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OTTAWA July 3rd, 1942.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1256.

Physical Tests on an Aircraft
Engine Adaptor Casting.

(Copy No. 6.)

BUREAU OF MINES
DIVISION OF METALLIC MINERALS

ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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R E P O R T

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Origin of Request:

On April 17th, 1942, Group Captain A. L. Johnson, for Chief of Air Staff, Department of National Defence (Air Service), Ottawa, Ontario, asked (by letter, File No. 938DD-3-5) that an aircraft engine adaptor ring which was delivered to the Bureau of Mines by Squadron Leader A. J. Smith be tested under loading conditions equivalent to those experienced in service. An outline of these tests is given on the next page under paragraph heading "Tests Required".

Part Received:

Part Name ADAPTOR. Part No. 2414(d).

Shown on drawing of the DeHavilland Aircraft of Canada Limited, Toronto.

The drawing calls for an aluminium casting to Material Specification AC-123.

The casting submitted for test weighed 14.256 pounds.

Figure 1 shows the casting as received.

Figure 1.

ADAPTOR CASTING
AS RECEIVED.

Tests Required:

(a) Proof test. The following loads to be applied for 1 minute:

Total yawing couple	21,260 lb./in.
" pitching "	30,036 "
" torque	18,000 "
Net forward thrust	406 lb.
Net shear	4,420 "

(b) Ultimate test. The above loads to be doubled and held for 1 minute.

(c) The casting to be checked for deformation before and after each test.

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Apparatus Used:

A structural steel stand with face plate was constructed. The adaptor was bolted to the face plate. To the adaptor was bolted a fixture (weighing 260 lb.) consisting of a plate and the necessary arms for the various couples. The set-up is shown by photographs, Figures 4-6, at the end of this report.

As the shear load was applied by a spring-and-jack in a vertical upward direction, the casting was mounted in an "upside-down" position and the directions of the couples were reversed accordingly.

It will be noted that for the Yawing Couple two arms were used with two forces, one forward and one backward. The pitching couple was obtained by applying the vertically upward shear force to the fixture at a distance calculated to give the proper moment arm. The torque couple was applied with one moment arm. This necessitated a correction to the shear force. The forces for the torque, yawing moment, and forward thrust were applied by wire ropes in which the proper tension was obtained by loading platforms supported by the ropes which passed over pulleys.

The shear load was applied with a spring and jack screw which can be seen in the photographs. This spring was carefully calibrated in the Amsler testing machine, both before and after the test. The check calibration agreed with the original one.

Loads Applied:

Normal Load.

	Force, pounds	Movement arm, inches	Movement, inch-pound
Forward thrust	406		
Torque	455	39.5	18,000
Vertical shear	4420		
Pitching couple	5135⊕	5.9	30,060
Yawing couple	269	39.5	21,260
Weight of fixture	260		

⊕ Load on spring = Vertical shear + torque force + weight of fixture = 4420 + 455 + 260 = 5,135 pounds.

Compression of spring to give a force of 5,135 pounds.
= 2.06 inches.

Over Load

	Force, pounds	Movement arm, inches	Movement, inch-pound
Forward thrust	812		
Torque	910	39.5	36,000
Vertical shear	8840⊕⊕		
Pitching couple	10000	6.0	60,120
Yawing couple	538	39.5	42,520
Weight of fixture	260		

⊕⊕ Load on spring = Vertical shear + torque force + weight of fixture = 8840 + 910 + 260 = 10,010 pounds.

Compression of spring to give a force of 10,010 pounds
= 4.125 inches.

Discussion of Tests and Results:

The loads applied were within 1 per cent of the nominal theoretical loads.

The casting investigated would not sit flat on a plane surface before test and apparently had some initial deformation, or the bosses surrounding the bolt holes had not been machined flat.

The method of gauging the casting for deflection was to place it on a 14" x 21" surface plate and measure to the top of the bosses (surrounding the bolt holes) with a dial indicator. This height is given on the drawing as 9.3 in. and was approximately correct for the casting. The bosses were lettered as in Figure 2 and measurements made to each of them with the dial indicator. Readings of the dial indicator were made for each boss and are plotted in Figure 3.

Owing to the limitations of the gauging tools and the initial deformation of the casting, measurements were made under three conditions and are plotted, as follows:

"A" - Casting sitting freely on face plate.

"B" - Slight pressure applied to the boss being gauged.

"C" - Dial indicator held in stationary position and casting moved to bring each boss under the dial indicator.

The reading of the dial indicator on boss A was taken as a datum, and the indicator was reset to the "A" value for the check after normal and overloads.

The readings of the dial indicator are plotted in Figure 3 but they do not appear to suggest any definite deformation of the casting due to the loadings. One reason why this is so is that considerable work was required to bolt the heavy fixture to the adaptor and some deformation of the bosses may have been caused owing to the use of drift pins and hammering. This is likely the cause of the slight differences in measure-

(Discussion of Tests and Results, cont'd) -

ments of the distances between bolt holes. Some of the bolt holes were definitely made out of round by the use of drift pins during the assembly.

Measurements between Bolt Holes:

Back of Casting.

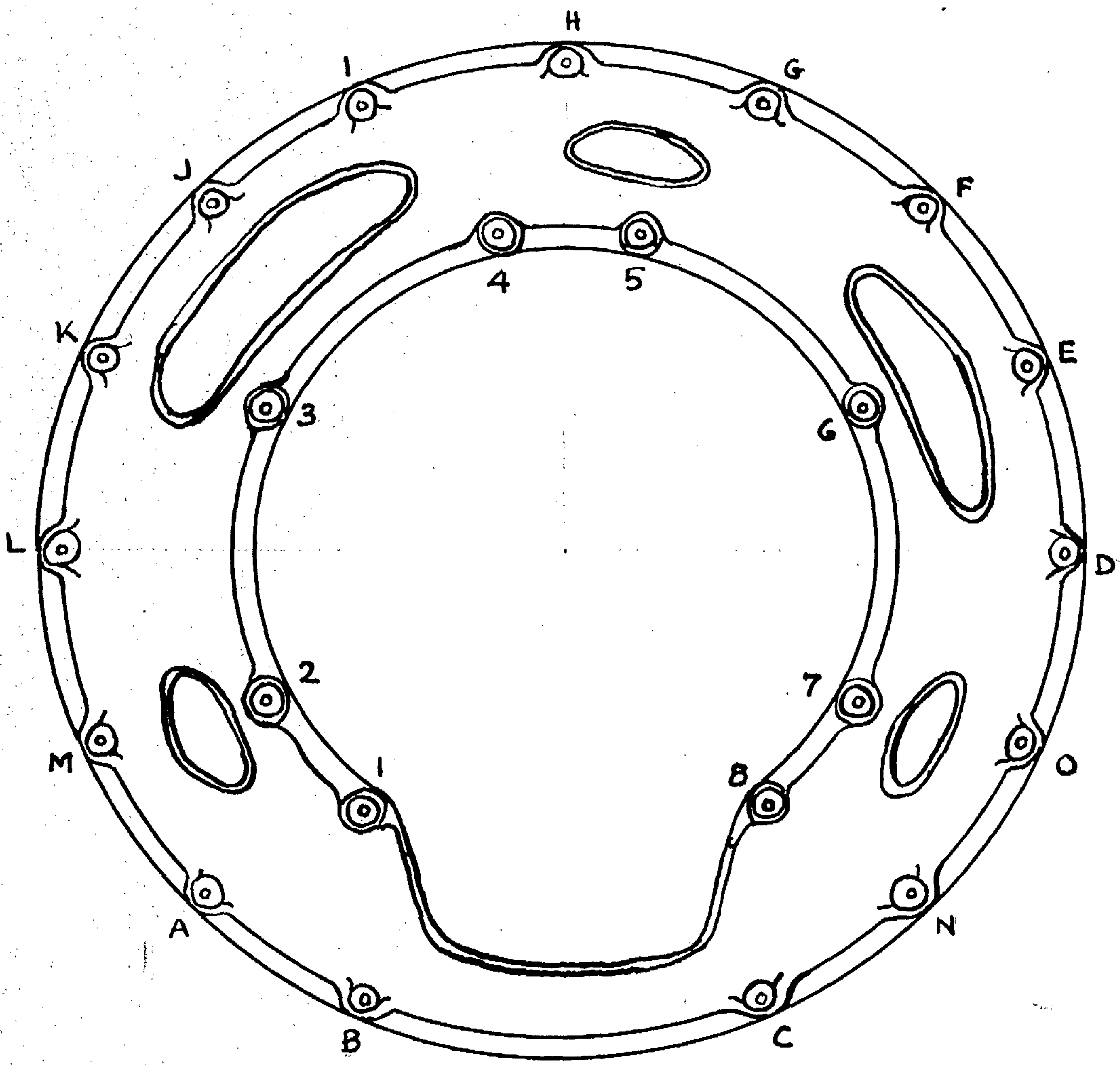
Distance	Before test, inches	After normal load, inches	After double load, inches
A - F	25-1/16	25-1/16	25-1/32
B - G	25-1/8	25-1/8	25-1/8
C - I	25	25-1/64	25-3/64
N - J	25-1/64	25-1/32	25-1/16
O - K	25	25	25
D - L	24-63/64	25	24-31/32
E - M	25	25	25

Front of Casting.

Distance	Before test, inches	After normal load, inches	After double load, inches
1 - 5	16-1/4	16-3/8	16-1/4
2 - 6	16-1/2	16-1/2	16-1/2
3 - 7	16-7/16	16-7/16	16-7/16
4 - 8	16-3/16	16-3/16	16-7/32
8 - 1	10-3/8	10-5/16	10-5/16

(Figures 2 and 3 follow on Pages 7 and 8).

FIGURE 2.

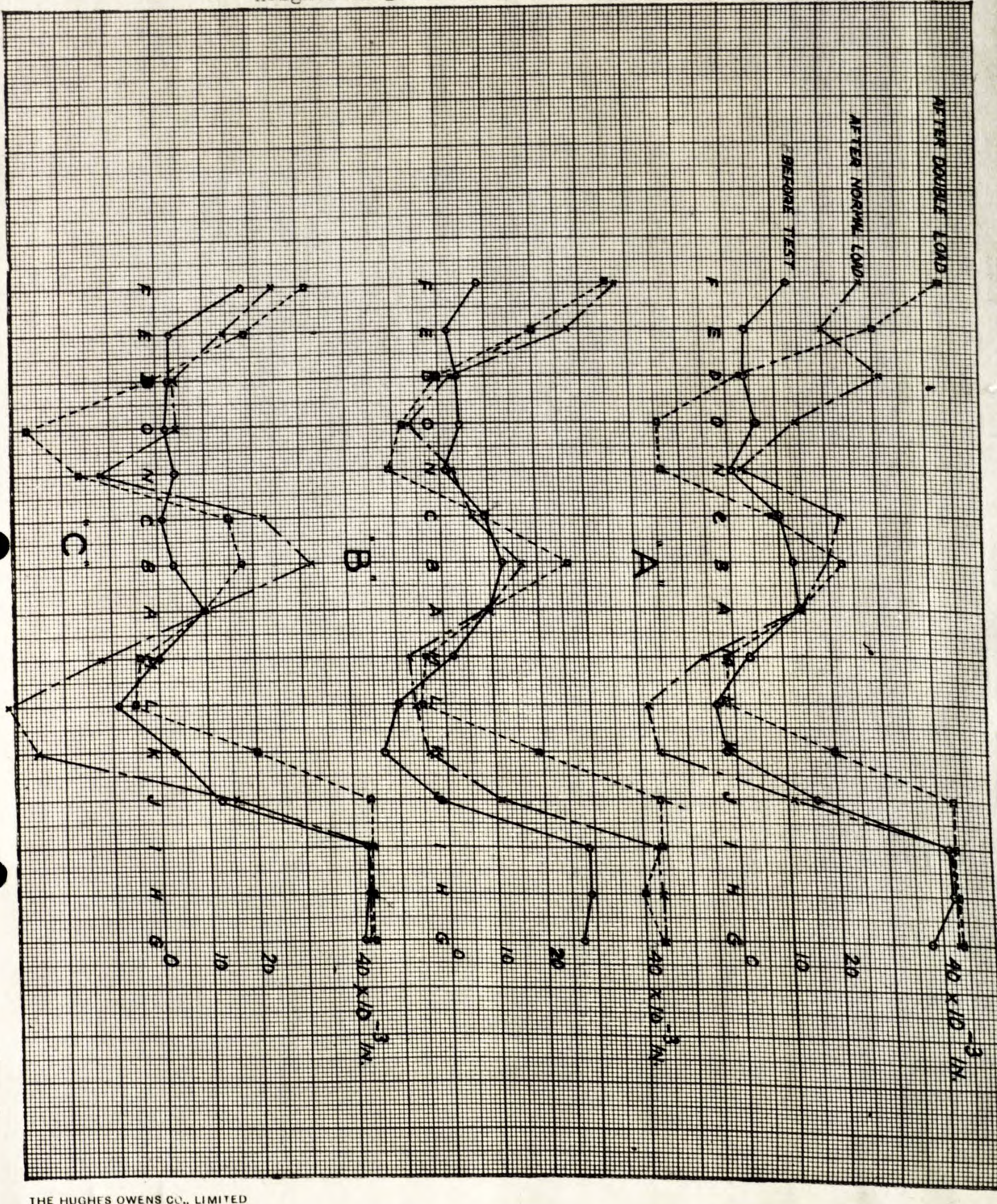


PLAN VIEW
LOOKING FROM ENGINE SIDE

Sketch showing position of bosses to which measurements were made.

FIGURE 3.

Heights of Bosses Before and After Tests.



Conclusions:

The adaptor casting showed no superficial fractures or defects caused by the loads which were applied.

There was no apparent permanent deformation of the casting following the tests.

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SJH:HHF:GHB.

(Pages 10, 11, and 12 show the fixture ready for test).

Figure 4.

Figure 5.

Figure 6.

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SJH:HHF:GHB.