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DATE 8/16/62 INIT.

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ALMD62081450206

August 16, 1962

Mr. Hank Weiss
University of California
Lawrence Radiation Laboratory
Livermore, California

Dear Hank:

The specific heat determination of the plutonium-one weight per cent gallium alloy has been completed from 100° to nearly 500°C. A graphical representation of the data is enclosed.

The specific heat values are in the same range as observed for unalloyed plutonium. The slight difference in the specific heat values above and below 397°C indicates that a phase transformation occurs at that temperature. This difference is very small, as has been reported between the various phases of unalloyed plutonium. The appreciable heat of transformation measured at 397° confirms that a first-order phase transformation occurs at that temperature. The temperature of the transformation measured by Mound DTA, 396°, and by the Mound calorimeter, 397°C, are in good agreement.

The heat values are given in terms of gram-atoms (gram-atoms plutonium plus gram-atoms gallium) so that the values are directly comparable to the most recent plutonium data given by Loasby of Aldermaston. In Table I the heats of transformation for unalloyed plutonium as measured by Loasby are listed together with the values determined in the Mound calorimeter. The agreement between the two determinations are quite good except for the delta-prime to epsilon value. In Table II the specific heats for the various phase in unalloyed plutonium are listed as determined by Loasby. These values have not been checked, as yet, in the Mound calorimeter.

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The scatter in the specific heat data for this alloy is caused by a known fault in the high temperature calorimeter. Consequently, the specific heat line above 400° has been drawn horizontally instead of with an upward slope as indicated from the two measurements at 425° and 495°. The difficulty with the calorimeter which causes scatter in the specific heat determinations will be corrected when the calorimeter is rebuilt during the next several months.

The heat of transformation is more precisely measured at present than the specific heat since the fault in the calorimeter does not bother the heat of transformation. The measured heat of transformation, 28 calories/gram-atom is remarkably close to the value reported for the delta to delta-prime, heat of transformation in unalloyed plutonium. The occurrence of delta-prime plutonium as low as 397° has never been reported in any alloy system, as far as I know.

As we discussed, the chemical purity of these samples should be determined before any further speculations are made regarding the transformation at 397°. Further examination of the DTA trace which I sent you gives evidence that the sample contains some impurities which lowers the beginning of the melting reaction to 623°, 17° below the melting point of plutonium. Neither the lowering of the melting point nor the 397° phase transformation are reported in LA-2312, which was probably accomplished with very high purity plutonium. As time permits we will analyze the alloy samples which were sent here, but our analytical group is not familiar with this alloy so that it may take them a month to get time to develop a procedure for this material. Further examination of the material for inclusions by use of the electron micro-probe x-ray analyzer is desirable, but this instrument is out of operation for about a month while a new scanner system is being added. Analytical results will come slowly, therefore, but I will let you know when any significant results are obtained.

If you wish any further interpretation of the data or the data presented in a different manner, please let me know.

This project has been very interesting, and I would like to be kept informed regarding the other examinations which are being made on this alloy. We are sending this data to J. Willging and F. Schonfeld.

Very truly yours,
Original Signed By
L. J. WITTENBERG

L. J. Wittenberg
Section Leader
Reactor Fuels Section

LJW:clt

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SPECIFIC HEAT OF Pu - 1 W/O Ga. ALLOY

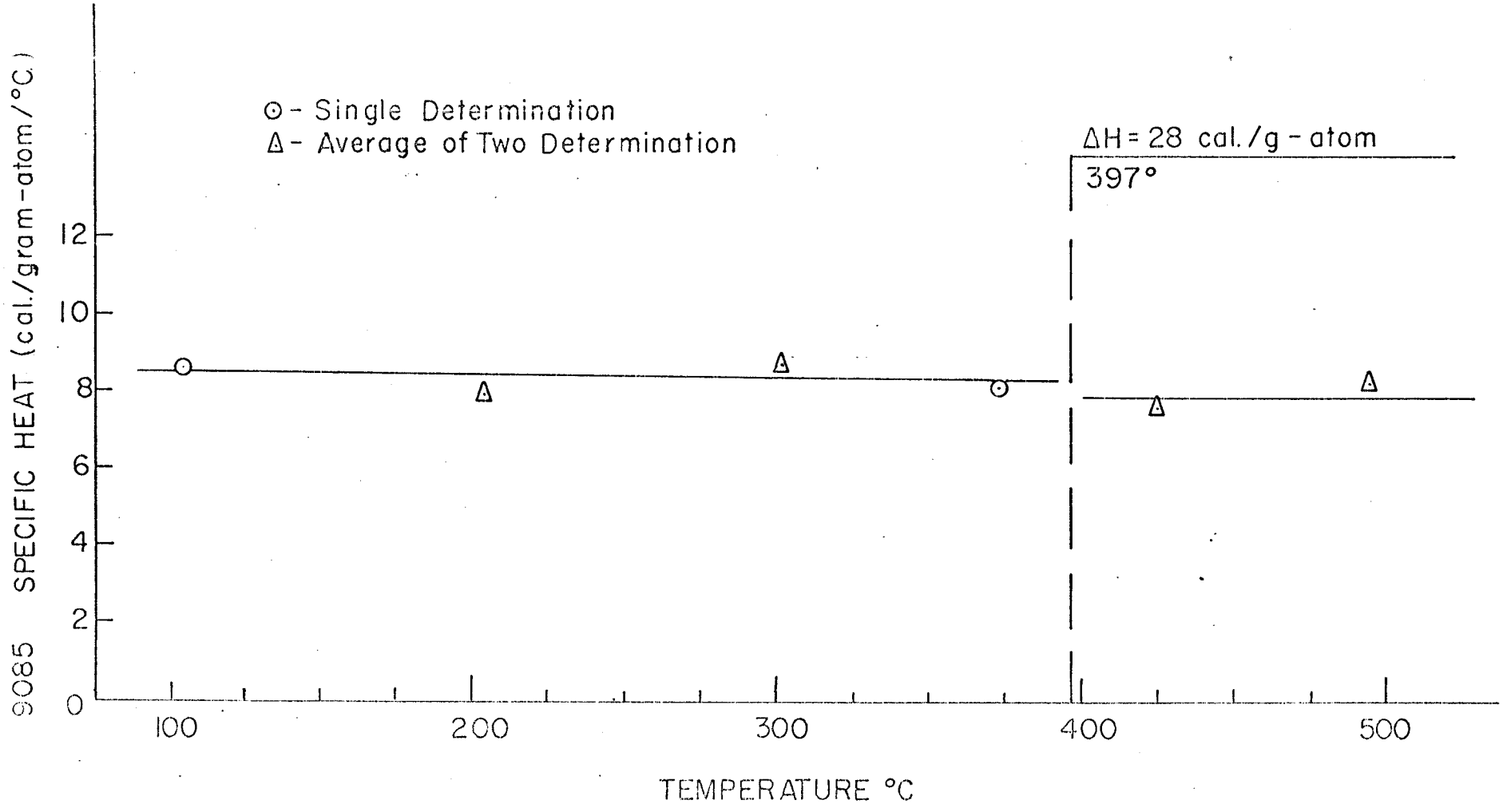

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TABLE I

LATENT HEATS OF TRANSFORMATION IN UNALLOYED PLUTONIUM

Phase transformation	Temperature (°C)	Heat of transformation (cal/g atom)	
		Loasby	Mound
α-β	119	803±10	813
β-γ	204	152±15	123
γ-δ	311	125± 5	140
δ-δ'	458	20±10	17
δ'-ε	480	444±10	309
ε-Liq	638	693±10	---

TABLE II

SPECIFIC HEAT OF THE PHASES IN UNALLOYED PLUTONIUM

Phase	Temperature (°C)	Specific heat (cal/g atom)
α	30	8·6
	100	9·0
β	140	8·3
	190	8·4
γ	220	8·6
	250	8·8
	300	9·6
δ	330	9·0
	420	9·0
δ'	No true values	
ε	490	8·4
	600	8·4
Liquid	650	9·9
	675	10·0