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Weapon Systems Technology Information Analysis Center

Small Caliber Lethality: 5.56mm Performance in Close Quarters Battle

WSTIAC 10 Spotlight: Lethality

Show Review: SpecOps East

WSTIAC Quarterly
Volume 8, Number 1
2008

WSTIAC is a DoD Information Analysis Center Sponsored by the Defense Technical Information Center

http://wstiac.alionscience.com/quarterly

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 JAN 2008	**N/A**	**-**

4. TITLE AND SUBTITLE
WSTIAC Quarterly, Vol. 8, No. 1 - Small Caliber Lethality: 5.56mm Performance in Close Quarters Battle

5a. CONTRACT NUMBER
5b. GRANT NUMBER
5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER
5e. TASK NUMBER
5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
WSTIAC Weapon Systems Technology Information Analysis Center, Rome, NY

8. PERFORMING ORGANIZATION REPORT NUMBER
WSTIAC-V8-N1

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Defense Technical Information Center, Ft Belvoir, VA

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT
This issue of the WSTIAC Quarterly features an article on small caliber lethality and how 5.56mm rounds perform in close quarters battle, and WSTIAC 10 Spotlight: Lethality. Also included is show review, "Preparing SOF for Future Challenges" from SPECOPS East 2007 Symposium & Warfighter Expo; Fayetteville, NC. Included the WSTIAC Calendar of Events and the Directors Corner. Details on several Training Courses sponsored by WSTIAC are also included in this issue.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**16**	

Director's Corner

Welcome to the latest edition of the *WSTIAC Quarterly*. The WSTIAC program has started very strongly in Fiscal Year 2008. With the first six months past us, I'm pleased to report that WSTIAC is collecting and disseminating information and providing technical expertise on weapons systems technologies at a rate that is significantly greater than this time last year. We are supporting a greater number of web inquiries, adding more scientific and technical information to our weapons library, and continuing to host students in our world class weapons systems technology training courses. In terms of providing technical solutions and expertise, we are at a contract effort pace that is expected to exceed previous WSTIAC levels.

As this publication is distributed, look for improvements to our website as we address key DoD weapons-related strategic areas. As I discussed in the previous edition of the *WSTIAC Quarterly* (Vol. 7, No. 4), these ten areas, called the "WSTIAC 10", are areas in which WSTIAC will provide expertise and information as they pertain to weapon systems technological advancement. From power and energy, to lethality, to capability, effectiveness, and requirements analyses, just to mention a few, these are weapon systems areas that the Department of Defense and many of the services are emphasizing. We will place a similar emphasis on these strategic areas from an informational and a technical expertise perspective.

For this quarterly edition, I believe that you will find the feature article about small caliber lethality to be very interesting. As one of the areas of the WSTIAC 10, lethality is a critical aspect of many weapon systems. With small caliber ammunition, given the close relative ranges, lethality is even more critical for our warfighters. However, in the past small caliber lethality has not always been objectively and empirically studied. That is changing. The feature article by Majors Dean and LaFontaine, discuss the performance of 5.56mm ammunition in Close Quarters Battle (CQB). The article explores the combat performance reports that we are getting concerning the 5.56mm rounds, what the science is behind them, and efforts that can be taken to improve impact performance of these rounds in CQB. This is the initial part of a greater effort that the Project Manager for Maneuver Ammunition Systems (PM MAS), Picatinny Arsenal, New Jersey, has undertaken to put science and physics into understanding and improving small caliber ammunition.

Before you read this feature article on small caliber lethality, you may want to check out the brief synopsis on lethality on page 8. It gives a good introduction to the subject as well as some examples of technologies that are enhancing weapon lethality. I hope that you find these articles and the rest of the publication useful in contributing to your efforts to support our warfighters.

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Small Caliber Lethality:
5.56mm Performance in Close Quarters Battle

Major Glenn Dean
Major David LaFontaine

Not long after the US Army's entry into Afghanistan, reports from the field began to surface that in close quarters engagements, some Soldiers were experiencing multiple "through-and-through" hits on an enemy combatant where the target continued to fight. Similar reports arose following the invasion of Iraq in 2003. Those reports were not always consistent – some units would report a "through-and-through" problem, while others expressed nothing but confidence in the performance of their M4 carbines or M16 rifles. The M249 Squad Automatic Weapon, which fires identical bullets as the M4 and M16, did not receive the same criticism. Often, mixed reports of performance would come from the same unit. While many of the reports could be dismissed due to inexperience or hazy recollections under the stress of combat, there were enough of them from experienced warfighters that the US Army Infantry Center asked the Army's engineering community to examine the issue. Specifically, the Infantry Center asked it to examine the reports of "through-and-through" wounds, determine if there was an explanation, and assess commercially available ammunition to determine if there was a "drop in" replacement for the standard issue 5.56mm M855 Ball rounds that might provide improved performance in close quarters battle (CQB).

What resulted grew into a lengthy, highly technical, and highly detailed study of rifle and ammunition performance at close quarters ranges that involved technical agencies from within the Army, Navy, and Department of Homeland Security; medical doctors, wound ballisticians, physicists, engineers from both the government and private sector; and user representatives from the Army, US Marines Corps, and US Special Operations Command.

After having made some significant contributions to the science of wounds ballistics effects and ammunition performance assessment, this Joint Services Wound Ballistics (JSWB) Integrated Product Team (IPT) was eventually able to conclude that: (1) there were no commercially available 5.56mm solutions that provided a measurable increase in CQB performance over fielded military ammunition, (2) the reports from the field could be explained and supported with sound scientific evidence, and (3) there are steps that can be taken to immediately impact performance of small arms at close quarters ranges.

BACKGROUND

Development of small caliber ammunition is an area which in recent years has largely been left to the manufacturers of the civilian firearms industry. Although there have been efforts by the military services to assess the performance of its small arms, the levels of effort and resources involved have been extremely low compared to those spent on other weapons systems: bursting artillery rounds, anti-tank munitions, etc. The general assumption within the services, despite evidence to the contrary from the larger wound ballistics community, has been that small arms performance was a relatively simple, well-defined subject. What has developed in the interim in the ammunition industry is a number of assessment techniques and measurements that are at best unreliable and in the end are able to provide only rough correlation to actual battlefield performance.

The major problem occurs at the very beginning: What is effectiveness? As it turns out, that simple question requires a very complex answer. For the Soldier in combat, effectiveness equals death: the desire to have every round fired result in the death of the opposing combatant, the so-called "one-shot drop." However, death – or lethality – is not always necessary to achieve a military objective; an enemy combatant who is no longer willing or able to perform a meaningful military task may be as good as dead under most circumstances. Some equate effectiveness with "stopping power," a nebulous term that can mean anything from physically knocking the target down to causing the target to immediately stop any threatening action. Others may measure effectiveness as foot-pounds of energy delivered to the target – by calculating the mass and impact velocity of the round – without considering what amount of energy is expended in the target or what specific damage occurs to the target. In the end, "foot-pounds of energy" is misleading, "stopping power" is a myth, and the "oneshot drop" is a rare possibility dependent more on the statistics of hit placement than weapon and ammunition selection. Effectiveness ultimately equates to the potential of the weapons system to eliminate its target as a militarily relevant threat.

The human body is a very complex target, one that has a number of built-in mechanisms that allow it to absorb damage and continue to function. Compared to a tank, it is far more difficult to predict a human target's composition and what bullet design will be most advantageous. The combinations of muscle, bone, organs, skin, fat, and clothing create a staggering number of target types which often require different lethal mechanisms. Physical conditioning, psychological state, size, weight, and body form all play a factor in the body's ability to resist damage, and all add to the complexity of the problem. The same bullet fired

This article was originally published in the September-October 2006 edition of *Infantry Magazine*. It has been reprinted with permission from the US Army Infantry School.

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against a large, thick, well-conditioned person has a very different reaction than that fired against a thin, malnourished opponent.

The physical mechanisms for incapacitation – causing the body to no longer be able to perform a task – ultimately boil down to only two: destruction of central nervous system tissue so that the body can no longer control function, or reduction in ability to function over time through blood loss. The closest things the human body has to an "off switch" are the brain, brain stem, and upper spinal cord, which are small and well-protected targets. Even a heart shot allows a person to function for a period of time before finally succumbing to blood loss. What the wound ballistics community at large has long known is that the effectiveness of a round of ammunition is directly related to the location, volume, and severity of tissue damage. In other words, a well-placed .22 caliber round can be far more lethal than a poorly placed .50 caliber machine gun round. Setting shot placement aside for the moment, though, the challenge becomes assessing the potential of a given round of ammunition to cause the needed volume and severity of tissue damage, and then relating this back to performance against a human target.

TERMINAL BALLISTIC TESTING

A common way of measuring this "damage potential," or "terminal ballistic effectiveness," is through what are known as "static" testing methods. Typically, these involve firing a weapon at a tissue simulant which is dissected after the shot to allow assessment of the damage caused by the bullet. Tissue simulants can be anything from beef roasts to blocks of clay to wet phone books, but the typical stimulant is ballistic gelatin. Gelatin has the advantage of being uniform in property, relatively cheap to make, and simple to process, which means that this form of static testing can be done almost anywhere without the need for special facilities. Unlike other simulants, gelatin is transparent. Therefore, assessment can take the form of video footage of a given shot, measurement of the cavity formed in the gelatin ("gel") block, and recovery of the bullet or its fragments for analysis. Static methods measure real damage in gel, but have difficulty translating that damage to results in human tissue.

When the Infantry Center initially asked its questions about 5.56mm performance, two agencies moved quickly to provide an answer through static testing, firing a small number of shots against gel blocks to compare several bullet types. Unfortunately, tests at the Naval Surface Warfare Center at Crane, IN, (NSWC-Crane) and the Army's Armaments Research, Development, and Engineering Center (ARDEC) at Picatinny Arsenal, NJ, produced significantly different results. Further analysis revealed that the two agencies had different test protocols that made the results virtually impossible to compare – and as it turns out, these test methods were not standardized across the entire ballistics community. The JSWB IPT began work to standardize test protocols among the participating agencies to allow results to be compared. Unfortunately, after that work had been completed and static firings of a wide range of calibers and configurations of ammunition were under way (see Figure 1), the IPT discovered that results were still not consistent. Despite using the same gel formulation, procedures, the same lots of ammunition, and in some cases the same weapons, the static testing results still had differences that could not initially be explained.

The IPT was ultimately able to determine a reason for the differences. The Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD, has long used a type of testing know as "dynamic" methods to evaluate ammunition performance, which estimate probable levels of incapacitation in human targets. Dynamic methods are resource intensive – the ARL measures the performance of the projectile in flight prior to impacting the target as well as performance of the projectile in the target. ARL was able to identify inconsistencies in bullet flight that explained the differences in the static testing results. Ultimately, the best features of both static and dynamic testing methods were combined into a new "Static/Dynamic" method that is able to much better assess weapon and ammunition performance. This method takes into account a range of parameters from the time the bullet leaves the muzzle, to its impact on the gel block target, its actions once in the target, and then uses a dynamic analysis tool to correlate the gel block damage to damage in a virtual human target. It provides a complete "shooter-to-target" solution that combines both live fire and

Figure 1. **Original Study Ammunition Configurations (Source: ARL)**

Ammunition Given Full Static/Dynamic CQB Analysis	Weapons Tested to Answer the Problem Statement:
◆ M855 "Green Tip" (62-gr.)	◆ M16A1
◆ M995 AP (52-gr.)	◆ M4
◆ M193 (55-gr.)	◆ M16A2/A4
◆ Mk 262 (77-gr.)	◆ Mk 18 CQBR (10" M4)
◆ COTS (62-gr.)	◆ M14
◆ COTS (69-gr.)	
◆ COTS (86-gr.)	
◆ COTS (100-gr.)	
◆ M80 7.62 (150-gr.)	

Figure 2. **Final Analysis Systems (Source: PM-Maneuver Ammunition Systems)**

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simulated testing, but is very time and resource-intensive to perform. As a result, the study effort narrowed, focusing on providing complete analysis of the most promising 5.56mm systems, and one reference 7.62mm system, needed to answer the original question (see Figure 2).

TERMINAL MECHANICS

Before providing an explanation of the JSWB IPT's results, a brief discussion of small caliber, high velocity terminal ballistics is in order. The small caliber, high velocity bullets fired by military assault rifles and machine guns have distinct lethality mechanisms; conclusions provided here do not necessarily apply to low velocity pistol rounds, for example, which have different damage mechanisms. The performance of the bullet once it strikes the target is also very much dependent upon the bullet's material and construction as well as the target: a bullet passing through thick clothing or body armor will perform differently than a bullet striking exposed flesh. This study focused on frontal exposed targets.

Take an average M855 round, the standard round of "green-tip" rifle ammunition used by US forces in both the M4 and M16 series weapons and in the M249 SAW. The 62-grain projectile has an exterior copper jacket, a lead core, and a center steel penetrator designed to punch through steel or body armor. An M16 launches the M855 at roughly 3,050 feet per second, and the M855 follows a ballistic trajectory to its target, rotating about its axis the entire way, and gradually slowing down. Eventually, the bullet slows enough that it becomes unstable and wanders from its flight path, though this does not typically happen within the primary ranges of rifle engagements (0-600m). (For more detailed ballistic discussion, see FM 3-22.9).

Upon impacting the target, the bullet penetrates tissue and begins to slow. Some distance into the target, the tissue acting on the bullet also causes the bullet to rotate erratically or yaw; the location and amount of yaw depend upon speed of the bullet at impact, angle of impact, and density of the tissue. If the bullet is moving fast enough, it may also begin to break up, with pieces spreading away from the main path of the bullet to damage other tissue. If the target is thick enough, all of these fragments may come to rest in the target, or they may exit the target. Meanwhile, the impacted tissue rebounds away from the path of the bullet, creating what is known as a "temporary cavity." Some of the tissue is smashed or torn by the bullet itself, or its fragments; some expands too far and tears. The temporary cavity eventually rebounds, leaving behind the torn tissue in the wound track – the "permanent cavity." It is this permanent cavity that is most significant, as it represents the damaged tissue that can impair and eventually kill the target, provided, of course, that the damaged tissue is actually some place on the body that is critical.

This is where the balance of factors in bullet design becomes important. Volume of tissue damage is important – which might suggest high velocities to enable the bullet to tumble and fragment sooner, materials that cause the bullet to break up sooner, etc. – but it must also occur in critical tissue. If the bullet immediately breaks up, it may not penetrate through outer garments to reach tissue, or it may break up in muscle without reaching vital organs underneath. The projectile must have enough penetration to be able to reach vital organs to cause them damage. At the same time, it must not have so much penetrating capability that it passes completely through the target without significant damage – resulting in a so-called "through-and-through." Energy expended outside the target is useless (incidentally, this is why "impact energy" is a poor measure of bullet comparison, as it does not separate energy expended in damaging the target from energy lost beyond the target). The ideal bullet would have enough energy to penetrate through any intervening barrier to reach vital organs without significantly slowing, then dump all of its energy into damaging vital organs without exiting the body. Unfortunately, design of such a bullet is nearly impossible in a military round, even if all human bodies were uniform enough to allow for such a thing. A round that reaches the vital organs of a 5-foot 6-inch 140-pound target without over-penetration is likely to react differently against a 6-foot 2-inch 220-pounder, even without considering target posture. To complicate matters, when hitting a prone firing target the bullet might have to pass through a forearm, exit, enter the shoulder, then proceed down the trunk before striking heart or spinal cord. A flanking hit would engage the same target through or between the ribs to strike the same vital regions. All these possibilities are encountered with the same ammunition. Ultimately, bullet design is a series of tradeoffs complicated by the need to survive launch, arrive at the target accurately, possibly penetrate armor, glass, or other barriers, and be producible in large quantities (1+ billion per year) at costs the military can afford.

FINDINGS

The significant findings of the JSWB IPT's efforts include:

1. *No commercially available alternatives perform measurably better than existing ammunition at close quarters battle ranges for exposed frontal targets.* Based on current analysis through the static/dynamic framework, all of the rounds assessed performed

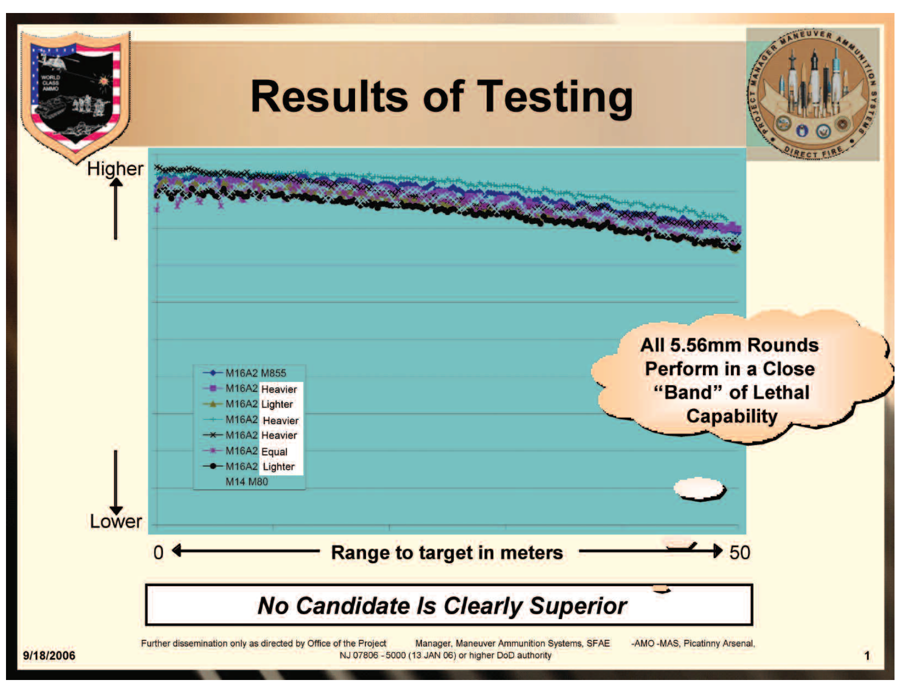

Figure 3. System Effectiveness for Studied Rounds (Source: PM MAS)

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similarly at the ranges of 0-50 meters. Though there might be differences for a single given shot, the tradeoffs of delivery accuracy, penetration, fragmentation and wound damage behavior, and speed and efficiency of energy deposit all serve to render differences between rounds minimal. The following chart (Figure 3) shows the rounds of interest plotted together. The specific values of the chart are not meaningful; what is meaningful is the fact that all of the rounds act in the same band of performance. Interestingly, the one 7.62mm round that received the full evaluation, the M80 fired from the M14 rifle, performed in the same band of performance, which would indicate that for M80 ammunition at least there appears to be no benefit to the larger caliber at close quarters range.

2. *Shot placement trumps all other variables; expectation management is key.* Though this should produce a "well, duh!" response from the experienced warfighter, it cannot be emphasized enough. We try hard to inculcate a "one-shot, one-kill" mentality into Soldiers.

When they go to the qualification range, if they hit the target anywhere on the E-type silhouette, the target drops. The reality is that all hits are not created equal – there is a very narrow area where the human body is vulnerable to a single shot if immediate incapacitation is expected. Hits to the center mass of the torso may eventually cause incapacitation as the target bleeds out, but this process takes time, during which a motivated target will continue to fight. While projectile design can make a good hit more effective, a hit to a critical area is still required; this fact is borne out by the Medal of Honor citations of numerous American Soldiers who continued to fight despite being hit by German 7.92mm, Japanese 6.5mm and 7.7mm, or Chinese or Vietnamese 7.62mm rounds. A more realistic mantra might be "One well-placed shot, one-kill."

3. *Field reports are accurate and can be explained by the phenomenon of bullet yaw.* Shot placement aside, why is it that some Soldiers report "through-and-through" hits while others report no such problems, despite using the same weapons and ammunition? The phenomenon of bullet yaw can explain such differences in performance.

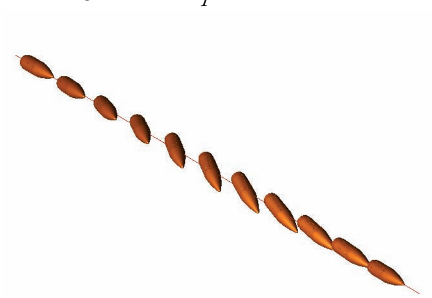

Figure 4. **Bullet Yaw vs. Path of Flight.**

Yaw is the angle the centerline of the bullet makes to its flight path as the projectile travels down range (Figure 4). Although the bullet spins on its axis as a result of the barrel's rifling, that axis is also wobbling slightly about the bullet's flight path.

Yaw is not instability; it occurs naturally in all spin-stabilized projectiles. However, bullet yaw is not constant and rifle bullets display three regions of significantly different yaw (see Figure 5). Close to the muzzle, the bullet's yaw cycles rapidly, with large changes of angle in very short distances (several degrees within 1-2 meters range). Eventually, the yaw dampens out and the bullet travels at a more-or-less constant yaw angle for the majority of its effective range. Then, as the bullet slows, it begins to yaw at greater and greater angles, until it ultimately destabilizes. A spinning top which wobbles slightly when started, then stabilizes for a time, then ultimately wobbles wide and falls over demonstrates the same phenomenon.

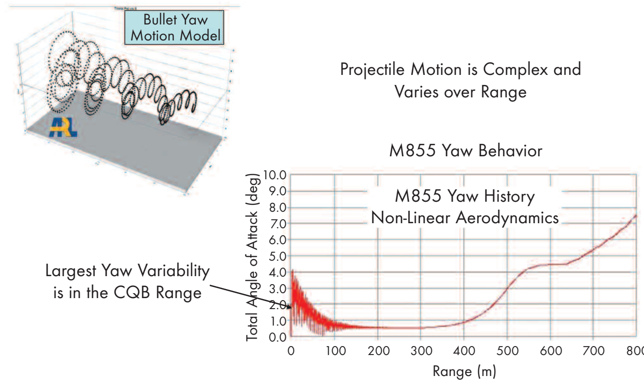

Figure 5. **Overview of Bullet Yaw (Source: ARL)**

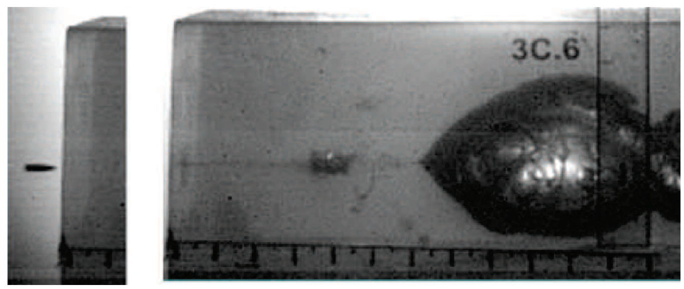

Figure 6. **Low Yaw Impact (Source: ARDEC)**

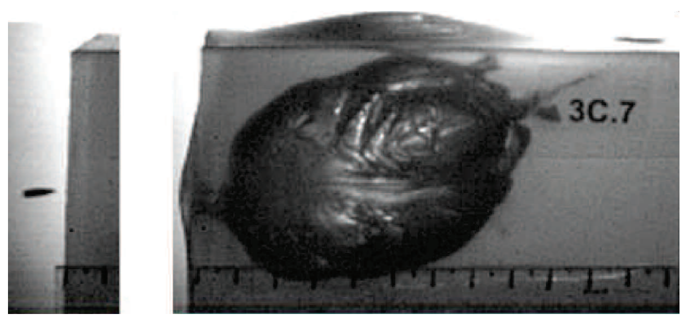

Figure 7. **High Yaw Impact (Source: ARDEC)**

Unfortunately, projectiles impacting at different yaw angles can have significantly different performance, particularly as the projectile slows down. Consider the two photos on this page. In the first (Figure 6), the bullet impacted at almost zero yaw. It penetrated deeply into the gel block before becoming unstable. In a human target, it is very likely that this round would go straight through without disruption – just as our troops have witnessed in the field. In the second photo (Figure 7), the bullet impacted the gel block at a relatively high yaw angle. It almost immediately destabilized and began to break, resulting in large temporary and permanent wound cavities. Our troops have witnessed this in action too; they are more likely to report that their weapons were effective.

So all we have to do is fire high-yaw ammunition, right? Unfortunately, it's not that easy. High yaw may be good against soft tissue but low yaw is needed for penetration – through clothing, body armor, car doors, etc. – and we need ammunition that works against it all. Further, we currently cannot control yaw within a single type of ammunition, and all ammunition displays this tendency to some degree. Both of the shots were two

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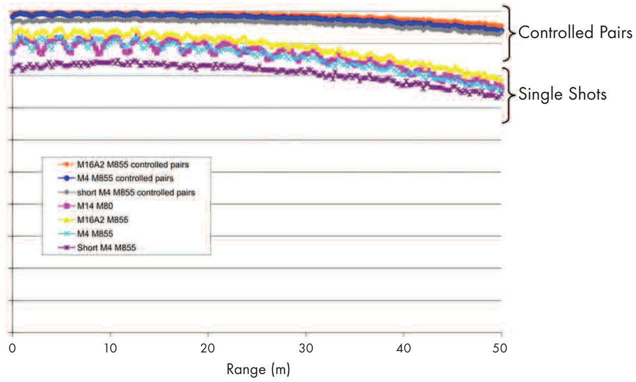

Figure 8. **Improvement in Performance Due to Controlled Pairs (Source: ARL)**

back-to-back rounds fired from the same rifle, the same lot of ammunition, at the same range, under the same conditions. Yaw requires more study, but the Army solved a similar problem years ago in tank ammunition.

4. There are doctrinal and training techniques that can increase Soldier effectiveness. The analysis tools used in this study were used to evaluate some alternative engagement techniques. The technique of engaging CQB targets with controlled pairs – two aimed, rapid shots as described in Chapter 7 of FM 3-22.9 – was shown to be significantly better than single aimed shots (see Figure 8). While that should certainly not be surprising to those who have been using this technique for some time, we now know why. Not only are two hits better than one, but controlled pairs help to average out striking yaw; on average, the Soldier is more likely to see a hit where the bullet's yaw behavior works in his favor.

CAVEATS

This study was an extremely detailed, indepth analysis of a specific engagement (5.56mm at CQB range); we must be careful not to apply the lessons learned out of context. The study did not look at the effectiveness of ammunition at longer ranges, where differences in projectile mass, velocity, and composition may have greater effect. The target set for this analysis was an unarmored, frontal standing target; against targets in body armor, or crouching/prone targets, the results may be different. Of course, most targets on the modern battlefield can be expected to be engaged in some form of complex posture (moving, crouching, or behind cover) and future analysis will have to look at such targets, too. The study evaluated readily available commercial ammunition; this does not rule out the possibility that ammunition could be designed to perform significantly better in a CQB environment. Human damage models need further refinement to move beyond gelatin and more closely replicate the complex human anatomy. While these caveats should not detract from the importance of the study's findings, they should be considered as a starting point for continued analysis.

CONCLUSION

Soldiers and leaders everywhere should take heart from the fact that despite all the myth and superstition surrounding their rifles and ammunition, they are still being provided the best performing weapons and ammunition available while the armaments community works to develop something even better.

More work remains to be done in this area, and the work is continuing with the participation of the major organizations from the original study. That effort is planned to look at longer ranges, intermediate barriers, and different target postures, and will further refine the tools and methods developed in the original study. The lessons learned are being put to immediate use as part of an ongoing program to develop a lead-free replacement for the M855 cartridge; the information obtained from this study will be used to develop a round that is expected to be more precise and consistent in its performance while still being affordable.

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Lethality

Lethality may be defined as "the probability that a weapon will damage or destroy a target such that it can no longer carry out its intended mission". It is an essential figure of merit for any weapon system. The lethality of a given system will vary with the target chosen and the circumstances of deployment. In the former case, for example, a given weapon may be 90% lethal against a field bunker and 50% lethal against a main battle tank. In the latter, the lethality of an air-launched guided munition against a main battle tank may be 50% if released from an altitude of 10,000 feet and a standoff range of 4 miles and 65% if the altitude and range are reduced to 1,500 feet and 1 mile.

Any discussion of lethality must begin with the target set. Typically, a weapon system will be designed to attack a particular class of targets or sometimes more than one class, with appropriate priorities assigned. For instance, the Javelin infantry weapon is primarily designed to defeat armor but can be used against fixed structures and even helicopters. The lethality required of a proposed system will be a function of expected battle scenarios, including likely number of targets, the priority of those targets, the number of systems available (itself a function of logistics considerations), and deployment conditions. The latter must take into account adverse weather, smoke or other obscurants, and active enemy counter-measures such as jamming. Ideally, the number of systems available, along with the lethality, should combine to produce a near-100 percent probability of destroying all targets in the expected scenario.

There are currently a number of avenues along which enhancements to weapon lethality are being pursued. These include:

- Scaleable warhead design, including guided blast and fragmentation warheads and kinetic energy penetrators
- High power micro/millimeter wave, frequency and modulation optimized for specific targets
- Chemical and other advanced laser technology
- High-density munition carriage with concomitant smaller, more precise weapons and increased lethality per platform load-out

A priori predictions of lethality are made difficult by the wide range of conditions encountered on the battlefield. Usually a good estimate may be made of CEP ("circular error probability", or probable miss distance) for guided and unguided projectiles. Warhead effectiveness against different target classes is more usually determined by experiment. Conventional electronic jammers can usually be modeled accurately against known threat systems, such as enemy radars. Less conventional systems, such as directed energy weapons, require a combination of analysis and experiment. For any procurement of a new system (or upgrade of an existing one), a program of analysis and test must be designed to assess lethality in a realistic yet cost-effective manner.

- **IED Defeat**
- **Embedded Training Systems**
- **LETHALITY**
- **Target Identification & Engagement**
- **Asymmetric & Irregular Warfare**
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- **Non-Lethal Weapons**
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SPECOPS EAST 2007 SYMPOSIUM & WARFIGHTER EXPO; FAYETTEVILLE, NC

"Preparing SOF for Future Challenges"

John Keefe
WSTIAC
Rome, NY

The SpecOps East 2007 conference was recently held in Fayetteville, NC. The conference was focused on the products and topics that are of interest to the Special Operations (SpecOps) world of the Special Forces, such as Navy SEAL Teams, Army Rangers and other elite, highly mobile groups. It was no accident that Fayetteville, NC, was chosen as the location for this conference. US Army Special Forces Command is located nearby at Fort Bragg, which resulted in the attendance of many active duty personnel that would otherwise not have been able to attend such an event. The 1600+ registered attendees represented a good mix of professionals from the military, industry and academia sectors. There were more than 140 exhibitors at the event and the 14 symposia tracks offered numerous pertinent topics for attendees. In addition, the show provided two hours for various exhibitors to demonstrate their products at an outdoor range.

Shows such as SpecOps East are replete with an array of products used by the military. Products and services exhibited at SpecOps East included small arms and weapons support (Glock, FN Herstal, LWRC, Dillon Aero, Gibbs Products, Surefire, General Dynamics, Night Vision Systems, and others), soldier apparel (W. L. Gore, Performance Sports Apparel, Nobel Biomaterials, Duro Textiles, Source One, Rocky Boots, and others), information and computer technology, communication systems, mission support services, containers and storage systems, ordnance producers, various types of consulting services, robotic systems, large mobile equipment, computer simulation of the battlespace, and just about anything else that could be used in support of SpecOps missions. Below are brief highlights of a few of the exhibits present at the conference.

TECHNOLOGY TRANSFER SERVICES

Developing a military product from scratch and transitioning it into a fieldable device can be a daunting task. Some companies offer a service to help with the jump from a prototype to a fielded product. These services can help speed up the transition of the technology in order to get it into the warfighters' hands much sooner than otherwise possible. One example of this service takes into consideration a technology developed under the Small Business Innovative Research grant (SBIR) program. The process has three phases where Phase 1 is the initial concept development, Phase 2 is the prototype building / testing process, and lastly Phase 3 is the manufacturing development and fielding of the device. In reviewing the effectiveness of the SBIR process what has been noted is that many small innovative companies have failed to make the transition to Phase 3. The reasons for this are varied. The jump from Phase 2 to Phase 3 is a very big leap. Most small companies do not go to Phase 3, unless approved by the government, for basic fiscal reasons. According to one company, a full 90% of the Phase 2 innovations are never optioned by the government to continue. For instance, after the evaluation of Phase 2 results no military program of record will state that "verifiable demand" exists for the technology's use with deployable units, so continuation on to Phase 3 development rarely occurs unless it is solely funded by the company.

The purpose of the technology transfer services companies are to help with this leap and to get the technologies to the warfighter. One company in particular has a reasonably-sized budget and they are able to assist numerous projects per year. With a technical network of experts at hand, the multifaceted transition can be made by being able to address any and all issues that arise during the process.

MilTech (Bozeman, MT) www.miltechcenter.com

ANTIMICROBIAL SOLDIER APPAREL

A unique yarn metalized with pure silver which when woven into the fabric of a range different materials will provide antimicrobial properties. Such a product provides protection against various microbial species including antibiotic-resistant strains and also provides odor management. There are numerous

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potential commercial applications including towels, bedding, pet products and home water filtration. However, for the military applications, the power of this technology may be in the medical field. Not only is it useful for odor management (it may be a hockey mom's dream as bacterial growth is inhibited by the metallic yarn), its use in wound care allows for a reduction in both the occurrence of infections and the total time required for healing. Warfighter medics may find this type of material suitable for treating wounded soldiers in the field.

Noble Biomaterials (Scranton, PA) www.x-static.com

SHOULDER MOUNTED ROCKET LAUNCHER

Other time well spent was in learning about the M3 Carl-Gustaf system of shoulder mounted, reusable launcher, 84mm rocket driven ordnance. The Carl-Gustaf system was developed in 1948 to give the individual soldier the improved ability to single-handedly destroy a modern tank.[1] This powerful system is described as a broad application, multipurpose weapons system. Special ops forces (SOF) in the US have been fielding this weapon with the designation of MAAWS (multi-role anti-armor, anti-personnel weapons system) for sometime. The application flexibility allows this man portable system to be used from anti-tank to anti-personnel functions. The system currently has 7 tactical rounds as well as 3 training / target practice rounds. The functions addressed are: anti-armor (with shape charge methodologies) capable of penetrating active armor systems, fragmentary, smoke, illumination and an anti-personnel round with 1100 flechettes.

One of the interesting features is the inclusion of three training rounds to simulate the action of the various tactical projectiles. It is well known that the total cost of training (ammunition, firing range time, safety & security personnel) associated with larger caliber, complex projectiles can be a very costly exercise. To reduce that cost the supplier has included a training round that loads like the 84mm round but uses a 7.62mm tracer bullet to simulate the targeting function of the anti-armor projectile. This targeting round can be provided with a back blast to make the practice even more realistic.

Additionally the supplier has also engineered three, 84mm ordnance based, single use shoulder mounted weapons: the NLAW (next generation light anti-armor weapon), AT4 CS and AT4 HEAT. These weapons, while not as flexible in ordnance types available as the Carl-Gustaf, offer several anti-armor and anti-tanks choices for the field soldier. The NLAW is touted to knock out any main battle tank by attacking the most vulnerable part of a tank – the top of the turret. This system has two attack modes: when used in OTA (overfly top attack) mode it is aimed above the tank and uses a special set of sensors that detonate the round exactly over the top of the tank, and when used in DA (direct attack) mode it behaves as would a traditionally aimed shape charge anti-tank round thereby acting upon impact. To ready this weapon takes approximately 5 seconds, not bad for a device that weighs 12 kg.[2]

The AT4 series of weapons offer a weapon that is lighter in weight and is effective against vehicles that are less armored than main battle tanks. The main distinctions are that the AT4 CS (confined space) can be used in an urban or jungle combat setting and can be fired from within rooms, hence the designation of CS for confined space. The ballistics system of this weapon allows it to be fired within close proximity of friendly troops and is accurate out to 300 m. The weight at 7.8 kg allows for the easy transport and setup by each warfighter. Similarly the AT4 HEAT, at 6.7 kg in weight, offers the same type of effectiveness but for open field firing situations. Both of these single use units give the warfighter close combat options when matched against light armor equipped forces.

Saab Bofors Dynamics (Karlskoga, Sweden)
www.saabgroup.com

KEYNOTE ADDRESS

The keynote address was given by Major General Thomas R. Csrnko (Commanding General, US Army Special Forces Command) who provided an assessment of the current state of the Special Forces. General Csrnko portrayed his confidence in the US Special Forces as being the right group to fight our current conflicts. He indicated that the range of skills, which include more than just fighting skills, within a Special Forces team form a group of soldiers that have the functionality to handle the social, language and diplomatic challenges of every mission.

General Csrnko overviewed several keys that will enable the Special Operations Forces (SOF) to achieve mission success:

- SOF must be able to choose the time, place and terms of battle for maximum effect
- We must maintain our dominance in Spec Ops world through continuous improvement
- Our improvement efforts can't afford a "modernization holiday"
- SOF needs the best and most capable equipment to serve the American people in its varied missions
- Technology must help us "see" on the battlespace more effectively
- Communication! Communication! Communication!
- Enhance mobility of the fighting force by improvement in the family of vehicles used
- Interoperability of equipment with our warfighting partners

REFERENCES

[1] www.saabgroup.com
[2] Saab Bofors Dynamics product literature

Mr. John C. Keefe is a Senior Engineer with Alion Science and Technology. He holds a BS in Industrial Engineering from Purdue University and an MS in Industrial Engineering from Lehigh University. Previously he worked as a Senior Engineer at General Dynamics in the Ordnance and Tactical Systems division where he was responsible for programs in large, medium and 40mm munitions. While with General Dynamics Mr. Keefe worked on the process development and ongoing production aspects of the M1028, M865, M919, and 40mm Flechette munitions programs. He has also previously worked as the Manager of Manufacturing Engineering at Johnson Matthey (Precious Metals Division) in West Chester, PA, where he supervised engineering and fabrication of a wide range of products made from precious metals and their alloys. Mr. Keefe has further interest in general engineering education and has been a college instructor for more than 20 years. Mr. Keefe is currently supporting SOPMOD (Special Operations Peculiar Modifications) which is under the direction of US SOCOM (Special Operations Command).

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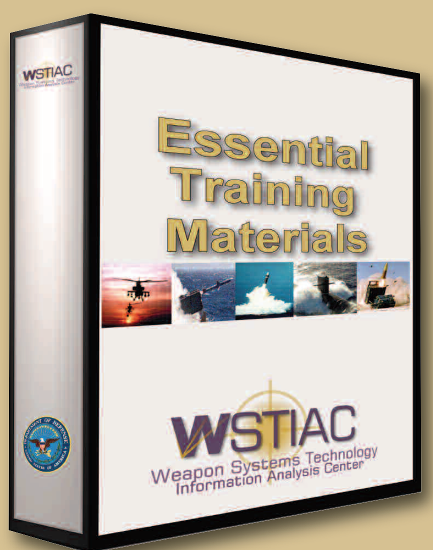

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- Product support
- A practical approach to capability maturity

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DIRECTED ENERGY WEAPONS

Provides an introduction to the basic principles and techniques of Directed Energy Weapons (DEWs). Weapon System applications are also thoroughly analyzed. The technologies behind each type of DEW are examined and the critical path components are identified and explored with respect to their effect on future DEW development.

IMPROVISED EXPLOSIVE DEVICE (IED)

The objective of this course is to inform materiel and combat developers, systems analysts, scientists, engineers, managers and business developers about the IED threat and countermeasures.

INTRO TO SENSORS AND SEEKERS

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SMART/PRECISION WEAPONS

This course is aimed at providing general knowledge about smart weapons technology and a source of current information on selected US programs across the military services including system description, concept of employment, performance characteristics, effectiveness and program status.

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calendar of events

Upcoming Conferences and Courses

March 2008

Maritime Security & Domain Awareness Conference
31 March – 1 April 2008
Arlington, VA
http://www.ttcus.com/

5th Annual Sensor to Shooter, Tightening the Kill Chain
31 March – 2 April 2008
Arlington, VA
http://www.iqpcevents.com/ShowEvent.aspx?id=55830

Tactical Vehicle Summit 2008
31 March – 2 April 2008
Alexandria, VA
http://www.iqpcevents.com/ShowEvent.aspx?id=51604

6th Annual Maritime Homeland Security Summit 2008
31 March – 3 April 2008
Charleston, SC
http://www.iqpcevents.com/ShowEvent.aspx?id=51234

6th US Missile Defense Conference and Exhibit
31 March – 3 April 2008
Washington, DC
http://www.aiaa.org/

April 2008

Net-Centric Communications Conference
3 – 4 April 2008
Alexandria, VA
http://www.ttcus.com/

DTIC 2008 Conference
7 – 9 April 2008
Alexandria, Virginia
http://www.dtic.mil/dtic/annualconf/

AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference
7 – 10 April 2008
Schaumburg, IL
http://www.aiaa.org/

Unmanned Aircraft Systems Conference – East
10 – 11 April 2008
Alexandria, VA
http://www.ttcus.com/

Airborne Electro-Optical Sensor System Seminar
14 – 15 April 2008
Washington, DC
http://www.ttcus.com/

Precision Strike Annual Programs Review
15 – 16 April 2008
Springfield, VA
http://www.precisionstrike.org/

9th Annual Science & Engineering Technology Conference DoD/Tech Exposition
15 – 17 April 2008
North Charleston, SC
http://www.ndia.org/

43rd Annual Armament Systems: Gun & Missile Systems Conference & Exhibition
21 – 24 April 2008
New Orleans, LA
http://www.ndia.org/

Defense Systems Acquisition Management Course (DSAM)
21 – 25 April 2008
Atlanta, GA
http://www.ndia.org/

Directed Energy Weapons Training Course
22 – 23 April 2008
Huntsville, AL
http://wstiac.alionscience.com/pdf/2008DEWsheet.pdf

IAC Small Business Industry Day
29 April 2008
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http://www.sbid2008.com/

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http://www.iqpcevents.com/ShowEvent.aspx?id=73304
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2008 Joint Undersea Warfare Technology Spring Conference
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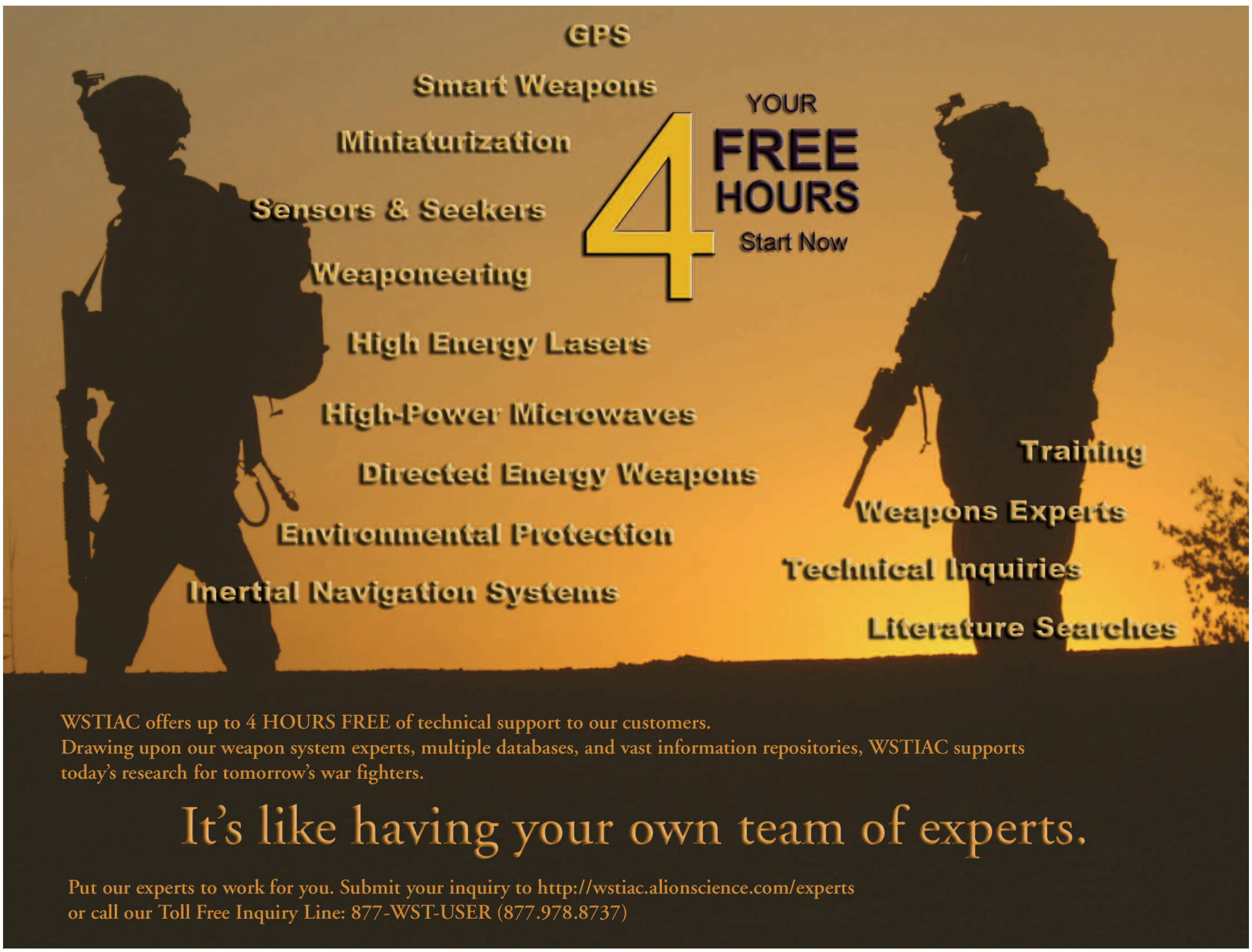

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