275557

TECHNICAL DIVISION
SAVANNAH RIVER LABORATORY

DPST-89-372
GENERAL PURPOSE HEAT SOURCE
IRIDIUM WELDING
RETENTION TIME - 10 YEARS

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Derivative Classifier

MEMORANDUM

TO: R. F. MEADORS, 703-F
SEPARATIONS TECHNOLOGY DEPARTMENT

FROM: W. R. KANNE, 773-42A WRK
MATERIALS TECHNOLOGY DIVISION

GPHS URANIUM OXIDE ENCAPSULATIONS SUPPORTING SATELLITE SAFETY TESTS (U)

SUMMARY

General Purpose Heat Source (GPHS) simulant-fueled capsules were assembled, welded, nondestructively examined, and shipped to Los Alamos National Laboratory (LANL) for satellite safety tests. Simulant-fueled iridium capsules contain depleted uranium oxide pellets that serve as a stand-in for plutonium-238 oxide pellets. Information on forty seven capsules prepared during 1987 and 1988 is recorded in this memorandum along with a description of the processes used for encapsulation and evaluation. LANL expects to use all capsules for destructive safety tests, which are under way. Test results so far have demonstrated excellent integrity of the Savannah River capsule welds, Reference 1.

INTRODUCTION

Los Alamos National Laboratory performs explosion, fragment, and impact tests on simulant-fueled GPHS capsules supplied to them by the Savannah River Laboratory. Tests are necessary to demonstrate containment in the event of a launch vehicle explosion or other failure causing return of plutonium to the earth's surface. Tests are conducted at high temperature to measure the integrity of capsules at accident conditions:

Explosion Test -	a detonation near the capsules simulating a space shuttle explosion
Fragment Test -	space shuttle parts, such as aluminum fragments, are fired at the capsules
Impact Test -	capsules are driven onto a hard surface at high velocity simulating earth impact of capsules

Thirty nine of the capsules reported in this memo are being used by LANL for safety verification tests in support of the upgraded Galileo mission to Jupiter. Until the Challenger explosion in early 1986, the launch of the Galileo satellite by the space shuttle was scheduled for May of 1986. The Challenger explosion caused postponement of the mission and redesign of the satellite system. The explosion also caused a rethinking of the safety tests for the mission. The Galileo satellite is now scheduled for launch in October 1989. Two Radioisotopic Thermoelectric Generators will supply electrical power for the instruments in the satellite. Each RTG contains 72 plutonium oxide pellets fabricated and then encapsulated in iridium shells in the Savannah River Plutonium Fuel Form (PuFF) Facility. This mission will be the first NASA application of production from the PuFF facility. The Galileo satellite will be followed a year later by the launch of the Ulysses satellite with one RTG, also containing pellets fabricated and encapsulated at Savannah River, for exploration of the sun from a polar orbit.

Eight of the test capsules will be used to confirm acceptability of a new iridium fabrication process developed at the Oak Ridge National Laboratory, Reference 2 . LANL will perform impact tests to supplement previous results from Mound and Savannah River (References 3 & 4 , respectively) that indicate the new process is acceptable.

The uranium oxide pellets were encapsulated in a specially equipped facility in the Equipment Engineering Division, Building 723-A. The production facility, Building 235-F, for encapsulating plutonium-238 oxide pellets is presently in stand-by.

Previously, 61 uranium oxide pellets, reported in References 5 & 6, were encapsulated for use in the initial Safety Verification Tests to support Galileo and Ulysses missions.

WELDING PROCESS

A permanent welding station was set up in Cubicle G of Building 723-A. This station consisted of equipment used for previous encapsulations performed in Building 322-M. A Multihundred Watt welding fixture modified to accommodate the cylindrical GPHS shape was used. The welding fixture was covered with a plexiglass box, with a glove port, to provide containment of a helium atmosphere during assembly and welding of the capsules. Oxygen content of the box was continuously monitored using a Teledyne Oxygen Analyzer. A Merick TXR-100 programmable power supply with an Amp Trak V controller provided sequenced welding current. Electromagnetic arc oscillation was provided by a Cyclomatic Model 90A four-pole oscillator. Welding current was monitored by a Hewlett-Packard Model 3490A Multimeter connected to a shunt within the power supply. The current sequence was recorded on a high speed Hewlett-Packard Model 7402A recorder.

To accommodate the slight radioactivity of the depleted uranium oxide, the cubicle was designated a temporary regulated area while the encapsulations were in progress. The uranium oxide pellets were hard and refractory and no contamination was ever detected in the room during Health Protection monitoring. It was interesting to note that the commercial 2% thoriated welding electrodes set off the radiation monitors in a similar fashion to the uranium oxide pellets. Health Protection requirements are given in Appendix A.

Welding conditions were chosen to produce welds equivalent to those made for encapsulation of plutonium-238 oxide pellets in the PuFF production facility, Reference 7. A summary of parameters for the uranium oxide encapsulations is given in Table I. The step by step procedure used to weld the iridium capsules containing uranium oxide pellets is given in the appendix B. Appendixes A and B are taken from Reference 8.

Mound Facility supplied the iridium shells. "Old process" shells were used for capsules to be tested at LANL for the Galileo Safety Verification Program. "New process" shells were used for capsules to be tested as part of the qualification of the new iridium fabrication process. LANL supplied the uranium oxide pellets. Identification of shell numbers, pellet numbers and shell type with assembled capsule numbers is provided in Table II.

All welding went routinely with one exception. An electronic irregularity caused the welding chuck not to rotate during one of the welds. A large molten spot developed before the the welding current was stopped. Rewelding of the capsule could not completely repair the defect. No other capsules were welded until correction of the problem was confirmed by repetitive test welds on a tungsten test piece. The capsule with the reject weld is Q-21 and is noted in Table III. LANL plans to use the capsule in a nonsensitive position in their test matrix.

One set of completed capsules is shown in Figure 1.

NON DESTRUCTIVE EXAMINATION

All capsules were examined for defects by: visual examination, weld measurements, a helium leak test, a bubble test, and an ultrasonic test. Results of these examinations are recorded in Table III. Visual examination included inspection of welds at 30x magnification with a binocular microscope for any cracks or pores, and for the presence of a normal oscillation pattern (0.015 in. oscillation spacing). Irregularities are noted in the footnotes of Table III.

Measurements included weld beadwidth and capsule diameter. Beadwidth measurements were made using a telescope while the capsule remained in the welding chuck. Beadwidth limits for production capsules are 0.080 to 0.120 inch (Reference 7) and a preferred range is 0.090 to 0.100 inch. (Narrow welds run the risk of a lack of penetration and wide welds have a large grain structure that results in reduced impact strength.) All capsules met production limits as indicated by the average readings listed in Table III. Capsule diameters were checked by a series of three ring gages. The production requirement is that each capsule pass through a 1.090 inch ID ring gage. One capsule in this series had an OD of 1.091 inch as shown in Table III. (Oversize diameters are usually due to a bulge in the weld overlap that is unacceptable due to a thinning of the wall in the bulge.)

Capsules were helium leak tested to less than 10^{-8} atm cc/sec by personnel qualified to level I or above (production requirement is less than 10^{-7} atm cc/sec). Capsules contained a small quantity of helium at atmospheric pressure from the assembly and welding atmosphere. Several capsules did not meet the leak rate criterion due to preexisting leaks in the iridium shells. The capsule with a reject weld passed the helium leak test only because all the helium was pumped out of the capsule before being monitored by the mass spectrometer (thus highlighting the importance of the bubble test discussed below).

Bubble testing was performed by suspending capsules in ethylene glycol in a Plexiglas chamber, evacuating with a vacuum pump, and visually observing any bubbles. Leaks of a moderate size could thereby be determined and located. As noted in Table III, one capsule leaked through the reject closure weld discussed in the previous section and one capsule leaked through the edge of the decontamination cover on the top of the capsule.

Ultrasonic testing was performed using a process developed by EED, Reference 9, to detect internal cracks that were initially found in production capsules, Reference 10. Sensitivity of the ultrasonic testing was improved early in this program, as noted in Table III, resulting in higher readings than had been seen previously.

DESTRUCTIVE EXAMINATION

Four capsules were welded for routine destructive evaluation to optimize welding conditions and confirm satisfactory welds. Examination of the internal bead on the first test weld (Q-1) showed marginal bead width at the well overlap as shown in Figure 2A. The weld current during the post-weld taper was increased to alleviate this potential problem and a smooth internal bead width was seen at the weld overlap in the remaining three test welds. Full penetration was present in all four test welds.

An irregularity that occurs occasionally in production welds was observed in capsule Q-2. Figure 2B shows the adherence of the weld shield to the weld bead at one location. The weld shield is a 0.005 inch thick foil of iridium that is positioned inside the weld area to shield the pellet from the weld heat. As far as we know weld integrity remains satisfactory in spite of this occasional adherence of the weld shield.

One capsule had a crack in the weld underbead that is typical of occasional cracks that occurred in production capsules, Reference 10. This crack is shown in Figure 3. An ultrasonic indication was present at this crack, and at several other locations.

Other than the irregularities noted above, metallographic sectioning of the welds showed typical microstructures. Typical face and transverse sections of the welds are shown in Figures 4 and 5. Routine data from the test welds is listed at the ends of Tables II & III.

CONCLUSIONS

1. Forty seven capsules were assembled, welded, nondestructively examined, and shipped to the Los Alamos National Laboratory for their use in support of the General Purpose Heat Source program.

2. All capsules are satisfactory for use by LANL.

3. Destructive examination of four capsules in the series showed the basic integrity of the welds and the nature of some defects which have been inherent in the PuFF production process.

This report completes work on RPTA's 1276-S and 1318-S. A final set of encapsulations, previously scheduled for the fourth quarter of 1988, was postponed indefinitely by Los Alamos due to technical difficulties fabricating special iridium shells.

REFERENCES

1. T. G. George, Los Alamos National Laboratory, Private Communication, February, 22, 1989.

2. R. L. Heestand, G. L. Copeland, and M. M. Martin, "A Consumable Arc-Melting, Extruding, and Rolling Process for Iridium Sheet", ORNL-6270, Oak Ridge National Laboratory, Oak Ridge, TN, 1986.

3. M. A. Forest, J. R. McDougal, and R. W. Sayor, "General Purpose Heat Source (GPHS) Clad Vent Set (CVS) Formability Study", MLM-3395, Mound Laboratory, Miamisburg, OH, November 3, 1986.

4. W. R. Kanne, "Weldability of General Purpose Heat Source New Process Iridium", US DOE Report DP-1748, May 1987.

5. W. R. Kanne to T. G. George/R. Zocher, "GPHS Uranium Oxide Encapsulations", EED840351, November 27, 1984.

6. W. R. Kanne to J. T. Buckner, "GPHS Uranium Oxide Encapsulation II", EED860328, November 25, 1986.

7. "Setting up Cell 6 Welder for Iridium Encapsulation of GPHS pellets" and "Iridium Encapsulation of GPHS Pellets", DPSOL 235-F-PuFF-4610, Rev. 11 & 4610A, Rev. 8, December 1983.

8. W. R. Kanne, "Handling, Welding, and Testing of GPHS Capsules Containing Depleted Uranium Oxide Pellets", EED Special Procedure No. 246, April 9, 1987, Rev. 10/1/87.

9. M. W. Tarpley / R. S. Peters to G. W. Wilds, "Proposed Nondestructive Test Procedure for GPHS Iridium Shells", June 15, 1981.

10. W. R. Kanne, "Welding Iridium Heat Source Capsules for Space Missions", Welding Journal, p. 17-22, August 1983.

ACKNOWLEDGMENTS

Welding, examination, and leak testing of the capsules reported in this memo were performed by E. B. Hartzog of the Equipment Engineering Division. Ultrasonic testing was performed by R. J. Tunstall under the direction of B. D. Howard. Instrumentation support was provided by R. F. Eakle. Metallographic sections were prepared by the EED Metallographic Laboratory.

TABLE I
WELDING PARAMETERS FOR GPHS SIMULANT-FUELED IRIDIUM CAPSULES

Chuck rotation speed, rpm	8 (within 1 sec. over 16 revolutions)
Torch gas type	He-25%Ar
Torch gas flow, cfh	40 on He flow meter (at 30-50 psig)
Welding atmosphere	Helium (<150 ppm oxygen)
Arc gap, in.	0.035 - 0.040
Electrode type	1/8 in. dia. 2% thoriated tungsten
Electrode protrusion	1/8 inch beyond gas cup
Electrode position	Horizontal, normal to surface, center 0.010 in above weld joint
Torch type	HW-9 (Linde)
Gas cup size	5
Oscillator position	Probe tips at gas cup tip
Oscillator Model 90A settings	
Positions 1&2, shaping	Centered (vertical up)
Frequency, Amplitude 1	Completely clockwise
Amplitude 2	30° below left horizontal
Tack weld starting positions	120° & 240° beyond notches
Girth weld starting position	0.060 inch (5.8°) beyond notches (0.4 inch beyond chuck zero mark)

Controller settings on TXR-100:

		TACK WELD	GIRTH WELD
Currents, A:	PREHEAT	55.0	55.0
	WELD	74.0	88.5
	TAPER	22.0	22.0
	POSTHEAT	22.0	22.0
Time, sec:	PREHEAT	0.60	0.60
	INITIAL SLOPE	0.00	0.00
	WELD	0.37	7.10
	TAPER	0.00	2.95
	FINAL SLOPE	0.00	0.00
	POST HEAT	0.00	0.00

TABLE II
CAPSULE IDENTIFICATION

Capsule No.	Pellet No.	Top Shell No.	Bottom Shell No.	Shell Type
Q-3	871-02	B1-5-1	B2-4-1	New Process
Q-4	871-03	B1-6-1	B1-3-2	New Process
Q-5	871-04	B1-6-6	B1-6-4	New Process
Q-6	871-05	B2-3-3	B1-5-3	New Process
Q-8	871-06	B2-3-7	B1-6-8	New Process
Q-9	871-07	B2-4-6	B2-3-5	New Process
Q-10	871-08	B1-3-4	B2-4-3	New Process
Q-11	871-09(a)	B4-5-2	B1-5-7	New Process
Q-12	871-10	Z558-6	Z555-4	Old Process
Q-13	871-11	Z545-4	Z539-5	Old Process
Q-14	871-12	Z543-5	Z510-5	Old Process
Q-15	J-5	ZR589-1	ZR589-4	Old Process
Q-16	J-11	ZR589-6	Z551-1	Old Process
Q-17	J-13	ZR581RR2	ZR587-3	Old Process
Q-18	J-14	ZR587-6	Z556-4	Old Process
Q-19	J-16	ZR573-2	ZR568-3	Old Process
Q-20	J-18	ZR587-2	ZR590-3	Old Process
Q-21	J-20	Z555-1	Z556-6	Old Process
Q-22	J-21	Z551-2	Z551-3	Old Process
~~Q-23~~	~~J-23~~	~~Z551-6~~	~~Z551-5~~	~~Old Process~~
Q-25	J-26	Z564-2	TR134-2	Old Process
Q-26	O-1	Z564-4	TR134-4	Old Process
Q-27	O-2	Z564-6	YR430-1	Old Process
Q-28	O-3	Z565-5	YR430-5	Old Process
Q-29	O-4	ZR566-1	ZR566-2	Old Process
Q-30	O-5	ZR566-5	ZR567-1	Old Process
Q-31	O-6	ZR567-4	ZR568-1	Old Process
Q-32	O-7	ZR568-2	ZR568-4	Old Process
Q-33	O-8	TR134-5	Z564-3	Old Process
Q-34	O-9	YR430-2	Z556-3	Old Process
Q-35	O-10	ZR569-4	ZR569-3	Old Process

a) Pellet has crack

TABLE II, Cont.
CAPSULE IDENTIFICATION

Capsule No.	Pellet No.	Top Shell No.	Bottom Shell No.	Shell Type
Q-36	O-11	XR359-1	XR371-4	Old Process
Q-37	O-12	XR360-2	XR371-6	Old Process
Q-38	O-13	XR362-1	XR373-1	Old Process
Q-39	O-14	XR362-3	XR373-5	Old Process
Q-40	O-16	XR365-3	XR375-2	Old Process
Q-41	O-17	XR366-2	ZR591-6	Old Process
Q-42	B-14	XR366-3	ZR592-2	Old Process
Q-43	B-18	XR367-4	ZR596-5	Old Process
Q-44	B-21	XR368-3	XR358-3	Old Process
Q-45	B-22	XR371-3	XR360-3	Old Process
Q-46	B-29	XR372-1	XR362-2	Old Process
Q-47	B-30	XR373-2	XR363-1	Old Process
Q-48	B-31	XR375-1	XR366-1	Old Process
Q-49	D-19	ZR592-1	XR368-1	Old Process
Q-50	D-23	ZR592-3	XR369-1	Old Process
Q-51	D-24	ZR597-1	XR369-5	Old Process
Q-1*	Alumina	X324-5	Y402-6	EWO**
Q-2*	871-01	X308-1	X332-2	EWO**
~~Q-7*~~	~~Alumina~~	~~B1-5-5~~	~~Z539-4~~	~~Mixed~~
Q-24*	Alumina	B4-2-1	Z559-5	Mixed

* Test Weld for Destructive Examination
** For Evaluation Weld Only

TABLE III

CAPSULE EVALUATION DATA

Capsule No.	1.190" Ring Gage	Average[a] Beadwidth (inch)	Bubble Test	Helium[b] Leak Test	Ultrasonic[c] Test
Q-3	PASS	0.108	OK	OK	0
Q-4	NO PASS[d]	0.102	LEAK[e]	LEAK	~130
Q-5	PASS	0.100	OK	OK	0
Q-6	PASS	0.098	OK	OK	0
Q-8	PASS	0.101	OK	OK	230 [f]
Q-9	PASS	0.105	OK	OK	110
Q-10	PASS	0.104	OK	OK	150
Q-11	PASS	0.104	OK	OK	190
Q-12	PASS	0.099	OK	OK	90
Q-13	PASS	0.097	OK	OK	140
Q-14	PASS	0.098	OK	OK	140
Q-15	PASS	0.098	OK	OK	0.0
Q-16[g]	PASS	0.098	OK	OK	84
Q-17	PASS	0.098	OK	OK	123
Q-18	PASS	0.097	OK	OK	85
Q-19[g]	PASS	0.094	OK	OK	80
Q-20[g]	PASS	0.097	OK	OK	77
Q-21[h]	PASS	0.087	LEAK	OK	NOT TESTED
Q-22	PASS	0.091	OK	OK	140
Q-23	PASS	0.093	OK	OK	150
Q-25	PASS	0.100	OK	OK	200
Q-26	PASS	0.098	OK	OK	200
Q-27	PASS	0.099	OK	OK	180
Q-28	PASS	0.098	OK	OK	0
Q-29	PASS	0.097	OK	OK	200
Q-30	PASS	0.096	OK	OK	150
Q-31	PASS	0.099	OK	OK	200
Q-32	PASS	0.102	OK	OK	200
Q-33	PASS	0.100	OK	OK	200
Q-34[i]	PASS	0.096	OK	LEAK	0
Q-35[j]	PASS	0.096	OK	OK	77

********* FOOTNOTES SEE PAGE 13 ****************

TABLE III, Cont.
CAPSULE EVALUATION DATA

Capsule No.	1.190" Ring Gage	Average[a] Beadwidth (inch)	Bubble Test	Helium[b] Leak Test	Ultrasonic[c] Test
Q-36	PASS	0.104	LEAK[k]	LEAK[k]	147
Q-37	PASS	0.103	OK	OK	200
Q-38	PASS	0.096	OK	OK	108
Q-39	PASS	0.103	OK	OK	170
Q-40	PASS	0.103	OK	OK	168
Q-41	PASS	0.099	OK	OK	215
Q-42	PASS	0.100	OK	OK	177
Q-43	PASS	0.098	OK	OK	243
Q-44	PASS	0.098	OK	LEAK[l]	256
Q-45	PASS	0.099	OK	OK	235
Q-46	PASS	0.097	OK	OK	94
Q-47	PASS	0.093	OK	OK	126
Q-48	PASS	0.092	OK	OK	133
Q-49	PASS	0.094	OK	OK	44
Q-50	PASS	0.094	OK	OK	108
Q-51	PASS	0.093	OK	OK	122
Q-1*	PASS	0.094	OK	OK	0
Q-2*	PASS	0.102	OK	OK	0
Q-7*	PASS	0.094	LEAK[m]	LEAK	N/A
Q-24*	PASS	0.100	LEAK[m]	LEAK	227

* Test Weld for Destructive Examination

********* FOOTNOTES SEE PAGE 13 ****************

FOOTNOTES FOR TABLE III:

a) Average of four measurements 90° apart.

b) Capsules tested to a sensitivity of less than 10^{-8} cc/sec helium.

c) Maximum reading in weld area as a percent of 0.006 inch deep standard notch.

d) 1.191 inch diameter at bulge in weld.

e) Leak of approximately 10^{-3} cc/sec through decontamination cover.

f) UT sensitivity improved before Q-8.

g) Weld depression at ~45°.

h) Reject capsule. Capsule did not rotate during welding causing molten spot. Cracks in spot after rewelding.

i) Leak of 2.7×10^{-6} cc/sec He measured. Mound reported a leak of 1×10^{-6} cc/sec He in shell YR430-2.

j) Visible crack on compound radius of shell ZR569-3. Crack noted by Mound.

k) Leak through edge of decontamination cover. Leak rate too large to read on helium leak detector. Leak rate of 1×10^{-6} (background) reported by Mound for shell XR359-1.

l) Leak of 1.2×10^{-7} cc/sec in unknown location. Leak rate of 1.1×10^{-8} (background) reported by Mound for shell XR 368-3.

m) Leak through shell outside of weld.

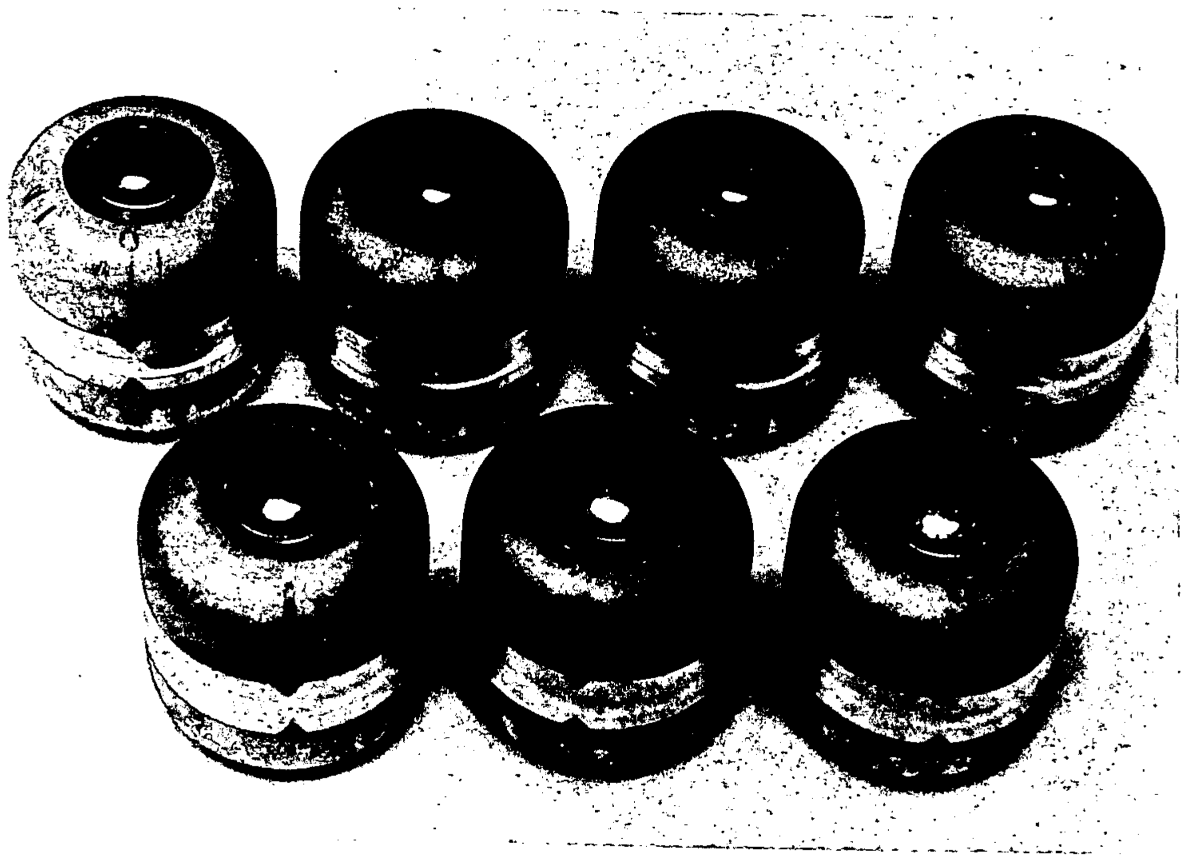
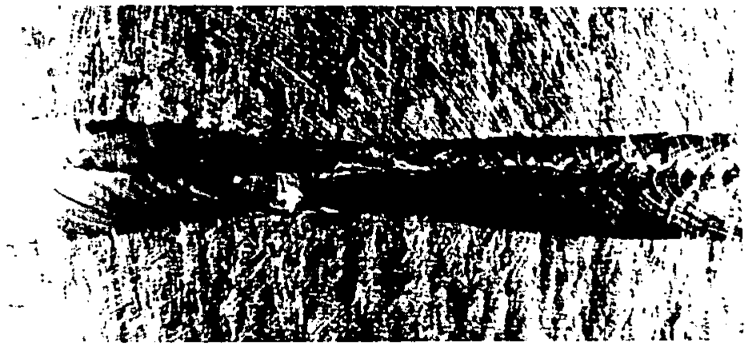
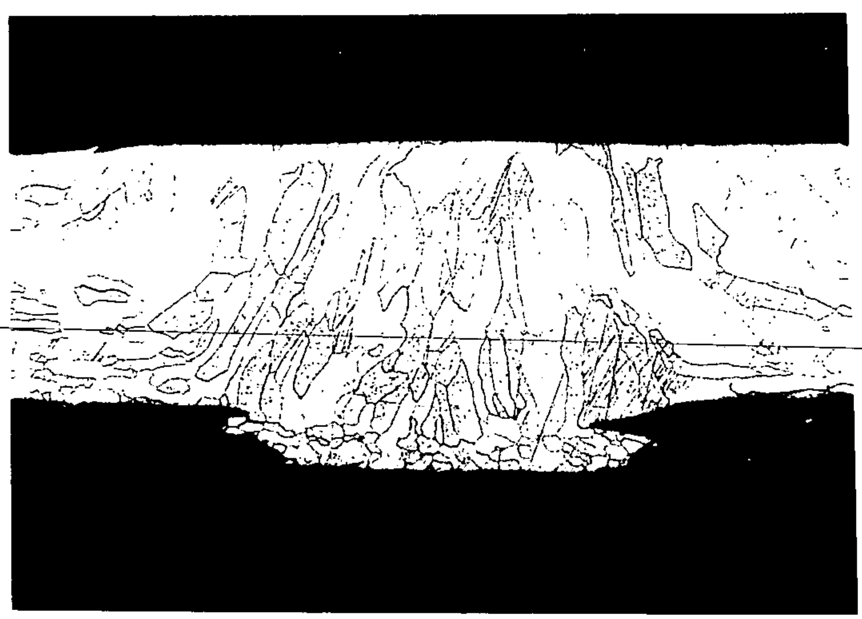


FIGURE 1. SET OF GPHS SIMULANT-FUELED CAPSULES PRIOR TO SHIPMENT TO LOS ALAMOS. CAPSULES SHOWN ARE NUMBERS Q-8 THROUGH Q-14 (FROM UPPER LEFT TO LOWER RIGHT). WELD MADE AT SAVANNAH RIVER IS AROUND GIRTH IN SHINY AREA HALF WAY UP CYLINDRICAL SIDE WALL. PENCIL MARKINGS ON CAPSULES ARE REFERENCE MARKS FOR ULTRASONIC TESTING. (EE45573-A, 1X)

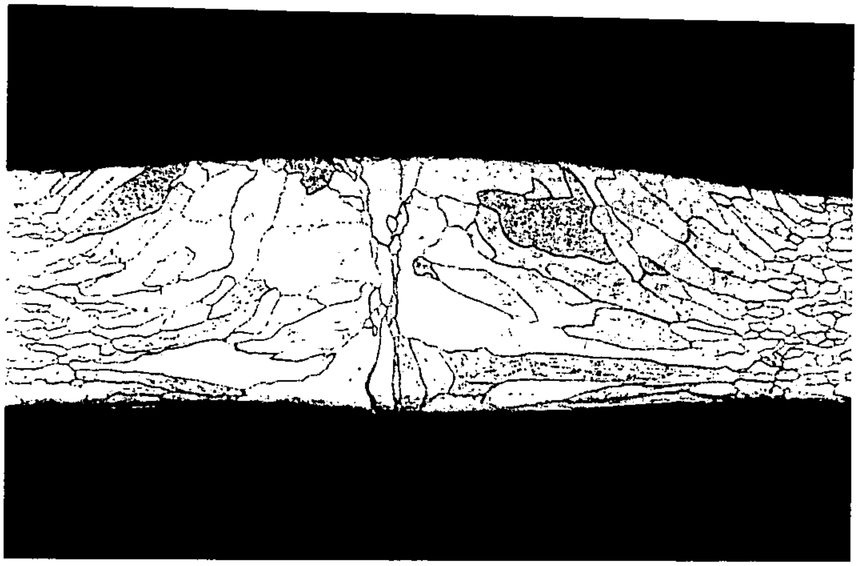


A. INTERNAL SURFACE OF WELD BEAD IN CAPSULE Q-1 SHOWING MINIMAL BEAD WIDTH OF ABOUT 0.020 INCH AT WELD OVERLAP (EE45261-A, 10X)

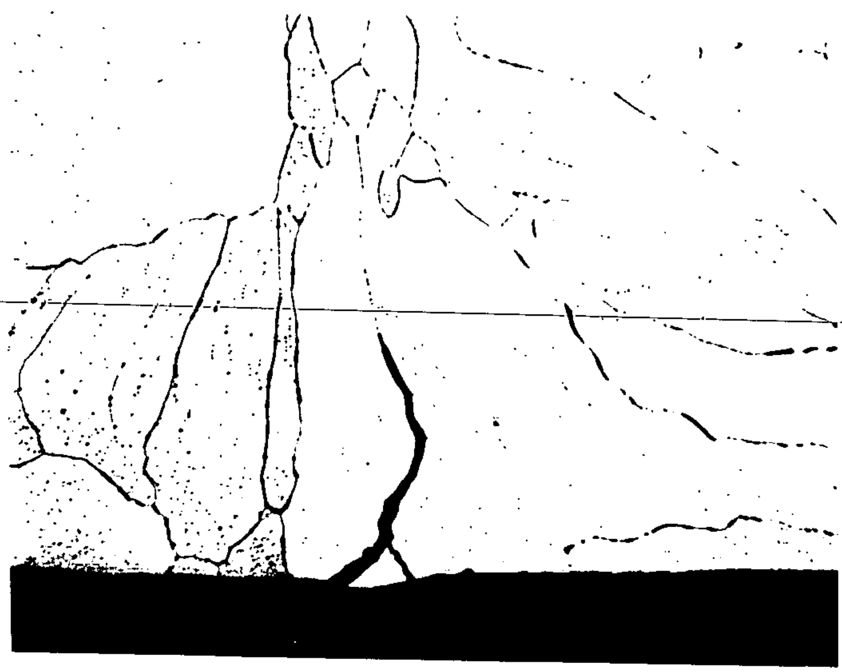


B. METALLOGRAPHIC SECTION SHOWING ADHERENCE OF WELD SHIELD IN CAPSULE Q-2 (EE45376-A, 50X).

FIGURE 2. IRREGULARITIES ON THE INTERNAL SURFACE OF WELD BEADS.

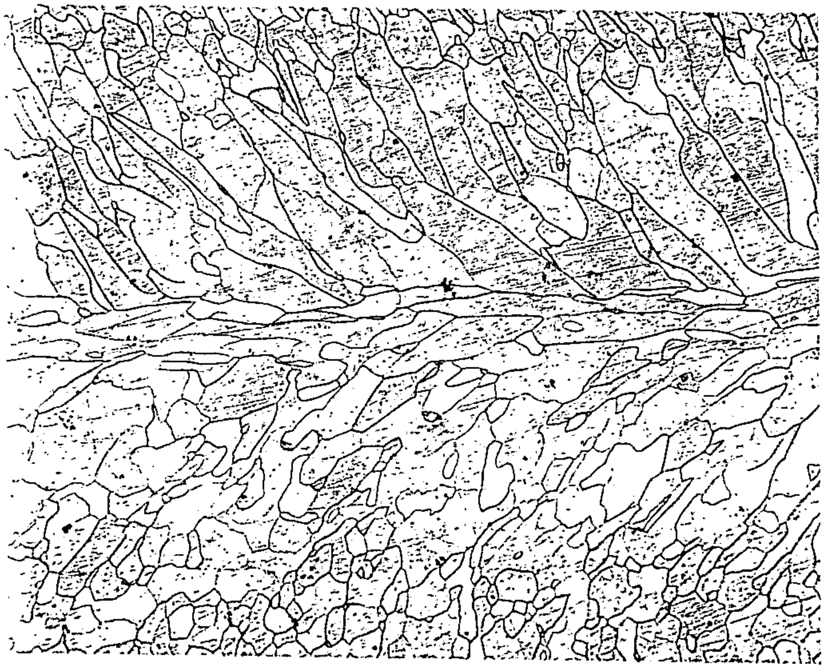


A. COMPLETE WELD CROSSECTION (EE45808-A, 40X)

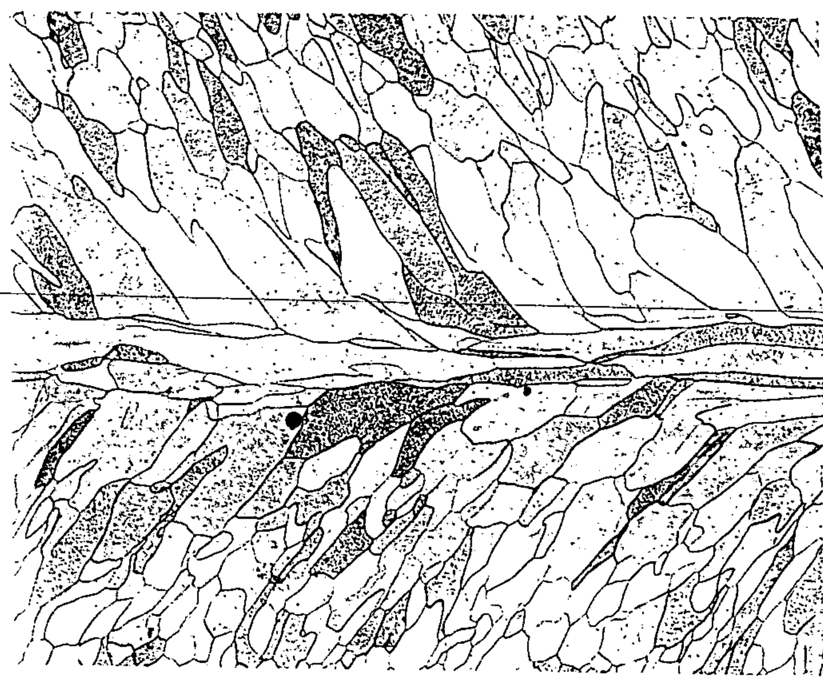


B. AT HIGH MAGNIFICATION (EE46699-A, 200X)

FIGURE 3. UNDERBEAD CRACK IN CAPSULE Q-24 AT TWO MAGNIFICATIONS.

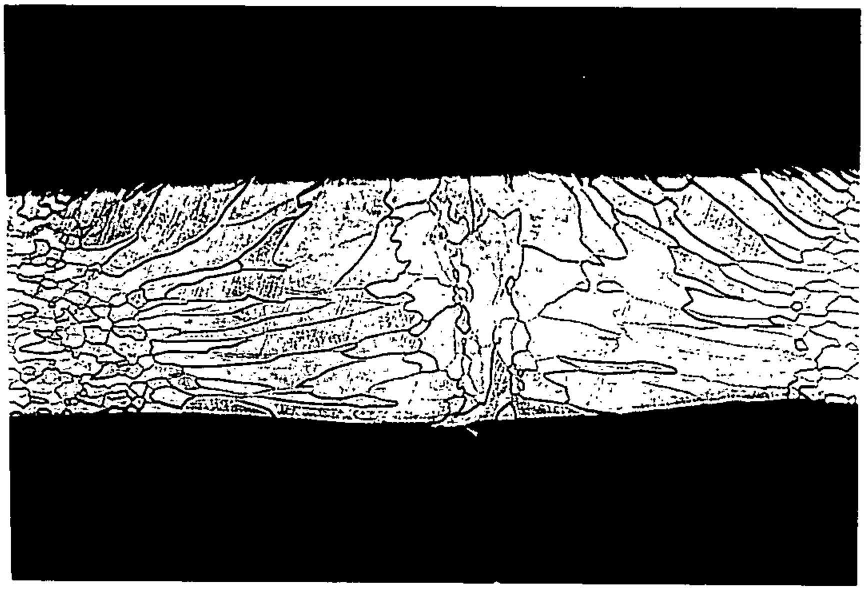


A. AT 180° TO OVERLAP IN Q-24 (EE45811-A, 40X).

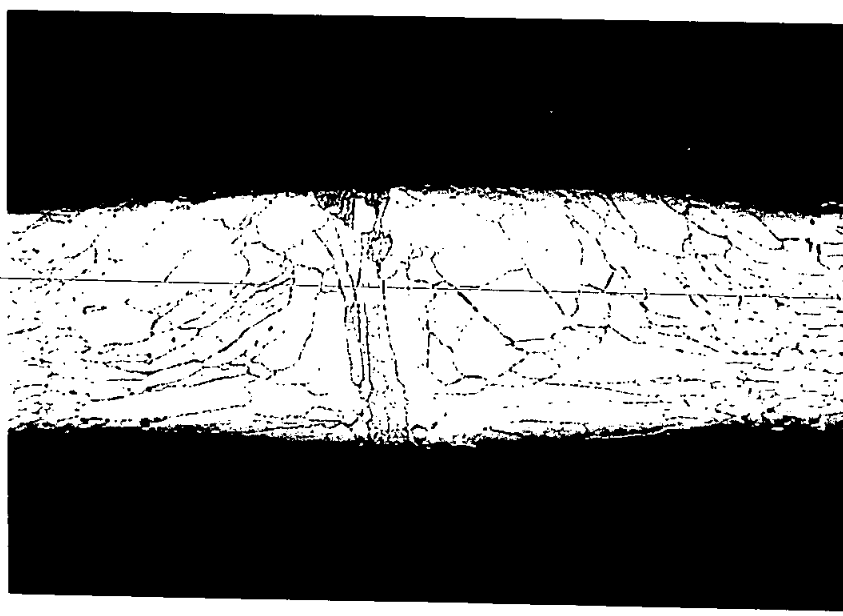


B. IN OVERLAP REGION OF Q-7 (EE45805-A, 40X).

FIGURE 4. FACE SECTIONS (FROM TOP SURFACE) OF WELDS.



A. AT 180° TO WELD OVERLAP IN Q-24 (EE45810-A, 40X).



B. IN OVERLAP REGION OF Q-7 (EE45804-A, 40X).

FIGURE 5. TRANSVERSE SECTIONS ACROSS WELDS.

APPENDIX A

HEALTH PROTECTION (HP) REQUIREMENTS FOR HANDLING GPHS DEPLETED URANIUM OXIDE PELLETS IN BUILDING 723-A, CUBICLE E

1. Cubicle E will be set up as a temporary regulated area with the following equipment: a regulated area sign, a count rate meter, brown lab coats, and a waste container for disposal of contaminated waste.

2. All personnel will monitor with the count rate meter upon exiting the room. Personnel handling the uranium oxide pellets will be trained by HP for self monitoring.

3. All personnel entering the regulated area will wear a TLD badge and a brown lab coat.

4. The names and plant extensions of the custodian (W. R. Kanne, ext. 52713) and HP contact (T. D. Hegler, ext. 52166) will be posted.

5. Broken uranium oxide pellets will not be removed from their secondary containment without HP approval. Any pellets that become broken during handling will be placed in secondary containment and HP will be contacted for any monitoring and cleanup that may be required.

6. Between encapsulation runs, the temporary regulated area may be removed with the approval of HP. Contact HP for monitoring of the room and disposition of contaminated waste and lab coats.

APPENDIX B

PROCEDURE FOR WELDING GPHS CAPSULES CONTAINING DEPLETED URANIUM OXIDE PELLETS

1. Turn on oven. Place regulated area sign on both doors to cubicle and turn on count rate meter. Check that all personnel have a TLD badge and lab coat. Open pellet container over padded tray on lab bench. Record pellet number on weld data sheet. Using tongs, place pellet in oven. Place pellet wrapper back in pellet can. Bake pellet for a minimum of 15 minutes at 300 to 600°F.

2. Turn on electrical switch on power supply and on plug board. Open helium valve in cubicle. Open He-25Ar supply valve on cylinder outside building.

3. Set up welding controller for girth weld per welding procedure. Check the following:

___Rotation speed correct (within 1 sec. over 16 revolutions)
___Rotation direction correct (counterclockwise)
___Helium supply adequate
___Electrode tip satisfactory
___Torch gas on and at 40cfh
___Timer and current settings correct for girth weld
___Oscillator on with correct settings

4. Run at least three full program welds. Make dummy weld on tungsten piece for "Girth" weld (run chart). Change controller settings to those for tack welds and make dummy weld on tungsten piece for "Tack" weld (run chart). Use charts to confirm correct welding programs. Raise upper chuck and remove tungsten piece from chuck (Caution - may be hot!).

1-4 REPEAT. For repeat welds on the same day, Steps 1-4 above may be bypassed except for the following:

___Change controller settings to "Tack" weld sequence
___Bake pellet
___Check electrode
___Check helium supply

5. If iridium shells are other than "prime", measure shells as described on data sheet. Install top iridium shell (without shield) in lower welding chuck (capsules are welded upside down to provide good view of notch for alignment with electrode). Align vent notch in shell with torch tip while red indicator line on chuck is at zero position. Rotate chuck so notch faces forward and place bottom iridium shell on edge of chuck base.

6. Set arc gap at 0.035 inch. Set torch height to 0.010 inch above shell edge.

7. Turn on oxygen analyzer electrical switch. Turn scale switch to Cal. Open cell shut off valve. Calibrate analyzer with air.

8. Using insulated tongs, remove pellet from furnace and place into iridium shell in welding chuck. Caution: Do not touch pellet to anything to avoid heat and contamination problems.

9. Close welding box and purge box with helium to less than 150 ppm oxygen.

10. Place bottom iridium shell over pellet. Align vent notches on shells. Lower upper chuck.

11. Check torch height and adjust if necessary. Check arc gap every 90° with feeler gauge and adjust if necessary. Visually examine torch height and arc gap while chuck rotates.

12. Measure and record cup mismatch (offset between shells) and gap (between shells). Recheck notch alignment and reset if necessary.

13. Position chuck for first tack weld (black mark on top of chuck base at zero position). Check that program switch is on "weld". Make first tack weld. Position chuck at black mark 120° from first and make second tack weld. Visually inspect and measure bead width of tack welds.

14. Check chuck rotation speed.

15. Position chuck at start position for girth weld (short black indicator line at zero position).

15. Reprogram welding controller for girth weld. Check that oxygen content is less than 150 ppm.

17. Make girth weld per welding procedure. Read DVM during weld. Run current chart during weld.

18. Record DVM reading. Label chart with weld number and date.

19. Close cell shut off valve (#41) on oxygen analyzer and turn off analyzer electrical switch. Turn off helium flow to box.

20. Visually inspect girth weld; using telescope, measure and record bead width every 90° (any readings outside 0.080 to 0.120 must be evaluated before another capsule is welded).

21. Open welding box. Using glove, remove encapsulated pellet and place on padded tray on lab bench. Monitor glove with count rate meter. If there is no meter indication above background, glove can be discarded in normal trash.

22. If no further welds are to be made the same day, place tungsten piece in welding chuck and tighten chuck. Lower upper chuck and bring in torch to welding position. Turn off helium supply with valve in cubicle. Shut off torch gas supply by closing He-25Ar cylinder valve outside building. Turn off electrical switch on power supply and on plug board.

23. Have HP survey and tag capsule. Capsule must have no smearable contamination for continued handling in Building 723-A. Radiation tag must indicate no smearable contamination.

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AUTHOR(S) W. B. KANNE, PHONE NO. 5-2713

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December 12, 1989

Ms. W. F. Perrin, Technical Information Officer
U. S. Department of Energy
Savannah River Operations Office
Aiken, SC 29801

Dear Ms. Perrin:

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DPST-89-372, "GPHS URANIUM OXIDE ENCAPSULATIONS SUPPORTING SATELLITE SAFETY TESTS (U)," By W. R. Kanne.

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J. M. Stone, Manager
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