



Figure 1. Top 30x113, Middle 30x173 and Bottom 50x228. From 2019 AUSA, Weapon/Ammo.

Advanced 50mm Cannon Caliber Weapons and Ammunition

By Jay Bell

These are amazing times in the Ammunition and Weapon worlds. Technology is advancing faster than we can fully utilize it and incorporate it into a product in

the field. In recent months I have written articles on some of the advancements in cutting-edge technologies in lightweight small-caliber ammunition and improved 40mm grenade training

ammunition. These two areas had two key objectives: lighter weight ammunition and improved night training, respectively. There are dozens of other sub-objectives which are ideally suited



Figure 2: Medium Caliber Ammunition Family.

for another entire article or two. These two program areas are not the only areas of significant development. Medium Cannon calibers have also seen some activity.

Medium cannon calibers have not seen significant development in the last 30 or 40 years. The new 50mm cannon caliber ammunition and weapons are going to change the stagnation and usher in a new era of highly specialized weapon platforms. See *Figure 1* for a photo of the ammunition and the weapon as compared to 30x173mm in the middle row and 30x113mm top row. The key objective or benefits are difficult to pinpoint. There are really several key objectives. I have examined dozens of sources on this topic and all have a slightly different twist in key objectives. Overmatch, that is increased engagement distance and

lethality over the enemy, appears to be a key objective. Engagement distance is self-explanatory. The winning weapon platform is the one that can engage the enemy, while safely out of range of the other or at least out of range for reasonable accuracy. Increased lethality is a combination of accuracy, payload amount/quantity, and performance/effects on the target. Additional objectives include increased accuracy via advanced fire control system (i.e. computer with numerous inputs) and increased performance in the ammunition via air bursting technology. Additional benefits of increased accuracy results in less ammo fired and less collateral damage. The Air Bursting capability seems to be the Key capability these rounds will bring to the party. However, airburst has been a challenge in

the past on other programs (more on that later).

The Current Gang of Medium Caliber

The historical family of cannon calibers for the U.S. Government inventory includes the 20x102mm, 25x137mm, 30x113mm, and 30x173mm. This lineup has been serving the military together for decades and, in some cases, over a century. They have served well and with great distinction while seeing incremental improvement over the years. They have provided land, air and sea combat superiority for the U.S. and its allies. Some of these old boys have been in service in one form going back over 100 years, very similar to some small-caliber rounds. See *Figure 2* for the Medium Caliber families of rounds.

The workhorse 20mm dates back to World War I, with heavy use in the

EAPS Concept

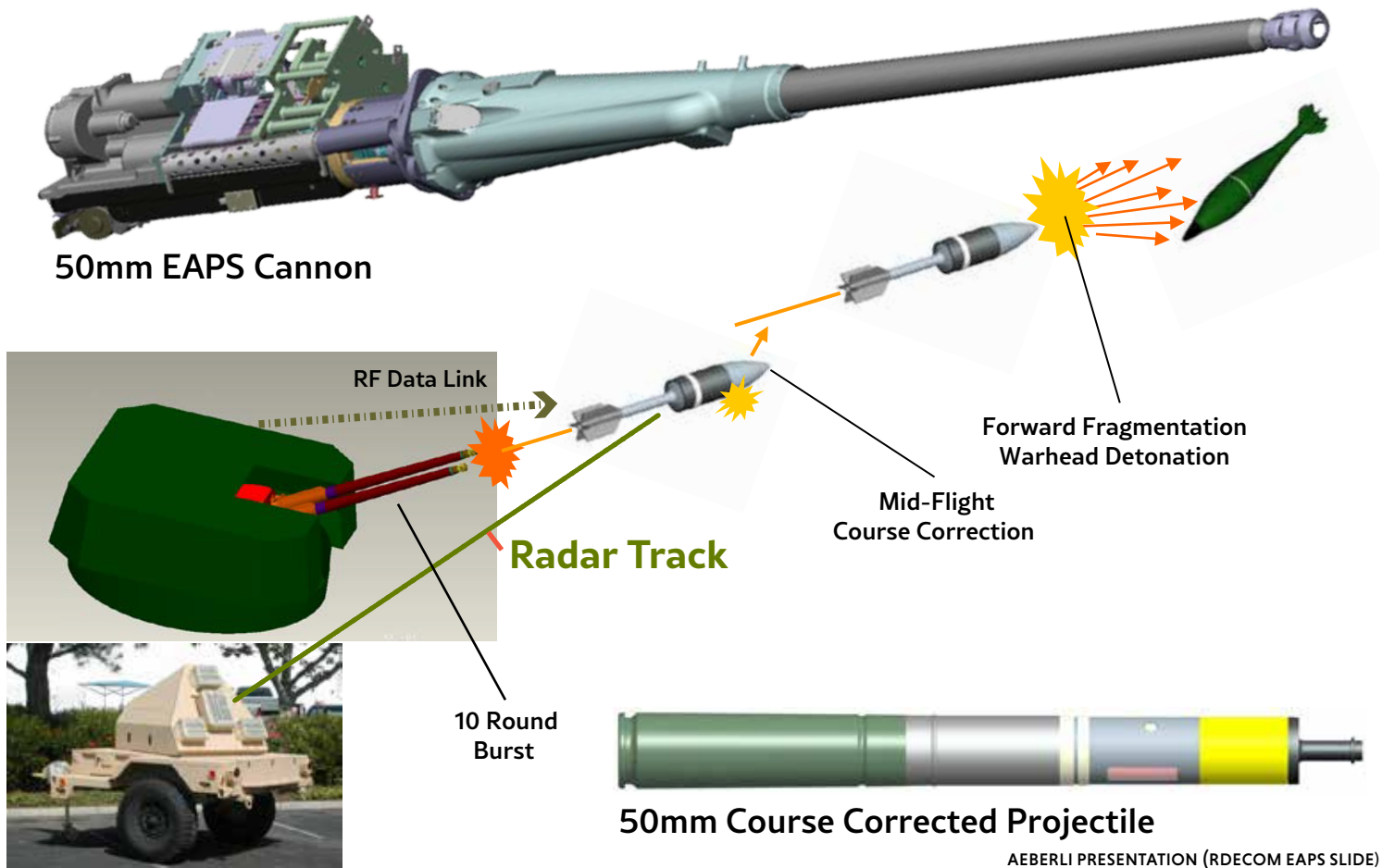


Figure 3. 50mm Concept from the 2010 Timeframe.

Second Great War. The most modern versions of 20mm, Projectile Gun Unit (PGU), date back to development in the 1980s and fielding in the 1990s. It is typically fired from the M61 Vulcan, typically seen on the F-22, F-14, and F/A-18 aircraft. A five-round group is shown in Figure 1. Due to its time in service, there are easily another 25 or more rounds that are no longer manufactured by the U.S. Government or other international players.

The 25mm was developed by Oerlikon in the 1960s. It was fielded around 1981 and has undergone some improvements and U.S. Government modifications since its introduction. It is fired from the M242 Bushmaster on the Bradley fighting Vehicle. The family of rounds shown in Figure 1 includes seven rounds, which covers the basics of the group. Rough estimates of maximum effective distance is 3000 meters and maximum distance 6500 meters.

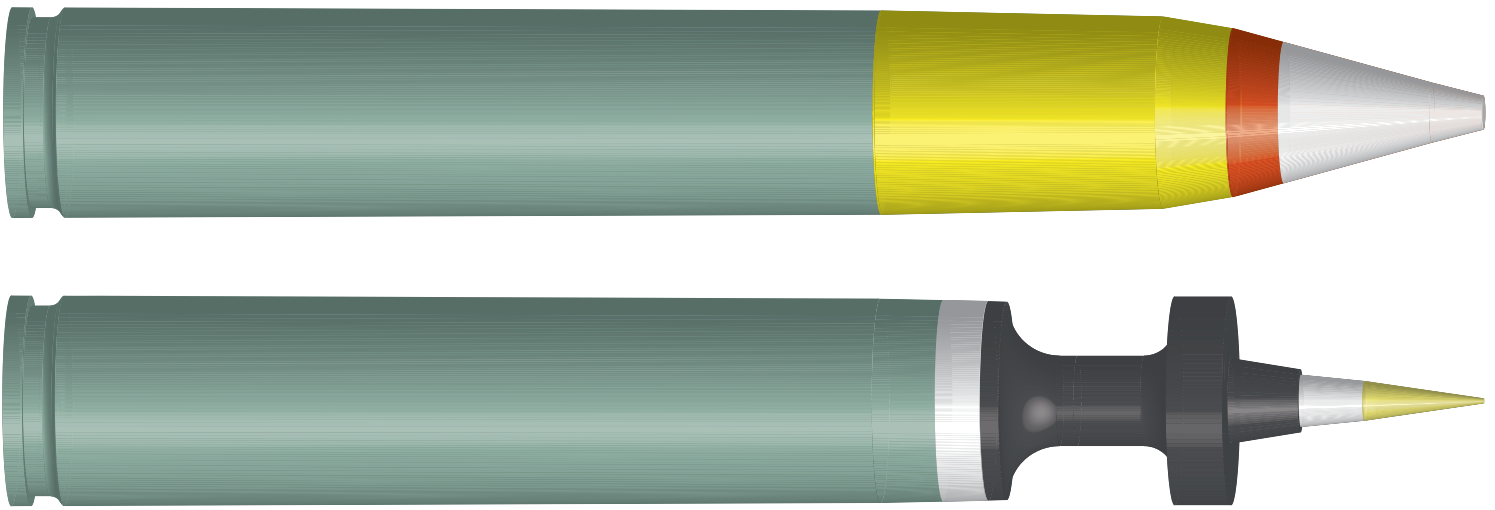
The 30x113 has a few different variants for the older revolver cannon and the more modern chain guns. It

is German WWII vintage and was the first cannon caliber to undergo NATO standardization. The *Direction des Études et Fabrications d'Armement* (DEFA) cannon was introduced in the late 1940s. The ADEN (Armament Development Enfield) cannon was designed in 1946. This caliber is a confusing mix of minor differences. The modern 30x113mm ammunition is fired in the M230 chain gun that was originally in service around 1983 and the GIAT 30mm Model 781 was around the same time. This is the main gun on the Apache Helicopter and the MRAP. Figure 2 shows two rounds. However, due to all of the different variants, there are many more versions of this round made in the U.S.A. and abroad. Rough estimates of maximum effective distance are 1500 meters and a maximum distance of 4000 meters.

Lastly, the 30x173mm rounds or Gatling Autocannon (GAU-8) family of rounds began with the Air Force in 1966. They were first in service around 1976. The weapon is either the GAU-8

Avenger or the Mk244 Bushmaster II. They are currently used on the A-10 and Goalkeeper. The nine versions shown in Figure 1 are a good representation of the U.S. inventory. Rough estimates of maximum effective distance are 1200 meters with a maximum distance of 3600 meters.

All these old-timers have been virtually untouched for 30 years or more. It's quite surprising that almost nothing new has been added to the mix, until now. The U.S. Army has been developing the 50x228mm for the Next Generation of Combat Vehicles (NGCV). Looking like a sized-up 30x113mm, the design makes sense for the never-ending struggle for more payload in the projectile to deliver more downrange effect. The projectile diameter increase from 30mm to 50mm results in an increased projectile weight of over 4x. The 50mm projectile weight will be 1540 grams, as compared to 360 grams for the 30x173mm. The term "overmatch" has been used frequently in the last decade. It comes



HART PRESENTATION

Figure 4. 2012 Version of the 50mm PABM, top, and AP ammunition.

from recent conflicts where our troops were outgunned using 5.56 NATO versus 7.62x54R (Eastern Bloc/Non-NATO/Non Standard Ammunition). Opinions vary greatly on exact distances, however, the consensus seems to state that the M249 is effective to 800 meters and the SVDS or PKP are effective to 1000 meters. The same situation can exist in larger platforms like medium cannon caliber ammunition. The 50mm will obtain overmatch in projectile/payload weight and engagement distance, at a minimum.

The New Guard

A 2010 Army Research & Development Command (RDECOM) presentation is the first record I can find of the development of the 50mm. Therefore, at this point, all ideas are very conceptual. The ammunition will be fired from the 50mm XM193 Bushmaster III Autocannon. This is a sized-up 30mm Bushmaster XM813. This weapon weighs +/- 460 lbs. and is 135 inches long. The up-scaled cannon weighs around 660 lbs and is 158 inches long. The initial ammunition planned included the following:

1. Programmable Airburst Muniton (PABM). The airburst fuse is programmed to function at a distance set by the fire control system, typically prior to firing. A laser rangefinder would "lase" the target and program the fuze to detonate at 1126m, for an 1125m wall. It is therefore capable of going off behind/over the top of a wall. This is ideally used against personnel. See Figure 3.
2. Armor Piercing Fin Stabilized Discarding Sabot (APFSDS). A tung-

sten carbide penetrator would punch a hole in multiple inches of armor plate.

The ammunition will be fired from an XM193 50mm Bushmaster cannon. These cannons are capable of firing nearly 7000 meters, however, it is not clear if this is effective or maximum distance. Either way, this is farther distance with much greater payload than the rest of the Medium Caliber family. The slide from this 2010 presentation shows a massive length cartridge, identified as the "course-corrected projectile." However, the May 2012 Hart presentation shows the initial downsizing of the ammunition to a more conventional design. See Figure 4. This presentation has most tasks to still be "designed and developed" to include the gun, munitions and fire control system.

The next major leap was the 2018 PM-MAS Industry Day presentation, which updated the information to identify that various cannon caliber rounds will have "Multimode programmable fuzing/guidance/pre & post-launch data-link, advanced warhead enabled munitions that increase range, target effects, stowed kills." The concept images of the "ground combat ammo" rounds are also provided, as seen below.

The 2019 PM-MAS Industry Day included the Optionally Manned Fighting Vehicle (OMFV) as an additional platform, along with the NGCV. The scope changed to include a "family of ammunition" and provides nomenclature to the rounds as seen in Figure 5. There was a live-fire demonstration of the weapon and the basic ammo, which

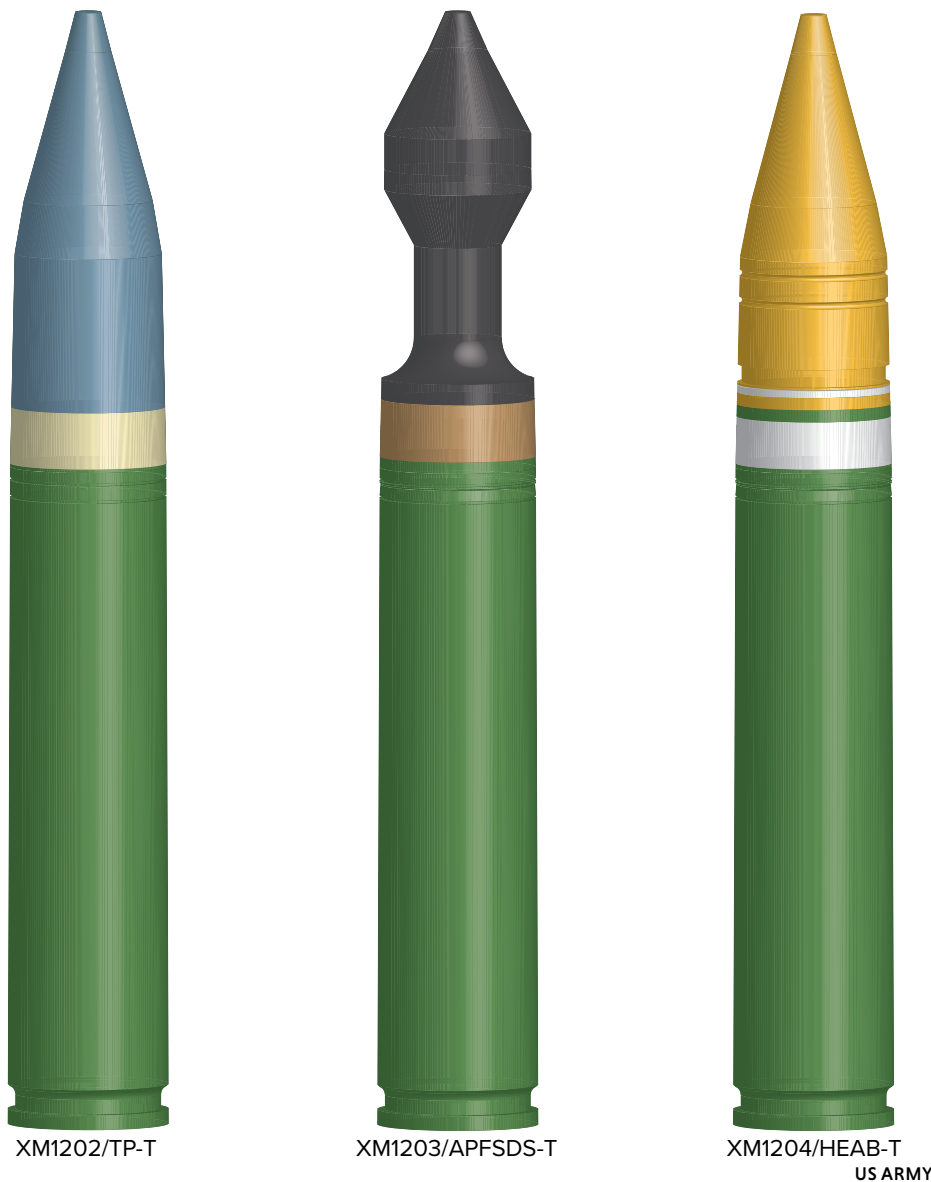
can be found online. The weapon was never a huge challenge and the basic ammo is not extremely difficult either.

The progression of the ammunition here is significant. The rounds are given experimental X and M number designations to signify that there are at least preliminary designs. The new XM1202 Target Practice Tracer (TP-T) is a lower-cost training round. The XM1203 APFSDS-Tracer is the modification of the prior concepts APFSDSD/AP to provide anti-armor/material solutions. The XM1024 High Explosive Air Bursting Tracer (HEAB-T) replaces the previously identified/named PABM to address the anti-personnel requirements.

This presentation reiterates the objective of overmatch and increased lethality. The program planned to award 60,000 TP-T by the second quarter of fiscal year 18. Fiscal Year 20 HEAB Prototype Phase 1, and first quarter of fiscal year '21 and TPDS-T DET. These dates are typically a little aggressive and COVID-19 has slowed much of this type of work down to a crawl. The HEAB-T will have multiple modes of function: airburst, point detonate, point detonate delay and self-destruct (SD) capabilities. SD is uncommon in the U.S. arsenals, however, it is almost mandatory for many other governments around the world.

Airburst Challenges

The biggest challenge the 50mm ammunition and the whole program faces is the Air Bursting capability. This technology is surely the future of medium caliber and larger munitions. The question remains - Is it ready for prime time? There have been numerous



XM1202/TP-T

XM1203/APFSDS-T

XM1204/HEAB-T
US ARMY

Figure 5: 2019 named rounds.

efforts and not any fielded ammunition. This could be like the Micro Electro Mechanical Systems (MEMS) fuzing saga. This technology is supposed to take a mechanical clock like fuze the diameter of a silver dollar down to that of a dime. This allows more room for payload as a primary benefit. This technology is so old that patents are expiring. Numerous players have committed significant dollars to trying to mature the technology. The concept has not been fielded to the best of my knowledge.

The airburst ammunition has been “the objective” for some time. The bursting feature allows the round to detonate in mid-air without having to impact the target as in most traditional fuzes. The fire control system uses a laser to determine the distance to the target. The gunner can select

where the round should detonate. The round can go off 1 meter before, 1 meter above or 1 meter behind. The distance is also adjustable, i.e. 1, 2, 3, etc. meters after the barricade is all programmable.

The now infamous XM29 Objective Individual Combat Weapon (OICW) started in the 1990s and was finally canceled in 2004/5. It was to fire the 20x28mm air bursting grenade style round. There were videos available of the 20x28mm round showing it supposedly bursting mid-air and spreading shrapnel over a large area and breaking dozens of balloons. It is not known by this author, with 100% certainty, if this was accomplished as designed or just a timed fuze going off at a pre-set distance. This could have been accomplished with a traditional timed pyrotechnic delay train that would detonate

X seconds after an energetic delay column was ignited upon setback or firing. Assuming it did work in a test setting is acceptable as long as we acknowledge that test setting to fielded ammunition is a quantum leap.

Despite multiple programs and numerous companies claiming to have successfully developed air bursting ammunition, the field appears to be quite limited. An internet search page for Airburst ammunition contains around 22 entries. Most of these entries are XM application or copy of an XM platform by international companies. Of the 22 entries, the only information and quantifiable evidence I can find is Nammo’s video from Jan 2020. This video demonstrates the NM264 HEDP-RF for radio frequency. Rheinmetall may have some capability in this area. However, it was not easily verified. The U.S.A. manufacturers continue to be well behind the Europeans in terms of advanced technology in this field.

The Nammo video shows the airburst capability of the ammo to burst in front of, over the top of, and behind a barricade. This makes it truly able to “shoot around corners,” when the round bursts just after a building or structure. This capability will change the battlefield and warfare as we know it, once it is successfully fielded. Your guess is as good as mine for how long this will *actually* take.

In conclusion, we should all be truly excited by all of the technology, advancements and potential advancements described in this article. The battlefield of the future will have far less hiding places for our enemies. A majority of our enemies will take decades to catch up and the complexity of the platforms will limit who can successfully operate the systems. However, I feel like a broken record (modern correction: a repeatedly crashing phone app). There seems to be a lot of effort and large leaps in technology. Maybe I am too skeptical for my own good, but it seems that we could be quite a ways away from having *fielded* Air Bursting 50mm Ammunition. The other two variants of the 50mm ammunition and weapon should not be an insurmountable challenge and will provide the overmatch that is desired. I wonder what the odds are on the 50mm platform moving forward without the Air Bursting Fuze and laying up with a more traditional fuze? **SADJ**