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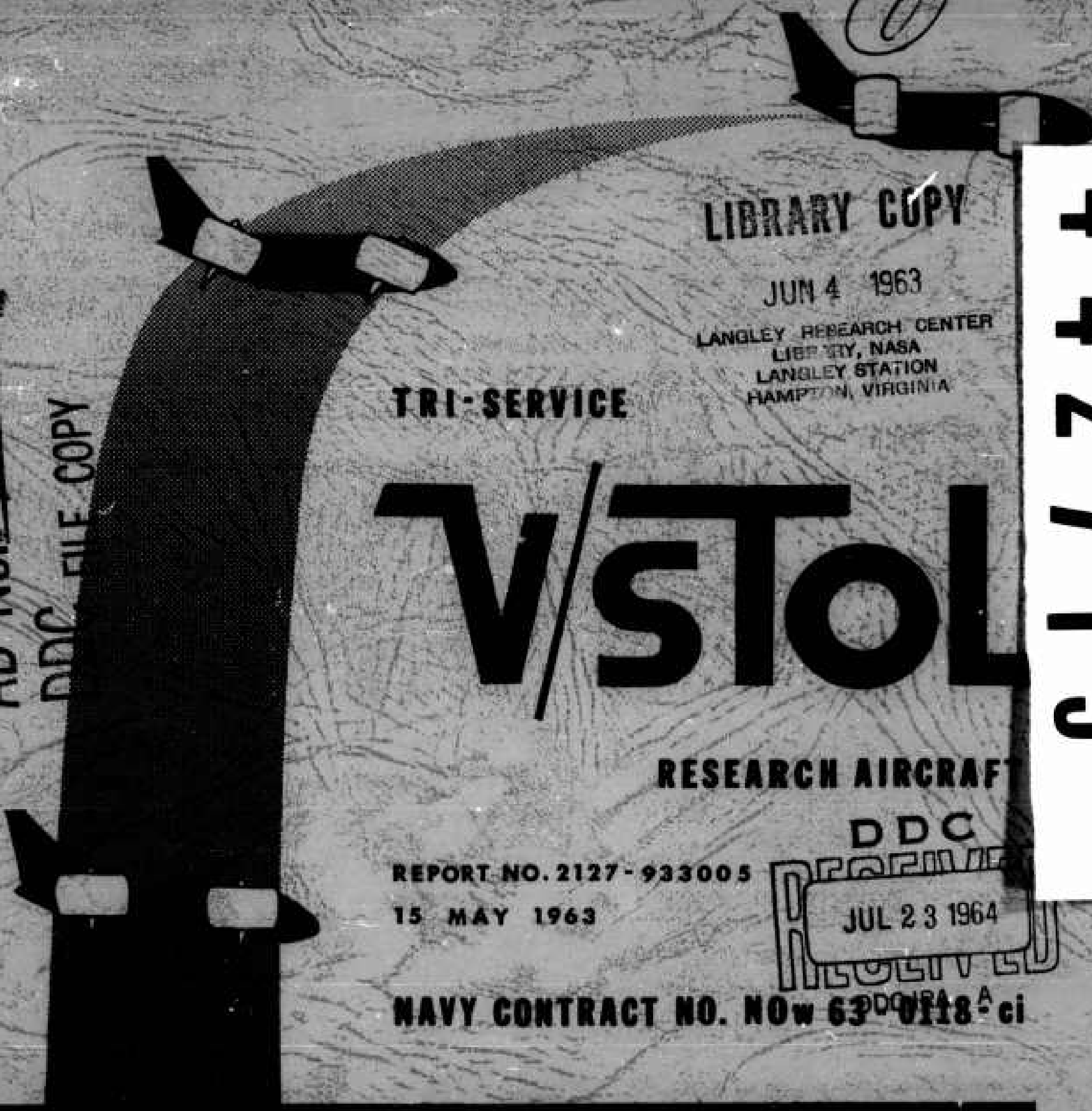
X-22A PROGRESS REPORT NO. 5

APRIL 1963



TRI-SERVICE

V/STOL

RESEARCH AIRCRAFT

REPORT NO. 2127-933005

15 MAY 1963

NAVY CONTRACT NO. NOw 63-0118-ci

BELL AEROSYSTEMS COMPANY

DIVISION OF BELL AEROSPACE CORPORATION-A textron COMPANY

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BELL AEROSYSTEMS COMPANY

Buffalo, N.Y.

(6) X-22A TRI-SERVICE V/STOL AIRCRAFT.

(9) MONTHLY PROGRESS REPORT, no. 5, 1-30 Apr 63,

(14) Report No. 2127-933005

April 1963

This is the fifth Monthly Progress Report as required in Section F (5) of the contract, and outlines progress for the period 1 April 1963 through 30 April.

A J. Marchese

A. J. Marchese
Project Director
X-22A PROGRAM

CONTENTS

CONTENTS (CONT)

ILLUSTRATIONS

I. INTRODUCTION

Bell Aerosystems Company was awarded Contract NOw 63-0118-ci by the Department of the Navy, Bureau of Naval Weapons for two Model X-22A Tri-Service V/STOL aircraft. The official negotiated contract was authorized on 30 November 1962. The X-22A aircraft is a dual tandem ducted propeller research airplane (Figure 1), with a prime mission of exploring the mechanical and aerodynamic problem of an aircraft designed and constructed for both vertical takeoffs and landings and conventional type operation. It carries a flight crew of two men in the cockpit, a pilot and copilot, and is capable of carrying a nominal 1200-pound payload. The aircraft will be designed to a target value for weight empty of 10,635 pounds, a speed of 303 knots, and endurance of 1.09 hours.

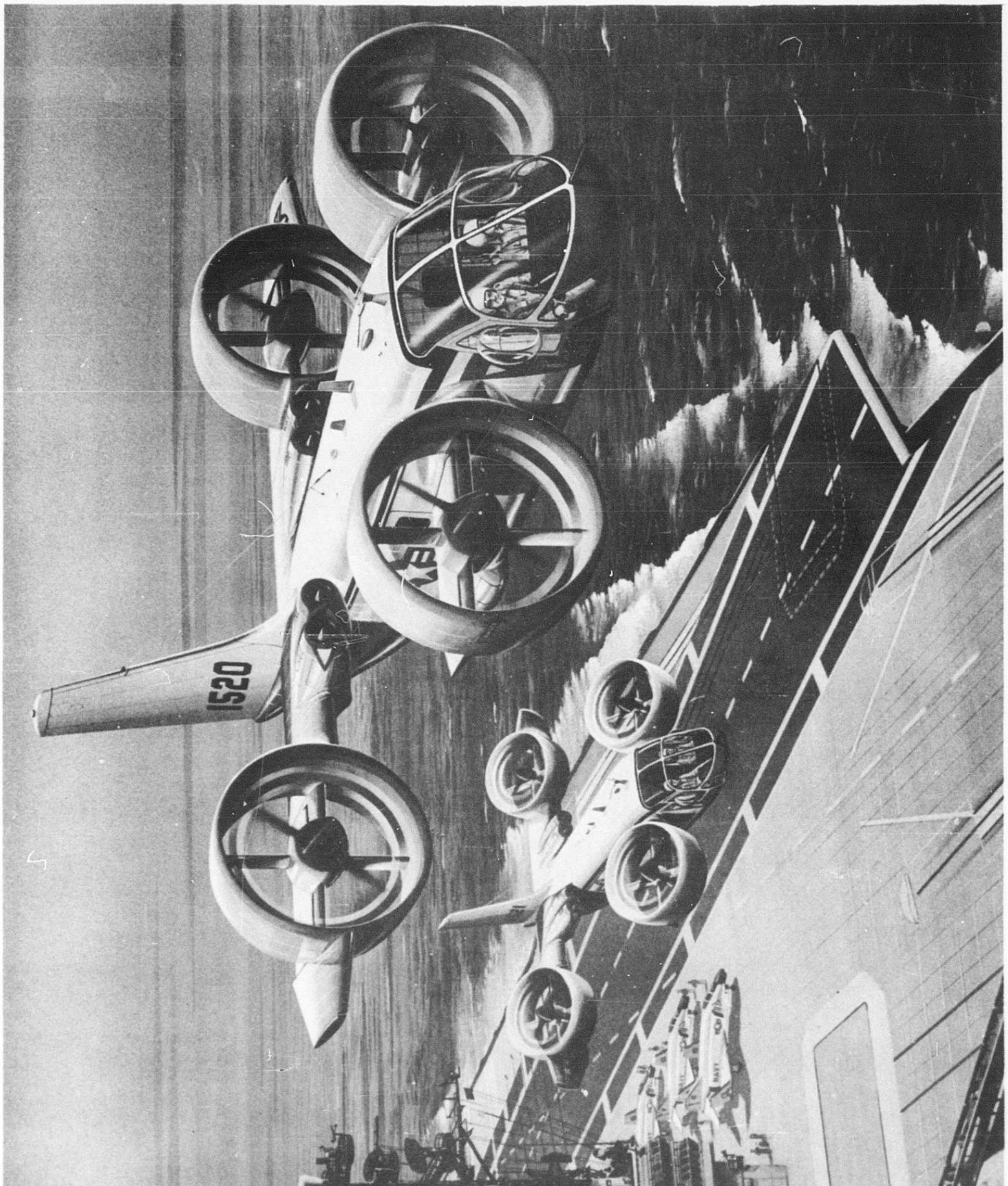

Figure 1. X-22A Tri-Service V/STOL Aircraft

II. SUMMARY

A

Preliminary design work, performance and weight studies, and calculation reviews of various configurations which have been in work since go-ahead on this program have now been reduced to designs for all systems and components. The engineering effort aimed at a Design Freeze in the month of May has been met, with the exception of minor studies to improve the longitudinal and directional stability as a result of the 1/6 scale wind tunnel testing.

The wind tunnel program, design, fabrication and test is being revised to reflect necessary redesigns as a result of the 1/6 scale model test data.

The transmission systems (gearboxes and shafting) have been reviewed and the evaluation is in its final phase prior to the award of a subcontract. Steel Products Engineering Co. and Curtiss-Wright are the two remaining vendors. A selection will be made on or before 6 May 1963.

Effort in finalizing procurement specifications and work statements for other required subcontracts is continuing.

During this period, all contractual data requirements were completed essentially as scheduled.

Management controls (PERT scheduling and costing) are continuing. Nets and EDP runs are still being expanded and improved on an expeditied basis. The second PERT COST report from this effort was issued, as scheduled, on April 18, 1963.

Schedules and expenditures for this report period were within the Departmental Work Instructions (DWI) issued to each operational department and the PERT schedules insofar as contract commitments are concerned. The present funding authorized to date covers scheduled expenditures through 15 July 1963.

III. PLANNING

Progress between 1 April 1963 and 30 April 1963 has continued in the detail planning of all program efforts. In PERT schedules, we are continuing to revise our original top level nets into expanded detail nets. During April, the networks have been updated resulting in Revision 17 to Network 2127-PN-200. The PERT Milestone Computer report and the PERT Interim Report for the month of March were submitted to BuWeps on schedule.

Again, as indicated in the last report, until this PERT/Cost program has been completely debugged and oriented into our operations, budgets in line with negotiated costs through April 1963 have been issued and are being used by each operational department. Daily reviews of these budgets are being made and expenditures through 30 April 1963 are within the authorized funds for this period. The authorized direct labor hours for each net, through the use of the PERT/COST EDP run, is being released as the operating official hours to each department as soon as each detail net is completed and the estimated hours assigned.

Figure 2, X-22A Milestone Data Requirements Chart, for the 2nd Quarter 1963, and Figure 3, Program Schedule, reflect the program as of 30 April 1963.

All operation departments are continuing with necessary planning and interdepartmental coordination as required, spearheaded by a weekly meeting attended by all members of the X-22A Management Organization.

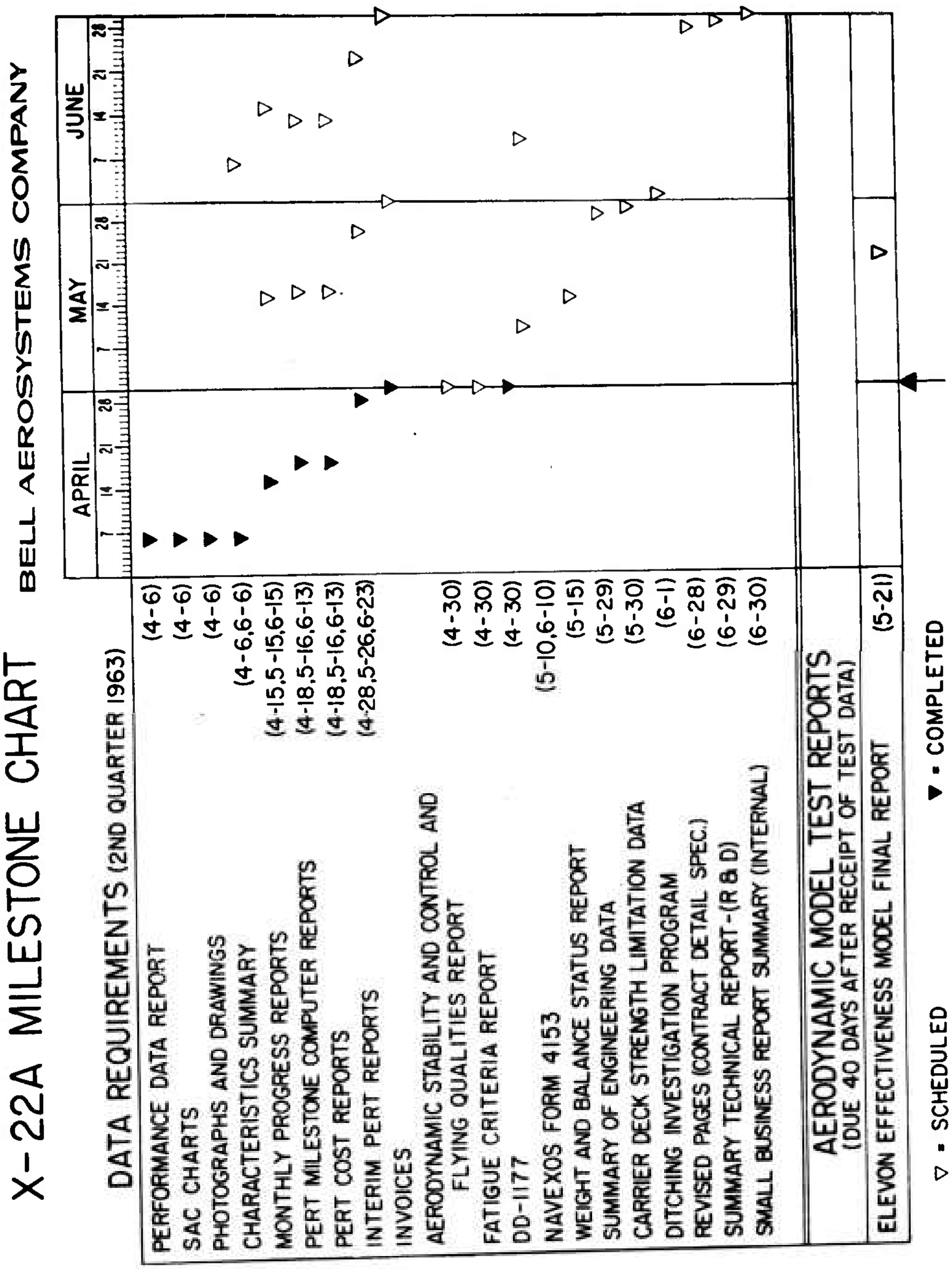

Figure 2. X-22A Milestone Chart - Data Requirements (Second Quarter)

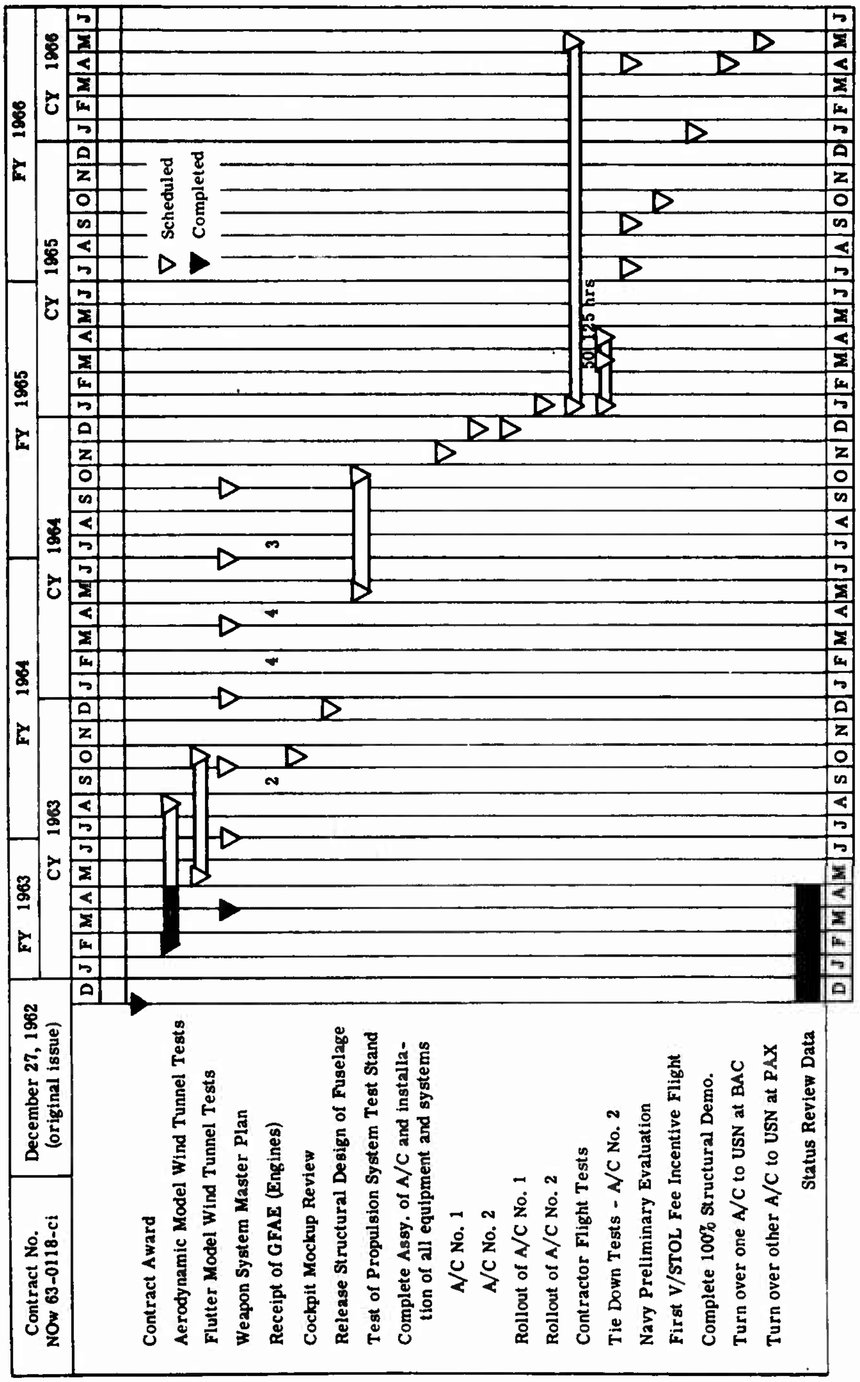

Figure 3. Program Schedule

The Engineering and Manufacturing weekly meetings to discuss and review designs, techniques, specifications, equipment, etc., are continuing.

A weekly top management program review has been started. The sole purpose of this review is to assure that problems not solved at the working level receive the attention and support of top managment.

Progress is continuing on planning and establishing requirements for conducting the various test programs.

IV. PRELIMINARY DESIGN

A. FLIGHT TECHNOLOGY

1. Performance

The Standard Aircraft Characteristics Charts, Characteristics Summary, and Performance Report were completed and submitted. Additional performance data regarding partial engine climb and the effects of zero lift drag increments were calculated and will be delivered in May as a revision to the Performance Report.

Additional detailed tradeoff performance for a 7 ft 3 in. propeller diameter were completed and indicated that there are no significant overall gains in increasing the diameter.

Preliminary wind tunnel results from the 1/6-scale unpowered model indicate much lower attitude drag than predicted for this configuration. $\Delta C_D/C_L{}^2$ for the model is on the order of 0.07 compared to the predicted value of 0.11 from previous wind tunnel tests of a similar configuration.

2. Propulsion Analysis

The analysis of engine nacelle cooling and ventilating with ejector inlet characteristics was completed, and the electrical compartment cooling analysis was started.

A complete directional control analysis for 100 to 300 knots, with propeller speeds of 70 to 100 percent of rated rpm was completed. The change in control with power level previously calculated was not verified.

Extending the operating envelope to 365 knots could not be done with this propeller map, but general ducted propeller performance maps indicated 450 hp could be absorbed at 2100 prpm with the 48 degree blade angle maximum position. Propeller thrust was also plotted from the calculated data points and will be given to Hamilton-Standard for their IBM program input.

Information on the T-58 engine was obtained relative to the deletion of overrunning clutches. Along with the requested information, GE recommended that the clutches be retained.

Propeller plane flow characteristics are being calculated using University of Wichita test pressure data.

All necessary inputs for the Therm subcontract on ducted propellers have been prepared and sent to the subcontractor.

Thermal analysis of engine compartment structural temperatures for sea level static, hot day, steady state was completed. Additional calculations for nacelle longitudinal skin temperatures were started. Surface emissivities and surface finish recommendations were also made.

Several contacts were made with Hamilton-Standard representatives on propeller specification items. A design priority for propeller optimization was given and design conditions for integral gearbox cooling were defined.

3. Stability and Control

The second quarterly revision of the "Stability and Control and Flying Qualities Report" (2127-917003, Rev. 1) was prepared for publication and release. The data and analyses in the report are based on the same body of wind tunnel data as the previous issue. This report contains all current aerodynamic design data and stability and control analyses.

Phase I tests of a 1/6 scale model of the X-22A were conducted at the David Taylor Model Basin Subsonic Wind Tunnel. Six component data was obtained for various configuration arrangements. Preliminary data has been received and is presently being evaluated in terms of the overall aircraft design.

Stability and control data for use in the initial variable stability system analysis was developed and issued to Cornell Aeronautical Laboratory. The data includes perturbation derivatives, stability and control derivatives, and pertinent physical constants.

B. VEHICLE STRUCTURES

1. Criteria and Loads

Duct circumferential load distributions for the University of Wichita "bell-mouth" and "high-speed" inlet configurations have been determined for a variety of test conditions. This data indicates that the majority of normal force developed at angle of attack is carried on the lower portion of the shroud. This tends to hold true even at very high angles of attack. A 90 degree angle of attack condition, corresponding to a high disk load (200 psf), produced a high degree of distortion of the 0 degree angle radial load distribution. The normal force developed was not unusually high since the radial load distribution was essentially symmetrical about the duct centerline.

Fuselage shear, bending moment, and torsion data have been determined for approximately one third of all landing and taxi conditions.

The Fatigue Criteria Report has been submitted for publication and release.

2. Structural Analysis

a. Front and Rear Ducts

The IBM program for evaluation of torsional and bending deformations of the duct including all effects of struts and center body has been completed. Results of loading conditions studied indicate that additional stiffening, primarily in the torsional mode, is necessary in order to maintain the desired clearance margin between the propeller tip and inner surface of the duct.

Influence coefficients yielding duct deformations at various regions have been established. This data will be used to calibrate the 1/7 scale wind tunnel flutter model.

With respect to detail design of the main duct support tube, basic wall thicknesses have been established based on strength requirements and using maraging type steel heat treated to 250,000 psi. Generally, while tube wall thicknesses are governed principally by stability considerations, use of the high heat treatment with these maraging type steels permits obtaining the required surface hardness for direct placement of the needle bearings.

b. Wing and Duct Support Structure

Detail analyses of the wing rib structure in the region of the duct bearing supports are continuing. Present effort is concerned with obtaining deflections and internal stress distributions for the machined fittings forward of the front beam, which form the outer elements of the duct support bearings.

In the current design, these fittings are an integrally machined part in maraging steel. Studies are being conducted of an alternate scheme in which most of the fitting is machined from aluminum with only the inside flange which forms the track for the needle bearings fabricated from steel.

Additional items currently in work include analysis of the engine support beam in combination with temperature effects associated with extended hovering. Preliminary structural sizes for the beam and the engine support fittings have been established.

c. Elevons and Controls

Study of flight controls loads in the cabin area has been completed and investigation of engine controls has been initiated.

Design airloads for the $q_{max.}$ condition have been determined for both the forward and aft elevons. The hinge moments on the aft elevon in the center section region just aft of the gearbox are somewhat higher than originally anticipated. Structurally, this area requires use of an 0.32 in. skin with 4.0 in. rib spacing. The remaining area consists of an 0.25 skin with ribs spaced at 5.0 in. based on acoustical fatigue requirements.

d. Fin

In connection with the configuration changes which are being studied to improve longitudinal and directional stability, a substantial increase in fin area is required. Studies have been made of various methods of attaching this larger fin. The principal change has involved moving the attachment of the front fin beam from the rear wing beam to the front wing beam.

e. Fuselage

The nose gear trunnion support was revised and a fore and aft member added to tie the trunnion directly to the drag brace support. This eliminated deflection of the seat rails which could interfere with the ejection system.

Studies conducted on the canopy showed that a 0.25 in. thick Plex 55 stretched enclosure was feasible from a strength standpoint. However, stretched Plex 55 is undesirable for ejection because of its break-up pattern. A Plex 55 as-cast canopy is being studied. The canopy is to be replaced after a specified number of flight hours, consistent with the working stress and creep-rupture strength. Ejection seat support structure and main landing gear bulkheads were established for the critical design conditions.

f. Transmission System

Analyses have been made of the loads on bearings in all gearboxes and a preliminary summary has been made of the loads applied to the propeller gearbox by the struts within the ducts. This latter information is required by Hamilton-Standard for propeller gearbox design. Technical evaluation of the proposal submitted by potential transmission system subcontractors has been completed and recommendations made from the point of view of structural integrity.

g. Wing

Configuration changes required to improve stability involving greater wing span and chord were studied to determine the effects on wing rib and beam locations. Optimum relationship between the wing, fuselage, and fin attachment structure for the new design is being investigated.

3. Aeroelasticity and Flutter

Symmetric and antisymmetric flutter analyses are being performed utilizing fuselage rigid body translation, pitch and roll degrees-of-freedom, fuselage first torsion and first vertical bending modes, aft wing first bending, first and second torsion degrees-of-freedom, and duct pitch and roll degrees-of-freedom. Analyses are presently in progress for five degree-of-freedom analysis subcases using duct pitch and roll degrees-of-freedom in frequency ratio parameter studies.

Results of antisymmetric analyses indicate that a duct roll-to-wing first torsion frequency ratio of 1.0 in combination with a duct pitch-to-wing first torsion frequency ratio of 2.0, or higher, will be flutter free. Results of symmetric analyses will have to be studied however, to confirm that the aforementioned frequency ratios will prove to be flutter free for symmetric modes.

4. Weights

The weight empty at the end of the reporting period is 10,623 pounds which is 12 pounds under the guaranteed weight empty and 2 pounds over the weight reported in the previous progress report. During the present reporting period, however, a number of weight changes have been made. The body group weight was reduced 56 pounds because the landing gear support fittings were duplicated in landing gear and body weight and the gear weight has been reduced due to changes in sink speed. The stability augmentation and variable stability system weights have been increased by additions in actuator and gyros and the transfer of weight from useful load to weight empty. The introduction of the single fuel tank saved 30 pounds and the fire extinguishing system was reduced 25 pounds because smaller fire extinguishing bottles resulted from an analysis of nacelle airflow. The starting and electrical systems increased, however, by 44 pounds due to increased wiring lengths and the fuel system weight increased 15 pounds as a result of adding a boost pump. Twenty pounds were added to the engine mount weight due to the transfer of the torque measuring arrangement from the engine gearboxes to the engine mount links. Other small weight savings resulted from oil system and structural changes.

Studies are being conducted to determine the weights for proposed configuration changes to improve longitudinal and directional stability. A comprehensive review of the center of gravity envelope has been conducted in order to make the attainable cg limits more consistent with aerodynamic stability and control capabilities. Various arrangements of payload and passengers have been examined and the most promising approach eliminates payload from the rear compartment.

Preliminary weight estimates of the engine support structure have been reviewed based on sizes and thicknesses determined by structural requirements. The requirement for cast rather than stretched plexiglass are being examined and indications are that additional weight will be required.

C. DESIGN

1. General Design

Configuration change studies are being made, based on data from recent wind tunnel tests. This includes investigations of added main wing area, changed outer panel area, and a longer fin.

Layouts of the mounting and control of the ducts continue with special emphasis on the drive system.

Reviews of the power plant system layouts were made, and are continuing.

Reviews of the electrical system were held to evaluate the possibility of eliminating the battery (30 amp/hour) and the constant speed drive for the 10 KVA alternator.

Approval layouts on the power plant are being routed for signatures prior to submittal to BuWeps.

2. Airframe

Layouts of the duct supports and harmonic drive, incorporating new loading conditions, are well under way.

Work on the wing, fin, and fuselage attachments has been stopped pending decision on revised wing and fin areas.

The windshield and canopy layouts are in work. An additional longitudinal member has been added to the canopy to allow use of as-cast plexiglass in the ejection area. Stretched plexiglass will be used elsewhere.

Full size nacelle lines are in work and investigations of the fuselage and nacelle filleting continue.

An investigation of a dual cylinder for operating the elevon is now being studied.

Detail layouts of the canted bulkhead are progressing to the point where they are now being studied by Structures and Weights.

The layout of the main landing gear bulkhead is under way.

Investigations of cylindrical ends versus honeycomb for fuel tank supports are in progress.

Layouts of the forward duct support bulkhead are continuing.

Investigations of larger access doors in the accessory drive area have been made and given to Structures and Weights for comment.

3. Flight Controls and Equipment

The isometric drawing of the entire control system has been completed.

Routing studies for the flight controls continue.

A study of the removal of the mechanical feel system was investigated and a tentative decision was made to retain it.

A brief study on integrating the VSS and SAS servos was conducted. This appears doubtful at the present time.

The flight control system layout has been completed.

4. Propulsion

Design drawings completed during this period were: all propulsion system schematics, fuel and oil system installation layouts, engine installation and nacelle drawings, and the engine control installation.

The propulsion system test stand program initial concept layouts of the facilities have been completed. The preliminary test stand structure and propulsion system installation drawings are completed. Work is continuing on further studies of the test program. The first rough draft of the propulsion test plan has been completed.

5. Electrical and Electronic

A layout of the installation of electrical, electronic, and VSS equipment in the area just aft of the cockpit has been made.

Detail studies of the electrical system weights have been prepared and are being reviewed.

A draft of the document supporting the selection of electronic equipment has been completed.

Studies are in work on the elimination of the battery and a constant speed alternator drive. Revisions to the load analysis are in work to prove the feasibility of these changes.

A discussion was held with CAL for redefining the gyro requirements for the VSS.

Documentation for revising the SD-550-1 specification electronic equipment has been completed.

6. Landing Gear and Hydraulics

The following DAL's were completed and issued for comment and signatures:

Main Landing Gear Arrangement
Nose Landing Gear Arrangement
Brake Control System
Landing Gear Geometry

The Work Statement and specification drawings for the nose gear and main landing gear were completed.

A layout has been started on a dual elevon actuator located in the aft end of the propellor gearbox fairing.

A diagram of the landing gear control system is being prepared to establish the hydraulic and electrical requirements.

A heat study of the hydraulic system indicated that a type I (150°F max) may be marginal. A type II (275°F max) system will be examined for application if necessary.

D. SYSTEMS SUPPORT

1. Human Factors

During this report period, human factors effort was directed toward a more detailed analysis of display/control requirements and toward the initiation of a cockpit integration program.

Preliminary planning for the simulation program was undertaken. Detail simulator requirements to support human factors experiments were determined based on current indications of task criticality. These will be revised and updated as mission and task analysis progresses.

Progress in subsystem design has permitted a more detailed analysis of certain control-display requirements and the development of a more cogent rationale covering their design, location, and use. Specific items which received attention are noted in Section VI, Human Factors Mockup.

2. Environmental Factors

A detailed analysis has shown that the internal noise level in the cockpit can be expected to be 133 plus or minus 3 db. Tests are planned to determine the effectiveness of combining the microphone shield and noise cancelling microphone.

The expected sound pressure level inside the ducts has been calculated, and it was found to be 153 db re 0.0002 microbar. This is higher than the external sound pressure on the outer surface of the duct.

The draft of the first part of the Preliminary Environmental Vibration Report has been prepared. It includes a summary of the procedures used for the prediction of internal noise levels.

3. Maintainability and AGE

Engine installation layout, fuel system layout, engine oil tank layout, and the gearbox oil reservoir layout have been reviewed.

Maintainability-AGE Section and the Human Factors section have been working together on the problem of open cable and shafting through the cargo compartments.

The T-58 service requirements and inspection requirements have been studied to establish frequency, access location, and ground support equipment requirements.

E. SYSTEMS ANALYSIS AND INTEGRATION

Bell personnel visited BuWeps 4 April 1963 to further discuss a proposal to transfer the Variable Stability System (VSS) from weight empty to payload. Bell suggested this transfer to allow the VSS system to be treated as a part of test equipment, with technical and financial resources utilized to improve system capability, convenience of use, and removability during non-VSS use, rather than to limit weight. However, it was the consensus of BuWeps that the system would be used as a basic part of the aircraft, as the present specification implies.

Primary emphasis should be placed on weight and physical integration of the VSS with the basic aircraft is desirable. It was further concluded that the weight of sensors (33 pounds) shared between the VSS and flight test instrumentation should be charged to the variable stability system and included in weight empty.

Several engineers from CAL visited Bell on 26 April 1963 to give a general lecture on the VSS to all concerned, and to discuss aerodynamic simulation, flight test instrumentation, and protection of structural limits with the appropriate groups.

F. SUBCONTRACTS

1. Propellers

Vendor design effort is progressing. Contract specifications and schedule negotiations are continuing with anticipation of firm definitization in May. A visit was made to Hamilton-Standard reviewing the design status and suggested changes.

2. Variable Stability System

BuWeps approved of preliminary specifications, permitted release of go-ahead to Cornell Aeronautical Laboratories 16 April. Formal agreement was reached on specifications and work statement. The schedule is in the process of being adjusted to allow for BuWeps approval of final specifications prior to hardware design and fabrication.

3. Transmission System

Proposals were evaluated and narrowed to two possible vendors. Facility surveys were made of these two vendors (Curtiss-Wright, and Steel Products Engineering Company). The contract awarding is scheduled for 1 May.

4. Ejection Seats

The order for Douglas 1D ejection seats for use in the cockpit mockup will be placed in May.

5. Landing Gear

Specifications and work statement for the main and nose landing gears were submitted to Procurement. Bid requests will be submitted to prospective vendors in May.

6. Duct Rotation System

United Shoe Machinery is developing a design for a harmonic drive system for use on the X-22A which will be submitted to Bell for evaluation in May.

Curtiss-Wright has been contacted for consideration as to the adaptability of their mechanical actuator system.

V. MODELS

A. WIND TUNNEL TEST PROGRAM

1. 1/6 Scale Unpowered Airplane Model

The first series of tests of this model were completed April 24. Difficulties were encountered with model actuators which initially slowed the program. The early test data showed insufficient directional and longitudinal stability and modifications to wing plan form and vertical tail were made by DTMB and tested. The test data from these tests are being analyzed. Sections of the aft surfaces were returned to Bell for additional modifications. A second test period is planned for next month.

2. 1/5 Scale Powered Airplane Model (See Figure 4)

This model was completed and shipped to Langley Field on 29 April 1963. Modification parts are being fabricated as a result of the 1/6 scale tests and are scheduled, by utilizing a second shift, to be available by the time the model goes in the wind tunnel. The availability of these parts should not delay NASA checkout and static shakedown tests of the model.

The pretest report was completed and delivered to the test facility.

3. 1/3 Scale Powered Duct Model

Model fabrication at DTMB is approximately 45 percent complete. The pretest report is being completed and will be submitted in May.

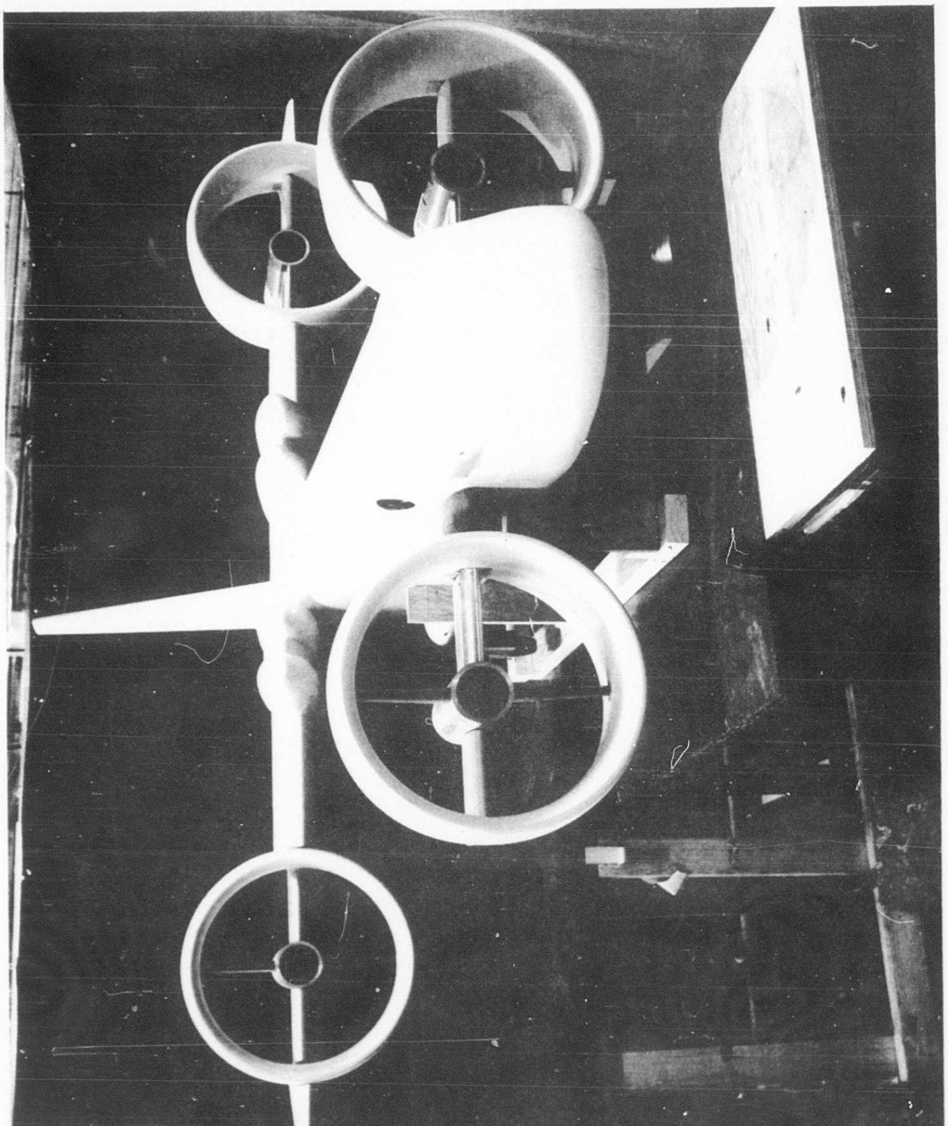

Figure 4. 1/5 Scale Powered Airplane Model

4. Full-Scale Powered Duct Model

Assembly and tunnel installation drawings are 75 percent complete. Detail design of gearbox and drive shafts has been initiated. A procurement cycle for the gearbox has indicated a delay in delivery schedule to NASA-Ames. This problem is under management study now.

5. Elevon Effectiveness Model

Tests of this model have been completed and the data are being analyzed.

6. Free Flight Model

Fabrication of this model was temporarily held up at NASA-Langley due to higher priority programs. Work has resumed.

7. 1/20 Scale Spin Model

A meeting between DTMB, NASA Langley, and Bell personnel was held, and spin model details determined. The model fabrication has started and completion is scheduled for August 1963.

8. 1/7 Scale Duct/Wing Flutter Model

The flutter model for the June 3 - 14th wind tunnel test period at DTMB will be completed during the first week in May. Manufacture of the aft wing beam and fin have been held up to allow incorporation of design changes developing from aerodynamic model tests conducted during April at DTMB. Stiffness calibration has been started on model components. Model calibration will be completed by May 24th which will allow shipment of the model to DTMB on that date.

9. 1/7 Scale Complete Airplane Flutter Model

Model design details for the wind tunnel test period were submitted to NASA and were approved. It presently appears that this test program can be accomplished more effectively at the DTMB subsonic tunnel rather than at the NASA Langley Freon Flutter Tunnel. NASA Langley indicated approval of such a switch to alleviate their tunnel work load. DTMB has indicated that the testing program can be fitted into their subsonic tunnel test schedule period. Formal action will be taken for approval of this change.

10. Ground Effects Model

Model ducts and nacelles have been fabricated. The fuselage wing and fin are about 70 percent completed. Tests are scheduled for June 1963.

Report 2127-917001, "Aerodynamic and Flutter Model Test Program" was revised to reflect the current program plan.

VI. MOCKUP

A. COCKPIT MOCKUP (See Figure 5 and 6)

Plaster forms were completed for the enclosures and the glass enclosures were fabricated during April. Canopy and skin installations are in work. Details for the pedestal, control stick, flight and engine controls were released and are also in work.

The windshield wiper installation has been released for work. The approval for mockup use of the Douglas Aircraft 1D ejection seat has been received from BuWeps.

The overall mockup is progressing ahead of schedule.

B. HUMAN FACTORS MOCKUP

Studies using this economical three-dimensional mockup continued on the following:

(1) A movable set of throttle levers and arm rests were provided and two test pilot subjects were required to perform throttle positioning tasks with the controls located in various positions. Conclusions based on observations of pilot arm position and on subjective opinion indicate that throttles should be moved aft from 3 to 5 inches.

(2) Collective Pitch - A mockup stick was installed and clearance problems noted. Stick location and console plan were modified to improve clearance.

(3) Duct Rotation and Lock - Based on analysis and discussion with electrical and mechanical design specialists, the display/control requirements for this task may be limited to the following:

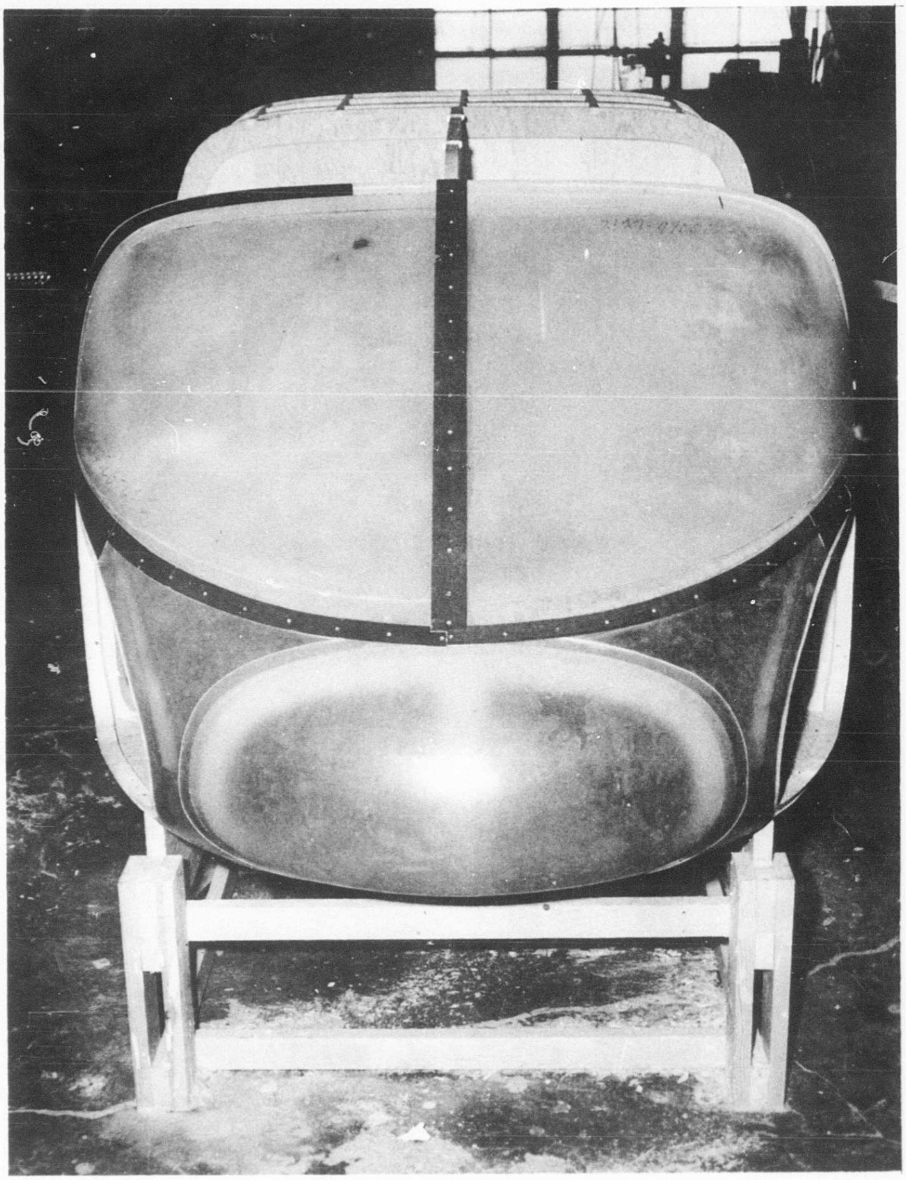

Figure 5. Model X-22A Cockpit Mockup

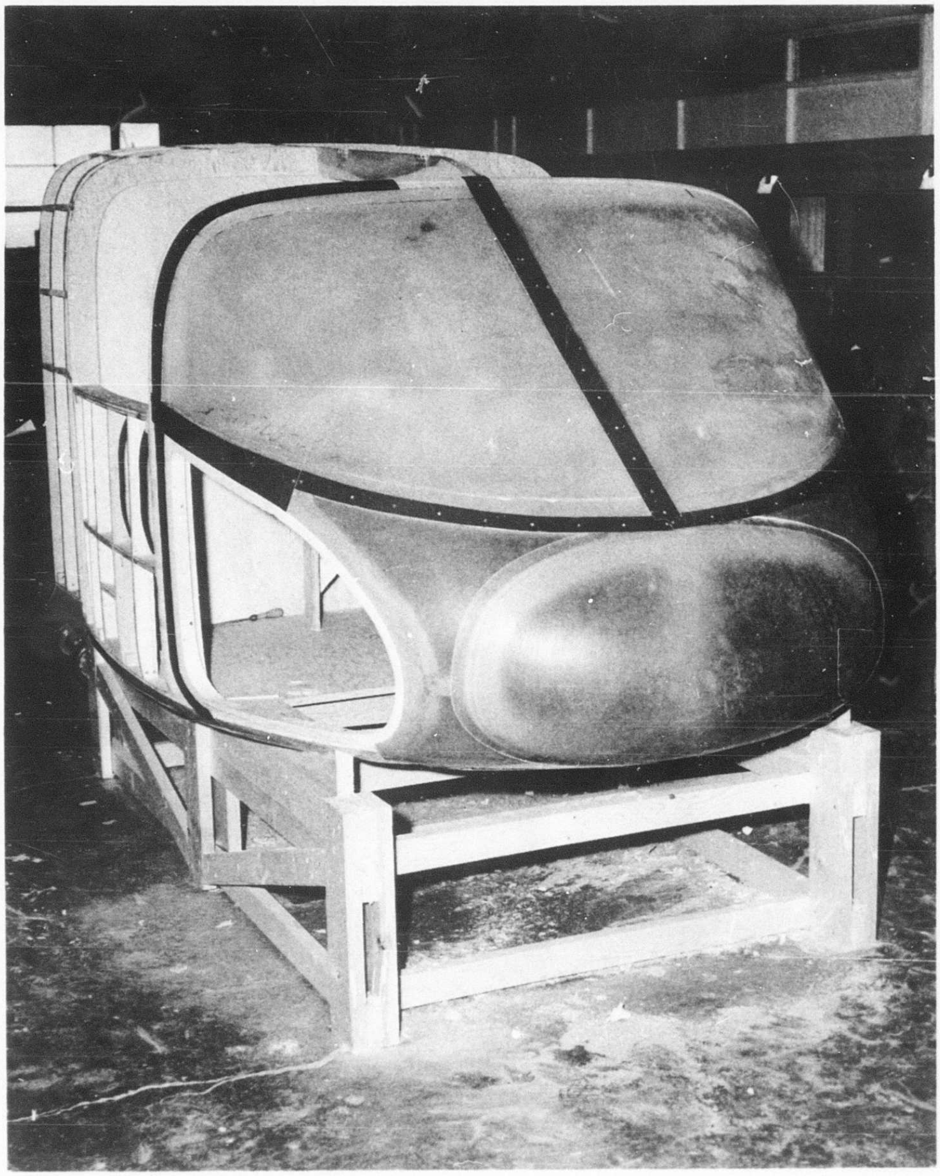

Figure 6. Model X-22A Cockpit Mockup

Controls - 1. Duct angle position - spring centered slide switch.

2. Duct lock - two position toggle or rocker switch.

Display - 1. Duct position indicator - 2" offset center, angle indicator.

(4) Glare and Reflection - To provide design data at an early date, a preliminary analysis and investigation of possible glare and reflection problems in the cockpit area was accomplished. For this purpose the Human Factors mockup was equipped with movable reflective discs to represent instrument faces and a movable light source to represent external and internal illumination. No serious glare problem was apparent. A reflection survey was made in the windshield and lower forward transparency areas using a flat glass which was moved and rotated to approximate windshield curvature. The sizing requirement for the glare shield over the main instrument panel was determined. A more thorough investigation of this area will be conducted in the contractual mockup as soon as it is available.

(5) Systems - Routing of power control cables, propeller master control cables, Beta control shafting and duct rotation synchronizing shafting have been added to the mockup for study of proximity, access, service points, and maintenance.

VII. GENERAL

A. COMMENTS

B. TRIPS AND VISITORS

1. Trips

Date	Destination	Purpose
4/1/63	Foote Brothers, Chicago	Facility survey
4/4/63	BuWeps	Discuss VSS
4/8/63	DTMB	Wind tunnel testing
4/9/63	NASA-Langley	Discuss spin models
4/15/63	DTMB	Wind tunnel testing
4/16/63	Dynamic Devices, Dayton, Ohio	Flutter model
4/17/63	BuWeps	Loads criteria discussions
4/22/63	General Electric, Lynn	Engine installation
4/24/63	Hamilton Standard	Propeller design review
4/26/63	Curtiss Division, Caldwell, N.Y.	Facility Survey
4/29/63	Dynamic Devices, Dayton, Ohio	Flutter model
4/30/63	Steel Products, Springfield, Ohio	Facility survey

2. Visitors

Date	Representing	Purpose
4/1, 4/8	Steel Products	Transmission proposal
4/1, 4/9	Curtiss-Wright	Transmission proposal

4/2	Bendix	Generators
4/9	Hamilton Standard	Propeller contract negotiation
4/9	Goodyear	Disc brake system
4/9	Simmons	Instrument panel lighting
4/10	Hamilton Standard	Specification review
4/10	General Electric	Engine installation details
4/15	Granger Associates	Precipitation static control
4/15	Cornell Aero. Lab.	VSS subcontract
4/16	Crowder	Review X-22A Flight Control System
4/17	TRECOM	Review X-22A Program
4/25	Therm, Inc.	Propulsion Analysis Consultation
4/26	Cornell Aero. Lab.	VSS Briefing

C. REPORTS AND CORRESPONDENCE SUBMITTED DURING APRIL 1963

BAC Letter No.	Date Submitted	To	Subject	Reason
123	4/1/63	Aero Systems Division WPAFB, Ohio	Prel. Wiring Diagram Transmittal of	Info.
124	4/1/63	U.S Army Transport. Res. Command SMOFE	Prel. Wiring Diagram Transmittal of	Info.
125-134	4/2/63	See Dist'd. List Weapon System Master Plan - Pg. 23	Trans. of W.S.M.P.	Info.
135	4/2/63	BuWeps - RA-443	Correction to Douglas Tech. Proposal	Info.
136	4/2/63	BuWeps Rep	Revised Pages SD-550-1	Approval
137	4/4/63	Aero Systems Division WPAFB, Ohio - ASZTV	Sched. of Structural Work (Rev.)	Info.
138	4/4/63	U.S Army Transport. Res. Command SMOFE	Sched. of Structural Work (Rev.)	Info.
139	4/5/63	BuWeps - RA-443	Characteristic Summary Report	Info
140	4/5/63	BuWeps Rep	Temporary Second Shift - Wood Shop	Approval
141	4/5/63	BuWeps - RA-443	Performance Data	Approval
142	4/9/63	BuWeps - RA-443	Propeller Install. Dwg.	Approval
143	4/9/63	BuWeps Rep	Propeller Install. Dwg.	Info.
144	4/10/63	BuWeps -RA-443	Approval of Reports	Info.
145	4/10/63	NASA, Ames	Full Scale Duct & Prop. Model	Info.

BAC Letter No.	Date Submitted	To	Subject	Reason
146	4/10/63	BuWeps - RA-443	Revision to SD-550-1	Approval
147	4/10/63	Aero Systems Division WPAFB, Ohio - ASZTV	Propeller Install. Dwg.	Info.
148	4/10/63	U.S. Army Transport. Res. Command - SMOFE	Propeller Install. Dwg.	Info.
149	4/10/63	Aero Systems Division WPAFB, Ohio - ASZTV	Characteristics & Perform. Data	Info.
150	4/10/63	U.S. Army Transport. Res. Command - SMOFE	Characteristics & Perform. Data	Info.
151	4/10/63	BuWeps - NPR-2411	Schedules for Del. Items	Info.
152	4/11/63	BuWeps - RA-443	Rev. to SD-550-1 Hyd. Sys.	Approval
153	4/12/63	BuWeps - RA-443	Monthly Progress Rept. No. 4	Info.
154	4/16/63	NASA, Langley	1/7 Scale Flutter Model	Approval
155	4/17/63	DTMB	Spin Model	Info.
156	4/17/63	DTMB	1/6 Scale Model	Info.
157	4/18/63	BuWeps - NPR-2411	Defense Materials Sys (DMS) Self-Authorization	Approval
158	4/18/63	BuWeps	PERT Reports	Info.
159	4/19/63	Dist. List Per Rept.	Monthly Progress Rept No. 4	Info.
170	4/25/63	BuWeps -RA-443	Trans. PERT Interim Rept.	Info.
171	4/26/63	BuWeps - RA-443	Revision to SD-550-1 (Pilot's Cockpit)	Approval
172	4/29/63	BuWeps Rep	Temporary Second Shift - Wood Shop	Approval

D. OPEN ITEMS

1. BuWeps and BuWeps Rep

BAC Letter No.	Subject	Date Submitted	Required Approval Date
28	Basic Aerodynamic Data Report - Revision (2127-917002)	1-24-63	5-31-63
31	Human Factors Data Report (2127-919001)	1-29-63	5-31-63
75	Vibration Program Report (2127-932001)	2-27-63	5-31-63
84	Revision to SD-500-1 Para. 3.1.2.1 (Endurance Reqmt)	3-1-63	*
94	Douglas Ejection Seat	3-12-63	
120	Preliminary Wiring Diagrams - Electrical System	3-28-63	
122	Revised Pages - Contract Detail Spec. SD-550-1	3-29-63	

* Commander Braun verbally advised BAC on April 30, 1963 that a letter is forthcoming which will describe method of requesting changes.

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