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FINAL REPORT
OF
MILITARY POTENTIAL TEST
OF THE
MODEL 500B FIXED-WING INSTRUMENT TRAINER

DA PROJECT NO. NONE

USATECOM PROJECT NO. 4-5-1001-01

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USAADTA (PROV)
14 Apr 76
AR 340-16

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U S ARMY
AVIATION TEST BOARD
FORT RUCKER, ALABAMA

DETAILED DESCRIPTION OF MODEL 500B AIRPLANE AS TESTED

1. General. The Model 500B airplane is a high-wing, all-metal, tricycle-landing gear, twin-engine airplane. Each IO-540-E1A5 engine drives an 80-inch diameter, three-bladed, full-feathering, constant-speed HC-A3XK-2/8433-4 propeller. The fuselage and tapered cantilever wings are an integral semimonocoque structure. The 500B is certificated in the Standard-Normal category by the Federal Aviation Agency (FAA), and the Approved Type Certificate is 6A1. The manufacturer's airplane serial number is 500B-1207-99.

2. Cockpit. Side-by-side seating is provided for the instructor pilot and student in individual, adjustable seats. Entrance to the cockpit is gained by a side door located abeam the pilot's seat or from the cabin area. Rudder pedals and a wheel-type flight control are provided for the instructor pilot and student. An overhead panel contains electrical, magneto and avionic master switches, electrical controls for fuel valves and pumps, and the flight trim. The instrument panel provides space for the engine and flight instruments and avionic control heads.

3. Cabin. Individual passenger seats are located in the cabin area behind the instructor pilot's and student pilot's seat. The seats are forward facing, adjustable fore and aft, reclining chairs. Folding arm rests are provided on all of the seats. Entry into the cabin is accomplished through a side door located toward the rear and left side of the cabin. The cabin has provisions for lighting, heating, and ventilation. The cabin floors are carpeted and the walls and ceiling are fitted with sound-proofed appointments. The combined cockpit and cabin area has the following dimensions:

Height - 53 inches (max.)

Width - 52 inches (max.)

Length - 129.5 inches

Volume - 177 cubic feet

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4. Flight Controls. The 500B airplane has dual flight control columns, affording control of the aircraft from either the instructor pilot or student pilot's station. A rotary movement of the control wheel controls the aileron travel. Fore-and-aft movement of the control column positions the elevator. The rudder travel is controlled by a dual set of rudder pedals mounted on the cabin floor forward of the pilot and copilot stations. The wing flap movement is hydraulically controlled by positioning the flap control lever mounted on the engine control pedestal. The ailerons, elevators, and rudder are mechanically actuated by a system of cables, pulleys, torque arms, and push-pull tubes. The rudder and elevator trim-tab control wheels are on the trim-tab control panel located overhead between the instructor and student pilot stations. Mechanical systems consisting of cables and jack shafts transmit trim control wheel movements to the trim tabs and to an electrical trim-position indicator. No in-flight aileron trim tabs are provided. A fixed-position trim tab is attached to the right aileron. Turning the elevator trim-tab control wheel forward gives a nose-up attitude, and turning the wheel rearward gives a nose-down attitude. Turning the rudder trim-tab control wheel clockwise provides a right rudder trim, and turning the wheel counterclockwise provides a left rudder trim.

5. Engine. The 500B is powered by two IO-540-E1A5 engines. The IO-540-E1A5 is a direct-drive, wet-sump, horizontally-opposed, six-cylinder, air-cooled, fuel injection engine. The engine displacement is 541.5 cubic inches, and the compression ratio is 8.7 to 1. The rated takeoff and rated maximum continuous brake horsepower is 290 at 2575 r.p.m. The FAA Type Certificate number for this engine is 1E4. The oil capacity is 12 quarts.

6. Engine Cowling. The engine cowling consists of seven sections, each being removable for access to the engine. To facilitate servicing the engine, four large cowl sections, two forward and two immediately behind, hinge downward. A cowling nose ring, a top cowl panel incorporating the crankcase oil filler door, and the lower engine cowl complete the cowling assembly.

7. Engine Cooling. Cooling air enters the engine compartment through the openings in the cowling nose ring. An up-draft cooling system directs this cooling air up and around the engine cylinders and out through the upper engine nacelle openings equipped with cowl flaps adjustable from the cockpit.

8. Propellers. The Model 500B is equipped with all-metal HC A3XK-2A/8433-4, controllable, full-feathering, constant-speed, three-blade propellers. The propeller is controlled by a governor mounted on the left forward side of the engine. Oil pressure acting on the blade-actuating piston changes the propeller blade angle to low pitch. The propeller counterweights rotate the propeller blades to a high-pitch angle. The governor regulates the oil pressure acting against the counterweights to position the propeller blades for a constant rotational speed selected by the pilot. A combination of the centrifugal force of the counterweights and force from an internal spring rotate the propeller blades to the feathered position when the oil pressure is relieved. A spring-loaded, high-pitch stop latch prevents the propeller from feathering when the airplane is on the ground and the engine is stopped. The latch is disengaged by centrifugal force when the propeller is rotating above 800 r.p.m. Feathering the propeller is accomplished by moving the cockpit pedestal-mounted propeller control lever rearward through the detent into the feathering range. Although unfeathering can be accomplished in flight by starting the engine with the propeller control lever just forward of the feathering detent, a positive unfeathering system is installed to assist in the operation. This system consists of an electric pump mounted on each engine, a three-position switch spring-loaded to the OFF position, oil hoses, and electrical wiring. Holding the switch either to the left or right, depending on which propeller requires unfeathering, permits the pump to supply engine oil at high pressure through the propeller governor to the propeller piston, causing the propeller blades to unfeather. The windmilling propeller makes it unnecessary to engage the starter for in-flight engine starting.

9. Fuel System. The fuel is contained in five rubberized fuel bladders, two located in each wing, and one in the center wing section above the baggage compartment. The five cells have a total usable fuel capacity of 156 US gallons and are interconnected by two-inch diameter tubes. The cells are filled through the filler opening located on top of the right wing above the forward right fuel cell. A fuel sump is attached to the bottom of the center fuel cell and extends into the baggage compartment. Two electric fuel boost pumps are available for emergency operations and provide fuel pressure for engine priming and starting. From the fuel boost pumps, fuel is fed to the fuel on-off valves located in each engine nacelle and through the fuel filters and engine-driven pumps to the fuel control valve on the engines. The fuel on-off valves are electrically actuated from the cockpit by selector

switches. A fuel quantity indicating gauge in the instrument panel provides readings from a transmitter in the center fuel cell. Only 135 of the 156 US gallons are measurable by the system.

10. Hydraulic System. The hydraulic system provides the power to operate the wing flaps, landing gear, brakes, and the nose gear steering mechanism. Two engine-driven hydraulic pumps provide the hydraulic pressure. The major system components are installed in the left engine nacelle and consist of the hydraulic reservoir, hydraulic shut-off valves, hydraulic pressure-regulator unit, and the auxiliary hydraulic system pump and pressure switch. The hydraulic fluid flows from the reservoir, through the hydraulic shut-off valves to the engine-driven hydraulic pumps. The hydraulic fluid flows under pressure from the pumps to the hydraulic pressure regulator unit. The regulator unit contains an accumulator piston which absorbs the pulsating pressure caused by intermittent flow. The prime function of the regulator unit is to maintain a line pressure of between 900-1075 p.s.i. If the line pressure exceeds 1300 p.s.i. because of fluid expansion or system malfunction, a relief valve bypasses the fluid until the pressure drops. Hydraulic fluid under the above pressure is furnished to the power brakes, pressure gauge, wing flaps, and landing gear. An electrically-driven auxiliary hydraulic system supplies hydraulic pressure for brake and flap operation in the event of failure of both engine-driven hydraulic pumps or the complete loss of fluid from the normal hydraulic reservoir supply. The fluid supply for this auxiliary system is obtained from below the normal system standpipe in the reservoir. The auxiliary system is automatically actuated whenever the line pressure drops below 500 p.s.i.

11. Landing Gear System. The Model 500B airplane is equipped with a hydraulically-retractable tricycle landing gear. The nose gear retracts rearward into the nose section. The main landing gear retracts rearward, rotating the wheels 90 degrees during the cycle so that the wheels lie horizontally flat in the shallow nacelle wheel wells. The main landing gear is retained in the full "up" position with mechanical uplocks while the nose gear is held up by hydraulic pressure only. In the event of a complete hydraulic failure, the main landing gear is extended by an emergency air pressure system and the nose gear falls free and locks in position. The nose wheel is hydraulically steerable and may be turned by applying light toe pressure to the top of the proper rudder pedals.

12. Brake System. The main landing gear wheels are equipped with single-disc, hydraulically-actuated brakes. The brakes are individually controlled by the power brake valves operated by toe pressure applied to the rudder pedals. The valve directs hydraulic pressure to the brake cylinders. In the event of hydraulic failure, the auxiliary hydraulic system pump provides hydraulic pressure for the operation of the brakes. Turning a parking brake valve control knob locks the brakes by trapping fluid in the brake line.

13. Electrical Power Supply System. A 28-volt d. c. electrical system is the basic source of electrical power. Current for starting the engine is normally supplied from two 12-volt, 36 ampere-hour, wet-cell storage batteries installed in the aircraft fuselage aft of the baggage compartment (figure 1). Two 28-volt engine-driven generators provide electrical power. A plug-in receptacle in the left side of the fuselage is available in the event an external power source is desired.

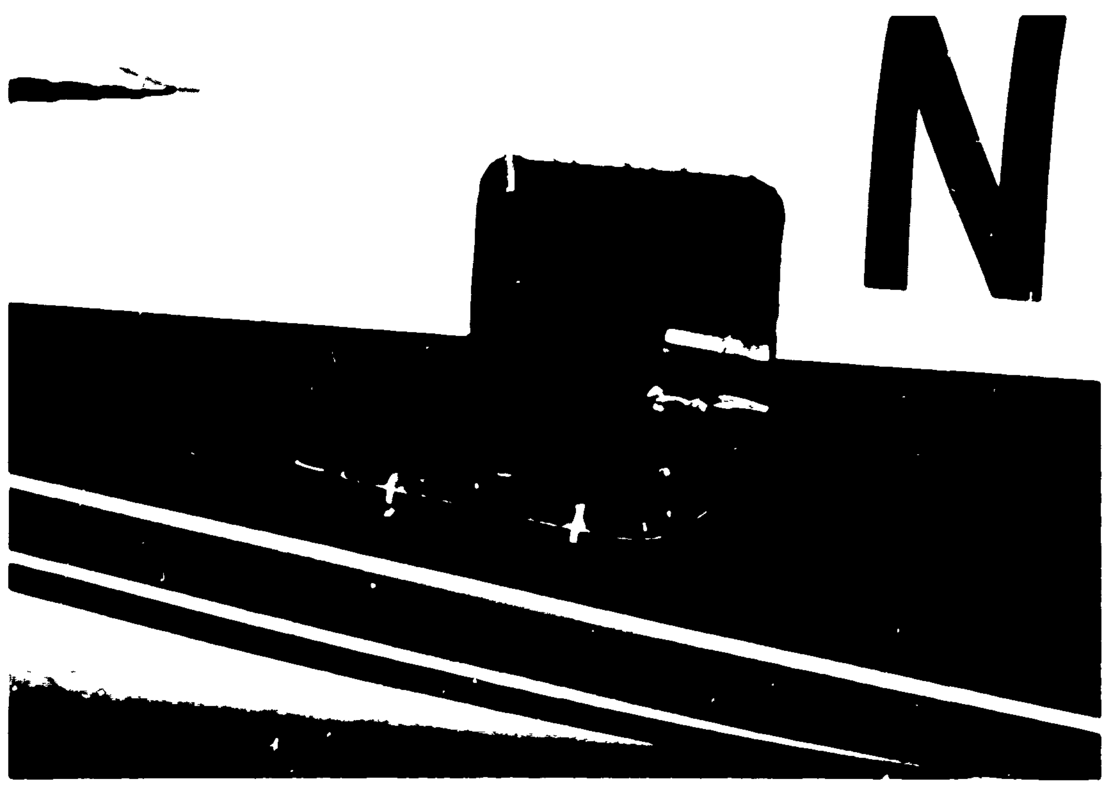

Figure 1. Battery installation

14. Heating and Ventilating System. A forced air heating and ventilating system provides controllable cabin heat and ventilation. Blower air is furnished until the aircraft is in flight and the landing gear is retracted, and then ram air replaces blower air. Cabin air exhaust vents complete the air circulation system. A 25,000-B.t.u. combustion-type heater provides heat for the cabin and the windshield defroster.

15. Basic Aircraft Data. (See figure 2 for general dimensions.)

Aircraft serial No. 500B-1207-99

Aircraft Type Certification No. 6A1

Engine serial No. (Left) L-937-48; (Right) L-1156-48

Engine Type Certification No. 1E4

Areas

Wing (total)	255.0 sq. ft.
Flaps (total)	21.2 sq. ft.
Ailerons (total)	20.52 sq. ft.
Tabs	Small fixed tab only
Horizontal tail (total)	53.6 sq. ft.
Elevators (incl. tabs)	20.54 sq. ft.
Vertical Tail (incl. rudder)	39.4 sq. ft.
Rudder (incl. tab)	15.4 sq. ft.
Dorsal fin	1.15 sq. ft.

General Data

Wing

Airfoil section (root)	NACA 23012

Airfoil section (tip)	NACA 23015
Span	49 ft. 6 in.
Root chord	100 inches
Tip chord	25.42 inches
Mean aerodynamic chord	70.05 inches
Taper ratio	4
Dihedral (outboard)	4 degrees
Aerodynamic washout (outboard)	3.5 degrees
Aspect ratio	9.45
Flaps	
Span (total)	14 ft. 11 in.
Chord	25.8 percent
Hinge line	21.4 percent
Ailerons	
Span (total)	18 ft. 9 in.
Chord	18.6 percent
Hinge line	18.6 percent
Horizontal tail	
Airfoil section	NACA 0011
Span	16 ft. 9 in.
Mean aerodynamic chord	41.15 in.

Taper ratio	3.01
Aspect ratio	5.18
Elevator mean aerodynamic chord	14 inches
Vertical tail	
Airfoil section	NACA 0009
Height	100 inches
Height (ground line)	14 ft. 6 in.
Mean aerodynamic chord	58.65 inches
Taper ratio	2.01
Aspect ratio (geometric)	1.7
Rudder mean aerodynamic chord	58.65 inches
Maximum fuselage area cross section	
Height	5 ft. 5 in.
Width	4 ft. 7.5 in.
Landing gear	
Tread of main wheels	12 ft. 11 in.
Wheel base	13 ft. 11.75 in.
Clearances	
Propeller to fuselage	12 inches
Propeller to ground (normal static position)	27.3 inches

Propeller to ground (flat struts and tires)	21.63 inches
Fuselage to ground (flat struts and tires)	1.0 inch
Control surface movements	
Wing flaps (maximum)	
Inboard	40 degrees down
Outboard	40 degrees down
Ailerons	23 degrees up
	15 degrees down
Rudder	20 degrees right
	20 degrees left
Elevator	30 degrees up
	10 degrees down

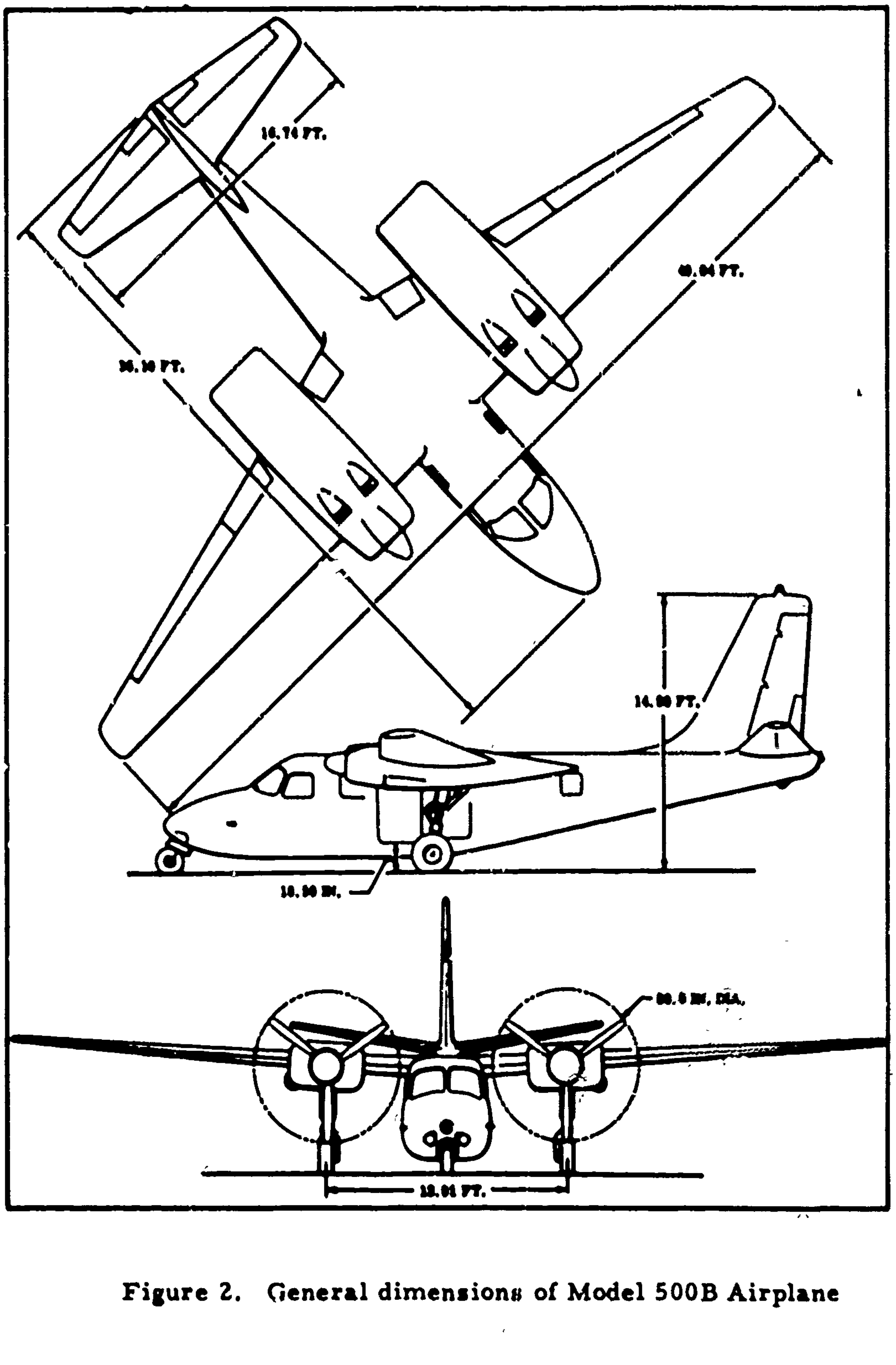

Figure 2. General dimensions of Model 500B Airplane

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CARBON MONOXIDE INVESTIGATION OF THE OFF-THE-SHELF FIXED WING INSTRUMENT TRAINERS

1. INTRODUCTION.

The US Army Aeromedical Research Unit was requested to determine the carbon monoxide concentration within the crew/passenger compartment of the five Off-the-Shelf Fixed Wing Trainers.

The aircraft submitted for the evaluation were:

a. Aero Commander 500B.

b. Beechcraft Baron B-55-B.

c. Cessna 310"I".

d. Piper Aztec "B".

e. Piper Aztec "C".

2. METHODS AND MATERIALS.

a. Equipment used:

(1) Mine Safety Appliance Company Univ rsal Testing Kit Model 2 with carbon monoxide detectors.

(2) A 250cc air sample was forced through a vial of carbon monoxide sensitive crystals (part no. [illegible]34) using a manually operated "piston type" pump (part no. 83498). n the presence of carbon monoxide, the normally pale yellow indicating crystals turn green. The concentration of carbon monoxide is determined by comparing the color of the exposed vial to a standard color chart (part no. 994200). Sensitivity of the indicating crystals is .001 to 0.1% carbon monoxide.

b. Method.

(1) Samples of the crew/passenger compartment air were collected while the aircraft operated at normal cruise with all vents closed and the heater on.

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(2) The air samples were collected at the heater duct opening to readily detect the slightest amount of carbon monoxide.

3. RESULTS AND CONCLUSIONS.

No carbon monoxide was detected in any of the five aircraft while operating at a cruise with all vents closed and the heater on.

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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

FINAL REPORT
OF
MILITARY POTENTIAL TEST
OF THE
MODEL 500B FIXED-WING INSTRUMENT TRAINER

DA PROJECT NO. NONE

USATECOM PROJECT NO. 4-5-1001-01

(9) Final Rept. (11) 30 Nov 64 (12) 47p.

(16) USATECOM-4-5-1001-01

Raymond E. Johnson
for: A. J. RANKIN
Colonel, Armor
President

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ABSTRACT

The Military Potential Test of the Model 500B Fixed-Wing Instrument Trainer was conducted by the US Army Aviation Test Board during the period 3 September to 16 October 1964 at Fort Rucker, Alabama. Flight under actual and simulated instrument conditions and demonstrations to personnel representing the US Army Aviation Center and the US Army Aviation School were conducted during the test period. It was found that the Model 500B test airplane as changed by the technical proposal will meet all of the requirements contained in the Model Specification. It was recommended that a confirmatory test be performed on the initial production airplane if the Model 500B airplane is selected as a fixed-wing instrument trainer.

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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

FINAL REPORT OF

MILITARY POTENTIAL TEST OF THE

MODEL 500B FIXED-WING INSTRUMENT TRAINER

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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

USATECOM PROJECT NO. 4-5-1001-01

REPORT OF MILITARY POTENTIAL TEST

OF THE MODEL 500B

FIXED-WING INSTRUMENT TRAINER

SECTION 1 - GENERAL

1.1. REFERENCES.

A list of references is contained in appendix I.

1.2. AUTHORITY.

1.2.1. Directive.

Letter, AMSTE-BG, US Army Test and Evaluation Command, 29 October 1964, subject: "Test Directive for USATECOM Project No. 4-5-1001-01, Military Potential Test of Fixed Wing Instrument Trainer Aircraft."

1.2.2. Purpose.

To determine whether the "off-the-shelf" Model 500B airplane fulfills the Model Specifications for fixed-wing instrument trainers (reference 2).

1.3. OBJECTIVES.

To determine:

a. Specified physical characteristics.

b. Specified performance.

c. The adequacy of the electronics configuration as proposed.

1.4. RESPONSIBILITIES.

The US Army Aviation Test Board (USAAVNTBD) was responsible for developing, preparing, and publishing the plan of test and the report of test. Assistance during the test was provided by the US Army Aviation School (USAAVNS). Final approval of the plan and report of test is the responsibility of the US Army Aviation Materiel Command (USAAVCOM).

1.5. DESCRIPTION OF MATERIEL.

The proposed Model 500B instrument trainer airplane is a high-wing, all-metal, tricycle-landing gear, twin-engine airplane. The fuselage and tapered cantilever wings are an integral semimonocoque structure. The airplane is powered by two IO-540-E1A5 direct-drive, wet-sump, horizontally-opposed, six-cylinder, air-cooled, fuel injection engines. The rated takeoff and rated maximum continuous brake horsepower is 290 at 2575 r.p.m. Each engine drives an 80-inch diameter, three-bladed, full-feathering, constant-speed propeller. The propellers are equipped with a blade unfeathering system. The cockpit provides individual, adjustable, side-by-side seats for the instructor and student pilot. Individual forward-facing passenger seats are located in the cabin area behind the instructor pilot's and student pilot's seat. The fuel capacity is 156 US gallons. The gross weight of the proposed instrument trainer airplane is 6350 pounds.

1.6. BACKGROUND.

1.6.1. In June 1962, the USAAVNS submitted to the Commanding General, US Continental Army Command (USCONARC), a requirement for a commercially produced, "off-the-shelf," fixed-wing instrument trainer to replace the tactical airplanes presently used by USAAVNS for instrument training. In February 1963, the Director of Army Aviation, Office, Deputy Chief of Staff for Operations (DCSOPS), submitted a Statement of Materiel Requirements to the Commanding General, US Army Materiel Command (USAMC), for an "off-the-shelf" fixed-wing instrument trainer. A two-step procurement program was established. The Model Specification, which was revised June 1964, accompanied the Request for Technical Proposals (Step One for the Invitation for Bid) which was prepared by the USAAVCOM and mailed to industry 16 July 1964. Each bidder was required to submit a written technical proposal and one unit of the version of the aircraft on which it proposed to submit a bid. The Step Two of the competition will be confined to the bidders whose airplanes and technical proposals are found acceptable. The second step consists of a formal procurement in which bid prices will be submitted.

1.6.2. A Model 500B test airplane possessing a Federal Aviation Agency (FAA) Standard-Normal Category Certificate was delivered to the USAAVNTBD for evaluation on 3 September 1964.

1.7. FINDINGS.

The Model 500B test airplane as changed by the technical proposal will meet all of the requirements contained in the Model Specification (appendix II).

1.8. CONCLUSION.

None.

1.9. RECOMMENDATION.

It is recommended that a confirmatory test be performed on the initial production airplane if the Model 500B airplane is selected as a fixed-wing instrument trainer.

SECTION 2 - DETAILS AND RESULTS OF SUB-TESTS

2.0 INTRODUCTION.

2.0.1. During the period 3 September 1964 to 16 October 1964, the Model 500B test airplane underwent a 25- to 50-hour flight test program conducted by the US Army Aviation Test Board (USAAVNTBD), at Fort Rucker, Alabama.

2.0.2. Flight under actual and simulated instrument conditions and flight demonstrations to personnel representing the US Army Aviation Center (USAAVNC) and the US Army Aviation School (USAAVNS) were conducted during the test period.

2.1. PHYSICAL CHARACTERISTICS.

2.1.1. Objective.

To determine the physical characteristics of the Model 500B test airplane as contained in paragraphs 1.1.1, 3.2 - 3.4, 3.6, 3.7, and 3.9 - 3.11 of the Model Specification (appendix II).

2.1.2. Method.

2.1.2.1. The physical characteristics listed in Model Specification paragraph 1.1.1 were determined by visual study.

2.1.2.2. Determination of the physical characteristics listed in Model Specification paragraphs 3.2, 3.3, and 3.4 was made by measuring the airplane and weighing it with full oil and with fuel drained. Weight and balance computations were made for the proposed gross weight.

2.1.2.3. The physical characteristics listed in Model Specification paragraph 3.6 were determined by visual and physical studies. Instrument panel cutouts were used to study the panel proposal.

2.1.2.4. The requirements for interior and exterior lighting outlined in the Model Specification paragraph 3.7 were checked during night flights. The rotating beacon was checked for conformity with paragraph 3.705, Civil Aeronautics Manual 3.

2. 1. 2. 5. The heater was operated and an analytical study was made based on the Model Specification requirement paragraph 3. 9. 1 and on the rated output of the heater.

2. 1. 2. 6. The aircraft furnished for the test was not equipped with deicing and anti-icing equipment; therefore, a study was made from the description of the system in the FAA Approved Flight Manual and Maintenance Manual to determine conformity with the provisions of Model Specification paragraph 3. 9. 2.

2. 1. 2. 7. Oxygen equipment was not provided with the test aircraft. A study was made of the descriptive material of the equipment found in the FAA Approved Flight Manual and Maintenance Manual to determine if the equipment offered in the technical proposal was capable of meeting Model Specification paragraph 3. 9. 3.

2. 1. 2. 8. The area for stowage was measured and photographed to determine whether the space provided met the provisions of Model Specification paragraph 3. 10.

2. 1. 2. 9. A study was made of the publications that accompanied the test aircraft to determine whether the requirements of Model Specification paragraph 3. 11 were met.

2. 1. 3. <u>Results.</u>

2. 1. 3. 1. General Description, paragraph 1. 1. 1, Model Specification:

2. 1. 3. 1. 1. The Model 500B test airplane was equipped with individual side-by-side seating for a student and instructor pilot in the cockpit. Immediately to the rear in the cabin area, individual side-by-side seats were provided for two students. (See figure 1.)

2. 1. 3. 1. 2. Dual side-by-side flight controls were provided in the cockpit.

2. 1. 3. 1. 3. The Model 500B test airplane was powered by two IO-540-E1A5 reciprocating engines. Each engine drove a three-bladed, full-feathering, constant-speed HC-A3XK-2/8433-4 propeller. A positive propeller unfeathering system was incorporated.

Figure 1. Seating arrangement

2. 1. 3. 1. 4. The Model 500B test airplane featured an all-metal semi-monocoque construction and was equipped with hydraulic retractable tricycle landing gear.

2. 1. 3. 2. Paragraph 3. 2, Model Specification: The basic weight of the test airplane was 4862 pounds. This weight did not include all of the equipment required by paragraph 3. 9 and the electronic equipment listed in appendix II of the Model Specification, which were not installed on the test airplane. No deletions were made from the basic weight for items installed on the test aircraft which were not required by the Model Specification. The weight analysis in the technical proposal gave the basic weight of the proposed aircraft as 4670 pounds. This figure could not be substantiated due to the impossibility of obtaining exact weights of all the items in question, and particularly for components permanently installed.

2.1.3.3. Paragraph 3.3, Model Specification: The center-of-gravity (c.g.) range was 166 inches (forward c.g. limit) to 174.4 inches (aft c.g. limit). No restrictions to mission payload or utility arose from constraints relating to the c.g. range.

2.1.3.4. Paragraph 3.4, Model Specification: In addition to fuel and oil necessary to accomplish the endurance mission (5.0 hours at 65% power at 7500 ft. MSL), the useful load of the test airplane was 717 pounds. The technical proposal presented a figure of 905 pounds of useful load for the proposed trainer.

2.1.3.5. Paragraph 3.6.2.1, Model Specification: The Model 500B test airplane featured an all-metal semimonocoque construction of the airframe.

2.1.3.6. Paragraph 3.6.2.2, Model Specification: The cabin interior arrangement provided individually adjustable side-by-side front seats. Two additional seats were provided immediately to the rear of the front seats. The seating arrangement permitted the exchange of the seating of the three students during flight. Shoulder harnesses were not provided in the test airplane; however, the item was listed in the weight analysis of the technical proposal.

2.1.3.7. Paragraph 3.6.2.2.1, Model Specification: The fire extinguisher (4210-555-8837) and first-aid kit (9-196-650) are Government Furnished Aircraft Equipment (GFAE) and, therefore, were not present on the test aircraft.

2.1.3.8. Paragraph 3.6.2.3.1, Model Specification: The test airplane was equipped with dual flight controls including rudder pedals with toe-type brakes (figure 2). The rudder pedals were not adjustable; however, the technical proposal provided for adjustable pedals.

2.1.3.9. Paragraph 3.6.2.3.2, Model Specification: The rudder and elevator trim-tab control wheels were located in the overhead trim-tab control panel. These controls were accessible to both the student and instructor pilot. No provisions existed in the test aircraft for in-flight aileron trim. The technical proposal included an in-flight aileron trim.

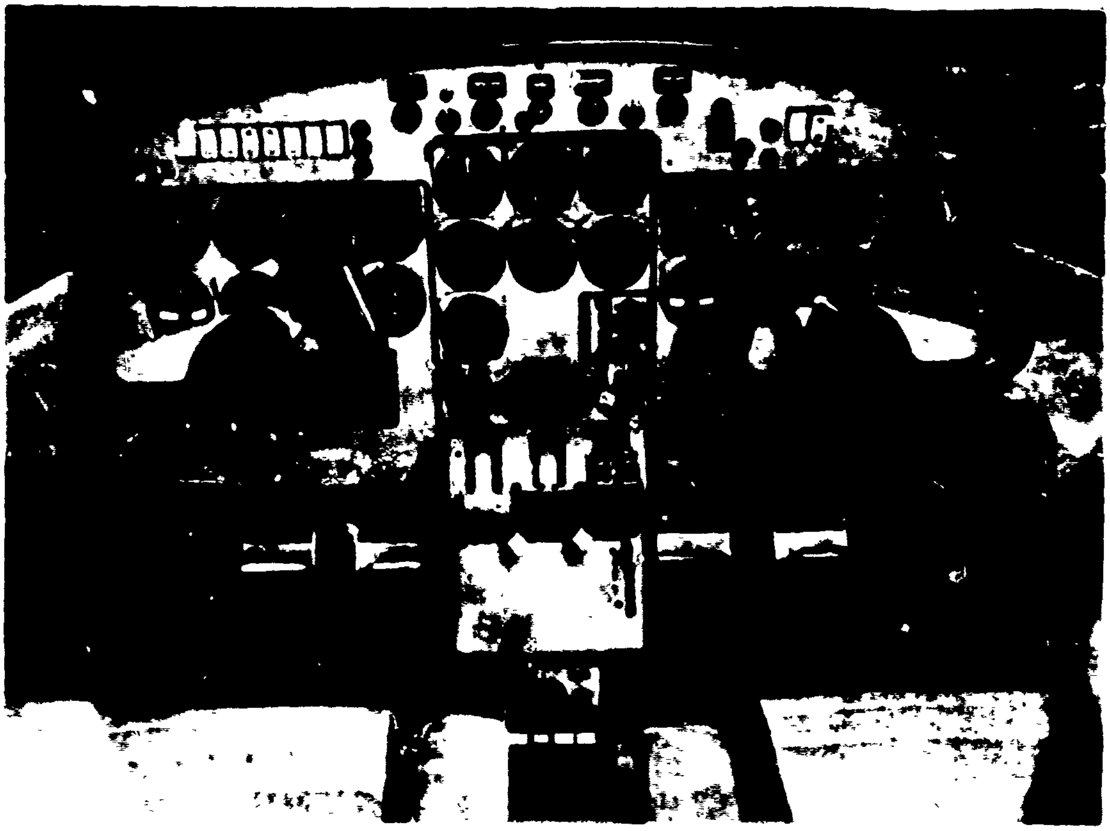

Figure 2. Model 500B dual flight controls

2.1.3.10. Paragraph 3.6.2.3.3, Model Specification: The engine control levers were mounted on the engine control pedestal located in front of, and between, the student and instructor pilot. The engine control levers controlled the throttle, propeller, fuel mixture, and alternate air. Two large friction lock wheels, one on each side of the engine control pedestal, locked the engine control levers in any desired position. These control levers were easily accessible to the student and instructor pilot.

2.1.3.11. Paragraph 3.6.2.3.4, Model Specification: A positive three-axis control surface lock which could be installed on either the student pilot's or instructor pilot's flight controls was provided with the test aircraft. Additionally, a wedge design exterior rudder lock was furnished.

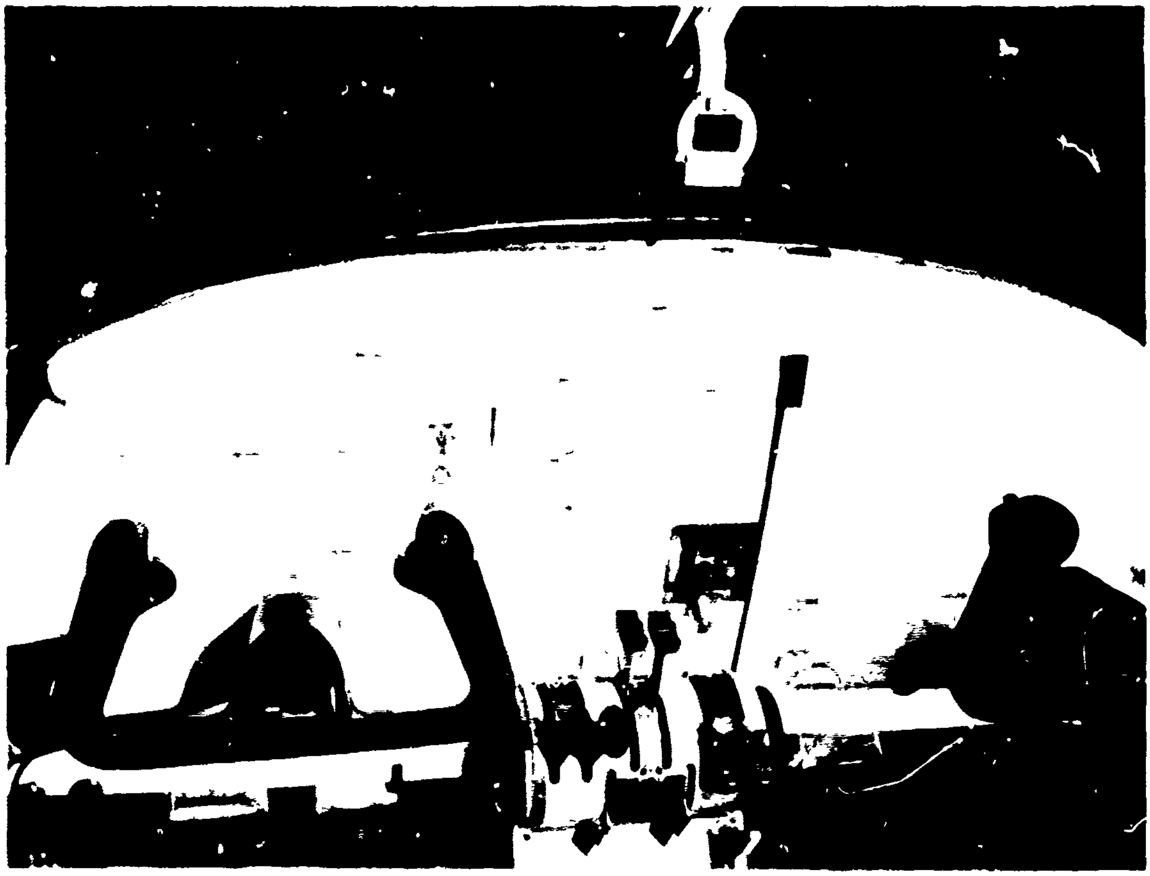

Figure 3. Proposed engine instruments and electronic controls

2.1.3.12. Paragraph 3.6.2.4.1, Model Specification: The test aircraft was delivered with a factory custom instrument panel which did not conform to the provisions of the Model Specification. The instrument panel described in the technical proposal had the proper arrangement of instruments. The two proposed attitude indicators had separate power sources.

2.1.3.13. Paragraph 3.6.2.4.2, Model Specification: The proposed engine instruments were readable by both student and instructor pilot. However, it was noted that the left and right hand engine gauges were partially obscured from the instructor pilot's view by the flight control wheel. (See figure 3.)

2.1.3.14. Paragraph 3.7.1, Model Specification: All of the instruments on the test aircraft were individually lighted and were compatible with night and instrument flight rule operations. A secondary lighting system consisting of red panel flood lights was located in the overhead trim-tab control panel. The intensity of the flood lights was controlled by a rheostat control knob. An individual, white, reading spotlight was located on each side of the cockpit above the student and instructor pilot's heads. Additionally, a white light mounted internally within the bottom section of the flight control wheels and operated by a thumb button atop the control wheel, furnished light on charts and note paper held on the pilot's lap.

2.1.3.15. Paragraph 3.7.2, Model Specification: The Model 500B test airplane was equipped with a rotating anticollision beacon faired into the top edge of the vertical stabilizer. The installed beacon met the provisions of the FAA requirements as set forth in paragraph 3.705 of the Civil Aeronautics Manual 3.

2.1.3.16. Paragraph 3.9.1, Model Specification: A 25,000-B.t.u. combustion-type cabin heater was installed in the test airplane. Existing climatic conditions precluded actual tests to determine the capability of the heater to meet the criteria of the Model Specification. However, using the ventilating air flow rate stated in the aircraft maintenance manual and available combustion heater information (reference 4), the installed heater should amply fill the requirements of the Model Specification.

2.1.3.17. Paragraph 3.9.2, Model Specification: The Model 500B test airplane was not equipped with wing deicing and propeller anti-icing equipment. The technical proposal stated that pneumatic deicer boots for the wing and tail surfaces, operated by engine-driven pumps, and electric propeller anti-icing equipment were available. The Model 500B airplane had FAA approval for installation of inflation type wing and empennage deicer boots, electrothermal type propeller anti-icers, and fuel vent deicer. The test airplane was equipped with pilot-controlled, heated alternate air for each engine induction system. On the test airplane, the fuel vent tubes extended below the lower wing surface. A small hole was drilled through the rear side of the vent tubes to effect emergency venting in the event icing covered the tube end.

2.1.3.18. Paragraph 3.9.3, Model Specification: No oxygen equipment was installed in the Model 500B test airplane. The technical proposal cites availability of oxygen tc each occupant through individual outlets, installed in the proposed trainer. The FAA has approved a model 8885 oxygen breathing system for the test airplane. The flight manual stated that the equipment would provide 2.9 hours' duration for four persons at 15,000 feet altitude. This system did not employ liquid oxygen.

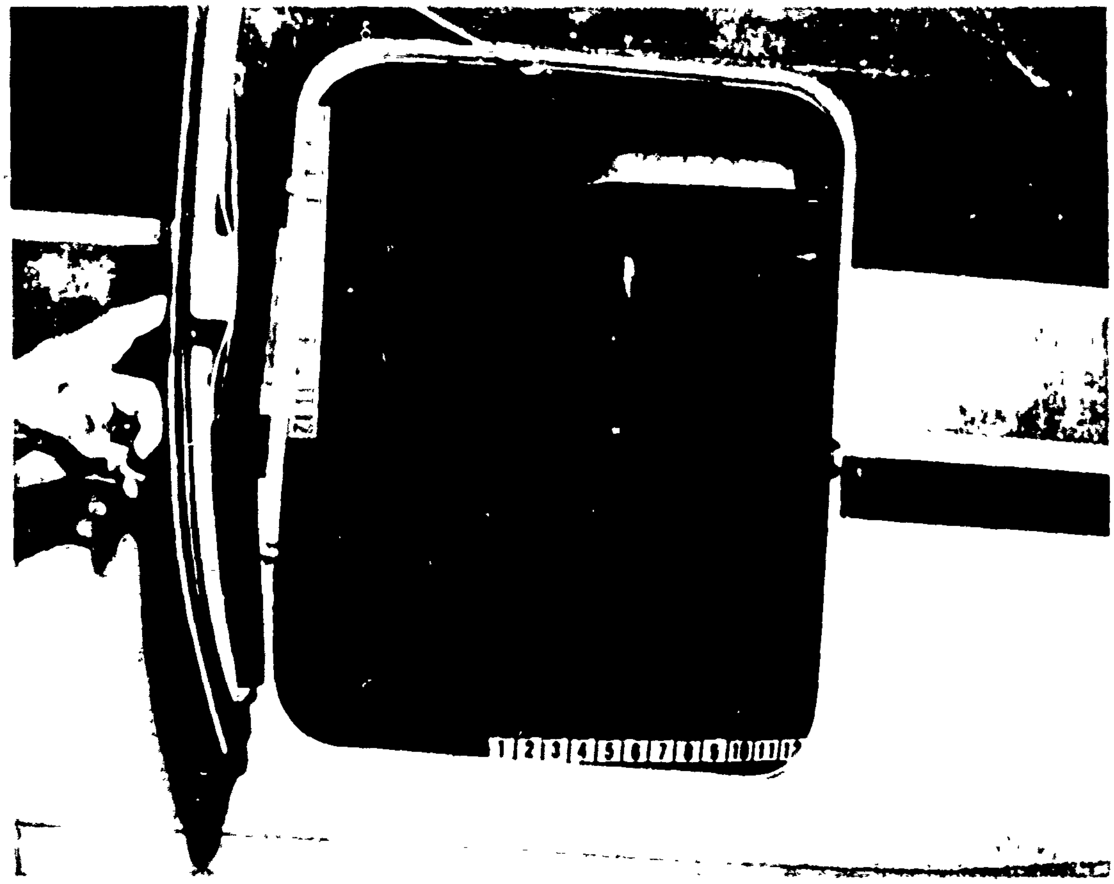

Figure 4. Baggage compartment

2.1.3.19. Paragraphs 3.10.1 and 3.10.2, Model Specification: The test airplane had the required baggage space for a minimum of 100 pounds of personal baggage. A baggage compartment aft of the cabin provided approximately 32 cubic feet of baggage space (figure 4). A door 19 inches wide by 23 inches high provided access to the baggage compartment from the outside. A compartment located between stations 216 and 224 provided approximately 8.85 cubic feet of space and was placarded for a weight limit of 150 pounds (figure 5). There was ample storage space within the cabin for maps, charts, computers, and one TM 11-2557 (Jeppeson Case). A stowage area behind the rear seat measured 45 inches wide, 48 inches high, and 28 inches long (figure 6). The weight capacity of this area was limited only by the gross weight considerations of the aircraft. Outside access to this area was by the cabin door which measured 25 inches wide and 42 inches high.

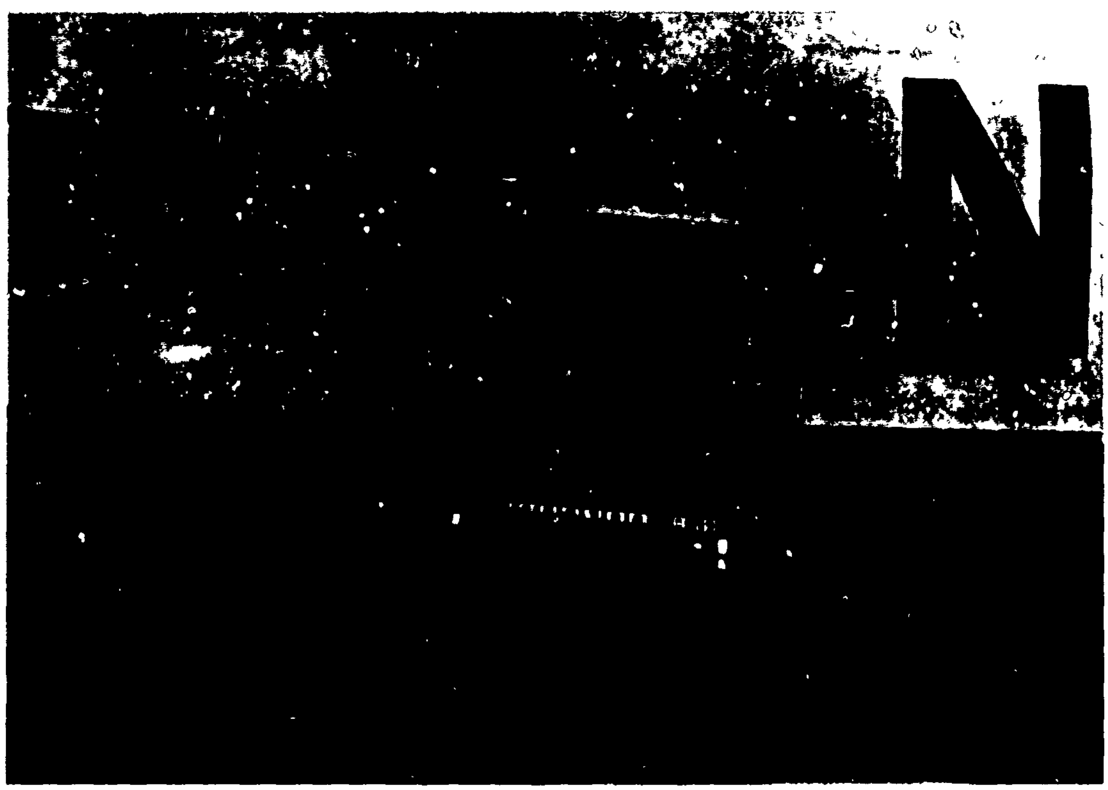

Figure 5. Compartment between stations 216 and 224.

Figure 6. Stowage area behind rear seat.

2.1.3.20. Paragraph 3.11, Model Specification: The Model 500B test airplane was delivered with an FAA-approved airplane flight manual and a maintenance and parts manual.

2.1.4. Analysis.

Not applicable.

2.2. PERFORMANCE.

2.2.1. Objective.

To determine the performance characteristics of the Model 500B test airplane as related to the requirements specified in paragraph 3.5 of the Model Specifications.

2.2.2. Method.

2.2.2.1. The test airplane was flown at the gross weight outlined by the useful load requirement (paragraph 3.4, Model Specification), and tests were conducted to determine the cruise true airspeed (TAS), endurance, single-engine service ceiling (FAA requirement), and minimum safe single-engine speed (V_{mc}). Ballast was used to bring the gross weight of the test airplane up to the proposed Standard-Utility Category gross weight of 6350 pounds. Data were tabulated in the National Aeronautical Space Administration Standard-Day format.

2.2.2.2. The airspeed indicator from the test aircraft was calibrated. The airspeed position errors were obtained by the ground speed course method outlined in reference 3.

2.2.2.3. The factory engine cruise control chart and procedures outlined in the flight manual were used to determine the power settings for a series of stabilized level flight, 65-percent, cruise power runs. The data recorded were corrected to standard-day conditions.

2.2.2.4. The endurance data were obtained by use of the installed flow meters and verified by controlled flight profiles. The power was in accordance with recommended power charts and procedures. The mixture controls were set for best economy.

2.2.2.5. The single-engine service ceiling was determined by a series of saw-tooth climbs to substantiate the factory-recommended single-engine climb schedule. Using the climb schedule, climb data were obtained and reduced to standard-day conditions.

2.2.2.6. The minimum safe single-engine speed was investigated using the procedures and conditions described in paragraph 3.111, Civil Aeronautics Manual 3 (reference 6).

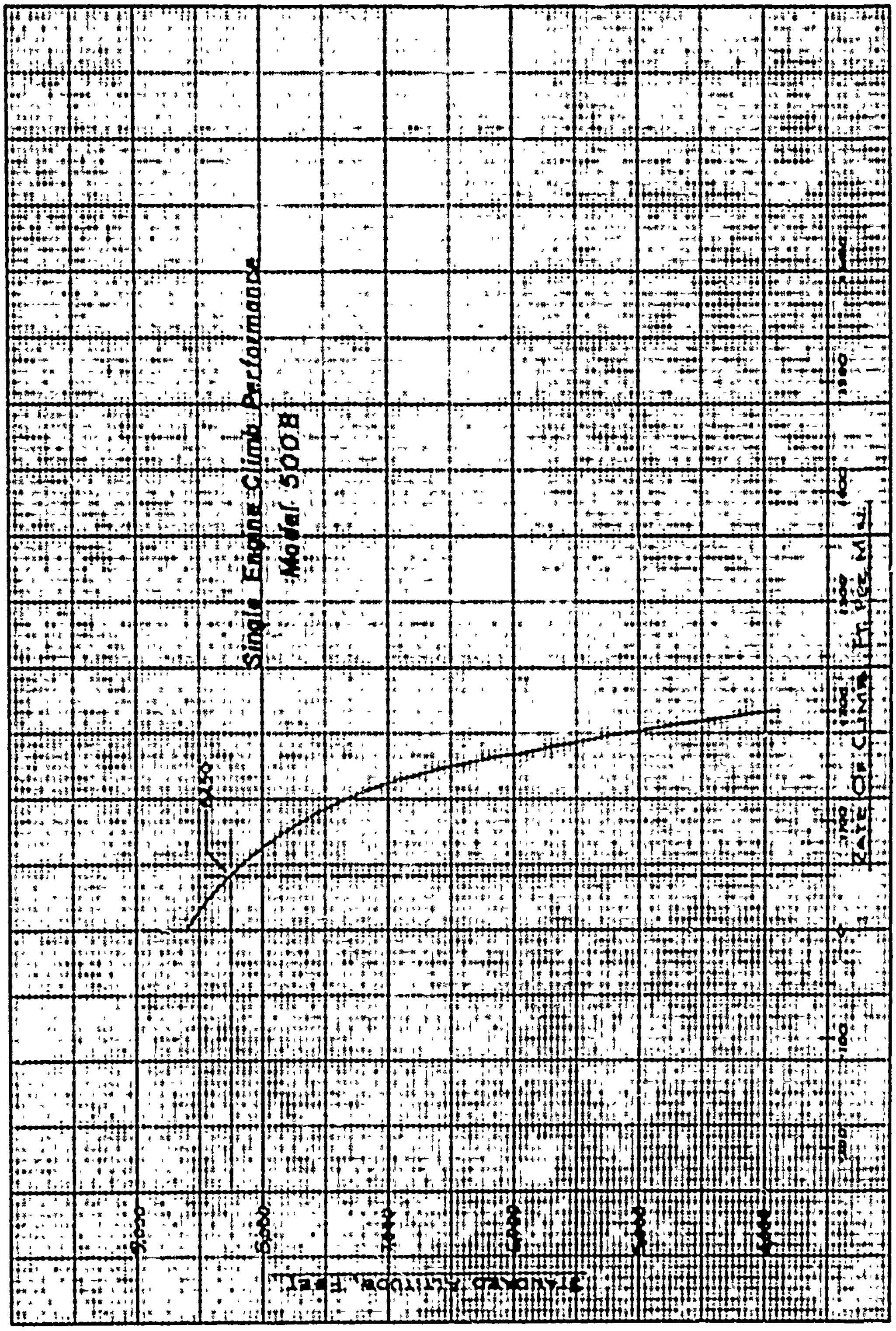

Figure 7

2.2.3. Results.

2.2.3.1. The cruise speed at 65 percent power, 7500 feet mean sea level was 176.5 knots TAS.

2.2.3.2. The Model 500B test airplane consumed an average of 24.2 gallons of fuel per hour at 7500 feet altitude using a 65-percent best economy engine power setting. The test airplane basic weight was 4862 pounds. With the engine oil (45 pounds) and the 900-pound useful load required by the Model Specification, only 543 pounds of fuel (90.4 gallons) may be added to meet the proposed Standard-Utility Category gross weight of 6350 pounds. With this quantity of fuel, the test airplane will operate at the prescribed altitude and power settings for 3.73 hours. However, the technical proposal basic weight of 4670 pounds for the instrument trainer will allow 735 pounds (122.5 gallons) for fuel. This quantity of fuel will give the proposed instrument trainer an endurance figure of 5.06 hours based on the fuel consumption rate of the test airplane engines.

2.2.3.3. The Model 500B test airplane had a single-engine service ceiling (climb rate of 50 f.p.m.) of 8250 feet (see figure 7).

2.2.3.4. The minimum safe single-engine speed (V_{mc}) at sea level was 64 knots calibrated airspeed (CAS).

2.2.4. Analysis.

Not applicable.

2.3. ELECTRONICS CONFIGURATION.

2.3.1. Objective.

To study the technical proposal and determine the adequacy of the electronics configuration as related to paragraph 3.8 of the Model Specification.

2.3.2. Method.

2.3.2.1. The technical proposal was studied with regard to electronic equipment as listed in appendix II, Model Specification. Where practical, the installation plans of the above items were studied.

2.3.2.2. Cardboard cutouts were installed to check accessibility and readability of the electronic controls.

2.3.2.3. A study was made to ascertain the conformity of the electronic control locations with paragraph 3.8.3, Model Specification.

2.3.3. Results.

2.3.3.1. Paragraph 3.8.1, Model Specification: The electronic configuration proposed for the instrument trainer was in accordance with appendix II, Model Specification.

2.3.3.2. Paragraph 3.8.2, Model Specification: The electronic controls were easily accessible and readable to the student and instructor pilot (see figure 3).

2.3.3.3. Paragraph 3.8.3, Model Specification: The electronic controls proposed were front panel mounted. No overhead control panel installation was proposed.

2.3.4. Analysis.

Not applicable.

SECTION 3

APPENDICES

APPENDIX I

LIST OF REFERENCES

1. Plan of Test, USATECOM Project No. 4-5-1001-01, "Military Potential Test of 'Off-the-Shelf' Airplanes as Fixed Wing Instrument Traners," USAAVNTBD, dated 18 November 1964.

2. Letter, AMSTE-BG, USATECOM, 29 October 1964, subject: "Military Potential Test of Fixed Wing Instrument Trainer Airacraft," with inclosures.

3. AF-TR-6273, Flight Test Engineering Manual, Major Russel M. Herrington and Captain Paul E. Shoemacher, May 1951 (revised January 1953).

4. Kent's Mechanical Engineering Handbook (Power), Revised 1957.

5. Model 500B Flight Manual, Aero Commander Division of Rockwell-Standard Corporation, 13 July 1960 (Revised 20 September 1963).

6. Civil Aeronautics Manual 3, Airplane Airworthiness, Normal Utility, and Acrobatic Categories, May 1962.

7. Model 500B Maintenance Manual, Aero Commander Division of Rockwell-Standard Corporation, 15 December 1962.

8. Model Specification, Fixed Wing Instrument Trainer, Revised 26 June 1964, with Flight Instrumentation Appendix I and Table E, Appendix II.

9. Letter, SMOSM-PAIF-1, USAAVCOM, 16 July 1964, subject: "Invitation for Bid No. AMC(T)-23-204-64-459 (Step One)."

10. Technical Proposal, Aero Commander Division of Rockwell-Standard Corporation, 31 August 1964.

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APPENDIX II

COMPARISON WITH MODEL SPECIFICATIONS

Model Specification		Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
Fixed-Wing Instrument Trainer			
1. SCOPE			
1.1 Scope. This specification covers the essential requirements for an instrument training airplane capable of performing the missions specified in 1.2			
1.1.1 Designation and General Description			
Army Model Designation	Not yet assigned		
Number of Crew	1 Pilot (instructor)	Yes	
Number of Passengers	3 Students	Yes	
Flight Controls	Dual, side by side	Yes	
Propulsion	Two reciprocating engines, feathering and positive unfeathering propellers	Yes	

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Model Specification	Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
Configuration and Construction — All metal with retractable tricycle landing gear	Yes	
1.2 <u>Mission.</u> The primary mission in which this airplane will be employed is the training of military pilots in instrument flying, in both day and night instrument flight rule operations.		
1.2.1 <u>Secondary Mission.</u> Twin Engine Transition Trainer for single engine rated aviators.		
1.3 <u>Performance Information.</u> Those items of performance stated as requirements herein which are not included in the FAA approved flight manual are subject to verification by the U. S. Army.		
2. <u>APPLICABLE DOCUMENTS</u>		
2.1 The applicable documents shall be those necessary to fulfill the requirements of paragraph 3.10, Federal Aviation Agency Certification.		
3. <u>REQUIREMENTS</u>		
3.1 <u>Federal Aviation Agency Certification.</u> The airplane shall have a Part 3 (effective as of the	Yes	Test airplane had FAA Standard-

Model Specification	Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
date of issuance of the IFB) standard airworthiness certificate for instrument flight operations, issued by the Federal Aviation Agency in the Utility category.		Normal Category Certificate.
GFAE (electronics), contractor installed, shall be operationally verified by FAA.	Yes	
3.2 Basic Weight. The basic weight of the airplane shall include all required installed equipment including the items in Section 3.9 and the Electronic Equipment as stated in appendix II.	Yes	Test airplane basic weight did not include required installed equipment.
3.3 Center-of-Gravity Range. No restrictions to mission payload or utility shall arise from constraints relating to center-of-gravity range, i.e. indiscriminate loading not to exceed useful load.	Yes	
3.4 Useful Load. The useful load shall be a minimum of 900 lbs. of payload in addition to fuel and oil necessary to accomplish the endurance mission of paragraph 3.5.1.	Yes	Test airplane had 717 pounds of payload in addition to fuel and oil.
3.5 Required Performance		
3.5.1 ICAO Standard Day Performance		
(at certificated gross weight)		

Model Specification		Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
Cruise Speed (Minimum)	150 knots True Air Speed (TAS) at 65% Power at 7500 ft. Mean Sea Level (MSL)	Yes	
Endurance (Minimum)	5 hours at 65% Power at 7500 ft. MSL	Yes	Test airplane had 3.73 hours endurance.
Single Engine Service Ceiling (minimum) - 7000 ft. MSL		Yes	
Minimum Safe Single Engine Speed at Sea Level, not to exceed 80 knots		Yes	
3.6 <u>Aircraft Structure</u>			
3.6.1 <u>Landing Gear.</u> The landing gear shall be nose-wheel type tricycle configuration and shall be retractable. The nose wheel shall be steerable.		Yes	
3.6.2 <u>Airframe</u>			
3.6.2.1 Construction shall be all metal.		Yes	
3.6.2.2 <u>Interior Arrangement.</u> Individual side-by-side adjustable			

Model Specification	Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
front seats for the student on the left and the instructor on the right. Two additional seats immediately to the rear to accommodate two additional students. Seating arrangement must permit exchange of the three (3) students in flight.		
Shoulder harnesses shall be required for the front seats only.	Yes	Test airplane had no shoulder harnesses.
3.6.2.2.1 One (1) fire extinguisher and one (1) first aid kit shall be installed and shall be accessible in flight. (See appendix III.)	Yes	
3.6.2.3 <u>Flight and Engine Controls</u>		
3.6.2.3.1 Dual flight controls to include adjustable rudder pedals with toe-type brakes.	Yes	Test airplane had no adjustable rudder pedals.
3.6.2.3.2 In-flight trim controls for elevator, aileron, and rudder are required and shall be easily accessible to both the student and instructor.	Yes	Test airplane had no in-flight aileron trim controls.
3.6.2.3.3 Engine controls shall be easily accessible to both the student and instructor.	Yes	

Model Specification	Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
3.6.2.3.4 Positive control surface locks will be provided for ramp use.	Yes	
3.6.2.4 Instrumentation		
3.6.2.4.1 The instrument panel shall have dual instrumentation incorporating the "T" panel arrangement depicted in appendix I. Further, the two (2) attitude indicators shall have separate power sources.	Yes	
3.6.2.4.2 Engine instruments shall be readable by both student and instructor pilot.	Yes	
3.7 Lighting		
3.7.1 Cockpit and instrument lighting are required for night and instrument flight rule operations. (Fluorescent and/or red flood lighting not acceptable as primary lighting of instrument panel.)	Yes	
3.7.2 The aircraft shall have rotating beacon(s) per FAA requirements.	Yes	
3.8 Electronic Equipment		
3.8.1 Electronics shall be in accordance with appendix II.	Yes	
3.8.2 Controls shall be easily accessible and readable to the student and instructor.	Yes	

Model Specification	Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
3.8.3 Electronics controls shall be front panel mounted wherever possible. Overhead control panels are not acceptable.	Yes	
3.9 Aircraft Systems		
3.9.1 Cabin Heating. The aircraft shall have a heating system capable of maintaining a minimum of +40°F. cabin temperature with -25°F. outside air temperature.	Yes	
3.9.2 Deicing Equipment. Lightweight deicing and anti-icing equipment shall be installed on the aircraft as certificated. Deicing equipment must be capable of continuous operation for flight endurance of the aircraft.	Yes	Test airplane had no deicing or anti-icing equipment.
3.9.3 Oxygen Equipment. Equipment for four (4) persons for a minimum of 1.5 hours duration at 15,000 feet MSL. A liquid oxygen system is not acceptable.	Yes	Test airplane had no oxygen equipment.
3.10 Stowage		
3.10.1 Baggage space shall be provided for a minimum of 100 lb. of personal baggage.	Yes	
3.10.2 Storage space within the cabin shall be provided for maps, charts, computers, and one (1) TM 11-2557 (Jeppesen Case).	Yes	

Model Specification	Proposed Model 500B Trainer Airplane Meets Mod Specs	Remarks
3.11 Manuals		
3.11.1 The aircraft shall be furnished with a Flight Operator's Manual in accordance with FAA regulations and a Maintenance and Parts Manual.	Yes	

APPENDIX III - COORDINATION

The following agencies participated in the review of the test report:

US Army Aviation School

US Army Combat Developments Command Aviation Agency

APPENDIX IV - DISTRIBUTION LIST

REPORT OF USATECOM PROJECT NO. 4-5-1001-01

Agency	No. Copies
Commanding General US Army Aviation Materiel Command ATTN: SMOSM-EP St. Louis, Missouri 63166	10
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Commanding General US Continental Army Command ATTN: Colonel Greer Fort Monroe, Virginia	2
Commanding General US Army Test and Evaluation Command ATTN: AMSTE-BG Aberdeen Proving Ground, Maryland 21005	2
Commanding General US Army Mobility Command ATTN: AMSMO-M Warren, Michigan	2

AD__________________________ Accession No.__________________
US Army Aviation Test Board, Ft. Rucker, Alabama. Final Report of USATECOM Project No. 4-5-1001-01, Military Potential Test of the Model 500B Fixed-Wing Instrument Trainer, 30 November 1964. DA Project No. None. 42 pp., 8 illus. FOR OFFICIAL USE ONLY
The Military Potential Test of the Model 500B Fixed-Wing Instrument Trainer was conducted by the US Army Aviation Test Board during the period 3 September to 16 October 1964 at Fort Rucker, Alabama. Flight under actual and simulated instrument conditions and demonstrations to personnel representing the US Army Aviation Center and the US Army Aviation School were conducted during the test period. It was found that the Model 500B test airplane as changed by the technical proposal will meet all of the requirements contained in the Model Specification. It was recommended that a confirmatory test be performed on the initial production airplane if the Model 500B airplane is selected as a fixed-wing instrument trainer.

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