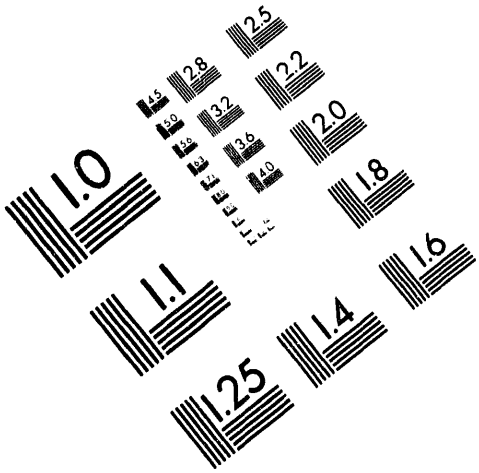

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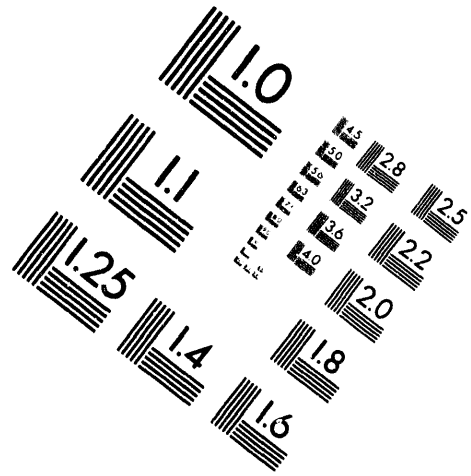

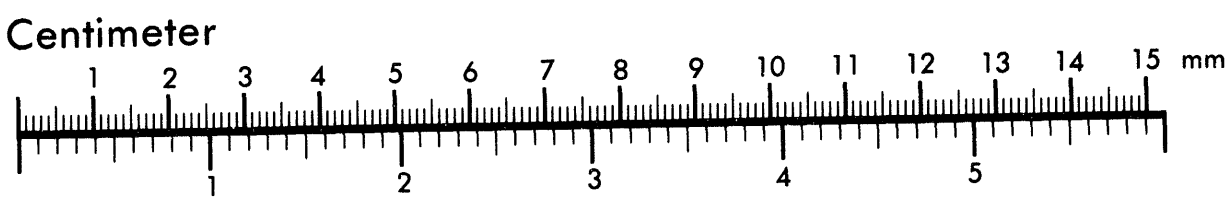

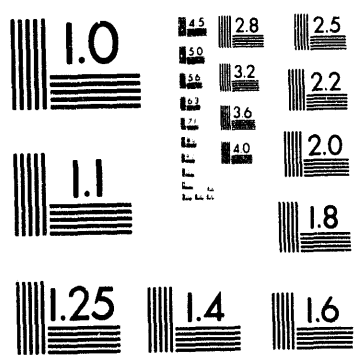

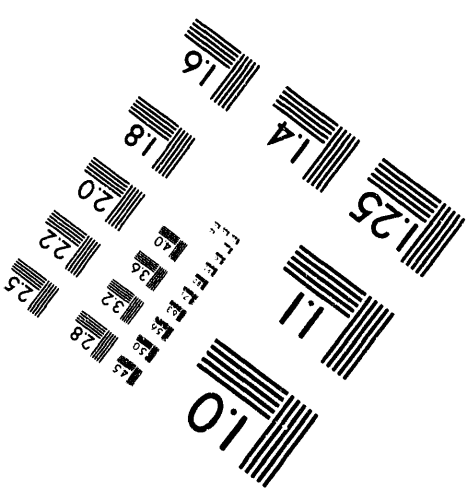

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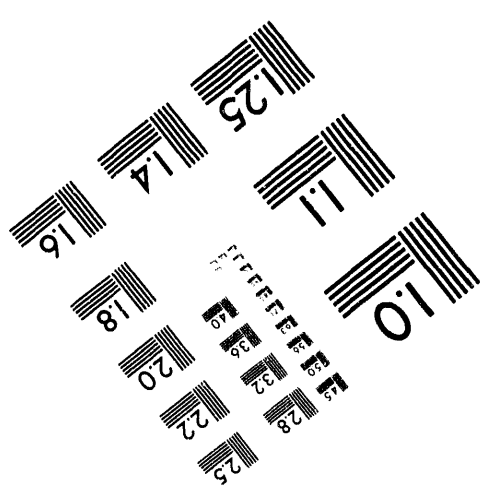

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EXAMINATION OF A SEVERELY PITTED X-8001 ALLOY CLAD FUEL ELEMENT (RM-303)

by

M. E. McMahan

December 7, 1959

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EXAMINATION OF A SEVERELY PITTED X-8001 ALLOY CLAD FUEL ELEMENT (RM-303)

INTRODUCTION

An X-8001 clad, I & E natural uranium fuel element irradiated in tube 2762D to 886 MWD/T was discharged in February 1959 and sent to Radiometallurgy Laboratory for examination at the request of Irradiation Processing Department.

SUMMARY AND CONCLUSIONS

After discharging tube 2762D which was loaded with X-8001 clad fuel elements, a fuel element (KL018D) was observed to be very badly pitted. Visual and photographic inspection revealed the pits had penetrated into the AlSi layer. The pitting appeared as the result of erosion-corrosion as there was no evidence of intergranular or transgranular corrosion and no mechanical deformation. Chemical analyses for %Ni and Fe indicated normal concentrations.

DETAILS

One I & E element (lot number - KL018D) from tube 2762D representing the severest pitting attack on a charge of X-8001 aluminum alloy clad fuel elements was received by Radiometallurgy for examination on May 5, 1959. Visual inspection of the element showed the pits had extended from one end to the other and covered approximately one half of the surface area. (Figure I.) The location of the rib marks revealed that the pits were on the top side of the element. The deepest pits appeared to have penetrated into the AlSi.

Two transverse samples were sectioned from the deepest pitted area (Figure I) for metallographic examination. Photomicrographs of sample 303A (Figure II) revealed that the deepest pits go through the AlSi and bond layer and into the uranium. Metallographic examination, on sample 303A5A (Figure III) also showed the pits had penetrated to the uranium.

A canwall specimen was removed from pitted area of sample 303A2 for metallographic examination. There was no evidence of intergranular or transgranular corrosion (Figure IV) and the grain structure did not appear to be mechanically deformed or worked.

Two small canwall specimens were taken from the pitted and non-pitted (180° from pits) areas of sample 303A2 for wet chemical analysis of the iron and nickel content. The iron content (Table I) from the pitted specimen was approximately twice as great as the non-pitted specimen.

TABLE I

Wet Chemical Analysis of X-8001 Aluminum Canwall Samples.

Sample No.	Ni(%)	Fe(%)
303A2 (Pitted Area)	1.45	1.37
303A2 (Non-pitted - 180° from pits)	1.36	0.623

TABLE II

Sample No.	Ni(%)	Fe(%)
303A1 (Pitted side)	1.04	0.53
303A4 (Pitted side)	0.99	0.54
303A5A (Pitted side)	0.95	0.57

The high content of nickel in both specimens and iron in one specimen was unexpected, therefore, three more canwall specimens from the pitted side only were analyzed. The results are also shown in Table II.

The nickel and iron content of the last three canwall specimens is normal for X-8001 aluminum alloy. Explanation of the high percentage of iron in sample 303A2 (Pitted area) is not definite but could have been picked up while removing specimen from the fuel element.

The data from which this report was taken may be seen in Personal Notebook, HWN-2253.

M. E. McMahan

M. E. McMahan, Engineer
Radiometallurgy Laboratory
MATERIALS DEVELOPMENT OPERATION

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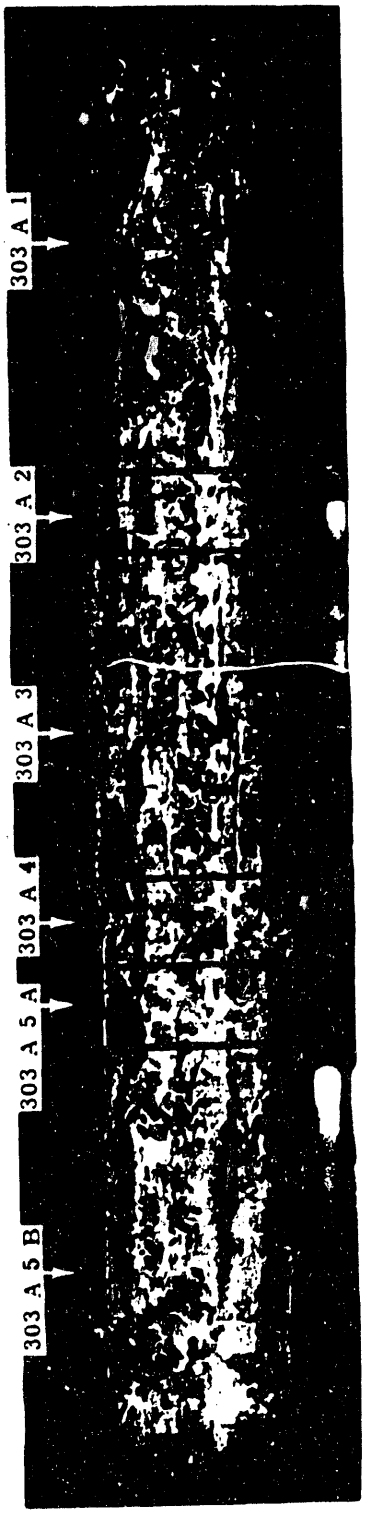


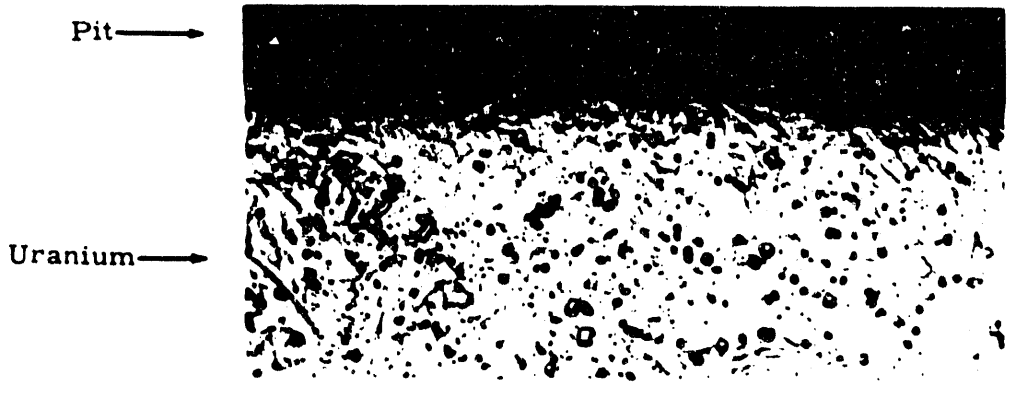
FIGURE 1

X-8001 Aluminum Clad Element as Received

Neg. #s 11766
11767
11768

Neg. #11833 A 50X Mag.

Electrolytic Etch

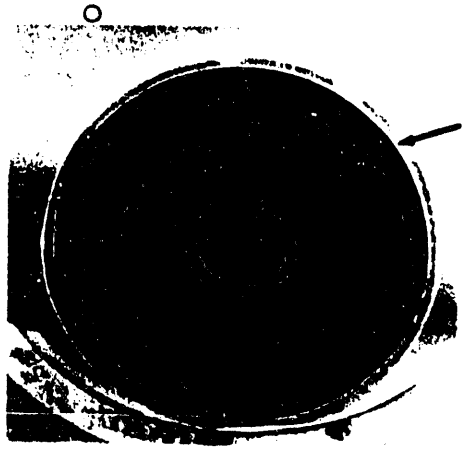


Neg. #11883 B 250X Mag.

Cathodic Etch

FIGURE 2

Photomicrographs of the Same Deep Pit (Sample 303 A 4) Showing Depth of Penetration.



Neg. #12252 A 1.5X Mag.

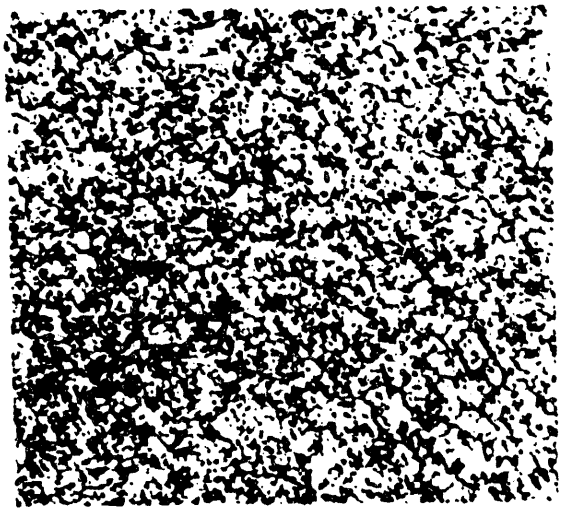
As Polished

Neg. #12314 B 75X Mag.

FIGURE 3

Photographs of Sample 303 A 5 A Showing Depth of Penetration had Reached the Uranium.

Neg. #11929 A 100X Mag.
Chemical Etch



Neg. #11931 B 250X Mag.
Chemical Etch

FIGURE 4

Photomicrographs Showing Typical Ni-Al Structure from the Pitted Side of the Fuel Element.

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