

# Special Reference Material Report

GM 10

## Encapsulated Plutonium Heat Source

### Introduction

The enclosed encapsulated plutonium heat source provides a convenient measured standard for calorimeter calibration [1] in the calorimetric assay of plutonium-bearing solids. This report summarizes the NBS measurements made on this reference material. The reference material is produced and certified by the Mound Facility\*, Monsanto Research Corporation, Miamisburg, Ohio.

### Description of Source

This heat source, fabricated and calibrated at the Mound Facility, consists of a doubly encapsulated sample of plutonium-oxide. The sealing of both inner and outer capsules was carried out using documented and reproducible welding procedures. Nondestructive testing (radiography and He leak tests) was conducted to ensure the integrity of each capsule. Since the active materials are largely alpha-particle emitters, helium gas will accumulate within the inner capsule. The capsules have a conservative design life of five years. The lack of long-term compatibility and creep data for the materials of construction precludes the assignment of longer working lifetimes to the sources at this time. Therefore, it is strongly recommended that this source be returned three years from the date of receipt to the Mound Facility for reevaluation and recertification. This source should be handled with the normal precautions for alpha-particle emitters.

### Certification

This source was calibrated at the Mound Facility using Mound heat-flow calorimeters and electrical standards traceable to the National Bureau of Standards. A separate certificate issued by the Mound Facility accompanies this Reference Material. Accompanying that certificate are calibration results in the form of a computer printout and a microfiche giving the decay power calculated from these measurements, day-by-day, for a three-year period after the calibration. Also included are the physical parameters of the source including materials of construction and measured radiation dose rates.

Selected Mound plutonium heat sources similar to the one accompanying the Mound certificate have been independently measured in a precision Bunsen ice calorimeter at NBS.

\*Mound Facility is operated by Monsanto Research Corporation for the U.S. Department of Energy under Contract No. DE-AC04-76-DP00053.

(over)

### NBS Measurements on Mound Encapsulated Sources

Each measurement was made in a precision Bunsen ice calorimeter and reflects the average (unweighted) of at least 10 independent determinations of heat flux (power) for a single source. Three such measurements were carried out on Mound sources of nominal power, 0.23W, 1.5W, and 1.0W, and are summarized below. Sources 0.23 WB and 1.5 WB were measured in 1974 and are documented extensively in [2]. The 1.0 WK source was measured in 1979.

	<u>Mound Source Designation</u>		
	<u>0.23WB</u>	<u>1.5WB</u>	<u>1.0WK</u>
Mound Predicted Power <sup>a</sup> [W]	0.22544	1.44942	0.97027
NBS-Measured Power <sup>a</sup> [W]	0.22517	1.44936	0.96996
Number of NBS Measurements	16	19	11
$s_m^b$ [W]	0.00005	0.00004	0.00034
Estimated NBS Overall Uncertainty <sup>c</sup> [W]	0.0003	0.0007	0.0014

<sup>a</sup>Individual data for each source calculated for a single time mid-way through the measurements series for that source.

<sup>b</sup> $s_m$  = Computed standard deviation of the mean.

<sup>c</sup>Sum of maximum conceivable systematic errors and 99% confidence limits for the mean.

At NBS measurements were carried out by D. Ditmars of the Chemical Thermodynamics Division and at the Mound Facility by K. C. Jordan, Senior Research Specialist.

The technical and support aspects involved in the NBS measurements and issuance of this Special Reference Material Report were coordinated through the Office for Nuclear Technology by B.S. Carpenter and H.T. Yolken and through the Office of Standard Reference Materials by T.E. Gills.

Packaging and reshipment of this source to the Mound Facility for testing and recalibration must follow all applicable Department of Transportation, U.S. Department of Energy and/or U.S. Nuclear Regulatory Commission regulations. All shipments should be addressed to:

Group Leader  
Safeguards Research and Development  
Monsanto Research Corporation  
Mound Facility  
P.O. Box 32  
Miamisburg, Ohio 45342

[1] ANSI Standard N15.22-1975, "Calibration Techniques for the Calorimetric Assay of Plutonium-Bearing Solids Applied to Nuclear Materials Control", available from American National Standards Institute, 1430 Broadway, New York, New York 10018.

[2] D. Ditmars, Intl. J. Appl. Radiat. Isotopes 27, 469 (1976).