MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0361335 6

Cy. 4

CENTRAL RESEARCH LIBRARY
DOCUMENT COLLECTION

ORNL-2638
Chemistry-General
TID-4500 (14th ed.)

A TECHNIQUE FOR PREPARING NEPTUNIUM TARGETS OF UNIFORM CROSS SECTION

B. J. Massey

CENTRAL RESEARCH LIBRARY
DOCUMENT COLLECTION
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON
If you wish someone else to see this document, send in name with document and the library will arrange a loan.

OAK RIDGE NATIONAL LABORATORY
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

Printed in USA. Price 50 cents. Available from the

Office of Technical Services
U. S. Department of Commerce
Washington 25, D. C.

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission to the extent that such employee or contractor prepares, handles or distributes, or provides access to, any information pursuant to his employment or contract with the Commission.

ORNL-2638
Chemistry-General
TID-4500 (14th ed.)

Contract No. W-7405-eng-26

OPERATIONS DIVISION

A TECHNIQUE FOR PREPARING NEPTUNIUM TARGETS OF UNIFORM CROSS SECTION

B. J. Massey

DATE ISSUED

MAR 13 1958

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0361335 6

A TECHNIQUE FOR PREPARING NEPTUNIUM TARGETS OF UNIFORM CROSS SECTION

B. J. Massey

ABSTRACT

As a result of a request for targets of uniform cross section for determination of the fission cross section of neptunium, an evaporation technique was developed for preparing films of the desired uniformity. Despite the fact that neptunium is an alpha emitter, it was possible to contain the activity and to subsequently recover the neptunium.

PROCEDURE

The equipment used consisted of an LC-12A evaporator made by Consolidated Electrodynamics Corporation, which included a canned 10-rpm Bodine motor for rotating the targets during evaporation and which had a maximum distance of 6 in. between target and filament. The assembly, including a cluster of three target holders, is shown in Fig. 1.

Prior to the actual evaporations a uniformity test was made in which gold was evaporated on split disks and then each segment weighed. (Gold was used in this test because small quantities which would be deposited on the equipment would not interfere with the subsequent target preparation.) Since a cluster of targets was to be made, some disks were split perpendicular to the radius of rotation and others split on the radius. The average weight of the film formed on the segment was considered to be the weight at the center of the segment. The nonuniformity determined by this method was extrapolated to the periphery as shown in Fig. 2. Adjustments were made to the position of the disk in order to obtain equal deposits on each segment. The results obtained by this method agreed very well with uniformity determinations by alpha counting of the completed targets.

In order to facilitate the decontamination following evaporation, potassium chloride was evaporated in the system. Then platinum backings were carefully abraded, degassed, cleaned with a glow discharge, and placed in the target holder. The filament which had been used in the uniformity test, a seven-strand tungsten filament as shown in Fig. 3, was replaced with a new one, which was degassed and then charged with neptunium tetrafluoride. The filament was surrounded by a slotted glass tube to minimize the evaporation of neptunium in directions other than that desired. The neptunium tetrafluoride was slowly evaporated at a temperature of between 1000 and 1150°C and a pressure of 7×10^{-5} Torr (approximately equivalent to mm Hg). Before the targets were placed in the holder and after the evaporation, they were weighed on an Ainsworth microbalance.

RESULTS

Two groups of targets were made; for the first group, three evaporations were made and for the second group, four evaporations were made. The filament was recharged after each evaporation. Target data are given in Table 1.

Preparing the backing metal as described caused the neptunium fluoride to adhere tightly to the backing, as was evidenced by smear tests. A sample target was mounted in a brass holder which had not been previously treated. Following an evaporation both the target and the holder were smeared with paper; the amount of alpha activity removed is shown below:

	Alpha Activity Removed (counts/min)	
	From Target	From Holder
Paper pressed lightly, no motion	14	38
Wiped once	4	4650
Wiped twice at right angles	6	5360
Thorough, hard wiping	159	

On the target, thorough, hard wiping was required to remove a significant amount of alpha activity. On the holder, however, even a light wipe removed a significant amount.

DECONTAMINATION AND RECOVERY

All manipulations involving neptunium tetrafluoride were carried out on the base plate of the evaporator, thus confining gross contamination to the evaporator. The bell jar was placed on blotter paper spread on the floor when it was necessary to recharge the filament or to change the backing disks. This paper was used only

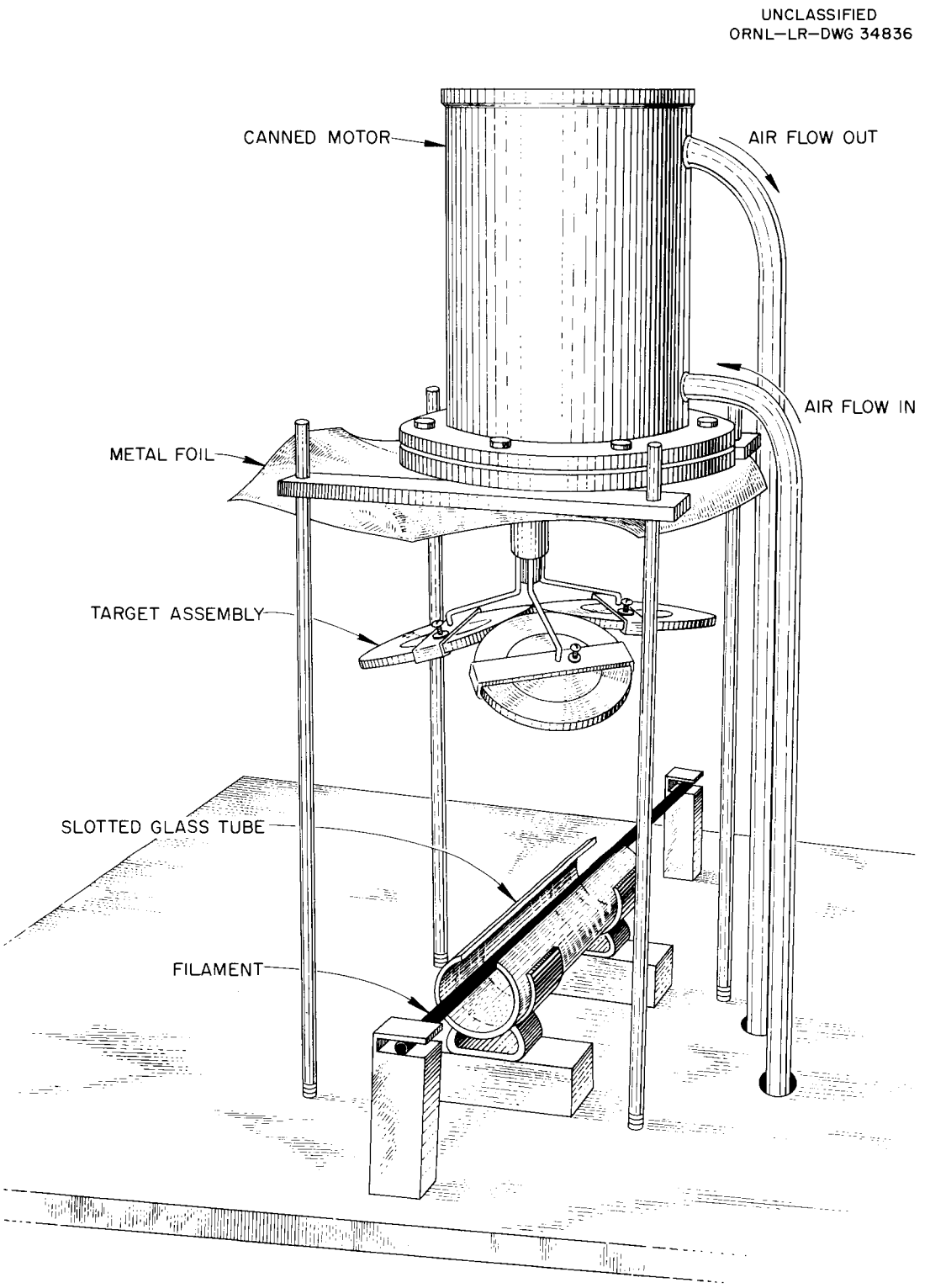

Fig. 1. Target Holder Assembly.

once, then discarded. Air counts made by Health Physics during typical operations showed no airborne activity.

Recovery of the neptunium tetrafluoride and decontamination of the equipment were done in a 4 × 4 × 7 ft plastic hood equipped with neoprene gloves (similar to a dry box). As a further precaution an air filter pad was placed over a hole in the top of the hood. Blotter paper was put around the evaporator to protect the floor. The hood was suspended from the ceiling and held against the paper with lead bricks. Air counts made by Health Physics showed no airborne activity during decontamination procedures.

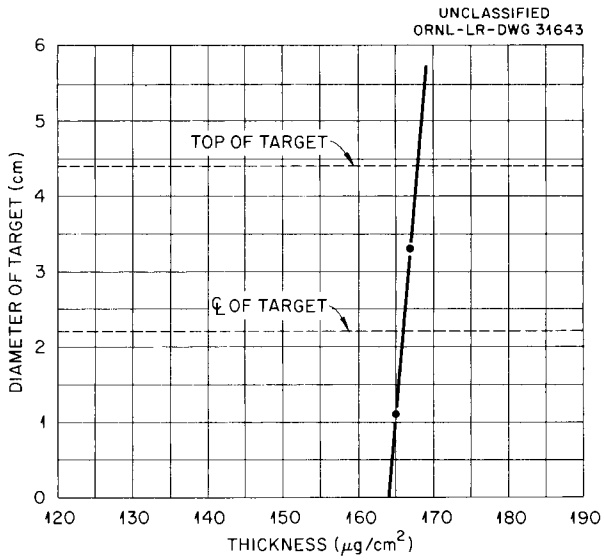

Fig. 2. Determination of Uniformity.

Following the first decontamination, smears were approximately 50,000 counts/min throughout the system. By repeated scrubbings of the assembly with Bab-O and then with citric acid–versenate solution, smear tests were reduced to 20 counts/min. Final decontamination was made with acetone and resulted in smears showing not over 2 counts/min over background. One small spot on the floor showed 24 counts/min. Smears were made of the entire building with negative results.

As a result of the precautions described above, 69% of the neptunium was recovered.

ACKNOWLEDGMENTS

The assistance of K. B. Campbell and J. C. Smith in doing the work and the constructive criticism of E. E. Beauchamp are gratefully acknowledged.

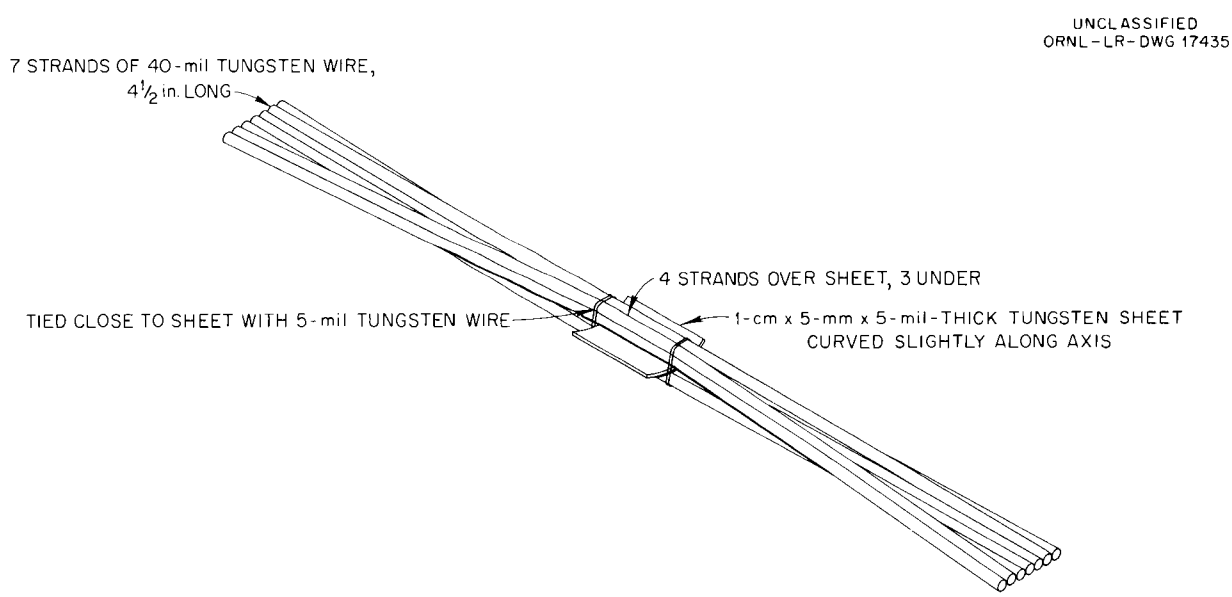

Fig. 3. Filament for Target Assembly.

Table 1. Target Data

Target Size (cm^2)	Weight (g)			Film Thickness (mg of NpF_4 per cm^2 of target)
	Gross	Backing	NpF_4 on Target	
		First Group of Targets		
15.52	15.499390	15.497345	0.002045	132
	15.780880	15.778910	0.001970	128
5.07	15.681035	15.680385	0.000650	128
		Second Group of Targets		
5.07	15.513490	15.511180	0.002310	455
	15.664130	15.661705	0.002425	478
15.52	15.421930	15.414615	0.007315	471

INTERNAL DISTRIBUTION

1. C. E. Center
2. Biology Library
3. Health Physics Library
4–5. Central Research Library
6. Reactor Experimental Engineering Library
7–26. Laboratory Records Department
27. Laboratory Records, ORNL R.C.
28. A. M. Weinberg
29. L. B. Emlet (K-25)
30. J. P. Murray (Y-12)
31. J. A. Swartout
32. E. H. Taylor
33. E. D. Shipley
34. S. C. Lind
35. M. L. Nelson
36. C. P. Keim
37. J. H. Frye, Jr.
38. R. S. Livingston
39. H. Schmidt
40. F. L. Culler
41. A. H. Snell
42. A. Hollaender
43. M. T. Kelley
44. K. Z. Morgan
45. T. A. Lincoln
46. A. S. Householder
47. C. S. Harrill
48. C. E. Winters
49. D. Phillips
50. D. S. Billington
51. J. A. Lane
52. M. J. Skinner
53. W. H. Jordan
54. G. E. Boyd
55. R. R. Dickison
56. P. M. Reyling
57. G. C. Williams
58. H. E. Banta
59. E. E. Beauchamp
60. H. E. Seagren
61. A. F. Rupp
62–86. B. J. Massey
87. ORNL Y-12 Technical Library, Document Reference Section

EXTERNAL DISTRIBUTION

88. Division of Research and Development, AEC, ORO
89–649. Given distribution as shown in TID-4500 (14th ed.) under Chemistry General category (75 copies – OTS)