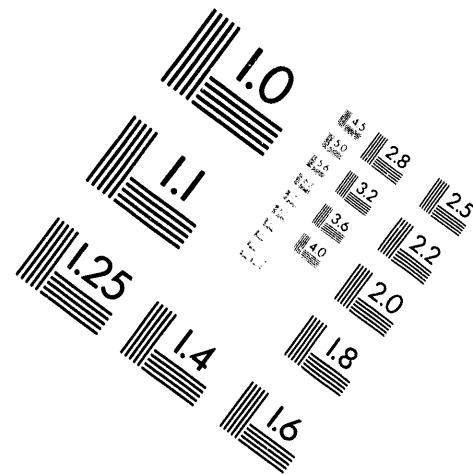
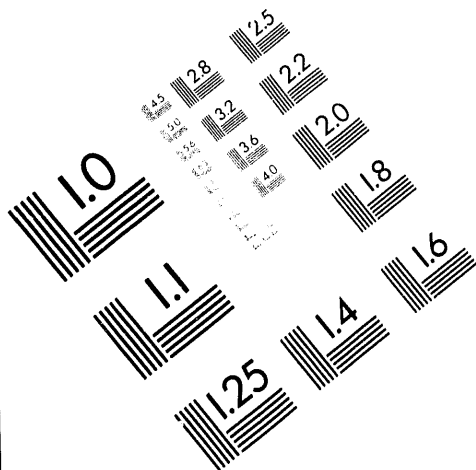




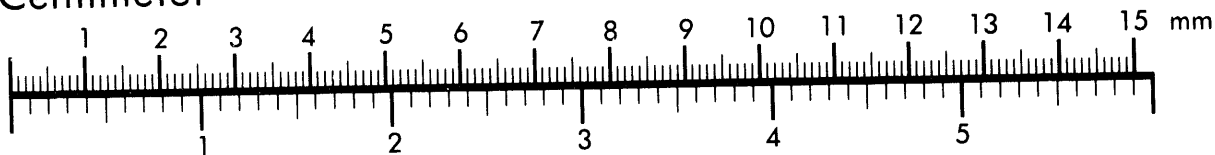
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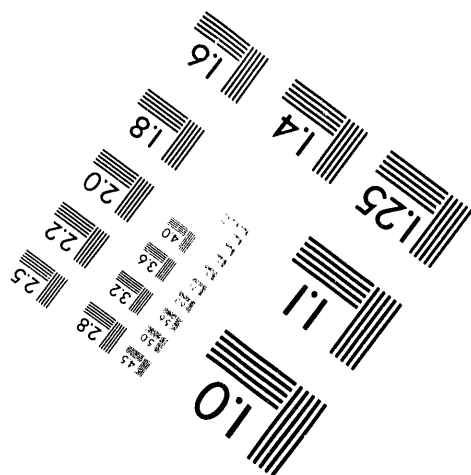
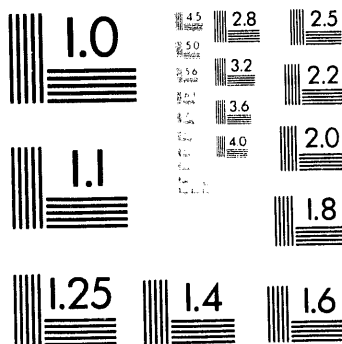
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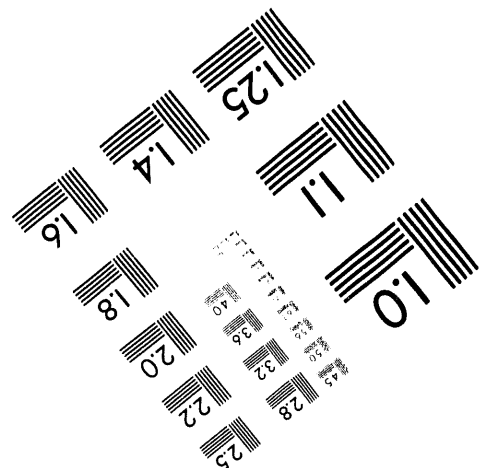
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POST IRRADIATION EXAMINATION OF SELF SUPPORT
ELEMENTS WITH SEVERE IN-REACTOR CLADDING CORROSION

(RM 425)

by

W.J. Gruber

Radiometallurgy Laboratory Operation
Materials Development Operation
REACTOR AND FUELS RESEARCH
AND DEVELOPMENT

August 28, 1961

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POST IRRADIATION EXAMINATION OF SELF SUPPORT ELEMENTS WITH SEVERE IN-REACTOR CLADDING CORROSION (RM425)

INTRODUCTION

Three self support, natural uranium, I & E production fuel elements, which exhibited serious in-reactor cladding corrosion were selected from several tubes of discharged pieces from PT-IP-272-A-FP. The elements were transferred to the Radiometallurgy Laboratory for detailed examination to determine thickness of the remaining cladding and measure any irradiation induced dimensional changes in the fuel cores.

Each element had four support tabs attached to each end and was from Parent Lot KE.009. The fuel geometry of all three was C IV NS.⁽¹⁾

Fuel Element Histories

Tube - Reactor	2264-C	2264-C	3869-C
Series and Piece #	50W-12	50W-16	52W-14
Date Charged	1/17/61	1/17/61	12/4/60
Date Discharged	4/17/61	4/17/61	4/17/61
Exposure (MWD/T)	686	686	1051
Tube Factor	1.183	1.183	1.242

SUMMARY AND CONCLUSIONS

Most of the corrosion occurred in the central one third of the elements between the sets of support tabs. However, localized ledging⁽²⁾ attack extended from the area of general corrosion to the cladding between the tabs at the ends of the elements. The surface area affected and the amount of cladding removed were

(1) Pre irradiation specifications, E-3-7360, Rev. 9 8/1/60

(2) HW 64590 Rev. 3, JM Fouts, Post Irradiation Fuel Element Examination Data March 3, 1961 - Unclassified

greater in the central portion, the depth of penetration being about 5 mils greater. The thickness of removed cladding averaged over the total external surface area was about 4 mils. The minimum and maximum remaining cladding observed were 26 and 43 mils excluding Al-Si. Corrosion in the spire was less with 52 mils maximum and 36 mils minimum of cladding remaining excluding Al-Si.

The average uranium OD increase was 10 mils and the average ID increase was 8 mils. Growth in the uranium was not uniform as the dimensions varied along the length.

DETAILS


The elements were visually examined and photographed as received (Fig. 1). Element 52W-14 contained a hot area at the male end. The corrosion occurred generally in the central portion of the elements with fingers of ledging attack extending toward the ends between the support tabs.

Each element was sectioned to remove three wafers; one from the midpoint and from 1.5 inches from each end. The sectioning lines are drawn in Fig. 1 and for reference the wafers from #50W-12 were prefixed A, those from 52W-14 were prefixed B, and those from 50W-16 were prefixed C.

The wafers were ground and polished to remove surface metal disturbed by sectioning. Optical measurements of the cladding OD, the uranium OD, the uranium ID, and the spire ID accurate to ± 0.003 inch were obtained. Two sets of measurements along perpendicular diameters were obtained from each wafer and appear in Table I.

External and internal cladding and Al-Si thicknesses were obtained by using a Filar eyepiece in the remote metallograph and appear in Table II.

Photographs of the wafers and the approximate locations where measurements were made are shown in Figure 2.


W. J. Gruber, Engineer
Radiometallurgy Laboratory

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TABLE I

WAFER	DIAMETER	CLADDING OD	URANIUM OD	URANIUM ID	SPIRE ID
A1 OD ₂	D1	1.491	1.410	.497	.388
	D2	1.493	1.413	.489	.385
A2 OD ₁	D1	1.493	1.411	.491	.390
	D2	1.500	1.418	.492	.392
A3 OD ₃	D1	1.493	1.403	.493	.394
	D2	1.502	1.417	.495	.395
B1 OD ₂	D1	1.489	1.402	.476	.372
	D2	1.516	1.432	.503	.393
B2 OD ₁	D1	1.497	1.418	.490	.387
	D2	1.506	1.419	.492	.389
B3 OD ₃	D1	1.492	1.403	.478	.374
	D2	1.520	1.425	.495	.390
C1 OD ₂	D1	1.502	1.414	.490	.386
	D2	1.503	1.422	.494	.390
C2 OD ₁	D1	1.501	1.414	.491	.391
	D2	1.523	1.434	.495	.392
C3 OD ₃	D1	1.505	1.415	.490	.384
	D2	1.516	1.425	.497	.392
(1)		1.502	1.416	.492	.388
(2)		1.500	1.406 ^{+.001} -.002	.484 ^{±.007}	.378 ^{±.003}

1. Average post irradiation reading

2. Pre-irradiation specifications. H-3-7350 Rev. 9

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TABLE II

External Cladding and Al-Si Thicknesses $\times 10^{-3}$ Inches

Wafer	*Maximum Thickness	*Minimum Thickness	Max. Al-Si Thickness	Min. Al-Si Thickness
A1	38.1	29.6	10.7	6.8
A2	39.4	34.8	12.5	5.3
A3	40.7	33.5	18.9	5.3
B1	43.0	27.6	17.6	3.2
B2	40.1	31.8	9.6	1.3
B3	41.8	25.5	13.1	4.0
C1	41.1	32.5	11.3	3.1
C2	41.9	38.4	9.4	3.6
C3	43.5	33.4	12.4	3.4

Spire and Al-Si Thicknesses $\times 10^{-3}$ Inches

Wafer	*Maximum Thickness	*Minimum Thickness	Max. Al-Si Thickness	Min. Al-Si Thickness
A1	43.4	37.7	27.3	7.5
A2	41.6	38.9	20.0	7.4
A3	41.0	39.5	19.9	7.7
B1	48.6	37.7	26.5	4.0
B2	41.5	36.1	16.1	12.4
B3	52.6	43.2	18.5	1.8
C1	45.1	40.5	21.3	2.2
C2	45.7	40.4	18.4	2.8
C3	47.1	40.9	16.7	2.6

*Cladding thickness readings do not include Al-Si.

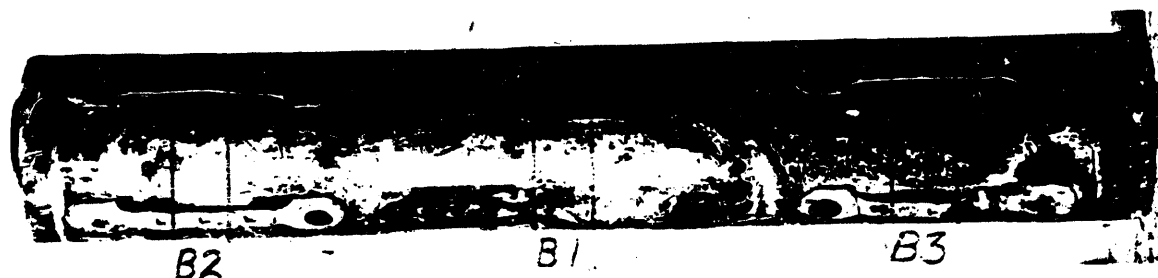
Figure 1
Fuel Elements As Received



Neg. A3307

Piece #50W-12

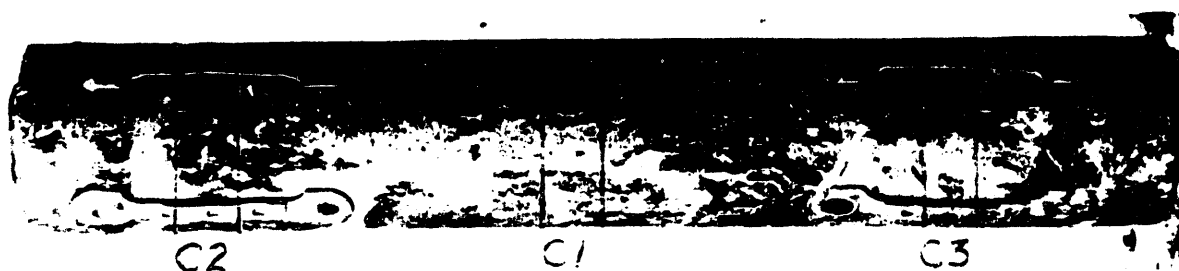
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Neg. A3312

Piece #52W-14

2/3X



Neg. A3316

Piece #50W-16

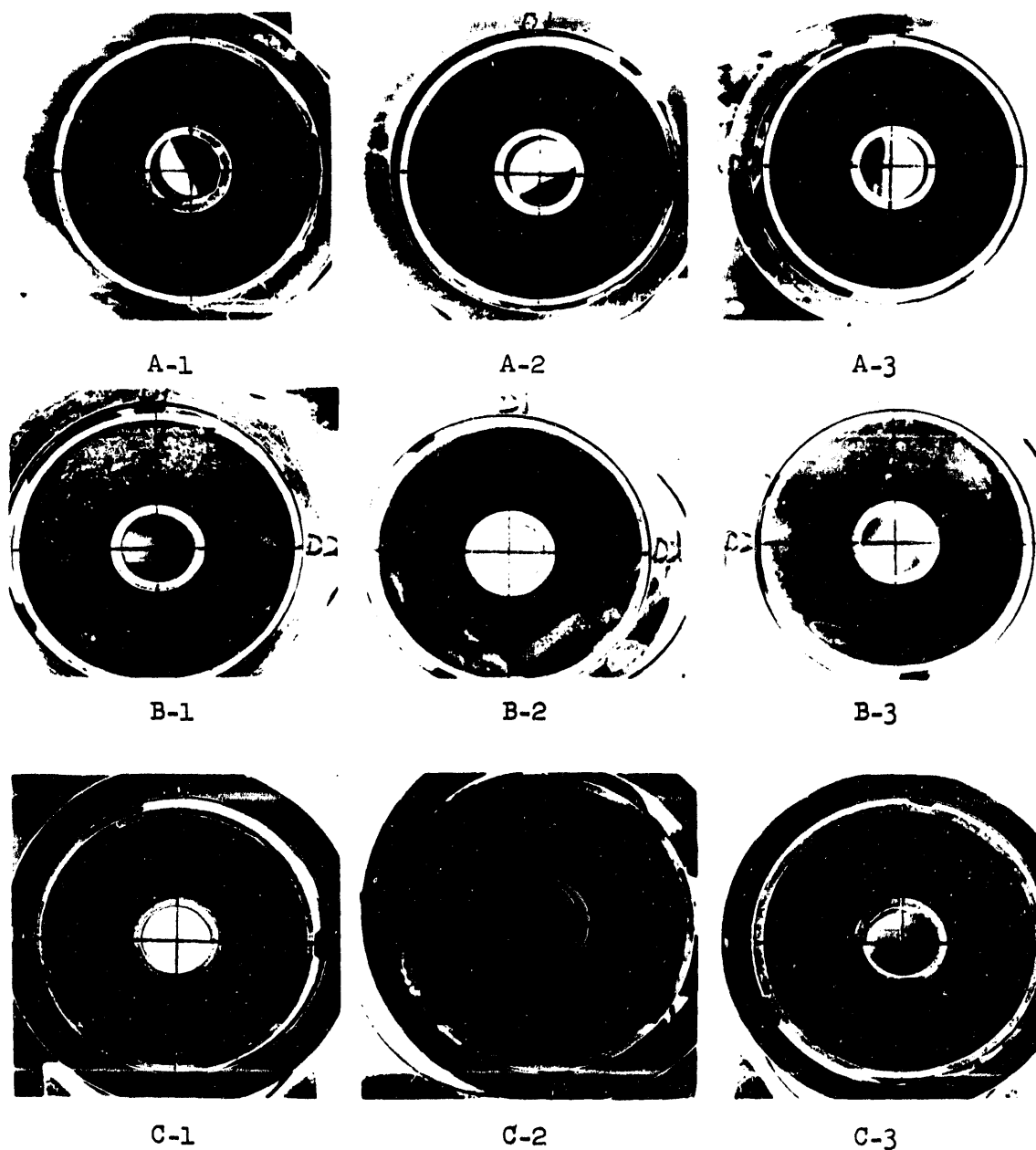
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The lines indicate where sections were made and the wafers were indexed for reference to the tables containing the dimensional data.

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Figure 2

The wafers from which the dimensional data were obtained.



The approximate location of the diameter where measurements were made were drawn. These correspond to the diameters listed in Table 1.

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