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US ARMY TEST & EVALUATION COMMAND

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FINAL REPORT

OF

MILITARY POTENTIAL TEST

OF THE

MODEL B55-B FIXED-WING INSTRUMENT TRAINER

DA PROJECT NO. NONE

USATECOM ~~PROJECT NO.~~ 4-5-1001-01

NOV 1964

30 Nov 64

47p.

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J C Malloy
USAAVNTBD (RAV)
14 Oct 76
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US ARMY AVIATION TEST BOARD

FORT RUCKER, ALABAMA

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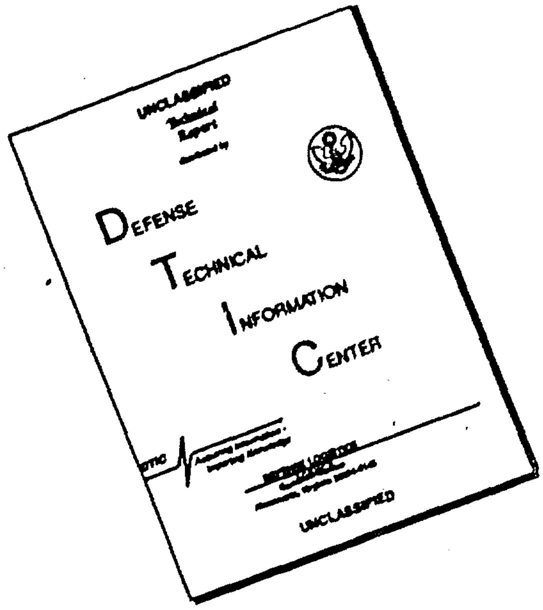

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DETAILED DESCRIPTION OF MODEL B55-B AIRPLANE AS TESTED

1. General. The Model B55-B airplane is a low-wing, all-metal, tricycle-landing gear, twin-engine airplane. Each IO-470-L engine drives a 78-inch diameter, two-bladed, full-feathering, constant-speed 2AF34C55/78FF-O propeller. The fuselage and tapered cantilever wings are separate semimonocoque structures. The B55-B is certificated in the Standard-Normal and Utility Category by the Federal Aviation Agency (FAA), and the Approved Type Certificate is 3A16. The manufacturer's airplane serial number is TC-663.

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 on the right side of the fuselage or from the cabin area. Rudder pedals and a wheel-type flight control are provided for the instructor pilot and student. The instrument panel provides space for engine and flight instruments, avionic control heads and indicators, and secondary electrical switches and circuit breakers. A panel containing the magneto-starter, battery, and generator switches is located below the pilot's storm window. The fuel selector panel contains a fuel selector valve for each engine and a schematic diagram of fuel flow. This panel is located in front of, and between, the instructor and student pilot's seats.

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 the rear seats. Entry into the cabin is accomplished through a side door located on the right side of the fuselage. The cabin has provisions for lighting, heating, and ventilation. The cabin floors are carpeted and the walls and ceiling are fitted with soundproofed appointments. The combined cockpit and cabin area has the following dimensions:

Height - 50 inches (max.)

Width - 42 inches (max.)

Length - 102 inches (max.)

Volume - 143 cu. ft.

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4. Flight Controls. The B55-B airplane has dual flight controls affording control of the aircraft from either the instructor pilot or student pilot's station. A rotary movement of the control wheel determines the aileron travel. Fore-and-aft movement of the control column positions the elevator. The rudder travel is controlled by a dual set of adjustable rudder pedals mounted on the cabin floor forward of the instructor and student pilot's stations. The wing flap movement is electrically controlled by positioning the flap control lever mounted on the engine control pedestal. The ailerons, elevators, and rudder are mechanically actuated through push-pull rods and closed-circuit cable systems terminating in bell cranks. The aileron, elevator, and rudder trim-tab control wheels are located on the lower portion of the engine control pedestal. Mechanical systems consisting of closed-circuit cables and jack shafts transmit trim control movements to the trim tabs. Indicators adjacent to the trim-tab control wheels show the trim-tab position. The trim-tab control wheels are located with the axis of the wheel coincident with the maneuvering axis of the respective trim tab. Turning the aileron trim-tab control wheel clockwise gives a left wing-up attitude, and turning the wheel counterclockwise gives a right wing-up attitude. A nose-up attitude is obtained by turning the elevator trim-tab control wheel downward, and turning the wheel upward gives a nose-down attitude. Turning the rudder trim-tab control wheel to the left provides a left rudder trim, and turning the wheel to the right provides a right rudder trim.

5. Engine. The B55-B is powered by two IO-470-L engines. The IO-470-L is a direct-drive, wet-sump, horizontally-opposed, six-cylinder, air-cooled, fuel injection engine. The engine displacement is 471 cubic inches, and the compression ratio is 8.6 to 1. The rated takeoff and rated maximum continuous brake horsepower is 260 at 2625 r.p.m. The FAA Type Certificate number for this engine is 3E1. The oil capacity is 12 quarts.

6. Engine Cowling. The engine cowling consists of five sections. To facilitate servicing the engine, a large cowl section on each side of the engine hinges downward. A cowling nose ring, a top cowl panel incorporating the oil level indicator access, 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. A down-draft cooling system directs this cooling air down and around the engine cylinders and out through the lower engine nacelle openings equipped with cowl flaps adjustable from the cockpit.

8. Propellers. The Model B55-B is equipped with all-metal 2AF34C55/78FF-O, controllable, full-feathering, constant-speed, two-bladed 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 500 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 control lever just forward of the feathering detent, a positive unfeathering system is installed to assist in the operation. This system consists of a nitrogen-charged accumulator, a special governor, and a hose running between the governor and the accumulator. The governor contains a spring-loaded check valve which is unseated while the propeller control lever is in any position except "FEATHER," thus permitting governor-pressurized oil to flow to and from the accumulator. When the propeller control lever is moved to the "FEATHER" position, the check valve is seated and oil under governor pressure is trapped in the accumulator and hose. As the propeller control lever is moved out of the "FEATHER" position, the trapped oil flows back through the governor to the propeller to unfeather it. The windmilling propeller makes it unnecessary to engage the starter for in-flight engine starting.

9. Fuel System. The fuel is contained in four rubberized bladder-type fuel cells, two located in each wing. The four cells have a total usable fuel capacity of 142 US gallons. During normal operation each engine draws fuel from the adjacent wing fuel cells. However, a system of fuel cross-feed lines permits either engine to consume the entire fuel supply of any or all cells. Each fuel cell is filled through its own filler opening located in the upper wing surface. The openings are covered by flush-type filler caps. An individual two-speed electric boost pump is provided for each engine. High pressure is used for starting and provides for near maximum engine performance should the engine-driven pump fail. When necessary in high ambient temperatures, low pressure can be used for ground operation, take-off, climb, and landing. The fuel on-off valves are manually actuated from the cockpit by the fuel selector handles.

Fuel quantity is measured by float-type transmitter units which transmit signals to the fuel gauges on the instrument panel. A two-position selector switch, controlled by the pilot, determines the fuel cell, main or auxiliary, to which each gauge is connected.

10. Landing Gear System. The Model B55-B airplane is equipped with an electrically-retractable tricycle landing gear. The landing gear is operated through push-pull tubes by a reversible electric motor and actuator box under the front seat. The motor is controlled by a two-position landing gear switch located on the right-hand side of the power control pedestal. Limit switches and a dynamic braking system automatically stop the retraction mechanism when the landing gear reaches its full-up or full-down position. The nose gear retracts rearward into the nose section. The main landing gear retracts inward into the wing wheel wells. With the landing gear in the UP position, the wheels are completely enclosed by fairing doors which are operated mechanically by the retraction and extension of the gear. Individual up-locks actuated by the retraction system lock the main gear in the UP position. No down locks are necessary since the over-center pivot of the linkage forms a geometric positive lock when the gear is fully extended. The linkage is spring loaded to the over-center position. Landing gear position lights, located above the landing gear switch, indicate the fully extended or retracted position. Additionally, a mechanical indicator beneath the engine control pedestal shows the nose gear position at all times. When either or both throttles are retarded in flight below a preset engine manifold pressure, with the gear retracted, a warning horn will sound an intermittent note. A safety switch prevents accidental landing gear retraction on the ground. The landing gear may be lowered manually by a handcrank located to the rear and between the front seats (figure 1). The crank, when engaged, drives the normal landing gear actuation system. Approximately 50 turns of the crank are required to lower the landing gear. The nose wheel is made steerable through a spring-loaded linkage connected to the rudder pedals.

11. Brake System. The main landing gear wheels are equipped with single-disc, hydraulically-actuated brakes. The brakes are actuated by individual master cylinders connected to the rudder pedals and operated as toe brakes. The hydraulic brake fluid reservoir is located in the forward baggage compartment. The parking brake is set by a push-pull control with a center-button lock. Setting the control closes a valve in the brake lines so that pressure built up by pumping the toe pedals is retained and the brakes remain set. Pushing the control in opens the valve and releases the brakes.

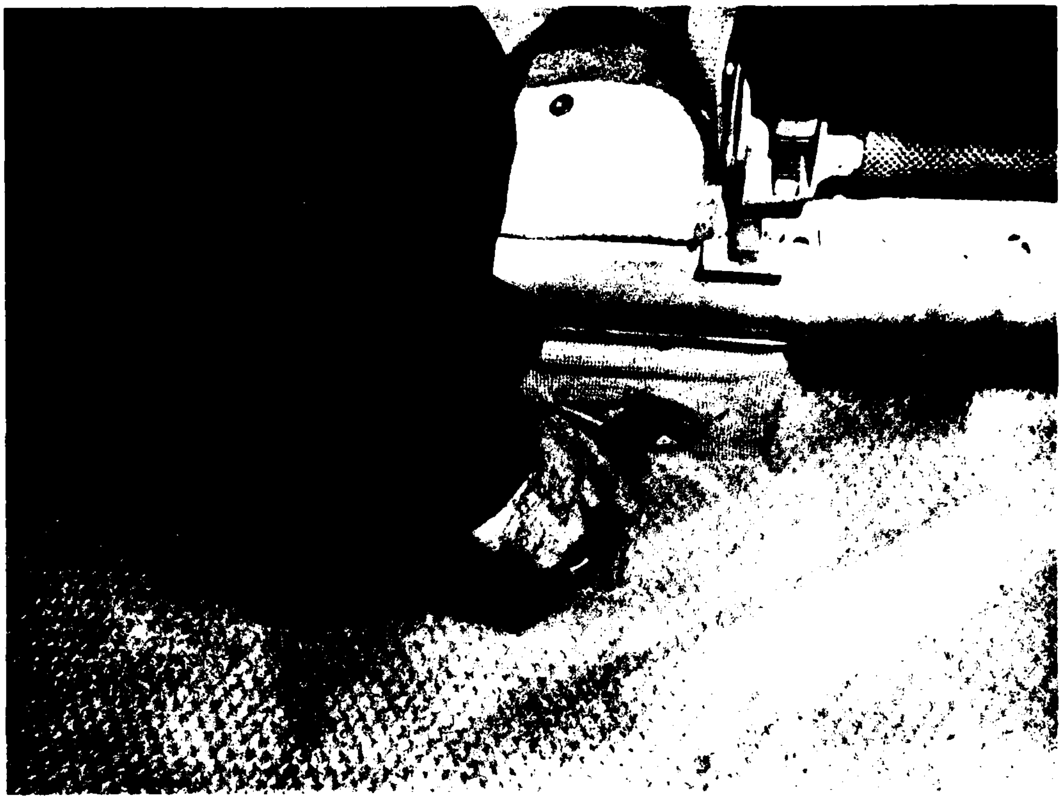

Figure 1. Handcrank for lowering landing gear.

12. 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 a 24-volt, 17 ampere-hour, wet-cell storage battery installed under the nose baggage compartment floor (figure 2). Two 28-volt engine-driven generators provide electrical power. A plug-in receptacle on the left side of the port engine nacelle is available in the event an external power source is desired.

Figure 2. Battery installation.

13. 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. In addition to the air supplied to the cabin through the heater fresh-air system, a manually retractable air scoop on top of the cabin conducts outside air to individual fresh air outlets above each seat. The outlets can be manually adjusted to control the quantity and direction of air flow. A manually-controlled cabin air exhaust vent completes the air circulation system. A 50,000-B.t.u. combustion-type heater provides heat for the cabin and the windshield defroster.

14. Basic Aircraft Data. (See figure 3 for general dimensions.)

Aircraft serial No. TC-633

Aircraft Type Certification No. 3A16

Engine serial No. (Left) CS-91408-4L; (Right) CS-91409-4L

Engine Type Certification No. 3E1

Areas.

Wing (total)	199.2 sq. ft.
Flaps (total)	25.7 sq. ft.
Ailerons (total)	11.4 sq. ft.
Tabs	3.1 sq. ft.
Horizontal tail (total)	48.1 sq. ft.
Elevators (incl. tabs)	16.2 sq. ft.
Vertical tail (incl. rudder)	22.6 sq. ft.
Rudder (incl. tab)	11.6 sq. ft.
Dorsal fin	5.2 sq. ft.

General Data.

Wing

Airfoil section (root)	NACA 23016.5
Airfoil section (tip)	NACA 23010.5
Span	37 ft. 9.8 in.
Root chord	84 in.
Tip chord	35.64 in.

Mean aerodynamic chord	63.08 in.
Taper ratio	2.4
Dihedral (outboard)	6 degrees
Aerodynamic washout (outboard)	5 degrees
Aspect ratio	7.16
Flaps	
Span (total)	14 ft. 10 in.
Chord	25 percent
Ailerons	
Span (total)	13 ft. 2.2 in.
Chord	20 percent
Horizontal tail	
Airfoil section	NACA 0009 modified
Span	13 ft. 9.2 in.
Mean aerodynamic chord	43.3 in.
Taper ratio	1.4
Aspect ratio	3.9
Elevator mean aerodynamic chord	15.3 in.
Vertical tail	
Airfoil section	NACA 0008 modified
Height	70 in.

Height (ground line)	9 ft. 6 in.
Mean aerodynamic chord	58.0 in.
Taper ratio	1.9
Aspect ratio (geometric)	1.2
Rudder mean aerodynamic chord	24.0 in.
Maximum fuselage area cross section	
Height	5 ft. 4 in.
Width	3 ft. 10 in.
Landing gear	
Tread of main wheels	9 ft. 7.1 in.
Wheel base	7 ft. 0 in.
Clearances	
Propeller to fuselage	13.5 in.
Propeller to ground (normal static position)	10.4 in.
Propeller to ground (flat struts and tires)	3.75 in.
Fuselage to ground (flat struts and tires)	16.0 in.
Control surface movements	
Wing flaps (maximum)	28 degrees down
Ailerons	20 degrees up
	20 degrees down

Rudder	25 degrees right
	25 degrees left
Elevator	30 degrees up
	15 degrees down

THREE-VIEW DRAWING

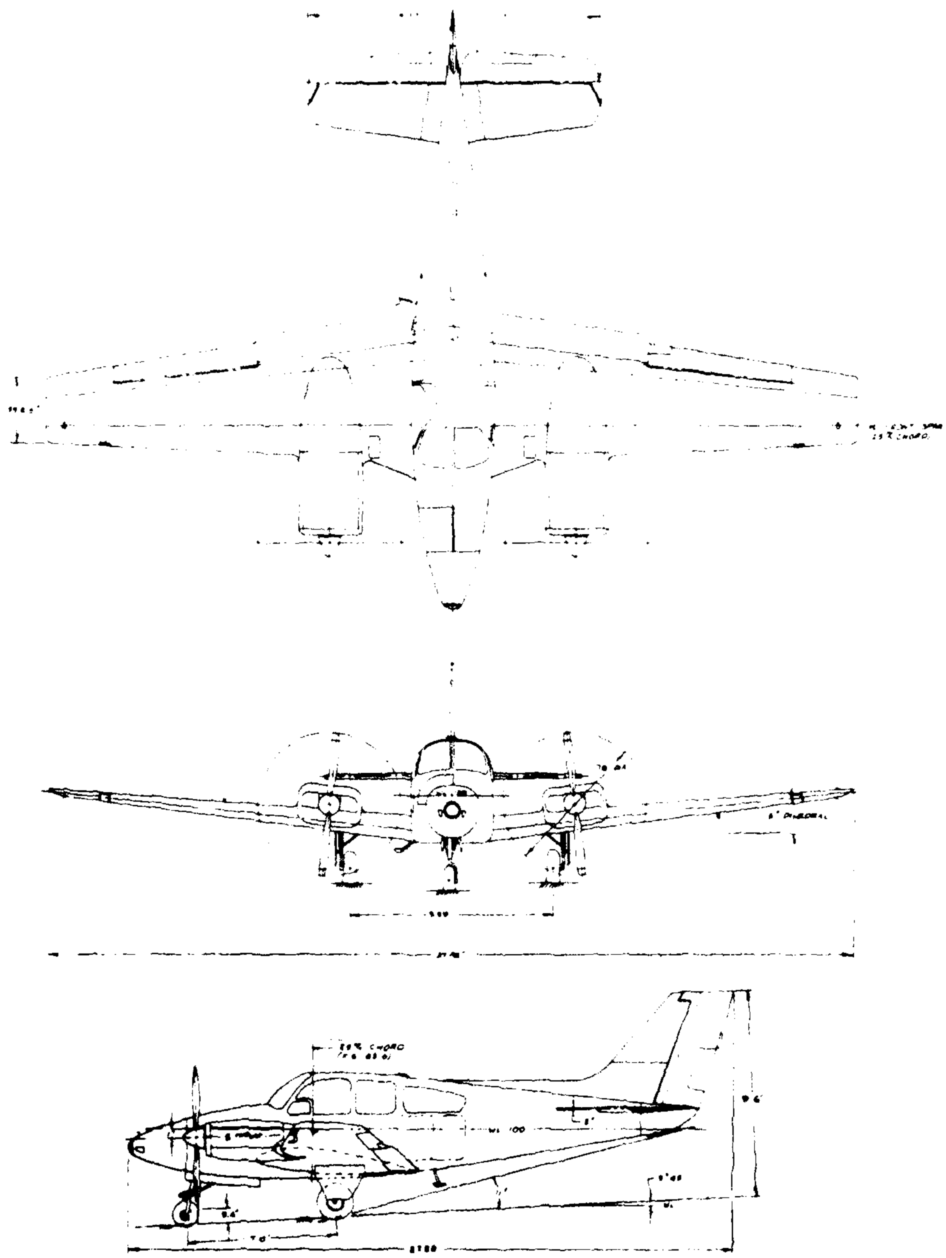

Figure 3.
General dimensions of Model B55-B Airplane.

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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 Universal 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. 47134) using a manually operated "piston type" pump (part no. 83498). In 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 B55-B FIXED-WING INSTRUMENT TRAINER

DA PROJECT NO. NONE

USATECOM PROJECT NO. 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 B55-B Fixed-Wing Instrument Trainer was conducted by the US Army Aviation Test Board during the period 2 September to 26 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 B55-B 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 B55-B airplane is selected as a fixed-wing instrument trainer.

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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama

FINAL REPORT OF
MILITARY POTENTIAL TEST OF THE
MODEL B55-B 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 B55-B

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, [illegible] 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 B55-B 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.

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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 B55-B instrument trainer airplane is a low-wing, all-metal, tricycle-landing gear, twin-engine airplane. The fuselage and tapered cantilever wings are separate semimonocoque structures. The airplane is powered by two IO-470-L direct drive, wet-sump, horizontally-opposed, six-cylinder, air-cooled, fuel injection engines. The rated takeoff and rated maximum continuous brake horsepower is 260 at 2625 r.p.m. Each engine drives a 78-inch diameter, two-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 120 US gallons. The gross weight of the proposed instrument trainer is 5100 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 B55-B test airplane possessing a Federal Aviation Agency (FAA) Standard-Normal and Utility Category Certificate was delivered to the USAAVNTBD for evaluation on 2 September 1964.

1.7. FINDINGS.

The Model B55-B 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 B55-B 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 2 September 1964 to 26 October 1964, the Model B55-B 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 B55-B 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 de-icing 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 B55-B 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.

2.1.3.1.2. The Model B55-B test airplane was powered by two IO-470-L reciprocating engines. Each engine drove a two-bladed, full-feathering, constant-speed 2AF34C55/78 FF-O propeller. A positive propeller unfeathering system was incorporated. Moving the propeller control lever forward out of the feathering detent activated this system.

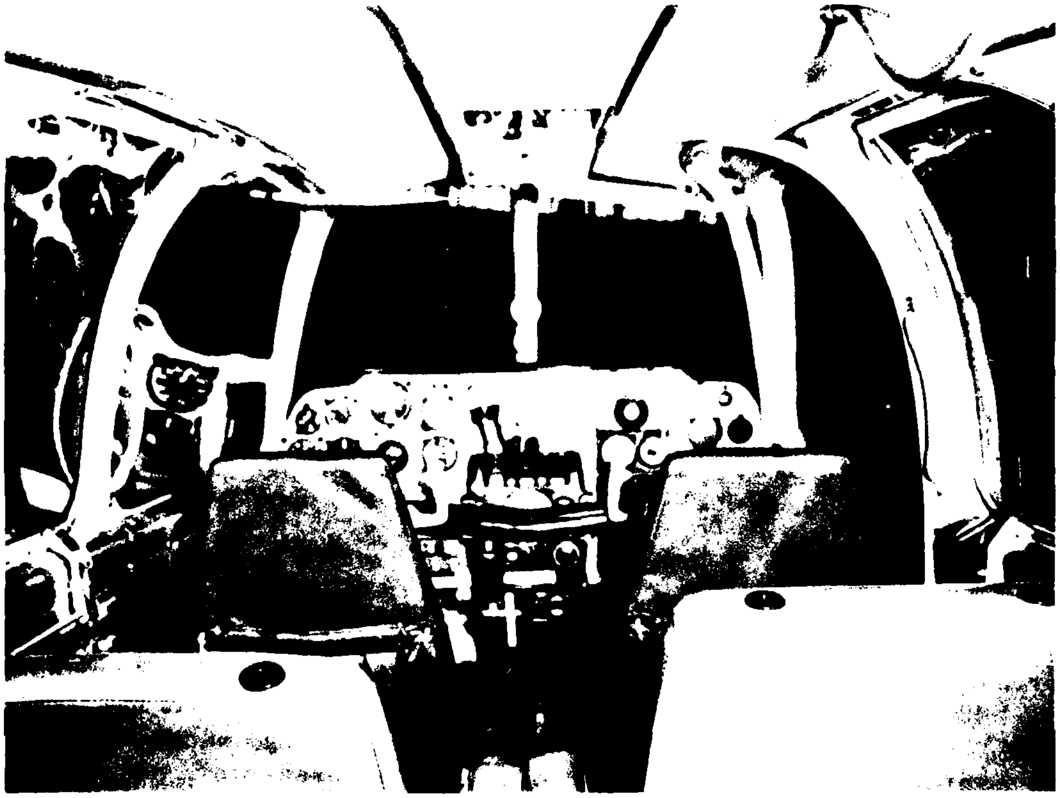

Figure 1. Seating arrangement

2.1.3.1.4. The Model B55-B test airplane featured an all-metal semi-monocoque construction and was equipped with electrically retractable tricycle landing gear.

2.1.3.2. Paragraph 3.2, Model Specification: The basic weight of the test airplane was 3248 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 3423 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 82.0 inches (forward c.g. limit) to 83.5 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 1087 pounds. The technical proposal presented a figure of 900 pounds of useful load for the proposed trainer.

2.1.3.5. Paragraph 3.6.2.1, Model Specification: The Model B55-B 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 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 adjustable.

2.1.3.9. Paragraph 3.6.2.3.2, Model Specification: The rudder, elevator, and aileron trim-tab control wheels were located in the lower portion of the engine control pedestal. These controls were accessible to both the student and instructor pilot.

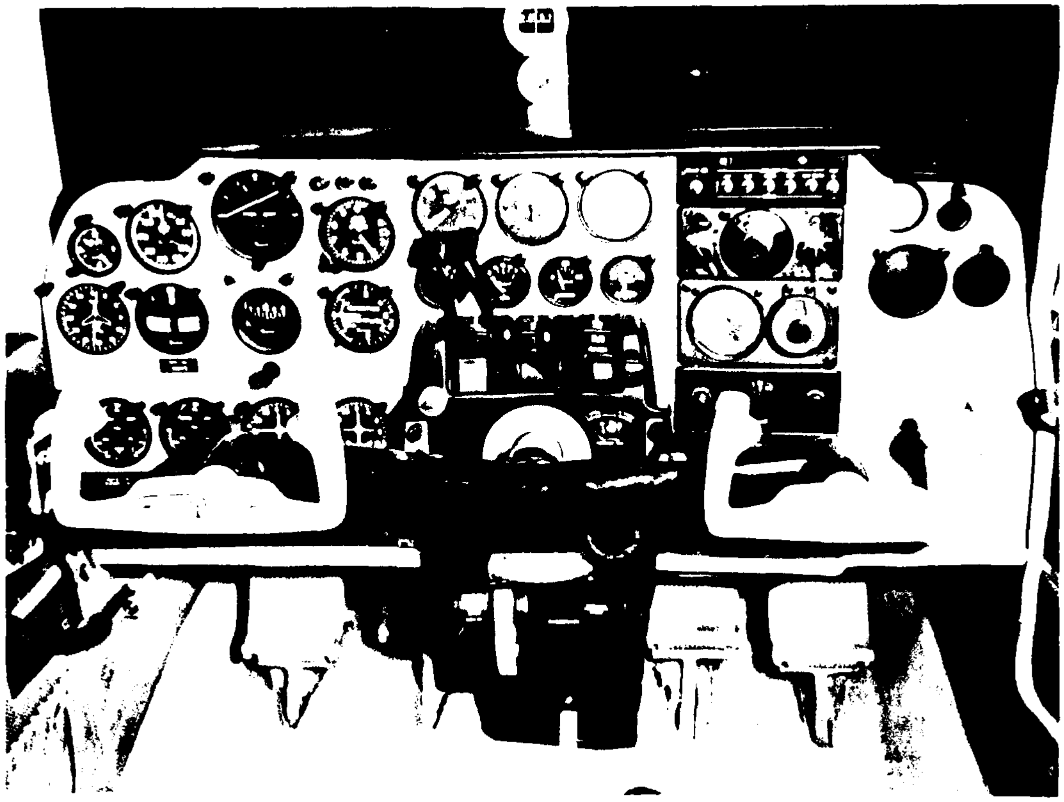

Figure 2. Model B55-B dual flight controls

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, and fuel mixture. A large friction lock knob on 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 the flight control column and the rudder pedals was provided with the test aircraft.

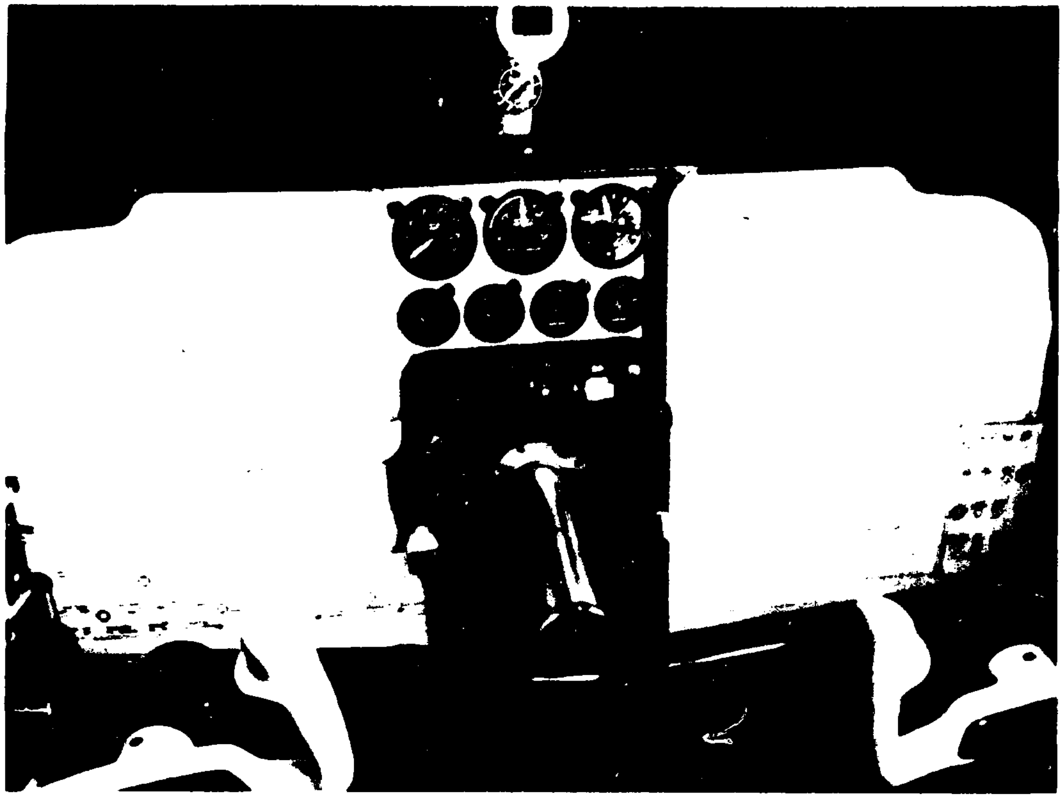

Figure 3. Proposed engine instruments and electronic controls

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 (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 panel. The intensity of the flood lights was controlled by a rheostat control knob. Cabin illumination was furnished by a white dome light located in the overhead panel. This light was controlled by an "ON-OFF" switch beside the light.

2.1.3.15. Paragraph 3.7.2, Model Specification: The Model B55-B 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 50,000-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 B55-B 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 alcohol propeller anti-icing equipment were available. The Model B55-B airplane had FAA approval for installation of inflation type wing and empennage deicer boots and alcohol propeller anti-icers.

2.1.3.18. Paragraph [illegible] oxygen equipment was installed [illegible] technical proposal cites availability [illegible] through individual outlets. installed in the [illegible] The FAA has approved a Model 96-560001-7 oxygen [illegible] for the [illegible] airplane. The flight manual stated that [illegible] would provide [illegible] hours' duration for four persons [illegible] altitude. This system did not employ liquid oxygen.

Figure 4. Baggage compartment

2.1.[illegible] Paragraphs 3.10.1 and 3.10.2, Model Specification: The test airplane [illegible] the required baggage space for a minimum of 100 pounds [illegible] baggage. A baggage compartment in the nose section provided approximately 12 cubic feet of baggage space (figure 4) and was placarded for a weight limit of 270 pounds. A door 21.0 inches wide by 15.5 inches high provided access to the baggage compartment from the outside. There was ample storage space within the cabin for maps, charts, computers, and one TM 11-2557 (Jeppesen Case). A stowage area behind the rear seat measured 39 inches wide (average), 44 inches high (average), and 39 inches long (figure 5). The weight capacity of this area was placarded for a weight limit of 400 pounds. Outside access to this area was by a side baggage door which measured 22.5 inches wide and 18.5 inches high (figure 6).

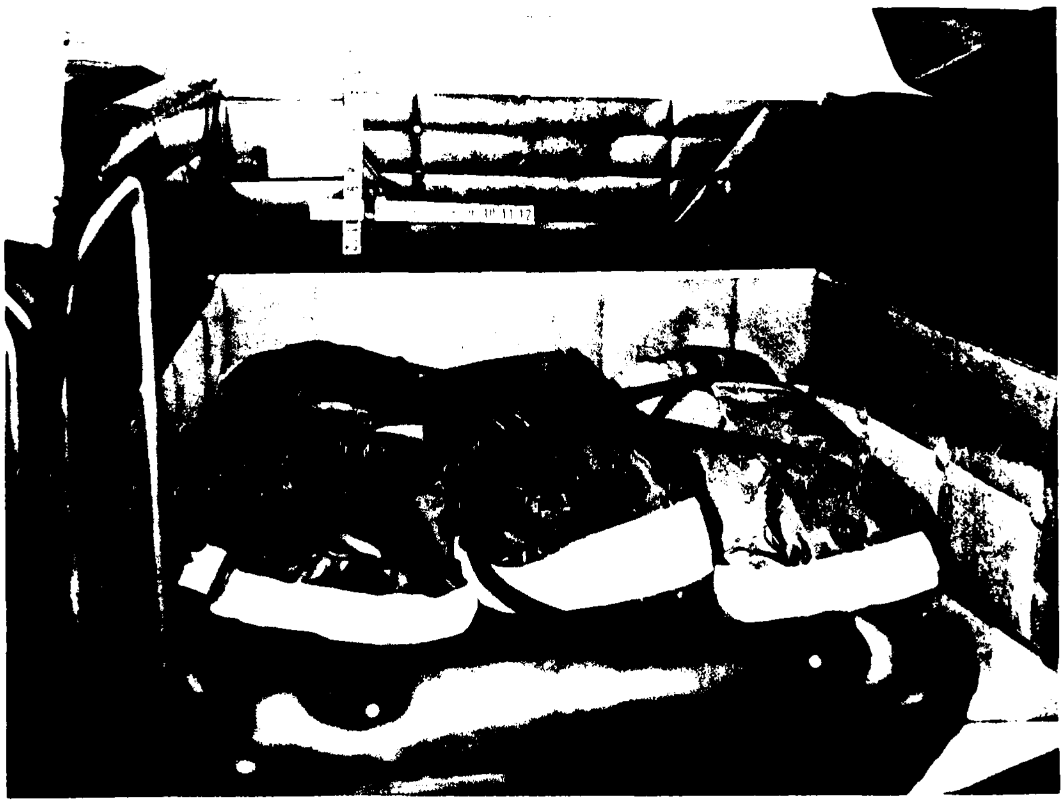

Figure 5. Stowage area behind rear seat

Figure 6. Access by side baggage door.

2.1.3.20. Paragraph 3.11, Model Specification: The Model B55-B 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 B55-B 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 Standard-Utility Category gross weight of 5100 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 5).

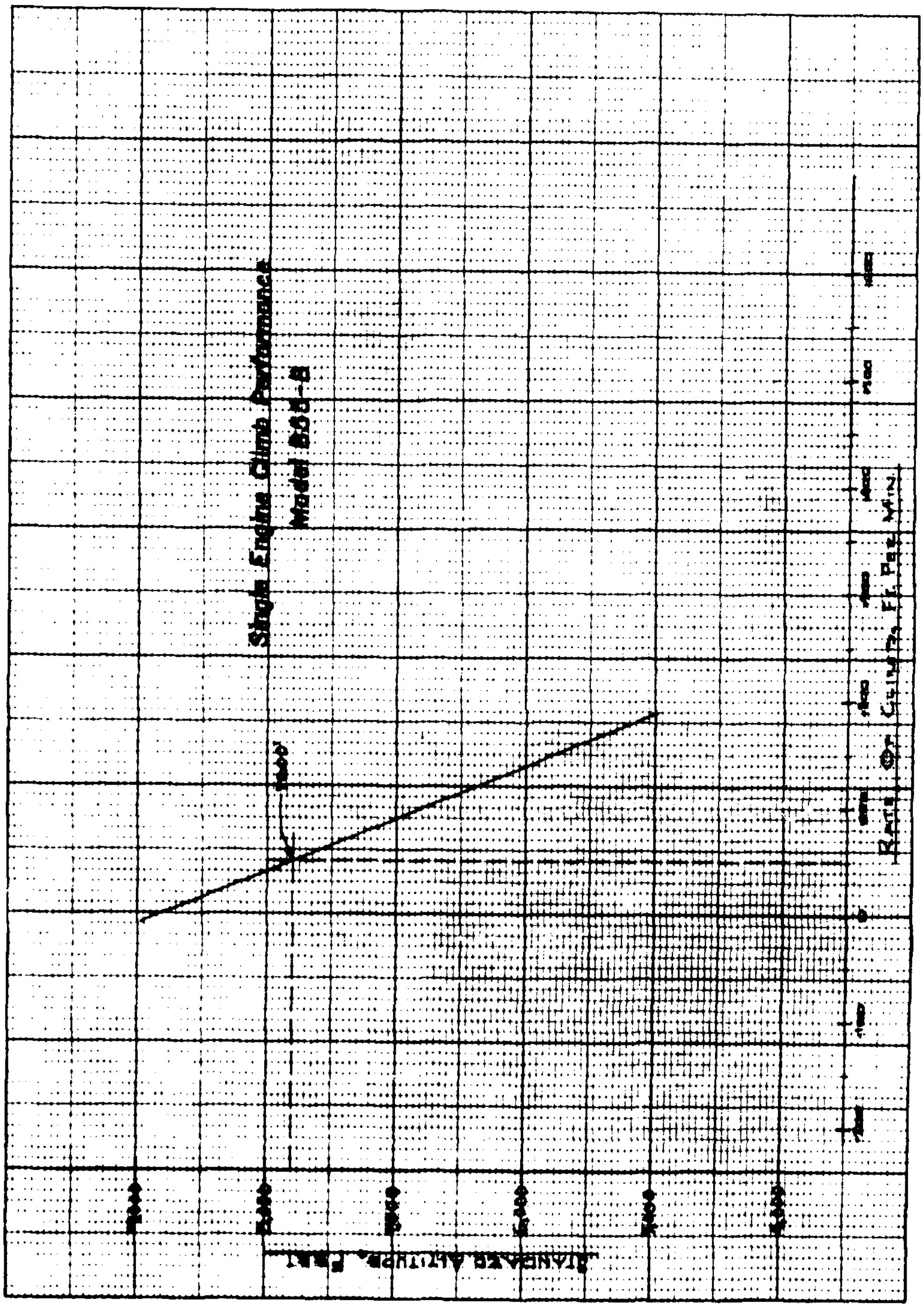

Figure 7

2.2.3. Results.

2.2.3.1. The cruise speed at 65 percent power, 7500 feet mean sea level was 187.8 knots TAS.

2.2.3.2. The Model B55-B test airplane consumed an average of 24.0 gallons of fuel per hour at 7500 feet altitude using a 65-percent best economy engine power setting. The test airplane basic weight was 3248 pounds. With the engine oil (45 pounds) and the 900-pound useful load required by the Model Specification, 907 pounds of fuel (151.1 gallons) may be added to meet the Standard-Utility Category gross weight of 5100 pounds. With this quantity of fuel, the test airplane will operate at the prescribed altitude and power settings for 6.28 hours. However, the technical proposal basic weight of 3423 pounds for the instrument trainer will allow 720 pounds (120 gallons) for fuel. This quantity of fuel will give the proposed instrument trainer an endurance figure of 5.0 hours based on the fuel consumption rate of the test airplane engines.

2.2.3.3. The Model B55-B test airplane had a single-engine service ceiling (climb rate of 50 f.p.m.) of 7800 feet (see figure 7).

2.2.3.4. The minimum safe single engine speed (V_{mc}) at sea level was 68 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.

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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 Trainers," USAAVNTBD, date 18 November 1964.

2. Letter, AMSTE-BG, USATECOM, 29 October 1964, subject: "Military Potential Test of Fixed Wing Instrument Trainer Aircraft," 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. Civil Aeronautics Manual 3, Airplane Airworthiness, Normal, Utility, and Acrobatic Categories, May 1962.

6. B55 Owner's Manual, Beech Aircraft Corporation, 20 September 1963.

7. B55 Shop Manual, Beech Aircraft Corporation, 20 September 1963.

8. Model Specification, Fixed Wing Instrument Trainer, Revised 2[illegible] 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, Beech Aircraft Corporation, 20 August 1964.

APPENDIX II

COMPARISON WITH MODEL SPECIFICATIONS

Model Specification		Proposed Model B55-B 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	

Model Specification	Proposed Model B55-B Trainer Airplane Meets Mod Specs	Remarks
Configuration and Construction — All metal with retractable tricycle landing gear	Yes	
1.2 Mission. 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 Secondary Mission. Twin Engine Transition Trainer for single engine rated aviators.		
1.3 Performance Information. 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. APPLICABLE DOCUMENTS		
2.1 The applicable documents shall be those necessary to fulfill the requirements of paragraph 3.10, Federal Aviation Agency Certification.		
3. REQUIREMENTS		
3.1 Federal Aviation Agency Certification. The airplane shall have a Part 3 (effective as of the	Yes	

Model Specification	Proposed Model B55-B 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.		
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 excluding the items in Section 3.9 and the Electronic Equipment as listed in appendix II.	Yes	Basic weight of test airplane 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	
3.5 Required Performance		
3.5.1 ICAO Standard Day Performance.		
(certificated gross weight)		

Model Specification		Proposed Model B55-B 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	
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 tri-cycle 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		Yes	

Model Specification	Proposed Model B55-B 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	
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.		
3.6.2.3.3 Engine controls shall be easily accessible to both the student and instructor.		

Model Specification	Proposed Model B55-B 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 B55-B 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 B55-B 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
Commanding General US Army Materiel Command ATTN: AMCMR-MC Washington, D.C. 20315	2
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

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US Army Aviation Test Board, Ft. Rucker, Alabama. Final Report of USATECOM Project No. 4-5-1001-01, Military Potential Test of the Model B55-B Fixed-Wing Instrument Trainer, 30 November 1964. DA Project No. None. 42 pp., 8 illus. FOR OFFICIAL USE ONLY report. The Military Potential Test of the Model B55-B Fixed-Wing Instrument Trainer was conducted by the US Army Aviation Test Board during the period 2 September to 26 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 B55-B 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 B55-B airplane is selected as a fixed-wing instrument trainer.

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