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A.R.C. Technical Report

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CURRENT PAPERS

Records of Static Pressure Tests on Pressure Cabins

By

P. B. Hovell and A. R. Butler

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ONE SHILLING NET

1 Introduction

Records are given of the strengths under static pressure of test specimens of twenty different types of pressurised fuselage.

For fighter aircraft, the complete pressurised portion of each fuselage was tested. For bomber and transport aircraft, special specimens were built to incorporate the pressure bulkheads and representations of all types of openings such as windows and doors.

Tests were usually made with water. The size of the specimens for the large aircraft was governed by the size of the water tanks available.

Leakage frequently occurred before any structural failure. The sealing was therefore improved to enable the pressure test to proceed. It was recognized, however, that the sealing in service did not have to withstand the fully factored water pressure.

2 Test results for Bomber, Transport and Civil Aircraft

Table I compares the factored design pressure required with the maximum pressure attained in test without any strengthening modifications. This Table also states the operating differential air pressures for which the fuselages were designed and records the locations of the first structural failures.

Three of the fourteen fuselages were satisfactory for strength. Seven failed to reach 75% of the factored design load. Of these seven, one had a structural failure at 33% of the required load.

3 Test results for Fighter and Fighter-Bomber Aircraft

Five aircraft that were originally designed for pressure reached the factored design load without structural failure.

In the sixth case, the aircraft had not been originally designed for pressure but adapted to take it. The adaptation was unsuccessful and the first structural failure occurred at 66% of the factored design load, when the attachment of the hood side rails to the cabin shell failed under the up load imposed by the pressurised hood.

The pressure differential required by the specifications was normally 3.5 p.s.i. In the approval test this differential pressure was increased by 1.0 to 2.0 p.s.i. to simulate the mean aerodynamic suction on the hood.

4 General description of failures

In general, premature failure occurred at discontinuities where precise estimation of strength is difficult. In many cases it was necessary to make two or more tests before sufficient strengthening modifications had been incorporated to ensure that the fuselages withstood the design pressures. An analysis of all test reports gives the following frequency of location of premature failure:- front or rear bulkhead (8), doors and hatches (6), nose-wheel well (3) and transparency mountings (2).

5 Conclusions

For bomber and transport aircraft the proportion of premature structural failures (eleven out of fourteen) is much higher than was obtained in a corresponding analysis[1] of wing structures. It is clear that the strength of a cabin under pressure is not at present being estimated with an accuracy

comparable to that achieved for stress calculations in general. The features which give most trouble are pressure bulkheads, doors, hatches and the structures round the nose-wheel wells. The need for static strength tests is clearly shown.

The conclusions given above do not apparently apply with equal force to fighter aircraft. As, however, the number of specimens was small and the required differential pressures happened to be low, it is not considered that the evidence here recorded would justify dispensing with static strength tests on fighter pressure cabins.

REFERENCE

No.	Author	Title, etc.
1	P. B. Walker	Records of major strength tests. R.&M.2790. 1953

TABLE I

Static Pressure Tests of Bomber, Transport and Civil Aircraft

Aircraft	Working Differential Pressure lb/sq in.	% of Ultimate Design Pressure at first failure	Location of Failure
A	8.0	130	Beam supporting a bulkhead.
B	6.5	106	Hatches.
C	5.5	100	Completely wrecked, air used for pressurisation.
D	5.5	98	Windscreen support.
E	8.2	94	Baggage door.
F	9.0	93	Front bulkhead.
G	8.2	79	Door casting
H	6.5	74	Bolt housings at door.
J	9.0	61	Hatches.
K	4.16	60	Rear bulkhead.
L	5.5	59	Nose-wheel well.
M	9.0	55	Bolts at rear bulkhead.
N	8.77	55	Nose-wheel well.
O	9.0	33	Ejector hatch bolts sheared.

Ultimate design pressure = 2 × working pressure differential

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by

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and
A. R. Butler

SUMMARY

Results of static pressure tests on 20 fuselages are given. The information is primarily for record and further use as required. Brief details of the locations of premature failures are given, and general conclusions are drawn to account for the difference in the results obtained for fighter and transport aircraft.

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