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O T T A W A June 23rd, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1432.

Magnaflux and Radiographic Examination of Cylinders for Cheetah Aircraft Engines.

(Copy No. 10.)

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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Origin of Material and Object of Investigation:

In Investigation No. 1380 (Examination of a Cylinder Barrel from a Cheetah Aircraft Engine) the suggestion was made that magnaflux or X-ray examination of the finished cylinders should reveal defects of the type responsible for the failure in question. One hundred Cheetah cylinders were submitted on April 10th, 1943, by Wing Commander A. J. Smith, Department of National Defence for Air, Jackson Building, Ottawa, for the purpose of determining the relative merits of magnaflux and radiographic examination as a means of detecting defects in such cylinders. It was understood that these barrels were magnaflux-inspected at the Ford factory in Windsor, Ontario.

Magnaflux Examination:

The cylinders were carefully magnafluxed in these Laboratories, using the wet method with residual magnetism. Two cylinders were indicated as being definitely defective. Several others were thought to be possibly defective and were segregated as such, but the indications

on these were not thought to be sufficiently conclusive to warrant rejection of the cylinders on that basis alone. Interpretation of indications on the black treated exterior surface of the barrels was considerably complicated, particularly between the fins, by the presence of small red particles, some of which could not be removed by ordinary rubbing with a brush. These may have been particles from a previous magnafluxing or may have been formed as a result of the surface treatment.

Radiographic Examination:

The cylinders were then forwarded to the National Research Council, where sixty-five of them were radiographed. Of this number twelve were said to show defects clearly, while ten showed them faintly. It was said that no definite relationship existed between the ones found possibly defective by magnafluxing and those indicated as defective by radiographing.

Comparison of Magnaflux and Radiographic Indications:

One of the cylinders which had been shown to be definitely defective by magnafluxing passed the radiographic examination because the defect, being in the unfinned portion of the barrel, was evidently overexposed so much as to make interpretation impossible. A one-quarter-inch strip containing part of the defect, which seemed to be about one-half inch long, was removed from the barrel. It broke open with a very light blow from a hammer. The defect extended inward from the outer surface to a depth of approximately 0.047 inch at the point measured. Photomicrographs obtained from a specimen removed from the defective portion and polished on a face perpendicular to the main axis of the barrel are given in Figures 1 and 2. This defect, which does not seem to be of the shrinkage type, probably originated during the centrifugal casting.

A barrel found defective by radiographing and missed in magnafluxing was then remagnafluxed. While the defect was

again confused with particles of magnetic material in the barrel when examined under incandescent light, a small indication was found when the part was examined in daylight. Evidently, reflection caused by surface tension of the oil around particles of magnetic material in the interior of the cylinder is not as severe in shaded daylight as under incandescent lights.

Discussion of Results:

If it is important that all shrinkage defects in the cylinders be located, radiographic inspection would seem to be in order. Such inspection, however, would have to be made very carefully as the interpretation of films is quite difficult. Even so, defects in the unfinned portion of the barrel, especially those of the type discussed in the first paragraph of the preceding section, may be missed. Magnaflux inspection would probably locate the more serious defects. It is imperative, however, that great care be used with this method also, for while location of defects is probably not as difficult as with the radiographic procedure, it is still far from easy.

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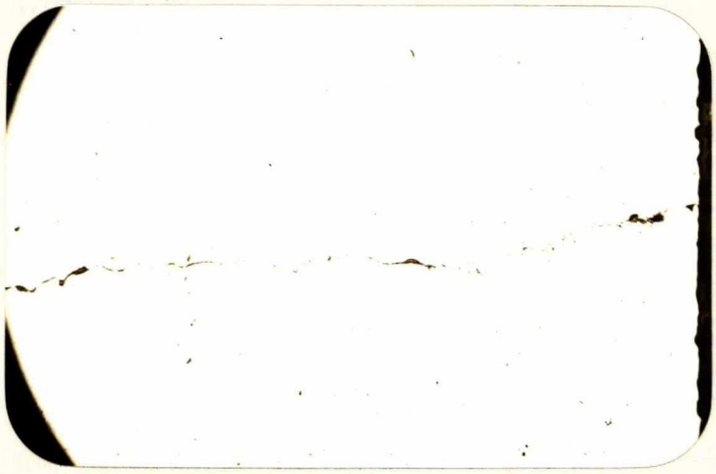
LPT:MMD.

(Figures 1 and 2 comprise)
(Page 4, following.)

Figure 1.



X100, unetched.

CROSS-SECTION OF THE DEFECT.

Figure 2.

X1000, unetched.

Note inclusions in the defect.

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