

Development of Infrared Welder for Sealing of Polyethylene TRU-Waste Containers

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RECORDS ADMINISTRATION



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WSRC-TR-99-00107

DEVELOPMENT OF INFRARED WELDER FOR SEALING
OF POLYETHYLENE TRU-WASTE CONTAINERS (U)

SAVANNAH RIVER TECHNOLOGY CENTER
REMOTE AND SPECIALTY EQUIPMENT SYSTEMS

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DOES NOT CONTAIN
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NUCLEAR INFORMATION

A. D. Marzolf
R. B. Milling
March 31, 1999

ADC &
Reviewing Official: Michael Metz, ADC/RO
(Name and Title)
Date: 3/31/99

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DEVELOPMENT OF INFRARED WELDER FOR SEALING OF POLYETHYLENE TRU-WASTE CONTAINERS

Summary

Engineers at the Savannah River Technology Center (SRTC) have successfully performed infrared welding of High Density Polyethylene (HDPE) test specimens to prove the feasibility of using the infrared welding process in the HANDSS-55 TRU-Waste Repackaging Module.

Background

The Handling and Segregation System for 55-Gallon Drums (HANDSS-55) project is being jointly funded by DOE's Office of Science and Technology and its Mixed Waste Focus Area. The purpose of this project is to provide a method of sorting and segregating non-compliant items from stored transuranic waste prior to shipment of the waste to the Waste Isolation Pilot Plant. HANDSS-55 is being designed as a modular system with the modules being the Automated Drum and Liner Opener, Sorting and Segregation, Process Waste Reduction, and Transuranic Waste (TRU-waste) Repackaging.

To facilitate repackaging of the waste after sorting and segregation, the TRU-Waste Repackaging Module will utilize split-plug bagless transfer into high-density polyethylene containers specially molded for this process. The sealing and bonding of the plug into the containers will be done by an infrared welder currently being developed by engineers at the Savannah River Technology Center.

The infrared welding process requires that one of the parts being welded is translucent and the other is colored, usually black. The two parts are pressed together and infrared energy is passed through the translucent part and collected on the darker part. The heat energy generated causes the two parts to melt and, therefore creates a bond between the two.

In the TRU-waste repackaging process, the container is the translucent part and the plug which will seal the container is black. The mating walls of the container and plug are tapered at 10 degrees so that downward pressure on the plug will ensure good wall contact, necessary for the welding process. Figure one below shows a sketch of the container and plug.



Figure 1. TRU-waste container and plug

After the container is filled with waste, the plug will be inserted. Then, an array of infrared lamps will encircle the container at the elevation of the plug seat, and infrared energy will be used to weld the plug in place, as shown in figure 2.

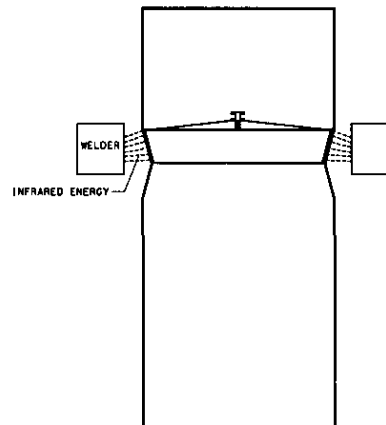


Figure 2. Plug inserted and weld being applied

The infrared welder is not commercially available and is therefore being developed and fabricated by SRTC engineers.

Experimental Development

For experimental purposes, a test welder was fabricated using four parabolic reflector infrared heat lamps purchased from Research, Inc., a company that specializes in the manufacture of heat lamps. This segment represents 1/12 of the circular array necessary to weld all the way around a container. The lamps were configured on an adjustable

radius slightly larger than that of the container so the distance from the lamps to the container can be varied. (See figure 3)

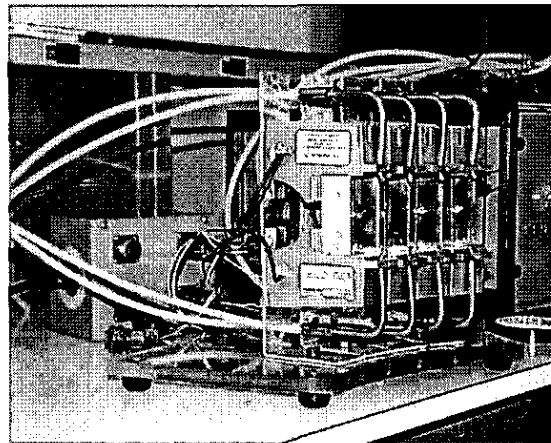


Figure 3. Test welder

To expedite welder development a local plastics vendor was contracted to fabricate from sheet polyethylene a number of frustum sections that were used to simulate the container/plug combinations.

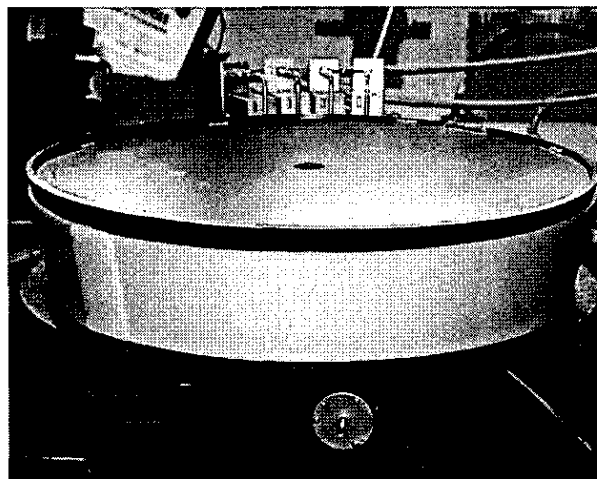


Figure 4. Simulated container/plug combination. The white part represents the container while the black part is the plug

Criteria for an acceptable weld were set as follows.

1. The weld area must be at least 1" wide.
2. The bond must be hermetic, i.e., there can be no voids (air pockets) in the weld area.
3. The bond must be strong enough to maintain the integrity of the sealed container as it is moved from the repackaging module to permanent storage in a 55-gallon steel drum.

Past experience indicated that initial verification of criteria 1 and 2 above could be done visually. When a weld is made, the translucent material darkens as the black material begins to bond to it. Voids in the weld area will remain translucent and are readily visible as shown in figure 5. Ultrasonic testing and dye penetrant testing of cut planes through the weld were also used to verify weld integrity.



Figure 5. Shaded area is welded. Arrow points to void area.

Testing for criterion three, bond strength, will be developed later. However, it should be noted at this time that the bonding of the test welds is very strong, i.e., they cannot be pulled apart manually. Therefore, meeting strength criterion is not a concern of the development team.

Numerous test welds were made, with variations in distance between the welder and container wall, voltage, lamp power (wattage), and weld time. Lamps of 300 watts and 500 watts were used at distances of two to three inches. With both lamps, distances of over two inches usually required that the energy be applied for longer times, and caused the heat absorption by the substrate to be excessive. This excessive heating caused distortion of the welded parts, which is undesirable.

With the lamp-to-container distance shortened to two inches or less, the 500-watt lamps tended to overheat the outer layer, again causing undesirable distortion as shown in figure 6. However, although most of these earlier welds were unacceptable, the bond between the parts was in all cases very strong.

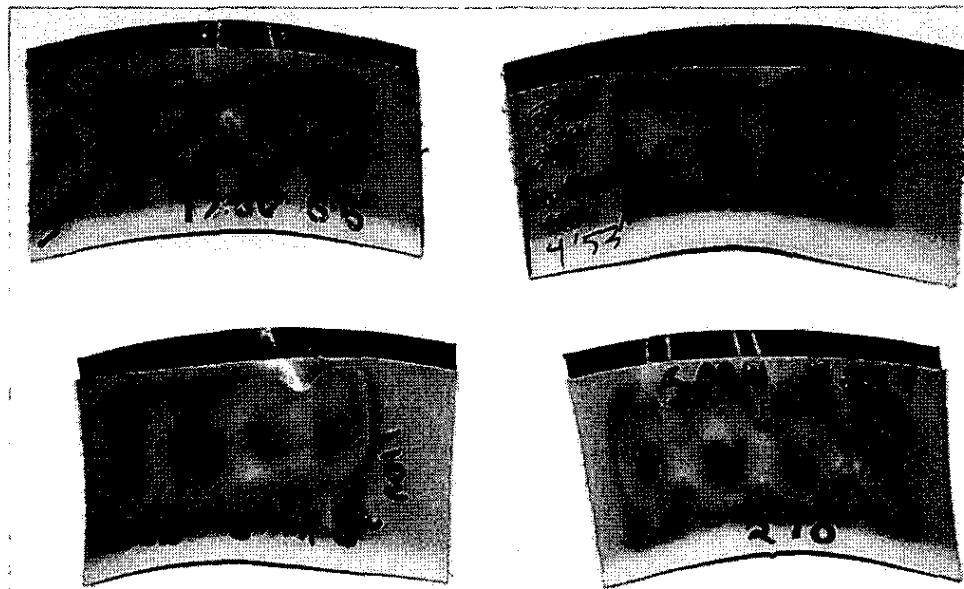


Figure 6. Initial test results.

Example at top left shows distortion caused by excessive heating of (black) substrate. Other three examples show effect of 500-watt lamps at distances greater than two inches.

Further experimentation showed that 300-watt lamps, at 125 volts and 1-1/2" to 2" distance produces a very attractive weld with little distortion. However, under these conditions the lamp patterns do not overlap and therefore the weld, though probably acceptable, is not thoroughly distributed over the weld area. (Figure 7)

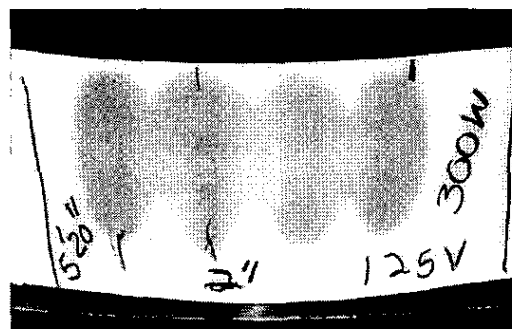


Figure 7. Unevenly distributed weld pattern.

This problem of uneven weld distribution was finally solved by oscillating the welder relative to the part being welded, causing the infrared energy and therefore the resultant weld to be evenly distributed. (Figure 8)

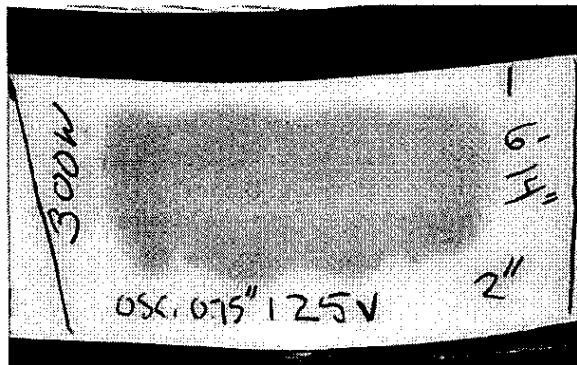
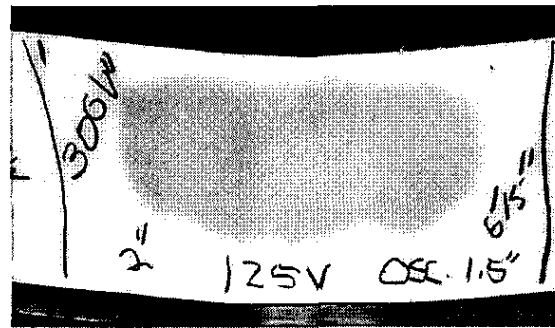


Figure 8. Examples of good welds.

Ultrasonic and dye penetrant tests were performed on various test weld specimens. The UT testing was able to detect areas of full, partial, and no bonding. It was verified that areas having no bond can be readily identified with the naked eye. Areas of partial bonding are identified as those areas having a strong interface but which also allow transmission of sound through the interface. These areas are not readily identifiable with the naked eye, and require more study.

The PT examination of sectioned samples detected areas of no bond and no indications were detected at areas with full bond. No areas of partial bonding were included in this test but, as in the case with the UT specimens, this requires more study.

There were few areas of no bonding and partial bonding detected and these were very small. Also, these incomplete bonds were in all cases near the edge of a weld area and the development team is confident that further development will produce uniform, hermetic bonds.

Documentation of the development testing and results is included as Attachment 1. Dye penetrant and ultrasonic test reports are included as Attachment 2. It should be noted that some of the samples submitted for testing were known to be defective to verify that the PT and UT tests would show said defects.

Conclusion

Testing completed to date has confirmed that infrared welding is a viable alternative for sealing HDPE containers in the HANDSS-55 TRU-waste repackaging module. Future work should focus on the completion of a full-scale test welder with a more precise control system and means to provide oscillation of the lamp array.

TESTING RESULTS OF INFRARED WELDING FOR TRU-WASTE REPACKAGING

1.0 Introduction

EES is developing a system to seal polyethylene containers for the TRU waste repackaging module. This system is an adaptation of the "hollow plug", bagless transfer technology now in use at SRS. The process of sealing the polyethylene hollow plug to a polyethylene drum liner utilizes infrared welding technology. This technique incorporates infrared radiation to bond translucent polymers to colored (preferably black) polymers by transmitting the infrared energy through the translucent material to heat the colored material. Since polymers do not transfer heat readily, the surface of the colored material absorbs the heat, which is then passed back to the translucent material by conduction. This action causes both materials to melt and upon cooling, form a strong bond. Infrared welding of polymers is fast, relatively inexpensive, and readily adaptable to the bagless transfer technology for sealing TRU waste in polyethylene containers. SRTC engineers conducted an investigation to determine the adaptability of this technology for sealing TRU waste in polyethylene containers.

2.0 Objective

The objective of the investigation was to develop a prototype infrared welder that could be adapted for sealing TRU waste in polyethylene (HDPE) containers. The prototype infrared welder was used to determine:

- 2.1 optimum quartz lamp power requirements
- 2.2 effects on weld area relative to varying light source to drum liner distance
- 2.3 effects of quartz lamp voltage magnitude vs. through-transmission of infrared energy
- 2.4 air flow requirements for cooling of translucent material to minimize absorption of infrared energy
- 2.5 conditions affecting contact between colored material and translucent material that interfere with achieving satisfactory bonding
- 2.6 time required to achieve satisfactory bonding
- 2.7 effects of static weld vs. oscillatory motion of welding array
- 2.8 if cooling of lamp parabolic reflectors is necessary

3.0 Experimental

3.1 Experimental Materials:

The infrared welder was fabricated using high intensity, short wavelength, tubular quartz, infrared, lamps with polished aluminum parabolic reflectors as shown in Figure 1. The lamps were arranged in a circular array at a radius that is adjustable between 1.0 to 4.0 inches larger than the radius of the drum liner. Air cooling of the translucent liner material was accomplished by attaching tubing to infrared lamp assemblies. An XY rotational table was used to provide a lamp oscillatory motion, and adjust weld placement on the translucent material.

The drum liner was simulated with a translucent HDPE material 4 inches wide, 22-1/8 inches in diameter, and 125 mils thick. The plug was represented by a 4 inch wide, slightly less than 22-1/8 inch diameter, 125 and 250 mil thickness, black, HDPE material. As shown in Figure 2, the black plug was placed inside the translucent liner material.

3.2 Experimental Setup and Testing Results

Using the experimental setup shown in Figure 2, welds were made statically (welder and materials were stationary) and dynamically using an oscillatory motion. In this investigation, the material was oscillated with respect to the welder.

3.2.1 Determining optimum quartz lamp power requirements

- Different standard wattage ratings (500W, 300W, 150W) of quartz lamps were used to determine the effects on through-transmission and absorption of infrared energy relative to the translucent material. Infrared energy absorption relative to the black material was also studied.

Results:

Testing results indicates that the 300-watt infrared lamp would be the best selection for the infrared welding array. This is due to the reduction in power requirements (approximately 40%) when compared to the 500 watt infrared lamp and also, the reduced absorption of radiant energy by the translucent material. Better control of the weld process was obtained using the 300-watt lamp. The 150-watt lamp did not provide sufficient infrared energy to produce a weld.

3.2.2 Studying effects on weld area when varying light source to drum liner distance

- The infrared light energy source was assembled to a fixture to permit varying the radial distance of the infrared light energy source relative to the translucent liner material. This may influence the weld area produced. The minimum weld area desired is 1.0"x1.5" for each parabolic reflector/quartz lamp assembly utilized.

Results:

A distance of 1.5 to 2 inches from the outer surface of the drum liner was selected when using a 300-watt infrared lamp. This distance produces a good weld appearance and the desired weld area without overheating of the translucent material by excessive absorption of the radiant energy. Increasing the distance beyond 2 inches increases the welding time significantly as illustrated in Figure 3. The outer translucent material depicts increased overheating when decreasing the distance below 1.5 inches.

3.2.3. Determining lamp voltage requirements for optimum through-transmission

- The quartz lamps are rated for 120 volts. Varying the voltage can reduce the power requirement of the lamp assembly, however published literature suggests the reduced voltage may increase the wavelength of the infrared energy which may affect the through-transmission properties of the translucent materials, i.e., overheating of the translucent material. For each standard wattage quartz lamp used in the study, the voltage was varied between 90 to 125 volts to determine effects, if any, on the through-transmission.

Results:

Reducing the voltage of the infrared lamps did not noticeably increase absorption of radiant energy of the translucent material. However, the time to produce a weld did increase significantly as shown in Figure 4. Therefore, the 120V nominal single, phase line voltage will be utilized as the infrared welding voltage. This will also eliminate the need to provide variable control of the infrared welder voltage.

- 3.2.4 Determine air flow requirements for cooling of translucent material to prevent absorption of infrared energy
- The surface of the translucent material of the drum liner must be cooled to prevent excessive absorption of infrared energy. Air, flow rates were varied to determine the requirements to prevent absorption of infrared energy (i.e., prevent heating the surface of the translucent material) and permit through-transmission of the energy.

Results:

Air surface velocities of approximately 6000 FPM using ¼ diameter tubing was required for cooling of the translucent drum liner material to prevent excessive absorption of radiant energy. This suggests an air, flow rate of approximately 300 SCFM. This flow rate can be reduced by external forced cooling of the instrument air.

- 3.2.5 Study the effects of contact between colored material and translucent material to achieve satisfactory bonding
- The drum liner and plug must be in contact before the absorbed infrared energy of the plug can be transferred to the liner through heat conduction. If insufficient conduction occurs between the plug and the liner, a bond will not occur. The study analyzed conditions that may prevent continuous contact between liner and plug.

Results:

The HDPE frustum sections were cleaned with tap water prior to any welding. The sections were fitted together to ensure contact between the translucent and black material. No additional force was applied during the welding process. It is recommended to apply force on the topside of the drum plug during the welding process to ensure good continuous contact. This was not possible during the test since only 1/12 of the circumference was being welded at any one time.

It is also recommended that the surface to be welded be clean and free of debris and contaminants prior to making the weld. Methods to ensure a clean surface prior to welding will be studied.

- 3.2.6 Determine the time required to achieve satisfactory bonding
- Wattage rating, voltage setting and distance relative to infrared light source influence the time to achieve a satisfactory bond

between translucent and black material. Each variation in wattage, voltage and/or distance was monitored relative to the effect of time required to achieve bonding.

Results:

The voltage and distance was varied for both the 300-watt and 500-watt lamp applications. As the voltage was decreased from the nominal 120V single, phase line voltage, the time to weld the material increased significantly as illustrated in Figure 4. Figure 3 shows that the time to weld the material also increased significantly when increasing the distance between the drum liner and infrared lamps. For the 500-watt lamp application, a distance of 2 ¾ to 3 inches at 110 volts was considered optimal, since these parameters permitted adequate cooling of the outer translucent material with the air, flow, cooling system used and provided a good weld appearance. The optimal conditions for the 300-watt lamp application was 1 ½ to 2 inches at the nominal 120V, line voltage. Again, these parameters permitted good cooling of the outer translucent material and provided an excellent weld appearance.

3.2.7 Effects of static weld vs. dynamic weld

- The weld pattern of the infrared lamp array assembly was tested using static welding, i.e., holding the position of the lamps constant with respect to the drum liner. The weld pattern was also tested dynamically, using an oscillatory motion of the infrared welding array. The oscillatory motion of the infrared welder was simulated by oscillation of the HDPE liner/plug assembly.

Results:

Static welding left voids of weld in the extreme upper and lower regions of the welded area as shown in Figure 5. Figure 6 shows that the weld pattern was more evenly distributed over the area of the weld when using oscillatory motion. Oscillations of 0.75, 1.0 and 1.5 inches were tested at a speed of 1 degree/second (approximately 0.2 inches/second). Oscillations of 0.75 and 1.0 inch provided the best weld appearances.

3.2.8 Determine if cooling of parabolic reflectors is required

- The infrared quartz lamp was assembled with a polished, aluminum parabolic reflector that is used to transmit the infrared energy uniformly over a 1.5"x2.0" area. Heat from the quartz lamp is transferred to the reflector. The temperature of the

reflector was measured relative to the time the infrared energy source is required to be on. According to manufacturer specifications, the reflector should not exceed a surface temperature of 400F.

Results:

The temperature of the parabolic reflector did not exceed 180 degrees F for the 500-watt, infrared lamp application. The reflector temperature did not exceed 110 degrees F for the 300-watt lamp application. This strongly indicates that no external cooling of the reflector is required for the infrared welding process. According to the manufacturer, the parabolic reflectors should last indefinitely under these operating conditions.

Conclusions:

Frustum sections of high, density polyethylene (HDPE) of both black and translucent colors were welded together successfully using infrared welding technology. Drum plug material thickness of 250 mils was selected, since less distortion of the liner/plug was realized. The testing results of the infrared welding indicates using the following parameters:

Liner/translucent material thickness:	125 mils
Plug/black material thickness:	250 mils
Infrared lamps required:	48 infrared lamp array
Total power requirements:	14400 watts
Infrared lamp wattage rating:	300 watt each
Liner/material to lamp distance:	1 ½ to 2 inches
Infrared lamp operating voltage:	120 Volts nominal, single phase
Welder oscillatory motion vs. static:	Oscillatory motion - 0.75 to 1.0 inch
Oscillation speed:	0.2 inches per second
Time required to make weld:	5 minutes @ 1 ½ inches distance
	6 min. 15 sec. @ 2 inch distance

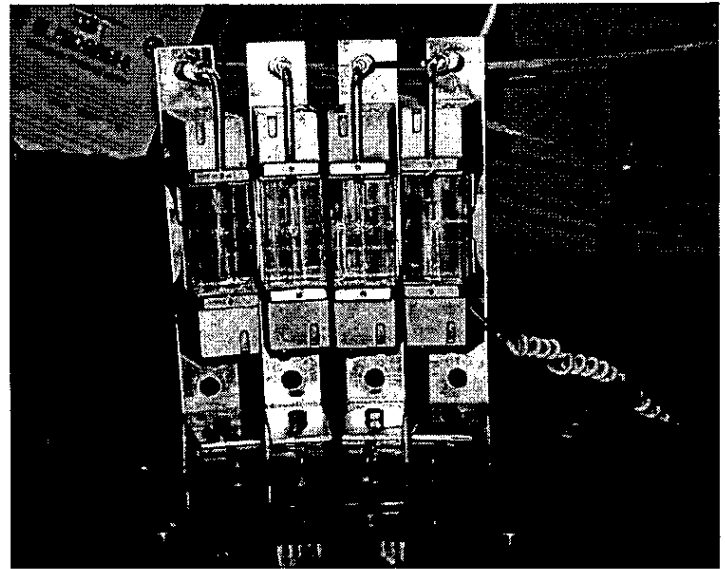
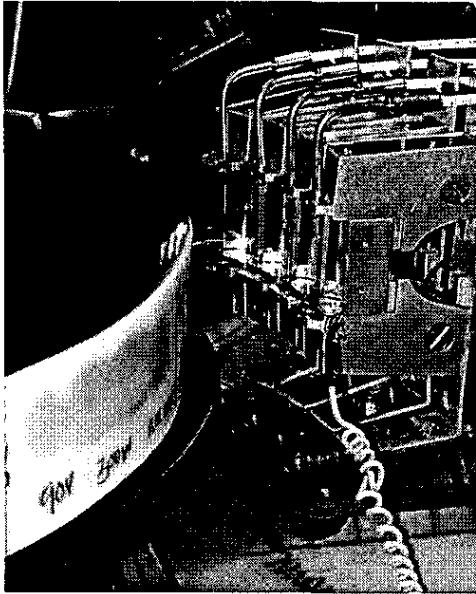


Figure 1. Infrared welding array assembly

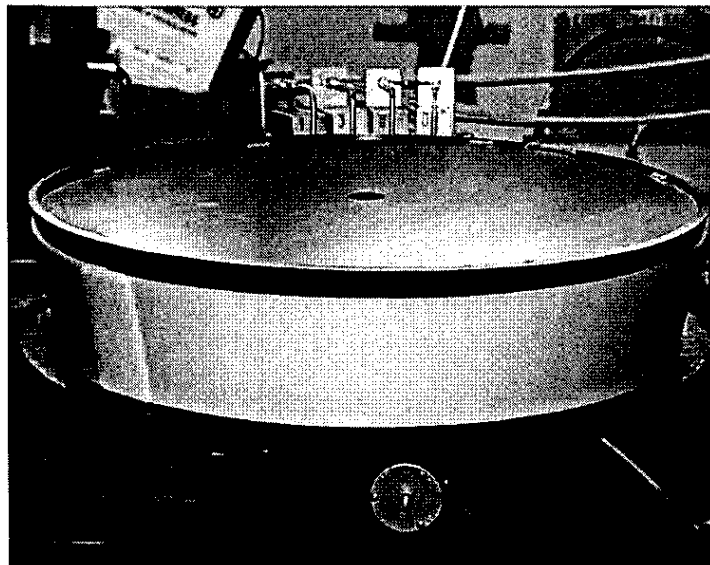


Figure 2. HDPE frustum sectional drum liner/plug assembly

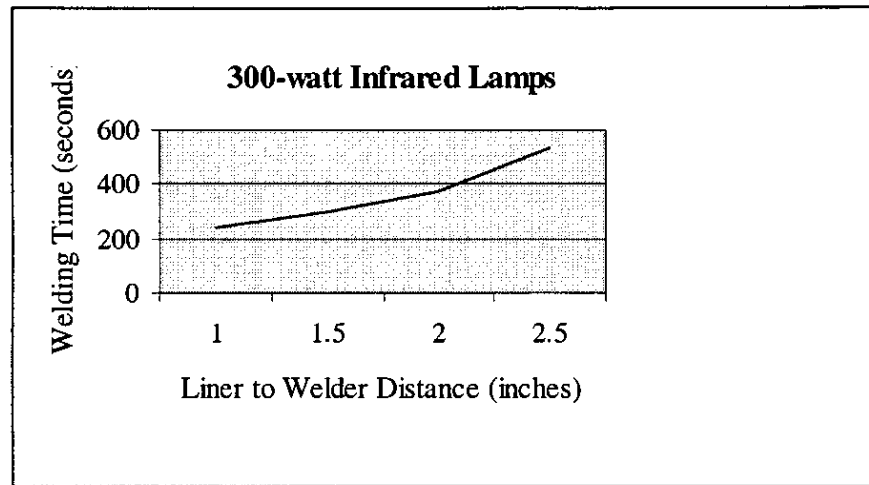


Figure 3. Welding time vs. distance from liner, for 300-watt, infrared lamps at 120 volt nominal operating voltage.

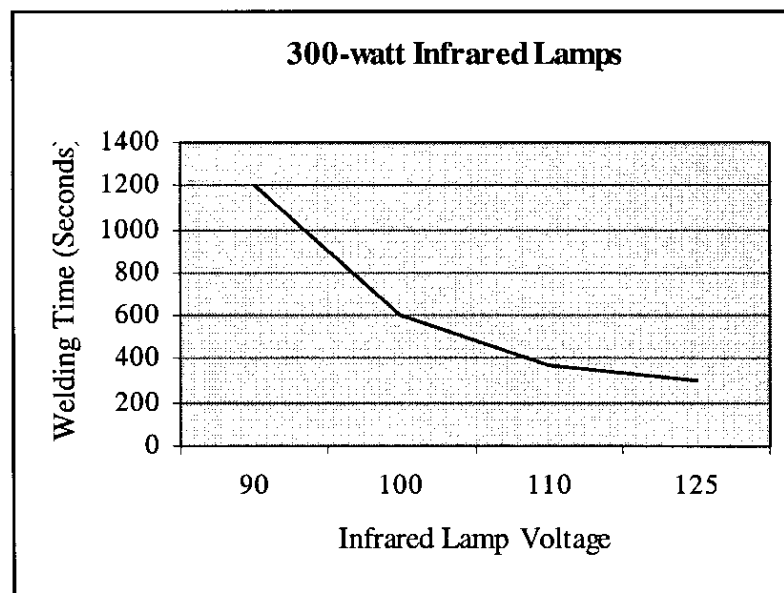


Figure 4. Welding time vs. applied lamp voltage for 300-watt, infrared lamp application.

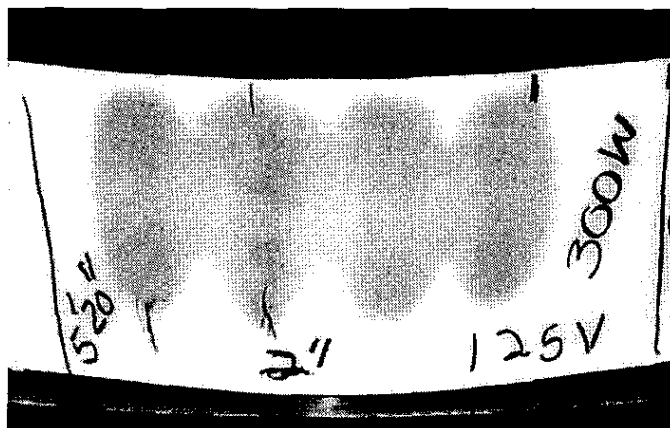


Figure 5. Static infrared welding using 300 watt lamps.

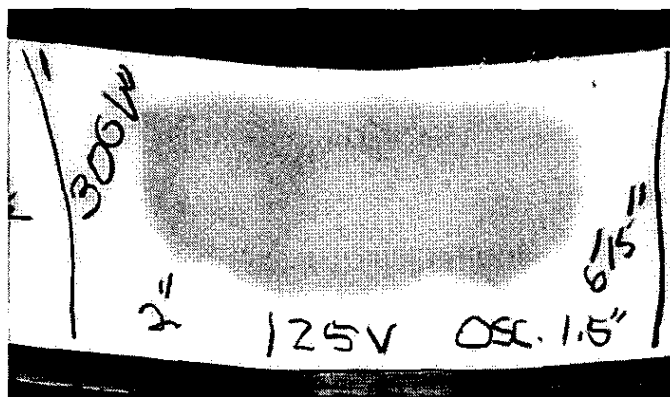
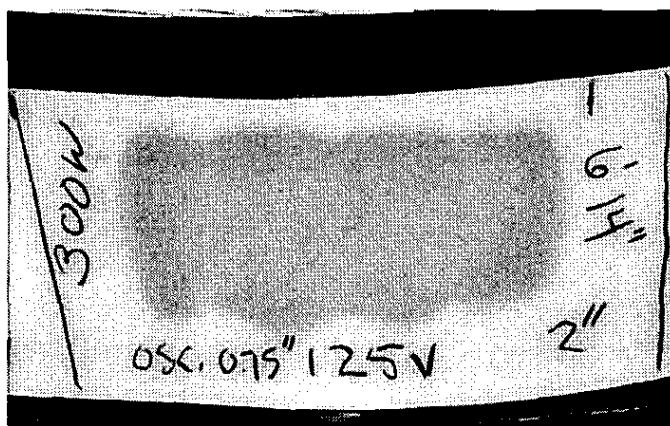


Figure 6. Dynamic, infrared welding using an oscillatory motion of 0.75 inches (top view) and 1.5 inches at 0.2 inches per second.

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03/31/99
ATTACHMENT 2
PAGE 1 OF 5



Nondestructive Examination Condition Report

TSD-NDE- 990256
JOB NO: A990295
Work N/A
Request #:
Retention: 2 Years
Keywords: HDPE

Distribution:

A. D. Marzoff, EES Remote Sys. 723-A *
R. B. Milling, EES Remote Sys. 723-A *
R. F. Fogle, EES Robotics, 773-A *
M. A. Kyle, JR., EES, 773-A *
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D. G. Bevard, QSD, 703-A
R.E. Sprayberry, NDE, 730-A
730-A NDE Files

Page: 1 of 3

Date: 3/30/99

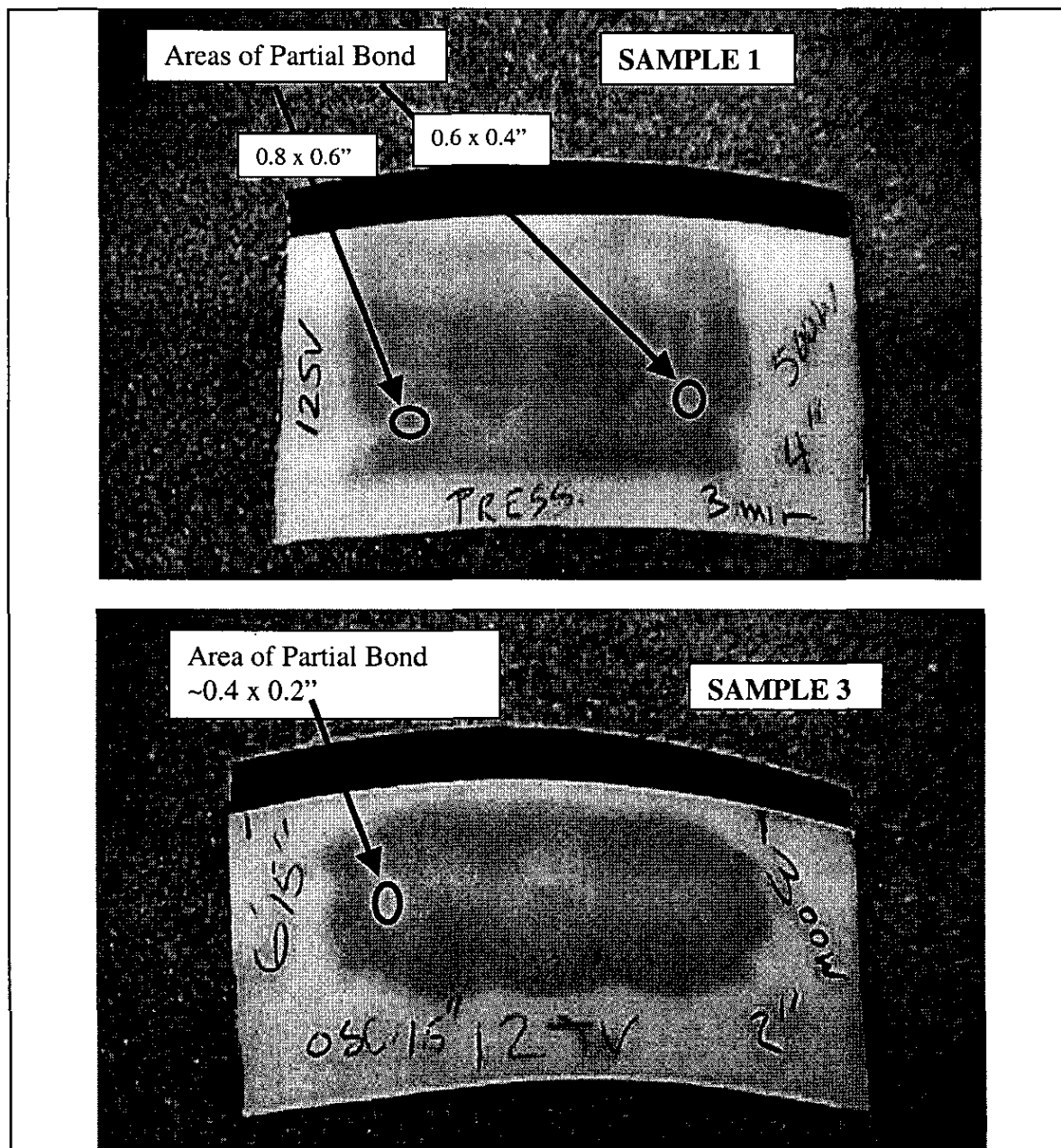
Reported by: J. B. Elder	Inspectors/Level: R. W. Vande Kamp / UTII, J. B. Elder / UTIII, PTII
Equipment Examined: HDPE IR Weld Specimens for HANDSS-55 TRU Waste	
Location: 723-A	IP, IDP, PIPE N/A
Date(s) of Examination: 3/26/99	EN / EP #: SPECIMENS 1, 2, 3, 4A, 4B, 5A, 5B & 6A
Service Condition: Test Specimens	Materials of Construction: HDPE plastics
NCR Number (if applicable): None	
Inspection Procedure (Number and Title): NDEP 6.1, Liquid Penetrant Examination-Solvent Removable NDEP 7.1, Ultrasonic Thickness Examination	
Acceptance Criteria (Source): Info. Only	
Inspection Summary: <p>The QSD/NDE group was requested to perform ultrasonic (UT) and liquid penetrant (PT) examinations on several HDPE weld test specimens for the HANDSS-55 Tru-waste repackaging bagless transfer project. The NDE methods were used to help determine if bonded areas could be verified visually. An ultrasonic technique was used to verify the bond between the two sheets of HDPE. Liquid penetrant was performed on five samples that were sectioned through the bond area.</p> <p>The UT technique was able to determine if areas have no bond, "full" bond or "partial" bond. The UT was performed on all samples that were provided. It was determined that areas of no bond can be readily identified with the naked eye. Areas of partial bond are not readily identifiable visually. Areas of partial bond are classified as areas that produce a strong interface signal but also allow for the transmission of sound through the interface.</p> <p>The PT examination was able to detect areas of no bond. No interface indication was produced at areas of full bond. There were no areas of partial bond in the sectioned areas.</p> <p>For further information or to request additional NDE services please call Jim Elder (5-9844) or Paul Smock (5-4937)</p> <p>* NDE reports attached (99-IR-06-PT-0294 and 99-IR-06-UT-0295)</p> <p>PS 3/30/99</p>	

A

Nondestructive Examination Condition Report Sketch Sheet

TSD-NDE- 990256
JOB NO: A990295
Work Request #: N/A
Page: 2 of 3
Date: 3/26/99

Samples 1, 3 and 6A have areas of "partial bond".

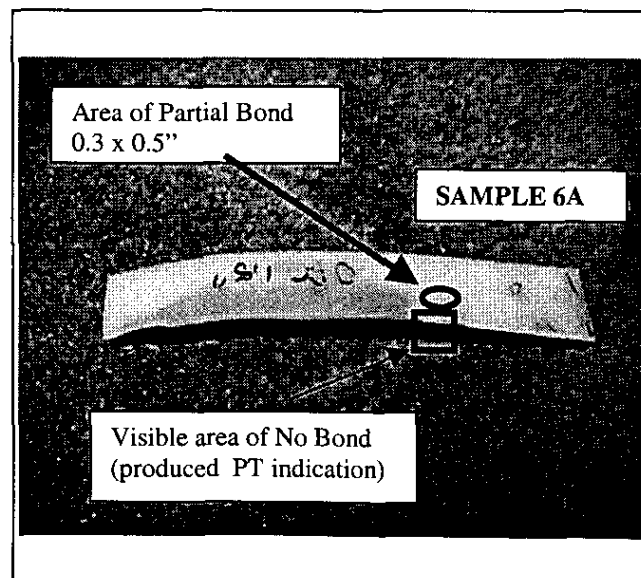
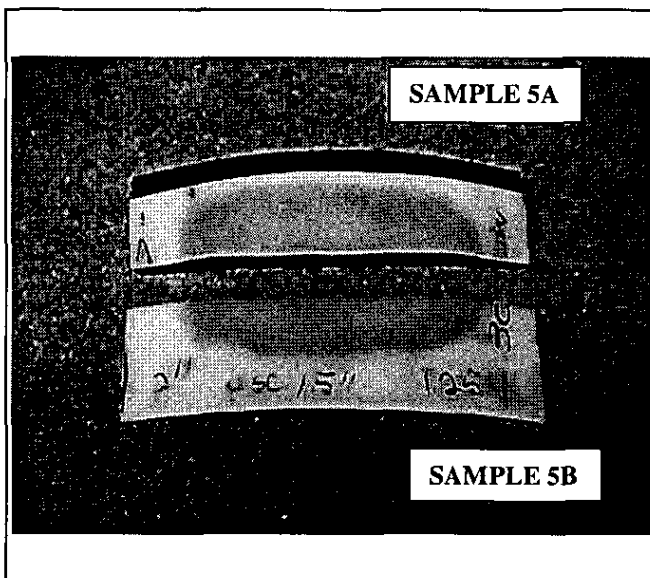
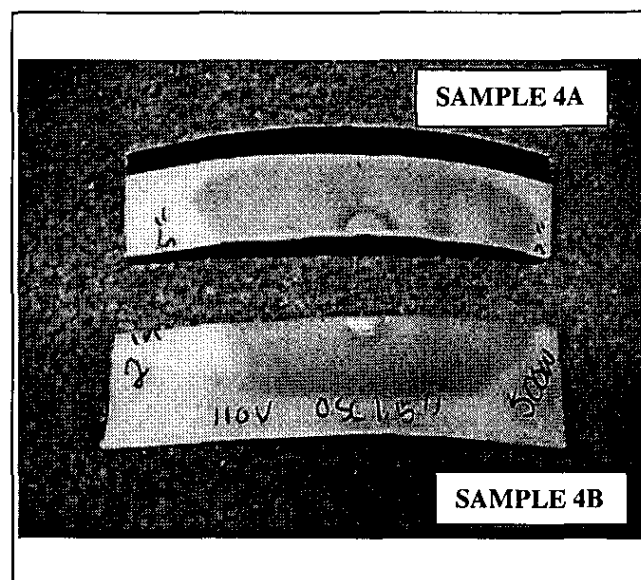
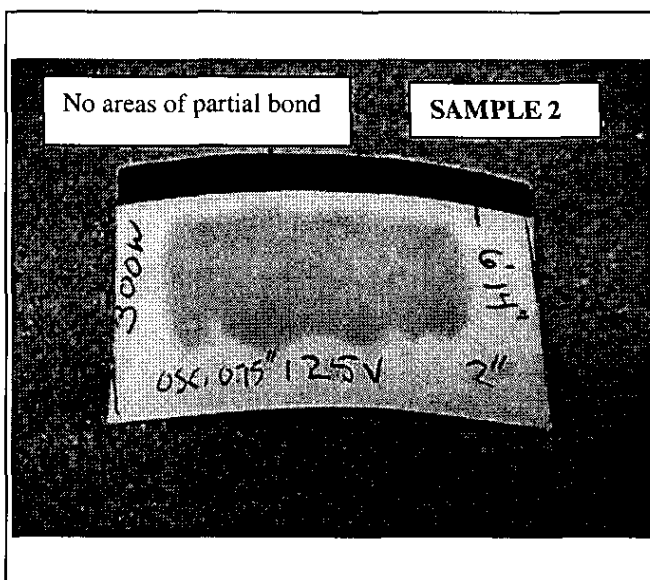


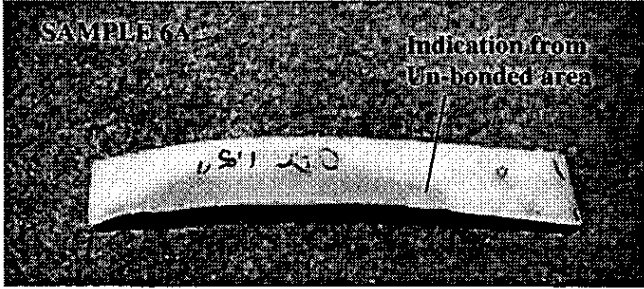
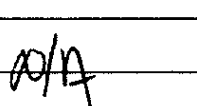
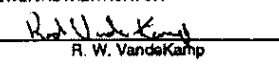
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Nondestructive Examination Condition Report Sketch Sheet

TSD-NDE- 990256
JOB NO: A990295
Work Request #: N/A
Page: 3 of 3
Date: 3/30/99

Samples 2, 4A, 4B, 5A & 5B did not have areas of "partial bond". All areas of no bond were visible with the naked eye



<b style="font-size: 1.2em;">WSRC SAVANNAH RIVER SITE OPERATIONS		9.01 2/96 LIQUID PENETRANT EXAMINATION REPORT	REPORT # 99-IR-06-PT-0294 IDP# N/A
AREA / SYSTEM 723-A, HDPE IR Weld Specimens - HANDSS-55		PROCEDURE NDEP 6.1	REV 6
WELD / COMPONENT I.D. Specimens 1, 2, 3, 4A, 4B, 5A, 5B & 6A		REPAIR N/A	INSPECTION PLAN / INSTRUCTION # N/A
DRAWING N/A		REV. N/A	SURFACE TEMP <600° F
MATERIAL TYPE HDPE plastics		PRODUCT FORM Plate	UV LIGHT METER READING N/A $\mu W/cm^2$
SIZE O.D. / THICKNESS ~0.13" white and ~0.25" black HDPE		TECHNIQUE <input checked="" type="checkbox"/> COLOR CONTRAST <input type="checkbox"/> FLUORESCENT OTHER N/A	
SURFACE FINISH As Cut/IR Welded		METHOD <input checked="" type="checkbox"/> SOLVENT REMOVE <input type="checkbox"/> WATER WASHABLE <input type="checkbox"/> POST EMULSIFIABLE OTHER N/A	
PENETRANT MATERIALS			
PRECLEAN SOLUTION	MANUFACTURER Magnaflux	TYPE SKC-S	BATCH# 98JO4K
PENETRANT	Magnaflux	SKL-SP	97A10K
REMOVER/EMULSIFIER	Magnaflux	SKC-S	98JO4K
DEVELOPER	Magnaflux	SKD-S2	96610K
POST-CLEAN SOLUTION	Magnaflux	SKC-S	98JO4K
EXAMINATION RESULTS			
ITEM / WELD#	ACC.	REJ.	N/A
Sample 6A	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Indication from un-bonded area visible through outer layer
Sample 4A & 4B	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> No relevant indications with bonded area.
Sample 5A & 5B	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> No relevant indications with bonded area.
SKETCH - INDICATION SIZE, LOCATION, ORIENTATION, DISTRIBUTION OF INDICATIONS <div style="text-align: center;">  </div>			
REMARKS Areas that appeared bonded visually/ultrasonically produced no relevant indications. Areas of no bond did produce and interface indication.			
EXAMINER <div style="text-align: center;">  J. B. Elder </div>		REVIEWER/AUTHENTICATOR <div style="text-align: center;">  R. W. VandeKamp </div>	
LEVEL	DATE 3/26/99	LEVEL II	DATE 3/26/99
		LEVEL II	DATE 3/30/99
		PAGE 1 OF 1	

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03/31/99
ATTACHMENT 2
PAGE 5 OF 5

<b style="font-size: 1.5em;">WSRC SAVANNAH RIVER SITE OPERATIONS				ULTRASONIC THICKNESS REPORT		REPORT # 99-IR-06-UT-0295 IDP# N/A	
AREA / SYSTEM 723-A, HDPE IR Weld Specimens - HANDSS-55				PROCEDURE NDEP 7.1		REV 6	
WELD / COMPONENT I.D. Specimens 1, 2, 3, 4A, 4B, 5A, 5B & 6A				INSPECTION PLAN# N/A		JOB # A990295	
DRAWING N/A		REV. N/A		MATERIAL TYPE HDPE plastics		SURFACE CONDITION As Cut/IR Welded	
				NORMAL DIA/SCH OR THK. ~0.13" white and ~0.25" black		MINIMUM ALLOWABLE THK. N/A	
EQUIPMENT							
INSTRUMENT <input type="checkbox"/> DTG <input checked="" type="checkbox"/> CRT		MANUFACTURER Krautkramer Branson		MODEL USN-50		UT MATE # 4-1439	
TRANS/ICER <input checked="" type="checkbox"/> SOL <input type="checkbox"/> DUAL		MANUFACTURER Krautkramer Branson		MODEL ALPHA		SIZE 0.250"	
CABLE LENGTH 5'		COUPLANT Ultralag II		BATCH 092101		CAL STANDARD MATE# test item	
						UT CALIBRATION POINTS ~0.13, 0.25, 0.38"	
EXAMINATION RESULTS							
Location/Thickness						SKETCH - IDENTIFY AREAS/CONTROL POINTS EXAMINED	
ID	White HDPE	Full Bond	Interface Present *	Partial ** Bond ?	Size of PB area		
1	.13"	.38 -.41"	YES	YES 2 ea	0.8x0.6" 0.6x0.4"		
2	.13"	.38 -.45"	NO	N/A	N/A		
3	.13"	.38 -.46"	YES	YES 1 ea	0.4x0.2"		
4A	.13"	.38"	NO	NO	N/A		
4B	.13"	.39"	NO	NO	N/A		
5A	.13"	.38 -.45"	NO	NO	N/A		
5B	.13"	.38"	NO	NO	N/A		
6A	.13"	.39"	YES	YES 1 ea	0.3-0.5"		
N/A							
<input type="checkbox"/> ACC. <input type="checkbox"/> REJ. <input checked="" type="checkbox"/> N/A						MINIMUM READING OBTAINED 0.13"	
REMARKS - Provide details concerning nature of reduction in wall thickness. List all other M&TE used, M&TE#, and Due Dates. * Interface signal refers to the signal from the back wall of the outer sheet of HDPE. This signal is not present in areas of full bond. Samples 1, 3 and 6A had areas of partial bond (**areas where both an interface and backwall signal were present). Calibration performed on test item, thickness verified with vernier calipers.							
EXAMINER N/A				REVIEWER/AUTHENTICATOR J. B. Elder		PAGE 1 OF 1	
LEVEL _____ DATE _____				LEVEL III DATE 3/26/99		LEVEL II DATE 3/30/99	

Westinghouse Savannah River Company Document Approval Sheet

Document No. WSRC-TR-99-00107

SAT-RSE-99-0219

Title DEVELOPMENT OF INFRARED WELDER FOR SEALING OF POLYETHYLENE TRU-WASTE CONTAINERS		Key Words (list 3) <u>HDPE, TRU-WASTE, WELDING</u>	
Primary Author/Contact (Must be WSRC) R. B. MILLING	Location 723-A	Phone No. 725- 1885 2692	Position PRINCIPLE
Organization Code L8140	Organization (No Abbreviations) REMOTE AND SPECIALTY EQUIPMENT SYSTEMS		

Other Authors
A. D. MARZOLF

Approval Requested by (date)
4-15-99 5/14/99

Has an invention disclosure, patent application or copyright application been submitted related to this information? ☐ Yes ☒ No If yes, date submitted _____

Disclosure No. (If Known) _____ Title _____

If no, do you intend to submit one? ☐ Yes ☒ No If yes, projected date _____

Information Product Description

<input checked="" type="checkbox"/> Technical Report <input type="checkbox"/> Semiannual <input type="checkbox"/> Annual <input type="checkbox"/> Final Topical <input checked="" type="checkbox"/> Other _____	<input type="checkbox"/> Journal Article Journal Name _____ Book/Book Chapter Book Name _____
<input type="checkbox"/> Administrative Report <input type="checkbox"/> Semiannual <input type="checkbox"/> Annual <input type="checkbox"/> Final <input type="checkbox"/> Topical <input type="checkbox"/> Other _____	<input type="checkbox"/> Conference Submission* <input type="checkbox"/> Abstract <input type="checkbox"/> Conf. Paper <input type="checkbox"/> Conf. Proceeding <input type="checkbox"/> Slides/poster/display <input type="checkbox"/> Other _____
<input type="checkbox"/> Videotape/Multimedia	*Conference Title _____
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<input type="checkbox"/> Brochure/Booklet	*Conference Dates _____ m/d/y thru _____ m/d/y
<input type="checkbox"/> Procedure/User Guide	*Conference Sponsor _____
<input type="checkbox"/> Drawing	
<input type="checkbox"/> Software Package	

References ☐ In Public Literature ☐ Routing Concurrently ☐ Approved for Release ☐ Other N/A

I understand that for the information in this material to be given external distribution, approvals by both WSRC and, as appropriate, DOE-SR are required. Distribution (verbally or published) must be in accordance with policies set forth in WSRC management requirements and procedures (MRP 3.25) and in DOE-SR orders, and the content of the external distribution must be limited to that actually approved.

R. B. Milling
Author's Signature

3-31-98
Date

Approvals by Author's Organization

Derivative Classifier <u>Michael Wicks</u>	Classification <u>Unclassified</u>	Topic <u>Infrared Welding for Sealing Polyethylene</u>
Intended Distribution <input checked="" type="checkbox"/> Unlimited (release to public) <input type="checkbox"/> Limited (see explanation)	Explanation for Limited Dist. <input type="checkbox"/> Corporate/University Partner <input type="checkbox"/> Site Use Only <input type="checkbox"/> Other DOE facility(ies) only	

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John C. Whitehouse
Manager's Name (Print)

John C. Whitehouse
Manager's Signature

3-21-99
Date

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Abstract <input type="checkbox"/> S <input type="checkbox"/> C <input type="checkbox"/> UCNI <input type="checkbox"/> U	
Title <input type="checkbox"/> S <input type="checkbox"/> C <input type="checkbox"/> UCNI <input checked="" type="checkbox"/> U	
WSRC Classification Officer's Name (Print) <u>R. L. Shankle</u>	WSRC Classification Officer's Signature <u>R. L. Shankle</u>
Date <u>3/31/99</u>	

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OSTI Subj. Category No. <u>42</u>	Routing <u>CLASS/EC/DOE</u>	Editor/Illustrator/On-line Support	MSD Project No.
--------------------------------------	--------------------------------	------------------------------------	-----------------

NOTE OSR 17-8 must be completed in addition to this form when submitting information for review and approval.

Keywords: transuranic waste
split-plug bagless transfer
infrared welding } see above



Westinghouse
Savannah River Company

P.O. Box 616
Aiken, SC 29802

March 31, 1999

WSRC-TR-99-00107
MSD-STI-97-4039

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

Dear Ms. Perrin:

REQUEST FOR APPROVAL TO RELEASE SCIENTIFIC/TECHNICAL INFORMATION

The attached document is submitted for classification and technical approvals for the purpose of external release. Please complete Part II of this letter and return the letter to the undersigned by 5/14/99. The document has been reviewed for classification and export control by a WSRC Classification staff member and has been determined to be Unclassified.

Kevin J. Schmidt
Kevin J. Schmidt, WSRC STI Program Manager

I. DETAILS OF REQUEST FOR RELEASE

Document Number: WSRC-TR-99-00107

Author's Name: R. B. Milling

Location: 723-A

Phone 5-2692

Department: Remote and Specialty Equipment

Document Title: Development of Infrared Welder for Sealing of Polyethylene TRU-Waste Containers

Presentation/Publication:

Meeting/Journal:

Location:

Meeting Date:

N/A

OSTI Reportable

II. DOE-SR ACTION

Date Received by TIO 4/1/99

☒ Approved for Release

☐ Not Approved

☐ Approved Upon Completion of Changes

☐ Revise and Resubmit to DOE-SR

☐ Approved with Remarks

Remarks: _____

W. F. Perrin

W. F. Perrin, Technical Information Officer, DOE-SR

6/8/99
Date

US DEPARTMENT OF ENERGY
ANNOUNCEMENT OF U. S. DEPARTMENT OF ENERGY (DOE)
SCIENTIFIC AND TECHNICAL INFORMATION (STI)

OMB Control No.
1910-1400

RECORD STATUS (select one):

X...New Revised Data Revised STI Product

Part I: STI PRODUCT DESCRIPTION

A. STI PRODUCT TYPE (select one)

X... 1. Technical Report

a. Type: ☐ Topical ☐ Semiannual ☐ Annual ☒ Final Other (specify)

b. Reporting Period (mm/dd/yyyy).....thru

..... 2. Conference

a. Product Type: Conference Proceedings Conference Paper or Other (abstracts, excerpts, etc.)

b. Conference Information (title, location, dates)

..... 3. Software Manual (The actual software package should be made available simultaneously. Follow instructions provided with ESTSC F 1 and ESTSC F 2.)

..... 4. Journal Article

a. Type: ☒ Announcement citation only ☐ Preprint ☐ Postprint

b. Journal Name

c. Volume..... d. Issue e. Serial identifier (e.g., ISSN or CODEN)

..... 5. S&T Accomplishment Report

..... 6. Book

..... 7. Patent Application

a. Date Filed (mm/dd/yyyy) ____/____/____

b. Date Priority (mm/dd/yyyy) ____/____/____

c. Patent Assignee

..... 8. Thesis/Dissertation

B. STI PRODUCT TITLE Development of Infrared Welder for Sealing of Polyethylene TRU-Waste Containers.....

C. AUTHOR(s) R. B. Milling.....

E-mail Address(es):

D. STI PRODUCT IDENTIFIER

1. Report Number(s) WSRC-TR-99-00107.....

2. DOE Contract Number(s) DE-AC09-96SR18500.....

3. R&D Project ID(s)

4. Other Identifying Number(s)

E. ORIGINATING RESEARCH ORGANIZATION Savannah River Site.....

F. DATE OF PUBLICATION (mm/dd/yyyy)

G. LANGUAGE (if non-English) English.....

(Grantees and Awardees: Skip to Description/Abstract section at the end of Part I)

H. SPONSORING ORGANIZATION

I. PUBLISHER NAME AND LOCATION (if other than research organization)

Availability (refer requests to [if applicable])

J. SUBJECT CATEGORIES (list primary one first) 42.....

Keywords Transuranic Waste, Split-Plug Bagless Transfer, Infrared Welding.....

K. DESCRIPTION/ABSTRACT

Engineers at the Savannah River Technology Center have successfully performed infrared welding of High Density Polyethylene test specimens to prove the feasibility of using the infrared welding process in the HANDSS-55-TRU-Waste Repackaging Module.

US DEPARTMENT OF ENERGY
ANNOUNCEMENT OF U. S. DEPARTMENT OF ENERGY (DOE)
SCIENTIFIC AND TECHNICAL INFORMATION (STI)

DOE F 241.1 (p. 2 of 2)

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 - d. Declassification Status:
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 - e. OpenNet Document Type _____
 - f. OpenNet Document Keywords _____
 - g. OpenNet Addressee _____
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- 6. **Small Business Technology Transfer (STTR)** Release date (mm/dd/yyyy) _____
- 7. **Proprietary/Trade Secret**
- 8. **Patent Pending**
- 9. **Protected data** _____ CRADA _____ Other (specify) _____ Release date (mm/dd/yyyy) _____
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- 11. **Program-Directed Special Handling** (specify) _____
- 12. **Export Control/TAR/EAR**
- 13. **Unclassified Controlled Nuclear Information (UCNI)** _____
- 14. **Classified Classification Level/Category of**:
 - a. This form **U**.....
 - b. The STI Product **Unclassified**.....
- 15. **Other information relevant to access** (specify; for OSTI internal use only) _____

B. OTHER (information useful to include in published announcement record which is not suited for any other field on this form)

C. CONTACT AND RELEASING OFFICIAL

1. Contact (if appropriate, the organization or site contact to include in published citations who would receive any external questions about the content of the STI Product or the research information contained therein)

Name and/or Position **K.J. Schmidt, Manager STI Program & Site Support**
E-mail _____ Phone **(803) 725-2321**
Organization **Westinghouse Savannah River Company**

2. Releasing Official ☒ I verify that all necessary reviews have been completed (e.g. Patent, Copyright, ECI, UCNI, etc.)

Released by (name) **K. J. Schmidt** Date (mm/dd/yyyy) _____
E-Mail _____ Phone _____ (803) 725-7373