

## THE GUN THEY BUILT AN AIRPLANE AROUND - THE A-10 WARTHOG

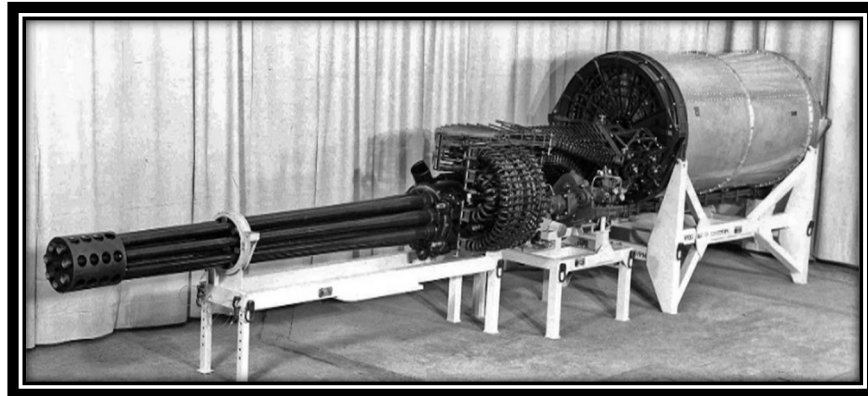
EARLY ON, THE LEGENDARY GUN WAS BOTH A BLESSING AND A CURSE

THE AIR FORCE HAD TO MAKE SURE THE MASSIVE CANNON WOULDN'T BLIND THE PILOT, KNOCK OUT THE ENGINES OR SHAKE THE PLANE APART

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*An A-10 with Gatling Gun Firing*



*The GAU-8/A Avenger 30MM Gatling Gun (ABOVE) - With Size Comparison to a Volkswagen Bug (BELOW)*



*The famous shot of General Electric's GAU-8, along with its ammunition drum and feeding system, next to a Volkswagen Beetle.*



*The 30MM Shell Fired by the A-10 Gatling gun*

**The cartridges measure 11.4 inches (290 mm) in length and weigh 1.53 pounds**



*The A-10 Built to Carry the Gun*



*The Seven-barrel Gatling gun to fire the Shells*

The A-10 Warthog's massive 30mm cannon, the GAU-8/A Avenger, is one of the most iconic weapons ever designed and is as famous as the plane that carries it into battle. But as undeniably badass as it is, a closer look at its history reveals that early on, the gun seemed to spend almost as much time trying to kill the aircraft's pilot as the enemy, producing potentially blinding smoke and fire, fumes that threaten to choke out its engines, and violent vibrations. The Air Force had to find creative solutions to all of these issues in order to make sure the weapon and its flying carriage functioned properly.

The Avenger's story really gets started in 1971 when the U.S. Air Force hired General Electric and Philco-Ford to build competing prototype cannons for a future close air support aircraft then only known as A-X. The two companies would be responsible for building the weapons and ammunition, as well as installing them, along with a link less feed system and fire control equipment, onto the two A-X prototypes, the Northrop YA-9A and Fairchild Republic YA-10A.

"The Air Force understood that the fortunes of the A-X and the GAU-8/A were intertwined, and recognized the importance of the integration effort given four prime contractors, two each for the aircraft and the gun," retired U.S. Air Force Lieutenant Colonel David Jacques and Dennis Strouble wrote in an official case study of the A-10's development. "It was clear by then that aircraft would be designed to accommodate the gun, instead of the gun being chosen to 'fit' in the aircraft."



*The Northrop YA-9A*

As it happened, the prototype GAU-8s were not ready for the fly-off between the YA-9 and YA-10 aircraft. The Air Force provided smaller 20mm M61 Vulcan cannons instead for the fly-off tests to pick the winning airframe, which the Fairchild Republic design ultimately won. As such, Northrop's entry never actually carried the Avenger.

In 1973, the Air Force picked General Electric as the winner of the separate gun competition with its huge seven-barrel rotary cannon, *which weighed in at approximately 700 pounds with its associated components and ammunition feed system.*



*A YA-10A prototype with the smaller M61 Vulcan cannon installed.*

The service briefly considered the single-barrel 30mm Oerlikon 304RK cannon, also known as the KCA, but found it to be substantially less reliable.

The sample 304RKs, which received the designation GAU-9/A, suffered, on average, one malfunction for every 900 rounds fired. The Avenger could shoot nearly 10 times as many shots without a stoppage.

After settling on the General Electric GAU-8, the firm began the real work of cramming it into the A-10. Tests on the ground went just fine. It was when test pilots got the first fully-loaded YA-10s into the air in *March 1974 that the issues became apparent.*



For context, it's important to remember the immense power of the GAU-8. The Avenger spits out nearly *70 rounds every second.* *Each complete 30mm cartridge is bigger than a typical beer bottle* and the projectiles alone – either full of high explosive and an incendiary mixture or an armor piercing design with a depleted uranium core – *weigh three quarters of a pound.* It takes two hydraulic motors to spin the barrels and work the system.

When the pilot pulls the trigger, the gun breathes literal fire and shakes and rattles the airframe. It spews huge clouds of hot gun gas full of particulate matter as it makes its signature “BRRRT!” sound. *There's a long-standing urban legend that the shooting actually slows the plane down.*

According to Jacques and Strouble, *the most immediate issue was that the muzzle flash simply blinded the pilot,* which could be dangerous even in a shallow dive at a relatively slow speed at low altitude. The gasses left dark soot on the windscreen, as well as the fuselage, that eventually blocked their view, too. To deal with the latter issue, the A-10 has a window-washing function. A switch on the right-hand side of the cockpit triggers the 30-second wash cycle, according to an official 1988 flight manual. Using cooled

bleed air from the auxiliary power unit, the system floods the windshield with cleaning fluid for six seconds, followed by another 24 seconds of just air to “purge” the liquid. The same burst of air can clean rain at low speeds, too.

“The windshield wash system should not be used anytime forward vision is essential since forward vision is obscured during the wash cycle,” the manual warns in a somewhat ironic twist.



*This picture shows just how dirty a Warthog can get from firing its main gun.*

Repeated firing shook the gun mounts so much that parts galled, a process by which the repeated friction causes separate metal components to adhere together. As one test report noted, this had no impact on the aircraft's ability to fly or fire the gun, but made it especially difficult to get the GAU-8 out of its compartment for routine maintenance.

More worrisome, the gases, which contained no oxygen, had a tendency to flow up over the aircraft's wing and into its engines, threatening to choke them out. In addition, the particles in the fumes might contain unburned gunpowder, which could cause flameouts, or would build up in the engine turbines, both potentially serious issues.



*A photo of an A-10 with the early, angular gas diverter.*

One immediate attempt to fix the issue simply involved lengthening the barrels to try and dissipate the blast and disperse the gases, as well as switching from copper bonding in the ammunition to plastic to make the resulting debris less dangerous. It didn't work, though the plastic bands turned out to help reduce wear and tear on the barrels and became standard.

For more than a decade work continued on other potential solutions. We know that the Air Force designed at least three-gun gas deflector concepts, which were supposed to help mitigate the blast and keep the fumes away from critical components. An initial design simply added an angular shield to the end of the nose.



A more polished design extended the overall shape of the nose, entirely encapsulating the cannon's muzzle and leaving just a slit for the gun to shoot through, also turning the Warthog into more of an ant eater, aesthetically speaking.

We don't know what happened to these configurations, but they could have disrupted the aerodynamics of the aircraft, upset its balance or caused all new vibration issues while the gun was firing.



*The Battelle muzzle device*

There was a third and much less involved gas diverter that simply attached to the GAU-8's muzzle, giving it an even more sinister appearance. Defense contractor Battelle built this piece of equipment, known as the GFU-16/A, which contained two sets of baffles. It caused added stress on the nose, leading to significant cracks. One report from 1986 said the problem wouldn't necessarily impact flight safety, but presented a significant maintenance burden.

In the end, none of the gas diverter designs made it beyond testing. The Air Force settled, in part, on a revised propellant mixture for the ammunition that helped reduce some of the issues. But according to the documentary *Against All Odds: The Story of the A-10*, the ultimate solution was both crude and ingenious.

Since the most significant issue is the gases getting into the engine and causing it to give out, when the pilot in a Warthog pulls the trigger, it continually trips the ignition system. So, even if the engine *does* stop suddenly, it immediately restarts.

All of this work to mitigate the impact of the gun on the A-10's airframe and engines is an amazing concession of aircraft design to one single component. It's testament to the fact that the gun was just as important as the plane itself, if not more so. With this in mind, it's no surprise really there have been attempts, although largely unsuccessful, to work similar capabilities onto other existing tactical aircraft.

Just six years ago the U.S. Air Force was on the verge of culling its entire fleet of A-10 Thunderbolt IIs, better known as Warthogs. In 2014, the then USAF Chief of Staff, Gen Mark Welsh III, said the Air Force had to retire the A-10 completely if it was to make substantial cuts to its budgets, and that it required freed-up funding and manpower to be channeled into the standup of new F-35 units. Welsh claimed



divesting the close air support stalwart would save \$3.7 billion across the five-year future-year defense program and another \$500 million in cost avoidance for upgrades that wouldn't be necessary.

*How times have changed.* Fast forward to 2020 and the A-10 is not only here to stay, but it's getting a raft of upgrades to keep it relevant for years to come. New weapons, a new cockpit layout, and an overhaul of tactics are some of the elements now in the pipeline to keep the "Hawg's" tusks sharp and its community a meaningful contributor on the front-line fight.

Built to ravage Soviet tanks on the plains of northern Europe, the A-10 was designed around the General Electric GAU-8/A Avenger 30mm cannon and its seven barrels, which are able to dish out devastating punishment to armor.

Over the years, the Warthog's 11 hardpoints have evolved from carrying dumb iron bombs and rockets to hauling the latest guided ordnance.

Despite carving itself a fearsome reputation during Operation Desert Storm in 1991, and evolving with the times as new technology became available, *the venerable ground attack jet has repeatedly come under fire from within the Air Force when it comes to cutbacks.*

The USAF made the case for the F-35A Lightning II to assume the A-10's roles, emphasizing how the Warthog was no longer survivable in modern high-threat environments littered with advanced air defense systems. The A-10 community was told that the drawn-out war in Afghanistan was over and that close air support (CAS) specialists were no longer needed. All the while, A-10 supporters in Congress vehemently rejected the proposals on the grounds that it would severely impact the USAF's ability to cover this mission, *and some demanded a fly-off to prove once and for all that the F-35 could adequately replace the A-10 in this mission.*

#### **THE FIGHT AGAINST ISIS HELPS MAKE THE CASE FOR RETAINING THE A-10**

*As talk of retiring the A-10 grew in 2014,* Operation Inherent Resolve (OIR), the U.S.-led mission to dismantle the so-called Islamic State in Iraq and Syria, was ramping up fast and pressure was put on the USAF to step up its involvement in the expanding campaign. *Back home, the Fiscal Year 2015 spending plan included House and Senate Armed Services Committee stipulations that essentially blocked efforts to retire the A-10 fleet. It was a perfect storm that effectively saved the A-10.*

The Indiana Air National Guard's 163rd Fighter Squadron, the "Blacksnakes," deployed to the Central Command (CENTCOM) area of operations in October 2014, as part of a Theater Security Package sent to Kuwait. The unit was quickly re-tasked to Afghanistan to cover U.S. Army withdrawals from forward operating bases (FOBs) in that war-ravaged country. However, after only a month in theater, the pressure was on to move the "Blacksnakes" back to Kuwait to join the burgeoning effort against ISIS.

The A-10s were immediately pressed into combat missions, a move that was to again underscore the usefulness of the A-10 to senior leaders. As time went on, a succession of Warthog squadrons were called upon to join the OIR mission, providing both CAS, as well as cover for Combat Search and Rescue (CSAR) for coalition operations.



*An A-10C drops a flare during a mission on the Nevada Test and Training Range.*

### NEW UPGRADES FOR THE A-10

The scheme to retire the A-10 had started a knock-on effect with regard to support and upgrades. Operational testing for the active-duty A-10 fleet at the 422nd Test and Evaluation Squadron (TES) at Nellis Air Force Base, Nevada, and the A-10 Program Office at Hill Air Force Base, Utah, had both effectively been shut down. However, with OIR at its height, by the summer of 2016, this was all being reversed, with a renewed impetus for mission-critical enhancements for the A-10. The planned end of the A-10 briefly stalled some supply chains, but a rolling series of upgrades were soon back on track.

“In 2017, the Lightweight Airborne Recovery System [LARS] V-12 was installed on all active-duty and Air National Guard and Reserve Command A-10s to allow pilots to communicate more effectively with individuals on the ground such as downed pilots and pararescue men,” explains Air Force Major Matthew Kading, the A-10 Test Director for the 59th TES. “This was integrated in [Operational Flight Program, OFP] Suite 8, and all A-10s now have this system integrated into the Central Interface Control Unit to provide critical Combat Search and Rescue [CSAR] information.”

As a community with limited funding, the active-duty test effort under the 422nd and the 59th Test and Evaluation Squadrons and that of the Air National Guard/Air Force Reserve Command Test Center (AATC) at Tucson Air National Guard Base, Arizona, now work collectively. The USAF currently fields 281 A-10s, but there have been numerous failed attempts to reduce the fleet. The USAF's proposed Fiscal Year 2021 budget looks to cut three squadrons-worth of jets, effectively 44 Warthogs. This too may well end up curbed and now major A-10 upgrades are moving full steam ahead.

Such is the resurgence of the A-10, that a new Common Fleet Initiative is planned to keep the type in service and credible out towards 2035. Central to the upgrades for the A-10 is the need to be survivable in a contested environment. This involves Warthog pilots evading threats through the additional use of standoff weapons from longer ranges, combined with the use of updated tactics. A-10 operations will evolve to include the ability to tackle some threats with precision weapons from extended ranges. Once these threats are destroyed, the A-10s will then theoretically be able to swing into more traditional missions.

“Survivability isn’t just about upgrading equipment and software, it’s about ensuring we’re going into battle with the most up-to-date and lethal tactics,” says Major Kading. “What makes the 422nd/59th TES, and the 53rd Wing as a whole, a unique organization is that we do all of these things.”



*An A-10C from the USAF Weapons School at Nellis AFB.*

The aircraft can send weapons to different targets with one button push on one pass, whereas before it took a lot of pilot workload. A-10 pilots can employ 500-pound-class GBU-38 or 54 or 2,000-pound class GBU-31 Joint Direct Attack Munitions (JDAM) and *the aircraft will inform the pilot if they can all hit their intended targets on a single run.*

HOBIT (Hybrid Optical-based Inertial Tracker), which is a development of the Thales Visionix Scorpion helmet that A-10 pilots have been wearing since 2013. The improved helmet more accurately tracks pilot head movements via a new optical head tracker, consisting of a series of dots on the canopy.



*This pilot from the Idaho ANG is wearing the new HOBIT (Hybrid Optical-based Inertial Tracker) helmet.*

### THE BIGGEST UPGRADE SINCE THE A-10C

The upgrade of A-10As to A-10Cs from 2005 onwards was a huge leap for the Warthog. This essentially added precision weapons, a partial glass cockpit, and a laser designator pod. Further upgrades will field in the spring of 2021, and it's a foundational step in the modernization of the A-10," says Kading.

Other upgrades will include "multiple target list improvements" that will enable the pilot to engage multiple targets with three different weapon types on one pass. It also includes full AGR-20 APKWS integration, which Kading says "provides the ability to target at the maximum kinematic range of the rocket with aiming solutions designed within rocket tolerances." GBU-31(V)3 JDAM integration brings expanded capabilities for utilizing new fuze types, and "improved JDAM feedback" will enable the pilot to have greater confidence in weapon accuracy. "Threat information can now be shared between A-10s utilizing the data link, which allows all flight members increased situation awareness for survivability."





*The new HRDS display will replace the central pack of analogue instruments in the A-10 cockpit*

“This upgrade is important because it provides modern navigation instruments to improve situational awareness when flying in IMC [Instrument Meteorological Conditions],” Kading explains. “It will make targets much more visible through a higher definition display of targeting pod footage and improved map imagery will allow enhanced target correlation.”

“SDB testing is currently in developmental testing with the 40th Flight Test Squadron, Detachment 1, based at Davis-Monthan Air Force Base, Arizona. This will give the A-10 a four-fold increase in standoff bomb capability and allows the A-10 to provide weapons effects in much [greater] threat environments than before.” This is due to the standoff range of these weapons, which means the A-10 pilot will be able to strike from outside the range of some ground threats.



*The GBU-39 SDB will give the A-10 greater ability to make precision standoff strikes.*

The USAF completed a project to re-wing a portion of its A-10C fleet on July 25, 2019. The project began in 2007 when Boeing received a \$1.1-billion contract to provide 173 sets of wings. The new wings are expected to last for up to 10,000 equivalent flight hours without requiring a depot inspection and will permit the modified aircraft to remain in service through 2030 or beyond.

A further project to provide 112 additional wing sets for the remaining A-10Cs was funded in Fiscal Year 2018. The service is acquiring the wing sets under the A-10 Thunderbolt Advanced-Wing Continuation Kit (ATAK) program.

A long-held ambition to re-engine the A-10s isn't included in current plans. New parts suppliers with modern techniques may help restore the original engine thrust of the General Electric TF34 engines rather than the slight de-tune that the aircraft currently operates with.

Together, this host of capability upgrades will keep the A-10 at the forefront of the USAF CAS mission for at least another decade, and likely substantially longer. A lot will depend on whether or not the USAF decides to mount another attack on the Thunderbolt II fleet, but with new investments being made to recapitalize the A-10 force and with reduced interest in a successor or new Light Attack platform, all indications are that the A-10 will not be going away anytime soon, but the powers to be keep trying

To see a 10-minute video on The Story of The A-10 copy and paste the below link into your browser

[https://www.youtube.com/watch?v=\\_r8WdBeyMSQ](https://www.youtube.com/watch?v=_r8WdBeyMSQ)



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