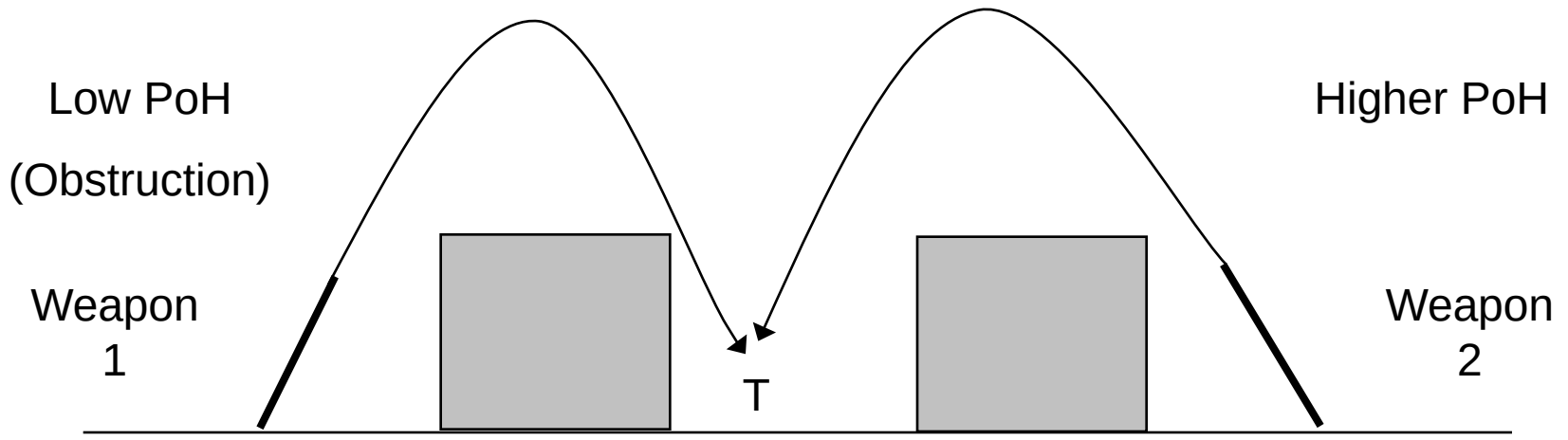
- The current trend towards a "*… **distributed battlespace**, where small units have a greater area of influence than they have had in the past, rivaling that of big units"* will continue (Mr. Solhan, ONR, JSSAP Futures Meeting, March 2008).
- Irregular warfare and the *Three Block War* will continue. Restricts the weapon size.
- Terrain will be irregular.
  - *These units will have to support each other.-*

Combat Assumptions and *Current Trends*

- Distributed units will be Beyond Line of Sight (BLOS) from each other, out of visual contact but still in effective weapon range.
- Current sights only provide *ballistic solutions for visible targets. Distributed forces may have to fire at non-visible or defilade targets.*
- Guided rounds may be available, but they need to reasonably aimed.

Combat Assumptions

- Distributed units will have to support each other with individual weapons (M203, M32) and light vehicle mounted systems (HMMWV and IFV/LAV with CROWS or other mounted systems) using a *blind ballistic firing solution*.
- The optimal firing position may be anywhere! Use the warfighter with the best PoH.



BLOS Targeting Requirements

For someone to engage a target which cannot be observed:

- A BLOS ballistic firing solution will have to be presented to the supporting warfighters.
- The firing solution requires:
  - The position of the target must be accurately known, usually relative to the observing/in-contact warfighter.
  - The position of the friendly warfighters must be accurately known.

Essentials for BLOS Targeting Where is everybody?

To calculate a ballistic firing solution:

- Need range from observer to target.
  - Range finding research is on-going.
  - Elevation is an issue.

Essentials for BLOS Targeting - Where are our forces?

Need to know where our forces are.

- Positioning possibilities:
  - GPS
    - Not 100% available.
  - Location via the local battlespace communications network
    - Possible – Uses signal time of arrival to various receivers. Assuming speed of light propagation, can get a positional radius. For multiple receivers, the radii will intersect somewhere.
    - Accuracy depends on the number of receivers and how well we know their positions.
  - Inertial navigation
    - Possible - DARPA recently funded development for shoe sized inertial guidance units.

BLOS aiming and firing

- Once the position of the target is known and the position of the friendly forces is known, a BLOS ballistic firing solution can be calculated.
- For a servo actuated (CROWS) system, the proper firing solution can be entered directly into the control system.
- For a hand held or manual tripod weapon (M32, M203, XM307), the firing solution will have to be entered into the sight. Ideally, the sight will cue the warfighter when the weapon is oriented correctly.
  - IC's for inclination and heading (Honeywell µPoint™)

BLOS targeting and engagement – Conclusion

- Much of the indirect fire/BLOS groundwork has already been implemented or is being researched.
- We just have to tie it together.
- If implemented, all available weapons can be used within a very short timeframe.
- Result - *We can overwhelm any enemy.*

Functionality









1. Aim and measure range



2. Realign and shoot



NATO demonstration

- Executed in Toledo 2007-02-15
- Target distancies from 100 to 250m
- Mainly unexperienced shooters
- Result
  - > 65% direct hit probability at 1.2x1.2m targets from 100 to 250m!



Aimpoint BR8 - Background

- Fully integrated USER FRIENDLY Sight and Fire Control System
- Suitable for a variety of weapons where ballistical correction to improve range performance and P_{Hit}/P_{Kill} is essential
- System prepared for additional functionalities as technology matures

Aimpoint BR8 – NATO Demo



Aimpoint BR8 – NATO Demo





THE FUTURE IN SIGHT



FMV Live Fire Demonstration

- Executed in Kungsängen on 2008-10-01
- Target distancies fro 120 to 150m
- Mainly unexperienced shooters
- Result
  - > 80% direct hit probability and
  - about 95% hit within lethal radious

FMV Live Fire Demonstration





Aimpoint BR8 – Status

- Prototypes have been delivered to FMV (Swedish Defence Materiel Administration)
- Demonstrated for NATO in Toledo 2007-02-15: > 65% P_{Hit} at 1.2x1.2m targets from 100 to 250m!
- Demonstrated in Sweden 2008-10-01: > 80% P_{Hit} at different targets from 120 to 150m!
- 100 units ordered in May 2009 for use on the Carl-Gustaf ISW (”the goose”). Deliveries in mid and late 2010.

NAVSEA
WARFARE CENTERS
CRANE

CRANE DIVISION

NAVAL SURFACE WARFARE CENTER



Distribution Statement A – Approved for public release; distribution unlimited.

CREW SERVED WEAPONS

MODERN SIGHTING SYSTEMS FOR PROVEN WEAPONS

Michael H. Jones

Naval Surface Warfare Center Crane

(NSWC Crane)

NDIA Small Arms Symposium

21 May 2009

Distribution Statement A – Approved for public release; distribution unlimited.

BACKGROUND



- **Crew Served Weapons currently fielded:**
  - **M2HB .50 Caliber Machine Gun**
  - **MK44 Minigun**
  - **MK46/MK48 Light Machine Guns**
  - **M240/M249 Heavy Machine Guns**
  - **MK19/MK47 Grenade Launchers**
- **MK47 has an integral targeting system**
- **Iron sights are the “targeting system” for the remainder**

Distribution Statement A – Approved for public release; distribution unlimited.

DEFICIENCY



- **Mounting surfaces**
- **Targeting Optics**
- **Active Aiming Components**
- **Illumination Systems**
- **Control At Operator/Weapon Interface**

Distribution Statement A – Approved for public release; distribution unlimited.

OBSTACLES



- **Increased shock load from weapon**
- **Shock from vehicle platforms**
- **Maintain Situational Awareness (SA)**
- **Protection from Accidental Discharge (AD) of illumination and target designation equipment**

Distribution Statement A – Approved for public release; distribution unlimited.

OBSTACLES



- **Ballistic compensation for Targeting, Designation, and Illumination (TDI) components**
- **Control of TDI components**
- **Power source for TDI components**
- **Integration with existing ballistic shields**
- **Size, Weight, and Location (Weapon Balance) of Devices**

Distribution Statement A – Approved for public release; distribution unlimited.

SOLUTION



- **Utilize the MK93 mount as the platform for M2HB, MK19, and M240**
- **Mount TDI components to the MK93 mount**
- **Component mounts incorporate ballistic compensation**
- **Provide targeting components that have long standoff distance (eye relief)**

Distribution Statement A – Approved for public release; distribution unlimited.

SOLUTION



- **All Combat Critical functions of TDI components controlled from spade grip area**
- **All TDI capable of operating from internal battery, remote battery, and vehicle power**
- **Stand alone optic**
- **Large components mounted forward of the ballistic shield**

Distribution Statement A – Approved for public release; distribution unlimited.

PROJECT DEVELOPMENT



- **USSOCOM's Weapons Accessories program initiated the Miniature Day/Night Sight-Crew Served Weapons (MDNS-CSW) project**
- **Integrated Product Teams (IPT) developed initial requirements for MDNS-CSW project**
- **Early User Assessment (EUA) provided a "first look" at COTS TDI components**
- **Results from the EUA were used to refine MDNS-CSW Performance Specification**

Distribution Statement A – Approved for public release; distribution unlimited.

PATH FORWARD



- **MDNS-CSW will utilize a two-phase incremental development path**
- **Initial effort will provide TDI components which are mounted on the MK93 Mount and controlled from the spade grip area**
- **Incremental development will explore a "smart" integrated system that incorporates magnified day/night optics, Head Mounted Targeting Viewer (HMTV) and remote observation capability**

Distribution Statement A – Approved for public release; distribution unlimited.

INITIAL EFFORT



- **Large “Reflex” sight: MDNS-CSW identifier: Enhanced Combat Optical Sight-Heavy (ECOS-H)**
- **Visible and IR laser: MDNS-CSW identifier: Crew Served Heavy Weapon Aiming Laser (CSHWAL)**
- **White Light Source: MDNS-CSW identifier: Visible Bright Light-Heavy (VBL-H)**
- **Ranging Device: MDNS-CSW identifier: Laser Range Finder-Heavy (LRF-H)**
- **Flash Suppression: MDNS-CSW identifier: Crew Served Flash Suppressor (CSFS)**

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INCREMENTAL DEVELOPMENT



- **Will integrate control of system components**
- **Incorporate Day/Night camera technology**
- **Video display at weapon with remote capability**
- **Data bus controlled from Operator/Weapon interface**

Distribution Statement A – Approved for public release; distribution unlimited.

CONTACT INFO



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NSWC Crane
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michael.h.jones@navy.mil

Distribution Statement A – Approved for public release; distribution unlimited.

Rapid Adaptable Zoom for Automatic Rifle

RAZAR

Sandia National Laboratories

Brett Bagwell and David Wick

In collaboration with

Joint Service Small Arms Program (ARDEC)

John Edwards and Terry Rice

NDIA Small Arms Systems Symposium

May 28, 2009

CONOP
Mixed Range Environments

Sandia National Laboratories



“At the touch of a button”





J·S·S·A·P JOINT SERVICE SMALL ARMS PROGRAM

M4 Automatic Rifle Current Solutions

All are manually actuated.

Sandia National Laboratories

SU-237 (Trijicon)



Elcan SpecterDr



Leupold CQT



SU-237:
- requires a “hold-off” due to over/under
- binary (1X or 4X)

Leupold:
- limited to 3X
- narrower FFOV (20°) at 1X
- long

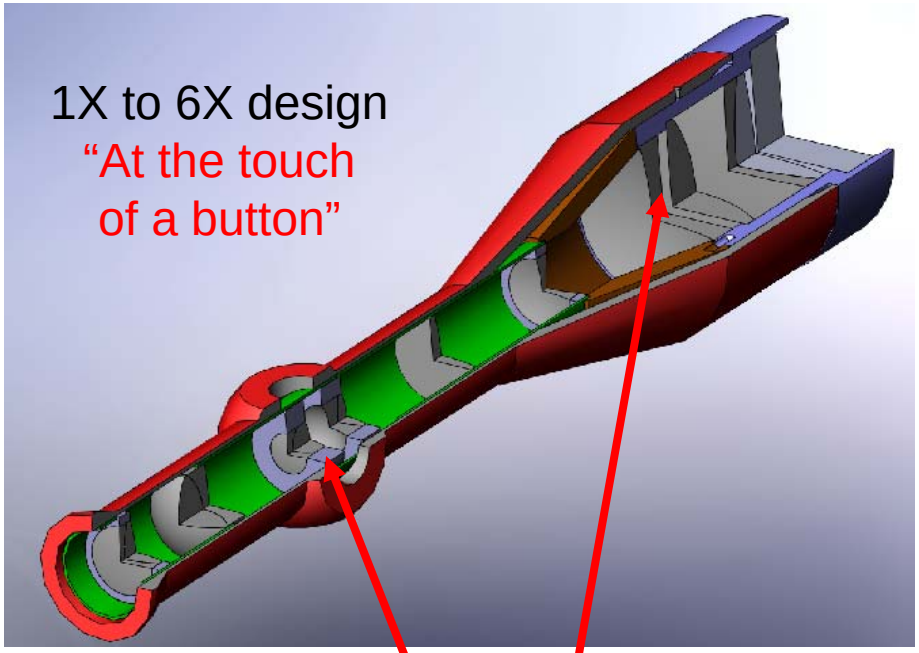
Elcan:
- binary (1X **OR** 4X)
- heavy (1.3 lbs)

J·S·S·A·P JOINT SERVICE SMALL ARMS PROGRAM

M4 **RAZAR**

Concept

- **Multiple** zoom positions (quasi-continuous, or multiple discrete states)
- Large zoom range
  (6X for M4 - could be 8X)
- **Push-button** actuation
  (maintain sight picture)
- Coaxial optical path
  (not over/under)
- Small package (~ ACOG)

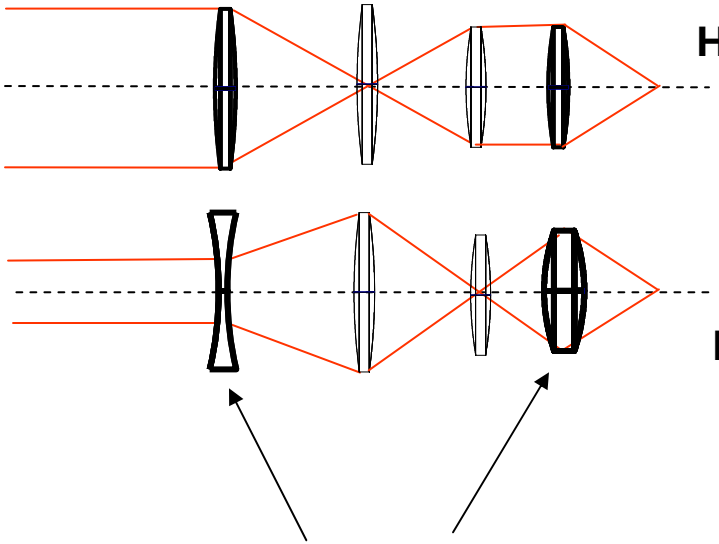


Adaptive Zoom Overview

Sandia Patent #6,977,777

Sandia National Laboratories

Adaptive Zoom



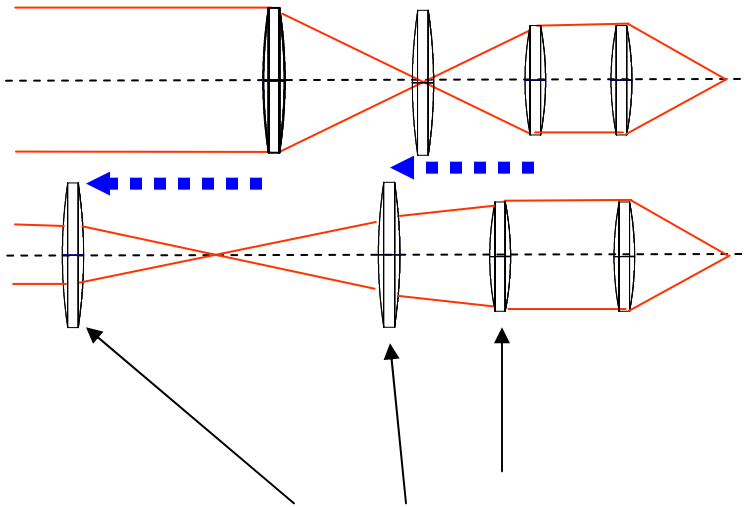
Active Lenses Change Focal Length

HIGH MAG

VS.

LOW MAG

Conventional Zoom



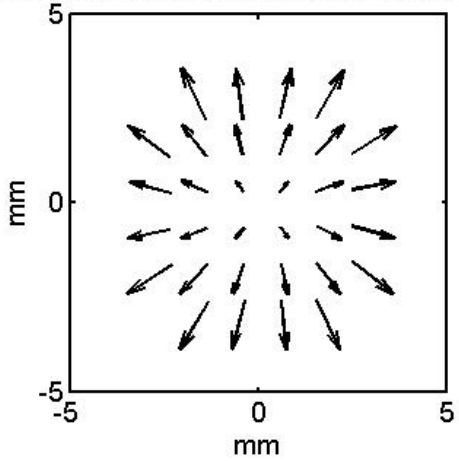
Static Lenses Move Along Optical Axis (e.g. 35mm camera)

RAZAR Program Goals

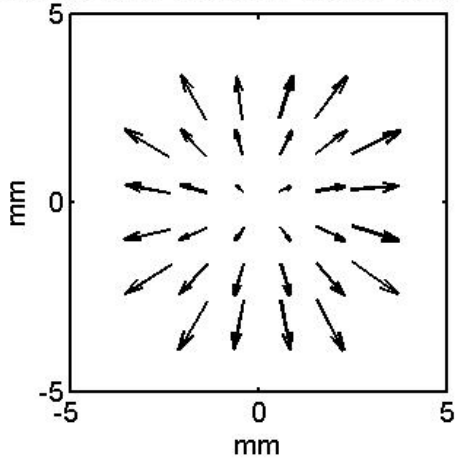
- **Magnification:**1-6X (larger zoom is possible but increases overall length/weight)
- **Overall Length:** 200 mm
- **Weight:** 680 grams (1.5lb)
- **Full Field of View:** 24 deg (1X) , 4 deg (6X)
- **Objective Diameter:** 32 mm
- **Power:** 2 AA Lithium Batteries
- **Reliability (MTBF):** 480 operational hours, 20 actuations/hr.

Polymer Lens: Fabrication

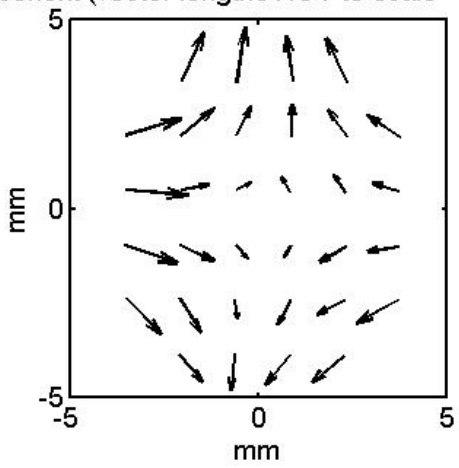
Total Displacement Vectors (vector lengths to scale)



Radial Component r=r+.5062*r (vector lengths to scale)



Non-Radial Component (vector lengths NOT to scale - enlarged for visibility)



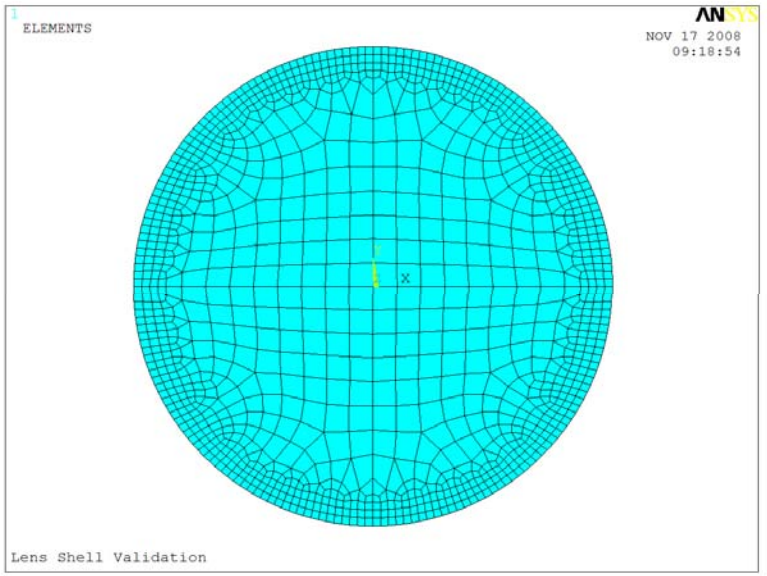
Stretch vectors for membrane show some astigmatism representing 8.2% of the magnitude of the radial component

FE Modeling

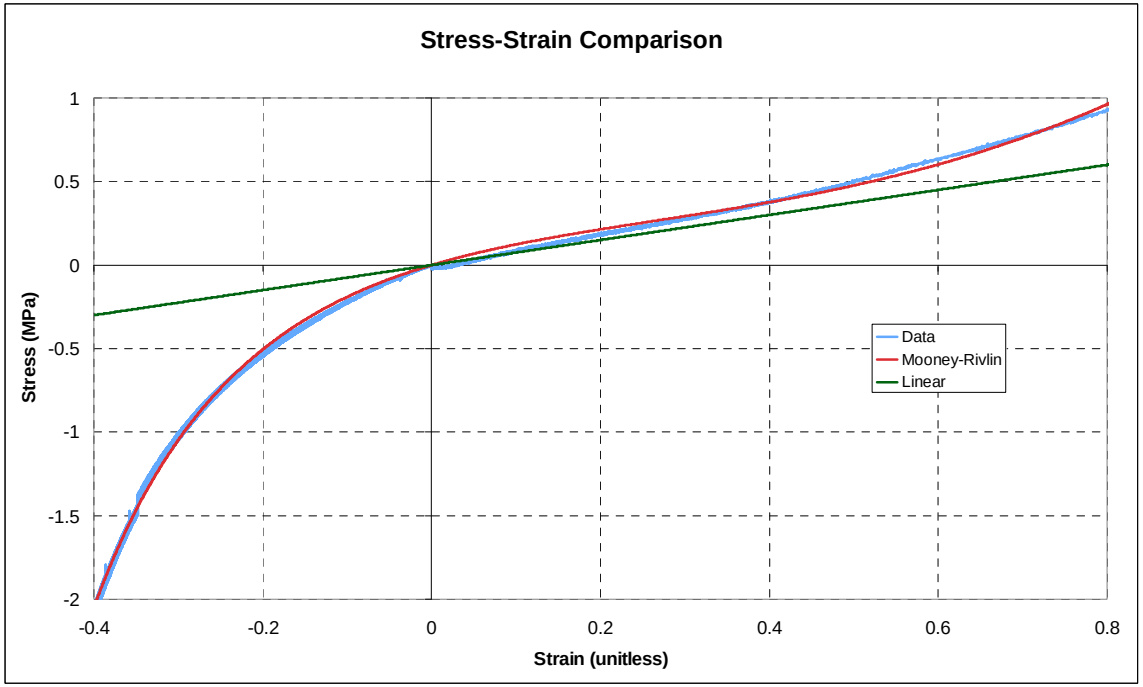
Sandia National Laboratories

Un-prestrained

- Thin and Thick shell models (FEA)
- **Low Order**: Peak deflection as a function of membrane thickness.
- **Higher Order**: Departure from Best-Fitting Sphere (BFS) as a function of pressure.



Measurement: Uniaxial Properties

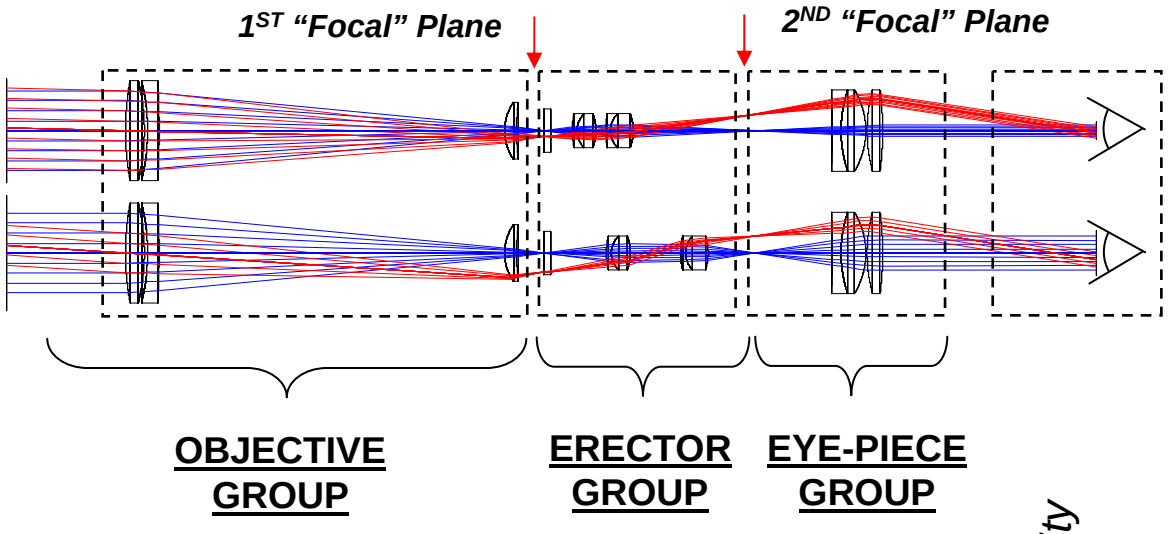


$$T = 2\left(\lambda - \frac{1}{\lambda^2}\right)\left[C_{10} + \frac{C_{01}}{\lambda} + 2C_{20}\left(I_1 - 3\right) + C_{11}\left[\left(I_2 - 3\right) + \frac{\left(I_1 - 3\right)}{\lambda}\right] + 3C_{30}\left(I_1 - 3\right)^2\right]$$

C_{10} = 0.2 MPa, C_{01} = 0.15 MPa, C_{30} = 0.05 MPa, and C_{11} = 0

Comparison of stress-strain data, Mooney-Rivlin model fit, and linear Young's Modulus.

Review - System



Order of Priority

Adaptive Zoom Module =
- **Erector**
- **Erector + Eyepiece**
- **Erector + Eyepiece + Objective**

SWaP Objectives
- Length: 200 mm (O)
- Diameter: 50 mm (O)
- Weight: 680 grams (O)
- Power: 3K Actuations (O), 1K Actuations (T) – Source = 2 x AA Batteries

First Demonstration

Sandia National Laboratories

*No Longitudinal Motion

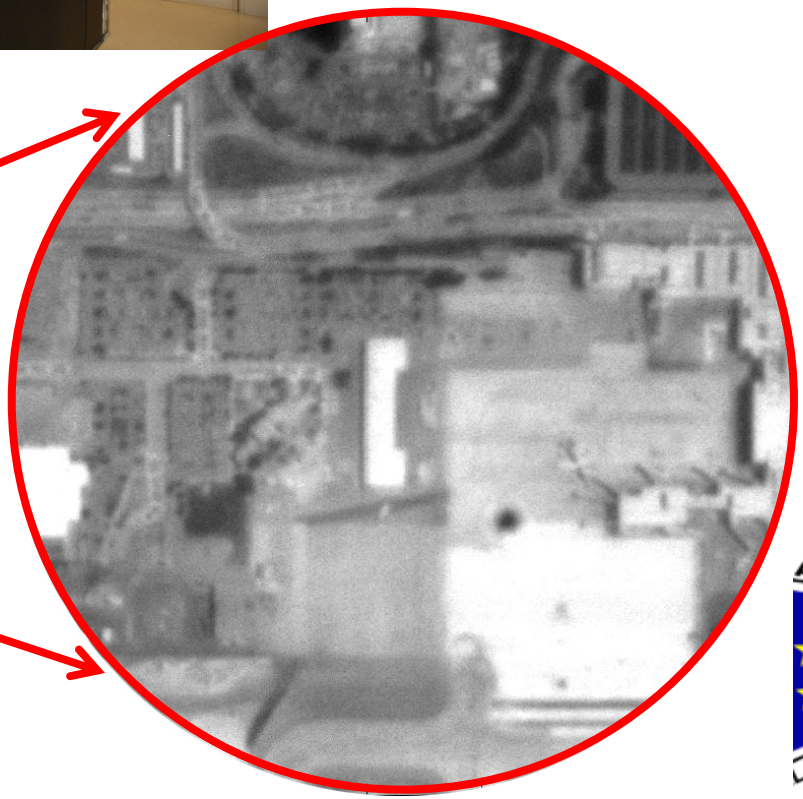


8X zoom using two APLs – 23 inches long

1X

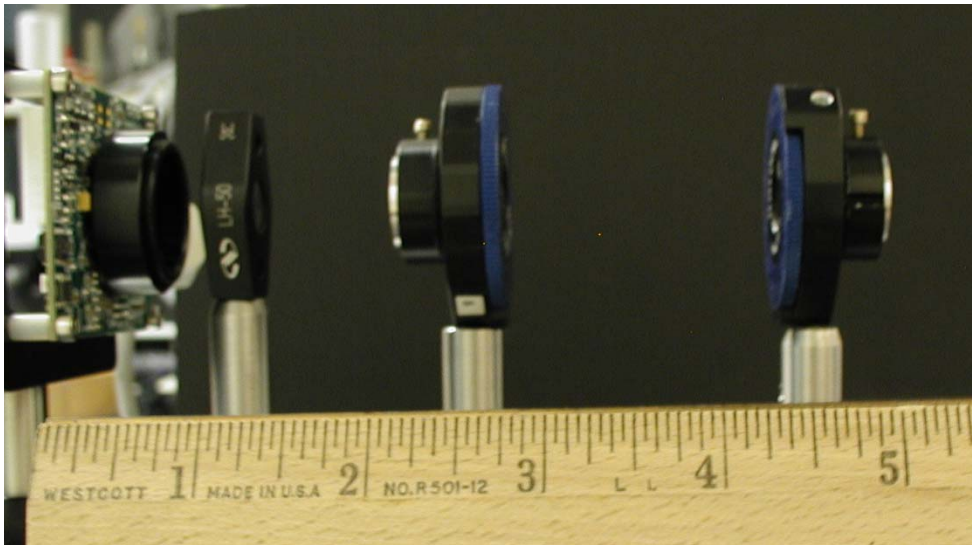
8X

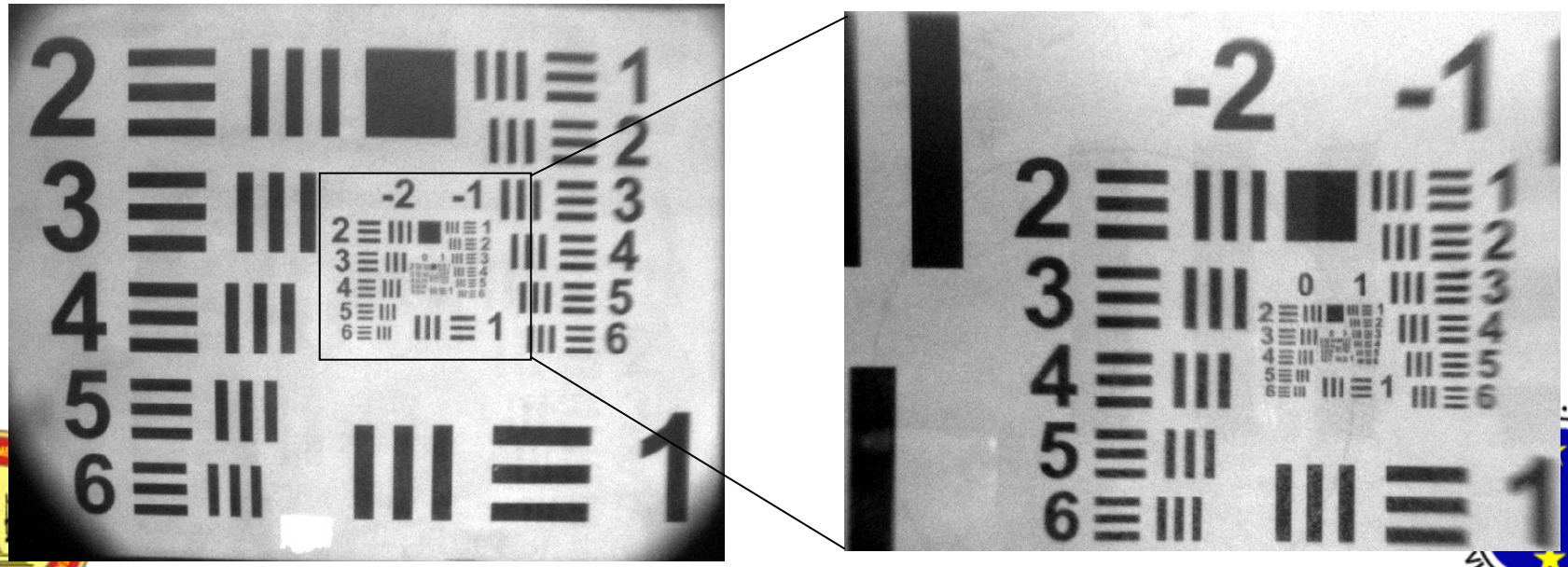




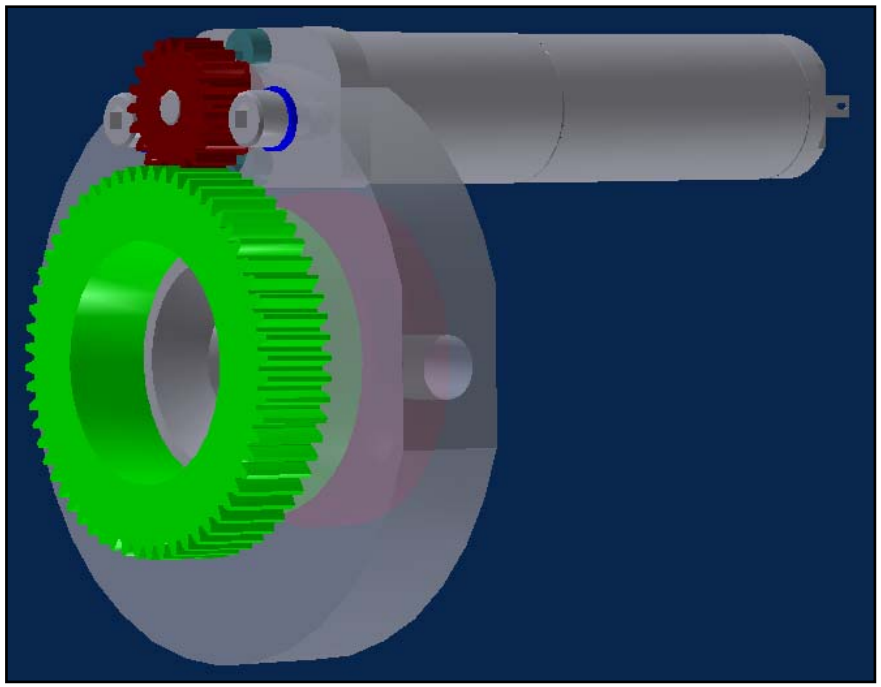
Second Demonstration

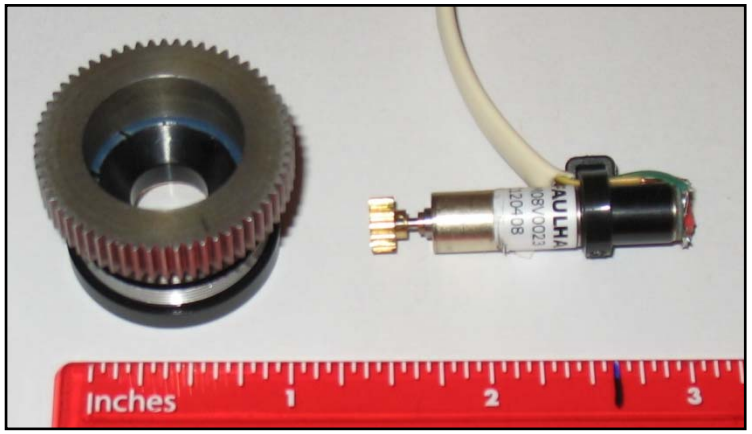
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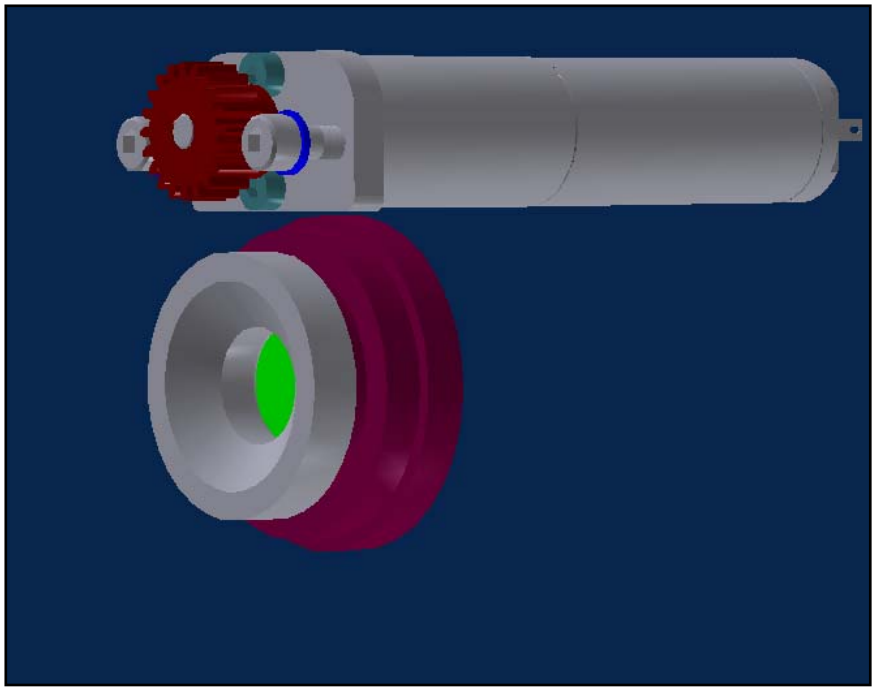




Actuation: Current

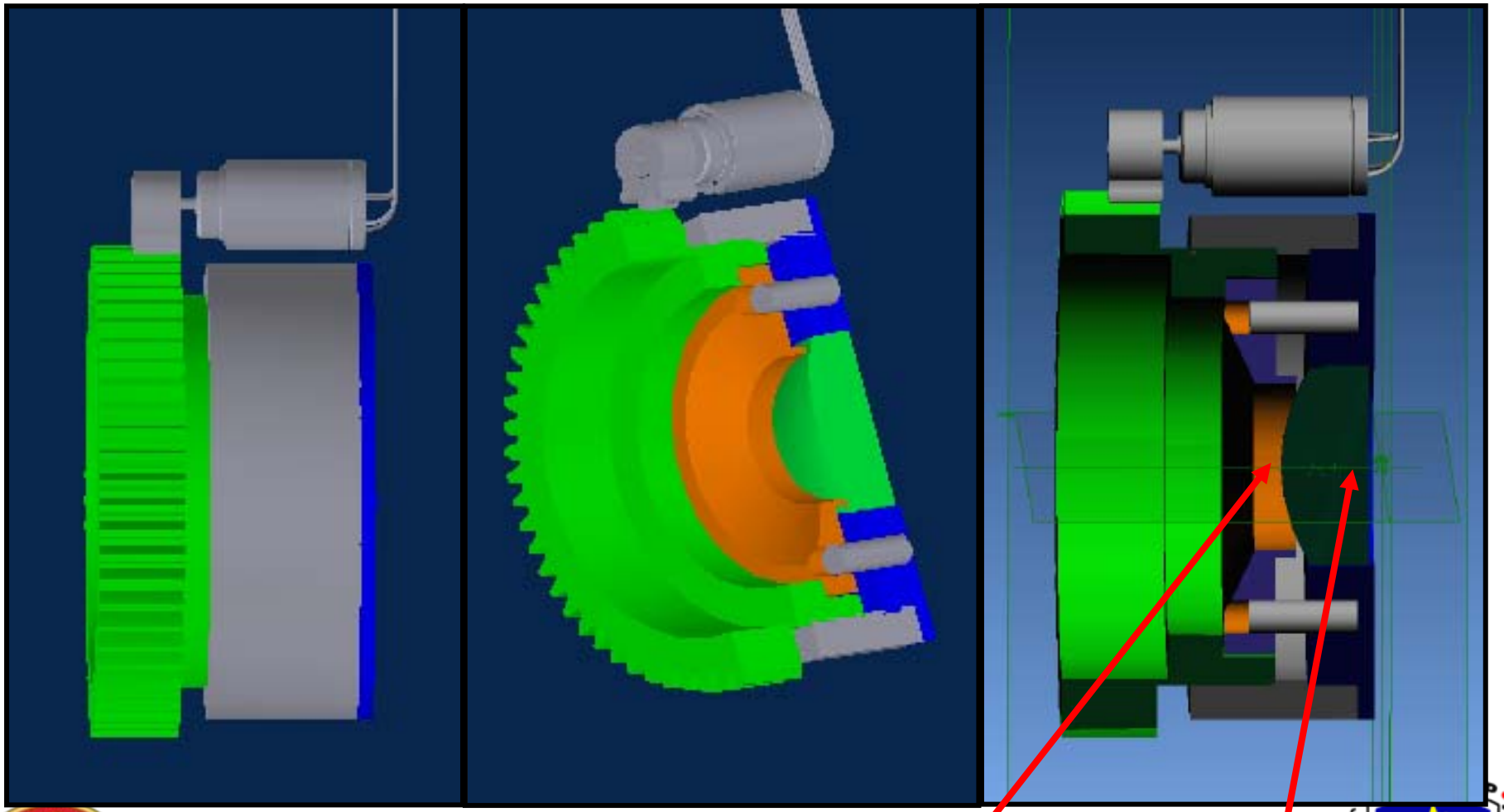






- 3RD Iterarion of unaltered APL (1W → 3 W → 6W instantaneous power).
- Combination of friction and increased membrane pre-strain (necessary for image quality).

Actuation



Acknowledgements

- JSSAP – John Edwards and Terry Rice
- Grant Soehnel and Mike Baker

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000. This work was supported in part by Sandia National Laboratories Lab Directed Research and Development program.

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DEFENCE R&D DÉFENSE

Using a 40mm Automatic Grenade Launcher as a Precision Weapon at Long Ranges

Dr. Daniel Corriveau

Flight Mechanics Group / Precision Weapons Section

International Infantry & Joint Services SMALL ARMS SYSTEMS Symposium

May 18-21, 2009

Defence Research and Development Canada

Recherche et développement pour la défense Canada

Canada

Presentation Overview

- Objective
- Background
- Aerodynamics of a 40 mm HV grenade
- Error budget development
- Long range firing trial and simulation dispersions
- Weapon system simulation results
- Conclusions

Objective



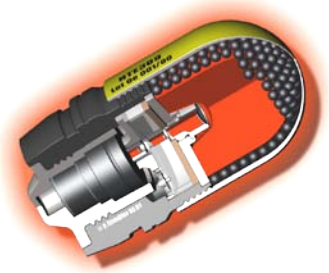
- Demonstrate the feasibility of using a 40mm AGL at long range for precision effects
  - Develop an aerodynamics model for a generic 40 mm HV grenade
  - Develop an error budget model for the MK19 AGL
    - Drag/Mass error (%)
    - Round-to-round muzzle velocity error (m/s)
    - Gun dispersion (mils)
    - Ammunition dispersion (mils)
  - Validate results with long range firings

Background

Weapon system modeling

Ammo: mass, CP, CG, shape, aero





Weapon System representation



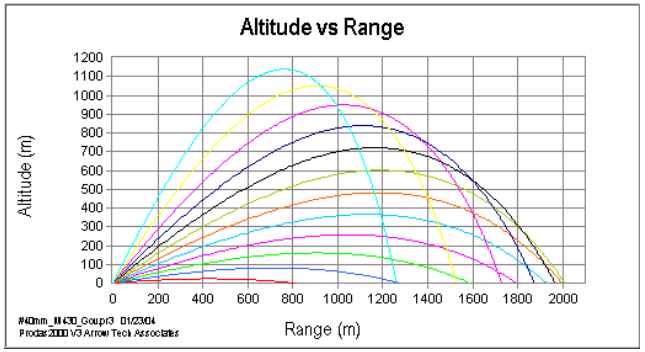
MET data

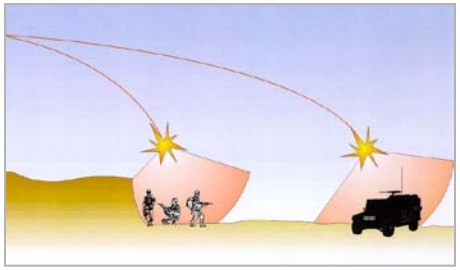


PRODAS

Round Characteristics at time of burst or detonation:

- Dispersion
- Probability of hit
- Remaining Speed
- Remaining Spin
- Angle of descent (AOD)
- Time of Flight



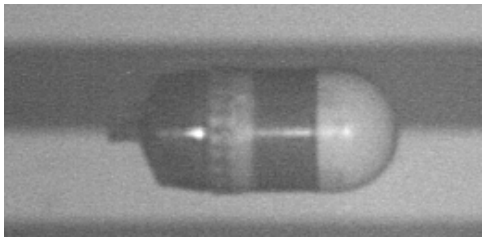


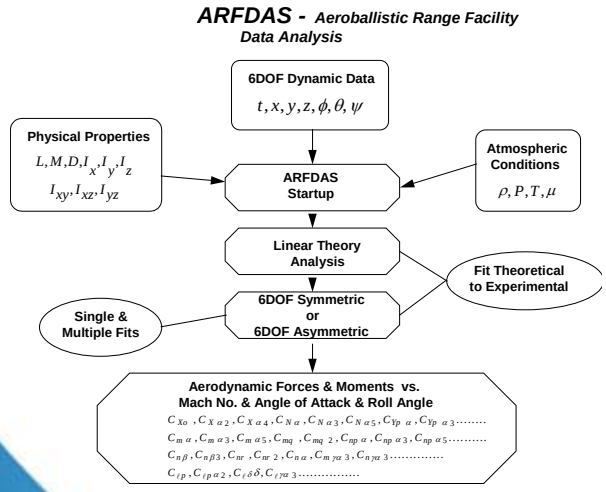
Ammo model development

Aeroballistic range trial







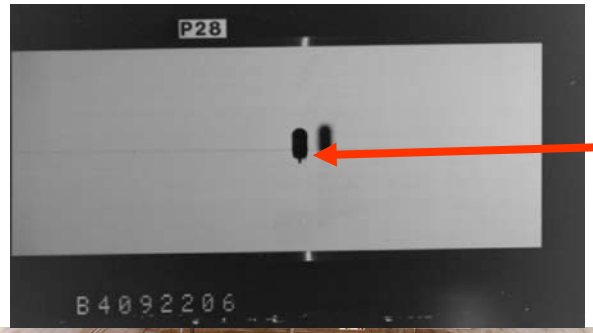


- Complete ammo aero model

Ammo model development

Shadowgraphs

- Instrumented length: 220 m
- Section: 6 m x 6 m
- 54 Stations:
  Indirect orthogonal shadowgraphs
- 4 Schlieren stations



Pit View

Shadow

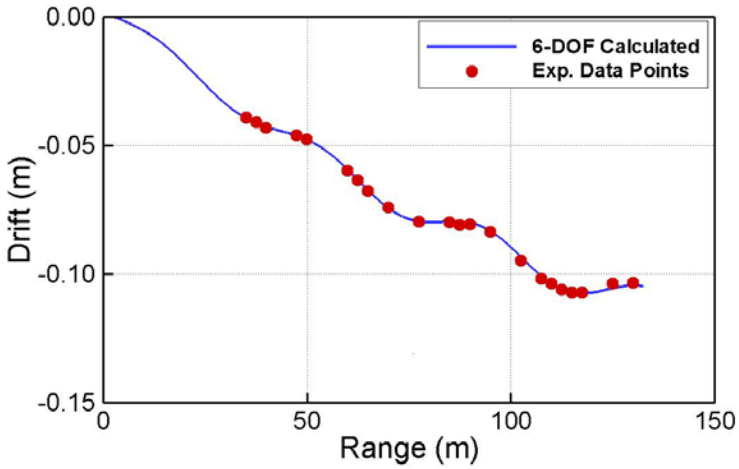


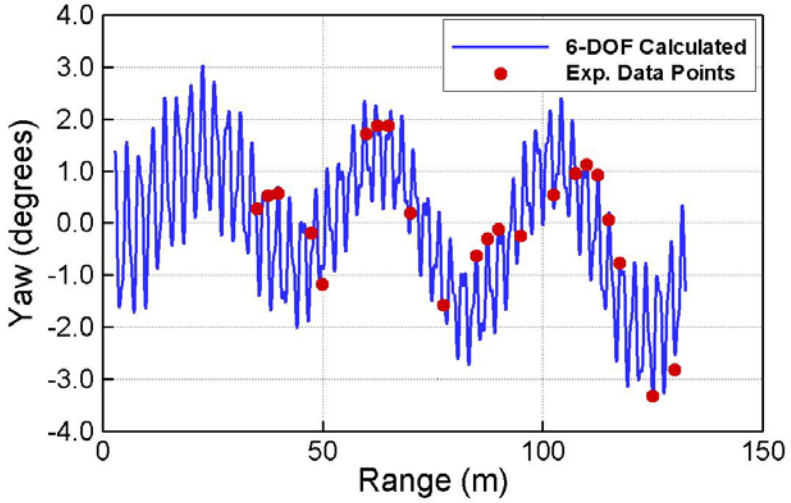


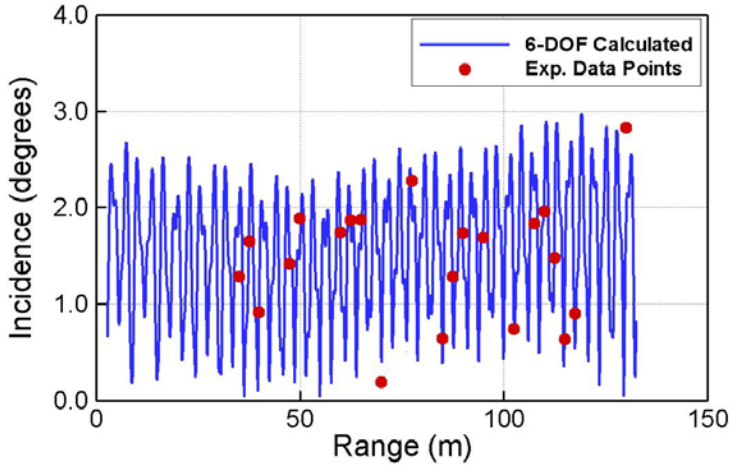
Wall View

Ammo model development

Projectile motion_

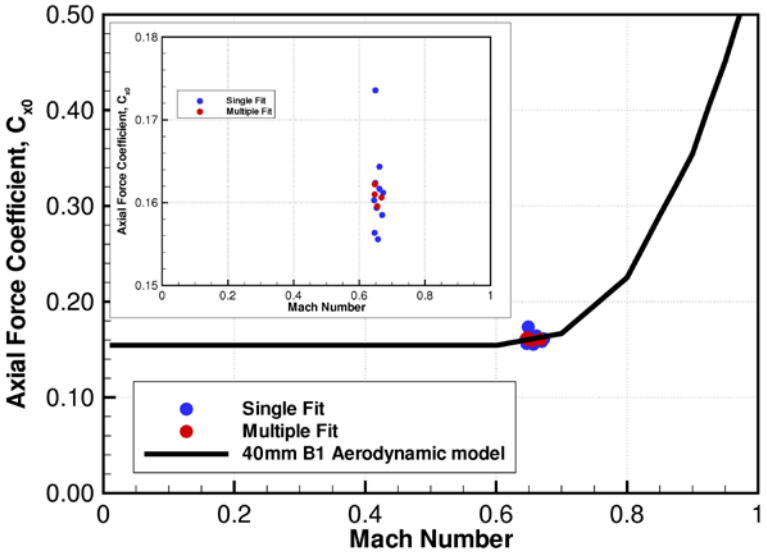




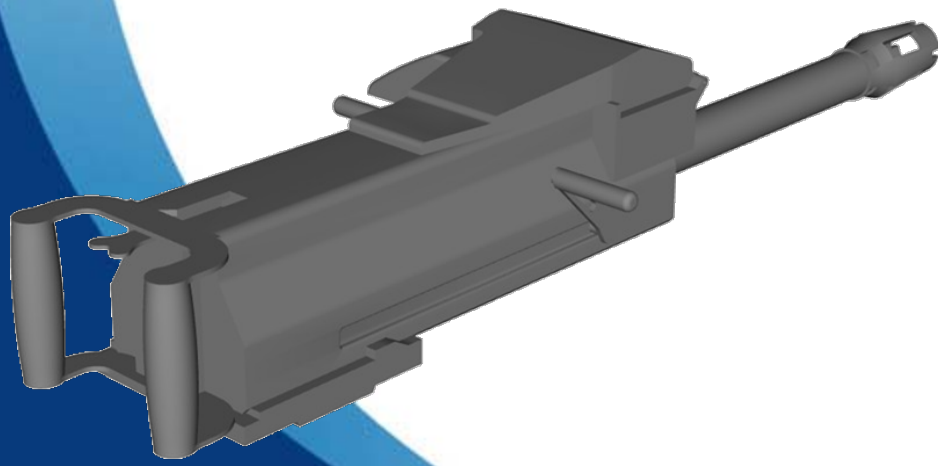


Ammo model development

Aerodynamic model







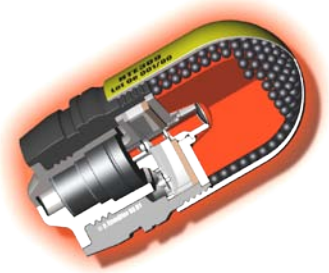


Background

Weapon system modeling

Ammo: mass, CP, CG, shape, aero





Weapon System representation



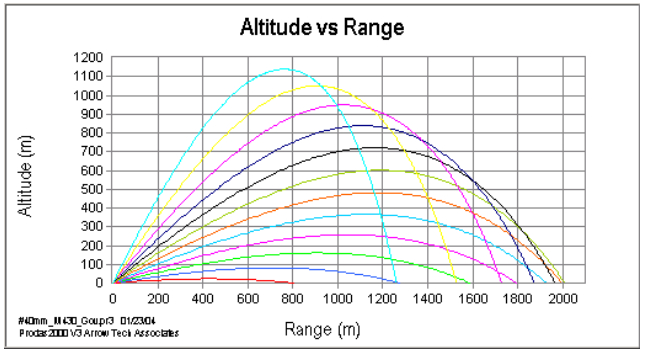
MET data

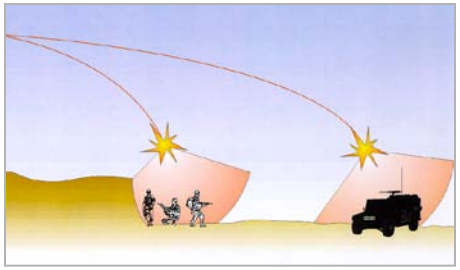


PRODAS

Round Characteristics at time of burst or detonation:

- Dispersion
- Probability of hit
- Remaining Speed
- Remaining Spin
- Angle of descent (AOD)
- Time of Flight





Error budget development

MODEL	40mm HV
Errors	Measured
Drag/Mass (%)	
V_M – round to round (m/s)	
V_M – lot to lot (m/s)	
Wind Std(m/s)	
Pressure Std (mbars)	
Air Temp (C) Std Dev	
Vert. Aiming Error (mils)	
Horz. Aiming Error (mils)	
Vert. Boresight alignment (mils)	
Horz. Boresight alignment (mils)	
Target range Error (m)	
Horz. Gun dispersion (mils)	
Vert. Gun dispersion (mils)	
Ammunition Dispersion (mils)	
Fuze Error (% of time)	

- Required as input to Prodas:
  - Estimated based on literature and user experience
  - Determined accurately through an accuracy trial

Error budget development

Total dispersion breakdown

$$S^2_{D_{X\,TOTAL}} = S^2_{D_{Vx}} + S^2_{GDx} + S^2_{ADx}$$

$$S^2_{D_{Y\,TOTAL}} = S^2_{D_{Vy}} + S^2_{GDy} + S^2_{ADy}$$

Total Observed Dispersion

Gravity Drop (V_{MUZ}, mass, C_{X0})

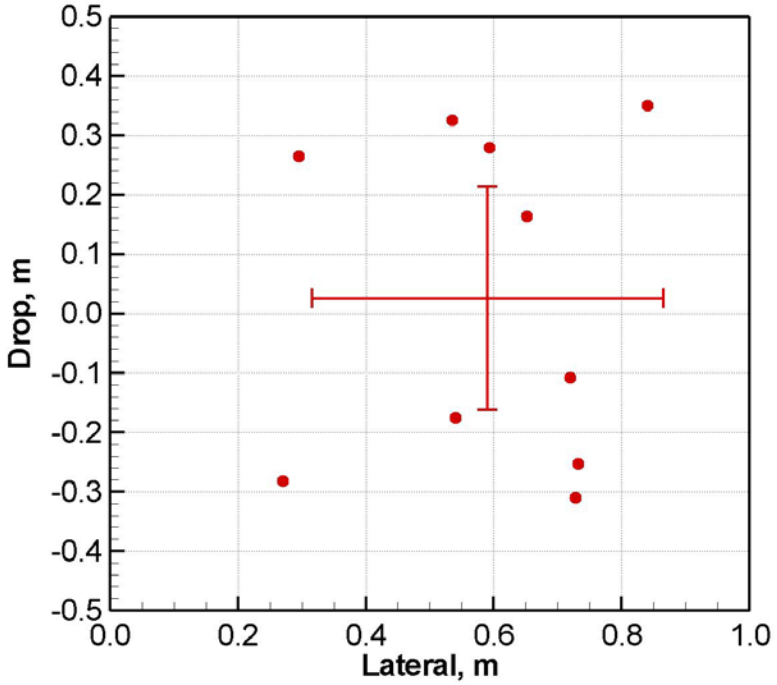
Gun Dispersion

Ammunition Dispersion

Error budget development

Total dispersion





Precision trial:

- NATO StanAg procedure
- Firing at 300m
- Tripod mounted MK19 on natural ground
- T&E mechanism
- Single-shot firing
- Elevation and azimuth adjusted manually prior to firing

$$S_{DX_{TOTAL}} = 0.93 mils$$

$$S_{DY_{TOTAL}} = 0.64 mils$$

Error budget development

Ammunition dispersion (aerodynamic jump)

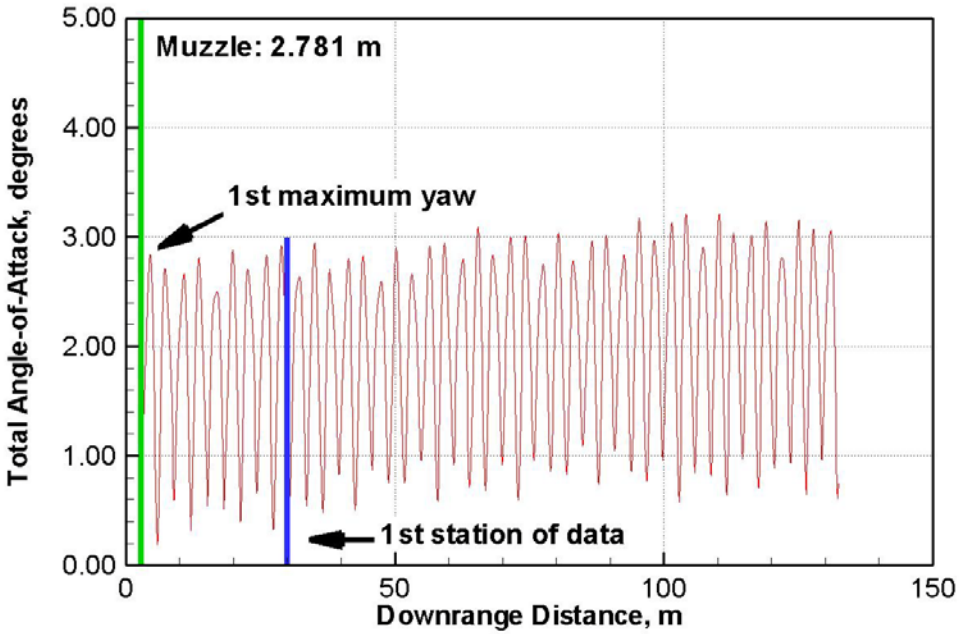
- **Due Mainly to Initial Yaw Rate**
  - **In bore Balloting**
  - **CG Offset**

- **Theory States** ⇒
  - **If initial yaw rate, q_0 , is known**
  - **with aerodynamic package and physical properties**
  - **can calculate ammunition disp.**

Error budget development

Ammunition dispersion (aerodynamic jump)

Angle of Attack – Extrapolated to Muzzle with A/B Range Data



SHOT NUMBER	1st Max Yaw (deg)
B01	2.87
B02	1.55
B03	2.85
B04	2.90
B05	1.74
B06	2.71
B07	2.46
B08	2.10
B09	2.73
B10	1.31
Mean	2.323
STD. DEV.	0.601

$$q_0 = \frac{\left(\dot{\phi}_F - \dot{\phi}_S\right)}{2}\overline{\alpha}_{\max} \quad \rightarrow \quad \theta_{aero} = \frac{\left(C_{N\alpha} - C_X\right)d}{C_{m\alpha}V_0}\left(\frac{I_y q_0}{md^2}\right)$$

$$S_{ADx} = S_{ADy} = 0.4 mils$$

Error budget development

Muzzle velocity error

- Measured for each individual round in precision trial at 300m
- Determined using Radar measurements
- Data processed using Radar2000



SHOT NUMBER	V_{MUZ} (m/s)
D01	243.5
D02	242.6
D03	245.1
D04	243.2
D05	243.8
D06	242.9
D07	242.6
D08	242.1
D09	243.4
D10	241.0
Mean	243.0
Std Deviation	1.1

Error budget development

Drag/Mass error

- Measured for each individual round in precision trial at 300m

SHOT NUMBER	Mass (gm)	C_{X0}
D01	239.64	0.16120
D02	240.56	0.16028
D03	240.03	0.16167
D04	242.10	0.17356
D05	240.75	0.16238
D06	241.54	0.16434
D07	240.36	0.15635
D08	242.16	0.15558
D09	241.11	0.15850
D10	240.82	0.15936
Mean	241.26	0.154
Std Deviation	0.7336	0.002
Std Deviation (%)	0.30	1.30

- Variation in C_{X0} due to non-uniform band engraving
- Variation in mass due to quality control

$$\sigma\left(\frac{\overline{C_{X0}}}{\overline{M}}\right) = \frac{\sigma_{\overline{C_{X0}}}}{\overline{M}} - \frac{\overline{C_{X0}}}{\overline{M}^2}\sigma_{\overline{M}} = 1.0$$

Error budget development

Gun dispersion: lateral analysis

$$S^2_{D_{X\,TOTAL}} = S^2_{D_{Vx}} + S^2_{GDx} + S^2_{ADx}$$

Total Observed

0.93mils

Gravity drop (V_{MUZ}, mass, C_{X0})

0.00mils

Gun Dispersion

0.84mils

Ammunition Dispersion

0.40mils

Error budget development

Gun dispersion: drop analysis

$$S^2_{D_{Y\,TOTAL}} = S^2_{D_{Vy}} + S^2_{GDy} + S^2_{ADy}$$

Total Observed

0.64mils

Gravity drop (V_{MUZ}, mass, C_{X0})

0.35mils

Gun Dispersion

0.35mils

Ammunition Dispersion

0.40mils

Error budget development

Error budget model

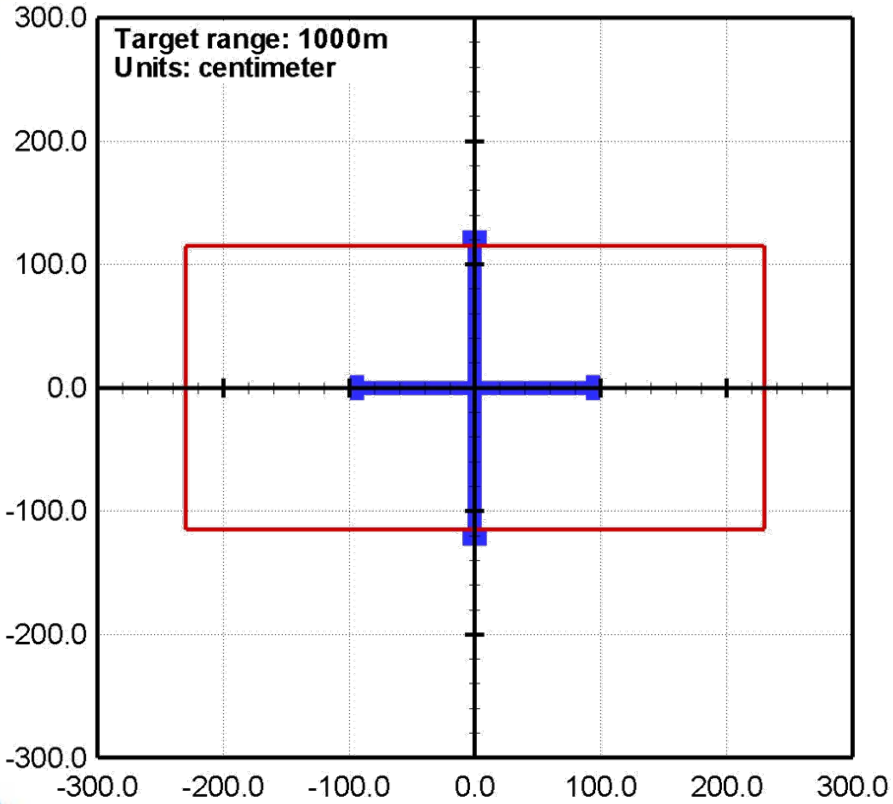
MODEL	40mm HV
Errors	Measured
Drag/Mass (%)	1.0
V_M – round to round (m/s)	1.1
V_M – lot to lot (m/s)	
Wind Std(m/s)	
Pressure Std (mbars)	
Air Temp (C) Std Dev	
Vert. Aiming Error (mils)	
Horz. Aiming Error (mils)	
Vert. Boresight alignment (mils)	
Horz. Boresight alignment (mils)	
Target range Error (m)	
Horz. Gun dispersion (mils)	0.84
Vert. Gun dispersion (mils)	0.35
Ammunition Dispersion (mils)	0.40
Fuze Error (% of time)	

Valid for:

- Tripod mounted MK19 on natural ground
- T&E mechanism
- Single-shot firing

Scenario/Mission Simulations

Firing simulations at 1000m



NATO side profile:
2.3m x 4.6m

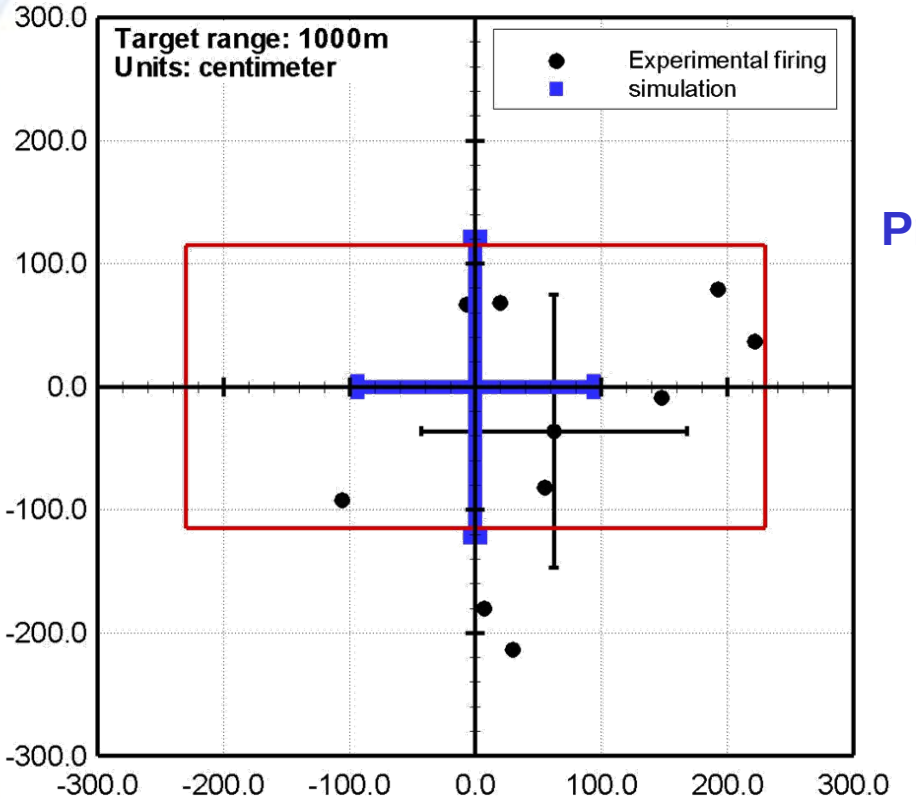
Horz. Disp.: 0.94mils

Vert. Disp.: 1.22mils

Single shot P_{hit}: 0.66

Scenario/Mission Simulations

Firing simulations at 1000m



NATO side profile:
2.3m x 4.6m

Precision trial:

- NATO StanAg procedure
- Firing at 1000m
- Tripod mounted MK19 on natural ground
- T&E mechanism
- Single-shot firing
- Weapon zeroed on target
- Elevation and azimuth adjusted manually prior to firing

Simulation:

Horz. Disp.: 0.94mils
Vert. Disp.: 1.22mils

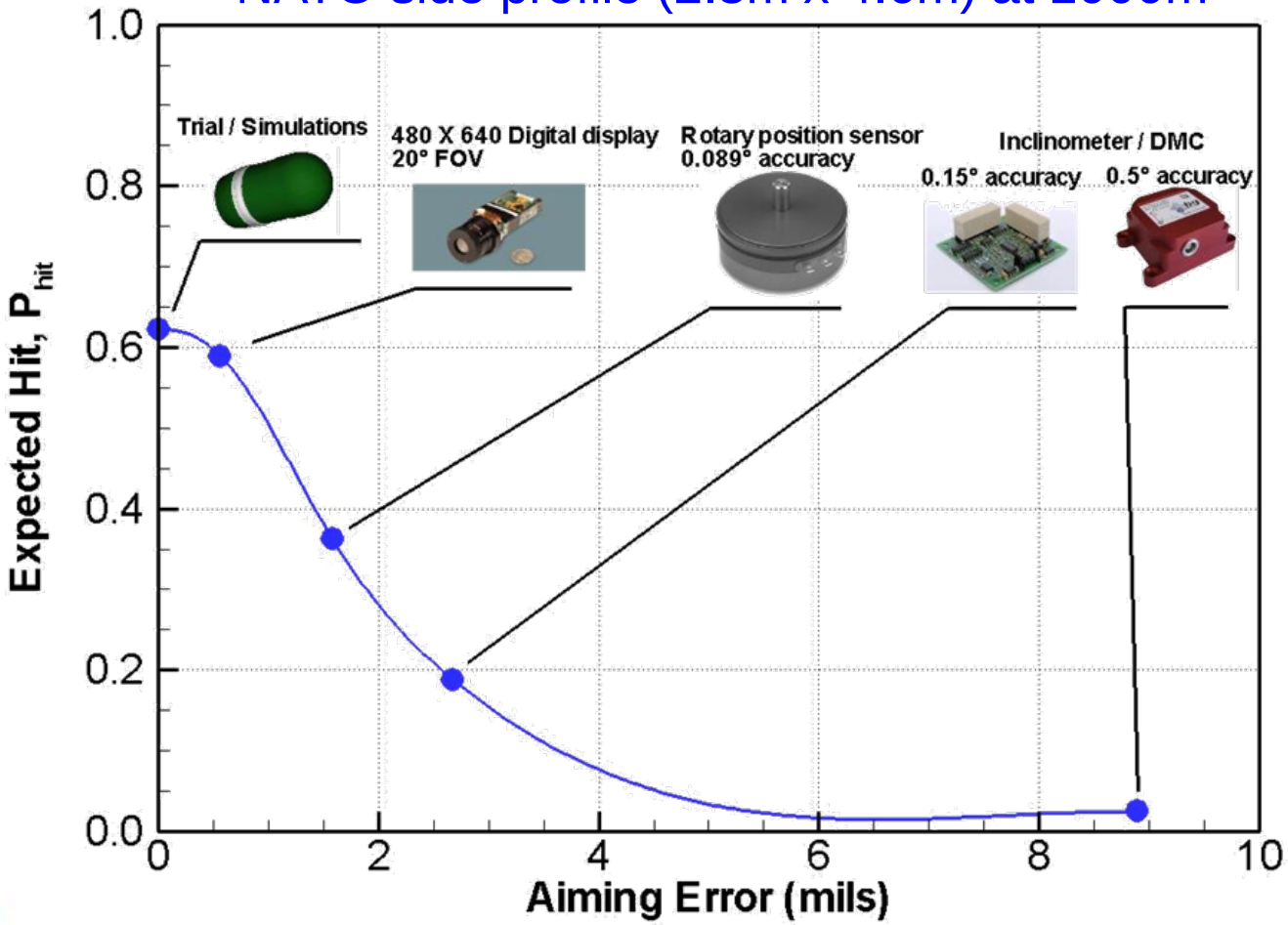
Experimental firing:

Horz. Disp.: 1.05mils
Vert. Disp.: 1.11mils

FCS Performance Estimations

Effect of error on elevation (aiming error)

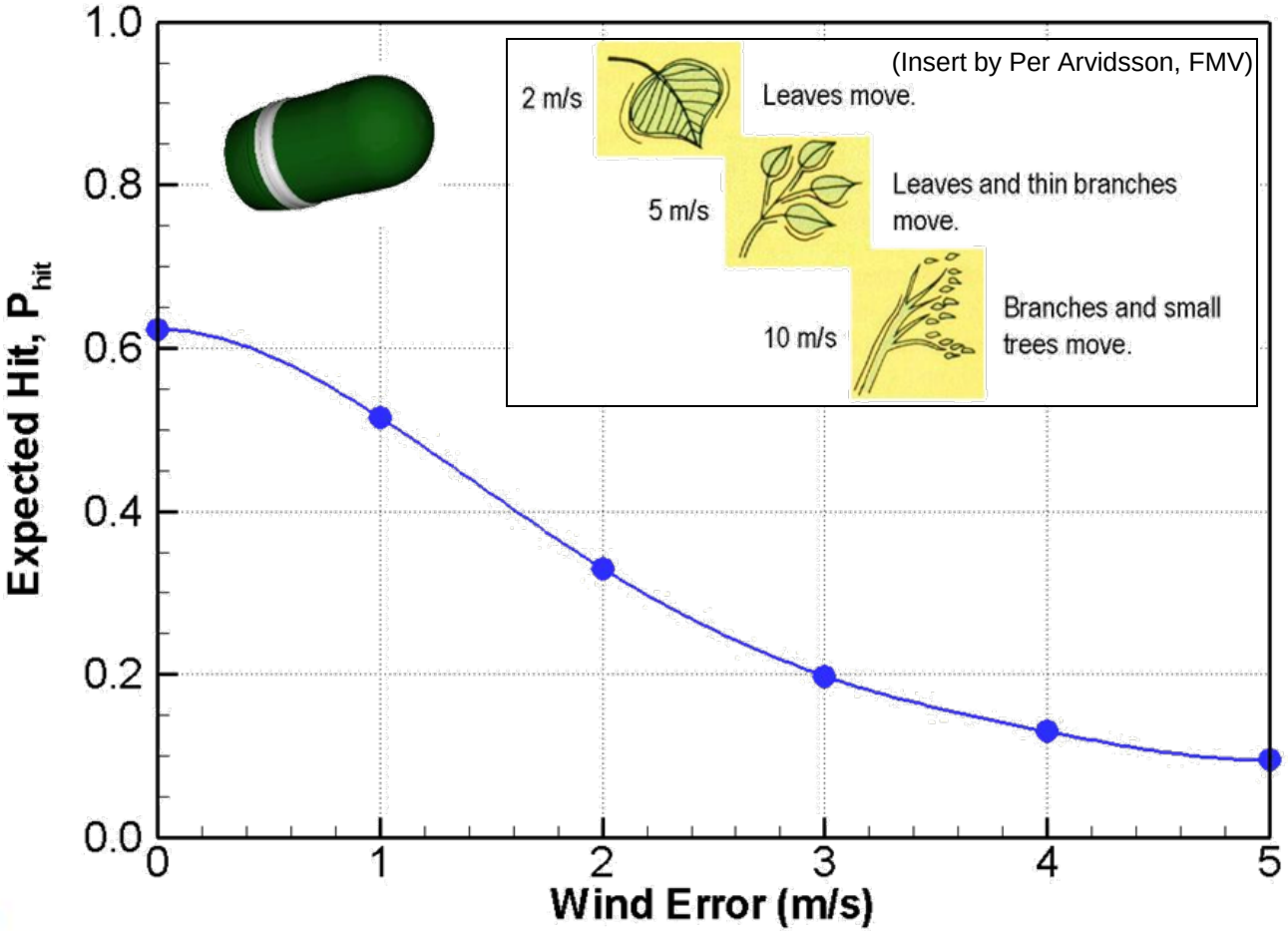
NATO side profile (2.3m x 4.6m) at 1000m



FCS Performance Estimations

Effect of error on wind (std. dev.)

NATO side profile (2.3m x 4.6m) at 1000m



FCS Performance Estimations

Adding the aiming error and the wind error...

NATO side profile (2.3m x 4.6m) at 1000m



- Baseline single-shot model prediction (no aiming or wind errors): P_{hit}= 0.66

- Single-shot model prediction with aiming and wind errors: P_{hit}= 0.12
  - Std. Dev. on wind: 2m/s
  - Elevation set using DMC with an accuracy of 0.15°

Extrapolating...

- 5 rounds burst model prediction with aiming and wind errors: P_{hit}= 0.66
  - Std. Dev. on wind: 2m/s
  - Elevation set using DMC with and accuracy of 0.15°

(!!!Caution: model not developed for burst firing!!!)

Conclusions

- An experimentally developed error budget model was used to demonstrate the precision of a properly zeroed 40mm AGL at long ranges (~1000m)
- The simulation results at 1000m were validated with live firings
- Without a state-of-the-art FCS, the precision of the 40mm AGL would be limited in a real engagement scenario
  - » Aiming error
  - » Wind error
  - » Ballistic solution error


DEFENCE
R&D
DÉFENSE

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National Small Arms Center Update

FY 08 – 09

Agenda

- Vital Statistics
- Notable Achievements
- Course Corrections
- Upcoming Events
- Summary

Vital Statistics

- To date, over $13.5M award activity
- Added 12 members within the past twelve months pegging membership at 94 organizations
- Awarded 7 new efforts within the past twelve months valued at $3.0 M

Notable Achievements

- Moved closer to achieving an economical, weight reducing simplified manufacturing material alternative to brass for cartridge cases
- Developed and employed a high fidelity thermal management weapon design tool
- Introduced an annual PM brief opportunity for notable annual white paper submissions

Course Corrections

- At expiration of current OTA agreement (FY09), will transition procurement function from Picatinny Arsenal to the Department of Interior's National Business Center
  - Interim Measure (FY10 through FY12)
  - Establish new OTA for this period
  - Regain business cycle predictability
- Assessing path forward in light of OSD/DA denial of waiver request to exempt NSAC from cost-share/mandatory partnering requirements

Upcoming Events

- Membership Meeting @ Ft. Benning 17-18 June
- Release of Request for Business Development Proposal Solicitation (June 09)
- Establish new OTA between NSAC and NSATC
- Release FY10 Request for Project Proposal (July 09)
- Eight additional awards planned for FY09 cycle

Summary

- Membership continues to grow
- Business cycle stability and enhanced member collaboration are chief goals for FY10
- Membership meetings continue to evolve into forums for high value information exchange and user/supplier networking opportunities





Time for a Change

US "Incremental" Small Arms Fielding

- Status Report 2009 -

by Jim Schatz

052109





Part I
Introduction



Observations



Oh what a difference a year can make! Turning a corner.

- New Opportunities. Making progress.
- New industry confidence in the process
- Is visible in attendance and industry response, developments

New Leadership at PEO-S, PM-SW, USAIC Small Arms Division

- User Focused. Openness. Engaged. Less Arrogance.
- Incremental fielding successes (MK48, M24 PIP, NC, M2 QCB)
- Participation Here – online at the firepower demo!

User Proponent Excellence

- LTC Henthorn's "SWEAT" concept and briefing
- New Requirements Documents seeing the light of day

Still takes too long and is too difficult to rapidly field what is needed.

SAAS – Got it! Right on! But training cannot make up for hardware failures.



Briefing Take-Aways



1. **Author not employed in any way by any small arms/ammo maker since May 2006.**

2 Concern is for the front line small arms end user

3 Is not, never was about just one weapon

4 Current legacy producers are producing quality weapons that meet *current* Performance Specs

5 Current Performance Specs are aged and not current with the available state-of-the science for small arms and ammunition



Briefing Take-Aways



1 Not employed by any small arms/ammo makers, etc.

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Briefing Take-Aways



6. How do we know we have the very best if we do not assess available new offerings, technology?

7 We have assessed and selected through F&O competition only 1 of 8 legacy weapons for replacement (M203) since 1985 (XM9)

8 Only asking that we assess and field "incrementally superior" small arms and ammunition through regular full and open competition

9 Empower the front line small arms end user through policy change and the formation of the USAAAP



Briefing Take-Aways



6. How do we know we have the very best if we do not assess available new offerings, technology?

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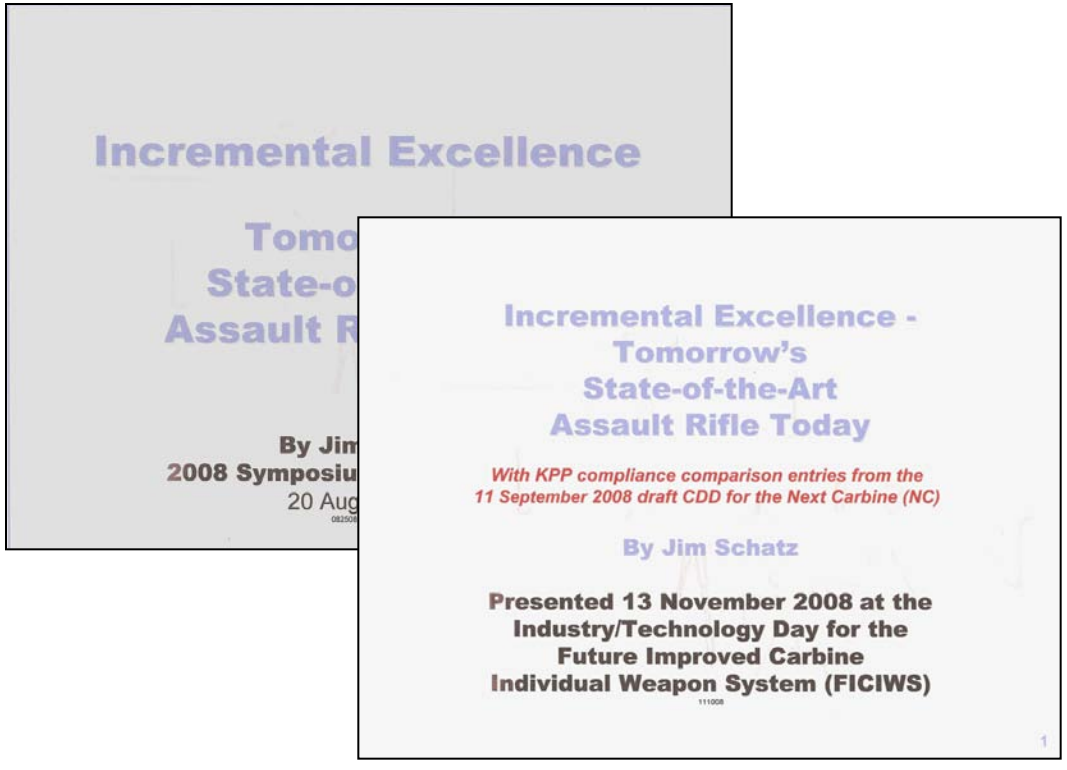
9. Empower the front line small arms end user through policy change and the formation of the USAAAP

10. The enemy of progress is bureaucracy – <u>it must be breached!</u>

Past Public Presentations

Both available at www.dtic.mil/ndia/2008Intl/Schatz.pdf





May 2008
NDIA Small Arms Conference
Dallas, Texas USA

Aug. 2008 – European Small Arms Symposium
Shrivenham, England
Nov. 2008 – US Army Next Carbine Industry Day
Arlington, Virginia USA



Purpose



- **To create a national awareness and dialogue on serious small arms issues for *"the real"* (front line, close combat) small arms end user**
- **Not to cast blame. No one entity responsible!**
- **To breach the "deeply ingrained institutional resistance" to "incremental" change**
- **To affect positive, permanent change *now***
  - **Current small arms and ammunition**
  - **In P&P to prevent continued/future stagnation**
- **To persuade "the system" to test incrementally superior ammunition and COTS small arms systems *today!***



Caveats



- **Not all services, organizations are the same**
- **The larger the organization, the less they tend to support the true needs of the real end user**
- **There are well intentioned people trying to do the right thing for the war fighter *but are often smothered by entrenched bureaucracy***
- **Specific weapons, names, organizations omitted**
- **All data and claims supported by reference materials, public domain info and/or first hand knowledge**



Definitions



- "War Fighters" "Real Small Arms End Users" – current US ground combatants who engage the enemy with small arms in close combat

- "Select US Units" – Public domain. See "Army Times"

- The "System" – DoD organizations tasked with weapons acquisition, testing, fielding and logistical support of US DoD small arms and ammunition. *Contacted by author for comment. Included herein when received.*

- "US Standard" – current issue



"Incremental" Improvements



- The "90% solution"
- Available as COTS/NDI, modified COTS
- Fielded elsewhere and available *NOW*
- Some ***in threat use***
- Significant advantages for ***the real end user!***
  - > **Reliability**: 4-7X that of US standard
  - > **Service Life**: 3-4X that of US standard
  - > **Improved Accuracy**: 30-50% increase
  - > **Safety**: OTB (2 vs. 6 sec. drain time), Increased (60%+) Cook Off (210-240 vs. 120-150 rounds), SBFA (catch live projectiles during blank firing)
  - > **Weight Reduction**: 25-40%
  - > **Unique Capabilities**: Advanced penetrator technologies, "caseless" cartridges (40mm), mechanically increased pH, LV 40mm ABMS, advanced threat body armor





Part II
The state of the science



"The Big 8" – Showing their Age



Average:	**34**	**All eight weapons**
Average:	**27**	**Without M2HB**
Average:	**25**	**Without M2HB and M203**
Average:	**24**	**Without M2HB, M203, M16A2** (3)
Average:	**27.5**	**Without M203 & M4 - replaced by current programs**

(1) All initial fielding dates extracted from "Jane's Infantry Weapons" (2007/2008 edition).
(2) "OFW" - Objective Family of Weapons from "Small Arms Master Plan" (SAMP) first briefed in 1984 by the USAIC.
(3) America's longest serving service rifle in models AR-15, M16, M16A1, M16A2, M16A3/M16A4 (> 42 years).

- **Trickle Down" effect. What the US Army buys often ends up in:**
  - **All branches of our military**
  - **US State Department/Embassy security**
  - **OGA's (federal law enforcement, DOE, NRC, FBP, other)**
  - **State and Local law enforcement**
  - **Foreign Military Sales (FMS)**



Our Aged Fleet – "The Big 8"

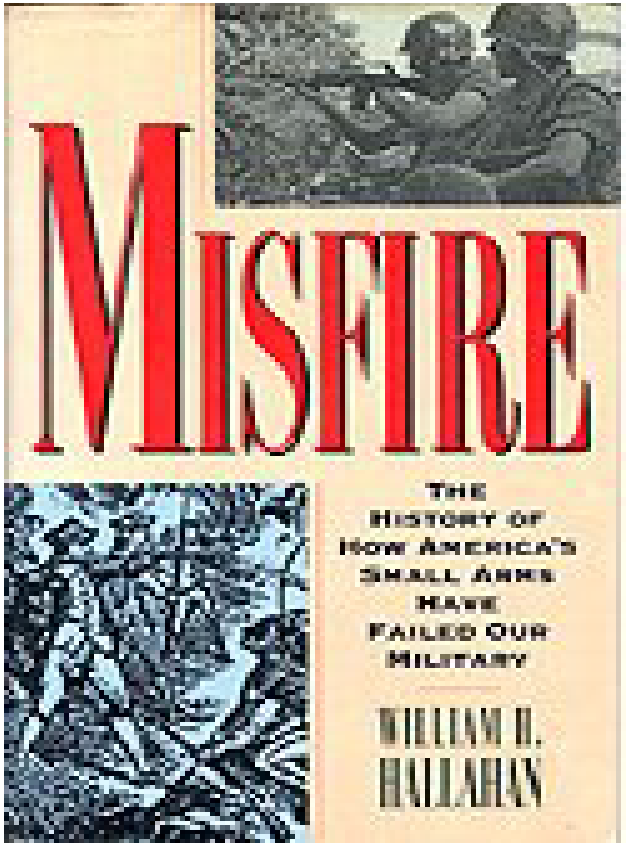
8 Primary US DoD Small Arms



Weapon	Year First Fielded [1]	Age (Years)	Manufacturer	Modern Design Available	Replaced by OFW Candidate[2]	Comments
M9 Pistol 9x19mm	1985 (Army)	24	Beretta USA	Beretta Brigadier, PX4, others	No	Numerous modern alternatives abound, to include PDW calibers.
M4 Carbine 5.56x45mm	1994 (Army)	15	Colt Defense	Colt M5/APC/AHC, HK XM8, HK416, SCAR L, others	No	Modern Op Rod designs abound, fielded in select US units. Army "Next Carbine" effort underway CY09 – FUE not before 2012 (18 years after M4).
M16A2 [3] **Rifle 5.56x45mm**	1982 [4] (Army)	27	FNMI, Colt Defense	FN SCAR, F2000 Colt M5, HK XM8, HK416	No	[4] M16A1 type-classified by Army in 1967 – 42 years ago. Modern Op Rod and/or bull pup designs abound, fielded.
M203 Grenade Launcher 40x46mm	1969 [5]	40	Various	US XM320, FN Mk13 Mod O (SCAR EGLM)	No	[5] M203 replacement w/ M320 begins in CY09 - 4+ years since COTS contract award.
M249 Squad Automatic Weapon 5.56x45mm	1982	27	FNMI	FN MK46	No	MK46 fielded within USSOCOM since 2000.
M240B Medium Machine Gun 7.62x51mm	1976 (Army)	33	FNMI	FN MK48, Vector SS77, US Ord. M60E4, Barrett LW240, HK121	No	MK48 fielded within USSOCOM since 2002. First "forced" Army fielding in 2008 to 101st.
M2HB Heavy Machine Gun .50 BMG	1923	86	GD	GD M2E2, GD XM312	No	
MK19 MOD 3 Automatic Grenade Launcher 40x53mm	1988 (Army)	21	GD	GD MK47, HK GMG, Russian 40mm 6G27 "Balkan"	No	MK47 and GMG fielded with USSOCOM, OGA's, numerous foreign friendly countries.

Required Reading

- **Current "dysfunction" reoccurs @ every 30-50 years**
- **Bureaucracy enabled**
- **War fighter input "lost" in the red tape**
- **Incremental advancements mostly ignored**



- **Required reading: *"Misfire"***

***The history of how American small arms have failed our military"* By William H. Hallahan. Available from amazon.com**

Summary available. Send email to presenter.

Threat Successes - Weapons





Russian AN-94 "Blow Back Shifted Pulse" Assault Rifle caliber 5.45x39mm w/ 40mm GP-34 grenade launcher. pH doubled w/ 1800 rpm ROF. In limited production and fielding since 2001. Used/ found outside Russia. Being developed in 7.62x39mm.

The System has nothing that competes with these weapon capabilities!

Chinese QBZ-95 Family of Weapons Caliber 5.8x42mm rifle, carbine, LMG, GPMG, sniper rifle, and 5.8x21mm PDW. Superior cartridge/bull pup ammunition performance. First fielded in 1998. Now fully fielded in the PLA (2.25-3M). Exported.



Russian GSh-18 Armor Piercing Semi-automatic Pistol. Fires 9x19mm PBP AP ammo. Penetrates 8mm mild steel or Class IIIA body armor at 20 meters. First fielded in 2000.

Threat Successes - Ammo







Russian "family" of compact and in some cases "subsonic" exposed-penetrator core AP rounds. L-R: 9x18mm AP, 9x38mm SP-6 subsonic, 9x21mm SP-10 for Gyurza pistol and Veresk submachine gun. Found often outside Russia. Defeats level IIIA body armor @ 20+ m.

The System has nothing that competes with these weapon capabilities!



Russian 7P39 40mm HV Caseless Grenade for Russian "Balkan" 6G27 AGL. MER 2,500 meters. 2X increased HE-Frag effectiveness. 71 lb. AGL system weight is 40% < US standard w/ LW tripod (98 lbs.). Ready for fielding in 2009.



Left to right 5.56x45mm, 5.45x 39mm, 5.8x42mm

Chinese 5.8x42mm DBP-95 round (with enhanced penetrator defeats 10+ mm steel at 310 m.) - outperforms both 5.45x39 mm AP and 5.56x45mm SS109/M855 "penetrator" rounds while retaining more energy for soft tissue destruction behind armor. A PDW in 5.8x21mm is now also available. In service since 1998. Fully fielded with Chinese forces.

Export Threats - Weapons



K11 Combination Air-bursting Weapon

- 5.56x45mm select-fire rifle
- 20mm bolt-action grenade launcher
- MER 460-500 meters
- Weight: 13.5 lbs empty
- 6-round 20mm box magazine
- Developed 2000-2009
- http://www.youtube.com/watch?v=j_MdhG6bxao
- http://www.youtube.com/watch?v=XNr8bWqrP5s&feature=related

Nov. 14 2008 Press Release: "Im chung-bin, the chief of staff of the ROK Army examines the new South Korean double-barreled rifle K-11 at the ground weapon conference on 11 Nov. 2008 in Daejeun South Korea. This rifle uses 20mm airburst ammunition and 5.56mm NATO ammunition. The 20mm launcher operates as bolt-action and uses a 5 round mag. This weapon will be fielded next year"(2009)

- **April 23 2009 Press Release** "South Korea has become the first nation in the world to operate a battle rifle using precision-guided high-explosive airbursting projectiles," said the press release. "The K11 is expected to be a key defense export item, as well as help boost the South Korean military's operational capability to an extent."



Small Arms “Disconnect”



- **While various US small arms, ammunition types remain fundamentally unchanged in regards to performance, the same does not apply to other and often more costly (3-8 X) equipment items.**

- **Behind water and rations, small arms rank third as the most important piece of individual equipment to the war fighter. Yet we fight today with on average (34 years) Vietnam-age small arms and ammunition.**

- **Do we have the best available? Is there better out there? How will we know if we don’t look? Others have.**

We must!

Small Arms "Disconnect" (cont.)

- Night Fighting Equipment
- Helmets and suspension
- Load bearing equipment
- Uniforms, boots, gloves
- Body Armor
- Eye, Ear Protection
- Rations, water carriers
- Communications gear
- Cold/wet weather gear
- First Aid pack, gas masks
- Anti-tank weapons

21 years Ago



2009



…but many positive developments have occurred since May 2008



It simply takes too long!



Item	Years in Pipeline	Status
COTS XM26 MASS	> 11	FUE FY10
COTS XM320 GLM	> 4*	FUE 2QFY09
COTS XM110 SASS	> 2**	FUE CY08
M240L	> 11	FUE 3QFY10
OICW/XM25	> 17	Pending as XM25
OCSW/XM307/312/806	> 13	Pending as XM806

* Since contract award (05/05)

** Since RFP release (03/06)



Select US Unit Success



- **Have replaced 7/8 US standard weapons with incrementally superior COTS weapons – *the 90% solution***
  - **In near term (< 2 years)**
  - **Few if any R&D dollars spent – low risk to vendors**
  - **Advanced and unique capabilities fielded – *ALL COTS!***
    - **> FN Minimi before M249**
    - **> MAG58 before M240**
    - **> MK19 in Navy Spec War in 1960's**
    - **> .50 caliber Sniper Weapons before M107**
    - **> SR-25 before M110 SASS**
    - **> AG416 before XM320**
    - **> .40 S&W caliber handguns years before JCP/CP/MHS**
    - **> PDW caliber weapons and ammo**
    - **> HK416/417, MK46/48, GMG, SCAR/EGLM, others**
    - **>.300 WINMAG sniper rifles before M24 PIP**

Many fielded with limited US Govt R&D spending, *if any!*

The US DoD should embrace and adopt the winning ways of these Select US units to prevent US small arms stagnation.



Much Good News

Incremental Fielding Successes since May 2008



- **USSOCOM fields LRIP SCAR/EGLM's (and soon SOST)**
- **Army announces "Next Carbine" effort**
  - **RFP expected out summer 2009. Caliber still "open".**
- **Army fields MK48's, MK46's in OEF. More to come.**
- **Army SEC Geren requests JAT/DST of the "Big 8".**
- **Army w/ help from industry - Congress funds M24 .300 WINMAG PIP**
- **Army fields first M320's to replace 1960's era M203**
- **Army plans release of new JCIDS-approved handgun CDD/RFP**
- **M2E2/QCB kits and M240L – soon ready**
- **USMC IAR effort enters down-select phase**

Well Done!



The “7 Talons”

What is takes to breach the bureaucracy



Catalyst	1960’s	2006-2009
1 Legacy System Stagnation	M14 fielded – after 13 years. (19 after MP44, 11 after AK47)	Average age of the US “Big 8” is 34 years - 24 years w/o the oldest 3
2 Field Reports	May, Sept, Nov 1958 – Inf Board, CONARC, CDEC reports - AR-15 vs. M14 - 1962 DoD “Hitch” report	2006 CNAC Survey – - 18% average failures - M855 failures Extreme dust test x 3
3 Media	July 1969 – Newspapers report on SECDEF attack of M14 in Congress	Army Times, AP, Defense News, CNN, This Wk in Def News, etc.
4 Congress	- Def. App. Comm - 1961 - 1967 Ichord comm. after 6 reports of M16 combat failures.	Congressmen Coburn, Webb, Salazar, Tancredo, others (5/15/09 ltr to Army COS x 10 Senators)



The "7 Talons" (cont.)

What is takes to move the mountain



Catalyst	1960's	2006-2009
5 VIP Involvement	Pres. Kennedy, SECDEF McNamara – Ord. Corps becomes AMC.	SECDEF Gates, USD AT&L Young, SEC Army Geren - JAT/DST
6 Users	Vietnam troops writing home	User "Advisors" to Army SEC Geren, Army VCOS
7 New Requirements Documents	AR-15/M16/M16A1	- Next Carbine CDD - Sub Compact CDD? - SAA JAT/DST - LW LMG's to OEF - New Pistol CDD - USAAAP?

A culmination of historic events, an "aligning of the stars", that has not occurred in @ 4 decades. Events that are making a real difference in the weapons and ammunition carried by the end users of today and tomorrow *if the trend continues*.



Still more Work to Do

Incremental Fielding "Challenges" since May 2008



- **Legacy purchases continue using *old performance specs***
  w/o looking first at superior, proven, fielded COTS alternatives
  - **1000's/$10M's of Pistols and SAW's –**
    26% and 30% stoppages in 2006 CNAC survey
  - **1000's/$10M's 7.62mm MMG's and 40mm *AGL's***
    their performance eclipsed by lighter, more modern COTS systems fielded in Select US SOF units
- **AWG has 9mm Glock pistols stripped from operators**
  like COTS HK416 Carbines in 2007
- **Follow-on to M855 round not yet ready for fielding *after @ 15 years***
  superior COTS "BTB" rounds already fielded in US SOF
- **XM25 funding continues after 17+ years, $207M – *(S.K K11 ready!)***
  Summer 2009 user assessment to determine fate. SOGOTP!
- **LSAT Caseless Ammunition funding continues**
  High risk with serious, well known technical obstacles (ACR)





Part III

Modern Incrementally/ Evolutionary Superior COTS Alternatives

(already fielded and available today for US Army comparative testing)





Quad Chart Explanation

Each quad represents one proven, fielded COTS system in use by select US units or foreign organizations

- Each quad provides a photo and Key Superior Performance Capabilities over the comparable US DoD legacy system

- All items are available NOW for US Army evaluation and are already on US Govt contract where noted or in threat use

- System Cost and Delivery Schedules are comparable to US legacy systems when ordered in volume

Intermediate/"Medium Caliber" Rounds

The effectiveness of any small arms system is only as good as the projectile it launches.

- Current US handgun and rifle cartridges/ projectiles have not changed since the 1980's when they were first adopted.
- Incrementally superior intermediate or "medium" caliber cartridges are available.

- Proven by various US military, SOF, and law enforcement organizations, the two medium caliber COTS rounds described below offer NLT 33% increased terminal performance and maximum effective range from small arms platforms comparable in size, capacity, cost, reliability, accuracy, felt recoil, ease of use and weight to current legacy systems & with superior ergonomics.



Medium caliber 6.8x43mm round flanked by 5.56x45mm (left) and 7.62x51mm (right) rounds

- **The 6.8x43mm cartridge can be fired from the M4 or M16 by exchanging barrel, bolt and magazine only.**
- **The cartridge is available commercially in all bullet styles to include Hague-compliant FMJ, as well as AP rounds.**
- **The 115 gr. 6.8 projectile has 2X the projectile mass compared to the 62 gr. 5.56mm M855 projectile.**
- **The 6.8 projectile has 24% greater frontal surface area than the 5.56mm projectile to better destroy tissue in FMJ loadings, especially when fired from short-barreled carbines in common use today.**

- **The COTS .40 S&W round is in the US DoD supply system (US Coast Guard) in various loads to include a Hague-compliant FMJ and is the most popular pistol cartridge in US law enforcement to include the DHS, TSA, FBI, DEA, etc.**
- **The .40 S&W round/pistol is in use and has been proven in combat by select US SOF units wherein it replaced both 9x19mm *and .45 ACP pistols*.**



Medium caliber .40 S&W round flanked by 9x19mm (left) and .45 ACP (right) rounds.

- **The 155-180 gr. .40 S&W projectile is 35-56% greater in weight than that of the 115 gr. 9mm projectile and has 34% greater frontal surface area to destroy tissue in Hague-compliant FMJ loadings.**
- **COTS .40 S&W pistols, that are smaller in size than the 9mm US M9 pistol but with =/> magazine capacities, are available on US Govt contract.**

Blind to Barrier Ammo

- **"Blind to Barrier" (BTB) Ammunition** ***User must ask for it!***
  - **New development within last 5 years**
  - **Offers a balanced combination of penetration through armor, windshields, heavy clothing and personal equipment and soft tissue destruction beyond the intermediate barrier**

- **Is not reliant upon muzzle velocity, fragmentation or bullet yaw to destroy tissue (like M855)**

- **Proven. Already fielded in Select US Units, US Federal Law Enforcement**

- **COTS – Available Now AND Hague-compliant, DoD General Counsel "friendly"!!!**



Barnes TSX – Solid Copper Projectile

(available in four 5.56mm bullet weights and many calibers – Lead Free)

- Two of many -

Remington CLUB (Core-Lokt Ultra Bonded)

(fully encapsulated lead core with bonded copper jacket – Lead Free)



Alternative COTS Handguns





Glock 22
Glock 23

Fielded with US LE and DoD units

- Most popular modern free-world pistol fielded worldwide
- Magazine Capacity in excess of US M9 (19 versus 15 rounds)
- Various sizes, models, calibers available
- Comparable in cost to 9mm M9



HK P2000

@ 60,000 fielded with US DHS (USBP, ICE, etc.)

- Minimum 20,000 round service life – all parts
- Ambidextrous slide and magazine releases
- Various sizes, models, calibers available
- One-piece steel slide
- Convertible fire controls and operating modes (SA, DA, DAO)



SIG P229

Fielded with US DHS (USBP, ICE, etc.) & US Coast Guard

- One-piece steel slide and integral accessory rail
- DAK trigger system requires no external safety or decocker
- Various sizes, models, calibers available
- One-piece steel slide and integral Picatinny accessory rail
- Convertible fire controls and operating modes (SA/DA, DAO)



Russian “Gyurza”



SR-2 Veresk
Submachine gun

Fielded with Russian GRU, police, special forces

- Fires 103 gr. 9x21mm armor piercing SP-10 ammo at 1378 fps
- Defeats NATO CRISAT target (2 x 1.4mm Ti plates, 30 layers Kevlar) @ 100 m! Maximum effective range of 200 m.
- 18 round magazine
- Part of family “complex” with Russian SR-2 Veresk sub gun

Alternative COTS/Near COTS Carbines



FN MK16 MOD 0 - SCAR Light
(Op Rod Gas System)

Fielded with USSOCOM units (LRIPs)
- Ambidextrous operating controls, user barrel replacement
- Barrel, parts service life in excess of 30,000 rounds
- Various sizes, models, calibers available
- Comparable in cost to US legacy weapons (in volume)
- Over-the-Beach capable



HK HK416
(Op Rod Gas System)

Fielded with Select US SOF units
- Available as a complete weapon or M4/M16 upper receiver kit
- Barrel, parts service life in excess of 24,000 rounds
- Various sizes, models, calibers available
- Comparable in cost to US legacy weapons (in volume)
- Over-the-Beach capable



HK XM8 Baseline Carbine
(Op Rod Gas System)

Modular "Family of Weapons" (5) - developed for the US Army
- Fully ambidextrous operating controls
- Barrel, parts service life in excess of 30,000 rounds
- High reliability polymer magazine and hammer forged barrel
- Comparable in cost to US legacy weapons (in volume)
- Modular stock, Dual Function sight, PCAP accessory mounts



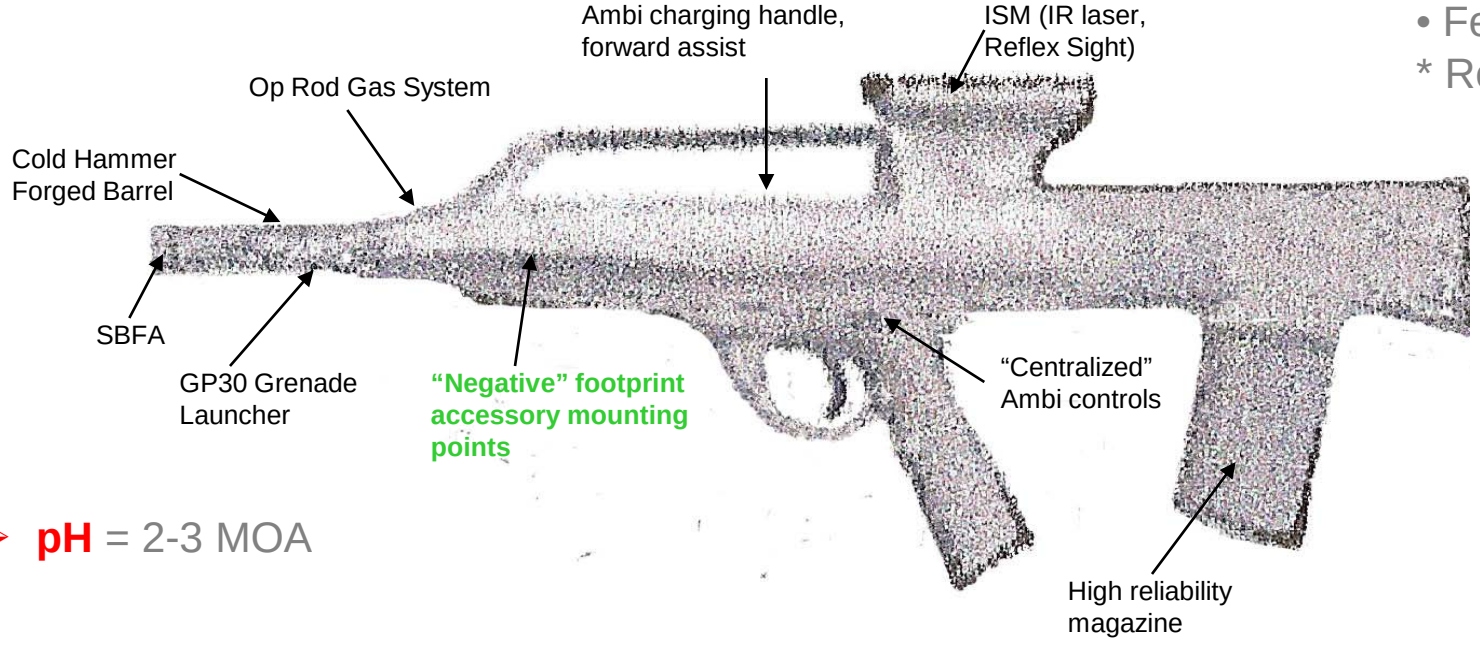
Chinese Type 95 (aka QBZ-95)
(Op Rod Gas System)

Fielded w/ Chinese PLA and police since 1998. Fully fielded.
- "Bullpup" configuration – only 29" long with 19" barrel delivering 3051 fps MV/1330 ft. lbs. ME (US standard carbine is 33"long (stock open) with 14.5" barrel and delivers 2750 fps MV/1222 ft. lbs. ME)
- @12% increase in MV over US standard (longer barrel)
- @9% increase in ME (64 gr. bullet) vs. US M855 (62 gr. bullet)
- "Family" includes PDW, rifle, carbine, sniper rifle, LMG, GPMG

The "Ultimate" Incrementally Superior Bullpup Assault Rifle

If the US Army asks for it, Industry can (has provided it) already

- **Safety**
  - **Cook-off =/> 270 rds.**
  - Barrel failure =/> 900 rds.
  - OTB Capable (0 seconds)
- **Reliability** =/> **18,000 MRBF/S**
- **Family of Modular Weapons**
  - Barrels
  - Stocks, trigger groups
  - Calibers
  - Feed systems
  - * Reduced life cycle costs



- **System Weight**
  - =/< 3.27 kg (7.2 lbs.) (TAR-21)
  - LW ammunition
- **pH** = 2-3 MOA
- **Lethality**
  - BTB projectiles
  - Medium caliber option
  - **Increased MV (NLT 11%)**
  - **Increased ME**
- **Maintenance**
  - **72% less operator cleaning**
  - > 2X bolt service life
  - > 3X barrel service life
  - 2X receiver service life

Alternative COTS/Near COTS Rifles



HK HK416
(Op Rod Gas System)

- Fielded with Select US SOF units
- Available as a complete weapon or M4/M16 upper receiver kit
- Barrel, parts service life in excess of 24,000 rounds
- Various sizes, models, calibers available
- Comparable in cost to US legacy weapons (in volume)
- Over-the-Beach capable



FN MK16 MOD 0 - SCAR Light
(Op Rod Gas System)

- Fielded with USSOCOM units (LRIP's)
- Ambidextrous operating controls, user barrel replacement
- Barrel, parts service life in excess of 30,000 rounds
- Various sizes, models, calibers available
- Comparable in cost to US legacy weapons (in volume)
- Over-the-Beach capable



Colt M5/APC/ AHC Carbine
(Op Rod Gas System)

- Follow-on development to excellent SCAR candidate
- Available as a complete weapon or M4/M16 upper receiver kit
- Increased barrel, parts service life
- Various sizes, models available
- Comparable in cost to US legacy weapons (in volume)
- Monolithic rail system, folding PDW-style buttstock option



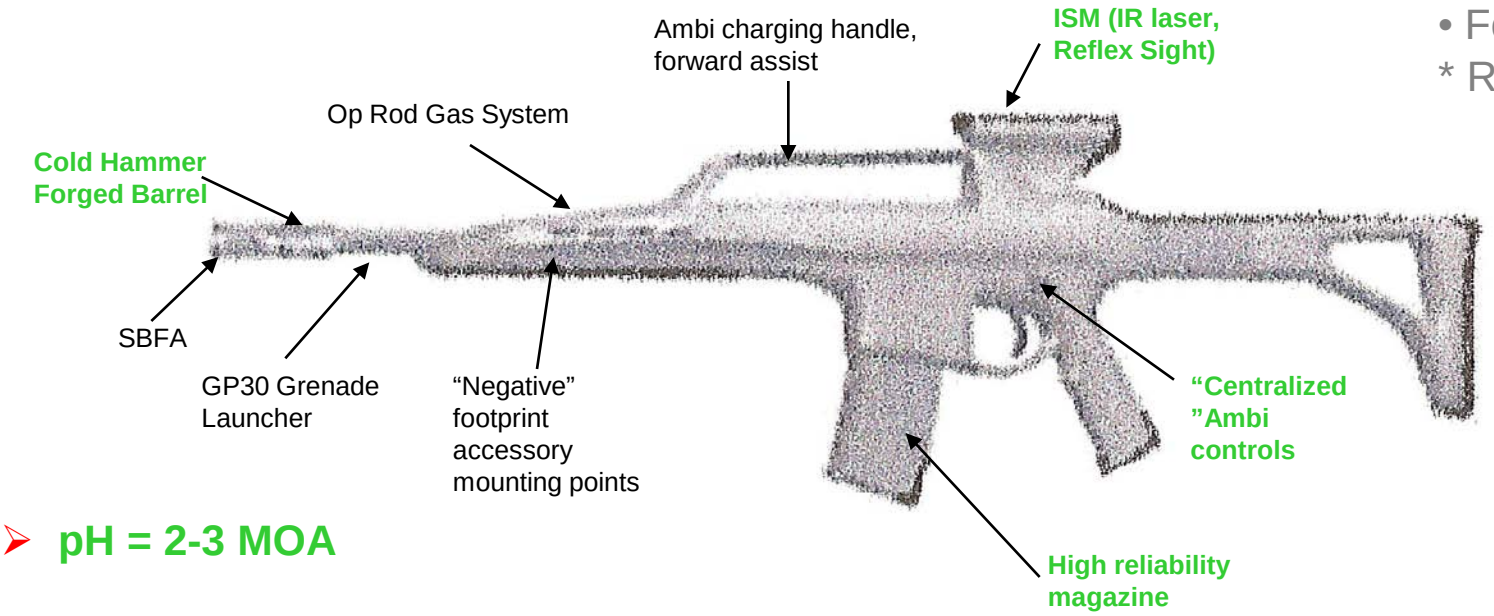
Russian AN-94 "Nikinov"
(Blow Back Shifted Pulse)

- Limited fielding since 2001. Offered for export. Seen abroad.
- "Shifted Pulse" operating system delivers 2 rounds at 1800 rpm
- Reduced felt recoil, advanced muzzle break reduces dispersion
- 1.5X increase in pH due to controlled 2 round dispersion
- Available in 5.45x39mm. Development underway in 7.62x39mm
- Body Armor defeat capability due to successive strikes @ POA

The "Ultimate" Incrementally Superior Conventional Assault Rifle

If the US Army asks for it, Industry can (has provided it) already

- **Safety**
  - Cook-off =/> 270 rds.
  - **Barrel failure =/> 900 rds.**
  - OTB Capable (0 seconds)
- **Reliability** =/> 18,000 MRBF/S
- **Family of Modular Weapons**
  - Barrels
  - Stocks, trigger groups
  - Calibers
  - Feed systems
  - * Reduced life cycle costs



- **System weight**
  - **=/< 2.8 kg (6.1 lbs.) (XM8 BC)**
  - LW ammunition
- **pH = 2-3 MOA**
- **Lethality**
  - BTB projectiles
  - Medium caliber option
  - Increased Terminal Effectiveness against unprotected and protected targets
- **Maintenance**
  - 72% less operator cleaning
  - **> 2X bolt service life**
  - **> 3X barrel service life**
  - 2X receiver service life

Alternative COTS/Near COTS 40mm LV Grenade Launchers



US Army (HK) M320/320A1 GLM

- First fielded by US Army in 2009. Contract awarded in 2005.
- Fielded with Select US SOF units, foreign armies since 2000
- Can be used on any rifle or in stand-alone mode
- Barrel, parts service life in excess of 10,000 rounds
- Day/Night sighting system available as an option
- Improved reliability over M203



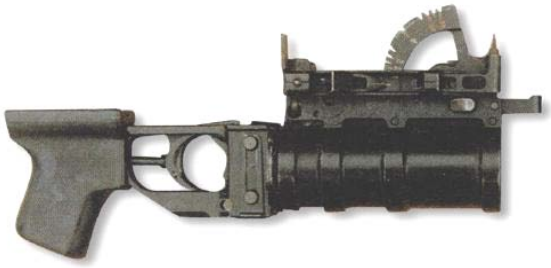
FN MK13 MOD 0 (SCAR EGLM)

- Fielded with USSOCOM units in 2009 (LRIP's) with SCAR rifles
- Can be used on MK16 and MK17 rifles or in stand-alone mode
- Rotating barrel can be loaded from left or right side
- Day/Night sighting system available as an option
- Medium velocity (to 800 meters) ammunition in development



ST Kinetics 40mm LV ABMS

- First shown publicly in 2008 at the Eurosatory expo
- Fires pre-programmed, RF set, air-bursting 40x46mm rounds
- Can be attached to most host weapons with adapters
- Full solution fire control "reflex" sight with laser range finder
- Fires all 40x46mm grenades
- Time based air-bursting rounds include self-destruct feature



Russian GP34 (40mm)

- First fielded by Russian forces in 1989 (in 30mm).
- Fires "caseless" 40mm rounds. No breach to open/close.
- Is only 11" long (M203 is 15 inches long)
- Weighs only 2.8 lbs. (M203 weighs 3.1 lbs)
- Double action only trigger system
- Silenced version available (30mm BS-1)

Alternative COTS Light Machine Guns



FN MK46 MOD 0
(5.56x45mm NATO)

- Fielded with USSOCOM and other units since 2000
- Light weight – only 12.6 pounds (US M249 weighs 16.5 lbs.)
- Barrel, parts service life in excess of 50,000 rounds
- 7.62x51mm "family" variant (MK48) available
- Comparable in cost to US legacy weapons (in volume)



HK MG4E
(5.56x45mm NATO)

- Fielded with German Army (in 2006) and Spanish Army
- Short overall length – 29.5" with short barrel and stock folded
- Barrel, parts service life in excess of 50,000 rounds
- Safe loading features include locking cocking handle, belt position indicator and case deflector
- Comparable in cost to US legacy weapons (in volume)



Israeli (IWI) Negev
(5.56x45mm NATO)

- Fielded with Israeli IDF units since 1998
- Light weight – only 15.3 pounds (US M249 weighs 16.5 lbs.)
- Folding buttstock for compact carry, use from confined spaces
- Semi-automatic fire option for "probing" fire
- Excellent performance in dusty, desert-type environments



Russian PKP "Pecheneg"
(7.62x54mm Rimmed)

- Fielded with Russian Spetsnaz and other units
- Developed as LMG based on Chechnya experience with PKM
- Light weight – 19.2 lbs. (US M240E6 weighs 23.5 lbs.)
- Special heavy profile barrel with active cooling fins/jacket
- 600 round sustained fire capability
- Maker claims 2.5X increase in accuracy out to 1500 meters over competing designs

Alternative COTS/Near COTS Medium Machine Guns



FN MK48 MOD 0

- Fielded with USSOCOM and other units since 2002
- Light weight – only 18.6 lbs (17% lighter than US M240B)
- Barrel, parts service life in excess of 50,000 rounds
- 5.56x45mm "family" variant (MK46) available
- Comparable in cost to US legacy weapons (in volume)



FN M240L

- Under contract through US Army PM-SW
- Light weight – > 3.5 pounds lighter than US M240B
- Durability and reliability equal to US M240B
- Titanium receiver block, light weight barrel
- Improved charging handle, bipod, gas regulator, front sight, buttstock and trigger group



US Ordnance M60E4/MK43 MOD 0

- Fielded with USSOCOM and other units since the 1990's
- Light weight – 22.5 lbs with short barrel
- Eliminates all previous/past M60 technical issues
- Produced and assembled in the United States
- Comparable in cost to US legacy weapons (in volume)



Russian PKM (7.62x54mm Rimmed)

- In service in more than 100 countries
- Light weight – 19.8 lbs. (US M240B weighs 27 lbs.)
- Extremely reliable and durable in hostile conditions
- Easily maintained by the untrained
- Removable barrel, right side feed (ease of carry)

Alternative COTS Automatic Grenade Launchers



GD-ATP STRIKER40 (MK47 MOD 0)

- Fielded with USSOCOM and other units since 2004
- Light weight – only 39.6 lbs. (US MK19 MOD 3 weighs 77 lbs.)
- % of Recoiling Mass – 55% (22% for US MK19 MOD 3)
- Full Solution FCS w/ Preprogrammed Air-Bursting ammunition
- QC Barrel and lightweight tripod with non-conventional T&E mechanism



HK GMG

- Fielded with select USSOCOM units and 15+ other countries
- Light weight – only 64 lbs. (US MK19 MOD 3 weighs 77 lbs.)
- Unpowered Day/Night reflex sight, buffered mount and QC barrel
- Enhanced user safety w/ NLT 6 internal safeties
- LMG-type loading and unloading improves operator safety
- Comparable in cost to US legacy weapons (in volume)



ST Kinetics 40LWAGL ABMS

- Manufactured for Indonesian armed forces. Samples exported.
- Light weight – only 31 lbs. (US MK19 MOD 3 weighs 77 lbs.)
- Soft-mount cradle and non-conventional "lock-fire" T&E mech.
- Full Solution FCS with Preprogrammed Air-Bursting ammunition
- Man portable (3 man crew)



Russian 6G27 "Balkan"

- Undergoing official Russian Army trials in 2008
- Light weight – only 71 lbs. (weapon *with tripod & sights*)
- Fires 40mm extended range "caseless" ammunition
- MER of 2,500 meters w/ 2X effectiveness of earlier HE rd
- Equipped with optical and back-up iron sights

Alternative COTS/Near COTS .50 BMG Heavy Machine Guns



GD-ATP M2E2

- Adopted b y US Army as "M2E1" in 2009
- Increases user safety and reduces operator pre-firing effort
- QCB "kit" can be retrofitted to existing M2HB's
- Kit includes fixed headspace components (barrel, barrel ext.)
- Under US Army testing for procurement as of 2008/2009

NOTE: Similar kits available from other vendors



FN M2 HB QCB

- In production and in foreign service since 1978
- Increases user safety and reduces operator pre-firing effort
- QCB "kit" can be retrofitted to existing M2HB's
- Kit includes fixed headspace components (barrel, barrel extension) as well as optional flash hider

NOTE: Similar kits available from other vendors



GD-ATP XM806 (LW50MG)

- Light weight – only 30 lbs. (US M2HB weighs 84 lbs.)
- Reduced recoil similar to 7.62x51mm M240 MMG
- Light weight tripod – man-portable system
- QC barrel and fixed headspace
- Under US Army testing for procurement and FUE in FY12
- Byproduct of OCSW/XM307/312 effort started @ 13 years ago



ST Kinetics CIS 50MG

- Light weight – only 66 lbs. (US M2HB weighs 84 lbs.)
- Left or right hand feed option
- Open-bolt operation to reduce cook-offs
- QC barrel and fixed headspace
- Reflex and night vision sights available





Part IV

Policy & Procedure Changes Required

(to address and prevent continued US DoD small arms and ammunition stagnation)



1 – End User Absence



Small Arms Decisions are being made "too far from the field" and not by <u>the real</u> small arms end user but by:

- **GO's, PEO's, PM's, Proponents, Retirees *that are not fighting with small arms!***
- **The system MUST support the specific needs <u>of the real end user</u>, *NOT vice versa!***
- **Current system bureaucracy repeatedly fails or is too slow to react.**

ANSWER: *Adopt Select US Unit SOP!*



2 – Unrealistic Requirements



Stop chasing after "Star Wars"
(SAMP, OFW, Caseless Ammo, XM25?)

- **What do US select units/SOF purchase, field?**
  Combine efforts!
- **Efforts must focus on obtainable goals.**
- **"Leap ahead" efforts divert focus and funds from real end user *combat needs*.**

ANSWER: Look to the future
but buy what works, and buy it now!



3 – Changes in Direction



Too many Changes, False Starts, Revisions

- Form the ”User Small Arms and Ammunition Advisory Panel” (USAAAP)

- Directs DoD Small arms “system” on:
  - > Incremental Fielding Focus (1-3 years)
  - > Future Programs (3-5 years)
  - > R&D (5-10 years)

Answer: Form the USAAAP now!

Answerable to Congress and SECDEF only!



USAAAP

(User Small Arms and Ammunition Advisory Panel)



- **Real Users, Select US Unit representation**
- **Proven incremental fielding representation**
- **Self-vetting. No PM's, PEO's, AO's, other**
- **Answerable only to Congress, SECDEF**
- **Directs, approves actions of system on:**
  - **Current product performance**
  - **New item assessment, testing**
  - **Contract awards and extensions**
  - **R&D program funding (current and new)**

The system truly working for the real end user!



3-year Incremental Fielding Cycle



On a three-year cycle the USAAAP:

- Reviews (every 3rd year)
  - USG and COTS System Performance and Specifications, PIP's, Threats, etc.
  - R&D Programs (current, new)
- Tests (every 4th year)
  - Solicits Industry for and tests incrementally superior systems
- Contract Award (every 5th year) NTE 6 years



3-year Incremental Fielding Cycle (cont.)



- **Limited Combat Evaluations to prove out system capabilities**
- **First fielding to high-use, front line units**
- **Keeps opponents guessing on the US small arms capabilities set while leveraging newly emerging COTS capabilities**
- **Contractor-provided Logistical Support should be leveraged as in the UK and Germany**



4 – Outdated SPECS



US Small Arms Performance Specs (PS's) are outdated and force endless sole-source procurement of outdated materials

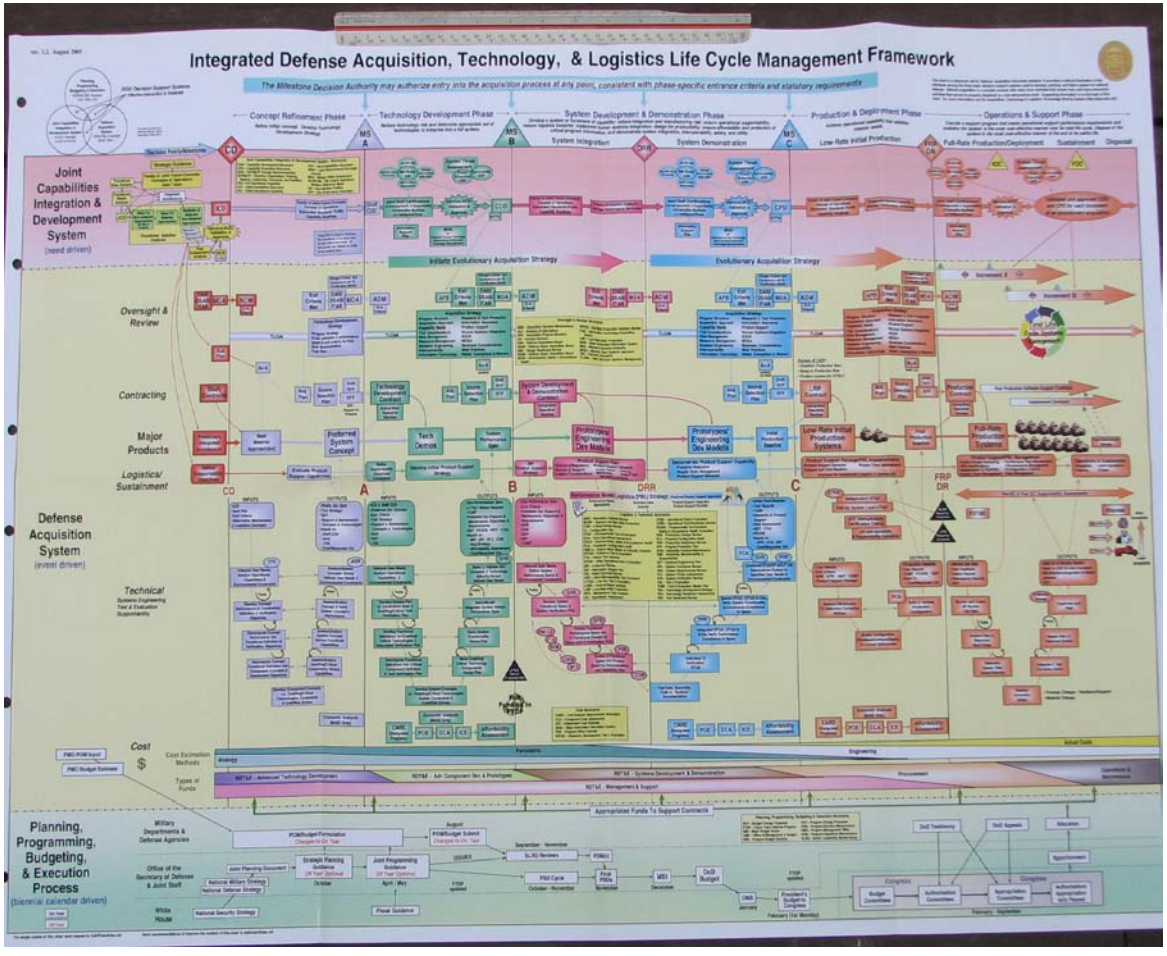
- **Must be revised every 3 years and for each new contract based upon comparative testing of available and emerging state-of-the-art COTS/NDI systems**
- **New "best of breed" must be found, evaluated and exploited regularly for the benefit of the real end user**
- **New PS's must be written/approved by USAAAP *before contract recompetes!***

ANSWER: Update PS's often

5 – Amend JCID's for Small Arms

The JCID's process is simply unworkable <u>for incremental and timely small arms fielding</u>

- **Delays fielding**
- **Hampers urgent responses**
- **Drives up costs**
- **Creates programs versus solutions!**



ANSWER: Amend JCID's for Small Arms



6 – System Support



The Small Arms Support System (Development, Acquisition, Contracts, Logistics) must support the direction/decisions of the real small arms end user through the USAAAP.

- **Utilize the talents, facilities already in the system**
- **Stop chasing the Logistical Tail!**
- **The system works for the real end user**
- **More security for all by greater turnover of new systems and system successes**

ANSWER: User/USAAAP directs Support System



7 – R&D Black Hole



Studies, Simulation and Modeling should not replace regular incremental fielding

- **Find and field the "90% solution", *and regularly***
- **Reoccurring Competition and Incremental Fielding provides the greatest return on investment and innovation**
- ***Endless Multi-year Programs do not kill bad guys! Nor do they protect the friendlies!***

ANSWER: User/USAAAP approves all new small arms R&D programs



8 – "Career Suicide"



Remove the "Yes Man" promotion rule from small arms efforts/programs

- **Few AO's, PM's have extensive small arms experience let alone hands-on small arms expertise**

- **Act on real user/USAAAP direction, not that of superiors inexperienced with small arms who control a subordinates future and push bad small arms decisions**

Then PM's will become true "Action Officers"

ANSWER: Make the system answerable to the real end User/USAAAP



9 – Joint Efforts



Very few combined efforts exist today
in US Small Arms development
yet the basic use of small arms is the same

- **Combine Requirements, Interagency Participation and Support**
- **Generate realistic real user/USAAAP-based requirements for Near Term Fielding**
- **Real User/USAAAP Selection *a must!***

ANSWER: Joint efforts will bring success if real user requirements are supported by the system



10 – Contract Limits



No Small Arms Contract should exceed 6 years

Regular contract awards will:

- **Generate more competition, innovation, willingness to participate by talented non-traditional vendors (e.g. Daewoo K11 success)**
- **Keep unit prices low and quality high**
- **Will leverage emerging technologies more often**
- **Will respond to ever-changing warfare trends**

ANSWER: Restrict contracts to maximum of 6 years for same item from same vendor



11 – Don't Buy TDP's



Most small arms production TDP's are usually outdated before contract end and often even before they are received

- **Especially in a "stimulated" small arms competitive environment as described above**

ANSWER: Look for new superior products, not yesterdays product drawings



12 – Avoid Distractions



System developed alternatives (NSAC/NSATC) seldom bring real value to the real small arms end user

- **Costly duplication of effort. A distraction at best.**
- **Must "pay to play" ($1000 + 10% on award)**
- **Would Messrs. Hall, Maxim, Browning, Lewis, Thompson, Garand, Stoner, Sullivan, etc. have paid to participate?**

(or would they have taken their designs elsewhere to more "welcoming arms" overseas as was the case with many superior weapon designs from US inventors?)

ANSWER: Focus the existing support system on rapidly answering the needs of the real end user



13 – Limited Combat Evals



Use Limited Combat Evaluations by actual combat end users to assess the effectiveness of proven systems and capabilities

- **Apply Select US Unit SOP**
- **Field multiple candidates at Company or BN level *in combat***
- **After mandatory safety testing**
- **After pre-deployment, New Equipment Training by SME's (SOF, contractor, etc.)**

ANSWER: Let the real End Users and their local Commanders decide what works best on the battlefield and against the enemy



14 – “Up gun” Calibers



Reevaluate self-imposed voluntary US Hague restrictions on Ammunition and Projectile limitations for Conventional US Forces

- **Consider a medium-caliber for America’s rifle/carbine and LMG**
- **Consider non-NATO “medium” calibers (.40 S&W, 6.5/6.8mm, .300 WINMAG/.338)**
- **Consider proven COTS US “Land of Warfare” approved “Blind to Barrier” (BTB) projectile technology (TSX, CLUB, SOST, etc.) already successfully employed**
- **Follow Select US Unit SOP, successes**
- **Field a PDW (handgun) round that can defeat threat body armor)**
- **Develop an optimum weapon/ammo “system”**

ANSWER: Adopt the very best in ammunition and projectile technology



15 # - Small Arms Funding



With greater success in small arms fielding for the war fighter the system AND INDUSTRY will:

- Be rewarded with additional funding for future procurements and small arms efforts
- Stop being maligned and criticized
- Attract the best and brightest
- Better guarantee job and facility security
- Experience unparalleled support from Industry, Congress and the American people
- Better insure the safe return of American troops from close combat

ANSWER: Solicit for it and they will come!

SUMMARY

- **The last 10 years have produced substantial incremental enhancements in small arms and ammo performance (*most notably in potential threat weaponry, ammunition and AP projectile technology).***
- **With few but partial exceptions these incremental enhancements have not been combined into single systems or evaluated by the US Army for potential use.**
- **Too many new developments/procurements are being made using outdated performance specifications and/or without "real" user input/direction.**
- **The "Ultimate" incrementally superior "Big 8" systems could be available in 18-24 months if all-inclusive performance specs would be released to industry in "responsive" programs (Example: current "Next Carbine" effort).**
- **Incrementally superior COTS weapons fielded today will always outperform promised and "unfielded" so-called "Leap Ahead" technologies, and at comparably modest developmental costs! ($430M+ USD spent in past 20 years on "Leap-ahead" programs vs. low $ Select US Unit successes).**

America has not been matching threat weapon/ammunition capabilities and has fallen behind in its conventional small arms superiority!





Thank you for your time and attention!

Contact Information

Jim Schatz

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www.dtic.mil/ndia/2008Intl/Schatz.pdf

NAVSEA
WARFARE CENTERS
CRANE

SPECIAL MISSIONS



RAPID RESPONSE
PROVEN SOLUTIONS

Harnessing the Power of Technology for the Warfighter



Rotary Wing Crew Served Weapon Integration – Abstract 8423

21-May 2009

Nigel Wasil
Naval Surface Warfare Center Crane
Com (812) 854-5940
DSN 482-5940
Nigel.wasil@navy.mil

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Small Arms Air Platform Integration



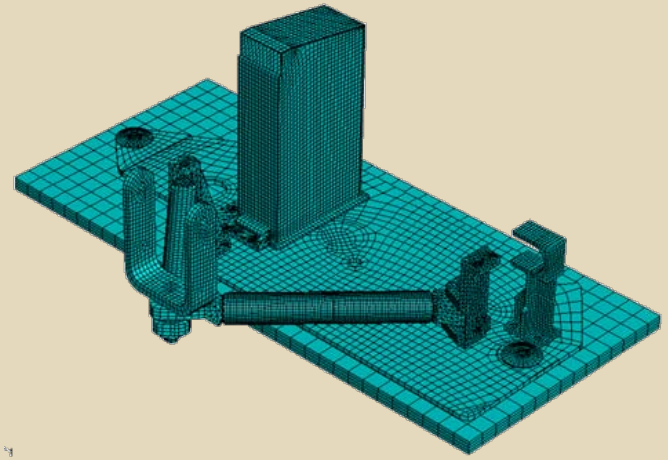
- **Who are we?**
  - **NAVSEA employees located at Naval Surface Warfare Center, Crane Indiana.**
  - **We are a team of engineers, logisticians, and technicians with vast crew served weapons integration experience.**
  - **We have the capability to support the full life cycle of the systems we deploy.**
  - **We support multiple platform offices and team with industry partners.**
  - **We take great pride in providing high quality support to our customers in a timely manner.**

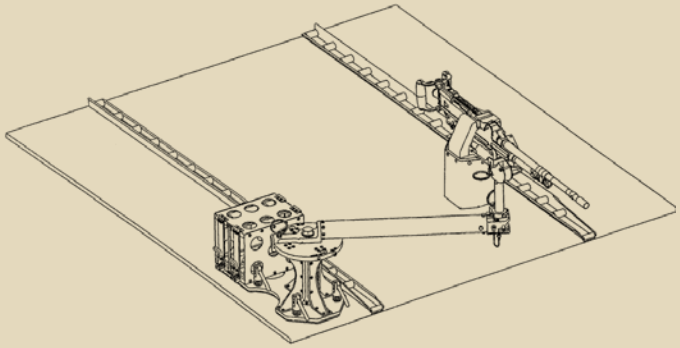
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Small Arms Air Platform Integration



- **What do we do?**
  - **Design and integrate weapon systems for various aircraft.**
  - **Fabricate prototype parts for fit checks and testing.**
  - **Support flight certification process through the NAVAIR Performance Monitors.**
  - **Provide Finite Element Analysis (FEA) modeling for fatigue and crash loads.**
  - **Procure production hardware through GOV contracts.**
  - **Receive, inspect, kit, and deploy high quality systems.**
  - **Provide interim supply support.**





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Recent Weapon Integration

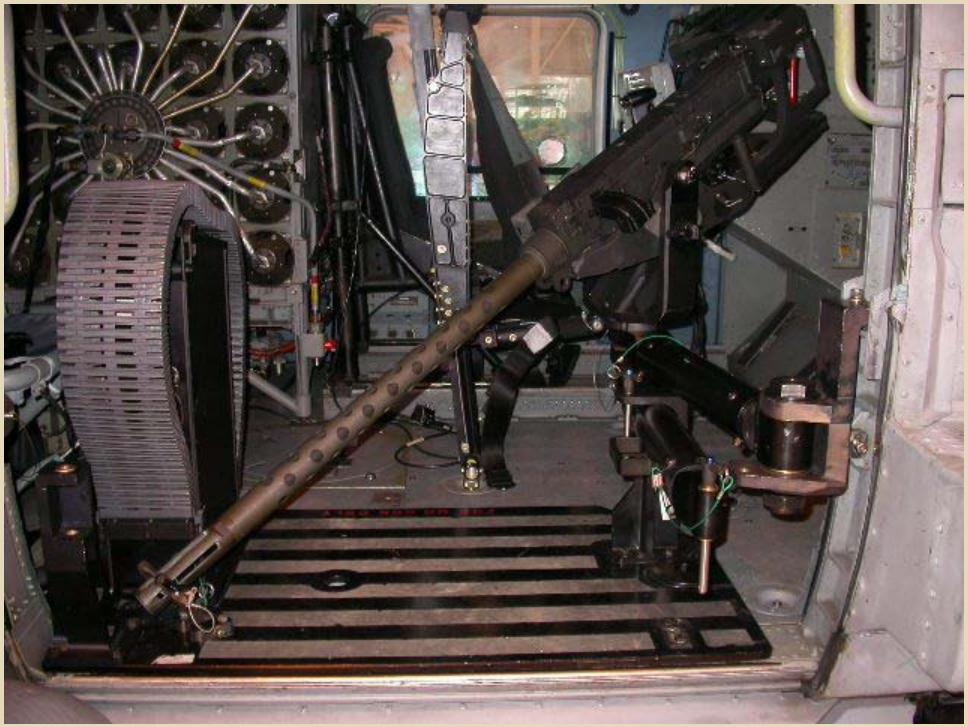


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Small Arms Air Platform Integration

- **USN MH-60R Integration**
  - **M240D door system**
  - **GAU-21 door system**







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Small Arms Air Platform Integration

- **USN MH-60S Armed Helo Integration**
  - **M240D window system**
  - **GAU-21 door system**
  - **(2000) round 7.62mm ammunition rack**
  - **Other non-weapon integration support**



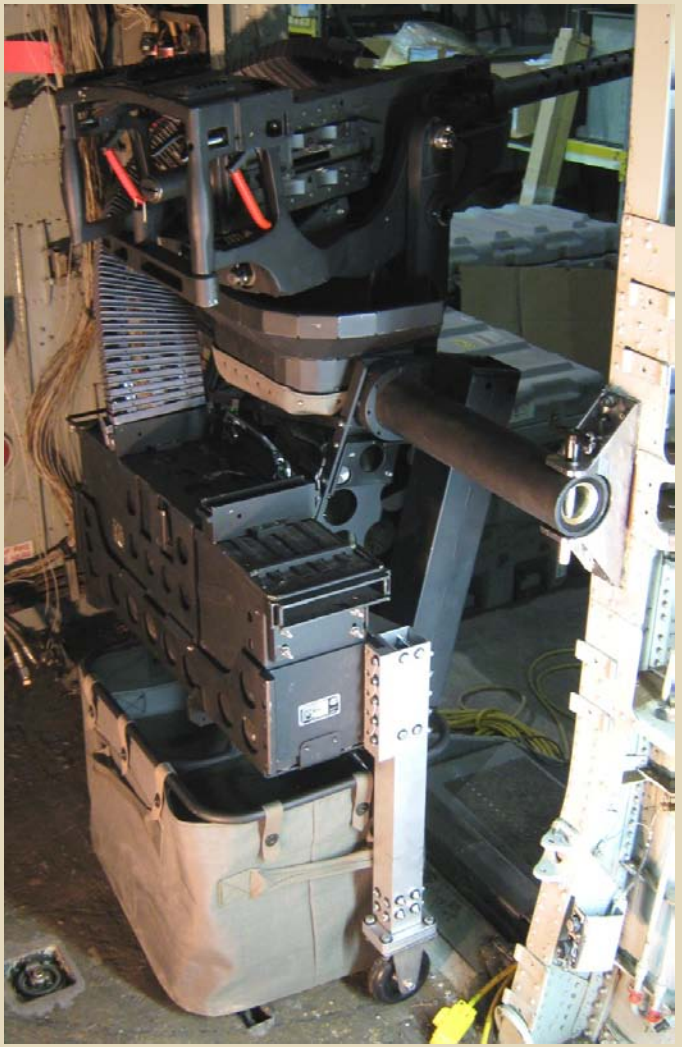


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Small Arms Air Platform Integration

- **USMC CH-53E Integration**
  - **CH-53E GAU-21 system**
    - **Modifications only**





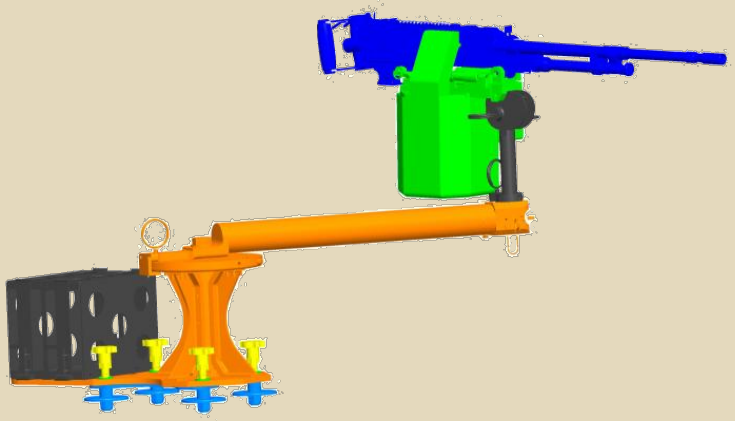
Approved for Public Release; Distribution is unlimited.

Small Arms Air Platform Integration

- **USMC CH-46 Integration**
  - **M240D ramp system**
  - **.50 cal window system**







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Small Arms Air Platform Integration

- **USMC/AFSOC MV/CV-22 Integration**
  - **M240D ramp system**
  - **.50 cal ramp system upgrades**

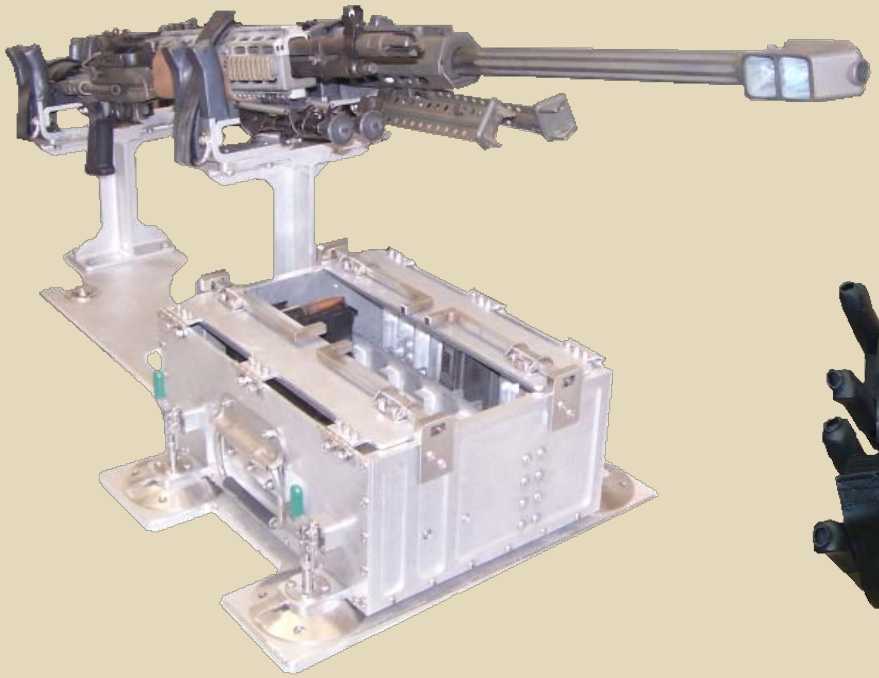


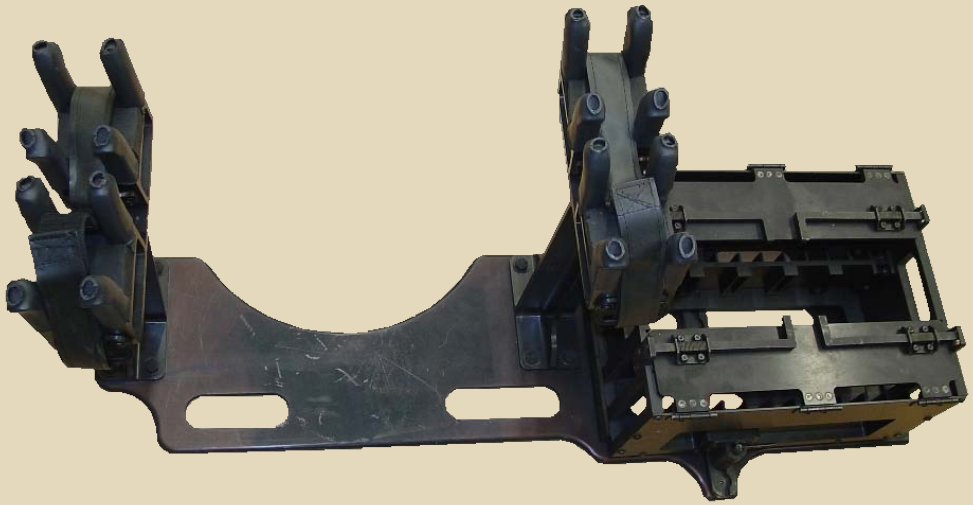
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Small Arms Air Platform Integration

- **USCG H-65 Integration**
  - **H-65 M240D door mount**
  - **MK14 – M107 weapon rack**
  - **Ammunition clip rack**







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Small Arms Air Platform Integration



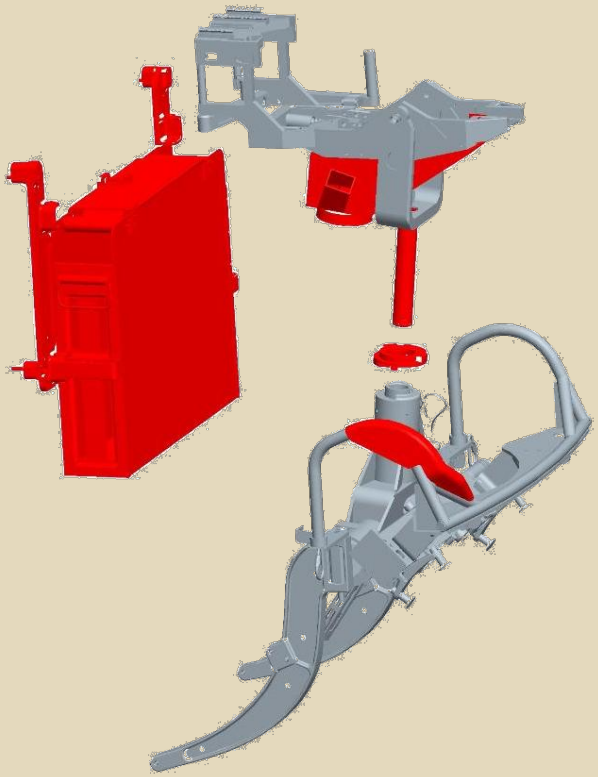


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Small Arms Air Platform Integration

- **USMC UH-1Y Integration**
  - **DAS GAU-21 upgrade**
  - **Developmental Test underway**





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Small Arms Air Platform Integration



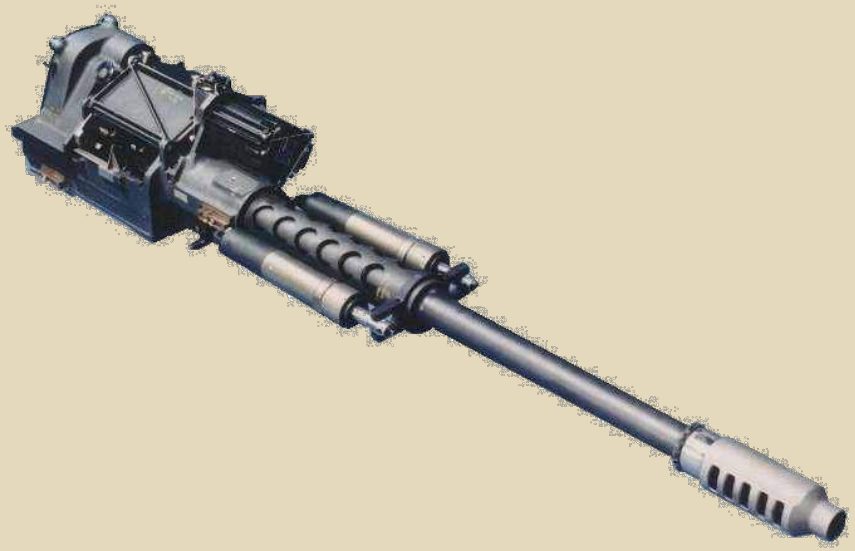
- **AROWS remote stabilized weapons system.**
  - **“Pop-up” design**
  - **Multiple weapon options**
  - **Open Architecture**
  - **Government owned design enables flexibility**

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Small Arms Air Platform Integration

- **USN MH-60S Armed Helo**
  - **Supporting role to PMA-299**
  - **Medium caliber fixed forward fire (FFF)**
  - **Weapon selection process underway**
  - **Spiral effort to stabilized remote system**





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Thank you for your time and attention!



For more information on NSWC Crane, please visit www.crane.navy.mil

Most aircraft images retrieved from http://www.news.navy.mil/view_galleries.asp

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Sound Suppressor Specification and Measurement

Owen Cramer, Senior Mechanical Engineer
Science Applications International Corporation
Naval Surface Warfare Center, Crane

Distribution Statement A: Approved for Public Release; Distribution Unlimited

Topics



- **Characteristics of Sound**
- **Changes required in the acoustic measurement / characterization of suppressors.**
- **The best way to specify the acoustic performance of a suppressed weapon**

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What is Sound



- **Variation in Air Pressure.**
- **Air Pressure is measured in Pascals (Pa)**
- **The Larger the Variation, the Louder the Sound.**

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Sound Pressure Level



- **Measured in deciBels. (dB)**
- **dB is a logarithmic scale.**
- **1 dB is the threshold of hearing**
- **3 dB represents a doubling in SPL**

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Addition of Sound Pressure Levels



- **dBs can’t be simply added.**
- **For instance**
  - **Sound A = 90 dB**
  - **Sound B = 90 dB**
  - **Sound A + Sound B = 93 dB**

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Inverse Square Law

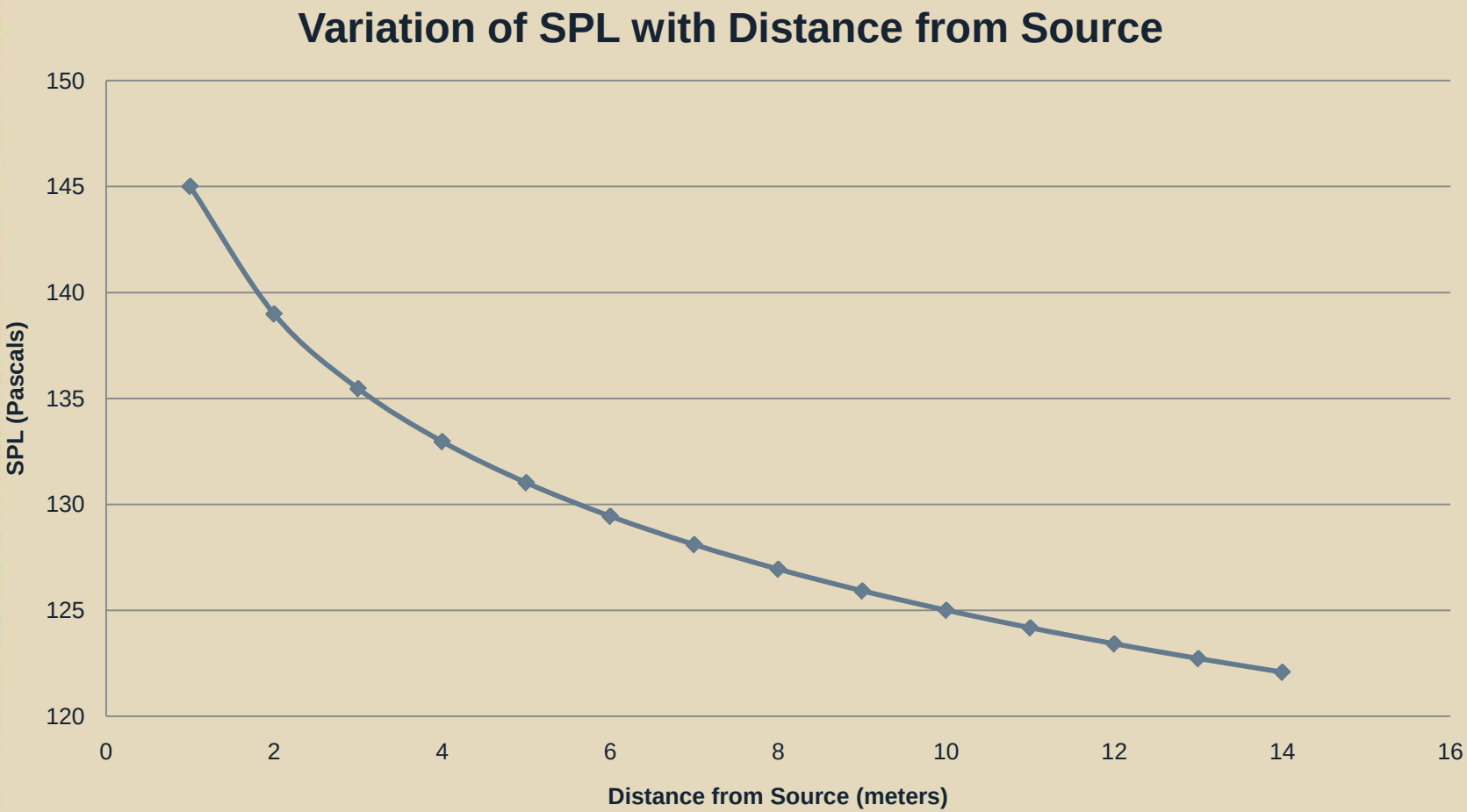


- **Describes the decrease in intensity of a volumetric property as the radius increases.**
- **At twice the distance, 1/4 the power.**

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Inverse Square Law II





Distribution Statement A: Approved for Public Release; Distribution Unlimited

Weighting



- **Weighting is a Filter that attenuates higher frequencies**
  - **Approximation of the Equal Loudness Curve**
- **Current TOP calls for “A-weighting”**
- **Good for measuring Industrial Noise**
  - **For Impulse Noise, C or No Weighting is probably more appropriate.**

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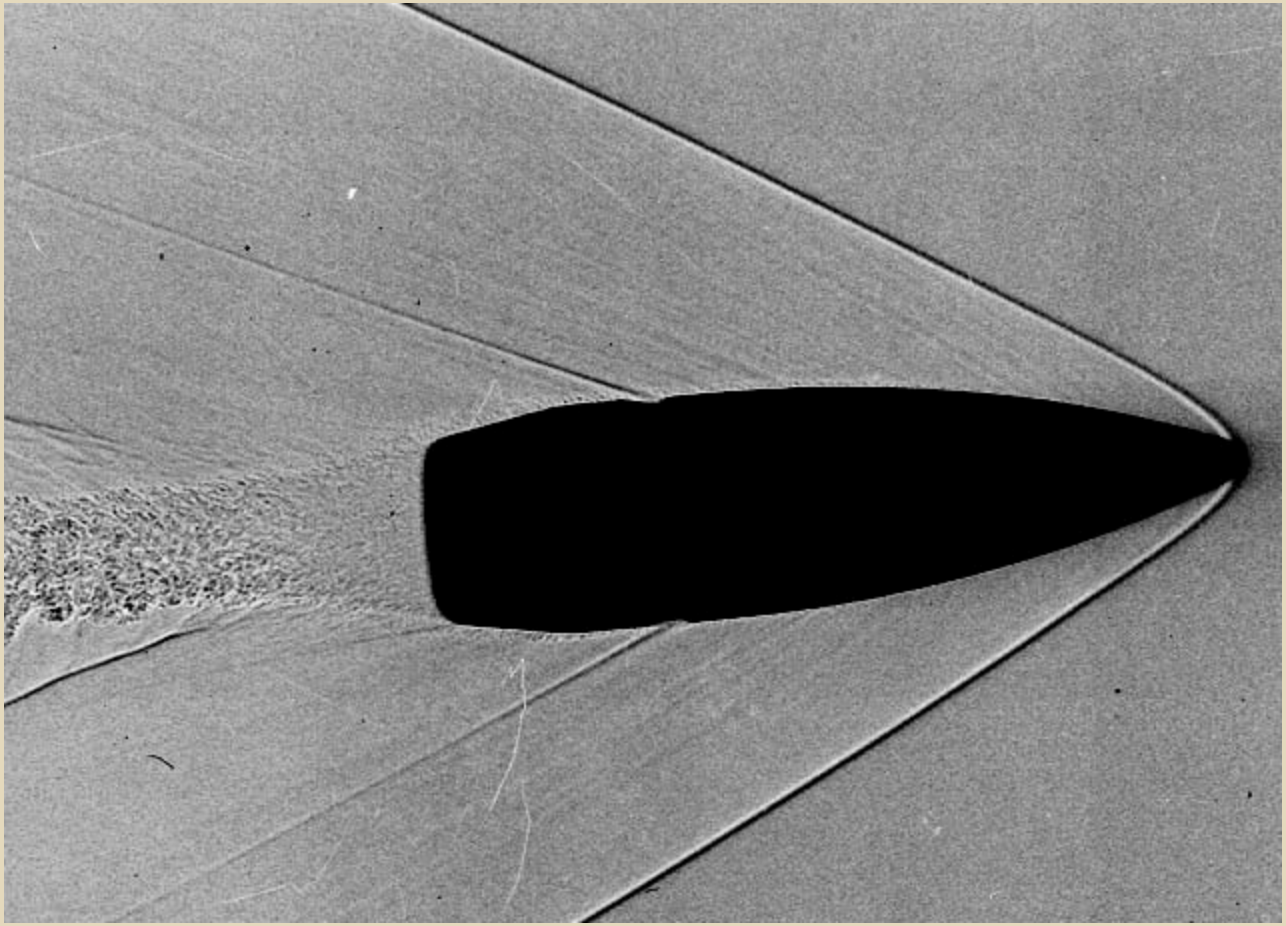
Components of Small Arms Sound Signature



- **Crack – Thump**
  - **Crack = Shockwave created by the bullet**
  - **Thump = Muzzle Blast**
    - **Product of Hot Gasses escaping from the muzzle**

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Sonic Shockwave (Crack)



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Muzzle Blast (Thump)



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Speed of Sound(s)



- **The Thump travels at the Speed of Sound**
  - **Generally about 1100 feet/second**
- **The Crack travels with the bullet**
  - **Typical rifle bullet velocities are 2500 to 3300 fps**

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Audiolocation



- **Audiolocation is the capability of a person to locate the source of a sound**
- **Location from left-to-right is accomplished by pressure differences and arrival times of the sound**

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Audiolocation II



- **The crack arrives at the observer first, followed by the thump.**
- **The crack points at the path of the bullet**
- **The thump locates the shooter**
- **Soldiers are trained to ignore the crack, and wait for the thump**

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A Day on the Range



- **MK13 Product Improvement**
  - **Two Barrel Lengths**
  - **Two different loads (190 and 220 gr. projectiles)**
  - **Two different suppressors**
- **Early User Assessment**
  - **Operators expressed that one suppressor was much quieter than the other**

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The Surprise



- **Acoustic Signature within 0.3 dB**
- **1 dB is the “Just Noticeable Difference”**
- **0.3 dB should not have made an audible difference to a human**

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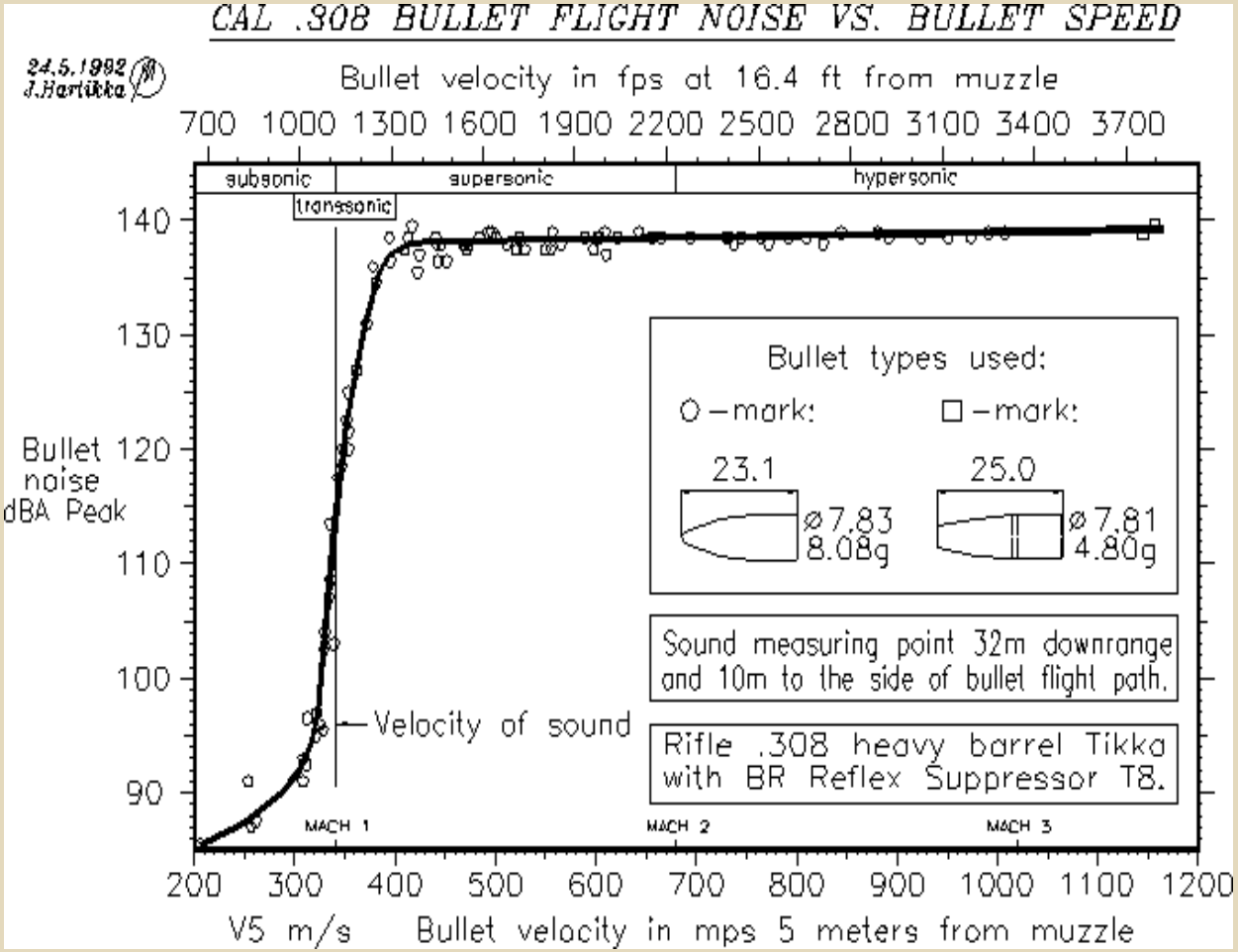
Hypothesis



- **Suppressors are now efficient enough to decrease the SPL of the Muzzle Blast below the SPL of the Bullet's Crack**

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The Magic Chart



Source: http://guns.connect.fi/gow/highpow.html

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Other Observations



- **The Major Players in the suppressor industry advertise nearly identical Peak SPL's,**
  - **137 dB**

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Pie in the Sky Weirdness



- **Audio Location in the Vertical Plane**
  - **Human head acts like a directional microphone**
  - **Sounds that are in the vertical, front to back plane can't be located by left-to-right pressure differentials**
  - **Head resonates, and causes a frequency shift**
  - **The degree of the Frequency Shift indicates location of the sound**

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Pie in the Sky Weirdness II



- **A sound in the 8Khz range indicates that the source is directly behind the observer.**
- **Potential to exploit this?**

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A Thought Experiment



- **A sniper engages a target.**
- **A witness catches the sniper's motion out of the corner of his eye, and looks directly at the sniper's position**
- **Immediately afterwards, the report of the rifle arrives at the witness' location.**
- **The frequency of the report tells the witness that the sniper is actually behind him.**
- **In other words, report itself becomes a tool of deception**

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Tactical Employment of Sound Suppressors



- **Protects operators hearing to allow communication**
- **Disguises location by short-circuiting audio-location**
- **Acts as a Muzzle Brake**
- **Current Method addresses none of these directly**

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Why a New Method?



- **The Current Method:**
  - **Measures “Crack”**
  - **Inappropriate Weighting**
  - **Ignores Spectrum**
  - **Suppressors are no longer add-ons**
  - **Current method offers potential to cheat**

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Proposal



- **Use two microphones.**
  - **One at Shooter's Ear**
  - **One 50 meters downrange**
- **Use Inverse Square Law to calculate back to source**
- **Record and report Spectrum**

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Suppressor Specification: How it is



- **“X system shall have a …sound suppressor that will reduce audible signal by 24 dB (T), 30 dB (O).**

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What's Wrong With That?



- **NSW and USSOCOM now typically procure weapons with suppressors, or the intention to suppress them.**
- **SPL of interest is the "System SPL"**
- **Only Addresses Hearing Protection**
- **Possibility of Cheating**

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How to Cheat



- **Use an attachment method that makes the rifle louder**
  - **Muzzle Brake?**
- **Higher Unsuppressed SPL**
- **Greater SPL Reduction...**

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Cheating Example



- **Suppressor A: System SPL of 141 dB**
  - **Suppressor A mounts on a standard flash hider**
  - **SPL with flash hider = 164 dB**
  - **22 dB of reduction**
- **Suppressor B: System SPL of 142 dB**
  - **Suppressor B uses a muzzle brake**
  - **SPL with Brake = 166 dB**
  - **24 dB of Reduction**
- **Suppressor B scores better**

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Suppressor Specification: How It Should Be



- **The Suppressed Weapon shall have a Muzzle Blast SPL of 130 dB (T) 120dB (O).**
- **In the Future, preferred audio spectra should also be defined.**
  - **Industry needs to demonstrate the capability first.**

Distribution Statement A: Approved for Public Release; Distribution Unlimited

Contact



- **Owen Cramer**
- **Email: owen.cramer.ctr@navy.mil**
- **Phone: 812-854-4514**

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NAVSEA
WARFARE CENTERS
CRANE

CRANE DIVISION

NAVAL SURFACE WARFARE CENTER



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WEAPON SHOT COUNTER

PROVIDING MORE THAN JUST ROUND COUNT

Jason M. Davis
Weapon Shot Counter Project Manager
Naval Surface Warfare Center Crane
(NSWC Crane)

NDIA Small Arms Symposium
21 May 2009

Distribution Statement A – Approved for public release; distribution unlimited.

Background



- **2003: Weapon Shot Counter (WSC) initiated as congressional add**
- **2003: WSC contract awarded**
- **Jul 2004: WSC-Carbine (WSC-C) DT/OT I**
- **Aug 2005: WSC-C DT/OT II**
- **Jul 2006: WSC-C LRIP**
- **2006: USMA develops algorithms for WSC Enhanced Arms Repair (WEAR) Software**
- **Jan 2007: WSC-C FRP**
- **Sept 2007: WSC-C fielded in low numbers**
- **May 2008: WSC contract expires**
- **Apr 2009: Release of WSC synopsis for MK16/MK17**

Distribution Statement A – Approved for public release; distribution unlimited.

M4A1 Carbine WSC System

- **Weapon Shot Counter (WSC)**
  - **Fits in standard pistol grip**
  - **Weighs approximately 2.0 oz (56.7 g)**
  - **Uses a 3.6V lithium battery**
  - **Electrical components permanently potted**
  - **Records cumulative round count and number of rounds in a burst of fire**
  - **No date/time stamp**



Distribution Statement A – Approved for public release; distribution unlimited.

M4A1 Carbine WSC System

- **Data Collection Device (DCD)**
  - **Transfers data via infrared communication**
  - **Requires PC, software, and RS-232 serial cable to download data**



Distribution Statement A – Approved for public release; distribution unlimited.

WSC Limitations



- **<u>Primary limitation</u>: Tracking of individual weapon parts**
- **Discernment of ammunition type**
- **Suppressed/unsuppressed fire**
- **Modular weapon systems**

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Overcoming Limitations



- **<u>WSC Enhanced Arms Repair (WEAR) Maintenance Software</u> was developed to overcome the primary limitation of tracking individual parts**
- **WEAR uses USMA-developed algorithms based on weapon reliability data to predict part failure**

Distribution Statement A – Approved for public release; distribution unlimited.

WEAR Login Screen

WEAR

WSC ENHANCED ARMS REPAIR Maintenance System



User Name:

Password:

OK Cancel

version 1.0

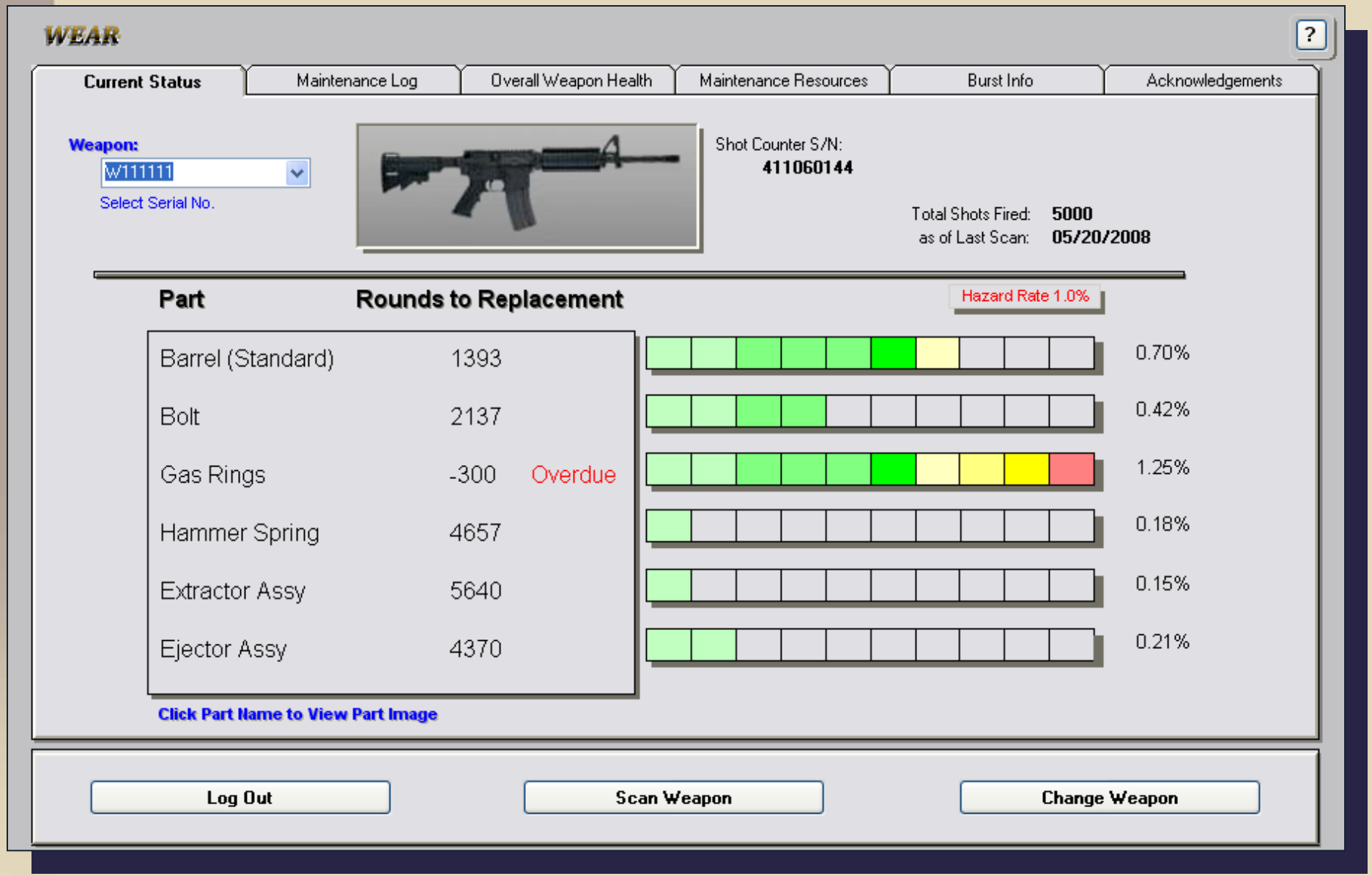
Distribution Statement A – Approved for public release; distribution unlimited.

WEAR Weapon Selection Screen



Distribution Statement A – Approved for public release; distribution unlimited.

WEAR Current Status Screen



Distribution Statement A – Approved for public release; distribution unlimited.

WEAR Maintenance Log

WEAR

Current Status | **Maintenance Log** | Overall Weapon Health | Maintenance Resources | Burst Info | Acknowledgements

Weapon:

Select Serial No. to Jump to Maintenance Log



Maintenance Functions

Update

Export

Maintenance History

Weapon S/N	Shot Counter S/N	Shots Fired to Date	Date of Last Scan	Part	Round Count	Date of Maintenance	Result of Maintenance	User
W359013	411060044	3981	01/30/2008	Barrel (Standard)	3981	02/15/2008	Replaced (Failure)	admin
W456777	411060150	10	01/30/2008	Bolt	10	02/15/2008	Replaced (Failure)	admin
				Barrel (Standard)	10	02/15/2008	Replaced (Failure)	admin
W456778	411060174	519	01/30/2008	Hammer Spring	519	02/15/2008	Replaced (Prevention)	admin
				Gas Rings	519	02/15/2008	Replaced (Failure)	admin
				Bolt	519	02/15/2008	Replaced (Failure)	admin
				Barrel (Standard)	519	02/15/2008	Replaced (Prevention)	admin

Log Out | Scan Weapon | Change Weapon

Distribution Statement A – Approved for public release; distribution unlimited.

WEAR Overall Weapon Health

WEAR

Current Status | Maintenance Log | **Overall Weapon Health** | Maintenance Resources | Burst Info | Acknowledgements

Weapon:

Select Serial No. to Jump to Weapons Overall Health



No attention needed
Action may be required
Maintenance suggested

Health Functions

Part Weight

Weapon S/N	Barrel	Bolt	Gas Rings	Hammer Spring	Extractor Assy	Ejector Assy	Overall Weapon Health
Q222222	Standard						96.57
W111111	Standard						67.47
W350833	Standard						73.26
W358623	CQB						73.00
W358888	Standard						72.41
W358894	Standard						98.60
W359013	CQB						73.59
W456777	Standard						98.59

Log Out | Scan Weapon | Change Weapon

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WEAR Maintenance Resources

WEAR

?

Current Status | Maintenance Log | Overall Weapon Health | **Maintenance Resources** | Burst Info | Acknowledgements



Resource Functions

Upload

Remove

Document Number	Title	Date Uploaded
EB/4081/C06/1515	Engineering Bulletin, M4A1 Carbine	10/18/2007
M4A1 IPB	Illustrated Parts Breakdown M4A1 5.56 Carbine	01/09/2008
IMWR/4081/C03/1334	Intermediate Maintenace Work Requirements for M4A1 5.56MM Carbine	01/09/2008
SW370-BUJ-OPI-010	Operator's Manual for Carbine, 5.56mm M4A1	10/18/2007
EB/4081/C06/1503	SOPMOD Engineering Bulletin	01/09/2008
SOFWEP-86-G10-00006-01	Technical Manual for Carbine, 5.56mm M4A1	10/18/2007

Double-Click Title to View Resource

Log Out | Scan Weapon | Change Weapon

Distribution Statement A – Approved for public release; distribution unlimited.

Future of WSC



- **Wireless technology / USB upgrades**
- **Automatic detection of weapon type**
- **Detection of weapon accessories**
- **Un-tethered DCD**
- **Discernment of ammunition type**
- **Suppressed/unsuppressed fire**

Distribution Statement A – Approved for public release; distribution unlimited.

WSC for MK16/MK17

- **Synopsis released April 22, 2009**
  - Tracking Number: N00164-09-S-NB03
- **Contains draft performance specification for industry/academia comment**



Distribution Statement A – Approved for public release; distribution unlimited.

Contact Information

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300 Hwy 361

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GENERAL DYNAMICS
Armament and Technical Products

M2E2 Barrel Extension Enhancements

Dave Stouffer

21 May 2009

APPROVED FOR PUBLIC RELEASE

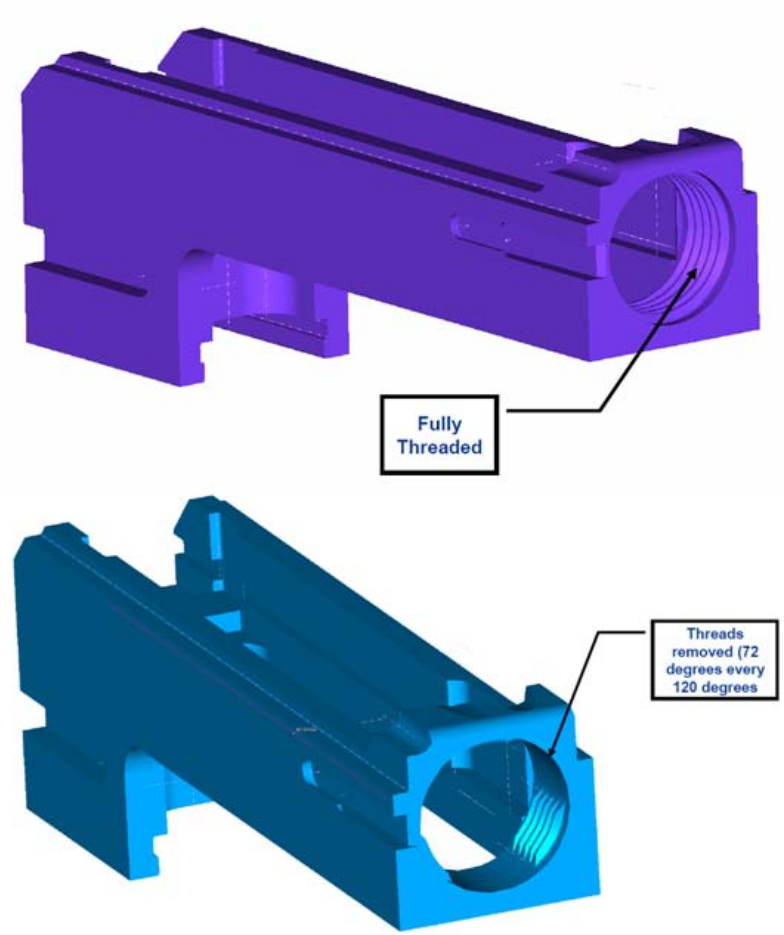
History/Background

- Mid 1990's
  - GDATP developed a Quick Change Barrel (QCB) kit capable of converting the standard M2HB weapon to QCB configuration with fixed headspace & timing.
- 2006
  - Six QCB weapons were evaluated by the US Army at Aberdeen Proving Grounds.
  - Endurance testing not completed due to development of fatigue cracks in all six alloy steel barrel extensions.
- Failures occurred consistently in the same area, and were considered to be fatigue related.

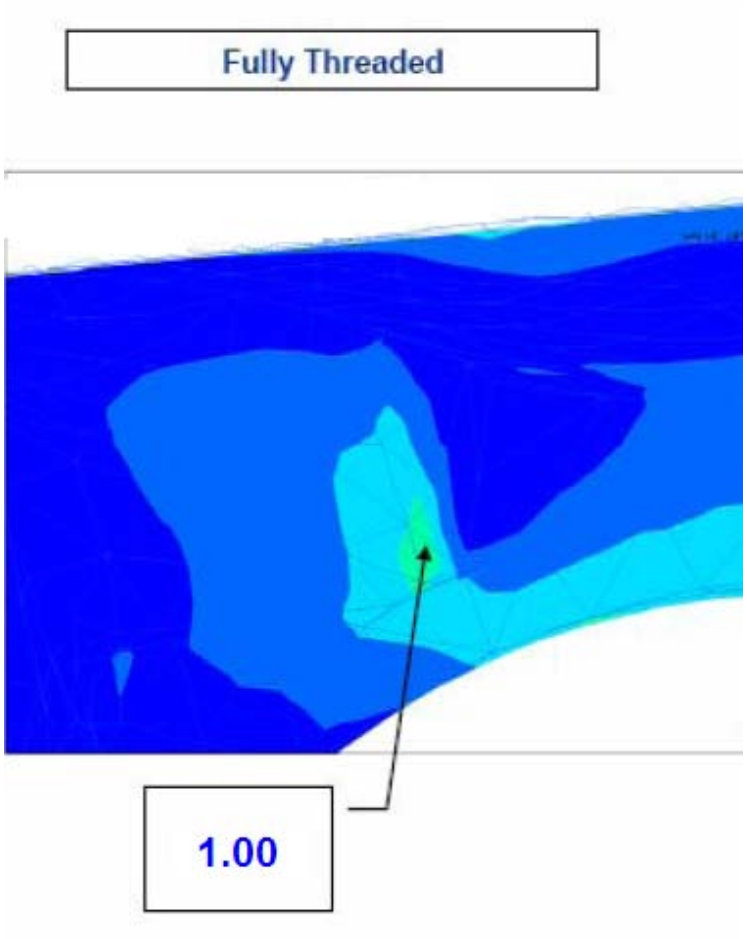


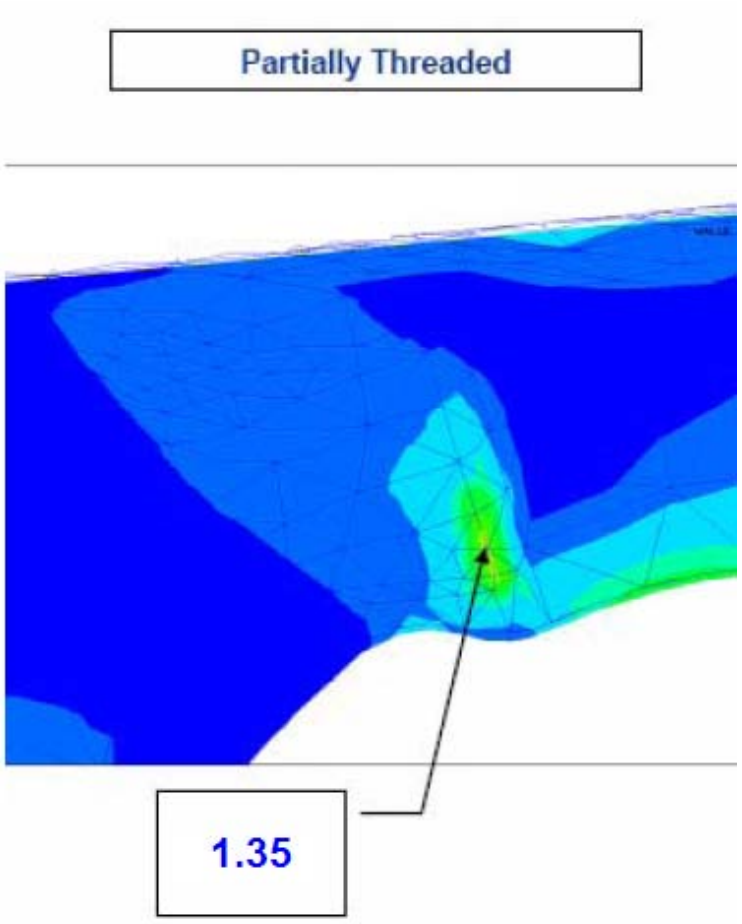
FEA Analysis

- Initially theorized that the interruption of the threads/reduction of threaded area significantly weakened the QCB configuration
- Conducted a Finite Element Analysis comparison of the standard M2HB Barrel Extension and QCB Barrel Extension to further investigate this theory.
- Generated FEA Models
  - Standard HB Barrel Extension (fully threaded)
  - QCB Barrel Extension (interrupted thread)
- Conducted Instrumented load tests to correlate model strains with test strains.
- Found the peak stress in the area of interest to be ~ 35% higher in the area of interest on the QCB version.



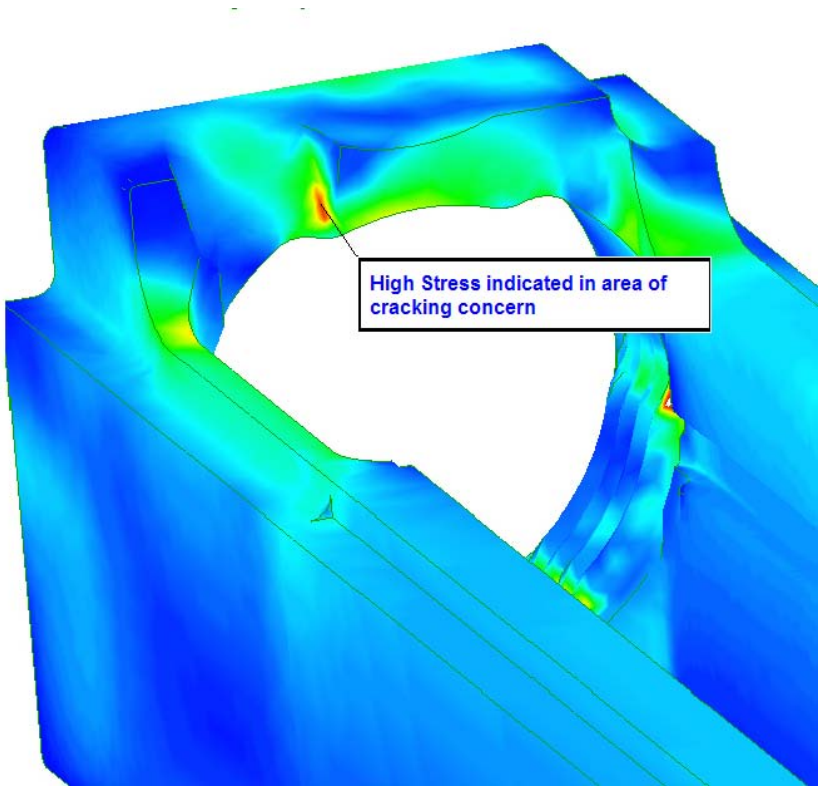
Stress Field Comparison





Redesign Effort

- IR&D Project executed to develop, implement and test a solution to the fatigue cracking problem.
- Project Requirements:
  - Minimize geometry changes to maintain commonality & interchangeability with standard M2HB Barrel
  - 30,000 firing cycles minimum life
  - Hot Operating Temperature (~800 deg F)
- Started with material studies, which led to Maraging Steel
- Benefits of Maraging Steel
  - Additional strength
  - Superior performance at extreme temperatures
  - Greater fracture toughness and reduced susceptibility to local fatigue cracking



Test & Evaluation

- 2007 IR&D Effort
  - Fabricated prototype QCB Barrel Extensions using Maraging steel and subjected to a 30,000 round fire test.
  - Conducted Magnetic Particle Inspection and Dye Penetrant inspections at 1K, 5K, 10K, 15K, 20K and 30K round intervals.
  - No discernable indications of fatigue cracks.
- 2008 Bid Sample Test & Evaluation
  - Maraging steel barrel extensions were submitted as part of GDATP's M2A1 bid samples for competitive testing and evaluation.
  - Three bid sample weapons were each fired in excess of 33,000 rounds prior to barrel extension failure.
- Today
  - The durability of these components has generated interest in transitioning from alloy steel to maraging steel for standard M2HB barrel extension production.

M2E2 Kit Components



- Flash hider
- Quick Change Barrel
- Barrel Support
- Barrel Extension
- Solid Breech Lock

Benefits to the Soldier

- Increased safety margin
- Reduction in damaged weapons
- Increased weapon Operation Readiness
- Reduced logistics burden

Questions?



GENERAL DYNAMICS

20mm AMR – New Use for Unused Ammo

Harnessing the Power of Technology for the Warfighter

US Special Operations Command

FOREIGN COMPARATIVE TESTING (FCT) PROGRAM

Dave Armstrong - SOF Weapons Section
Crane Division, Naval Surface Warfare Center
Small Arms Weapons Systems Division
Joint Weapons Engineering Branch
Joint Special Operations Response Department (JSORD) Ph: 812-854-5731 DSN: 482-5731
Email: david.armstrong@navy.mil

USSOCOM Comparative Testing Office
HQ Special Operations Command
SOAL-MA (CTO)
7701 Tampa Point Blvd
MacDill AFB, FL 3362

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20mm AMR – New Use for Unused Ammo

- **Anti Material Rifle Concept Dates to WWI (Mauser)**
  - **Developed in Response to British Tank Threat**



Lt. - 13.2 X 92 SR
Ctr. - .55 Boys
Rt.- .50 BMG



British MK 1 Tank



M1918 @ 41 lbs



M1918 Mauser T-Gewehr



Boys AT Rifle @36 lbs (1937)

The .50 Browning Machine Gun (BMG 12.7X99mm) is the only one of these 3 similar performance rounds still in use today. The .55 cal Boys AT round is also known as 13.9X99B.

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

- **Anti Tank Rifle Applications Continue into WWII**



Lahti L-39 20X138B @ 109 lbs Brake cut Recoil Energy 44% and Recoil Operation cut it another 25% (reportedly)



Solothurn S18-1000 20X138B "Long Solothurn" (Reinmettal) – Recoil Op. Semi-Auto @ 118 lbs



PTRD 14.5X114mm Single Shot w/ Long Recoil Mech. @ 38 lbs



Japanese Type 97 20X125mm @ 130-140 lbs rear monopod dug in for felt recoil reduction



PTRS 14.5X114mm Semi-Auto (5 shot) @ 46 lbs

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20mm AMR – New Use for Unused Ammo

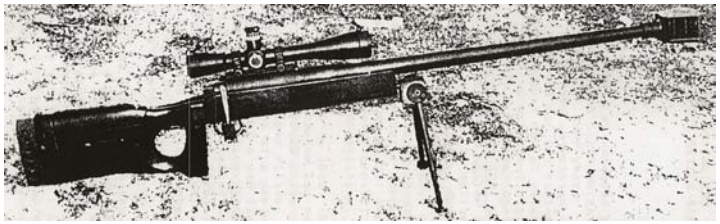
1980's .50 caliber rifles for Material Targets



RAI "Haskins" M500 circa 1983 at 35 lbs, fielded in support of 1981 NAVSPECWAR Op. Req.



M107 – started as M82 in 1982 approx. 33 lbs



McMillan M88 SASR (Special Applications Sniper Rifle) at 24 lbs fielded in 1988 by NAVSPECWAR



Pauza P-50 available 1989 approx. 30 lbs



MK 15 MOD 0 SASR @ 28.2 lbs Naval Special Warfare Current Issue

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

Recent Foreign .50 caliber AMR efforts with some integrating recoil mechanisms along with brake.



DSR 50 from DSR-Precision GmbH
- hydraulic buffer in stock (.50 BMG)



Chinese 99 (avail. In .50 BMG)
- buffering in stock



Czech OP-96
Falcon 12.7X99mm
- spring in stock





Accuracy International
AS-50 (UK) 12.7X99mm



Russian ASVK 12.7X108mm
(aka KSVK & SVN-98)
- novel combo. muzzle device



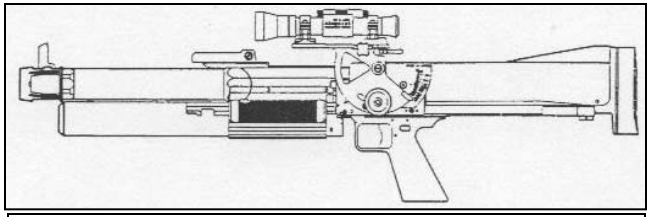
Russian OSV-96
12.7X108mm
(& .50 BMG)
Semi-Auto with
hinged barrel

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

Current US Anti-Materiel Efforts



XM109 AMPR – Anti-Material Payload Rifle (25mm OICW / OCSW "Grenade") 35 lbs w/ 17.6 in. barrel)





FN Herstal 40mm HV Grenade Launcher (17 lb threshold)

NOS Louisville also had a similar 1990's 40mm effort EX41 prototype @ 21 lbs & 500 fps (M430 projectile)



XM500 AMR .50 Caliber 26 lbs (Gas Op. Semi) – Lighter / Shorter than M107 at 46 inches long

U.S. Army also has lightweight M107 project with specified weight of 23.7 pound at 57 inches long (M107 is same length but at approx 33 pounds).

20mm AMR – New Use for Unused Ammo

US “Commercial” Offerings (Anzio Iron Works)



20X102mm Bolt Action (3 shot) 49 inch barrel (advertised @ 59-130 lbs)



20mm Takedown Single Shot (39 lbs)

- **Currently chambered for 20X102mm (Vulcan / M61). Cases converted to percussion priming (from electric).**
- **Other known U.S. Companies working with 20mm include Serbu Firearms and Pioneer Machining & Weapon Systems.**

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

Current catalog prices per round for 20mm rounds for Vulcan Cannon M61 (20X102mm).

DODIC AA24	**PGU-27A/B 20mm TP**	**$5.58**
DODIC AA28	**PGU-30A/B 20mm TP-T**	**$10.00**
DODIC AA22	**PGU-28A/B 20mm SAPHEI**	**$14.29**



Based on recent 20X102mm SAPHEI pricing and only looking at available HEI/APT (M210/M95) A862 quantity of **1.4 Million rounds** that equates to a cost savings of over **20 Million Dollars**. Not Counting the 250K of M204 TP (Practice) Ammunition also available (Linked with APT). Based on AA24 20X102mm TP value that is another **$1.4 Million** in Free Issue Ammo.



20X102mm M61 / M39 Gun Systems

<<20X110HS vs .50 BMG, .300 Win Mag, 7.62 & 5.56 mm NATO

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

General AMR / Heavy Sniper Rifle (HSR) Requirements Background

- 1992 USSOCOM Directive 70-2
- HSR JORD Approved 16 March 1994
- Special Operations Weaponeering Manual 61 JTCG/ME-83-8 Target Defeat Goal of 5 shots or less at ranges from 50 to 1200 meters
- 1.5 MOA accuracy goal to 1500 meters 2 MOA threshold (32 ft-lb recoil threshold)
- 5 second TOF (Time of Flight) to 2000 meters Goal
- PSR CDD Increment 4 Anti-Material Capability
  - Allows for AM focused Supplemental Weapon System

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

Foreign 20X110mm HS (Hispano-Suiza) Rifles Procured for Evaluation



RT-20 M1 (RH Alan - Croatia)
43.4 lbs – 36 in. barrel – 52.5 in. OL



SR-20 (Truvelo – South Africa)
Approx. 55 lbs – 39 inch barrel – 72 inch OL
(20X82mm as shown, aka 20X83.5mm)



20X110HS NTW-20 Rifle
DENEL – South Africa
70 lbs – take down capable
39 inch barrel – 70.5 inch OL

Other Available Chamberings:
20X82mm (MG151Round)
14.5X114 Russian and .50 BMG

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20mm AMR – New Use for Unused Ammo

DENEL NTW 20X110HS AMR



NTW 20X110HS AMR Data

Weight	70 lbs
Barrel Length	39 inches
Overall Length	70.5 inches
Projectile Mass	2030 grain
Projectile Velocity	2600 fps
Recoil Vel. (Bench)	6.4 fps

MK 15 MOD 0 SASR – Caliber .50 BMG



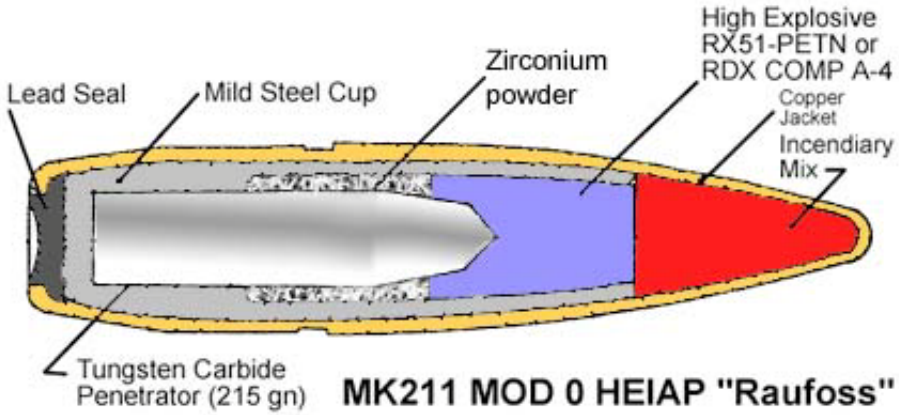
MK 15 MOD 0 Data

Weight	28.2 lbs
Barrel Length	27.5 inches
Overall Length	55.5 inches
Projectile Mass	660 grain
Projectile Velocity	2700 fps
Recoil Vel. (Bench)	6 fps

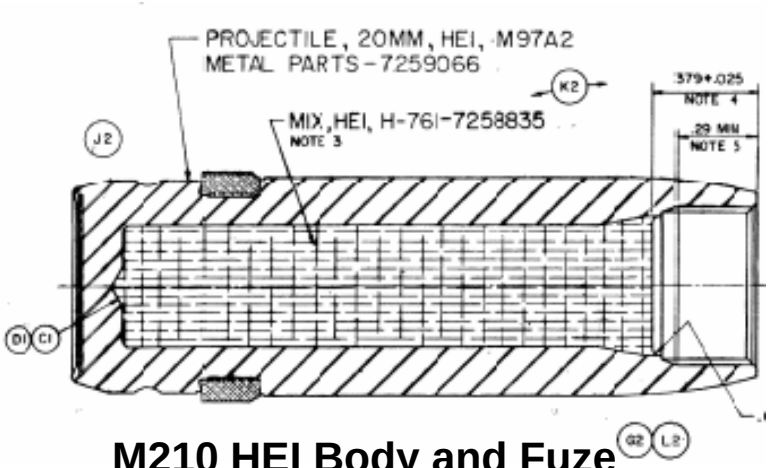
Felt Recoil Velocities Achieved during Bench Shoulder Firing

20mm AMR – New Use for Unused Ammo

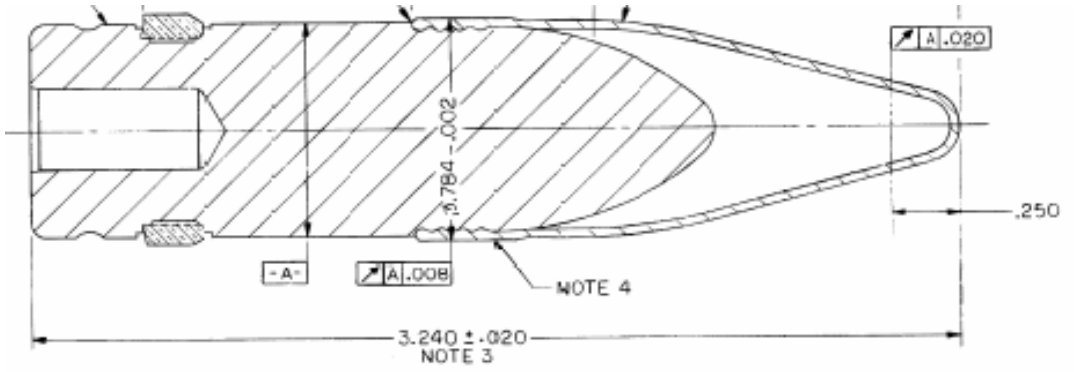
.50 cal. MK 211 Current Baseline Projectile Construction vs. 20mm M95 APT and M210 HEI



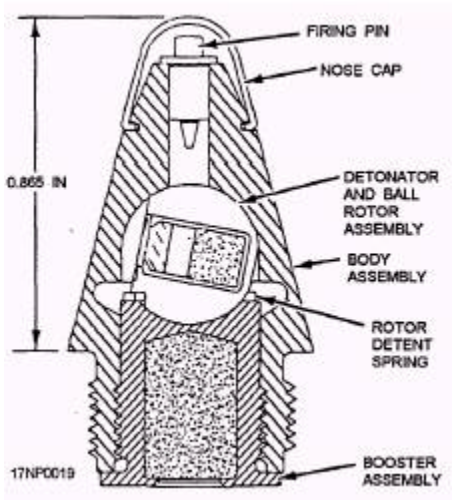
MK211 MOD 0 HEIAP "Raufoss"



M210 HEI Body and Fuze



M95 Armor Piercing Tracer Projectile



M505A3 Fuze

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

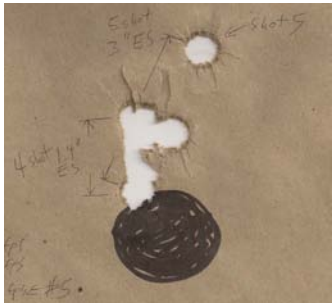
20mm AMR – New Use for Unused Ammo



.50 BMG Cartridge top vs.
20X110mm Hispano Suiza



M204 TP & M95 APT



First 5 shot group of M204 TP
100 yds from bench 3 in. ES –
First 4 shots in 1.4 in. ES



.27 cal MK 211
.43 cal M2 AP
.77 cal M95 APT

Cartridge	.50 caliber MK 211	20mm M210 HEI	M2 AP	20mm M95 APT
Explosive	Comp A4 (RDX)	Comp A4 (RDX)	None	None
Incendiary	Zirconium + Incendiary Mix	Aluminum Powder	None	Tracer Comp.
Penetrator	.27 cal. 215 grain Tungsten-Carbide	No Penetrator	.43 cal. steel @ 425 grains	.77 caliber steel @ 1750 grains
Fuze	Pyrotechnic Train Activation	M505A3 – Arms at 10-35 ft	No Fuze	No Fuze

Note: Mass of Incendiary / Explosive for M210 HEI @ 120 grains is approx. 3.3 times that of MK 211.

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20mm AMR – New Use for Unused Ammo

All groups are 3 shots each			1 MOA at 600 yds is 6.3 inches			
Data compiled from 5 different days			1 MOA at 1000 yds is 10.5 inches			
Rifle	"Shooter"	Range (yds)	# Groups	Ammo	Avg. ES (in.)	Avg.ES (MOA)
RT-20	Fixture	600	4	APT	9.4	1.5
NTW-20	DA	600	6	TP&APT	8.6	1.4
MK15	DA&DS	600	2	AP	9.5	1.5
NTW-20	DA&OC	1000	5	TP&APT	17.3	1.6
MK15	DA&OC	1000	3	AP	19.8	1.9
NTW-20	SEAL	1000	1	TP	21.5	2.1
MK15	SEAL	1000	1	MK211	23.5	2.24
NTW-20	SEAL(BS)	1400	1	TP	10.5	0.72



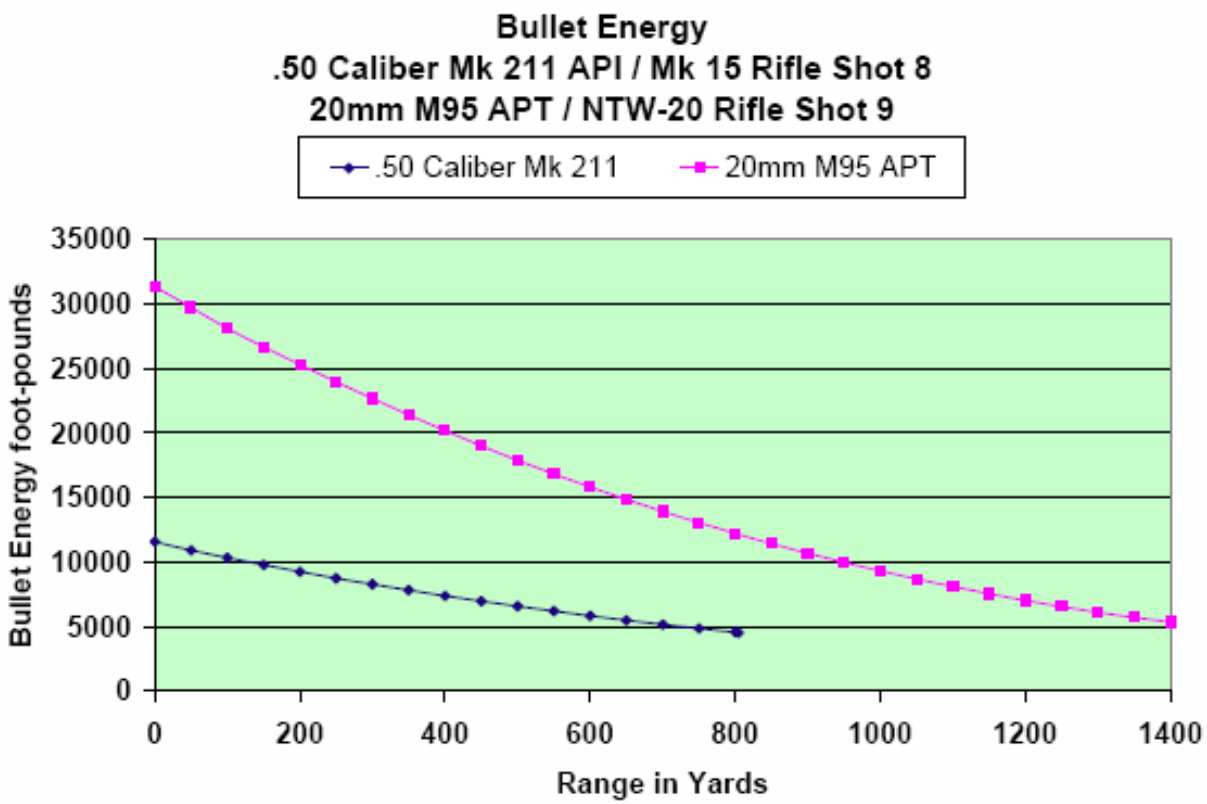
Acoustic Target - 1000 yards @ NSWC Crane

SEAL shot groups were documented during familiarization firing – Camp Atterbury, IN
Their Recoil Comments:

1. **Recoil at Max – cannot use non-standard shooting positions (overpressure minimal, recoil sufficient).**
2. **Recoil is spread over more time but compresses body more (than other weapons). Need to allow for more than 25 shots a day to get accurate dope.**
3. **Recoil Near Max – Similar to MK 15 but longer/deeper.**
4. **Recoil Excessive – Hardest hitting gun he has shot.**
5. **Recoil at Max – Imagine Push and Overpressure is like 25mm on Hard Mount.**
6. **Recoil Excessive – Training and Employment issues (Size and Config. as well).**

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo



Doppler Radar Velocities (fps)		
Range (yards)	MK 15 MK211	NTW-20 M95 APT
MV	2607	2638
200	2332	2370
400	2082	2117
600	1853	1874
800	1639	1647
1000		1438
1200		1248
1400		1091
NTW-20	M210 HEI	
0	2648	
400	2086	
800	1610	
1200	1210	

.50 cal. MK 211 lost 968 fps over 800 yds versus 991 fps for 20mm M95 APT and 1038 fps for M210 HEI.

Burning tracer reduces drag on the 20mm APT projectile. The MK 211 available had lower than expected velocities.

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

MK 15 MOD 0 firing MK 211 multi-purpose .50 caliber against simulated Heavy Vehicle Door with 18 gage (0.043”) witness panels @ 21 and 33 inches to rear of target face.



Shot 1

Entry



Exit





W1- 4 Complete Pen.
5 Partial Pen.



W2- 6 Complete Pen.
11 Partial Pen.



Shot 2

Entry



Exit





W1- 8 Complete Pen.
5 Partial Pen.



W2- 3 Complete Pen.
13 Partial Pen.

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

NTW-20 firing M210 HEI against simulated heavy vehicle door made up of 2 layers of 18 gage steel (0.043”) spaced 3.5 inches with 18 gage steel witness panels @ 21 and 33 inches back (2x2 ft).



“Door” Entry 9.5 in. dia.

“Door” Exit 13.5 in. dia.



W 1 –

35 Complete Penetrations

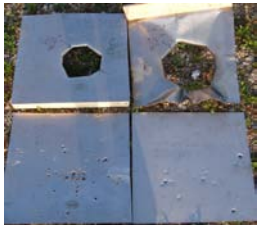
167 Partial Penetrations



W 2 –

9 Complete Penetrations

40 Partial Penetrations



“Door” Entry 9 in. dia.

“Door” Exit 13 in. dia.



W 1 –

32 Complete Penetrations

197 Partial Penetrations



W 2 –

4 Complete Penetrations

36 Partial Penetrations

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

More views of 100 yard Simulated Vehicle Door Damage along with other material target damage (MK 211 penetrator did penetrate concrete & wood & both W1 & W2).





Shot 1 of M210 HEI -100 yd "Car Door" as Found





Stacked Solid Concrete Block was breached by 20mm HEI but no damage to 18 gage steel Witness Panel – need APT for deep penetration of fortified targets.





Shot 2 of M210 HEI - 100 yd "Car Door" Exits



As Found Post-Fire



Pine Boards – 6 inches thick (4 boards) 18 gage steel W1& W2 were penetrated completely

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20mm AMR – New Use for Unused Ammo

200 yard Car Door - MK 211 vs. 20mm HEI. Data not yet available at further ranges but effects should be similar out to max. range of approx. 2000 meters.
M505A3 Point Detonating Fuze acts immediately upon impact versus the slower MK 211 pyrotechnic train.



HEI Car Door Exit





HEI Car Door Entry



MK 211



½ inch dia. in & out



W1 @ 11.5" .02 alum.

W2 @ 36.5"steel 5 CP



20mm HEI Entry



20mm HEI Exit



W1 @ 11.5" 142 CP



W2 @ 36.5"steel 20 CP

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20mm AMR – New Use for Unused Ammo

MK 15 fired MK 211 & NTW 20 fired M95 APT at High Hard Armor (HHA) Gun Mount Protective Plate at 100 yards (W1 at 18.5 inches and W2 at 29.5 inches behind target plate) **MIL-A 46100 Spec. 0.4 inch**

MK 211 .50 caliber



MK 211 vs. HHA Exit



W1: 4 CP / 33 PP



W2: 6 CP / 11 PP

M95 APT 20mm



M95 APT vs. HHA Exit



W1: 15 CP / 67 PP



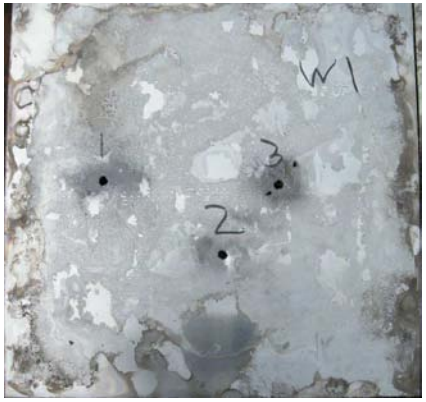
W2: 18 CP / 65 PP

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

100 yards .50 cal M2 AP & 20mm M95 APT vs. 0.5 in. AR400 Steel Plate (simulated RHA) (per Mil-A 12560)







.50 caliber M2 AP

.020" Alum. Witness Panels W1 @ 6" and W2 @ 14"









20mm M95 APT

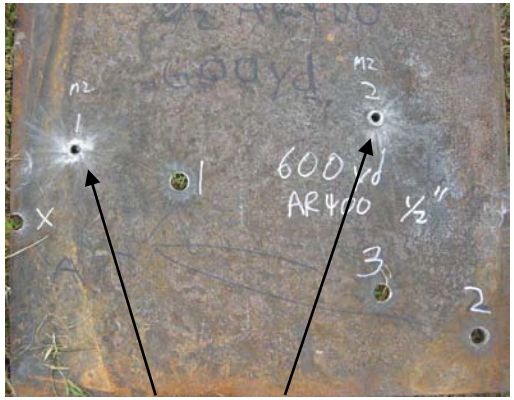
Rear of W1 & W2

.020" Alum. Witness Panels W1 @ 6" and W2 @ 14"

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

600 yards .50 cal M2 AP & 20mm M95 APT vs. 0.5 in. AR400 Steel Plate (simulated RHA)

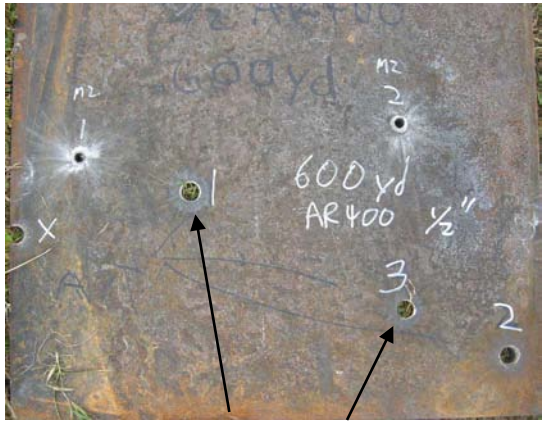


.50 cal M2 AP at 600 yds





.020" Alum. Witness Panels W1 @ 6" and W2 @ 14"



20mm M95 APT at 600 yds





.020" Alum. Witness Panels W1 @ 6" and W2 @ 14"

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

1000 yard "Vehicle Target" - This represents a general Vehicular Target Engine Defeat: ½ inch 65-45-12 Ductile Iron behind 2 layers of ¼ inch Aluminum Plate (5052H32).

Proj.	Shot-Pen.	MuzV (fps)	RemV (fps)
M2AP	2-CP	2734	1748
M2AP	6-PP	2692	1706
M2AP	12-PP	2690	1704
M2AP	13-CP	2664	1678
M95	2-CP	2661	1518
M95	3-CP	2676	1533
M95	6-CP	2586	1443

RemV estimated based on prior test Avg. Velocity Loss @ 1000 yards. See next slide for Iron Plate Hits.



¼ inch Alum. ¼ inch Alum. ½ inch Iron ¼ inch W1



1000 yard "Vehicle Target"

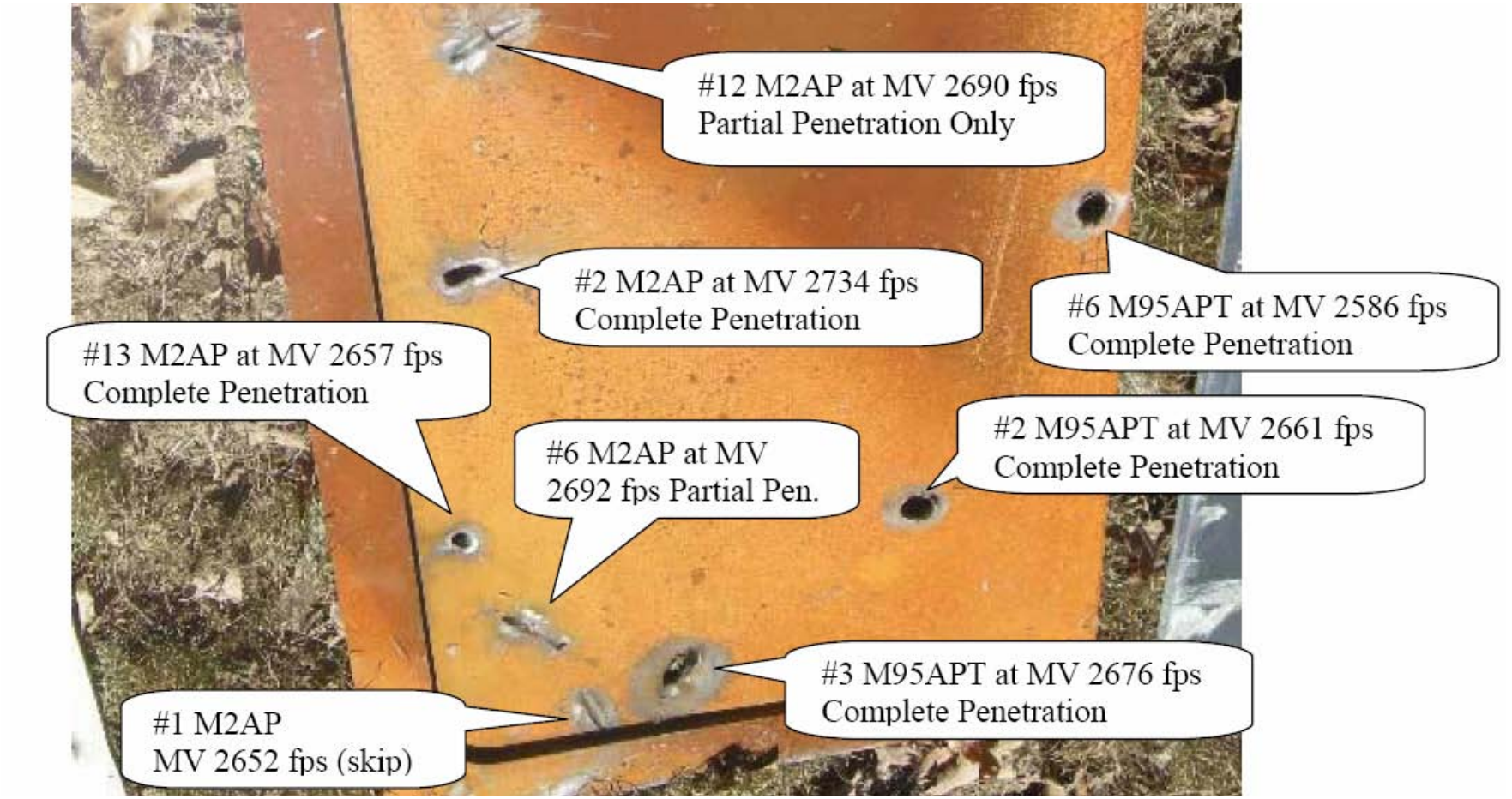


M95 APT vs. M2AP Penetrators

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

Ductile Iron Target Plate @ 1000 yards (set 48 inches from front alum. plate)



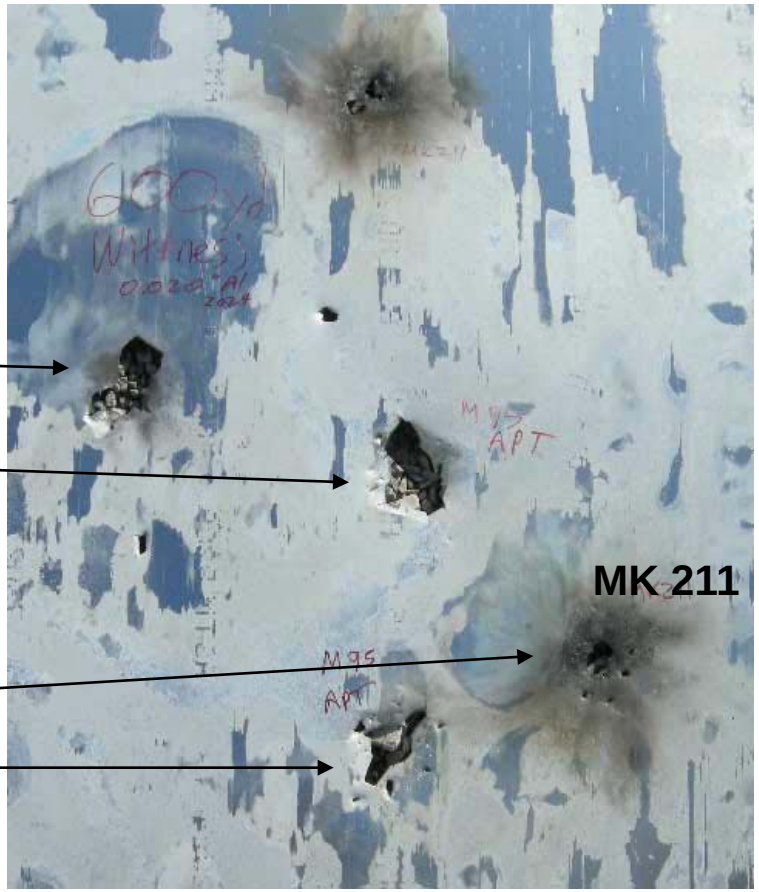
M95 APT Average 1500 fps Impact Velocity at 1000 yards (all 4 Complete Penetrations, 3 seen here)

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20mm AMR – New Use for Unused Ammo



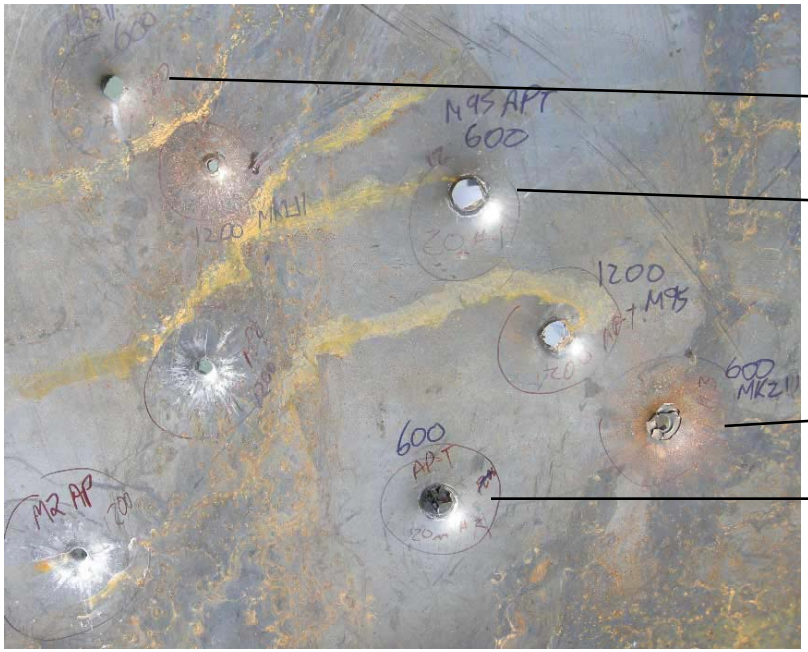
600 yards MK 211 against 20mm Ammo Can with other empty ammo cans inside (blew off lid) - for 20mm HEI expect major damage to all.



3 hits M95 APT

and

1 hit MK 211



¼ inch A36 Steel @ 600 yards

¼ inch mild steel "Behind Target Effects" are more significant for M95 APT 20mm than for exploding MK 211 rounds at 600 yards.

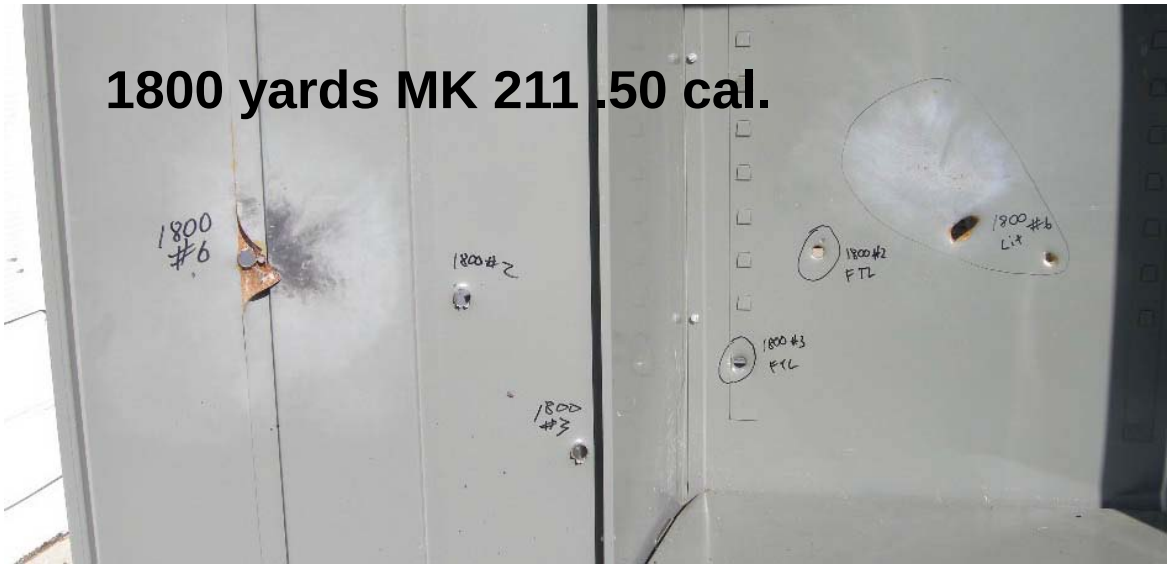
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20mm AMR – New Use for Unused Ammo

At 1800 yards majority of MK 211 projectiles Failed to Light (activate / explode) designated FTL.

Surrogate Light Material Targets were Steel Office Fixtures as well as ¼ inch A36 mild steel plate.

MK 211 damage is also significantly reduced at this range even when it activates.

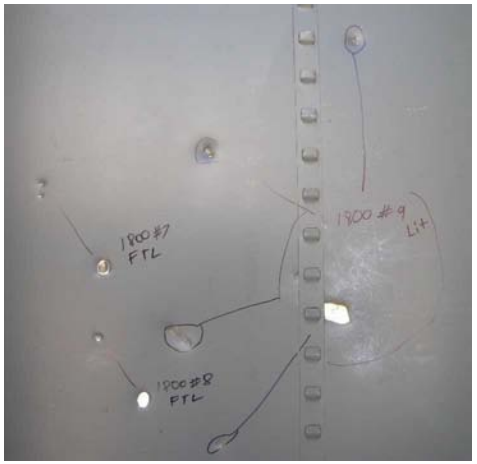


Inside view of open door and back wall of target - 2 of 3 FTL





Another 2 of 3 FTL - #9 activated on latch plate





MK211 Pen. lodged in A36 mild steel FTL

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20mm AMR – New Use for Unused Ammo

1800 yard MK 15 - MK 211 Impacts on 20/23 gage target lengthwise (Failed to Light) and 19/20 gage profile (Lit). Damage Marginal, even when activated remaining velocity under 1000 fps at 1800 yds.







1800 yard MK 211 into target face and completely penetrated without activation









MK 211 at 1800 yards that did activate – perhaps due to heavier 14 gage layer just past entry

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20mm AMR – New Use for Unused Ammo

Vehicles and Dismounted Machine Gun and Mortar Teams are most probably hit / defeated during the initial contact before they can react. Rapid Target Acquisition, Engagement, and short Time of Flight are critical to Hit Probability – especially for ”dumb” (unguided) munitions. A rifle based weapon system can provide this combination. Probability of Kill is then enhanced by the blast and fragmentation available in a 20mm HEI projectile.













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20mm AMR – New Use for Unused Ammo

20X110HS AMR is well suited for Modern Material Targets:

(M210 HEI for thin skinned / light targets and M95 APT for hard / lightly armored)









& **E**xplosive **O**rdnance **D**isposal









Potential VBIED







Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

BATF Explosive Standards

ATF	Vehicle Description	Maximum Explosives Capacity	Lethal Air Blast Range	Minimum Evacuation Distance	Falling Glass Hazard
	Compact Sedan	500 pounds 227 Kilos (In Trunk)	100 Feet 30 Meters	1,500 Feet 457 Meters	1,250 Feet 381 Meters
	Full Size Sedan	1,000 Pounds 455 Kilos (In Trunk)	125 Feet 38 Meters	1,750 Feet 534 Meters	1,750 Feet 534 Meters
	Passenger Van or Cargo Van	4,000 Pounds 1,818 Kilos	200 Feet 61 Meters	2,750 Feet 838 Meters	2,750 Feet 838 Meters
	Small Box Van (14 Ft. box)	10,000 Pounds 4,545 Kilos	300 Feet 91 Meters	3,750 Feet 1,143 Meters	3,750 Feet 1,143 Meters
	Box Van or Water/Fuel Truck	30,000 Pounds 13,636 Kilos	450 Feet 137 Meters	6,500 Feet 1,982 Meters	6,500 Feet 1,982 Meters
	Semi-Trailer	60,000 Pounds 27,273 Kilos	600 Feet 183 Meters	7,000 Feet 2,134 Meters	7,000 Feet 2,134 Meters

Vehicle Borne Improvised Explosive Devices

VBIED's

Goal:

Disrupt or Detonate @ Safe Stand-off w/ min. Collateral Damage

Plus Water and Aircraft

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20mm AMR – New Use for Unused Ammo













A few current alternative threat response options - all with time / precision & / or cost trade-offs vs. AMR for Material Targets (up to light armor).



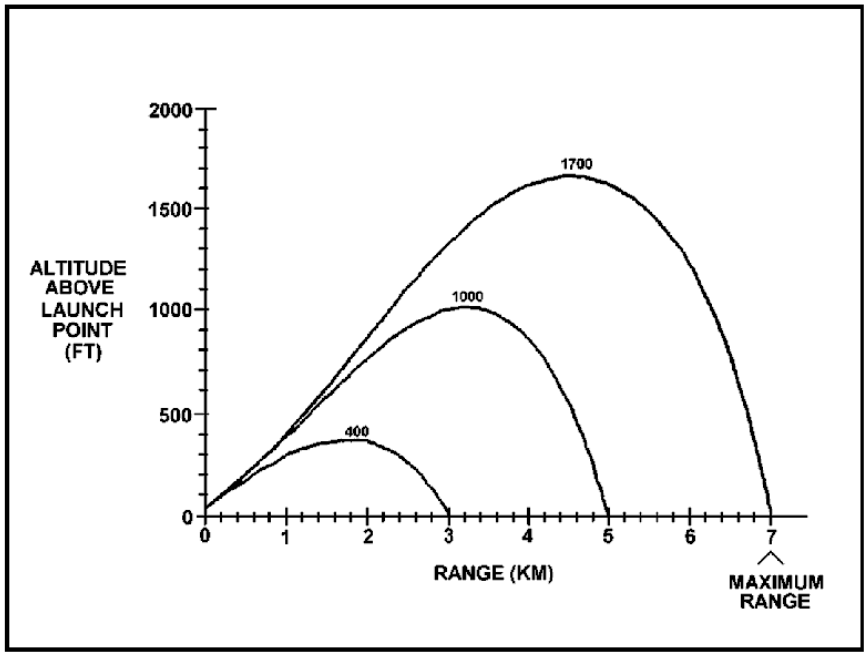




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20mm AMR – New Use for Unused Ammo

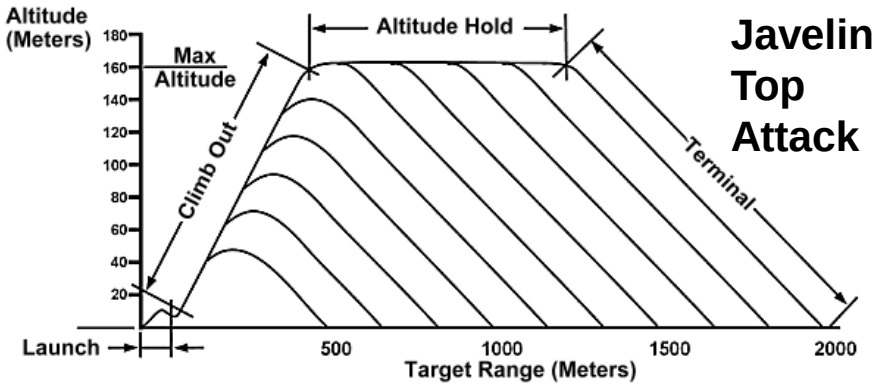
High Trajectory / Max. Ordinate requires Air Space Coordination.



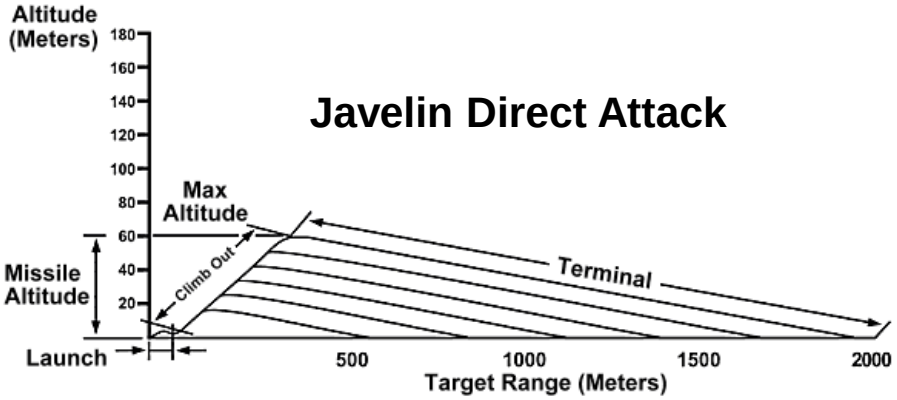
LOBL Trajectories (AGM-114A)

Hellfire Missile Trajectory - current AGM-114C alternate trajectory is 40% lower.

Javelin – Minimum Engage Distance of 65m Direct Attack or 150 meters Top Attack to maximum of 2000 meters.



Javelin Top Attack

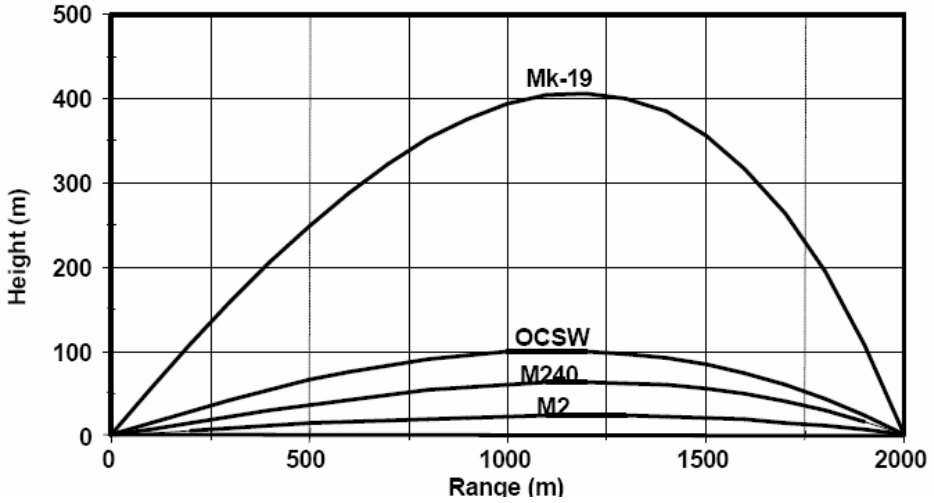


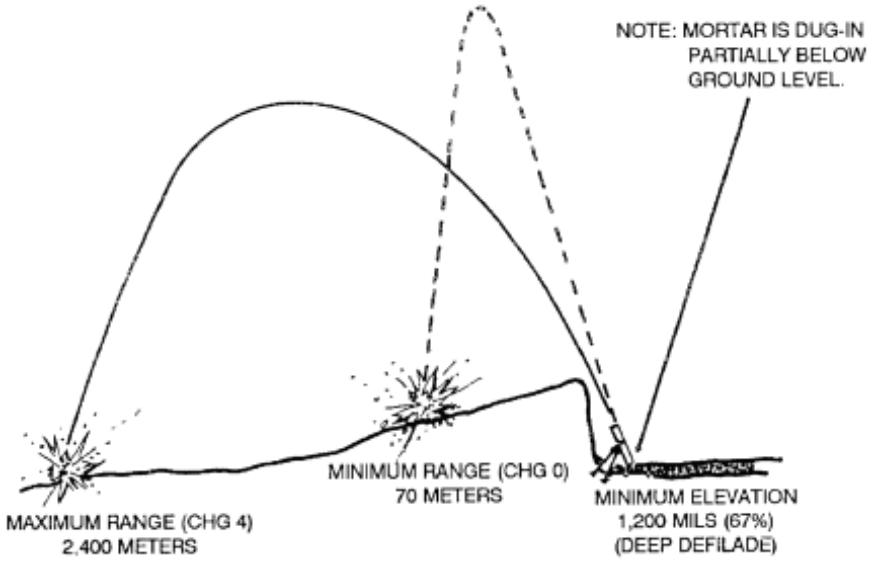
Javelin Direct Attack

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20mm AMR – New Use for Unused Ammo

60mm M720 Mortar Bomb Bursting Radius is 15m and 40mm Grenade Lethal Radius is 5 meters (20 m Hazard) vs. 2 meter Lethal Radius for 20mm HEI Cannon Shell (6 m Hazard)





TOF (sec)	500m	1000m	1500m	2000m
OCSW	1.55	3.55	5.97	8.89
M2	0.62	1.47	2.65	4.24
Mk-19	2.78	6.49	11.39	17.99
M240	0.77	2.19	4.18	6.68
20X110mm	.7	1.8	3.2	< 6

While the M224 60mm Mortar is fairly light weight and covers 70m to well beyond 2000m (3500m) it has poor first round hit probability and has a Max. Ordinate of 6825 ft along with associated Long Time of Flight (near 30 seconds). Also, collateral damage is an issue.

TOF & Trajectory Data from 2000 Gun & Ammo Symposium JSSAP Brief

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20mm AMR – New Use for Unused Ammo

The Below Chart is an example of how Weapon Systems can be compared using a Matrix – (%'s only estimated). Colors (Red/Amber/Green) would be used given requirement based MOE % ranges. A 60%+ effective (1-3 shots) 20mm AMR at 35 pounds capable of delivering perhaps 20 rounds in 2 minutes @ 2 MOA, could prove highly effective & efficient versus alternatives. Machine Guns / Mortars / Artillery / TOW / M3 Carl Gustav. etc. could also be added.

MOE / MOP One Shot	.300 Win Mag	MK15 w/ MK211	AMR 20mm HEI	Shoulder GL 40mm HEDP	JDAM "smart-bomb"	Hellfire	Javelin
Stop Vehicle/ Boat (Mobility Kill)	5%	25%	75%	60-80%	100%	100%	100%
Incapacitate Driver	15%	25%	75%	60-80%	100%	100%	100%
Detonate on Board Explosives	1%	30%	75%	60-80%	100%	100%	100%
Range	1200m	1500m	2000m	2000m	NA	3000m+	2000m
Accuracy / ES	1.5 moa	2 moa	2 moa	8 moa	10 m	3 m	3 m
TOF to 1500m	3 s	2.9 s	3.2 s	11.4 s	~30 s	~12 s	~10 s
Round Weight	1/10 lb	1/3 lb	0.57 lb	0.75 lb	500 lbs	100 lbs	35 lbs
System Weight	16 lbs	28 lbs	35 lbs	40 lbs	500 lbs	100 lbs	50 lbs
SOF Materiel Targets (typical)	1%	40%	75%	85%	100%	100%	100%
Cost per Shot	$ 1	$12	$15	$20-30	$10K	$60K	$80K

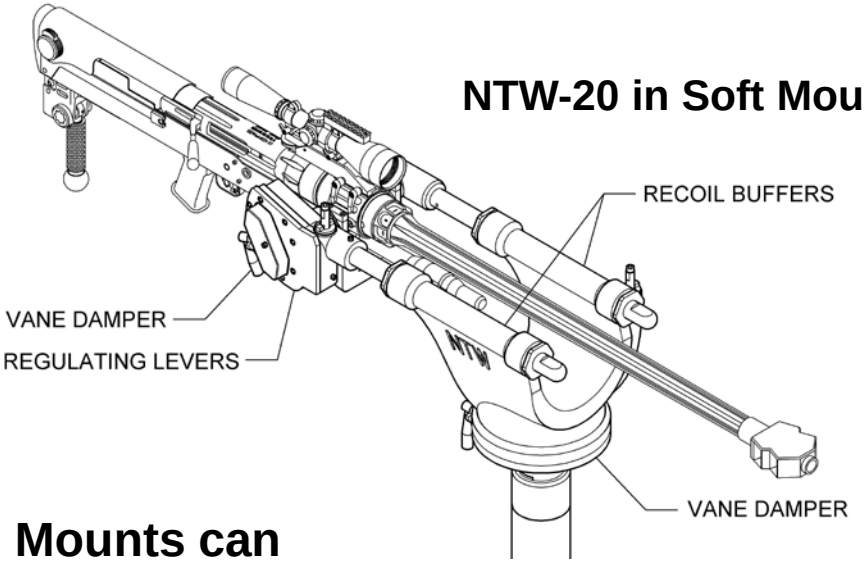
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20mm AMR – New Use for Unused Ammo



NTW-20 Bipod





NTW-20 in Soft Mount

Mounts can remove nearly all Felt Recoil



NTW-20 bipod digs in and transfers a portion of recoil energy into the ground when prone. Adding a spiked rear monopod – forming a reversed tripod- could also help reduce felt recoil considerably.

Navy MK 125 Tripod at 7 lbs (alum.) vs. original steel M122 at 15 lbs.

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20mm AMR – New Use for Unused Ammo

Advanced AMR Concepts with Recoil Management



Steyr IWS 2000 15.2mm @ 39.5 lbs

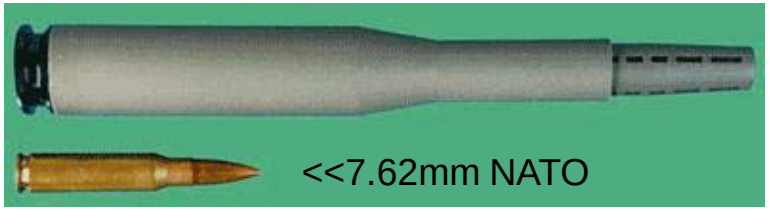


HK WSG 2000 9X90mm MEN @ 17.6 lbs (assumed w/o fire control included)



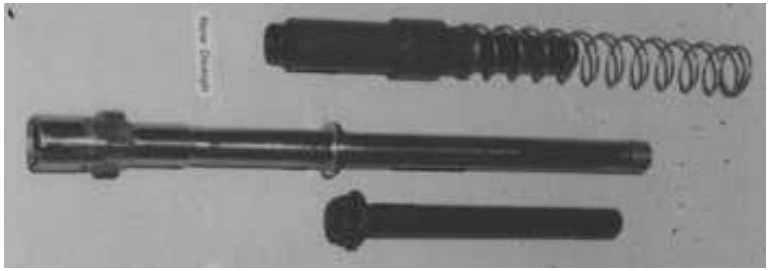
.50 BMG left 9X90mm ctr.

Long Recoil Operation – Barrel recoils in a Hydro-Pneumatic Sleeve. System also includes a Howitzer style Muzzle Brake. This Smoothbore System fired a sub-caliber 308 grain Tungsten Dart @ over 4700 fps. Barrel recoiled nearly 10 inches to spread energy transfer over time.



Projectile Weight with Sabot is 540 grains

This HK system did not need a muzzle brake to have only 5.29 lb-sec of recoil impulse. It used a hydro-mechanical long recoil mech. - like the HK - CAW system shown below.



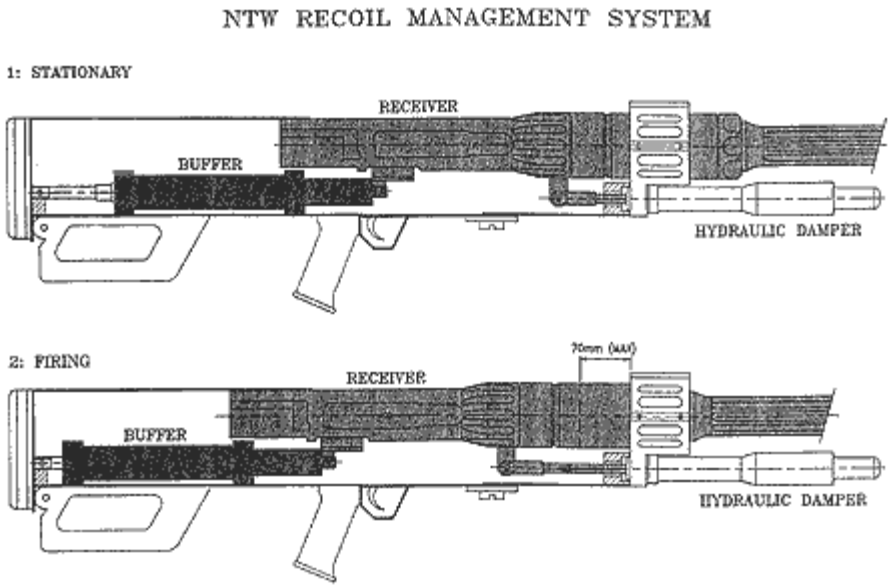
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20mm AMR – New Use for Unused Ammo

Undesirable Recoil Handling Technologies would include anything adding mass inefficiently:

Use of rearward venting (RT-20) or counter-mass (Davis Gun), which limits system versatility (avoid).

Use of an "out of battery" firing system with mass moving forward prior to and during primer ignition, which would tend to degrade accuracy potential (use as last resort).



V Below is Rifle "Free" Bench Velocity

MK 15 Free Recoil: (V=8.44 fps)
31.2 ft-lbs KE / 7.4 lb-sec Impulse
Peak Shoulder Force = 230 lbs

NTW-20 Free Recoil: (V=10 fps)
109 ft-lbs KE / 22 lb-sec Impulse
Peak Shoulder Force = 140 lbs

<u>Spreading Recoil Transfer Over Time</u> is key to decreasing Felt Recoil by lowering Peak Shoulder Force, which in turn can allow for a lighter System Overall Weight, necessary for a Highly Mobile AMR. The ideal situation is "Constant Recoil" where no "Bottoming" occurs.

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Comparative "Free Recoil" Data Table

Weapon System	Cartridge	System Wt. (lbs)	Bullet (grains)	Muzzle Vel. (fps)	Powder (grains)	Bullet KE (ft-lbs)	Recoil Vel. (fps)	Recoil KE (ft-lbs)	Recoil Impulse (lb-sec)	Recoil Data Source
Rem870 12 gage	#4 buck						21.60	50.70	4.69	Pendulum Test 1987
Rem870 12 gage	#4 buck	8	600	1250	27	2079.64	14.21	25.07	3.53	Calc. K=1.35
M16A2	5.56mm	8	62	3100	26	1321.69	5.38	3.59	1.34	Calc. K=1.35
M14 K=1.35	7.62mm	9.5	147	2800	46	2556.52	8.80	11.43	2.60	Calc. K=1.35
M14 Pendulum	7.62mm	9.5	147	2800	46	2556.20	8.80	11.50	2.60	Pendulum Test 1989
M14 Crane Brake	7.62mm	9.6	147	2800	46	2556.20	6.00	5.65	1.87	Pendulum Test 1989
M14 Crane Brake	7.62mm	% Reduction in Data Element Due to Brake >>					32%	51%	28%	Pendulum Test 1989
.338-.416 RAP	.338-416	15.9	250	2950	95	4826.14	10.06	25.09	4.99	Pendulum Test Crane
.338-.416 K=1.35	.338-416	15.9	250	2950	95	4826.14	10.03	24.82	4.95	Calc. K=1.35
Win Mag Sniper	.300WM	13.9	190	2950	72	3667.87	8.76	16.64	3.80	Crane Pendulum Test
Win Mag Sniper	.300WM	13.9	190	2950	72	3667.87	8.71	16.37	3.76	Calc. K=1.35
Win Mag (calc.)	.300WM	13.9	190	2950	72	3667.87	7.39	11.78	3.19	www recoil calc.
Win Mag K=1.75	.300WM	13.9	190	2950	72	3667.87	9.58	19.81	4.14	TOP 3-2-504 calc.
MK 13 MOD 5	.300WM	16	190	2950	72	3667.87	7.20	12.73	3.58	Crane Accel. Shoulder
MK 13 MOD 5	.300WM	16	190	2950	72	3667.87	7.56	14.22	3.76	Calc. K=1.35
T-Gewehr M1918	13.2X92SR	41	795	2550	210	11467.36	9.58	58.46	12.20	Calc. K=1.35
Boys .55 cal ATR	13.9X99B	36	735	2600	225	11021.74	10.72	64.21	11.98	Calc. K=1.35
MK 15 MOD 0	.50 BMG	28.2	660	2750	235	11071.98	13.61	81.16	11.92	Calc. K=1.35
Russian PTRD	14.5X114	38	990	3250	470	23196.26	19.85	232.46	23.42	Calc. K=1.35
NTW 20	20X110	70	2030	2600	490	30440.99	14.28	221.69	31.05	Calc. K=1.35
20mm RT-20	20X110	43.4	2030	2500	490	28144.41	22.15	330.60	29.85	Calc. K=1.35
Solothurn S18-1000	20X138B	118	2270	2725	570	37391.68	10.03	184.24	36.75	Calc. K=1.35
Lahti L-39	20X138B	109	2270	2650	570	35361.75	10.56	188.62	35.74	Calc. K=1.35
Note: Most calculated data is from "Winchester" equations using K=1.35 found to correlate well with prior NSWC Crane Pendulum Test Data										
(TOP 3-2-504 uses same formula but with K=1.75 - gas velocity factor - predicting higher results)										

As seen with "M14 Crane Brake" above – Muzzle Brake Recoil Reduction is not included in any of the calculated recoil characteristics (counter recoil tube effect for the RT-20 also not included). Even if a particular system had a 60% KE reducing brake, several systems have been fielded with over the U.S. 60 ft-lb limit for free recoil energy. PTRD also has a long recoil mech. (even though single shot).

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20mm AMR – New Use for Unused Ammo

A 20mm AMR System Configuration Optimized for Lightest Practical Weight with Long “Action Travel” and Cannon Style Breech (compact and rapidly reloaded by team mate) should be considered. Barrel length could be reduced to balance weight & range. Light Weight / High Strength Materials would be combined with a mix of Recoil Attenuation Technologies:

- Muzzle Device – Try to Combine Blast and Flash Reduction with Recoil Compensation / Brake Effects – Balanced Device.
- Hydraulic / Magneto-Rheological Damping System – Integrate into design to absorb some energy and slow the energy transfer to shooter / mount – be aware of any temperature sensitivity issues.
- Pneumatic Damping / Spring Buffering – Per Ron Sugg 1994 Patent Concepts. Spread Recoil Energy over large time duration and store some using the spring for release over more time (long recoil effect).
- Friction or Magnetic Braking – Sugg 1994 Patent includes Friction. Eddy Current Braking (using permanent magnet) could also be applied.
- Spiked Bipod & Rear Monopod plus Mounting Capabilities.

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20mm AMR – New Use for Unused Ammo





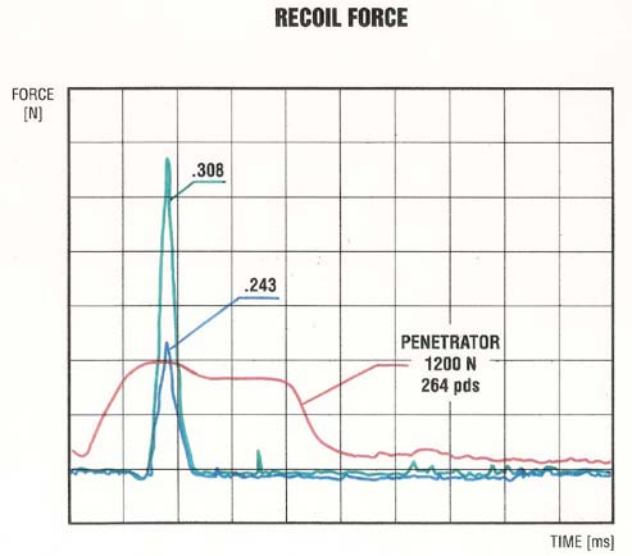
Recoil Force / Acceleration, and High Speed Video Test Setups





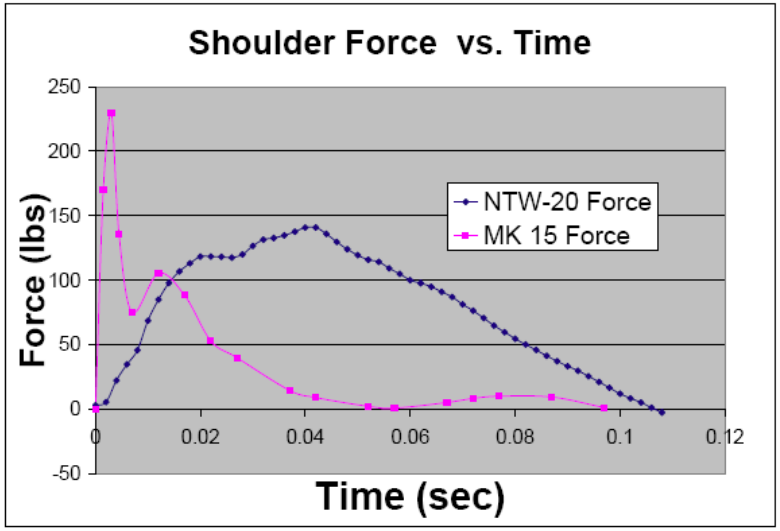






<< Steyr IWS 2000 Recoil Force Compared to .308 Win. and .243 Win.

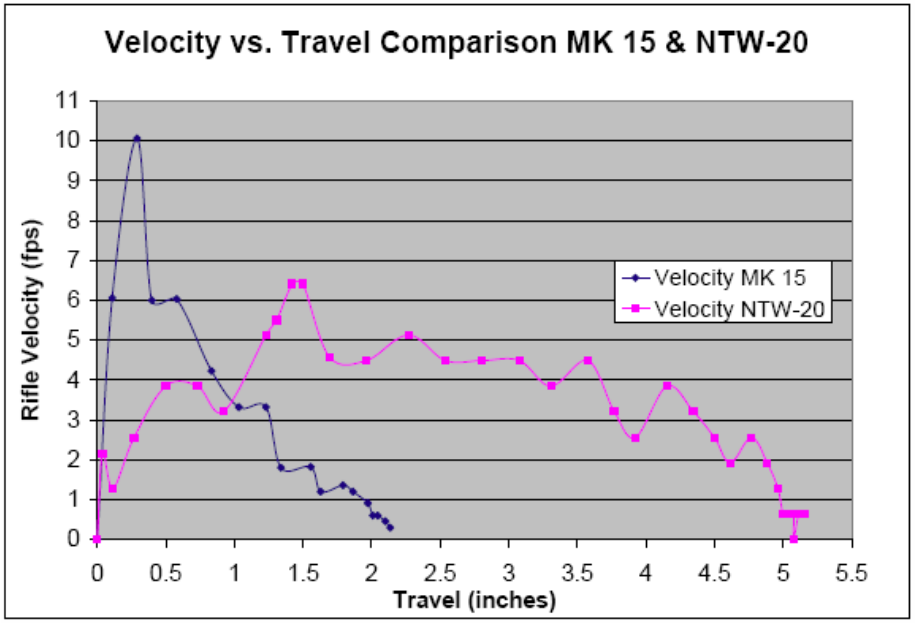
MK 15 versus NTW-20 Force >>

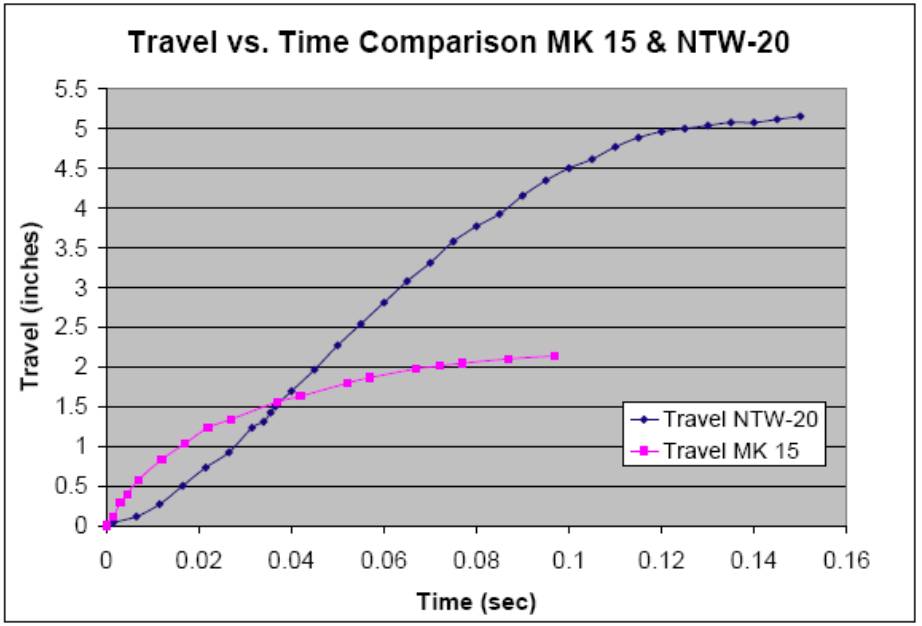


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20mm AMR – New Use for Unused Ammo

- **Extending Recoil Duration by Storing Energy with Spring and Damping with Hydraulics Reduces Felt Recoil by Reducing the Peak Force Felt by the Shooter.**

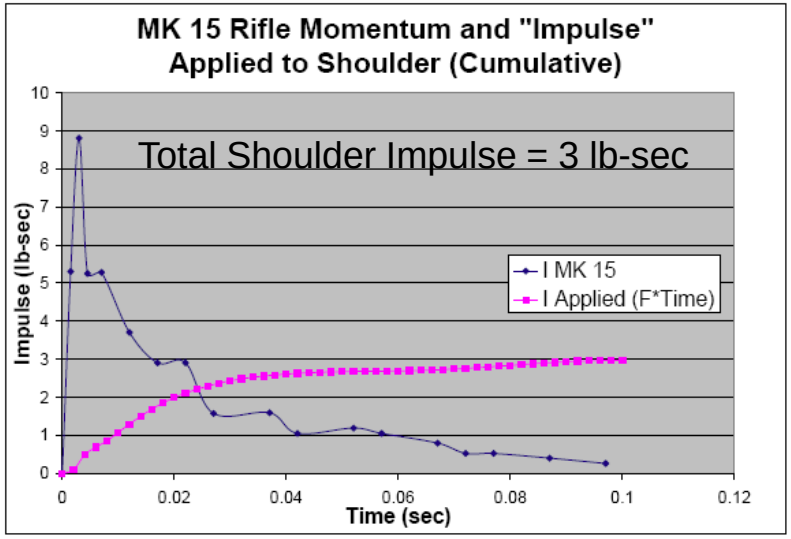




Peak Forces from prior slide plot occur at approx. 0.5 inches and .0045 sec for MK 15 @230 lbs and at 1.5 inches and .045 sec for NTW-20 @ 140 lbs. Also notice the "effective" shoulder fired velocity (post muzzle brake effect) is 6 fps for MK 15 and only 6.4 fps for the NTW-20. The significant momentum of the NTW-20 along with the return of stored energy from its buffer spring result in more than 2 times the travel (at shooting bench) compared to the MK 15.

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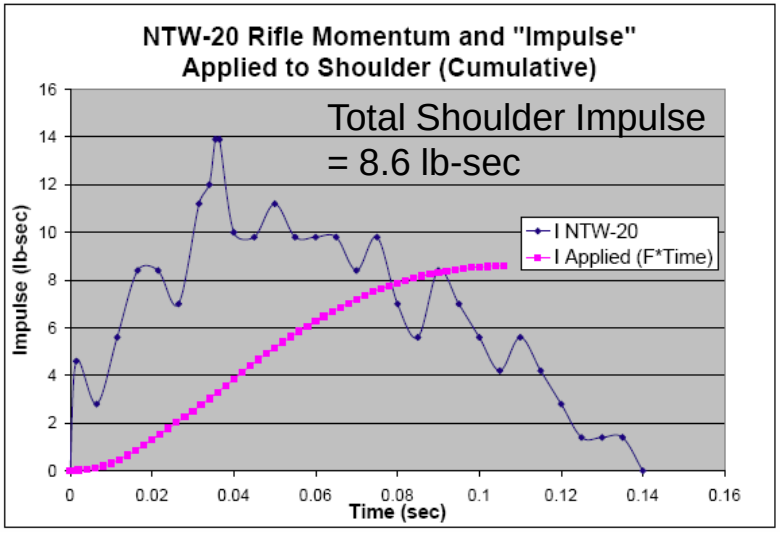
20mm AMR – New Use for Unused Ammo

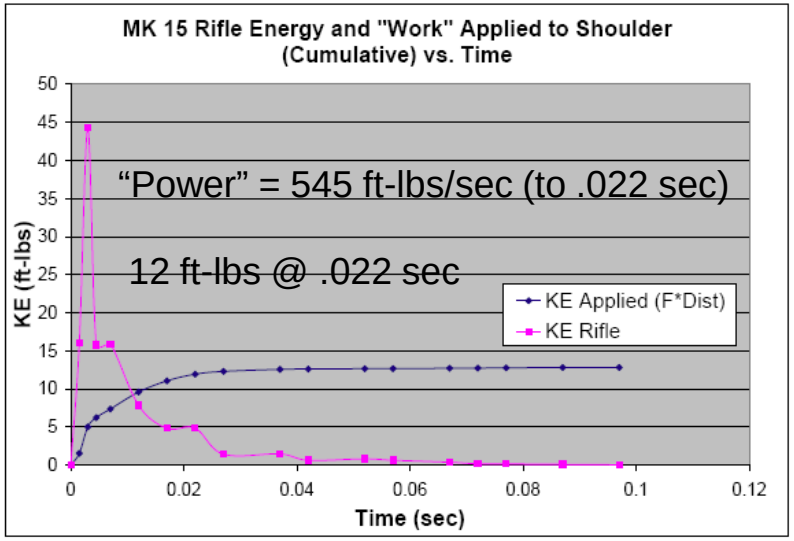


Impulse – << MK 15 NTW-20 >>

Rifle (M*V) & Shooter (F*T)

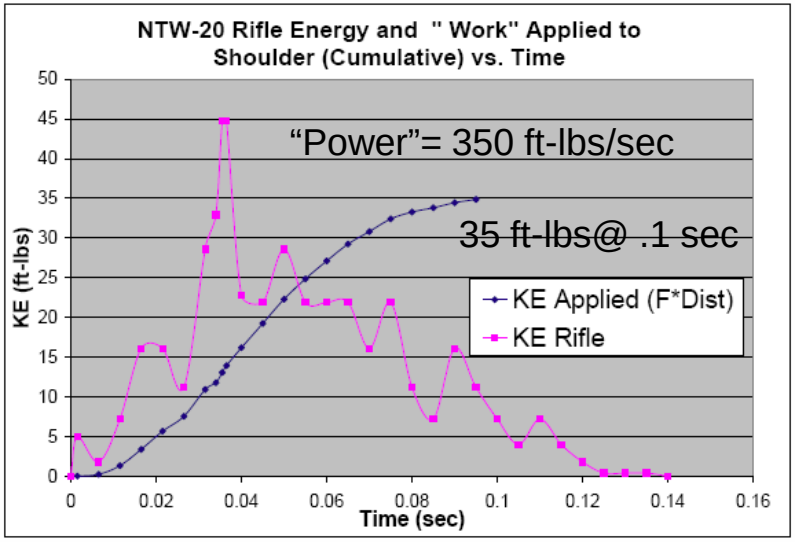
Both apply @ 100 lb-sec/sec max rate





Energy – << MK 15 NTW-20 >>

Rifle & Shooter (F*D)

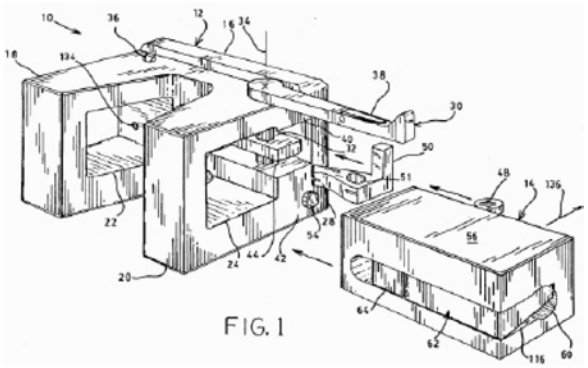


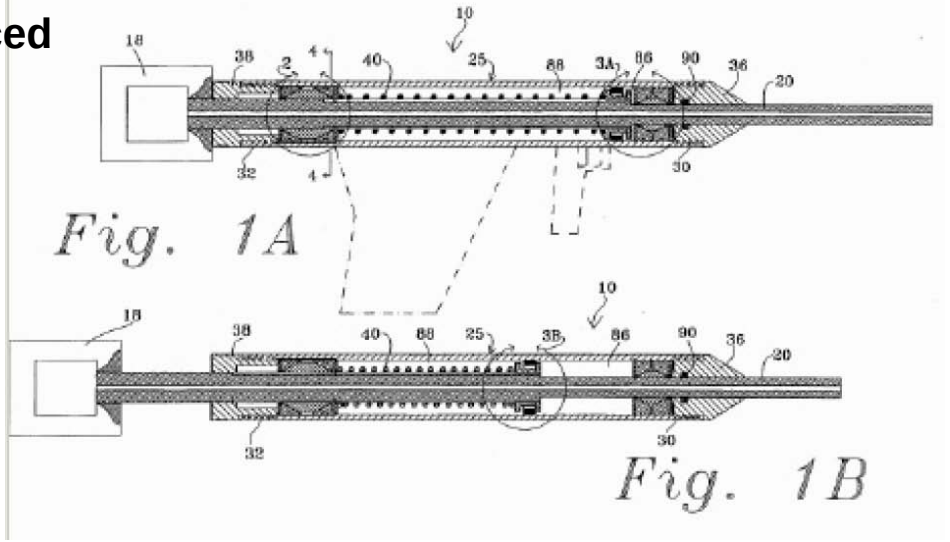
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Sugg Breech & Recoil Mechanisms

Compact Side Open – Auto Extract / Eject Design

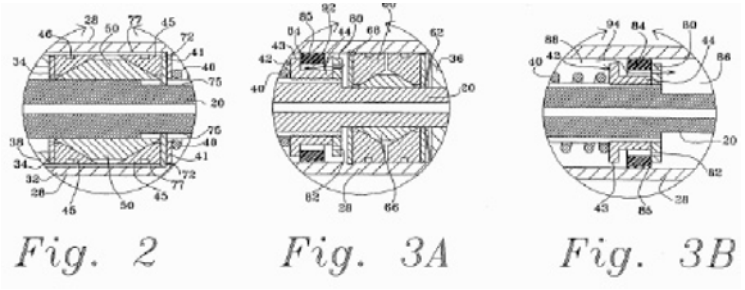
Sugg .50 Action – Several Rifles Produced







Combines Spring / Friction and Pneumatic Damping to Extend Recoil Pulse - a "Constant Recoil" System



Distribution Statement A - Approved for Public Release; Distribution is unlimited.

Sugg Recoil Mechanism Patent

Combines Spring / Friction and Pneumatic Damping

US005353681A

United States Patent [19]

Sugg

[11] **Patent Number: 5,353,681**

[45] **Date of Patent: Oct. 11, 1994**

[54] **RECOIL DAMPENING DEVICE FOR LARGE CALIBER WEAPONS**

[76] Inventor: **Ronald E. Sugg**, 7800 Castlecomb Rd., Knoxville, Tenn. 37849

[21] Appl. No.: **31,961**

[22] Filed: **Mar. 16, 1993**

[51] Int. Cl.[5] F41A 25/16

[52] U.S. Cl. 89/43.01; 89/177

[58] Field of Search 42/1.06; 89/42.01, 43.01, 89/44.01, 44.02, 177, 178, 198

[56] **References Cited**

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Very High Power, FCSA Newsletter, 4th Qtr. 1992

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Primary Examiner—Stephen C. Bentley
Attorney, Agent, or Firm—Pitts & Brittian

[57] ABSTRACT

A recoil dampening device incorporating a dynamic braking system and index ring. The recoil dampening device of the present invention is intended for use on weapons, especially heavy caliber weapons, having a recoiling barrel. The recoil dampening device is coaxial with the weapon's barrel and has a constant pressure brake assembly and a dynamic brake assembly. The recoiling barrel and the brake assemblies are carried within a cylindrical tube that is coaxial with the brake assemblies and the barrel. As the weapon is discharged, the force of the recoil causes the barrel to travel rearwardly thus engaging a coaxial spring. The spring engages the dynamic brake assembly and as the barrel travels rearwardly, the force applied to the dynamic brake is increased in a linear fashion, causing an increasing amount of frictional braking pressure to be applied to the inner surface of the tube and the exterior surface of the barrel. When the frictional braking force exceeds the recoil force, the rearward travel of the recoiling barrel is halted and the energy stored within the spring returns the barrel to battery. Thus the acceleration of the recoil impulse is applied to the shooter through the frame of the weapon over a longer period of time thus reducing the perceived recoil force experienced by the shooter.

16 Claims, 3 Drawing Sheets

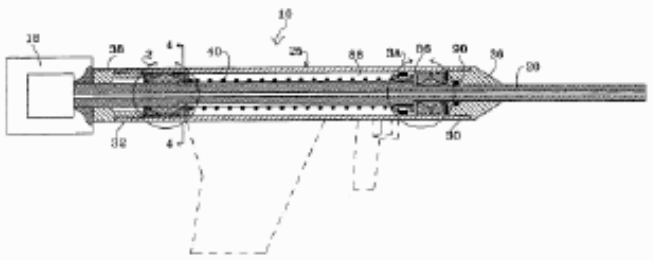




Photo Above - Sugg Rifle Action in "Recoiling" Status

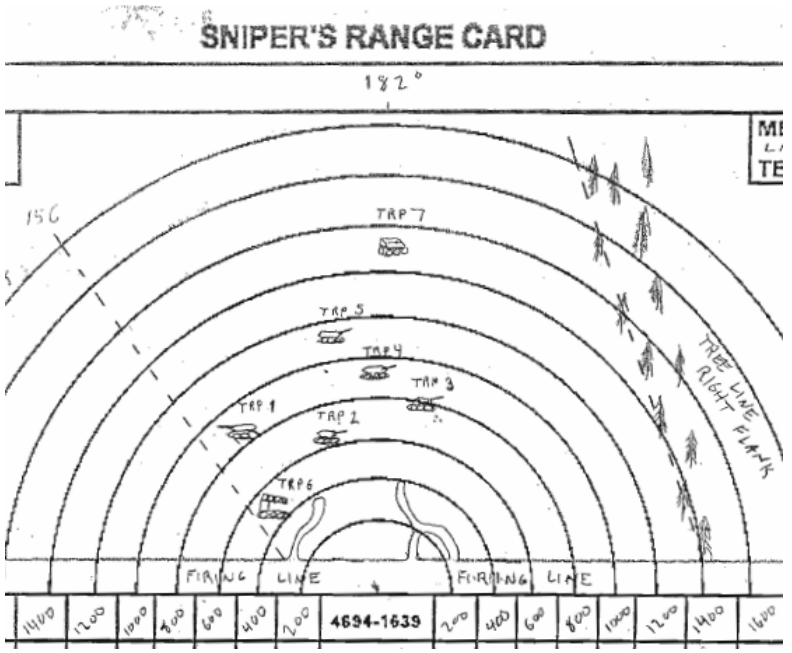


Friction Braking Increases with Spring Compression while Pneumatic Braking is Greatest Initially at Highest Action Velocity.

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo





- **20mm Shoulder Fired Target Engagement – NTW-20X110HS**
  - **Fixed power optic on NTW-20 has range dial built into QD mount.**
  - **Mount for SAGEM Thermal Sight is available.**
  - **Able to consistently hit M113 APC at 1500 yards (APT & HEI).**
  - **Time of Flight to 1400m (1531 yds) is 2.9 sec @1033 fps Rem. Velocity.**
  - **DENEL advertised Operational Range at 1750 meters (1914 yds).**

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

- **Conclusions**
  - **Available 20X110mm Ammunition is Effective Against Material Targets – More Damage and at Longer Range than for .50 Caliber BMG.**
  - **20mm AMR Accuracy can equal .50 Caliber with existing "free" ammo.**
  - **Currently available 20mm Rifles could be used for Area Denial & Over-Watch / Defense from Fixed Positions and Vehicles.**
  - **A 20X110mm chambered rifle could be converted to 20X102mm electric primed in the future to allow for a wider selection of ammunition.**
  - **While a .338 chambering can achieve 1500m+ anti-personnel capabilities, these lack the payload to be effective against material targets. Thus, a rifle focused on the Material Target Set is highly desirable.**
  - **The combination of standoff (1500m+), Accuracy, and Destructive Performance of a 20mm AMR could allow for decisive neutralization of many High Value Material Targets.**
  - **The increased proliferation of Advanced Mobile Missiles - to include Medium Range Theatre Ballistic Missiles, Long Range Surface to Air Missiles, and Anti Ship Cruise Missiles - is of great concern. (all prime 20mm AMR targets).**
  - **The challenge of developing a system light enough for full SOF mobility and suitable felt recoil can be overcome through efficient design with use of modern materials and recoil handling technologies.**

Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo



Distribution Statement A - Approved for Public Release; Distribution is unlimited.

20mm AMR – New Use for Unused Ammo

Harnessing the Power of Technology for the Warfighter

US Special Operations Command

FOREIGN COMPARATIVE TESTING (FCT) PROGRAM

Dave Armstrong - SOF Weapons Section
Crane Division, Naval Surface Warfare Center
Small Arms Weapons Systems Division
Joint Weapons Engineering Branch
Joint Special Operations Response Department (JSORD) Ph: 812-854-5731 DSN: 482-5731
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USSOCOM Comparative Testing Office
HQ Special Operations Command
SOAL-MA (CTO)
7701 Tampa Point Blvd
MacDill AFB, FL 3362

Distribution Statement A - Approved for Public Release; Distribution is unlimited.



Ares Defense Systems, Inc.

Innovative Weapons for the Modern War-Fighter

SHRIKE 5.56

Advanced Weapons System



SHRIKE 5.56 - Advanced Weapons System ™

Ares-16 AMG - Assault Machine Gun (Dual Feed)





AAR - Ares Automatic Rifle





Common Receiver

AAR/C - Ares Automatic Rifle Compact







Ares-16SPW - Special Purpose Weapon

PATENTED COMMON RECEIVER GROUP CAN BE CONFIGURED FOR:



MAGAZINE FEED



DUAL FEED



BELT FEED



SHRIKE 5.56

Advanced Weapons System

Weapons System Features

- Fires 5.56 x 45mm NATO (.223 REM)
- Can be supplied as a complete weapon or as an upgrade to existing M16/ M4 weapons
- Shares the Excellent Ergonomics & Lightweight Class of the M16
- Intuitive Modular Design
- Designed with the Operator in Mind with all Captive Pins
- Only a Single Cartridge is necessary to field strip the weapon or Disassemble into Basic Modules

ARES

SHRIKE 5.56

Advanced Weapons System

Weapons System Features

- Gas – Piston, Short-Stroke Tappet Operation
- Quick Change Barrel Assemblies are complete with their own Piston, Cylinder, Gas Regulator and Sights
- Select Fire Controls
- Compatible with ALL MIL-STD AR15 / M16 Lower Receivers
- Mission Flexible

ARES

SHRIKE 5.56 – Barrel Assembly



Barrel Assembly Features:

- Chrome Lined
- Quick Change with Fixed Headspace
- 12.5” – 20” lengths
- 1:9 inch RH, 1:7 inch RH and 1:12 inch RH
- Lightweight Gas-Piston & Cylinder Assembly
- Modular , 4-Position Adjustable Gas Regulator

SHRIKE 5.56

Advanced Weapons System

Weapons System Features

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ARES

SHRIKE 5.56

Advanced Weapons System

DUAL FEED CONFIGURATIONS

Ares-16 AMG - Assault Machine Gun ™





ARES

SHRIKE 5.56

Advanced Weapons System

Shrike 5.56 – AMG Assault Machine Gun

- Fills the Existing Gap between the M16/M4 and the M249 SAW

- Provides the Individual Operator with the Mobility of the Lightweight Carbine with the Firepower of the SAW

ARES

Shrike 5.56 - AMG Technical Specifications

Caliber:	5.56 x 45mm NATO (.223 REM)
Weight:	7.5 lbs. Complete Weapon (without ammunition and with lightweight barrel)
Barrel:	16.25” Quick-Change – Standard 12 – 20” Quick-Change – Optional Sound Suppressed Barrel Assembly - Optional
Rifling:	1:9” RH Twist Rate – Standard 1:7” RH, 1:12” RH Twist Rates – Optional
Overall Lengths:	22.5” – 39.75” (Special Compact – Automatic Rifle/ LMG)
Feed Devices:	4179 STANAG (M16) Magazine, or 100 Round BETA C-MAG Drum Magazine, or M27 (M249 SAW) Disintegrating Metallic Ammunition Links
Rate Of Fire:	625 – 1000 Rounds Per Minute (RPM)
Method Of Operation:	Gas-Piston, Short Stroke Tappet
Special Features:	Quick-Change Barrels Dual-Feed Ammunition Supply Sound Suppressor Capable Mounting Points for Accessories including 40mm Grenade Launcher

SHRIKE 5.56 - Advanced Weapons System ™

Ares-16 AMG - Assault Machine Gun (Dual Feed)





AAR - Ares Automatic Rifle





Common Receiver

AAR/C - Ares Automatic Rifle Compact







Ares-16SPW - Special Purpose Weapon

National Defense Industrial Association

40mm Grenade Improvements Panel Overview--Purpose Introduction

21 May 2009

International Infantry and Joint Services Small Arms Systems Symposium

Las Vegas, Nevada

National Defense Industrial Association

Panel Objectives

- Demonstrate 40mm Grenade Ammunition Engineering Activity
- Confirm Attention Enhancement of 40mm Grenade Ammunition
  - Design/Performance
  - Weapon Interface
- Highlight Key Product Improvement Projects
  - Approach
  - Status
  - Production Introduction Transition
- Confirm Partnership of Government and Industry
  - System Contractor Management
  - Project Partnership with Government
  - Leader-Follower Technology Transition
- Verify the Improvement Benefits are Realized by Warfighter

40mm Grenade Ammunition Design/Performance Assessment Activity

Rigorous In-Depth Engineer Rationale and Design/Performance Data Base Evolving for all 40mm Ammunition

- Baseline Design/Performance Evolving

Attention to Implementing Priority Product Improvements

- Development (New Technology, Components, Cartridges)
- Addressing Producibility Topics
- Technology Insertion

Linking the 40mm Government and Contractor Community

- Effective IPT Teams
- Addressing Needs
- Communication of Information

40mm Grenade Improvement Participants

- US Army PM--MAS
- US Army Infantry School
- US Army JMC
- ARDEC
- PEO-Soldier Weapons
- USMC
- ARL
- ATC
- 40mm Grenade Ammunition System Management Contractors
  - AMTEC Corporation
  - DSE
- Various Support Contractors

Integrated Product Teams
Linking
Technology, Development, Production
To Realize
40mm Grenade Ammunition
Improvements

National Defense Industrial Association

Panel Approach

- **Communicate Key 40mm Grenade Improvements**
  - Technology
  - Producibility
  - Design/Performance Data Bases
- **Panel Dialogue of 40mm Grenade Ammunition Improvements**
  - Moderator Lead
- **Questions and Answers (as time permits)**

Panel Participants

Panel Moderator --Dave Broden

Panel Members--ARDEC

Peter Martin---Project Team Lead
Art Pizza--Technical Expert --40mm Ammunition

Presenters

Mann Barrel --Adam Sorchini

Single Chamber Cartridge Case --Matthew Millar

M385A1 Composite Projectile --Christopher Summa

Shaped Charge Liner Assessments --James Grassi

Advanced Lethal Mechanism-40mm Grenades--
Jason Wasserman

40mm Grenade Ammunition Technology and Product Focus

- 40mm Grenade Weapons
  - **Low Velocity--M203, M320 etc.**
  - **High Velocity--MK19 MOD 3, MK 47 etc.**
  - **Weapon Interfaces**
- Grenade Ammunition
  - **Low Velocity Family**
  - **High Velocity Family**
  - **Product Improvements**
  - **Producibility**
- Design/Performance Baselining--
  - **Interior, Exterior, Terminal Ballistics**
  - **Reliability**
  - **Safety**
  - **Test Methods**

Establishing Interface Parameters

Establishing Technologies and Products Enabling Operational and Cost Benefits

Providing In-Depth Characterization Data Base

40mm Grenade Improvement Benefits

- **Establishing Engineering Rigor to Baseline Configurations**
- **Addressing "Lessons Learned" Improvements**
- **Assessment and Application of State of Art Technology**
- **Enabling Enhanced Producibility--Realizing Quality and Cost**

Supporting the Warfighter Objectives
40mm Ammunition
Capability, Quality, Reliability, Availability, and Affordability
Today and the Future



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

40mm Grenade Ammunition Panel Papers

21 May, 2009

40mm Grenade Ammunition Special Projects Team

RDECOM

Malcolm Baldrige National Quality Award 2007 Award Recipient

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Development of a 40mm Mann Barrel System for both High and Low Velocity Ammunition

21 May, 2009

Adam Sorchini, 40mm Grenade Ammunition Special Projects

Program Objectives

- Develop 40mm test fixture for both High and Low Velocity ammunition
- Design electronically controlled breech system for remote initiation
- Ensure that new Mann barrel system interfaces with current data acquisition system to record EPVAT (Electronic Pressure, Velocity, and Action Time)

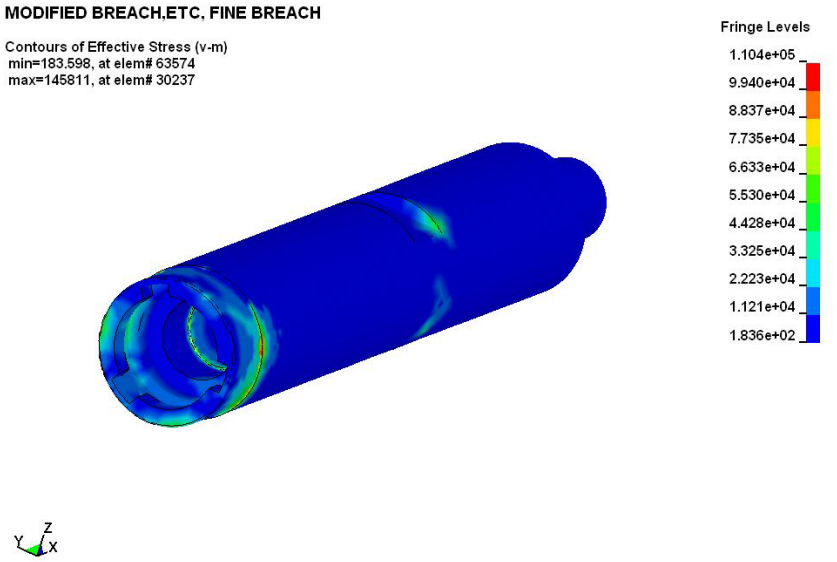
Previous Designs

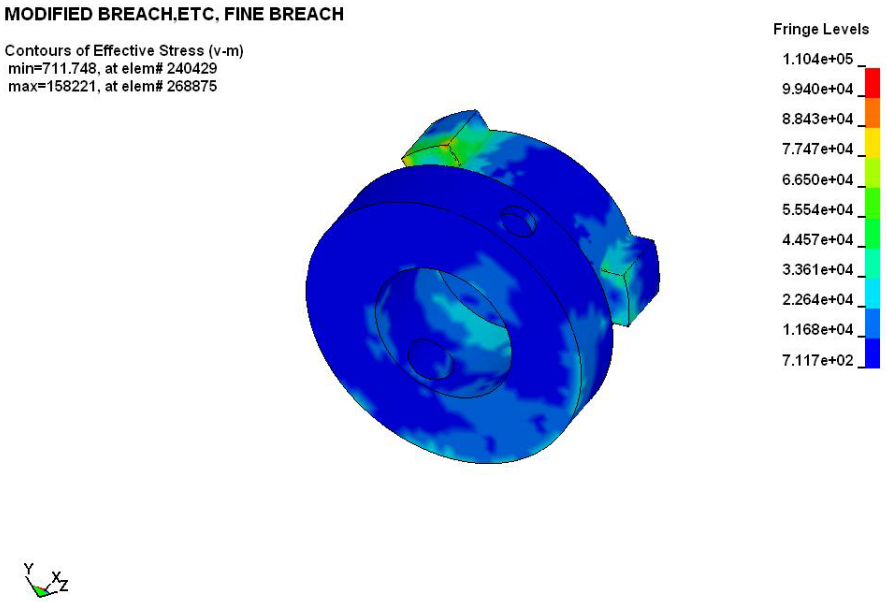
- Previously version of Mann barrel breech used pinball style plunger to initiate primer
- Pin on rope/pulley system was used to release plunger remotely
- Previous breech used interrupted thread to interface with barrel requiring custom fitting



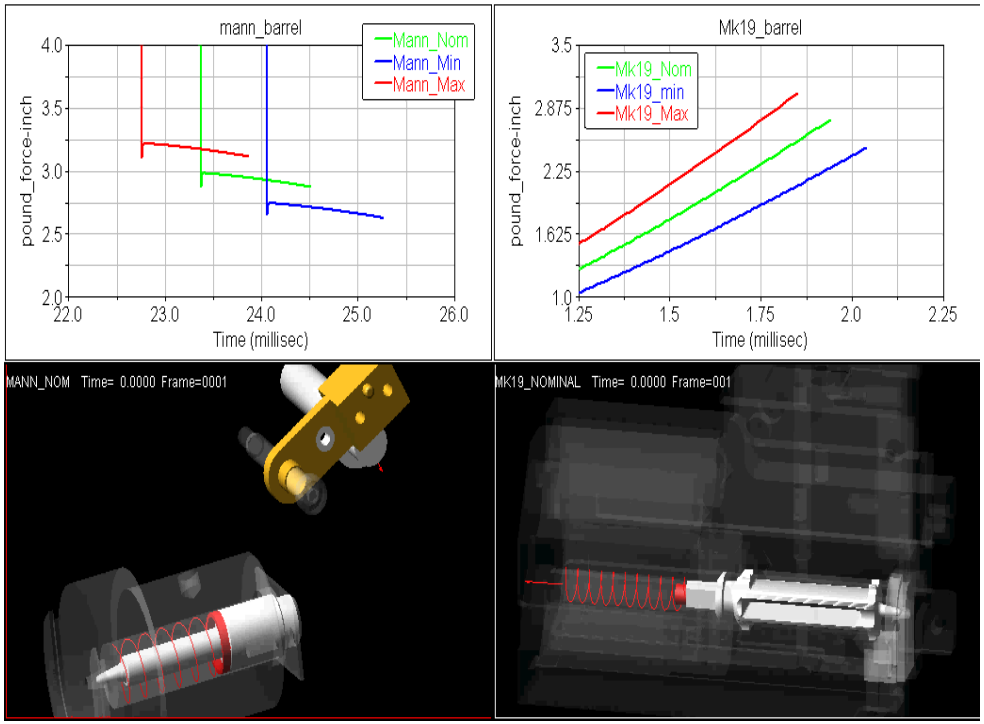


- Mann barrel is rated up to a max pressure of 20 ksi with failure at ~60 ksi
- Breech lugs see highest stress concentrations on lug corners



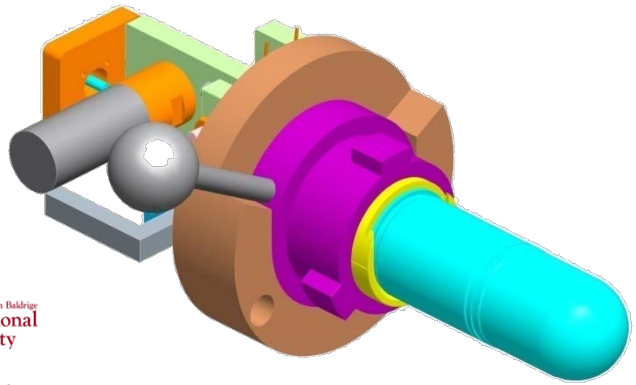


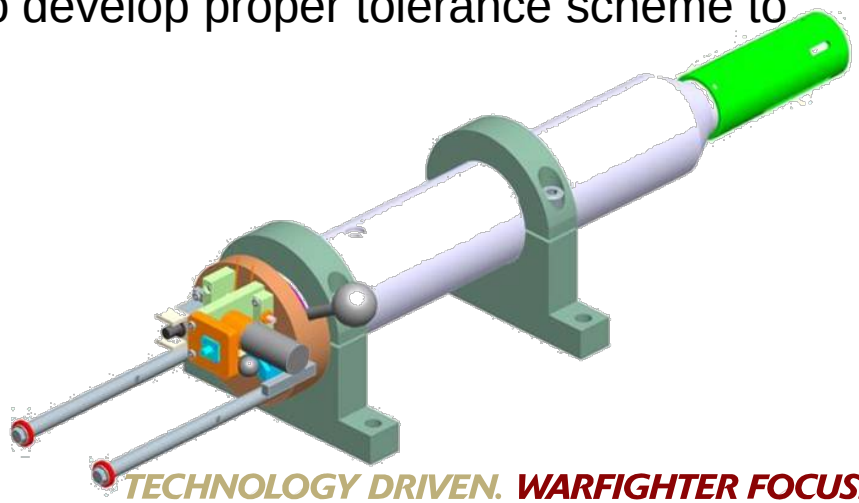
- Used ADAMS to refine the Mann barrel firing energy to match the MK19 and M203 weapons
  - Matched value of energy at primer initiation
  - By changing the firing pin and firing pin spring, the breech is easily converted from a high velocity system to a low velocity system



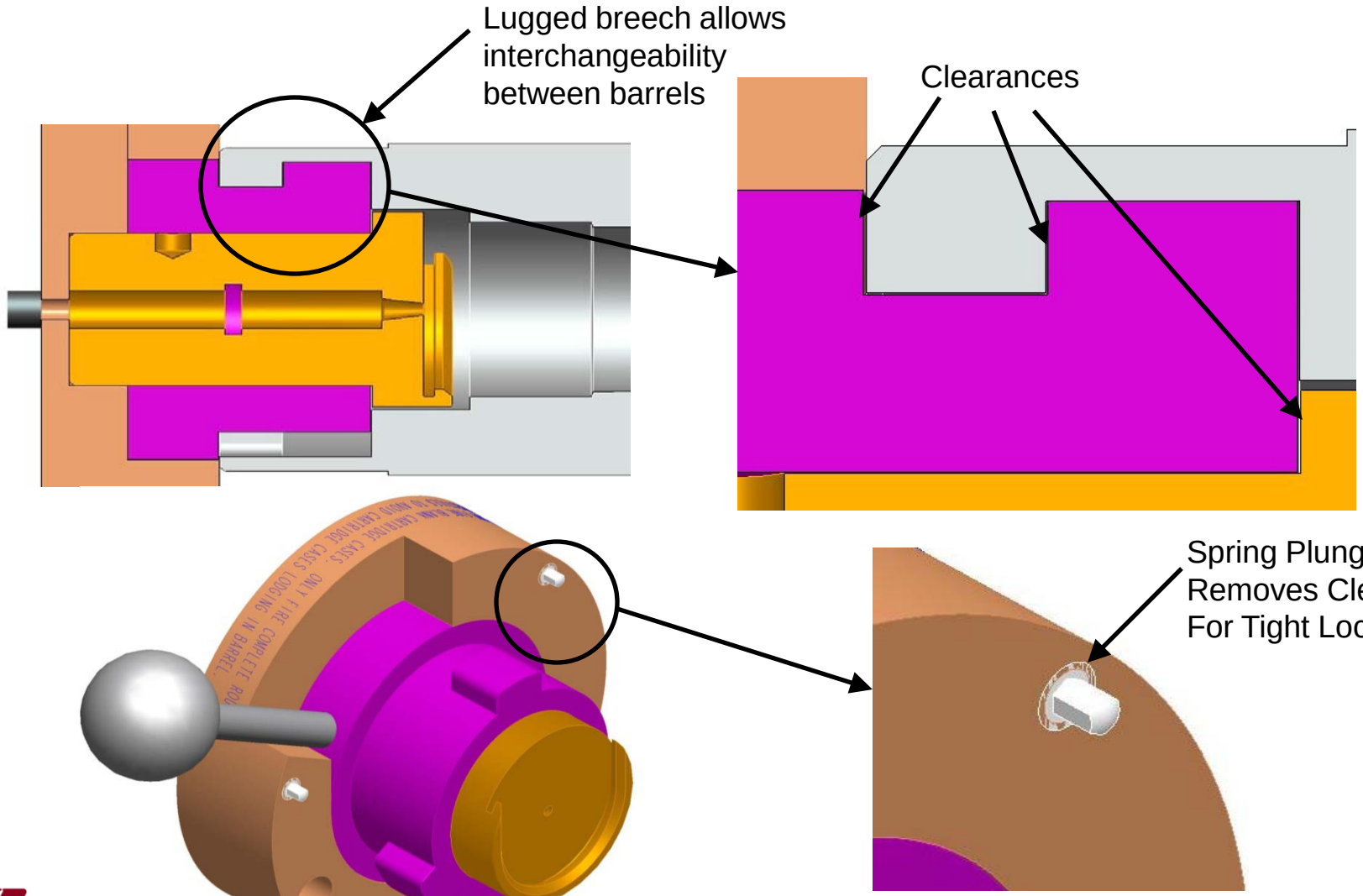
Initial Prototype

- Mann Barrel System with electronically controlled breech system
  - Design based on Cannon Cal Mann barrel breech
  - Solenoid released hammer
  - Action Time start signal triggered by hammer fall
  - Multiple pressure ports
- Lugged breech configuration allows for interchangeability and eliminates the need to custom fit breeches to barrels
- Tolerance and Fits
  - Collaborated with fabricator to develop proper tolerance scheme to achieve desired fitments





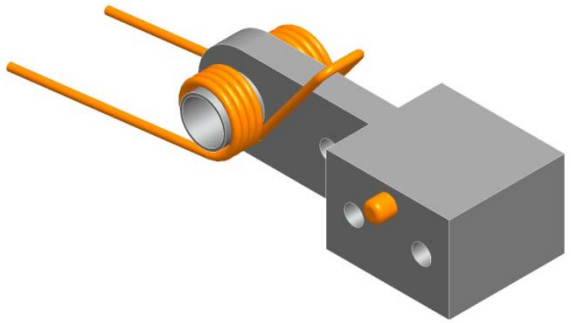
Next Generation Mann Barrel Breech Lock-Up



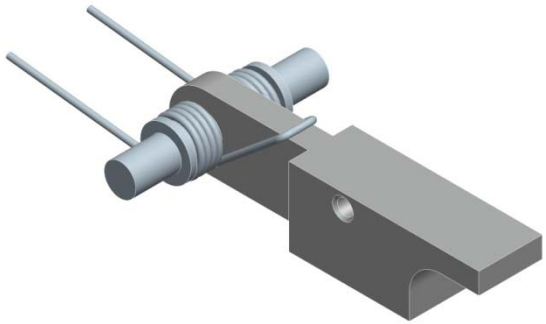
Malcolm Baldrige National Quality Award 2007 Award Recipient

Next Generation Mann Barrel Hammer & Spring Design

- New hammer and spring system provides improved consistency over plunger system
  - More consistent primer initiation
  - More accurate Action Time Start signal
  - Commercially available spring (AR15/M16A1 hammer spring)
- Upgrades to system:
  - New two-piece axle design allows for easier installation
  - New hammer design allows operator to cock hammer easily
  - Assembly simplified



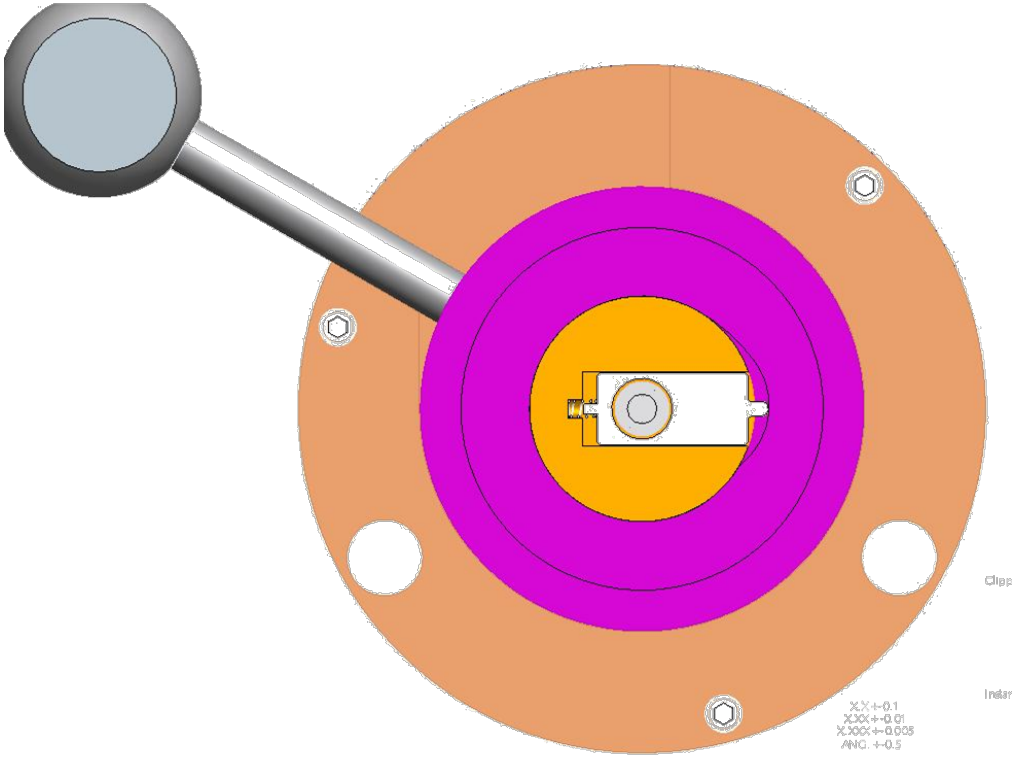
Original Hammer Design



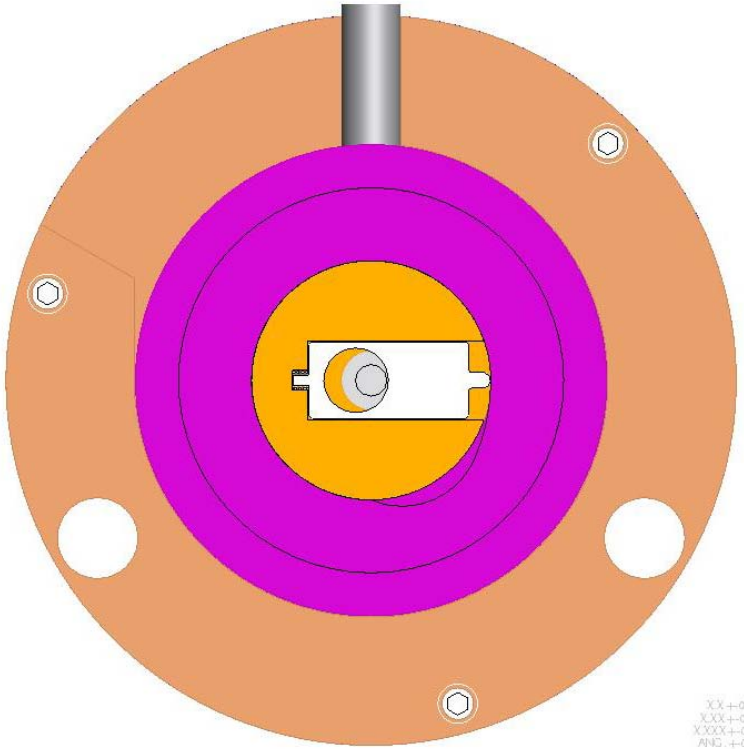
User Friendly Hammer & Two-Piece Axle System

Next Generation Mann Barrel Safety Upgrades

- Upgrade to system includes internal safety interlock
  - Cartridge cannot be initiated until breech is locked
  - Manual safety necessary but secondary



Locked



Unlocked

Path Forward

- ARDEC currently refining the Mann barrel to maximize user friendliness and safety
- Long term plan to introduce system into production for lot acceptance testing
- Considering ways to determine difference between breeches equipped for high or low velocity ammunition
- Perform 1,000 round endurance test
- Comparison test of Mann barrel to MK19

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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

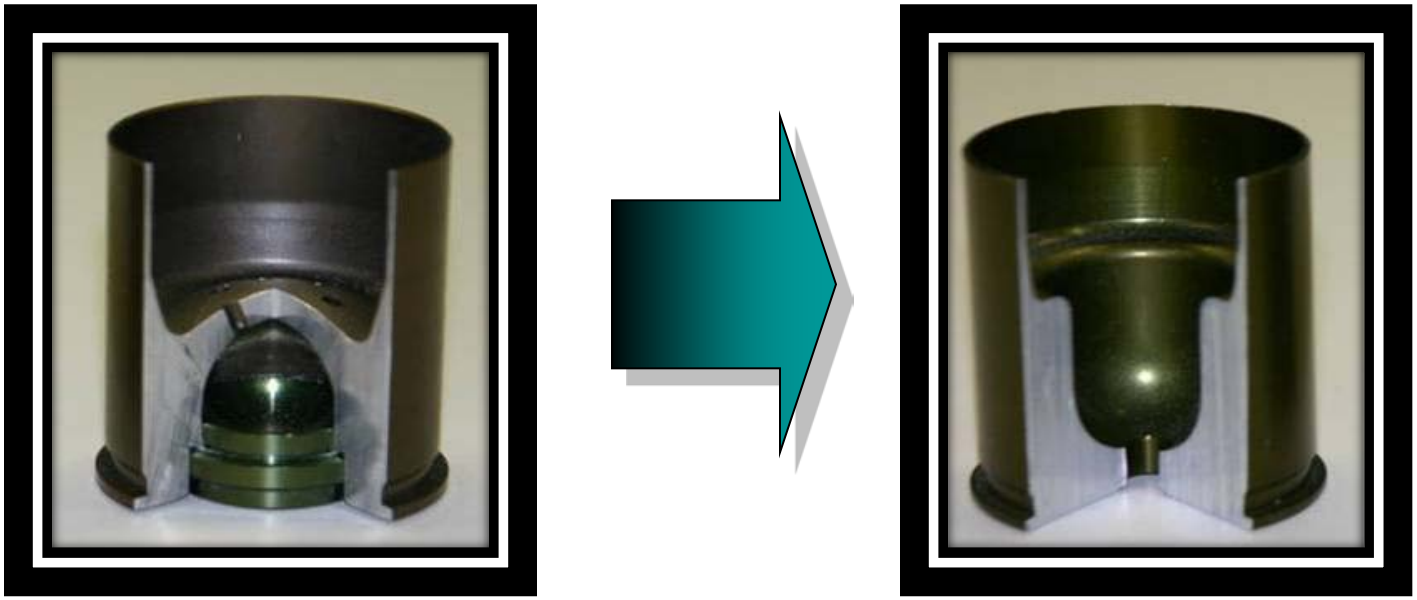
Development of a 40mm High Velocity Single Chamber Cartridge Case (SCCC)

21 May, 2009

Matthew Millar, 40mm Grenade Ammunition Special Projects
Peter Martin, 40mm Grenade Ammunition Special Projects

Single Chamber Cartridge Case Program Objectives

- Replace standard dual chamber M169 cartridge case with single chamber case
  - Reduces cost
  - Reduces number of critical/major defects and inspections at the system level
  - Does not degrade current performance



SCCC Benefits

- Eliminate gun stoppage
  - Excessive base plug movement
- Eliminate bolt face erosion
  - Leaking of hot propellant gases past the base plug
- Safety
  - Inability to fire de-bulleted cartridge case into barrel
  - Eliminates base plug ejection during cook-off situation
- Reduce cost
  - Elimination of base plug and closing cup
  - Easing manufacturing processes
  - Reduce critical/major defect inspection

SCCC Program Approach

- Phase I – Design Development
  - Evaluation of case material, primer, propellant confinement methods
  - Finite Element Analysis (FEA) to support design, material, and process development
  - Process and quality assurance criteria
  - Evaluate design, material, and process and quantify variables
- Phase II – Design Validation
  - Evolve manufacturing process
  - Advanced performance analysis/assessment
- Phase III – Production Verification
  - Comprehensive verification tests for transition to production

SCCC Material Selection

Objectives:

- Establish producible SCCC configuration
- Select and define SCCC material ensuring strength, quality, and Affordability
- Establish a reliable, repeatable high volume manufacturing process ensuring availability, and affordability

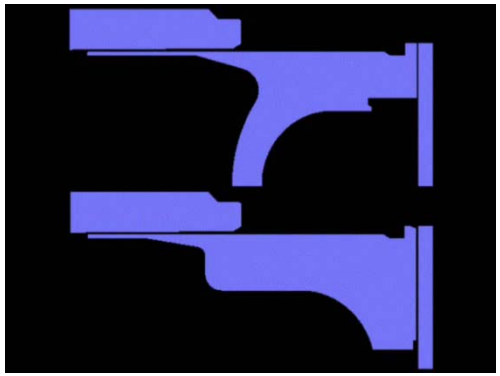
- Material candidates (6061, 6061 PT, 6066, 6070)
  - Stress/Strain under pressure
  - Crimp/Pull test
  - Thermal effects
  - Weapon interface

- 6061-T6 chosen as case material
  - Cost, formability, strength



SCCC Modeling and Simulation

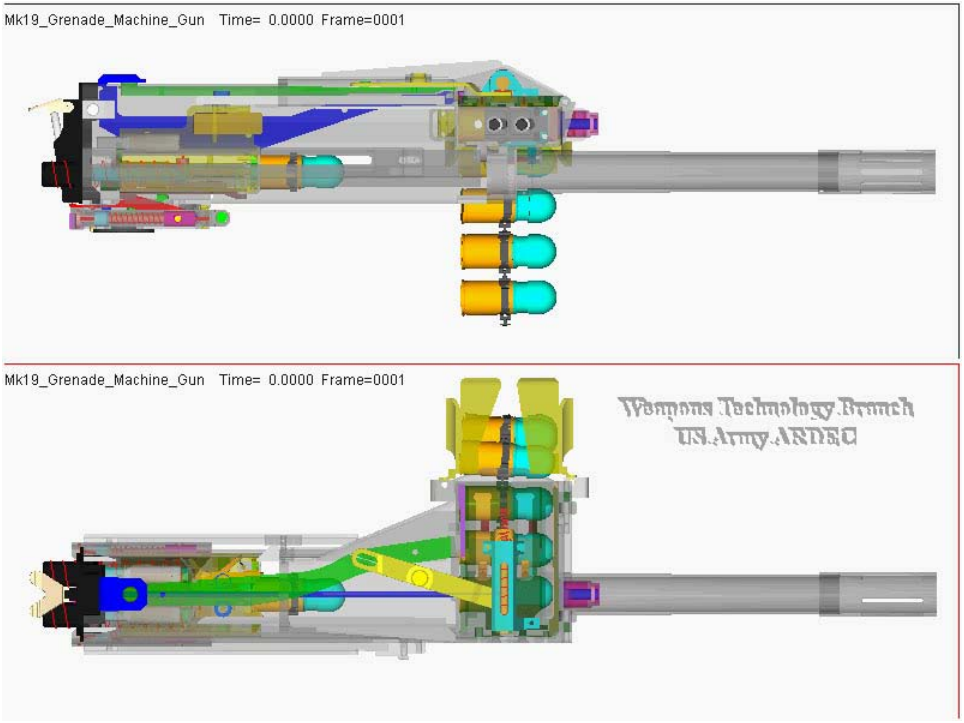
- MK19 weapon function and interface simulation
- Completed FEA with candidate materials



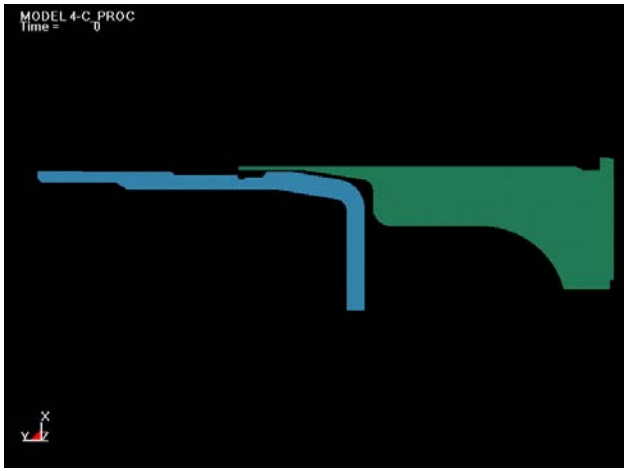


FEA on Unsupported Area of Case

Bullet Pull Analysis



MK19 Simulation



Malcolm Baldrige National Quality Award 2007 Award Recipient

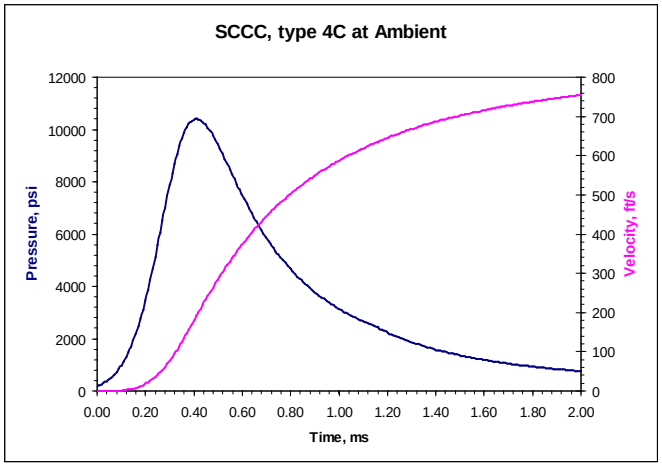
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

SCCC Propulsion Modeling and Simulation

- Objective
  - Determine appropriate propellant for SCCC
  - Determine charge weights
  - Model pressures and velocities

- Propellant Candidates
  - M9 Flake, Mil-P-50206
  - M2 Single Perf, Mil-P-60989
  - M9 Flake, Mil-P-48127

Producibility and Availability



IB Analysis

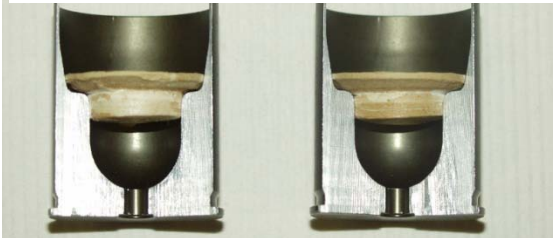
Propellant	Charge Wt, g	Pressure, psi	Velocity, ft/s	% prop burnt
M9 Flake, Mil-P-50206 (D=0.034", L=0.005")	**3.00**	**11952**	**769**	**100**
	3.25	**13478**	**807**	**100**
M9 Flake, Mil-P-48127 (D=0.058", L=0.006")	**3.25**	**10057**	**766**	**100**
	3.50	**11239**	**804**	**100**
M2 Single Perf, Mil-P-60989 (D=0.039", L=0.048", web=0.016")	**3.00**	**3495**	**358**	**38**
	4.00	**3423**	**435**	**39**

Malcolm Baldrige National Quality Award 2007 Award Recipient

Propellant Confinement Method

- Objective
  - Confine the propellant in the cavity from cartridge case loading until firing
  - Closure disc adhere to anodized aluminum
  - Ease of assembly / support high volume production
  - Immune to environmental/aging effects
  - Compatible with propellant
- Candidates
  - 5 adhesive discs & 1 combustible plug
    - Various facestock and adhesive

Combustible Plug



Closing Discs



- Down-selected candidates
  - Cost, adhesive strength, ease of assembly, compatibility

DISC MATERIAL
Aluminum
7830
8414
Chic A
Chic B
NC
7871

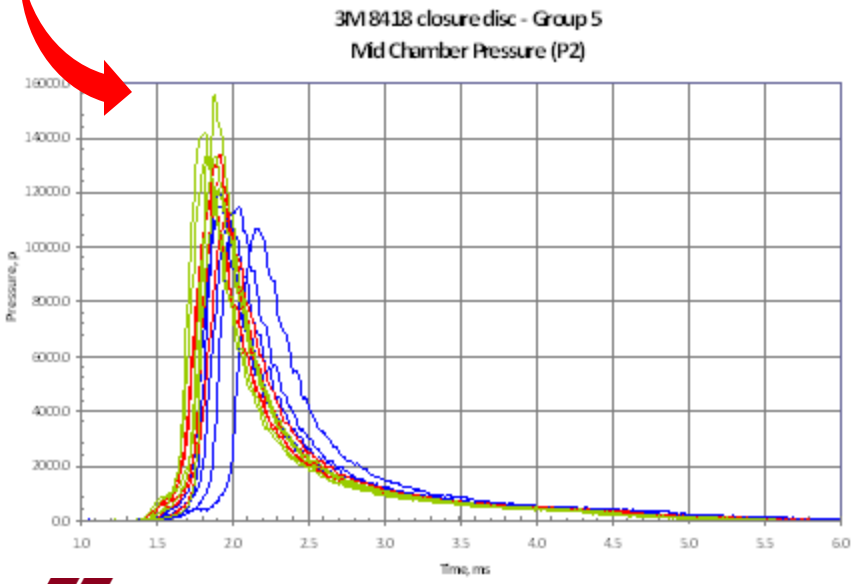
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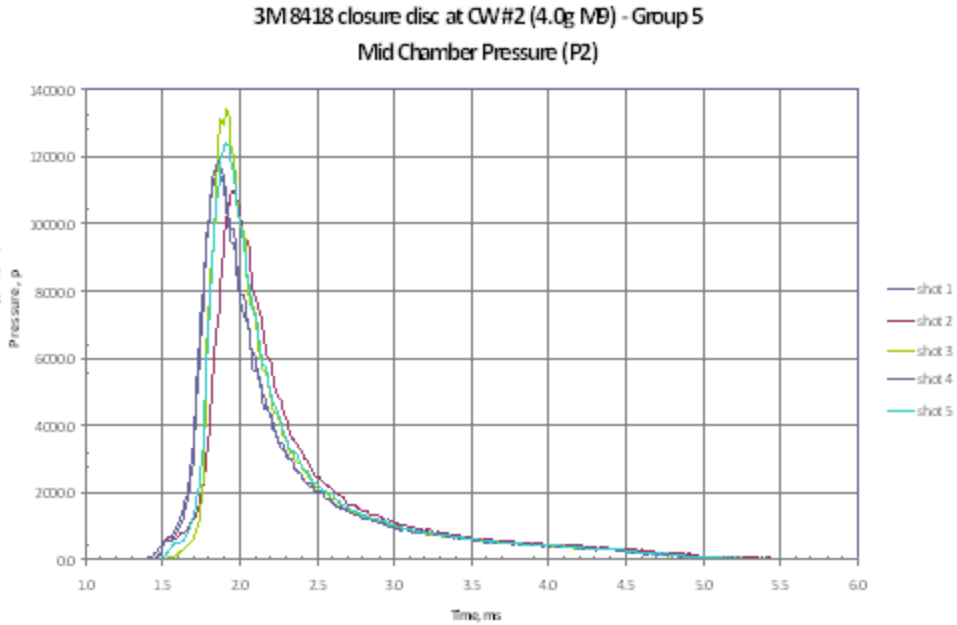
Ignition System

- Objective
  - Repeatable output and sensitivity
  - Output to support combustion of propellant
- Primer Candidates
  - W209 (shotshell primer) & Fed215 (large rifle magnum)
    - W209 more sensitive & higher energetic output
    - Similar profiles and action times
    - Fed215 more production oriented
- Closed bomb analysis - primers are interchangeable when used with the same propellant

Charge Establishment

- Established baseline performance of M169 case using Mann Barrel
- Initial propellant charge weight for SCCC determined from IB code
  - Charge weights constant for two closing discs
  - Charge weight adjusted for combustible plug energy
- Cases loaded to ±5% of initial IB code weight
  - Fired at hot (+165ºF), cold (-65ºF), and ambient (70ºF)
- Test showed signs of unburned propellant
  - IPT is investigating ways to improve propellant efficiency





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TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Path Forward

- Optimize propulsion system efficiency
  - Alternate primer
  - Alternate propellant
- Down select to best propulsion system and confinement method & continue maturity
- Continue into next phase of testing
  - Environmental
  - Rough handling
  - MK19 integration
  - Qualification
  - Production transition

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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

M385A1 Composite Projectile Feasibility Study

21 May, 2009

Christopher Summa, 40mm Grenade Ammunition Special Projects

Overview

- **Objectives**
  - **Reduce unit cost**
  - **Integrate rotating band to projectile body**
  - **Meet existing requirements of M385A1**

- **Method**
  - **Replace aluminum with injection molded plastic/metal powder composite**
  - **Reduce manufacturing/assembly operations**



Feasibility Studies

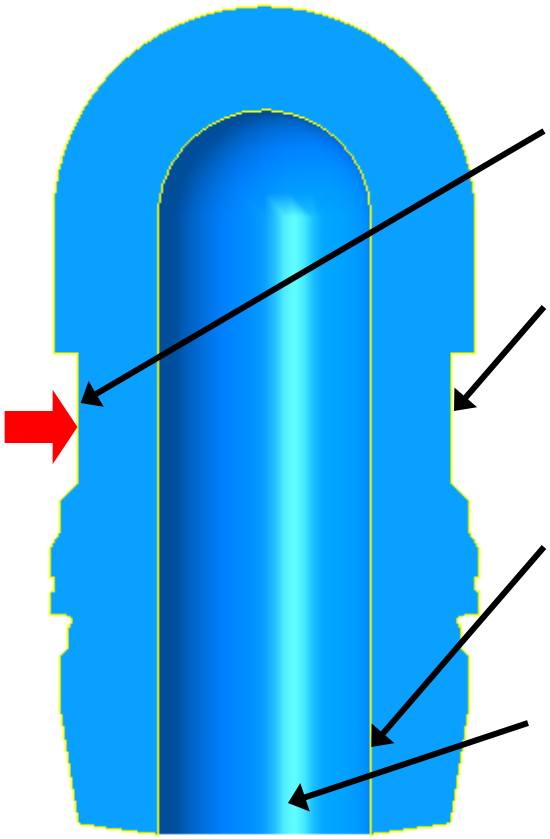
- Phase 1: Characterize and down-select materials
- Phase 2: Mold, assemble, and inspect projectiles
- Phase 3: Conduct live fire and environmental testing

- Results of Phases 1-3:
  - Some success test firing from Mk19 Mod 3 GMG
  - Gas cap required for projectile to survive launch
  - Improvement potential for part strength and dimensional stability

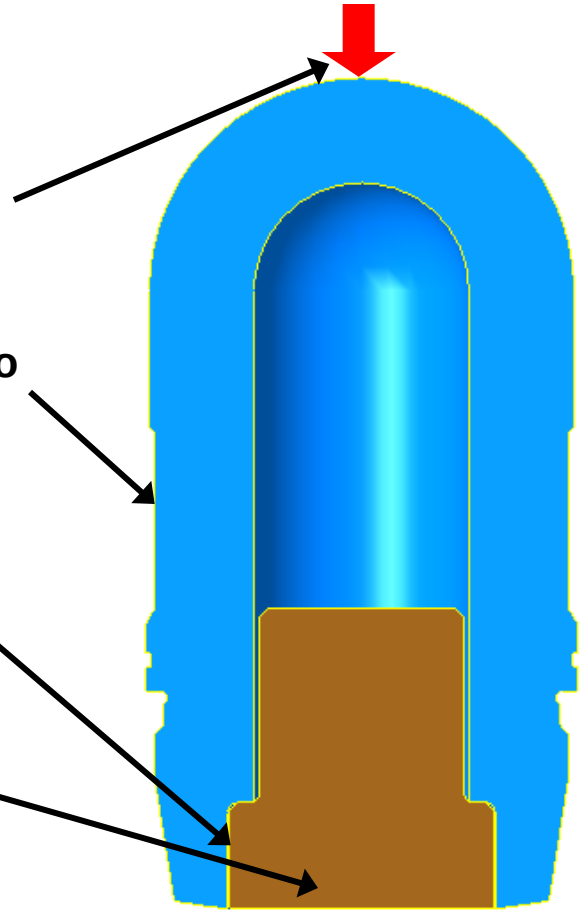
- Phase 4: Follow On Effort
  - Projectile Design Changes
  - Mold Optimization Analysis
  - Mold Modification
  - Produce/Inspect Projectiles
  - Inspection
  - Test Firing at ARDEC

Projectile Design Changes

Previous Design



New Design



1. **Moved gate location from side to top**
2. **Saddle region thickened to match M430A1 HEDP (tactical cartridge)**
3. **Gas cap recess added to mold core pin**
4. **Steel gas cap assembled to aft of projectile**

Material: PA 6/10 with Stainless Steel Fill

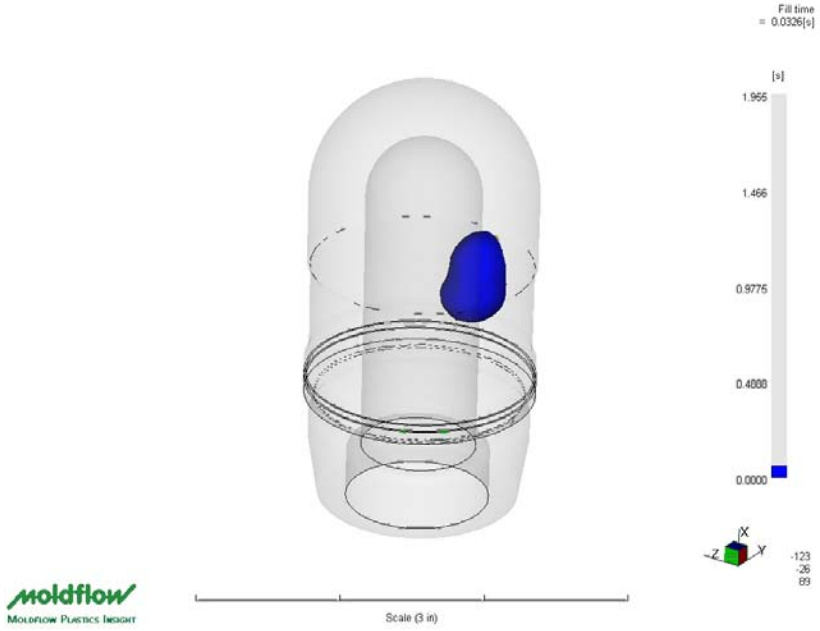
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Mold Optimization Analysis

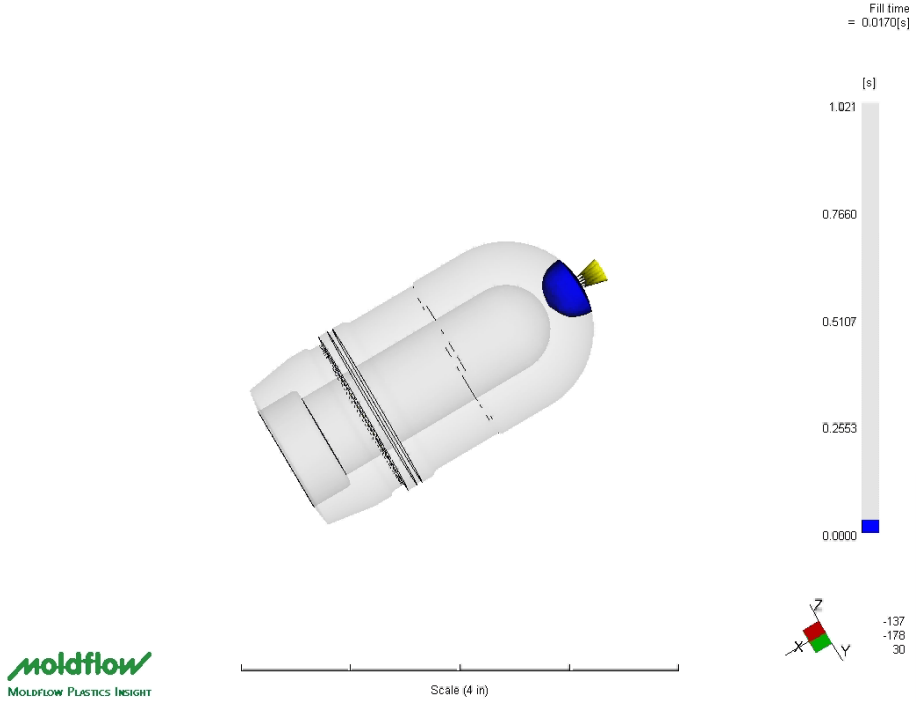
- Mold flow analysis baselined on original geometry
- Analysis calibrated to actual projectile dimensions from original effort
- New projectile geometry implemented into analysis
- Used fill material similar to PA 6/10 with SS
  - Better characterized than actual material
- Gate configuration, size, and location optimized
- Full round top gate superior to existing side fan gate:
  1. Reduced core pin deflection
  2. Part geometry more stable
  3. Less part ovality

Mold Optimization Analysis

Side Fan Gate



Top Gate

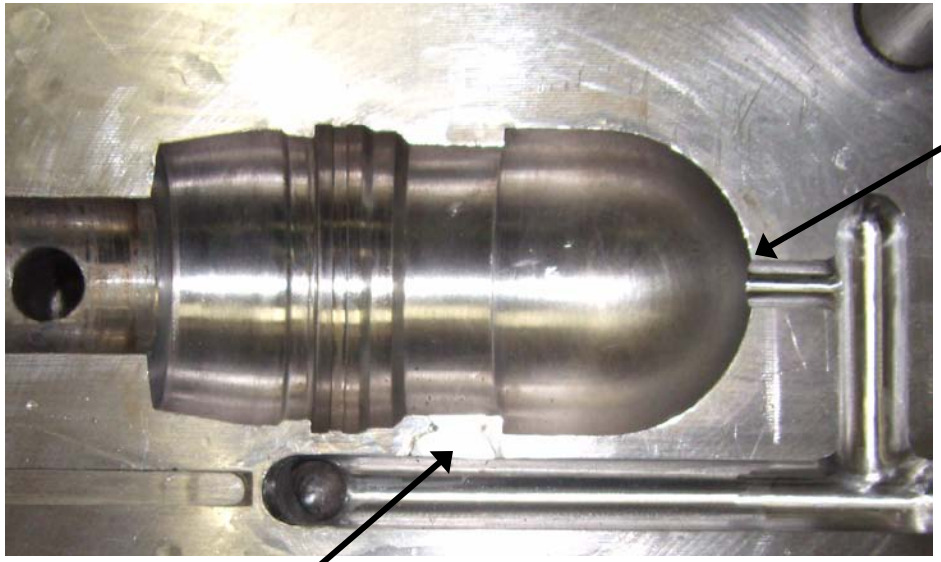


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Mold Modification

- **Top gate implemented before other modifications**
- **Examined shrink rate with top gate on current geometry**
- **Modified existing mold cavity and core pin**





Path Forward

- **Contractor to mold & inspect 100 projectiles**
- **Test Firing**
  - **Performed at Armament Technology Facility (ATF) located at ARDEC**
  - **Hot, Cold, Ambient cartridge conditioning**
  - **Unlinked & linked belt configuration (single shot and burst) from Mk19 Mod 3 GMG**
  - **EPVAT Testing from Mann Barrel**
    - **Muzzle Velocity**
    - **Pressure**
    - **Action Time**
- **PM to decide future of composite projectile program**
  - **Technology applicable to other cost reduction programs**

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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Producibility Improvements of 40mm High and Low Velocity Liners

21 May, 2009

James Grassi, 40mm Grenade Ammunition Special Projects

Program Objectives

- M433 HEDP One-Piece Liner (Low Velocity – M203 GL)
  - Reduce cost of liner production by combining components
  - Improve penetration reliability
- M430A1 HEDP Non-Fluted Liner (High Velocity – Mk19 GMG)
  - Reduce cost of liner production by simplifying geometry



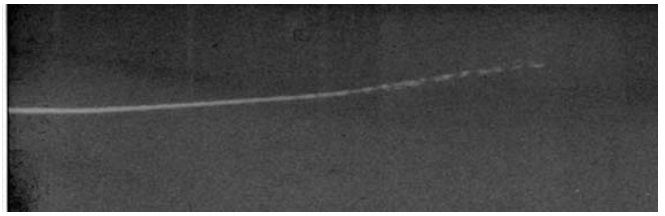
M433 HEDP



M430A1 HEDP

Baseline Testing and M&S

- Baseline Testing
  - Performed at ARDEC using production hardware
  - Jet tip formation
    - Spin and no spin
    - Events captured by x-ray
      - Tip velocity
      - Jet straightness
  - Armor penetration depth
    - Spin and no spin
    - RHA steel plates
- Baseline Modeling and Simulation
  - Test data feeds into baseline model
    - Model represents actual performance
  - Baseline model stepping stone to design improvements



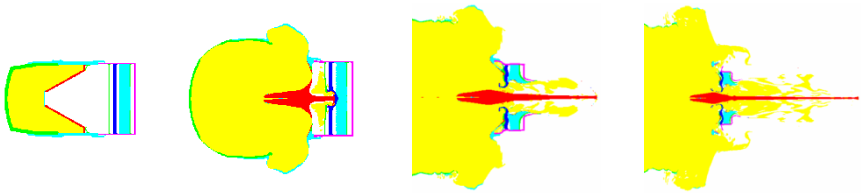
X-Ray of Jet Formation



Penetrated RHA



Test Projectile

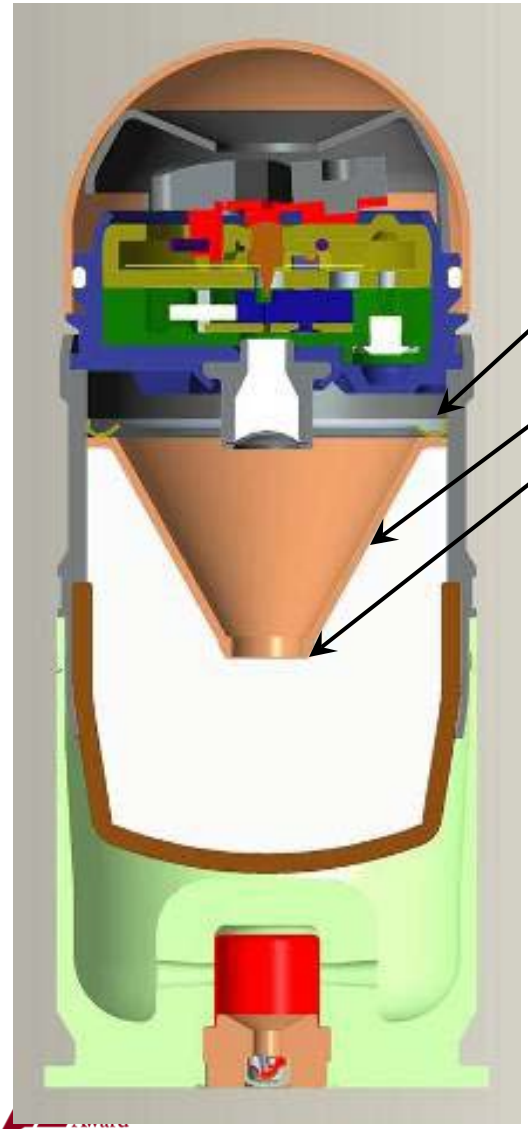


Jet Formation Simulation

M433 HEDP One-Piece Liner Program Overview

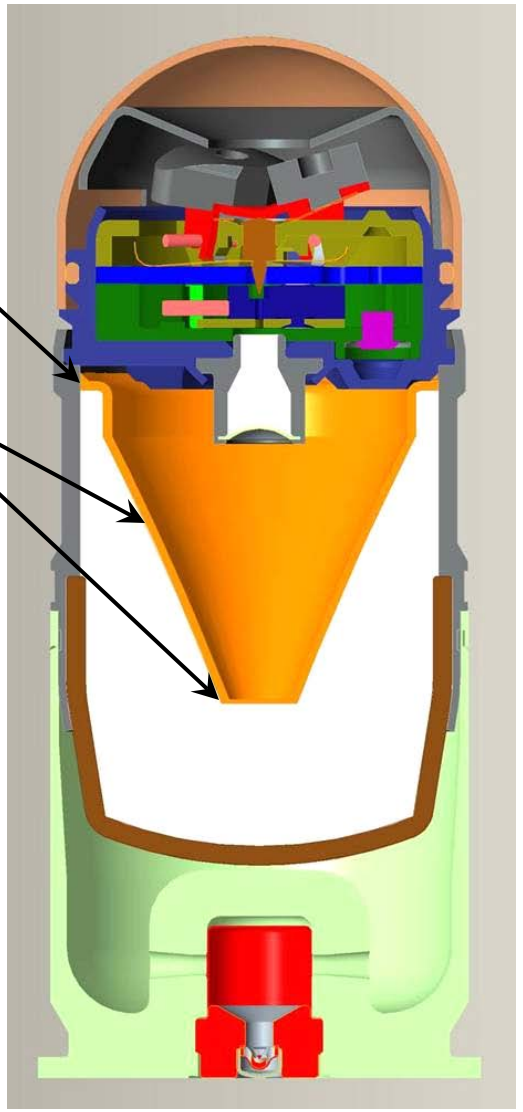
- ARDEC **Warheads** designed liner based on validated simulation
- ARDEC **Ammo** integrated apex cap & retaining ring features
  - Analysis showed slight jet velocity loss with integrated apex cap at full wall thickness
- Phase 1 - fabricate liners with varying apex cap thickness & perform static armor penetration test
  - Objective: determine max allowable apex thickness
- Integrated Product Team
  - PM-MAS
  - ARDEC (Ammo & Warheads)
  - DSE (Prime Contractor)
  - FCI & Trans-Matic (Liner Mfg Sub-Contractor)
  - American Ordnance (Projectile Assembly)

M433 HEDP One-Piece Liner



One-Piece Liner

1. Retaining Ring replaced by press fit flange
2. Liner elongated and added radius
3. Liner Cap integrated into liner apex



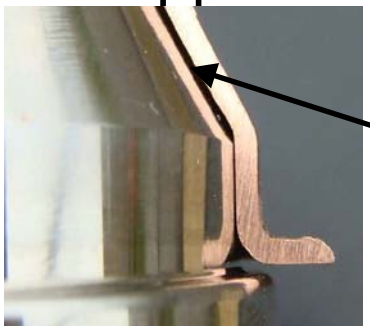
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M433 HEDP One-Piece Liner

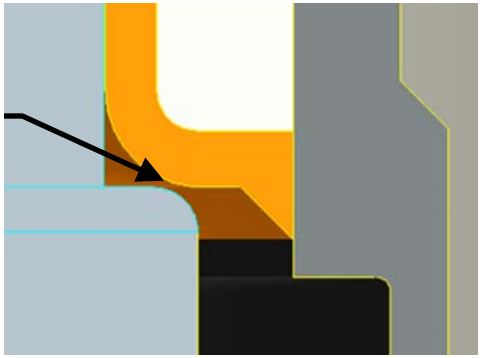
- Challenges
  - Required multiple iterations on both liner & explosive press tooling
  - Flange not forming up as expected and leaving void under flange (flange not supported)

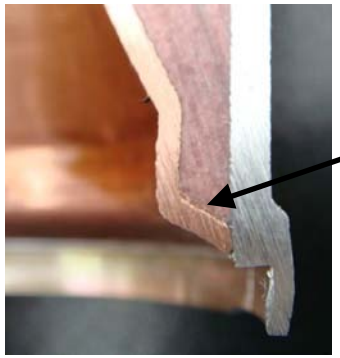




Explosive Tooling Gap

Contact should be farther out radially to eliminate annular depression





Flange Not Forming As Anticipated

M433 HEDP One-Piece Liner Results & Path forward

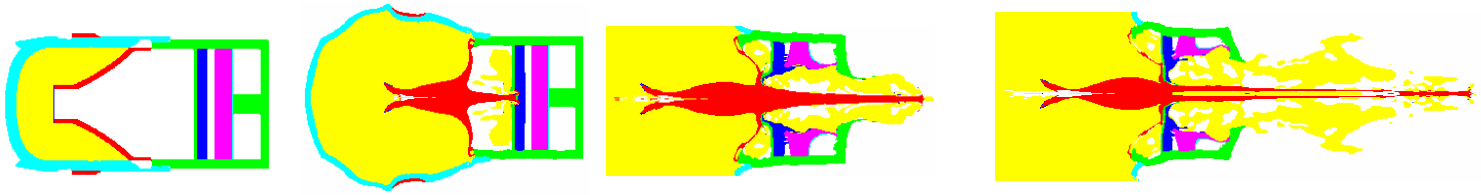
- Phase 1 Results
  - Slightly greater penetration
  - Can function with full apex cap wall thickness
  - Requires optimization of flange design to improve loading

- Path forward
  - Conduct Phase 1B contract
    - Fabricate optimized liners
    - Jet characterization & penetration lab tests
    - Gun launch projectiles against armor plate

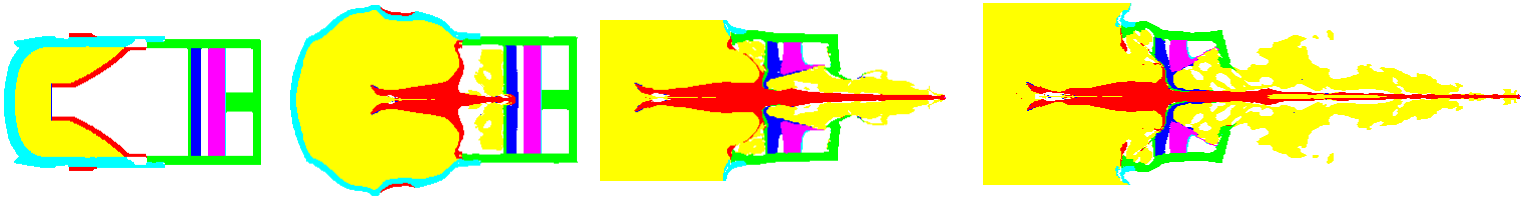
M430A1 HEDP Non-Fluted Liner

- ARDEC **Warheads** designed liner & ARDEC **Ammo** teamed with contractors to integrate producibility enhancements
- Phase 1 - fabricate liners & perform static shaped charged jet characterization & armor penetration test
  - No spin
  - Multiple spin rates analyzed due to large spin decay over effective range

Fluted Liner

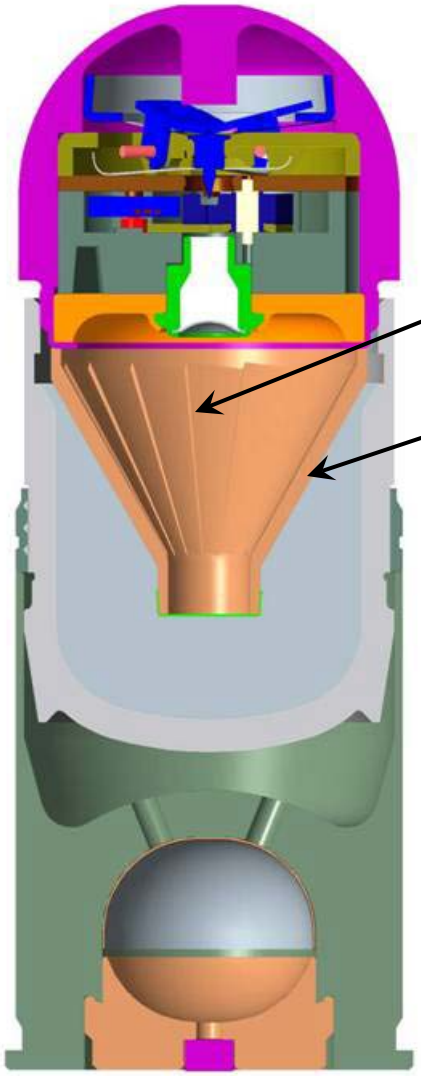


Non-Fluted Liner



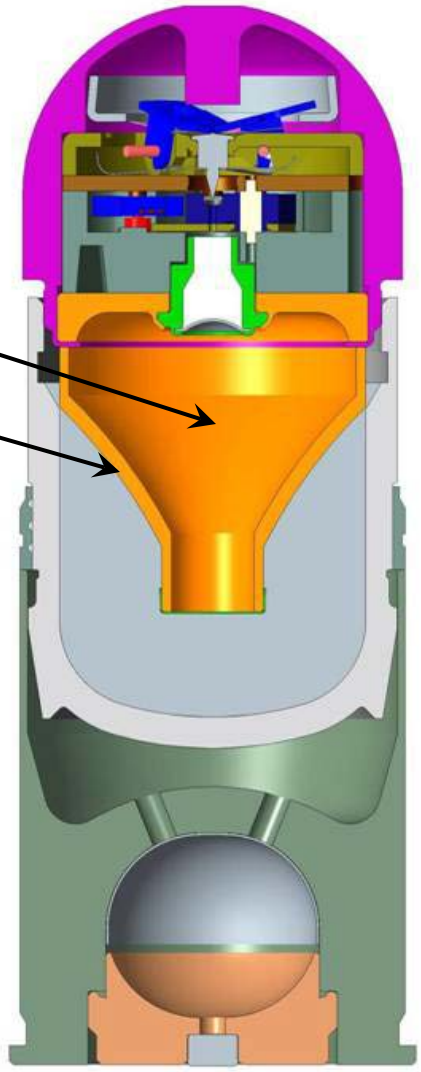
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M430A1 HEDP Non-Fluted Liner



Non-Fluted Liner

1. Flutes in liner removed
2. Slight radius added to liner



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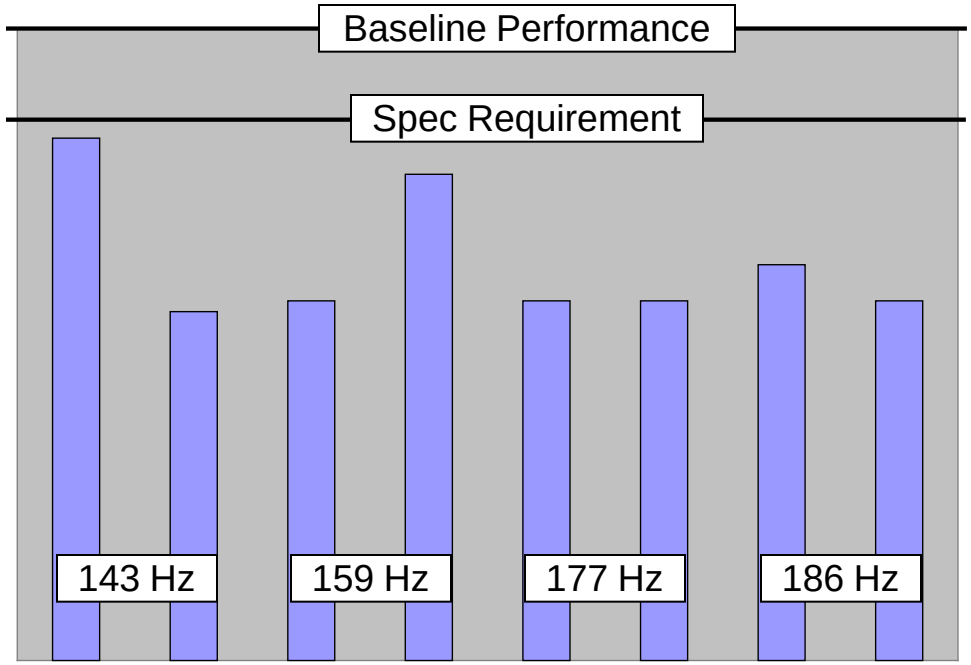
M430A1 HEDP Non-Fluted Liner

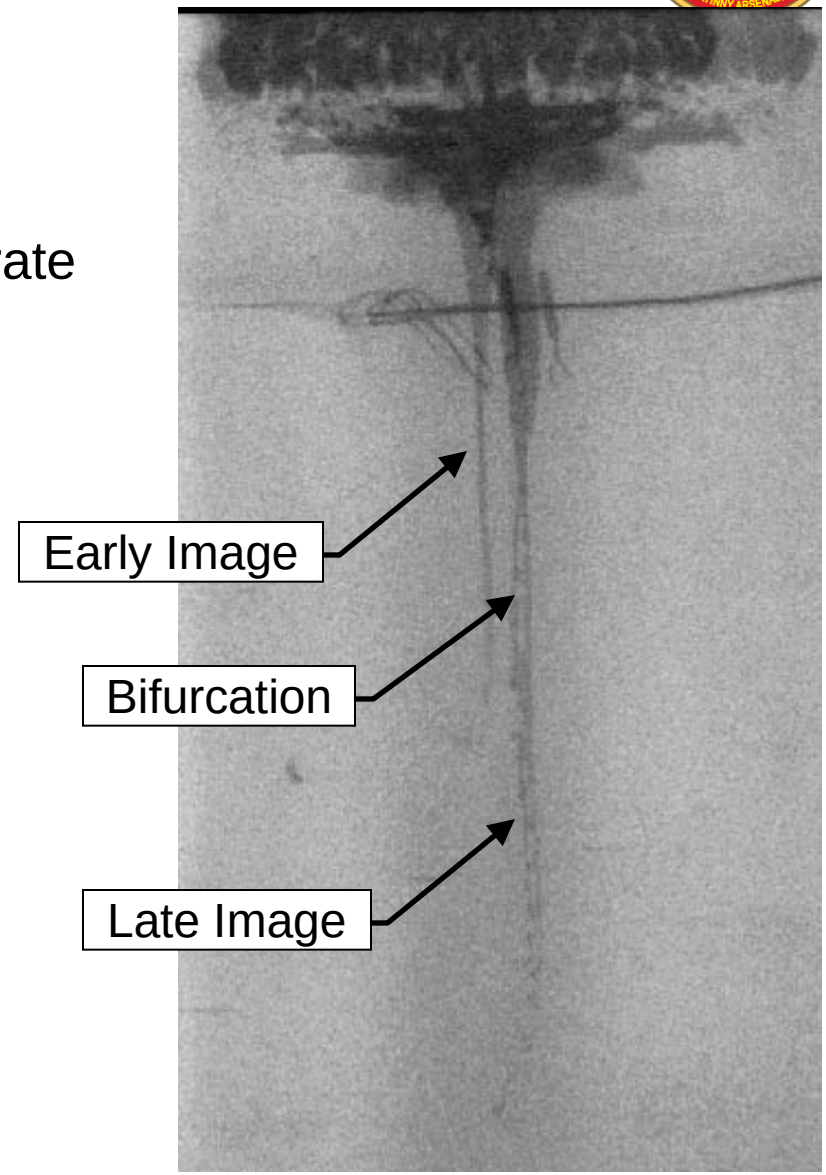


- Integrated Product Team
  - PM-MAS
  - ARDEC (Ammo & Warheads)
  - AMTEC (Prime Contractor)
  - FCI & Trans-Matic (Liner Mfg Sub-Contractor)
  - American Ordnance (Projectile Assembly)
- Producibility Study & Fabrication
  - IPT adjusted dimensioning scheme for producibility
  - Tightened material specification
  - Looked at grain structure uniformity
  - Reduced learning curve due to One-Piece Liner Program
    - No issues with tooling, part fabrication or explosive loading

M430A1 HEDP Non-Fluted Liner

- Test Results
  - Poor penetration
  - Bifurcation regardless of spin rate including no spin condition





M430A1 HEDP Non-Fluted Liner

- Path Forward
  - M&S of Liner using inspection data to reproduce bifurcation (2D & 3D simulations)
  - Copper material & grain size study

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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Study of Advanced Lethal Mechanisms in 40mm Grenade Ammunition

21 May, 2009

Jason Wasserman, 40mm Grenade Ammunition Special Projects

Objectives

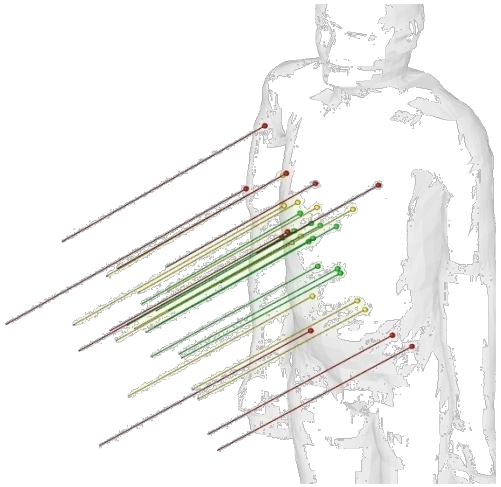
- Close-In Anti-Personnel Lethality Study
  - Characterize the lethality of sub-projectiles given various parameters
  - Analyzed both mission oriented and independently
  - Study intended to establish cartridge design parameters for 40mm low velocity system
- Enhanced Fragmenting Grenade Study
  - Scalable technology for high and low velocity grenade ammunition
  - Dramatically increase lethality over currently fielded high and low velocity system

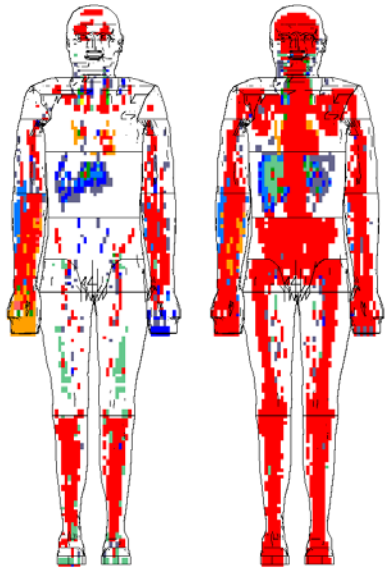
Close-In Anti-Personnel
Overview

- Analyze how various parameters affect sub-projectile lethality
  - Determine added benefit over currently fielded systems
    - 12 Ga. Shotgun and M576 Multiple Projectile Ctg (Spherical shot based systems)
  - Determine optimal design requirements for increased lethality
  - Analyzed Parameters
    - Sub-projectile Shape, Size, Material, Quantity
    - Range, Muzzle Velocity, Pellet Spread, Aim Error

Close-In Anti-Personnel
Lethality Analysis

- ARL using ORCA to determine individual sub-projectile lethality
- Calculations made assuming randomly placed pellets given dispersion parameters
- Lethality is calculated as mission-oriented
  - Inability to carry out assigned task in a prescribed time frame
    - Stand, Aim, and Fire



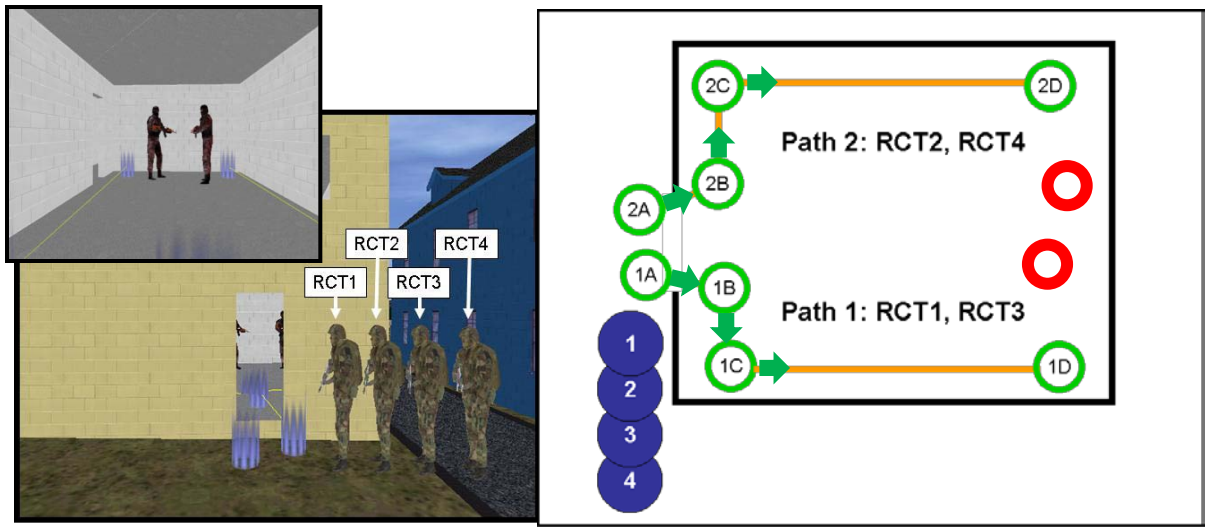




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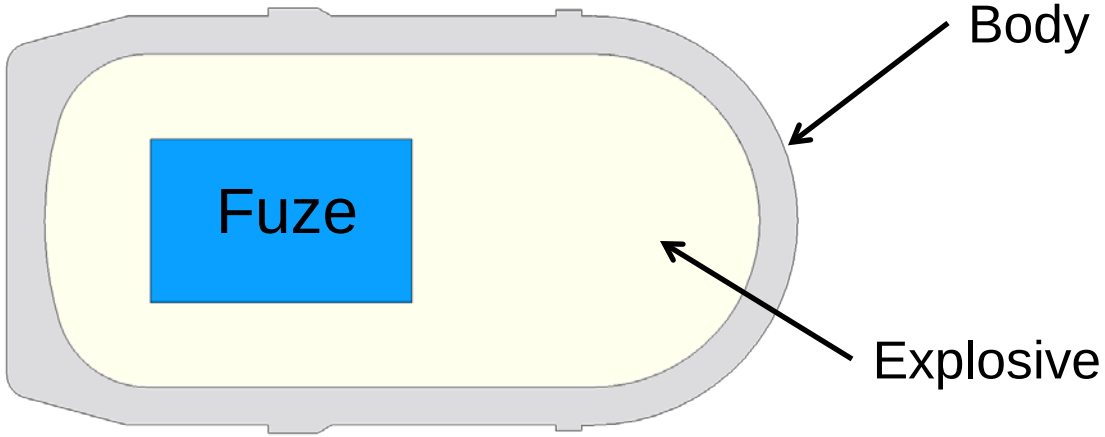
Close-In Anti-Personnel
Infantry Warrior Simulation (IWARS)

- Used to determine system effectiveness in a realistic Close Quarter Battle situation
  - Evaluates loss of fire team under various scenarios
- Baselined against fielded shotgun system and M4 carbine
- Able to include various protective gear, number of enemy combatants, and tactics



Enhanced Fragmenting Grenade

- Design Parameters
  - Designing complete new cartridge system
    - Started with generic shape to develop ideal flight properties
    - Potential new propulsion system for heavier projectile
  - Using fuze envelope from MEMS S&A program
  - Lethal mechanism based on work done in cannon caliber



Enhanced Fragmenting Grenade

- Producibility Study
  - Working with contractor to develop production methods
    - Placing preformed fragments
    - Optimizing packing factor
    - Material selection
    - Assembly procedures prior to explosive loading

Path Forward

- Close-In Anti-Personnel
  - Anticipate study to conclude by October 2009
  - IPT to determine feasibility of forming a cartridge development program
- Enhanced Fragmenting Grenade
  - Lethality analysis
  - Prototype fabrication
  - Lab testing for fragmentation performance

USMC UPDATE



2009 JSSAST PANEL

19 May 2009

Col Andrew Bianca
Program Manager
Infantry Weapons

CURRENT EFFORTS

- Infantry Automatic Rifle
- Multi-Shot Grenade Launcher
- M40A5 Sniper Rifle Modular Stock
- Scout Sniper Ballistic Computer
- M16A4 Collapsible Buttstock
- Lightweight Company and Battalion Mortars

FUTURE EFFORTS

- Rapid Engagement Precision Rifle
- Long Range Sniper Rifle
- M40A5 Improved Barrel
- MEU (SOC) Pistol Receiver
- Foreign Weapons Kits

QUESTIONS?

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Joint Service Small Arms Synchronization Team (JSSAST) Update

Malcolm Baldrige National Quality Award 2007 Award Recipient

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Presented By

COL Scott Flynn
JSSAST Chairman

Agenda

- JSSAST Mission
- JSSAST Membership
- JSSAST Themes
- Awareness Campaign
- Current Programs
- What's Next?

JSSAP Mission

A Chartered Joint-Centric Activity

Providing Small Arms Technology
&
Requirements Harmonization

For All the Armed Services

Focus on the Warfighter Always!

Charter Updated and Approved by ASA (ALT) Hon Claude Bolton 31 Aug 04

$14-17M Annual Budget

Mission Statement

- Intensive Management of the DoD Small Arms Tech Base
- Harmonization of Requirement
- Transition to PM's for System Development and Demonstration
- Long Range Plans and Strategies
- Influence of International Small Arms Activities

…for the Joint Service Small Arms Synchronization Team

Chairman

COL Scott Flynn (Commander, ESIC)

Meets Semiannually

Principals:

Army:	**LTC T. Henthorn (USAIC)**
Marines:	**Col A. Bianca (MCSC)**
Air Force:	**Col P. Lopardi (HQ AFSFC)**
Navy:	**CAPT P. Sullivan (PEO LMW)**
Coast Guard:	**CAPT S. Genovese (HQ USCG)**
SOCOM:	**COL K. Noonan (PEO SOF Warrior)**

Associates:

Army PMSW:	**COL D. Tamilio (PEO Soldier)**
JNLWD:	**Mr. K. Swenson (JNLWD)**

JSSAST Themes

FY08-10

JSSAP Awareness Campaign:

➲ **- Continue meeting with Service Members and HQ's**

➲ **- Extend to the Office of the Secretary of Defense.**

Lightweight Small Arms Technologies (LSAT)

➲ **- Establishment of a Joint Requirement and Transition Strategy**

- Build a jointly funded program for the SDD and Production Phases of Acquisition.

Requirements Harmonization

- Harmonize the various on-going Service capabilities assessments/requirements.

- Update current Joint Small Arms Capabilities Assessment

➲ **- Create Catalog of Service Requirements**

Joint Service Small Arms Master Plan (JSSAMP)

✓ **- Complete Departmental approvals of current document,**

➲ **- Update JSSAMP in FY09**

Awareness Campaign Status

Completed

- ✓ PEO SOF Warrior, US SOCOM
- ✓ PM Infantry Weapon Systems, USMC
- ✓ Director, Combat Arms and Training, USAF
- ✓ OSD Acquisition, Logistics and Technology
- ✓ Air Force Requirements Review Board
- ✓ HQDA Office of Director of Technology

Planned

- Asst Comdt Counterterrorism, Special Missions, USCG
- PEO Littoral and Maritime Warfare, NAVSEASYSCOM
- Joint Non Lethal Weapons Directorate, USMC
- All Service Higher Headquarters
- OSD Defense Research and Engineering

Lightweight Small Arms Technology



Cased Telescoped LMG:



Caseless LMG



Cased Telescoped Rifle:



Caseless Rifle:

	M855	Spiral 2 Loose Fill	Spiral 3 Compressed @ 1.45 g/cc	Caseless
Volume (cu in)	0.247	0.262	.195	0.152
Percent Volume Reduction	----	**-6%**	**21%**	**38%**
Weight (grains) Including link	220	141.2	130.6	105.1
Percent Weight Reduction	----	**36%**	**41%**	**52%**

Schedule (R&D)

TRL 6 Cased Telescope Light Machinegun (LMG)	FY08
Rifle Design	FY09
Initial Capabilities Document Draft	FY09

Cost and Affordability:

High commonality of design and function, some action component differences

- Ammunition cost comparable
- Industrialization under study

	M249	Goal	Caseless/CTA
Weapon	17.5 lb	11.3 lb	9.8/10.8 lb
Ammo (600 Rds)	20.8 lb	12.5 lb	10.1/13.6 lb
System (Wpn +Ammo)	38.3 lb	23.8 lb	19.9/24.4 lb

Advanced Fire Control Technology for Small Arms (ATO)

Purpose

To demonstrate advanced fire control component technology determining correct range to moving targets and further power sharing within weapon for current and future warfighters.



Challenges



- Moving targets prior to their seeking cover
- Unsupported firing position.
- Inaccurate ranging limits precision
- Weight near muzzle leads to poor aiming
- Multiple batteries reduces accessory availability

How do we solve this problem

- Technologies for automatic target detection
- Laser steering to increase the soldier's ability to accurately determine range to non cooperative moving targets.
- Improved lethality in direct and indirect fire situations for unsupported firing positions.
- Develop range determination to overcoming wobble associated in an unsupported firing position

Payoff

TRL 4 (Breadboard) component technologies integrated to establish that they will work together

This is relatively "low fidelity" but shows we are getting there!!



R.LE.2008.03/Advanced Lethal Armament Technology for Small Arms

Purpose:

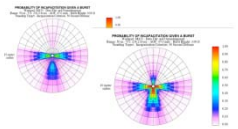
To demonstrate advanced lethal armament component technology for providing improved munition effectiveness to targets.

Challenges:

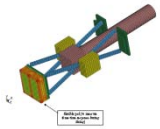
- Incapacitation of defilade threat targets
  - Behind objects
  - Under cover
- Incapacitation is limited by:
  - Small payload volume
  - Lack of directionality
- Co-development of eight reduction and recoil reduction

How do we solve this problem

- Improvements to small fragmenting payloads through directionality and materials for increased effectiveness
- Proximity fuze small size application
- Low weight recoil attenuation coupled with other weight reduction to deliver more effective payloads







Payoff:

- Multiple critical technology demonstrations enabling maturity measurement coupled with cross integration analysis fulfilling broad small arms capability gaps for spiral transition



Follow-on Activities

- Continue Operational Awareness Campaign
- Continue Development of LSAT Transition Strategy
- Update Joint Service Small Arms Master Plan
- Update Joint Small Arms Capabilities Assessment
- Next JSSAST Meeting in November 2009



NAVY SMALL ARMS



CDR Thomas Gajewski
Program Manager, PMS-340
Email: Thomas.Gajewski@navy.mil
Phone: (202) 781-5782

Navy Small Arms Program Overview

- Full life cycle support for the Navy's small arms
  - Engineering
  - Acquisition
  - Maintenance
  - Weapons distribution
  - Weapons Tracking
  - Acquisition and acquisition support are provided for all small arms, mounts and related equipment
    - **Majority of acquisitions are from Army or direct from OEM**
    - **Occasional modifications to in-service weapons/mounts**
    - **1,223 worldwide activities**
    - **Over 422,000 weapons**

Navy Small Arms Program

Road Map

Small Arms Modernization Way Ahead

Obsolete Systems — Modernization Program

FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015
Medium Machine Guns									
 M60					M240N/B				
 M60E3 / MK43					MK48 LWMG				
Mounts									
 MK26 MOD17					Universal Mount MK93				
 MK64 MOD 4									
 MK82					MK97 Mount				
 MK58									
Carbines									
 Colt 727 Carbine					M4A1 Carbine				

Small Arms Modernization Way Ahead (cont.)

Obsolete Systems	Modernization Program
FY2006 FY2007 FY2008 FY2009 FY2010 FY2011 FY2012 FY2013 FY2014 FY2015	
Rifles	
 M16A1HB	 M16A3/5
 M14	
40MM Grenade Launcher	
 M79	 M203
Surface Ship Machine Gun	
 MK19 GMG	 Twin M2HB MG
 MK44 Mini Gun	 in M240 MG

What can industry do for Navy Small Arms?

- Ship Board
  - Problem - Harsh sea environment corrodes weapons
  - Need – Improved maritime coatings or materials

  - Problem – Weapons and ammunition are stowed below deck and must be transported top side using ladders, hatches, etc.
  - Need – Lighter, smaller, more compact weapon and ammunition

  - Problem - Weapon round counts are inaccurate
  - Need – Automatic round counters

- Navy Shore Stations
  - Problem – Increased training requirements for crew served weapons
  - Need – Reduced range training ammunition for M240, M2HB, MK19, virtual simulators, etc.

  - Problem – Increased security at check points at base entrances and piers.
  - Need – Ability to choose between non-lethal or lethal force, rapid transition from less than lethal to lethal

- Naval Air
  - Problem – Overheating barrels on XM218 / GAU16 barrels
  - Need – Barrels that can be fired maximizing the number of rounds on target per aircraft pass

Office of Capability





Joint Service Small Arms Systems Annual Symposium
19 May 2009

Captain Scott Genovese
Commandant (CG-7D)
Coast Guard Headquarters



Overview

- Handgun Replacement Project
- Near Term



Handgun Replacement Project

- **SIGARMS P229R-DAK is Replacing the M9 Beretta.**
  - Approximately 85% of the Coast Guard has transitioned.
- **Type classification – NSWC Crane Division.**
  - .40 caliber (JHP, & Ball).
  - 5 year Indefinite Delivery/Indefinite Quantity (IDIQ) contract with FEDERAL for JHP & Ball (both 155 grain).
  - WSESRB 80% Complete, limited release.



Near Term Goals

- Refine policy and the supporting Tactics, Techniques, and Procedures for three (03) new weapons initiatives in the inventory:
  - MK11 rifle. The MK11 will be used for precision engagement.
  - M14T & M107 rifle. The M14T & M107 rifles will be used in support of Airborne Use of Force.







Precision Service Shotgun

- Develop a Precision Service Shotgun (PSS) to be used for disabling fire.



Gyro Stabilized Weapon System

- Initiated a program for gyro stabilized weapon systems for small boats to enhance crew safety and effectiveness.





Location & Organization

- Location.

  Commandant (CG-7D)
  Coast Guard Headquarters
  2100 2nd Street SW, Room 4311
  Washington, DC 20593

  Phone: (202) 372-2030

- Organization.
  - Office of Capability.
    - Member of the Joint Service Small Arms Synchronization Team (JSSAST).
  - Organization Staffing.
    - Captain Scott Genovese (Deputy, Assistant Commandant for Capability)
    - Lieutenant Sean Cashell (Small Arms Program Manager)
    - Chief Warrant Officer John McDaniel (Assistant Small Arms Program Manager).
  - Liaison Positions.
    - Small Arms Repair Facility at NSWC Crane, Indiana.
    - Liaison to the Naval Operational Logistics Support Center (NOLSC) Mechanicsburg, Pennsylvania.

Questions?

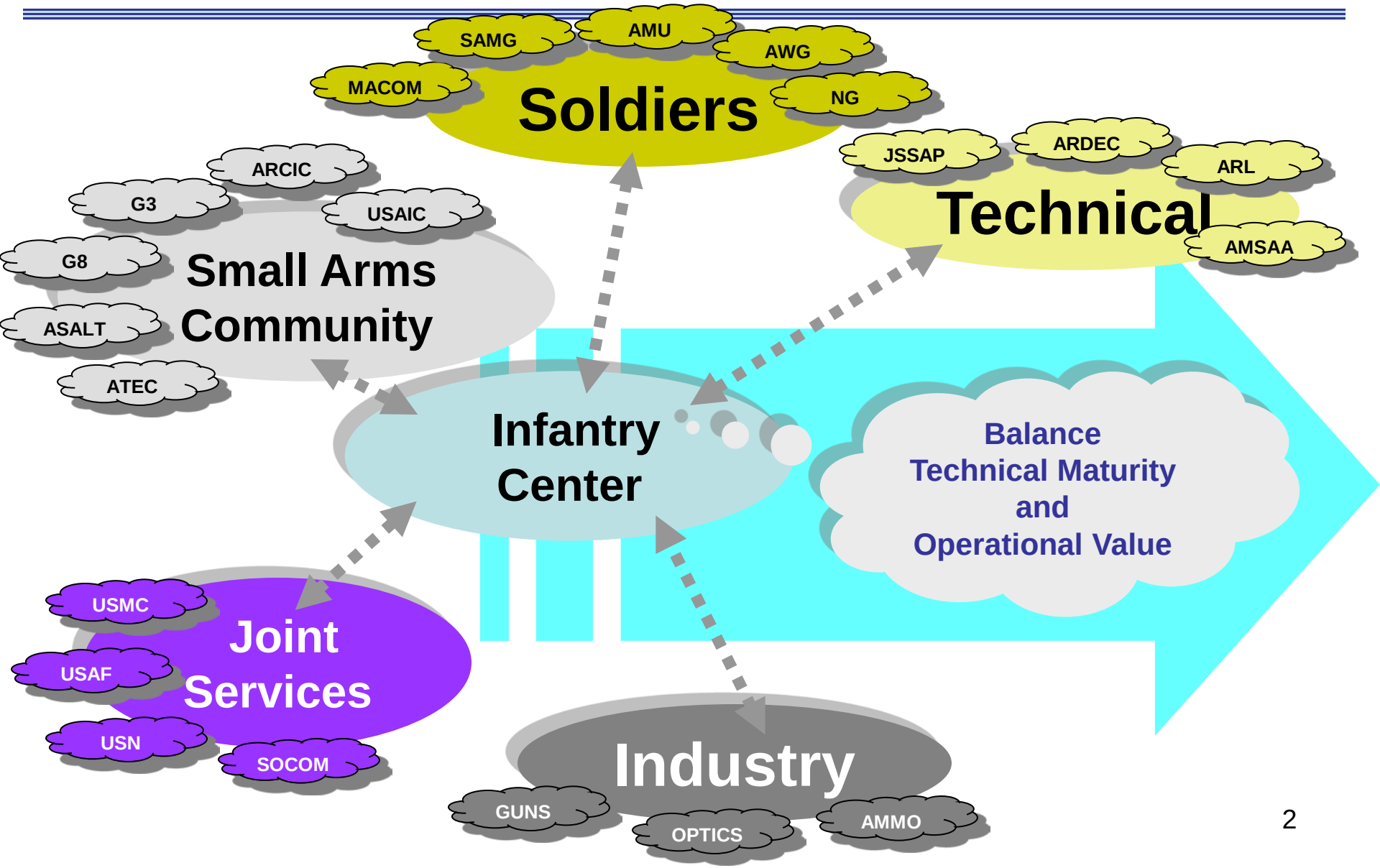
Army Service Update

NDIA

19 May 2009

LTC Tom Henthorn
Chief, Small Arms Branch
SRD, USAIC
thomas.henthorn@us.army.mil
706-545-1910

Strategic Communications



2009 Weapons Development Strategy

Near Term (0-2 years)
Field


Expand Carbine Issue


Rifle Combat Optic


M110 SASS


M2A1


M240L


M320 GL


Modular Shotgun

Short Term (2-5 years)
Field / Develop

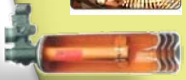

Individual Carbine


Sub-compact


Long Range Anti-personnel


- Dual Combat Optic
- Heavy Machinegun Day Optic


Modular Handgun System



Suppressors


Machinegun Configurations

Mid Term (5+ years)
Develop / Evaluate


Counter Defilade Target Engagement

Future Weapons


Advanced Ammo


Advanced Fire Control



Commonality / Family Concept


Light Weight Small Arms (Case-telescopic Ammo)

Other Small Arms Initiatives

- Effects Based Standard
- Higher Fidelity Operational Metrics
- Small Arms Modeling and Simulation
- Arms Room Concept
- Approved Procurement Equipment List
- Functional Solution Analysis (complete SA CBA)
- Post Combat Survey
- Small Arms Website

Headquarters U.S. Air Force

Integrity - Service - Excellence

USAF Combat Arms Program



U.S. AIR FORCE

Colonel Patrick Lopardi
Chief, Programs, Requirements & Innovations Division
HQ Air Force Security Forces Center

U.S. AIR FORCE

USAF Combat Arms Program

- No AF led small arms programs
- Working to further interoperability with sister services and components in DoD by partnering on their programs
- Sustainment and product improvement of current small arms inventory
- Improve and expand small arms training and range capabilities

U.S. AIR FORCE

USAF Small Arms Interest Items

- Lighter and more effective crew-served weapons
- Longer range precision rifles
- Greater capability in optics -- night and day
- Improved accuracy/terminal effects for all munitions
- Ability to identify/engage targets in defilade
- More effective/capable dye-marking cartridge systems
- Suppressors for all small arms

USAF
Range & Training Interest Items

- Standardized range templates for use in constructing/ improving base ranges; indoor and outdoor
- Improved bullet traps; environmental, safety & health
- More dynamic, realistic and interactive targetry
- Simulators and virtual training
- Ranges for moving and shooting/tactical engagement
- More effective ventilation systems/particulate containment; integrated HVAC/climate control
- Ranges capable of vehicle firing engagements

JNLWP Update to the International Infantry & Joint Services Small Arms Symposium

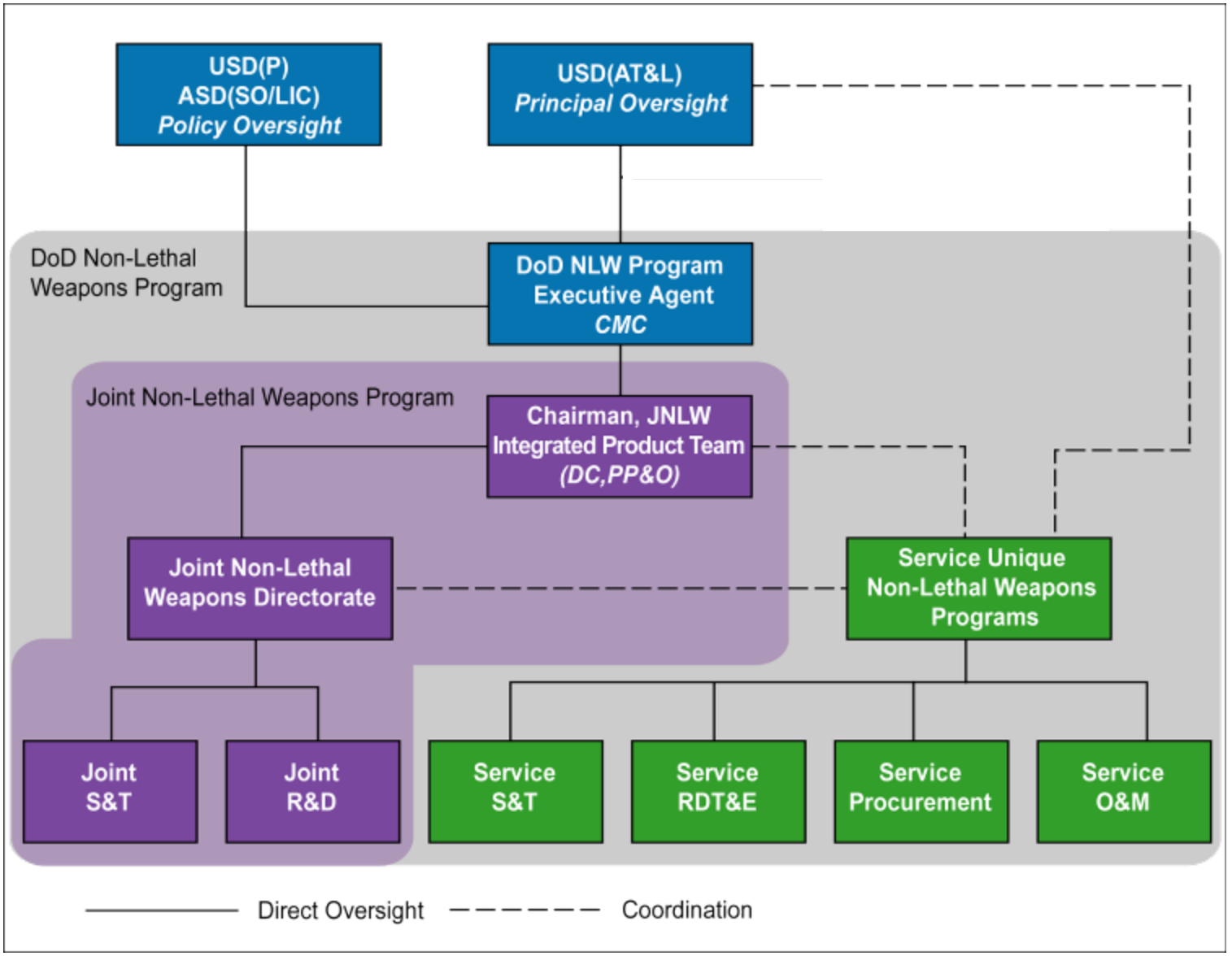
Less Lethal Capabilities in the Escalation of Force

19 May 2009

Kevin Swenson
Acquisition Division Chief, JNLWD
3097 Range Road
Quantico, VA 22134

Distribution Statement A – Approved for Public Release

DoD Non-Lethal Weapons Program Management Structure



Distribution Statement A – Approved for Public Release

Non-Lethal Weapons & Munitions in Use

Counter-Personnel Capability Gaps



12 Gauge / 40 mm Point, Area and Flash Bang Warning Munitions



FN303



Obstacle Distractors



Washable Paint



Permanent Paint



Training



X-26 Taser



Modular Crowd Control Munitions



66mm Vehicle Launched NL Grenades



Flash Bang Grenades



Vehicle Lightweight Arresting Device M2 Net



Stingball Grenades & Launch Cups



Pen Flairs



Acoustic Hailing Devices

NLW Munitions Developmental Efforts

Counter-Personnel Capability Gaps

Suppress, Move and / or Deny Individuals / 1-150 Meters





MK19 NL Munition

USA Lead



Improved Flash Bang Grenade

SOCOM Lead

Counter-Personnel Capability Gaps

Suppress, Move and / or Deny Individuals / 100-300 Meters



Mission Payload Module

USMC Lead
Milestone C:
4QFY12







Joint NL Warning Munitions

USN Lead
Milestone C:
2QFY09





Airburst NL Munition

USA Lead
Milestone C:
4QFY11

Distribution Statement A – Approved for Public Release

Joint Integration Program (JIP)



DESCRIPTION:

The Joint Integration Program (JIP) is a forum established to coordinate a comprehensive program that maintains state-of-the-art non-lethal capability sets (NLCS) for each Service through product demonstrations, sharing lessons learned, and evaluating commercial off-the-shelf (COTS) products for potential inclusion into Service NLCS.

JIP Researcher –

shawn.williams@americansystems.com

Recent Accomplishments:

- NLM Test Harmonization MOA Staffed for Joint Signatures
- Updated JIP MOA in final JNLWD review
- NLERM Market Research
- Oct 08 JIP Meeting at Nellis AFB, NV

Future Activities:

- Follow-on NLM Characterization (PSU)
- Spike Strip Evaluation (USAF)
- JIP Range Kit Purchase (JNLWD)
- May 09 JIP Meeting in Dumfries, VA

Performers:

- JNLWD (JIP Chair) American Systems –JIP Researcher
- Services to include USCG
- Various vendors with COTS & developmental items

Next JIP Meeting – 21-23 Oct at Nellis AFB, NV

SCHEDULE & COST:

ITEM	FY09				FY10
	1Q	2Q	3Q	4Q	1Q
NLM Characterization II				▲	
Spike Strip Eval			▲		
JIP Kit				◆	

JNLWP Funding		
FY08	FY09	FY10
$700K	$700K	$600K

SUPPORTED BY: USA, USAF USMC, USN, USCG and SOCOM

Distribution Statement A – Approved for Public Release

Non-lethal Munitions Characterization



DESCRIPTION: This effort is a follow on to the initial NLMC. This includes testing of available COTS non-lethal 12 gauge, 40mm, Flash-bang Grenades and Multi-Sensory Stingball Grenades. Data captured during the test events will feed into the Advanced Total Body Model (ATBM) to determine injury potential. The results of this effort will assist the Services and other Government Agencies with non-lethal ammunition procurement.

TYPE OF DATA BEING GATHERED INCLUDES:

1) Muzzle velocity, 2) Accuracy, 3) Impact Energy
4) Weapons Fouling, 5) Blast Pressure, 6) Light Intensity,
7) Impact Pattern, 8) Velocity at range

Recent Accomplishments:

- Gathered Multi-sensory grenades and Blunt Impact non-lethal munitions
- HECOE Coordination on ATBM input requirements

Future Activities:

- Conduct test events and gather data.
- Reduce Data and write Test report
- Service down-select ammo to flow through ATBM
- Back brief ammunition manufacturers on test processes and results

Performers:

- Penn State University-Performer
- JNLWD-JIP PM

SCHEDULE & COST:

ITEM	FY09				FY10
	1Q	2Q	3Q	4Q	1Q
Gather test articles					
Complete test events					
Write Test Report					
Draft Report					
Final Report					

JNLWP Funding		
	FY09	
	$186K	

Distribution Statement A – Approved for Public Release

Business Opportunities

- FY10 JNLWP Science & Technology "Clear A Space without Entry" BAA
  - Planned Release Date: Jun 09, Closes: Aug 09
  - https://www.jnlwp.com/admin/solicitations.asp
- FY10 JNLWP Science & Technology BAA
  - Planned Release Date: Jun 09, Closes: Aug 09
  - https://www.jnlwp.com/admin/solicitations.asp
- Improved Flash Bang Grenade (IFBG) Request for Proposals
  - Released: 13 Feb 09, Closes: 15 Jul 09
  - www.crane.navy.mil/acquisition/synopcom.htm
  - Anticipate Contract Award – Nov 09
- XM-104 NL Bursting Hand Grenade – Performance Specification
  - Released: 8 Apr, Closes: 26 Jun 09
  - Restricted to National Technology Industrial Base
  - http://procnet.pica.army.mil
  - Anticipate Contract Award Sep 09
- XM1140 Extended Range Blunt Impact / Marking Munition
  - Request For Proposals expected to be release in Jun 09
  - Contract Award scheduled for 4QFY10
  - http://procnet.pica.army.mil
- Mission Payload Module – NL Weapon System
  - Request for Proposals – Jun 09
  - Contract Award estimated for Dec 09
  - https:www.fbo.gov

Distribution Statement A – Approved for Public Release

What is your Response?



Distribution Statement A – Approved for Public Release

US Special Operations Command



2009 NDIA Small Arms
Joint Service Small Arms Synchronization Team Panel

Mr. Nyle Wilcocks
Target Engagement Systems
19 MAY 2009

The overall classification of this briefing is:
UNCLASSIFIED

Technology Development Objectives Weapons Systems

- **Improved Weapon Suppression**
  - Signature Reduction
  - Size and Weight Optimization

- **Enhanced Weapon Accessories**
  - Day/Night Sight Improvements
  - Enhanced Hardening of Devices
  - Device Signature Reduction
  - Anti-Tampering

Improved Weapon Suppression

- **Current State of the Technology**
  - **1909 Silencer Patent**
  - **1950 Baffle Technology**
  - **Present: Incremental Improvement of 1950's Technology**

- **Ongoing Efforts**
  - **National & Service Laboratories (Modeling/Materials)**
  - **Legacy Weapon Suppressors Procurement**
  - **PEO-Soldier – Small Arms Suppression Technologies**
    - Infantry School drafting Joint Capabilities Development Document

Improved Weapon Suppression (cont.)

- **Where We Want To Be**
  - **Aural and Visual Reduction**
  - **Reduction in Size and Weight**
    - Innovative Materials
    - Optimized Design Geometries from Assault to Crew Served Weapons
  - **Maintain Weapon Accuracy**
  - **Reduce Life Cycle Costs**

Enhanced Weapon Accessories

- **Current State of the Technology**
  - **Systems Limited to Single Sensor**
    - Image Intensification (I^2) Clip-on Night Vision Devices
      - "Tube Production & Technology Limitations"
    - Thermal (IR) Clip-on Night Vision Devices
  - **Optics Not Interchangeable Due to Different Shock & Vibration Environments associated with SOF Weapons**
  - **Limited to Legacy Technologies**
    - Aiming Optics
    - Laser Pointers/Markers – Visible and Infrared
    - Rail Interface System (RIS)
- **Ongoing Efforts**
  - **Fused I^2/IR (Analog) Clip-on Night Vision Device**
  - **Service Lab Efforts in Shock Modeling & Testing**

Enhanced Weapon Accessories (cont.)

- **Where We Want To Be**
  - **Clip-on Night Vision Devices –** Fusion (Digital & Hardened)
  - **Aiming Optics –** Watershed, Adaptive Optics, Signature Reduction, Wireless Activation
  - **Laser Pointers –** Multi-spectral, Rangefinding, Thermal, Signature Reduction, Wireless Activation
  - **Hardened Universal Devices –** Survive Broad Shock and Vibration Environment for All SOF Weapons
  - **Rail Interface System –** Barrel Cooling Capability, Signature Suppression, Shock Reduction
  - **Device Anti-Tampering –** Eliminate Potential Reverse Engineering, Protects Critical US Technology

Questions



PEO SOF Warrior

Project Manager Maneuver Ammunition Systems

"Enhancing Small Arms Effectiveness in Current and Future Operations"

DISTRIBUTION STATEMENT A.
Approved for Public Release; distribution is unlimited.
Other requests shall be referred to the:
Office of the Project Manager for Maneuver Ammunition Systems
ATTN: SFAE-AMO-MAS, Picatinny, NJ 07806-5000



Chris Grassano
Project Manager

22 May 2009



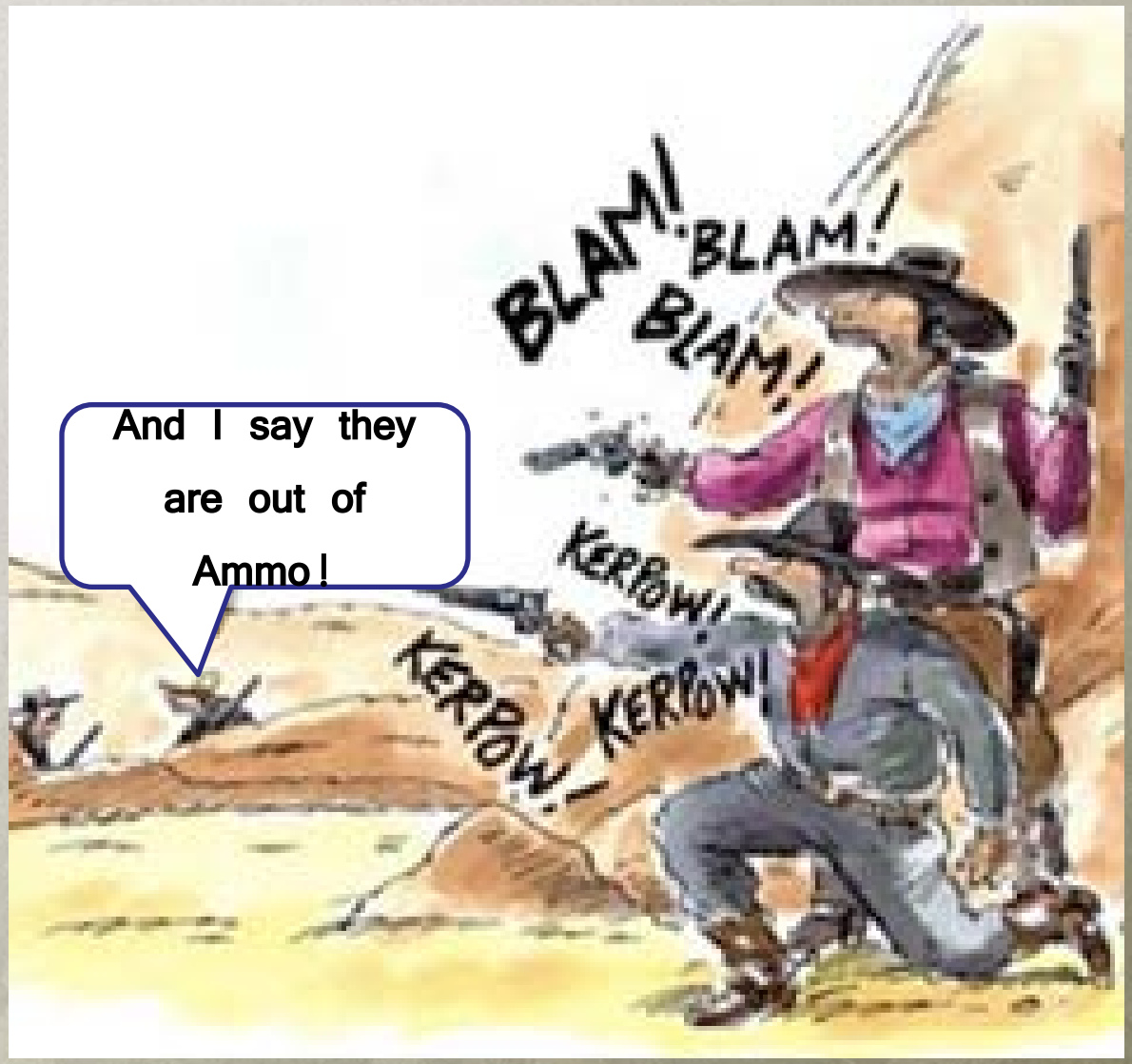
Project Manager
Maneuver Ammunition Systems (MAS)-Direct Fire



MISSION: Provide Lifecycle Management of Direct Fire Combat And Training Ammunition Capabilities To All Warfighters (Army, Navy, Air Force, Marines)

DISTRIBUTION STATEMENT A:

Ensure This Never Happens



DISTRIBUTION STATEMENT A:

PM-MAS 09 Goals

- **Support Warfighters**
  - Production / Fielding
  - Logistics
  - Training
- **High Performing, Agile & Ethical Workforce**
  - **Grow People & Teams**
    - Training
    - Skills
  - Effective Management
    - System & Family Approach
    - Integrated Acquisition Lifecycle
    - War Reserve Management
- **Enhance Organic/Commercial Strategic Capabilities**
  - Shape Industrial Base Capacities to Meet Requirements
  - Modernize & Maintain Future Viability
  - Identify/Establish Alternate Sources
- **Develop & Field Capability Improvements**
  - Airburst fuzing
  - Small Cal RDT&E
  - FCS Support
  - Lethality

Small and Medium Caliber

- **Support Warfighter**
  - **Meet Scheduled Production Goals**
  - **Reduce Delivery Backlogs**
  - **40mm Baselining**
- **High Performing Workforce**
  - **Developmental Assignments**
  - **Training / Certifications**
- **Enhance Strategic Capabilities**
  - **Lake City Modernization Program**
  - **Develop Future Small Caliber and 40mm Strategies**
- **Field Capability Improvements**
  - **Green Ammunition**
  - **Case Mouth Waterproofing**
  - **Flash Suppression**
  - **Packaging Improvements**
  - **DDI Improvement Effort**
  - **40mm Pivoting Coupling**
  - **Down-select 40mm High Velocity Non-dud-producing Training Round Configuration**

DISTRIBUTION STATEMENT A:

Enterprise Management Philosophy



- Promote Best Value Acquisitions
- Utilize Disciplined Processes
- Deploy Six Sigma and Lean Design/Production
  - Using Six Sigma Principles in the Establishment of PEO Strategic Plans
    - Industrial Base
    - Demil
    - Insensitive Munitions



- Promote Continuous Process Improvement and Technology Insertion



- Promote Commonality and Interoperability
- Promote Spiral or Evolutionary System Development

Put Eyeballs On – "Trust, but Verify"

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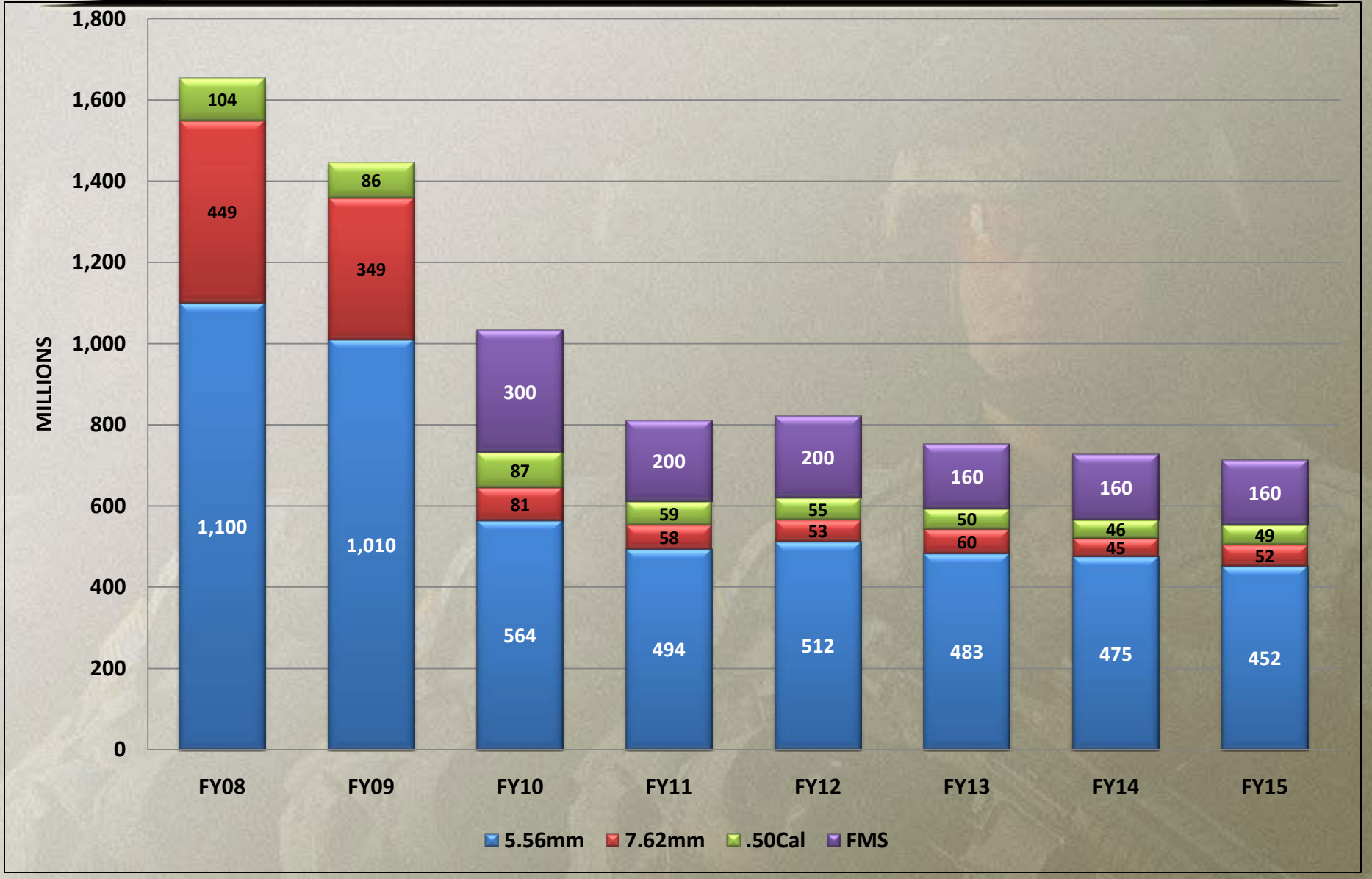
Future for Direct Fire Ammunition

- **Strategic Situation**
  - Production: At/Near Capacity in Many Cases
  - Requirements: Declining in FY10 and Flattening
    - Army and Marine Corps Size Increases Accelerated 2-3 yrs
  - Expenditures:
    - Training – approaching historical levels, 70%
    - Operational – steady since FY06, potential increases
  - Stockpile: Continuing to Grow…At or Nearing Objective Requirements for Many Items
  - FMS: Continuing to Grow Overall
    - 500% sales increase ($600M) FY04-08
    - 35% ammo hardware buys in FY08
    - 10% small cal buys in FY08

New Administration Plan Uncertain Beyond FY10

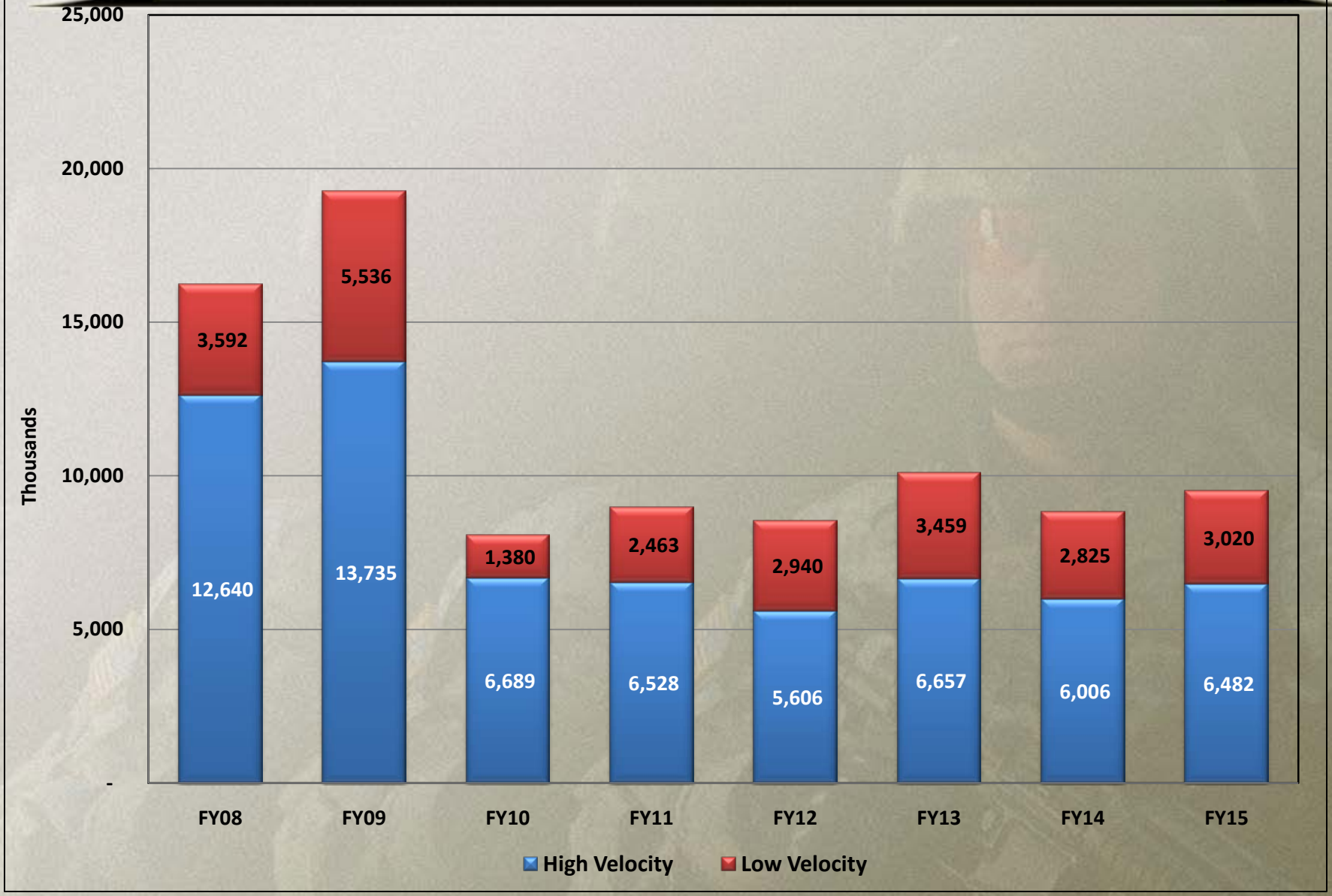
DISTRIBUTION STATEMENT A:

Small Caliber Buys



DISTRIBUTION STATEMENT A:

40mm Buys



DISTRIBUTION STATEMENT A:

Small Caliber Ammunition





LTC J. Woods
Product Manager
Small Caliber Ammunition
5.56mm, 7.62mm, 9mm, .50 Cal



5.56mm Family



7.62mm Family

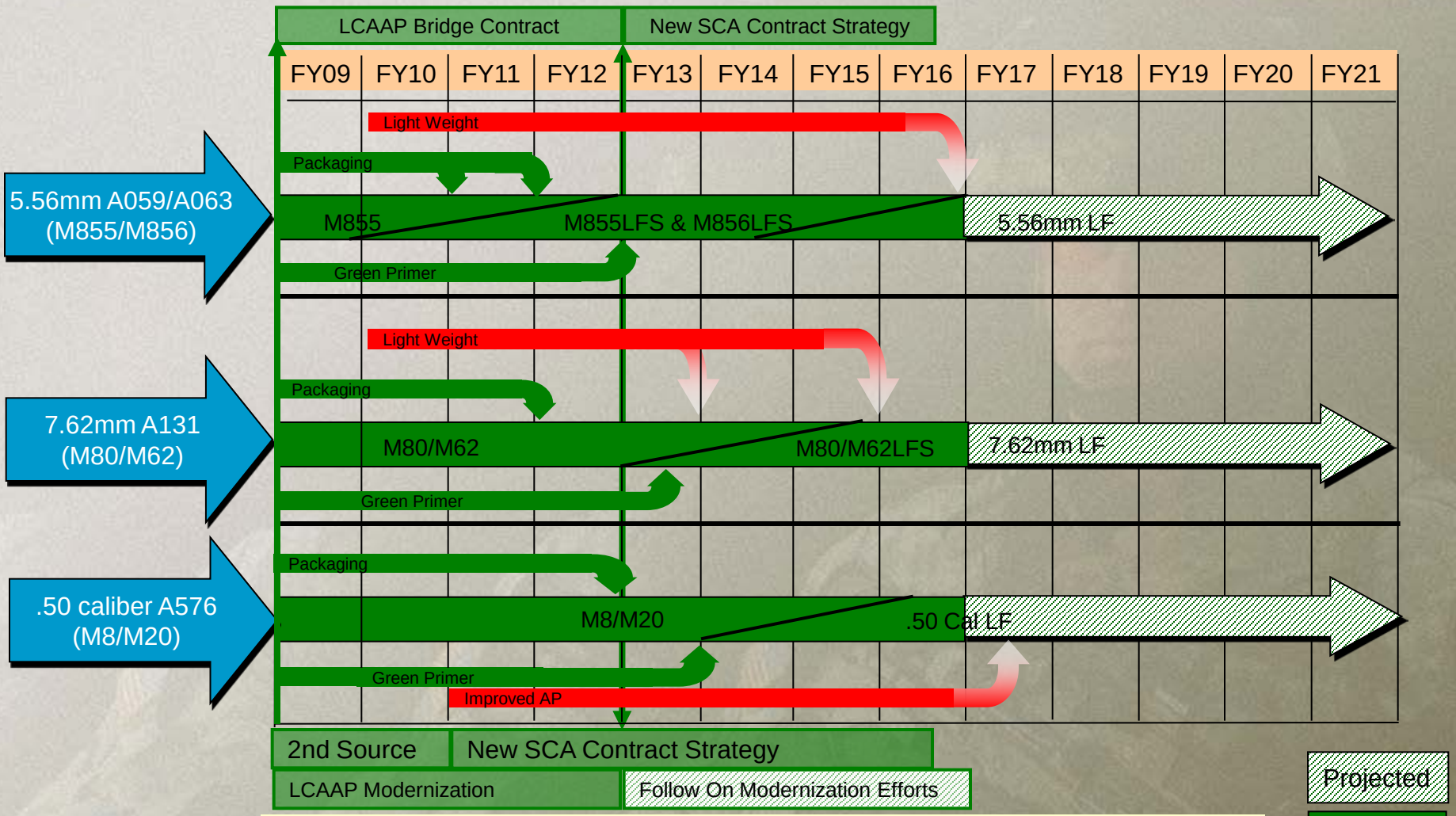


.50 Cal Family

ENHANCING SMALL CALIBER EFFECTIVENESS

DISTRIBUTION STATEMENT A:

Small Caliber Roadmap



- Propellant / Tracer Efforts Ongoing
  - Flash Reduction (end of FY09 Across Calibers)
  - Velocity improvements, Temperature Sensitivity Reduction (FY10-12)

DISTRIBUTION STATEMENT A:

Green Ammunition

M855 Lead Free Slug (LFS)

M856 LFS

M80 LFS

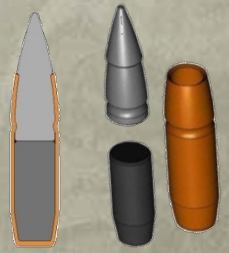


5.56mm Family



M855 LFS

M855 LFS





7.62mm Family

DISTRIBUTION STATEMENT A:

Background
(What Started the Program)

- **Original Lead Free Program: Replace Lead Slug Component**
  - Used Tungsten/Nylon to Replace Lead
  - Program Stopped for Performance and Manufacturing Problems
  - Later Research Indicated Tungsten Possible Environmental Hazard

- **Lethality Concerns:**
  - Field Reports of Performance Issues With M855
  - Question: "Are There Commercial Off-the-Shelf (COTS) 5.56mm Bullets Available That are Better Than M855 in Close Quarter Battle (CQB)?"
  - <u>Conclusions from Lethality Study in 2006</u>
    - There is no Significant Difference Between M855 and Commercially Available 5.56mm Rounds
      - Shot Placement Far Outweighs Minor Differences Among Rounds
      - Good Shot With any Candidate Will Work; Bad Shot With any Candidate Won't
    - Weapon-bullet Interaction Varies Greatly and Affects CQB Performance
      - Causes Variation in Soldier Experience

DISTRIBUTION STATEMENT A:

M855 LFS Approach and Results

- In 2007, applied ***a Systems Approach*** to Cartridge Improvements (M4 Optimized)
  - Incorporated Lessons Learned from Lethality Study Conducted in 2006
  - Working in close coordination with Weapon Engineers
  - Addressing concerns from the field
  - Significant Extension in Range of Hard Target Performance
  - No Training Transfer Difference
  - Leverage Existing Lake City Equipment and Modernization Efforts



M855 LFS

- Environmental Impact
  - Eliminates ~2,000 Metric Tons/Year of Lead Currently Left in Theater and Training
  - Removes Lead Hazard From Slug Manufacturing
  - Enables Use On Currently Restricted Ranges

- Provides ***Consistent*** Performance on Shot By Shot Basis

- Equal to or Better than M855 in Close Quarter Battle Performance

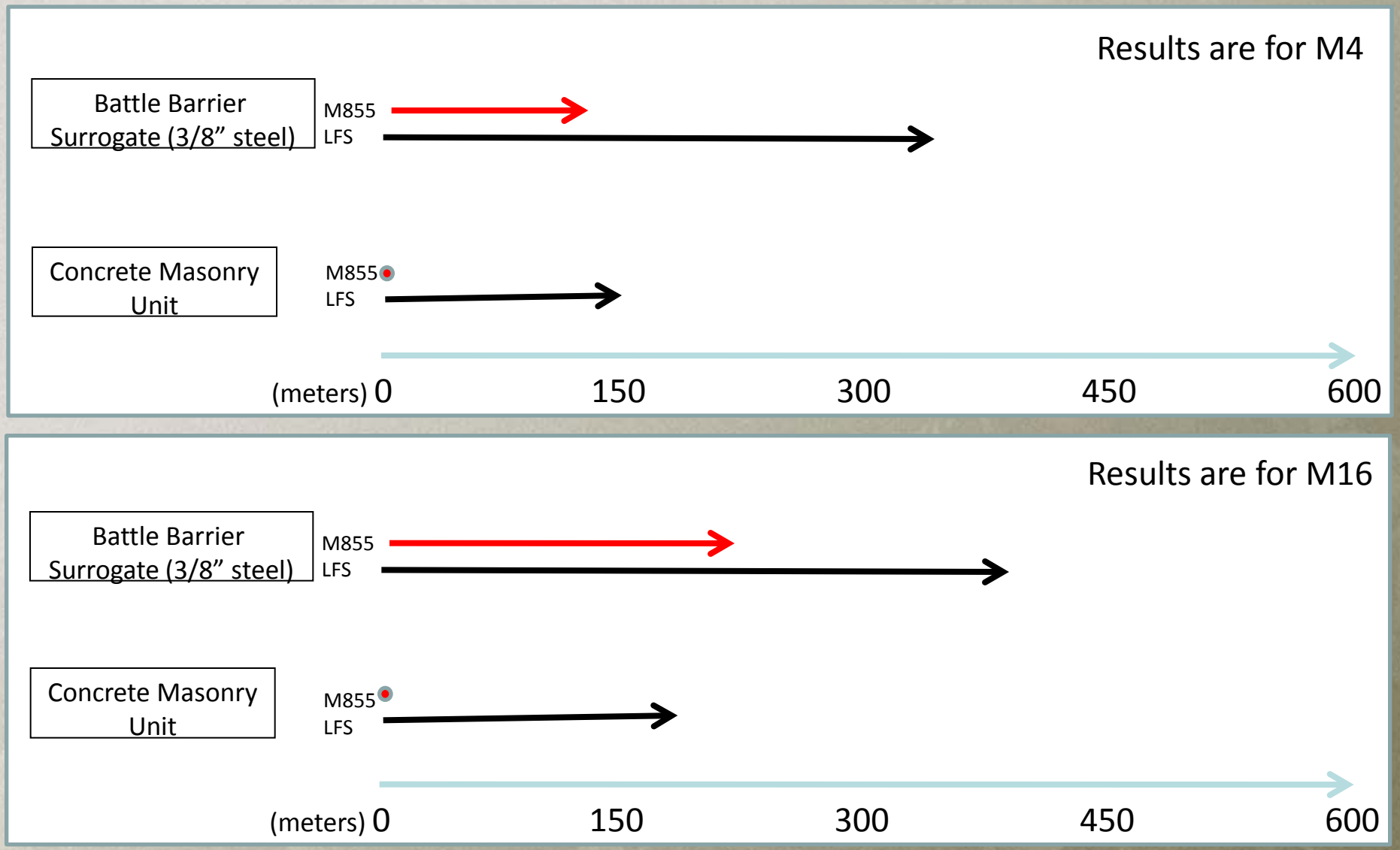
DISTRIBUTION STATEMENT A:

M855 LFS Key Points

- **M855 Round Performs Very Well in our Current Weapon Systems**
  - New Round Is Better For The Environment Through Elimination Of Lead Slug
  - New Round Allows use in Lead Restricted Ranges and Eliminates 2000 Metric Tons of Hazardous Material From Soil and Ranges Per Year
- **New Round Enhances Performance**
  - Better Hard Target/Barrier Performance
  - Improved Propellant – Reduced Flash
- **Shot Placement Still Matters The Most**
  - Trajectory Match to M855
  - No Change to Current Training
- **Optimized to Current Carbine and Concepts Applied From Lessons Learned**
  - Maintains Consistent, Superior Performance Across Weapons and Shot To Shot

DISTRIBUTION STATEMENT A:

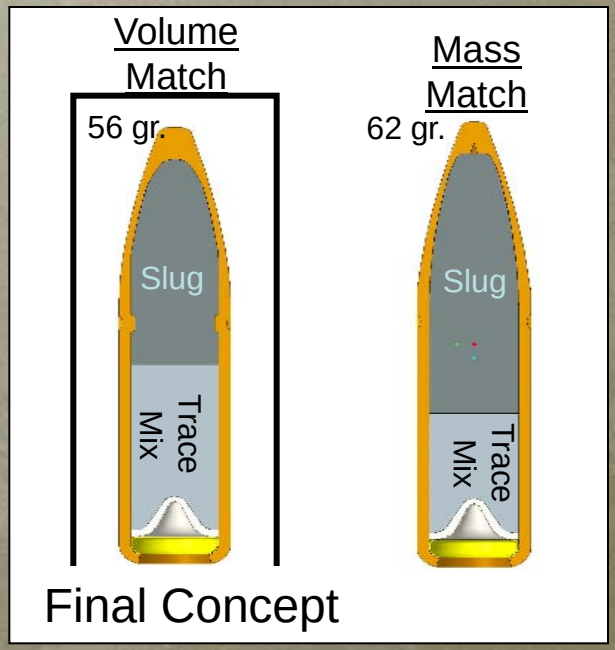
Hard Target Performance



DISTRIBUTION STATEMENT A:

5.56mm Green Ammunition
M856 Lead Free Slug (M856 LFS, Tracer)

- **Goal**
  - Implement green technology in M856 Tracer
  - Ballistic match to M855 LFS
  - Improve trace to range consistency compared to current M856 – 900 meters in M249 SAW
  - Reduction of lead at LCAAP
- **Approach**
  - Systems approach
  - Maintain performance, especially trace burn time/distance and trajectory match
- **Environmental impact**
  - Replacement of lead
  - Allows integration of M855 LFS for M249 and rifle systems to create complete “lead free bullets”
  - Eliminates ~ 500 metric tons of lead from the environment
- **Status**
  - Production qualification testing 3QFY10
  - Full rate production 2QFY11



DISTRIBUTION STATEMENT A:

7.62mm Green Ammunition
M80 Lead Free Slug (M80 LFS)

- **Goal**
  - Environmentally friendly cartridge with same or better performance than current M80 cartridge
- **Approach**
  - Systems approach
  - Eliminate lead from all 7.62mm bullet producing processes at LCAAP and at field ranges
  - Leverage 5.56mm design
- **Environmental impact**
  - Green M80 – 2nd highest consumer of lead at LCAAP
  - Eliminates ~ 1,500 metric tons of lead from environment
- **Status**
  - Production qualification testing 1QFY11
  - Full rate production 2QFY12



DISTRIBUTION STATEMENT A:

Powder Improvements Flash Reduction /Temperature Stability/Velocity Improvements

Flash Reduction

- 5.56mm – Currently being implemented with M855LFS, Will investigate potential for use with M856LFS
- 7.62mm – Near term - ECP being staffed to implement in M80 DODICs
- Mid Term – M80LFS and M62LFS will contain flash suppressed technology
- .50 Cal – Already contains some level of flash suppressed technology, future efforts will examine potential for additional improvement

Temperature Stability

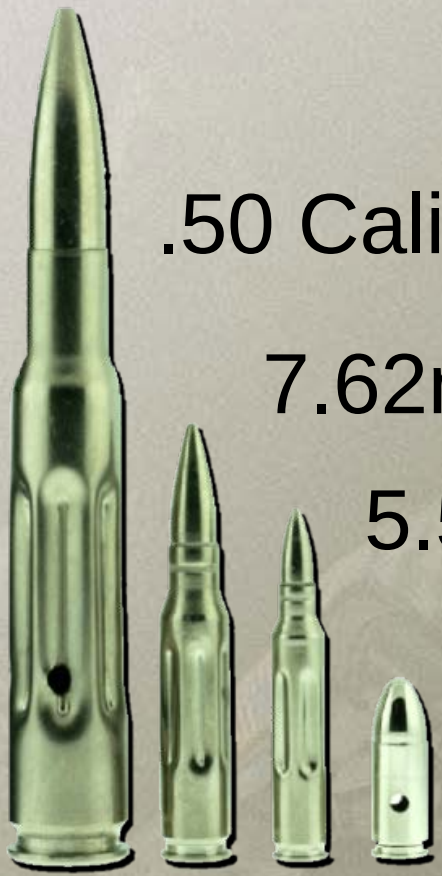
- 7.62mm – Alternate M118LR propellant design being identified and will provide both flash suppression and temp stability
- All Calibers – All future investigations into alternate propellants will add flash suppression and temperature stability as a requirement

Velocity Improvements

- 5.56mm – increased velocity incorporated into current M855LFS design (required modification of current propellant and an increase in chamber pressure)
- All Calibers – All future investigations into alternate propellants will investigate potential for increased velocity

DISTRIBUTION STATEMENT A:

Dummy, Drilled, & Inert (DDI) Cartridge Overview



.50 Caliber

7.62mm

5.56mm

9mm

DISTRIBUTION STATEMENT A:

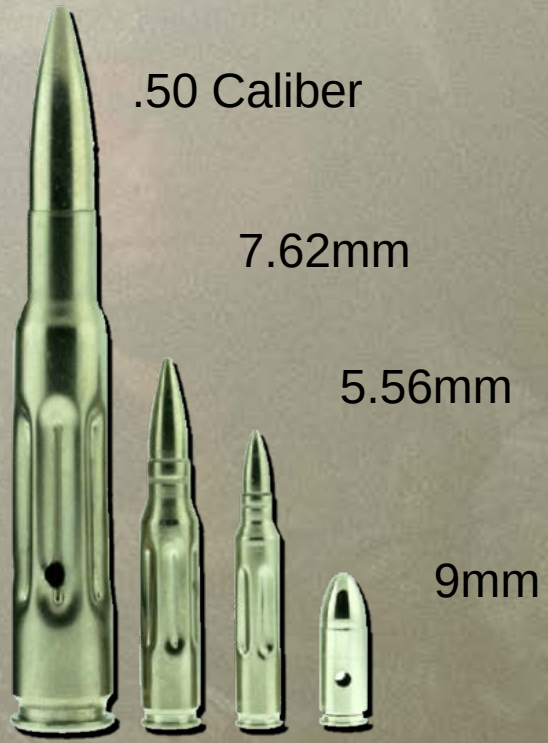
Background

- **TRADOC Training Incidents (2) in Fall 07**
  - **Live .50 Cal Ball Cartridge Mixed Into .50 Cal Inert Cartridge Linked Belt**
- **Gen Wallace Letter (15 Feb 08) to PEO Ammunition**
  - **Standardize Appearance of Dummy / Inert Ammunition**
  - **Revise Guidance for Accountability, Storage, Use and Requisition of DDI Ammunition**
  - **Review and Revise Appropriate Publications to Reflect New Standards**

DISTRIBUTION STATEMENT A:

Summary of DDI Effort

- **Standard Color / Configuration for Small Caliber DDI Selected**
- **Publications / Standards Updated**
  - **Definitions for Dummy, Drill, Inert Ammunition Revised**
  - **Mil-Std-709C (Ammunition Color Coding) Updated**
  - **Weapon Technical Manuals Updated to Improve Information on Ammunition Color Coding**
  - **Training Support Packages Updated to Include Ammunition Identification Information**
- **Guidance For Storage, Accountability, And Use Revised**
  - **Graphic Training Aid (GTA) Card Included**
  - **Ammunition Information Notice (AIN) on DDI to be Published**



DISTRIBUTION STATEMENT A:

Questions / Discussions



?









DISTRIBUTION STATEMENT A:

Project Manager Maneuver Ammunition Systems

NDIA Small Arms Systems Symposium

DISTRIBUTION STATEMENT A.
Approved for Public Release; distribution is unlimited.
Other requests shall be referred to the:
Office of the Project Manager for Maneuver Ammunition Systems
ATTN: SFAE-AMO-MAS, Picatinny, NJ 07806-5000



LTC Chris Seacord
Product Manager
Medium Caliber Ammunition

19 May 2009



Agenda

- 40mm Family
- 40mm Grenades Roadmap
- 40mm Acquisition Strategy
- Low-Velocity (LV) & High Velocity (HV) Non-Dud Producing (NDP) Rounds

DISTRIBUTION STATEMENT A:

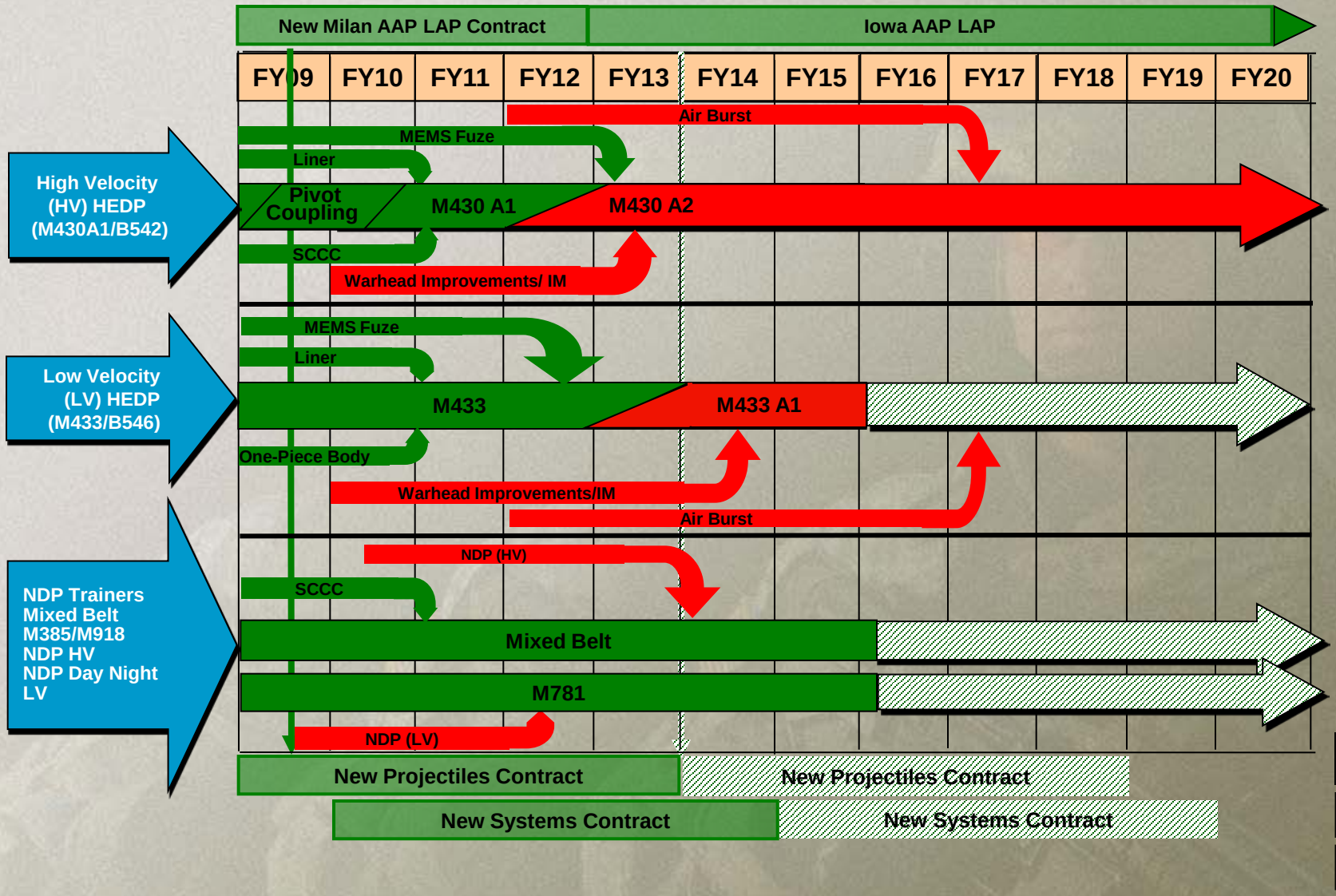
40mm Family



M433 M781 M385A1 M430 M1001 M918 M992 M662 M661 M585 M583

DISTRIBUTION STATEMENT A:

40mm Grenades Roadmap



DISTRIBUTION STATEMENT A:

40mm Acquisition Strategy

- **Main Components**
  - Small Business (SB) Set Aside
  - 8A contracts for projectiles
  - Directed LAP for HV rounds at Milan

- **Relevant Facts**
  - 40mm contract is largest SB set-aside in the Army
  - Main components are parameters we work within
  - SB must manufacture 51% of products
  - Maintain capability in NTIB
  - New Systems Contract Award planned in 2QFY10

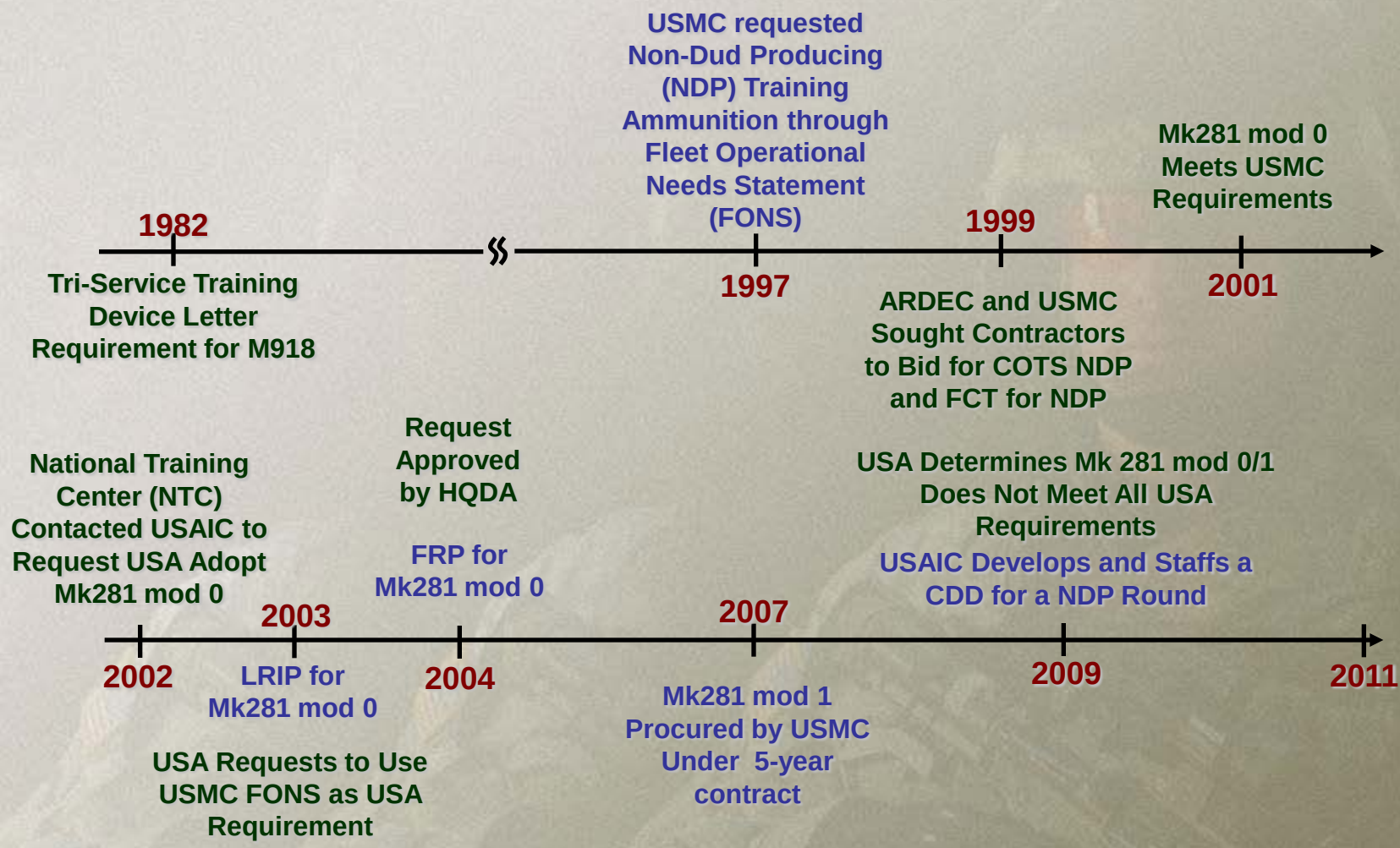
DISTRIBUTION STATEMENT A:

LV NDP Round Status

- **PM-SW program for SOCOM Requirement**
  - Estimate FRP Sep 09 with deliveries in Jan 10
  - R&D / Production contract in place
  - XM1110 (Rheinmetall) was selected through FCT
- **PM-SW / PM-MAS working w/ USAIC on CPD**
  - CPD being staffed internally
  - Future capabilities are being discussed
  - Possible COTS solution (XM 1110)

DISTRIBUTION STATEMENT A:

HV NDP Round Requirements History



HV NDP Round
Requirements & Current Status

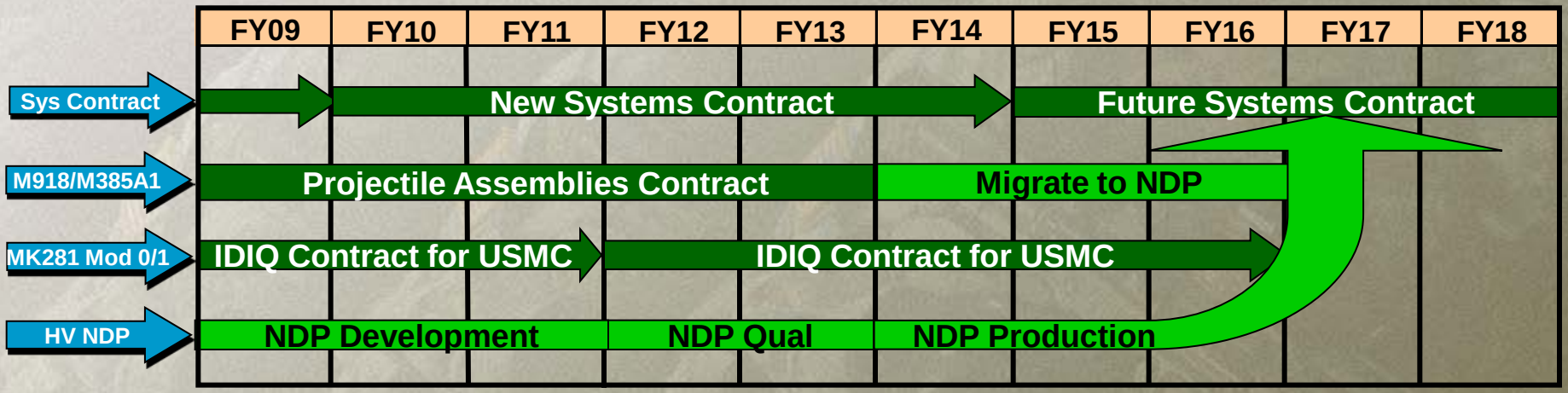
- **Requirements**
  - Ballistic match to M430
  - Visual signature upon impact day/night
  - Audible signature upon impact
  - Thermal signature upon impact with existing weapon sights
  - Minimum hazard to soldier (NDP)

- **Current Status**
  - PM-MAS working w/USAIC on CDD
  - Draft CDD nearly complete (fine tuning wording on KPPs)
  - Expecting CDD approval by 2010

DISTRIBUTION STATEMENT A:

HV NDP Round Road Ahead

- Staff CDD
- Submit CDD through JCIDS process
- Conduct Market Survey
- Draft Acquisition Strategy
- Develop Detailed Schedule
- Continue to procure Mk281 Mod 0 for Army as needed on USMC IDIQ Contract



DISTRIBUTION STATEMENT A:

Summary

- NRE efforts will increase reliability, producability and effectiveness of the 40mm Family
- 40mm will remain a SB set-aside for the foreseeable future
- LV & HV NDP requirements are on-going and we expect to have approved requirements in 2010
- PM-MAS is committed to providing the Warfighter with the most reliable and lethal grenades available

DISTRIBUTION STATEMENT A:



Project Manager Soldier Weapons
Ammunition Programs

LTC Chris Lehner
Product Manager
Individual Weapons

LTC Michael Ascura
Product Manager
Crew Served Weapons

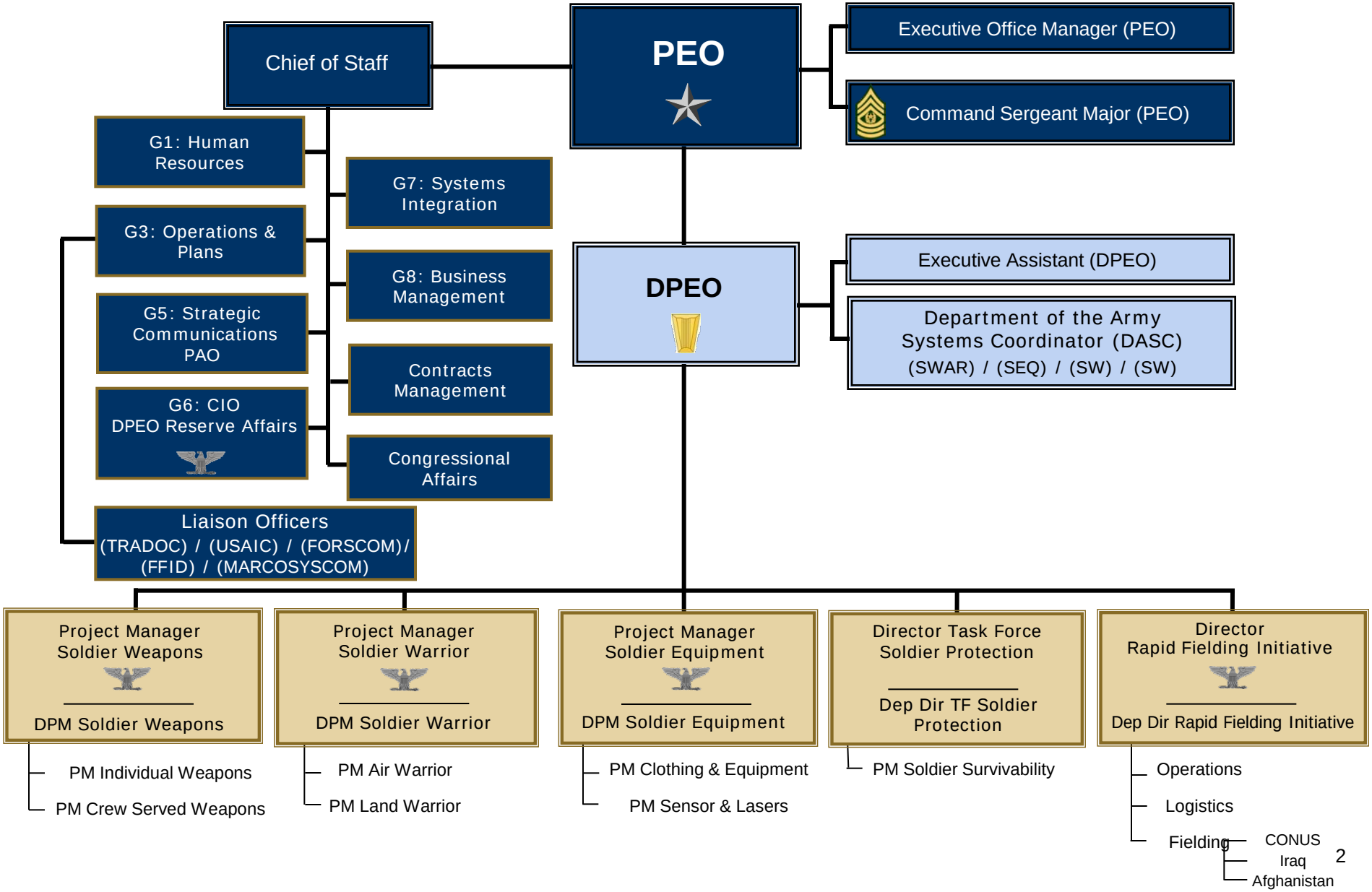
BG Peter N. Fuller
Program Executive Officer Soldier

COL Douglas A. Tamilio
Project Manager Soldier Weapons

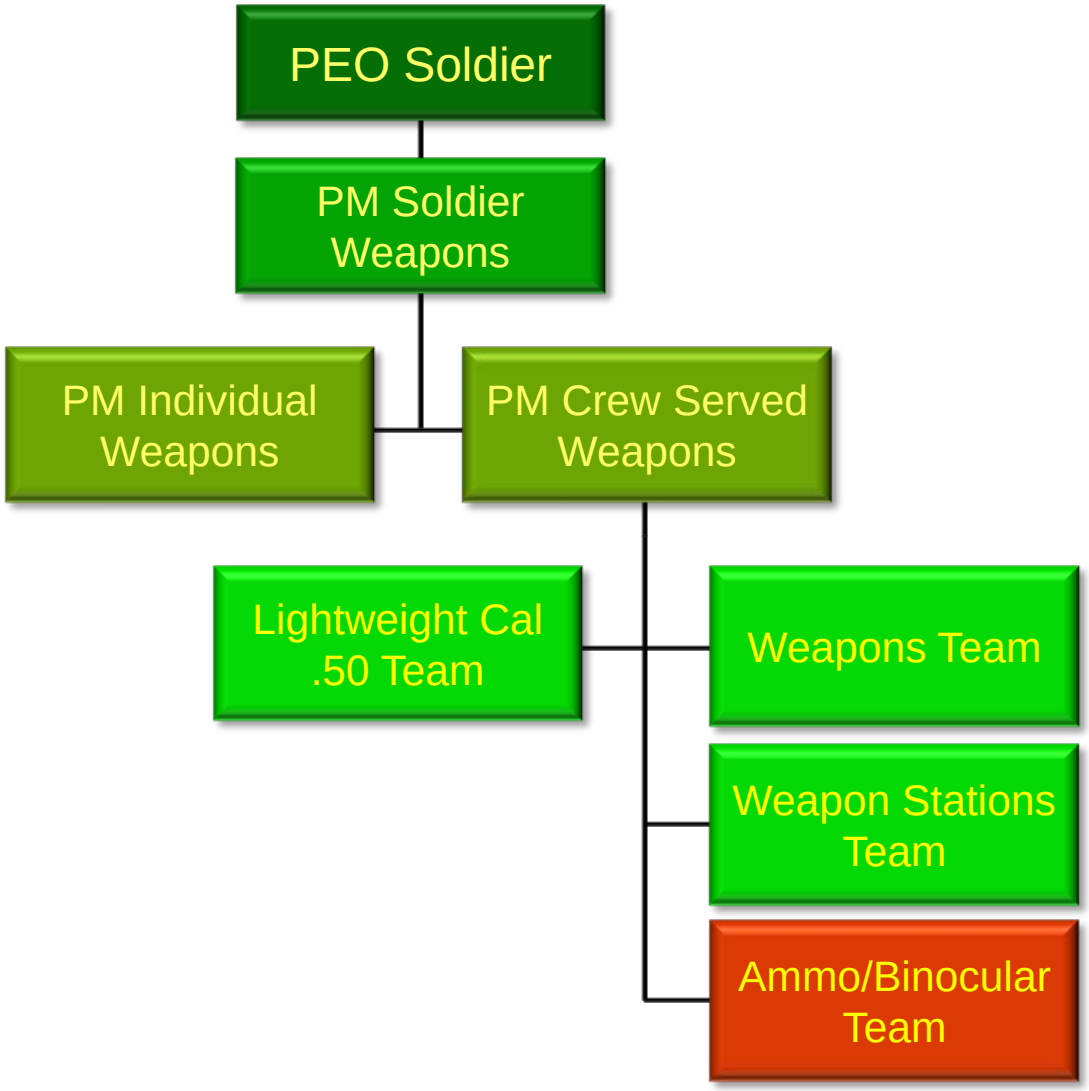
20 May 2009

Program Executive Office Soldier

As of 20 April 2009



Organizational Tree



Small Arm Systems Improvements

- View Small Arms as **Systems**
  - Weapon
  - Fire Control
  - Ammunition

Programs Coordinated with PEO Ammo
- Concur on Acquisition Strategy
- Concur on Executive Summary

- RDT&E of Ammunition for Existing Weapon Systems
  - Includes Small Cal and 40mm Development Projects
    - Tactical/Lethal
    - Lightweight
    - Training
    - Non Lethal

PM CSW Ammo Team

Rob Zienowicz Ammunition Team Chief - PM Crew Served Weapons Office

Percy Mistry
- XM1112 40mm Airburst Non Lethal Cartridge
- Micro Electro-Mechanical S&A

Ben Wong
- M100 GREM / M101 GREM-TP
- M903/M962 Cal .50 SLAP/SLAP-T
- M973/M974 7.62mm Short Range Training Ctg

Fred Fitzsimmons
- XM1110 40mm Day/Night TP Cartridge
- M24 Minature Binocular
- M25 Stabilized Binocular

George Dieterle
- Improved 9mm Cartridge
- 40mm Close-In Antipersonnel Cartridge
- M992 40mm Infrared Illumination Cartridge

Brian O'Neill
- M862 5.56mm Short Range Training Cartridge
- M1030 12 Gauge Breaching Cartridge

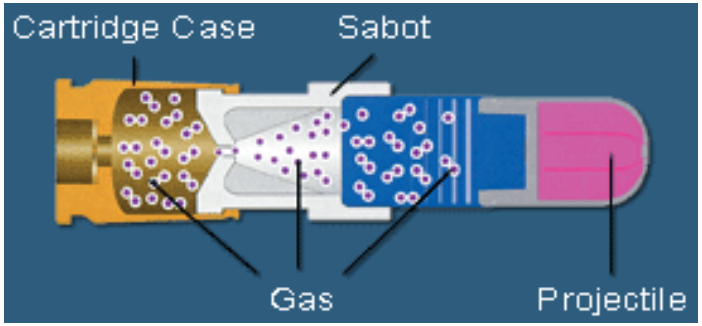
Gene Hudson
- XM1037 5.56mm Short Range Training Cartridge
- M1041/M1042/M1071 CCMCK Ammo

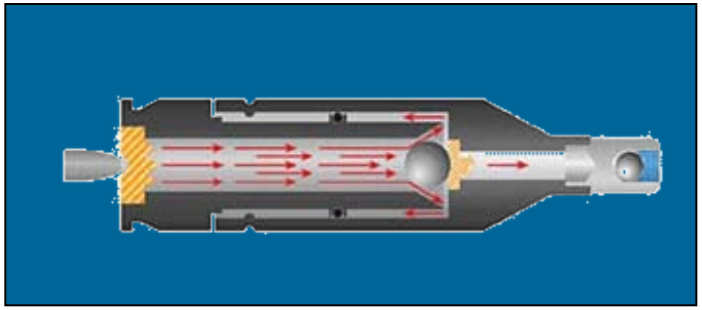
Audrey Shabazz
- Lightweight Small Caliber Ammo
- XM1116 12 Ga Extended Range Non Lethal Ctg
- XM1140 40mm Extended Range Non Lethal Ctg

PM-SW Managed
Support to PM-MAS FY09 Production

Close Combat Mission Capability Kit (CCMCK)







- Operator Installation
- Must Not Fire Service Ammo
- Not Fracture SWD Goggles at 12 in
- Fire From Standard M4/M16/M249/M9/M11
- Not Penetrate Skin Thru Hot BDU at 5M (T) 0M (O)

Milestone C Approved July 2008

Close Combat Mission Capability Kit

Rifle
XM1042



SAW
XM1071



Pistol
XM1041



Close Combat Mission Capability Kit





Rifle





SAW







Pistol



XM1037 5.56mm Short Range Training Ctg



- Ballistic match with standard ammo out to 100m
- Maximum Range 600m
- M4, M16, M249 Series Weapons
- No Weapon Modification

Program Objective:

Development

- Developmental Program
- Initial Production Start up – FY10

Next Major Milestone – Conduct Developmental Test

- Conduct Limited User Evaluation
- ATC Final Report
- ATEC Independent Evaluation (OER)

Lightweight Small Caliber Ammuninition

Objectives

To develop a functional alternative 7.62mm M80 Ball and M62 Tracer cartridges assembled with an alternative case material

- 20% weight savings
- Meets current ballistic performance
- Manufactured using standard industrial techniques
- Assembled on LCAAP loading machinery

Move on to:

- 7.62mm Blank
- 5.56mm Ball
- 5.56mm Blank
- Cal .50

Lightweight Small Caliber Ammunition

- **Feasibility – Computer Modeling & Studies**
- **Phase 1 –Demonstration**
  - Test full up cartridges in a Mann barrel
  - Machinegun tests
- **Phase 2 – Development & Production Prove - Out**
  - Ballistic testing
  - Product refinement
  - Ensure compatibility with production equipment
- **Phase 3 – Production Qualification Testing (PQT)**

Lightweight Small Caliber Ammunition



Weight Of ***5*** Assembled LSCA M80 Cartridges = ***4*** Conventional Brass Cased M80

- Accomplishments
  - Weight reduction objective met
  - Demonstrated F&C with M240 Machinegun in Ball & Tracer configurations
  - Complies with MIL-C-46931 Specification
  - Compatible with conventional loading equipment

Improved 9mm Ammunition

- Develop an Environmentally Friendly 9mm Cartridge that will Exhibit Better Performance Than Current Leaded M882
  - Operational In M9 & M11 Weapons
  - Improve Lethality
  - Meet NATO Requirements
  - Utilizes Latest Science And Technology To Improve Upon All Aspects Of The Round (Environmental Compliance, Accuracy)
  - Ballistically Matched To M882
  - Cost Equivalent to M882



- Two Phased Approach
  - Study Determines Feasibility of Alternative Designs
  - Perform Qualification of Selected Design

XM1116 12 Ga Ext Range NL

- Based on Urgent Requirement for XM1092
- Blunt Trauma Non Lethal Munition
- Capable of Marking Targets
- No Weapon Modifications Required
- Range 5-75 Meters



XM1140 40mm Ext Range NL

- Based on Urgent Requirement for XM1091
- Blunt Trauma Non Lethal Munition
- Capable of Marking Targets
- Fired From M203/M320
- Range 10-80+ meters



Notional Pending Source Selection

40mm Airburst Non-Lethal Munition, XM1112

Develop A Cartridge That Provides Non Lethal Effects Through Blast Characteristics (E.G. Flash & Sound) Without The Range Limitations Encountered With Traditional Blunt Trauma Munitions



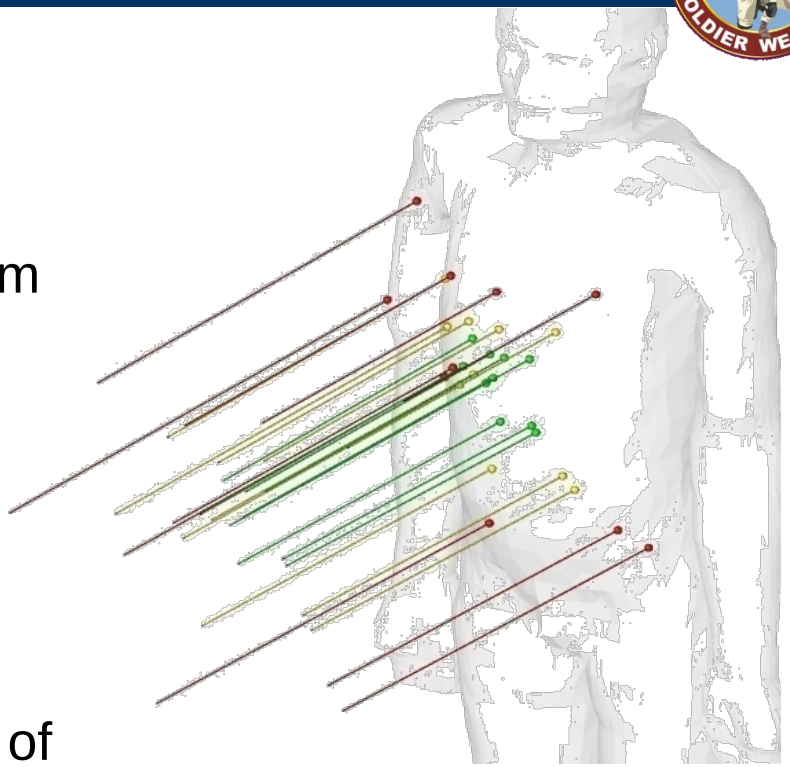
Capabilities:

Increased Range (300m (T), 400m (O)) for Crowd Dispersal Capability with 40mm systems.

40mm Close-In Antipersonnel (CIAP)

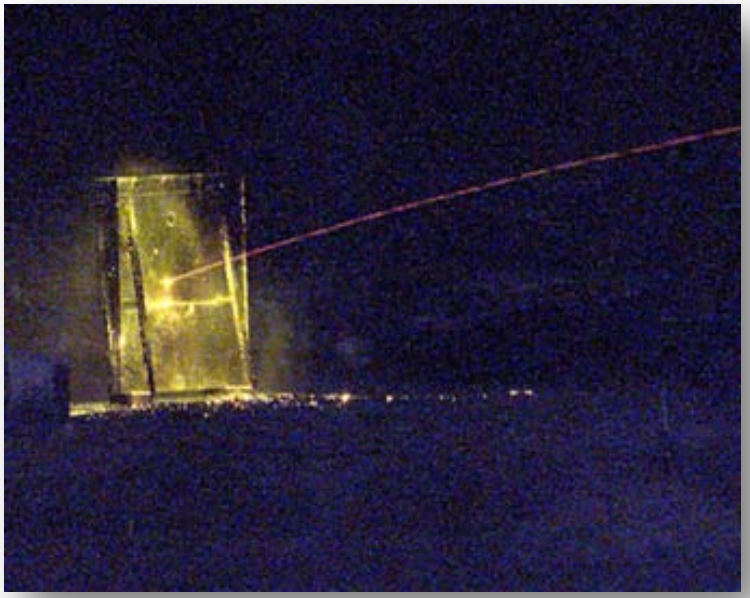
Description:

- Low velocity 40mm cartridge fired from M203 and M320 grenade launchers
- Expels multiple projectiles providing anti-personnel capability at short ranges
- Evaluate buckshot versus flechette cartridges for lethality and probability of a hit



XM1110 Improved 40mm Training Cartridge

- Contains Both A Day And Night Signature And W/Improved Performance On Soft Targets
- Annular Groove In Ogive
- Payload = M781's Orange Powder Plus Glow Stick Mix In Glass Ampoules
- Non Dud Producing /No Pyrotechnics/ No Brush Fires
- Compatible W/ All 40mm LV Grenade Launchers
- Developed To Support SOCOM'S EGLM W/ Day-night Sights
- Marks With Visible Light For Night Time TP Capability







XM1110 *M781*

Micro Electro-Mechanical S&A (MEMS)

Goal: Develop Mechanical safety and arming (S&A) device and explosive ink writing technology for the M433 & M430A1 40mm HEDP cartridges

- New fuze with electronic initiation, improved target sensing, self-destruct capability, command-arm-enable function, more accurate arming distance, lower volume & cost
- Improved reliability on soft targets and in graze impacts using paired MEMS omnidirectional impact sensors (g-switch)

Objective:

- Reduced fuze volume
- Equal to or better Lethality and penetration
- Improved reliability on soft targets (snow, grass)/graze angles
- Reduced tolerance on arming/non-arming distance



Future Plans

- Develop Materiel Solutions to Meet Gaps
  - Extended Ranges
  - Marking
  - Training
  - Door Breaching
- Continue Weight Reduction Efforts
- Incorporate Technological Improvements
  - Lethality
  - Insensitive Munitions Technology
- Mature Relationship With PEO Ammo


PROJECT MANAGER
SOLDIER WEAPONS
PROJECT MANAGER
SOLDIER WEAPONS
THE BEST
FOR THE BEST

NAVSEA
WARFARE CENTERS
CRANE

U.S. Navy Small Arms Ammunition Advancements

Presented by:

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Ph: (763) 323-2392
Email: david.leis@ATK.com



DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

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7.62MM Special Ball, Long Range

MK 316 MOD 0

DODIC: AB39

NSN: 1305-01-567-6944



DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

7.62MM Special Ball, Long Range

Shortfall

- Accuracy inconsistencies in the M118LR cartridge were identified
  - Joint working group failed to correct deficiencies

Objective

- NSWC Crane tasked to develop a cartridge to better meet user requirements
  - Consistent lot to lot accuracy (Minute of Angle (MOA))
  - Function in new and existing gas operated sniper weapons



MK 11 MOD 2



MK 17 Sniper Support Rifle (prototype)

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

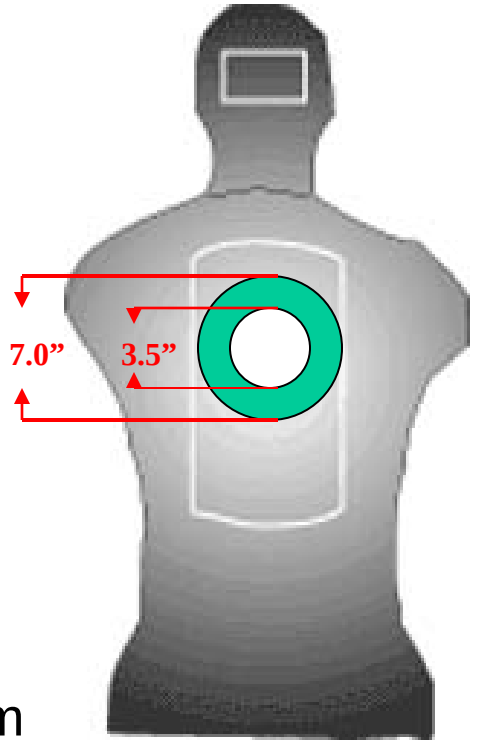
7.62MM Special Ball, Long Range

Objective (continued)

- Flash reduction

Specification Development

- Accuracy requirement based around 10 round shot groups
  - 7.0 in extreme spread max avg @ 600 yds (1st Production Lot)
  - 3.5 in extreme spread max avg @ 300 yds (after 1st Production Lot)
- Velocity standard deviation 15 fps maximum
  - A lower value equates to less vertical extreme spread at long range



DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

7.62MM Special Ball, Long Range

Specification Development (continued)

- Flash reduced and temperature stable propellant
  - Comparable performance -25 F to +165 F
- Each production lot consists of a single lot of projectiles, cases, propellant, and primers
  - Ensures consistency across lots



Accuracy Test Equipment

Solicitation for Contract

- Full and open competition
- Projectile open to weights of 150 to 200 grain
- Product bid samples tested for:
  - Accuracy, Pressure, Velocity, etc

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

7.62MM Special Ball, Long Range Development

- Desired performance requirements communicated:
  - Accuracy, accuracy, accuracy…
  - Function & casualty and muzzle flash requirements in both bolt action and semi-automatic rifles
  - Extreme temperature stability
  - Supersonic past 1,000 yards, etc.
- Federal Cartridge has over 25 years experience with Gold Medal brand of match ammunition



MK 316 – 7.62MM Special Ball, Long Range

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

7.62MM Special Ball, Long Range Development

Cartridge Case:

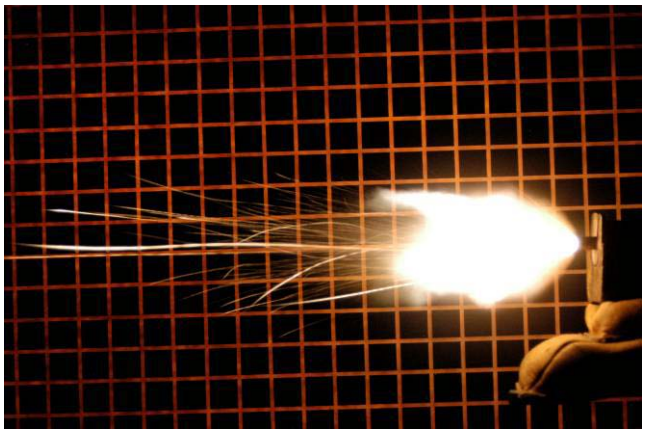
- Developed a new, 7.62mm Match Cartridge case from our experience with 308 Win. Gold Medal match cartridge

Primer:

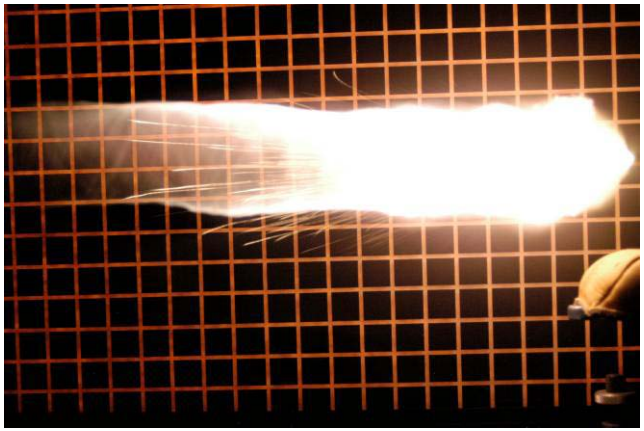
- Federal Cartridge Company's Gold Medal Match Primer was selected

Projectile:

- Over 15 different projectile designs were tested
- Sierra MatchKing, 30 caliber – 175 grain projectile was selected



FCC Gold Medal Match Primer Assembly (Lead Styphnate based)



Other Match Primer Assembly (Excessive Flame from Over-Pressure from PETN)

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

7.62MM Special Ball, Long Range Development

Propellant

- Over 20 different existing propellants and new propellant blends were evaluated
- A modified extruded propellant was utilized

Manufacturing Process:

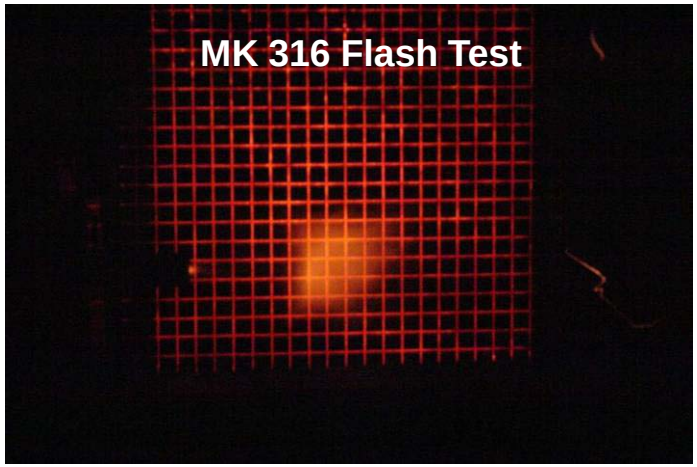
- Cartridge can be assembled on conventional high speed loading equipment
- Unique quality controls and test plan were established for manufacturing this cartridge

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

7.62MM Special Ball, Long Range

Results

- Contract award to FCC
- 175 grain Sierra MatchKing® Projectile
- Propellant stable across operational temps
  - -25 F to +165 F
- Reduced flash propellant
- Performance consistency



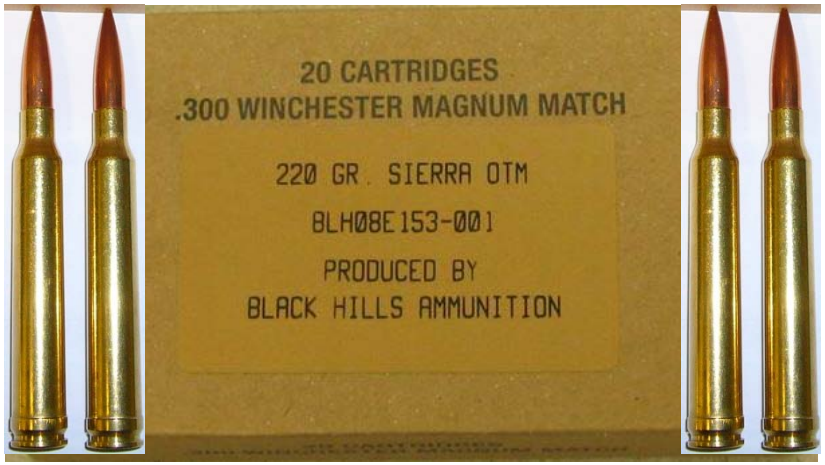
MK 316 New Production Lot Acceptance Results

LOT #	600 Yard Accuracy (in)	300 Yard Accuracy (in)	Velocity Std Dev (fps)
FCC09A750-001	4.8		11
FCC09B750-002		1.612	15
FCC09B750-006		1.833	14
FCC09C750-007		1.859	13
FCC09C750-008		1.721	13

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

NAVSEA
WARFARE CENTERS
CRANE

.300 Winchester Magnum Match Product Improvement (PIP) MK 248 MOD 1 DODIC: AB43 NSN: 1305-01-568-7504



Harnessing the Power of Technology for the Warfighter

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

.300 Win Mag PIP

New Requirement

- The current 190 gr. .300 Win Mag cartridge, DODIC A191, has a published effective range of 1200 yds (1100 m).
- New requirement established a 1500 yds (1370 m) effective range
  - Initial tasking was to develop a 250 gr. .338 Lapua Magnum cartridge.

Objective

- Extend effective range from 1200 yds to 1500 yds (1370 m)
- Decrease the effect of wind drift on the projectile
- Flash reduced and temperature stable propellant -25 F to +165 F

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

.300 Win Mag PIP

RDT&E

- Research indicated that objectives could be met with .300 Win Mag
- Obtained prototypes
  - 210 gr. Sierra MatchKing® VLD .300 Win Mag
  - 220 gr. Sierra MatchKing® .300 Win Mag
  - 250 gr. Scenar .338 Lapua Mag
  - 250 gr. Sierra MatchKing® .338 Lapua Mag
  - 300 gr. Sierra MatchKing® .338 Lapua Mag
- Pressure, velocity, and 1000 yd accuracy testing conducted

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

.300 Win Mag PIP

RDT&E (continued)

- Results
  - Accuracy
    - All rounds performed similarly with exception of the 300 gr. .338 Lapua Mag.
  - Velocity
    - Comparable velocity retention between 250 gr. .338 Lapua Mag and 210/220 gr. .300 Win Mag

Mean Values	.300 Win Mag			.338 Lapua Mag		
	190 gr. Sierra	210 gr. Sierra	220 gr. Sierra	250 gr. Sierra	250 gr. Scenar	300 gr. Sierra
Muzzle Velocity (fps)	2,936	2,864	2,879	2,831	2,814	2,701
Velocity @ 1000 yds (fps)	1,470	1,557	1,550	1,594	1,544	1,657

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

.300 Win Mag PIP

Down Select

- 220 gr. Sierra MatchKing® .300 Win Mag
  - Meets objectives
  - Can be fired in existing weapons
  - Less sensitive than the 210 gr. VLD
  - Comparable accuracy and velocity retention to the 250 gr. .338 Lapua Mag
  - Significant cost savings over the .338 Lapua Mag



MK 13 MOD 5

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

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CRANE

.300 Win Mag PIP

Results

- Increased effective range to 1,500 yds
- Reduced wind deflection
- Propellant stabile across operational temps (-25 F to +165 F)
- Comparable accuracy to existing A191
- Contract estimated award of June 09

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

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CRANE

5.56MM	7.62MM
Cartridge, Caliber 5.56mm Ball, Carbine, Barrier	Cartridge, Caliber 7.62mm Ball, Rifle, Barrier
MK 318 MOD 0	MK 319 MOD 0
DODIC: AB49	DODIC: AB50
NSN: 1305-01-573-2229	NSN: 1305-01-572-8492



DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

5.56MM & 7.62MM Enhanced

5.56MM & 7.62MM Enhanced

- AA53 MK 262 & MK 12 Special Purpose Rifle (SPR) Fielded late FY01 (Post 9/11)
- Post 9/11 reports of ineffective ammunition (specifically M855 w/M4A1)
- April 02 received funding for terminal study (M855, MK 262, M193, M995 and COTS 87 gr.).
- Joint Service Wound Ballistics (JSWB) IPT 1st meeting 28 April 03.

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

5.56MM & 7.62MM Enhanced

5.56MM & 7.62MM Enhanced (Continued)

- SCAR JORD included “Enhanced Ammunition”
- Enhanced ammunition program funded July 05
- Developmental contract awarded to ATK Sept. 06.
- Key performance characteristics derived from knowledge obtained from participation in JSWB IPT
- SOST developmental contract final report & proof of concept rounds delivered August 07.

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

NAVSEA
WARFARE CENTERS
CRANE

5.56MM & 7.62MM Enhanced

Objective

- Develop ammo & weapon as a SYSTEM
- Incorporate lessons learned from JSWB IPT.

Performance

- Consistency; shot to shot & lot to lot.
- Accuracy, Combat - NTE 2 MOA.
- Intermediate barriers; auto glass/doors.
- Terminal, specifically CQC & behind barriers.
- Cost; as close to current rounds as possible.



DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

Enhanced Cartridge Development

- Desired performance requirements communicated:
  - Behind barrier performance
  - Function & casualty and muzzle flash requirements in short barrel carbines
  - Extreme temperature stability
  - Accuracy, waterproof, cartridge configuration, etc.
- Federal Cartridge Company has over thirty years experience working with military and law enforcement customers on developing custom projectiles
- Testing begun with ATK and externally manufactured projectiles against performance requirements

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

Enhanced Cartridge Development

- New projectile developed from technology utilized in current law enforcement projectile
  - Front of bullet is designed to help defeat barrier
  - Back of bullet is solid copper and acts as a rear penetrator
- Short barrel propellant was specifically designed for this cartridge configuration
- Test results are positive
- Cartridge is compatible with various 5.56mm and 7.62mm firearms
- Projectile can be manufactured on conventional bullet assembly machinery and it can be assembled on high speed loading equipment



5.56mm Ball, Carbine, Barrier - MK 318 MOD 0



7.62mm Ball, Carbine, Barrier - MK 319 MOD 0

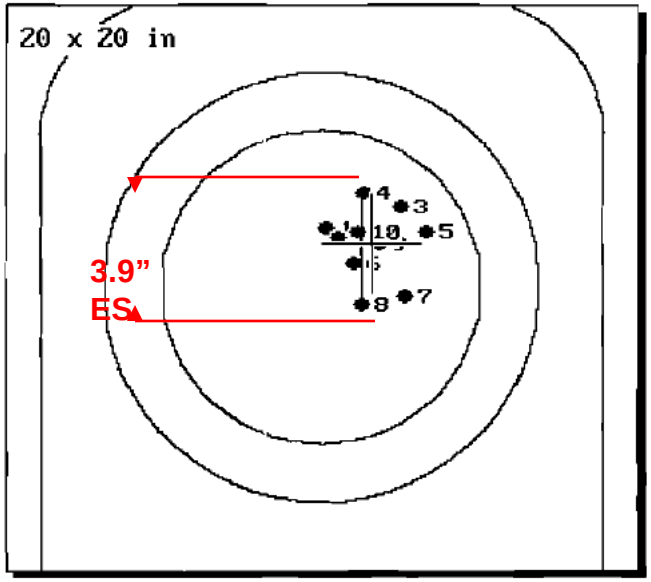
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

5.56MM & 7.62MM Enhanced

Accomplishments

- ✓Consistency; shot to shot & lot to lot
- ✓Accuracy, combat - NTE 2 MOA. (600 yds)
- ✓Intermediate barriers; auto glass/doors.
- ✓Terminal, Specifically CQC & behind barriers
- ✓Cost: as close to M855 and M80 as possible.

ACCURACY



5.56 Enhanced 300YD
3.9 IN. EX. SPREAD

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

NAVSEA
WARFARE CENTERS
CRANE

5.56MM & 7.62MM Enhanced

AB49, MK 318 MOD 0
(5.56MM Enhanced)

- 62 grain OTM (reverse draw jacket) bullet
- Temp stable flash reduced propellant
- Not yaw dependant
- Optimized for MK 16 (14” BBL)
- 2925 fps @ 15’

AB50, MK 319 MOD 0
(7.62MM Enhanced)

- 130 grain OTM (reverse drawn Jacket) Bullet
- Temp stable flash reduced Propellant
- Not yaw dependant
- Reduced recoil (10%)
- Optimized for MK 17 (16” BBL)
  - 2925 fps @ 15’
  - 2750 fps @ 15 (13” CQC BBL)

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

NAVSEA WARFARE CENTERS CRANE

5.56MM & 7.62MM Enhanced

Scheduled Availability

- 260K rounds 5.56MM, 750k rounds 7.62MM under a one year Limited Release to support MK 16/17 LRIP fielding
- Safety Testing for full type qualification in process. Completed by Sept. / Oct. 09
- Contract Award – Nov. 09 / May 10 (will know more by 5/8/09)
- Initial contract deliveries, full fielding capability – 1st/2nd Qtr 10.

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited

NAVSEA
WARFARE CENTERS
CRANE

Questions?

Also available at booth #620

MECAR

MECAR
USA



The M200 HEDP

A new generation of rifle grenade

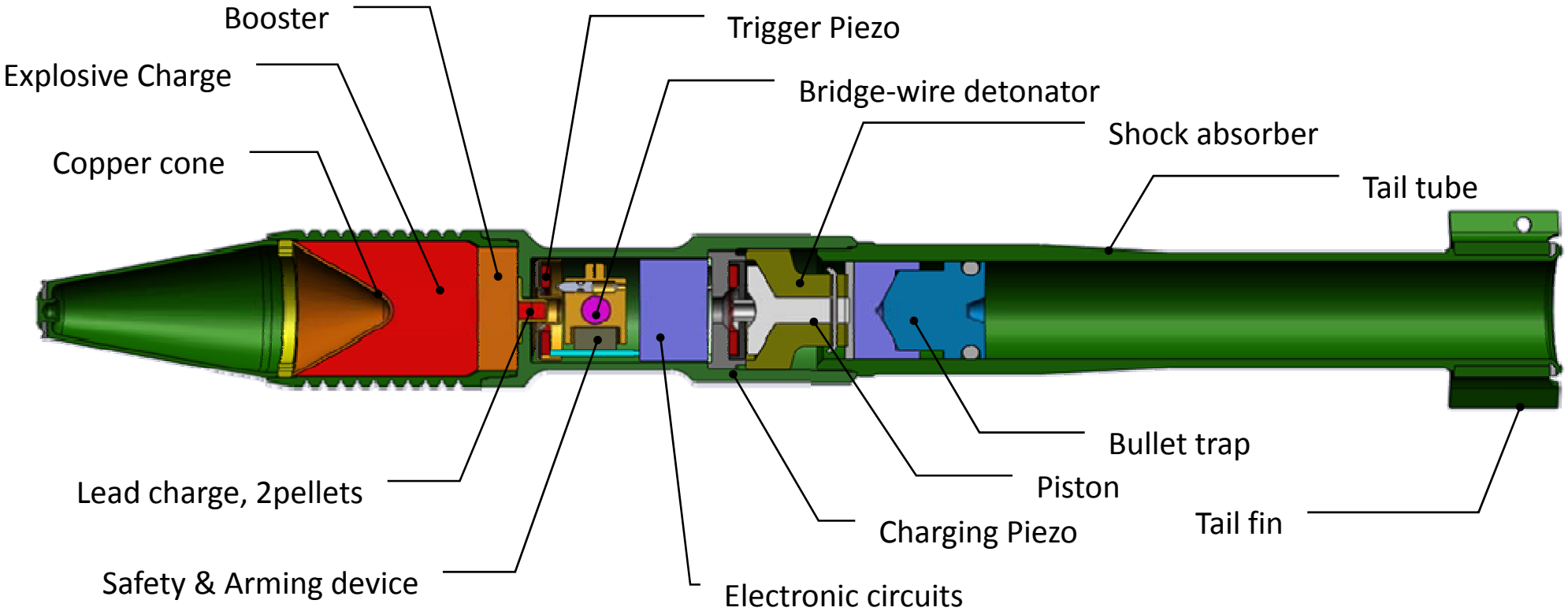
Background

- Modern references to the rifle grenade start in the 1904 Japan – Russia war
- Used in Second World war but reached a peak usage in Korean War
- Displaced by 40mm grenade launcher
- Still used extensively by some defense forces
- Resurgence of interest, as additional weapon not alternative to M203

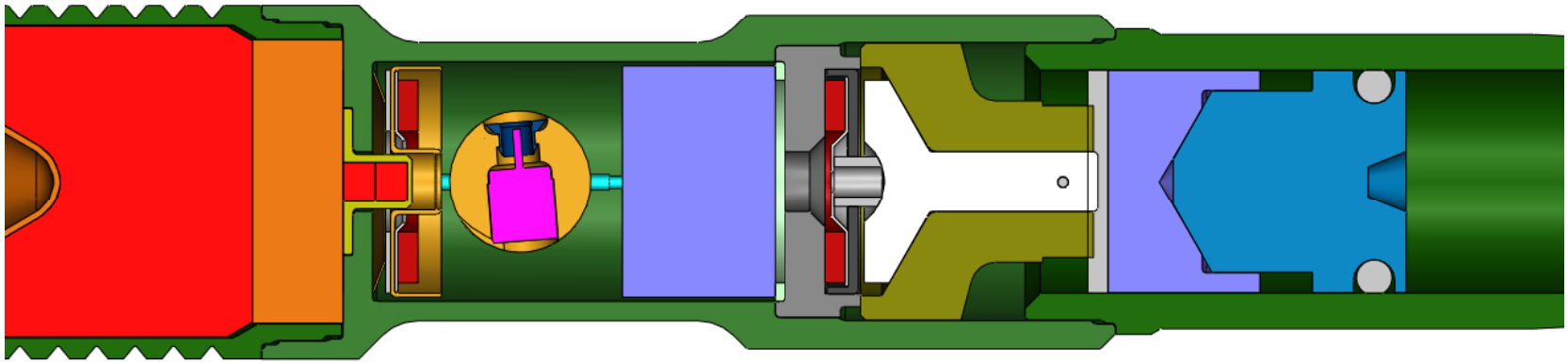
Overview

- M200 uses well proven bullet trap
  - No bullet to worry about
  - No special cartridge required, fires with standard 5.56 or 7.62
- No launcher required
  - Grenade slips over flash hider
  - No added bulk to weapon
  - Every soldier in the squad has one
- Electronic fuze
  - MIL-STD-1316 – Two totally independent arming environments
  - Fast acting base detonating fuze ideal for shaped charge
  - Excellent graze sensitivity
  - Self sterilization – impossible to rearm

Overview


Booster
Explosive Charge
Copper cone
Trigger Piezo
Bridge-wire detonator
Shock absorber
Tail tube
Bullet trap
Piston
Charging Piezo
Tail fin
Lead charge, 2pellets
Safety & Arming device
Electronic circuits

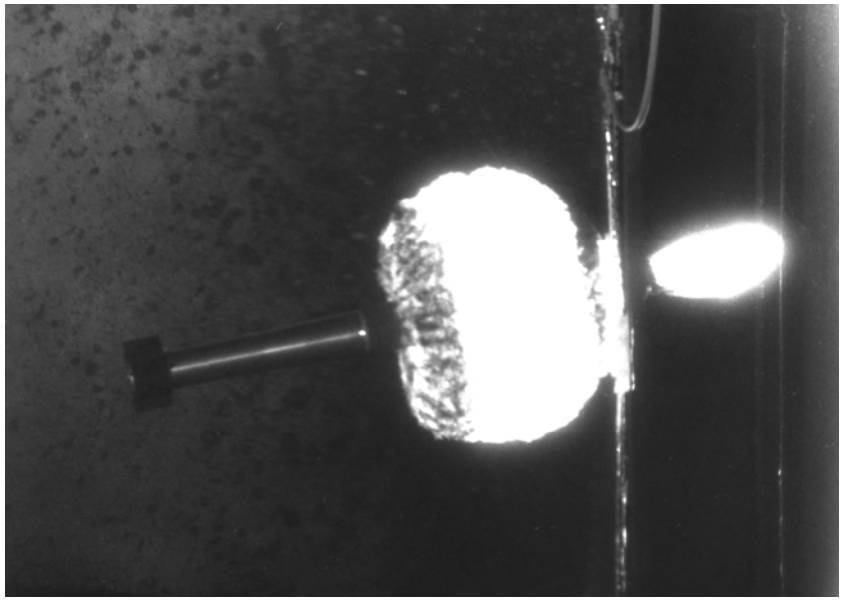
Fuze Arming

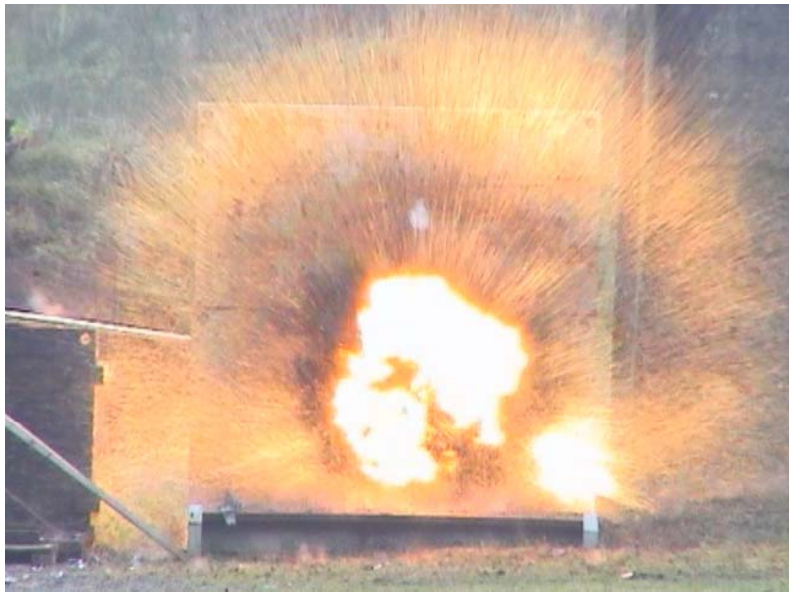


- No stored energy
- Bullet impact
- Charge generated by piezo
- Acceleration of grenade due to gun gas

- Safety and arming brings detonator in line
  - 120 msec
  - 6 – 8 m
- Electronic delay allows firing circuit to be active
  - 290 msec
  - 10 – 20 m

Fuze Functioning





- On impact trigger piezo closes firing circuit
  - Shock travels at sound speed through body
  - Acts on 1mm cardboard
- Shaped Charge capable of penetrating 80mm RHA
- Fragmentation comparable classic hand grenade
- Sterilization after 40 sec in event of soft landing

Enhancing small arms effectiveness



LIGHTWEIGHT AMMUNITION DESIGN - 8550

Kevin Brown, VP Government Relations, Colt Defense LLC
Vincent Battaglia, VP Operations, BML Tool & Mfg. Corp

National Small Arms Conference - 9610

Las Vegas, Nevada

20 May 2009

Introduction

- NSAC Contract Award
- Colt / BML teaming relationship
  - Colt Defense is a leading designer, developer and manufacturer of small arms and weapons systems for the U.S. Military, its allies and federal, state and local law enforcement agencies.
  - B.M.L. Tool & Mfg. Corp. has been serving the Metal Stamping industry for over thirty years with critical application tooling and parts and offers full engineering services for all needs including tool & die design as well as product design.
- Introduction of nontraditional suppliers
- Introduction of speaker

Overview

- Purpose of presentation
- Modular case concept
- Prior art
- Patents pending
- Development of alternatives
- Project growth
- Future efforts

Agenda

- Problems with current ammo
- Casing technology improvements
  - Modular case
  - Spiral case
- Benefits
- Next steps

Change is needed in ammo manufacturing

- Develop sub component to fast assembly systems and process
- Target goal:
  - 80% sub component
  - 20% live ammunition
- Dramatic culture change required to modernize current ammunition manufacturing activities.
- New Standards and Specifications need to be developed.



Design & development objectives

- Create manufacturing systems to allow JIT manufacturing.
- Partial mitigation of yearly “LIVE AMMO” supply through sub-component stock pile and “AS NEEDED” assembly.
- Consider GREEN components in both casing and Projectile materials.
- Reduce weight! Ammo is in top 4 of items (by weight) carried by the individual soldier/Marine.
- Scale: develop manufacturing systems for small arms through mid cannon caliber ammunition (5.56mm – 40mm).
- Need to recognize fiscal realities, costs need to deflate while capabilities inflate.

Specific problems with casings

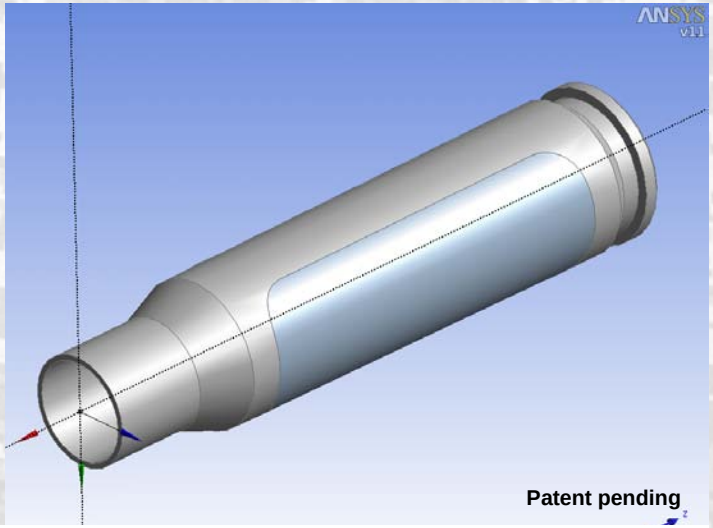
- Brass has many positive aspects:
  - Heat transfer/extraction
  - Elasticity
  - Strength
- But there are negatives:
  - Weight (firepower)
  - Cost
  - Corrosion



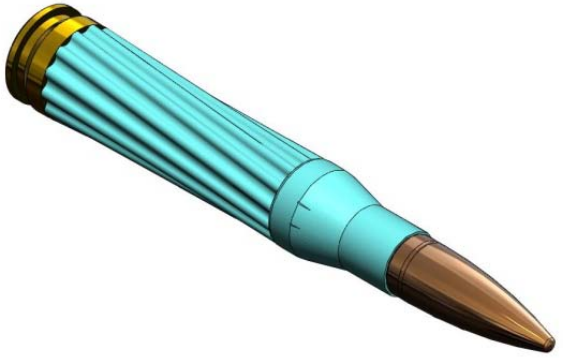


Two design solutions to casing problems

- MODULAR CASE
  - Hybrid Steel/Polymer System for 50BMG and larger munitions.
  - Can replace any conventional steel or brass bottle neck case.
- SPIRAL CASE
  - All-polymer molded case in two parts Case Body and Rim Base.
  - Primary use for 5.56 through 50BMG small arms ammunition



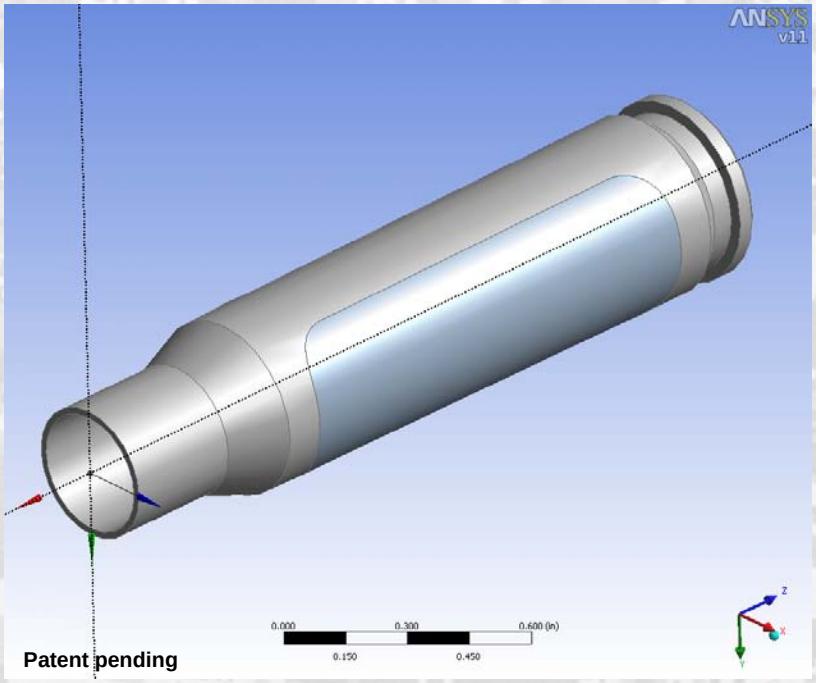
Patent pending



Patent pending

Modular case

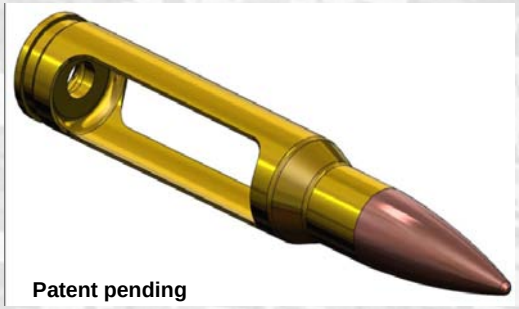
- Variant Polymer/Steel design for 50CAL through 40MM.
- Skeleton Case Metal stamping with insert molded charge vessel.
- Good weight savings in large cases.
- Very strong hoop strength.
- Modular Manufacturing for JIT or SCAMP.

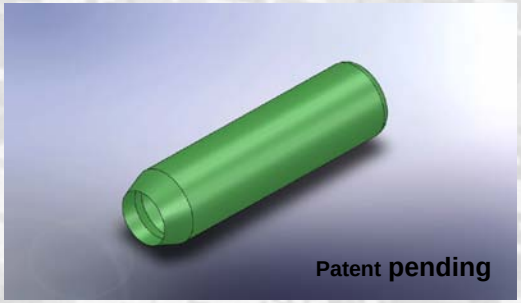


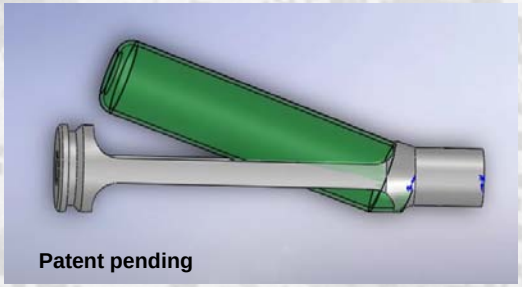
Patent pending

Separate the case from the powder!

- Skelton case portion
  - A determined progressive metal stamping of two drawn target areas rotated to a common centerline.
- Charge vessel
  - Propellant storage to charge weight, purged, covered.
  - Stored as sub-component.
- Assembly of Charge Vessel
  - dynamically inserted into the “Skeleton Case” followed by Primer for a “Live Round”.

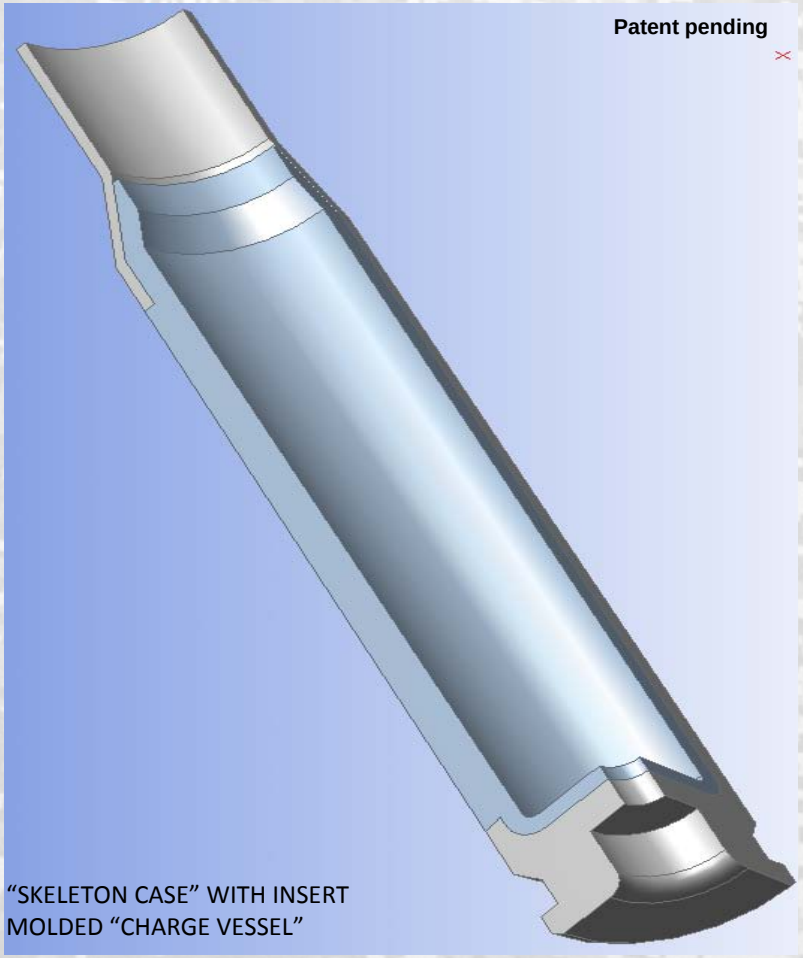






2nd variant, insert molded

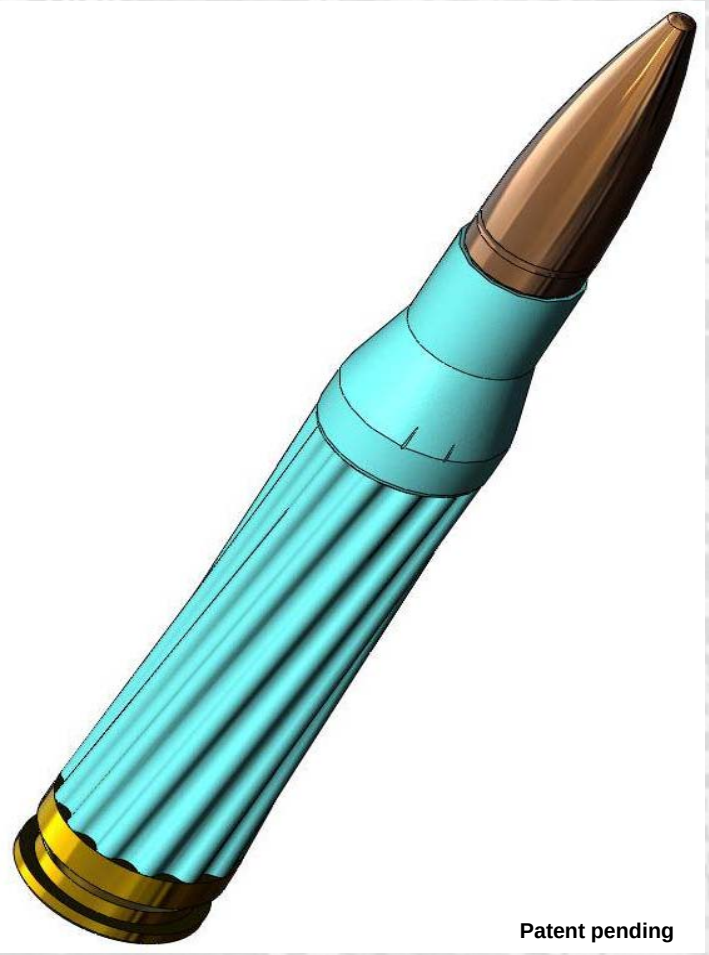
- Second mode of manufacturing with “CHARGE VESSEL” as integral insert molded operation.
- The insert molded “Charge Vessel” allows the variant case to be assembled in conventional manner.



“SKELETON CASE” WITH INSERT MOLDED “CHARGE VESSEL”

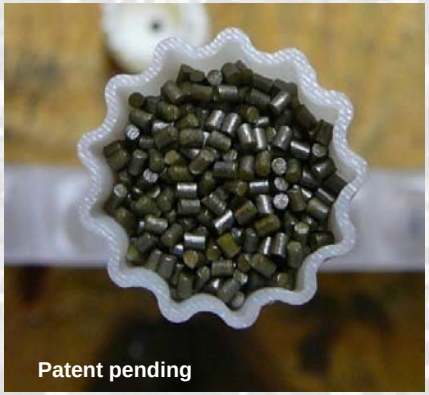
Spiral polymer case

- Benefits
  - Spiral Ribbing enhances “hoop strength”
  - eliminates “heat transfer”
  - reduces “extraction friction by 70%.
- Manufacturing process allows for conventional bullet insertion in the SCAMP line or can be insert molded with the case.



Benefits at the prototype stage

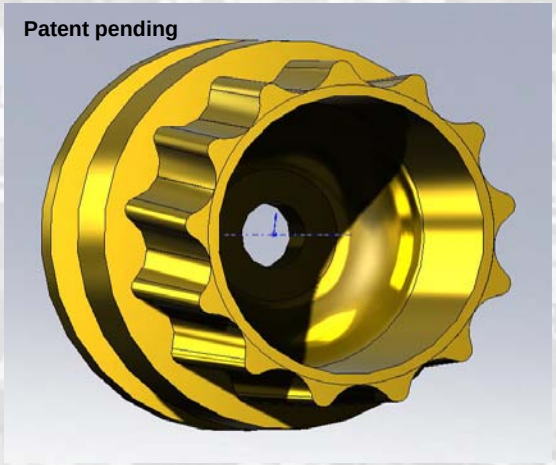
- Charge weight measurement within 5% of conventional 50BMG.
- Case weight savings of 47% over Brass.
- .091 lbs per round weight savings in 50BMG.

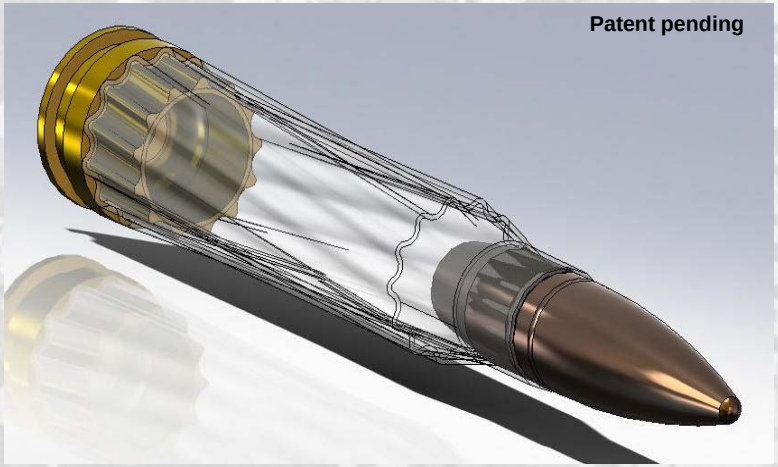




Other spiral case features

- RIM/BASE COMPONENT
  - This is a molded component with an insert stamping internal in the shape of an “H”, the bottom houses the primer with the flash hole pierced out and the top portion acts as a blast tray for ignition.
- ASSEMBLY & BONDING
  - Ribbed Perimeter adds approximately 50% more perimeter for bonding and joint strength.
  - Helical Twist of ribbing mitigates pressure force line at ignition. Also aids in the extraction sequence from the weapon.



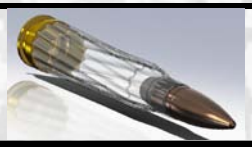


Manufacturing benefits



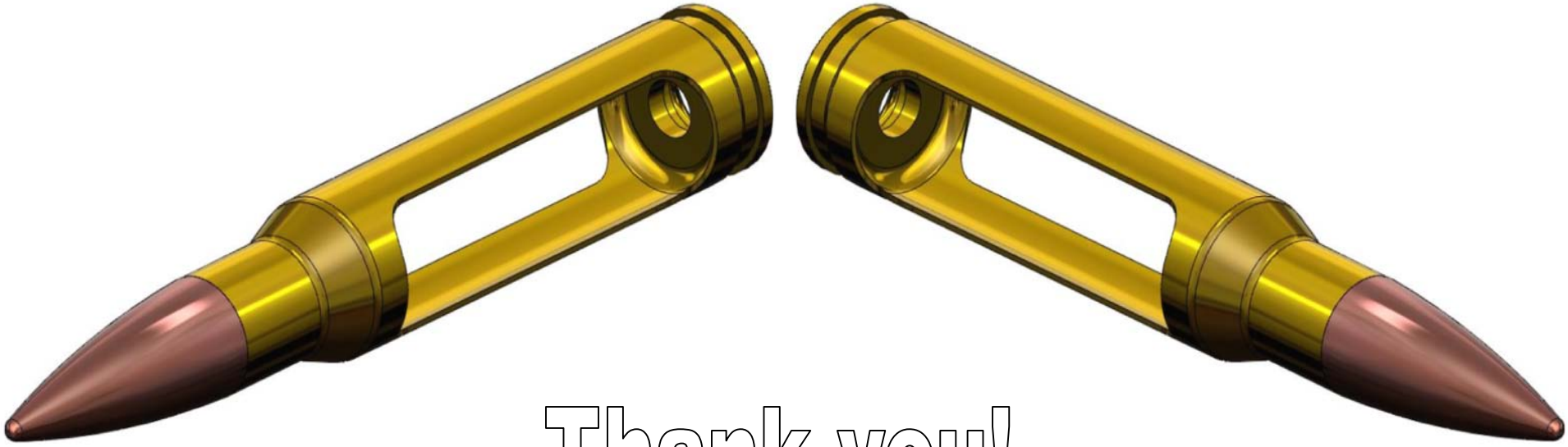
- Can be manufactured as a conventional case by bonding the rim/base to the case for conventional processes.
- Projectile can be insert molded to the case for a back fill technique.
- Modularity allows JIT and stock pile of components.
- NOT “LIVE” Ammunition.

Summary of attributes/benefits

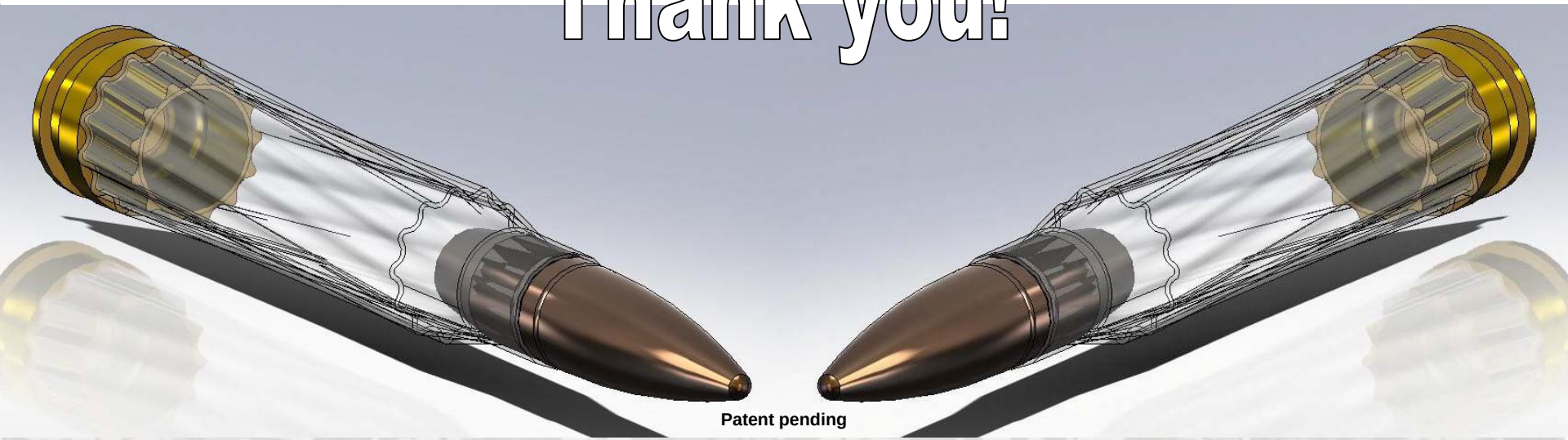
		
	Modular Case	**Spiral Case**
Best application	50 BMG – 40 mm	5.56mm – 50 BMG
Case weight saving	20-25%	40-47%
Strength	Equivalent	Equivalent
Modular manufacturing	YES	YES
Case cost reduction	~15%	0-8%

Next steps

- Complete all product and process designs.
  - Tool design and prototyping on going in early phases.
- Establish commercial partnerships with critical path vendors.
- Live fire testing at earliest opportunity.



Thank you!



Patent pending

ARROW TECH

If you can't get a bigger target...

BARNES™

Unleaded. Unfailing. Unbeatable.

Factors Affecting Small Caliber Dispersion

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435-856-1000
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Purpose

- **Enhance Warfighter Lethal Capability via Reduced Small Caliber Ammunition Dispersion**
- **Product Capability Achieved Thru:**
  - **Design**
  - **Performance**
  - **Manufacturing**
  - **Ensure Reduced Dispersion thru changes in:**
  - **High Volume Production**
  - **Specialized Weapons and Ammunition**
    - **Precision Products**
    - **Low Volume**

Why is small cal dispersion so hard to estimate?

- **Small caliber bullets in hi pressure systems operate at stress levels above projectile material yield stress**
  - **Deformed projectile shape may not be symmetric**
  - **Orientation of in-bore angle & CG offset varies shot-to-shot**
  - **"Linearity" assumptions valid for med. & large cal are not valid for small caliber**

- **Average dispersion (in mils) is small, factors not a significant influence for dispersion of medium & large cal rounds can be a large fraction of total error budget in small caliber…**

"Internal" Dispersion Factors

- **Projectile**
  - **Geometry / Mass Prop. (Quality?)**
  - **Exterior Grooves**
- **Cartridge**
  - **Projectile run out**
  - **Seating depth / free run**
- **Gun / Fixture**
  - **Barrel Flexural Properties (bending & hoop stiffness)**
- **Cartridge / Fixture Interactions**
  - **Action Time variation / Bore Straightness / Barrel Pointing**
  - **Engraving Variations**
    - **In Bore Angle / Exit Angular Rate / Effect on IB**
  - **Projectile radial stiffness / barrel bending**
  - **Bore Parameters**
    - **Groove-Land width ratio**
    - **Free run / Forcing Cone**
  - **Muzzle Blast / Base Pressure at Muzzle Exit**

"External" Dispersion Factors

- Muz. Vel. / Action Time Variations
- Projectile mass / Drag Variation
- Winds / Wind Variation
- Aiming/Boresite Variation
- Muzzle Blast
- Cant Error
- Range Measurement Error

Spinner Dispersion

$$\Theta_j = \left[\left[\left(\frac{C_{N\alpha} - C_D}{C_{m\alpha}}\right)\left(\frac{I_y - I_x}{md^2}\right)\left(\frac{d}{V_m}\right)\left(\alpha_g \bullet p_m\right)\right]^2 + \left[\Delta_{CG} \bullet \frac{p_m}{V_m}\right]^2\right]^{\frac{1}{2}}$$

Aero's | Mass Prop. | "Scale" | Angular Rate | Cross Vel.

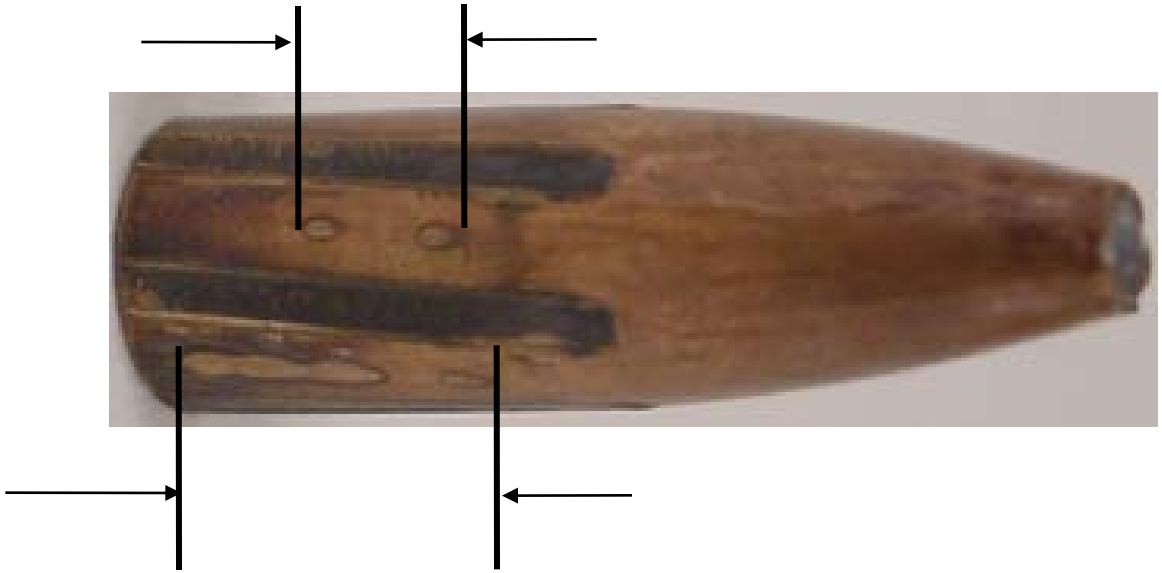
- Transverse Moment of Inertia
- Separation between CG & CP
- Run out of inner cavities or core relative to the bourrelet
- In-Bore Clearance
- Bourrelet Length
  - The last 3 above factors combine to produce CG offset and tilt of the principal axis

-----Factors which are not very important

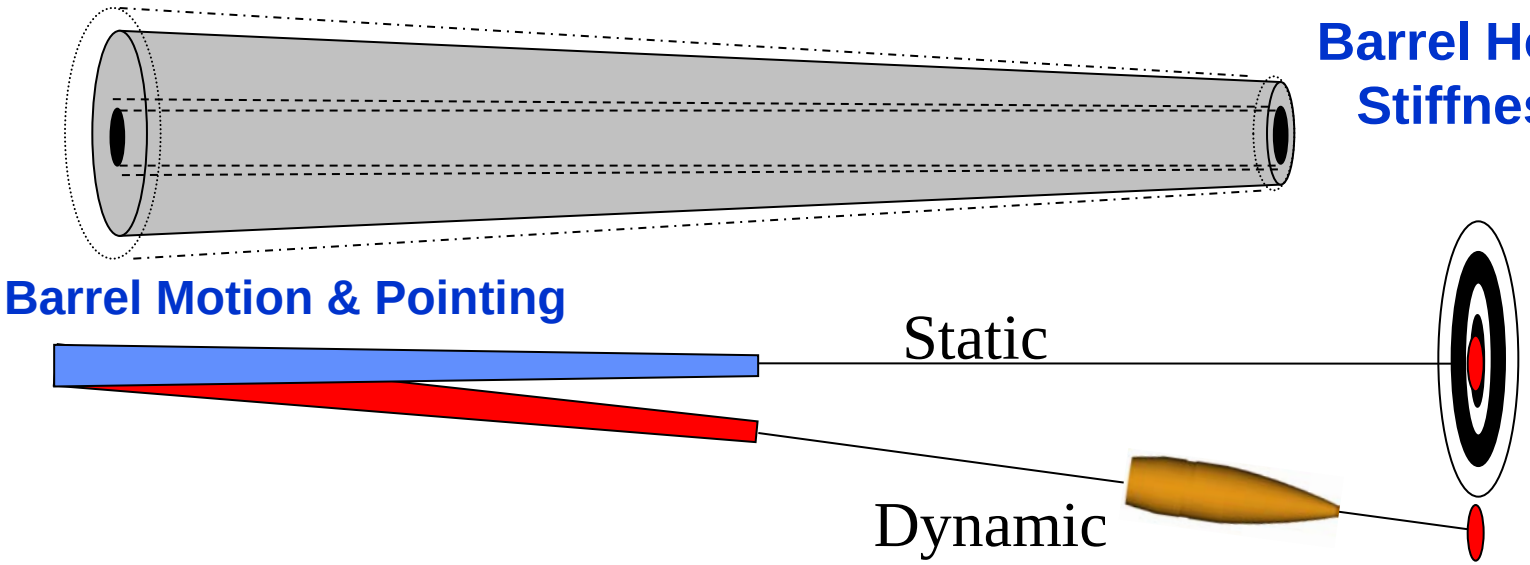
- Gyroscopic Stability (must be above 1)
- Dynamic Stability
- Aerodynamic asymmetries (provided Axis Tilt & CG offset not affected)

Why is there Small Cal Dispersion?

- Projectile body is nominal interference fit w/ lands, but…
- Elastic deflection of bore due to internal pressurization allows the projectile to tip in-bore relative to bore centerline
- Random orientation of projectile in-bore angle and random magnitude of in-bore angle applies loads to the barrel which affect barrel pointing and cross velocity @ muzzle exit.

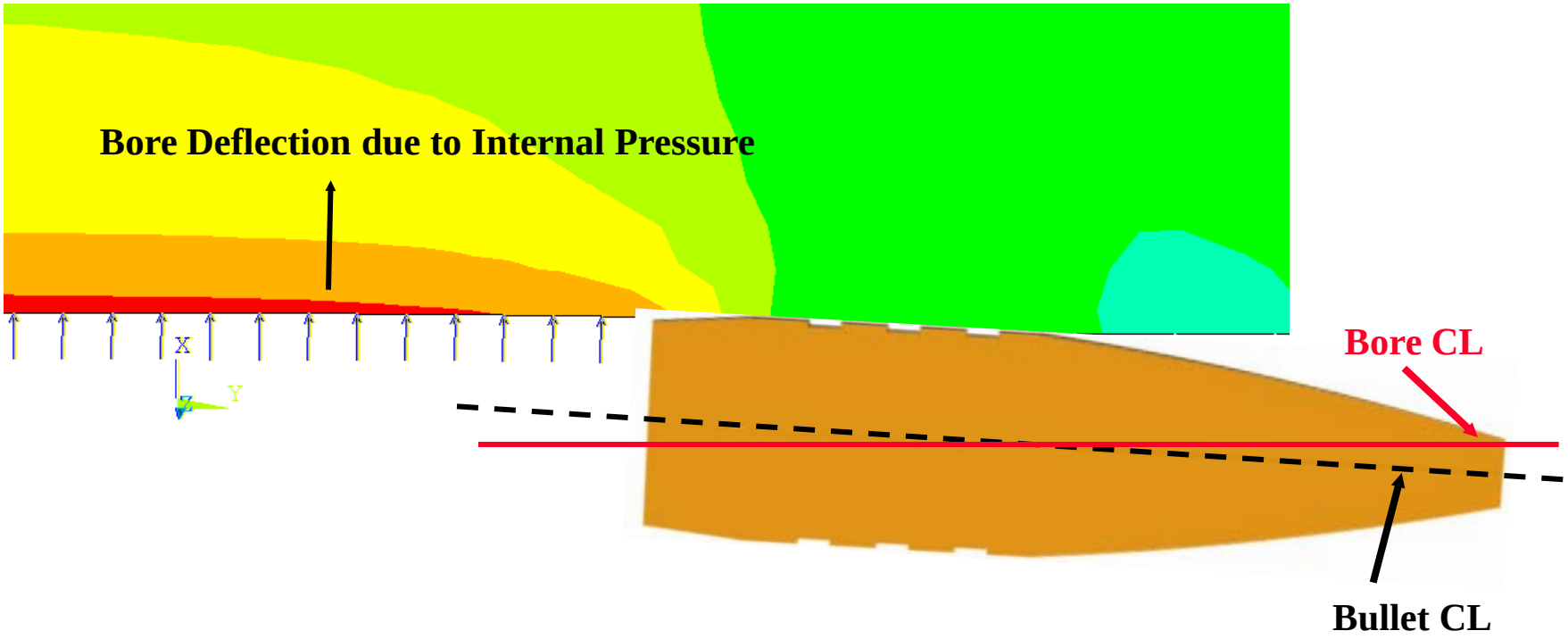


Barrel Hoop & Bending Stiffness



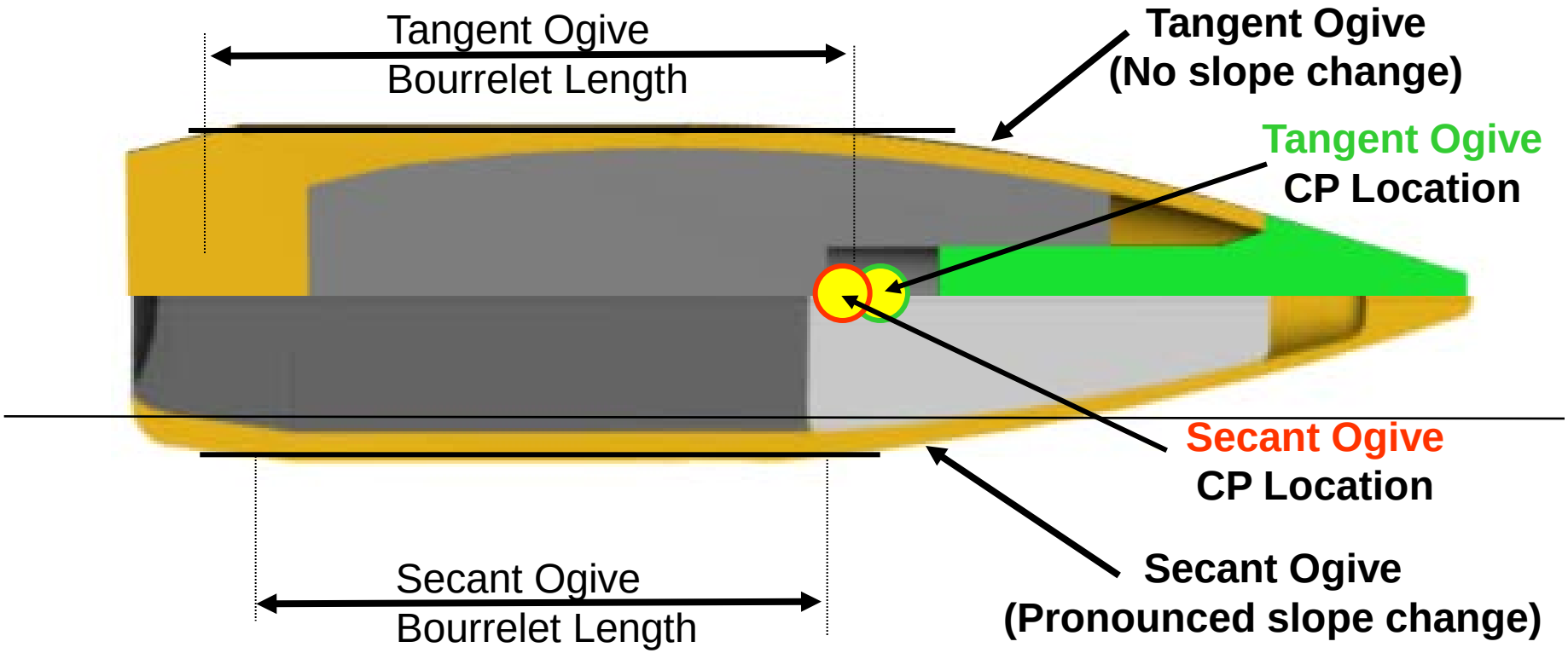
- **Gun barrel diameter grows elastically in response to internal pressurization**
  - **OD influences ID growth**
- **Projectile Tips in Bore due to ID Growth**
- **Projectile tilt / CG offset / spin during early in-bore travel drives barrel transverse motion**

Projectile/Barrel Interaction



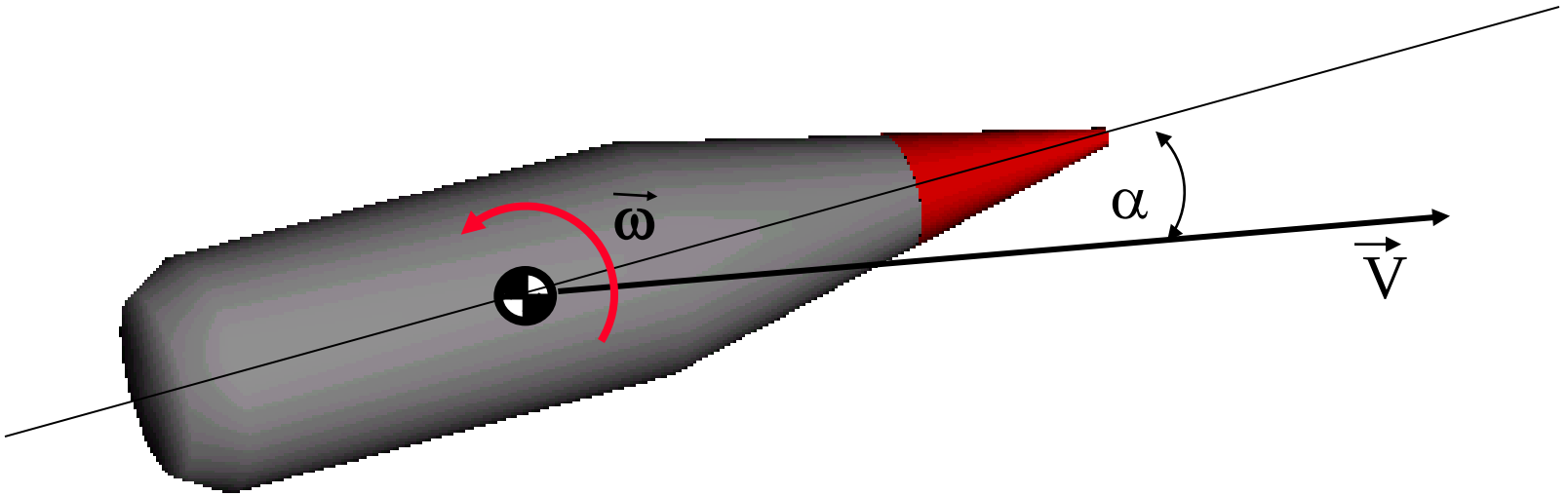
- Forward bourrelet controlled by (undeflected) barrel lands
- Aft bourrelet has clearance caused by bore deflection due to internal pressure
- Bullet CG Offset & Tilt, combined w/ spin forces barrel vibration…

Land Interface & Ogive Geometry



- Tangent Ogive Moves CP Fwd ~ 0.2 Caliber, ~ 20% dec. in Jump Sens.
- Ogive Geometry Has Effect on Bourrelet Length
  - Tangent ogives have longer contact length = lower in-bore angle

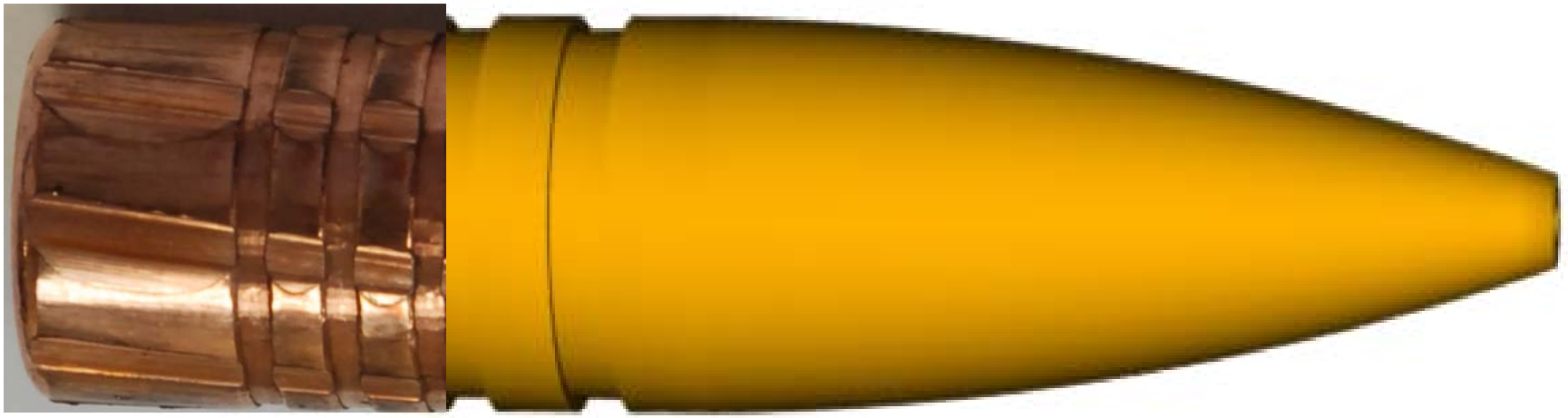
Initial Angle of Attack & Initial Angular Rate



- **Initial angle of attack (α) with respect to initial velocity vector at muzzle release**
  - **Bad news: difficult to measure**
  - **Good news: usually small, and effect on dispersion (~10%) is small even for large angles**

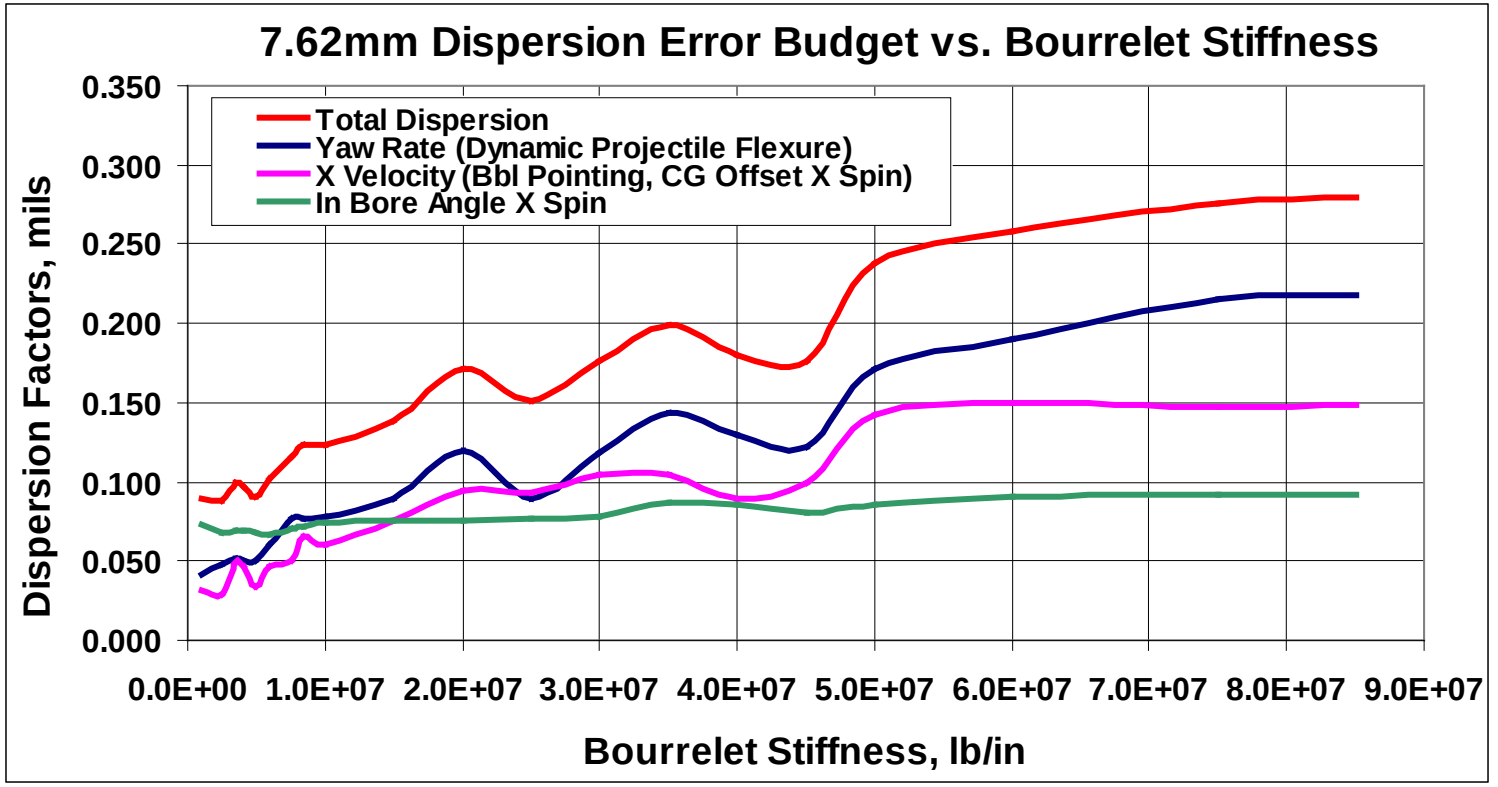
- **Initial Angular Rate (ω):**
  - **THE major dispersion source (~ 75% +)**

External Grooves



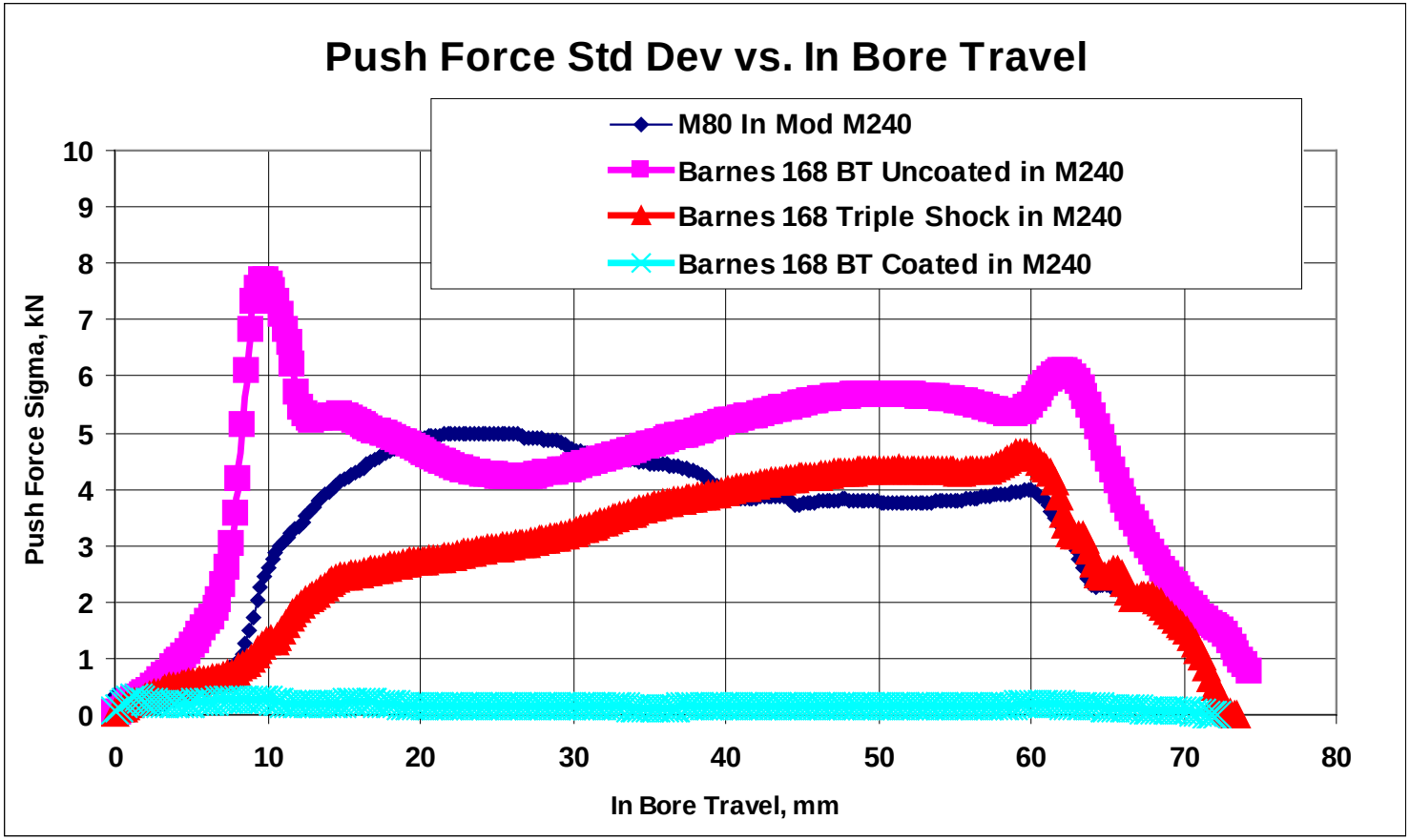
- **External Grooves provide clearance for body material displaced during engraving**
  - **Prevents tipping of projectile in bore during engraving**
- **Reduces radial stiffness relative to same bullet w/o Grooves (see next slide)**
- **Empirical evidence: no benefit if grooves are > Land diameter**

Bourrelet Stiffness vs. Dispersion



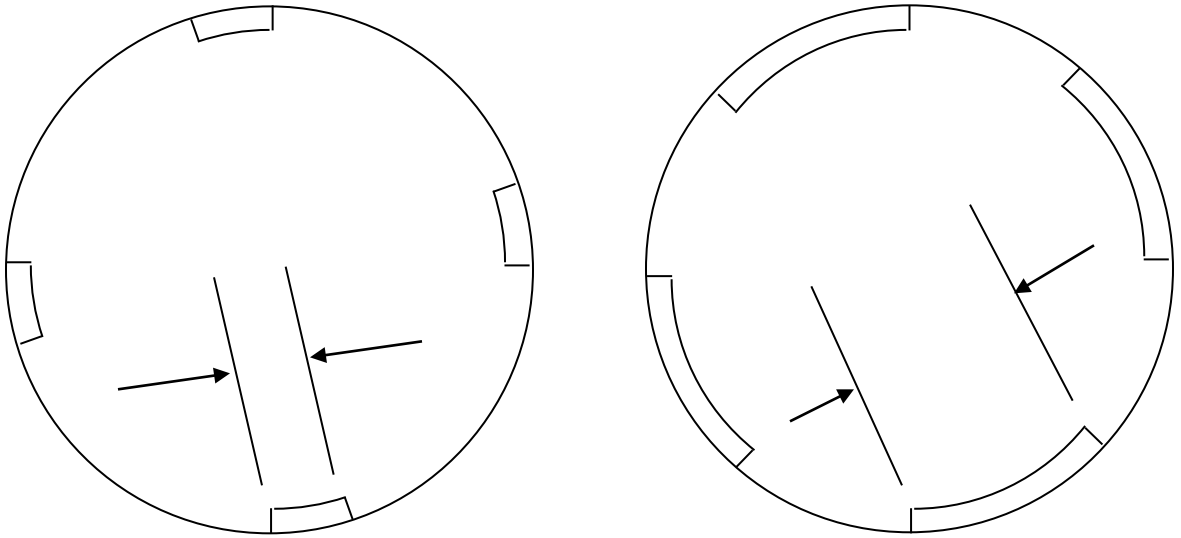
- **Disp. @ 5m lb/in is <40% of Disp. @ 50 m lb/in.**
- **Analysis assumes solid copper projectile….**
- **Unique response map for each bullet/fixture combination**

Engraving Variation



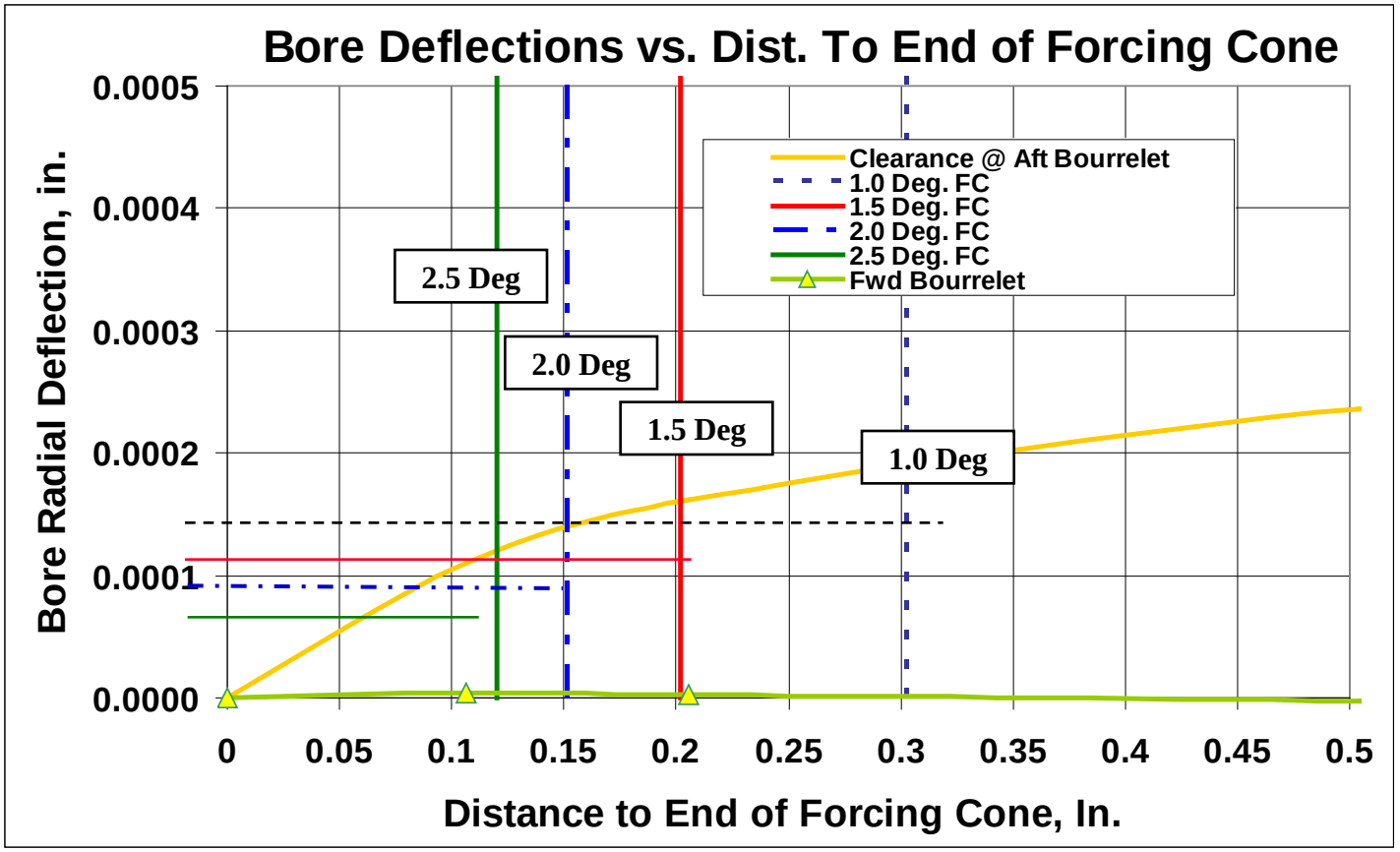
- **Increased Engraving Std. Dev = Inc. MV & Action time Variability**
- **Both can have an effect on barrel dynamics & dispersion**

Barrel G/L Width Ratio



- **Low G/L Width Ratio = Wider Lands**
- **Provides Inc. In Bore Control = Dec. Dispersion**

Bore Growth vs. Forcing Cone Angle

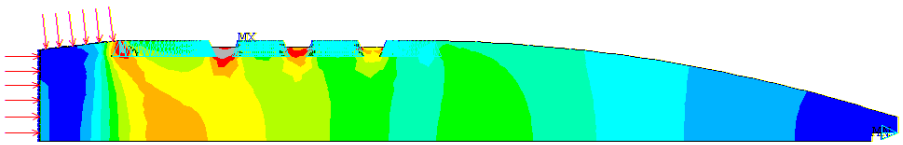


- **Shallower Angles = Inc. press. & inc. bore defl. @ all engraved**
- **Inc. projectile material remains @ end of engraving, reducing in-bore angle down bore**

Free Run & Bullet Construction

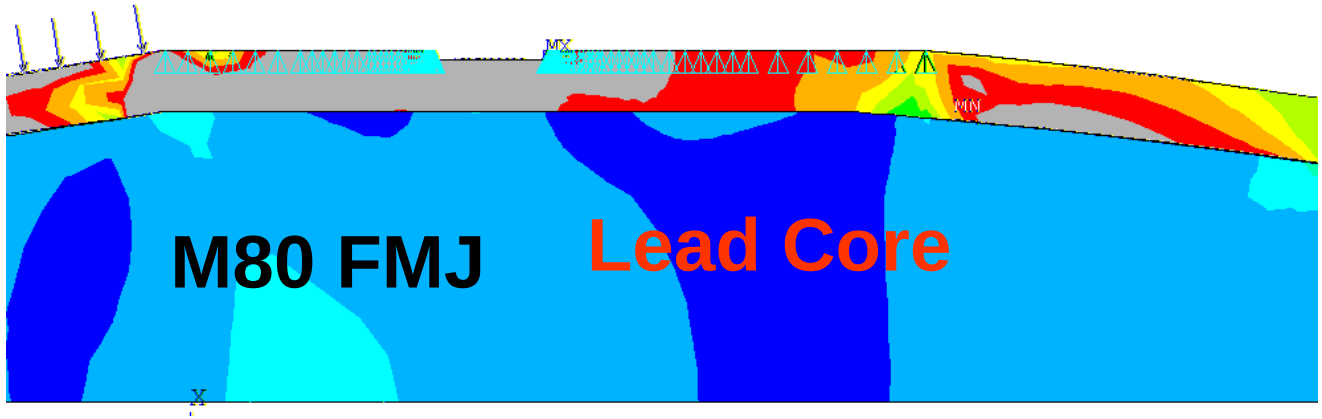
- **Solid Bullets shoot smallest dispersion w/ 0.050"-0.080" Free run**
- **"Conventional" Drawn Copper Jacket / Lead Core bullets shoot smallest dispersion w/ 0.015-0.030" free run**
- **Details dependent on:**
  - **Case volume & propellant rise rate**
  - **Yielding/deformation of jacket and / or core resulting from accel.**
  - **Travel until projectile side wall is fully supported**
  - **Details of bore elastic deflection during engraving**

30 Cal Von Mises Stress @ 60 KPSI



Barnes 168g TSX

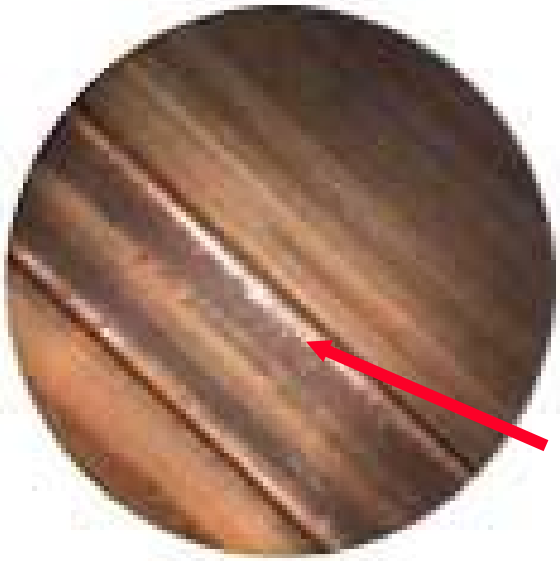




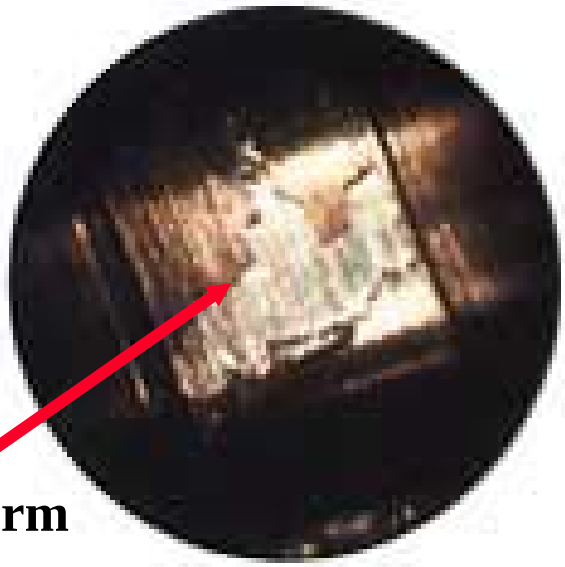
- Jacketed Bullet has higher stresses @ rifling interface
- What is Yield Strength of body/jacket/core?
- Earlier support (e.g. less free run) required for lead bullet to limit asymmetric deformation due to low mat'l Y.S.

Jacket Deposits on Lands

Bore Photos From:
www.gradientlens.com



Relatively Uniform Deposition



Non-Uniform Deposition

- **Non-uniform deposition causes local, asymmetric variations in bore straightness, varies shot-to-shot**
- **Generates lateral loads on projectile & barrel**
- **Creates increased variations in projectile angular rate & bore pointing vector at muzzle release**
- **Exit Conditions vary shot-to-shot, causing dispersion**

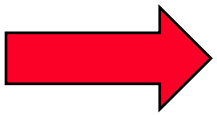
Summary
Design Factors

- **Ammunition Parameters:**
  - High Quality Projectile & Cartridge
  - Projectile Material Properties Selected for Mission
  - Radial Stiffness Appropriate for Weapon
  - Reduce Engraving variability
  - Reduce Jacket Melting / Deposition
  - Appropriate Projectile "Free Run"

- **Barrel Parameters:**
  - Shallow Forcing Cone
  - Increased Land Width
  - Appropriate Hoop & Bending Stiffness

Wrap-Up Conclusions

- **Established and Quantified Ammunition and Weapon Interaction Parameters Which Drive Dispersion**
  - **Dispersion Capability**
  - **Repeatability**
- **Priorities Established for Ammunition and Weapons**
  - **Design**
  - **Performance Guidelines**
  - **Production**
  - **Maintenance**
- **Parameter Impact confirmed by Analysis and Test**
  - **Expanded Test Approach Established**



Factors Identified are Compatible with Volume Manufacturing and Applications

Warfighter Benefits

- **Reduced Dispersion**
- **Uniformity of Performance Across Lots**
- **Establish Design & Manufacturing Criteria for:**
  - **Weapon**
  - **Ammunition**

Enhance Small Arms Effectiveness in Current and Future Operations

Modeling of Gas Flow and Heat Transfer in Small Arms Weapons Systems



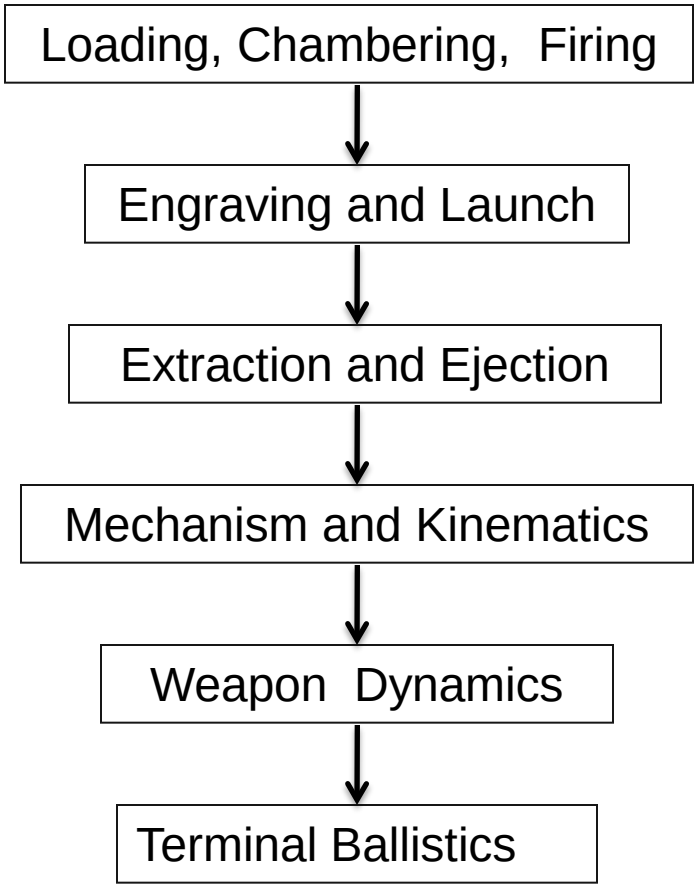
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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US ARMY ARDEC
Picatinny Arsenal, NJ
laurie.florio@us.army.mil
May 20, 2009

Topics Covered

- Modeling and simulation in small arms systems
  - Goals and capabilities
  - Advantages
- Gas flow and heat transfer in small arms systems
  - Barrel heating
  - Muzzle devices
  - Gas flow internal to weapon systems
- Conclusions
- Future work

Virtual analysis of weapon function



Fluid flow and heat transfer are involved in all of these functions

Modeling and Simulation of Small Arms Systems

- Advantages of modeling
  - Test concepts before building prototype
  - Isolate certain effects and understand how they influence system operation
  - Computational fluid dynamics (CFD) advantages
    - Visualization of the velocity, temperature, pressure
    - Measurements at any location without restrictions

Current capabilities of fluid flow and heat transfer modeling in small arms systems

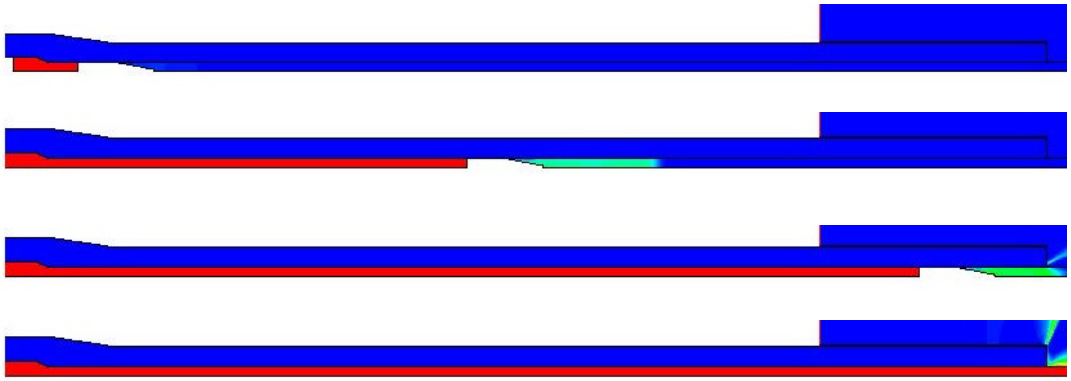
- 1. Barrel heating
- 2. Muzzle devices
- 3. Gas flow internal to the weapons system

1. Barrel heating

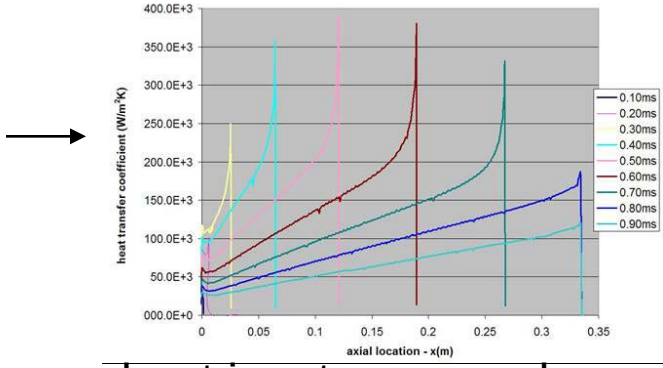
1. Modeling barrel heat transfer

Used to estimate the barrel temperature for a given firing schedule

- a. CFD model determines gas conditions as bullet moves along the barrel



CFD gas flow model

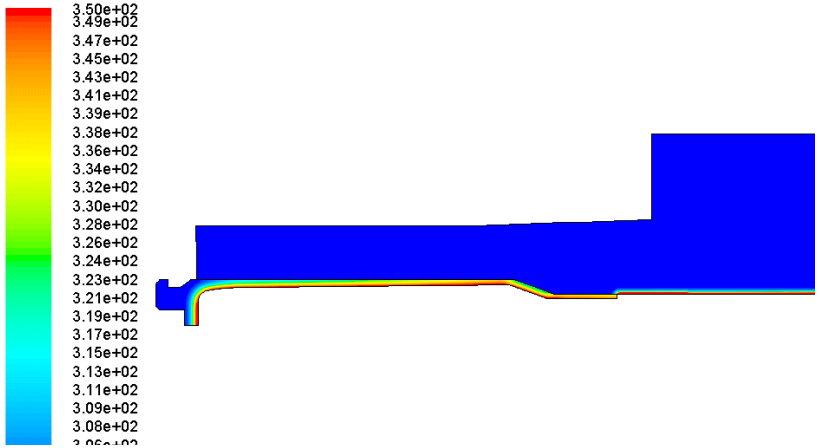


heat input per round

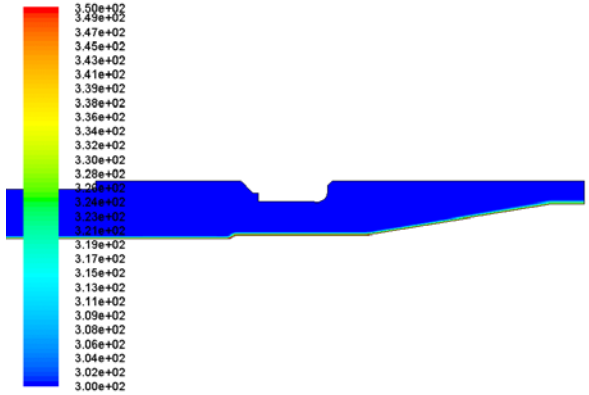
- b. Results used to estimate heat transfer to barrel during one shot
- c. Apply heat input per round to heat conduction model of barrel

1. Barrel heat transfer

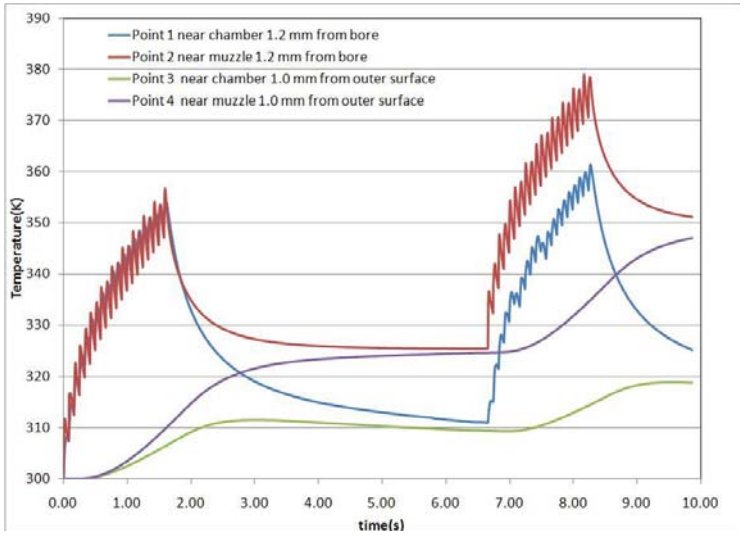
- Simulate:
  - Any number of rounds
  - Evaluate barrel performance
  - Evaluate heat mitigation concepts
- M4/ M240



Temperature near chamber



Temperature near muzzle



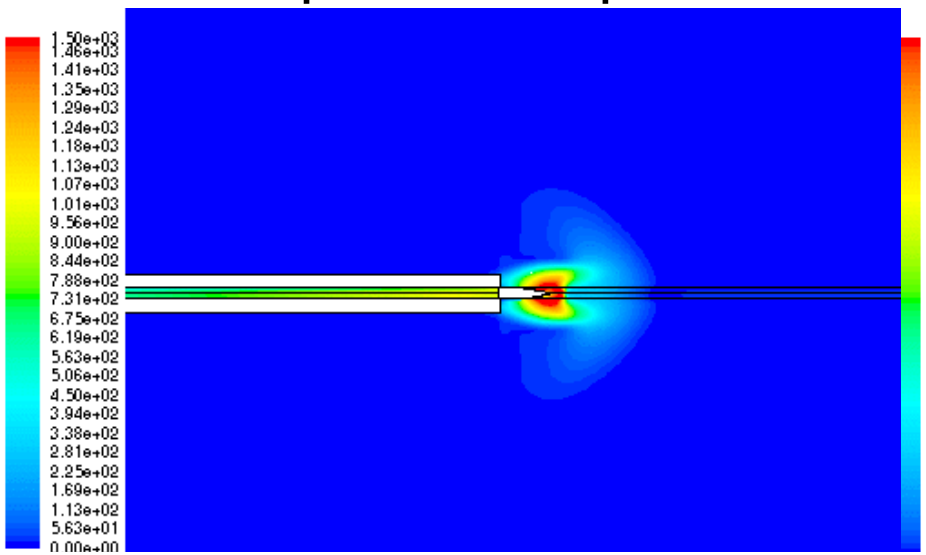
Temperature at a point vs. time

2. Gas flow through muzzle devices

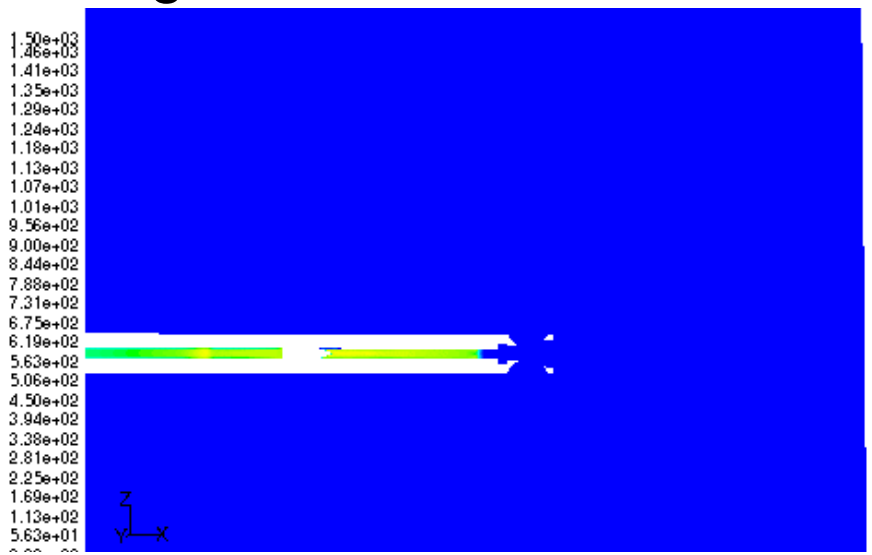
2. Models of gas flow through muzzle devices

Simulate movement of bullet along barrel and through muzzle device

- Determine gas velocity, temperature, and pressure distributions
- Compare blast patterns, resulting forces



Bare Muzzle

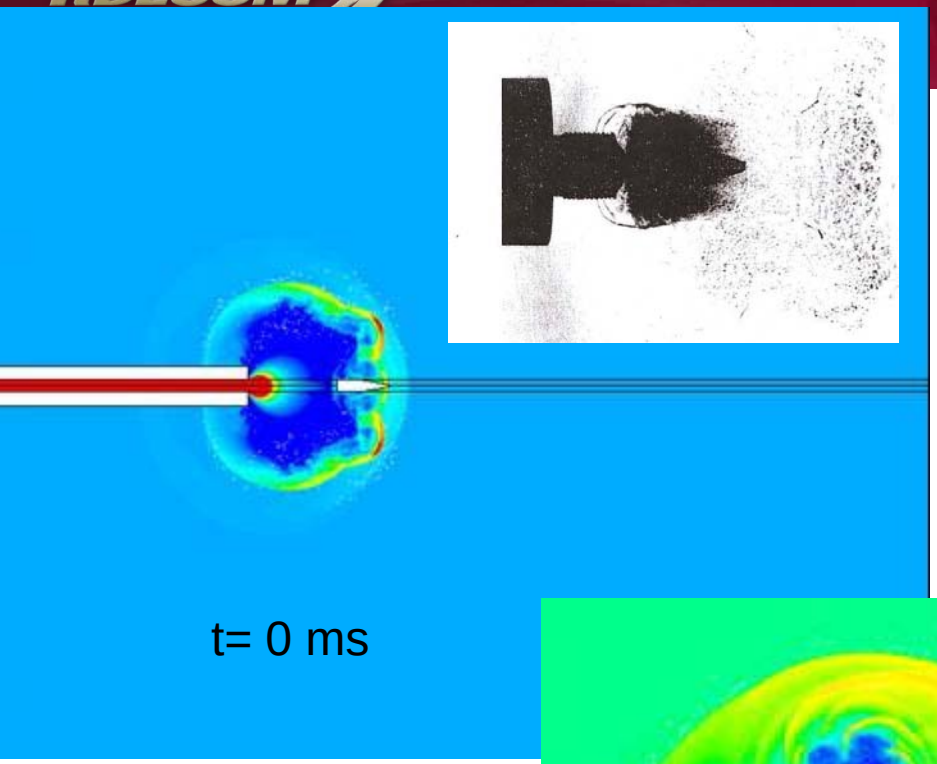


Flash Suppressor

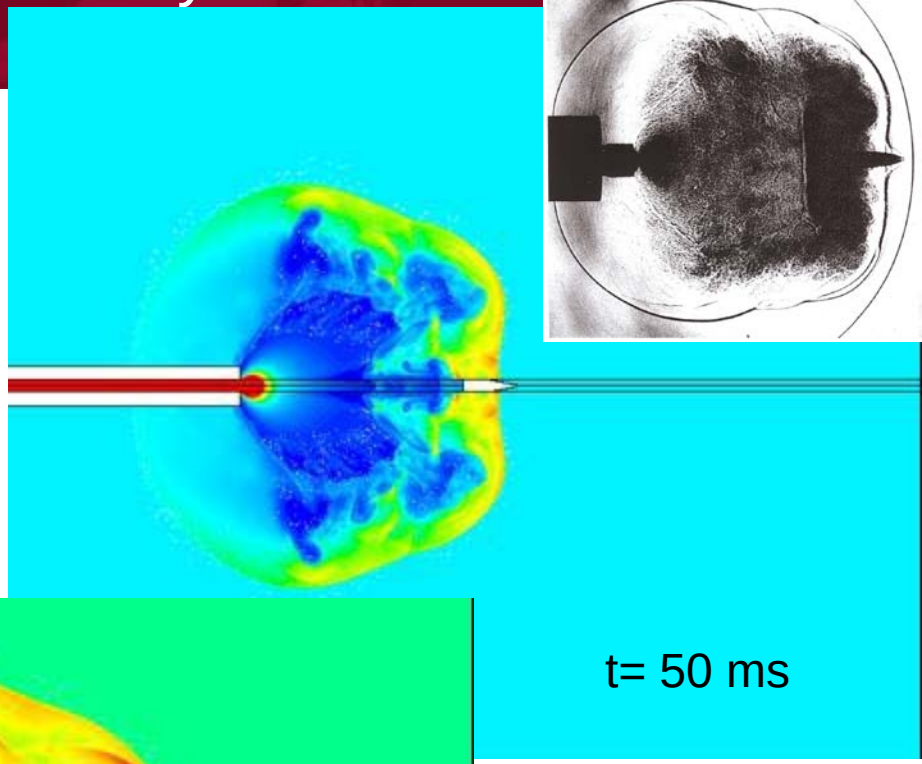
Velocity Contour Animations

A. Comparison to Shadowgraphs and System with and Without Muzzle devices

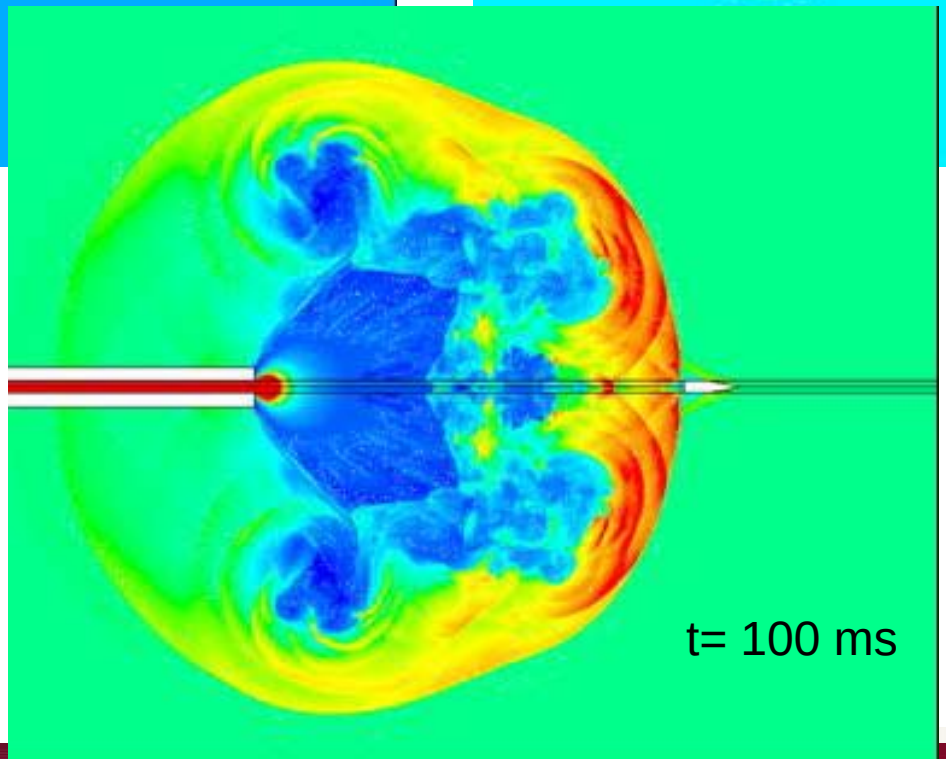
Bare Muzzle – Density Contours



t= 0 ms



t= 50 ms

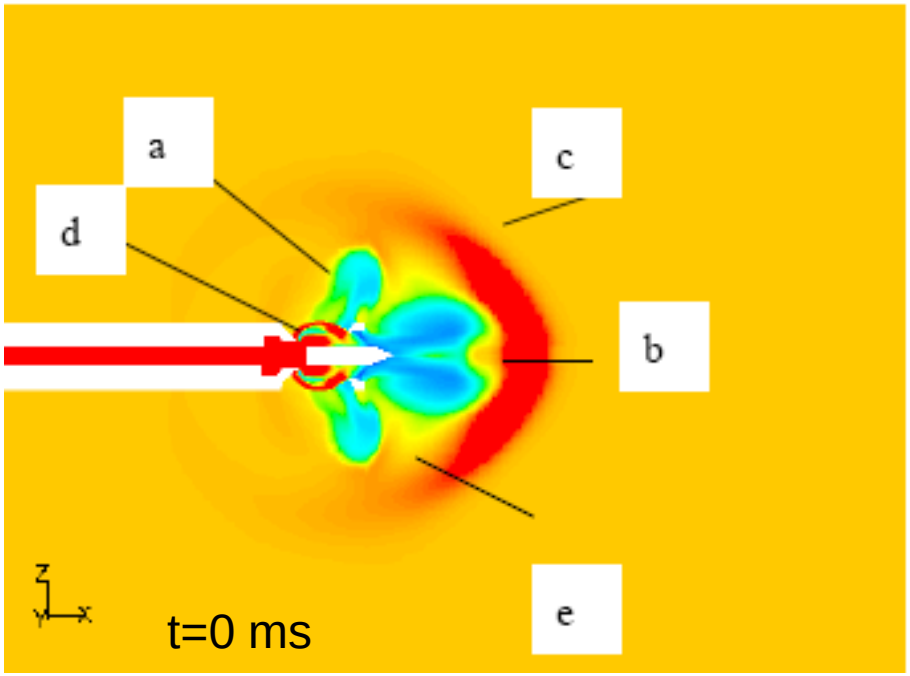


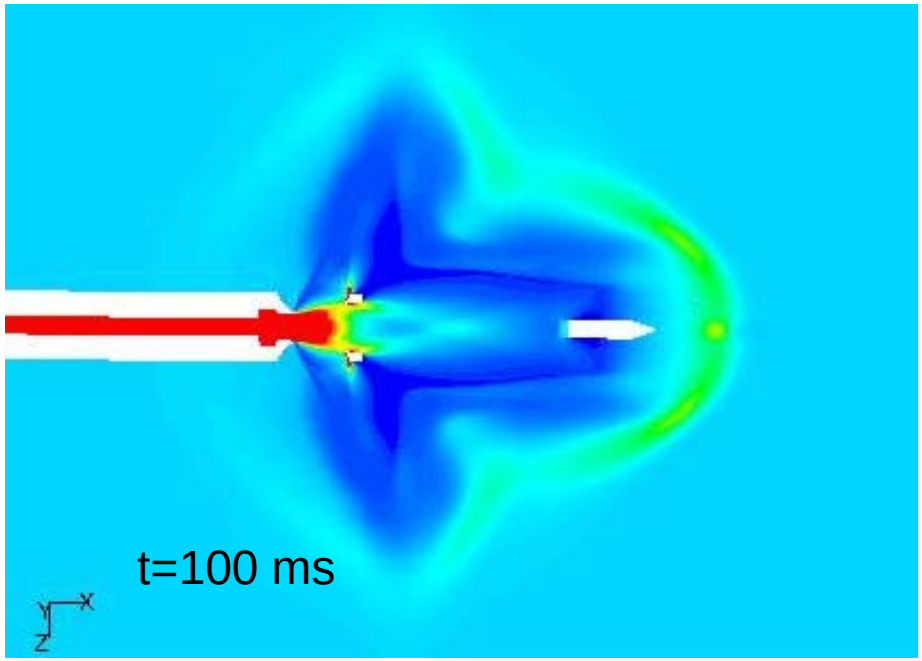
t= 100 ms

Shadowgraphs from Schmidt ARBRL-TR-02373, 1981.

Compared well with additional shadowgraphs from Baur and Schmidt BRL-MR-3513, 1986.

M16 Muzzle Device – Density Contours

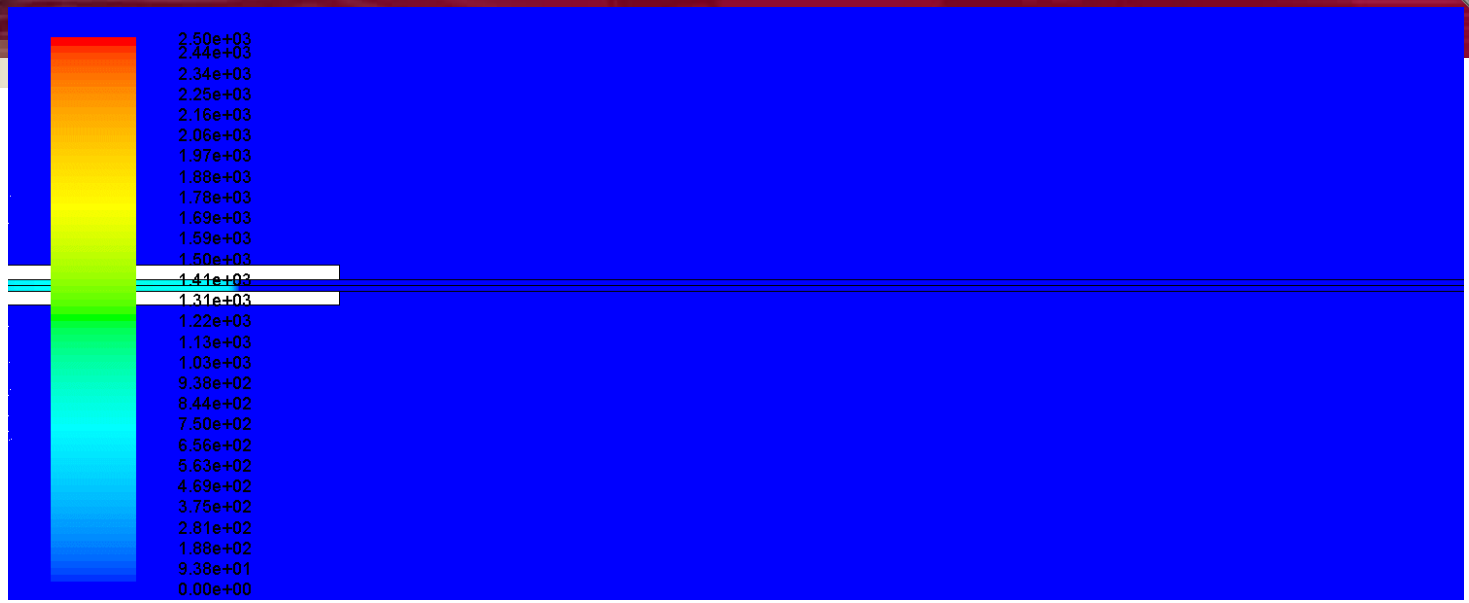




Compared well with shadowgraphs from Baur and Schmidt BRL-MR-3513, 1986.

B. Differences in flow and pressure field with muzzle device with four expansion chambers

Velocity Contours

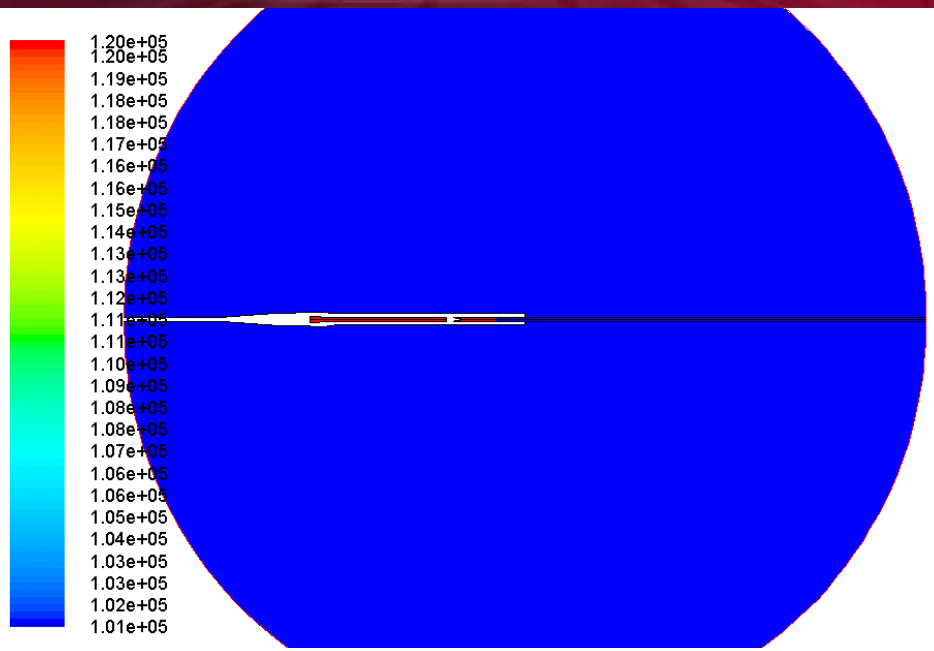


Baseline – bare muzzle

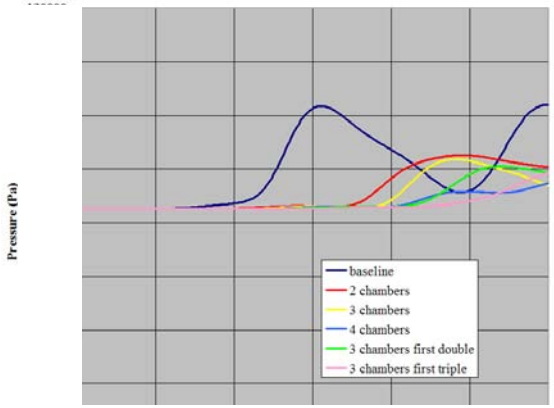


Four expansion chambers

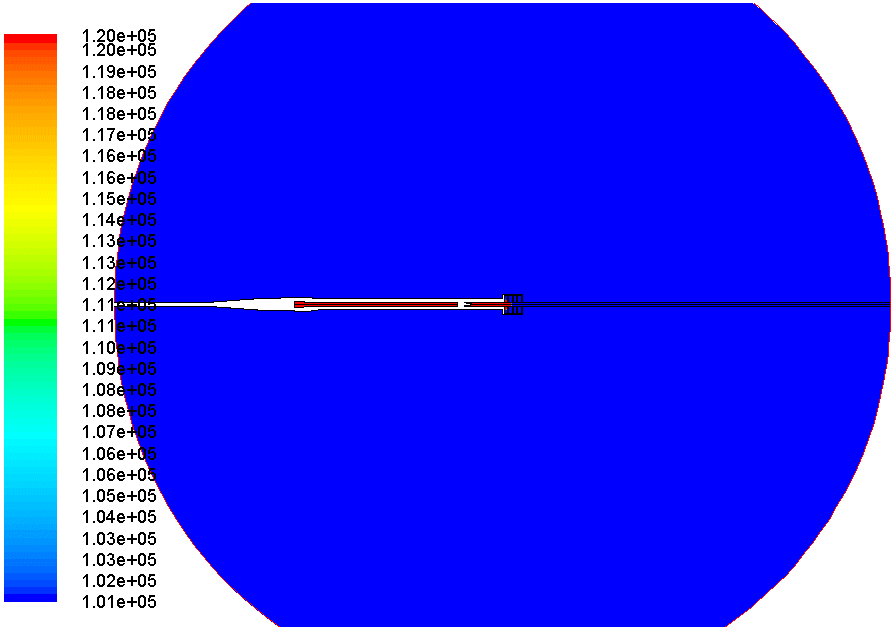
Pressure Results



Baseline – bare muzzle



Pressures at point vs. time different arrangements



Four expansion chambers

3. Gas flow through weapon system and mechanism actuation

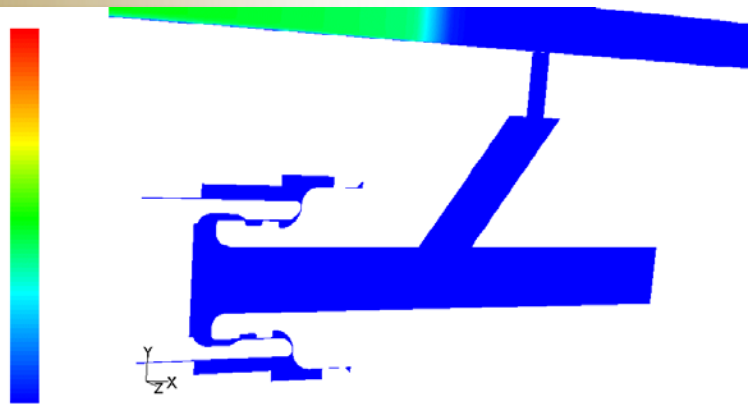
3. Gas flow internal to weapon system

Model:

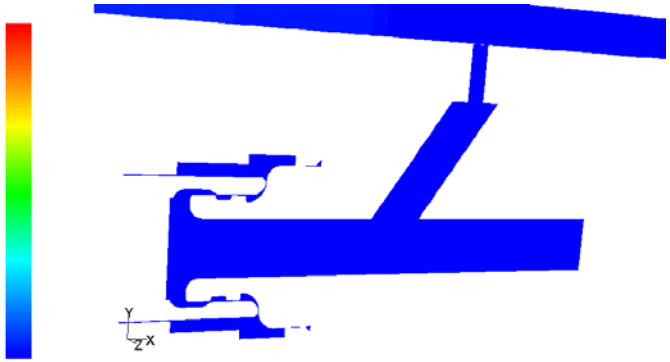
- From start of bullet motion to time bolt unlocking is approached
- Motion of bullet and operating group included
- Used to :
  - Visualize the flow field
  - Estimate pressures, temperatures, flow rates at important locations in the system
  - Estimate acting fluid forces
  - Estimate bolt/bolt carrier velocities
  - M4, M16, M249

A. Gas flow and weapon system mechanism actuation

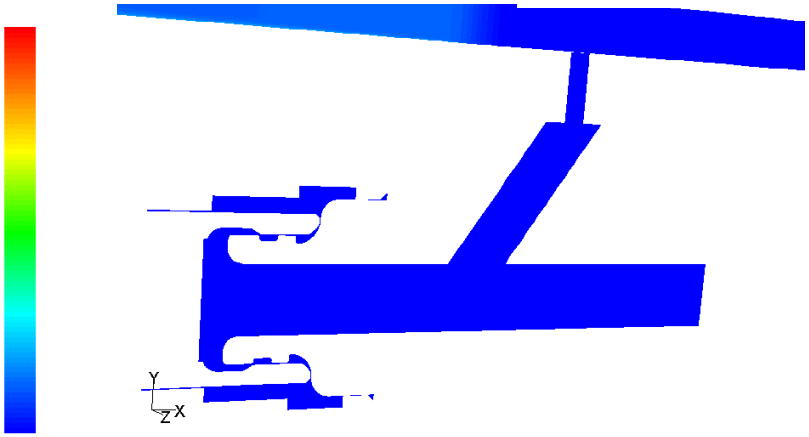
Animations M249



Velocity

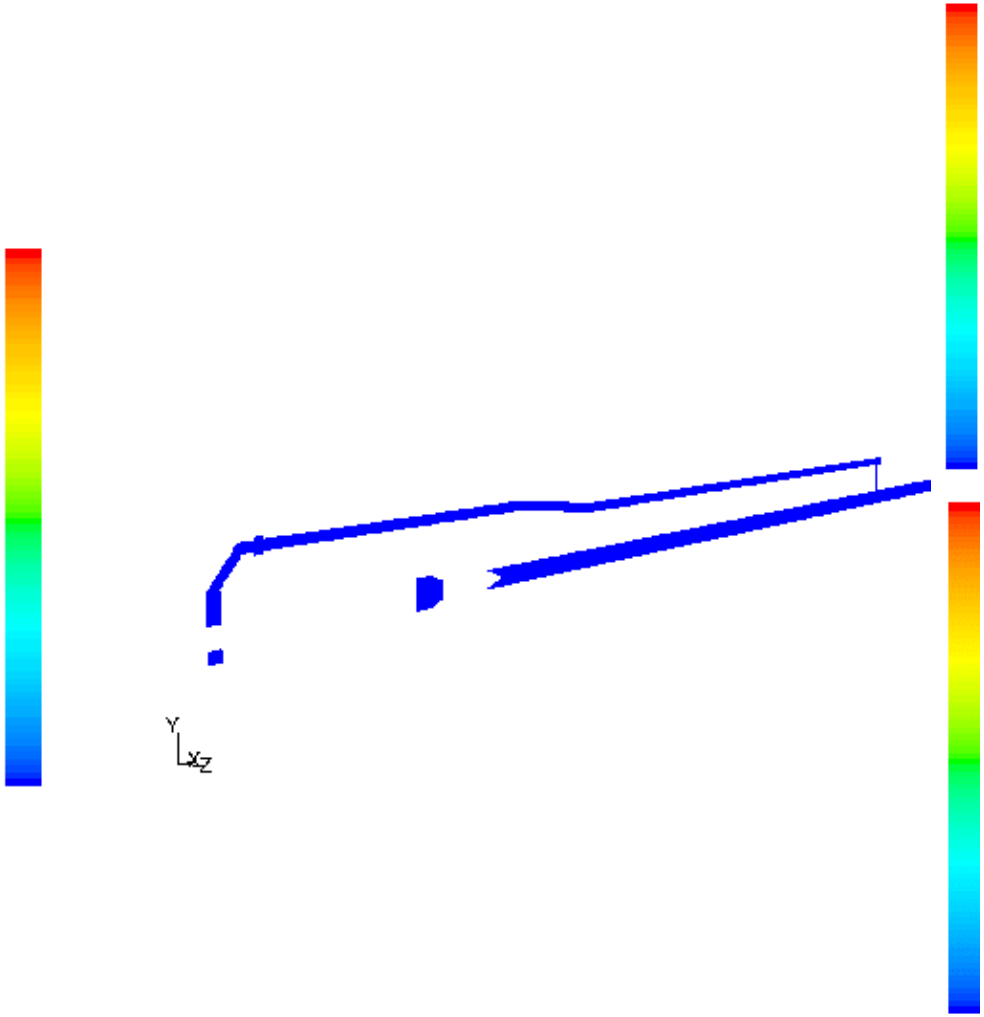


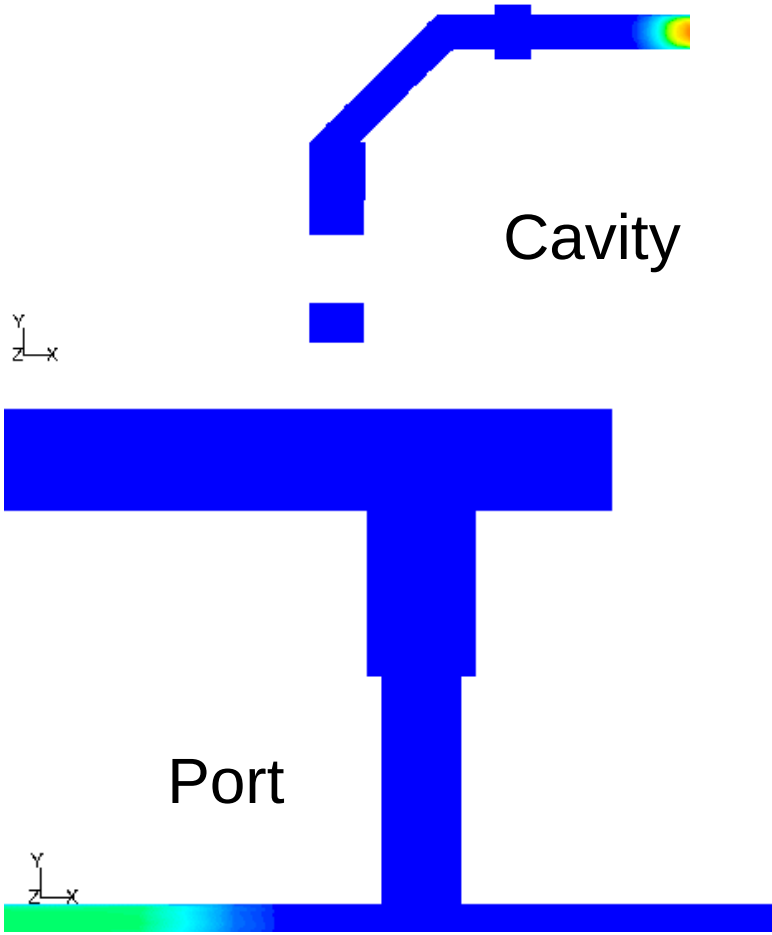
Pressure



Temperature

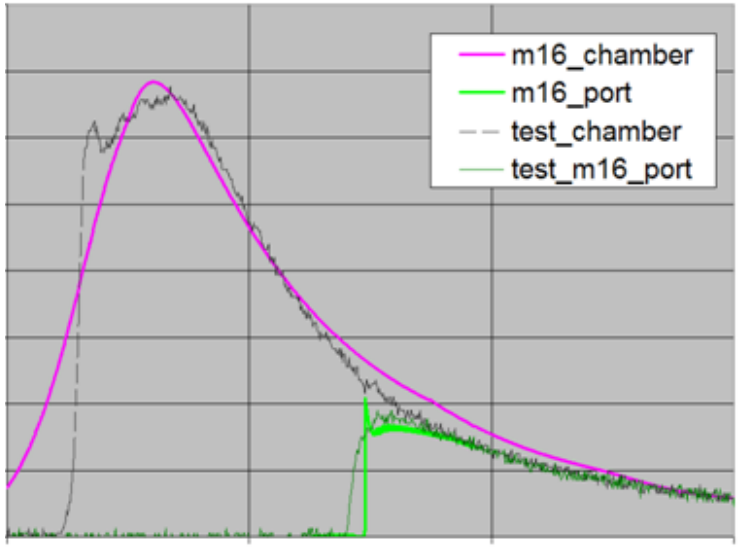
M16 Velocity Contour Animations

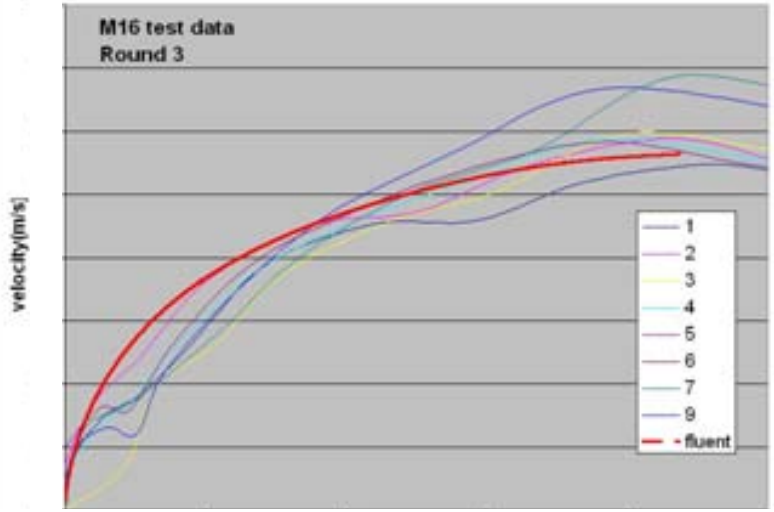




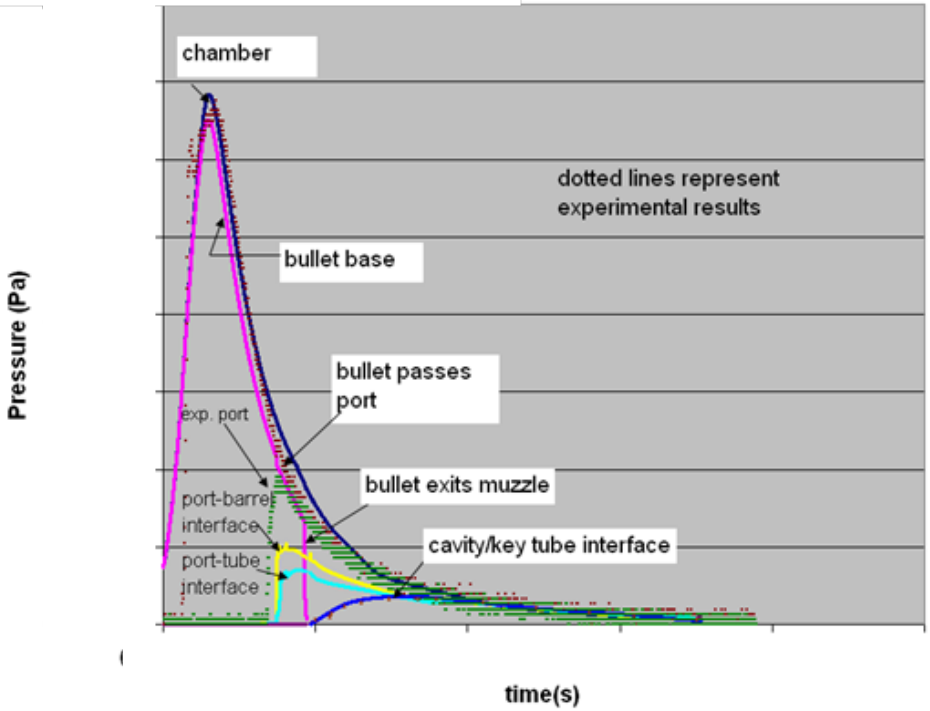
Velocity Contours

M16 data





Pressure results compared to experiment



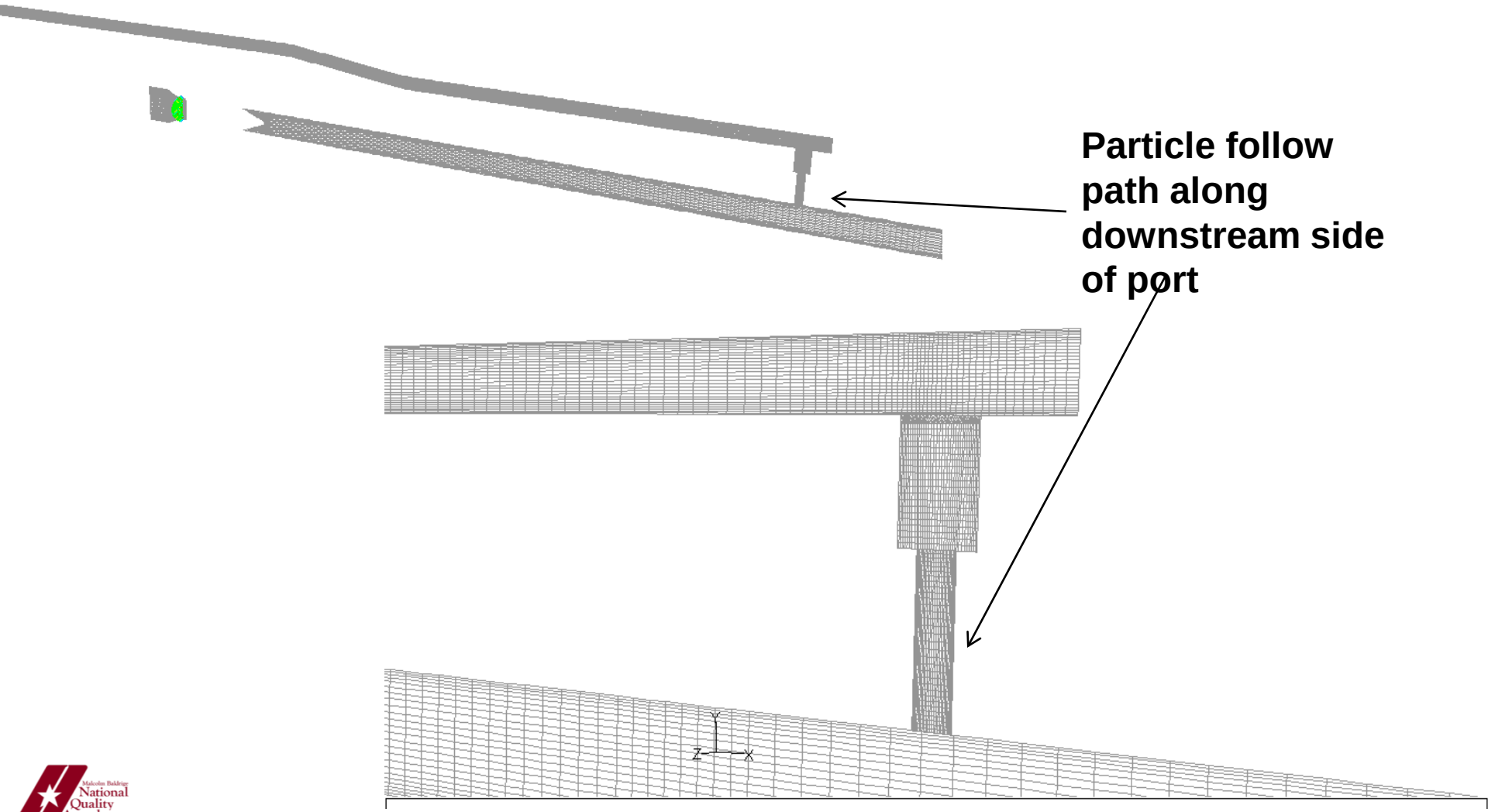
Bolt carrier motion results compared to experiment

Pressure results

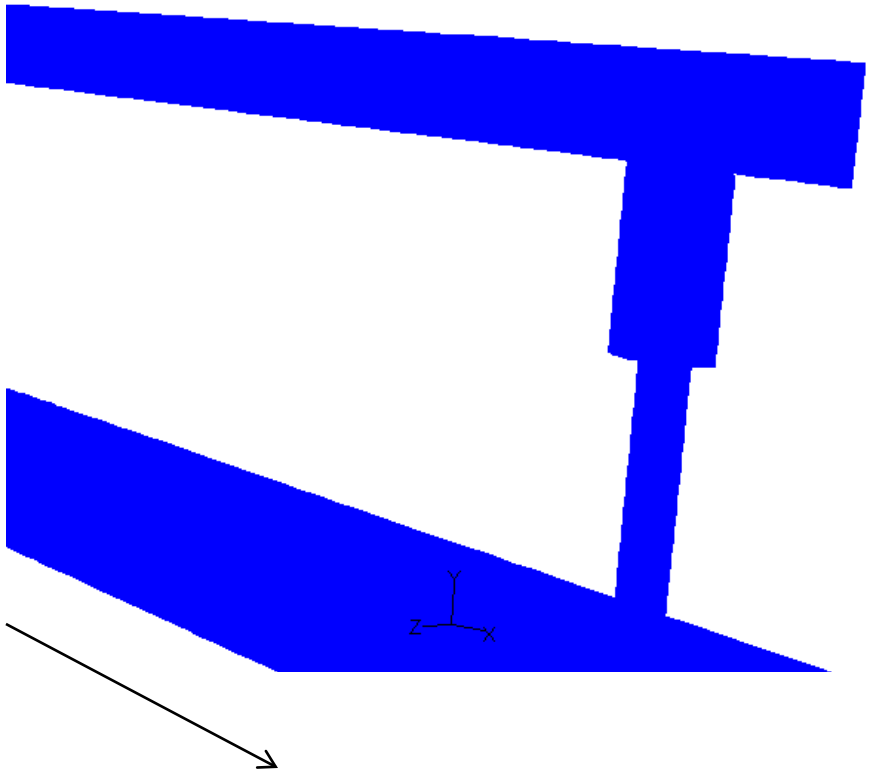
B. Particle flow carried by gas flow in M4

Flow of particles in weapon gas system

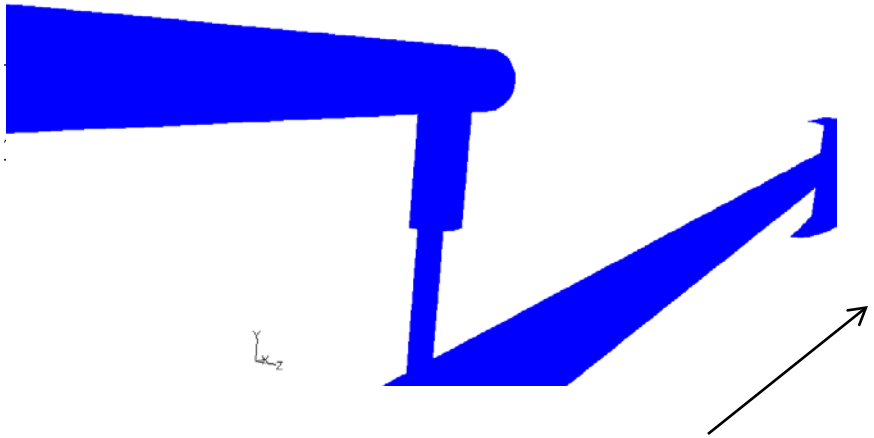
- Identify areas prone to erosion or build up



Flow of particles in weapon gas system



- Erosion most likely on downstream side of the port- corresponds to areas where port erosion has been noted
- Virtually investigate how changes in geometry alter characteristics

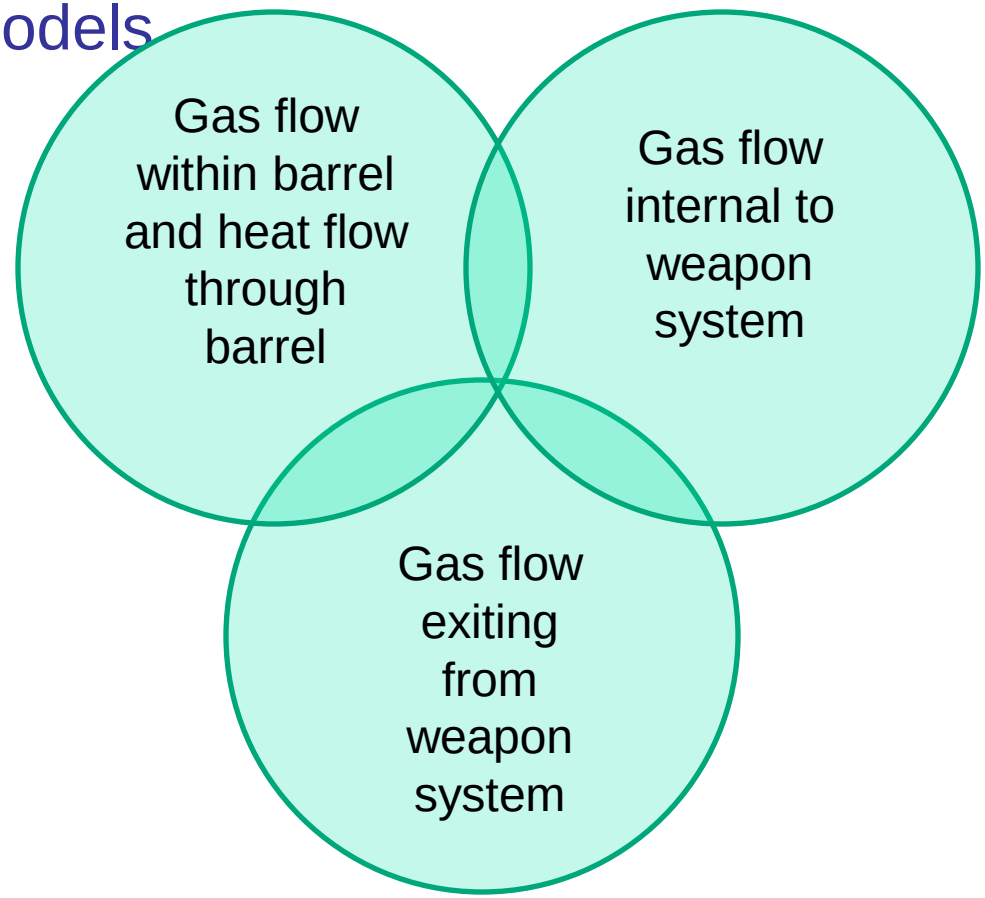


Conclusions

- CFD modeling can be used to “test” designs in virtual environment
  - Evaluate barrel temperature
  - Evaluate muzzle device designs
  - Understand and estimate gas flow through weapons systems
- Reduces number of physical tests
- Provides basis for design improvements and new designs
- Provides insight and understanding of current weapon system operation

Future Work

- Continue to develop and apply gas flow and heat transfer models



- Long term goals: Integrate fluid flow models directly with mechanism and stress analysis/dynamics

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US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

J·S·S·A·P JOINT SERVICE SMALL ARMS PROGRAM

Malcolm Baldrige National Quality Award 2007 Award Recipient

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Advanced Fire Control Technology for Small Arms

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Joint Services Small Arms Program Office(JSSAP)
RDAR-EIJ
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Agenda

- *Introduction*
- *Advanced Fire Control Technology for Small Arms ATO*
- *Technical Approach (Metrics & Objectives)*
- *Project Portfolio*
- *Industry Status*
- *Enabling Technology Status*
- *Summary & Path Forward*

Introduction

What is Fire Control?

- Fundamentally, fire control are variations of the same basic situation
  - Launching a projectile from a weapon station to hit a selected target.
  - Target or the weapon station or both may be moving.



- **Small Arms Fire Control**
  - Used in a Direct fire control situation
  - Weapon fired at a target that can be observed by:
    - Optical or electro-optical instruments or
    - From the weapon itself or from nearby elements



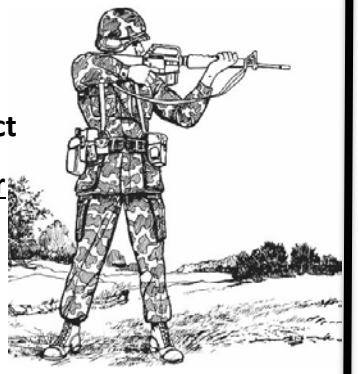


Advanced Fire Control Technology for Small Arms (ATO)

US ARMY RDECOM

Purpose

To demonstrate advanced fire control component technology determining correct range to moving targets and further power sharing within weapon for current and future warfighters.

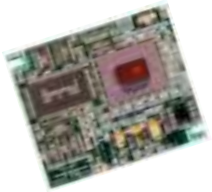


Challenges



- Moving targets prior to their seeking cover
- Unsupported firing position.
- Inaccurate ranging limits precision
- Weight near muzzle leads to poor aiming
- Multiple batteries reduces accessory availability

How do we solve this problem



- Technologies for automatic target detection
- Laser steering to increase the soldier's ability to accurately determine range to non cooperative moving targets.
- Improved lethality for unsupported firing positions
- Develop range determination to overcoming wobble associated in an unsupported firing position



Payoff

- TRL 4 (Breadboard) component technologies integrated to establish that they will work together
- This is relatively "low fidelity" but shows we are getting there!!



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TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Technical Approach
(Metrics and Objectives)

Measure	Current	Program Objective	Army Objective	Technology Maturity Level
Unsupported Range Determination	4+% to 15% of range	3 meters to targets in cover	2 meters to targets in cover	Start: TRL 2 End: TRL 4
Missed moving targets	60%	20%	<20%	Start: TRL 2 End: TRL 4
Shared Power Weight reduction	Batteries (multi) & cables	Reduce weight & one battery	Reduce weight & one battery	Start: TRL 2 End: TRL 5

TRL 2: Technology concept and/or application formulated
TRL 4: Component and/or breadboard validation in laboratory environment
TRL 5: Component and/or breadboard validation in relevant environment

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Project Portfolio

Project Name	Technology Partner	Metrics		
		1	2	3
Automatic Fire Control - Phase One	AAI	X	X	X
Laser Steering and Automated Target Tracking	L3/Brashear	X	X	X
Tracking and Fire Control	Stevens Institute of Tech	X	X	X
Small Arms Electrical Energy Harvesting by Linear Induction	ARDEC			X
Optical Fiber Based Barrel Reference Sensor	ORNL	X	X	
Adaptive Optical Zoom for Combat Rifles	SANDIA	X	X	
Target Tracking Laser Range Finder for Small Arms TA/FC*	Award Pending*	X	X	
Target Tracking Laser Range Finder for Small Arms TA/FC*	Award Pending*	X	X	X



Metrics (Advanced Fire Control ATO)	
1	Unsupported Range Determination
2	Missed moving targets
3	Shared Power Weight reduction

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Industry Status

Three (3) contracts awarded through National Small Arms Center

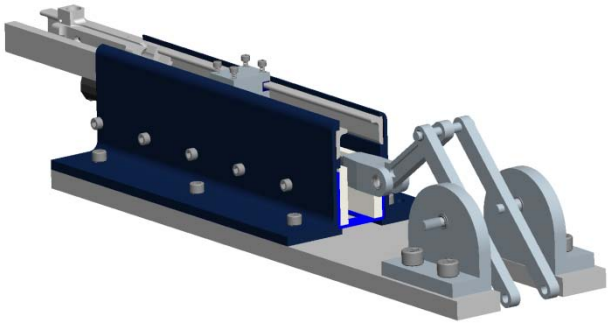
- **Stevens Institute of Technology**
  - **Project Title:** "A Standalone/Networked, Compact, Low Power, Image-fused Multi-Spectrum Sensor System for Target Acquisition, Tracking and Fire Control"
  - **Status:** Phase I complete, TRL 2 achieved
- **L-3 Brashear Corp.**
  - **Project Title:** "Steering and Automated Target Tracking
  - **Status:** Phase I complete, TRL 2 achieved
- **AAI Corp**
  - **Project Title:** "Automatic fire control -- phase one"
  - **Status:** Phase I complete, TRL 2 achieved

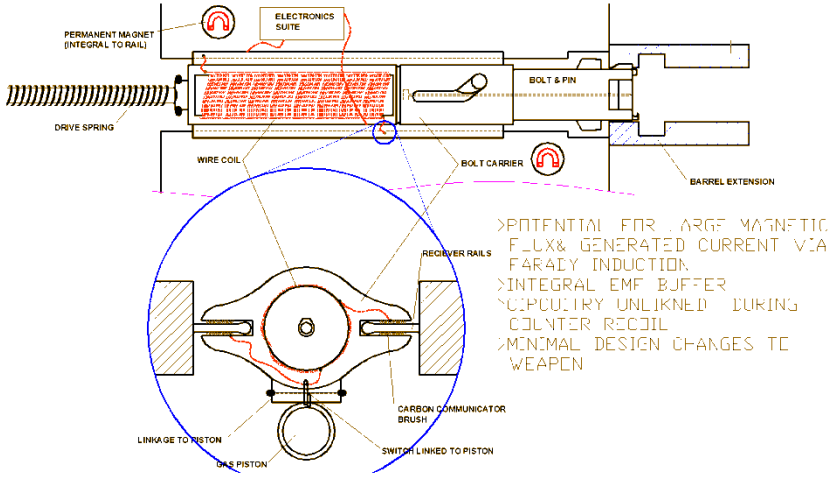
Fire Control Technology Areas Addressed

- Multi-wavelength imaging target acquisition system comprised of a dual laser radar system (LIDAR)
- Acoustic SONAR and forward looking infrared (FLIR) image acquisition technologies.
- Transmit/receive optics for DVO, night vision, and range-finding
- Integrated technologies for Laser Rangefinder, Micro-Display, Thermal Imager, and control electronics
- Low light level TV/IR camera, Software target recognition, Software trackers
- Laser transmitter, Laser beam steering, Laser receiver, Laser signal processing, Advanced optics
- Minimization of weight, volume, and power consumption parameters

Armament Research Development & Engineering Center (ARDEC)

- ***Title:*** *Weapons Electrical Energy Harvesting (WEEH)*
- ***Objective:*** *Investigate novel ways by using the cyclic motion in small caliber machine guns to generate electricity*
- ***Status***
  - ✓*Magnetic circuit design and bolt wiring scheme optimization (wire loop dimensions, orientation, magnet selection, mounting)*
  - ✓*Prototype under construction*

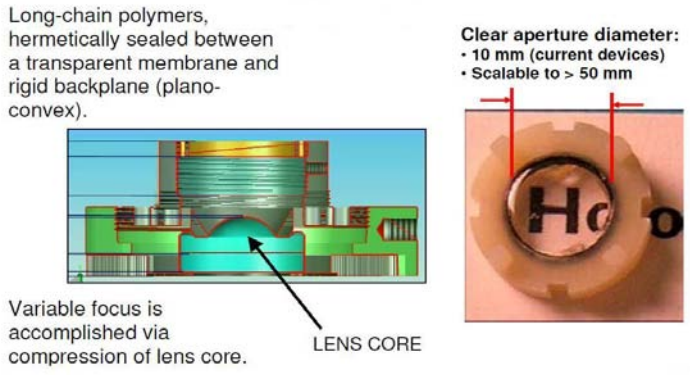




Enabling Technology Updates (Department of Energy)

Sandia National Lab

- **Title:** *Adaptive Optical Zoom for Combat Rifles*
- **Objective:** *Provide a variable power magnifying optic which would enable the soldier to discretely adjust magnification over a much wider range*
- **Status:**
  - *Polymer lens aberrations & power to actuate lens addressed*
  - *Prototype underdevelopment*





Oak Ridge National Lab

- **Title:** *Optical Fiber based Barrel reference sensor*
- **Objective:** *Implement a barrel reference sensor on weapon barrel to sense barrel deflection.*
- **Status:**
  - *Barrel reference sensor implemented*
  - *Measuring & characterizing barrel oscillations as projectiles are fired*

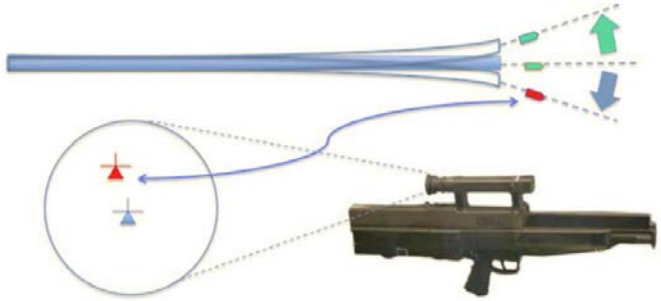


Figure 0. Barrel position sensor and reticle compensation system.

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Summary & Path Forward

- *Three (3) year R&D effort for Advanced Fire Control component technology*
- *TRL 2 achieved on efforts contracted through NSAC*
- *Enabling Technology Efforts on-going*
- *Two (2) new efforts to be awarded in FY09*

Path Forward for Fire Control?

We are getting answers from industry, academia, and government.

We are still looking for good ideas

Highlighted Technology Areas of Specific Interest

1. Power Distribution/Sourcing
2. Volume Reduction
3. Use of Enabling Technologies

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2009 International Infantry & Joint Services Small Arms Systems Symposium

System Analysis: Infantry Studies and Simulations

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Timothy Fargus, Michael Wilson, and Alexander Lee

System Analysis, ARDEC

Timothy.fargus@us.army.mil, michael.c.wilson1@us.army.mil, alexander.lee5@us.army.mil

5/21/09

Background

- July 2007 – Completed Breaching and Marking/Tagging studies for Ft. Benning Infantry School
- May 2008 – Presented briefing at NDIA Small Arms Symposium
- Providing continuous support to JSSAP Advanced Fire Control and Advanced Lethal Armaments ATOs

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Overview

1. The Role of Modeling and Simulation in the Small Arms Acquisition Process
2. Modeling and Simulation Tools
3. Examples of Small Arms Analyses Performed
4. Modeling and Simulation Outlook

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Improving Small Arms through Modeling and Simulation

- **How does Modeling and Simulation improve the Small Arms Acquisition process?**
  - Sensitivity analyses indicate which parameters can be changed to best address capability gaps
  - Technology concepts can be compared according to applicable metrics

Guidance

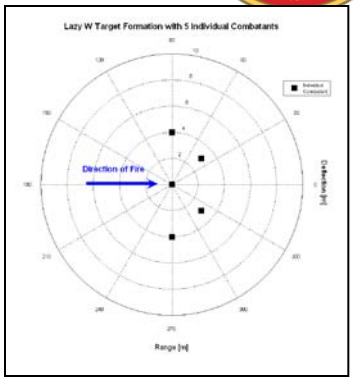
- Guidance from Subject Matter Experts (eg: Infantry School at Ft. Benning)
- Working in coordination with other efforts to support Army Technology Objectives
- Major Demands
- Given this information, what input provides the system with the best performance according to the MOE's?

Tools: CASRED and FBAR

Weapon Characteristics
- Fragmentation Data[1]
-Terminal velocity [2]
- Angle of Fall [2]

Delivery Accuracy
- Baseline Case
- Improved Range Finder
-Improved MV
- Improved Range & MV

Target Formation
- 5 combatants
- Lazy W [3]



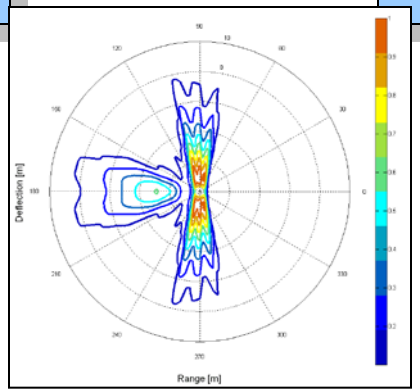
CASRED (Lethality)

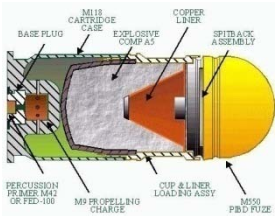
Pk Contour files

FBAR (Effectiveness)
50,000 Monte Carlo Trials

Expected Fractional Casualty Values

Individual Soldier Data
-Winter Uniform
-No Armor / No Helmet
-Standing Posture
- 5-min Assault Criteria



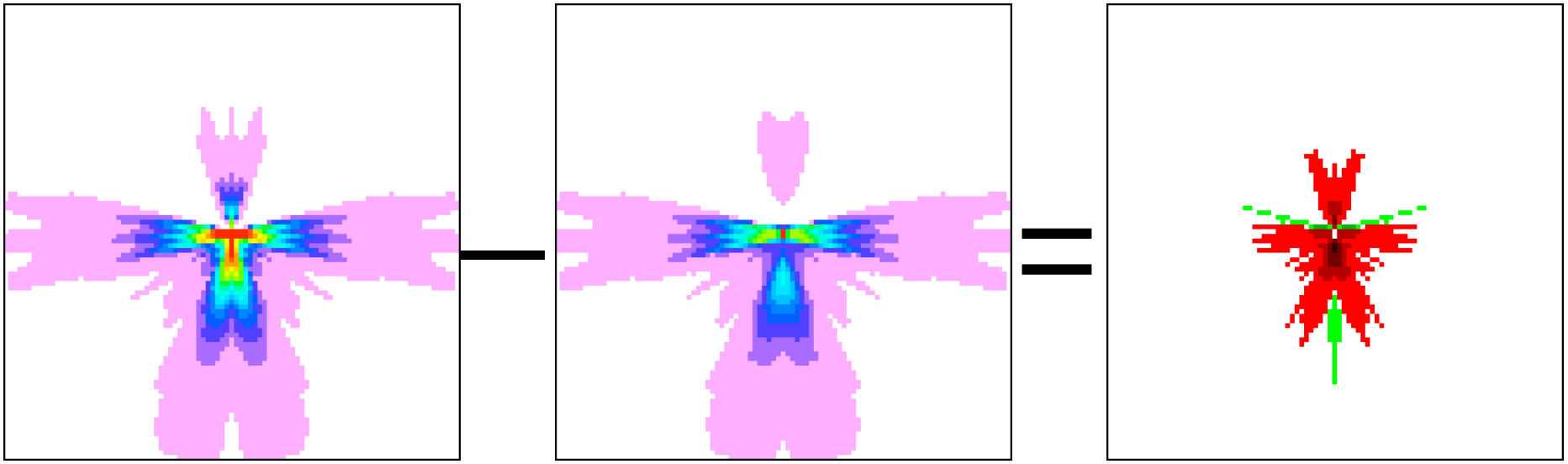


Allows examination of lethality of theoretical weapon systems in comparison to ones in use today.

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Item Level Effectiveness

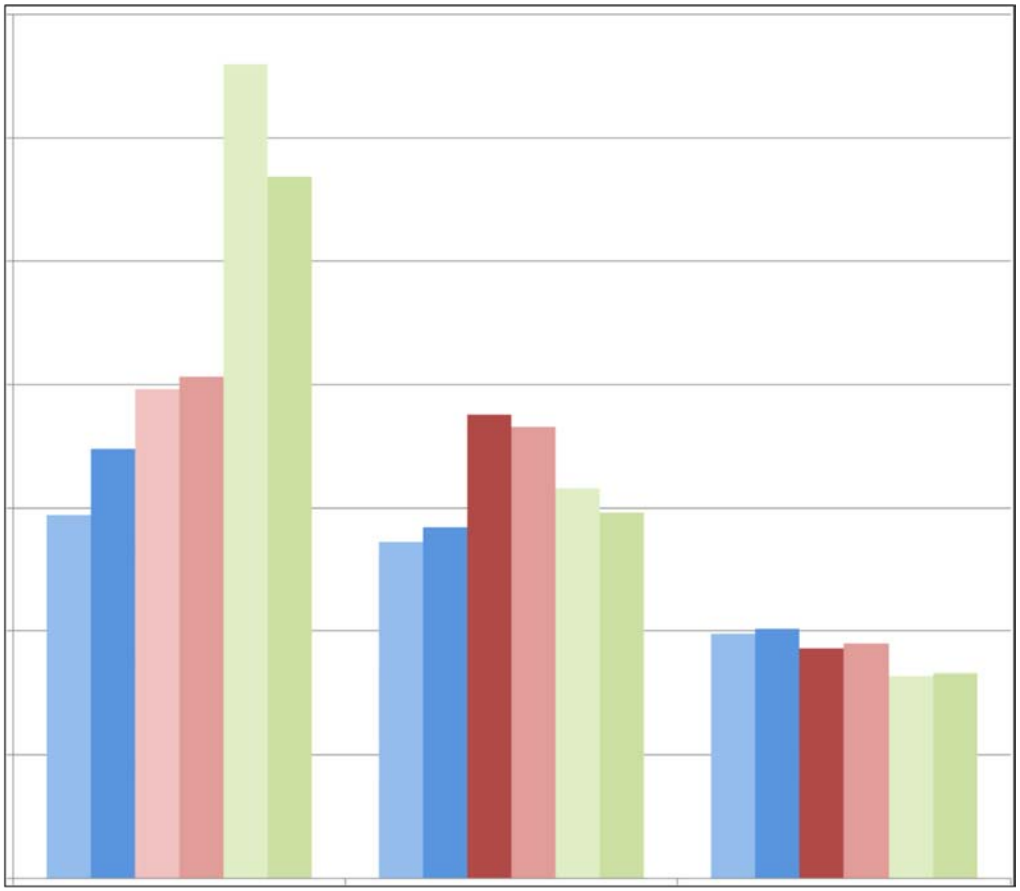


Concept 1 — Concept 2 = Performance Improvement

- CASRED gives detailed representations of lethality
  - Details lethality from fragmentation in a specified area
  - Can accommodate modifications to several variables
  - Improvements can be tracked from one concept to another, to give a picture of comparative effectiveness

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Item Level Effectiveness



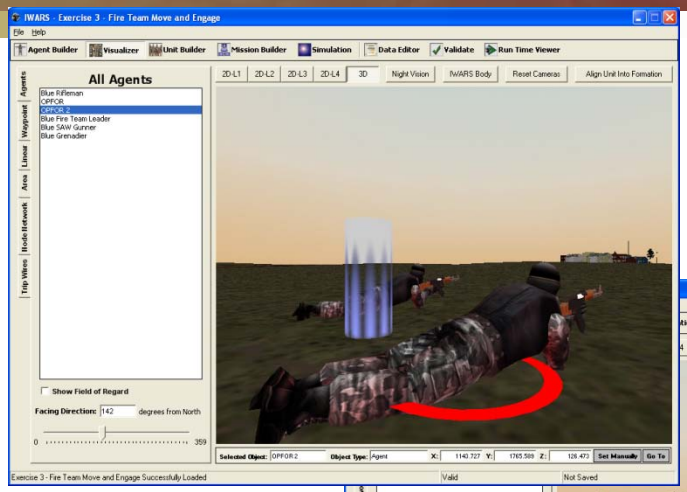
- FBAR uses CASRED output as input
- Uses delivery errors to model the actual firing of the weapon
- Output is Expected Fractional Casualty Value

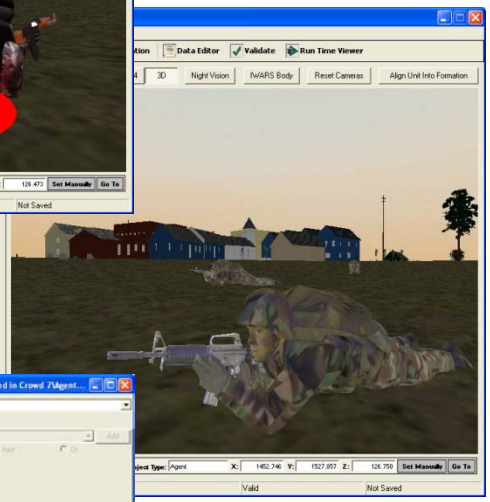
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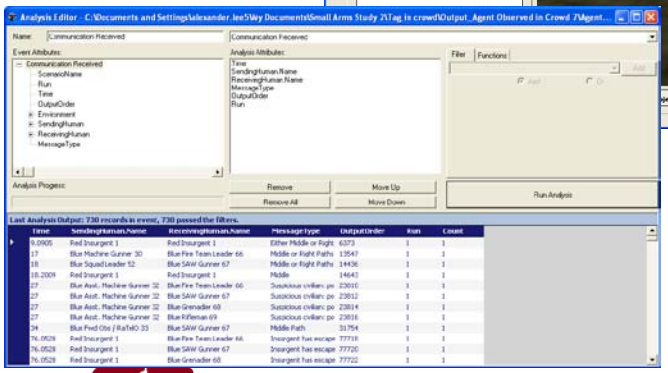
Item Level Effectiveness

- Item level tools have several uses
  - Sensitivity analyses to find avenues of highest potential payoff
  - Comparative analyses of proposed weapons concepts

Tools: IWARS







IWARS (Infantry Warrior Simulation) – AMSAA approved model

- Force-on-Force Analysis
- High resolution Dismounted Infantry model
- Programmable Small Infantry Engagements
- 3-D representation and run time viewer
- Output analysis tool

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Missed Moving Targets

Acquisition includes the following:

- Detection
- Recognition
- Correct ID

Some variables affecting acquisition time:

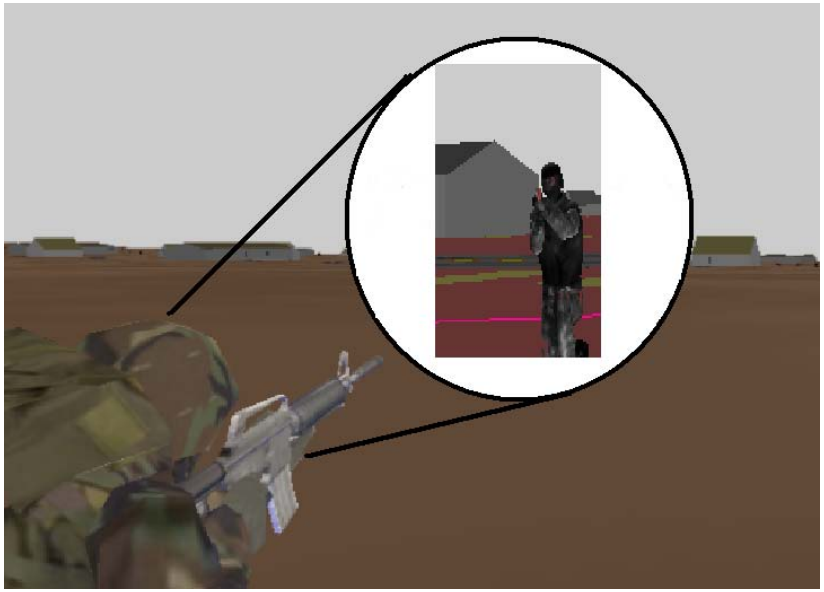
1. Visual sensor characteristics
2. Environment
3. Target characteristics
3. Training and experience



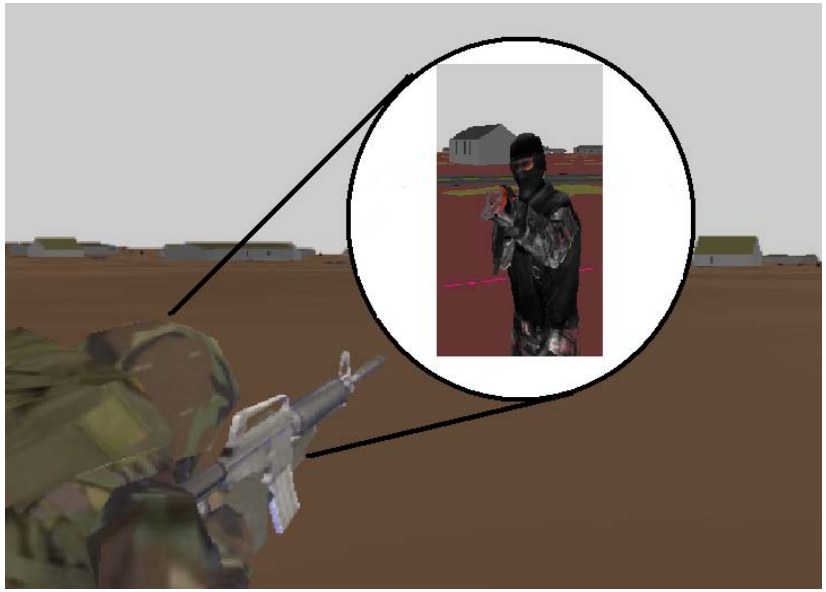
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Missed Moving Targets

A.



B.



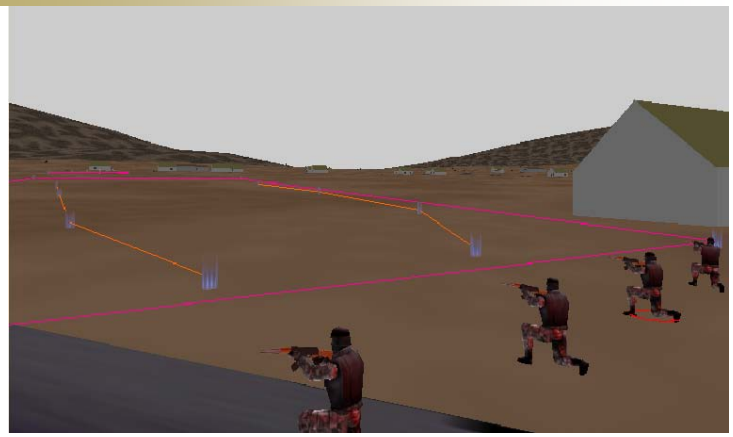
- Warfighter B has better visual resolution than A.
  - Better eyesight
  - Better experience or technology

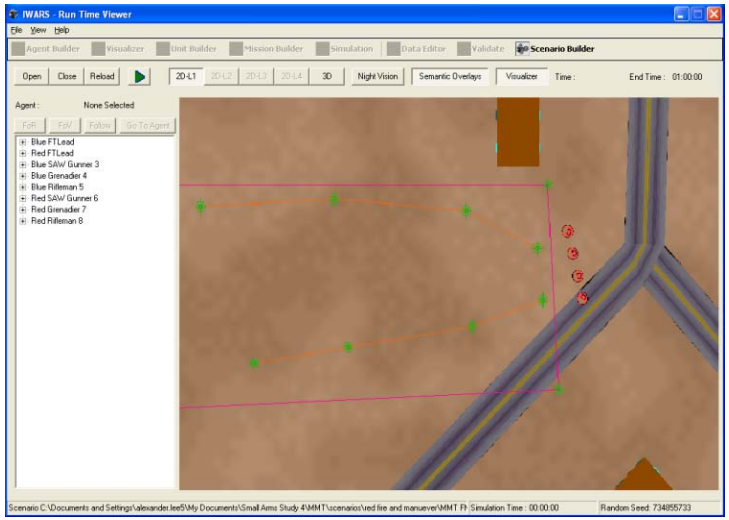
Work in Progress

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Missed Moving Targets Scenario





-Red OPFOR attempts to fire and maneuver

-BLUFOR is pinned down and engages targets.

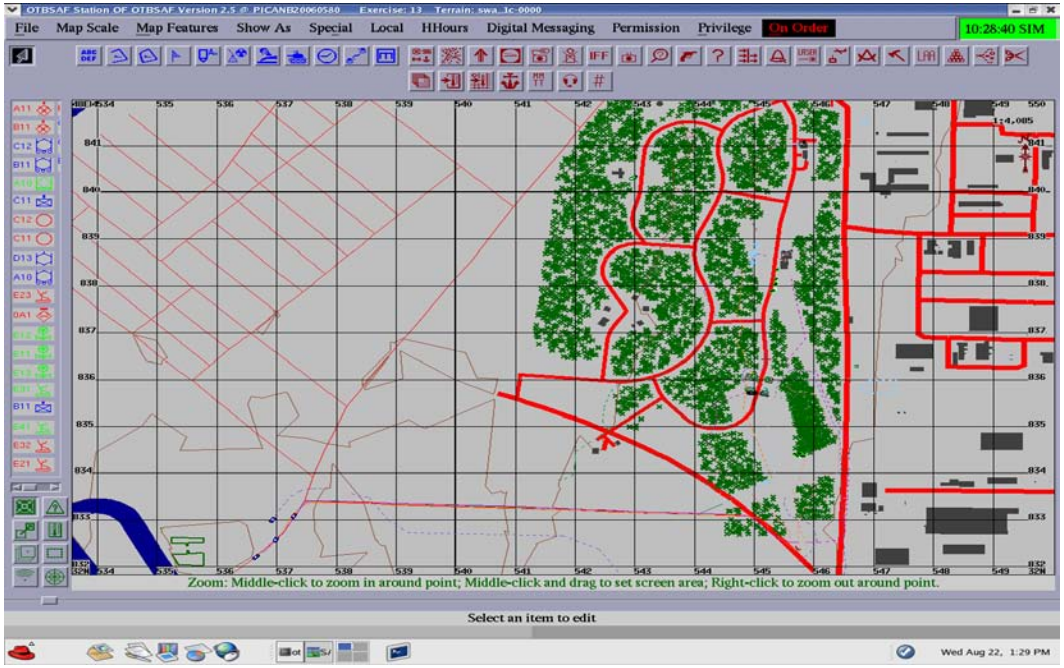
-New weapon systems, sights, etc. can be simulated.

-Many metrics can be used to measure system performance

Work in Progress

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Tools: One Saf Test Bed (OTB)

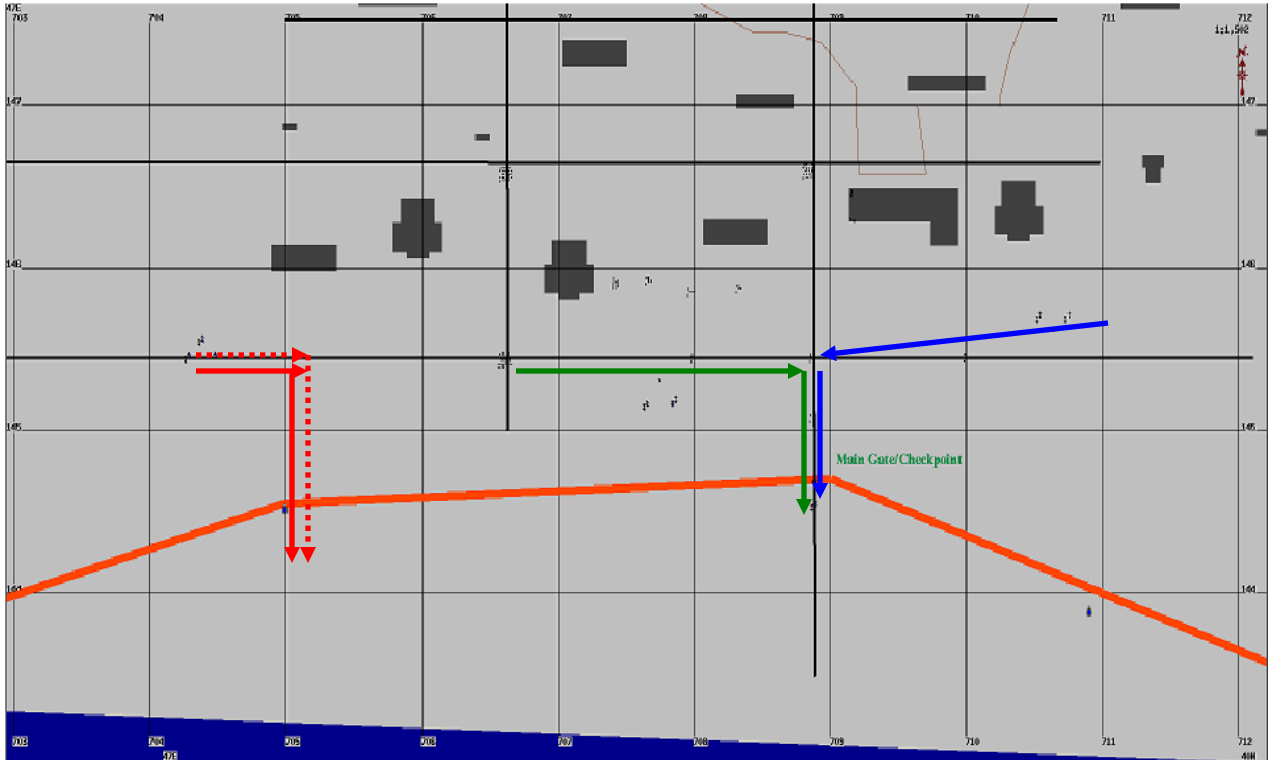


- Distributed force-on-force simulation
  - A macro perspective allows large force-on-force engagements
  - Shows what technology can do under operation conditions

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Truck Bomb

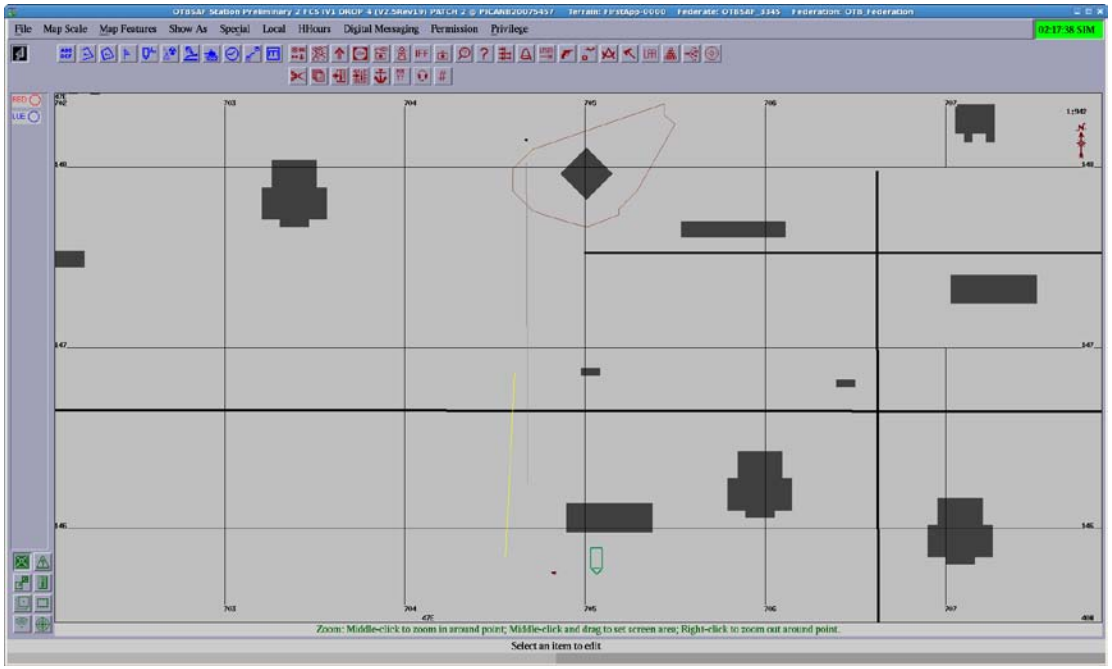


- Group of civilians head to checkpoint to cause distraction
- Blue forces converge onto checkpoint in support
- Red, to west, drive into unguarded section of gate with truck bomb
- Red soldiers on foot enter hole in gate
- Blue force retaliates

- Allows us to test the capability of M16.
- Change accuracy of weapon to determine which characteristics give the best results (Most Red Kills and Least Blue Kills)

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One on One



- Blue with M4 vs. Red with M4
  - ~240 meters apart
  - Red does not shoot
  - Red runs for cover behind building
    - Exposed for about 3-5 seconds

- Running this very simple vignette in two models (IWARS and OTB) will let us find a baseline for both to use.
- Able to change characteristics of the M4 in OTB to more closely match IWARS.
- This will allow us to transition more easily from squad-on-squad to force-on-force

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Infantry Study Outlook





- Continue to support the development of improvements (materiel or otherwise) to support the warfighter.
- Help to optimize R&D efforts to bring the most benefit to the warfighter.
- Continue to implement new tools to expand our effort.

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US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

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Lightweight Small Arms Technologies

May 2009

Lightweight Small Arms Technologies



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Lightweight Small Arms Technologies

Question #1: Why do we need to make weapons and ammunition lighter?

"Today, the average soldier load consists of a rucksack, weapon, ammunition, helmet, and other gear; the total weight can range from 63-130+ pounds depending on the variables of mission type, duration, and environment."

"…infantry Soldiers carrying a load of 101 pounds for 12.5 miles had a decrease of 26% in marksmanship (number of targets hit), a 33% increase in distance from the target center, and an increase in back pain compared to pre-load and march scores."





GEN Peter W. Chiarelli
Vice Chief of Staff, United States Army
Before the House Appropriations Committee
Subcommittee on Defense
March 11, 2009

Lightweight Small Arms Technologies

Question #2: How is this different from other efforts to lighten the load?

- Three main issues with polymer 5.56mm ammo:
  - Heat build-up in chamber
  - Unsupported area of case
  - Extraction loads

- LSAT:
- → Separate, rotating chamber
- → Fully supported cartridge case
- → Push-through feed and eject

- Purpose-designed weapon:
  - Make it lighter without losing any capability
  - Barrel length, muzzle velocity, range, dispersion, rate of fire…
  - Total weapon weight: 9.5 lbs (45% less than current)
- Modeling & Simulation:
  - 15 different M&S tools used
  - Everything from internal ballistics, finite element analysis, and thermal analysis, to dynamic function of the complete system
  - We even model Life Cycle Cost, training requirements, and maintenance…

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Lightweight Small Arms Technologies

Question #3: Why are you doing CT, instead of focusing only on CL?

- Three main reasons:
  - Low risk
  - Significant weight reduction
  - Provides baseline
- Cased Telescoped Ammunition:
  - Over 10,000 rounds fired
  - Temperatures from -65F to +160F
  - 35-40% weight reduction
  - 10-15% volume reduction
- Cased Telescoped Light Machine Guns:
  - Conducted 4 major live fire demos
  - Beginning fabrication of third weapon
  - 45% weight reduction





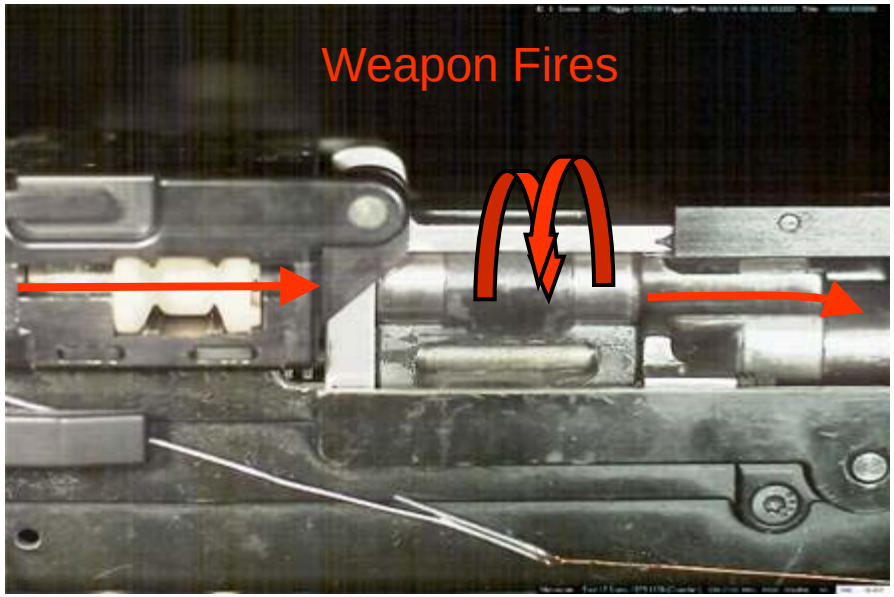
Lightweight Small Arms Technologies

Question #4: What's the deal with that "rotating" chamber?

- Straight through feed and eject:
  - Allows use of cylindrical ammunition and circumferential polymer links
  - Increases reliability
  - No ejection groove required
- Ammunition fully supported in chamber:
  - Allows use of lightweight polymers with no additional reinforcement in base
- Thermal Management:
  - Isolated from barrel
  - Movement disperses heat

Cartridge Rammed From Feed Tray

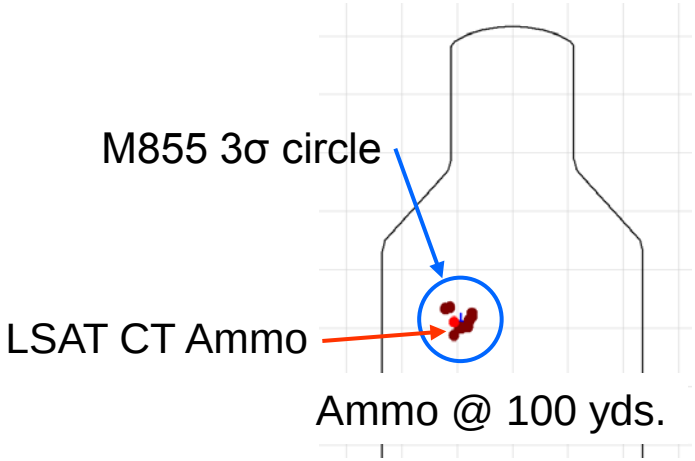
Spent Cartridge Ejected from Chamber

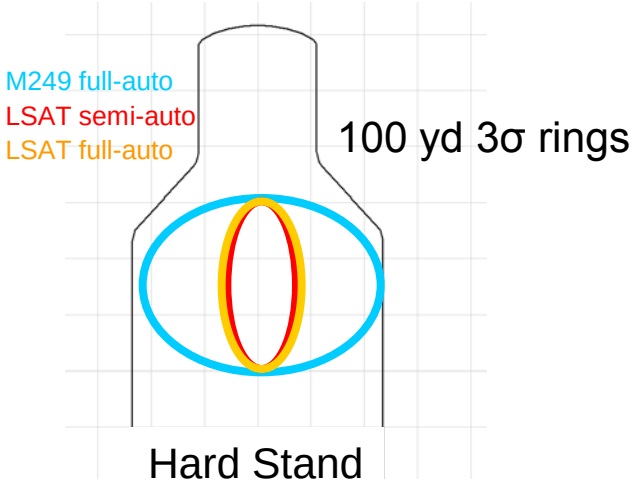


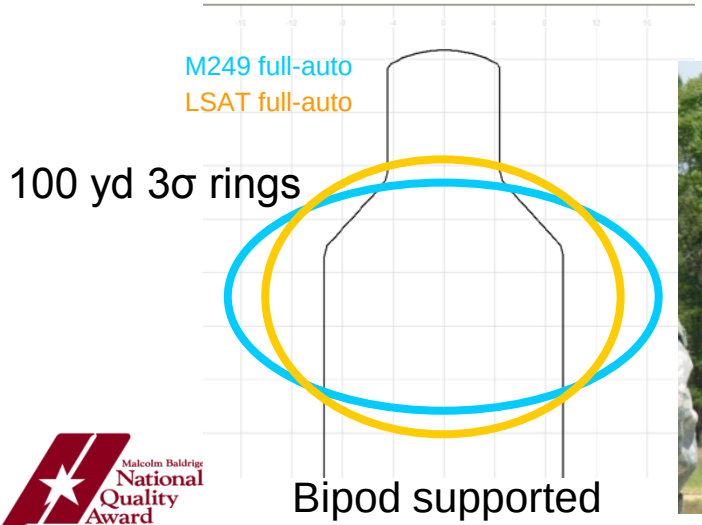
Chamber Rotates into Feed Position

Lightweight Small Arms Technologies

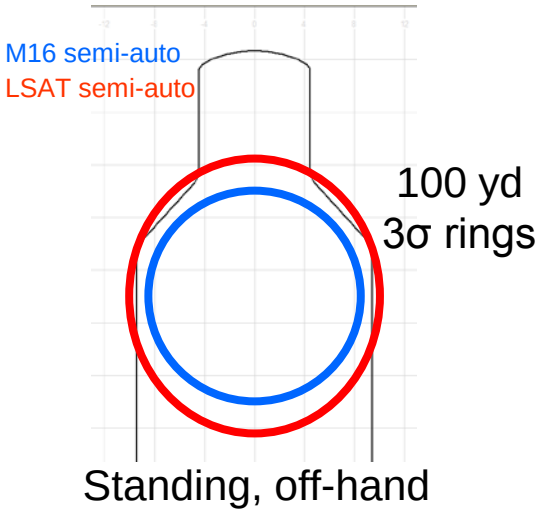
Question #5: What kind of dispersion does the CT system have?









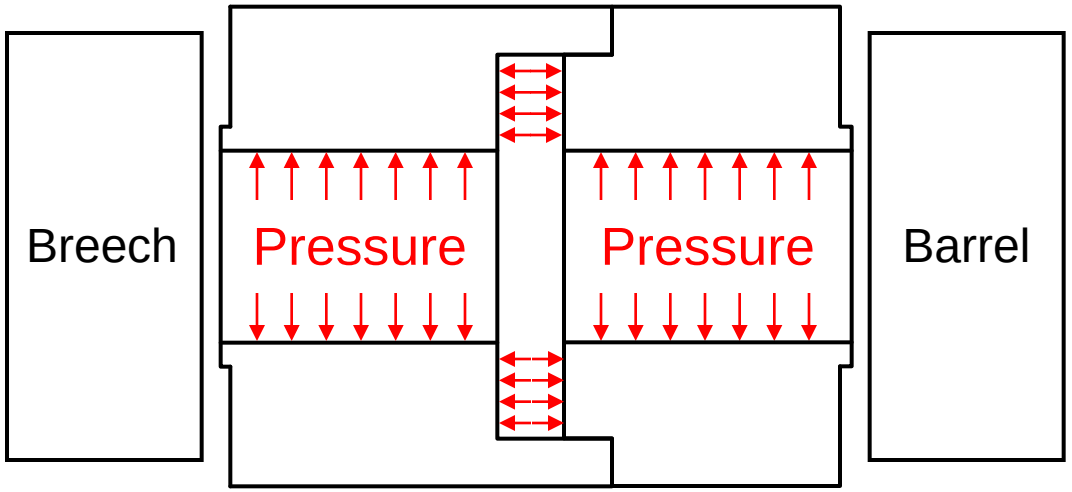


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Question #6: How do you seal the caseless chamber?

- Two piece sliding chamber
  - Seals at breech and barrel faces
  - Allows expansion of propellant gases
- Sealed firing pin uses rotating motion rather than linear motion

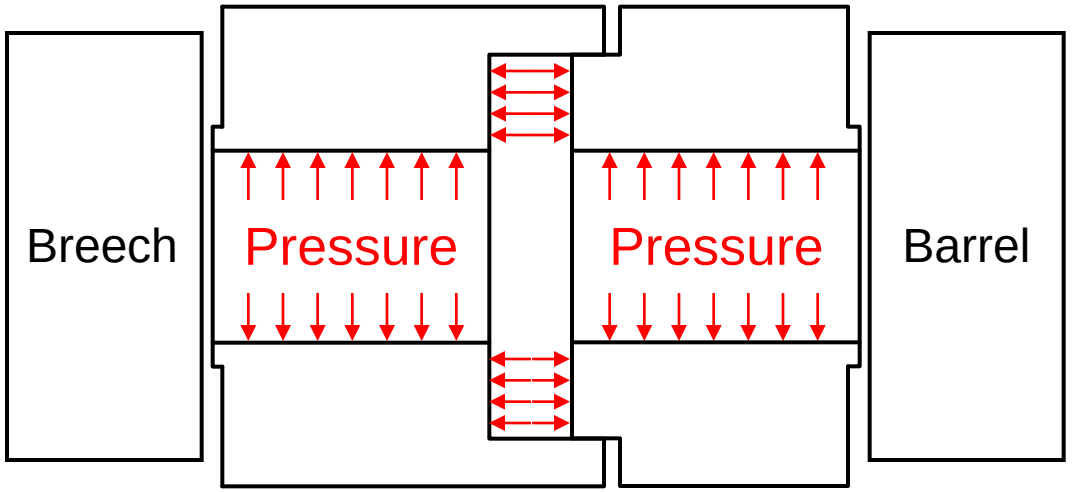
Propellant ignition pressurizes the chamber



Question #6: How do you seal the caseless chamber?

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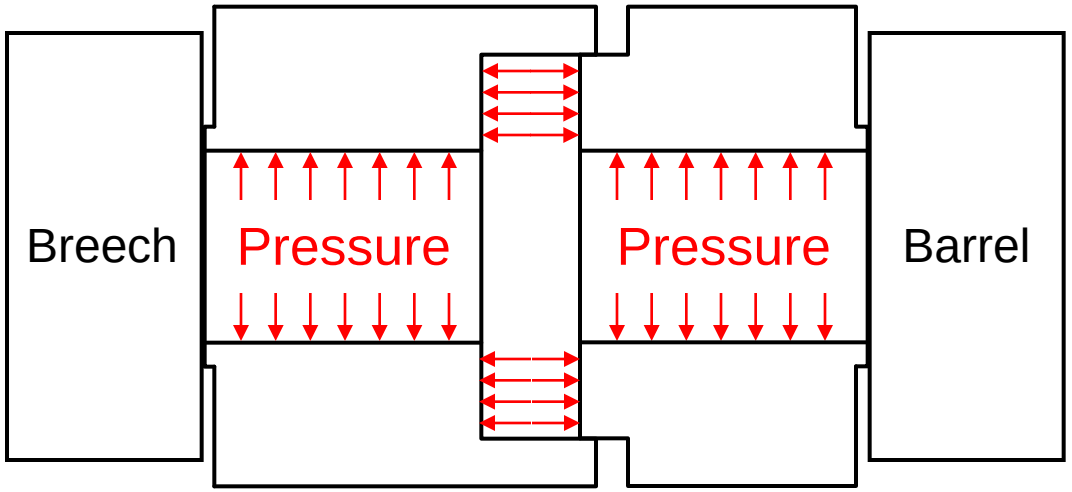
Chamber pressure acts on axial faces to spread chamber segments apart



Question #6: How do you seal the caseless chamber?

- Two piece sliding chamber
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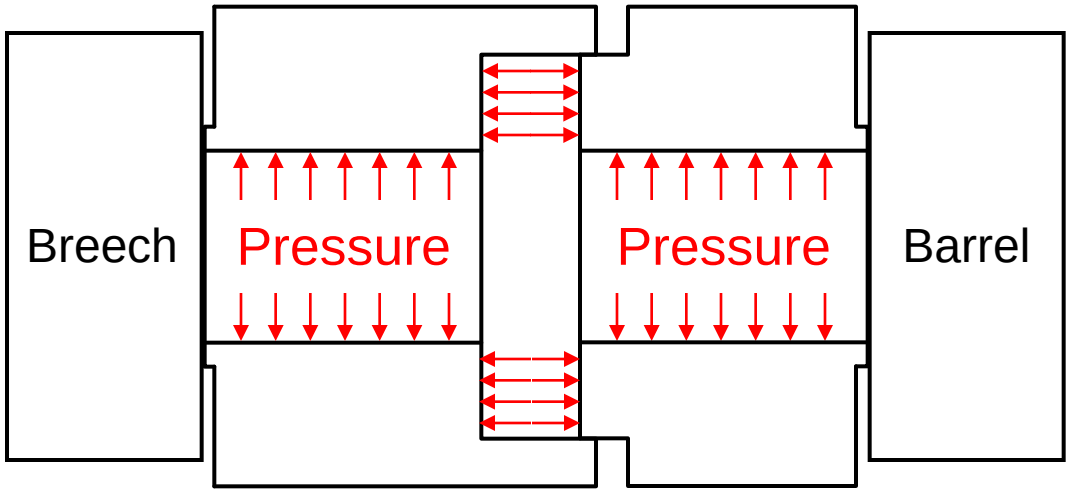
Chamber pressure completes spreading chamber segments apart



Question #6: How do you seal the caseless chamber?

- Two piece sliding chamber
  - Seals at breech and barrel faces
  - Allows expansion of propellant gases
- Sealed firing pin uses rotating motion rather than linear motion

Chamber pressure completes spreading chamber segments apart



Lightweight Small Arms Technologies

Question #7: What gets ejected from the caseless weapon?

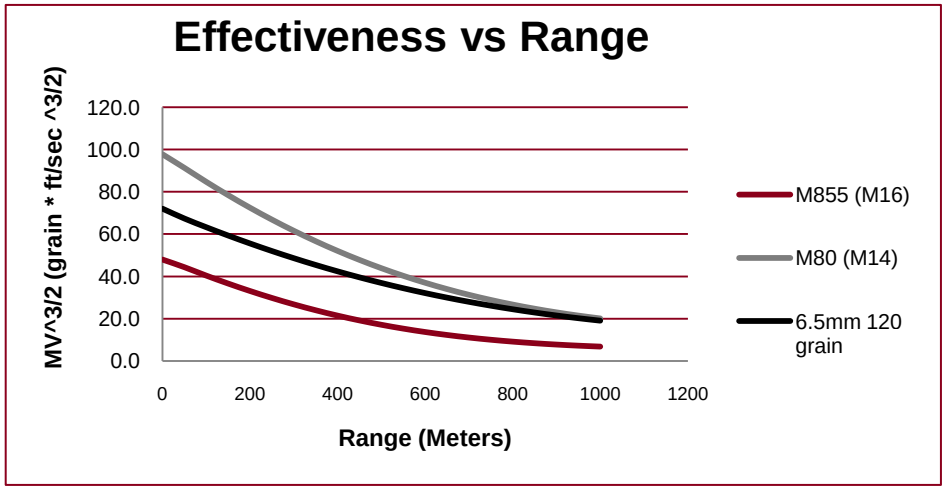




Lightweight Small Arms Technologies

Question #8: Where else can we apply this technology?

- Ammunition calibers/configurations
  - Investigating "intermediate" calibers
  - Evaluation of Green Ammo projectile
- Weapon configurations
  - Rifle (in work)
  - Medium Machine Gun
  - Sniper Rifle



- Applications:







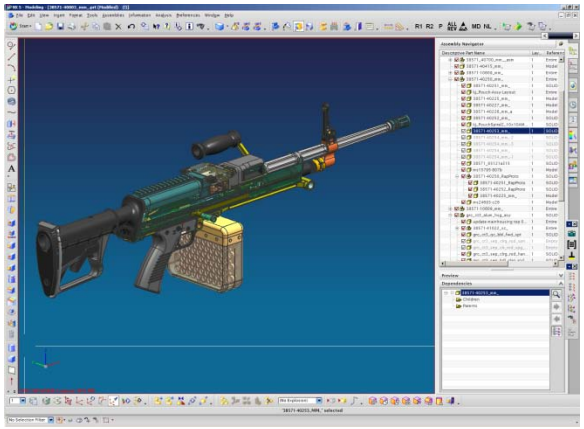




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Lightweight Small Arms Technologies

Question #9: Is it affordable?



- Weapon:
  - Current weapon costs used as baseline
  - Designed for ease of manufacturing and maintenance
  - Uses readily available materials

- Advantages of polymer
  - Uses conventional molding process
  - Can be outsourced to multiple suppliers
  - Adaptable to current assembly line



- Caseless :
  - Previous efforts proved feasibility
  - Future efforts focused on reducing cost



- Relative cost :



M1 Tank - $4.5 M



JSF- $83 M

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Lightweight Small Arms Technologies

Question #10: When is this going to be fielded?

- Joint Capability Technology Demonstration
  - Purpose: to demonstrate military utility of lightweight small arms technology
  - Timeframe: Demonstration in 2011
  - Status: On hold pending DA approval

- Field Assistance in Science and Technology (FAST) team in Afghanistan
  - LSAT team responded to request for information in April
  - Feedback: "…a lot of people here like your program. If it were more mature, we'd get an ONS out…"

- Demo :
  - Conducted multiple demos already (one for this conference in 2007)
  - Looking to schedule more – USMC, SOCOM…
  - Generate interest, possible requirements



Lightweight Small Arms Technologies



Questions?

US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

J·S·S·A·P JOINT SERVICE SMALL ARMS PROGRAM

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ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Advanced Lethal Armament Technology for Small Arms

By: Shawn Spickert-Fulton
Small Caliber Munitions Division
(973) 724-6088 Shawn.SpickertFulton@US.Army.Mil

Agenda

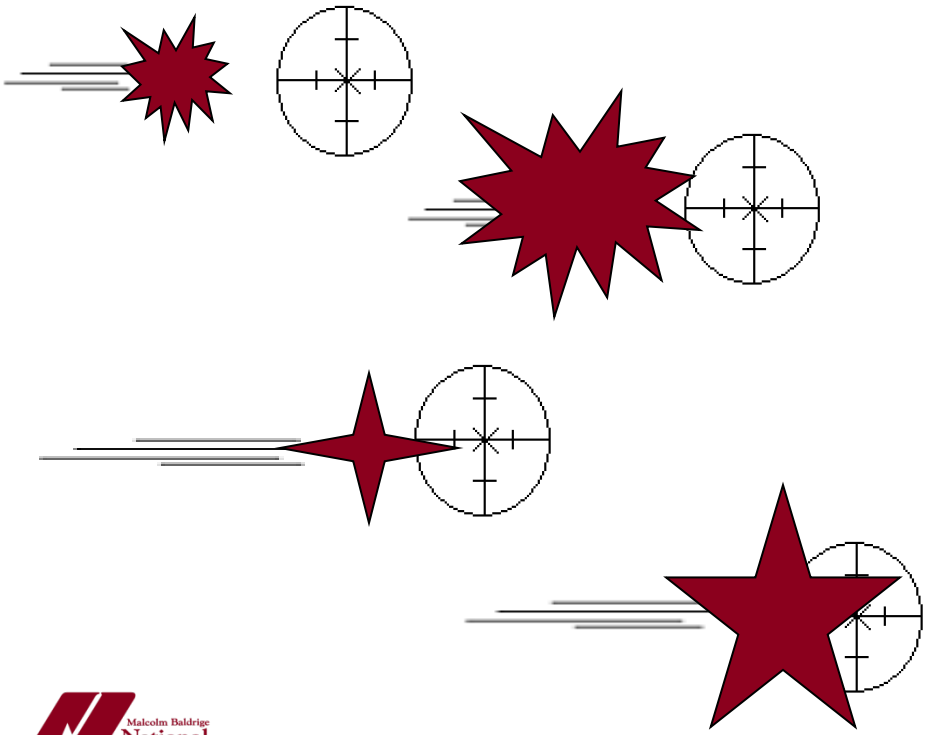
1	Introduction
2	Introduction to the ATO
3	Metrics and Goals
4	Where are we Looking?
5	What are we Doing?
6	Updates
7	Summary

Introduction

The next generation of weapons is always tasked to do more with the same or smaller foot print.







Areas of Interest:

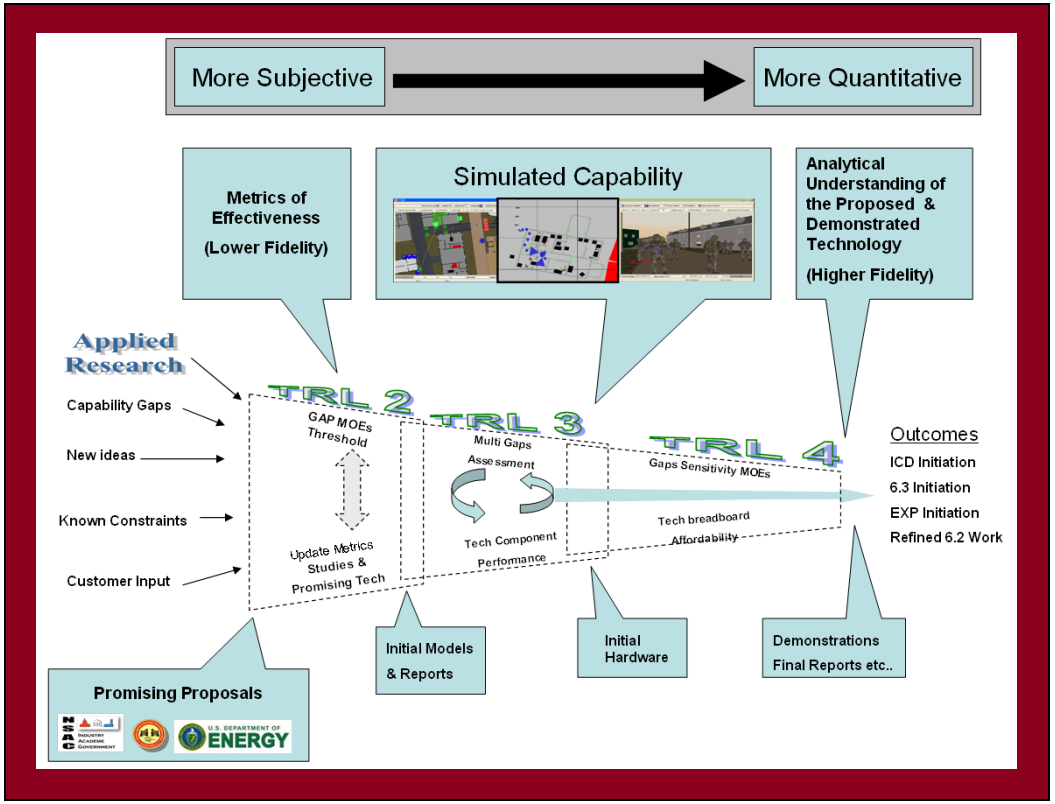
1. Larger Effects
2. Controlled Distribution of Effects
3. Better Accuracy of Effects
4. Less Weight

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The Advanced Lethal Armament Technology ATO

What is the ALA ATO?

The Advanced Lethal Armament Army Technology Objective (ATO) is a 3-year JSSAP effort which was started in 2008 and was designed to find, mature, and demonstrate state-of-the-art component technology that when integrated, tested, and fielded has the potential to bring new and improved effect capabilities to the unit and to the War-Fighter.



•R.LE.2008.03/Advanced Lethal Armament Technology for Small Arms

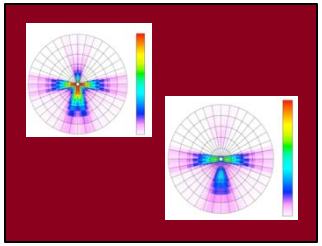
What is the Objective?

To improve our ability to incapacitate targets especially those hidden behind objects and under cover.



What are some of the Challenges?

Incapacitation potential is limited by delivery accuracy, payload efficiency, payload size, and payload type.



What are we looking for?

Immature component technologies in the TRL 2-4 range (applied research through prototype) that will directly or indirectly increase our ability to put effects on target.

Can you be more specific?

Right now, we are primarily interested in air burst technology components.

1. *Technologies that make us more lethal.*
2. *Technologies that make our warhead bursts more controllable and/or more efficient*
3. *Technologies that deliver more effects to the target.*

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What is the expected Outcome?

TRL 4 (Brass Board) component technologies that have been assessed and demonstrated to decision makers enabling further development



Where are the Opportunities?

Advanced Fuzes, Fragment Distribution Techniques, Warhead Efficiency

Metrics and Goals

#	Intent	Current Metric	Goal	Technology Maturity Level
1	Increase the warhead lethality and/or the size of the area affected	P(Incapacitation) / Area	We want to increase the ratio of P(incapacitation) to area affected by 25% or more over current systems.	Start: TRL 2 (M & S Work, Papers, Applied Research)
				Finish: TRL 4 (Brass Board Prototype Demonstration)
2	Increase our ability to focus/ control fragment delivery	Models & Tests	Optimize the effect on the target(s)	Start: TRL 2 (M & S Work, Papers, Applied Research)
				Finish: TRL 4 (Brass Board Prototype Demonstration)
3	Want to launch bigger payloads without making the guns heavier	Launch Recoil per unit Weight	We want to increase the ratio of effects to weight by 25% or more.	Start: TRL 2 (M & S Work, Papers, Applied Research)
				Finish: TRL 4 (Brass Board Prototype Demonstration)
4	Want to reduce the recoil of current and future systems	Launch Impulse (lb-sec)	Reduce launch impulse by 30% or more	Start: TRL 2 (M & S Work, Papers, Applied Research)
				Finish: TRL 4 (Brass Board Prototype Demonstration)

Where are we Looking?

Answer: At Industry, Academia, and Government. Our search for new technologies is ongoing. This is a tough R&D area and we want good ideas from every venue.





Current Actions and Desires

What	Who	Which Metrics			
		1	2	3	4
Guided Projectile Technology Efforts	Academia, Government, Industry	X		X	X
Advanced Warhead Technology Efforts	Government & Industry	X			
Recoil Mitigation Technology Efforts	Government & Industry			X	X
Controlled Fragment Technology Efforts	Industry	X	X		
Advanced Warhead Electronics / Fuzing Efforts	Industry	X	X		
Advanced Material Efforts	Government	X		X	
Enabler Efforts	Government	X		X	



1	Increase the warhead lethality and/or the size of the area affected
2	Increase our ability to focus/ control fragment delivery
3	Want to launch bigger payloads without making the guns heavier
4	Want to reduce the recoil of current and future systems



Objective

Mature course correction technologies to reduce delivery error.

Why?: To place more effects on target more often

Targeted Weapon Platforms

Evolving and existing 25mm - 40mm Grenade Launch Systems such as the M203

Update

1. Multiple Efforts
2. Trade Studies Under-away
3. Preliminary Reports are Encouraging
4. Initial Hardware Tests being Planned.

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Objective

Mature Warhead Technologies to more effectively utilize and enhance explosive payloads especially against difficult targets in challenging settings

Why? Larger more controlled effects are needed to defeat the enemy in many situations where cover is ample.

Scenarios to Consider

1. Targets behind walls, trees, and other barriers
2. Difficult to Range Targets
3. Targets in Body Armor

Updates

1. Multiple Efforts
2. Government Models have been promising
3. Initial Hardware Tests are being scheduled.
4. Commercial efforts are being initiated.

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Objectives

Mature recoil mitigation technologies to enhance marksmanship and to allow for the fielding of systems with larger and/or more complex payloads

Why? Soldiers need to be able to rapidly deliver precision effects.

More Recoil Mitigation Opens more options:

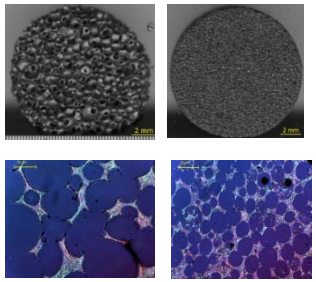
1. Larger Calibers
2. Faster Muzzle Velocities
3. Faster Rate of Fire

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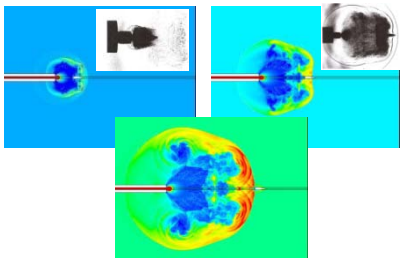
Update

1. Initial Concepts have been submitted.
2. Government Testing is being planned.
3. Commercial efforts are being initiated.
4. Government design work is ongoing.

Technology Enabler Updates



Advanced Materials



Advanced Models

Why?

We also are including those efforts and processes which:

1. Will enable other advance warhead technology to be implemented
2. Reduce the overall R&D risk
3. Allow us to focus in on the technical objectives and challenges

Examples:

1. Miniaturization of Warhead Electronics
2. Modeling and Simulation
3. Advanced Materials

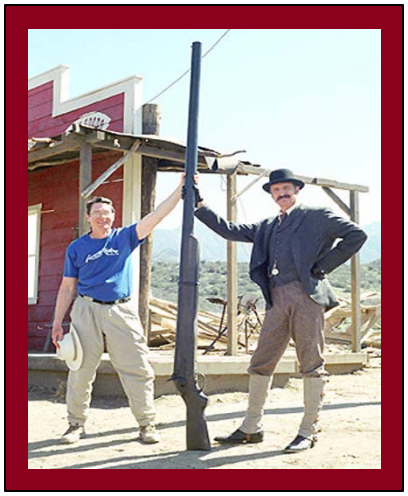
Updates

1. Multiple Efforts
2. Developing a smaller set back generator to power warheads
3. Maturing a carbon foam to eliminate heat in barrels faster.
4. Developing models to model gas flow in select weapon platforms
5. Developing models to examine the impact of technology efforts to the War-Fighter

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We Know the Work is Challenging

1. Small Arms Research and Development has been ongoing for centuries.
2. Ballistics couples just about every physical science there is.
3. Costs MUST be kept down.
4. Everything must be ruggedized, versatile, and ready at a moments notice.
5. Weight is an issue, as is the rest of the human condition.





"No sense getting their hopes up. They couldn't afford it if it worked."

Summary

1. This is a 3-year 6.2 R&D effort looking at component technology that will enhance our ability to deliver precision effects to designated targets.
2. We are seeking to mature advanced component technology from TRL 2-4.
3. We are primarily interested in airburst component technology.
4. We are still in need of good ideas. Watch for upcoming announcements

Highlighted Technology Areas of Specific Interest

1. Directional Fragmentation Technology
2. Control of Projectile Orientation at Target
3. Combined Lethal and Non-Lethal Warhead

Help Us to Help Them



Weapons & Sensors

Per G. Arvidsson

Chairman

Weapons & Sensors Working Group

Land Capability Group 1 - Dismounted Soldier

NATO Army Armaments Group

Tel: +46-8-782 4181, Fax: +46-8-782 6412

E-mail: per.arvidsson@fmv.se

Web-site: www.fmv.se

Agenda

- History of the two NATO rifle calibers.
- NATO Nominated Weapons.
- STANAG 4694 “NATO Accessory Rail”.
- National programs.
- Small arms lethality.

History of 7.62 NATO

- In WWII the Allies learned that ammunition supply was a nightmare.
- After NATO was founded in 1949, it was therefore decided to standardize calibers.
- USA proposed that the new rifle caliber should be the US developed .30 Light Rifle (7.62x51mm), which was a shortened .30-’06.
- GBR proposed the British 7.1x43mm intermediate caliber.
- In 1953 NATO standardized 7.62x51mm as the new rifle caliber.



7.62x63 7.1x43 7.62x51

History of 5.56 NATO

- In 1970 NATO decided to try to standardize a common rifle and a second rifle caliber.
- During 1977-1980 they therefore performed mutual tests with rifles and ammunition.
- The calibers tested were:
  - 5.56mm rounds with increased penetration from BEL and USA.
  - GBR 4.85mm round.
  - DEU 4.7mm caseless round.



USA **GBR** **DEU** **BEL**
5.56 **4.85** **4.7** **5.56**
XM777 **SS109**

NATO rifle and ammunition trials 1977-1980



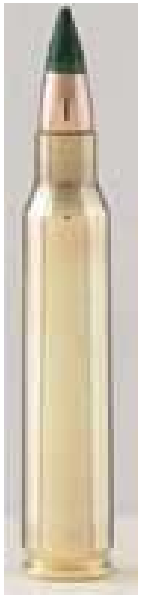





Country	Weapon	Caliber (mm)	Ammunition
Germany	G11	4.7	4.7 caseless
United Kingdom	4.85 IW	4.85	4.85
Belgium	FNC	5.56	SS109
Netherlands	MN 1 (Stoner 63)	5.56	M193
United States	M16A1	5.56	XM777
France	FAMAS	5.56	F1 brass and steel cased (M193 type)
United States (control)	M16A1	5.56	M193
Germany (control)	G3	7.62	7.62 NATO

The results

- No weapon could be agreed upon.
- Some were in their prototype status.
- The BEL SS109 round was found to be the best, and was standardized as NATO's second rifle caliber in 1980.



There is no NATO rifle!

- During the tests the US M16A1 was a control weapon.
- You can often see reference to:
  - NATO/STANAG magazine.
  - NATO/STANAG flash hider.
  - NATO/STANAG bayonet.
- There is currently no such thing!



NATO Nominated Weapons

- NNW's are used as reference when new ammunition is standardized.
- As of 2009 the 5.56mm rifles are:
  - FNC, Belgium
  - G36, Germany
  - AR70/90, Italy
  - L85A2, United Kingdom
  - M16A2, USA
- A new NNW must work with all qualified 5.56mm ammunition designs.

5.56mm NATO Ball Qualified Designs

NATO Design Number	Sponsoring Country	Head Stamp Initials	Publication Date	Manufacturer
AC/225-111A	USA	LC	30/06/1987	GOCO, Lake City, USA
		WCC		Olin Winchester USA
		TAA		205th Arsenal, Taiwan
AC/116-112A	BEL	FNB	14/11/1989	Fabrique Nationale, Belgium
AC/225-113A	ITA	SMI	12/04/1990	Europa Metalli, Italy
AC/225-114A	GBR	RG	14/08/1995	Royal Ordnance, United Kingdom
AC/225-116A	BEL	FNB	16/11/1995	Giat Industrie, France
AC/225-117A	NLD	HP	15/05/1996	Hirtenberger, Austria
AC/225-118A	CAN	IVI	17/01/1997	GD-OTS, Canada
AC/225-120A	PRT	FNM	31/08/1998	Indep, Portugal
AC/225-122A	ITA	GFL	11/01/1999	Fiocchi, Italy
AC/225-124A	GBR	RG	24/02/1999	Royal Ordnance, United Kingdom
AC/225-125A	DEU	DAG	10/03/2000	RUAG, Germany
		MEN		MEN, Germany
AC/225-126A	BEL, FRA	IMI	10/03/2000	IMI, Israel
AC/225-127A	SPA	SB	26/09/2000	Santa Barbara, Spain
AC/225-128A	NOR	CG	6/07/2004	NAMMO, Sweden
AC/225-130A	LIT	GGG	26/05/2005	GGG, Lithuania
AC/225-132A	GBR	RG	27/01/2006	BAE Systems Radway Green, United Kingdom
AC/225-133A	GBR	RG	30/01/2006	BAE Systems Radway Green, United Kingdom

W&S STANAG's

- We are currently updating STANAG's that were created during the cold war to better reflect current and future operation:
  - STANAG 4512 Dismounted Personnel Targets
  - STANAG 4513 Incapacitation & Suppression
  - STANAG 4498 Unarmoured Vehicles, Helicopters & Field Fortification Targets
  - STANAG 4536 Representative Building Targets
- STANAG 2129 - Identification of land forces on the battlefield and in an area of operation.
- STANAG 4694 NATO Accessory Rail.

NATO RTO study

- Ten Nations have under the umbrella of the NATO Research and Technology Organization (RTO) formed a team with the objective to standardize a NATO rail.
- Industry has been heavily involved.

R&T ORGANIZATION



STANAG 4694 “NATO Accessory Rail”

- Approved by NATO on May 8.
- The NATO Accessory Rail has full backwards compatibility with MIL-STD-1913 rail grabbers/mounts.
- Recommendation on how to attach rail grabbers/mounts to the NATO Accessory Rail.



NATO/PFP UNCLASSIFIED
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STANAG 4694
Draft

NORTH ATLANTIC TREATY ORGANISATION
(NATO)

NATO STANDARDISATION AGENCY
(NSA)

STANDARDISATION AGREEMENT
(STANAG)

SUBJECT: DRAFT STANAG 4694 – NATO ACCESSORY RAIL

Promulgated on

Jean A. MORENO
Vice Admiral, ESP (N)
Director, NATO Standardization Agency

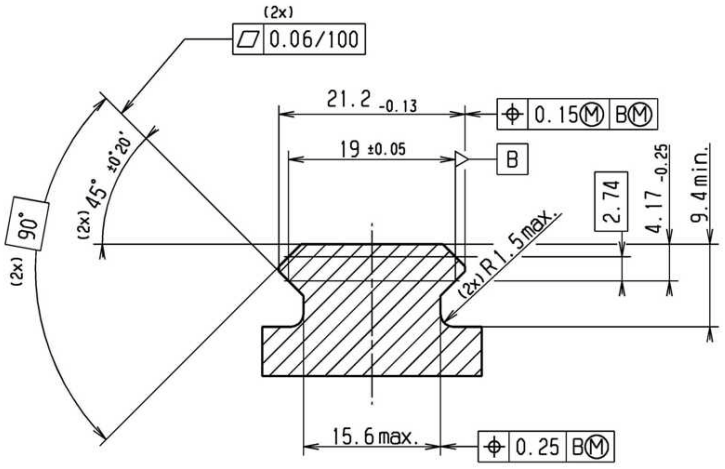
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MIL-STD-1913 / STANAG 4694

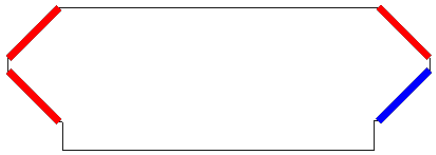
The differences between MIL-STD-1913 and STANAG 4694 are:

- Metric drawing.
- Added some new necessary measurements and tolerances.
- Adjustment of some measurements.
- Reduction of straightness tolerances with approx 50%.



Recommendations

- On a typical Mil-Std-1913 rail the grabber is clamping the rail on the v-angles.
- Our tests have shown that this does not provide good repeatability.
- We recommend instead that the top surface is used as a reference and alignment of the grabbers.
- Our tests have shown that this provides excellent repeatability.



Typical US MIL-STD-1913 Rail/Grabber Interface



NATO Rail/Grabber Interface

National programs

- Information exchange is an important issue.
- This has shown that there are many similar programs among the nations:
  - Upgrade of rifles.
  - Procurement of the same type of accessories (sights, laser pointers and magnification devices).
  - Studies of light weight fire control systems.
  - Studies of suppressors.





Assault rifle development



1942
MKb 42 (H)



2009
FN Mk 16 (SCAR-L)

What has happened in the last 67 years?

- Reduced caliber
- Rails
- Foldable and adjustable butt stock
- Reduced weight

Accessories that were not available 30 years ago

- Good electro-optic day and night sights.
- Laser pointers
- Overhead weapon stations
- Compact fire control systems
- LED flash lights


Aimpoint CompM4


ITT AN/PVS-14


Raytheon AN/PVS-13 TWS


Laser Devices DBAL-A2


Rheinmetall LLM 01

Kongsberg Protector




Aimpoint FCS BR8


Streamlight TLR-1

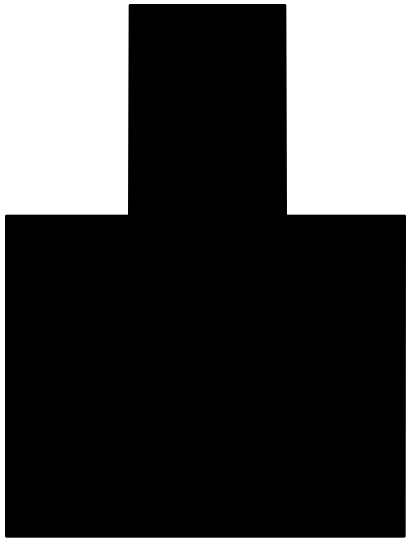

IT AN/PAQ-4C

Small Arms Lethality

- There has previous been many discussions about small arms lethality.
- GBR therefore hosted a two day ”Workshop on Small Arms Lethality” on February 18-19 at the Defence Academy of the United Kingdom in Shrivenham.
- The group agrees that shot placement is the most important parameter.
- This is achieved through good and realistic training.
- We have included this topic in our agenda.

Modification of Swedish pop-up target

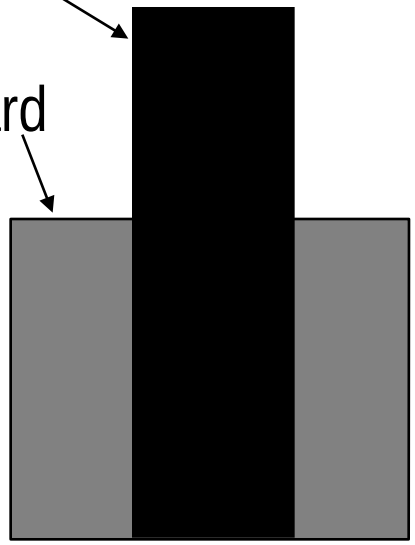
Sheet metal



Original target

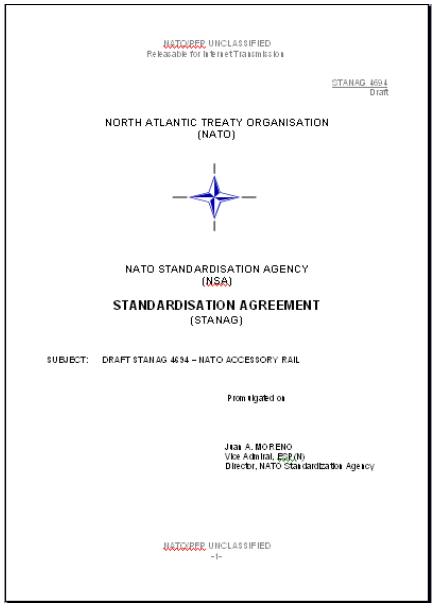
Sheet metal (w=120mm)

Cardboard



Modified target





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(NATO)

NATO STANDARDISATION AGENCY
(NSA)

STANDARDISATION AGREEMENT
(STANAG)

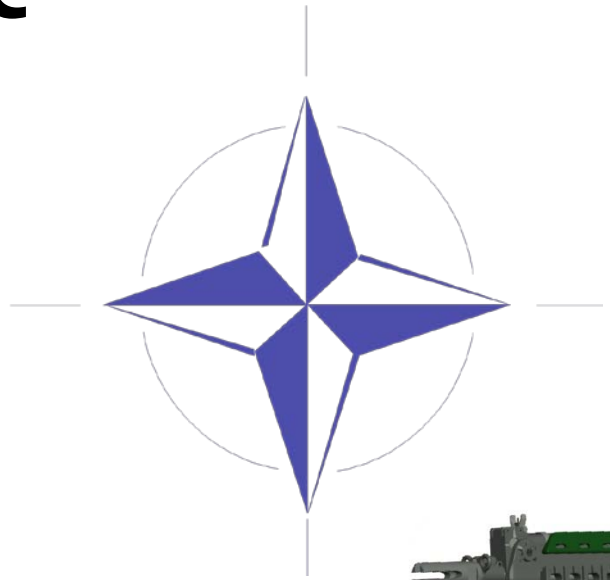
SUBJECT: DRAFT STANAG 4694 – NATO ACCESSORY RAIL

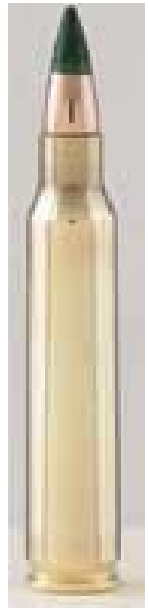
Promulgated on

Jean A. MORENO
Vice Admiral, ESP(N)
Director, NATO Standardization Agency

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Questions?





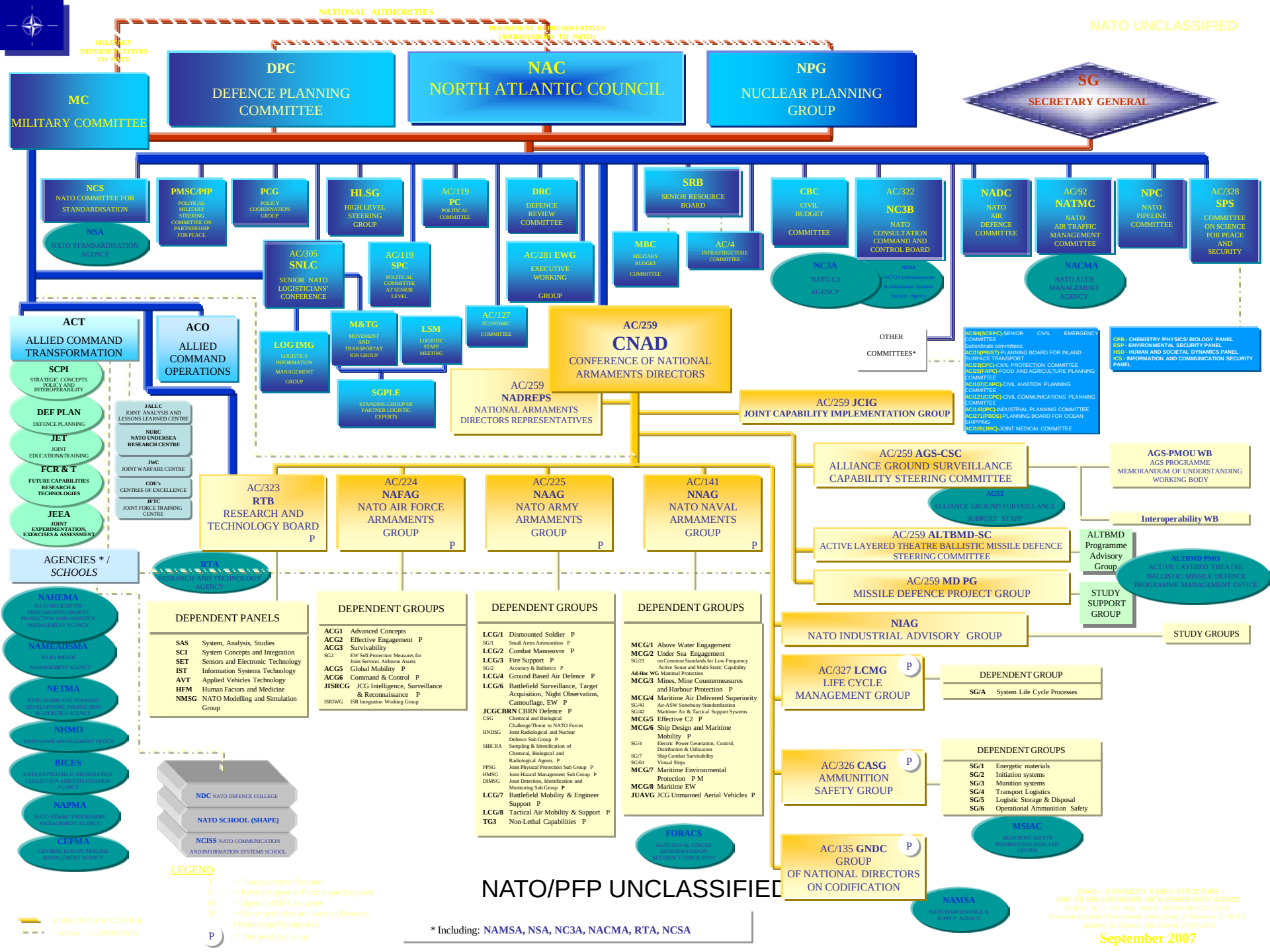




NORTH ATLANTIC TREATY ORGANIZATION
ORGANISATION DU TRAITE DE L' ATLANTIC NORD
AC/225 Land Capability Group 1
Dismounted Soldier



LCol Mike Bodner
Chairman


NATO UNCLASSIFIED
NATIONAL AUTHORITIES
MILITARY REPRESENTATIVES TO NATO
PERMANENT REPRESENTATIVES (AMBASSADORS) TO NATO
MC
MILITARY COMMITTEE
DPC
DEFENCE PLANNING COMMITTEE
NAC
NORTH ATLANTIC COUNCIL
NPG
NUCLEAR PLANNING GROUP
SG
SECRETARY GENERAL
NCS
NATO COMMITTEE FOR STANDARDISATION
NSA
NATO STANDARDISATION AGENCY
PMSC/PfP
POLITICAL MILITARY STEERING COMMITTEE ON PARTNERSHIP FOR PEACE
PCG
POLICY COORDINATION GROUP
HLSG
HIGH LEVEL STEERING GROUP
AC/119 PC
POLITICAL COMMITTEE
DRC
DEFENCE REVIEW COMMITTEE
SRB
SENIOR RESOURCE BOARD
MBC
MILITARY BUDGET COMMITTEE
AC/4
INFRASTRUCTURE COMMITTEE
CBC
CIVIL BUDGET COMMITTEE
AC/322 NC3B
NATO CONSULTATION COMMAND AND CONTROL BOARD
NC3A
NATO C3 AGENCY
NCSA
NATO Communications & Information Systems Services Agency
NADC
NATO AIR DEFENCE COMMITTEE
AC/92 NATMC
NATO AIR TRAFFIC MANAGEMENT COMMITTEE
NACMA
NATO ACCS MANAGEMENT AGENCY
NPC
NATO PIPELINE COMMITTEE
AC/328 SPS
COMMITTEE ON SCIENCE FOR PEACE AND SECURITY
AC/305 SNLC
SENIOR NATO LOGISTICIANS' CONFERENCE
AC/119 SPC
POLITICAL COMMITTEE AT SENIOR LEVEL
AC/281 EWG
EXECUTIVE WORKING GROUP
ACT
ALLIED COMMAND TRANSFORMATION
ACO
ALLIED COMMAND OPERATIONS
LOG IMG
LOGISTICS INFORMATION MANAGEMENT GROUP
M&TG
MOVEMENT AND TRANSPORTATION GROUP
LSM
LOGISTIC STAFF MEETING
AC/127
ECONOMIC COMMITTEE
SGPLE
STANDING GROUP OF PARTNER LOGISTIC EXPERTS
AC/259
CNAD
CONFERENCE OF NATIONAL ARMAMENTS DIRECTORS
AC/259 NADREPS
NATIONAL ARMAMENTS DIRECTORS REPRESENTATIVES
AC/259 JCIG
JOINT CAPABILITY IMPLEMENTATION GROUP
OTHER COMMITTEES*
AC/98(SCEPC)-SENIOR CIVIL EMERGENCY COMMITTEE
Subordinate committees:
AC/135(PBIST)-PLANNING BOARD FOR INLAND SURFACE TRANSPORT
AC/23(CPC)-CIVIL PROTECTION COMMITTEE
AC/25(FAPC)-FOOD AND AGRICULTURE PLANNING COMMITTEE
AC/107(CAPC)-CIVIL AVIATION PLANNING COMMITTEE
AC/121(CCPC)-CIVIL COMMUNICATIONS PLANNING COMMITTEE
AC/143(IPC)-INDUSTRIAL PLANNING COMMITTEE
AC/271(PBOS)-PLANNING BOARD FOR OCEAN SHIPPING
AC/320(JMC)-JOINT MEDICAL COMMITTEE
CPB - CHEMISTRY /PHYSICS/ BIOLOGY PANEL
ESP - ENVIRONMENTAL SECURITY PANEL
HSD - HUMAN AND SOCIETAL DYNAMICS PANEL
ICS - INFORMATION AND COMMUNICATION SECURITY PANEL
SCPI
STRATEGIC CONCEPTS POLICY AND INTEROPERABILITY
DEF PLAN
DEFENCE PLANNING
JET
JOINT EDUCATION&TRAINING
FCR & T
FUTURE CAPABILITIES RESEARCH & TECHNOLOGIES
JEEA
JOINT EXPERIMENTATION, EXERCISES & ASSESSMENT
JALLC
JOINT ANALYSIS AND LESSONS LEARNED CENTRE
NURC
NATO UNDERSEA RESEARCH CENTRE
JWC
JOINT WARFARE CENTRE
COE's
CENTRES OF EXCELLENCE
JFTC
JOINT FORCE TRAINING CENTRE
AGENCIES * / SCHOOLS
AC/323 RTB
RESEARCH AND TECHNOLOGY BOARD
P
AC/224 NAFAG
NATO AIR FORCE ARMAMENTS GROUP
P
AC/225 NAAG
NATO ARMY ARMAMENTS GROUP
P
AC/141 NNAG
NATO NAVAL ARMAMENTS GROUP
P
RTA
RESEARCH AND TECHNOLOGY AGENCY
AC/259 AGS-CSC
ALLIANCE GROUND SURVEILLANCE CAPABILITY STEERING COMMITTEE
AGS3
ALLIANCE GROUND SURVEILLANCE SUPPORT STAFF
AGS-PMOU WB
AGS PROGRAMME MEMORANDUM OF UNDERSTANDING WORKING BODY
Interoperability WB
AC/259 ALTBMD-SC
ACTIVE LAYERED THEATRE BALLISTIC MISSILE DEFENCE STEERING COMMITTEE
ALTBMD Programme Advisory Group
ALTBMD PMO
ACTIVE LAYERED THEATRE BALLISTIC MISSILE DEFENCE PROGRAMME MANAGEMENT OFFICE
AC/259 MD PG
MISSILE DEFENCE PROJECT GROUP
STUDY SUPPORT GROUP
NIAG
NATO INDUSTRIAL ADVISORY GROUP
STUDY GROUPS
AC/327 LCMG
LIFE CYCLE MANAGEMENT GROUP
P
DEPENDENT GROUP
SG/A System Life Cycle Processes
AC/326 CASG
AMMUNITION SAFETY GROUP
P
DEPENDENT GROUPS
SG/1 Energetic materials
SG/2 Initiation systems
SG/3 Munition systems
SG/4 Transport Logistics
SG/5 Logistic Storage & Disposal
SG/6 Operational Ammunition Safety
MSIAC
MUNITIONS SAFETY INFORMATION ANALYSIS CENTER
AC/135 GNDC
GROUP OF NATIONAL DIRECTORS ON CODIFICATION
P
NAMSA
NATO MAINTENANCE & SUPPLY AGENCY
DEPENDENT PANELS
SAS System, Analysis, Studies
SCI System Concepts and Integration
SET Sensors and Electronic Technology
IST Information Systems Technology
AVT Applied Vehicles Technology
HFM Human Factors and Medicine
NMSG NATO Modelling and Simulation Group
DEPENDENT GROUPS
ACG1 Advanced Concepts
ACG2 Effective Engagement P
ACG3 Survivability
SG2 EW Self-Protection Measures for Joint Services Airborne Assets
ACG5 Global Mobility P
ACG6 Command & Control P
JISRCG JCG Intelligence, Surveillance & Reconnaissance P
ISRIWG ISR Integration Working Group
DEPENDENT GROUPS
LCG/1 Dismounted Soldier P
SG/1 Small Arms Ammunition P
LCG/2 Combat Manoeuvre P
LCG/3 Fire Support P
SG/2 Accuracy & Ballistics P
LCG/4 Ground Based Air Defence P
LCG/6 Battlefield Surveillance, Target Acquisition, Night Observation, Camouflage, EW P
JCGCBRN CBRN Defence P
CSG Chemical and Biological Challenge/Threat to NATO Forces
RNDSG Joint Radiological and Nuclear Defence Sub Group P
SIBCRA Sampling & Identification of Chemical, Biological and Radiological Agents P
PPSG Joint Physical Protection Sub Group P
HMSG Joint Hazard Management Sub Group P
DIMSG Joint Detection, Identification and Monitoring Sub Group P
LCG/7 Battlefield Mobility & Engineer Support P
LCG/8 Tactical Air Mobility & Support P
TG3 Non-Lethal Capabilities P
DEPENDENT GROUPS
MCG/1 Above Water Engagement
MCG/2 Under Sea Engagement
SG/21 on Common Standards for Low Frequency Active Sonar and Multi-Static Capability
Ad-Hoc WG Mammal Protection
MCG/3 Mines, Mine Countermeasures and Harbour Protection P
MCG/4 Maritime Air Delivered Superiority
SG/41 Air-ASW Sonobuoy Standardization
SG/42 Maritime Air & Tactical Support Systems
MCG/5 Effective C2 P
MCG/6 Ship Design and Maritime Mobility P
SG/4 Electric Power Generation, Control, Distribution & Utilization
SG/7 Ship Combat Survivability
SG/61 Virtual Ships
MCG/7 Maritime Environmental Protection P M
MCG/8 Maritime EW
JUAVG JCG Unmanned Aerial Vehicles P
FORACS
NATO NAVAL FORCES SIMULATION/WEAPON ACCURACY CHECK SITES
NAHEMA
NATO HELICOPTER DESIGN&DEVELOPMENT PRODUCTION AND LOGISTICS MANAGEMENT AGENCY
NAMEADSMA
NATO MEADS MANAGEMENT AGENCY
NETMA
NATO EF 2000 AND TORNADO DEVELOPMENT, PRODUCTION & LOGISTICS AGENCY
NHMO
NATO HAWK MANAGEMENT OFFICE
BICES
NATO BATTLEFIELD INFORMATION COLLECTION AND EXPLOITATION AGENCY
NAPMA
NATO AEW&C PROGRAMME MANAGEMENT AGENCY
CEPMA
CENTRAL EUROPE PIPELINE MANAGEMENT AGENCY
NDC NATO DEFENCE COLLEGE
NATO SCHOOL (SHAPE)
NCISS NATO COMMUNICATION AND INFORMATION SYSTEMS SCHOOL
LEGEND
T = Transparent to Partners
P = Partially open to Partner participation
M = Open to MD Countries
W = Some activities are open to Partners (Workshops/Symposia)
P = Partnership Group
DIRECTION AND CONTROL
LIAISON / CO-OPERATION
NATO/PFP UNCLASSIFIED
* Including: NAMSA, NSA, NC3A, NACMA, RTA, NCSA
CNAD – CAPABILITY BASED STRUCTURE AND ITS RELATIONSHIPS WITH OTHER NATO BODIES
Drafted by Lt. col. eng. Vasile SERBANESCU (2004)
Defence Section / Permanent Delegation of Romania to NATO
Updated by Daniela Balaicheva (NHQ-JAS)
September 2007

Mission - Main Armament Groups

- NATO Armament Handbook – 20 May 2008
  - Foster exchange of Information
  - Promote technical Standardization, Interoperability and Integration
  - Identify and promote Technical advancements
  - Plan/direct/coord subordinate groups
  - Liaise with all relevant organizations
    - Within NATO – RTO, IMS, NIAG, ACT, NSA, JALLC, etc
    - Outside – EU, MD, ICI, NGOs, Industry, etc

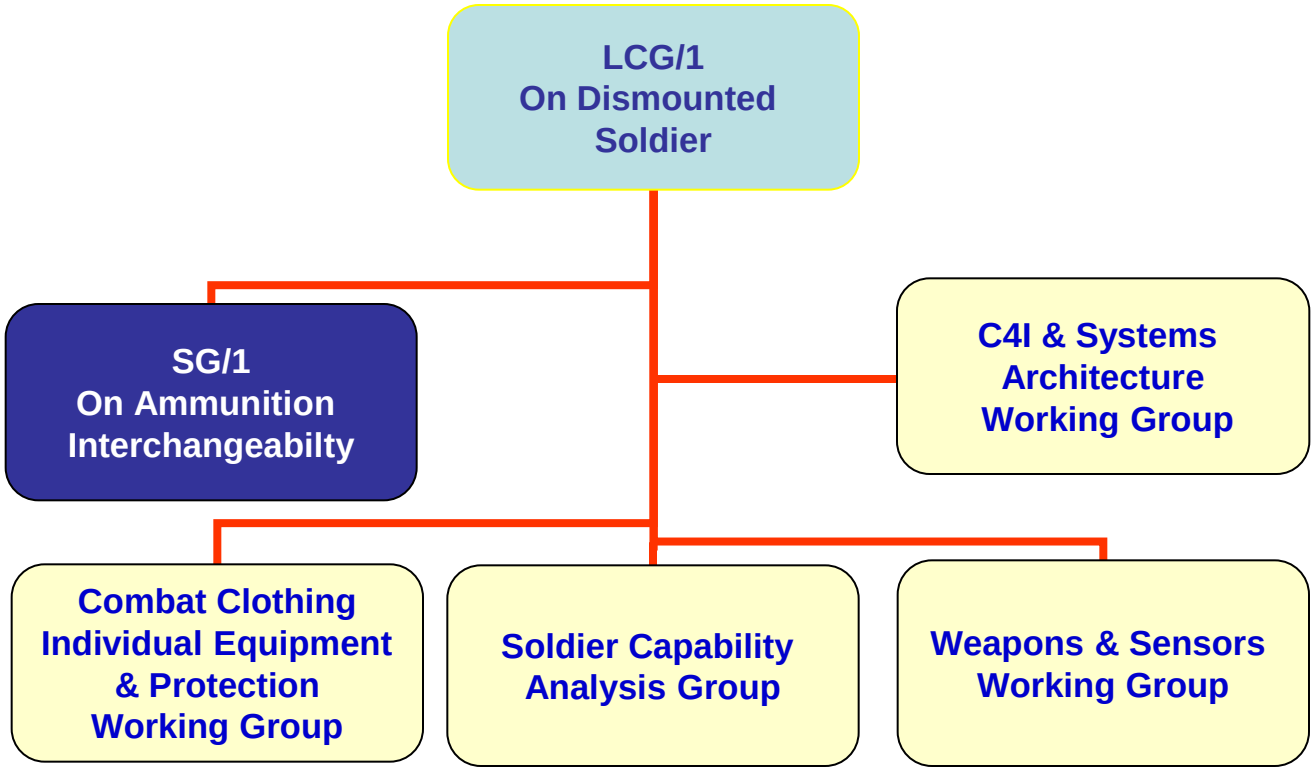
Three Levels of Standardization AAP 6 (01 Apr 2008)

- 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

- *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).

- *Interoperability:* The ability to operate in synergy in the execution of assigned tasks (22 Jun 2004)

LCG/1 and Sub-groups



Two Team of Experts - Power and Head-borne Systems

NATO Soldier System History

- **Working Group of Experts in Panel 3**
  - **1991-1993**
- **NIAG Pre-Feasibility Study Dismounted Soldier Modernization**
  - **1992-1994**
- **WG 3 of Panel 3 Soldier Modernization**
  - **1994- Oct 2000**
- **Topical Group 1 Soldier System Interoperability**
  - **Oct 2000 – Dec 2005**
- **Land Group 1 Soldier Systems**
  - **Jan 2006**
- **Land Capability Group 1 Dismounted Soldier**
  - **Jan 2007**

Land Capability Group 1 Management

- **Chairman**
  - **LCol Mike Bodner – CAN**
- **Deputy Chairman**
  - **LCol Wolfgang Althoff - DEU**
- **NATO International Staff Support**
  - **Matt Dove – Land Armaments Unit, NATO HQ**
- **Land Capability Group 1 - Many Pers (300 experts)**
  - **NATO Countries - 22**
  - **Partners - 4**
  - **Contact Country – 1 (Australia)**

LCG/1 Sub – Group/Working Group Structure

- **Sub-Group/1 Ammunition Interchangeability**
  - **Mr Fridtjof Guth – NLD Chairman**
  - **Iain Morris – GBR Superintendent ERTC**
  - **Dominic Pellegrino – USA Superintendent NRTC**
- **Soldier Capabilities & Analysis Group**
  - **Mr Mark Richter – USA Chairman**
  - **Maj Torstein Johnson – NOR Deputy**
- **Combat Clothing Individual Equipment & Protection WG**
  - **Mr Henk Reulink – NLD Chairman**
  - **Mrs Jana Barancicova – CZE Deputy**
- **C4I & Systems Architecture WG**
  - **Mr JD Wilson – USA Chairman**
  - **Mr Marcel Vanderlee – NLD Deputy**
- **Weapons & Sensors WG**
  - **Mr Per Arvidson – SWE Chairman**
  - **Maj Sean Hoopey – CAN Deputy**
- **Power TOE**
  - **Maj Eelco Vroon - NLD Chairman**
  - **Deputy - Vacant**

Specific Work of LCG 1

Sub Group 1 Ammunition Interchangeability

Qualify NATO Ammunition designs

- **Certify NATO Ammo Interchangeability**
- **Operate NATO Regional Test Centers**
- **Certify National Test Centers**
- **This year**
  - ✓ **Production Tests performed on the 5.56 mm Ball, 7.62 Ball & Tr and 9 mm for FRA, ITA, GBR, CAN and USA**
  - ✓ **Plan to certify the ERTC for the 12,7mm calibre**
  - ✓ **promulgate and start the ratification of STANAG 4624 (30mm x 173)**
  - ✓ **publish the MOPI 30mm (end June 2009)**

Specific Work of LCG 1

Soldier Capability and Analysis Group

- Serve as oversight and provide operational direction to LCG/1
- Provide rationale for work – link to other WGs and TOEs

- Completed 3 Dismounted Coalition Scenarios
  Approved by ACT Feb 2007

- Updating an Overarching Definition and Capabilities document
- New NATO Soldier Capability Analysis out for comment
- Address Dismounted BCID - STANAGs 4630 and 2129
- Address the lack of NATO Soldier Symbology
- Address report on Lessons Learned from Ops with JALLC Monsanto

Specific Work of LCG 1

Combat Clothing Individual Equipment and Protection Working Group

- Group is addressing NATO Long Term Capability Requirement on Integrated Personal Protection (one of the top 16)
- Maintain 16 Other STANAGs
  - 5 in Ratification, 3 in Development, remainder under review
- Identifying long term proposals for NATO research projects
- Updating Laser eye Protection
- Tracking Smart Textiles

Specific Work of LCG 1

C4I / Systems Architecture Working Group and Power TOE

- **"Develop the ability to exchange tactical information and individual soldier positional information at the soldier level" – NAAG Chairman MGen Dam, NLD**
- **Originally developed 4677 (C4I STANAG) and 4678 (Architecture STANAG Data Model) – need to pursue 4 more STANAGs (Exchange Mechanisms, Network Access, Transmission Connectivity and Data Model**
- **Link to NATO C3 Board on a wide variety of issues**
- **NIAG Study 123 on Information Exchange Mechanisms**
- **Power TOE**
  - **STANAG 4619 Electrical Standard for Soldiers – in ratification**
  - **New STANAG 4695 – Power Source Interoperability**
  - **Strategy - 'NATO Standard Power Connector'**
  - **R and D SET 126 Power Optimization for the NATO Warfighter**

Specific Work of LCG 1

Weapons & Sensors Working Group

- **Review STANAGs and Nations SA plans**

  New STANAG 4694 “NATO Accessory Rail”

  Update:

  STANAG 4498 Un-armoured Vehicles, Helicopters & Field Fortification Targets
  STANAG 4512 Dismounted Personnel Targets
  STANAG 4513 Incapacitation & Suppression
  STANAG 4536 Representative Building Targets

  Review Infantry Weapons Master Plan

- **RTO Study initiated to address Future Small Arms:**
  - ✓ **Weapons interfaces**
  - ✓ **Human Factors & analysis**
  - ✓ **Electrical Power**

- **Deliver a Technical Report by Dec 2009**

World Stage - Soldier Systems





Germany
IDZ-BS
IDZ-ES





USA
Land Warrior
GSS



France
FÉLIN



UK
FIST



Norway
NORMANS





Israel
IAS



Italy
Combattente
2000

Update German National Soldier Modernisation Program



“Infanterist der Zukunft I d Z”

NATO HQ, Brussels

12.-14.11.2008

Karl-Heinz Rippert
bwbu42@bwb.org

NATO/PFP UNCLASSIFIED

Summary to NDIA SA

- **NATO / NAAG has a capability-based focus to better align with the Allied Command Transformation (ACT)**
- **Considerable History of Soldier System documents, definitions and programmes**
- **LGC/1 is a large group with significant responsibilities – Most Project Managers**
- **All dismounted soldier standardization falls under LCG/1**
- **US Military, Defence Research and Industry play a key roles**

QUESTIONS ?



Small Arms Replacement Project 2
Presentation to the
NDIA

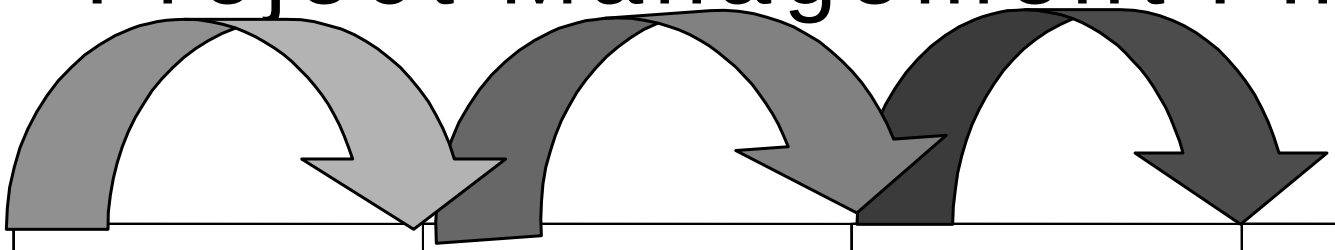
Maj B Gilchrist

DLR 5-5

Outline

- Canadian Project System
- SARP 2
- Research and Development
- Networked Weapons

Project Management Phases



IDENTIFICATION	OPTIONS ANALYSIS	DEFINITION	IMPLEMENTATION
Identify Capability Deficiency	**Formulate options** Discard invalid options Assess benefits of remaining options Examine risk **Decide which option should be pursued** Development	Detailed review, risk assessment and costing of selected option. Implementation planning **Finalize SOR**	Implementation Implementation management Implementation monitoring Reports on status of implementation Operational Handover Close out

Decision SS(ID) | Decision SS(PPA) | Decision SS(EPA)

X yrs → **2-3 yrs** → **2-4 yrs** → **7 yrs**

Aim of SARP 2

SARP 2 will modernize or replace the CF small arm capability

CANADIAN FORCES SMALL ARMS - MENU
ARMES LÉGÈRES DES FORCES CANADIENNES - MENU



• 71349 •
RIFLE, AIR, .177 calibre, DAISY, Model 853C
FUSIL À AIR, calibre .177, DAISY, Modèle 853C



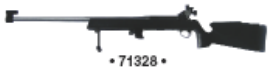
• 71314 •
RIFLE, AIR, .177 calibre, ANSCHÜTZ, Model 380
FUSIL À AIR, calibre .177, ANSCHÜTZ, Modèle 380



• 71313 •
RIFLE, TARGET, .22 calibre, ANSCHÜTZ, Model 1403
FUSIL DE TIR SUR CIBLE, calibre .22, ANSCHÜTZ, Modèle 1403



• 71317 •
RIFLE, BIATHLON, .22 calibre, ANSCHÜTZ, Model 1827 & Fortner
FUSIL DE BIATHLON, calibre .22, ANSCHÜTZ, Modèle 1827 & Fortner



• 71328 •
RIFLE, TARGET, 5.56mm, C11
FUSIL DE TIR SUR CIBLE, 5.56mm, C11



• 71347 •
RIFLE, TARGET, 7.62mm, C12A1
FUSIL DE TIR SUR CIBLE, 7.62mm, C12A1



• 71108 •
RIFLE, .22 calibre, LEE ENFIELD, C No 7 MK 1
FUSIL, calibre .22, LEE ENFIELD, C No 7 MK 1



• 71111 •
RIFLE, .303 calibre, LEE ENFIELD, No 4, all marks
FUSIL, calibre .303, LEE ENFIELD, No 4, toutes catégories



• 71327 •
RIFLE, SAR, 30.06 calibre, RUGER, Model M77
FUSIL, SAR, calibre 30.06, RUGER, Modèle M77



• 71117 •
SHOTGUN, Double Barrel, 12 gauge, LION
FUSIL DE CHASSE, à deux canons, 12 gauge, LION



• 71288 •
SHOTGUN, Semi-automatic, 12 gauge, REMINGTON, Model 1100
FUSIL DE CHASSE, Semi-automatique, 12 gauge, REMINGTON, Modèle 1100



• 71336 •
SHOTGUN, Pump, 12 gauge, REMINGTON, Model 870P
FUSIL DE CHASSE, Pompe, 12 gauge, REMINGTON, Modèle 870P



• 71336 •
SHOTGUN, Pump, 12 gauge, REMINGTON, Model 870P
FUSIL DE CHASSE, Pompe, 12 gauge, REMINGTON, Modèle 870P



• 71194 •
GUN, GAS, 38mm, W/SAFETY LOCK
GUN À GAZ, 38mm, avec loquet de sureté



• 71234 •
RIFLE, SNIPER, 7.62mm, C3A1
FUSIL DE PRÉCISION, 7.62mm, C3A1



• 71361 •
RIFLE, SNIPER, .338 (LM) calibre, C14
FUSIL DE PRÉCISION, calibre .338, (LM) calibre, C14



• 71348 •
RIFLE, SNIPER, .50 calibre, McMILLAN, Tactical
FUSIL DE PRÉCISION, calibre .50, McMILLAN, Tactique



• 71340 •
GUN, SUB-MACHINE, 9mm, H&K, MP5N
MITRAILLETTE, 9mm, H&K, MP5N



• 71294 •
CARBINE, Automatic, 5.56mm, C8
CARABINE, Automatique, 5.56mm, C8



• 71294 •
CARBINE, Automatic, 5.56mm, C8A3
CARABINE, Automatique, 5.56mm, C8A3



• 71295 •
RIFLE, Automatic, 5.56mm, C7
FUSIL, Automatique, 5.56mm, C7



• 71295 •
RIFLE, Automatic, 5.56mm, C7A1
FUSIL, Automatique, 5.56mm, C7A1



• 71295 •
RIFLE, Automatic, 5.56mm, C7A2
FUSIL, Automatique, 5.56mm, C7A2



• 71350 •
LAUNCHER, GRENADE, 40mm, M-203A1, w/rifle C7A1
LANCE-GRENADE, 40mm, M-203A1, a/fusil C7A1



• 71296 •
MACHINE-GUN, Light, 5.56mm, C9
MITRAILLEUSE, Légère, 5.56mm, C9



• 71296 •
MACHINE-GUN, Light, 5.56mm, C9A1
MITRAILLEUSE, Légère, 5.56mm, C9A1



• 71296 •
MACHINE-GUN, Light, 5.56mm, C9A2
MITRAILLEUSE, Légère, 5.56mm, C9A2



• 71267 •
MACHINE-GUN, GPMG, Flexible, 7.62mm, C6
MITRAILLEUSE, Polyvalente, Mobile, 7.62mm, C6



• 71267 •
MACHINE-GUN, GPMG, Coaxial, 7.62mm, C6
MITRAILLEUSE, Polyvalente, Coaxiale, 7.62mm, C6



• 71267 •
MACHINE-GUN, GPMG, LAV, Coaxial, 7.62mm, C6
MITRAILLEUSE, Polyvalente, VBL, Coaxiale, 7.62mm, C6



• 71107 •
PISTOL, 9mm, BROWNING FN, HP No 2 MK1*
PISTOLET, 9mm, BROWNING FN, HP No 2 MK1*



• 71318 •
PISTOL, 9mm, SIG SAUER, Model P225
PISTOLET, 9mm, SIG SAUER, Modèle P225



• 71227 •
PISTOL, .22 calibre, COLT, Police Target
PISTOLET, calibre .22, COLT, Pistolet de tir sur cible



• 71258 •
PISTOL, Signal, 1-1/2 inch, AN M8
PISTOLET, Signalisation, 1-1/2 pouce, AN M8



• 71323 •
PISTOL, SIGNAL, 19mm, H&K
PISTOLET, Signalisation, 19mm, H&K



• 71159 •
MACHINE-GUN, Heavy, Flexible, .50 calibre, M2HB, QCB
MITRAILLEUSE, Lourde, Mobile, calibre .50, M2HB, QCB

SARP 2

- **Value $1.0 Billion to 1.4 Billion**
- **Three phases**
- **Definition followed by procurement**
- **Phase 1 (Tentative 2012-2015)**
  - Pistol, Ranger Rifle, Grenade Launcher, Shotguns & Breaching System
- **Phase 2 (Tentative 2015-2018)**
  - PDW, Other Service weapons, Light Vehicle Armament System
- **Phase 3 (Tentative 2018-2022)**
  - Infantry Assault Weapons

S&T Projects Support the Soldier System Vision

Environment Clothing System

Mobility Systems



FAVS/ADVANCE

AMMPHS

Ballistic Protection System

Head Systems



SIHS TD

Weapon Systems



SIPES TD

Smart-Textile DIR

Personal Network

Battle Mgt Systems



Comms Systems



Navigation Systems



Power Sources

ASAP TD



Fuel Cell DIR

Sensors Systems

SaSnet

UGS



Micro-UAV



EA-MAV

Personal



SIREQ TD

Soldier Integrated Precision Effects System

Objective

To demonstrate the viability, utility and usability of integrated novel and high pay-off small arms related lethal and non-lethal technologies for future, lightweight, small calibre weapon systems which address current capability deficiencies

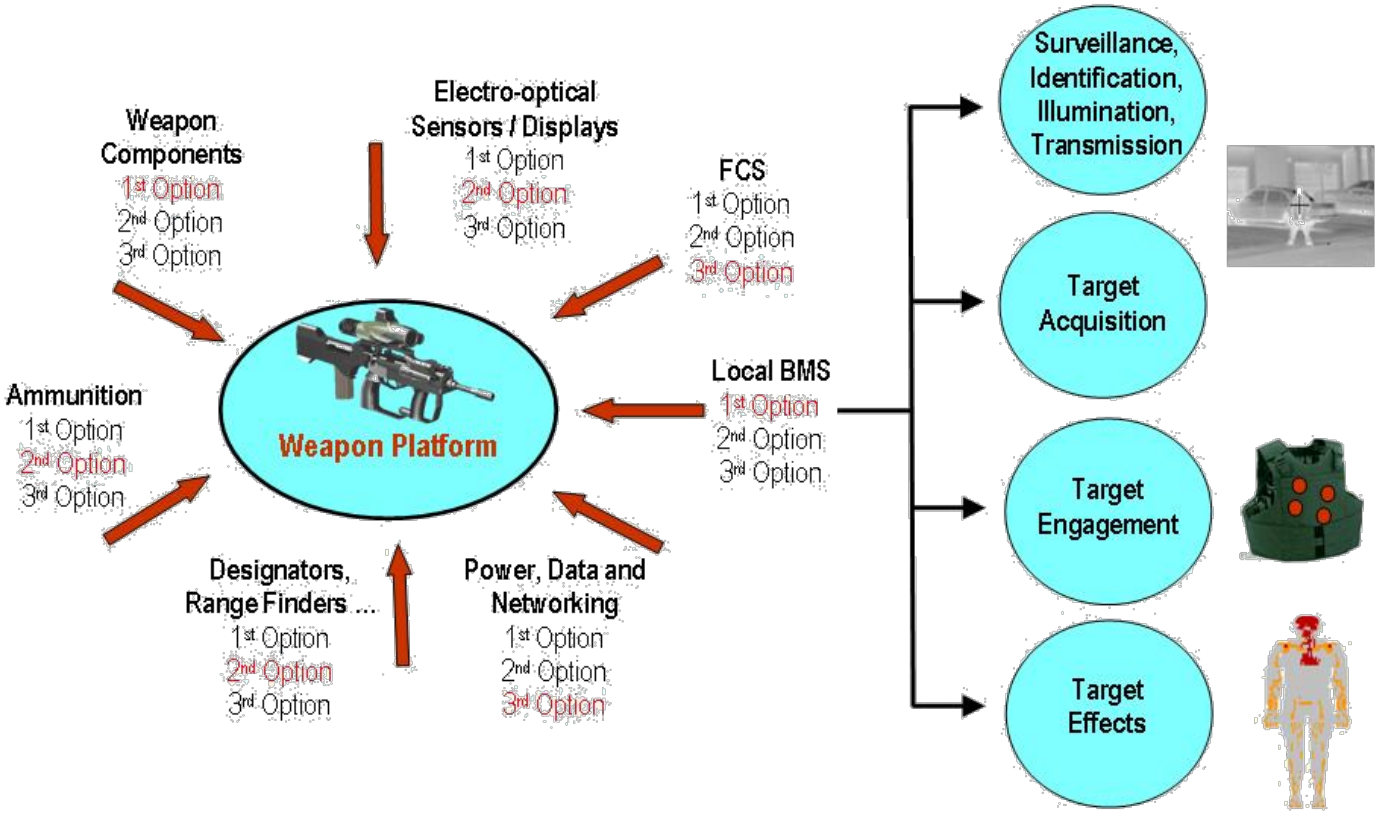
Key Deliverables

- **Scientifically rigorous requirements analysis for SARP 2**
- **Improved weapon systems evaluation capabilities**
- **Optimized soldier lethality options**
- **A future small arms R&D program plan**

SIPES Concept

Key Deliverables

- Scientifically rigorous requirements analysis for SARP 2
- Improved weapon systems evaluation capabilities
- Optimized soldier lethality options
- A future small arms R&D program plan



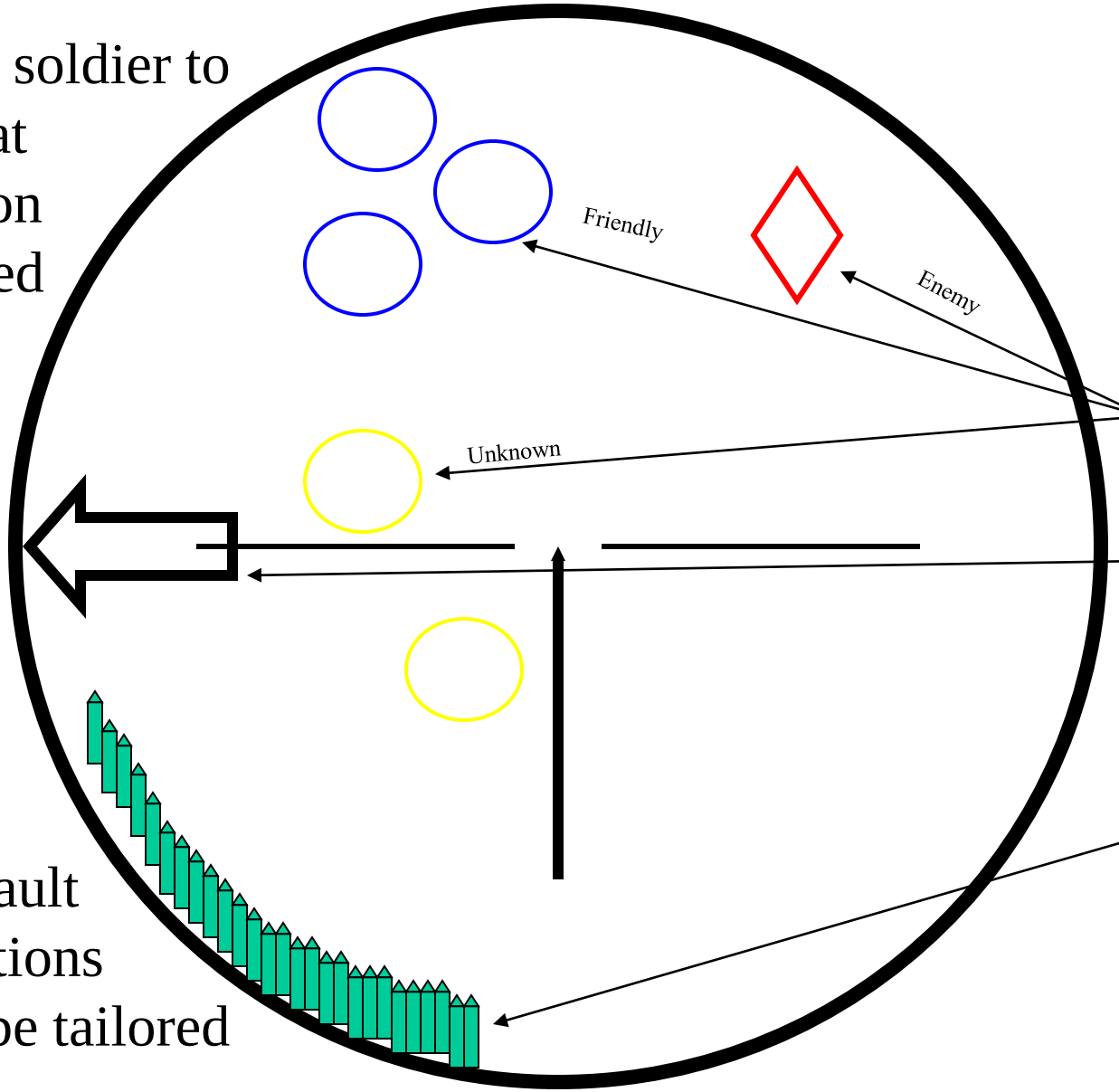
Weapons and the Network

Networked Weapon?

- **The weapon is already the location for sensors and electronic devices**

- **Pointing with a weapon is natural for a soldier**
  - Export information used by accurate pointing
  - Use the Battle Management System to help the soldier locate the tgt in the weapon sights
- **Accurate pointing can be used to enhance the squad SA if the EO devices export information & images to the network**
  - Need to be geo-referenced
  - Time stamped

Allow the soldier to select what information is displayed



Information from the network

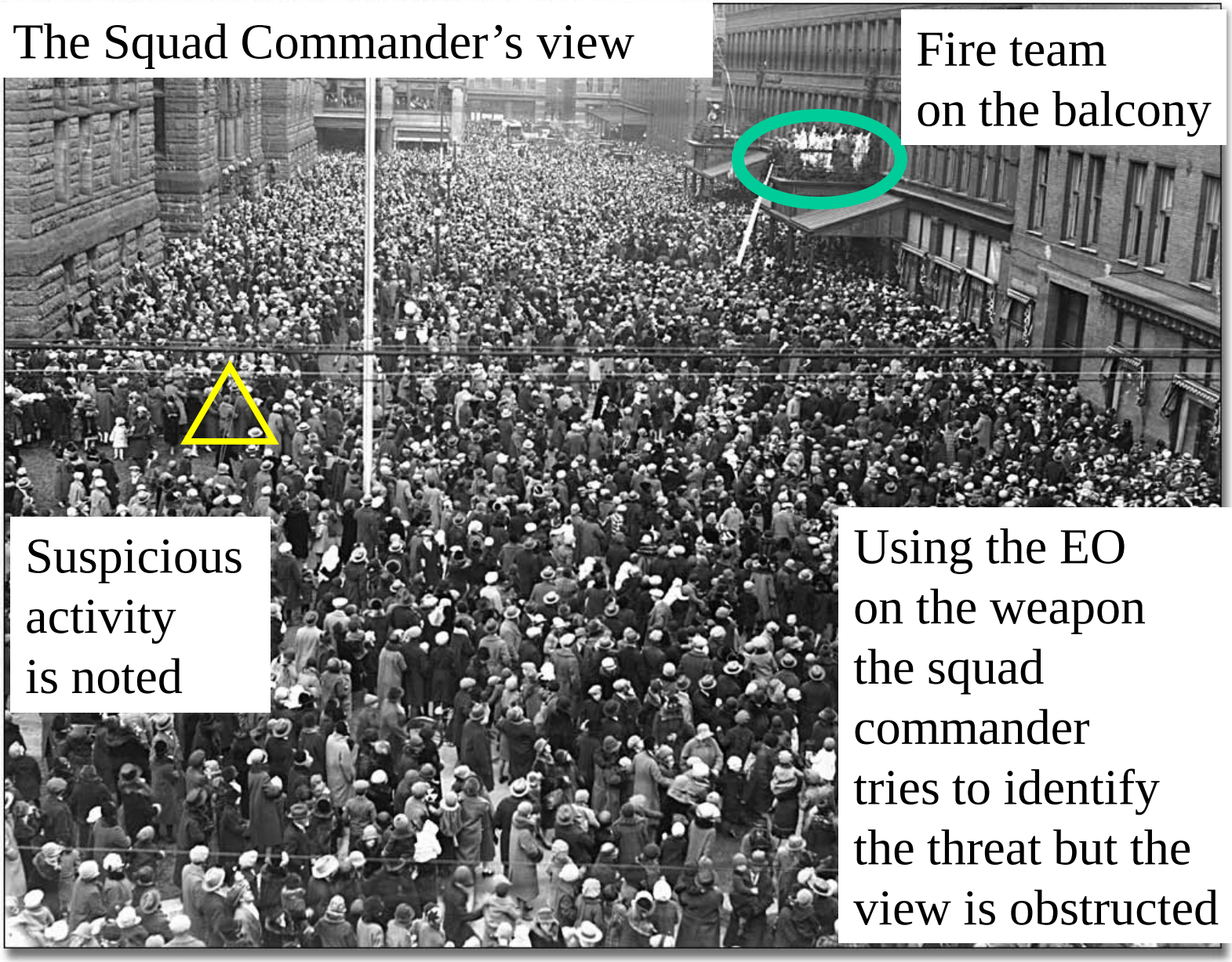
IFF

Direction to an assigned target

Remaining Ammunition

1 or 2 default configurations That can be tailored

The Squad Commander's view



Fire team on the balcony

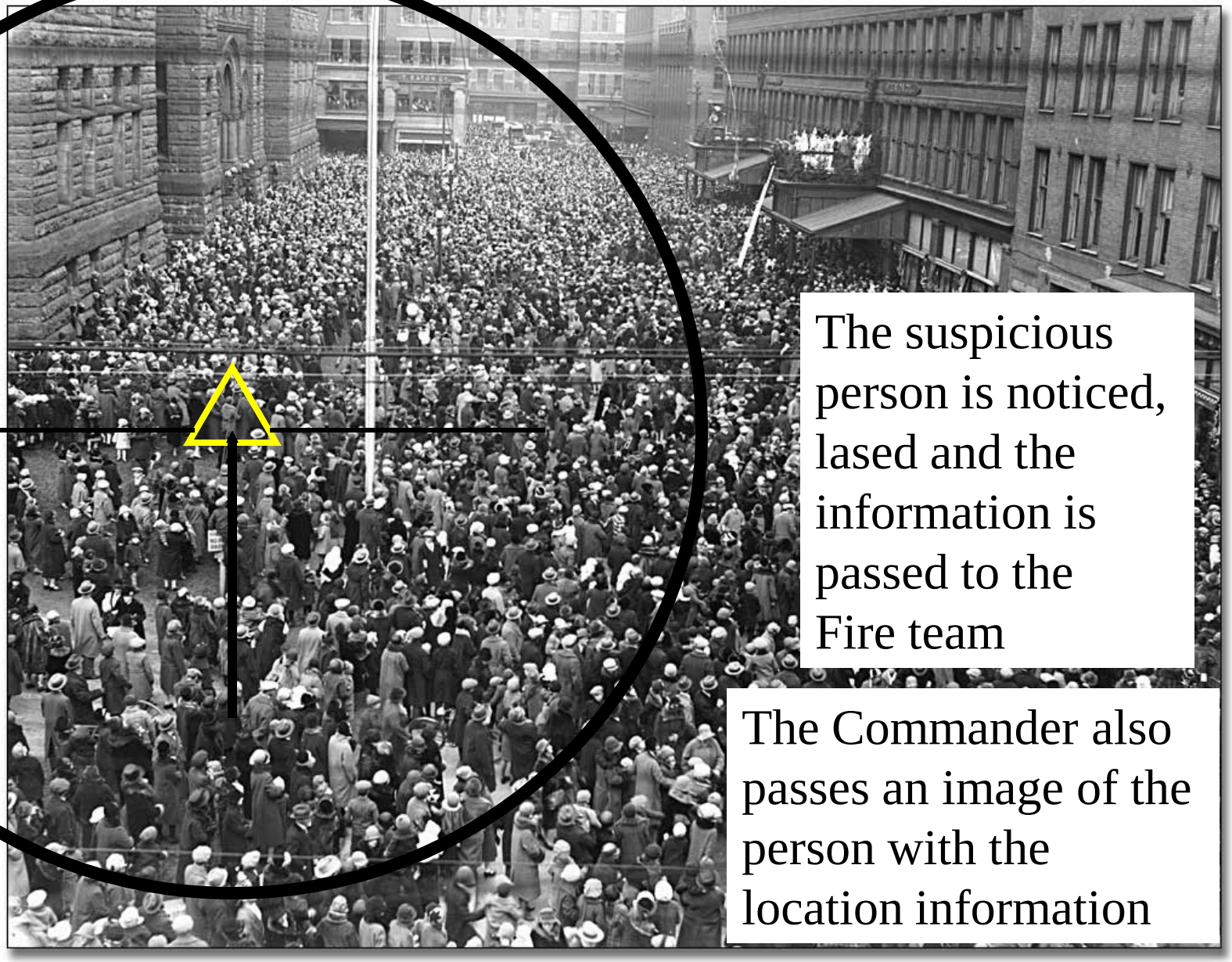
Suspicious activity is noted

Using the EO on the weapon the squad commander tries to identify the threat but the view is obstructed

The Scene



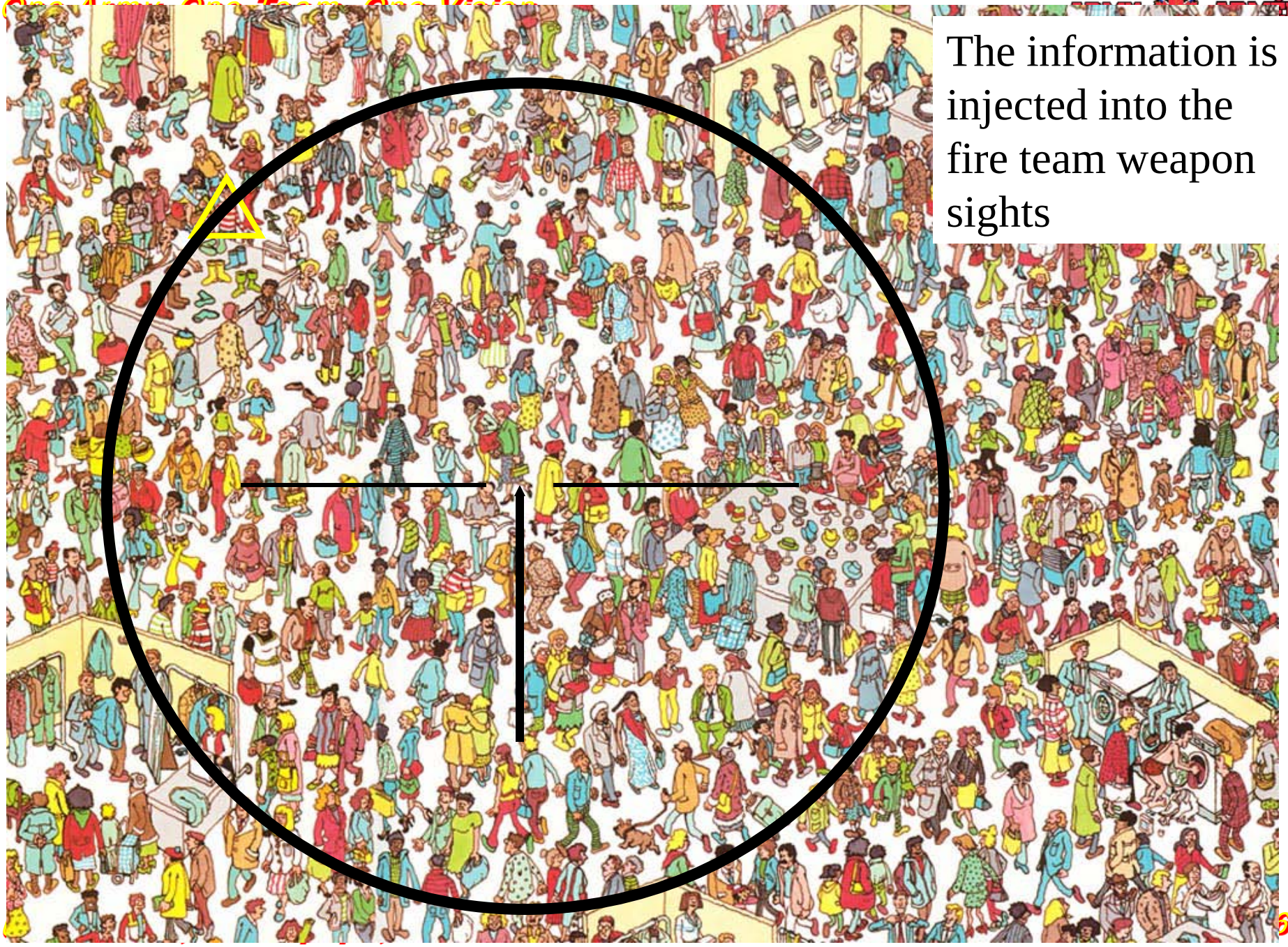
The Fire Team's view

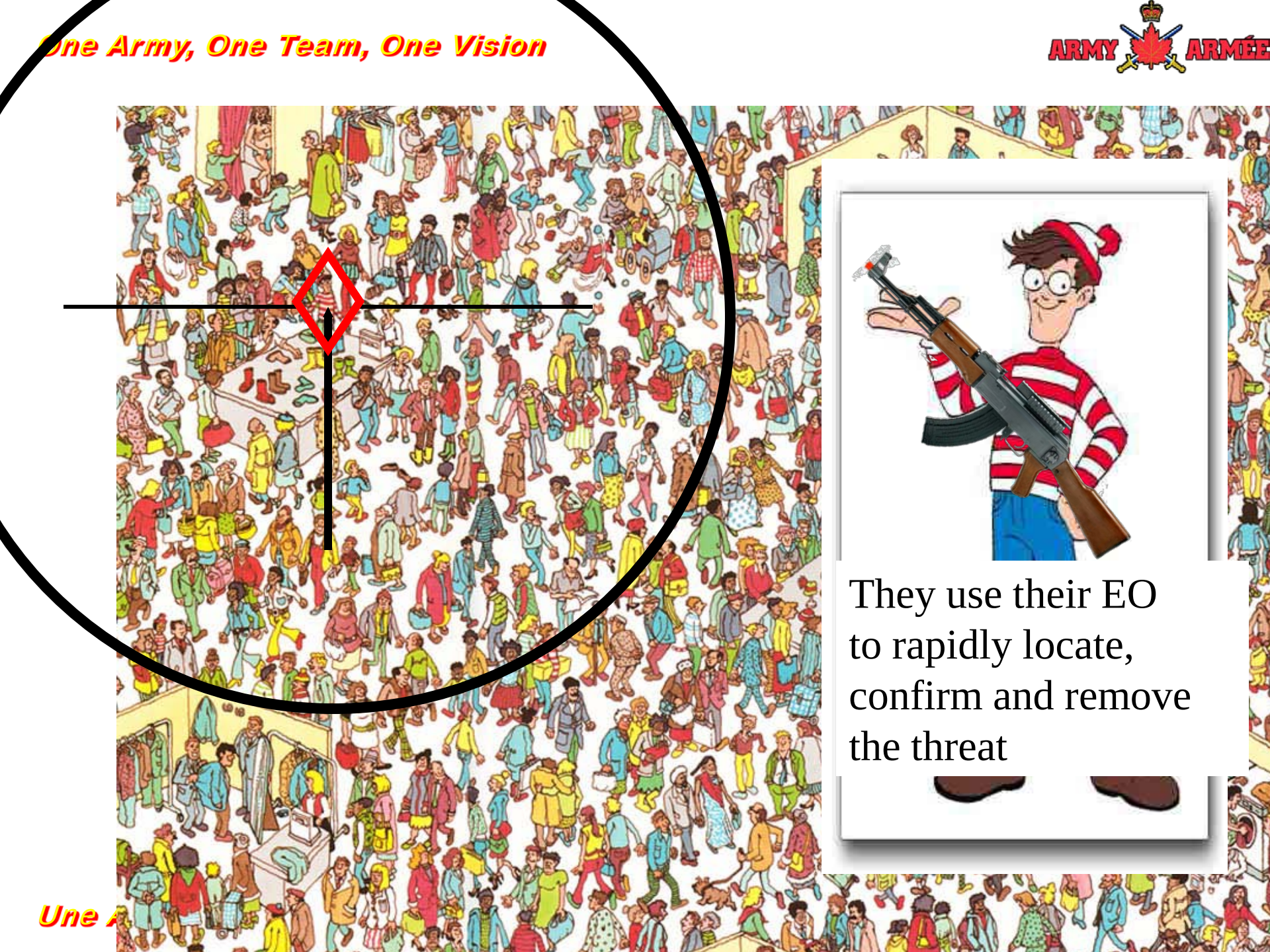


The suspicious person is noticed, lased and the information is passed to the Fire team

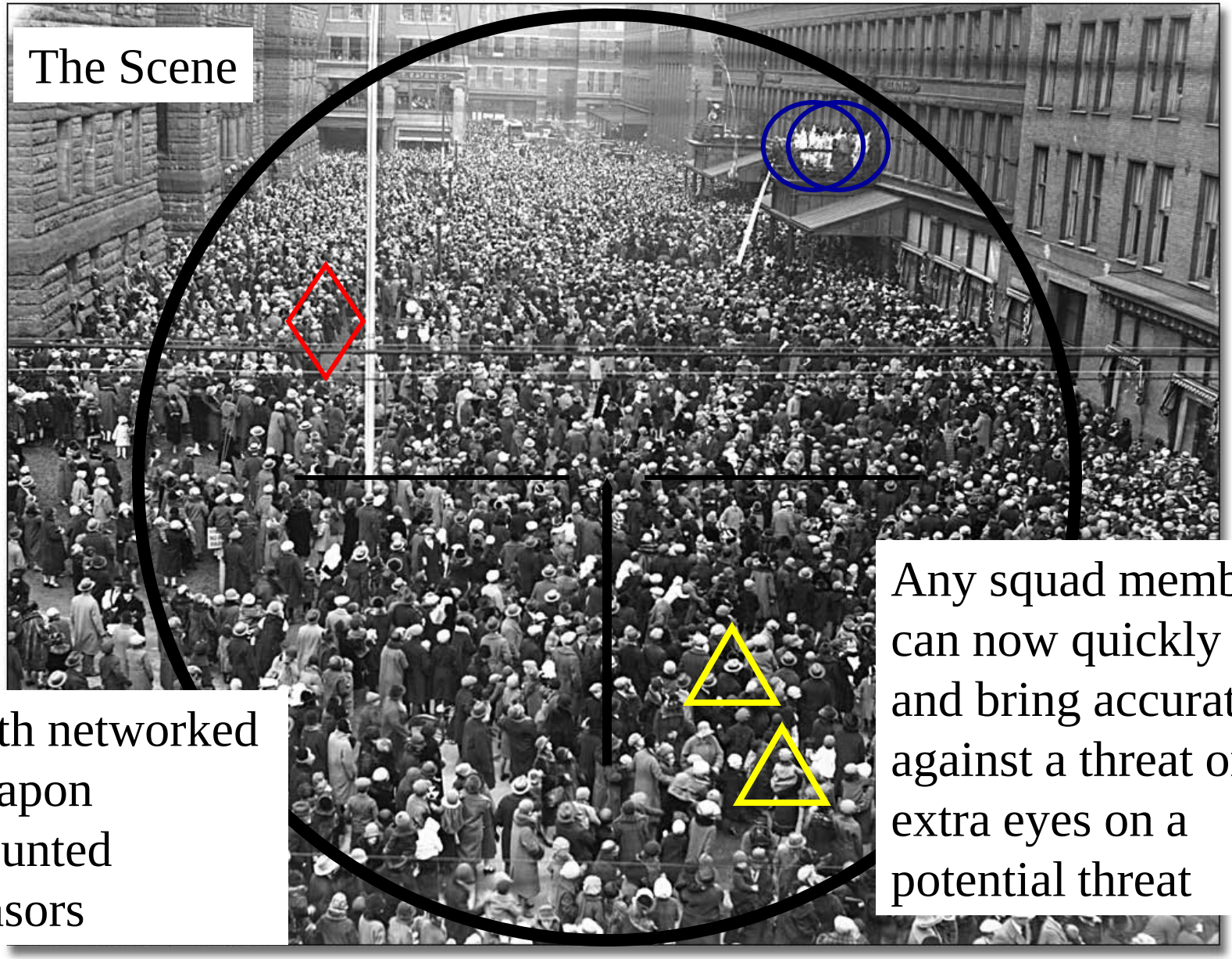
The Commander also passes an image of the person with the location information

The information is injected into the fire team weapon sights





They use their EO to rapidly locate, confirm and remove the threat


The Scene
With networked weapon mounted sensors
Any squad member can now quickly locate and bring accurate fire against a threat or put extra eyes on a potential threat

The networked weapon with the right capability can enable target handoff at the soldier to soldier level

The networked weapon with the right capability could be used to control and/or direct a UAV or UGV or other system's weapons

Like This

Even unstressed persons are not that steady especially when fatigued

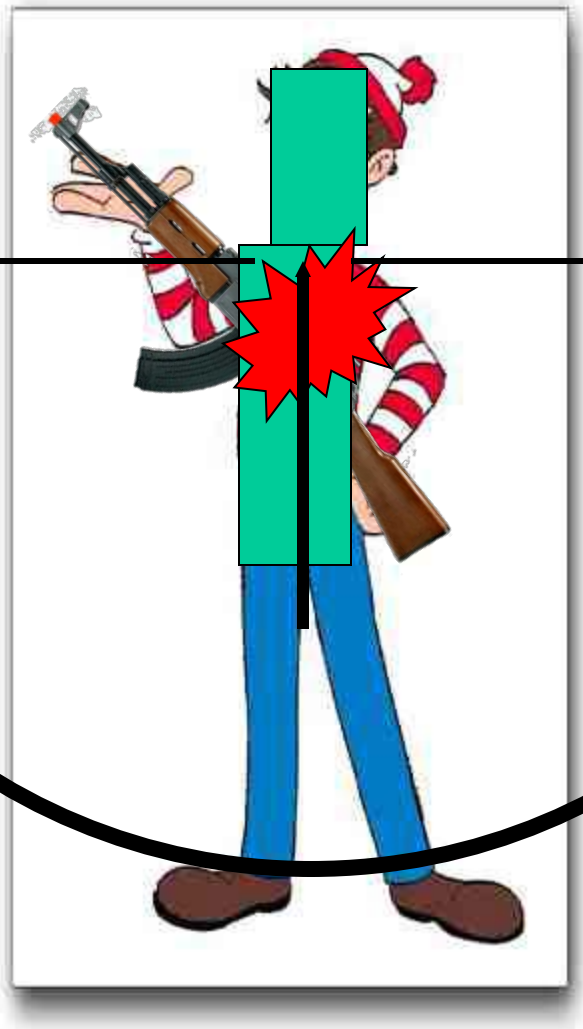
Through the sight the target appears to jump around & pass by the point of aim



Image recognition technology coupled to the sensors can be used to identify an obscured target & overlay "windows" on the critical parts of the target

The overlays can be coupled to an electronic fire control system to fire when the weapon is correctly aligned to hit the target within the window

Image recognition technology coupled to the sensors can be used to identify an obscured target & overlay “windows” on the critical parts of the target



The overlays can be coupled to an electronic fire control system to fire when the weapon is correctly aligned to hit the target within the window

Summary

- **SARP 2 will be a science based project requiring:**
  - Long term scientific effort
  - Collaborative Effort DRDC + DLR + Industry guided by an R&D Plan
  - Close integration with the products of existing projects
- **SARP 2 will integrate the weapon with the soldier system**
- **The networked weapon will enhance soldier lethality and precision**

Questions?



Project Manager Soldier Weapons
Ammunition Programs

LTC Chris Lehner
Product Manager
Individual Weapons

LTC Michael Ascura
Product Manager
Crew Served Weapons

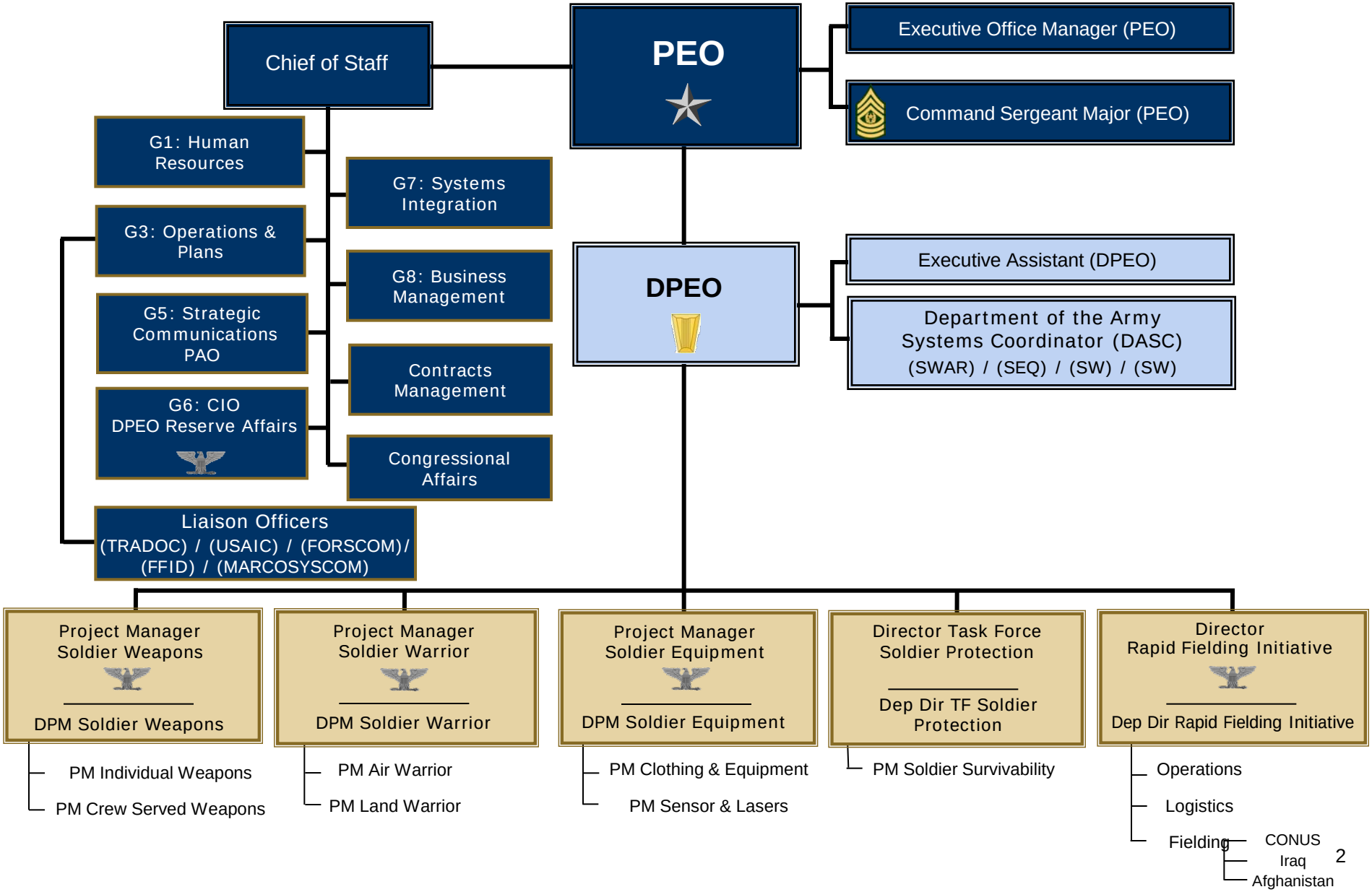
BG Peter N. Fuller
Program Executive Officer Soldier

COL Douglas A. Tamilio
Project Manager Soldier Weapons

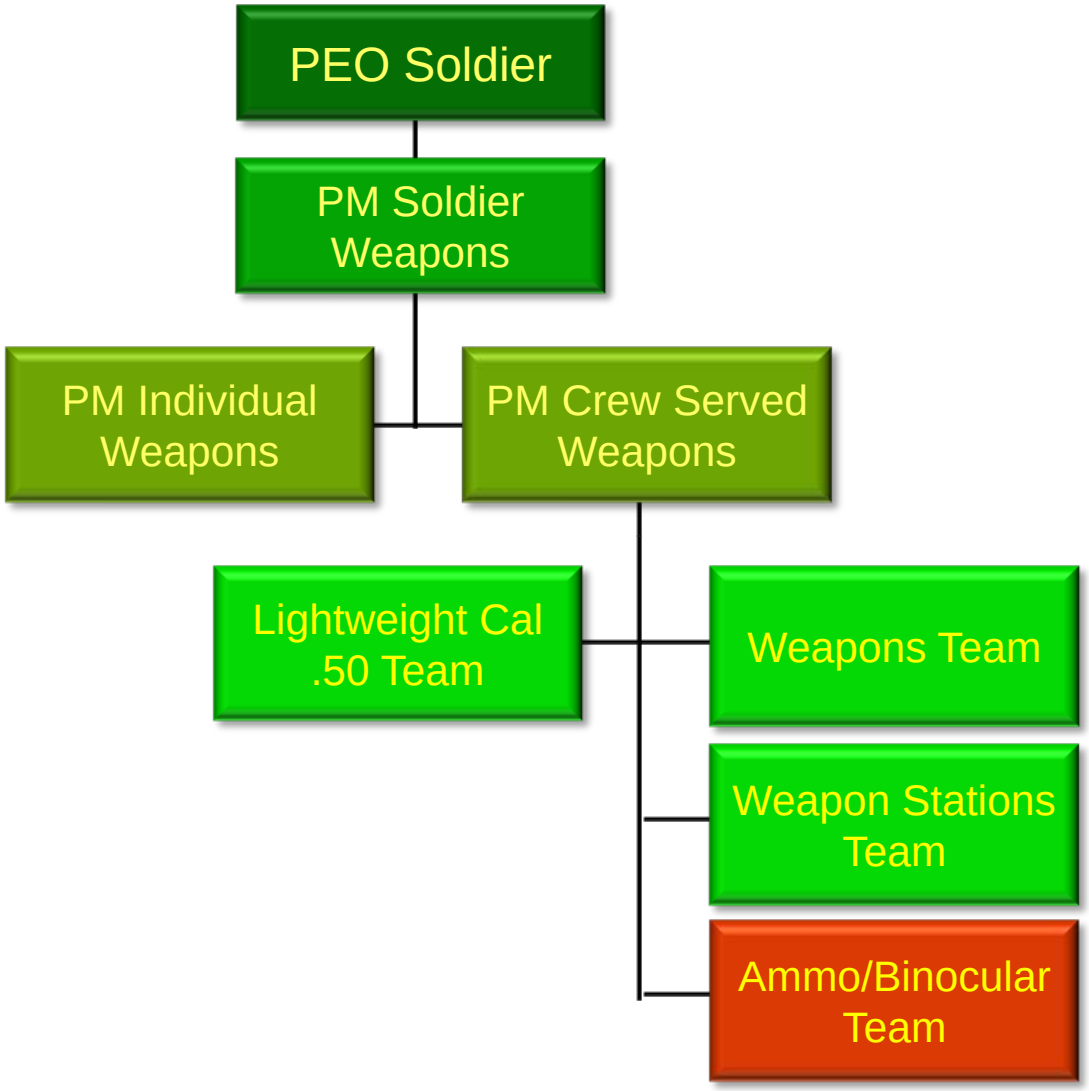
20 May 2009

Program Executive Office Soldier

As of 20 April 2009



Organizational Tree



Small Arm Systems Improvements

- View Small Arms as **Systems**
  - Weapon
  - Fire Control
  - Ammunition

Programs Coordinated with PEO Ammo
- Concur on Acquisition Strategy
- Concur on Executive Summary

- RDT&E of Ammunition for Existing Weapon Systems
  - Includes Small Cal and 40mm Development Projects
    - Tactical/Lethal
    - Lightweight
    - Training
    - Non Lethal

PM CSW Ammo Team

Rob Zienowicz Ammunition Team Chief - PM Crew Served Weapons Office

Percy Mistry
- XM1112 40mm Airburst Non Lethal Cartridge
- Micro Electro-Mechanical S&A

Ben Wong
- M100 GREM / M101 GREM-TP
- M903/M962 Cal .50 SLAP/SLAP-T
- M973/M974 7.62mm Short Range Training Ctg

Fred Fitzsimmons
- XM1110 40mm Day/Night TP Cartridge
- M24 Minature Binocular
- M25 Stabilized Binocular

George Dieterle
- Improved 9mm Cartridge
- 40mm Close-In Antipersonnel Cartridge
- M992 40mm Infrared Illumination Cartridge

Brian O'Neill
- M862 5.56mm Short Range Training Cartridge
- M1030 12 Gauge Breaching Cartridge

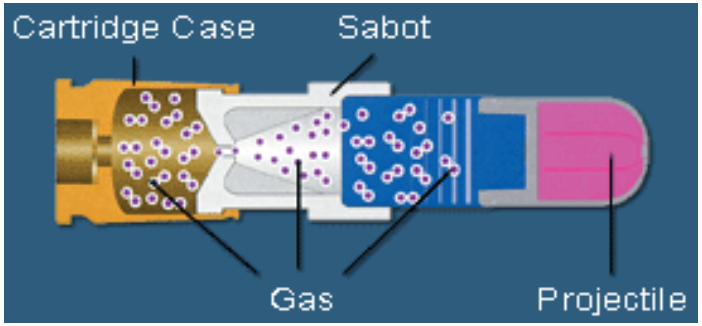
Gene Hudson
- XM1037 5.56mm Short Range Training Cartridge
- M1041/M1042/M1071 CCMCK Ammo

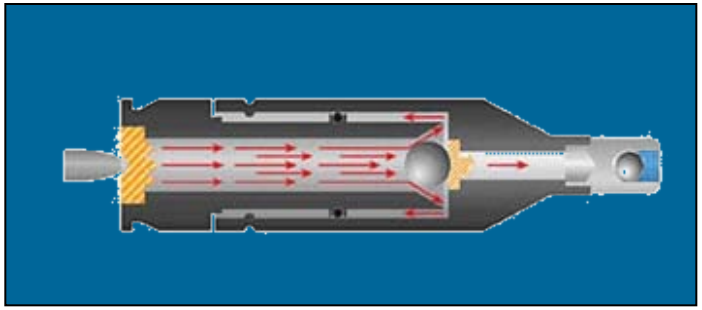
Audrey Shabazz
- Lightweight Small Caliber Ammo
- XM1116 12 Ga Extended Range Non Lethal Ctg
- XM1140 40mm Extended Range Non Lethal Ctg

PM-SW Managed
Support to PM-MAS FY09 Production

Close Combat Mission Capability Kit (CCMCK)







- Operator Installation
- Must Not Fire Service Ammo
- Not Fracture SWD Goggles at 12 in
- Fire From Standard M4/M16/M249/M9/M11
- Not Penetrate Skin Thru Hot BDU at 5M (T) 0M (O)

Milestone C Approved July 2008

Close Combat Mission Capability Kit

Rifle
XM1042



SAW
XM1071



Pistol
XM1041



Close Combat Mission Capability Kit





Rifle





SAW







Pistol



XM1037 5.56mm Short Range Training Ctg



- Ballistic match with standard ammo out to 100m
- Maximum Range 600m
- M4, M16, M249 Series Weapons
- No Weapon Modification

Program Objective:

Development

- Developmental Program
- Initial Production Start up – FY10

Next Major Milestone – Conduct Developmental Test

- Conduct Limited User Evaluation
- ATC Final Report
- ATEC Independent Evaluation (OER)

Lightweight Small Caliber Ammunition

Objectives

To develop a functional alternative 7.62mm M80 Ball and M62 Tracer cartridges assembled with an alternative case material

- 20% weight savings
- Meets current ballistic performance
- Manufactured using standard industrial techniques
- Assembled on LCAAP loading machinery

Move on to:

- 7.62mm Blank
- 5.56mm Ball
- 5.56mm Blank
- Cal .50

Lightweight Small Caliber Ammunition

- **Feasibility – Computer Modeling & Studies**
- **Phase 1 –Demonstration**
  - Test full up cartridges in a Mann barrel
  - Machinegun tests
- **Phase 2 – Development & Production Prove - Out**
  - Ballistic testing
  - Product refinement
  - Ensure compatibility with production equipment
- **Phase 3 – Production Qualification Testing (PQT)**

Lightweight Small Caliber Ammunition



Weight Of ***5*** Assembled LSCA M80 Cartridges = ***4*** Conventional Brass Cased M80

- Accomplishments
  - Weight reduction objective met
  - Demonstrated F&C with M240 Machinegun in Ball & Tracer configurations
  - Complies with MIL-C-46931 Specification
  - Compatible with conventional loading equipment

Improved 9mm Ammunition

- Develop an Environmentally Friendly 9mm Cartridge that will Exhibit Better Performance Than Current Leaded M882
  - Operational In M9 & M11 Weapons
  - Improve Lethality
  - Meet NATO Requirements
  - Utilizes Latest Science And Technology To Improve Upon All Aspects Of The Round (Environmental Compliance, Accuracy)
  - Ballistically Matched To M882
  - Cost Equivalent to M882



- Two Phased Approach
  - Study Determines Feasibility of Alternative Designs
  - Perform Qualification of Selected Design

XM1116 12 Ga Ext Range NL

- Based on Urgent Requirement for XM1092
- Blunt Trauma Non Lethal Munition
- Capable of Marking Targets
- No Weapon Modifications Required
- Range 5-75 Meters



XM1140 40mm Ext Range NL

- Based on Urgent Requirement for XM1091
- Blunt Trauma Non Lethal Munition
- Capable of Marking Targets
- Fired From M203/M320
- Range 10-80+ meters



Notional Pending Source Selection

40mm Airburst Non-Lethal Munition, XM1112

Develop A Cartridge That Provides Non Lethal Effects Through Blast Characteristics (E.G. Flash & Sound) Without The Range Limitations Encountered With Traditional Blunt Trauma Munitions



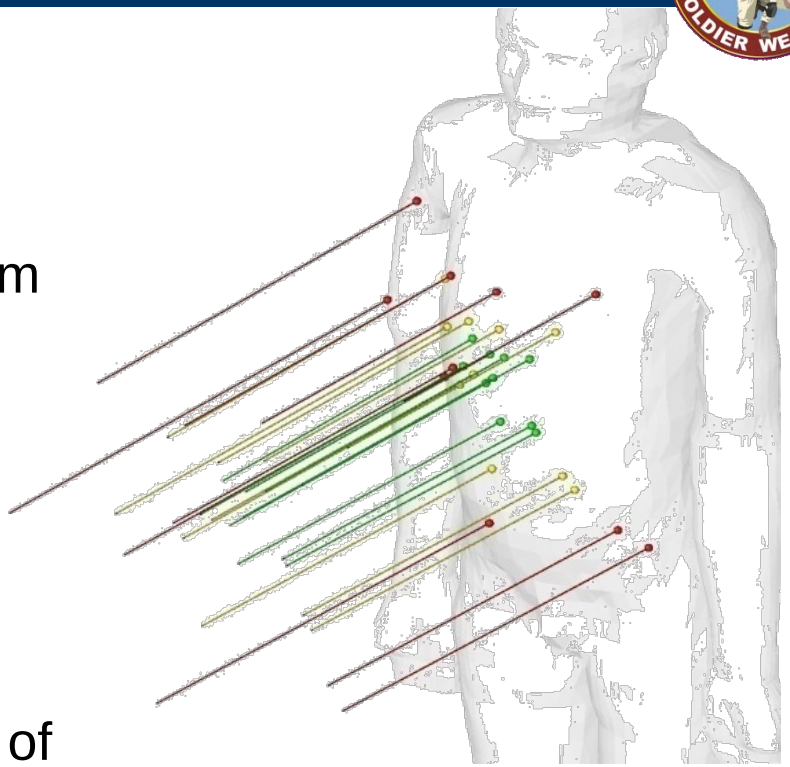
Capabilities:

Increased Range (300m (T), 400m (O)) for Crowd Dispersal Capability with 40mm systems.

40mm Close-In Antipersonnel (CIAP)

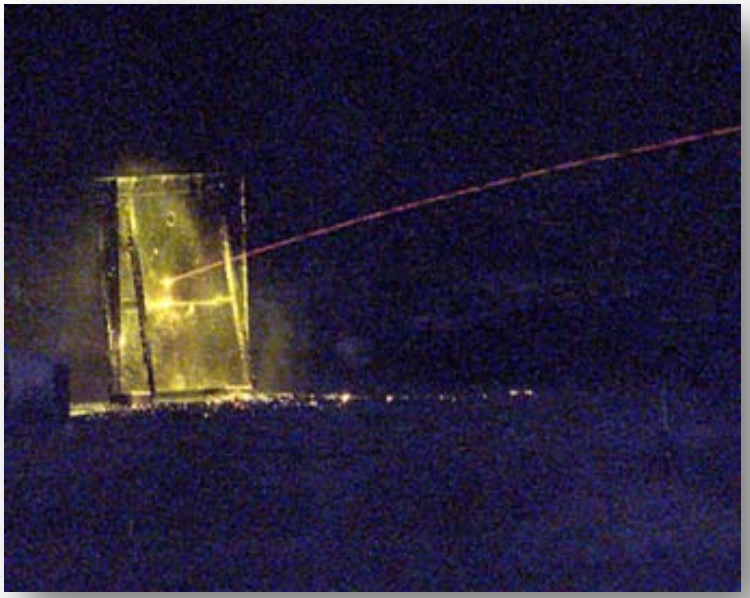
Description:

- Low velocity 40mm cartridge fired from M203 and M320 grenade launchers
- Expels multiple projectiles providing anti-personnel capability at short ranges
- Evaluate buckshot versus flechette cartridges for lethality and probability of a hit



XM1110 Improved 40mm Training Cartridge

- Contains Both A Day And Night Signature And W/Improved Performance On Soft Targets
- Annular Groove In Ogive
- Payload = M781's Orange Powder Plus Glow Stick Mix In Glass Ampoules
- Non Dud Producing /No Pyrotechnics/ No Brush Fires
- Compatible W/ All 40mm LV Grenade Launchers
- Developed To Support SOCOM'S EGLM W/ Day-night Sights
- Marks With Visible Light For Night Time TP Capability







XM1110 *M781*

Micro Electro-Mechanical S&A (MEMS)

Goal: Develop Mechanical safety and arming (S&A) device and explosive ink writing technology for the M433 & M430A1 40mm HEDP cartridges

- New fuze with electronic initiation, improved target sensing, self-destruct capability, command-arm-enable function, more accurate arming distance, lower volume & cost
- Improved reliability on soft targets and in graze impacts using paired MEMS omnidirectional impact sensors (g-switch)

Objective:

- Reduced fuze volume
- Equal to or better Lethality and penetration
- Improved reliability on soft targets (snow, grass)/graze angles
- Reduced tolerance on arming/non-arming distance

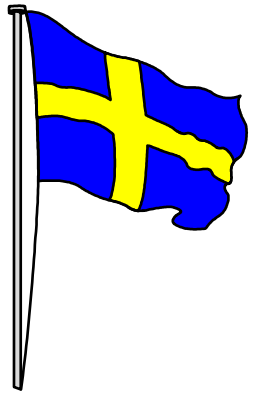


Future Plans

- Develop Materiel Solutions to Meet Gaps
  - Extended Ranges
  - Marking
  - Training
  - Door Breaching
- Continue Weight Reduction Efforts
- Incorporate Technological Improvements
  - Lethality
  - Insensitive Munitions Technology
- Mature Relationship With PEO Ammo


PROJECT MANAGER
SOLDIER WEAPONS
PROJECT MANAGER
SOLDIER WEAPONS
THE BEST
FOR THE BEST





Swedish Small Arms Programs

Presentation at NDIA Small Arms Conference
Las Vegas, May 20, 2009

Per G. Arvidsson

Product Manager Small Arms Systems

Försvarets Materielverk (Swedish Defence Materiel Administration)

Tel: +46-8-782 4181, Mobile: +46-8-682 4181

E-mail: per.arvidsson@fmv.se

Web-site: www.fmv.se

FMV

Försvarets Materielverk (FMV)



FMV is the technical and procuring agency for the Swedish armed forces.





FMV receives assignments from the armed forces for the development, procurement, upkeep and subsequent de-mil of all defense materiel.





We date back to *1630*!

The Vasa ship was the reason…



After the Vasa sunk on her maiden trip in 1628, king Gustavus Adolphus decided that he wanted to have his own procurement agency, and FMV's predecessor was founded two years later.

Current Swedish small arms

5.56 mm Ak 5



12.7 mm Barrett



12.7 mm HMG
M2HB QCB



7.62 mm PSG 90



5.56 mm Minimi



40 mm AGL Mk 19



9 mm Glock 17



7.62 mm MAG 58



40 mm GL M203



FMV



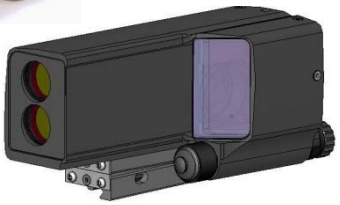
Ongoing small arms projects

- Ammo (Green, APHC, Dim Tracer)
- Ak 5 upgrade
- PSG 90 upgrade
- Accessories
- NLW
- Integrated light and laser module
- Minimi Para TR
- MAG 58 upgrade
- FN M3M HMG
- FX Simunition kits
- Future grenade launchers
- Kongsberg Protector































FMV

Ak 5 upgrade program

- Extensive tests during 2003-2005.
- Industry contract with Saab Bofors Dynamics in 2005.
- Modification of 40,000 weapons in 2006-2010.
- Ak 5C is the primary weapon for all Swedish Soldiers.



User priorities on ak 5C



9. Foldable emergency iron sights for ranges up to 300m

2. New effective flash hider

1. MIL-STD 1913 rail

5. New shoulder stock, adjustable in length

2. Barrel shortened to 350mm

6. Cut-outs for pressure switches and cables on left and right sides

7. New ambidextrous selector lever

6. Hand guard, with full length MIL-STD 1913 rail at 6 o'clock, and 80mm rails at 9 and 3 o'clock.

8. Automatic bolt catch

7. Slimmer pistol grip at a different angle

3. Weight max 3.9kg.

4. MRBS >2000.

10. Transparent plastic magazines

FMV

Swedish red dot sight for small arms



Aimpoint CS



- Manufacturer: Aimpoint AB
- Type: Red dot sight
- Magnification: None
- Battery life: >10 years
- Rail: Mil-Std-1913
- Deliveries: 2003-2006
- Will be used on all rifles and machine guns.

FMV

AGL Competitors

- *Nammo Raufoss/General Dynamics* (Norway/USA/Canada): *Striker/ALGL/Mk47*
- *Singapore Technologies Kinetics/ Oerlikon Contraves Pyrotec* (Singapore/ Switzerland): *Tiger/SLWAGL*

Striker/ALGL/Mk47



- 18 kg
- 250 rds/min
- Short recoil operated
- Fires from closed bolt

Raytheon ”LVS” Fire Control System with day and night channel.

40ABMS
Nowhere to hide....

Tiger/SLWAGL



Muzzle coils

- 18 kg
- 350 rds/min
- Recoil operated
- Fires from open bolt

FCS with optical day channel

FMV

Current Swedish AGL status

- Mk19 in service since 1993.
- Users want a lighter system with FCS and programmable ammo.
- Nordic AGL program during 2000-2005.
- Sweden found that none of the systems at that time was mature for adoption.
- Swedish tests will continue on a small scale during 2009.
- Sweden delayed its procurement until 2010 with deliveries in 2011-2012.

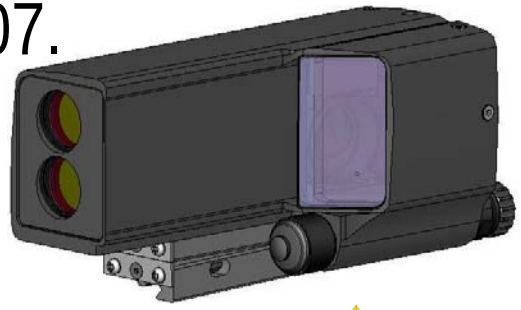






Swedish FCS development

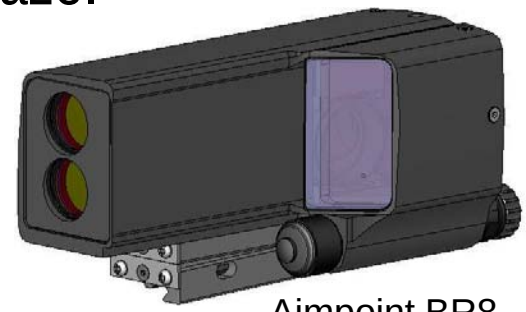
- Trials with AGL's with different FCS's, and a market study showed that there was no simple, lightweight, robust and affordable FCS available.
- Sweden therefore decided to develop a FCS with industry for use with under slung grenade launchers, AGL's and 84mm Carl Gustaf recoilless rifles.
- A PDF study was done in 2002.
- A development contract was placed with Aimpoint in 2005.
- Delivery of prototypes started in August -07.
- Procurement started in 2009.



FMV

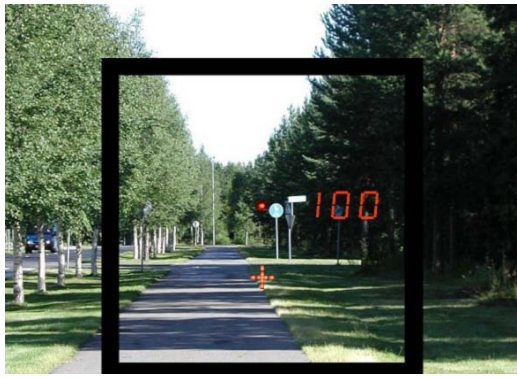
Requirements for Swedish FCS

- Red dot for aiming and laze.
- Moving cross.
- No magnification.
- No moving parts.
- Large field of view (20°)
- Easy to use and fast.
- High contrast in display.
- All information in display.
- Accurate when ranging.
- Small and light (less than one kg).
- NVD compatible.
- Capability to program ammunition.
- MIL-STD 1913 rail (“Picatinny rail”).
- “Long” battery life (more than one week).
- Realistic price.



Aimpoint BR8





How it works





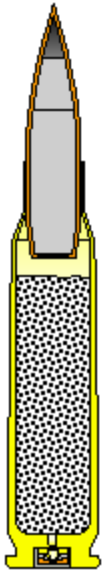
1. Aim and measure range





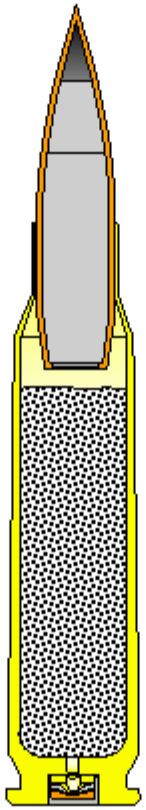
2. Realign and shoot

Current Swedish ”Green Ammo”



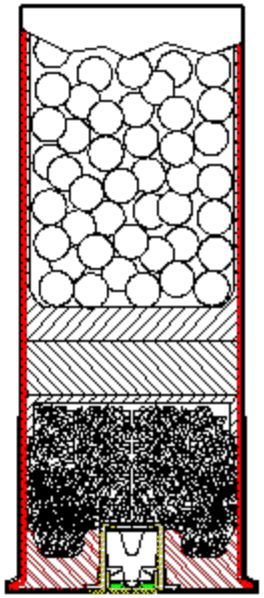
5.56 NATO

Development 1997-1999
In service since 2000



7.62 NATO

Development 2000-2004
In service since 2006



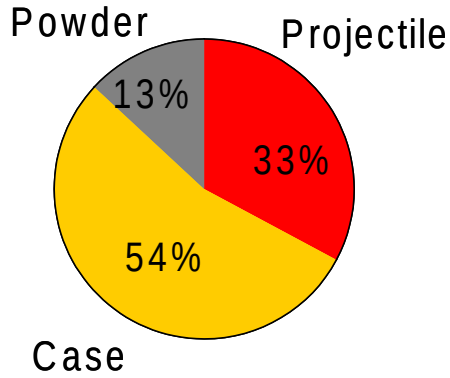
12 Gauge

”COTS”-procurement
2000

5,56 Green Ammo Mk II



- The biggest problem with future soldier systems is weight.
- We can not expect a dramatic weight reduction in future weapons or accessories.
- FMV has together with industry studied the possibility to reduce the ammunition weight.
- We studied both cartridge cases made of aluminum and steel.
- A reduction of up to 30% of the cartridge weight is possible.
- FMV will let industry compete for a development contract.



Weight data for standard brass cased 5.56 NATO round

FMV

Swedish future rifle program

2005 2010 2015 2020 2025

Deliveries 2006-2010 — 40,000



Ak 5C

★ 2010 Final report NATO RTO Study on future small arms

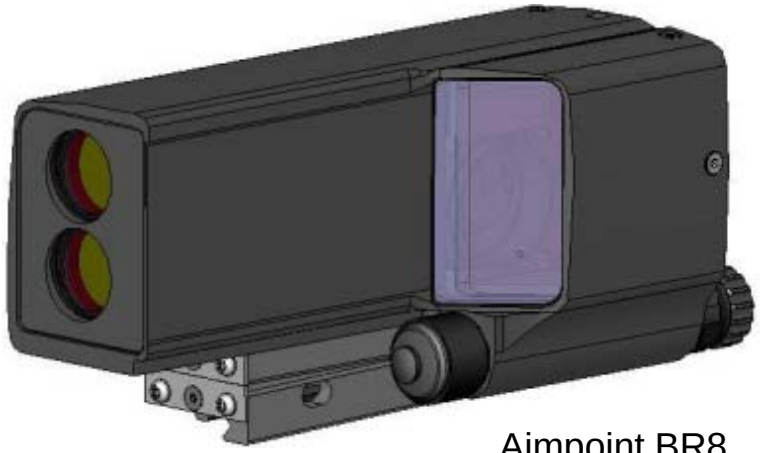
Ak 6 — Dev & Test (2014) — Deliveries 2019-2022 — ?



Picture of FN SCAR is only an examples



Aimpoint CS



Aimpoint BR8

Questions?



General Dynamics MK47



Ak 5C

Interoperability and Integration of Dismounted Soldier System Weapon Systems



Major Bruce Gilchrist
on behalf of
Mr. Mark Richter
Chairman
SCI-178 RTG-043
20 May 2009



Overview

- NATO Research and Technology Organization: formed in 1998; ensures the Alliance has at its disposal the best scientific knowledge and technical capability that member nations are prepared to make commonly available. R&T must be responsive to changing requirements and conditions, long term capability requirements, and new science and technology advancements. See www.rta.nato.int for more info.
- Land Capability Group-1 Weapons and Sensor Sub Group desired to initiate a R&D effort to answer critical weapons subsystem problems for current interoperability issues and long term soldier system interfaces and development issues.
- 10 Countries from LCG-1 teamed together: Canada, Germany, Italy, The Netherlands, Norway, Romania, Slovakia, Spain, Sweden, and United States (Army and Marine Corps). Submitted a proposal to the NATO RTO Panel which was approved.
- Exploratory Team developed Terms of Reference, Technical Activity Plan, and Plan of Work during 2005. A Task Group was initiated in January 2006 with a completion timeline slated for December 2008.
- The Task Group requested an additional year based on completion of STANAG 4694 NATO Accessory Rail and desire to pursue powered rail technologies and complete a comprehensive human factors plan of work.

Objectives

- Recommendation for NATO standard Weapons System Interface STANAG. Complete-STANAG 4694 NATO Accessory Rail
- Define and Outline Human Systems Integration principles and concepts for future Soldier Weapons Systems. In progress
- Investigate the Power Requirements for future weapon systems and methods of providing or generating power. In Progress.

Organization

- The Task Group is led by the chairman, two sub group chairman, and the Heads of Delegation of the 10 countries.
- Two sub groups
  - Human Factors Team: Lead by Major Linda Bossi from Canada.
  - Power Team: Lead by Torbjörn Eld from Sweden.
- Both teams have to work together because of overlap in various areas.
- Completion of tasks: NLT December 2009

Tasks Currently Underway to Achieve Goals

1. Weight/Balance Studies
2. HF Requirements Specification
3. Tactical User Requirements (Survey & Priorities)
4. Weapon Info Display Characterization
5. Sighting System Characteristics



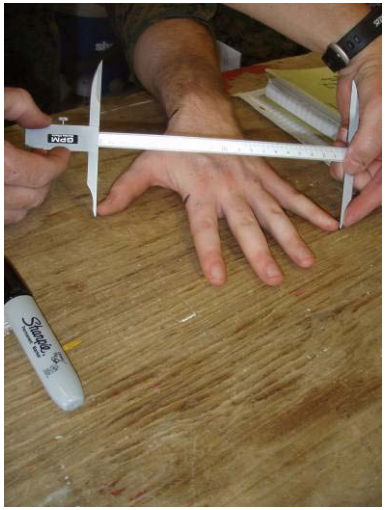
6. Standardization of Control Devices
7. Modularity vs Integration Analysis
8. Weapon/ Future Helmet Integration and Compatibility (butt/novel sight design)
9. NATO Workshop
10. Compendium of HF References
11. Final HF Sub-Group Report

Purpose

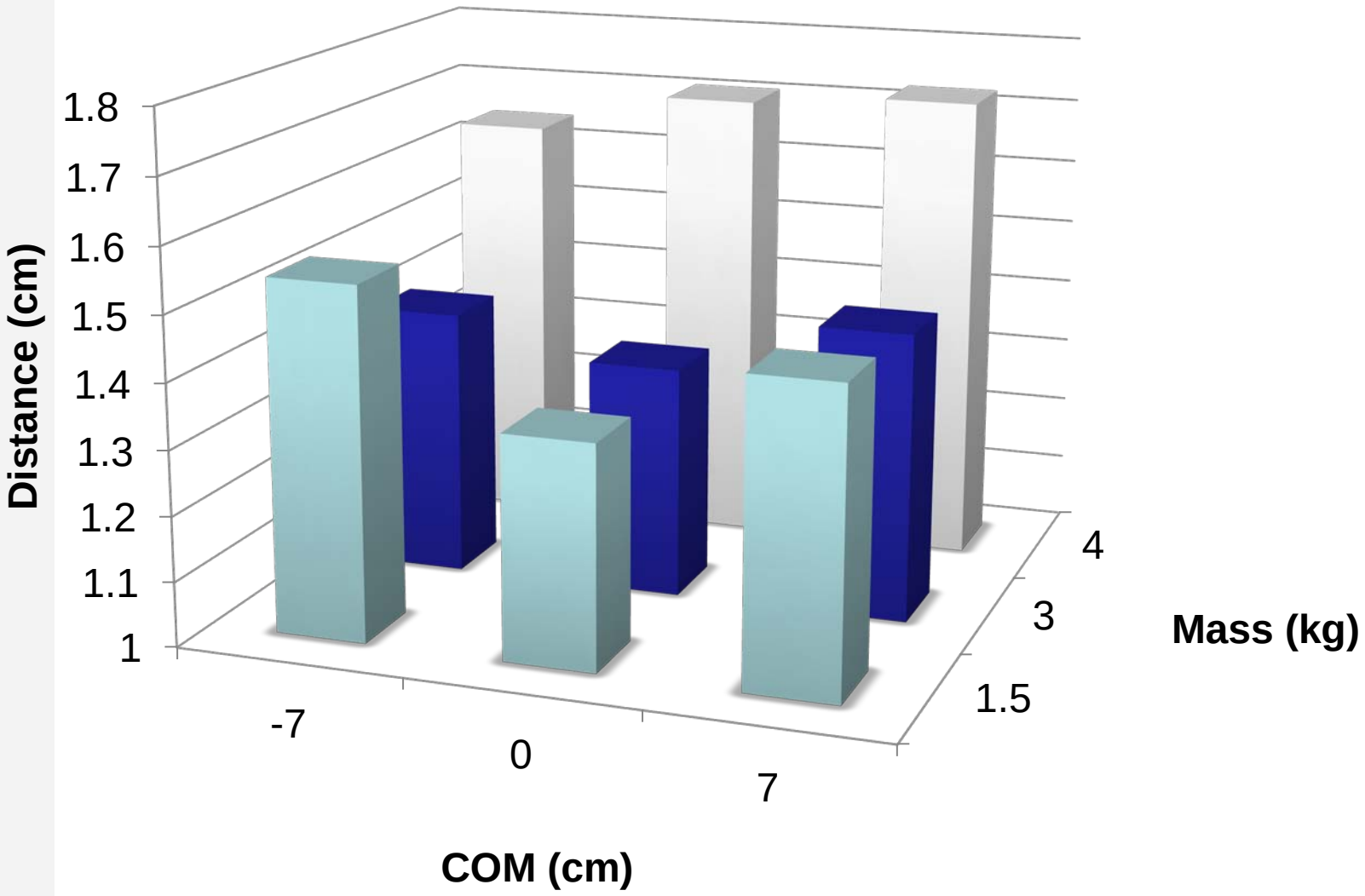
- Investigate the effects of rifle weight and center of mass on rifle handling performance using a weapon mounted accelerometer.







Rifle Tracking During Fine Aiming



Butt-stock Integration









Test rig redesigned to accommodate lateral positioning 2cm closer to the face for offset sights

Control Placement Study

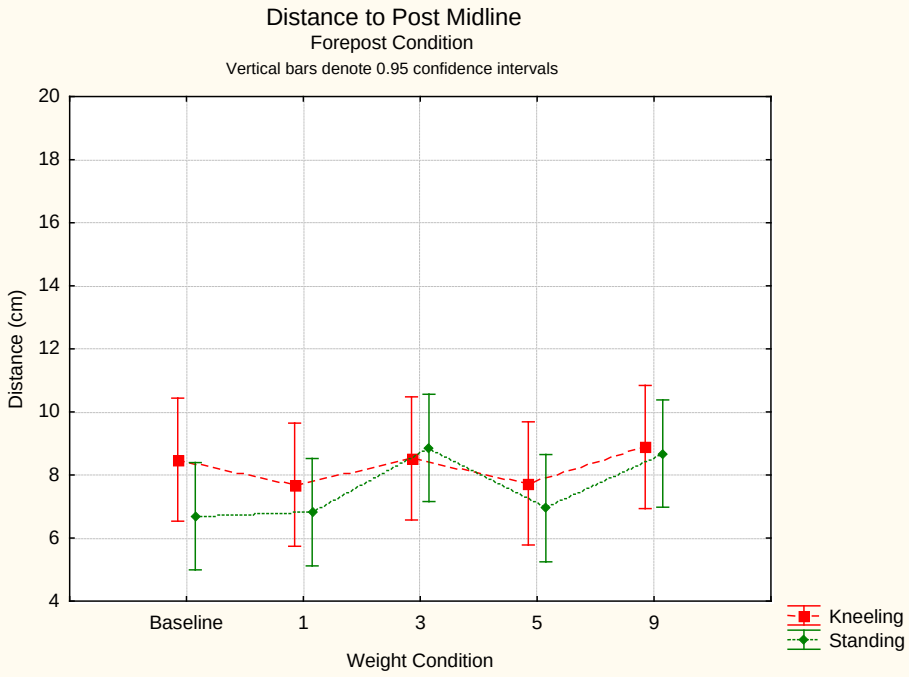
- Three firing posture conditions



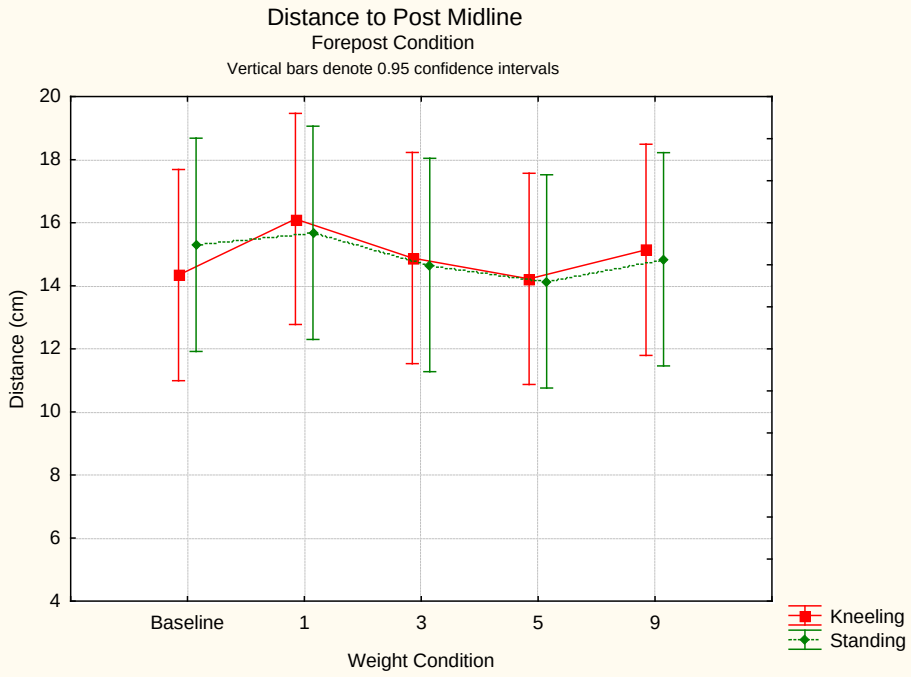


Foregrip Location





Canadian Data



Swedish Data

Fore Grip Thumb Sweep Study

- Study to determine the left and right sweep of the supporting hand's thumb movement for control placement and accessibility.





Powered Rail Tasks for 2009

- 1 - Finalizing the Power document
- 2 - Set up a Power rail matrix
- 3 - Set up a Power Transfer Matrix
- 4 - Work out a suggested test procedure for powered rails
- 5 - Final Report

SCI-178 RTG-043
Points of Contact

- Chairman – Mr. Mark Richter
  - Mark.richter@usmc.mil
- Human Factors Chairman – Major Linda Bossi
  - Linda.bossi@drdc-rddc.gc.ca
- Power Chairman – Torbjörn Eld
  - Torbjorn.eld@fmv.se
- Canada- Major Bruce Gilchrist
- Germany- Karl-Heinz Rippert
- Italy- LtCol Eugeno Gallo
- The Netherlands – LtCol Franz van Weenen
- Norway- Mr. Haakon Fyske
- Slovakia- Mr. Lubomir Uherik
- Spain – Mr. Angel Perez
- Sweden- Mr. Per Arvidsson
- Romania – Major Tiberius Tomoiaga
- United States Army – Mr. Dave Ahmad
- United States Marine Corps – Mr. Mark Richter

Powered Rail

Presentation to
Intl Infantry & Joint Service Small Arms System Symposium
May 20, 2009

Torbjoern Eld
Chairman
Powered rail team
NATO SCI-178 / RTG-043
Integration and Interoperability Issues for Dismounted Soldier System Weapon Systems

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Agenda

- History
- Current NATO Small Arms
- Existing accessories
- Scope of work 2009
- This can be achieved
- Path forward
- Questions

History

- Eleven Nations are teamed upped with the objective to standardize a Powered NATO rail
- Power and TI have been merged into the Powered Rail team
- 6 nations has brought forward national Powered Rail programs



Current NATO Small Arms



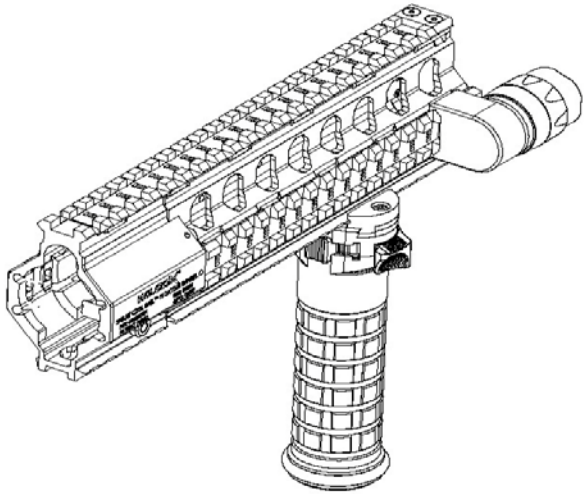
Existing accessories

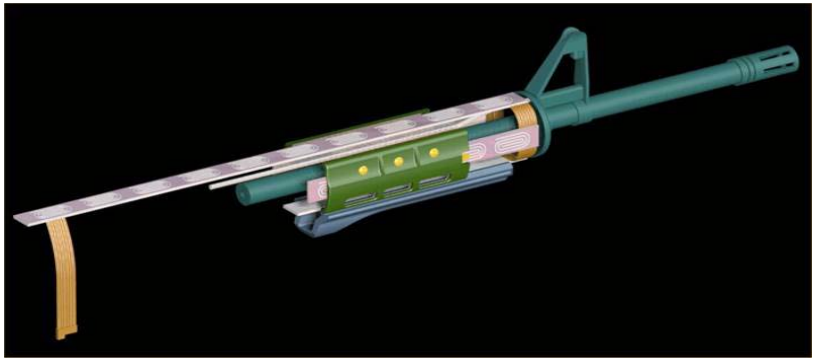
- Most contain batteries, of different types
- Batteries account often for up to 50% of the mass and volume of the item
- As most are mounted around the hand guard, the center of gravity is moved forward
- This affects the handling of the weapon



Scope of work 2009

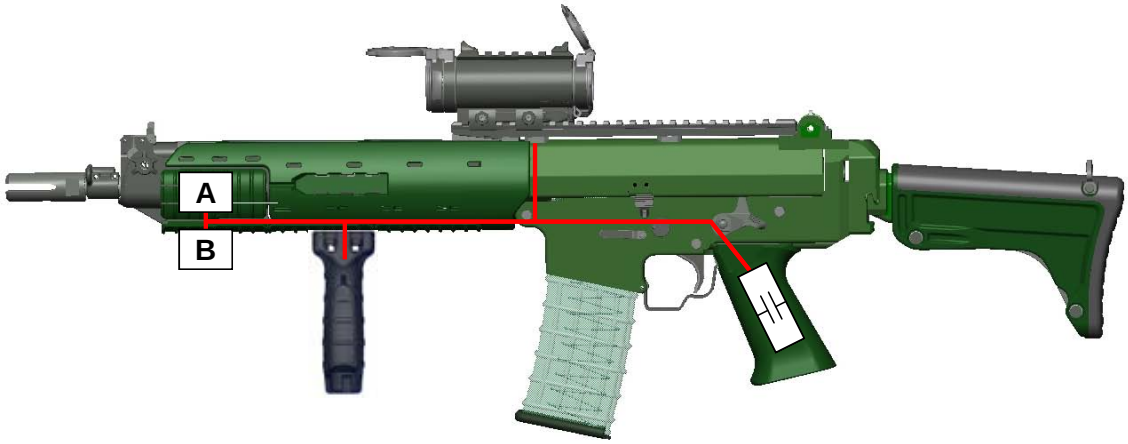
- Create a matrix over the 6 national programs
  - All programs have different technical approaches
  - 2 different energy transfer techniques
    - Inductive and Conductive
- Create a test procedure for powered rail's
- Finalizing the Power documents





This can be achieved

- A Powered accessory rail built on STANAG 4694 gives the possibility to:
  - move the Centre of gravity
  - reduce weight
  - create or improve the power management system
  - improve interoperability



Path forward

- Creating a STANAG for a Powered Rail based on the Accessory Rail STANAG 4694
- Future STANAG considerations
  - Interoperability
  - Open for different weapon system designs



Questions?