NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLLEY RESEARCH CENTER
LANGLLEY FIELD, VA.

SPECIFICATIONS
FOR
DESIGN, FABRICATION, AND ASSEMBLY
OF THE SCOUT
ORBITAL RESEARCH VEHICLES, LAUNCHER, AND WORK TOWER

SPECIFICATION NO. S-25A

April 15, 1959
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Figure 1 General Configuration of Vehicle
Figure 1a Aerodynamic Fin and Jet Vane Configuration
1.0 Description of Contract Articles

1.1 General

This specification defines four four-stage vehicles, launcher, and work tower which are to be procured by the Government. The stages of these vehicles are all solid-fuel rockets which should insure reliability and ease of firing, as well as provide an economical vehicle for many types of research experiments. Langley Research Center has developed and fired many multistage vehicles of a similar type and this program is felt to be an extension of the previously developed design concepts.

1.2 Solid-Fuel Rocket Systems

The vehicles and rocket motors are described in the table below. The motors and the controls and guidance package will be supplied under separate contract.

<table>
<thead>
<tr>
<th>Stage</th>
<th>NASA Name</th>
<th>Manufacturer</th>
<th>Stabilisation</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ALGOL</td>
<td>Aerojet Senior</td>
<td>Fins</td>
<td>Fins and jet vanes</td>
</tr>
<tr>
<td>2</td>
<td>Castor</td>
<td>Thiockol improved Sergeant X3-20-4</td>
<td>H₂O₂ fixed jets</td>
<td>H₂O₂ fixed jets</td>
</tr>
<tr>
<td>3</td>
<td>Antares</td>
<td>Alleghany-Ballistics X-254</td>
<td>H₂O₂ fixed jets</td>
<td>H₂O₂ fixed jets</td>
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<tr>
<td>4</td>
<td>Altair</td>
<td>Alleghany-Ballistics X-248A5</td>
<td>Spin</td>
<td>None</td>
</tr>
</tbody>
</table>

Note: The guidance package is to be located at the head of the third stage.

A preliminary sketch of the system appears in figure 1. The
general external dimensions shown in the sketch shall be followed. Dimensional changes may be made only with the approval of the Government. Wind-tunnel measurements of the aerodynamic parameters will be supplied to the contractor by the Government.

1.21 Operational Requirements

1.211 General

The system shall be designed so that orbital, probe and reentry type trajectories may be flown. For all trajectories the 1st stage motor shall remain attached to the system after its burnout and the system will coast to a minimum of 100,000 feet before 2nd stage ignition. Probe flights can be described as those launched at 75° to 90° with no delay between the 2nd and 3rd or 3rd and 4th stage firings.

For orbital and reentry flights the 3rd and 4th stages shall coast together after burnout of the 3rd stage. The attitude of the two coasting stages shall be controlled by the guidance and control units mounted in the 3rd stage. For orbital shots the attitude of the last two stages will be placed at an angle predetermined as equal to that of the horizontal at the apogee of the ascent trajectory. At this time the 4th stage shall be spun-up by spin rockets and fired. For reentry flights the attitude and timing of spin-up and firing of the 4th stage will be such that the last stage with payload will burn out at altitudes of the order of 100,000 feet.

1.212 Launching and Flight Path

The vehicle design shall be based on programmed zero-lift flight trajectories with apogee altitudes varied by changing the initial launch angle. The launch angle range shall be from 70° to 90°. The minimum altitude at 4th stage ignition when the flight path is parallel to the local horizontal shall be 200 nautical miles.
1.22 Performance

The objective of the Scout design shall be to achieve final stage theoretical velocity of 34,000 ft/sec, based on a payload of 100#. This velocity is defined as

\[ V = \sum g \text{SI} \ln \frac{\text{WL}}{\text{WE}} \]

where the specific impulses to be used are

- AGOL 220 Sea level
- Castor 273 Vacuum
- Antares 255 Vacuum
- Altair 256 Vacuum

1.3 General Description

The following table outlines estimates of the physical characteristics of the guidance and control system to be supplied by Minneapolis-Honeywell. The guidance package and first-stage control specifications are from Minneapolis-Honeywell, while the estimates for the hydrogen-peroxide control systems were made by the Government.

**First Stage**
- Controls 80 lb

**Second Stage**
- Controls 200 lb

**Third Stage**
- Controls 50 lb
  - Guidance 40 lb Size 13 Inches Diam, by 10 Inches long

1.31 Control Parameters

Control parameters have been determined by assuming thrust misalignments of \(1/14^\circ\) for the first two stages and \(1/10^\circ\) for the last two stages of Scout. While future analysis may change these assumptions they shall be used for the purposes of this specification.
1.4 Description of Launcher

The launcher shall meet the following requirements:

(a) To launch the Scout at angles to the horizontal from 70° to 90° and at azimuth angles ±5° from some nominal direction. All angle changes shall be possible with the vehicle attached to the launcher.

(b) The launcher beam shall be lowered from the vertical position to the launch angle in a maximum of 30 seconds. Control shall be provided so that during lowering the launch beam follows the pitch gyro position within ±5° while the gyro is being torqued at a rate of 1° per second.

(c) The launch attitude shall be rigidly held within 1/10° of the nominal, and the launch azimuth shall be held within ±1/2° of the nominal.

2.0 Scope of Contract

2.1 General

The contractor shall furnish services and materials to perform the engineering, fabrication, development, type approval, acceptance test, and delivery to Wallops Island, Virginia, of the airframe components of four (4) four-stage Scout solid-propellant rocket research vehicles and one launcher and work tower as specified herein. The launcher and work tower shall be erected by the contractor on a Government furnished concrete pad at Wallops Island, Virginia. The contractor shall not design or furnish the propulsive rocket motors, the guidance control system including reaction jets and servos, or the research experiment. The contractor shall be responsible for the design, manufacture, assembly and wiring of all dual ignition timing devices required for ignition of airborne rocket motors, subject to Government inspection and safety approval. The contractor is also
responsible for design manufacture and installation of any required tunnels to protect exterior stage-to-stage wiring. The contractor shall be responsible for an adequate dual ignition power supply and associated wiring, terminating in some externally accessible junction box with standard plug provisions for igniter leads. The contractor shall be responsible for assembly of the airframe components to the rocket motors at Wallops Island, Virginia, and shall assemble and erect the components of the vehicle on the launcher into a final assembly.

The guidance and control systems shall be installed in the airframe by the control contractor. (See 5.1) The vehicle launching shall be done by Government personnel. All assembly shall be subject to inspection by a representative of the Contracting Officer. The contractor shall be responsible for on-the-job training of Government personnel in the assembly, servicing, and operation of the airframe components and launcher. (See 5.8) Dynamic balancing of the payload, 4th stage motor, and spin table will be the responsibility of the Government.

2.2 Engineering

2.2.1 General

From consideration of the specified operational envelope, the characteristics of the guidance system, ground handling, assembly, and launching procedures, the contractor shall determine loads and elastic requirements, shall select structures and materials accommodating same, shall perform complete dynamic and stress analysis, shall provide all manufacturing, processing, and mechanical inspection specifications, and shall perform a program of static and other ground tests as outlined in 2.4 to establish the integrity of both engineering and fabrication. Engineering data for components not furnished by the Government shall be obtained by the contractor directly from the particular
component supplier. All available aerodynamic or other data peculiar to the specified configuration will be supplied by the Government. Integration of components not furnished by the contractor into the basic airframe shall be performed with due consideration to the operational and servicing requirements of those components as so specified by the vendor.

2.22 Load Factors for Design of Airframe Structure

2.221 Airframe Structure

The structure shall be designed to obtain positive margins of safety for design yield load and design ultimate load, including applicable elevated temperature effects.

Limit load = anticipated load on structure
Design yield load = 1.15 × limit load
Design ultimate load = 1.50 × limit load

2.222 Hoisting and Launching Fittings

Fittings shall be designed with a margin of safety of 3.0 based on the yield stress of the material.

2.23 Launch and Flight Design Gust Condition

2.231 Launch

30 mph side wind at launch
70 mph in vertical position on launcher

2.232 Flight

The vehicle shall be designed to withstand 45 ft/sec gust to 10,000 feet, and 100 ft/sec from 10,000 to 50,000 feet, and 75 ft/sec from 50,000 to 150,000 feet, and zero above 150,000 feet.
2.3 Fabrication

The contractor shall furnish services and material, jigs, fixtures, patterns, etc., required to fabricate, shop and field assemble the mechanical devices and stage components and launcher. Special tools required to shop or field assemble or service any parts furnished by contractor shall become the property of the Government.
2.4 Hardware Test & Evaluation Program

2.41 INTRODUCTION

The test program to be conducted by the contractor shall be outlined and programmed by the contractor and furnished to the Government before proceeding with the tests, and shall be divided into four major areas as follows:

2.42 Developmental Tests
2.43 Type Approval Tests
2.44 Operational Tests
2.45 Acceptance Tests

Under these headings, a detailed breakdown and description of tests to be conducted in provided. Broadly speaking, development type tests are conducted using prototype "hogouts" with simulated back up structure while type testing, and utilizes production hardware identical to that installed in the vehicle or launcher.

The Government considers reliability to be the major design requirement on the Scout vehicles and launcher. All phases of design, fabrication and assembly shall be substantiated with test data to insure the maximum possible reliability. Testing shall be used to verify analysis rather than used in lieu of analysis (or an abbreviated form thereof).

2.42 DEVELOPMENT TESTS

2.421 Structural

2.4211 Material

Transient heating tensile tests shall be made to supplement data already available and to complete information measured on Molybdenum at 2500° F and Rene 41 at 1800° F and 2500° F.
2.422 Element

A short series of structural tests shall be made to complete the application of the data realized from the material temperature transient tests conducted in paragraph 2.4211 above. These tests include:

(a.) Short time elongation tests of the pretensioned guide vane lock cable at approximately 1000° F.

(b.) Attachment tests including bolt tension and shear allowables at temperatures of 1000° F for times of 10 and 30 seconds. Also spotweld strength will be determined for 1800° F and times of 10 and 30 seconds. Hi shear rivet allowables will be established for 10 and 30 seconds at 1800° F.

(c.) Tensile tests of angles of 2040-T3 aluminum at 600° F for 30 seconds and 4130 steel at 900° F for 30 seconds (a critical joint verification test).

2.422 Fourth Stage Spin Up

Additional development tests on a full scale operational mockup shall be conducted on the spin table in order to optimise the design. Basic objectives include minimum spin table friction and optimization of roller or bearing arrangement. Included in the test arrangement procedure shall be mechanical separation of the dummy motor from the table after spin up. One successful separation test shall be made using an Atlantic Research Corp's. Arcon Booster (0.4 Ks 3000) or equivalent.

2.423 Jettison and Separation

2.4231 Nose Cone Latch Mechanism

An operational mock-up of the complete latch and jettison mechanism for the 3rd and 4th stage shell shall be fabricated during the design phase. This
mock-up shall be used to conduct functional tests to demonstrate that the mechanism operates satisfactorily and has sufficient power to clear the 3rd and 4th stages. These tests shall be conducted unloaded and under critical load and temperature conditions. The reliability of the mechanism shall be proven by repeated cycles of the operation under all conditions. A preliminary static load test of the latch mechanism to design ultimate load shall be conducted on the mock-up.

2.4232 Stage Separation

Element test specimens duplicating each stage separation device and the local carry-through structure shall be fabricated. Static load test of each shall be conducted to demonstrate adequate strength and stiffness. The specimens shall also be placed on sealed chambers for the purpose of preliminary determination of rupture pressures required, time sequence reliability, and disturbance by rapid rupture. As in all the development test programs, the results of these tests shall be coordinated with NASA and the resulting information reflected in the design as released for manufacture of the actual flight vehicle.

2.4233 Jet Vane Jettison

A complete assembly of a jet vane, its control and jettison mechanism, and support structure shall be fabricated and mounted on a test fixture. This test structure shall be used initially to demonstrate the adequacy of the control and jettison mechanism under load at room temperature. It shall then be used to place the jet vane in the exhaust of a ram jet heater at the contractor's facility for demonstration under load and temperature. A minimum of two satisfactory jettisons shall be conducted to verify the design.
2.424 Launcher

Vehicle-launcher separation verification including fittings performance shall be covered in a two fold manner: First, an analytical approach shall be utilized to cover the design under various types of dynamic (misalignments, wind effects, etc.) conditions. A significant input to this design and analysis phase will be NASA experience with regards to fitting design, separation characteristics, etc. Secondly, verification of the design shall be accomplished on the completed launcher during proof loading tests. Several specific operations such as the dynamics of the "swing away" upper launch support arms shall be checked.

An additional step that shall be taken to insure the adequacy of the design of the launcher consists of construction of a scale model launcher tower, base, and vehicle (1/30 sizes) from layouts. This shall be used to check the adequacy of the design and serve as a practical three dimensional check design aid. Information resulting from the model shall be incorporated into the design prior to initial release. The final check will be provided on the erection and checkout of the completed missile launcher.

2.425 Equipment and Components

2.425 General

In order to insure the highest possible reliability, maximum use shall be made of existing proven items. Experience indicates, however, that some equipment items will either be modifications of existing items or, in a minor number of cases, actual developments of new equipment may be required. These new or modified components will either be contractor fabricated or vendor fabricated and supplied to the contractor. In
addition, they will fall into two categories: flight quality (for the vehicle proper), commercial quality (for the launcher and tower). It is anticipated that no development tests will be required for commercial quality items. Some developmental testing will be required for the flight type components. Type Approval Tests and documentation thereof shall be required for both categories and is covered under section 2.43.

2.4252 Contractor Purchased Items

If the design program entails any unusual or development type features, the contractor shall require substantiating development test data during the vendor design phase in order to monitor vendor progress.

2.4253 Contractor Fabricated Items

In the process of initial design, certain questions regarding dynamic action and deflection of cartridge operated devices, bearing loading, wear and friction under temperature transient conditions, etc., will arise and shall be verified by test rather than analysis alone. These tests shall be conducted in the contractor's engineering test facilities.

2.426 Wind Tunnel

NASA will furnish the models and perform the necessary wind tunnel tests and supply the contractor with the required design data.
2.427 Propulsion

NASA will furnish the contractor with one set of empty rocket cases.

2.428 Guidance

Although the contractor will have no direct responsibility in the qualification and test of the GFE guidance package, the guidance contractor program shall be closely observed by the airframe contractor to assure overall airframe - guidance - control compatibility. Close liaison also shall be required with the guidance contractor during the design of the vehicle to assure compatibility of the mounting provisions with the alignment requirements of the guidance package. As part of this coordination, the contractor shall furnish that portion of the transition section containing the guidance package to the guidance contractor in order to functionally checkout equipment.

2.429 Telemetry and Destruct Command Radio Tests

That portion of the transition section between the 3rd and 4th stage housing this equipment shall be furnished to NASA for functional and fit checks, antenna mounting and pattern evaluation work, and telemetry and beacon mounting.

2.4210 Control System

The contractor shall supply the necessary structural packages and vehicle components in the base section area (with fin and control mechanism), and in the second and third stage transition assemblies to Minneapolis Honeywell in order to support the control system mock-up and test. In addition, the contractor shall furnish M-H with the dynamic and frequency response data developed under paragraph 2.434. Also, liaison shall be provided with M-H in order to coordinate the packaging, arrangement, stiffness, etc. of their controls mounted in the contractor furnished
structure.

2.43 TYPE APPROVAL TESTS
2.431 General
A structurally complete test article utilizing production parts shall be fabricated for the purpose of conducting fit and assembly check-outs, and static and dynamic loads tests. The test article will consist of all the contractor fabricated structure and hardware, and a complete set of empty rocket motors cases furnished by NASA.

2.432 Static Tests
2.4321 Fourth Stage Tests
2.43211 Static-Room Temperature
The fourth stage rocket spin table and support structure shall be static and dynamic load tested with the critical combinations of rocket thrust acceleration and maneuvering loads.

2.4322 Static-Heat
The 3rd and 4th stage shells and adjacent transition section shall be mounted on support structure in a manner representative of the attach-ment to the ANTARES rocket motor. Static load test of the shell shall be conducted for the maximum temperature and the critical load-temperature conditions.

2.4323 Dynamic-Heating and Pressure
Test of the nose cone section Station 0.0 to Station 27.0 shall be conducted utilizing the ram jet heater at the contractor's facility.
The structural adequacy of the joining of the first, second, and third steps, their transition shells and carry-through structure shall be demonstrated by static load tests of each to the critical load-temperature conditions in a manner as described in paragraph 2.43212. Support structure of the control jet motors shall be tested. The support structure of all control system and guidance components shall be tested for rapid onset and decay of accelerations by dynamic load tests. The launch fitting mounted on the ALGOL to CASTOR transition shall be static tested by applying the critical loads (dynamic and static) to the fittings.

The base section shall be mounted on a support structure in a manner representative of it's attachment to the ALGOL motor. The structure shall be static load tested for critical conditions of pre-launch, launch, and flight. Pre-launch and launch load shall be applied directly to the base launch fitting; Critical flight load shall be applied to the fin attach fittings by dummy fins and by mechanical attachment to the structure.

The fins shall be supported in a fixture in a manner representative of the fin support structure. Static load test of the fin, fin tip control, jet vane, control system support structure, and the control system hardware fabricated by the airframe contractor shall be conducted in this fixture. Loads shall be applied to the surfaces by means of tension pads and mechanical attachments.
2.4.3.31 **Launcher Proof Load**

2.4.3.31 **General**

Those portions of the launcher involved directly in the handling of the vehicle or the safety of working personnel shall be proof load tested to 1.50 x the normal working load.

2.4.3.32 **Work Platforms**

The work platforms shall be proof loaded on the tower.

Each platform will be loaded to 1.50 x the critical load distribution.

(cont'd)
2.433 Hoist and Elevator

The structural adequacy of all hoist and elevator equipment shall be demonstrated by 50 cycles of complete operation under a dead load equivalent of 1.50 x the specified working load.

2.434 Vibration Test

The test article as described in paragraph 2.43 shall be suspended at Stations 250 and 650 by supports of known spring rate. Force inputs shall be applied by electron voice-coil shakers. The resonant frequencies and mode shapes shall be determined for all modes of vibration with frequencies (up to 200 cps) which are important to large mass items supported within the structure.

2.435 Equipment and Components

2.4351 General

Type Approval Tests shall be required for all equipments and components furnished under the contract. These include flight quality items and commercial quality items, whether fabricated or vendor supplied. Maximum utilization shall be made of existing documented test results in order to avoid test duplication. As part of the basic design program, the contractor shall establish the environmental criteria (vibrations, "g", temperature, shock, life cycles, etc.) including safety factors applicable to the contractor supplied equipments installed in the vehicle or associated with the launcher and work tower. These "ground rules" shall be reflected in the design of all items procured or fabricated. A type Approval Test simulating the actual environmental conditions (and combinations of conditions) shall be conducted.
Purchased Items:

Type Approval Tests on purchased items shall be conducted in the manner described above. Examples of items included in this area and the type of Type Approval Test required is noted below.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Type Test (C-Commercial Quality)</th>
<th>Type Test (F-Flight Quality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jet Vane Explosive Release</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>First Stage Pressure Switches</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Second Stage Pressure Switches</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Second Stage Ignition Timer</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Nose Cone Jettison Timer</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Nose Cone Jettison Actuator</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Batteries</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sensitive Relays – Standard</td>
<td>F</td>
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</tr>
<tr>
<td>9</td>
<td>Sensitive Relays – Time Delay</td>
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<td>10</td>
<td>Breakaway Electrical Connectors</td>
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<td>11</td>
<td>Shaped Charges – Rocket Case Destruction</td>
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</tr>
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<td>12</td>
<td>Launcher-Base</td>
<td>C</td>
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<td>13</td>
<td>Launching Beam Lock Cylinder</td>
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<td>14</td>
<td>Hoisting Cables</td>
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<td>15</td>
<td>Launcher Beam Hoist</td>
<td>C</td>
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<td>16</td>
<td>Launcher Beam Hoist Motor</td>
<td>C</td>
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<td>17</td>
<td>&quot;A&quot; Frame Hoist</td>
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<tr>
<td>18</td>
<td>&quot;A&quot; Frame Hoist Motor</td>
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<td>19</td>
<td>Personnel Elevator</td>
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<td>Personnel Elevator Motor</td>
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<td>Missile Handling Slings</td>
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<td>23</td>
<td>Ignition Power Supply</td>
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<td>24</td>
<td>Spin Table Bearing</td>
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<td>25</td>
<td>Payload Bearings</td>
<td>C</td>
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<td>Fin Control Bearings</td>
<td>F</td>
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<td>27</td>
<td>Spin Table Rockets</td>
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<td>Missile Loading Actuators (SSE)</td>
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<td>Launcher Hydraulic Power Source</td>
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<td>30</td>
<td>Squib Switches</td>
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<td>Electrical Wiring</td>
<td>F &amp; C</td>
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<td>Squib Test Set</td>
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<td>Ignition Timer Test Set</td>
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<td>34</td>
<td>Hydraulic Actuators (SSE)</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>
2.4353 Contractor Fabricated Items

2.43531 Jet Vane Jettison

A complete set of jet vanes shall be installed in the static test article. Satisfactory jettisons under minimum load at room temperature will be demonstrated. Next, demonstration of satisfactory jettisoning of the production design shall be conducted in the Contractor's ram jet facility.

2.43532 Nose Cone Separation

The static test 3rd and 4th stage shell shall be equipped with separation hardware. A minimum of two satisfactory nose cone separations under critical load and environmental condition shall be demonstrated. The adequacy of the method of connecting wiring to the nose cone jettison actuator shall also be demonstrated by this test.

2.43533 Spin Table

In addition to the static and dynamic load test program conducted on the spin table as summarized in paragraph 2.4321, a complete operational type approval test program shall be conducted on a production assembly. A minimum of two satisfactory spin ups will be demonstrated. Each demonstration shall be conducted under conditions wherein the critical limit load and environmental condition are applied. The adequacy of the method of routing ignition cables to the spin motors and fourth stage motor igniters shall also be demonstrated by these tests.

2.43534 Electrical Systems Tests on Full Scale Mock-Up

The integrity of the contractor furnished electrical system shall be demonstrated by system reliability testing on a full scale mock-up. All wires in this mock-up shall be of the same size and length as used in the actual vehicle to demonstrate that there are no excessive voltage drops.
in the wiring which will affect proper operation of the system. Components of a flight quality and identical to those installed in the actual vehicle are to be utilized in the mock-up. The ability of the system to perform under failures in accordance with the failure analysis shall be demonstrated by testing on the electrical system mock-up.

2.4355 Transition Section Separation

Separation diaphragms and diaphragm support structure shall be installed in the static article. Required stiffness and strength shall be demonstrated during static test of the transition section. Reliability of the data recorded during the tests described in paragraph 2.4232 will be demonstrated by rapid rupture tests of the final design. The adequacy of the method of separating interstage wiring shall be demonstrated in these tests. Umbilical cord separation at launch shall also be demonstrated in these tests.

2.44 Operational tests

Every equipment item, or system, mechanism assembly, etc., whether vendor supplied or contractor fabricated, and whether it is intended for vehicle, launcher, work tower, or test equipment use, shall be operationally tested to a specific engineering test procedure.

A typical specification describes the test equipment needed, the test procedure to be followed, the exact measurements to be taken and the manner in which to take them, and the performance values with tolerances that are acceptable. Two types of tests are conducted:

a. Those demonstrating integrity such as bellow leakage tests, Hi-pot tests, proof pressure or load tests, etc.

b. Those demonstrating acceptable performance such as measuring output vs. input (in position, load, force, rate, etc. as
applicable), friction, resolution, etc.

In the latter type of test, actual or simulated circuits are utilized to insure that inputs are representative of operational conditions. This, consequently, assures that the measured output performances are representative of those that will be realized in actual use.

Upon test completion, the article shall be certified as acceptable or rejected for specified reasons. Typical examples of items that shall receive these tests would include vehicle pressure switches, timers, breakaway connectors, igniters, spin table assembly, nose cone separation control mechanism, etc., and launching beam lock cylinder, personnel elevator hydraulic motor, etc.

2.45 Acceptance Tests

2.451 Verification of Qualification and Operational Tests

Suitable documentation shall be provided to verify that all components and equipments provided under the contract have satisfactorily passed their respective tests prior to installation in a particular vehicle or launcher. Also, verification of satisfactory operation of all systems, etc., in each completed article supplied under the contract shall be provided.

In addition to this verification information supplied with each delivered article, the Contractor shall furnish documentation to the Government of satisfactory completion of all Type Approval Tests as part of the basic contract.

2.452 Checkout and Inspection of the Finished Article

A completed article delivered under the contract (vehicle, launcher, or work tower) shall be subjected to a series of tests to insure that all components and assemblies, which have previously passed their respective Operational Tests, function and/or fit satisfactory in the completed assembly.
These tests shall cover two basic areas; systems and mechanical.

2.4521 Systems

Systems tests shall apply to the complete final checkout of each system in the vehicle including components and their connecting wiring, plumbing, etc. A specific engineering test procedure shall be followed for each system. A typical test procedure includes the following:

a. Description of system.

b. Description of purpose of the tests.

c. List of required equipment to conduct the test.

d. Schematic of proper hookup of test setup.

e. Visual inspection.

f. Check-off list for position of devices, proper circuit hookup, etc.

g. Energizing system.

h. Specific inputs to be introduced into the system.

i. Acceptable outputs with tolerances, etc.

j. Verification of satisfactory compliance with the systems test specification.

2.4522 Mechanical

Mechanical tests and checks conducted on the completed assembly include proper fit of structure during assembly and proper fit and operation of mechanical systems in the assembly. The mechanical fit of devices is demonstrated by check against templates, and fixtures while the proper functioning and operation of mechanical systems (such as a nose cone latch mechanism) is demonstrated by compliance to a test specification in the manner similar to that described under 2.4521 above.
2.5 Delivery Schedule

2.51 Design Data

The contractor shall submit for Government review, engineering layouts and preliminary load analysis of the vehicle covering all essential assembly, handling, and launching features within 30 calendar days from date of receipt of notice of award of contract. Layouts and calculations shall be available for NASA review as design proceeds. The major assembly drawings shall be approved by the technical representative of the Procurement Officer. Contractor shall deliver to the Government any modifications to the launching pad within 45 calendar days after award of contract.

2.52 Assembly Procedure and Check List

The contractor shall submit for Government approval, a complete preflight and a complete launch-site assembly procedure and check list of the entire assembly program 30 days before delivery of the first vehicle.

2.53 Hardware Delivery

At the completion of all acceptance tests the contractor shall deliver the first Scout and the launcher and work tower, not later than 155 calendar days from award of the contract. The missile, launcher and tower shall be completely assembled not later than 30 days thereafter. Subsequent units shall be delivered each 30 calendar days after the delivery of the first unit.

2.6 Engineering Calculations, Material, and Fabrication Specification

Applicable Federal or Military structural material specifications shall be used throughout. The Contractor shall specify all primary structural materials and size, attachment methods, and load temperature conditions dictating design. The contractor shall provide the Government with calculations predicting first-stage aerodynamic fin efficiency, torque tube, and aileron control elastic characteristics and resulting loss in control
effectiveness, airframe bending frequencies, and divergence investigations.

2.7 Destruct System

The contractor shall design, furnish, and assemble a destruct system which will destroy the first and second stage rocket motors as propulsive units only. This shall be accomplished by some relatively simple scheme such as destroying the rocket motor cases as pressure vessels. The Government shall furnish the ground-command system which initiates the destruct signal and vehicle-command receiver, antennas, and power supply. The contractor shall design the airframe to accommodate the above-furnished units and furnish and install the required mounting brackets.

2.8 Instrumentation

For the purpose of this specification it is assumed that the telemeter required to monitor the guidance and the tracking beacons will be housed in the guidance compartment shown in figure 1. The contractor shall provide, locate and assemble telemeter and beacon mounts to the airframe at locations specified by the Government. The Government will furnish and assemble the telemeter and beacons. The contractor shall provide space and structural modifications as directed by the Government for telemetry and beacon antennas. The antennas will be provided by the Government. The design and location of the antennas will be given to the contractor. The Government will install the antennas.
3.0 Scout Configuration

3.1 First Stage (See Fig. 1.) (ALGOL)

3.11 Fins

See figure 1(a) for fin, aileron plan form, and airfoil section. Only flush-type fin skin construction shall be acceptable and if any unconventional material or fabrication method is proposed, contractor shall specify all primary structural material and size, attachment methods, and load, temperature conditions dictating design. The contractor shall provide the Government with calculations predicting aero-dynamic fin efficiency, predicted maximum fin misalignment, torque tube and aileron control elastic characteristics, and resulting loss in control effectiveness.

3.12 Jet Vanes

A preliminary jet-vane configuration has been furnished by the Government in Fig. 1(a). A material and configuration test of said vane shall be conducted by Aerojet General Corp. and the contractor shall be forwarded resulting data from which he shall develop and manufacture the jet vane assembly. The vanes will only experience the rocket-motor blast for a short time since it is required that the jet vanes be jettisoned from first stage at the end of first 15 seconds (maximum) of flight.

3.13 Control

See 5.1 for required liaison between airframe and guidance contractor. Design shall provide assembly of the fin and controls and servicing without removal of ALGOL rocket-motor nozzle.
3.14 First-Stage Rocket Ignition

The first-stage rocket motor shall be ground ignited remotely from the block house.

3.2 Second Stage (See fig. 1.) (Castor)

3.21 Castor Rocket-Motor Nozzle

Due to the fact that this rocket-motor performance can be increased 20 percent by expanding the nozzle, the Government has initiated this revision with Thiokol. Since the nozzle thickness is relatively large, dictated by burning characteristics, the nozzle shall serve also as the structural coupling between first- and second stages. The Contractor shall verify that the rocket motor will withstand the required conditions.

3.22 Control

See 5.1 for required liaison between airframe and control contractor. Design shall provide complete control assembly and servicing without removal of Castor rocket-motor nozzle.

3.23 Second Stage Rocket-Motor Ignition

The first-stage motor shall remain attached to system after its burnout and the system shall coast to minimum of 100,000 ft attitude before second stage motor ignition. The timing signal for this sequence may be supplied by the guidance master timer preset from take-off.

3.3 Third Stage

3.31 Third-Stage Rocket-Motor Ignition

The third-stage rocket motor shall be ignited at the burnout of the second-stage motor, by use of pressure actuated switches.
3.4 Fourth Stage

3.41 Payload

See figure 1 for payload configuration and location. Contractor is not responsible for furnishing any part of this payload, but must provide space and design structure to accommodate same. In order to survive the anticipated heating condition, the payload must have some protection during a portion of the flight, however, due to performance penalties any appreciable weight required to accomplish this must be jettisonable. The mechanism to attach the payload to the fourth-stage motor will be furnished by the Government and the Government will install payload.

3.42 Spin-up

The fourth-stage shall be spin stabilized at approximately 160 R.P.M.

The fourth-stage shall be attached to the third-stage by a spin table.

3.43 Fourth-Stage Ignition

The fourth stage shall be ignited by a signal from the control programer.

4.0 Handling and Launching Equipment

4.1 Launching Tower

The launching tower or work tower shall be an open framework. Tower shall be approximately 80 to 90 feet tall. The work tower launcher shall be mounted on a pad furnished by the Government in accordance with drawing LD 200715. Alterations to this pad to suit the launcher and tower installation proposed by the contractor will be made by the Government. The following features shall be incorporated in the design of the tower. There shall be 4 work platforms at stage joints each surrounded by a suitable safety rail. Tower shall be designed to
provide sufficient clearance for a 5° dispersion angle on a vertical shot. Tower shall have a 600 pound capacity personnel elevator to enable working personnel to reach the platform levels. Tower design shall also include an emergency ladder so personnel would not be trapped on platforms in the event of an elevator malfunction. Tower shall have an "A" frame or a small hoist at or near the top, capable of lifting the third or fourth stages for assembly on the vehicle. Aircraft warning lights shall be included.

4.2 Launching Beam

Beam shall be mounted on a pivot that enables it to be lowered to a horizontal position for possible attachment of the first and second stages of the vehicle. Beam shall be capable of elevating both stages to a vertical position at a rate of 2° to 4° per minute for assembly of additional stages. Launching beam shall be supported at the launch position by a method which will hold the beam rigid at firing.

Pivot point of beam shall be at such an elevation that axis of vehicle in the horizontal position shall be 5 feet (minimum) above ground level and give adequate ground clearance in the launching position. Launch beam shall pivot to align the vehicle at the desired launching azimuth. Beam shall be of sufficient strength to restrain first and second stages at 1-1/2g in the horizontal position and all stages in the vertical position with a 70-mph wind blowing normal to axis of vehicle. The vehicle shall be mounted on the launching beam so that the first stage fins are in the vehicle pitch and yaw planes.

All motive power and equipment required for the launcher and tower shall be furnished by the contractor. The Government will furnish all electrical power required.
4.3 **Hoist**

Contractor shall provide a reasonable means of lifting the first stage from its position on its transtainer, under the beam, into an attachment position on the launch fittings. Alignment problems should be given careful consideration, and provisions for correcting any alignment errors shall be incorporated into the design.

4.4 **Launching Fittings**

Launching beam fittings shall be permanent fixtures so size and complexity are not prime considerations. Vehicle launching fittings are expendable so they shall be small and simple. Each vehicle shall be delivered with its own set of launching fittings. All vehicle launching fittings shall function smoothly in the permanent set of launching beam fittings. Launching beam fittings shall be detachable from beam for shop assembly to first stage of vehicle. Front-end launching beam fittings may be retractable to eliminate possible interference with vehicle after firing. When the vehicle is in a launch or vertical position, it is suggested that the axial load and torsional moment be carried by a rear beam launch fitting.

4.5 **Handling Equipment**

The Aerojet "transtainer" will be furnished by the Government and it appears that this shall be the only piece of handling equipment required in assembly of the first stage. Since the Government has experience in handling and launching motors of the Caster, Antares, and Altair class existing handling equipment at Wallops Island should prove adequate. Therefore, the contractor should base his design on
the use of the above-mentioned equipment. Any motive power required
to transport motors and airframe components at Wallops will be furnished
by the Government. Equipment required to completely
assemble the vehicle components and to assemble the vehicle to the
launcher will be furnished by the contractor.

4.6 Electrical Safety Zone

All electrical motors, switches, and related equipment shall be
located outside of the safety zone which shall cover an area within
a radius of 50 feet about the base of the launching beam.

5.0 General Specification Provisions

5.1 Design Coordination

The airframe contractor shall be responsible for conferring with
the control contractor as to the location and assembly of the control
equipment into the airframe.

Close liaison and cooperation between the airframe and control con-
tractors are required to insure an efficient use of the space available
in the vehicle. The Government shall decide all questions as to
conflicts arising between the control contractor and airframe designer.
All decisions by the Government shall be final.

5.2 Definitions

Wherever in these specifications or upon the drawings the words
"directed," "required," "permitted," "necessary," "ordered," "designated,"
or words of like import are used, it shall be understood that the direc-
tion, requirement, permission, order, and designation of the Procurement
Officer, or his authorized representative, is intended and, similarly,
the words "approved," "acceptable," "satisfactory," or words of like import, shall mean approved by, or acceptable or satisfactory to, the Procurement Officer, or his authorized representative.

5.3 Subcontractors

The contractor shall be responsible for familiarizing each of his subcontractors with all aspects of the contract affecting each subcontractor, respectively, and shall be responsible for coordinating the work of his subcontractors to prevent any interference or omission whatsoever.

5.4 Drawing Approval

Approval of contractor's drawings will be general and will not relieve the contractor from the responsibility for the correctness of the drawings furnished by him, nor for their compliance with the specifications, nor for proper fitting and construction of the work, nor for furnishing materials and work required by the contract which may not be indicated on the drawings when approved. The approval of the contractor's drawings shall not be construed as approving changes in scope of the contract unless such changes have been specifically approved as contract changes.

5.5 Materials and Equipment

Unless otherwise approved in writing by the Procurement Officer, all materials furnished by the contractor for incorporation in the work shall be new, shall meet the requirements of a generally recognized standard, and shall be of kind, composition, and physical properties best adapted to their several purposes.
At any time prior to the expiration of the contract period, the Procurement Officer may request, and the contractor shall promptly furnish an additional information, instructions, technical or engineering data, or expert advice necessary for the proper installation, operation, and maintenance of the equipment supplied under these specifications.

5.6 Progress Report

The contractor shall submit monthly technical reports (5 copies) on the project status of the equipment covered by these specifications, to the Procurement Officer.

5.7 Drawings, Manuals, and Specifications

The contractor shall furnish one complete set of reproducible drawings for all components making up the airframe, launcher, and work tower to the Government concurrent with the second vehicle delivery. Outline drawings of all commercial components as well as electrical circuit wiring diagrams and one copy of significant calculations and data involved in the design and development shall be furnished to the Government. Also, 10 copies of an assembly, operation and service instruction manual shall be furnished to the Government. One set of specifications for the airframe components furnished under this contract shall be furnished to the Government for use in procuring additional quantities.
5.3 Launch Site Assistance

The Contractor shall supply the necessary skilled personnel to erect the launching system and assemble and checkout the first four scout vehicles. In addition to the operating personnel, a technical publications representative and a training instructor will be available to revise handbooks and conduct "on the job" training of NASA personnel on the assembly, servicing, and operation of the vehicles and launcher. A contractor group supervisor will be on hand for all Scout operations to supervise the contractor personnel and coordinate all field modifications for future incorporation by the factory.

The entire program shall include 50-1/2 man months to be furnished by the contractor as required during the life of the contract.