

AVROCAR (VZ-9AV)

FLIGHT TEST PLAN

15 July 1959

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INTRODUCTION

The prime purposes of the test program on the Avrocar are the following:

1. Define flight characteristics of this particular testbed, (performance, stability, control, etc.).
2. Specifically, define and investigate problem areas that may be inherent with the principles used.
3. Provide an evaluation of this principle of flight from standpoint of flying qualities.
4. Provide data from which an analysis and evaluation of the "operational usefulness" may be made.

At this stage of development of the testbed, evaluation of the operational potential of the principle involved by the services is the major objective. The enumerated purposes above are established as means of accomplishing this objective.

The gathering of quantitative data by the contractor to support future design efforts is of secondary importance at this point. Provision for this type of testing will be made after evaluation by the services and a decision to proceed with design studies.

All effort must be directed at this point toward answering the question of whether or not this principle of flight warrants further development by the services.

In order to accomplish the major objective of this program a series of tests will be conducted on the Avrocar by various agencies. Plans for the conduct of these tests are described in this document. A general breakdown of the tests required to accomplish the above enumerated purposes, the agencies responsible for conduct of these tests, and the agencies responsible for management of these tests is given in the following chart.

BREAKDOWN OF AVROCAR TEST PROGRAM

| <u>Test</u> | <u>Agency</u> |
|--|---|
| Ground Test AVRO SPG/TR-195 Phase I |) AVRO WSPO Management |
| Development Test AVRO SPG/TR-195 Phase II |) AVRO |
| Category I - 29 hr. |) |
| Evaluation Test Category II - 30 hr |) AFFTC Edwards Management WSPO Approval WADC Co-ordination- consultation |
| NASA Wind Tunnel Test |) NASA |
| NASA Flight Test - 50 hr. |) NASA |
| Follow-on Research | AVRO/NASA/ARMY |

GENERAL ASSIGNMENT OF RESPONSIBILITIES

In order to most expeditiously accomplish the objectives described in the introduction the following will be the responsibilities of the various agencies with respect to the overall program. Specific responsibilities on a given test are described later in this test plan.

Directorate of System Management - Hq. ARDC, WPAFB, Ohio, (RDZSXC)

- (a) Provide direction to technical test teams as to objectives, budgetary limitations, scheduling deadlines, contractual problems, etc.
- (b) Provide administrative management of entire program.
- (c) Provide technical management of ground test program.
- (d) Co-ordinate and approve test plan submitted by AFPTC.

AFPTC - Edwards AFB, Calif.

- (a) Provide technical management of entire test program from contractor's development test through the NASA flight test program.
- (b) Conduct evaluation tests to provide the major portion of the data required to evaluate the operational potential of the principles involved.
- (c) Monitor contractor's development test and make decision as to when the vehicle has been sufficiently developed to allow NASA and AFPTC flight tests to commence.
- (d) Provide a project monitor from initiation of contractor development test through NASA flight test.
- (e) Provide guidance to NASA on areas requiring detailed investigation, from the standpoint of the Army and Air Force.

AVRO, - Malton, Ontario.

- (a) Develop and refine the test aircraft toward the end of providing an airworthy vehicle for testing by AFPTC and NASA.
- (b) Provide required technical support on the AFPTC and NASA programs.

NASA (Ames) - Moffett NAS., Calif.

- (a) Conduct full scale wind tunnel tests on test aircraft.
- (b) Conduct a flight test program for the purpose of carrying out a detailed investigation of specific problem areas.

GENERAL ASSIGNMENT OF RESPONSIBILITIES (cont'd.)

NASA (Ames) - Moffett NAS., Calif. (cont'd.)

- (c) Co-ordinate on test plan
- (d) Co-ordinate all test plans with AFFTC
- (e) Attempt to make flight test program responsive to expressed interests of services, i.e., investigate problem areas considered of interest to the service.

WADC

- (a) Provide technical guidance on entire test program as requested by WSPO on ground testing and by AFFTC on remainder of tests.
- (b) Co-ordinate on test plan.

GROUND TEST

Objectives:

Operate all systems and develop these systems to the point that they are functionally adequate for the flight test program which is to follow.

Discussion of Objectives:

Since these tests are already in progress at this time, a detailed discussion of this portion of the test program will not be made.

Responsibilities:

- | | |
|-----------|--|
| (1) WSPO | Overall Management |
| (2) WADC | (a) Technical consultants and co-ordination on test plans and questions of qualification. (b) Provide instrumentation as requested. |
| (3) AVRO | Responsible for conducting test and all support activities |
| (4) AFFTC | Review test results for application to further tests. |
| (5) NASA | Review test results for application to NASA test plans. |

DEVELOPMENT TEST (Category I)

Objectives:

- (a) Demonstrate hovering in accordance with Appendix I
- (b) Develop the testbed, by flight test, until it is considered by AFFTC, (1) to be sufficiently airworthy and (2) to have demonstrated an adequate flight envelope for initiation of the evaluation tests.
- (c) Demonstrate compliance with guarantees as stipulated by contract.

Discussion of Objectives:

It is well at this point to review the major objective of the test program which is to provide data from which an evaluation can be made of the operational potential of this flight principle. It is the prime responsibility of the AFFTC to provide the data for this evaluation and primarily the contractor's responsibility to develop the aircraft to the point where the AFFTC and NASA can conduct a satisfactory flight test program.

In view of the objectives it should be emphasized again that the prime purpose of this program is developmental in nature and the contractor should refrain from extending the test program to obtain data for support of design efforts.

Objectives (a) and (c) are the contractor's responsibility and consequently the contractor has the authority to decide on the necessary modification to the test aircraft which may be required to accomplish these objectives.

With respect to objective (b), however, the AFFTC will be the authority for approving step by step the direction of this portion of the development tests.

This portion of the test program will be allowed to proceed, at the discretion of the AFFTC representative, regardless of the status of the wind tunnel testing by the NASA.

Responsibilities:

AVRO

- (a) Conduct test program - maintain operational control of test aircraft.
- (b) Conduct tests and modify aircraft as necessary to accomplish objectives (a) and (c).
- (c) Conduct tests and modify aircraft as approved by AFFTC to accomplish objective (b).

DEVELOPMENT TEST (Category I) (cont'd.)

Responsibilities:

AFFTC

- (a) Closely monitor this portion of the test program to assure expeditious accomplishment of objective (b).
- (b) Obtain advice as required from NASA, WADC, WSPO, et al, to assist in direction of this test.
- (c) Provide pilot evaluation of aircraft at various stages of the test program (estimated 3 hours total flight time).

WSPO

- (a) Approve all test plans
- (b) Review all decisions by the AFFTC test monitor to assure no conflict with schedules, contracts, budgets, etc.

WADC

- (a) Provide technical advise as requested by AFFTC, AVRO or WSPO.

NASA

- (a) Monitor results of this test for application to NASA testing.
- (b) Provide pilot for flight evaluation periodically during this test (estimated 1 hour total flight time).

EVALUATION TEST (Category II)

Objectives:

- (a) Define performance, stability and control characteristics of this particular testbed.
- (b) Define problem areas that may be inherent in this design.
- (c) Evaluate the flying qualities peculiar to this principle of flight.
- (d) Provide data from which analysis and evaluation of the "operational application" may be made.

Discussion of Objectives:

The prime purpose of the contractor's ground and development testing was to provide an airworthy vehicle on which this evaluation test could be conducted. This evaluation test is intended to provide the major portion of the information required to enable the Army and Air Force to decide whether the principle warrants further development.

It should be emphasized that this test is primarily a fact-finding exercise. The only evaluation or opinion that will be rendered by the test team will be in the area of flying qualities. No evaluation or opinion will be ventured on the operational application of this design, the obvious may be suggested, but primary purpose of the test will be to provide data from which the Army or Air Force operational analyst may determine the potential of the principle. It is essential that a service agency conduct this test in order that the tests conducted, the data gathered and the discussion of this data reflect the operational viewpoint. Information and guidance on type of data, service problems, will be furnished to AFFTC by the WSPO.

It is desirable that this test be completed before initiation of NASA flight testing in order that plans for the NASA tests can be based upon problem areas already defined by the AFFTC test program. It has been implied throughout this test plan that the NASA tests will follow the AFFTC tests. In any event, the NASA flight testing will continue beyond the AFFTC tests since a longer program is planned and NASA will not commence flying until the contractor's development testing is complete.

It is estimated that 30 hours of testing will be required to complete this program.

Responsibilities:

AFFTC

- (a) Provide pilot and engineer to plan testing, perform all flying, supervise reduction of data and write the report of test.

EVALUATION TEST (Category II) (cont'd.)

Responsibilities(cont'd.)

AFFTC

- (b) Operational control of test aircraft during the period of this test. This will include scheduling of flights, monitoring of maintenance, supervision of instrumentation etc.
- (c) Co-ordinate test program with WSPO, Army, Avro, WADC and NASA.
- (d) Report progress of this test to WSPO.
- (e) Publish final report of test and distribute.
- (f) Recommend areas that require detailed investigation to NASA.
- (g) Provide all instrumentation equipment for this test and supervision of installation.

AVRO

- (a) Maintain test aircraft and test instrumentation.
- (b) Provide engineering services as required to reduce test data.
- (c) Co-ordinate on all test plans to assure that no aircraft limitation is exceeded.
- (d) Install all test instrumentation under supervision of AFFTC instrumentation personnel and to AFFTC instrumentation specifications.

WSPO

- (a) Approve overall planning from standpoint of schedules, costs, etc.
- (b) Decide unforeseen questions of deviation from test plan, changes in contract, modification to test aircraft etc.
- (c) Provide to AFFTC information and specific requests for additional data as may be determined from the services. (USAF and US Army).

EVALUATION TEST (Category II) (cont'd.)

Responsibilities (cont'd.)

NASA

- (a) Co-ordinate on test program
- (b) Monitor program in order that maximum benefit may be obtained from test results.

WADC

- (a) Provide consultation services as requested by AFPTC.
- (b) Co-ordinate on overall test plan.

FULL SCALE TUNNEL TEST

Objectives:

Provide basic aerodynamic data on full scale test aircraft to aid in evaluating problems associated with the principle and to guide flight test efforts which follow.

Discussion of Objectives:

None.

Responsibilities:

NASA

- (a) Plan and conduct this test.
- (b) Co-ordinate test plan with AFFTC

AVRO

- (a) Provide support presently in existing contract, (AF33(600)-37496).

AFFTC

- (a) Expedite co-ordination of test results from this program with Avro, WADC and other interested agencies.
- (b) Assure application of test results to tests being conducted at contractor's facility.

NASA FLIGHT TEST

Objectives:

Conduct flight tests on the test vehicle to provide detailed investigation of problem areas determined during Avro, NASA and AFFTC testing.

Discussion of Objectives:

This test will not be conducted on a specific time schedule and may be carried on indefinitely.

Responsibilities:

NASA

- (a) Plan and conduct this test program.
- (b) Co-ordinate test plan with AFFTC

AVRO

- (a) Provide support as required by NASA.

AFFTC

- (a) Recommend to NASA problem areas where the Army and Air Force desires further investigation. These recommendations will result from test experience gained at the contractor facility.

FOLLOW-ON RESEARCH

Objectives:

Provide data to support studies of application of the principle on future designs of a specific vehicle.

Discussion of Objectives:

Admittedly the test program as planned does not provide a broad background of quantitative data to support future designs. If this aircraft were a prototype of a production design then a prime objective would be to obtain test data to support the design. In this case the original objective of test is only to provide sufficient data to decide whether the design warrants further development.

If this decision is favorable, then there are at least two possibilities, (1) design studies of advanced applications of the principle would be requested or (2) the contractor may be requested to proceed with design of a prototype. In any event more research data will be required to support this design work.

This testing may be accomplished in wind tunnels, on computers, by modification and/or development of the present testbed, etc. This is the same type of research that was performed in support of the design of the present testbed.

The purpose in discussing this future testing in this plan is to place these design support tests in proper perspective and thereby further clarify the major objective of the present test program.

Responsibilities in these follow-on research tests will not be discussed since they are not pertinent to the present test program.