

= Fairchild Republic A @-@ 10 Thunderbolt II =

The Fairchild Republic A @-@ 10 Thunderbolt II is a single seat , twin turbofan engine , straight wing jet aircraft developed by Fairchild @-@ Republic for the United States Air Force . Commonly referred to by its nicknames " Warthog " or " Hog " , its official name comes from the Republic P @-@ 47 Thunderbolt , a fighter particularly effective at close air support . The A @-@ 10 was designed for close @-@ in support of ground troops , close air support (CAS) , providing quick @-@ action support for troops against helicopters , vehicles , and ground troops . It entered service in 1976 and is the only production @-@ built aircraft that has served in the USAF that was designed solely for CAS . Its secondary mission is to provide forward air controller - airborne (FAC @-@ A) support , by directing other aircraft in attacks on ground targets . Aircraft used primarily in this role are designated OA @-@ 10 .

The A @-@ 10 was intended to improve on the performance of the A @-@ 1 Skyraider and its poor firepower . The A @-@ 10 was designed around the 30 mm GAU @-@ 8 Avenger rotary cannon . Its airframe was designed for durability , with measures such as 1 @,@ 200 pounds (540 kg) of titanium armor to protect the cockpit and aircraft systems , enabling it to absorb a significant amount of damage and continue flying . Its short takeoff and landing capability permits operation from airstrips close to the front lines , and its simple design enables maintenance with minimal facilities . The A @-@ 10 served in Operation Desert Shield , and Operation Desert Storm , the American intervention against Iraq 's invasion of Kuwait , where the A @-@ 10 distinguished itself . The A @-@ 10 also participated in other conflicts such as Operation Urgent Fury in Grenada , the Balkans , Afghanistan , Iraq , and against ISIL in the Middle East .

The A @-@ 10A single @-@ seat variant was the only version produced , though one pre @-@ production airframe was modified to become the YA @-@ 10B twin @-@ seat prototype to test an all @-@ weather night capable version . In 2005 , a program was started to upgrade remaining A @-@ 10A aircraft to the A @-@ 10C configuration with modern avionics for use of precision weaponry . With a variety of upgrades and wing replacements , the A @-@ 10 's service life may be extended to 2028 .

= = Development = =

= = = Background = = =

The Air Force entered the 1960s after a long period of introducing ever @-@ faster attack aircraft intended primarily for the nuclear strike role . This led to high speed designs like the F @-@ 101 Voodoo and F @-@ 105 Thunderchief , optimized for penetrating enemy airspace at high speeds to deliver a nuclear payload . Designs concentrating on conventional weapons were largely ignored , leaving their entry into the Vietnam War led by the Korean War @-@ era A @-@ 1 Skyraider . While a capable aircraft for its era , with a relatively large payload and long loiter times , the propeller driven Skyraider was also fairly slow and vulnerable to ground fire . The Air Force and Marine Corps lost 266 A @-@ 1s in action , the vast majority of these to small arms fire .

The lack of modern conventional attack capability led a few service members to call for a specialized attack aircraft . On 7 June 1961 , Secretary of Defense McNamara ordered the air force to develop two tactical aircraft , one for the long @-@ range strike and interdictor role , and the other focussing on the fighter @-@ bomber mission . The former became the Tactical Fighter Experimental , or TFX , which emerged as the F @-@ 111 , while the second was filled by a modified version of the US Navy 's F @-@ 4 Phantom II . While the Phantom would go on to be one of the most successful fighter designs of the 1960s , and proved as capable fighter @-@ bomber , it was clearly lacking in the pure CAS role . The lack of loiter time was a major problem , and to a lesser extent , its poor low @-@ speed performance . It was also an expensive aircraft both to purchase and operate , with a flyaway cost around \$ 2 million in FY1965 , and operational costs over \$ 900 / hour .

The Air Force undertook a broad review of its tactical force structures and concluded that it should adopt a cheap aircraft to supplement the F @-@ 4 and F @-@ 111 . The Air Force first focused on the Northrop F @-@ 5 because of its air @-@ to @-@ air performance . A 1965 cost effectiveness study shifted the focus from new F @-@ 5s to cheaper LTV A @-@ 7Ds , and a contract was awarded . However , this platform was soon the subject of a " gold plating " exercise that led to demands for an upgraded engine and new avionics which doubled its cost .

= = = Helicopter competition = = =

Through this period , the US Army had been introducing the UH @-@ 1 Iroquois into service . First used in its intended role as a transport , it was soon modified in the field to carry more machine guns in what became known as the helicopter gunship role . This proved so effective against the lightly armed enemy that new gun and rocket pods were quickly added to arsenal . These were all further improved with the AH @-@ 1 Cobra , dedicated to the attack role and armed with the long @-@ range TOW missile , able to destroy any tank from well outside the range of defensive fire . The platform was so effective that it led to a revolution in military thought about ways to confront the Warsaw Pact in Europe , blunting their advance using a force of anti @-@ tank helicopters instead of a large number of tactical nuclear weapons that had been the basis for NATO 's battle plans since the 1950s .

As the helicopter improved , Air Force planners became worried that more advanced designs like the Lockheed AH @-@ 56 Cheyenne would pose a threat to Air Force funding . A 1966 Air Force study on existing CAS capabilities revealed gaps in the escort and fire suppression roles , which the Cheyenne could fill . The study concluded that the Air Force should acquire a simple , cheap , dedicated CAS aircraft at least as capable as the A @-@ 1 , and that it should develop doctrine , tactics , and procedures for CAS aircraft to accomplish the missions for which the armed helicopters were provided .

= = = A @-@ X program = = =

In 1966 , the USAF formed the Attack Experimental (A @-@ X) program office . On 8 September 1966 , General McConnell ordered that a specialized CAS aircraft be designed , developed , and obtained , on 22 December a Requirements Action Directive (RAD) was issued for the A @-@ X CAS airplane . On 6 March 1967 , the Air Force released a request for information to 21 defense contractors for the A @-@ X. The objective was to create a design study for a low @-@ cost attack aircraft . In 1969 , the Secretary of the Air Force asked Pierre Sprey to write the detailed specifications for the proposed A @-@ X project ; Sprey 's initial involvement was kept secret due to his earlier controversial involvement in the F @-@ X project . Sprey 's discussions with Skyraider pilots operating in Vietnam and analysis of aircraft used in the role indicated the ideal aircraft should have long loiter time , low @-@ speed maneuverability , massive cannon firepower , and extreme survivability ; possessing the best elements of the Ilyushin Il @-@ 2 , Henschel Hs 129 , and Skyraider . The specifications also demanded that each aircraft cost less than \$ 3 million . Sprey required that the biography of World War II Luftwaffe attack pilot Hans @-@ Ulrich Rudel be read by people on the A @-@ X program .

In May 1970 , the USAF issued a modified , more detailed request for proposals (RFP) for the aircraft . The threat of Soviet armored forces and all @-@ weather attack operations had become more serious . The requirements now included that the aircraft would be designed specifically for the 30 mm rotary cannon . The RFP also specified a maximum speed of 460 mph (400 kn ; 740 km / h) , takeoff distance of 4 @,@ 000 feet (1 @,@ 200 m) , external load of 16 @,@ 000 pounds (7 @,@ 300 kg) , 285 @-@ mile (460 km) mission radius , and a unit cost of US \$ 1 @.@ 4 million . The A @-@ X would be the first USAF aircraft designed exclusively for close air support . During this time , a separate RFP was released for A @-@ X 's 30 mm cannon with requirements for a high rate of fire (4 @,@ 000 round / minute) and a high muzzle velocity . Six companies submitted aircraft proposals , with Northrop and Fairchild Republic selected to build prototypes : the YA @-@

9A and YA A-10A , respectively . General Electric and Philco Ford were selected to build and test GAU-8 cannon prototypes .

Two YA A-10 prototypes were built in the Republic factory in Farmingdale , New York and first flew on 10 May 1972 by pilot Howard " Sam " Nelson . Production A-10 's were built at Fairchild in Hagerstown , Maryland . After trials and a fly off against the YA A-9 , on 18 January 1973 , the USAF announced the YA A-10 's selection for production . General Electric was selected to build the GAU-8 cannon in June 1973 . The YA A-10 had an additional fly off in 1974 against the Ling Temco Vought A-7D Corsair II , the principal USAF attack aircraft at the time , in order to prove the need for a new attack aircraft . The first production A-10 flew in October 1975 , and deliveries commenced in March 1976 . In total , 715 airplanes were produced , the last delivered in 1984 .

One experimental two seat A-10 Night Adverse Weather (N / AW) version was built by converting an A-10A . The N / AW was developed by Fairchild from the first Demonstration Testing and Evaluation (DT & E) A-10 for consideration by the USAF . It included a second seat for a weapons system officer responsible for electronic countermeasures (ECM) , navigation and target acquisition . The N / AW version did not interest the USAF or export customers . The two seat trainer version was ordered by the Air Force in 1981 , but funding was canceled by U.S. Congress and the jet was not produced . The only two seat A-10 built now resides at Edwards Air Force Base 's Flight Test Center Museum .

== Production ==

On 10 February 1976 , Deputy Secretary of Defense Clements authorized full A-10 rate production , with the first A-10 being accepted by the Air Force Tactical Air Command on 30 March 1976 . Production continued at a rate of 15 aircraft per month , which was believed to be the best rate Fairchild could deliver . A total (including the two prototypes) 715 airplanes was delivered in 1984 . When A-10 full rate production was first authorized the planned service life was 6 ,000 hours . A small reinforcement to the design was quickly adopted when the A-10 failed initial fatigue testing at 80 % of testing , with the fix , the A-10 passed the fatigue tests .

8 ,000 flight hour service lives were becoming common at the time , so fatigue testing of the A-10 continued with a new 8 ,000 flight hour target . Fatigue testing for the new target quickly discovered serious cracks at WS . 23 where the outboard portions of the wings are joined to the fuselage . The first production change was to add cold working at WS . 23 to address this problem . Soon after that , the Air Force determined that the real world A-10 fleet fatigue was more harsh than estimated forcing them to change their fatigue testing , introducing " spectrum 3 " equivalent flight hour testing .

Spectrum 3 fatigue testing started in 1979 . This round of testing quickly determined that more drastic reinforcement would be needed . The second change in production , starting with aircraft # 442 was to increase the thickness of the lower skin on the outer wing panels . A tech order was issued to retrofit the " thick skin " to the whole fleet , but the tech order was rescinded after roughly 242 planes leaving roughly 200 planes with the original " thin skin " . Starting with aircraft # 530 cold working at WS0 was performed , and this retrofit was performed on earlier aircraft . A fourth , even more drastic change was initiated with aircraft # 582 , again to address the problems discovered with spectrum 3 testing . This change increased the thickness on the lower skin on the center wing panel but it required modifications to the lower spar caps to accommodate the thicker skin . The Air Force determined that it was not economically feasible to retrofit earlier planes with this modification .

== Upgrades ==

The A-10 has received many upgrades over the years . Beginning in 1978 , the Pave Penny laser receiver pod was adopted , which receives reflected laser radiation from laser designators for faster and more accurate target identification . The A-10 began receiving an inertial navigation

system in 1980 . The Low @-@ Altitude Safety and Targeting Enhancement (LASTE) upgrade provided computerized weapon @-@ aiming equipment , an autopilot , and a ground @-@ collision warning system . The A @-@ 10 is compatible with night vision goggles for low @-@ light operation . In 1999 , aircraft began receiving Global Positioning System navigation systems and a multi @-@ function display . The LASTE system was upgraded with Integrated Flight & Fire Control Computers (IFFCC) .

Proposed further upgrades included integrated combat search and rescue locator systems and improved early warning and anti @-@ jam self @-@ protection systems , and the Air Force recognized that the A @-@ 10 's engine power was sub @-@ optimal and had been planning to replace them with more powerful engines since at least 2001 at an estimated cost of \$ 2 billion .

= = = = Hog @-@ Up Service Life Extension and Wing Replacement Program = = = =

In 1987 , Grumman Aerospace took over the A @-@ 10 program . Following from the 1992 decision to keep the A @-@ 10 , Grumman developed a Force Structural Maintenance Plan and Damage Threat Assessment by 1993 . On the military side , the A @-@ 10 Program Office did not incorporate the updated procedures into the maintenance tech orders . Critically , the Analytical Condition Inspection implemented by the program office did not inspect every plane as specified in the FSMP , but , instead , employed statistical sampling , inspecting only a fraction of the fleet . A @-@ 10 maintenance suffered from budget constraints , and inspections were performed in the field rather than centralized with programmed depot maintenance . The A @-@ 10 program would see a large amount of upheaval on both the military and corporate side , with numerous changes in contractor along with large upheavals on the military side resulting from changes brought about by the base re @-@ alignment and closure commission .

The first sign of trouble were two " near @-@ critical " sized cracks found . Initially these were classified as minor , they would be reclassified as critical in 2001 . Northrop Grumman was tasked with creating a plan to double the service life of the fleet in 1998 , this would be used as the foundation for attempted service life extension programs . Unfortunately the Grumman plan was based on the assumption that the FSMP had been implemented and that subsequent testing had been uneventful , both these assumptions were wrong . The SPO began a repair program to implement Grumman 's planned wing replacement program in 1999 as the " HOG UP " program . Classing it as a repair program bypassed the acquisition process , and allowed the SPO to use maintenance funding for the program . This also bypassed the Configuration Control Board , as well as strict evaluation of the proposed upgrade .

The SPO added center wing fuel bladder replacement , rework of the flight control system , nacelle fitting inspections , and other areas at the request of Air Combat Command . During this period the two near critical cracks previously uncovered received more scrutiny . The cracks previously classified as minor were classified as critical . This disrupted the HOG UP program , greatly increasing its scope and more than quadrupling its cost . An independent review of the HOG UP program at this point concluded that the data the wing upgrade relied on could no longer be trusted . This independent review was presented in September 2003 . Shortly after that , fatigue testing on a test wing failed . There were also mounting problems with wings in service that were failing inspections at an increasing rate . The Air Force estimated that they would run out of wings by 2011 . Three plans were explored , replacing all the wings with new ones was the cheapest , costing \$ 741 million to implement , and \$ 1 @. 72 billion over the life of the program .

In 2007 , the A @-@ 10 was subject to a service life extension program (SLEP) ; Boeing was awarded a contract to build as many as 242 A @-@ 10 wing sets in June 2007 . In November 2011 , two A @-@ 10s flew with the new wings fitted . In September 2013 , the USAF awarded Boeing a \$ 212 million follow @-@ on contract for 56 new wings , increasing the total ordered to 173 . Re @-@ winging improves mission readiness , decreases maintenance costs , and allows the A @-@ 10 to be operated up to 2035 . In plans to retire the A @-@ 10 , the USAF considered halting the wing replacement program , saving an additional \$ 500 million on top of the total savings of retiring the fleet , for a total of \$ 4 @. 2 billion . By May 2015 , the re @-@ winging program was too far into

the contract to be financially efficient to cancel . The A @-@ 10 fleet with the new TUSK wings could fly past 2040 according to the contractor , Boeing .

===== A @-@ 10C =====

In 2005 , the entire A @-@ 10 fleet began receiving the Precision Engagement upgrades that include an improved fire control system (FCS) , electronic countermeasures (ECM) , and smart bomb targeting . Aircraft which received this upgrade are redesignated A @-@ 10C ; work was to be completed in 2011 . The Government Accounting Office in 2007 estimated the cost of upgrading , refurbishing , and service life extension plans for the A @-@ 10 force to total \$ 2 @. @ 25 billion through 2013 . In September 2007 the A @-@ 10C reached initial operating capability . The Air Force Material Command 's Ogden Air Logistics Center at Hill AFB , Utah completed work on its 100th A @-@ 10 precision engagement upgrade in January 2008 . The PE upgrade will also add all @-@ weather combat capability to the A @-@ 10 . The upgrade will also upgrade the A @-@ 10 with a Hand on Throttle and Stick configuration mixing the F @-@ 16 's flight stick with the F @-@ 15 's throttle . The A @-@ 10 will also receive a modern communications suite including Link @-@ 16 radio and SATCOM .

The Precision Engagement upgrades " backbone is the central interface control unit , which replaces most of the old armament control system and also interfaces with other mission subsystems to provide an integrated solution for the pilot and maintenance technician . The CICU takes various sources of information from the aircraft 's subsystems--such as targeting pods , radios , processors and displays--and integrates and displays the information in a manner that is meant to reduce pilot workload . " The A @-@ 10 's low @-@ altitude safety and targeting enhancement (LASTE) system is replaced by the integrated flight and fire control computer (IFFCC) included in the PE upgrade .

The central interface control unit (CICU) " provides digital stores management and overall avionics systems integration , upgraded processors , Up front controller (UFC) , a new instrument panel , upgraded power systems , and the interfaces necessary to accommodate the new gps guided smart weapons . " The upgrade also includes " the situational awareness data link (SADL) which will provide both air @-@ to @-@ air and ground @-@ to @-@ air digital communications of target data . " " SADL uses the enhanced position location reporting system (EPLRS) waveform , which will provide secure , jam @-@ resistant data communications , such as friendly force data from Army units , in near real time . "

Two multifunction displays replace analog switching displays and controls . Information from the data link and other sources are automatically oriented and scaled providing the pilot an accurate view of forces from both sides on the ground . " Pilots thumb through the menus on the displays , using the surrounding bezel keys or the HOTAS (hands on throttle and stick) . The PE kit will add the up front controller , which is positioned just below the HUD , so that Warthog pilots can keep eyes up while inputting data . The UFC has the same keyboard as on the CDU and typically would be used to input menu items , navigational information and weapons delivery data . "

" The mission planning system (MPS) will allow the pilot to plan his route , the weapons employed and drop sequences , and target information on the ground . He then uses a cartridge to load the mission plan onto the aircraft . " An MPS upgrade is part of the PE upgrade . Pilots will be able to check the status of , and target weapons in @-@ flight . " For the maintenance technician , the A / OA @-@ 10 's CICU and an existing control display unit (CDU) have been fitted with upgraded software to improve the detection and isolation of avionics subsystem failures . " The diagnostic system provided by the new operational test system included in the upgrade will improve the system 's maintainability and , thus , its availability .

In July 2010 , the USAF issued Raytheon a contract to integrate a Helmet Mounted Integrated Targeting (HMIT) system onto A @-@ 10Cs . The Gentex Corporation Scorpion Helmet Mounted Cueing System (HMCS) was also evaluated . In February 2014 , Secretary of the Air Force Deborah Lee James ordered that development of Suite 8 software upgrade continue , in response to Congressional pressure . Software upgrades were originally to be ceased due to plans to retire the

A @-@ 10 . Suite 8 software includes IFF Mode 5 , which modernizes the ability of friendly units to identify the A @-@ 10 as a friendly aircraft .

In 2012 , Air Combat Command requested the testing of a 600 @-@ gallon external fuel tank which would extend the A @-@ 10 's loitering time by 45 ? 60 minutes ; flight testing of such a tank had been conducted in 1997 , but did not involve combat evaluation . Over 30 flight tests were conducted by the 40th Flight Test Squadron to gather data on the aircraft 's handling characteristics and performance across different load configurations . The tank slightly reduced stability in the yaw axis , however there is no decrease in aircraft tracking performance .

Sometime prior to 2012 , the Air Force began removing the Pave Penny pods from their pylons , as the receive @-@ only capability had become redundant with the installation of the AN / AAQ @-@ 28 (V) 4 LITENING AT targeting pods (typically on station 9 or 10) , or the Sniper XR targeting pod (typically on station 2) , which have both a laser designator and laser rangefinder (along with other sensors) . The pylons for the Pave Penny have been left in place initially , but are being removed to avoid possible repairs .

= = = Other uses = = =

On 25 March 2010 , an A @-@ 10 conducted the first flight of an aircraft with all engines powered by a biofuel blend . The flight , performed at Eglin Air Force Base , used a 1 : 1 blend of JP @-@ 8 and Camelina @-@ based fuel . On 28 June 2012 , the A @-@ 10 became the first aircraft to fly using a new fuel blend derived from alcohol ; known as ATJ (Alcohol @-@ to @-@ Jet) , the fuel is cellulosic @-@ based that can be derived using wood , paper , grass , or any cellulose based material , and are fermented into alcohols before being hydro @-@ processed into aviation fuel . ATJ is the third alternative fuel to be evaluated by the Air Force as a replacement for petroleum @-@ derived JP @-@ 8 fuel . Previous types were a synthetic paraffinic kerosene derived from coal and natural gas and a bio @-@ mass fuel derived from plant @-@ oils and animal fats known as Hydroprocessed Renewable Jet .

In 2011 , the National Science Foundation granted \$ 11 million to modify an A @-@ 10 for weather research for CIRPAS at the U.S. Naval Postgraduate School , replacing a retired North American T @-@ 28 Trojan . The A @-@ 10 's armor is expected to allow it to survive the extreme meteorological conditions , such as 200 mph hailstorms , found in inclement high @-@ altitude weather events .

In 2015 , Boeing revealed that it was holding initial discussions on the prospects of selling retired or stored A @-@ 10s in near @-@ flyaway condition to international customers . However , the Air Force subsequently stated that it will not permit the aircraft to be sold .

= = Design = =

= = = Overview = = =

" The A @-@ 10 Thunderbolt 2 is a cantilever low @-@ wing monoplane with wide chord , deep airfoil section . One @-@ piece constant chord center wing section , tapered outer panels , cambered wing tips . Two @-@ segment , three @-@ position , trailing @-@ edge slotted flaps , interchangeable right and left . Wide span ailerons , made up of upper and lower surfaces that separate to serve as airbrakes . Small leading @-@ edge slat inboard each mainwheel fairing . Redundant , armor shielded flight control system . Semi @-@ monocoque aluminum alloy fuselage with four main longerons , multiple frames , and lap @-@ jointed , and riveted skin . " It has " cantilever aluminum structure with twin fins and interchangeable rudders mounted at tips of constant chord tailplane . Interchangeable elevators , each with an electrically operated trim tab . "

The A @-@ 10 has superior maneuverability at low speeds and altitude because of its large wing area , high wing aspect ratio , and large ailerons . The wing also allows short takeoffs and landings , permitting operations from primitive forward airfields near front lines . The aircraft can loiter for

extended periods and operate under 1 @, @ 000 ft (300 m) ceilings with 1 @. @ 5 mi (2 @. @ 4 km) visibility . It typically flies at a relatively low speed of 300 knots (350 mph ; 560 km / h) , which makes it a better platform for the ground @- @ attack role than fast fighter @- @ bombers , which often have difficulty targeting small , slow @- @ moving targets .

The leading edge of the wing has a honeycomb structure panel construction , providing strength with minimal weight ; similar panels cover the flap shrouds , elevators , rudders and sections of the fins . The skin panels are integral with the stringers and are fabricated using computer @- @ controlled machining , reducing production time and cost . Combat experience has shown that this type of panel is more resistant to damage . The skin is not load @- @ bearing , so damaged skin sections can be easily replaced in the field , with makeshift materials if necessary . The ailerons are at the far ends of the wings for greater rolling moment and have two distinguishing features : The ailerons are larger than is typical , almost 50 percent of the wingspan , providing improved control even at slow speeds ; the aileron is also split , making it a deceleron .

The A @- @ 10 is designed to be refueled , rearmed , and serviced with minimal equipment . Its simple design enables maintenance at forward bases with limited facilities . Also , most repairs can be done in the field . An unusual feature is that many of the aircraft 's parts are interchangeable between the left and right sides , including the engines , main landing gear , and vertical stabilizers . The sturdy landing gear , low @- @ pressure tires and large , straight wings allow operation from short rough strips even with a heavy aircraft ordnance load , allowing the aircraft to operate from damaged airbases , flying from taxiways or even straight roadway sections .

The front landing gear is offset to the aircraft 's right to allow placement of the 30 mm cannon with its firing barrel along the centerline of the aircraft . During ground taxi , the offset front landing gear causes the A @- @ 10 to have dissimilar turning radii . Turning to the right on the ground takes less distance than turning left . The wheels of the main landing gear partially protrude from their nacelles when retracted , making gear @- @ up belly landings easier to control and less damaging . All landing gears are hinged toward the aircraft 's rear ; if hydraulic power is lost , a combination of gravity and wind resistance can open and lock the gear in place .

= = = Durability = = =

The A @- @ 10 is exceptionally tough , being able to survive direct hits from armor @- @ piercing and high @- @ explosive projectiles up to 23 mm . It has double @- @ redundant hydraulic flight systems , and a mechanical system as a back up if hydraulics are lost . Flight without hydraulic power uses the manual reversion control system ; pitch and yaw control engages automatically , roll control is pilot @- @ selected . In manual reversion mode , the A @- @ 10 is sufficiently controllable under favorable conditions to return to base , though control forces are greater than normal . The aircraft is designed to fly with one engine , one half of tail , one elevator , and half of a wing missing .

The cockpit and parts of the flight @- @ control system are protected by 1 @, @ 200 lb (540 kg) of titanium aircraft armor , referred to as a " bathtub " . The armor has been tested to withstand strikes from 23 mm cannon fire and some strikes from 57 mm rounds . It is made up of titanium plates with thicknesses from 0 @. @ 5 to 1 @. @ 5 inches (13 to 38 mm) determined by a study of likely trajectories and deflection angles . The armor makes up almost 6 percent of the aircraft 's empty weight . Any interior surface of the tub directly exposed to the pilot is covered by a multi @- @ layer nylon spall shield to protect against shell fragmentation . The front windscreen and canopy are resistant to small arms fire .

The A @- @ 10 's durability was shown on 7 April 2003 when Captain Kim Campbell , while flying over Baghdad during the 2003 invasion of Iraq , suffered extensive flak damage . Iraqi fire damaged an engine and crippled the hydraulic system , requiring the aircraft 's stabilizer and flight controls to be operated via the ' manual reversion mode ' . Despite this damage , Campbell flew the aircraft for nearly an hour and landed safely .

The A @- @ 10 was envisioned to fly from forward air bases and semi @- @ prepared runways with high risk of foreign object damage to the engines . The unusual location of the General Electric

TF34 @-@ GE @-@ 100 turbofan engines decreases ingestion risk , and allows the engines to run while the aircraft is serviced and rearmed by ground crews , reducing turn @-@ around time . The wings are also mounted closer to the ground , simplifying servicing and rearming operations . The heavy engines require strong supports , four bolts connect the engine pylons to the airframe . The engines ' high 6 : 1 bypass ratio have a relatively small infrared signature , and their position directs exhaust over the tailplanes further shielding it from detection by infrared homing surface @-@ to @-@ air missiles . The engines and their exhausts are angled upward by nine degrees to cancel out the nose @-@ down pitching moment they would otherwise generate due to being mounted above the aircraft 's center of gravity , avoiding the need to trim the control surfaces against the force .

To reduce the likelihood of damage to the A @-@ 10 's fuel system , all four fuel tanks are located near the aircraft 's center and are separated from the fuselage ; projectiles would need to penetrate the aircraft 's skin before reaching a tank 's outer skin . Compromised fuel transfer lines self @-@ seal ; if damage exceeds a tank 's self @-@ sealing capabilities , check valves prevent fuel flowing into a compromised tank . Most fuel system components are inside the tanks so that fuel will not be lost due to component failure . The refueling system is also purged after use . Reticulated polyurethane foam lines both the inner and outer sides of the fuel tanks , retaining debris and restricting fuel spillage in the event of damage . The engines are shielded from the rest of the airframe by firewalls and fire extinguishing equipment . In the event of all four main tanks being lost , two self @-@ sealing sump tanks contain fuel for 230 miles (370 km) of flight .

= = = Weapons = = =

Although the A @-@ 10 can carry considerable disposable stores , its primary built @-@ in weapon is the 30 mm GAU @-@ 8 / A Avenger Gatling @-@ type cannon . One of the most powerful aircraft cannon ever flown , it fires large depleted uranium armor @-@ piercing shells . In the original design , the pilot could switch between two rates of fire : 2 @,@ 100 or 4 @,@ 200 rounds per minute ; this was changed to a fixed rate of 3 @,@ 900 rounds per minute . The cannon takes about half a second to come up to speed , so 50 rounds are fired during the first second , 65 or 70 rounds per second thereafter . The gun is accurate enough to place 80 percent of its shots within a 40 @-@ foot (12 @.@ 4 m) diameter circle from 4 @,@ 000 feet (1 @,@ 220 m) while in flight . The GAU @-@ 8 is optimized for a slant range of 4 @,@ 000 feet (1 @,@ 220 m) with the A @-@ 10 in a 30 @-@ degree dive .

The fuselage of the aircraft is built around the cannon . The GAU @-@ 8 / A is mounted slightly to the port side ; the barrel in the firing location is on the starboard side at the 9 o 'clock position so it is aligned with the aircraft 's centerline . The gun 's 5 @-@ foot , 11 @.@ 5 @-@ inch (1 @.@ 816 m) ammunition drum can hold up to 1 @,@ 350 rounds of 30 mm ammunition , but generally holds 1 @,@ 174 rounds . To prevent enemy fire from causing the GAU @-@ 8 / A rounds to fire prematurely , armor plates of differing thicknesses between the aircraft skin and the drum are designed to detonate incoming shells . A final armor layer around the drum protects it from fragmentation damage . The gun is loaded by Syn @-@ Tech 's linked tube carrier GFU @-@ 7 / E 30 mm ammunition loading assembly cart .

The AGM @-@ 65 Maverick air @-@ to @-@ surface missile is a commonly used munition , targeted via electro @-@ optical (TV @-@ guided) or infrared . The Maverick allows target engagement at much greater ranges than the cannon , and thus less risk from anti @-@ aircraft systems . During Desert Storm , in the absence of dedicated forward @-@ looking infrared (FLIR) cameras for night vision , the Maverick 's infrared camera was used for night missions as a " poor man 's FLIR " . Other weapons include cluster bombs and Hydra rocket pods . The A @-@ 10 is equipped to carry laser @-@ guided bombs . A @-@ 10s usually fly with an ALQ @-@ 131 ECM pod under one wing and two AIM @-@ 9 Sidewinder air @-@ to @-@ air missiles under the other wing for self @-@ defense .

= = = Modernization = = =

The A @-@ 10 Precision Engagement Modification Program will update 356 A @-@ 10 / OA @-@ 10s to the A @-@ 10C variant with a new flight computer , new glass cockpit displays and controls , two new 5 @.@ 5 @-@ inch (140 mm) color displays with moving map function and an integrated digital stores management system .

Other funded improvements to the A @-@ 10 fleet include a new data link , the ability to employ smart weapons such as the Joint Direct Attack Munition (JDAM) and Wind Corrected Munitions Dispenser , and the ability to carry an integrated targeting pod such as the Northrop Grumman LITENING or the Lockheed Martin Sniper Advanced Targeting Pod (ATP) . Also included is the Remotely Operated Video Enhanced Receiver (ROVER) to provide sensor data to personnel on the ground .

In 2016 the USAF announced a thick @-@ skin urgent spares kitting (TUSK) wing assemblies program to extend the lifespan of the aircraft past 2040 .

= = = Colors and markings = = =

Since the A @-@ 10 flies low to the ground and at subsonic speed , aircraft camouflage is important to make the aircraft more difficult to see . Many different types of paint schemes have been tried . These have included a " peanut scheme " of sand , yellow and field drab ; black and white colors for winter operations and a tan , green and brown mixed pattern . Many A @-@ 10s also featured a false canopy painted in dark gray on the underside of the aircraft , just behind the gun . This form of automimicry is an attempt to confuse the enemy as to aircraft attitude and maneuver direction . Many A @-@ 10s feature nose art , such as shark mouth or warthog head features .

The two most common markings applied to the A @-@ 10 have been the European I woodland camouflage scheme and a two @-@ tone gray scheme . The European woodland scheme was designed to minimize visibility from above , as the threat from hostile fighter aircraft was felt to outweigh that from ground @-@ fire . It uses dark green , medium green and dark gray in order to blend in with the typical European forest terrain and was used from the 1980s to the early 1990s . Following the end of the Cold War , and based on experience during the 1991 Gulf War , the air @-@ to @-@ air threat was no longer seen to be as important as that from ground fire , and a new color scheme known as " Compass Ghost " was chosen to minimize visibility from below . This two @-@ tone gray scheme has darker gray color on top , with the lighter gray on the underside of the aircraft , and started to be applied from the early 1990s .

= = Operational history = =

= = = Entering service = = =

The first unit to receive the A @-@ 10 Thunderbolt II was the 355th Tactical Training Wing , based at Davis @-@ Monthan Air Force Base , Arizona , in March 1976 . The first unit to achieve full combat @-@ readiness was the 354th Tactical Fighter Wing at Myrtle Beach AFB , South Carolina , in 1978 . Deployments of A @-@ 10As followed at bases both at home and abroad , including England AFB , Louisiana ; Eielson AFB , Alaska ; Osan Air Base , South Korea ; and RAF Bentwaters / RAF Woodbridge , England . The 81st TFW of RAF Bentwaters / RAF Woodbridge operated rotating detachments of A @-@ 10s at four bases in Germany known as Forward Operating Locations (FOLs) : Leipheim , Sembach Air Base , Nörvenich , and Ahlhorn .

A @-@ 10s were initially an unwelcome addition to many in the Air Force . Most pilots switching to the A @-@ 10 did not want to because fighter pilots traditionally favored speed and appearance . In 1987 , many A @-@ 10s were shifted to the forward air control (FAC) role and redesignated OA @-@ 10 . In the FAC role the OA @-@ 10 is typically equipped with up to six pods of 2 @.@ 75 inch (70 mm) Hydra rockets , usually with smoke or white phosphorus warheads used for target marking . OA @-@ 10s are physically unchanged and remain fully combat capable despite the

redesignation .

A @-@ 10s of the 23rd TFW were deployed to Bridgetown , Barbados during Operation Urgent Fury , the American Invasion of Grenada . They provided air cover for the U.S. Marine Corps landings on the island of Carriacou in late October 1983 , but did not fire weapons as Marines met no resistance .

= = = Gulf War and Balkans = = =

The A @-@ 10 was used in combat for the first time during the Gulf War in 1991 , destroying more than 900 Iraqi tanks , 2 @,@ 000 other military vehicles and 1 @,@ 200 artillery pieces . A @-@ 10s also shot down two Iraqi helicopters with the GAU @-@ 8 cannon . The first of these was shot down by Captain Robert Swain over Kuwait on 6 February 1991 for the A @-@ 10 's first air @-@ to @-@ air victory . Four A @-@ 10s were shot down during the war , all by surface @-@ to @-@ air missiles . Another three battle @-@ damaged A @-@ 10s and OA @-@ 10As returned to base but were written off , some sustaining additional damage in crash landings . The A @-@ 10 had a mission capable rate of 95 @.@ 7 percent , flew 8 @,@ 100 sorties , and launched 90 percent of the AGM @-@ 65 Maverick missiles fired in the conflict . Shortly after the Gulf War , the Air Force abandoned the idea of replacing the A @-@ 10 with a close air support version of the F @-@ 16 .

U.S. Air Force A @-@ 10 aircraft fired approximately 10 @,@ 000 30 mm rounds in Bosnia and Herzegovina in 1994 ? 95 . Following the seizure of some heavy weapons by Bosnian Serbs from a warehouse in Ilid?a , a series of sorties were launched to locate and destroy the captured equipment . On 5 August 1994 , two A @-@ 10s located and strafed an anti @-@ tank vehicle . Afterward , the Serbs agreed to return remaining heavy weapons . In August 1995 , NATO launched an offensive called Operation Deliberate Force . A @-@ 10s flew close air support missions , attacking Bosnian Serb artillery and positions . In late September , A @-@ 10s began flying patrols again .

A @-@ 10s returned to the Balkan region as part of Operation Allied Force in Kosovo beginning in March 1999 . In March 1999 , A @-@ 10s escorted and supported search and rescue helicopters in finding a downed F @-@ 117 pilot . The A @-@ 10s were deployed to support search and rescue missions , but over time the Warthogs began to receive more ground attack missions . The A @-@ 10 's first successful attack in Operation Allied Force happened on 6 April 1999 ; A @-@ 10s remained in action until combat ended in late June 1999 .

= = = Afghanistan , Iraq , Libya , and recent deployments = = =

During the 2001 invasion of Afghanistan , A @-@ 10s did not take part in the initial stages . For the campaign against Taliban and Al Qaeda , A @-@ 10 squadrons were deployed to Pakistan and Bagram Air Base , Afghanistan , beginning in March 2002 . These A @-@ 10s participated in Operation Anaconda . Afterwards , A @-@ 10s remained in @-@ country , fighting Taliban and Al Qaeda remnants .

Operation Iraqi Freedom began on 20 March 2003 . Sixty OA @-@ 10 / A @-@ 10 aircraft took part in early combat there . United States Air Forces Central Command issued Operation Iraqi Freedom : By the Numbers , a declassified report about the aerial campaign in the conflict on 30 April 2003 . During that initial invasion of Iraq , A @-@ 10s had a mission capable rate of 85 percent in the war and fired 311 @,@ 597 rounds of 30 mm ammunition . A single A @-@ 10 was shot down near Baghdad International Airport by Iraqi fire late in the campaign . The A @-@ 10 also flew 32 missions in which the aircraft dropped propaganda leaflets over Iraq .

The A @-@ 10C first deployed to Iraq in 2007 with the 104th Fighter Squadron of the Maryland Air National Guard . The jets include the Precision Engagement Upgrade . The A @-@ 10C 's digital avionics and communications systems have greatly reduced the time to acquire a close air support target and attack it .

A @-@ 10s flew 32 percent of combat sorties in Operation Iraqi Freedom and Operation Enduring Freedom . The sorties ranged from 27 @,@ 800 to 34 @,@ 500 annually between 2009 and 2012 .

In the first half of 2013 , they flew 11 @,@ 189 sorties in Afghanistan . From the beginning of 2006 to October 2013 , A @-@ 10s flew 19 percent of CAS operations in Iraq and Afghanistan , more than the F @-@ 15E Strike Eagle or B @-@ 1B Lancer , but less than the 33 percent of CAS missions flown by F @-@ 16s during that time period .

In March 2011 , six A @-@ 10s were deployed as part of Operation Odyssey Dawn , the coalition intervention in Libya . They participated in attacks on Libyan ground forces there .

In September 2014 , the USAF 122nd Fighter Wing revealed it would be deploying to the Middle East in the next month , which includes 12 of the unit 's 21 A @-@ 10 aircraft . Although the deployment had been planned a year in advance in a support role , the timing coincided with the ongoing Operation Inherent Resolve against Islamic State militants . Since mid @-@ November , U.S. commanders began sending A @-@ 10s to hit IS targets in central and northwestern Iraq on an almost daily basis . In about two months time , A @-@ 10s flew 11 percent of all USAF sorties since the start of operations in August 2014 . On 15 November 2015 , two days after the ISIL attacks in Paris , A @-@ 10s and AC @-@ 130s destroyed a convoy of over 100 ISIL @-@ operated oil tanker trucks in Syria . The attacks were part of an intensification of the U.S.-led intervention against ISIL called Operation Tidal Wave II (named after the original Operation Tidal Wave during World War II , a failed attempt to raid German oil fields that resulted in heavy aircraft and aircrew loss) in an attempt to cut off oil smuggling as a source of funding for the group .

= = = Future = = =

In 2007 , the A @-@ 10 was expected to be in USAF service until 2028 and possibly later , when it may be replaced by the Lockheed Martin F @-@ 35 Lightning II . Critics have said that replacing the A @-@ 10 with the F @-@ 35 would be a " giant leap backwards " given the A @-@ 10 's performance and the F @-@ 35 's rising costs . In 2012 , the Air Force considered the F @-@ 35B STOVL variant as a replacement CAS aircraft , but concluded that the aircraft could not generate sufficient sorties . In August 2013 , Congress and the Air Force examined various proposals , including the F @-@ 35 and the MQ @-@ 9 Reaper unmanned aerial vehicle filling the A @-@ 10 's role . Proponents state that the A @-@ 10 's armor and cannon are superior to aircraft such as the F @-@ 35 for ground attack , that guided munitions other planes rely upon could be jammed , and that ground commanders frequently request A @-@ 10 support .

In the USAF 's FY 2015 budget , the service considered retiring the A @-@ 10 and other single @-@ mission aircraft , prioritizing multi @-@ mission aircraft ; cutting a whole fleet and its infrastructure was seen as the only method for major savings . The U.S. Army had expressed interest in obtaining some A @-@ 10s should the Air Force retire them , but later stated there was " no chance " of that happening . The U.S. Air Force stated that retirement would save \$ 3 @.@ 7 billion from 2015 to 2019 . Guided munitions allow more aircraft to perform the CAS mission , reducing the requirement for a specialized aircraft ; since 2001 , multirole aircraft and bombers performed 80 percent of CAS missions . The Air Force stated the A @-@ 10 is also more vulnerable to advanced anti @-@ aircraft defenses . The Army stated that the A @-@ 10 is invaluable for its versatile weapons loads , psychological impact , and reduced logistics needs on ground support systems .

In January 2015 , USAF officials told lawmakers that it would take 15 years to fully develop a new attack aircraft to replace the A @-@ 10 ; that year General Herbert J. Carlisle , the head of Air Combat Command stated that a follow @-@ on weapon system for the A @-@ 10 may need to be developed . It planned for F @-@ 16s and F @-@ 15Es to initially take up CAS sorties , and later by the F @-@ 35A once sufficient numbers become operationally available over the next decade . The service is considering purchasing a relatively inexpensive replacement to perform CAS against enemies that lack sophisticated air defenses . As of 2015 , the US Air Combat Command is considering developing a replacement aircraft . In January 2016 , the USAF revealed it was " indefinitely freezing " plans to retire the A @-@ 10 for at least several years . In addition to Congressional opposition , its use in anti @-@ ISIL operations , deployments to Eastern Europe as a response to Russia 's military intervention in Ukraine , and reevaluation of F @-@ 35 numbers

necessitated its retention . Retirement has been deferred until 2022 when F @-@ 35s will begin replacing it on a squadron @-@ by @-@ squadron basis . In March 2016 , the Air Force revealed it had begun studying future CAS aircraft to succeed the A @-@ 10 in low @-@ intensity ? permissive conflicts ? like counterterrorism and regional stability operations , admitting that the F @-@ 35 is too expensive to operate in day @-@ to @-@ day roles ; everything from low @-@ end AT @-@ 6 Wolverine and A @-@ 29 Super Tucano turboprops and the Textron AirLand Scorpion as more basic off @-@ the @-@ shelf options to more sophisticated clean @-@ sheet attack aircraft or " AT @-@ X " derivatives of the T @-@ X next @-@ generation trainer as entirely new attack platforms are being considered .

= = Variants = =

YA @-@ 10A

Pre @-@ production variant . 12 were built .

A @-@ 10A

Single @-@ seat close air support , ground @-@ attack version . (All updated to A @-@ 10C)

OA @-@ 10A

A @-@ 10As used for airborne forward air control . (All updated to A @-@ 10C)

YA @-@ 10B Night / Adverse Weather

Two @-@ seat experimental prototype , for work at night and in bad weather . The one YA @-@ 10B prototype was converted from an A @-@ 10A .

A @-@ 10C

A @-@ 10As updated under the incremental Precision Engagement (PE) program .

A @-@ 10PCAS

Proposed unmanned version developed by Raytheon and Aurora Flight Sciences as part of DARPA's Persistent Close Air Support program . The PCAS program eventually dropped the idea of using an optionally manned A @-@ 10 .

Civilian A @-@ 10

Proposed by the South Dakota School of Mines and Technology to replace its North American T @-@ 28 Trojan thunderstorm penetration aircraft . The A @-@ 10 would have its military engines , avionics , and oxygen system replaced by civilian versions . The engines and airframe would receive protection from hail , and the GAU @-@ 8 Avenger would be replaced with ballast or scientific instruments .

= = Operators = =

The A @-@ 10 has been flown exclusively by the United States Air Force and its Air Reserve components , the Air Force Reserve Command (AFRC) and the Air National Guard (ANG) . The USAF operates 283 A @-@ 10C aircraft , as of FY 2015 .

United States

United States Air Force

25th Fighter Squadron (Osan Air Force Base , South Korea)

66th Weapons Squadron (Nellis Air Force Base , Nevada)

74th Fighter Squadron (Moody Air Force Base , Georgia)

75th Fighter Squadron (Moody Air Force Base , Georgia)

354th Fighter Squadron (Davis @-@ Monahan Air Force Base , Arizona)

357th Fighter Squadron (Davis @-@ Monahan Air Force Base , Arizona)

422d Test and Evaluation Squadron (Nellis Air Force Base , Nevada)

Air National Guard

104th Fighter Squadron (Warfield Air National Guard Base , Maryland)

107th Fighter Squadron (Selfridge Air National Guard Base , Michigan)

163d Fighter Squadron (Fort Wayne Air National Guard Station , Indiana)

190th Fighter Squadron (Gowen Field Air National Guard Base , Idaho)

Air Force Reserve Command

45th Fighter Squadron (Davis @-@ Monthan Air Force Base , Arizona)

47th Fighter Squadron (Davis @-@ Monthan Air Force Base , Arizona)

76th Fighter Squadron (Moody Air Force Base , Georgia)

303d Fighter Squadron (Whiteman Air Force Base , Missouri)

= = = Former operators = = =

United States Air Force

18th Tactical Fighter Squadron

55th Tactical Fighter Squadron

78th Tactical Fighter Squadron

81st Fighter Squadron

91st Tactical Fighter Squadron

92d Tactical Fighter Squadron

343d Tactical Fighter Squadron

353d Tactical Fighter Squadron

355th Tactical Fighter Squadron

356th Tactical Fighter Squadron

358th Fighter Squadron

509th Tactical Fighter Squadron

510th Tactical Fighter Squadron

511th Tactical Fighter Squadron

Air Force Reserve Command

706th Fighter Squadron

Air National Guard

103d Fighter Squadron

118th Fighter Squadron

131st Fighter Squadron

138th Fighter Squadron

172d Fighter Squadron

176th Tactical Fighter Squadron

184th Fighter Squadron

= = Aircraft on display = =

= = = Germany = = =

A @-@ 10A

77 @-@ 0264 ? Spangdahlem AB , Bitburg

= = = South Korea = = =

A @-@ 10A

76 @-@ 0515 ? Osan AB

= = = United Kingdom = = =

A @-@ 10A

77 @-@ 0259 ? American Air Museum at Imperial War Museum Duxford

80 @-@ 0219 - Bentwaters Cold War Museum

== United States ==

YA @-@ 10A

71 @-@ 1370 ? Joint Base Langley @-@ Eustis (Langley AFB) , Hampton , Virginia

YA @-@ 10B

73 @-@ 1664 ? Air Force Flight Test Center Museum , Edwards AFB , California

A @-@ 10A

73 @-@ 1666 ? Hill Aerospace Museum , Hill AFB , Utah

73 @-@ 1667 ? Flying Tiger Heritage Park at the former England AFB , Louisiana

75 @-@ 0263 ? Empire State Aerosciences Museum , Glenville , New York

75 @-@ 0270 ? McChord Air Museum , McChord AFB , Washington

75 @-@ 0293 ? Wings of Eagles Discovery Center , Elmira , New York

75 @-@ 0288 ? Air Force Armament Museum , Eglin AFB , Florida

75 @-@ 0289 ? Heritage Park , Eielson AFB , Alaska

75 @-@ 0298 ? Pima Air & Space Museum (adjacent to Davis @-@ Monthan AFB) , Tucson , Arizona

75 @-@ 0305 ? Museum of Aviation , Robins AFB , Warner Robins , Georgia

75 @-@ 0308 ? Moody Heritage Park , Moody AFB , Valdosta , Georgia

75 @-@ 0309 ? Shaw AFB , Sumter , South Carolina . Marked as AF Ser . No. 81 @-@ 0964 assigned to the 55 FS from 1994 - 1996 . The represented aircraft was credited with downing an Iraqi Mi @-@ 8 Hip helicopter on 15 Feb 1991 while assigned to the 511 TFS .

76 @-@ 0516 ? Wings of Freedom Aviation Museum , Horsham , Pennsylvania

76 @-@ 0530 ? Whiteman AFB , Missouri

76 @-@ 0535 ? Cradle of Aviation , Garden City , New York

76 @-@ 0540 ? Aerospace Museum of California , McClellan Airport (former McClellan AFB) , Sacramento , California

77 @-@ 0205 ? USAF Academy collection , Colorado Springs , Colorado

77 @-@ 0228 ? Grissom Air Museum , Grissom ARB (former Grissom AFB) , Peru , Indiana

77 @-@ 0244 ? Wisconsin Air National Guard Museum , Volk Field ANGB , Wisconsin

77 @-@ 0252 (nose section only) ? Cradle of Aviation , Garden City , New York

78 @-@ 0681 ? National Museum of the United States Air Force , Wright @-@ Patterson AFB , Dayton , Ohio

78 @-@ 0687 ? Don F. Pratt Memorial Museum , Fort Campbell , Kentucky

79 @-@ 0097 ? Warbird Park , former Myrtle Beach AFB , South Carolina

79 @-@ 0100 ? Barnes Air National Guard Base , Westfield , Massachusetts

79 @-@ 0103 ? Bradley Air National Guard Base , Windsor Locks , Connecticut

79 @-@ 0116 ? Warrior Park , Davis @-@ Monthan AFB , Tucson , Arizona

79 @-@ 0173 ? New England Air Museum , Windsor Locks , Connecticut

80 @-@ 0247 - American Airpower Museum , Republic Airport , Farmingdale , New York

80 @-@ 0708 ? Selfridge Military Air Museum , Selfridge Air National Guard Base , Harrison Township , Michigan

== Specifications (A @-@ 10A) ==

Data from The Great Book of Modern Warplanes , Fairchild @-@ Republic A / OA @-@ 10 , USAF
General characteristics

Crew : 1

Length : 53 ft 4 in (16 @. @ 26 m)

Wingspan : 57 ft 6 in (17 @. @ 53 m)

Height : 14 ft 8 in (4 @. @ 47 m)

Wing area : 506 ft ² (47 @. @ 0 m ²)

Airfoil : NACA 6716 root , NACA 6713 tip

Empty weight : 24 @, @ 959 lb (11 @, @ 321 kg)

Loaded weight : 30 @, @ 384 lb (13 @, @ 782 kg) CAS mission : 47 @, @ 094 lb (21 @, @ 361 kg)
) Anti @-@ armor mission : 42 @, @ 071 lb (19 @, @ 083 kg)

Max. takeoff weight : 50 @, @ 000 lb (23 @, @ 000 kg)

Powerplant : 2 x General Electric TF34 @-@ GE @-@ 100A turbofans , 9 @, @ 065 lbf (40 @. @ 32 kN) each

Internal fuel capacity : 11 @, @ 000 lb (4 @, @ 990 kg)

Performance

Never exceed speed : 450 knots (518 mph , 833 km / h) at 5 @, @ 000 ft (1 @, @ 500 m) with 18 Mk 82 bombs

Maximum speed : 381 knots (439 mph , 706 km / h) at sea level , clean

Cruise speed : 300 knots (340 mph , 560 km / h)

Stall speed : 120 knots (138 mph , 220 km / h)

Combat radius : CAS mission : 250 nmi (288 mi , 460 km) at 1 @. @ 88 hour loiter at 5 @, @ 000 ft (1 @, @ 500 m) , 10 min combat

Anti @-@ armor mission : 252 nmi (290 mi , 467 km) , 40 nmi (45 mi , 75 km)) sea @-@ level penetration and exit , 30 min combat

Ferry range : 2 @, @ 240 nmi (2 @, @ 580 mi , 4 @, @ 150 km) with 50 knot (55 mph , 90 km / h) headwinds , 20 minutes reserve

Service ceiling : 45 @, @ 000 ft (13 @, @ 700 m)

Rate of climb : 6 @, @ 000 ft / min (30 m / s)

Wing loading : 99 lb / ft ² (482 kg / m ²)

Thrust / weight : 0 @. @ 36

Armament

Guns : 1 x 30 mm (1 @. @ 18 in) GAU @-@ 8 / A Avenger rotary cannon with 1 @, @ 174 rounds (capacity 1 @, @ 350 rd)

Hardpoints : 11 (8 x under @-@ wing and 3 x under @-@ fuselage pylon stations) with a capacity of 16 @, @ 000 lb (7 @, @ 260 kg) and provisions to carry combinations of :

Rockets : 4 x LAU @-@ 61 / LAU @-@ 68 rocket pods (each with 19 x / 7 x Hydra 70 mm / APKWS rockets , respectively)

4 x LAU @-@ 5003 rocket pods (each with 19 x CRV7 70 mm rockets)

6 x LAU @-@ 10 rocket pods (each with 4 x 127 mm (5 @. @ 0 in) Zuni rockets)

Missiles : 2 x AIM @-@ 9 Sidewinders air @-@ to @-@ air missiles for self @-@ defense

6 x AGM @-@ 65 Maverick air @-@ to @-@ surface missiles

Bombs : Mark 80 series of unguided iron bombs or

Mk 77 incendiary bombs or

BLU @-@ 1 , BLU @-@ 27 / B Rockeye II , Mk20 , BL @-@ 755 and CBU @-@ 52 / 58 / 71 / 87 / 89 / 97 cluster bombs or

Paveway series of Laser @-@ guided bombs or

Joint Direct Attack Munition (A @-@ 10C) or

Wind Corrected Munitions Dispenser (A @-@ 10C)

Other : SUU @-@ 42A / A Flares / Infrared decoys and chaff dispenser pod or

AN / ALQ @-@ 131 or AN / ALQ @-@ 184 ECM pods or

Lockheed Martin Sniper XR or LITENING targeting pods (A @-@ 10C) or

2 x 600 US gallon Sargent Fletcher drop tanks for increased range / loitering time .

Avionics

AN / AAS @-@ 35 (V) Pave Penny laser tracker pod (mounted beneath right side of cockpit) for use with Paveway LGBs (Currently the Pave Penny is no longer in use)

Head @-@ up display (HUD) for improved technical flying and air @-@ to @-@ ground support .

= = Notable appearances in media = =

= = Nicknames = =

The A @-@ 10 Thunderbolt II received its popular nickname " Warthog " from the pilots and crews of the USAF attack squadrons who flew and maintained it . The A @-@ 10 is the last of Republic 's jet attack aircraft to serve with the USAF . The Republic F @-@ 84 Thunderjet was nicknamed the " Hog " , F @-@ 84F Thunderstreak nicknamed " Superhog " , and the Republic F @-@ 105 Thunderchief tagged " Ultra Hog " . The saying Go Ugly Early has been associated with the aircraft in reference to calling in the A @-@ 10 early to support troops in ground combat .