FUTURE FORWARD AIR CONTROLLER AIRCRAFT

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SUBJECT: FUTURE FORWARD AIR CONTROLLER AIRCRAFT

1. PROBLEM. To determine desirable characteristics in future Forward Airborne Controller (FAC) aircraft from the standpoint of facilitating support to small-unit-reconnaissance operations.

2. ASSUMPTIONS.

a. Conditions encountered in future conflicts will permit the deployment of small, long-range reconnaissance teams.

b. Reconnaissance operations will continue to require the supportof FAC aircraft for the provision of communications, direction of air support, aerial resupply, and tactical fire support.

c. The United States Air Force (USAF) will continue to project needs for aircraft improvement and development based on past experience and estimates of future requirements.

d. When discussing reconnaissance operations, the scope of this study will be limited to small units with the mission of collecting information from enemy territory. The reconnaissance units may be either composed totally of US Army personnel or of US Army leaders and indigenous patrol members.

e. When discussing characteristics of FAC aircraft, the scope of this study will be limited to those characteristics affecting support to reconnaissance teams. Characteristics relative strictly to aircraft function and design will not be evaluated.

3. FACTS BEARING ON THE PROBLEM.

a. Interviews of eight USAF and US Army officers experienced in the coordination, provision, utilization, and evaluation of FAC support to reconnaissance operations in the Republic of Viet-Nam (RVN) revealed the unanimous finding that a US Army observer or "FAC rider" is essential to optimum FAC support. (2,3,5,6,7,8,10, 14)

b. Interviews with eight experienced USAF and US Army officers revealed the unanimous finding that none of the variety of FAC aircraft available to the US Army commander in RVN possessed complete support capabilities. Each type of aircraft displayed different characteristics which should be combined in one aircraft. (2,3,5,6, 7,8,10,14)

c. In a statement to the Cannon Subcommittee of the Senate Armed Services Committee, General W. W. Momyer, Commanding General of USAF Tactical Air Command (TAC), stated that the USAF is presently developing and testing the Attack Fighter, Experimental (AX). (9)

4. DISCUSSION.

a. The requirement for two crewmembers eliminates single-seat designs. Tandem seating is preferred to side-by-side seating so that both crewmembers may observe events or locations simultaneously. Maximum visibility should be afforded the crew by means of a large canopy. The canopy should be bulletproof, if at all possible. Redundant flight controls and instrumentation and an adequate crew ejection system for the future FAC aircraft are desirable. Aircraft survivability should be enhanced through use of armor plates, self-sealing fuel tanks, and multiple engines. (Annex C).

b. The future FAC aircraft should have the capability of resupplying a deployed reconnaissance element with ammunition, water, rations, and special items of equipment either on a preplanned or emergency basis. The aircraft also must be able to deliver ordnance in support of beleaguered units while tactical air support aircraft are being requested and provided. The AX will possess adequate delivery capabilities according to current specifications. (Annex D).

c. A FAC aircraft should be able to operate at high speeds to reach an area quickly or at low power settings and low speeds in order to conserve fuel and prolong loiter time. Short takeoff and landing roll requirements are desirable. (Annex E).

d. Communications capabilities of the future FAC aircraft are of extreme importance. The minimum desirable capability would be the following: two frequency modulated (FM) radios with secure-voice transmission, retransmission, and homing capabilities; one ultra-high frequency (UHF) radio with secure-voice transmission capability; one very high frequency (VHF) radio; and one high frequency (HF) or single-side band (SSB) radio. Additional communications capabilities such as Long Range Air Navigation (LORAN), Radar Homing and Warning (RHAW), Night Observation Devices (NOD), devices for the detection of laser illuminators and radar significant beacons, and equipment for the detection and confusion of infrared missiles are not normally required; however, the provision for acceptance and utilization of these devices will increase the desirability of newly developed FAC aircraft. (Annex F).

5. CONCLUSIONS.

a. A list of characteristics desired in future FAC aircraft by the US Army should be forwarded to the USAF. The list of desired characteristics should include the following: tandem seating for the pilot and observer, dual flight controls and instrumentation, an ejection system, multiple engines, foamed and self-sealing fuel tanks, a large bulletproof canopy, a wide range of acceptable power settings and speeds beginning at 95 knots, the communications capabilities listed in paragraph 4d, maximum ordnance/materiel delivery capability without significant loiter reduction, and armor protection for engines, crewmembers, and flight controls.

b. The US Army should request that the list of desired characteristics be given consideration in the development of a two-seat version of the AX. This model of the AX should be designated as the USAF aircraft that will support future small-unit-reconnaissance operations.

6. ACTION RECOMMENDED. The conclusions in paragraph 5 be approved.

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ANNEXES: A--Aircraft Utilized by USAF FACs in RVN
B--The AX Aircraft
C--Cockpit Facilities and Survivability
D--Ordnance/Materiel Delivery
E--Speed and Range
F--Communications
G--Bibliography

CONCURRENCES: (Omitted)
NONCONCURRENCES: (Omitted)
CONSIDERATION OF NONCONCURRENCES: (Omitted)
ANNEXES ADDED: (Omitted)
ACTION BY APPROVING AUTHORITY:

DATE:

Approved (disapproved), including (excluding) exceptions.

Signature

ANNEX A--Aircraft Utilized by USAF FACs in RVN

1. The primary FAC aircraft utilized by the USAF in RVN were the North American Rockwell "Bronco" (Military designation: OV10) and the Cessna Model 337 "Super Skymaster" (USAF designation: O2A). Both aircraft performed adequately in the opinion of personnel polled and according to my personal observation during more than 250 missions totalling over 1000 hours of flying. The OV10 was the preferable aircraft from the standpoint of speed, range, armament, visibility, tandem seating, ejection system, and numerous other factors. Although the OV10 was preferred by nearly every pilot, "FAC rider", and ground team member having experience with the OV10 and O2A, the O2A was an acceptable aircraft for most phases of support to deployed reconnaissance elements. (2,3,5,6,7,8,10,14)

2. The Douglas "Skyraider" (USAF designation: A1) was utilized by the USAF in a FAC-type role in search-and-rescue (SAR) operations. The A1 pilot would act as the on-scene commander directing all efforts at rescuing friendly personnel from enemy territory. The "Sandy" aircraft, as the A1 became known from its radio call sign, displayed many desirable characteristics for the future FAC aircraft such as: good visibility, excellent survivability, adequate communications, excellent ordnance delivery capability, and a wide range of speeds and power settings. Undesirable characteristics of the A1 were the side-by-side seating of the two-seat models, the less-than-outstanding ejection system, and the single engine. (3,5,10)

3. The T-28A trainer aircraft was utilized by FACs during the early stages of the conflict in RVN and later in special missions elsewhere. The T-28A possessed tandem seating, a large canopy providing good visibility, and adequate ordnance/materiel delivery capabilities. (3,5,10)

4. In succeeding annexes, the OV10, O2A, A1, and T-28A will provide bases for recommendations in developing a FAC version of the AX aircraft.

APPENDIX I to ANNEX A--Comparative Data (OV10 and O2A)

	OV10 (15:363-4)	O2A (15:284-5)
PURPOSE	"light armed reconnaissance airplane specifically suited for counterinsurgency operations"	"equipped for FAC missions, including visual reconnaissance, target identification, target marking, ground-air coordination, and damage assessment"
CREW	Two men, in tandem, ejection system	Two men, side by side, no ejection system
ORDNANCE/MATERIEL CAPACITY	4 - 600 pound attachment points under sponsons, 1 - 1200 pound attachment point under fuselage, 4 - M60C machine-guns, 2 - sidewinder missiles. Total - 3600 pounds	4 - underwing pylons for stores. Will accept rockets, flares, or other light ordnance
MAXIMUM SPEED (Sea Level)	244 knots (no weapons)	173 knots
MAXIMUM CRUISE SPEED (Sea Level)	N/A	165 knots
TOTAL USABLE FUEL	258 gallons*	122 gallons
SERVICE CEILING	N/A	18,000 feet
RANGE (Maximum Speed)	N/A	655 nautical miles
(Cruise Speed)	N/A	1115 nautical miles

* 230 additional gallons of fuel may be carried in an F102 tank on the center stores attachment point (13)

ANNEX B--The AX Aircraft

1. The Commanding General of TAC, General W. W. Momyer, described the AX in a prepared statement on close air support (CAS) for the Cannon Subcommittee of the Senate Armed Services Committee. (9) The AX is currently being developed to replace aging close air support aircraft such as the A1, T-28A, A26, and other propeller-driven aircraft. The Northrop A9A and Fairchild A10A are now being tested at Edwards Air Force Base and, should USAF requirements ~~be met~~ for performance and unit cost be met, one of these models should be accepted into the USAF inventory. (11)

2. In his statement, General Momyer listed numberous characteristics of the AX that would be acceptable in a FAC aircraft. The AX purportedly will combine the capabilities of "fast enroute time from ground or airborne alert" and long loiter time. The stated ordnance delivery capability will be 16,000 pounds including bombs, 30 millimeter (mm) guns, maverick missiles, and other ordnance. The AX will be able to take off with a 9500 pound ordnance/materiel load, fly 250 nautical miles, loiter two hours, and return to the base from which it launched. The planned capability of the AX being able to take off from between 1000 and 4000 feet of unimproved airfield is excellent for FAC purposes. The AX will feature foamed fuel tanks, of which one will be self-sealing; multiple engines and flight controls; and armor plating for the cockpit, engines, and flight controls. General Momyer stated that the AX will be capable of "massive attacks against a variety of widely separated targets." (9) The characteristics enabling the AX to perform this flexibly should permit the AX to adapt very well to the FAC role.

3. Several recent publications contain excellent articles regarding the development and current status of the AX. Copies are attached as Appendices to this annex. (1,4,11,12)

4. Between 10 and 20 percent of AX production models are programmed to be two-seat models. (13) Modification of these two-seat AX aircraft offers a most promising prospect for future FAC aircraft.

ANNEX C--Cockpit Facilities and Survivability

1. The "FAC rider" is essential to optimum FAC support for reconnaissance teams. His duties consist primarily of communication with deployed reconnaissance elements and relaying information either to the parent unit or the FAC pilot. Should the team require aerial resupply, mission guidance, assistance from tactical air support, or other assistance, the "FAC rider" should be able to coordinate their requests with the appropriate agency. Ideally the "FAC rider" should have previous reconnaissance experience and training in his role as observer for the FAC pilot. (2,3,5,6,7,8,10,14)

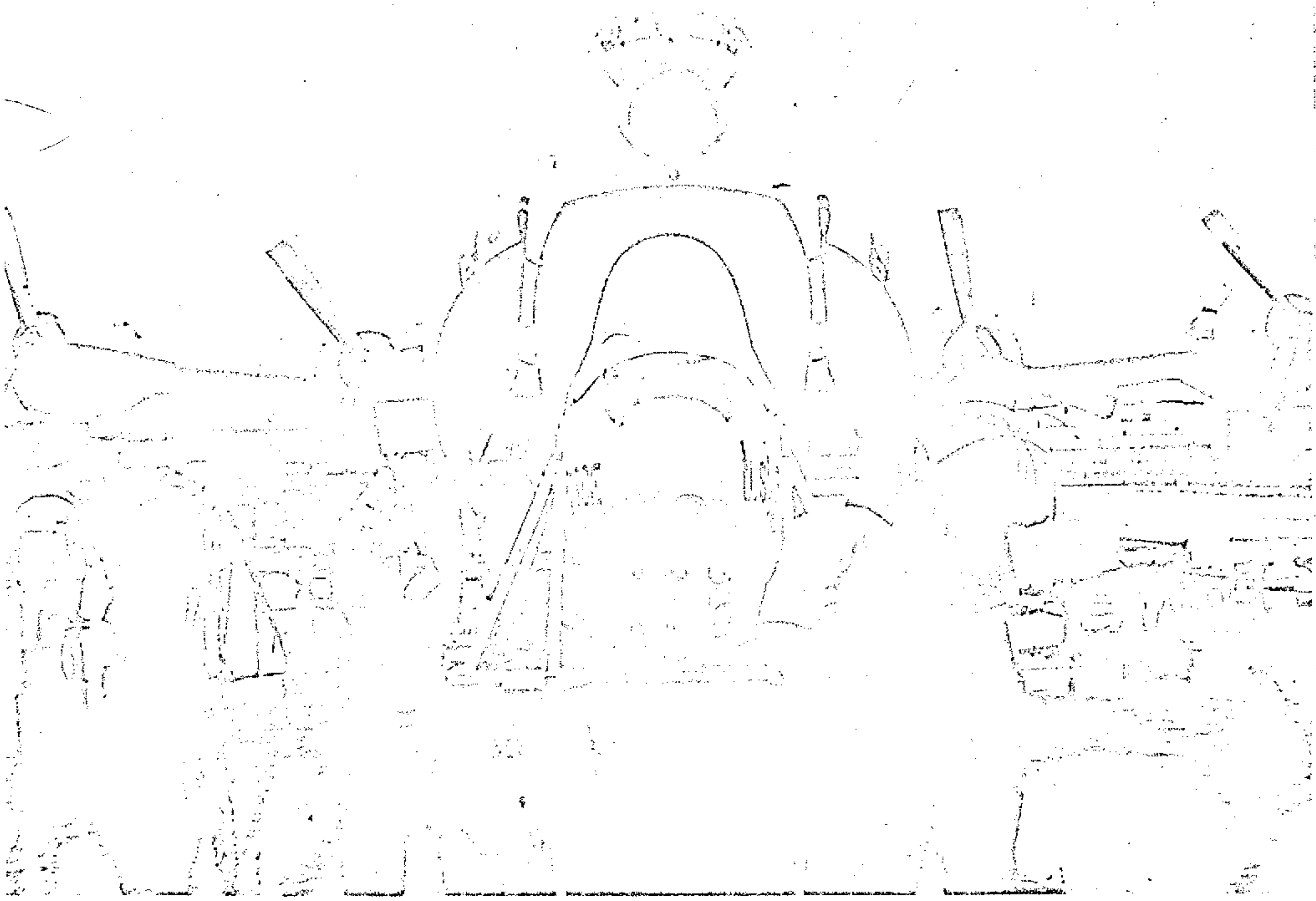
2. The duties of the "FAC rider" require his being able to see the same locations and events simultaneously with the pilot. This is virtually impossible in an aircraft with side-by-side seating. As the pilot banks or turns the aircraft to observe from his side of the aircraft, the "FAC rider" is banked upward and is able to observe only skyward from his window. The O2A and two-seat A1 are examples of this poor seating arrangement. The OV10 and T-28A feature tandem seating which enables both crewmembers to observe from the right or left side simultaneously. The pilot and "FAC rider" may thus coordinate placing of ordnance, direct helicopter approaches, or locate friendly positions much more quickly and efficiently. (2,3,5,6,7,8,10,14)

3. Maximum visibility is required in a FAC aircraft to enable the crew to quickly locate friendly positions, detect enemy ground fire, and maintain visual contact with other aircraft working in their immediate area. The windows in the O2A make 360-degree visibility extremely difficult. The greenhouse-like canopy of the OV10 is much more satisfactory. If at all possible, the canopy should be bulletproof due to the low working altitudes, slow speeds, and high exposure to ground fire inherent to FAC operations. (2,3,5,6,7,8,10,14)

4. The relatively high exposure of the FAC aircraft to enemy fire also necessitates adequate safety features. An ejection system for the crew should be installed in the FAC aircraft. If their aircraft is disabled at low altitudes, the crew of the O2A is in serious trouble as they must bail out quickly and hope there is enough altitude for their parachutes to open. The OV10 ejection seat is capable of a safe ejection at zero feet of altitude and zero knots forward speed, making it possible to eject under virtually any combat situation, other than aircraft inversion near ground level. Should small arms fire damage the flight controls of the pilot, rear-seat flight controls would enable the observer to fly the aircraft back to a friendly recovery base. Instrumentation for the rear seat should include as a minimum, a compass, altimeter, and a Tactical Air Navigation System (TACAN). Fuel tanks should be foamed to prevent explosion and fire. A sufficient number of tanks should be self-sealing to preclude complete loss of fuel due to small arms damage. Armor plate should protect the crew area, flight controls, and engines. The aircraft should be a multi-engine model with the capability of flying on one of the engines. The O2A is unable to fly very far on a single engine, while the OV10 can fly well on one of its engines. (2,3,5,6,7,8,10,14)

5. The AX, as currently planned, fulfills most of the desirable cockpit and survivability requirements. The cockpits shown in photographs of the A9A and A10A permit good visibility. An ejection system;

redundant engines, flight controls, and instruments; foamed and self-sealing tanks; and armor plating are all included in product development requirements. The seating arrangement for two-seat models is unknown to this author. If the seating is to be tandem, the AX will be an excellent FAC aircraft from the cockpit facility and survivability standpoint. (11:16-18)



After completion and rollout at Republic Div.'s Farmingdale, N. Y., plant, the A-10A was disassembled and loaded aboard two McDonnell Douglas C-124s for shipment to Edwards AFB, where it was reassembled preparatory to first flight. Fuselage (above), with engines, wings and empennage removed, is aligned with C-124 cargo bay on the ramp at Farmingdale after being dollied from plant to foot of loading ramp (below, left). Technicians check clearances (below, right) as wing moves into the transport.

1972. At that time, the program was seven weeks ahead of schedule, according to Tizio.

"The pace was brisk, we didn't loaf," he added.

Despite the brisk pace, many hundreds of hours of wind tunnel work—both in government facilities and in private ones where time was purchased—went into proving design concepts. These included tests simulating power-on conditions with the aircraft.

As a result, Tizio said, "we've had no surprises so far [in the flight test program]."

If any problems emerge that require modification, it will be done to both aircraft, he said, following the emphasis on providing the Air Force two "essentially production aircraft" for the flyoff.

Again, despite the brisk pace, the flight test program is being conducted as cautiously as possible with a strong emphasis on safety.

The No. 1 A-10A was rolled out here ready to fly and could have been tested from the airport at the Republic Div. plant. But Farmingdale is surrounded by suburbs and some wooded areas, while Edwards is on a large, empty dry lake bed on which an emergency landing can be made almost anywhere if it should be necessary.

Tizio said the decision for Edwards cost two weeks. The wings, engines and empennage had to be removed from the A-10A, everything flown to Edwards in McDonnell Douglas C-124 transports and the aircraft reassembled there before flight testing could begin.

But the company was willing to accept the two weeks delay in the interests of safety.

Construction of the two prototypes was undertaken in an area of the Republic plant screened by a high wooden fence that is prominently labeled "Tiger Works."

In building the two aircraft, Tizio said the company is using "semi-hard tooling." He explained that it is hard enough to build more than just the two prototypes but it is not high production tooling.

"We're preparing right now for production," he said, "organizing our people and developing production concepts as well as doing design layout on tooling." But he noted this manufacturing design-type work stopped short of capital investment.

As much of the aircraft as possible was built in-house at the Tiger Works.

Where it was necessary to go outside for subsystems, relations with suppliers were conventional except in two respects, Tizio said. They were asked to propose on only sufficient quantities for the two prototypes, and less data was required than would be the case in a production program.

In this regard, Tizio cited the Aeronautical Systems Div. AX systems program office headed by Col. James E. Hildebrandt "for keeping paper work and documentation to a minimum, while keeping communications open at all times."

He said that all the necessary data are in hand in the plant here, but a lot of time, work and expense would be involved in organizing them into formal documentation for the Air Force.

But, because of the way the program was being managed, these data are being saved, he said.

A key design decision in the A-10A development was the selection and placement of the engines, each of which provides approximately 9,200 lb. of thrust.

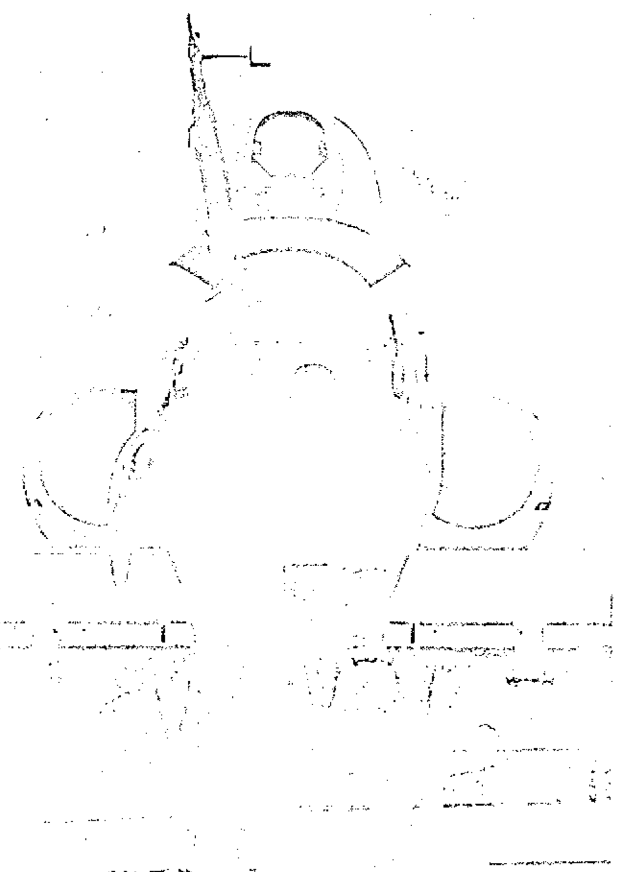
In the course of its development for the S-3A, the engine was flown for 200 hr. on a Boeing B-47 testbed and is currently flying on the S-3A prototypes.

In addition, it has been selected to be the powerplant for the USAF/Boeing EW-3A airborne warning and control system (AWACS) aircraft. With research and development support from these programs, the TF34 had the advantage of a low-risk, relatively low-cost approach, Fairchild believes.

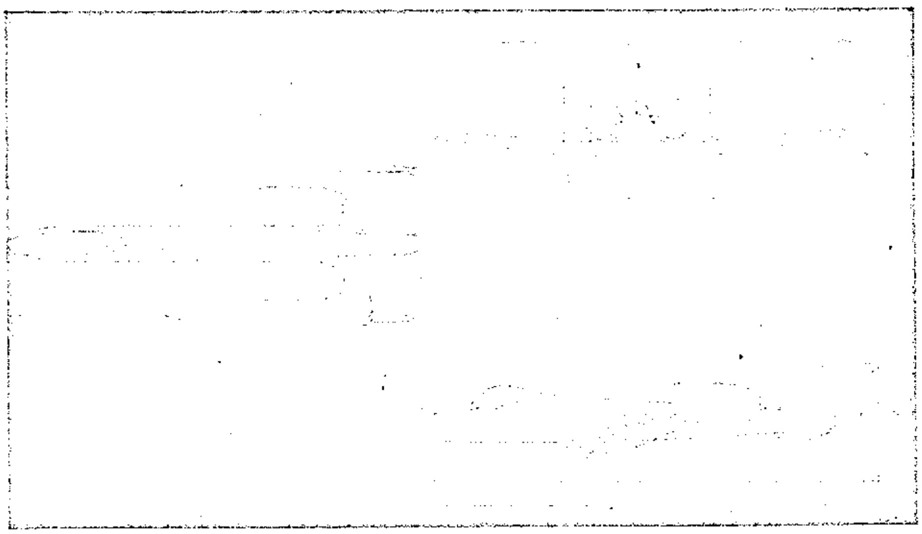
Placement of the engines on the fuselage just above and behind the wing was a decision that was reached after extensive engine location studies.

The position of the engines, Fairchild believes, offers a number of advantages for the aircraft:

- It permits a clear underwing and fuselage area for loading up to 11 pylons



View from right rear of A-10A (above) shows slight upward cant to the exhaust nozzles of General Electric TF34 engines. This reduces any exhaust impact on aircraft or other vehicles following during taxi and reduces danger to ground crewmen servicing aircraft with engines running for quick turnaround. Nose gear of the A-10A is offset from the centerline of the aircraft about 1 ft. to the right (right). This design feature allows center placement of the aircraft's nose-mounted gun, which minimizes the effect of recoil on both the aircraft's performance in flight.



Three-view drawing of A-10A shows many structural design features of aircraft.

with an unrestricted variety of ordnance. The A-10 has five pylons on each wing and one located on the fuselage centerline.

■ There is less vulnerability to foreign-object damage to the engines. This is an important consideration for an aircraft that will have to operate from rough, unsurfaced forward-area airstrips, Fairchild believes.

■ There is no danger of the engine ingesting gun gases from the 30-mm. cannon mounted in the nose of the aircraft fuselage.

■ Maintenance of the aircraft and reloading of ordnance for rapid turnaround of the aircraft can be performed while the engines are running with minimum hazard to the ground crews.

■ There is minimal jet blast effect to aircraft or other vehicles following the A-10A on the ground. This results from a slight upward cant from the horizontal that has been given the exhaust nozzles of the TF34s. Ground crewmen can walk upright behind the aircraft with the engines running and not get into the jet blast.

■ Mounting in separate nacelles on opposite sides of the fuselage reduces the likelihood of one engine knocking out the other in the event of structural failure of the first.

■ Fuel tanks are isolated from engine hot sections for safety.

■ Minimum engine noise reaches the cockpit. Fairchild believes this is a particularly good feature in minimizing crew fatigue for an aircraft like the AX, which will have a long loiter-time capability.

■ Positioning the engines outside the fuselage permits a simple, uninterrupted structure.

■ This is an optimum configuration for growth potential from the point of view of engine change and room inside the fuselage for additional equipment, Fairchild believes.

An added advantage of the low wing placement that resulted from the position of the engines is that it permitted the landing gear to be hung from the wings, according to Tizio.

This permitted a particularly wide landing gear track, which can offer maximum stability in operating from rough forward area landing strips.

The landing gear retracts into aerodynamically faired pods hung below each wing, with the wheel partially exposed in the retracted position. The added drag that resulted was acceptable due to sufficient power from the TF34s. The approach was adopted because it avoided any cutouts that could complicate wing design and prevent it from being as simple and low cost a structure as possible.

Except for the space occupied by the landing gear in the retracted position, the pods are hollow at this time. The space could be utilized, however, possibly by electronic countermeasures gear or other avionic equipment.

Offset Nose Gear

A particularly noticeable feature of the A-10A when it is taxiing is that the nose gear is offset about a foot to the right of the aircraft's centerline. This was done to allow a centerline nose position for the 30-mm. anti-tank gun, with a capacity for 1,350 rounds of ammuntion, that the Air Force specified for AX.

A similar solution was adopted by Northrop for its A-9A competitor in the program, but its nose gear is offset to the left.

Centerline positioning of the gun is important, Fairchild believes, in order to reduce recoil impact on both the performance of the aircraft in flight and on its structural members.

At present and probably for the flyoff competition, the AX prototypes are equipped with 20-mm. General Electric M-61 Gatling-gun-type cannon. The 30-mm. high-speed GAU-8/A gun that is to equip the production aircraft currently is under competition between GE and Philco-Ford and the Swiss Oerlikon 304RK, for which Hughes Tool Co. holds the U. S. license.

Another distinctive visual feature of the A-10A design is the sharply drooped wingtips. Wind tunnel testing showed that this wing design provided better lift capabilities at low speeds and minimized tip losses, according to Fairchild officials.

Use of the twin tail resulted from aerodynamic considerations following the placement of the engines, Tizio said.

Ailerons on the A-10A double as speed brakes, and, in the latter function, split and hinge upward and downward at the leading edge to slow the aircraft. Single-slotted flaps are inboard of the ailerons.

To assure simplicity and the lowest possible production cost, structural design of the A-10A utilizes single curvature and constant cross section to the maximum extent possible.

In addition to the engines, off-the-shelf subsystems used in the aircraft include landing gear, fuel and hydraulic pumps and electrical systems.

Forward Bases

To ease maintenance and spare parts supply at the austere forward bases from which the A-10A is designed to operate, much stress was placed on commonality of parts between the right and left sides of the aircraft. Parts that are interchangeable include the landing gear, ailerons, rudders, elevators, control actuators and engines.

Like its competitor, the A-10A has two primary hydraulic flight control systems and a manual backup system. The two hydraulic systems run along opposite sides of the aircraft to reduce the possibility of both being knocked out from a single hit by enemy ordnance. The A-10A can be flown on either system alone. In the event that both hydraulic systems should be damaged or fail, a manual control system is available to insure that the pilot can return the aircraft to its base.

The A-10A also incorporates emergency "go-home" fuel in self-sealing, foam-filled tanks, another feature common to both competitors in the program.

The A-10A is 52 ft. 7 in. in length, 14 ft. 5.5 in. in height and has a wingspan of 55 ft.

Test Flights

During the contractor flight testing stage at Edwards AFB preceding the competitive flyoff by pilots from both the Air Force Flight Test Center and the Tactical Air Command, the eventual operating command for the AX, Tizio estimates Fairchild will put a total of "a couple of hundred hours" on test flight of the two prototype A-10As.

But he emphasizes that this is only a ballpark figure that could be subject to considerable change, depending on what Fairchild learns as it progresses in the program.

The A

As a potential future addition to the tactical inventory, the A-X specialized close air support aircraft is generating increased interest. Because of the competitive nature of the prototype development, much of the specific information concerning each contractor's version of the aircraft is properly classified as "Competition Sensitive" by the contractors and the Air Force and has not been released. Additionally, since a decision on production will not be made until a future date, detailed plans for integration of the A-X into the TAC fleet are not yet available. However, the rationale behind the A-X program, the established requirements for the aircraft, and some features of the prototypes are available.

The purpose of this article is to provide a look at this new item of equipment which is possibly on the horizon for force modernization. Many of you may fly the A-X, many others may work on it or support it in a variety of ways, and certainly many more will benefit from its addition.

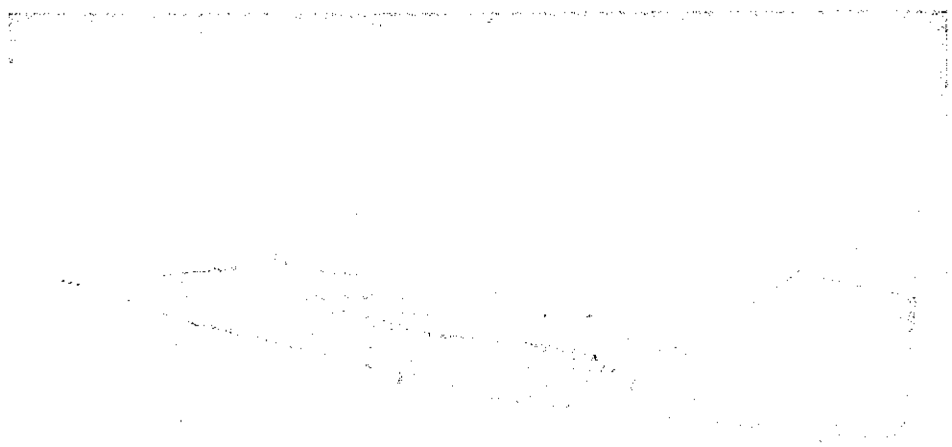
The Northrop A-9A and the Fairchild A-10A, the competing A-X prototypes, have flown successfully at Edwards AFB and are now undergoing flight testing and evaluation by contractor and Air Force personnel. TAC, as the principle operating command for this potential new weapons system, has been deeply involved in the development of the A-X and will be active in all further testing and evaluation of the prototypes until the source selection and production decision actions are completed.

This writer, as the TAC member of the A-X Systems Safety Group, has had the opportunity to examine both prototypes at various stages during design and construction and has even "logged" a little cockpit time in each. Both aircraft make a very favorable impression and, at this point, each appears to have an excellent capability to perform the required mission.

A-X EVOLUTION

Following a close air support study conducted in 1966, the Air Force directed that action be initiated for a new aircraft specialized for the close air support mission. Thus, the A-X concept was launched. Preliminary specifications were drawn up and design study contracts were awarded in 1967. Subsequent evaluation of these studies led to refinements in the specifications to achieve savings in size, weight, and costs. Formal Requests for Proposals were issued to 12 aircraft companies in May 1970 and six responded with proposals. In December 1970, the Air Force selected Fairchild Hiller (Republic Division) and Northrop Corporation as the finalists and awarded contracts totaling about $70 million for building and testing of two prototypes by each contractor. This "fly-before-buy" competitive procurement approach was a departure from the commonly used single-source selection for prototype construction and was possible due to the relatively low cost of the A-X program. With contract approval, Northrop and Fairchild initiated priority actions to complete design and construction of the prototypes under a closely supervised Air Force program managed by Colonel James E. Hildebrandt, System Program Director, Aeronautical Systems Division of AFSC at Wright-Patterson AFB, Ohio.

Prototype designations of A-9A for Northrop and A-10A for Fairchild were assigned as both contractors



X

by Lt Col William D. Neal, Jr.
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worked toward a first flight in June this year. Following several Air Force Design and Safety Reviews, the first prototypes were transported from each contractor's plant to Edwards AFB for additional ground testing and for the final safety inspection and review before flight. Both versions of the A-X were successfully flown in May. From prototype contract to first flights required less than 18 months. Slightly more than six months of intensive testing by contractor personnel and competitive evaluation by Air Force personnel, which includes mission suitability and overall maintainability, will be required before source selection is made and the anticipated production contract is awarded. If production is approved, up to 600 aircraft may be built at a contract cost per copy not to exceed $1.4 million (based on 1970 dollars and a total buy of 600).

WHY AN A-X ?

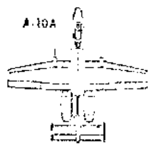
Close air support (CAS) is an Air Force mission, and experience in SEA has left no doubts concerning the operational requirement for a highly survivable aircraft that can provide rapid, accurate, and sustained support for ground troops, deliver a wide range of ordnance, and perform a variety of other important tasks such as escort and rescue support. The record established by those aircraft employed for these purposes in SEA speaks for itself and needs no embellishment. Few will belittle the accomplishments of aircraft such as the A-1, A-26, B-57, T-28, AC-47, and follow-on gunships, as well as the F-100, A-37, F-4, and others used to varying degrees in CAS and special missions; however, most of these are old vehicles and none were designed specifically for the roles into which they were pressed. Although the Air Force has proven that it possesses the flexibility to accomplish the mission with whatever equipment is available, to get the job done most efficiently and most effectively, an aircraft optimized for the role is required. One can hardly expect the same vehicle designed to intercept MIG 23s at 50,000 feet to be equally as effective at providing close air support for extended periods at low altitude.

So what characteristics should the A-X have? It would be desirable to include all the useful CAS capabilities of all previously used aircraft. Clearly, all these will not fit in one vehicle, so the essential capabilities were selected and a few more required characteristics added, based on projected needs.

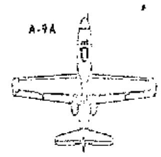
A-X REQUIREMENTS

The motherhood requirements of low cost, high effectiveness, and maximum survivability were appropriately amplified in the initial specification. The A-X would be a rugged, single-place, twin-engine aircraft with STOL capabilities for forward operations. It must possess excellent maneuverability with up to 16,000 pounds of external ordnance at speeds ranging from 120 knots to over 400 knots. The aircraft must also be capable of highly accurate weapons delivery, be easily maintainable to permit austere basing, and be able to survive intensive ground fire.

While the A-X concept called for a new design, it required no new technological development. The aircraft would have a conventional structure, turbofan engines



the A-X



requiring only modest development, and largely "off-the-shelf" avionics. Based on the requirements of the mission and in the interest of economy, sophisticated avionics for an all-weather capability were not specified; however, space provisions for potential growth were included. The basic avionics include a simple heads up display (HUD) giving airspeed, altitude, and dive angle; an optical sight with provisions for laser aiming; equipment for Maverick and Sidewinder missiles; TACAN; VOR/ILS; and UHF, VHF, and FM communications.

The specifications required rapid response with a top speed of over 400 knots, loiter times of one and a half to two hours with a mission radius of 200 to 300 nautical miles, and a fast turn-around capability for high sortie generation.

The required survivability called for armor around the cockpit and critical components, redundancy in flight controls and other systems, twin engines, blast resistant and redundant structure, and "go-home" fuel in self-sealing foam-filled tanks.

For firepower, the A-X specifications stated the requirement for an internally mounted, multi-barrel, high velocity, 30mm gun with a variable firing rate and over 1000 rounds of ammunition, and ten external stores stations designed to carry up to eight tons of ordnance including bombs, napalm, launchers, dispensers, missiles, or gun pods.

THE COMPETING CANDIDATES

The following details on the two versions are not necessarily an exact reflection of the final product, but serve to indicate how each competitor has elected to meet or exceed the minimum requirements.

The Northrop A-9A is a single-place, twin-engine aircraft incorporating straight wing, integrated wing root inlets, and a conventional empennage. It is powered by two Lycoming TF-102 engines (turbofan version of the T-55) each rated at more than 7000 pounds of thrust. The thick, high mounted wing has built-in camber to provide high lift capability and employs single slotted trailing edge flaps. Spoiler type lift dumpers are located on the wing upper surface above the flaps. The tricycle landing gear is conventional, and incorporates nose wheel steering.

The Fairchild A-10A is a single-place, twin-engine aircraft employing a low-wing, low-tail configuration with twin verticle stabilizers located at the outboard tips of the horizontal stabilizer. The two General Electric TF-34 turbofan engines, each with a thrust rating of more than 9000 pounds, are installed in nacelles mounted on pylons extending from the fuselage just aft of and above the wing. The forward retracting tricycle landing gear has short struts and a wide tread. The steerable nose gear retracts fully into the fuselage nose and the main gear retracts into streamlined fairings on the wing with a portion of the wheel permitted to protrude.

Both candidates employ hydraulically powered ailerons (decelerons) which double as speed brakes. The ailerons are split along the trailing edge and when opened serve as speed control devices while retaining roll control capabilities. Each candidate uses an offset nose gear to permit centerline mounting of the 30mm gun to eliminate yaw when firing. The cockpit location well forward of the wing provides excellent pilot visibility over both the side and the nose.

Based on design estimates and the prototypes that are now being tested, the approximate physical dimensions and estimated weights of the competing candidates are:

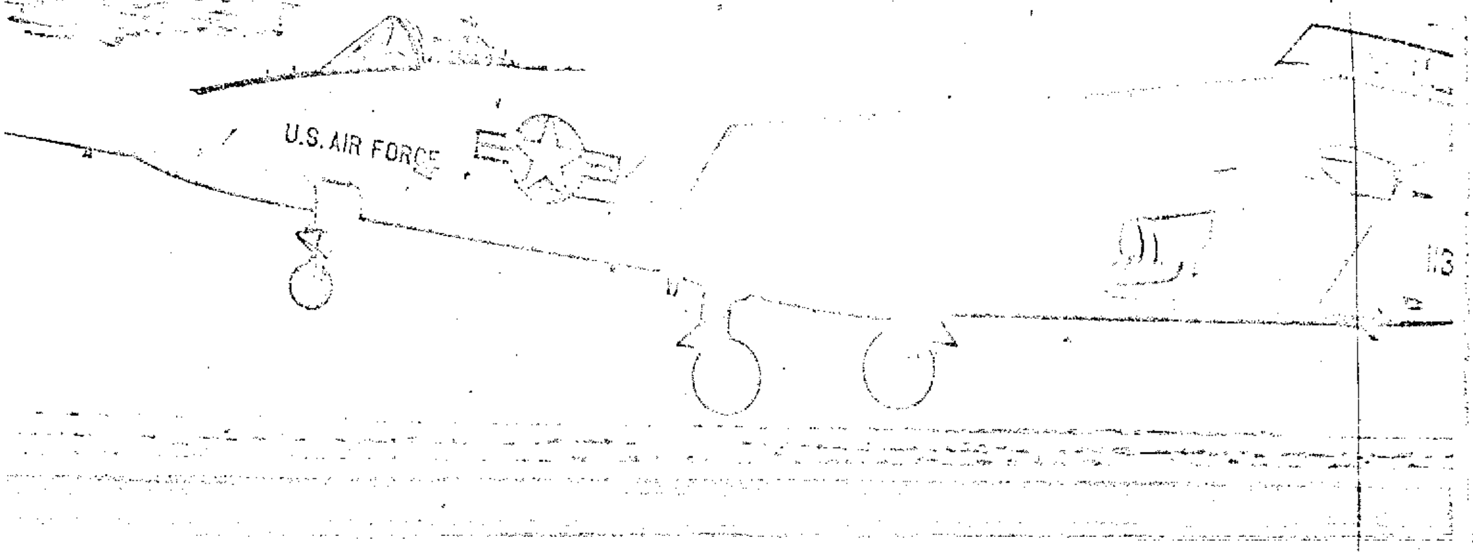
	A-9A	A-10A
Length	53 ft 6 in	52 ft 7 in
Wing Span	58 ft	55 ft
Height	16 ft 11 in	14 ft 8 in
Wing Area	580 sq ft	480 sq ft
Wing Loading (at BFDW)	43.0	58.0
Empty Weight *	19,457	18,618
Basic Flight Design Weight (BFDW)	24,950	27,842
Max Takeoff Gross Weight	41,300	43,800

* Cockpit armor is included in empty weight shown for the A-9A and is not included in that for the A-10A.

FINAL OBSERVATIONS

At this point, both the A-9A and the A-10A give every indication that they can perform the required job, which will make source selection a difficult task. From an operator's viewpoint, they both look like real flying machines with tremedous capabilities and each promotes a strong desire to pilot one in an operational unit. From a maintainer's or bomb loader's viewpoint, they both reflect that these tasks were major considerations in locating equipment and providing component access. Finally, from a safety viewpoint, the safety features designed into the system from the start and redundancy provided in subsystems included to enhance survivability will certainly contribute to reliability and safety in operation.

The A-X program deserves continued interest, for either an A-9 or an A-10 may well become the future Super Spad.



orthrop A-9A contender in the Air Force AX competition for a close-support aircraft takes off with Cessna A-37 flying chase.

AX Fighter Paved Way for Prototyping

right-Patterson AFB, Ohio–Air Force AX program to develop a highly-maneuverable, highly-survivable subsonic close-support aircraft is a concept forerunner to the USAF and Navy prototype projects now coming into being.

There are some similarities in the program management of the two—maximum contractor flexibility and a minimum of paperwork—but there also are some basic differences.

The advanced prototypes, such as the Air Force lightweight fighter, are being managed with a primary goal to expand the aerospace state-of-the-art envelope. The AX prototypes have been designed primarily to demonstrate an operational capability and, eventually, to support a production order for up to as many as 600 aircraft.

The Northrop A-9A and the Fairchild Industries A-10A on the verge of a competitive flyoff have been designed to go to full-scale production, if performance, cost and production proposals are satisfactory and, importantly, if program approval is given by the Air Force. USAF roles and missions in the close-close-support role vis-a-vis that of the Army with planned advanced armed helicopter have yet to be firmly defined—and probably won't be before the end of the year at least.

Essentially, what the Air Force wants from its AX program is exceptional low-speed maneuverability at low altitudes for accurate ordnance delivery in support of closely-engaged ground troops and a relatively high rate of survivability, including cockpit armor and structural redundancy.

During the prototype development and construction stage, the policy of the AX System program office (SPO) at Aeronautical Systems Div., headed by Col. James F. Hildebrandt, was to give Northrop and Fairchild a maximum degree of design latitude so long as the SPO was satisfied that the contractors were not doing anything that might jeopardize the safety-of-flight aspects of the program.

Hildebrandt and his office were closely integrated with the contractors during the prototype construction stage, now completed, but largely on an informal basis. Hildebrandt, for example, visited both Northrop and Fairchild once a month during this phase. Now, the office is deeply involved preparing for the flight evaluation and refining what amounts to requests for proposals to tell the two contractors just what is wanted in bid submissions for a full-scale development and production program.

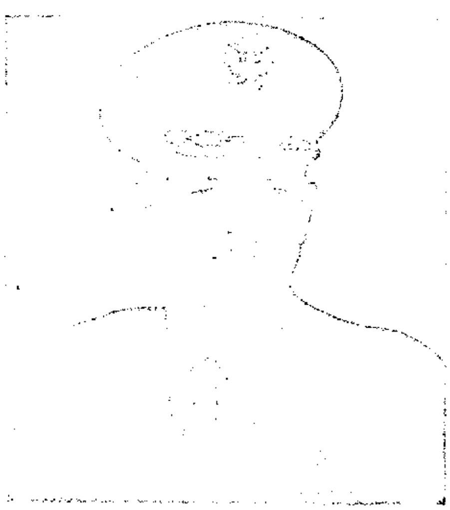
Company pilots are now flying their respective aircraft at Edwards AFB, Calif. The USAF flight-test evaluation of the two aircraft will begin Oct. 24 and continue through Dec. 23. Personnel from the Air Force Training Command, Tactical Air Command, Logistics Command and Systems Command will participate in the trials as well as officers from ASD. USAF evaluation flights will include 49 hr. devoted to aerodynamic qualities, 54 hr. to weapons delivery and 20 hr. to operational suitability. Two prototypes of both the A-9A and the A-10A will participate in the program.

The aircraft must demonstrate that they can achieve a 250-naut. mi. combat radius plus a 2-hr. loiter time on station and be able to take off after a 1,000-ft. ground roll with a 6,500-lb. useful payload. Maximum design payload is 16,000 lb.

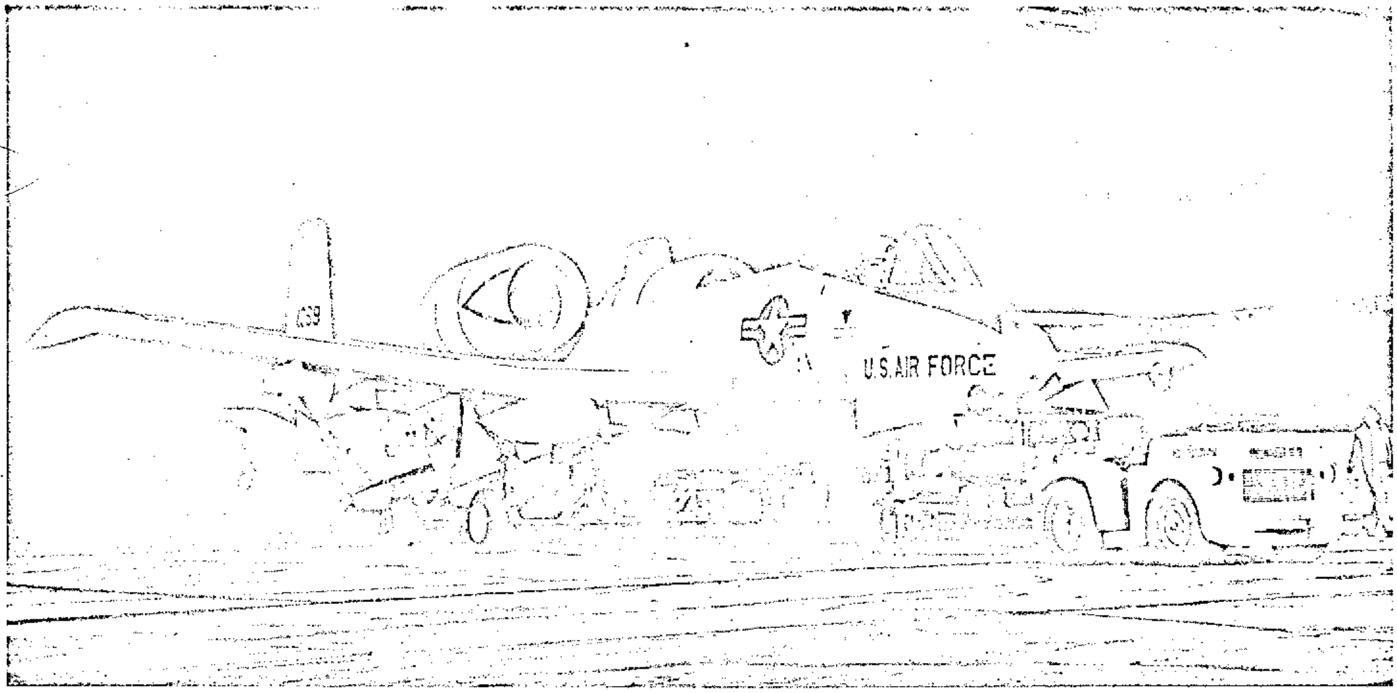
From a management standpoint, the AX SPO started life at a minimal level of manning. Approximately 30 persons were directly involved in the management and engineering aspects of the program. This figure now has grown to about 80, including administrative support representatives from the Logistics Command for Air Material Area logistics support and from the ASD Contract Management Div.

Despite its low-key aspects, the program enjoys a top priority among the Air Force development programs. Hildebrandt delivers progress-report briefings every three months to the USAF Air Council, the secretary and assistant secretaries and the chief of staff after review by ASD commander Lt. Gen. James T. Stewart and Systems Command commander Gen. George S. Brown.

One of the difficult problems the SPO faces is the interfacing of the hardware of two competing aircraft contractors with that of two competing contractors for the 30 mm. gun the production version of the AX is scheduled to carry. The two com-



Col. James F. Hildebrandt



Fairchild A-10A AX contender is shown on rollout from the Republic Div. plant prior to being shipped to Edwards AFB for flight testing.

panies bidding for the gun contract are General Electric and Philco-Ford. The gun will carry 1,350 rounds of ammunition, each weighing 1.5 lb.

To accomplish this, the SPO schedules meetings with all four contractors roughly at the same time but never in the same room in order to protect their design proposals from one another. In this regard, it requires four meetings to complete what is essentially one.

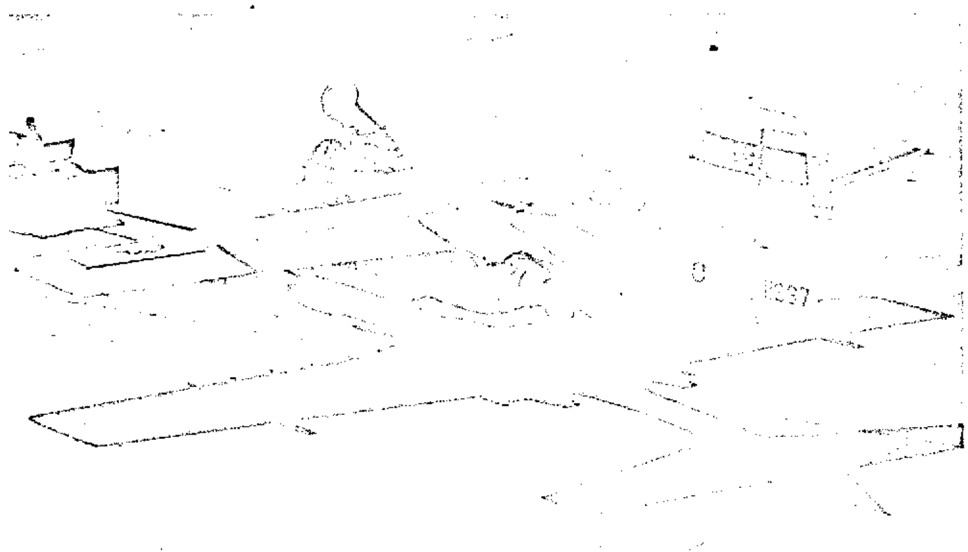
A shootoff between the competing prototype guns of GE and Philco-Ford is scheduled to be held at Eglin AFB, Fla., between January and March of next year, with a decision on a winner coming in May, approximately two months after selection of the AX aircraft has been made. Hildebrandt feels that he must have sufficient data in hand to demonstrate that the winning gun can be successfully interfaced with the winning aircraft before he can seek approval for a full development and production go-ahead.

The gun program at one point was 15 months behind the schedule of the aircraft project. But it was refined and accelerated in order to close the gap. One decision made to gain time was to drop the requirement for caseless ammunition, which is specified for the cannon on production versions of the USAF/McDonnell Douglas, F-15 air-superiority fighter.

Now, the prototype is scheduled to be fired in flight from the aircraft in January, 1974, and Hildebrandt hopes to have sufficient evaluation data to request an Air Force production decision by May of that year. Projected unit price for the complete system, including avionics, is $1.4 million in constant 1970 dollars based on a buy of 600 aircraft and a production rate of 20 a month. A smaller order or production stretchout would, of course, raise the unit price. Of the total, approximately $100,000 would go for avionics, including communications, navigation and a weapons delivery capability sufficient to operate under adverse weather conditions. The AX production version also can carry the Hughes Maverick air-to-surface anti-tank missile.

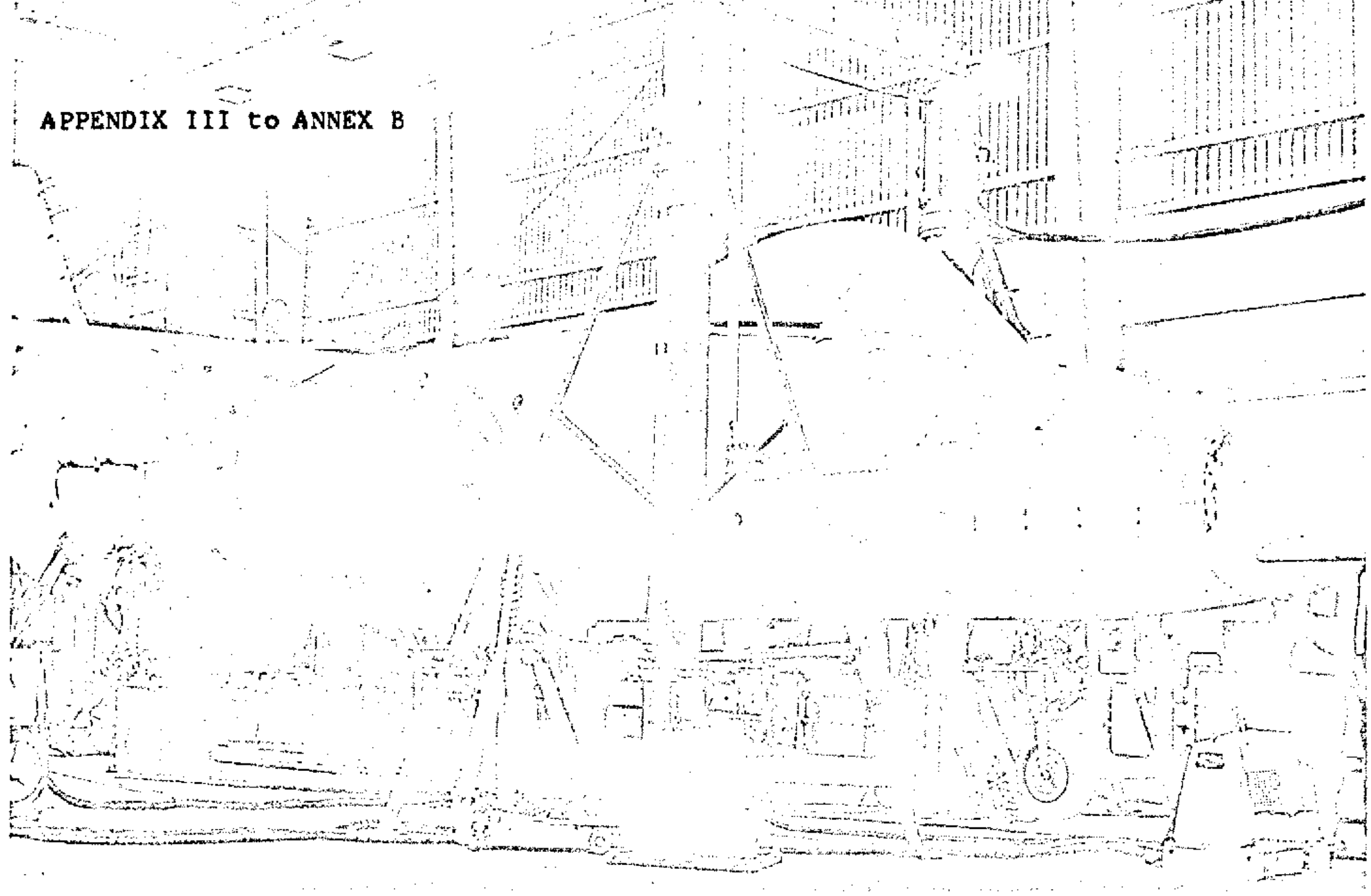
Another SPO management problem lies in the fact that the Northrop plant is under the cognizance of the Air Force, with a number of experts on hand for assistance in such fields as quality assurance, financial management, engineering and contract administration, while the Republic Div. of Fairchild Industries comes under the responsibility of the Defense Dept. Contract Administration Services Organization. The latter has relatively few people on site to provide technical/financial assistance, and the SPO has to make up the gap. In addition, Northrop can and does, receive progress payments within days of USAF authorization through the channels of the Air Force Contract Management Div. For Fairchild, it is a matter of weeks.

The AX as a concept began to form in 1966 when the Air Force let six-month study contracts to four companies—General Dynamics, McDonnell Douglas, Northrop, and Grumman—to define the requirements. The Defense Dept. approved a request for the Air Force to use requests for proposals in the spring of 1970, and the prototype production contracts were awarded to Northrop and Fairchild in December of that year.



Northrop A-9A is towed into place at Edwards AFB prior to the aircraft's first flight. Long flap tracks visible on the left wing would be removed on any production version of the aircraft, in which the flaps would be shortened. Dihedral in the horizontal stabilizer also would be removed in production aircraft.

APPENDIX III to ANNEX B



Northrop A-9A rests on air cushions while hydraulic jacks excite various [illegible] of the aircraft in order to determine the natural frequencies in torsion [illegible] a prerequisite before conducting flutter tests on [illegible].

Northrop Streamlines A-9A Management

Hawthorne, Calif.—Northrop Corp. used a small, independent, "skunk-works"-type organization to design and build its first two A-9A prototype attack aircraft for competition in the Air Force AX close-support fighter program.

An effort was made to keep lines of communications short, providing adequate control and visibility for the A-9 program manager. The project was granted as much autonomy as possible within the company. Engineering and manufacturing manpower never exceeded much more than 300 at any time during proposal preparations or fabrication of the first two prototypes. Those facilities and capabilities that were impractical to bring into the organization, such as wind tunnel tests and detail parts fabrication, were bought from other divisions within the company.

With the aircraft now flying and the development past its peak, emphasis now has shifted to preparation of a production plan that would be carried out by functional divisions within the company rather than the specialized program office should the program receive an Air Force go-ahead. Manpower has declined to about 150 at this point, most of whom are engaged in production planning. A small percentage of this total is supporting the flight test program at Edwards AFB, Calif.

The production planning effort began last November, and must be finished in time to prepare a full-scale development and production proposal for submittal to the Air Force in October, shortly before USAF begins its own competitive evaluation of the A-9A and the Fairchild Industries A-10. Proposal instructions from USAF are expected sometime around the end of June, and a production decision is anticipated as early as March, 1973.

Most of the remaining personnel within the A-9A program office at Northrop will begin transitioning back to functional organizations within the company during the proposal preparation phase of the program this fall. This will leave the program office with a core of 10-15 persons who will act as a matrix for the company's functional activities if and when a production contract is awarded.

Some of those who have transferred back to the functional divisions are acting as liaison between the divisions and the program office, coordinating the shifting of tasks to the functional organizations from the project office. Functional divisions provide support during the preparation of the production proposal, thereby establishing some familiarity with the program in case a production contract is awarded.

Northrop Aircraft Div. General Manager Welk E. Gasich has attempted to give all of his program managers a significant degree of autonomy since he took over the division last November. In the case of the A-9, program manager D. J. Deering is directly responsible for all costs on the fixed-price $28.9-million Air Force contract issued Northrop for the two prototypes.

A controller is assigned to the program office from the company's financial division. He handles all budgetary functions for the project. He also reports to the corporation's vice president of finance, thus providing an overview of the financial performance of the program. Other in-house program reviews also are conducted periodically, evaluating projects from both a technical and a cost standpoint.

Because of its prototype nature, the A-9 project is receiving very little direction from the Air Force at this point. As an undocumented program, relatively little data are transmitted to USAF, although the company submits an updated status report to the AX system program office each month—and a relatively brief technical narrative every two months—to keep the Air Force informed of the program's progress.

Northrop has put very heavy emphasis on cost controls in the A-9 program, sacrificing performance advantages in some areas for lower development and production costs. In this sense, it reflects the "high performance at low cost" philosophy Northrop has adhered to for the past several years. The company has been encouraged in this stand indirectly by the Air Force, which has indicated to the AX competitors that low cost is preferable to excess performance beyond stated requirements.

Air Force guidance in the AX prototype program calls for a simple, effective and easy-to-maintain aircraft at a unit flyaway cost not to exceed $1.4 million in 1970 dollars. This figure would be based on a total of 600 aircraft at a production rate of 20 per month. Included in these goals are requirements for short-field operating capability, maximum sortie rate, large payloads, long range/endurance capabilities, high survivability and weapons delivery accuracy with a wide range of weapons at delivery speeds of 150 to 400 kt.

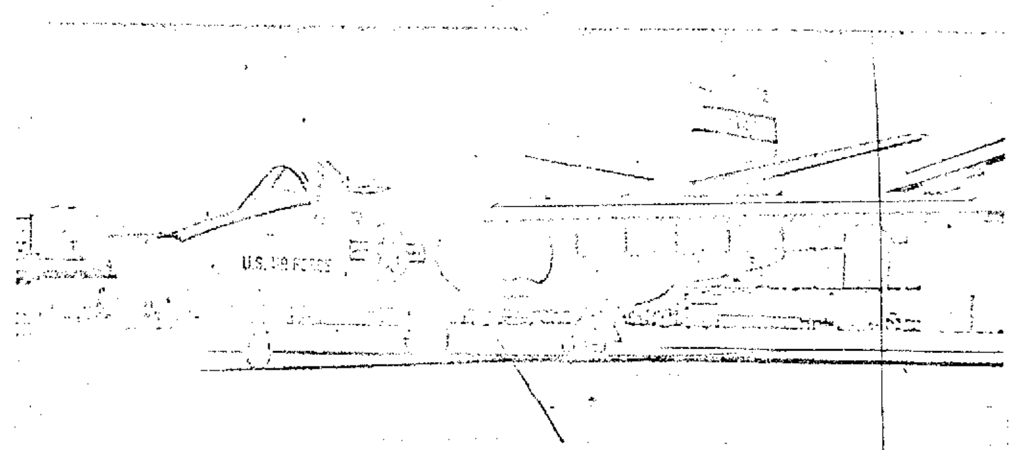
Northrop began its economizing early in the program when it opted to use the Lycoming F102 turbofan engine in the A-9A rather than the higher-thrust General Electric TF34 engine adopted by Fairchild for its A-10 prototype. The A-9A uses two of the F102-LD-100 engines, rated at 7,200 lb. thrust each. The TF34 is rated at 9,280 lb. thrust.

In choosing the smaller engines, the company had to trade off a number of performance benefits, but it managed to recover some of these by extending the wingspan by 7 ft. Using the TF34 would have provided a better turning capability, rate of climb and takeoff distance. However, it is believed that the larger wing with its increased area and aspect ratio will permit the A-9 to meet the Air Force's low-speed maneuvering and takeoff distance requirements, including a sustained 3.5g turn at low speeds.

Northrop program officials say it would have cost $150,000 to obtain this capability with higher-thrust engines, whereas the cost of increasing the wingspan to arrive at the same performance amounts to only $10,000.

Northrop also is using off-the-shelf hardware in a number of instances on its two prototype aircraft to reduce development costs. The same items would not be used if the aircraft goes into production, engineers say, but articles specifically for the A-9 could be fabricated at low cost and low risk when the time came. The borrowed equipment includes:

- Main landing gear struts from the McDonnell Douglas A-4.
- Wheels and brakes from the Grumman Gulfstream 2.
- Nose landing gear and strut from the Northrop F-5.



Cockpit canopy on Northrop A-9A offers 360-deg. visibility. Each wing has five pylons capable of carrying up to 10 500-lb. Mk. 82 bombs. The engine inlets and nacelles are sized to accept either the currently installed Lycoming F102 engine or the higher-thrust General Electric TF34 powerplant.

- McDonnell Douglas Escapac 2 ejection seat developed for the Lockheed S-3A.

A-9 project engineers at Northrop have had to devote much of their attention to production aspects of the aircraft. Deering says more effort is being spent on a day-to-day basis on production planning than on any other aspect of the program, including the building of the two prototypes.

Producibility studies have resulted in the adoption of several interchangeable left side and right side components on the A-9. These include the engines, main landing gear, flaps, speed brakes, ailerons, elevators, spoilers and a number of other articles. Engineers are still looking at other areas where the same technique might be applied.

The outcome is that only one part needs to be produced and stocked for both sides of the aircraft. Northrop expects to cut production and support costs considerably with this figure.

The A-9 in its current state is a single-place, twin-engine aircraft designed to provide close-support fire, armed escort and armed reconnaissance against intensive enemy ground threats. The engines are mounted in nacelles on either side of the fuselage just beneath the trailing section of the wing. The aircraft has large horizontal and vertical stabilizers, with the fixed horizontal stabilizer located about midway between the top and bottom of the vertical stabilizer.

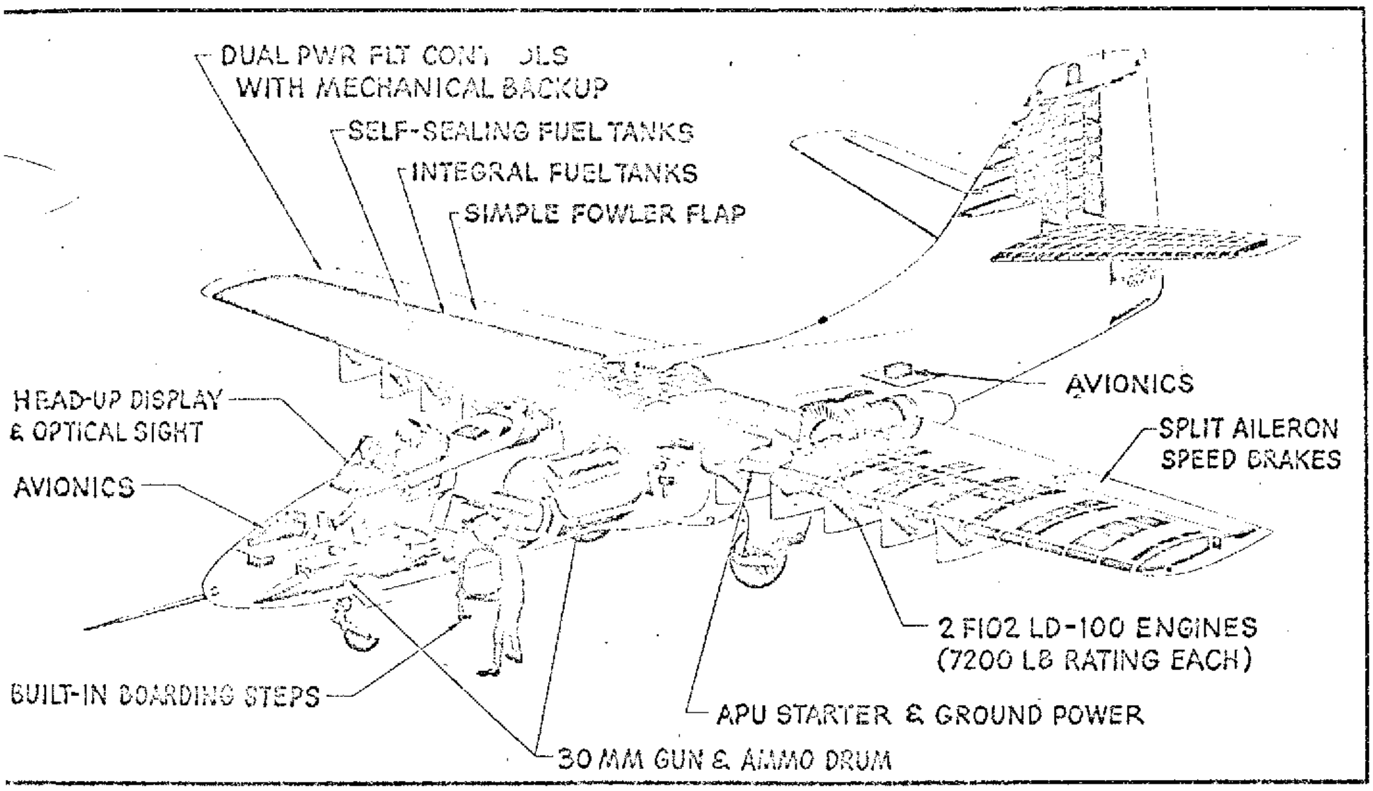
The 30-mm. Gatling-gun-type cannon that the Air Force plans to use on its AX aircraft will be mounted in the belly of the A-9, with its barrel extending from a slot in the fuselage beneath the cockpit to a point just ahead of the aircraft's nose gear. The gun will be mounted along the longitudinal centerline of the fuselage to reduce recoil effects on the aircraft, particularly in the yaw axis. As a result, the nose landing gear and strut have been displaced about 12 in. to the left of the centerline.

The 58-ft.-long wing has five hardpoints on each side for carrying a maximum of 16,000 lb. of mixed ordnance externally. Current plan is to carry up to 18 Mk. 82 bombs weighing 500 lb. each, using double ejection racks on each of the hardpoints except the outboard one on each side.

The two prototype aircraft have large Fowler flaps that cover about half the span of the wing on either side of the fuselage. Wind tunnel and simulator tests, however, have shown that the flaps need not be as large as they are now in order to meet the low landing speed requirements of the AX. As a result, North-

Northrop A-9A Performance

Basic mission design weight	
(750 rounds, six 500-lb. bombs, 150-naut.-mi. radius, 1-hr. loiter)	25,000 lb.
Maximum takeoff weight	41,000 lb.
At basic mission design weight:	
Maximum speed at sea level	450 kt.
Rate of climb (5,000 ft. MSL, tropical day)	5,000 fpm.
Turn radius at 150 kt.	Less than 1,000 ft.
Design mission takeoff weight	
(18 500-lb. bombs, 750 rounds)	40,000 lb.
Takeoff ground run	4,000 ft.
Radius/loiter	250 naut. mi., 2 hr.
Takeoff and landing ground run, forward airstrip operations	
(four pylons, four 500-lb. bombs, 750 rounds)	1,000 ft.



-9A airframe is simple and rugged, with redundant main structural members. Each wing has three separate fuel tanks.

-p will reduce the size of the flaps some-hat on any production version. Total ing area with the flaps retracted is about 30 sq. ft.

Large ailerons on the outboard third of e wings are split into upper and lower ctions and serve as speed brakes as well s ailerons. Flap-width spoilers are pro-ided on the upper trailing edge of the ing to dump lift in short-field landings.

Location of the horizontal stabilizer at e approximate center of the vertical sta-lizer is low enough to keep structural mplexity down, but high enough at the me time to keep the horizontal stabili-r out of the downwash from the wing. orizontal stabilizer on the two pro-type A-9s has a 10-deg. dihedral, but rther studies conducted since the A-9 esign proposal was submitted to the Air orce last year have determined the dihe-ral to be unnecessary. It would be elimi-ated in production aircraft. Conven-onal elevators and trim tabs are used on e horizontal stabilizers.

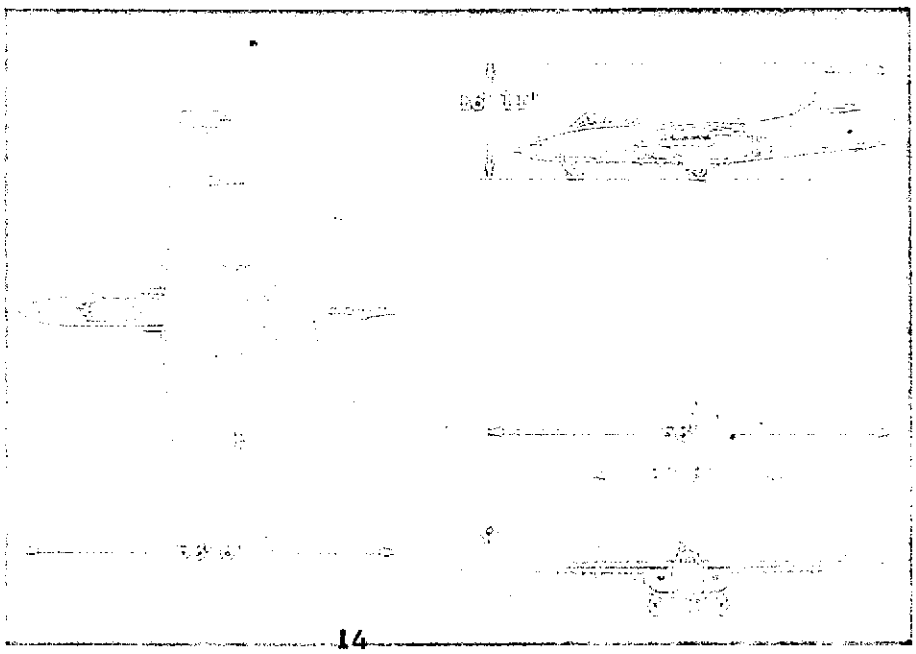
Rudder and vertical stabilizer on the -9 are unusually large, providing a high egree of directional stability. In addi-on, the large, movable rudder surface is n essential element in the side force con-ol system used in the aircraft. This sys-m makes use of the rudder and asym-etric application of the split-aileron peed brakes to provide sideward forces n the aircraft without the need for bank-g.

Under this system, when the pilot steps n the left rudder pedal to move his air-aft left for target alignment, the rudder eflects to the right. At the same time, the eed brake on the left wing opens up-ard and downward, creating asymmet-ric drag to prevent the aircraft from yaw-ing to the right. The result is a balanced sideward force to the left.

Ability to displace the aircraft side-wards without banking and S-turning eliminates resulting yawing and pitching reactions that tend to delay or upset tar-get lineup. The pilot will activate the sys-tem with a switch in the cockpit, possibly on the stick or throttle. On the prototype aircraft, it is located on the stability aug-mentation control panel just behind the throttles, but program officials have not yet decided where to put it in the final configuration.

Purpose of the switch is to reverse rud-der throw so that the rudder deflects in the opposite direction from rudder pedal application rather than in the same direc-tion, as it does under normal circum-stances. It also isolates the aileron/speed brakes from one another. A decision on the location of the switch will be made before the two prototypes are turned over to the Air Force for testing in October.

Computer and simulator studies at Northrop indicate that, in a nominal 275-kt., 45-deg. bombing run, the A-9 would achieve twice the tracking accuracy with side force controls as without. With other factors considered, however, this advan-tage would diminish to a 20-30% im-



ovement in total weapons system accu-cy with the controls.

Application of this concept is the out-owth of flight tests conducted jointly by orthrop and Cornell Aeronautical Lab-atory, Inc., which concluded that direct de force control significantly improves e pilot's ability to acquire and track a rget.

As a further consideration to weapons elivery accuracy, the A-9's two Lycom-g engines are mounted as close as pos-ble to the aircraft's center of gravity to inimize pitch trim changes required by ianges in power. At the same time, their roximity to the aircraft centerline results i limited yawing under engine-out con-itions.

The only stability augmentation cur-ently used on the A-9 is a yaw damper ystem. Engineers do not anticipate the eed for further augmentation, but they ill look at a possible requirement for itch stabilization during the flight test rogram.

Survivability was heavily stressed by he Air Force in its performance goals for he AX, and a number of design features n the A-9 are aimed at meeting those ob-ectives:

- Airframe is of simple, rugged con-truction with redundant critical struc-ural members, so that the aircraft can ose a major structural member and still eturn safely.
- Numerous access doors on the air-raft are fixed to blow out easily in case of an internal explosion, thereby reliev-ng pressure and preventing more serious damage.
- Dual redundant hydraulic systems and flight controls, with a manual backup mode for the controls. Control cables, ac-uators and other components are widely separated throughout the aircraft to min-imize the possibility of knocking out mul-tiple systems with a single hit. Primary flight controls are all mass balanced, with leading edges of the control surfaces well forward of hinge lines to allow for man-ual control, which engineers describe as "uncomfortable but manageable."
- Three independent foam-filled fuel tanks in each wing to minimize fire dan-ger and massive fuel loss. One tank in each wing is self-sealing to provide "go-home fuel" in case of loss from hits in the other tanks. The two prototype aircraft have five tanks in each wing, but this ar-rangement is considered too complex and would not be used in production aircraft.
- Heavy armor bathtub around and beneath the cockpit to protect the pilot from hostile fire.
- Twin-engine reliability. The engines themselves are relatively [illegible], and Northrop engineers originally con-sidered putting an armor wall inside the airframe between the two engines so that they would not both be damaged by a single hit. But this was ruled out after studies showed that a round penetrating [illegible] through the side of one engine would generally be stopped before reach-ing the other.

With these features, Northrop esti-mates aircraft and crew losses could be reduced by 90% in Southeast Asia with the A-9, using the same tactics now em-ployed by current operational aircraft. In the hostile environment in which the air-craft could be employed, Northrop offi-cials say the A-9 would reduce sorties re-quired per target, thereby reducing pilot and aircraft losses per target and reducing force size and cost for a given target ar-ray. With a fixed force, it would mean an increase in the number of targets de-stroyed.

For maintainability, the aircraft is ar-ranged so that nearly all maintenance work can be performed from the ground level. Engines are at approximately chest height on either side of the fuselage, and Northrop engineers say trained mainte-nance crews should be able to remove and replace an engine in about 30 min.

Engine accessories are mounted sepa-rately from the powerplants on pallets within the nacelles. The accessory pallets are interchangeable without modification between left and right engines, and can be lowered from the nacelles for mainte-nance after disconnecting a short drive shaft between the pallet and the engine.

Avionics have been standardized for both competitors during the AX flyoff and include a fixed-reticle optical sight with headup display and standard UHF and VHF communications/navigation equipment. These items probably would be replaced by a somewhat more sophis-ticated a[illegible]gement in a production ver-sion of the aircraft.

Other differences between prototype aircraft and possible production versions include:

- Substitute 20-mm. cannon until a suitable 30-mm. linkless, high-velocity, high-rate-of-fire gun is available. This program now is in the prototype develop-ment stage also.

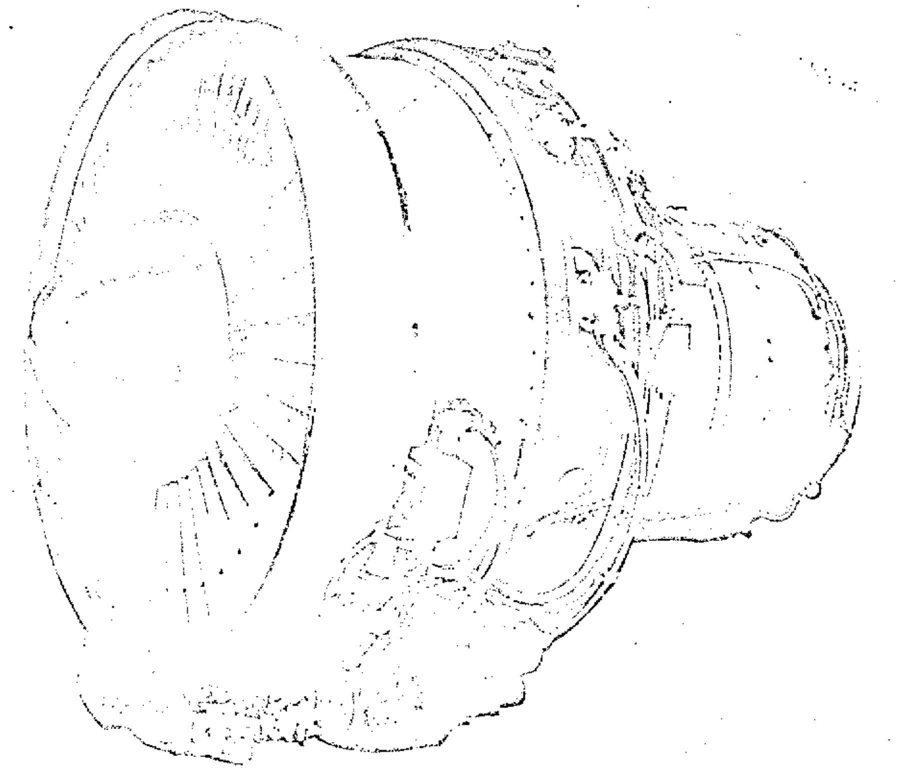
Another option concerns engines for the A-9—the aircraft is configured to ac-cept either the currently-installed Lycom-ing F102 or the higher-thrust GE TF34 turbofans.

Northrop engineers say they would like to leave the door open for the higher-thrust engines should the Air Force ex-press a desire for more power in the air-craft. USAF has the option of specifying the engine it prefers. Northrop selected the F102 as the prime engine because it met all performance requirements with the least acquisition and operating costs.

The engines can be switched with no changes in the basic airframe. Ducts and inlets are sized to accept both. However, an additional engine mount would have to be attached to the fuselage to secure the GE powerplant because it is longer than the Lycoming engine. Also, a larger auxiliary power unit and engine starter would be required.

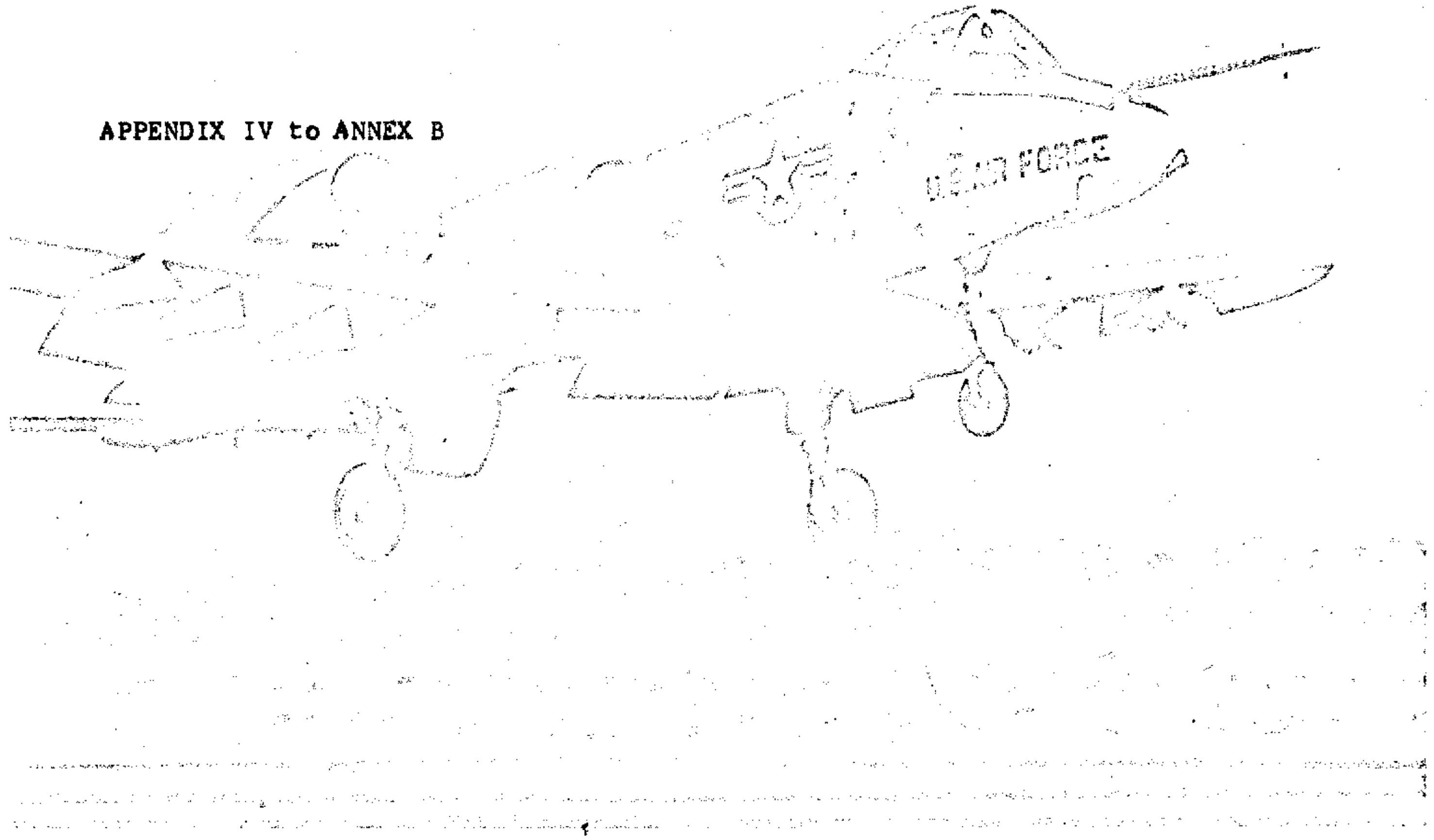
"It wouldn't be an overnight job," says Deering of a possible switch, "but it can be done without too much trouble."

Lycoming completed 60-hr. prelimi-nary flight rating tests on the F102 in late March, and Northrop and the Air Force issued approval of the tests in late April.



Avco Lycoming F102-LD-100 turbofan engine for the Northrop A-9A AX close-support aircraft is rated at over 7,200 lb. of thrust.

APPENDIX IV to ANNEX B



Fairchild Industries Republic Div. A-10A entry in the AX flyoff competition makes its first flight from Edwards AFB, Calif.

A-10 Prototype Designed for Production

By Woods Hansen

Farmingdale, N.Y.—Fairchild Industries, Inc., is placing strong emphasis on delivering two prototypes for the Air Force AX close-support aircraft flyoff competition that are as close as possible to a production version.

The Fairchild entry in the competition is designated the A-10A, one of which is now in flight test at Edwards AFB, Calif. The other has been completed at the company's Republic Div. here and shipped to Edwards where it is being readied for first flight.

The A-10A is a single-place, low-wing, twin-tail design with the engines hung from opposite sides of the fuselage just behind and above the wing in what Fairchild describes as "Caravelle style."

Vincent Tizio, program manager for the A-10A at the Republic facility, said the approach in the company's design of the aircraft was related more to the goals of the program than to its being in the first competition under the Air Force's new policy of prototype flyoffs for aircraft.

In most military combat aircraft developments, he noted, design is toward an advanced performance parameter, frequently with a weight constraint that may be a factor in the desired performance. Cost becomes a function of what it takes to achieve these specifications.

In the AX competition, he added, the design goal is to combine performance capabilities that already have been achieved into an optimum aircraft for the close-support role and environment, with an ease of maintainability for operations from austere airstrips close to battle lines.

"We were given a $1.4-million bogey," Tizio said. This is a target unit cost for the production aircraft, which the Air Force says is based on a possible production run of 600.

"There is strong emphasis on meeting requirements, but for minimum cost," Tizio said.

This led to maximum utilization of off-the-shelf components and subsystems wherever possible in the A-10A design.

"We made many, many trade-off studies on cost, maintainability and performance," according to Tizio.

An example of the off-the-shelf equipment is the General Electric TF34 turbofan engine that powers the A-10A. It originally was designed for the Navy/Lockheed S-3A carrier-based antisubmarine warfare aircraft.

"We worked hard with GE to come up with a less expensive [way to produce the] engine," Tizio said. "And we had to take some performance and weight penalties, but we got it."

Other examples of state-of-the-art and minimum-cost orientation are the use of brazed rivets, a minimum of honeycomb and no composites.

Tizio calls it "basically a state-of-the-art aluminum airplane."

No static or fatigue test articles or major component testing are required by the Air Force under the present contract for the two prototypes, although the company has done some component testing on its own.

Fairchild is working under a $41.2-million firm fixed-price contract for production and development testing of the two prototype A-10As.

"Going fixed-price on research and development on a new airplane is a sporty course," Tizio said.

The contract was issued to Fairchild in late December, 1970, and first flight of the No. 1 A-10A was made on May 10, ANNEX D--Ordnance/Materiel Delivery

1. An extremely important capability the FAC aircraft should possess is accurate delivery of ordnance or resupply. In most situations encountered in RVN, reconnaissance teams could anticipate waiting between 30 minutes and one hour fortactical air support after the FAC had requested the air support. The O2A has very limited ordnance delivery capability. The OV10 armed with 14 high explosive (HE) rockets, 14 white phosphorus (WP) rockets, and four M60C machineguns can normally suppress the fire and movement of up to a platoon of enemy for approximately 45 minutes to one hour. An even greater ordnance delivery capability is desirable for future FAC aircraft. (2,3,5,6,7,8,10,14)

2. Resupply of reconnaissance units is not normally desired, as their position is almost surely compromised by an air drop. Should aerial resupply be required due to shortage of ammunition, rations, water, or special equipment, the FAC should be able to deliver a container accurately. In RVN the OV10 and O2A both successfully delivered resupply to reconnaissance elements by dropping supplies packaged in modified napalm tanks, fuel tanks, or ordnance dispensers with great accuracy. (2,3,5,6,7,8,10,14)

3. The AX is programmed for a 16,000 pound external ordnance load and an internally mounted, multi-barrel, high velocity, 30 millimeter gun. The external ordnance will be carried on ten stores stations. Available ordnance will include general purpose bombs, napalm, rockets, dispensers for cluster bomb units (CBU) or smoke/gas, missiles, and gun pods. This ordnance delivery capability will be much more than adequate for a FAC supporting reconnaissance operations. The AX is designed for accuracy and close air support. Napalm containers packed with needed supplies will be deliverable from the AX and should provide an excellent resupply means. (11:16-18)

ANNEX E--Speed and Range

1. The FAC aircraft should be capable of both fast flight to reach a unit requiring assistance quickly and, once on station, sustained flight at an economic fuel consumption rate. The OV10 combines these capabilities well with a maximum speed in excess of 200 knots and the ability to throttle back to low power settings for long loiter time. The O2A is able to operate conservatively; however, its relatively small fuel capacity and slower speed makes the O2A less desirable than the OV10. (2,3,5,6,7,8,10,14)

2. The AX will possess the desired qualities of high speed (with a planned top speed of over 400 knots) and a long loiter time. The planned loiter will be approximately two hours at 250 nautical miles from the launch air base. The AX purportedly will be able to operate at speeds as slow as 120 knots, which will be acceptable for FAC support. (11:17) The minimum speed of 95 knots is more desirable than 120 knots for the support of reconnaissance operations. The slower speed would enable the FAC to match speed with the US Army UH1 family of helicopters and the USAF CH3 and CH53 helicopters during lead-ins into helicopter landing zones (HLZ). If possible, the AX should be designed with a minimum operational speed of 95 knots. (2,3,5,6,7,8,10,14) The takeoff and landing roll of 1000 to 4000 feet, depending on aircraft weight, planned for the AX will enable launch of the aircraft from forward-operating bases with unimproved airfields. (9)

ANNEX F--Communications

1. The FAC aircraft must possess adequate communications to fulfill its role. Two FM radios are required for the FAC and "FAC rider" to communicate with US Army ground stations and the deployed reconnaissance teams. Retransmission capability for extending the range of communications and secure-voice transmission capability for security are desirable. Homing capability on the FM radios will help the FAC crew to locate friendly bases and units during periods of poor visibility. One UHF radio with secure-voice transmission capability should be present for the FAC pilot to use primarily in coordinating tactical air support. One VHF radio should be present for the FAC pilot to use primarily in coordinating helicopter support. The UHF and VHF radios have many uses; however, the coordination of various supporting air elements are their primary justification. One HF radio will be required in any situation involving commitment of reconnaissance elements great distances from friendly bases. In RVN the OV10 and O2A were normally able to communicate with US Army operating bases from a distance of 125 to 150 nautical miles using organic FM radios. Distances greater than 150 nautical miles required the use of HF radios. (2,3,5,6,7,8,10,14)

2. The AX is designed to feature UHF, VHF, and FM communications. (11:18) The number and type of radios are unknown to this author. An HF capability should be added. If secure-voice, retransmission, and homing capabilities are not planned, they should be added to the current requirements. (2,3,5,6,7,8,10,14)

3. The provision for acceptance and utilization of Long Range Air Navigation (LORAN), Radar Homing and Warning (RHAW), Night Observation Devices (NOD), devices for the detection of laser illuminators and radar significant beacons, and equipment for the detection and confusion of infrared missiles would not only make the FAC aircraft of the future more flexible to the USAF and US Army, but also increase its salability abroad. (13)

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