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# METALLURGICAL EXAMINATION OF A BANSHEE AIRCRAFT WING HINGE FITTING

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by

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PHYSICAL METALLURGY DIVISION

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ABSTRACT

Metallurgical examination of a transverse crack, detected during a routine magnetic particle inspection, on a Banshee wing hinge fitting showed that the crack was decarburized. It was concluded that this crack having a depth, in the section examined, of approximately 0.110 in., was a manufacturing defect and had not propagated during service.

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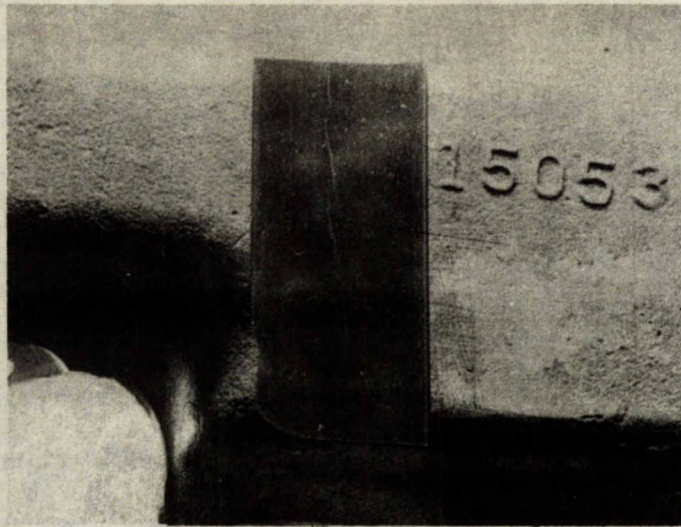
## INTRODUCTION

On September 3, 1958, a cracked Banshee Wing Hinge Fitting, No. PN 23-15053-1, was submitted to the Physical Metallurgy Division, Department of Mines and Technical Surveys, by the Naval Secretary, Department of National Defence, Ottawa. Metallurgical examination of transverse cracks present in the fillet region was requested, to determine whether the defects had originated during the manufacture or had developed during service.

The letter covering this enquiry, NS 7805-131 (DAE), enclosed defect report CNA 21, 1107, TSD No. 18 and photographs (Fairey Canada Nos. 768, 769, 770 and 771). The aircraft identification was Banshee F2H-3, serial number 126390, and the sub-assembly component was identified as "Outer Wing Panel, L.H.", part number 23-15001-1, serial number A1-95. The defective part was described as "Fitting Assembly Rear Spar, Upper Hinge L.H. - part number 23-15053-1, manufacturer - McDonnell Aircraft Corporation".

The appearance of the transverse defect, after removal of 0.060-inch of metal, is illustrated in Figure 1.





(X4/5)  
Figure 1. - Transverse fillet defect after removal  
of 0.060 in. of metal by grinding.

#### METALLOGRAPHIC EXAMINATION

A transverse microsection was taken through the defect for examination of the tip of the crack.

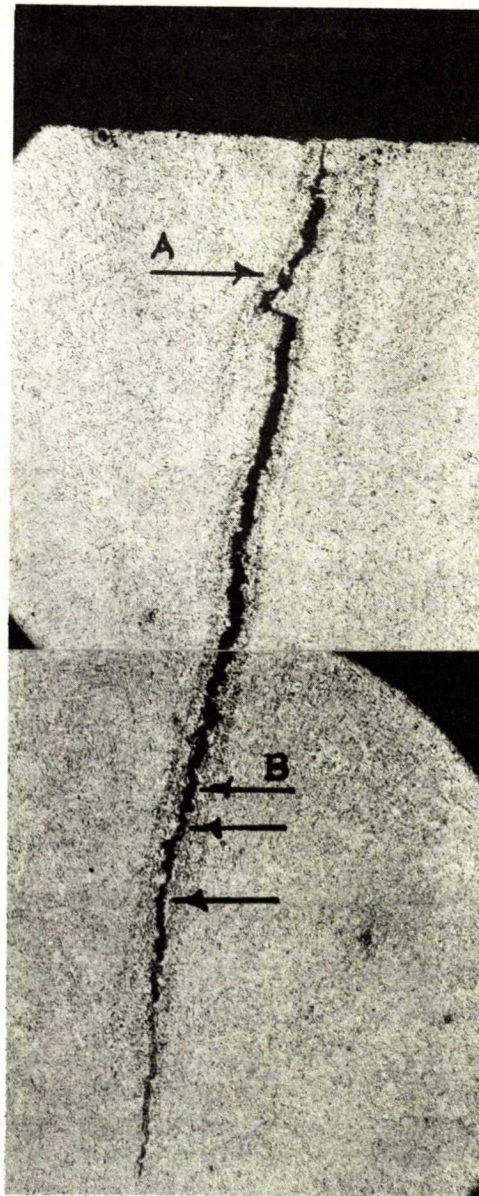
The appearance of the tip of the defect is illustrated in Figure 2. The presence of decarburized metal and spheroidized oxides along this crack shows that the defect originated during manufacture -- not in service. The appearance of the defect suggested that it was a forging lap which had opened during heat treatment\*.

The original defect had not progressed in service but its total depth was of the order of 0.110 in.

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\*The fact that the crack did not extend beyond the lap and the presence of oxide on the crack surfaces (Figure 5) indicate that the crack formed prior to service.





(X100; etched in 2% nital)

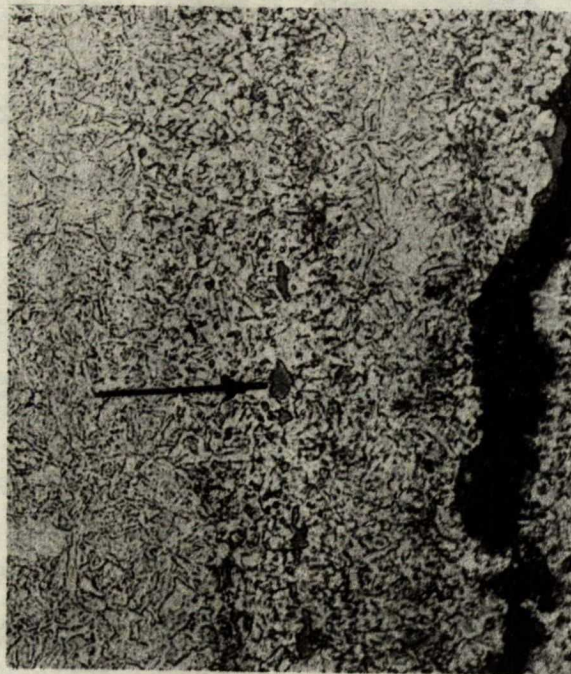
Figure 2. - Tip of transverse defect - transverse section.  
The crack is approximately 0.050 in. deep in this section, but 0.060 in. of metal had been removed previously. Decarburization (arrows) and oxides show that this defect originated during manufacture. The crack has not propagated in service.

At the ground surface, visible at the top of Figure 2, the lap consisted of three branches. The crack followed one branch, then



changed direction and followed the longest branch of the defect.

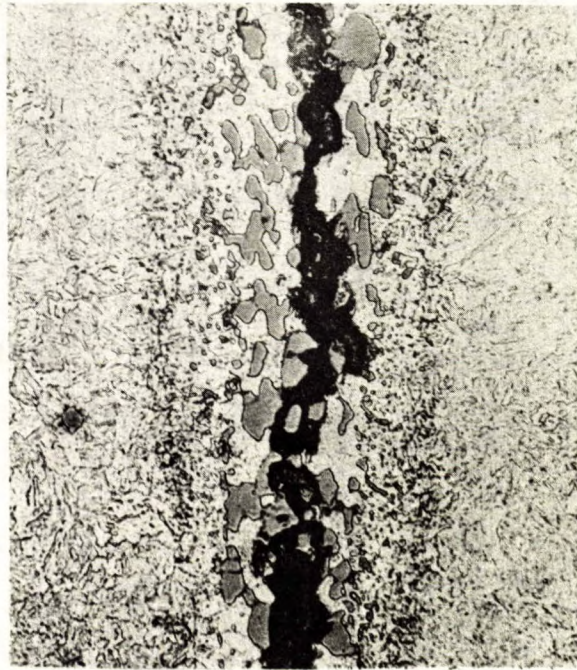
The areas marked A and B in Figure 2 and the tip of the crack are illustrated at higher magnification in Figures 3, 4 and 5, respectively.



(X500; etched in 2% nital)

Figure 3. - Area "A" - transverse defect. This photomicrograph illustrates the defect which has cracked and one branch of the defect which has not cracked (arrow).





(X500; etched in 2% nital)

Figure 4. - Area "B" - transverse defect. The appearance of the oxides suggests that the defect formed during forging. Decarburization is visible adjacent to the crack.



(X500; etched in 2% nital)

Figure 5. - Tip of the transverse crack. The presence of decarburization and high temperature oxide close to the tip of the crack indicates that in service the crack did not propagate.

#### DISCUSSION

The presence of decarburization and the shape of the oxide inclusions indicate that this defect occurred during forging. The actual crack might have formed during forging or during subsequent heat treatment. The defect originated during manufacture of this fitting and its appearance indicates that it has not progressed.

#### CONCLUSION

The defect originated during manufacture, probably during forging, and has apparently not progressed in service.

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