AVRO AIRCRAFT LIMITED

STRUCTURAL INTEGRITY OF THE ARROW AIRCRAFT

A NOTE ON THE PROPOSED FLIGHT PROGRAM

1. Introduction

This note discusses the purpose and intent of the flight program for demonstration of the structural integrity of the Arrow Aircraft.

It is proposed that the program be carried out in two distinct parts, the first using an Arrow I, either 25201, 2 or 3 and the second using an Arrow II which is at present No. 25215.

2. Purpose

The purpose of this program is to confirm, by strain gauge measurements, the accuracy of airloads calculations. Flight strain measurements will be compared with calculations for similar manoeuvres. The validity of these calculations will be demonstrated by use of a static ground test for particular design cases.

Associated with this program will be a demonstration of the airworthiness of the aircraft to the satisfaction of the company and the R.C.A.F.

The proposed program is planned with a view to the requirements of MIL-S-5711 being a considerable increase on the simple demonstration but somewhat less than the full flight loads survey.

3. Program

3.1 Part I

This part may be carried out on any of the first three Arrow I aircraft. The object will be to cover that part of the design flight envelope required for the Phase I program. It is expected that this will approach 80% of the design flight envelope.

The program will be carried out by gradually increasing the equivalent airspeed and allowable normal load factor and rolling velocity and monitoring the results continuously during the normal flight test program. This will be implemented with the use of about 57 strain gauged positions located at critical points in the structure together with other instrumentation to indicate local accelerations, pressures and control surface hinge moments. The purpose of this instrumentation is to monitor typical flight cases in order to assess stress levels at these singular position. No loads analysis is possible.

Before an increase in the envelope is attempted typical flight cases will be analysed on the simulator and these will be processed for flight loads and stresses using the available aerodynamic and stressing matrixes.

3.1 Part I (Cont'd)

Towards the end of this part of the program, the limiting devices on the damping system will be investigated. However, these will be set at falsely low values in order that the factors may be kept below those already tested in this part of the program. Examination of the resulting manoeuvres will give checks on the accuracy of simulation and allow for the more stringent tests of the Part II program.

3.2 Part II

Aircraft 25215 has been allocated solely for this program. It is intended that 400 strain gauged positions will be available together with other instrumentation as in Part I.

The extent of this instrumentation is such that comparison with design cases is more complete than in Part I testing. However, it is proposed that only 200 of these quantities will normally be used for conformation of airloads and the full quantity will only be available when unexpected results appear.

The object of this part of the program is to increase the flight envelope to the design limits and to demonstrate the flight worthiness of the aircraft during typical manoeuvres which may be expected to achieve these design limits. The basic program will consist of carrying out normal manoeuvres (pull ups, turns, rolling pull outs etc.) to the design limits, or to such limited manoeuvres as are possible for safe operation of the aircraft. In order to complete these tests some parts of the damping system will be inoperative, e.g. limiting devices and pitch and roll damping. It must be mentioned that owing to the low design weight certain parts of the aircraft which depend on n rather than nW cannot be demonstrated to the full factors.

Following this, the damper system limiting devices will be demonstrated at their design settings and damper system failure cases will be examined. Typical of this latter test are hard over control signals during various manoeuvres. The latter part of the program will be preceded by simulator and loads analysis in order to approach the limiting cases in a safe manner. The aircraft will be demonstrated using the normal damping system. Of course, the emergency damping system will automatically come into use during the tests on limiting devices and failure cases.

4. Conclusion

It must be emphasised that this program constitutes a considerable task. In order to conserve flying time and to achieve success in the limited time available very close liaison between Flight Test Engineering, Technical Design Department, and the Stress Office is necessary.

4. Conclusion (Cont'd)

It is suggested that the detailed program method of data handling and associated manpower requirements be examined and prepared as soon as possible.

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