105mm DPICM, M915 Insensitive Munitions Testing

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ABSTRACT

The US Army Tank-automotive and Armaments Command - Armament Research Development and Engineering Center (TACOM-ARDEC), Energetics and Warheads Division (EWD) is responsible for developing the performance, vulnerability, safety, and producibility of insensitive explosives for widespread Army applications. The most promising explosive formulations are selected for specific weapon system integration and Insensitive Munitions (IM) technology implementation. Picatinny Arsenal Explosive–2A (PAX-2A) was selected to be demonstrated in the U.S. Army's 105mm Dual Purpose Improved Conventional Munition (DPICM) M915 Cartridge. The M915 Cartridge consists of a propelling charge mated with a projectile carrying 42 each M80 grenade submunitions as payload. Each Dual Purpose grenade utilizes Composition A5 as the explosive fill. Insensitive munitions testing was performed to compare the M80 grenade's current energetic fill directly with PAX-2A for improvements in survivability. The sympathetic detonation, bullet impact, and slow cook-off hazard assessment test results showed that very significant survivability improvements are realized with PAX-2A. These results are presented in detail.

INTRODUCTION

TACOM-ARDEC has a vision to "Provide Overwhelming Firepower for Decisive Victory," along with several strategic intents. The main strategic intent is *to be recognized as the premier armament and munitions "Center of Excellence"*. One of several approaches to meet that strategic intent is *to be responsive and relevant to our ultimate customers--the soldiers in the field*. With this in mind, the Cartridge, 105mm DPICM M915 Project Office has teamed with the Energetics & Warheads Division (EWD) to insert the IM explosive PAX-2A into the M915 Projectile. It is viewed as a win-win strategy since it will provide vastly increased safety to the soldier in the field and above required performance with minimal cost impact for implementation. The M915 Project Manager has maintained the goal to enter full-rate production and field the 105mm bullets with PAX-2A, despite receiving an IM waiver in 1998.

PAX-2A BACKGROUND

The Energetics & Warheads Division of the U. S. Army TACOM-ARDEC has been involved in the development of PAX-2A, a less sensitive high explosive, since 1989. ARDEC's objective was to develop an IM explosive for use in high performance warhead systems that will be less sensitive to initiation by outside stimuli while maintaining the system's performance capability. Typical hazard threats that warheads may be exposed to in the field or storage can include stimuli such as fast or slow cook-off as a result of a fire, the impact from a bullet, fragment or shaped charge jet, or sympathetic detonation. The IM explosive PAX-2A was developed as an alternative to current HMX formulations (i.e., LX-14, PBXN-5) and RDX-based high explosives (i.e., Comp A3, Comp A5). PAX-2A is an HMX based pressable high explosive. The PAX-2A formulation has a lower percentage of solids than conventional explosives but uses an energetic plasticizer to maintain its explosive output. PAX-2A is 85% HMX, 9% BDNPA/F and 6% CAB as opposed to Comp A5 which is approximately 99% RDX and 1% stearic acid. PAX-2A composition uses only Class 5, five-micron average, HMX particles, while many conventional explosives, such as LX-14, use a mixture of coarse and fine HMX particles. It is known that fine particulate explosive is less sensitive to shock type stimuli than coarse particulate explosive. The ingredients used to manufacture PAX-2A are widely available, and PAX-2A could be mass produced with current technologies. Over 10,000 pounds of PAX-2A have been manufactured to date. Many explosive facilities have successfully produced PAX-2A, including TACOM-ARDEC, Thiokol Propulsion, Holston-RONA, Ensign Bickford, Hercules, and DYNO. Hazard Threat Assessment testing has been conducted with PAX-2A in many various warhead/munition systems, including Hellfire, Javelin, M830A1, SADARM, WAM and most recently the 105mm DPICM M915 Cargo Projectile. The PAX-2A survivability level was demonstrated to be either far superior or improved in comparison to the majority of fielded explosives tested.

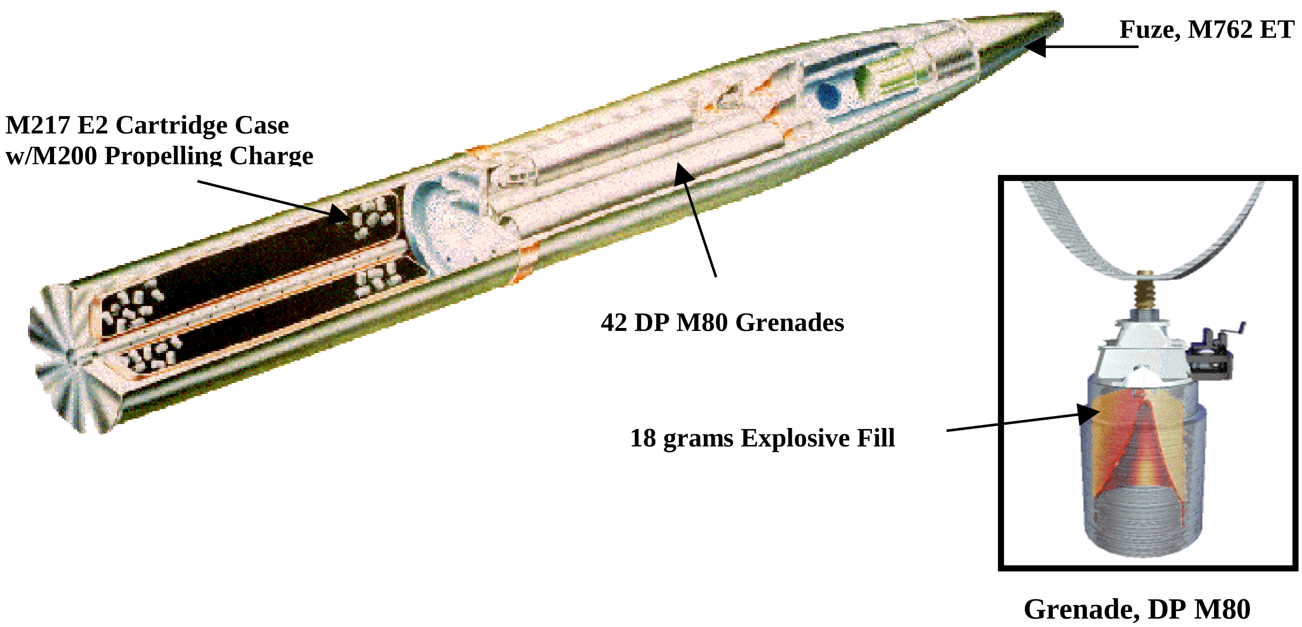
Since 1997, EWD has been teamed with Thiokol Propulsion, and most recently, Day & Zimmermann, Inc. for the development of a PAX-2A manufacturing process that provides compatibility with high-speed loading equipment originally designed for Comp A5. This teaming was extremely important since the high-speed production presses typically used for grenade submunition loading are dependent upon volumetric fill for consistent press density and performance. Ideally, the PAX-2A should mimic the particle size distribution and pour characteristics of Comp A5 as closely as possible; however, the following parameters were set by EWD: 1) The deliverable yield of granulated PAX-2A material, as a minimum, shall pass through an USS Sieve No. 20 (850 µm) and be retained on an USS Sieve No. 80 (180 µm). 2) Suitable drying cycles shall be applied that result in a final product with total volatiles equal to or less than 0.02%. 3) The final product must have a minimum bulk density of 0.95 g/cc. 4) The final product shall be free flowing (very pourable) and have no self-sticking characteristics. These parameters presented huge challenges, which have been met by Thiokol Propulsion. A manufacturing process has been developed with PAX-2A that yields material meeting these requirements. This material was consistently proven to exceed penetration performance requirements of 63.5 mm into BHN 280-300 armor test plate in M80 grenade submunitions at the R&D level at Day and Zimmerman Inc. (DZI), Kansas Army Ammunition Plant (KAAP). PAX-2A was subsequently proven out to load at full rate on the DZI, Lonestar Army Ammunition Plant (LSAAP), high-speed, rotary press with performance equivalent to that of conventional Comp A5 (Table 1).

M80	Armor Penetration Requirement	**Comp A5**	**PAX-2A**
# Grenades		20	28
Average Pen.	+ 63.5 mm	**+ 77.5 mm**	**+ 78.5 mm**

Table 1 – Armor Penetration Results for LSAAP Loaded M80 Grenades

105mm M915 DPICM PROJECTILE

Figure 1 - Cartridge, 105mm DPICM, M915



The Cartridge, 105mm DPICM M915 (Figure 1) was developed to increase the range and lethality afforded to the Light Infantry Division by the US Army's newly purchased inventory of M119A1 Light Towed Howitzers. Each 105mm cartridge carries 42 Dual Purpose M80 grenades with anti-personnel/anti-materiel capability. Additionally, each grenade is assembled with the M234 self-destruct (SD) fuze. The purpose of SD fuzing is to significantly reduce hazardous duds in the battlefield to one hazardous dud in 500 submunitions fired. This is accomplished through the use of a backup or independent secondary mode, which activates during the ejection sequence. Depending on the failure mode of the primary, the SD mechanism will either (1) render safe the grenade by sterilization of the firing train, or (2) function the bomblet sympathetically.

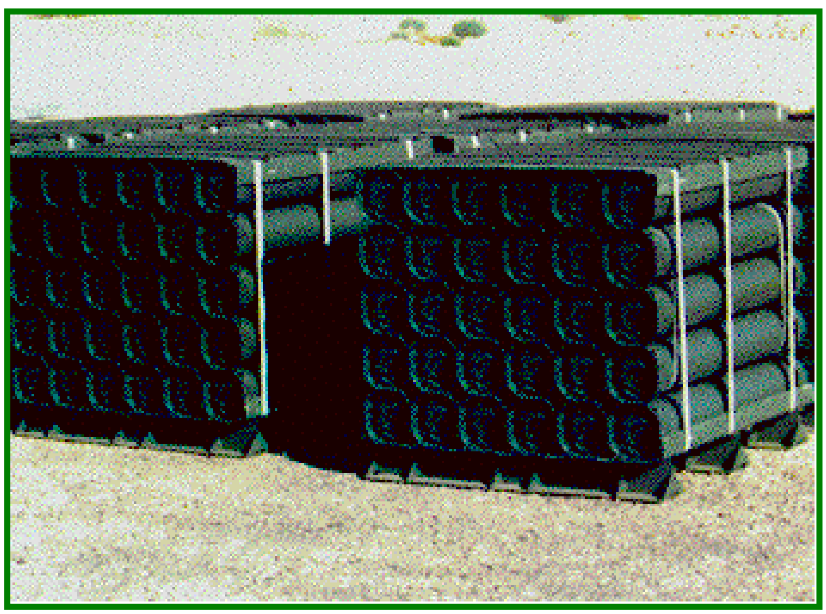
The M915 Cartridge was Type Classified for Low Rate Initial Production (TC-LRIP) utilizing the main explosive grenade fill Composition A5. Concurrently, through the development phase of the program, the IM explosive PAX-2A was made compatible with high-speed loading equipment. The intent of the M915 Project Management is to manufacture the M915 Cartridges in full-rate production with PAX-2A to decrease sensitivity to Army battlefield hazardous threats such as bullet/fragment impact or sympathetic detonation.

IM TESTING

The IM testing was performed at Picatinny Arsenal, NJ to evaluate if PAX-2A would provide significant safety improvements over Comp A5. Bullet impact, sympathetic detonation and slow cook-off were conducted IAW procedures of MIL-STD-2105B– Hazard Threat Assessment Testing. The IM tests performed were explicitly designed to compare only submunition-fill explosives and provide direct comparisons between Comp A5 and PAX-2A loaded projectile cargo. The M80 grenade submunitions cartridges were all loaded with both explosives and assembled using the same lot of hardware on the same production equipment at LSAAP. Sympathetic detonation and slow cook-off testing was completed with cartridges inside their respective metal PA117 shipping containers (Figure 2). Sympathetic detonation tests were done with stacks of shipping containers smaller than the standard palletized stack of Figure 3. Bullet impact testing was accomplished on the bare projectile, without container, to better hit the aim points. All cartridges for this test program contained live M80 grenades with Comp A5 (standard fill) or PAX-2A (IM fill) with live leads and fully inert conventional grenade fuzes. No other explosives were present in the rounds. Therefore, the results do not give an accurate indication of pass/fail with live fuzes, live expulsion charge, and/or live propellant, but give relative information as to the survivability improvement afforded over the standard A5 explosive fill. IM test requirements were determined by the M915 project office based on the criteria set forth in MIL-STD-2105B. The M915 project office did not seek official IM test ratings from the IM Board because a) the intent was strictly to compare explosive fills, and b) an IM waiver was previously obtained to proceed to full-rate production without implementing any IM improvements. The IM waiver was granted under Memorandum from the Under Secretary of Defense, SUBJECT: Exemption for Existing Inventory Items to Insensitive Munitions (IM) Requirements dated 26 January 1998. The waiver was directly applicable because all materials, hardware and explosives for full-rate production were already purchased, and any material changes to main components would be too costly to implement.

<u>Figure 2</u>
<u>PA117 Metallic Container Packaging</u>

<u>Figure 3</u>
<u>Palletized PA117 Metal Containers</u>



BULLET IMPACT TEST [4 Tests]

Two each M915 Cartridges were submitted for testing with the standard Composition A5 main explosive fill, and two each with the PAX-2A IM explosive fill. Testing was conducted IAW procedures for Bullet Impact (BI) testing, Section 5.2.3 of MIL-STD-2105B. One of each explosive fill was BI tested with a 0.50-caliber Armor Piercing bullet and one of each with a 7.62mm Armor Piercing bullet. Bullet aim points were located to impact the payload section of the projectile. The impact point was local to the third layer of grenades from the nose of the projectile, two thirds of the distance from the skirts of the grenades, positioned so that the bullet would pass through a line of three adjacent grenades at the center of the explosive for each. The aim point described above was obtained by

Figure 4- M915 Projectile Cross Section

Bullet Entry Point at Scallop Diameter

Figure 5- Test Projectile in Stand

measuring from the inside of the projectile and along the center of the radius of the scallop where the minimum wall thickness occurs (Figure 4). The bullet was targeted to impact the thinnest part of the projectile body (scallop diameter), approximately 6-3/16 inches from the base end of the projectile body, into the 3rd layer of grenades so that the bullet would penetrate 3 grenades of that layer along a diametrical line. Bullet impact testing was accomplished on the bare projectile, without container, to allow better aim at the target point (Figure 5). Instrumentation was IAW section of 5.2.3.3, and documentation was per 5.2.3.5 of MIL-STD-2105B. No other explosive or propellant fills or fuzing was employed.

One projectile of each grenade fill was tested using first a 7.62mm Armor Piercing (AP) shell, and then a 0.50-caliber AP shell. The Comp A5 loaded projectiless reacted with a Type 2 (Partial Detonation Reaction) failure when impacted with the 7.62mm shell (Figure 6), and a Type 1 (Detonation Reaction) failure (Figure 7) when impacted by the 0.50-cal. Both very violent, high-order reactions resulted in the entire rounds fragmenting and throwing debris in excess of 90 meters. The wooden test stands were destroyed in both Comp A5 tests (Figure 8).

Figure 6 – Comp A5 7.62mm Impact

Figure 7 – Comp A5 0.50-Cal. Impact

Figure 8 – Comp A5 – Test Stand Destroyed

Figure 9 – PAX-2A (7.62mm Impact)

Figure 10 – PAX-2A 7.62mm Impact

Figure 11- PAX-2A 7.62mm Impact

Figure 12- PAX-2A 0.50-Cal Impact

Excellent results were obtained with the PAX-2A loaded grenades. When impacted by both the 7.62mm and 0.50-cal shells, both rounds were observed to have Type-V Burning Reactions (PASS).

In the 7.62mm test, three bullets impacted and pierced the projectile before the PAX-2A burned and eventually caused a pressure buildup (Figure 9). The pressurization caused grenade dome separation, which culminated in the base plug threads shearing and the dispensing of the two grenade layers aft of the impact point near the test stand. Otherwise, the remaining components were recovered intact in their as-loaded configurations. There was no reaction from the first two shots as the bullets drifted slightly from the aim point; however, a reaction was observed subsequent to the third shot being fired. The grenade impacted by the bullet underwent a reaction similar to a burn, which generated a pressure resulting in the dome of the grenade rupturing. This culminated in a force buildup within the cargo area sufficient to shear off the base of the projectile. Eleven each intact M80 grenades were recovered at the base of the test stand (Figure10). No grenades were observed to function high order, and the entire projectile, subcomponents and remainder of the payload were intact within the body (Figure11). The wooden test stand constructed for the test was able to be re-used for the next test shot.

The next PAX-2A test was conducted with the 0.50-caliber armor-piercing bullet. The velocity obtained was recorded to be 2,738 ft/sec. Again, a

Type-V Burning Reaction was observed, and the results looked very similar to those witnessed in the previous test using the 7.62mm AP bullets. In the 0.50-caliber test, the bullet clearly missed the aim point, impacting the thick portion of the projectile body approximately 2 inches below the target location (Figure 12). The bullet pierced a hole into an adjacent grenade in the same layer (peripheral), which resulted in a burning reaction of the PAX-2A powder inside the two grenade bodies. Upon pressure buildup, the grenade domes ruptured, and the force was sufficient to shear the base, resulting in dispensing of the last two layers and part of the third layer of bomblets onto the ground near the test stand. These 15 grenades were recovered and are shown in Figure 13. No grenades functioned high order, and there was no evidence of any shape charge effects into the remaining payload or projectile sub-components. As in the previous test, the remainder of the cargo was intact within the carrier (Figure 14). The wooden test stand used for both PAX-2A shots remained intact after the conclusion of testing (Figure 15).

From the observed test results, the PAX-2A provided a significant survivability improvement over the conventional Composition A5 explosive fill in both of the bullet impact tests. The low order reactions witnessed here indicate that the full-up live cartridge could potentially survive the bullet impact test. However, more testing would be required to assess if this is indeed the case.

Figure 14- PAX-2A 0.50-Cal Impact

Figure 13- PAX-2A 0.50-Cal Impact

Figure 15- PAX-2A 0.50-Cal Impact

SYMPATHETIC DETONATION TEST [6 Tests]

A baseline test was first conducted to assess how many grenades sympathetically detonate when one grenade within a projectile payload is made to function. This test was used as a baseline damage assessment for the next tests in the sequence. Then, two more tests were conducted to investigate whether the item sympathetically detonates the adjacent rounds in the packaging configuration. This battery of tests (baseline + two tests) was conducted once with the conventional A5 explosive and then with the PAX-2A explosive.

Figure 16 – Baseline Test Setup

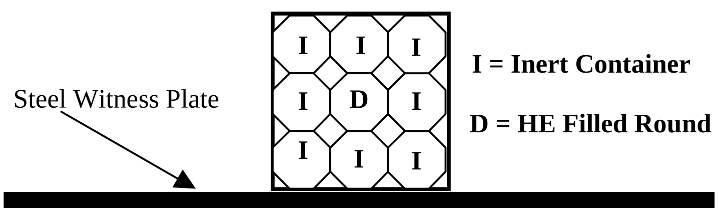


Figure 17- Baseline Test Setup

First, each explosive candidate had the baseline damage assessment by functioning one grenade within the payload and counting the number of grenades that remained. This was done in the packaged configuration, which was a 3 by 3 matrix of rounds with the test item centered in the matrix (Figures 16 and 17). Dummy packaged containers filled with sand were used to simulate the surrounding rounds in

Figure 18 – Composition A5 Baseline

Recovered Fragments

Figure 19- Composition A5 Baseline

Recovered Inert Containers

the stack.

The baseline tests were conducted for the purpose of damage assessment as a prelude to conducting the Sympathetic Detonation tests using HE filled Acceptor rounds. As with the bullet impact tests, the only explosives used in the battery of tests were the grenade explosive fills to investigate survivability enhancements that the PAX-2A could provide over the standard Composition A5 explosive fill. The donor projectiles for each test utilized grenades that had inert fuzes with the exception of the center column grenade located in the fourth layer, which was wired with a detonator to initiate the test

Figure 20 - PAX-2A Baseline

Recovered Components

Figure 21 - PAX-2A Baseline

Recovered Inert Containers

item. The projectiles were loaded into the fiber containers, then inserted into the metal shipping containers and strapped in a cube configuration for testing.

The baseline tests results indicated that the PAX-2A could provide exceptional vulnerability resistance in comparison to Composition A5. As seen in Figures 18 and 19, even the baseline test with Comp A5 was indeed a violent event. The donor round functioned high order, with only grenade body fragments and a piece of the nose of the projectile being recovered for inspection. There was also excessive damage to the dummy containers, most of which broke apart and flew distances ranging from nine to 32 meters, with the lid of the metal container of the donor round being recovered at 61 meters. The baseline test using the PAX-2A explosive yielded a significantly less violent reaction. As seen in Figure 20, the projectile body "banana peeled" into strips, and many low order grenade fragments were recovered. In addition, there were five grenades that were recovered intact. Figure 21 reveals that damage to the dummy containers was minimal, most of which remained intact after the test. The farthest container was recovered at a distance of 9.3 meters. Additionally, most of the recovered hardware was found within a 15-meter radius, with only some grenade and grenade fragments and metal can fragments from the donor round being recovered in excess of 15 meters. The farthest recovered object was the donor base plug found at a distance of 34 meters.

After the baseline tests, the actual Sympathetic Detonation tests were conducted using similarly wired donor rounds and HE filled acceptor rounds. Four HE rounds were required for each test, one "donor" and three "acceptors." They were banded in a packaged configuration with the remaining inert containers filled with sand (Figures 22 and 23). The matrix was three units high by four units across,

Figure 22 – Sympathetic Detonation Test Setup

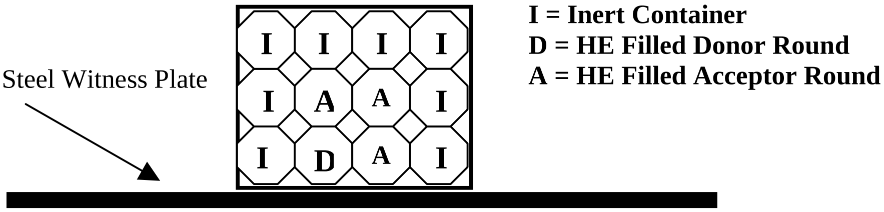


Figure 23 - Sympathetic Det. Test Setup

with the donor and one acceptor on the bottom against a steel witness plate and the remaining two acceptor rounds above them. One grenade within the middle of the center stack of grenades of the donor round was wired to function artificially, and the sympathetic detonation of the acceptor rounds was observed. Two tests were conducted for each explosive, A5 versus PAX-2A. Results similar to those obtained in the baseline testing were observed; PAX-2A showed a dramatic improvement in survivability over Comp A5.

The first test of the Comp A5 resulted in a high order reaction. Only four intact grenades from one acceptor round and only a few small fragments of a projectile body were recovered (Figure 24). Much damage was observed to the shipping containers (Figure 25), and remains were scattered throughout the debris field, the farthest remains being the end of a metal container at 84 meters.

Figure 24 – Composition A5

Recovered Components - only 4 intact grenades from one acceptor round

Figure 25 – Composition A5

Recovered Containers – all acceptor rounds functioned high order!

Testing utilizing the PAX-2A was conducted in a similar fashion. Again, as witnessed in the earlier baseline phase, the results were very impressive indeed. A very benign reaction was observed, and most of the test hardware was recovered within a 10-meter radius from the center. As seen in Figures 26 and 27, six intact grenades along with projectile peels from the donor round were recovered, along with the shipping containers in very pristine condition. The dummy containers exhibited little if any damage. The acceptor rounds were not set off, and their containers had dents only in the ends containing the HE filled projectiles. Although the HE acceptors could not be removed from the containers for safety reasons, it is highly probable that little damage to the projectiles or cargo within was realized.

Figure 26 – PAX-2A

Donor round banana peeled projectile body and resulted in intact grenades and fragments

Figure 27 – PAX-2A

Acceptor rounds failed to detonate sympathetically

Subsequently, two additional sympathetic detonation tests were conducted to build the database on the new explosive fill. The results of the repeated Composition A5 test were slightly different from those observed previously. In this instance, the donor round functioned high order, but failed to sympathetically detonate the acceptor rounds. However, the reaction saw the dummy cans hurled in excess of 67 meters. Also, the acceptor cans and projectiles suffered much damage. One acceptor round was recovered at a distance of 38 meters. It appeared that most of the energy from the detonation went into throwing the acceptor and dummy containers radially outward since the acceptor rounds failed to function sympathetically.

The second PAX-2A test had very same results as the first test (described above), thus, confirming the improvement over Composition A5. The team was very impressed with all of the PAX-2A sympathetic test results, and the survivability improvement observed over the Composition A5 fill.

SLOW COOK-OFF TEST [2 Tests]

Each M915 projectile, containing 42 each explosive filled M80 grenades with inert fuzes, was instrumented and subsequently tested inside its PA117 metal shipping container. No other explosives or propellants were loaded into the cartridge, just the grenade explosive fills, Composition A5 and PAX-2A, respectively. Thermocouples were placed inside the projectile nose, and on the exterior of the body (Figure 28). In addition, six thermocouples were placed at other locations outside the can to include inlet and outlet locations of the oven (Figure 29). Blast overpressure gages were placed at 4.6 meters and 7.6 meters, perpendicular to the side of the oven, to record peak pressure and time. Figure 30 shows the enclosed oven in the test area. The test projectile was taken to destruction by raising the temperature inside the oven at a rate of approximately 28º C per hour.

Figure 28 - Instrumented Projectile

Figure 30 – Slow Cook-Off Oven

Figure 29 – M915 Projectile & Container in Oven

Figure 31 – Comp A5 Post Test

Figure 32 – Comp A5 Post Test

Type 1 Reaction - Detonation

The total test for Composition A5 took approximately 6.5 hours. The initial observed temperature of the test projectile was 58.9º C. At the time of destruction, the temperature recorded inside the projectile nose was 212.7º C, and outside the cylindrical wall of the projectile was 193.8º C. The other readings are listed in Table 2. The round detonated in a high order fashion (Figure 31), with virtually no metal parts recovered other than a projectile fuze well fragment from the nose of the bullet (Figure 32). There were no grenades found, and no pieces of the projectile body were recovered. The pressures were recorded at distances of 4.6 and 7.6 meters, and are also shown in Table 2.

Temperatures at Destruction ºC

T1	T2	T3	T4	T5	T6	T7	T8
Inlet	Outlet	Bottom Lid End	Top Lid End	Bottom Base End	Top Base End	Fuzewell	Proj. Body
386.2	310.0	285.8	298.8	256.1	281.7	212.7	193.8

Blast Overpressure

Distance (m @90 Degrees)	Peak Pressure (psi)	Time to Peak Pressure (msec)
4.6	9.71	53.2
7.6	2.89	58.15

Table 2 – Composition A5 Cook-off Test Data

Figure 33 – PAX-2A Post Test Hardware

Figure 34 – PAX-2A Post Test Grenades

Type III Reaction - Explosion Reaction

- 5 Intact Grenades
- 5 each Empty Grenades
- 2 Adapters
- 2 each Low Order Grenade Fragments

Temperatures at Destruction ºC

	T2	T3	T4	T5	T6	T7	T8
Inlet	Outlet	Bottom Lid End	Top Lid End	Bottom Base End	Top Base End	Fuzewell	Proj. Body
335.2	316.2	322.6	320.9	319.7	318.5	223.9	214.8

Blast Overpressure

Distance (m @90 Degrees)	Peak Pressure (psi)	Time to Peak Pressure (msec)
4.6	2.96	42.75
7.6	1.52	85.00

Table 3 – PAX-2A Cook-off Test Data

The total test for PAX-2A took approximately 5.8 hours. The initial observed temperature of the test projectile was 65º C. At the time of destruction the temperature recorded inside the projectile nose was 223.9º C, and outside the cylindrical wall of the projectile was 214.8º C. The other readings are listed in Table 3. From the recovered hardware, five grenades were intact, with evidence of the PAX-2A explosive exudation from the body/liner interface. Another five grenades were observed to have the liners missing and evidence of unburned explosive remaining in the body (Figures 33 and 34). It is hypothesized that this condition could have resulted due to deformation of the grenade body by an adjacent grenade, allowing the liner to become dislodged and deposit of explosive to result. Additionally, two low order grenade body fragments were recovered.

Although PAX-2A did not pass the slow cook-off test, a substantial improvement over that witnessed with Composition A5 was observed. There were some grenades recovered still intact, and there was noticeably less overall damage to projectile hardware. The PAX-2A reaction occurred with a 21º C higher projectile body temperature than Composition A5. The PAX-2A slow cook-off improvement was not as dramatic as in the bullet impact and sympathetic detonation tests, however, the results do favor PAX-2A when comparing explosive fills.

ONGOING/FUTURE WORK

It was also originally intended to test M915 projectiles for Fast Cook-Off (FCO) and Army Fragment Impact (AFI). FCO was not done because the Picatinny Arsenal test site is limited by environmental restrictions to the amount of jet fuel it can burn. TACOM-ARDEC is not currently set up to perform AFI, however, plans are in process to bring this capability on-line in the near future. The M915 project office has requested quotes from the Naval Surface Warfare Center Dalgren, VA facility and the Army Aberdeen Test Center (ATC) to perform the FCO and FI tests.

The project office is currently running fragment lethality arena testing with PAX-2A loaded M80 grenade submunitions to confirm target effectiveness. This shall be completed with the AMSAA approved five-meter square arena.

The M915 projectile project management office has recently placed a procurement request for 18,800 pounds of PAX-2A from Thiokol Propulsion.

PM SADARM currently owns approximately 1,800 pounds of Hercules manufactured PAX-2A for the future Product Improved (PI) SADARM program. PAX-2A is currently under consideration for several other weapon systems, including Wide Area Munition (WAM) Explosively Formed Penetrator, 155mm XM982 Excalibur with M42 grenade submunition, Guided Multiple Launch Rocket System (GMLRS) with XM85 grenade submunition, and Non Self Destruct Alternatives (NSDA) with M43 grenade submunition.

Table 4 - IM Test Results Summary

IM Test	PAX-2A	Comp A5
7.62mm Bullet Impact	Burn/Pass	Partial Detonation/Fail
0.50-cal. Bullet Impact	Burn/Pass	Detonation/Fail
Sympathetic Detonation	(2) Pass	(1) Pass, (1) Fail
Slow Cook-Off	Explosion/Fail	Detonation/Fail

Reaction levels from the least violent to most violent are:
Burn – Deflagration – Explosion – Partial Detonation - Detonation

CONCLUSIONS

PAX-2A is a less sensitive high explosive replacement, suitable for current and future weapon systems' high performance warhead applications. PAX-2A was proven to provide survivability improvements over Composition A5 in all M915 IM comparison tests performed (Table 4). The M915

Project Office has elected to move forward into production and field the 105mm Cartridge with PAX-2A based on the oustanding safety improvements that can be realized by the soldier in the field. PAX-2A is now under consideration as an IM explosive replacement for several other weapon systems.

The TACOM-ARDEC strategic intent will be met by fielding the M915 projectile with the IM explosive PAX-2A as the submunition HE fill. The customers will have the "best value" munition with significantly reduced vulnerability to hazardous stimuli typically found as threats in today's battlefield.

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