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IMPACT PROPERTIES OF PLUTONIUM 1% GALLIUM ALLOY

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HW-82486

June 30, 1964

IMPACT PROPERTIES OF PLUTONIUM 1% GALLIUM ALLOY

INTRODUCTION

This investigation was undertaken to determine the approximate impact characteristics of delta stabilized plutonium 1% gallium alloy, both at room temperature and at 325°C. The testing done was non-standard, primarily because some approximate information was desired for another purpose and immediately available materials were used. While the results reported herein should be considered preliminary, they clearly depict the ductile impact behavior of this alloy.

SUMMARY AND CONCLUSIONS

The work done consisted of two Charpy-type tests at 325°C and one at room temperature and two tensile impact tests at room temperature.

The Charpy-type impact tests were performed on unnotched 0.400 inch diameter rods. On all three tests, the rods simply bent to about 90° and were dragged through the anvil. A slight "orange-peel" appearance was noted on the front of the bend, but there was no cracking.

The tensile impact tests were performed on standard diameter (0.237") slightly short specimens. The samples failed with a ductile break requiring about 15 ft-lbs. Elongation was about 13% with reduction of area at the break about 30%.

These results indicate that delta stabilized plutonium 1% gallium is quite ductile at impact testing strain rates, both at room temperature and at 325°C.

DISCUSSION

The work reported and discussed herein consisted of five impact tests of as-cast delta stabilized plutonium 1% gallium alloy. The intent of the work was to quickly determine the general impact characteristics of this alloy. Consequently, immediately available material and molds were used to prepare the test samples.

The three Charpy-type test specimens were unnotched 0.400" diameter by 2-1/4" long rods (see Figures 1 and 2) machined from the remains of two standard 0.505" diameter tensile specimens tested on another program. Chemical analysis of this metal is shown below:

Al - 5 ppm	Fe - 725 ppm	Si - 5 ppm
Ca - 2 ppm	Mg - 5 ppm	C - 200 ppm
Cr - 5 ppm	Mn - 13 ppm	Ga - 0.98%
Cu - 30 ppm	Ni - 5 ppm	Density - 15.77 g/cc

Metallography showed a cored structure, typical of non-homogenized delta stabilized Pu-1% Ga alloy.

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The three specimens were tested in a Sonntag Universal testing machine using the standard Charpy test arrangement. The light hammer was used (60 ft-lb maximum, 17 ft/sec. striking velocity). Two of these specimens were heated to $325^{\circ}\text{C} \pm 2^{\circ}\text{C}$ in a bath of peanut oil. Temperature was indicated by an immersion mercury thermometer. The specimens were transferred to the machine and tested within three seconds. The third specimen was simply tested at room temperature.

Each of the three test specimens bent about 90° and pulled through the Charpy anvil, as shown on Page 4. There was no macroscopic cracking visible. The sample surfaces on the outside of the bends did show an "orange-peel" effect.

The two tensile impact specimens were cylindrical, of button head design, as illustrated on Page 4. The gage diameter was 0.237" and the gage length between shoulders was 2-3/16". The ends were 9/16" diameter with blended 45° cone tapers between the ends and the gage length. These specimens were recast from the Charpy test specimens. A Fiberfrax coated graphite mold preheated to about 450°C was used and the casting temperature was about 850°C . The test specimens were machined directly from the castings and no homogenizing heat treated was used. No further chemical analyses or metallographic examination was made.

The two tensile impact specimens were tested on the Sonntag Universal impact testing machine using the heavy hammer (100 ft-lb. maximum, 11 ft/sec. striking velocity). Test results are tabulated below:

	<u>Specimen No. 1*</u>	<u>Specimen No. 2</u>
Impact energy to failure	11 ft-lb.	16 ft-lb.
Elongation, in 2-3/16"	11%	14%
Reduction of Area	28%	31%

* Specimen No. 1 showed a distinct casting flaw in the fracture, and these results should therefore be considered as low.

In each case, the fracture was ductile, with a fine grained appearance.

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Plutonium Metallurgy Development

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Bent Impact Samples Tested at 325 °C

Bent Impact Sample Tested at Room Temperature

Tensile Impact Samples Tested at Room Temperature

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