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# Final Results of Double-Shell Tank 241-AN-105 Ultrasonic Inspection

#### C. E. Jensen

Lockheed Martin Hanford Corporation, Richland, WA 99352 U.S. Department of Energy Contract DE-AC06-87RL10930

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Abstract: This document presents the results and documentation of the nondestructive ultrasonic examination of tank 241-AN-105. A tank inspection supplier was retained to provide and use an ultrasonic examination system (equipment, procedures, and inspectors) to scan a limited area of double-shell tank 241-AN-105 primary tank wall primary knuckle, and secondary tank bottom. The inspection found some indication of general and local wall thinning with no cracks detected.

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## FINAL RESULTS OF DOUBLE-SHELL TANK 241-AN-105 ULTRASONIC INSPECTION

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### Final Results of Double-Shell Tank 241-AN-105 Ultrasonic Inspection

July 12, 1999

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for

Lockheed Martin Hanford Corporation Richland, Washington

## Final Results of Double-Shell Tank 241-AN-105 Ultrasonic Inspection

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#### 1.0 INTRODUCTION

In May 1996, the Tank Waste Remediation System (TWRS) Decision Board recommended, and the U.S. Department of Energy-Richland Operations Office (DOE-RL) agreed, that the condition of the double-shell tanks (DSTs) should be determined by ultrasonic (UT) inspection of a limited area in six of the 28 DSTs. The Washington State Department of Ecology (WDOE) has agreed with the strategy of limited UT inspection of six DSTs. Data collected during the UT inspections will be used to assess the condition of the tanks, judge the effects of past corrosion control practices, and satisfy a regulatory requirement to periodically assess the integrity of waste tanks.

In November 1996, the primary and secondary walls of DST 241-AW-103 were remotely examined to determine if Hanford DST walls could be inspected without removing the existing surface rust and scale. The successful completion of this inspection represented the first UT inspection of a Hanford DST (Leshikar 1997).

Based on the results of the initial inspection, a statement of work (SOW)(Pfluger 1999b) was prepared for the remaining DST inspections scheduled for Fiscal Year 1998 and beyond. The service of COGEMA Engineering Corporation (COGEMA Engineering) was retained to provide an UT examination system (equipment, procedures, and inspectors) and perform the inspection.

Tank 241-AN-105 was selected as one of the six sample tanks that represent the complete 28-tank population. The tank began receiving waste in 1982 and is currently classified as a double-shell slurry feed tank (DSST). The current tank level is approximately 410 inches (Hanlon 1999). From 1983 to present, the waste temperature in the tank has not exceeded 115°F. Although the tanks are expected to have similar performance, the selection of tanks is purposely biased towards tanks whose primary walls may be more likely to be degraded by corrosion. The tank selection criteria (Schwenk and Scott 1996) considered variables that may influence corrosion, such as waste physical characteristics, waste chemistry, temperature, and age. Originally, 241-SY-101 was selected for examination but was removed from the list due to a lack of resources, mitigation activities, and a congested work area. Tank 241-AN-105 was chosen because it, like 241-SY-101, releases large amounts of hydrogen and is on the Hydrogen Watch List.

#### 2.0 OBJECTIVE / SCOPE

This report presents the results of the UT examination of DST 241-AN-105 with attention focused on the primary tank wall base metal and welds. Issuance of this report meets FY 1999 Performance Agreement TWR 6.3.1. The criteria, deliverables, and responsibilities for the UT examination are described in Pfluger 1999b.

#### 3.0 EXAMINATION EQUIPMENT DESCRIPTION

<u>P-scan</u> – P-scan is the name of the computerized pulse-echo UT inspection system used by the examination vendor. The P-scan system is manufactured by Force Institute in Denmark. It acquires data from zero and angle beam transducers mounted on the crawler, allows real-time analysis, and records the data in electronic memory for post inspection analysis. Force Institute has designated "P-scan mode" to represent the angle beam (flaw length) view and "T-scan mode" to represent the zero beam (thickness) view. T-scan mode is used for normal operation and, if crack-like indications are detected, the P-scan mode is employed. More information on the procedure for the P-scan system is found in Attachment 4.

<u>Crawler (UT Scanner)</u> – The crawler is a remotely-controlled device that delivers the UT sensors to the tank walls (Figure 2). It weighs approximately 30 pounds and has dimensions of approximately 21 inches wide x 18 inches long x 6 inches high. The crawler attaches to the tank wall with two pairs of magnetic wheels. A traveling bridge on the crawler is outfitted with UT sensors. As the crawler moves slowly forward the sensors glide from side-to-side over the tank wall surface. Water couplant is continuously fed to each transducer at a rate needed to maintain an acceptable signal.

Overview Camera – This camera was deployed to observe the area immediately around the inspection area and to aid crawler deployment in the annulus.

<u>Sideview Camera</u> – This camera and light system were installed in a riser adjacent to the inspection riser to provide an overall view of the inspection process.

<u>Data Acquisition Control Center</u> – A tent-type enclosure was erected to house the crawler controls, video monitors, and the data collection and evaluation hardware. The tent was located inside the tank farm boundary fence (Figure 2).

<u>Deployment Tool</u> – This device was specifically designed to insert and retrieve the scanner from the DST annular space. The scanner sits on a platform that is manually lowered to the appropriate elevation. That platform has cables attached that can be controlled to move the scanner platform into contact with the examination surface. The scanner is then driven onto the surface. The deployment tool is retracted until scanner removal is required.

#### 4.0 PERFORMANCE DEMONSTRATION TESTS

Prior to field use, COGEMA Engineering's UT examination system satisfactorily completed a performance demonstration test (PDT). The test was performed prior to examination of tank 241-AN-107 in FY 1998 (Pfluger 1999a). The test was conducted to qualify personnel, test procedures, and ensure the equipment's ability to detect and size wall thinning, pits, and cracks in a series of test plates with artificial and natural defects. The PDT was performed on a tank mockup in the 306E facility located in the Hanford site 300 area. This mockup also demonstrated the successful deployment and retrieval of the equipment. The Pacific Northwest National Laboratory report PNNL-12198 "Ultrasonic Examination of Double-Shell Tank 241-AN-105" provides a detailed report of the complete examination and includes a brief evaluation of the PDT.

#### 5.0 ULTRASONIC EXAMINATION DESCRIPTION

#### 5.1 Wall/Weld/Knuckle Inspection

The tank inspection was performed under Job Control System (JCS) work package 2E-98-02160/W during late calendar year 1998. All work steps, guidelines, procedures, personnel responsibilities, and protocol for the inspection (Pfluger 1999b) were included in the subject work package.

A remotely-controlled, steerable crawler was used to deliver the UT sensors to the tank wall. The crawler was deployed through a 24-inch annulus inspection riser number 6B. The crawler attached to the tank wall with two pairs of magnetic wheels. A traveling bridge on the crawler was outfitted with UT sensors. As the crawler moved slowly forward, the sensors glided from side-to-side over the inspection surface. Water couplant was continuously fed to each transducer at a rate needed to attain an acceptable signal. For examination of the wall, one dual element 0° transducer and two 45° shear wave transducers were used. To detect cracks perpendicular to welds, two opposing 45° shear wave transducers were directed parallel to the weld. To detect cracks parallel to the weld, a 60° shear wave transducer was directed towards the weld and a dual element 0° transducer was also included. Welds were examined from both sides of the weld crown.

#### 5.2 Secondary Tank Floor Inspection

The wall crawler was also used to inspect the 241-AN-105 tanks secondary bottom (floor). Prior to inspection, a vacuum cleaner was used to clean an approximately 9 sq. ft. area of the secondary tank floor. This allowed the transducers to achieve acceptable coupling to the floor for proper signal readings. The crawler scanned an area approximately 1 foot wide by 9 feet in length.

Data and images from both systems were returned to a control center located just inside the AN tank farm fence. The control center housed the crawler controls, video monitors, and data collection and evaluation software/hardware. The UT inspector continuously monitored the signal for reportable indications. The entire examination was viewed by a camera and lighting deployed in an adjacent riser.

#### 6.0 GENERAL REQUIREMENTS AND INSPECTION CRITERIA

The FY 1999 Performance Agreement TWR 6.3.1 is stated below:

"The contractor shall perform ultrasonic examination of four double-shell tanks (primary walls straight portion) to the extent described in HNF-2820, Rev. 1, "Engineering Task Plan for the Ultrasonic Inspection of Hanford Double-Shell Tanks". Completion is met when ultrasonic examination on four double-shell tanks is performed, a report of examinations observations is reviewed and approved by FDH, and the report is submitted to RL by July 31, 1999. The report shall include the extent of the examination, discussion of observations, findings, and conclusions."

Areas to be examined on the primary tank were identified in the SOW (Pfluger 1999b) as:

#### Primary Tank Wall:

- A vertical strip, approximately 30 inches wide by 35 feet long. The vertical strip may be comprised of one or more strips whose total width is approximately 30 inches. (The distance from the tank upper haunch transition to the lower knuckle is approximately 35 feet).
- 20 feet of the cylinder-to-lower knuckle weld.
- One vertical weld joining the lowest shell course plates (approximately 10 feet).
- One vertical weld joining the next to the lowest shell course plates (approximately 10 feet).

Additional work scope that was performed on both the primary and secondary tank but not directly tied to the performance agreement are:

#### Primary Tank Knuckle:

• An area approximately 20 feet long in the circumferential direction and, in the meriodional direction is from the weld joining the transition plate with the knuckle to the farthest reach of the transducer assembly that was allowed by the tank geometry.

#### Secondary Tank Bottom:

• An area covering 1 foot wide by 9 feet long was examined. The tank bottom was scanned between the primary and secondary walls for a total area of 9 sq. ft.

#### 7.0 INDICATION REPORTING CRITERIA

COGEMA Engineering was required to report to the customer the following anomalies (Pfluger 1999b):

- Wall thinning that exceeded 10% of the nominal plate thickness
- Pit depths that exceeded 25% of the nominal wall thickness
- Cracks in the primary tank wall that exceeded 0.18 inches in depth.

#### 8.0 EQUIPMENT SET-UP AT AN TANK FARM

Prior to performing the actual examination, the riser shield plug was removed and replaced with a sheetmetal cover.

A temporary structure, constructed of scaffolding, was erected around the riser to provide the means for deploying the UT equipment (Figure 2). A central I-Beam was secured to the top of the scaffolding and supported a single-line sheave. A manual cable winch was secured to the base with the cable running up to the sheave in a single-line hoisting method for maneuvering the equipment into position. The weather during the entire examination was cold to moderate. Some initial control center heating problems caused the equipment to malfunction but were addressed immediately. Once heat was restored, no further cold-weather problems were encountered. Due to the weather, a temporary structure was erected near the inspection riser. This "tent" was constructed of round tubing and covered with weather resistant material and housed the inspection overview video equipment, deployment tool and video monitor (Figure 2). The tent was used as the control center and provided adverse weather protection for the equipment and crew. The control cables were run along the ground to the equipment located at the riser. The cable was sleeved with plastic to prevent possible contamination

#### 9.0 EXAMINATION RESULTS

The Inspection Data Sheets and an interpretation of the data by a COGEMA Engineering Level III qualified inspector are included in Attachment 2. Tank 241-AN-105 (typical of all double-shell tanks) was fabricated from carbon steel plate.

The location of plates as identified in the PNNL report is as follows (See Attachment 1): Primary knuckle (top) – Connects dome of tank to sidewall.

<u>Primary wall</u> – Consists of (from top to bottom):

Plate #1 – approximately 7 feet, 8 inches tall, ½" nominal thickness

Plate #2 – approximately 7 feet, 8 inches tall, ½" nominal thickness

Plate #3 – approximately 7 feet, 8 inches tall, ½" nominal thickness

Plate #4 – approximately 9 feet tall, 3/4" nominal thickness

Plate #5 – approximately 2 feet tall, 7/8" nominal thickness

<u>Primary knuckle (bottom)</u> – Connects sidewall of tank to primary tank bottom. <u>Secondary tank floor</u> – The flat surface below the secondary knuckle (bottom) between the primary and secondary tank walls (annulus space).

All tank welds are in the "as-welded" condition. The primary tank's exterior surface varies from mill scale to a coating of rust caused by the normal weathering of carbon steel. The tank surface also contains chalk marks from hydrostatic test and miscellaneous material identifier markings from construction. In some places, streaks from concrete pouring can be found. The following pages contain tables that present the data as a percentage (%) of nominal wall thickness, which was derived from the "241-AN-105 Double-shell Tank Ultrasonic Examination Data Reports With Data sheets (Attachment 2) and Pacific Northwest National Laboratory report PNNL-12198 (Attachment 1) "Ultrasonic Examination of Double-Shell Tank 241-AN-105".

Table 1
Tank 241-AN-105 Ultrasonic Examination
Primary Tank Wall, Scan 1 (Attachment 2)

Plate	Design Nominal Thickness (inches)	Measured Minimum Thickness (inches)	% Wall Thinning
Plate #1 (upper)	0.50	0.465	7.0% of nominal thickness
Plate #2	0.50	0.413	17.4% (Additional scanning performed. See "Additional Passes" table below)
Plate #3	0.50	0.494	1.2% (See "Additional Passes" below)
Plate #4	0.75	0.729	2.8% of nominal thickness
Plate #5 (lower)	0.875	0.874	0.1% of nominal thickness

Table 2
Tank 241-AN-105 Ultrasonic Examination
Primary Tank Wall, Scan 2 (Attachment 2)

Plate	Design Nominal Thickness (inches)	Measured Minimum Thickness (inches)	% Wall Thinning
Plate #1 (upper)	0.50	0.452	9.6% of nominal thickness
Plate #2	0.50	0.400	20.0% (Additional scanning performed. See "Additional Passes" table below)
Plate #3	0.50	0.518	None detected (See "Additional Passes" below)
Plate #4	0.75	0.729	2.8% of nominal thickness
Plate #5 (lower)	0.875	0.905	N/A

Table 3
Tank 241-AN-105 Ultrasonic Examination
Primary Tank Wall, Plates 2 and 3
Additional Scans (Attachment 2)

Plate	Design Nominal Thickness (inches)	Measured Minimum Thickness (inches)	% Wall Thinning
Plate #2 (top)	0.50	0.448	10.4% (See Note 1)
Plate #2 (mid)	0.50	0.420	16.0% (See Note 1)
Plate #2 (bottom)	0.50	0.426	14.8% (See Note 1)
Plate #3 (top)	0.50	0.480	4.0% (See Note 2)
Plate #3 (mid-top)	0.50	0.480	4.0% (See Note 2)
Plate #3 (mid)	0.50	0.480	4.0% (See Note 2)
Plate #3 (bottom)	0.50	0.495	1.0% (See Note 2)

Table 4  Tank 241-AN-105 Ultrasonic Examination  Secondary Tank Floor and Primary Knuckle Scans (Attachment 2)					
Pate/Area	% Wall Thinning				
Secondary Floor Plate	0.50	0.499	0.2% of nominal thickness		
Primary Knuckle	0.875	0.896	N/A		

Table 5 Tank 241-AN-105 Ultrasonic Examination Horizontal and Vertical Primary Tank Weld Scans (Attachment 2)					
Weld	Design Nominal Thickness (inches)	Measured Minimum Thickness (inches)	% Wall Thinning		
Vertical Plate #3	0.50	0.475	5% of nominal thickness		
Vertical Plate #4	0.75	0.711	5.2% of nominal thickness		
Vertical Plate #5	0.875	0.843	3.7% of nominal thickness		
Horizontal Plate #5 to Knuckle	0.875	0.821	6.2% of nominal thickness		

Note 1: PNNL evaluated the data and concluded some wall thinning/corrosion is present. PNNL also concluded some pit-like corrosion exists. Refer to PNNL-12198 "Ultrasonic Examination of Double Shell Tank 241-AN-105" (Attachment 1).

Note 2: Additional scans were requested due to the plate thickness differences indicated in the first two vertical scans. PNNL evaluated the data and concluded surface roughness caused the indicated plate thickness difference.

Note 3: Although the data is reported to three decimals, the accuracy of the data, based on the results of the performance demonstration test is;  $\pm$  0.020 inch for wall thickness.

#### 10.0 EVALUATION OF EXAMINATION RESULTS

The results of the Tank 241-AN-105 UT examination indicated some wall thinning with no cracks detected. Attachment 1 contains the report prepared by Pacific Northwest National Laboratory (PNNL) that analyzes the data gathered from Tank 241-AN-105. Figure 1 shows the history of waste level matched with the "as-found" measurements of the primary tank wall generated from the inspection data sheets (Attachment 2). Each wall thickness measurement plotted on the figure is the average of all data collected over a 1-foot long by 15-inch wide scan area. Areas of interest are the vapor space above the waste, the liquid-vapor interface, the liquid region, the liquid-solids interface, and the solids region. The average measured wall thickness showed some indication of thinning at the lower 2 feet of plate 1 and all of plate 2.

PNNL UT examination experts independently evaluated (Attachment 1) the hard copy scans and inspection data sheets and concurred with the COGEMA Engineering interpretation (Attachments 2). The following is a summary of the results associated with the areas examined. The data have been reviewed and approved by W. H. Nelson, COGEMA Engineering Level III qualified inspector (Attachment 2):

#### Primary Tank Wall Thinning/Pitting/Corrosion/Cracking:

- Some thinning is occurring in primary tank wall plates #1 and #2. The additional plate #2 scans (horizontal) pass over a vertical weld at about 15 to 16 feet from the beginning of the scan. Thinning was detected in both plates #1 and #2.
- In addition to the general thinning, localized thinning is also occurring. The thinnest area identified is 0.40 inch wall thickness.
- Scans of the heat affected zones (HAZ) in Plate #3, #4, #5, and the knuckle revealed no corrosion, pitting, or crack-like indications.
- No crack-like indications were detected in the horizontal and vertical welds.

Note: The initial vertical scans (pass 1 and 2) showed a marked difference in thickness between the two scans. Additional scans were performed to determine the cause of the scanned thickness difference. Detailed analysis determined that surface roughness and/or coupling water variances resulted in unreliable data in the first vertical scan.

#### Primary Tank Knuckle:

• This region was inspected to the full extent of the mechanical scanning arm. No thinning, pits, or cracks were found.

Secondary Floor between Primary and Secondary Tanks:

No thinning, pitting or crack-like indications were detected.

#### 11.0 FINDINGS AND CONCLUSIONS

- The general wall thinning as measured in plates one and two is unexpected since the tank waste chemistry is within the corrosion control waste specification limits. In addition, presuming an in-service corrosion mechanism is at work, we would expect plate three, immediately below plate two, to have experienced in-service corrosion as well. The lack of any measurable corrosion in plate three is not consistent with the presumption. Nevertheless, the amount of wall thinning observed is minor. It is recommended that a corrosion assessment be performed and that the tank be reexamined periodically. The installation of corrosion probes should be considered as a way to determine if the tank is actively corroding.
- There is no correlation between the various waste zones and the corrosion measured in Plate #1 and #2. The vapor region, the liquid-vapor interface, the liquid region, the liquid-sludge interface, and the sludge region did not produce any corrosion pattern that can be attributed to these regions.
- The absence of cracks in the plate and weld HAZ indicates that the pre-service material quality control, weld stress relief treatment, and waste chemistry controls have been effective in preventing cracks.
- Based on visual observations in the tank annulus, the secondary tank liner appears to
  be uniformly corroding from the inside. The tank condition is similar to that observed
  during earlier visual inspections of Tank 241-AN-105 (Walter 1993). Corrosion asindicated by the UT scans is determined to be from the inside surface because the
  visual of the outer surface did not reveal the type of thinning as seen in the data.
- Additional tanks should be examined to determine if the corrosion that was observed in tank 241-AN-105 is unique. To select the additional tanks, the results of all tank UT examinations should be considered. In addition, the reason tank 241-AN-105 was selected for inspection (gas retention characteristics) should be considered.
- The rough outside tank surface and weld spatter reduced the quality of the inspection data. Wire brushing or otherwise cleaning the surface would improve the performance of the UT system.

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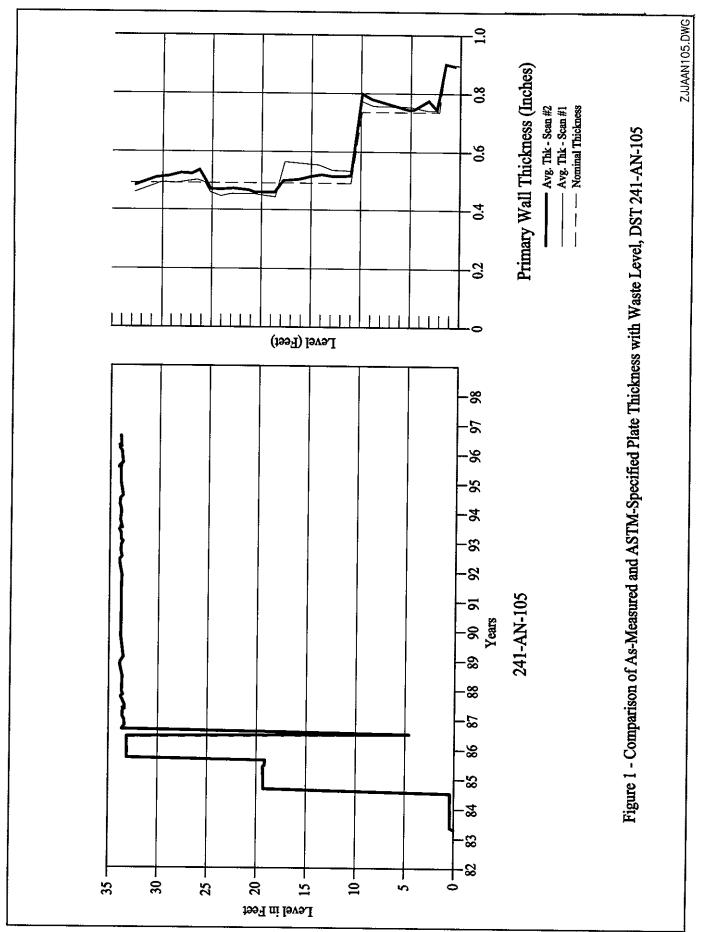
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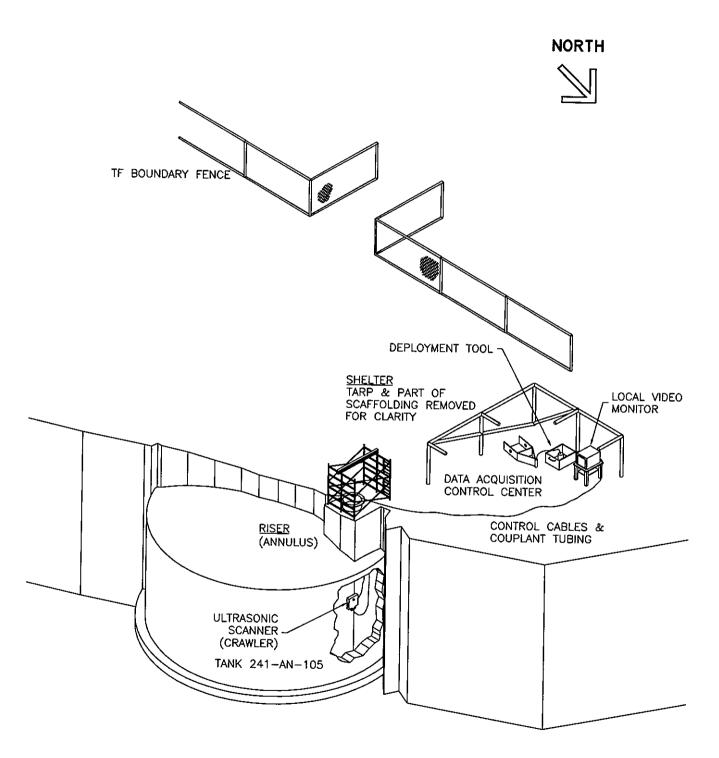


Figure 2 - Schematic of Inspection Set-up 241-AN-105

# **ATTACHMENT 1**

Ultrasonic Examination of Double-Shell Tank 241-AN-105

PNNL-12198

# Ultrasonic Examination of Double Shell Tank 241-AN-105

G. J. Posakony A. F. Pardini

June 1999

Prepared for Lockheed Martin Hanford Corporation Richland, WA 99352

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### Summary

COGEMA Engineering Corporation (COGEMA), under a contract from Lockheed Martin Hanford Corporation (LMHC), has performed an ultrasonic examination of selected portions of Tank 241-AN-105. The purpose of this examination was to provide information that could be used to evaluate the integrity of the wall of the primary tank. To implement the examination, COGEMA contracted with Swain Distribution, Inc. (Swain) of Searcy, Arkansas, for the qualified personnel, ultrasonic instrumentation, and remote-controlled mechanical crawler that were to be used in performing this examination. The equipment provided by Swain included the Force Industries, Inc. P-Scan Model PSP-3 ultrasonic flaw detector system and the Force Industries AWS-5 remote-controlled, magnetic-wheel mechanical crawler. These are the same ultrasonic and mechanical systems used previously for the ultrasonic examination of Tanks 241-AW-103, and -AN-107. COGEMA's Mr. Wesley Nelson, ASNT Certified Level III in ultrasonic testing (UT), was the UT Level III authority for this project.

Based on examination requirements provided by LMHC outlining the criteria for examination of the double shell tanks, Swain staff developed the ultrasonic examination procedure for performing the in-tank inspection for Tank 241-AN-105. Verification of the technical qualification of the Swain personnel, their examination procedure, and their ultrasonic system was achieved by having their staff satisfactorily pass a special Performance Demonstration Test (PDT) that was administered by staff from the Pacific Northwest National Laboratory (PNNL).

In developing the PDT for Tank 241-AN-107, COGEMA provided the mockup test vessel. The test specimens used in this PDT were designed to simulate wall thinning, corrosion and cracks in the heat-affected zone (HAZ) of welds that might be present in double-shell tanks. Data recorded from Tank 241-AN-107 were used to qualify the Swain analyst for performing the examination of Tank 241-AN-105. PNNL staff developed the acceptance criteria and evaluated the results developed by the analyst. The Swain analyst successfully performed the PDT.

The ultrasonic examination of 241-AN-105 was designed to detect wall thinning, pit corrosion and cracks in the primary tank wall. It was also designed to detect cracks, wall thinning and pitting in the HAZ of welds in the wall of the primary tank. Figure S.1 illustrates the two initial vertical ultrasonic scan paths performed on the primary wall of the tank.

There are five plates in the primary tank. The top three plates (Plates #1, #2, and #3) are nominally 8-ft high and 0.500-in. thick. Plate #4 is nominally 9-ft high and 0.75-in. thick. Plate #5 is a transition plate to the tank knuckle and is nominally 2-ft high and 0.875-in. thick. The examination was initiated by maneuvering the magnetic-wheeled crawler through the 24-in. riser to the top weld of the tank and scanning downward. Initially, two 15-in. wide vertical scan paths, separated by approximately 6.0 in.,

<sup>&</sup>lt;sup>1</sup> All historical dimensioning for the design, development and construction of this tank are in English units; consequently, English units are the primary units used in this report. For conversion to metric, use 1.0 in. equals 25.4 mm.

Ι

were made of the full 35-ft height of the tank. The data from the ultrasonic examination was acquired by the ultrasonic system, documented by the Swain analyst, and validated by the COGEMA UT Level III. The summary results are outlined below and details are found in the body of the report.

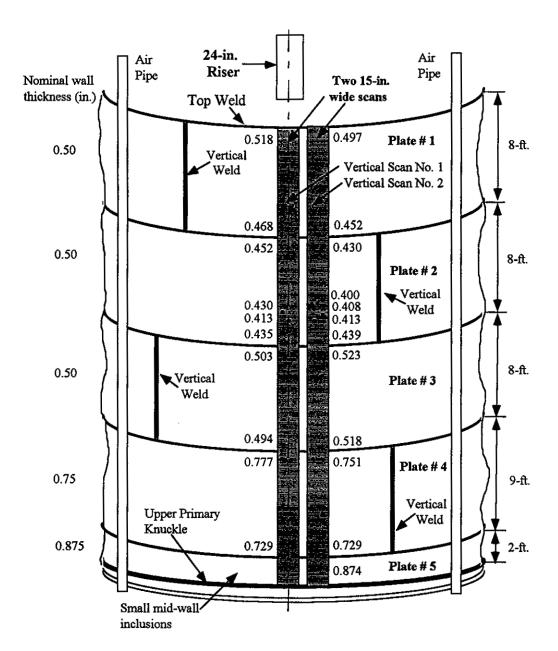


Figure S.1. Sketch of the UT Vertical Scan Paths No. 1 and No. 2 on Primary Tank 241-AN-105(a)

<sup>(</sup>a) All of the values in the graphics and tables describing ultrasonic thickness values have been digitally derived. Neither the ultrasonic system nor the encoder has the precision implied by the number of decimals. The values that were logged by the analyst were taken from information recorded by the system's software calculator.

- Plate #1—Scan Path No. 1—the ultrasonic data showed some general wall thinning/corrosion throughout the plate. The 1-ft section below the top weld showed the wall thickness to be 0.518 in. This thickness gradually reduced to 0.465 in. near the weld between Plates #1 and #2. Wall thickness values are shown in the Figure S.1 near the top and bottom on the plates.
- Plate #1—Scan Path No. 2—the ultrasonic data in this scan path showed the 1-ft section below the top weld to have a thickness of 0.479 in. This thickness decreased to 0.452 in. near the weld between the first and second plate.
- Plate #2—Scan Path No. 1—the ultrasonic data showed a wall thickness at the weld between Plates #1 and #2 to be 0.452 in. decreasing to 0.439 at the weld between Plates #2 and #3. However, there are several additional indications of wall thinning in the plate. Between 13 and 14 ft below the top weld, a small pit-like/corrosion indication was recorded at 0.430 in. Between 14 and 15 ft below the top weld a small pit-like/corrosion indication was recorded to be 0.413 in. The approximate locations of the pit-like/corrosion indications are shown as individual spots in Figure S.1.
- Plate #2—Scan Path No. 2—the data showed a wall thickness of 0.430 in. at the top and 0.439 in. at the bottom of the plate. However, between 13 and 14 ft below the top weld, a pit-like/corrosion indication was recorded at 0.400 in. Between the 14 and 15-ft level pit-like/corrosion indications of 0.408 and 0.413 in. were recorded. There also were other randomly spaced pit-like/corrosion indications throughout the lower half of this plate but none had thinner wall measurements than those identified. The approximate locations of these pit-like/corrosion indications are shown as spots in Figure S.1.
- Plate #3—Scan Path No. 1—the ultrasonic data from the vertical Scan Path showed the wall thickness ranging from 0.503 to 0.494 in.
- Plate #3—Scan Path No. 2—the ultrasonic data from the vertical Scan Path showed the wall thickness ranging from 0.523 to 0.518 in.

Note: Plate #3—Scan Path No. 1 of this plate initially recorded data indicating wall thicknesses ranging from 0.435 to 0.448 in., but Scan Path No. 2 recorded the plate as having near nominal thickness. Further investigations revealed a measurement error caused by abnormal acoustic noise from the surface roughness of the tank wall. To determine why there was a difference between the two scan paths, several additional scan paths in the horizontal (circumference) direction were made. These scans verified that the wall thickness of Plate #3 was near the nominal thickness of 0.50 in. Additional details, graphics and thickness tables are given in the text.

• Plate #4—Scan Paths No. 1 and No. 2—the ultrasonic data showed the total thickness measurements ranged from a minimum of 0.729 to a maximum 0.777 in.

- Plate #5—Scan Paths No. 1 and No. 2—the ultrasonic data showed the thickness to be 0.874 in. There were some mid-wall inclusions located in this plate. Their mid-wall location was verified by ultrasonic time-of-flight measurements.
- In addition to reporting the wall thinning/corrosion in Plates #1 and #2, the operator reported that the external surface of the primary tank was quite rough causing some anomalous responses on the record. Further, small pit-like/corrosion indications were scattered through the inner wall of the tank in Plates #1 and #2, but only the deepest in any one 1-ft by 1-ft area was recorded on the hard-copy record and listed on the data sheets.
- From the ultrasonic data obtained in these examinations, it would appear that the integrity evaluation made on this tank should be based on the affect of the wall thinning/corrosion that is recorded for Plate #1 and Plate #2. No other defects or anomalies were found that would indicate areas of concern for the integrity of this tank.

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## 1.0 Overview of the Ultrasonic Technology (UT)

Two ultrasonic inspection techniques were used to characterize wall thinning, pitting and cracking in the wall of the primary tank. The first inspection involved generation of short bursts of high-frequency ultrasonic energy from a zero degree (straight beam) ultrasonic transducer that propagated an acoustic beam straight into the wall to detect changes in wall thickness. The second inspection involved a short burst of high-frequency ultrasonic energy from a pair of ultrasonic angle-beam transducers that propagated their beams at ±45-degree angles in the tank wall. These angled beams are designed to detect cracks and/or to verify the presence of corrosion pits that have any significant depth. In scanning the wall of the tank, all three transducers are attached to the bridge of the AWS-5 remote-controlled, magnetic-wheel mechanical crawler. The three transducers are multiplexed to obtain the information on wall thickness, cracking in the wall of the tank, defects in the heat affected zones of welds, and to verify the presence of corrosion detected by the wall thickness examination. From a technical viewpoint, the ultrasonic system (electronics, transducers and mechanical crawler) can provide A-scan (time of flight), B-scan (cross-section) and C-scan (area) displays or images of the anomalies in the tank. These data are developed as the ultrasonic transducers traverse the wall of the tank.

The initial step in performing an examination is to perform a system calibration. In accordance with the ultrasonic examination procedure, this calibration is completed at the start of an examination and repeated following completion of any segment of the examination but not exceeding 12 hours. This procedure ensures that the system has operated consistently through that portion of the examination.

To perform the examination, the crawler and transducer assembly is positioned over the 24-in. riser, lowered into the annulus between the primary and secondary tanks and oriented so the magnetic wheels attach to the tank wall. Once attached, the position and location of the crawler can be maneuvered to operate in vertical, horizontal or angled directions using the remote-control joy-stick. The mechanical crawler and transducer network that go into the tank are interconnected to the main ultrasonic, data acquisition and control systems that may be several hundred feet from the tank being examined.

After being positioned directly below the 24-in. riser, the first scan performed was a vertical Scan Path No. 1 (see Figure S.1). This scan examined the 35-ft tank wall from the top weld between Plate #1 and the tank dome (top) to the bottom knuckle weld in Plate #5. For the second vertical scan path, the crawler was maneuvered to a line adjacent to the first scan path and a new vertical examination was performed. In Tank 241-AN-105, the mechanical system (crawler and transducer assembly) was adjusted to provide a mechanical scan path width of 15 in. In performing the scan, the transducer assembly was traversed at a constant rate over the 15-in. width of the scanning bridge on the mechanical crawler. Data were taken continuously as the transducer assembly traversed the wall of the tank. (a) Following each traverse, the crawler and transducer assembly were indexed a small increment down the tank wall. This process was repeated until data from the full 35-ft height of tank was recorded. The data from each

<sup>(</sup>a) Note: While the mechanical scanner assembly traversed a full 15-in. swath, the ultrasonic system acquired data only over a 12-in. distance. Thus data from each of the C-scan plots record an area that is 12-in. wide by 12-in. long instead of 15-in. wide and 12-in. long as was anticipated.

transverse and index were divided into pixels to record the position of any anomalies. In Scan Paths No. 1 and No. 2, the size of each pixel in the traverse direction (circumferential) was 0.133 in. In the vertical (index) direction the pixel size was 0.096 in. Thus data were acquired for each 0.133-in. by 0.096-in. pixel area in the scan path. In thickness measurements, the ultrasonic system recorded only the minimum measurement value in each pixel. These values were stored in the ultrasonic system's memory to be post analyzed. The angle beam plots are designed to provide additional information concerning depth of cracks and the presence of significant pitting detected by the straight beam ultrasonic transducer.

# 2.0 Results of Wall Thickness Measurements on the Primary Tank Wall of Tank 241-AN-105

The ultrasonic inspection procedure developed for the examination of the tank wall defined a requirement that the analyst was to locate, size and record the thinnest point(s) in each 1-ft area. The hardcopy report developed from the P-Scan Ultrasonic System provides a color plot of the data acquired. For vertical Scan Paths No. 1 and No. 2, data from a 12-in. by 12-in. area was recorded for each vertical foot of the tank examined. Several measurements are made at each pixel location, but the value recorded in each pixel is the single (not average) minimum value measured. These area plots (C-scans) provide the location and distribution of anomalous indications (wall thinning, pitting, cracks, etc.). The system also provides a B-scan cross-section view of the same area. The analyst uses both views, along with other software, to determine remaining wall thickness at any scanned area. The analyst records the minimum values manually on the "Automated Ultrasonic Thickness Data Report." Typical data from the Automated Ultrasonic Thickness Data Report are shown in Tables 1 through 8.

The nominal wall thickness of Plates #1 and #2 is listed as 0.500 in. The data in Table 1 shows the minimum wall measurements made in these plates. General wall thinning/corrosion can be observed in Table 1 but no wall measurement was recorded as thinner than 0.452 in. In review of the raw data from Plate #1, there are many regions that showed small, inner-wall, pit-like/corrosion indications, but none were thinner than 0.452 in. The analyst was not required to provide details describing areas where the remaining wall thickness was greater than 0.450 in. (90% of nominal thickness).

However, the data shown in Table 2 for Plate #2 shows several small pit-like areas in both Scan Paths No. 1 and No. 2 that were less than 0.450 in. thick (90% of the nominal thickness of 0.50 in.). A measurement of 0.400 in. was recorded in Scan Path No. 2 in the 12-in. by 12-in. area at the 13 to 14-ft level below the top weld of the tank. The 45-degree angle-beam inspection did not detect this spot, indicating the spot was shallow with respect to the surrounding area or was too small to reflect sufficient ultrasonic energy to be detected.

Table 1. Data from the Vertical UT Scan Paths on the Primary Tank Wall, Plate #1

	Minimum Wall Thickness Indication in Vertical Scan Path No. 1		Minimum Wall Thickness Indication in Vertical Scan Path No. 2		
Distance from the Top Weld (ft)	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded	
0 to 1	0.518	*	0.479	*	
1 to 2	0.518	*	0.497	*	
2 to 3	0.505	*	0.479	*	
3 to 4	0.505	*	0.465	*	
4 to 5	0.492	*	0.474	*	
5 to 6	0.479	*	0.465	*	
6 to 7	0.465	*	0.452	*	
7 to 8	0.465	*	0.452	*	
*No areas were recorded that were thinner than 0.450 in. (90% of the nominal 0.50-in, wall thickness).					

Table 2. Data from the Vertical UT Scan Paths on the Primary Tank Wall, Plate #2

	Minimum Wall Thickness Indication in Vertical Scan Path No. 1		Minimum Wall Thickness Indication in Vertical Scan Path No. 2	
Distance from the Top Weld (ft)	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded
8 to 9	0.452		0.430	not in the record
9 to 10	0.452		0.435	not in the record
10 to 11	0.452		0.439	not in the record
11 to 12	0.448	2 small spots	0.426	0.480 by 0.784
12 to 13	0.430	several small areas	0.430	0.192 by 0.266
13 to 14	0.430	several small areas	0.400	0.192 by 0.133
14 to 15	0.413	several small areas	See Scan Path No. 1	
14 to 15	See Scan Path No. 2		0.408	0.192 by 0.133
14 to 15	See Scan Path No. 2		0.413	0.192 by 0.265
14 to 15	See Scan Path No. 2		0.413	0.192 by 0.265
15 to 16	0.435	multiple small areas	0.439	0.480 by 0.929

The analyst noted several random pit-like/corrosion indications in Scan Path No. 1 throughout the 11 to 16-ft levels in Plate #2 that fell below 0.450-in. (90% of the nominal wall thickness). The minimum measurement values are noted in the Table 2.

In Plate #2, the vertical scans showed areas that were thinner than 0.450 in. However, from these scans, the extent of wall thinning that might be present in the circumferential direction around the tank could not be determined. As a result, further investigations were pursued. Figure 2.1 shows two vertical and the three horizontal (circumferential direction on the tank) scan paths made to investigate the wall thickness measurements in the plate. The data acquired in the horizontal scan paths were 12-in. wide and 25-ft long. Hard copy, C-scan plots were made for each foot of the horizontal scans.

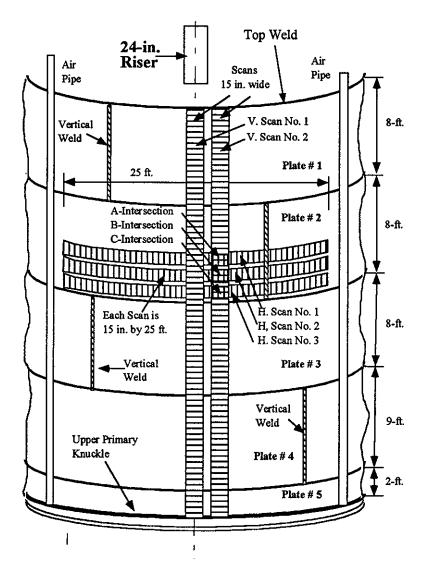


Figure 2.1. Sketch of Vertical and Horizontal Ultrasonic Scan Paths of the Wall of Plate #2 on the Primary Tank of Tank 241 AN-105

One of the regions of interest was the horizontal scan 13 to 14 ft from the top weld (6 ft below the weld between Plate #1 and #2) where the vertical scan measured a minimum wall thickness of 0.400-in. To obtain the data in the horizontal direction, the magnetic wheel crawler was maneuvered so that it was positioned at the left air pipe with the transducer assembly positioned so it could inspect the plate in the circumferential direction. Data was taken as the crawler indexed to the right air pipe shown in the sketch. The location of the air pipes with respect to the 24-in. riser was not clearly established and the physical size of the remote crawler made it difficult to locate the intersection of the vertical and horizontal scan paths. Table 3 shows the thicknesses recorded for the three 25-ft scan paths. From the data in Table 3 it appears that the thinnest areas are near the 10.5-ft and 11.5-ft distance from the air pipe. The 0.400-in. thickness measured in the vertical scan path was not detected, but several spots that were less than 0.450 in, were recorded in Scan Paths No 2 and 3.

Table 3. Results Recorded for the Three Horizontal Scan Paths in Plate #2

	Minimum Wall	Minimum Wall	Minimum Wall
Distance	Thickness Value in	Thickness Value in	Thickness Value in
from the Air	Horizontal Scan	Horizontal Scan	Horizontal Scan
Pipe (ft)	Path No. 1 (in.)	Path No. 2 (in.)	Path No. 3 (in.)
1.5	0.483	0.480	0.452
2.5	0.490	0.475	0.501
3.5	0,495	0.473	0.474
4.5	0.503	0.495	0.492
5.5	0.498	0.495	0.426
6.5	0.498	0.495	0.444
7.5	0.490	0.450	0.452
8.5	0.448	0.475	0.465
9.5	0.468	0.473	0.465
10.5	0.483	0.420	0.430
11.5	0.483	0.428	0.496
12.5	0.483	0.458	0.452
13.5	0.475	0.505	0.435
14.5	0.473	0.480	0.474
15.5	0.483	0.480	0.474
16.5	0.480	0.495	0.487
17.5	0.480	0.480	0.474
18.5	0.473	0,485	0.474
19.5	0.473	0.480	0.509
20.5	0.468	0.480	0.509
21.5	0.473	0.468	0.514
22.5	0.475	0.473	0.509
23.5	0.475	0.423	0.514
24.5	0.475	0.475	0.505
25.5	0.473	0.468	0.514

In an initial attempt to characterize the measurements in the area at the 13 to 14-ft level of the vertical Scan Path, a manual pixel-by-pixel plot was generated. This proved to be successful in gaining an understanding of the nature of the corroded spots but was so labor intensive that it was not considered practical for other areas of in the horizontal (circumferential direction). Subsequently, Swain Distribution, Inc. loaned COGEMA a software program that provided an automated means for transferring the P-Scan Path data from selected areas to an Excel spreadsheet. This permitted rapid characterization of the wall thickness values for each pixel of Plate #2, Scan Path No. 2. PNNL staff members used the software program and develop a series of plots to characterize the nature of the minimum wall thickness areas. This software program provided a means for displaying a global view of the 12 by 12-in area of interest and it provided the information used to develop orthogonal line profiles of vertical and horizontal data. The area and line plots provided a better interpretation of the condition of the inner surface of the tank wall and a better characterization of the remaining wall thickness.

Figure 2.2 is a C-scan view of the 12-in. by 12-in. area containing the 0.400-in. indication.(see Table 2, Scan Path No. 2 at 13 to 14-ft level below the top weld). The information is taken from the 0-degree beam record. In the figure, the numbers on the abscissa values (60.069 in. to 71.493 in.) are incremental (or index) steps of the 1-ft vertical distance measured from the weld between Plate #1 and #2. The ordinate (2.885 to 14.988) is the traverse or circumferential distance on the tank wall (horizontal distance in graphic). The position data are obtained from the encoder on the AWS-5 mechanical crawler.

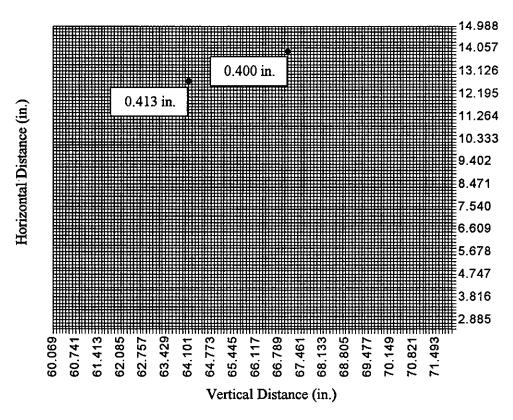


Figure 2.2. Global View of the 1-ft Area Containing two Minimum Wall Thickness Indications in the Wall of the Primary Tank (Scan Path No. 2 of Plate #2)

Only one minimum thickness indication (0.400 in.) was recorded in this 1-ft by 1-ft area in Table 1, but a second indication (0.413 in.) is shown in Figure 2.2. The analyst recorded only the minimum value but the C-scan plot shows that more than one pit-like indication can be present. To characterize both of the indications, orthogonal horizontal and vertical line profiles were generated from the information in the Excel spread sheet.

Figure 2.3 shows a 1-ft-long line profile through the 0.400 indication in the vertical axis (index direction). Figure 2.4 shows a 1-ft-long line profile through the 0.400 indication in the horizontal axis (traverse direction). Because of the way the P-Scan Path ultrasonic system was programmed, the pixel sizes in the horizontal and vertical axis were different. The pixel size in the horizontal axis is 0.133 in. The pixel size in the vertical axis is 0.096 in. Table 2 shows the area of the pit-like/corrosion indication as 0.192 in. by 0.133 in.

Figures 2.5 and 2.6 are line profiles of the 0.413 pit-like/corrosion indication. The pit-like/corrosion indication in the vertical axis (index direction) is approximately 3 pixels or 0.288 in. The pit-like/corrosion indication in the horizontal axis is approximately 4 pixels or 0.532-in. The area of the pit-like indication is estimated at 0.288 in. by 0.532 in.

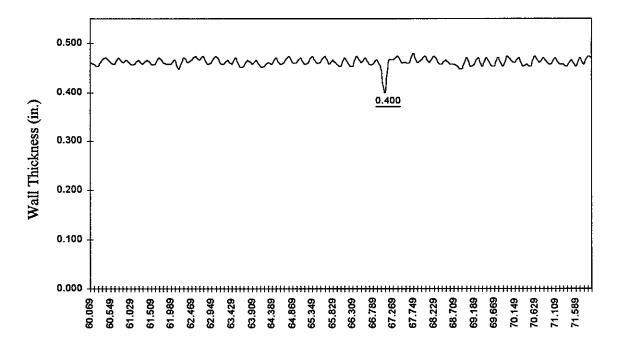


Figure 2.3. Line Profile through the Vertical Axis (index direction) of the Pit-Like/Corrosion 0.400-in. Minimum Wall Indication in Primary Tank Plate #2 of Tank 241-AN-105

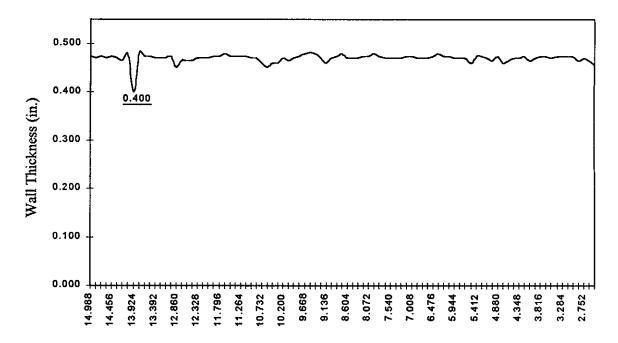


Figure 2.4. Profile through the Horizontal Axis (traverse direction) of the Pit-Like/Corrosion 0.400-in. Minimum Wall Indication in Primary Tank Plate #2 of Tank 241-AN-105

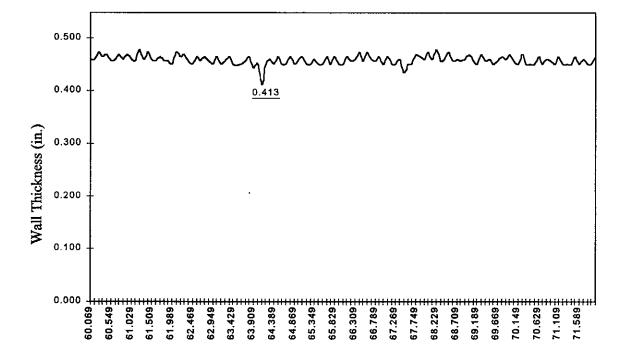


Figure 2.5. Profile through the Vertical Axis (index direction) of the Pit-Like/Corrosion 0.413-in. Minimum Wall Indication in Primary Tank Plate #2 of Tank 241-AN-105

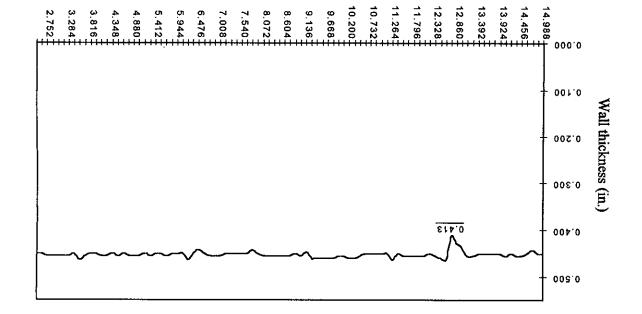


Figure 2.6. Profile through the Horizontal Axis (traverse direction) of the Pit-Like/Corrosion 0.413in. Minimum Wall Indication in Primary Tank Plate #2 of Tank 241-AN-105

The nature of these line profiles is typical of other profiles obtained from the data in the various Excel spreadsheets. As seen in Figures 2.3 to 2.6, there appear to be modest thickness changes from pixel to pixel with an occasional deeper pit-like/corrosion indication. In analyzing the data from the Excel spreadsheet for the vertical scan paths in the 13 to 15 ft. level below the top weld, all of the pit-like/corrosion indications appear to be randomly distributed and quite small.

The initial Scan Paths No. I and No. 2 on Plate #3 (made December 31, 1998) showed a notable difference between the two scans. The wall thickness measurements in Scan Path No. I ranged from 0.448 in. at the top of the plate to 0.435 in. at the bottom. Scan Path No. 2 showed a wall thickness ranging from 0.523 in. at the top of the plate to 0.518 in. at the bottom of the plate. Since the two scan paths were only 6-in. apart, it became important to establish that the difference did exist. The initial thought was that there was a weld between the two scan paths, but no weld was visible on the video camera. To establish the actual condition of the plate, four horizontal (circumferential) scan paths were made. Figure 2.7 shows the configuration of the Plate #3 scans.

Each of the horizontal scan paths was 4-in, wide and 25-ft long. The mechanical scanner was maneuvered to inspect the plate in the circumferential direction and was positioned to start the scan at the air pipe. The data from these scans are shown in Table 4. The results of these scans established that there was not a step change between Scan Paths No. 1 and No. 2.

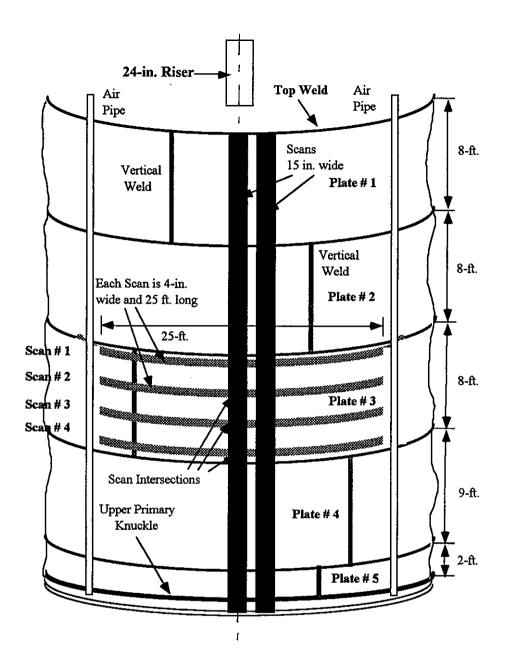


Figure 2.7. Sketch of the Vertical and Horizontal Ultrasonic Scan Path Paths on the Wall of the Primary Tank in Tank 241-AN-105

The horizontal scan #1 (see sketch on Figure 2.7) data showed a wall thickness ranging from 0.495 to 0.520 in. across the full 25-ft length of the scan path. Horizontal scan #2 showed a wall thickness ranging from 0.490 to 0.515 in. across the full length. Scan #3 showed a wall thickness ranging from 0.480 to 0.508 in., and scan #4 showed a wall thickness ranging from 0.480 to 0.528 in. across the full length of the scan.

Table 4. Results Recorded for the Four Horizontal Scan Paths in Plate #3

Distance	Minimum Wall	Minimum Wall	Minimum Wall	Minimum Wall		
from the	Thickness Value in	Thickness Value in	Thickness Value	Thickness Value		
Air Pipe	Horizontal Scan	Horizontal Scan	in Horizontal Scan	in Horizontal Scan		
(ft)	Path No. 1 (in.)	Path No. 2 (in.)	Path No. 3 (in.)	Path No. 4 (in.)		
1.5	0.495	0.503	0.508	0.490		
2.5	0.498	0.503	0.488	0.480		
3.5	0.498	0.503	0.480	0.490		
4.5	0.513	0.503	0.480	0.490		
5.5	0.520	0.513	0.495	0.495		
6.5	0.520	0.503	0.495	0.495		
7.5	0.500	0.498	0.480	0.495		
8.5	0.503	0.495	0.498	0.495		
9.5	0.520	0.508	0.500	0.503		
10.5	0.498	0.505	0.503	0.523		
11.5	0.498	0.500	0.500	0.520		
12.5	0.503	0.515	0.498	0.523		
13.5	0.503	Signal interrupted	0.503	0.528		
•		by thermocouple				
14.5	0.503	0.523	0.505	0.523		
15.5	0.505	0.505	0.505	0.508		
16.5	0.505	0.503	0.505	0.480		
17.5	0.505	0.490	0.508	0.495		
18.5	0.503	0.480	0.488	0.500		
19.5	0.503	0.488	0.495	0.490		
20.5	0.503	0.490	0.490	0.490		
21.5	0.503	0.493	0.483	0.495		
22.5	0.503	0.498	0.488	0.488		
23.5	0.503	0.498	0.483	0.498		
24.5	0.498	0.500	0.480	0.490		
25.5	0.505	0.495	0.483	0.503		

To further resolve the question of the difference between the initial vertical Scan Paths No. 1 and No. 2, a re-scan of Scan Path No. 1 was performed. The wall thickness values for this new scan (which was directly below the riser) is tabulated in Table 5. The table shows the wall thickness, based on the horizontal scans and the repeat of Scan Path No. 1, ranges from a minimum of 0.494 in. to a maximum of 0.503 in. In analyzing the cause for the initial discrepancy, the conclusion reached by the technical reviewers from COGEMA, Swain, and PNNL was that the error was caused by a rough surface condition that resulted in inadequate acoustic coupling between the transducer and the tank wall. This generated excessive acoustic noise that caused the electronic gate in the ultrasonic system to become unstable and to record in error. Since the in-calibration and out-calibration showed that the system was operating

correctly, and the data from the additional scans did not show abnormal wall thickness, the team is confident that there is little corrosion in Plate #3.

Table 5. Finalized Data from the Vertical UT Scan Paths on Primary Tank Wall, Plate #3

		Thickness Indication Scan Path No. 1	Minimum Wall Thickness Indication in Vertical Scan Path No. 2					
Distance from the Top Weld (ft)	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded				
16 to 17	0.494	No values were	0.523	No values were				
17 to 18	0.494	recorded that	0.523	recorded that				
18 to 19	0.494	were less than	0.523	were less than				
19 to 20	0.494	90% of the	0.523	90% of the				
20 to 21	0.503	nominal	0.523	nominal				
21 to 22	0.494	wall	0.518	wall				
22 to 23	0.494	thickness	0.518	thickness				
23 to 24	0.503		0.518					

Table 6 shows the data recorded for vertical Scan Paths No. 1 and No. 2 on Plate #4. The minimum wall thickness recorded was 0.729 in. and the maximum was 0.751 in. No crack-like indications were detected in either of these scans. The variations appear to be within the allowances in manufacturing tolerance of steel plates of this type.

Table 6. Data from the Vertical UT Scan Paths on Primary Tank Wall, Plate #4

	•	Thickness Indication Scan Path No. 1	Minimum Wall Thickness Indication in Vertical Scan Path No. 2					
Distance from the Top Weld (ft)	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded				
24 to 25	0.777	No values were	0.751	No values were				
25 to 26	0.764	recorded that	0.751	recorded that				
26 to 27	0.760	were less than	0.742	were less than				
27 to 28	0.747	90% of the	0.742	90% of the				
28 to 29	0.747	nominal	0.729	nominal				
29 to 30	0.738	wall	0.738	wall				
30 to 31	0.733	thickness	0.738	thickness				
31 to 32	0.729		0.729					
32 to 33	0.729		0.729					

Plate #5 is only two-ft high and has a nominal thickness of 0.875 in. The wall thickness in this plate was recorded as 0.874 in. See Table 7. No crack-like indications were detected, but there were several mid-wall inclusions recorded. The mid-wall locations were established from the rf waveforms in the time-of-flight record provided by the Swain analyst and verified by the COGEMA UT Level III.

		Thickness Indication Scan Path No. 1	Minimum Wall Thickness Indication in Vertical Scan Path No. 2						
Distance from the Top Weld (ft)	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) in Which the Min. Values were Recorded					
33 to 34	0.874	No values were	0.874	No values were					
34 to 35	0.874	recorded	0.874	recorded					

Table 7. Data from the Vertical UT Scan Paths on Primary Tank Wall, Plate #5

# 3.0 Results of the Ultrasonic Evaluation of Selected Welds in the Wall of the Primary Tank of Tank 241-AN-105

Vertical welds in Plates #3 and #4 and the horizontal weld between the Plate #5 and the knuckle of the primary tank were inspected for defects and cracks in the HAZs of the welds. The procedure for this examination required:

- one zero degree (straight beam) transducer to be used to detect defects in the heat affected zone
- two 45-degree angle-beam transducers to be used to detect cracks that might lie perpendicular to the weld line
- one 60-degree angle-beam transducer to be used to detect cracks that lie parallel to the weld line.

These transducers were arranged to examine both sides of the weld simultaneously as the magnetic-wheel crawler followed the weld. Since the HAZ extends beyond the weld itself, an area on both sides of the weld was examined. Mechanical interference with the weld crown prevented the zero-degree and 45-degree angle beam transducers from detecting closer than approximately 0.5 in. from the edge of the weld crown.

• Vertical Weld—Plate #3—a 5-in. wide by 8-ft long scan was made of one of the vertical welds that joined the plates in the third ring of plates in the primary tank. The scan path included the HAZ of the weld on either side of the centerline to detect wall thinning, defects and cracks that might lie perpendicular to the weld line. The zero-degree beam recorded a minimum wall thickness that ranged from 0.475 to 0.483 in. No inclusions or other anomalies were detected in the wall of the primary tank. The angle-beam transducers found no crack-like indications using either the 45-degree or 60-degree angle beam transducers.

- Vertical Weld—Plate #4—a 5-in. wide by 8-ft long scan was made of one of the vertical welds that
  joined the plates in the fourth ring of plates in the primary tank. The zero-degree beam transducer
  recorded a wall thickness as ranging from 0.711 to 0.751 in., but found no indication of inclusions or
  other anomalies in the wall. The angle-beam transducers found no crack-like indications lying either
  parallel or perpendicular to the weld line.
- Vertical Weld—Plate #5—a 5-in. wide by 2-ft long scan was made of one of the vertical welds that
  joined the plates in the fifth ring of plates in the tank. This ring is the transition between the shell and
  the knuckle of the primary tank and is only 2 ft in height. The zero-degree beam transducer recorded
  a wall thickness of 0.856 in. The angle-beam transducers found no evidence of crack-like indications
  lying either parallel or perpendicular to the weld line.
- Knuckle Weld—Plate #5 to Knuckle—a 5-in. wide by 20-ft long scan was made of the knuckle weld.
  The zero-degree beam transducer recorded wall thicknesses ranging from 0.830 to 0.891 in. The
  angle-beam transducers found no crack-like indications lying either parallel or perpendicular to the
  weld line.

## 4.0 Examination of the Floor Between the Primary and Secondary Tanks

The examination of the floor of Tank 241-AN-105 was severely restricted by obstructions. The thickness of a 9-ft section of the tank bottom was recorded. The nominal wall thickness of the floor plate is 0.500 in. The thickness measurements in this 9-ft section ranged from a minimum of 0.499 in. to a maximum of 0.523 in. The results are shown in Table 8. Data were acquired from an area 12-in. wide by 9-ft long.

Table 8. Data from the Vertical UT Scan Paths on Primary Tank Wall, Plate #5

Distance	Minimum Wall Thickness Indication from Scan of Tank Bottom										
Measured on the Tank Bottom (ft)	Minimum Value Recorded in Area (in.)	Size of Area (in. by in.) Where Minimum Values were Recorded									
1	0.517	No value were									
2	0.523	recorded that were									
3	0.523	less than 90% of the									
4	0.523	nominal wall									
5	0.523	thickness									
6	0.523	1									
7	0.505	1									
8	0.511	1									
9	0.499	1									

## 5.0 Conclusions from Data Obtained in the Ultrasonic Examination of Tank 241-AN-105

The goal of this ultrasonic examination was to perform a remote inspection to detect any corrosion or cracking in selected regions of the wall of the primary tank. This was accomplished by attaching a series of ultrasonic transducers to the scanning bridge of a remote-controlled, magnetic-wheel crawler that fitted through one of the 24-in. risers and was interconnected to the ultrasonic system with coaxial cables. The magnetic-wheel crawler was maneuvered to inspect the tank in both the vertical and horizontal directions to examine different portions of the primary tank wall and selected vertical and horizontal welds. The first phase of the ultrasonic examination was to perform two 15-in. wide scans of the full 35-ft height of the wall of the primary tank. The second phase examined selected welds in the primary tank to detect cracks or other anomalies in the HAZ of welds.

The data from the ultrasonic examination of Tank 241-AN-105 shows wall thinning/corrosion on the inner wall of Plates #1 and #2 of the primary tank. The minimum thickness found in the vertical Scan Path of Plate #1 was 0.452 in. Plate #2 displayed random, pit-like/corrosion spots with wall thickness of 0.430 in. or less in several areas. The thinnest spot in Plate #2 was a small pit-like/corroded area that was recorded as having a remaining wall of 0.400 in. Because of the concern that there might be thinner areas in Plate #2 than those found directly below the riser, three 15-in wide, 25-ft long horizontal scans (circumferential direction) were made. These scans did not detect any pit-like/corrosion areas less than the 0.400-in, area found in the vertical scans.

Plates #1, #2, and #3 had a nominal wall thickness of 0.500 in. While there was apparent wall thinning/corrosion in Plates #1 and #2, there was no significant wall thinning apparent in Plate #3. However, the initial results of Scan Path No. 1 and No. 2 in Plate #3 indicated as much as 0.050-in. difference between the two paths. Since Scan Paths No. 1 and No. 2 were only 6 in. apart and no weld existed between the two Scan Paths, questions were raised concerning this discrepancy. To resolve this issue, four 4-in. wide, 25-ft long scans and a new vertical scan were made on this plate. The new scans verified the discrepancy was the result of an error caused by the roughness of the surface and insufficient ultrasonic water coupling to the plate. There was little or no corrosion in Plate #3. There were no other anomalies or defects detected in Plate #3.

Plates #4 and #5 showed little or no corrosion and were within their respective nominal wall thickness. There were some mid-wall inclusions found in Plate #5, but they were not widespread.

Examinations were made of the heat-affected zones of welds in Plates #3, #4, and #5. In addition, the heat-affected zone of the knuckle weld was examined. No crack-like indications or other types of anomalies were found in any of these examinations.

From the ultrasonic data obtained in these examinations, it would appear that the integrity evaluation made on this tank should be based on the affect of the wall thinning/corrosion that is recorded for Plate #1 and Plate #2. No other defects or anomalies were found that would indicate areas of concern for the integrity of this tank.

### **ATTACHMENT 2**

241-AN-105 Double-Shell Tank Ultrasonic Examination Data Reports with Data sheets

COGEMA-99-1012 and COGEMA-99-1021



June 30, 1999

COGEMA-99-1021

Mr. Chris E. Jensen Lockheed Martin Hanford Corporation Post Office Box 1500, MSIN R1-56 Richland, Washington 99352-1505

Dear Mr. Jensen:

### RESUBMITTAL OF AN-105 DOUBLE SHELL TANK ULTRASONIC EXAMINATION DATA REPORTS

Reference: Letter, W. H. Nelson, COGEMA Engineering, to C. E. Jensen, Lockheed Martin Hanford Corporation, "AN-105 Double Shell Tank Ultrasonic Examination Data Reports", COGEMA-99-1012, dated June 29, 1999.

In our previous transmittal of the AN-105 double shell tank Ultrasonic Examination Calibration Sheets and Ultrasonic Data Reports two pages were inadvertently excluded. Enclosed please find the complete renumbered report.

If you have any questions, please feel free to contact me at (509) 373-2692.

Sincerely,

E. A. Nelson, Project Manager

Director of Services

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Enclosure

P.O. Box 840 Richland, Washington 99352-0840 Phone (509) 372-3572 • Fax (509) 372-3169



June 29, 1999

COGEMA-99-1012

Mr. Chris E. Jensen Lockheed Martin Hanford Corporation Post Office Box 1500, MSIN R1-56 Richland, Washington 99352-1505

Dear Mr. Jensen:

#### AN-105 DOUBLE SHELL TANK ULTRASONIC EXAMINATION DATA REPORTS

Reference:

Letter, W. H. Nelson, COGEMA Engineering, to C. E. Jensen, Lockheed Martin Hanford Corporation, "AN-105 Double Shell Tank Ultrasonic

Examination", COGEMA-99-417, dated June 15, 1999.

COGEMA Engineering is pleased to provide the enclosed AN-105 Double Shell Tank (DST) Ultrasonic Examination Calibration Sheets and Ultrasonic Data Reports. This completes our nondestructive examination of DST AN-105.

If you have any questions, please feel free to contact me at (509) 376-5403.

Sincerely,

W. H. Nelson

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COGEMA NDE Ultrasonic Level III

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Enclosure

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SCANNER CABLE  SCANNER CABLE  AUS  SIGNAL CABLE  AUS  SIGNAL CABLE  AUS  SIGNAL CABLE  AUS  SIGNAL CABLE  AUS  CHANNEL  TANNSDUCER  MAKE	3/8	199	· 						<u> </u>	BATCH#	20201
SCANNER CABLE  AUS  SIGNAL CABLE  CABLELENGTH  CABLELENGT	SCANNER TYPE	1	SERIA	102			· 	WATER			
SIGNAL CABLE  (C-58)  CHANNEL TRANSDUCER MODEL FRED. SIZE SERIAL # GATE EVAL. MIGHTON  1	SCANNER CABLE	1_					CABLE LE	NGTH	Į	W/4	
CHANNEL TRANSDUCER MODEL FREQ. SIZE SERIAL # GATE EVAL MEMORE MAGE MAGE MAGE MAGE MAGE MAGE MAGE MAG							CABLE LE	NGTH	CABL	E#J/A	
TRANSOUCER   MODEL   FRED.   SECRET   METHOD   METHOD	KG 5				F656	L CIZC					IMAGE
1 KBA MSEB 5E 5 2(512) 1642 PK.E (COVT 0" FIRED 2  2 K3A SAME AS \$\frac{1}{2}\$ \$ 11 1642 PK.E (COVT 0" FIRED 3  3 KBA MSEB 5E 5 2(212) 1637 PK.E (COVT 0" FIRED 3  4 K9A 54m. 43 \$\frac{1}{2}\$ \$ 11 (637) PK.E (COVT 0" FIRED 3  1 NITIAL CALIBRATION CHECKS  DATE 2/16/99 2/16/17  TIME 1935 2330  REFLECTOR BACKWALL MACGALL  CH. 1 THK.1 1.20 195 193  THK 2 60 593 500  CH. 2 THK.1 1.20 195 193  THK.2 60 593 500  CH. 3 THK.1 1.0 1155 1200  THK.2 60 593 500  CH.4 THK.1 1.0 1165 1200  THK.2 60 593 600  CH.4 THK.1 1.0 1165 1200  THK.2 60 1935 600  CH.4 THK.1 1.0 120 195  THK.2 60 1930 1930  THK.2 10 1900 1543  FILE # 07-116-1 07-116-2  DISK # DEVINSO 185NW2-0  EXAMINER # 15 NW3-0 185NW2-0  EXAMINER		₹ !	MODE	EL.	FREQ.	SIZE	SERIAL#			TYPE	<u> </u>
2 K3A SAME AS \$\frac{1}{2}\$ \$\			MSE	A 5E	5	2(842)	1642	EDGE COUT			
3 KBA   MSEB 5E   C(112)   1637   EXCE CONT   O FIFED   Y    4 KBA   Same 63 2 5   11 (637 PRE CONT   O FIRED   Y    INITIAL CALIBRATION   CALIBRATION CHECKS    DATE   2/16/99   2/16/91    TIME   1933   2350    REFLECTOR   MACKAGAL    CH. 1 THK. 1 20 . 195						Γ	1642	PK-E CONT			
1	1 211				<b>~</b>	2(212)			<u> </u>		
INITIAL CALIBRATION					5				100	FIXED	1 4
TIME  REFLECTOR  REFLECTOR  RAKWAM MANAU  CH.1 THK.1, ZO .195 .700  THK.2 60 .5%5 .600  CH.2 THK.1, ZO .195 .793  THK.2 .60 .593 .595  CH.3 THK.1, ZO .195 .700  THK.2 .60 .595 .600  CH.4 THK.1, ZO .10 .195  THK.2 .60 .595 .600  CH.4 THK.1, ZO .10 .195  THK.2 .60 .595 .600  CH.4 THK.1, ZO .10 .195  THK.2 .60 .600 .593  FILE # OT-2160 OT-21602  DISK # DSYW3-0 LOSYW3-0  EXAMINER  FIRE # OT-2160 OT-21602  THK.2 .60 .600 .595  THK.2 .60 .600 .595  THK.2 .60 .600 .595  THK.2 .60 .600 .595  THK.2 .60 .595  THK.2 .60 .595  THK.3 .60 .595  THK.2						<u> </u>	ALIBRATI	ON CHECKS			
REFLECTOR BACKWAL MAKAGAL  CH. 1 THK.1 . 20 . 195 . 200  THK.2 . 60 . 595 . 600  CH. 2 THK.1 . 10 . 195 . 193  THK.2 . 60 . 593 . 595  CH. 3 THK.1 . 10 . 195 . 120  THK.2 . 60 . 595 . 600  CH. 4 THK.1 . 10 . 110 . 1195  THK.2 . 60 . 595 . 600  CH. 4 THK.1 . 10 . 110 . 1195  THK.2 . 60 . 595 . 600  CH. 595 . 600  CH. 4 THK.1 . 10 . 110 . 1195  THK.2 . 60 . 595 . 600  CH. 595 . 600  CH. 6 THK.1 . 10 . 1195  THK.2 . 60 . 595 . 600  CH. 7 THK.1 . 10 . 1195  THK.2 . 60 . 595 . 600  CH. 8 THK.1 . 10 . 1195  THK.2 . 60 . 595 . 600  CH. 9 THK.1 . 10 . 1195  THK.2 .	DATE	2/16	199		$\geq$						
CH. 1 THK. 1, 20 . 195 . 200  THK. 2 60 . 585 . 600  CH. 2 THK. 1, 70 . 195 . 193  THK. 2 . 60 . 593 . 595  CH. 3 THK. 1, 10 . 115 . 1200  THK. 2 . 60 . 595 . 600  CH. 4 THK. 1 . 10 . 110 . 195  THK. 2 . 60 . 600 . 583  FILE # 07-2160 07-21602  EXAMINER						>					
THK 2 60 .545 .600  CH. 2 THK.1 .70 .195 .193  THK 2 .60 .543 .595  CH. 3 THK.1 .70 .195 .700  THK.2 .60 .595 .600  CH. 4 THK.1 .70 .100 .195  THK 2 .60 .595 .600  FILE # OTILICO 05.343  FILE # OTILICO 05.3						$\overline{}$					
CH. 2 THK. 1, 10 . 195 . 193  THK. 2 . 60 . 593 . 595  CH. 3 THK. 1, 10 . 115 . 1200  THK. 2 . 60 . 595 . 600  CH. 4 THK. 1, 10 . 110 . 195  THK. 2 . 60 . 600 . 593  FILE # OT-1/60 OT-1/602  DISK # LSYW3-0 105/W3-0  EXAMINER						_		1/			
THK. 2. 60 .593 .595  CH. 3 THK. 1. 70 .195 .200  THK. 2. 60 .595 .600  CH. 4 THK. 1. 70 .110 .195  THK. 2. 60 .593 .600  FILE # OT-2160 OT-21602  DISK # NSYW3-0 105YW3-0  EXAMINER	, 80										
CH. 3 THK.1, 10 ,195 THK.2, 60 ,595 ,600  CH. 4 THK.1, 10 ,110 ,110 ,195 THK.2, 60 ,600 ,543  FILE # OT-216C1 OT-216C2  DISK # VSVW3-0 105NW3-0  EXAMINER # OT-216C2 also.  Examiner # Examiner # Reviewer # Page  A./A. Reviewer # Page  A./A. Level Date	10						1				
THK.2,60 .595 .600  CH.4 THK.1 .70 .710 .195  THK.2 .60 .600 .593  FILE # OT-216C1 OT-216C2  DISK # DSYW3-0 LOSYW2-0  EXAMINER							_//			<del> </del>	
THK. 2. 60 . 600 . 543  FILE # OTIZICO OTIZICO  DISK # USVW3-0 loss 1/2-0  EXAMINER							12	)	7	<u> </u>	
FILE# OT-216C2 OT-216C2  DISK# VSVW3-0 LOSIW3-0  EXAMINER  REMARKS  * D.40° Step verified also.  Examiner Office also.  Examiner Office also.  Examiner Office also.  Date 2/12/49  Level Date  Level 70 Date 3/12/49  4 01 5/6	CH. 4 THK.1 120	.210					<del>-</del>				<del> </del>
DISK # VOVW3-0 105VW3-0  EXAMINER  REMARKS  * 0.40° step verified also.  Examiner of the state o	160	<del>,</del>					- 5.7				
EXAMINER  REMARKS  * 0.40° step verified also.  Examiner of the step of the st		01-214	<u>ci (</u>	01-5/PCS	<del>                                     </del>	<del></del>					
REMARKS  * 0.40° step verified also.  Examiner property of the		VIE AN	35-0	Mic							
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Examiner Date    Examiner   Reviewer   Page	* 0.40° step	verif	ied	<u>also.</u>							
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	Level u Date	1/6/1	1	Level	Date_	<del></del>	Lev	COCKMI	<del>```</del>		

2/99		A	UTOM	AT	ED ULTR	RASON	NIC THIC	KNES	S		CALIBRATION	REPORT#
				С	ALIBRA'	TION S	SHEET				Nla	7
LOCATIO	ÒΝ	HANFO	20	SYST	EM Dst			CALIBRATI	ON BLOCK	<del>-</del>		
PROCE	OUR	<b>:</b>	- 2.1	Re	- <u>- 237</u>			THICKNES	STEP S .1 To 1.0		MATERIAL 25	
UT SYS	IEM 2/5	p3		SER			<del>-1</del>	REFERENC	CE BLOCK		<u> </u>	
SOFTWA	\RE	VERSION T-5CA	 ນ		REV. 6.0.			THICKNES	* 1.0"		MATERIAL C5	
		UE DATE	4 14	, 19			· · · · · · · · · · · · · · · · · · ·	REFERENC	E BLOCK TEMP	٥F	PYROSN.	
SCANNE		YPE		SER	IAL# 105			COUPLAN	WATER		# BATCH Alu	
SCANNE	R C	15 5 D ABLE 1WS-D					· •••	CABLE LEN	IGTH 400'	CABLE	<del></del>	
SIGNAL	CA8	LE G 59-U	· <del>····································</del>				;	CABLE LE		CABLE		
CHANN		TRANSDUC MAKE		MOI	DEL	FREQ.	SIZE	SERIAL#	GATE EVAL METHOD	ANGLE	WEDGE TYPE	IMAGE
1		KRAUTK	RAMER	m	SED	5.0	8×Znr	1642	EDGE CONT.	0	FIXED	/
2		KRAUTK	RAMER	n:	SEB_	5.0	BXZNA	1642	PK-E CONT.	0	FIXED	2
3		NIA		ļ	NIA	NIA	UlA	N/A N/A	N/A	N/A	NID	NIA
4	T1.4	DIA	TIOM	<u> </u>	NIA	NIA	NIA	NIA	NIA	NIA		
DATE	HA	L CALIBRA					C,	ALIBRATIC	N CHECKS	<del></del>		
TIME			4-20		· · · · · · · · · · · · · · · · · · ·	<del></del>						
REFLE	ECT	OR	12:5		19:30 3TEP		$\overline{}$	<del></del>		-		
CH. 1		IK.1	.20		,201		+					
	TF	IK. 2	.69		1699		<del>-   - `</del>					
CH. 2	TF	IK.1	1/9		.184		<del>-  </del>	_		<u> </u>		·
	TH	K. 2	.6		,682				~ <u>~</u>		<del>-</del>	
CH. 3	Τŀ	IK.1	NIA		NA				-//	····		
	Th	IK. 2										
CH. 4		IK.1	1							$\overline{}$		
ļ		łK. 2										
FILE #			O-CAI		0-CN1-1					_	$\rightarrow$	
DISK												
EXAMI			EWS	<u> </u>	EWS					L		
REMA	<del>ነ</del> ተረት	12										
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<u>ea</u>	بعج	<u>ιω. 3</u> ,		-   -		NE	<u>,                                      </u>	100	to Melels			.01
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			2-SCAN CALIBRATION REPOR						REPORT#						
			C	ALIBRA	HONS	)HI	EEI							NI	
LOCATIO			SYST	EM DST				CALIE	RATIO	ON BLOCK	SDÌ	ل ح			
PROCEC	HAWFORD DURE		0					THICH	KNESS	3		PT-	·/	MATERIAL	
UT SYST	<u> </u>	2.1		2.3 IAL#_				REFE	RENC	<u>0.75</u> ΕΒLOCK				<u>cs</u>	
	EM 57.3 RE VERSION			75 305 TREV.	•			THICH			IIu	)		MATERIAL	
J)_	Scan / 7-	scan		1 NEV. 6	.05				- 1	<u>", 4"51</u>				MATERIAL CS	
LINEARI	LINEARITY DUE DATE 6/15/199									E BLOCK T		o F		PYROSN.	4
SCANNE	R TYPE いろ- 5D	)		COUF	LANT					BATCH#	Α.				
	R CABLE	AWS	r -	105				CABL	E LEN	IGTH		CABL	E#	N/A	<u> </u>
SIGNAL	CABLE	^		<u> </u>				CABL	400 E LEN			CABL	.E#		
CHANN	EL TRANSC	KG 5	DEL	FREQ.	<u>2</u> E	SERIA	40		/AI A	NGLE		ル/ハ WEDGE	1 IMAGE		
	MAKE		ļ		TINEQ.	312		SLINI	~L#	METHO		IOM./AC	T.	TYPE	IVIAGE
1 2				34-74 Ba	Ч		Lan	741		I code ?		5/44		FAED	162
3	Krantl	Camer	Mu	0845-4B	Ч	80	9mm	243	3	I100E	20  4	5-144	_	FIXED	314
4				n)	<del>)</del>		27			<u> </u>			=		-
	NITIAL CALI	BRATION			<u>.</u>			CALIB	RATI	ON CHE	CKS				
DATE		4/211		4/21/99							4/27	99			
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I	ENTATION	0.0 ID ~					IDN					/			
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CH. 2	AMPLITUDE	<u>I</u>		* 7	SIAB		<u>*2</u>			ξ1 ΣD	<i>II</i>			<del>//                                   </del>	<del>//</del>
	LOCATION	1 I		¥2 *2	ID	<u>,                                     </u>	<u>*2</u>			ン)	0_Z			<b>-</b> Y\√	/
CH. 3	AMPLITUDE		_/	1 /		$\angle$	Ŋ	$\overline{/}$							7
CH. 4	LOCATION	$\sim$		12/	$\mathcal{N}_{\lambda}$			<u>/</u>	-	10/_	N	$\leftarrow$		-/-/	/
0.1 4	LOCATION		4	A	/-/4		/	<u> </u>	-	/ /	//	4		<del>-/-/</del> /	1
FILE :		745A)		P45AXC3	PYSAXCE	Ĺ	745AX	<u>c 5</u>	PYS	AXC6	745AX	c٦		<u> </u>	1
DISK		<u> </u>	1151	7456451	P45AXC	.પ	PYSAX	<u>C-4</u>	74	<u> 281362-1</u>	7451	3RS	/		
REMA		17, 5	. W S	*, EWS	XI EV	VS.	X, E	WS_	<b>★</b> \	EWS	K, E	WS	<u>/</u>	1	
		. Sadler	^	lot avail	able to	<u></u>	Sian	۸							
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PROCED						<del></del>			THICK	NESS					MATERIAL	
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SOFTWA	<u>رج</u> ۲	IERSION Scan/TS	'נגומס		REV.	3 A			THICK	NESS	1.0	o ''		1	JATERIAL STEEL	
LINEARI	TY D	UE DATE				<del>9 /4</del>			REFERENCE BLOCK TEMP				PYRO SN.			
SCANNE	RTY	PE AWS-	-5	SER!	11. = 501		-		COUP	LANT	WATE		· <u>'</u>	5	SATCH#	
SCANNE	R CA								CASL	LEN		•	CABL	ξ ≠	PlA	
SIGNAL (	CABI	E	59	• •					CABL	ELEN	THIE	,	CASL	E #	p/4	
CHANNE	ĒL	TRANSDUCE MAKE		MOC	EL	FREQ.	SIZE	<b>.</b>	SERIA	L#	GATE EV	/AL	ANGLE		WEDGE TYPE	IMAGE
1		KBA	,	M	SEB	5.0	81	2	169	47	EDGE		0	<del></del>	FixED	1
2		KBA	1		5 <i>E</i> 8	5.0		مرابر <u>ح</u>	160		PK		0		FixED	2.
3		NIA				1										
4		NA		ļ			<u> </u>							. ]		
INI	TIAI	L CALIBRAT	<del>,</del>	Ļ,		· · · · ·					N CHEC	KS	<del></del> -		<del></del>	
TIME			01/2:		1/25/99	1/25/			6/99 1/36/99				نو	7/A	NIA	
REFLE	CT	OB	69:2		21:32	22:28		800			205C/C C) 7:30pm			$\leftarrow$	-/	
CH. 1		IK.1	120		i3, sck	Bock		idark a			<u>duall</u> 190	97	<u>.302.  </u>			
	TH	IK. 2	.80		.202 .795	,207		.20.				,195				
CH. 2	TΈ	IK.1	30		, 3⁄2 3	.3≏3		.307		-	195 300	1.77	2	$\neg$	<del></del>	1
	Ti	IK. 2	.8		,799	. 79		.864		1	790	-				
CH. 3	Th	IK.1	10.	_ں			<del>'  </del>	17.07		· ·	110	<del> </del>			<del>\                                    </del>	
,	TH	IK. 2						<del></del>				<del> </del>	一· f			$\overline{}$
CH. 4	T٢	IK.1				i									1	
	Tr	K, 2								1		<del> </del>				
FILE#			T-O-CA	10	CKONG	T-0-Cal	-7	T-C-CX	1-2	7-0	CA1-3	-Rus	11-		1	
DISK	#		1				<u> </u>						$\overline{}$		1-1	
EXAMIN			EWS		EW5	EWS		EWS		E	<i>25</i>	EWS	, ,		7	
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AUTOMATED ULTRASONIC THICKNESS CALIBRATION SHEET													ALIBRATION I	REPORT#			
						TION S	šΗ	IEET							NIt	7	
LOCATIO		ANFORD		SYST	TEM <b>D</b> 5 2				CALIE	RATI	ON BLOCK	14	<u>′</u> ′≤	<b></b>	· · · · · · · · · · · · · · · · · · ·		
PROCE			······································	0-	υ <i>ચ</i>	<del></del>			THIC	(NES	-		<u> </u>		MATERIAL	<del></del>	
UT SYS1	ГЕМ	<u> </u>	ī		IAL#	· <u>-</u>		<del></del>	REFE	RENC	E BLOCK	01.0			<u> </u>		
SOFTWA		PSP-3 VERSION	}[		<i>10</i> .	<u>5</u>			THICH			IIV	<u> </u>				
		RICAN/	, <u>T-5CA,</u>	<u>J</u>		103A					1.0'	_			MATERIAL STEE!		
LINEARI	LINEARITY DUE DATE 6/15/95										E BLOCK	TEMP	0F		PYRO SN. 584-79-06-00		
SCANNER TYPE SERIAL # 50/										COUPLANT					BATCH#	-06-W1	
SCANNE	R C		<u> </u>		501	<del></del> -		· · · · · · ·	CABLE LENGTH CABL				E#	Als.			
SIGNAL	CARI	AWS	55		<del></del>	···			325						NIA		
		RG-							325				CABL	.E#	N/A		
CHANNI	EL.	TRANSDUCI MAKE	ER	МО	DEL	FREQ.		ZE	SERIA	\L#	GATE E METHO		ANGL		WEDGE TYPE	IMAGE	
1 2	{	KBA			<u> </u>	5.0		3x2	165		ENGE		00		FILED	1	
3		KBA		m	SER	5.0		3 <u>rz</u>	164		PKE -C	27.	0		Firen	2	
4		NIA NIA			NIA NIA	1/4		N/A N/A	NI		NIA		NIA		<i>,,</i>	NIA	
INI	TIAI	CALIBRAT	TION	-	NIN	NA					<i>الر</i> N CHEC	_	MA		NA	NA	
DATE		0711210141	2-3-9	<u></u> -	2-3.99	2-8-90	3	2-8-			9.99	2-9-	ا مم				
TIME	_	•	08:30		2:15 pm	9:06		23:			55	17:3					
REFLE	CT	OR	BACWA		Arck	Back		BACK			Back						
CH. 1		K.1	,204		,202	.198		.18									
		K. 2	,997		,998	.697		.690			893	.89					
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PART#/ INDICATION	L START	L STOP		W START	WISTOP	3VA HHT	ζ	MIN, THK, R LIG	AREA REPORTA	BLE	COMMENTS		
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LOCATION HAWFORD	SYSTEM	K ANIOS	EXAM START	EXAMENO 11/0	108 # A						
		// 0	EXAMINATION	I SURFACE	NOM. THICKNESS						
THIN, WALL VERY CONFIGURATION	MELD !	2 45	Ø 00 ☐ ID ☐ PAINTED Ø 875  CALIBRATED RANGE TEMP								
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CIRCUMFERENCE/TOTAL LENGTH E	AMINED SCA	1	ORRECTION (TRANS.	DB DB							
PROCEDURE 551 2	. (	REV 2	MATERIAL TY	PE S OTHER	CONDITION						
FILE NAME/TEM# VW 5-45C	DATA DISK#	TRANSDUCER SOL 000EG MANGLE 45									
1 from toe of too weld WELD & SCAN WIDTH 5											
SIZING METHOD ANGLE REFERENCE CAL, SHEET SET-UP											
1 45 DEGREE SHEAR											
2 60 DEGREE SHEAR 3 AATT											
4 DUAL O DEGREE											
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2/99	ULTRASONIC P-SCAN DATA REPORT												
LOCATION Hanford	SYSTEM DS7	-	EXAM START	EXAMEND 1325	JOB# \A								
COMPONENT ID TANK AN 105	Vertical we		EXAMINATION SURFACE NOM. THICKNESS										
CONFIGURATION PLATE	TO PLAT		CALIBRATED R	ANGE	TEMP Ambies of F								
CIRCUMFERENCE/TOTAL LENGTH E	KAMINED SCA	N LENGTH/PART	REF. LEVEL CORRECTION (TRANS. CORR)										
PROCEDURE 501 Z.1		REV 3	MATERIAL TYPE		CONDITION Fair								
FILE NAME/ITEM# ANSVWS60	DATA DISK# AN 5-60	-7	TRANSDUCER		M ANGLE 60°								
XOREF. POINT (LO) Toe of Horzweld Top of Vivi	Yo REF. POINT (V	Vo)	SCAN WIDTH	5"									
SIZING METHOD	ANGLE	REFERENCE CA	L. SHEET		ET-UP								
1 45 DEGREE SHEAR 2 60 DEGREE SHEAR	60°			-A									
3 AATT			14										
4 DUAL 0 DEGREE	IND	I ICATION INFO	RMATION	<u> </u>									
	EPTH MAX L . LIG. AMP	.1 LENGTH	L2 W1	WIDTH W	2 INDICATION TYPE								
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Data disk ANS-6 available for print	- /	was analy	, ,	reportable									
were noted. ()	J	-											
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LOCATION	FORD	SYSTEM	D57			15TAFT :40	EXAMEND 7:45	103 = uEus				
ссирочемтю	AN 105				EXAMINATION SUFFACE IVON THICKNESS							
CONFIGURATION	N!	TO a	• /		CALIBRATED RANGE							
CIRCUMFERENC	Plate Etutal Length	ENAMESC	MTES U	<i>uell</i> Bireeet	1	10101	7 TION (TRANS (	<u>  83 °F</u>				
PROCEDURE	103"		12/9	BINFAFT PARTS	i			<u> </u>				
	JOI :	2./		E <sup>V</sup> ン	S1	PIALTYFE S ⊠CS C	THER	ROUGH				
FILE NAME/ITEM UT 60		CATAE	··\$*,#		TFAI-	ISDÚCER - COUAL / <del>TRES</del>	N /DEODEG &	X 4 5 5 60 ) - {				
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6		A			758	,729						
7					.757	,733						
7 8					1.762	733						
9					.769	,738	NA	NIA				
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LOCATION HANFOR	<b>b</b>	SYSTEM D67	- T/	TUP	CANIOS	EXAV	START	>	EXAM 104		108# A		
PRIMI DOLL V	EM 1	NELD	4		450	EXAI	MATION	SURFACE ID [] F			NOM. THICKNESS		
CONFIGURATION	-75 U	TO	PUAT	-K (	{		RATED F				TEMP AMBIEOTOF		
CIRCUMFERENCE/TOTAL LI	NGTH EX	AMINED	SCA	NLEV	GTHIPART	REF.	LEVEL CO	PRRECTIC	N (TR	WS.CC	ORR) 08		
OPPOSING	1.2,	ſ		T R	<sup>EV</sup> 2	MATE	RIAL TYP	E S OTHE			CONDITION FAIR		
FILE NAME/ITEM#		DATA O	ISK#			TRAN	ISD/ICER			eo K			
VWY-Y5C DUAL SIGL DOEG STANGLEYS  XOREF. POINT (LO) YOREF. POINT (WO) SCAN WIDTH  LI" from toe of top weld WELD &													
SIZING METHOD	were	ANGL		RE	FERENCE C	L. AL. SHE	ET	<u>\</u>	<u> </u>	SET	-UP		
1 45 DEGREE SHEA					A)								
2 60 DEGREE SHEA	R	·			00						<u></u>		
3 AATT 4 DUAL 0 DEGREE				<del></del>									
4 DOAL O DEGREE			INF	ICA	TION INFO	RMAT	ION						
IND METHOD WELL				1	LENGTH	L2	W1	aiw	TH	W2	INDICATION TYPE		
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2/99	ULTRASO	NIC P-SCAN	· · · · · · · · · · · · · · · · · · ·		RE	PORT#
	DATA	REPORT				alu
LOCATION Hanford	SYSTEM DS 7		EXAM START	EXAM	IEND I	J08# N/A
COMPONENTID TANK ANIOS Vert	ial Weld Pla	ate 4	EXAMINATION S		<del></del>	NOM. THICKNESS
CONFIGURATION Plate	TO Plat		CALIBRATED RA	NGE C'SP.	· · · · · ·	TEMP Ambient OF
CIRCUMFERENCE/TOTAL LENGTH EX		AN LENGTH/PART	REF. LEVEL CO	RECTION (TR	ANS. COR	R) (2 DB
PROCEDURE 501	2.1	REV 3	MATERIAL TYPE			CONDITION
FILE NAME/ITEM# AN 5VW 460	DATA DISK#	··7	TRANSDUCER		EG DØ	ANGLE 60°
XOREF, POINT (LO) TOE of HORZWEB topof V. 4.	YOREF. POINT (V	No).	SCAN WIDTH	<u> </u>	<u></u>	THOUSE THE PROPERTY OF THE PRO
SIZING METHOD	ANGLE	REFERENCE CA	AL. SHEET		/§ET-U	Р
1 45 DEGREE SHEAR 2 60 DEGREE SHEAR	600				<u>'</u>	
3 AATT						
4 DUAL 0 DEGREE	INC	I DICATION INFO	RMATION			
		L1 LENGTH	L2 W1	WIDTH	W2	INDICATION TYPE
No Cracklik	e Indi	cartions.			<u> </u>	<del> </del>
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REMARKS Data disk AN5-60-2		1 .	· ·			
were noted.	. Pata w	oas analyzed	. No repor	table in	dicatio	<u></u>
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						REP	ORT#
AUTOMA				CKNES	S		
	DAT	A REPO	DRT			REF.	CAL, # NA
LOCATION HAUFORD	SYSTEM	4N.0	5-	EXAMS ZI	START 45	EXAM END	JOB#
COMPONENT ID				EXAMI	NATION SURFA	CE	NOM. THICKNESS
AN 105 VERTICAL L	TO	(00	0E6. )		OD ID ID RANGE		1/2" TEMP
PLATE	70	ATE			_0.z" -	0.6"	OF
CIRCUMFERENCE/TOTAL LENGTH E	XAMINED	SCAN LEN	2 / /		EVEL CORRECT	TION (TRANS, CO	<i></i> DB
PROCEDURE SD/ 2.1		R	Z Z	MATER	NALTYPE DCCS OT	HER	CONDITION
FILE NAME/ITEM#	DATA DIS	K#		TRANS	DUCER		<u> </u>
105VM3-0	1 105	7W3-C			DUAL SGL	. 💢 ODEG 🗆	ANGLE
XOREF. POINT (LO) EDGE OF HORZ WELD PZ-	Yo REF. PO	OINT (WO) E_VERT	weld 3	SCÁN	<sup>иютн</sup> 6"		
PART#/ L START L INDICATION	STOP	W START	W STOP	AVE. THK.	MIN. THK,	AREA REPORTABLE	COMMENTS
105463-0.1				,508	.483	MA	Abjust Sanver *
",2		Λ.		,515	.480	NIA	*
" 3		7/2		,515	480	N/A	¥
4 ,4	, ,	1		,520	.488	NA	£
11 ,5				518	.480	NIA	*
11 .6	1			,518	,483	N/A	*
" .7				.513	1475	N/A	*
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·	1	1					
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SUMMARY MERGED RESULTS	84"	<u> </u>	-	<u> </u>	0,475"	N/A	LAMINATIONS.
REMARKS	··· — — — — — — — — — — — — — — — — — —		·- <del></del>				ļ
* NO LAMINATIONS	DETE	CTED.					
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Level III Date 2/16/99			Date 20/	6399		Date 3/7/	99 15 of 58

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		ONIC P-SCAN A REPORT			REPORT#
LOCATION HANFORD	SYSTEM TANK	44) (00	EXAM START	EXAME	
COMPONENTIO Vertical Well 3	45° CIRC		EXAMINATION		NOM, THICKNESS
CONFICURATION	TO		CALIBRATED F	ID PAINTED	Yz" TEMP
CIRCUMFERENCE/TOTAL LENGTH EX	AMINED LS	E CAN LENGTH/PART	1	7Z '' ORRECTION (TRAN	oF (0033)
84"		12"		·	<i>O</i> 08
PROCEDURE SDI 2.1		REV Z	MATERIAL TYPE		CONDITION
FILE NAME/ITEM# 105 VW345	DATA DISK#	3345	TRANSDUCER		1
Xc REF. POINT (L;)	Ye REF POIN	T (VV:)	SCAN WIDTH	SGL 00EC	S (& ANGLE 13 ANGLE
EDGE OF HORZ WELD PZ-P3 SIZING LIETHOD	ANGLE	REFERENCE C	AL CUEST	_(\$)'	CCT UD
1 45 DEGREE SHEAR -	VIARITE	NEI-LINENCE C.	TE. SHEET	1/1	SET-UP
2 60 DEGREE SHEAR				<del>-</del> /	
3 AATT		1	)		
4 DUAL 0 DEGREE		NDICATION INFO	PMATION		
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	PTH MAX LIG. AMP	L1 LENGTH	L2 W1	WIDTH	W2 INDICATION TYPE
*2					
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REMARKS  * Hammer MARKS	AN SURFI	45.	0 (0)(	1.1	
* z NO ZEZONTABU		4710105	o Colack	UKE IND	ICATIONS.
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	ULTRASONIC P-SCAN DATA REPORT  OCATION   SYSTEM   EXAM START   EXAM END															REPO	/u
LOCA	HANFO	· • •		SYST	iem Ank	41)	مح				STAR 2.34			AM E		JOE	B# \A
	ONENT ID		<u></u>							EXAM	INATIO	ON SUR	FACE		···	<u>' T</u>	NOM. THICKNESS
	S VERTICAL IGURATION	ALWELD	<u> </u>	70	20° AX		AL	<u>,                                     </u>				D RANG	PAIN	IED		<u> </u>	TEMP
OID OI	IL ICCOCNOC O	PLATE	LLEVA	. UNITE	PLAT		SUG	7115157	_		E1151	1/2					٥F
CIRCU	JMFERENCE/T	SY"	HEXA	MINEL	,	SCANI	ENG.	TH/PART	-	REF. L	.EVEL	. CORRE	ECTION (	TRA	NS. CO	RR)	O DB
PROC	EDURE	_	٦, ١				RE			MATES			OTUED				CONDITION
FILE	NAME/ITEM#			DA	TA DISK	#		<del></del>	_	TRANS	SDUC	ER	OTHER_				9000
/05/W360 /05/W360 □ DUAL X SGL □ ODEG X ANGLE 60°  X₀ REF, POINT (L₀) Y₀ REF, POINT (W₀) SCAN WIDTH											LE 60						
edge of HORZ WELD PZ-P3 E of VERT WELD 3																	
	SIZING ME			A	<b>VGLE</b>		REF	ERENCE (	CAL.	SHE	ΞŢ				SET-	UP	
	15 DEGREE			_							Λ						
<u> </u>	ODEGREE	SHEAR	+					7			Щ						
	DUAL 0 DEG	REE	+					$\longrightarrow \sim$									
<u> </u>	30/14 0 040	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				INDIC	CAT	ION INFO	ORN	ITAN	ON	·					
IND	METHOD	WELD SIDE	DEF R. L		MAX AMP	L1		LENGTH	L	2	W1		WIDTH		W2		INDICATION TYPE
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2	2	+	ا /در		-948	10.3	_	×2 0.4	<del></del>	.7		$\rightarrow$	<u> </u>	X			OD weldment
3	2	+	NI		-41B	46.		30.6		2.)		<del>\</del>	$\leftarrow$	7			Probe Rocking 3
<u>प</u> ऽ	<u>ر</u> 2	+	N/4 N/4	_	063 -12dB	46.3		83 0.Z 0.4"		<u>5</u> ۶.4			77	$\dashv$	$\sim$	$\dashv$	trade rocking 3
<b>/</b> /		Т	~1	14	1,500	120	+	0.4	٥٤	7.7				+		$\rightarrow$	veldment ind.
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	mas 5 2	we.		: <u>//</u>	aine		W	e .		14	<i>]</i> <u>/</u>		ch	<del>-</del>	100		17.56
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AUTOMATED ULTRASONIC THICKNESS REPORT#												
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LOCATION //		1	SYSTEM			EXAM S	START	EXAM E	ND I K	*80		
HA	NFORD		DST	MANK 1		16	20	193				
DRIMARY U		2120	NIME	werd	0	) EXAMII IXI	VATION SURF			NOM THICKNESS		
CONFIGURATION	V		10			CALIB	ATED RANGE			JEMP AMBIEUT OF		
CIRCUMFERENC	RAJZ PC EUTOTAL LENGT 240"	ATE HEXA	MINED	SCAN LEN			),3 - (, ( EVEL CORREC		IS CORR)			
PROCEDURE			,		EV	MATER	IAL TYPE			CONDITION D8		
FILE NAME/ITEM	<u>50z</u>	2	L ( DATA DIS	K#	ζ		Øcs c Dúc€r	THER		- I FAIR		
	H5-0-10	5	}				DUAL S	EL X ODEC	G 🔲 AN	IGLE		
X. REF. POINT (L	.0)		YOREF. PO	OINT (Wa)		SCANV	HTOIN	5"				
PART # / INDICATION	L START	LSI		W START	W STOP	AVE. THK	MIN. THK, R LIG	AREA REPORTAS		COMMENTS		
1					/	,905	,883	NO				
Z						905	.874	NO				
3						.905	,883	NO				
4			······································			909	,883	DO				
5		<u> </u>				905	1874	00				
6		ļ				.896	. 874	NO		<u> </u>		
7		[	<u>a)                                    </u>			1896	1861	ND				
8				<u>/</u>		,ম্বপ্ত	. 852	NO		/_		
9		ļ <u>.</u>		ļ		.891	.865	NO				
10		<del> </del>	-///			:887	.861	NO		/		
		<del>                                     </del>	ZK_			,887	.865	NO		<del>/</del>		
17		/	_			-887	1865	NO		/		
ι <u>3</u> 14						.883	,865	20	<del></del>	<i></i>		
15		-	_			1883	.826	ND	1/4	Κ.		
1,2		<del> </del>				.883	. <u>%61</u> .843	20		<u> </u>		
- 1)	/					.883 ~~	107A	NIM		FILE ELLOP		
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18			1			.865	,852	ಎರ				
19	·	1	1			1874	1848	20				
20		<u> </u>	A			1878	,821	NO		1		
SUMMARY		-				7078	1051	700				
MERGED RESULTS							ĺ					
REMARKS	l	A		L	<u> </u>	l	<u></u>	<u> </u>				
**			// l	O.11		<b>*</b> 2 .						
	17C cas	2,5	10 1)	7" -22	PATA	<u>-, 709</u>	55T. 1	<u>80.4-</u>	182.	2 "		
NO DATI	Ψ						<del></del>					
			<u> </u>									
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EDGAZ U	SADIE	<u>2</u> *	7	1 semes	->1/V	<del>`</del>   .	WK	Lkla	<u></u>	19-,56		
	Date 1/9/99	<u>_</u>	[	ével <u>III</u>	Date 7/13	<del> 115</del>	Level 111			18 or 58		
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2/99	ULTRASO DATA			REPORT#							
LOCATION MANFORD	SYSTEM 7	ANK ANIOS	EXAM STAR	TO EXAM	END JOB#						
COMPONENT 10 HORS. U	NELY	45°	EXAMINATION	N SURFACE	NOM, THICKNESS						
CONFIGURATION PRAISITION PA	TO LATE TO	CALIBRATED RANGE TEMP									
CIRCUMFERENCE/TOTAL LENGTH EX	AMINED SCA	REF. LEVEL CORRECTION (TRANS. CORR)									
PROCEDURE SDI 2.1	CONDITION										
FILE NAME TENSE 45CWH-5 DATA DISK# TRANSDUCER DE DE DE DE LANGLE 45											
X4 REF. POINT (L4)											
SIZING METHOD	ANGLE ANGLE	REFERENCE CAL	SHEET	5"	SET-UP						
1 45 DEGREE SHEAR 2 60 DEGREE SHEAR	45		<del>ا     ر</del>								
3 AATT				4							
4 DUAL 0 DEGREE	INC	I DICATION INFOR	MATION								
			.2 W1	WIDTH	W2 INDICATION TYPE						
1) 000	1457	dications.									
100 Sacr	TIME and	diantors.	·								
		7									
	<del></del>										
			7								
		<del></del>	+ -								
			1								
REMARKS											
Obsteuction 168-1	74.74 - N	o scan.			·						
NO CRACKLIKE INDICATIONS - Internittent entry surface worse.											
4											
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Examiner EXAMPLE *	Analyst R	500-	Review	er Mal	Page						
Level 11 Date 11/5/49	evel 11 Date 11/5/49   Fevel 11 Date 7//3/59   Level 20 Date 7-74-99   1 1 07 010										
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2/99	REPORT #				
LOCATION HANFORD	SYSTEM TA	EXAM START	EXAL 1/3	MEND JOB# A	
COMPONENTID		60°	EXAMINATIO	N SURFACE	NOM, THICKNESS
CONFIGURATION	OT		01115	DID PAINTE	TEMP
TILANS 11700 PU CIRCUMFERENCE TOTAL LENGTH E	478 to 7ru Kamineo Isca	M. KOUCKLE . IN LENGTH/PART	$\mathcal{L} = \mathcal{D}$	RANGE - 3.51" CORRECTION (TR	AMS. CORR) PART OF
240"		12."   REV			08
_ 5D/ J	1	1 <sup>nev</sup> 2	MATERIAL D	CS OTHER	CONDITION FATR
FILE NAME/ITEM# AN5?KW60	DATA DISK#		TRANSDUCE		DEG TVANGLE 60
Xo REF. POINT (Lo)	YOREF. POINT () WELD &	No)	SCAN WIDTH	<u></u>	7
SIZING METHOD	ANGLE	REFERENCE CA	L. SHEET		SET-UP
1 45 DEGREE SHEAR			2)		
2 60 DEGREE SHEAR 3 AATT		0	<del></del>	71-	
4 DUAL 0 DEGREE			<del></del>	7	
		ICATION INFOR			
	EPTH MAX I	L1 LENGTH	L2 W1	WIDTH	W2 INDICATION TYPE
No Crack	114 -				
NO Crack	ile and	CATIONS			
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			7-1-		
			<del>-'</del> -		
2514421/2					
REMARKS	T >> / A+ ==	, Fa.	,		
NO CRACKLIKE	ANNKHTIO	LECTION, DIS	k & \$41113	B PREUEAU	TED AAKING
PENTOUTS. (.16-	.ZI) Ju	TERNITENT W	FLAMENT	NOISE / GE	ometry
		-NO DATA			
h					. l Dogo
Ekaminer Wes	Aralyst	Sole	Review	2 John	Page
Level Iv Date 5/1/99	1076	Date_7/13/19	Level	Date 7-	1499 200156
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AUTOMATED ULTRASONIC THICKNESS REPORT#												
DATA REPORT REF. CAL#												
			DAT.	ANCH	JK I				KEF. (	JAL. #	alu	
LOCATION H	MENTS		SYSTEM	TANK	EXAM S	START 30	EXAME	ND	JO8 #			
COMPONENT ID	new KNU	eh		\$450	EXAMIN	ATION SURF	ACE	<u> </u>	NOM.	THICKNESS		
I CONFIGURATION	MARY		TOuckle	CALIBR	ATED RANGE	10-2	,5 <u>7</u> %	Ţŧ	MP NAVENTOF			
CIRCUMFERENC	ETOTAL LENGTI	I EXAN	AINEO		GTHIPART	REF. LE	VEL CORREC	TION (TRAI		₹) (	2 D8	
PROCEDURE	501	2,	1	R	<sup>εν</sup> λ	MATER	IAL TYPE TYCS O	THER		Ş <u>Ç</u>	CNDITION ALR.	
FILE NAME/ITEM	#105 PKN		DATA DIS	K#	<u>`</u>	TOALIC	DUCER DUAL IN SC	,	G TV	_		
XOREF. POINT (I	Norce LE V	14.	Yo REF PO	OINT (Wo)	weld to a	SCANY	HTOI W	1 ~ 8		ovesa		
PART#/ INDICATION	L START	LST	OP	WISTART	WISTOP	AVE THK.	MIN THK, R. LIG	AREA REPORTA		COMME	its /	
1						0.957	,418	20				
2					,	6970	,935	סע				
7			,		/	.966 .970	1940	NO		<del></del>		
5						975	935	<i>√</i> 0_		·		
Ь					/	962	,927	20				
7						953	922	20		1	1/	
8	-					,957	909	NO		$\Box$	$\prod$	
9			$\Delta$			957	.922	ND				
10			<i>y</i> –	/		,953	1918	NO .			//	
il				A		1944	1896	NO			11	
17			/	# <del>*</del>		1919	1918	NO			<del>/                                    </del>	
13 14				//		957 957	:931 :905	NO NO			<u> </u>	
15	1	$\vdash$	<i></i>	<u>!</u>		-,101 A57	,927	NO				
Ь						966	.935	NO				
17				· · · · · · · · · · · · · · · · · · ·	†	1975	,931	\$				
18						970	1935			1	<del></del>	
18						1975	940	Λ0		7	~	
30	/					1975	1935	70				
SUMMARY MERGED RESULTS									,			
REMARKS	·			<del></del>	<u> </u>		<u> </u>					
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- VO 1, WE	<u> </u>	<u> </u>	- 67	0.0251	- 100	- 184.3	· (very	merai				
1001	RACKLI	KE.	[NOI	CATION	13_							
A.		<del></del>	1/:		<u></u>	·	<u> </u>					
Examiner	25les		YΑ	inalyst Lanes	25 <i>98</i> 6	1.	Reviewer	Telse	<b>~</b>		age	
Level iu [	Date 2/16/9	9	¥	evel_III	Date_7//	4/99	Level II	Date		<u>7</u> 9 2	<u>ا مز 5 ا</u> of	

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·	AOTOM	ATED UL DAT	A REPO	OTTIVEO	J	F	REF. CAL. #			
LOCATION	643	SYSTEM	25-		EXAM START EXAM END JOB = 02/08/99					
HANA COMPONENTIO		<u> </u>	207		EXAMI	PATROM SURFA	02/08/	115	M THIGINIESS	
CONFIGURATION	AN105	Floor TO				10 □ lo E ATECRANGE			50" TEMP	
CIRQUMFEF,ENC	Floor PA	47E	1.6000000	ISTHFAST		120 TO	1.00	2.00000	85 °F	
	9 /108	T CAUTAMINEUS	12"/	9			CATIN TOWASS		<i>O</i> [13	
FRICASEDURS	JDIZ.	/	F	EV 2		IALTYPE  (Z) CS C'	THER		CONDITION Rough	
FILE NAMENTEMA		DATA C	\$1.#		TRANS	DUCER				
HERER PORUT (L	0-F70R	Ye REF	न्दरस्य (सर्व)	<del> </del>	SOALD	MUAL   SG METH	. K10050	) ( ) Milyot	<u> </u>	
* SEE REMARK		DAPPER A	orflow W	<i>E/L w\Sec.</i> 5 W STCP	عم: AVE	/5/   MH THK	AREA	00	ANAEINTS	
BUDICATION	\$ 317.51	<b>L</b> 37 ( 3/1	1 1 2 1 - 1 1		THK	RLIG	PEPORTABL			
/			<u> </u>	<u> </u>	.537	,5/7"				
2			1	<u> </u>	.548	,523"				
3				1	. 546	.523°				
4			<u> </u>	<u> </u> 	1549		<del></del>	- VI		
5					,549 .554	523"		_A_		
7	·	<u>}                                    </u>		<u> </u>	,530					
8	<u>                                     </u>		<del> </del>	<u> </u>	1,527	.505"				
9			<del> </del>	<del> </del>	. 526					
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SUMMARY		<del> </del>	<u> </u>	-		1		$\overline{}$		
MERGED RESULTS										
REMARKS	1	<u> </u>		<u> </u>	<u> </u>	<u> </u>	1			
*STACTED E	cam & the	26/d on the	e SECONDA	ey KNULL	Just PA	157 The 6	16 MAKE	ON SECON	DARY WALL	
WELD SPATE	TELON PLAT	E flom YI	TO 75	-	_,				<del></del>	
		<del></del>				<del></del>				
Examiner	- 10		Analyst	C 4.		Reviewer	1.1		Page	
Level I	<del>allu</del> Date <u> 02/03</u>	190	Elpan W	· <i>Saller</i> - Date <u>03/</u>	13/99	LevelT	Date 3/	10/99	22 OF 56	
	Care <u>02/03</u>	77	LEVES	- Date <u>03/</u>	<u>03/77.</u>		26-BM			

	REPORT#										
,	REF. CAL. #										
		UP	TA REPO	ואכ				NEF, OF	NL.#		
LOCATION	<del></del>	· SYSTEM		EXAM	EXAM START EXAMEND JOS#						
COMPONENT ID	NFORD		<u> </u>		25 <i>-9</i> 9	1-25-9	79	NIA			
COMPONENTID	AN105				NATION SURF			NOM. THICKNESS			
CONFIGURATIO	PLATE 2	TO		•		RATED RANG	=		TEMP		
CIRCUMFERENC	ENOTAL LENGT	H EXAMINED	SCANLEN	GTH/PART	REF. L	REF. LEVEL CORRECTION (TRANS. CORR)					
PROCEDURE	300°	<del></del>	12"/.						<i>O</i> D8		
PROCEDURE	Jox 2.		ĺ	EV 2	MATE	RIAL TYPE  (X) CS C	THER		CONDITION		
FILE NAME/ITEM	# PLQ-0-15	DATA	DISK#	· · · · · · · · · · · · · · · · · · ·	TRANS	DUCER					
Xo REF. POINT (	<u> アルマーショ/リ</u> La)	Y <sub>o</sub> REF	POINT (Wo)	<del></del>	SCAN	DUAL SO WIDTH		3 DAN	GLE		
Appens 18" WEST		15" A	bove Hosizons								
PART#1 INDICATION	L START	L STOP	W START	W STOP	AVE THK.	MIN, THK, R. LIG.	AREA REPORTAB		COMMENTS		
1					.554	.452	אנג		NA		
2					1560	1501	<i>ما</i> لد				
3					.548	.474	N/A				
4					. 547	,492	<i>مالب</i>		NIA		
5		·		.543	,426	465 0		ED 7/122124			
6		<u> </u>	<del> </del>	•	1541	.444	485	GED. TX:DN: N4			
7				,544	1452	NIA		NIA			
8		<del></del>			<i>539</i>	1465	4/4		NA		
9		A			,539	,465	JIA.		NIA		
10			<del>\</del>		, 5.38	1430 465		<i>G</i>	Ly 47:17:19		
-	1		<del>\</del>	<u> </u>	, 539	1496 NA			N/a		
12 13			<del></del>	-	.540				N/A		
14					, 538			- 4	ED. TL: NO. 14		
15			<del>\</del>		,540 ,543				N/A		
16	<del> </del>				.571				<del></del>		
17			_		,548		4/L				
18		·····		X	,555 ,555		NA				
19	1			1.	,551	,509	NIA		NA		
SUMMARY							7				
MERGED RESULTS											
REMARKS	.1	<u> </u>		<u> </u>		<u> </u>	<u> </u>				
SECTIONS	with GER	מנעה: אד	4 that is	REPORTAB	IE is H	ZHERT HL	e Complete	e PART.	The lowesT		
AREAS W	RE RECORD	ED.			· · · · · · · · · · · · · · · · · · ·						
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Level <u>I</u>	Date <u>/-25-9</u>	<u>/</u>	Level I	Date <u> ೩-೨</u>	-99	Level713		24-79	230=56		
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	•	IATED UL						REPO	RT#	
		NIA								
		DAT	A REPO	ORT				REF.	CAL.#	
							.	· N	4	
LOCATION		SYSTEM				START	EXAME	NO	JOB#	
HAN	FORD	<u> </u>		5-99	1-25.	99	NA			
COMPONENTID	ANIOS		EXAM	INATION SURF	ACE		NOM. THICKN	ESS		
CONFIGURATION	71N10)	TO			CALIE	OD DID (	PARTIEU		, 50" 	
CIRCUMFERENC	WALL	. •			UNCIL	20"	70.80"		85	٥,
CIRCUMFERENC	EMOTAL LENGTI 300	H EXAMINED	SCANLENG 12 /2	GTH.PART	REF. L	EVEL CORREC	CTION (TRAN	S. COR		3
PROCEDURE		<b>2</b> /		EV Z		RIAL TYPE	<del></del>		CONDITIO	
FILE NAME/ITEM	<u> 50I</u>	DATA DIS	· · · · · · · · · · · · · · · · · · ·			SOUCER	THER		_ RougH	
PILE NAME/TEM	" ク・ク・ノイ	CAIADIS	)(\#			DUAL 🗌 SC	GL 🖾 ODE	s П.	ANGLE	
AL 2 Xo REF. POINT (L	-0)	Yo REF. P	OINT (Wo)			WIDTH		<u>,                                    </u>		
AARAOS 18" WE.	or VENTLINE	15" Abo	UC HOLIZ.				·· ·			
PART#/ INDICATION	L START	L STOP	WISTART	W STOP	AVE THK.	MIN. THK, R. UG.	AREA REPORTAB	LE	COMMENTS	
20					, 552	.509	~ ~	11A	م/لہ	
21					.544	.514				
<i>2</i> 2	-	8/			1552	1509				
23		A			.554	1514				
24					.552					
25					1550	.514		/ .	۵/۵	$\rightarrow$
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SUMMARY	<del> </del>		<del> </del>			<del> </del>			<u> </u>	<u> </u>
MERGED			,	}						·
RESULTS				1		1				]
REMARKS										
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AUTOMATED ULTRASONIC THICKNESS DATA REPORT	REF. CAL. #										
DATA REPORT	NIA NIA										
LOCATION SYSTEM EXAM START EXAMEN	# 80L   QV										
HANFORD UST 1-26-99 1-26-	99 NA										
COMPONENT ID  ANCE  ANCE    EXAMINATION SURFACE	NOM. THICKNESS										
CONFIGURATION TO CALIBRATED RANGE	TEMP										
CIRCUMFERENCE/TOTAL LENGTH EXAMINED SCAN LENGTH/PART REF. LEVEL CORRECTION (TRANS	85 of										
300" 12"/25	o. CORR)										
PROCEDURE  SDI 2.1  REV  MATERIAL TYPE  SS (2) CS OTHER	CONDITION ROUGH										
FILE NAME/ITEM# DATA DISK# TRANSDUCER	X DUG W										
	ANGLE										
XO REF. POINT (Lo) YO REF. POINT (WO) SCAN WIDTH APPLOX IR" FROM WEST DENT LINE APPLOX BO FROM HOOZ. WELL 15"											
PART#/ L START   L STOP   W START   W STOP   AVE   MIN. THK,   AREA	COMMENTS										
	N/A										
1 ,534 ,480 N/A 2 ,535 ,475	~ //										
3 .535 .473											
4 .538 .495											
5 ,535 ,495											
5 1535 1495 16 1537 1495 16 17 1536 1450 145	NA										
7 .536 .450 yes	CORRASIONY										
8 1 536 475 NA	N/A										
9 1538 473 WA	مالد										
10 A 1521 1420 YES	אנגוע נונון *										
11 1,524 .428 465	This DING *										
12 1,528 .458 N/4	N/H										
13 ,531 ,505											
14 ,541 ,480											
15 1537 1480											
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LOCATION	UFORD		SYSTEM DST	TAUK	AN105	EXAM!	25-Q5	FXYY EI	ID P	JOB #	NA
COMPONENT ID	AN105	7	ATE			EXAM	ATXOLESURE OD ☐ ID (	ACE		MCM	THICKNESS
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			DATA	A REI	PC	RT					KET.	CAL.#	rw/A
LOCATION	NFORD		SYSTEM	~~~	·			EXAM S		MAX3		JOB#	
COMPONENT ID	NFORD	<u> </u>		<u>DST</u>		<del></del>		EXAMIN	<u>. Y 0</u> IATION SURFA	/ <i>3∴</i> \CE	ا_ دد	NO	M. THICKNESS
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CONFIGURATION	PLATE 3		ТО					CALIBR	ATED RANGE タップ。・8	a"			TEMP 0F
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FILE NAME/ITEM	# '3-0-l		DATA DISI	K#				TRANS	DUCER DUAL   SG	·		ANGLE	
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PART#/ INDICATION	L START	L S1	ΓÓΡ	W STAF	₹Т	W STOP	A۱	Æ. IK.	MIN. THK, R. LIG.	AREA REPORTA	ASLE	СОМ	MENTS
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Examiner				nalyst					Reviewer	201			Page
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Level 7	Date <u>2/8/7</u>	7		ي evel.	<u></u>	Date <u>0,3</u>	<u> 103,</u>	12x.	Level III	Date_	AM,	<del></del>	L10F 0 9

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COMPONENT ID	FORD		•	DST			examin	' <i>4 o</i> NATION SURF	13:5	5	NOM	. THICKNESS
	AN105						<b>(3)</b>	O □ I □	] PAINTED			50"
CONFIGURATION	PLATE #3	TC	)				CALIBR	ATED RANGE			1	1EMP 85 of
CIRCUMFERENC	E/TOTAL LENGT		Đ	SCAN LENG	STH/PART		REF. LE	VEL CORREC	TION (TRA	NS. COF		
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FILE NAME/ITEM	# 3-0-1	DA	ATA DIS	K#			TRANS	DUCER DUAL [] SO	e Danne	:G []	ANGLE _	
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INDICATION		ļ				Th		R. LIG.	REPORTA	BLE		
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LOCATION	JAN FORD	SYSTE	1 	•	EXAM S	START BPM	EXAM E		DB #				
COMPONENT ID	AN105				EXAMIN (X)	NATION SURF	ACE D PAINTED		NOM. THICKNESS				
CONFIGURATION	V _	TO			CALIBR	ATED RANGE	3	<u> </u>	TEMP				
CIRCLINEERENC	PIATE #.	H EXAMINED	SCANLEN	GTH/PART		·270,0	8 CTION (TRAN	ie (000)	85 ∘F				
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PROCEDURE	SDI 2.1			2	MATER SS	IAL TYPE  S CS C	THER		CONDITION ROUGH				
FILE NAME/ITEM	# PLT3-0-2	DATA	DISK#		TRANS	OUCER							
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LOCATION	FOLO		System J	57			START '&	EXAM ENI	D JOE	3#	1
COMPONENT ID		·				EXAM	INATION SURF	ACE PAINTED		NOM. THICK	NESS
CONFIGURATION	PLATE 3		TO			CALIB	RATED RANGE	"70.6"		TEMP 85	٥F
CIRCUMFERENC	EMOTAL LENGT	HEXA	MINEO	SCAN LEN	IGTH/PART	REF.	EVEL CORRE	CTION (TRANS	. CORR)	0	D8
PROCEDURE	5DI 2.1			_	EV 2	MATE	RIAL TYPE (2) CS O	THER		CONDIT Roug	
FILE NAME/ITEM	# PLT3-0-Z		DATA DIS			_   🛛	SDUCER DUAL   SO	GL 🔀 ODEG			
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Level <u></u>	<u>pollu</u> Date <u>02/08/</u>	199	Ī	evel <u>I</u>	Date 3/.	2/99		Date 3// GEMA	2/99	320	f 5/
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LOCATION HANDORD SYSTEM  DST TANK AN 10.5  COMPONENT D AN 10.5  CLATE 2 SCAPU 1  COMPONENT D AN 10.5  PLATE 1 SCAPU 1  REP. LEVEL CORRECTION (TRANS. CORR)  O B  PROCEDURE  SDI 2.1  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  PROCEDURE  SDI 2.1  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  PROCEDURE  SDI 2.1  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  PROCEDURE  SDI 2.1  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL CORRECTION (TRANS. CORR)  O B  COMPONENT D AN 15.0  REP. LEVEL D AN 15.0  REP. LEVE			<b>υ</b> Λ.	A 1141	J1(1				REF. U	AL. # N/A			
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CIRCUMPERENCE TOTAL LENGTH EXAMINED  SCAN LENGTH PART  12"  REP LEVEL CORRECTION (TRANS. CORR)  D 08  PROCEDURE  SDI 2.1  REP V MATERIAL TYPE  TRANSOUCER  TO - 45PD  VAREF, POINT (No.)  TRANSOUCER  TRANSOUCER  TRANSOUCER  TRANSOUCER  SOUL   SGL (ROOSE   ANGLE  NORTH INDICATION  L START   L STOP   WSTART   WSTOP   AVE.   MINITAR, AREA  RIGHT REPORTABLE   COMMENTS  RIDICATION  I START   L STOP   WSTART   WSTOP   AVE.   MINITAR, AREA  THE RIGHT REPORTABLE   COMMENTS  RIDICATION  I X 2 independent reps in 12x15" area  O.478 0.452 No.0-0%  I X 2 independent reps in 12x15" area  O.477 0.448 YES < 0.1% 2 spect  SWARD Small areas  I 2x15" area  O.477 0.448 YES < 0.1% 2 spect  SWARD Small areas  I 2x15" area  O.468 0.443 YES 0.6% sward small areas  REMARKS  Revealmation of areas Visuitally called. "L" s'w" start/stop dimensions Not Practical.  REMARKS  Revealmation of areas visuitally called. "L" s'w" start/stop dimensions Not Practical.  The percent of scan area that is reportable (0.455) viss 0.6% and tiple 2 pints.  The percent of scan area that is reportable (0.455) is pravided for each Institute of the start of the area of the start of the scale of the start of the scale of the start of the scale of	CONFIGURATION	1	TO -			CALIB	RATED RANGE						
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FILE NAMENTEMS  TO - 45802  DOTADISKS  TRANSOUCH  TO - 45802  XARER POINT (NO)  TO PASSED  TO - 45802						MATE	RIAL TYPE		<del></del>				
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XOREF, POINT (La) TOP USED TREES 24" THE MINIST ISTARY L STOP W STARY W STOP AVE.  R LUG. REPORTABLE  1 A) 1 O.4934 O.4952 NO - 090  2 O.4978 O.4952 NO - 090  3 O.4778 O.4952 NO - 090  4 * 2 independent 2013 in 12 X15" area.  O.4779 O.496 Yes < 0.1% 2 spectra  5 * * * * * * * * * * * * * * * * * *	TO-	- 45802	DATA OF	21/14				SL TX ODE	EG □AI	NGLE			
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D. 178 0.952 NO-0% PA  3 **A independent sets in 12x15" area. 0.977 0.948 % 6.01% 2 spots  5 ***Several small areas in 12x15" area. 0.977 0.948 % 6.01% 2 spots  6 ***Several small areas in 12x15" area. 0.977 0.930 % 6.01% 5 sevent small areas  7 ***Several small areas in 12x15" area. 0.978 0.930 % 6.01% 5 sevent small areas  8 ***Multiple sitts scattered through area. 0.968 0.935 % 6.06% multiple 20ints.  8 ***Multiple sitts scattered through area. 0.968 0.935 % 6.06% multiple 20ints.  8 ***Receivaluation of area2 previously called. "L" 8" W" start/stop dimensions Not fractical.  The percent of Scan area that is reportable (6.0.952") is gravided for each 12x15"  Part. These areas include multiple small 270ts (1-10 pixels) which are not 2 receival to internition for the area of 2 receival the dimensions of the area(s) of isolated, internition for solve area that the dimensions of the area(s) of isolated, internition for solve area for the area of 38 of 56  Examiner  ***Markey To 5600.067**  Page  ***Markey To 5600.067*  ***Provided for each 12x15"  ***Provided for each 12x15"  ***Provided for each 12x15"  ***Provided for each 12x15"  ***Provided for each 12x15"  ***Provided for each 12x15"  ***Part. These areas include multiple small 270ts (1-10 pixels) which are not 2 receival 12x15"  ***Page 12x10x10x10x10x10x10x10x10x10x10x10x10x10x							R. LIG.	REPORTA	BLE				
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COMPONENT ID	HNIOS					🗵	MINATION SURF	] PAINTED		NO	M. THICKNESS
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CIRCUMFERENC	ЕЛОТАL LENGTI 87.06	H EXAM	IINED	SCAN LEN	GTH/PART		LEVEL CORREC	CTION (TRA	NS. COI	RR)	0 DB
PROCEDURE	SDI 2.1			RI	<u>o</u> ▼3		RIAL TYPE S	THER	= ~ cy	T	CONDITION ROUGH
FILE NAME/ITEM PLT 3 VRS	# #		DATA DIS	SK#		TRAN	ISDUCER DUAL SO	<del></del>	·^ _	ANGLE	
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PART#1	L START	LST		రెల్లపు 24 W START	WSTOP	AVE. THK,	/ど MIN. THK,	AREA		СОМ	MENTS
INDICATION THK. R. LIG. REPORTABLE  1.5/5 .494 NO											
2 1514 .498 NO											
3			<del>\lambda</del>	[		,518	.498	NO		<u> </u>	\v
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COMPONENT ID	AN105	PI	ATE 41	1155	-01		EXAMIN	NATION SURF.	ACE ·		NON	1. THICKNESS
CONFIGURATION	TANK U	<u>ע</u> הל	10 TO		21,75			ATED RANGE		<del>/</del>		TEMP
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COMPONENT ID	ANIOS	PLATE 5/	1 15T SCAL	 J	EXA	MINATION SURF	ACE DIPAINTED		OM. THICKNESS
CONFIGURATION	TANK WA	10	<u> </u>	<u></u>	CAL	IBRATED RANGE	=======================================		TEMP
CIRCUMFERENC	E/TOTAL LENGT	H EXAMINED	SCANLEN	GTH/PART	REF	LEVEL CORREC	TION (TRAN	S. CORR)	102 of
PROCEDURE	19.988		/2"   R	EV	MAT	ERIAL TYPE		<del></del>	CONDITION
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AUTOMATED ULTRASONIC THICKNESS												
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LOCATION	16.45		SYSTEM	7)			START	EXAM		JOB#	<u> </u>	
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CONFIGURATION	14N105	PIA	TE 1	SCAN:	2	(2)	1 al 🗖 ao	GSTAIAS [		1 .5	50"	
ł	PLATE (	wa	TO 11 <i>5CA</i>			CALIBI	RATED RANGE	9"			EMP '0F	
CIRCUMFERENC	EJTOTAL LENGT 84.663	HEXA	MINED	SCAN LEN	GTH/PART	REF. L	EVEL CORREC	CTION (TRA	VS. COP	RR)		
PROCEDURE	SDI 2.				EV 27		RIAL TYPE			10	NOITION	
FILE NAME/ITEM		1	DATA D	ISK#	<u> </u>		☑CS O	THER			ROLGH	
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AUTOMATED ULTRASONIC THICKNESS  REPORT#  PEF CAL #											
			ATA REPO	ORT ———		<del></del>		REF. CAL.#	a/u		
LOCATION	JANFORD	SYSTE	M <u></u>		EXAM	START	EXAM EN				
COMPONENT	ANIOS	PLATE 21	SCANZ			VATION SURF		NOM.	THICKNESS		
CONFIGURATION	ON TANK U	TO Na		•		RATED RANGE			EMP 102 °F		
CIRCUMFEREN	СЕЛОТАL LENGTI	H EXAMINED	SCAN LEN	GTH/PART	REF. L	EVEL CORREC	TION (TRANS	S. CORR)	DB		
PROCEDURE	JDF 6	2 /		V Q		ALTYPE (Z) CS O	THER		CONDITION		
FILE NAME/ITE	M#	DATA	DISK#		TRANS	DUCER		<u> </u>	VRGA		
Xo REF. POINT	10451202		F. POINT (Wo)		SCAN 1	DUAL SO WIDTH		ANGLE_			
PART#1	L START	L STOP	= <u>A PAUR 15 76</u> W START	RIGHT OF RI.	AVE	/5'	AREA	COMME	NTS		
INDICATION					THK.	R. LIG.	REPORTABL				
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2		A			1460	,435	4 <i>ES</i>	/			
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5	57.179	57.37		6.222	,463	1430	485	<u> </u>	· · · · · · · · · · · · · · · · · · ·		
6	66.981	67.173		13.924	1	1400	465		<i>Y</i>		
7-1	76.014	76.202		12.197	1455	1408	465		<u> </u>		
7-2	76.783	76.97	5.690	5.823	1455	1413	4E5	<u>.                                    </u>			
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	A01011		A REPO					REF.	CAL.#	4/4
LOCATION H	NFORO	SYSTEM			EXAM:	START 42	EXAMI	END : 09	JOB #	10/1
COMPONENT ID		PLATE 3 -		۸.)	EXAMI	NATION SURFA	CE	.01	NOM	1. THICKNESS
CONFIGURATION	TANK W	TO A11			CALIBR	RATED RANGE				TEMP 100 °F
CIRCUMFERENC	E/TOTAL LENGTH 88.414"	H EXAMINED	SCAN LEN		REF. L	EVEL CORREC	TION (TRA	NS. COR	RR)	O DB
PROCEDURE	5DI 2.1			<sup>2</sup> 2	□ ss		HER			CONDITION LOLGH
FILE NAME/ITEM	3	DATA DIS				DUCER DUAL 🔲 SGI	_ ⊠ 008	.G 📋	ANGLE.	
X₀ REF. POINT (L 0 = Top	WELD		TO RIGHT	of RISER			5'' <u> </u>			
PART#/ INDICATION	L START	L STOP	WSTART	W STOP	AVE. THK.		AREA REPORTA	BLE	COM	MENTS
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	. AUTON		JLTRASO ATA REPO		CKNES	S	R	REF. CAL. #	
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LOCATION HAN	VFORD	SYSTE	M D57		EXAM S	START : 40	EXAMENO 16:5		1
COMPONENT ID	AN105 PA	Inted.	1 SEAN 2		EXAMI	VATION SURF	ACE	NON	I. THICKNESS
CONFIGURATION	1	TO	JEAN Z		0.11.00	OD □ID ( ATED RANGE			75" TEMP
CIRCUMSERENC	TANK WA		LSCANIEN	IGTH/PART		10Toi	90		100 of
·	104.651		/2"/	18			TION (TRANS.		208
PROCEDURE	JOI 2.1		R	EV 2		IAL TYPE	THER		CONDITION ROLLYH
FILE NAME/ITEM		DATA	DISK#		TRANS	DUCER			76.50
Xo REF. POINT (L	.a)		F. POINT (Wa)		SCAN	MIDTH	SL 200EG	ANGLE	
0:70P PART#1	NEYOL L START	L STOP	<i>15"ToRi4HT</i> WSTART	OF RISER	AVE.	MIN. THK.	AREA	COMM	ENTS
INDICATION	2 017.11.1		WOINKI	173105	THK.	R. LIG.	REPORTABLE		E1412
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	AUTOMATED ULTRASONIC THICKNESS  DATA REPORT  REF. CAL. #											
			DATA	A REPO	PRT			R	EF. CAL.	# \alpha		
LOCATION	ANFORD	Sì	rstem Z	) <i>57</i>	<del></del>		ISTART 5:20	EXAMENO 15:29				
COMPONENT ID	AN105	Dla	TE 5/	ر <sup>مدر</sup> /		EXAM	MATION SURF	ACE	N	OMTHIÇKNESS		
CONFIGURATION	<u>v</u> .	T	o í		CAN	CALI	OD DID [BRATED RANGE	_ PAINTED		750 TEMP		
0.00.00.00.00.00	TANK WAS	KNUC	K/E /7					TO.90	<del></del>	102 OF		
CIRCUMFERENC	15.76"	H EXAMIN	(ED		/2		LEVEL CORREC	TION (TRANS.	CORR)	O DB		
PROCEDURE	JDI =	./		RE	· <sup>v</sup> =?		RIAL TYPE S DCS O	THER		CONDITION ROLL H		
PO-45P	#		DATA DISI	<b>&lt;#</b>		TRAN	ISDUCER					
V DCC DOUT (I)										<u> </u>		
0= UPPLL WECA 15" TO RIGHT OF RISER 15"												
PART#/ INDICATION	L START	L STOF	,	W START	W STOP	AVE. THK.	MIN. THK, R. LIG.	AREA REPORTABLE		MMENTS		
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SUMMARY MERGED RESULTS								•				
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TRANSING	CERS ROC	KER.	up D	KLE TO	WEB JO	<u>977EL -</u>	STALTED	APPROX 4	.5" Z	FE/OW_		
WELD.							_ <del></del>	<u></u>	<del></del>			
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Level <u>zz</u> [	Jale <u>/W//7/</u>	18		evel <u>44</u>	Date <u>ノ</u> スノ	131178	Level 777	emp S/	1477			
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LOCATION HANFORD	SYSTEM	57		EXAM ST. 17:42		EXAMEND 19:34	JOB#	N/a				
COMPONENT ID  AN 105				EXAMINA [X] O	TION SURFAC	E		DM. THICKNESS				
CONFIGURATION PLATE CWA	15CAW P	DATE &	1 SCADZ	CALIBRA	TED RANGE			TEMP Amb of				
CIRCUMFERENCE/TOTAL LENGTH EX	KAMINED	SCANL	ENGTH/PART	REF. LEV	EL CORRECTI	ON (TRANS. (		O DB				
PROCEDURE SDI 2.1			REV 3	MATERIA SS	LTYPE			CONDITION ROUGH				
FILE NAME/ITEM# P45CP152	DATA DIS	K#		TRANSDU	JCER AL 🛛 SGL							
XOREF. POINT (Lo) APPROX & Below WELD &	Yo REF. PO	ONT (Wo)		SCAN WIL	OTH /5"		<u>LJ ANOCI</u>	<u>·</u>				
SIZING METHOD	ANGLE		REFERENCE C			SE	T-UP					
1 45 DEGREE SHEAR 2 60 DEGREE SHEAR	450				<del> </del>	<u> </u>						
3 AATT												
4 DUAL 0 DEGREE		INDIC	ATION INFO	RMATION	<u></u>							
	EPTH MAX LIG. AMI	< L1		L2 V		OTH W2		NDICATION TYPE				
No Gracklike	Tidica											
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REMARKS	4	-0	a ) <b>e</b>		, , - , -	100						
LIFT Of DUE TO Rouge	T SURFAC	E CONC	DITION. CKCE	SIVE MIN	OCAVE O	N MATE.						
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Edgan W. Sollan Level II Date 4/22/99	1	011	te_5/1/99	Level	777 Date	5/149	_ 'g .	47 of 56				
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2/99		NIC P-SCAN			REPORT#					
	DATA F	REPORT			ala					
LOCATION HANFORD	SYSTEM DST		EXAM START	EXAM ENI	4 4					
COMPONENT ID AN 105			EXAMINATION		NOM. THICKNESS					
CONFIGURATION PLATE CWA	TO Plaz	£ 2 5CAD2	CALIBRATED		TEMP Amb. °F					
CIRCUMFERENCE/TOTAL LENGTH EXA	MINED SCAN	N LENGTH/PART		ORRECTION (TRANS	. CORR)					
PROCEDURE  5DI 2.1		REV 3	MATERIAL TY		CONDITION ROUGH					
FILE NAME/ITEM# P45PL2RS	DATA DISK# サマリンシ		TRANSDUCER  DUAL	}	X ANGLE 45°					
XO REF. POINT (LO) APPROX 2" BELOW WELL	Yo REF. POINT (W	ARK ON WEIR	SCAN WIDTH	15"						
SIZING METHOD	ANGLE	REFERENCE CAL	. SHEET	S	ET-UP					
1 45 DEGREE SHEAR 2 60 DEGREE SHEAR	45°			-A						
3 AATT			A /							
4 DUAL 0 DEGREE	1115	IOATION INCOR	70							
IND METHOD WELD DEF	TH MAX L	ICATION INFOR  1   LENGTH   I	MATION .2 W1	WIDTH   W	/2 INDICATION					
SIDE R. L	IG. AMP				TYPE					
No crack	like in	lications								
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REMARKS		_								
LIFT Off DUE TO MILLS	SCALE ON PIPT	Γ <b>΄</b> Ε,		<u> </u>						
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Level <u>I</u> Date <u>4/27/99</u>	Level III D	ate <u>4/30/99</u>	Level 37	Ţ Date <u> 5//o/9</u>	18 of 56					

2/99	UL.	TRASC		P-SCAN							REPOF	rt# V/A
LOCATION HANFORD	SYS	TEM DS	-		1	EXAM STA				END	JOB	3#
COMPONENT ID	.i	<u></u>	/	<del></del>	+	//:_5; EXAMINA:	ION SU	JRFACE	<i>13:</i> ,		1	NOM, THICKNESS
ANIO5 CONFIGURATION	₹0					CALIBRAT	FD RAI	D D F	PAINTE	<u> </u>	<u>L</u> ,	·5"
PIATE CWAI S. CIRCUMFERENCE/TOTAL LENGTH EX		PLATE	3 50	ウンス NGTH/PART		REF. LEVE	2"7	ō.7°	N (TO	ANC CO	DD)	Amb. of
88.411"			<u>/2" /</u>	<u> </u>				KECH	או) אנ	ANS. CO	KK) 	<u>0</u> DB
PROCEDURE JDエ 2.1				Œν <i>3</i>		MATERIAL □ SS 【		ОТНЕ	-R			CONDITION Rough
FILE NAME/ITEM# P45PL3RS	DA'	TA DISK#	200			TRANSDU	CER	SGL		.co. #	1 ANG	LE_45°
Xo REF. POINT (Lo)	Y <sub>0</sub> F	REF. POINT	(Wo)		+;	SCAN WID		<del></del>		EG K	<u> I ANG</u>	LE _72
SIZING METHOD ANGLE REFERENCE CAL. SHEET SET-UP												
1 45 DEGREE SHEAR		5°	+	- LINLINGE O	<u> </u>	OI ILL I	┼			JE I	OF .	
2 60 DEGREE SHEAR								A				
3 AATT						$\mathcal{A}$			-			
4 DUAL 0 DEGREE		IN	<u>l</u> DICA	TION INFO	RM	IATION		<del></del>				
	PTH LIG.		L1	LENGTH	L2			WID	тн	W2		INDICATION TYPE
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LOCATION	SYSTEM	<del></del>			M STAR		EXAM	END	J08# /D
HANFORD COMPONENT ID	1 2	57	<del></del>		13:3	56	15:		,
AN105				EXA	MINATIO	ON SURFAC	E PAINTEC	)	NOM. THICKNESS
CONFIGURATION PIATE (W.	10	010	1845CANZ	CAL	IBRATE	D RANGE			TEMP Anib of
CIRCUMFERENCE/TOTAL LENGTHE	XAMINED	SCAN	LENGTHIPART	REF	. LEVEL	CORRECTION	ON (TRA	NS. CO	
PROCEDURE			REV 3	MAT	ERIAL T	YPE			CONDITION
FILE NAME/ITEM#	DATA DIS	K#	· .		NSOUC				RoufH
P45 PL4 RS Xo REF. POINT (Lo)	Y <sub>o</sub> REF. PC				DUAL		<u> </u>	EG (X	ANGLE 45°
APPROX 4" below WELD	APPROX	24/	NARK	SCA	N WIDT	15"			
SIZING METHOD	ANGLE		REFERENCE C	AL. SHE	EET			SET-	UP
1 45 DEGREE SHEAR	450						1		
2 60 DEGREE SHEAR 3 AATT					$\rightarrow$	- 4	Ţ		
3 AATT 4 DUAL 0 DEGREE		-+		— <i>-</i> /	-		_		
T DOAL O DEGILE	··	INDI	CATION INFO	, ΩRMAT	IONI	<del></del>			
	EPTH MAX	L1		L2	T-W1	WID	TH	W2	INDICATION TYPE
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100 Crack	like 1	Λdi	cations.						
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REMARKS									
Mobis han LiftoH do	ie to Ro	464 :	Suptace Cor	Dition	<u> ७५ (</u>	Mill SCA	Vε)_	570PP	EL SCAN
Appen 2" from Lower	weld due	10	SPATTER.	·		,	·		
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LOCATION HAUFORD	DST TA	Alle Anyon	EXAM STA			JOB#	
COMPONENT ID	. ^	NK ANIOS	1500	ON SURFACE	15241	NOM. THICKNESS	
PRIMARY WAKES	CAN 2, PCA	185 45°	<u></u> ₩00		INTED	10.875	
CONFIGURATION 5 (TOLA)	2517700 PC	ATE	CALIBRATE	D RANGE		TEMP AMBIENIOF	
CIRCUMFERENCE/TOTAL LENGTH 8	XAMINED SC	N LENGTH/PART			TRANS, CORP	NAME ALL	
PROCESURE 1516	<u>`</u>	12 1 06V	144750111	TV05		08	
501 211	<u> </u>	REV 2	MATERIAL SS S	CS OTHER	₹	CONDITION	
FILE NAME/ITEM# PO-45204	OATA DISK#		TRANSDUC	čo		1156	
Xo REF_POINT (Lo)	Y REF. POINT	Wo)	SCAN WIDT	M SGL	ODEG MA	NGLE 93	
XOREF POINT (LO)	do	·		H /5'	<i>t</i>		
SIZING METHOD	ANGLE	REFERENCE CA	SHEET		SET-UI		
1 45 DEGREE SHEAR	450						
2 60 DEGREE SHEAR 3 AATT							
4 DUAL 0 DEGREE			-/ <del>/-</del>			<del></del>	
4 DOAL O DEGREE	INI	I DICATION INFOR	MATION				
IND METHOD WELD D			2 W1	TWIDT	H W2	INDICATION	
SIDE	R, LIG. AMP					TYPE	
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NO CRACKLY	NE UNC	MATTONS	-				
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	DA.	TA RE	PORT						
LOCATION HAN FORD	SYSTEM	)5C		EXAM ST		EXAMEND	J08# /Q		
COMPONENT ID  AN 105			EXAMINA	EXAMINATION SURFACE NOM. THICK					
CONFIGURATION TO,				CALIBRA	☐ OO ☐ IO ☐ PAINTED .50"  CALIBRATED RANGE TEMP				
CIRCUMFERENCE/TOTAL LENGTH EXAMINED   SCAN LENGTH/PART				REF. LEV	REF. LEVEL CORRECTION (TRANS. CORR)				
PROCEDURE REV				_}	MATERIAL TYPE CONDITION				
SDI 2.1	1 0.7. 5.0		<u>``'3</u>	Ss	SS CS OTHER ROWGH				
P45CP151		BCP1S	31	TRANSDI	JCER IAL ⊠SGL	□ 0DEG	X ANGLE 450		
Xo REF. POINT (Lo) APPROX 3"BELOW HEAD TO SHELLW	YOREF. PO	DINT (Wo)	Pisel	SCAN WI	DTH /5"				
SIZING METHOD	ANGLE		FERENCE C	AL. SHEET		SE	T-UP		
1 45 DEGREE SHEAR 2 60 DEGREE SHEAR	45°					<del> </del>			
3 AATT			<del></del>	$\overline{\Lambda}$	,	Γ			
4 DUAL 0 DEGREE					/				
   IND   METHOD   WELD   DE	PTH   MAX		TION INFO			OTH W2	INDICATION		
	LIG. AMF			V	4416	7111	TYPE		
No Crack III	20 15	1	Defa	1					
100 Crack III	se marc	aprion	TS DEAT	ctex	•				
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2/99	_	NIC P-SCAN REPORT			REP	ORT#	
LOCATION HANFORD	SYSTEM DST TAN	alk deserve	EXAM STAP			DB#	
				0850 1037   Nom. THICKNESS 08 00 □ 10 □ PAINTED 0.5			
CONFIGURATION	TO	(-0	CALIBRATED RANGE TEMP				
				REF. LEVEL CORRECTION (TRANS. CORR)  OB			
PROCEDURE 50( 2.	/	REV 2	MATERIAL TYPE CONDITION SS OX CS OTHER				
FILE NAME/ITEM# TO-45P02	DATA DISK#						
YAREE POINT (LA)	YO REF. POINT (	Wo)	SCAN WIDT	TRANSDUCER  DUAL SISGL DODES STANGLE 15°  SCAN WIDTH  15"			
SIZING METHOD	ANGLE	REFERENCE CAL	. SHEET	13	SET-UP		
1 45 DEGREE SHEAR	45	1	>				
2 60 DEGREE SHEAR 3 AATT			1				
4 DUAL O DEGREE			77				
		ICATION INFOR			1 22		
	EPTH MAX ( L.LIG. AMP	1 LENGTH	L2 W1	WIDTH	W2	INDICATION TYPE	
HO CRAFA	7	DO CATTON			<del> </del>		
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Level 11 Date 17/10/98 Kevel 111 Date 7/17/99 Level 10 Date 7-14-99 55 of 50							

2/99		NIC P-SCAN REPORT			REPORT#			
LOCATION HANFORD	SYSTEM TA	NK ANIOS	EXAM STAF		MEND JOB # D			
COMPONENTIO PRIMARY WALL, SCAR	. ^		EXAMINATION SURFACE NOM. THICKNESS					
CONFIGURATION	TO	2, 43	CALIBRATED RANGE TEMP					
CIRCUMFERENCE/TOTAL LENGTH EXAMINED SCAN LENGTH/PART				REF. LEVEL CORRECTION (TRANS. CORR)				
PROCEDURE (7)				MATERIAL TYPE CONDITION				
	DATA DISK#		ss d≥	CS OTHER	FAIR			
FILE NAME/ITEM# P45PL3RS	<u> </u>		DUAL	TRANSDUCER DUAL SIGL DODES DEANGLE 45				
2 " from toe of too weld	YO REF. POINT (	₩₀)	SCAN WIDT	H				
SIZING METHOD	ANGLE	REFERENCE CA	L. SHEET		SET-UP			
1 45 DEGREE SHEAR 2 60 DEGREE SHEAR	45	- N						
3 AATT			A					
4 DUAL 0 DEGREE	INIC	CATION INFOR	AAATION					
			L2 W1	WIDTH	W2 INDICATION TYPE			
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100 CRAICK	415 4	VOIL ATTOM	<u> </u>					
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REMARKS								
NO CRACKLIKE	INDICATE	NS						
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l	DATA REPORT						
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LOCATION HANFORD	SYSTEM D57	EXAM STAR	EXA	M END :23	J03# W/D		
COMPONENT ID			EXAMINATION	N SURFACE	NOM, THICKNESS		
AN105	,			1 ☑ 00 ☐ ID ☐ PAINTED 10.75			
CONFIGURATION DIATE (	11 Saul Dlate	11-1001	CALISRATED RANGE TEMP				
CIRCUMFERENCE/TOTAL LENGTH E	PLATE (WALL SCAN) PLATE 4 SCAN   OTAL LENGTH EXAMINED   SCAN LENGTH PART			276,7 Anib. ∘F			
103.97	7.	2" /9	THE EEVEL CORRECTION (THORIS. CORR)				
PROCEDURE		REV	MATERIAL TYPE CONDITION				
SDI 2.1	DATA DICKH	<u> </u>	SS SICS OTHER ROUGH				
P45CP451	DATA DISK#	04<1	TRANSDUCE	R ⊠SGL □0	neg 🕅	ANGLE 450	
Xo REF, POINT (Lo)	Yo REF. POINT (V	Vo)	SCAN WIDTH	1			
APPROX 4" Below Gizth WELD	UNDER 24"	RISER		15"			
SIZING METHOD	ANGLE	REFERENCE CA	L. SHEET		SET-L	JP	
1 45 DEGREE SHEAR	45°			/\			
2 60 DEGREE SHEAR				7 1			
3 AATT			7				
4 DUAL 0 DEGREE			7				
		ICATION INFO	RMATION				
	EPTH MAX L R. LIG. AMP	.1 LENGTH	L2 W1	WIDTH	W2	INDICATION TYPE	
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100 Crackl	The Endica	vions					
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PRODES HAD LIFTOFF	due To Rough	SURTACE CON	DITIONS (	Mill SCALE).	STOPP	DEQ SCAN	
APPROX 2" FROM LOW	EL WELL du	E TO WELD 5	OPTICE.				
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2/99	DATA	NIC P-SCAN REPORT			REPO	#TRC	
LOCATION HAWFORD	SYSTEM TAN	UK AN105	EXAM STAR	T EXA	M END JO	)B# \ <u>\</u>	
COMPONENTIO WALL S		ATE 5 450	EXAMINATION SURFACE NOM. THICKNESS				
CONFIGURATION	10		CHIGOTECONING				
CIRCUMFERENCE TOTAL LENGTH EXAMINED SCAN LENGTH PART				REF: LEVEL CORRECTION (TRANS. CORR)			
PROCEDURE SD/ 2.	1	REV 2	MATERIAL TYPE CONDITION				
FILE NAME/ITEM#PD-45904	DATA DISK#	<u> </u>	TRANSDOCER DUAL WISGL DOEG MANGLE 45				
XO REE. POINT (LO)	YO REF. POINT O	Yo)	SCAN WIDTI			GLE_12	
~1" from to of top well SIZING METHOD	ANGLE	REFERENCE CAL	QUEET I	, 12 u	SET-UP		
1 45 DEGREE SHEAR	45	KEPLINEHOL OAL	STEE!	<del> </del>	361-07		
2 60 DEGREE SHEAR		Ü					
3 AATT 4 DUAL 0 DEGREE				$\Delta$			
4 DUAL 0 DEGREE	INC	ICATION INFOR	MATION.	/			
			2 W1	MDTH	W2	INDICATION TYPE	
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REMARKS		<u> </u>			1	L	
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#### **ATTACHMENT 3**

Field Guide for the Deployment, Operation, and Retrieval of AWS 5 Scanner and Slot Inspection System for Double-Shell Tank

LMF200-PJ-FI-01, Rev. 2

#### FIELD-GUIDE FOR DEPLOYMENT, OPERATION AND RETRIEVAL OF AWS-5 SCANNER AND SLOT INSPECTION SYSTEM FOR DOUBLE SHELL TANK

#### Deployment and Operation of Slot Inspection System

#### 1.0 Initial Setup

- 1.1 Ensure an overview camera and lights is installed in an adjacent 4" riser located in the direction of intended motion (CW or CCW from the 24" riser). Ensure the video signal from the overview camera is available in the inspection trailer.
- NOTE The lifting device must be capable of raising the hook 10' above the riser cover and lifting 350 lbs.
- NOTE The lifting device must be equipped with a 2' long sling, for use between the hook and deployment pan clevis.
- NOTE The lifting device hook must be capable of being rotated remotely.
  - 1.2 Ensure an approved lifting device and sling is staged over the riser.
  - 1.3 Ensure the temporary riser cover is installed on the riser.
  - 1.4 Route control cables from the inspection trailer to the riser.
  - 1.5 Stage both crawlers, tether cable, and the deployment pan at the riser. Crawlers can be separated from each other and transported to the riser separately using a handtruck, sling, etc. Approximate weight of each crawler is 130 lbs.

#### 2.0 Prestart Checks

- 2.1 Ensure the Crawler 1 and 2 bolts and screws are tight. Pay special attention to the fasteners which retain the latch rod, slide rod, and slide rod brackets.
- 2.2 Ensure the deployment arm is oriented correctly for the intended direction of travel around the annulus (CW or CCW). Reverse deployment arm if necessary.
- 2.3 Ensure all wiring connections are made and the crawler, deployment, and camera systems are powered.
- 2.4 Check Crawler 1 operation by confirming proper operation in all directions.

2.5 Check Crawler 2 operation by confirming proper operation in all directions.

## CAUTION - Do not fully traverse the deployment arm with the rotator in the "travel" position. Doing so will cause binding between the probe conduit and the traverse actuator, possibly causing damage.

- 2.6 Check deployment traverse function by traversing arm in both directions. Return arm to center of travel.
- 2.7 Check deployment rotation function by rotating deployment arm in both direction. Fully return the arm to "travel" position.
- 2.8 Ensure the camera system is operating correctly.
- 2.9 Deploy the UT sensor cart or camera probe out of the deployment housing using the probe pusher. Inspect sensor cart or camera probe for loose parts, broken springs, excessive mill scale buildup, etc.
- 2.10 If performing a UT inspection, calibrate the UT system. Ensure water system operates properly. If performing a visual inspection, ensure the lights and camera work properly.
- 2.11 Return the UT sensor cart or camera probe to the deployment housing using the probe pusher. Ensure proper encoder operation.
- 3.0 Load Crawlers Onto Deployment Pan
  - 3.1 Position deployment pan clevis within 1' of riser.
  - 3.2 Rotate the deployment arm until sensor cart housing is approximately horizontal. Center the traverse actuator.
  - 3.3 Drive both crawlers onto deployment pan until Crawler 2 engages the deployment pan latch.
  - 3.4 Drive both crawlers forward to ensure the latch is fully engaged.
  - 3.5 Connect lifting device to the deployment pan attachment point.

## CAUTION - The loaded deployment pan weighs approximately 350 lbs. Use caution when positioning the deployment pan into the riser.

3.6 Raise the deployment pan with the lifting device until suspended above the temporary cover.

3.7 Perform final check to ensure crawlers are correctly latched onto the deployment pan and the tether cable is not tangled.

#### 4.0 Lower Crawlers into Annulus

- NOTE During the entire inspection, radio communication will be maintained between the inspection trailer and the Operations person located at the riser.
  - 4.1 Remove temporary cover from riser.
  - 4.2 Slowly lower deployment pan into riser using lifting device. Ensure deployment pan bottom is against inside of riser.
- CAUTION Do not tie off tether cables or apply excessive resistance to the cable when lowering deployment pan into annulus. Doing so could damage the tether cables or result in the crawlers becoming disengaged from the deployment pan. Maintain a slightly noticeable amount of slack in the tether cables at all times.
  - 4.3 Feed tether cable into riser as deployment tool is lowered into annulus.

    Continue to lower deployment pan until front edge is slightly above the secondary tank bottom.
  - 4.4 Use lifting cable and tether cable to rotate pan until oriented correctly.
  - 4.5 Lower pan until back edge the annulus bottom.
  - 4.6 Back up crawlers until stopped by the latch arm. Raise lifting device until back edge of pan begins to lift off tank bottom.
  - 4.7 Rotate the deployment arm until sensor cart housing is approximately horizontal.
  - Drive both crawlers in the forward direction until free of deployment pan.

    Deployment pan may be removed from annulus at this time if required.
  - 4.9 Rotate the deployment arm away from the tank until the limit switch is activated ("travel" mode).

#### 5.0 Cable Management Guidelines

During movement of the crawler system around the tank annulus, continuous tether cable management will be required at the riser. The Operations person assigned this responsibility will need to have open communication to the crawler Operator and have a video monitor available for observing the overview camera image. The following are guidelines to help prevent the tether cable from being damaged or caught up in obstacles located in the annulus:

## WARNING - Do not move a crawler without maintaining visual contact with BOTH crawlers via the overview camera.

- 1) Using the overview camera, feed tether cable as necessary to limit the amount of cable laying on the annulus floor. When doing this, be careful to avoid damaging the cable on the sharp edge of the riser opening inside the annulus.
- 2) Ensure crawler operation is not significantly impaired by maintaining too much tension in the tether.
- 3) When deploying or retrieving the crawler system, be sure to maintain a slight amount of slack in the tether at all times. Failure to do so could result in inadvertent releasing of the crawlers from the deployment tray.
- 4) Use caution when navigating around the 4" airpipes located in the annulus. Their height off the floor and shape are ideal for causing the tether cable to become wedged underneath. Apply extra tension to the cable to maintain the cable off the floor.
- 5) If it appears that it will not be possible to maintain the cable off the floor in the vicinity of an airpipe, due to excessive distance between the riser and crawlers, perform the following:
  - a) Position crawlers 2 to 3 feet prior to an annulus riser.
  - b) Lower tether cable suspension tool through the riser to the annulus floor.
  - c) Orient cable suspension tool approximately 90 degrees to the tank wall.
  - d) Drive crawlers over the center bar of the cable suspension tool.
  - e) Raise the cable suspension tool as necessary to keep tether cables off the floor as crawler progresses around the tank.

WARNING - Releasing one cable of the suspension tool and attempting to pull the tool free could result in the tool cables becoming tangled with the crawlers and/or the tether cable.

f) Release the crawler tether cables from the cable suspension tool by lowering the tool to the floor and backing the crawlers over it.

# NOTE - The tether cable is capable of supporting the full weight of both crawlers (approximately 250 lbs). The tether cable can be pulled on with forces up to this amount if necessary to dislodge the tether or to recover the crawler system if equipment failure occurs.

6) If the tether cable becomes caught in an annulus obstruction, stop crawler movement, analyze the situation, and take appropriate action. In many cases it may be possible to reverse direction and use the crawlers to pull the cable free, assuming the cable is caught relatively close to the crawlers. The cable suspension tool may also be used to pull the cable free, if previously installed, or if the crawlers can be driven under an annulus riser. If the cable becomes severely stuck, COGEMA Engineering will provide additional instructions based on the particular situation.

#### 6.0 Perform Visual Exam of Airslot

- 6.1 Position Crawler 1 and 2 in close proximity of the specified airslot.
- 6.2 Traverse the deployment arm away from the tank until the end of travel limit switch is activated.
- Rotate the deployment arm towards the tank to use as a guide for aligning the crawlers with the airslot.
- 6.4 Position Crawler 1 approximately 1/2 1 1/2" (as measured from the outside edge of the near track) away from and tangent to the insulating concrete.

## NOTE - Crawlers 1 and 2 may be repositioned as needed during the performance of the following steps.

- Rotate the deployment arm torward the tank until the camera probe is angled slightly downward.
- 6.6 Check for proper position and alignment of the sensor cart housing with the airslot using the onboard and overview cameras. Reposition the crawlers as necessary.
- CAUTION If during the performance of the following step, excessive resistance is encountered, as indicated by Crawler 1 being moved by the deployment arm, carefully reposition Crawler 1 until acceptable. Attempting to deploy the sensor housing when misaligned with the airslot could result in damage to the equipment.

- 6.7 Traverse and rotate the deployment arm toward the tank until the camera probe is almost fully enclosed by the sides of the air slot.
- 6.8 If the end of travel limit switch is activated before the slot camera probe is sufficiently enclosed by the sides of the slot, repeat steps 6.1 through 6.10 with the crawlers positioned closer to the insulating concrete.
- 6.9 Position Crawler 2 as needed to minimize the bend angles in the probe pusher interconnecting conduit.
- 6.10 Zero encoder reading.
- CAUTION During deployment and retrieval of the camera probe, the probe must be enclosed by the air slot walls to provide alignment with the deployment arm. Attempting to deploy the camera probe when outside the airslot will cause misalignment with the deployment arm and make it impossible to fully retract the camera probe which could result in damage to the equipment.
- CAUTION Great care must be exercised during deployment of the camera probe if the tank brush is in place. The operator deploying the camera probe must watch for objects that project down into the airslot or up from the bottom to ensure that the brush does not become compressed too far and wedge the camera probe in the airslot.
  - 6.11 Advance the camera probe into the airslot until the desired distance is indicated on the encoder readout. If camera probe motion becomes inhibited retrieve the probe and move to another slot. **DO NOT ATTEMPT TO FORCE THE PROBE**.
  - 6.12 When visual inspection is complete, ensure camera probe is fully retracted into the deployment housing.
  - 6.13 Traverse the deployment arm away from the tank until the end of travel limit switch is activated.
  - 6.14 Rotate the deployment arm away from the tank until the end of travel limit switch is activated ("travel" mode).
  - 6.15 Proceed to the next designated airslot and repeat Section 6.0.

### 7.0 Perform UT Exam of Airslot

- 7.1 Position Crawler 1 and 2 in close proximity of the specified airslot.
- 7.2 Traverse the deployment arm away from the tank until the end of travel limit switch is activated.
- 7.3 Rotate the deployment arm towards the tank to use as a guide for aligning the crawlers with the airslot.
- 7.4 Position Crawler 1 approximately 1/2 1 1/2" (as measured from the outside edge of the near track) away from and tangent to the insulating concrete.

# NOTE - Crawlers 1 and 2 may be repositioned as needed during the performance of the following steps.

- 7.5 Rotate and traverse the deployment arm torward the tank until contact is made with the bottom of the airslot.
- 7.6 Check for proper position and alignment of the sensor cart housing with the airslot using the onboard and overview cameras. Reposition the crawlers as necessary.
- 7.7 Traverse the deployment arm away from the tank until the end of travel limit switch is activated.
- 7.8 Rotate the deployment arm until the top of the sensor cart housing is angled slightly down (5 10 deg. from horizontal).
- 7.9 Traverse the deployment arm towards the tank until the front edge of the deployment housing contacts the tank knuckle.
- 7.10 If the end of travel limit switch is activated before contact with the tank knuckle occurs, perform one of the following:
  - 7.10.1 Slightly rotate the deployment arm away from tank until contact is made or the sensor cart housing reaches horizontal.

#### OR

- 7.10.2 Repeat steps 7.1 through 7.10 with the crawlers positioned closer to the insulating concrete.
- 7.11 Position Crawler 2 as needed to minimize the bend angles in the probe pusher interconnecting conduit.

- 7.12 Zero encoder reading.
- 7.13 Slowly deploy sensor cart until approximately 2 feet within the airslot as indicated on the encoder readout.
- 7.14 Rotate and traverse the deployment arm until contact is made with the bottom of the airslot.
- CAUTION If during the performance of the following step, excessive resistance is encountered, as indicated by Crawler 1 being moved by the deployment arm, carefully reposition Crawler 1 until acceptable. Attempting to deploy the sensor housing when misaligned with the airslot could result in damage to the equipment.
  - 7.15 Simultaneously traverse the arm away from the tank while rotating the arm towards the tank until the sensor cart housing is approximately horizontal.
  - 7.16 Continue to advance the sensor cart into the airslot until the desired distance is indicated on the encoder readout. If sensor cart motion becomes inhibited, pull cart back 2 3 ft and retry.
  - 7.17 After sensor cart is at the desired position, rotate the deployment arm away from the tank until the top of the sensor cart housing is approximately horizontal.
  - 7.18 Traverse the deployment arm towards the tank until the front edge of the deployment housing contacts the tank knuckle.
  - 7.19 Pull probe tube back until motion of the sensor cart is detected by the UT system.
  - 7.20 Zero encoder reading.
  - 7.21 Perform the UT examination of the airslot in accordance with UT Procedure SDI-2.1). Minimize water addition to tank by turning off couplant flow when not performing scanning operations.
  - 7.22 When UT scan is complete, ensure sensor cart is fully retracted into the deployment housing.
  - 7.23 Allow water to drain from sensor cart for 2 3 minutes.
  - 7.24 Traverse the deployment arm away from the tank until the end of travel limit switch is activated.
  - 7.25 Rotate the deployment arm away from the tank until the end of travel limit switch is activated ("travel" mode).

7.26 Proceed to the next designated airslot and repeat Section 7.0.

### 8.0 Remove Crawlers From Annulus

- 8.1 If previously removed, lower deployment pan into annulus and orient pan correctly by rotating the lifting device hook.
- 8.2 Feed cable from the lifting device until cable is completely slack at the deployment pan attachment clevis. Latch arm should be horizontal.
- 8.3 Rotate the deployment arm until sensor cart housing is approximately horizontal. Center the traverse actuator.
- 8.4 Align crawlers with deployment pan and drive in reverse until motion is stopped by the latch arm.
- 8.5 Drive crawlers in the forward direction until motion is stopped by the latch arm. This indicates the latch arm is engaged.
- 8.6 If the latch arm does not engage, ensure lifting device cable is slack. Repeat steps 8.2 and 8.5.
- 8.7 Rotate the deployment arm away from the tank until the limit switch is activated ("travel" mode).
- 8.8 Slowly raise deployment pan to the vertical position.
- CAUTION Do not apply excessive upforce to the tether cable when raising the deployment pan out of the annulus. Doing so could damage the tether cable or result in the crawlers becoming disengaged from the deployment pan.

  Maintain a slightly noticeable amount of slack in the tether cable at all times.
  - 8.9 Ensure the lifting cable is centered in the riser.
  - 8.10 Continue to raise the deployment pan until just below the annulus dome.
  - 8.11 Allow deployment pan swinging to subside prior to raising the deployment pan into the riser.
  - 8.12 Use the overview camera, installed in an adjacent riser and the onboard camera, to ensure the deployment pan starts into the riser entrance without binding.
  - 8.13 Slowly raise the deployment pan until suspended above the riser.
  - 8.14 Install the temporary cover.

- 8.15 Position deployment pan to side of riser and lower to ground.
- 8.16 If system will not be re-deployed for an extended period of time, or severe weather conditions are expected, bag up crawler system and deployment pan or move to a protected location to prevent damage from rain or excessive dust.

# 9.0 End of Day Configuration

The UT system will require reverification of calibration at the beginning of each day, therefore the crawler system should be removed from the annulus at the end of the day per Section 8.0.

If the system is to be left in the annulus at the end of the shift, perform the following:

- 9.1 Ensure water supply pump is turned off and the flow control valve is closed.
- 9.2 Turn power off to the crawler, deployment, UT, and camera control systems.
- 9.3 Tie off tether cable at riser to prevent cable from being pulled into the annulus.
- 9.4 Ensure temporary cover is installed.

### Deployment and Operation of AWS-5 Scanner

10.0 Perform Primary and Secondary Tank Wall Inspection

NOTE -During deployment/retrieval operations radio communication will be maintained between the riser personnel in the tank farms, and inspection personnel in the trailer.

- 10.1 Perform a pre-deployment operational inspection of the scanner, deployment tool and water system.
- 10.2 Prior to deployment position overview camera in four-inch riser to guide in deployment and inspection. Record during the entire deployment and UT inspection of the double shell tank. The videotape shall identify day, time and location.
- 10.3 Connect hoist to deployment tool; secure safety line to the scanner and deployment tool. Secure the safety line to the safety handrail. Place the deployment crank assembly on the twenty-four inch flange. Lower deployment tool into the tank annulus and position on either primary or secondary tank wall.
- Once positioned use the deployment crank to position the deployment tool securely against the tank wall.
- Drive the AWS-5 scanner off deployment tool platform and position scanner approximately two-feet to the side of the deployment tool.
- 10.6 To retract the deployment tool, release the tension on deployment crank. When deployment tool is in the vertical position remove from tank annulus. Remove the deployment crank from twenty-four inch riser flange.
- 10.7 Place second over view camera system in the twenty-four inch riser and start the UT inspection in accordance with SDI-2.1 Rev. 1. Personnel at riser will manage cable as the scanner moves about in annulus of tank.
- 10.8 For removal or re-positioning of the AWS-5 scanner, first remove camera system from twenty-four inch riser. Replace deployment crank onto the twenty-four inch riser flange and lower deployment tool into tank annulus. Position deployment tool on the primary or secondary tank wall. Use the deployment crank to position the deployment tool securely to the tank wall. Drive AWS-5 scanner onto the deployment platform and release the tension on the deployment crank until deployment tool is vertical. The scanner can then be removed or re-positioned.
- 10.9 To re-position, follow steps 10.4, 10.5, 10.6 and 10.7.

- 11.0 Perform Secondary Tank Bottom Inspection
  - 11.1 Lower deployment tool to the bottom of the tank annulus until deployment platform is positioned flat on the secondary tank bottom.
  - 11.2 Remove deployment tool from tank annulus.
  - 11.3 Place secondary camera system back into twenty-four inch riser and start UT inspection.
  - 11.4 To remove the AWS-5 scanner from secondary tank bottom, first remove the secondary camera system.
  - 11.5 Lower the deployment tool to the secondary tank bottom until deployment platform is positioned flat on the secondary tank bottom.
  - 11.6 Drive the AWS-5 scanner onto deployment platform and retrieve from tank annulus.

# **ATTACHMENT 4**

Procedure for:

Automated Ultrasonic Examination for Corrosion and Cracking

SDI-2.1 Rev. 3

115

AUTOMATED ULTRASONIC EXAMINATION FOR CORROSION AND CRACKING

# AUTOMATED ULTRASONIC EXAMINATION FOR CORROSION AND CRACKING

PREPARED BY

APPROVED BY

DATE 2/22/99

DATE 2/22/99

# Revision History Log

Revision	Date	Description
0	4/22/97	Initial issue. This procedure is technically equal to SAIC UII 6.01 Revision 1, for P-Scan examination. (UII 6.01 is a joint effort, which combines several P-scan procedures along with some SAIC specific information for examination of Hanford Waste Tanks.) Report forms upgraded.
1	6/17/98	General revision to include weld area inspection and clarify wording. Delete summary report and revise report forms for weld inspection. Include attachment 1 for examination volume, minimum beam directions and extent of examination. Delete Par. 6.6 and 8.5.4.
2	11/8/98	Revision to include reporting level, clarify maximum cable length and revise data reports. Revision bars used.
3	2/22/99	Change to require all angle beam data to be collected using P-scan mode, and require data review of reportable indications.

### 1.0 PURPOSE

This procedure establishes the method, equipment, and requirements for automated, direct contact ultrasonic (UT) straight-beam, thickness measurements, angle beam flaw detection, and sizing in carbon steel waste storage tanks utilizing the "P-scan" ultrasonic imaging system.

### 2.0 SCOPE

- 2.1 The requirements herein are applicable to weld inspection, crack detection, sizing, wall thickness measurement, and the detection of wall thinning conditions, such as pitting, erosion, and corrosion in double shell tanks from 0.100 inches to 1.0 inches in thickness, provided at least one side is accessible and the component surface to be measured is parallel with the opposite surface. The requirements are also applicable to the automated UT detection and depth sizing of surface connected planar flaws.
- 2.2 Scanning is performed using remotely controlled automatic scanners.
- 2.3 Examinations shall be performed from inside the annulus of the double shell tanks.
- 2.4 This procedure provides the instructions for the use of Tip Diffraction Techniques including the Absolute Arrival Time Technique (AATT), and the Relative Arrival Time Technique (RATT), for the sizing of planar flaws.
- 2.5 The methodology in this procedure meets the requirements as addressed in Reference 3.1 as applicable to meet the requirements for inspection of double shell tanks.

### 3.0 REFERENCES

- 3.1 ASME Boiler & Pressure Vessel Code, Section V, Article 4, 1995 Edition.
- 3.2 SDI 1.1, Written Practice to the requirements of SNT-TC-IA, Personnel Qualification and Certification in Nondestructive Testing, December, 1992 Edition.
- 3.3 FORCE Institutes, "PSP-3 P-Scan Processor Operation Manual", (PSP3MAN910508).
- 3.4 FORCE Institutes, "P-Scan Post Processing Software Operation Manual", (PCMMANI9IO516).

### 4.0 PERSONNEL REQUIREMENTS

- 4.1 Personnel performing or supervising data acquisition or performing data analysis to the requirements of this procedure shall be qualified and certified to at least level II in ultrasonics in accordance with reference 3.2 or equivalent. In addition, they shall be trained in techniques for sizing stress corrosion cracking/planner flaws.
- 4.2 Personnel performing review for final acceptance of examination data shall be certified to at least level II in ultrasonics in accordance with reference 3.2 or equivalent.
- 4.3 Personnel whose responsibilities are limited to set-up, tear down, and track or scanner operation need not be certified. Such personnel shall possess sufficient knowledge of the equipment to satisfy the responsible examiner.

### 5.0 EQUIPMENT

### 5.1 <u>Ultrasonic Instrument/Examination System</u>

The P-scan computerized pulse-echo ultrasonic inspection system shall be used. The system shall be equipped with a stepped gain control in units of 1dB with a dynamic range of at least 115 dB, capable of generating and receiving frequencies in the range of 0.5 to 15 MHz. The following components may be used:

PSP-3 or PSP-4

P-scan processor

Analysis computer

Off-line data analysis with P-scan analysis software

WSC-2S, or later

Automatic scanner controller

AWS-5

Automatic P-scan scanner

Pump

Couplant pump for P-scan system

(\*) Later, compatible versions of equipment and/or software may also be used.

# 5.2 Transducers

Straight-beam and angle-beam transducers with single or dual elements, with or without delay tips, may be used, provided they can be attached to and manipulated by the scanner, and can be adequately coupled to the test item with a resultant backwall signal response of at least a 2 to 1 signal-to-noise ratio. Sizes and frequencies shall be as specified for the following applications:

5.2.1 For high sensitivity applications such as the detection of pitting, erosion or corrosion, transducer sizes in the range of 1/4 inch to 1/2 inch, with a frequency in the range of 4.0 to 10 MHz, shall be used.

- 5.2.2 For weld inspection, detection and sizing of planar flaws that are open to the surface, angle beam transducers with a nominal angle of 45 degrees with an element size in the range of 1/4 inch to 1/2 inch, with a frequency in the range of 4.0 to 10 MHz, shall be used. Where interference from weld geometry prevents examination of the required volume with a 45 degree an 60 degree angle may be substituted.
- 5.2.3 Transducers of other angles, element sizes, modes of propagation, or frequencies outside the above ranges may be used.

# 5.3 Cables

- 5.3.1 Cables of any compatible type and number of connectors may be used for examination. The length shall be limited to 400 feet, or less where signal degradation occurs. The same cables shall be used for calibration and examination.
- 5.3.2 The scanner control cable for analog scanners shall be limited to 100 meters (330 feet) maximum.

# 5.4 Couplant

- 5.4.1 Site approved water should be used as couplant.
- 5.4.2 Couplant application should be accomplished by means of an automatic couplant delivery system whenever possible. Care should be taken to use only as much water as required, as excess water in the annulus is undesirable.

# 5.5 <u>User Calibration Blocks</u>

- 5.5.1 For general thickness measurements, or the detection of pitting, erosion, or corrosion, user calibration blocks shall be made of an acoustically similar material as that being measured. A standard step block with 0.1 inch or greater increments encompassing the nominal thickness to be measured shall be used.
- 5.5.2 For weld inspection, crack detection and sizing measurements, user calibration blocks shall be made of an acoustically similar material as that being measured. A standard notched block with 0.1 inch or greater increments encompassing the nominal thickness to be measured shall be used.

### 5.6 Reference Blocks

Reference blocks (e.g., Rompas, IIW, DSC) utilized for beam angle exit point determination or screen width calibration shall be of similar material composition as the component under examination.

### 5.7 Pulse Repetition Rate

The repetition rates are set at rates such that signal wrap-around does not occur. In addition, the rates are sufficient to pulse the transducer at least six times within the time necessary to move one-half the transducer dimension parallel to the scan direction at maximum scanning speed.

### 6.0 CALIBRATION

### 6.1 <u>Verification of Instrument Linearity</u>

Instrument alignment verification for screen height and amplitude control shall have been performed within three (3) months prior to use of the instrument or at the beginning and end of each outage period, whichever is less. Instrument linearity verification is independent of transducer or scanner characteristics. Verification with one transducer/scanner combination is valid for any other combination. The due date for alignment verification shall be recorded on the Automated Ultrasonic Thickness Calibration Sheet (attachment 4).

### 6.2 System Parameters

The system parameters used for calibration and examination should be established as outlined in Reference 3.3 as required. The system should be operated in the T-SCAN program for thickness mapping and zero degree inspection and in the P-SCAN program for crack detection, weld inspection and/or additional evaluation.

### 6.3 General Requirements

- 6.3.1 Calibration shall include the <u>complete ultrasonic examination system</u>. Any change in transducers, wedges, couplants, cables, instruments, recording devices, scanners, power source, or any other parts of the examination system shall be cause for system calibration check.
- 6.3.2 If a secondary ultrasonic system is to be used, it must be calibrated before the inspection is started and not removed from the examination system during the inspection or recalibration will be required.

- 6.3.3 System calibration checks and final calibration for instrument sensitivity and sweep range shall be performed on the same block used for initial calibration using at least one reflector. These checks shall be performed:
  - A. At the start and finish of each series of examinations.
  - B. At intervals not to exceed 12 hours.
  - C. When there is a change as described in 6.3.1.
  - D. If the examiner suspects a malfunction.
- 6.3.4 If the horizontal sweep, thickness, or "Z" positions have changed more than <u>5 percent</u> of the nominal thickness, void all examinations performed after the last valid calibration verification, and reexamine the voided areas.
- 6.3.5 <u>Calibration checks</u> may be performed on either a reference block or the basic calibration block, but must include a check of the entire examination system. Calibration checks may be accomplished by static or dynamic calibration.
- 6.3.6 Simulated calibration checks may be used in lieu of calibration checks where the spread of contamination or serious time constraints would result from performing a standard calibration check. Simulated calibration will use blocks, cables, or transducers of similar types and lengths as those used for testing and will be documented on the calibration data sheet. A baseline, simulated calibration shall be performed immediately after performing the initial calibration, or after a calibration check where the entire examination system is utilized. The initial simulated calibration check values are independent of the values obtained utilizing the entire examination system. The established tolerance applies to the subsequent simulated calibration checks.
- 6.3.7 During calibration, the temperature of the calibration block should be within 25 degrees of the ambient inspection temperature.

# 6.4 Calibration Process

The basic process for calibration is the same for thickness mapping (T-scan), weld inspection, flaw detection, and sizing. The calibration reflectors for straight beam are the backwall reflections from a step wedge. The reflectors for angle beam transducers are the notch base and tips from a notched block. The basic calibration process is as follows:

6.4.1 Select and connect the appropriate transducer(s), input the parameters, including thickness, frequency, index delay, gate starts & ranges, inspection method(s), and velocity. Apply the couplant to the applicable points on the calibration standard.

(Select a sufficiently thin step for detection of unexpected low reading or pits and a step greater than the maximum thickness expected).

- 6.4.2 Place the transducer on the calibration step or notch nearest to the nominal thickness of the item to be examined. Adjust the gain control to produce a reflection of 80% full screen height (FSH). Obtain a responses from the other calibration points, then input these distance and amplitude values into the DAC curve for each transducer. After the DAC information is input, verify that the curve points are all within +/- 2dB. Initial calibration accuracy will be within +/- 0.010". in T-scan, +/- 2dB in P-scan.
- 6.4.3 Position the transducer to produce a response from the smaller of the two (2) steps or notches to be used for calibration. Using the scan menu, collect a reading from that step or notch. The transducer may be removed from the scanner and remain stationary "static" while the scanner is manipulated to make a larger indication on the screen.
- 6.4.4 Position the transducer on the thicker step/ deeper notch. Collect data, then using the Level control, obtain a reading from each step or notch. Adjust the system to read the correct thickness with index delay and velocity parameters. For weld inspection/crack detection, adjust the system to plot the reflectors in the appropriate positions.
- 6.4.5 Repeat steps 6.4.3 and 6.4.4 until the system is accurately measuring the thickness or depth over the entire inspection range. During initial calibration, all intermediate steps within the inspection range should be confirmed.
- 6.4.6 The vital parameters used for the calibration shall be identical to the inspection parameters with the exceptions of item, width, part length, reference level compensations or notebook parameters, where used.
- 6.4.7 As a minimum, readings from the thinnest and thickest calibration reflectors shall be recorded for each applicable transducer on the Automated Ultrasonic Thickness Calibration Sheet (Attachment 4).

# 6.5 Sizing Calibration for Tip Diffraction Techniques (AATT, RATT)

- A. Select an appropriate transducer.
- B. Select a sizing calibration block of similar thickness and material containing at least two notches of known depths.
- C. For the AATT technique, set at least two gates, one covering the entire area of interest and another in the first leg, ending just before the ID. Position the transducer

on the calibration block. Alternately peak the shallow and deep signals from the notch tips (see Figure 1). Using the IDLY and VELOC controls, adjust the system until the display represents a desirable linear depth screen in inches.

- D. For the RATT technique, the system mode should be set to A-SCAN. Manipulate the transducer until signals are obtained from the shallow notch tip and the notch base simultaneously (see Figure 2, Attachment 6). Using the IDLY, VELOC, and ASRNG parameters, adjust the distance between the two signals to read the actual reflector depth in inches. Repeat the same process on the deep notch. Alternate this procedure until the screen represents a desirable linear depth screen in inches.
- E Save the calibration, and record this data on the Automated Ultrasonic Calibration Sheet (Attachment 7).

#### 7.0 EXAMINATION

### 7.1 Surface Condition

- 7.1.1 The surface from which measurements are to be taken should be free of loose scale, unbonded coating, heavy oxidation, weld spatter, or other material which may interfere with movement of the transducer or the transmission of sound into the material.
- 7.1.2 A surface finish of 250 RMS or better should be provided. The requesting organization must approve the use of any base material preparation process which may reduce the thickness below the allowable tolerance.
- 7.1.3 Where an acceptable surface cannot be provided due to inaccessibility, wire brushes or other items should be attached to the scanner to provide surface preparation prior to and/or during the examination.

### 7.2 Extent of Examination

The location of the areas to be measured and/or the number of scans to be performed shall be designated by the applicable work instructions. The location, scan numbers, and reference points of all scans shall be recorded on the applicable data sheets. See attachment 1 for minimum examination volume and beam direction for weld inspection. NOTE: Additional scan areas will not require revision to this procedure.

### 7.3 Flaw Location

When performing examinations to detect planar flaws, angle beam transducers shall be used. Calibration is performed as in section 6.4. All angle beam examinations shall be performed in P-scan.

### 7.4 Ultrasonic Measurement

User calibration shall have been completed per the applicable requirements of Paragraph 6.0 prior to performing any of the examinations.

- 7.4.1 The amplitude of the first back reflection obtained from the item to be examined shall be adjusted as necessary using the Transfer Correction to maintain approximately the same amplitude as that used for calibration. The dB value obtained with straight beam transducer should be recorded on the report. This value should be considered during analysis of P-scan angle beam data also.
- 7.4.2 Transducer overlap between passes shall be a minimum of <u>50%</u> of the element size. Scanning speed shall not exceed <u>6 inches</u> per second.
- 7.4.3 Should measurements be observed larger or smaller than the range calibrated for in Paragraph 6.0, check the calibration for accuracy in the encountered thickness range. If the calibration is accurate in this range, amend the calibration sheet and continue the examination. If the calibration is <u>not</u> within the tolerance allowed in the spec, then <u>recalibrate and rescan</u> all areas where readings were encountered outside the originally calibrated range.

### 7.5 Limitations and Precautions

- 7.5.1 Care must be taken to ensure the transducer face is flush with the examination surface during scanning.
- 7.5.2 when it is necessary to determine the origin of mid-wall indications, a 4MHz shear wave transducer(s) may be used in the P-Scan program to detect pit openings or perpendicular connections between laminar indications.

# 7.6 Couplant Removal

When couplants other than water are used, the couplant should be removed, when possible. Water volume used should be minimized because, water left in the tank annulus may require removal.

### 7.7 Recording

Upon completion of each scan area "PART', the data file shall be recorded on a data disk. Each file for a given location should have the same ITEM name with consecutive file extensions. All measurements within the predetermined gated area are stored, along with the text information with each file.

### 7.8 General Sizing Guidelines

- 7.8.1 It is recognized that, of the methods of sizing described in this procedure, no one technique is completely accurate in sizing all flaws in all thickness'. By using complementary methods, however, a realistic approximation of the flaw depth can be obtained.
- 7.8.2. The methods of sizing pits is primarily utilizing the dual element transducer. The 45 degree shear wave transducers may be used to confirm qualitatively the depth of the pit.
- 7.8.3 When sizing crack-like indications, the entire flawed area shall be scanned with the imaging mode. The entire flaw length shall be evaluated. It is recommended that A-Scans be recorded at the <u>deepest</u> location of the flaw. The primary technique for sizing crack-like indications is the high frequency, 45 degree shear wave transducer utilizing the Absolute Arrival Time Technique (AATT). The dual element, straight beam may be used as a complimentary technique.
- 7.8.4 Additional sizing technique sequences may be utilized if the primary techniques identified prove to be indeterminable.

# 7.9 Sizing with Tip Diffraction Techniques (AATT, RATT)

7.9.1 The AATT technique uses shear waves to obtain a diffracted echo (satellite pulse) from the flaw tip (see Figure 1 Attachment 6). The RATT technique uses shear wave reflected signals from both the flaw tip and the flaw base (see Figure 2 Attachment 6). Both techniques can be utilized using the same transducer.

### A. AATT Technique

Locate the deepest extremity of the flaw and maximize the signal from the flaw tip. The distance to the flaw tip represents the remaining material ligament from the outside surface. To determine the relative through wall flaw depth, subtract this dimension from the local material wall thickness.

## B. RATT Technique

Locate the deepest extremity of the flaw, and obtain a signal from the flaw base. Manipulate the transducer until the doublet (flaw base and tip signal appearing simultaneously) is observed. These signals do not have to be peaked, as the doublet separation directly indicates the relative through wall depth. To determine remaining material ligament, subtract the relative through wall depth measurement from the local material wall thickness.

7.9.2 Other sizing techniques or variations to the techniques may be used with the approval of the UT Level III. Such approval, signature and a description of the technique shall be recorded in the "Remarks" column on the Ultrasonic Sizing Calibration Sheet (Attachment 7).

### 8.0 EVALUATION

- 8.1 Relevant indications including pitting, thinning and crack-like indications along with the minimum thickness reading in the area of interest shall be recorded and used for evaluation per Paragraph 8.2.
  - 8.1.1 P-scan data shall be evaluated to a sensitivity of 20% reference level (-14dB). All crack-like indications are recordable regardless of amplitude.
  - 8.1.2 T-scan data shall be evaluated utilizing all available images to detect and evaluate indications.
  - 8.1.3 Reportable indications shall be evaluated by SDI Level III personnel prior to final report submittal.
- 8.2 Reporting and special notifications criteria are noted in Paragraph 8.8 and 8.9.
- 8.3 The statistical information (Minimum and Mean thickness) provided under "Setup" pages 1 & 2 of the post-processing software should be reported for each "Part" of a given scan location. Where data noise invalidates these values, the analyst should determine the values using the level control.
- 8.4 Printouts should be made in accordance with the customer's request. In absence of further direction, both the merged set-up pages and the merged image, adjusted to show the minimum thickness, shall be printed at a level that best shows the wear patterns or at Nominal T 12.5%, whichever provides the most useful information. P-scan data should be printed with the level control set at 20% reference level (-14dB).

### 8.5 Recording Crack Size

- 8.5.1 All flaw sizing data acquired should be used to determine the flaw depth. This data shall be reported individually for each flaw and shall include all data necessary to achieve the best accuracy of flaw depth.
- 8.5.2 If, during sizing, a <u>flaw length other than that reported during the detection</u>
  <u>examination</u> is measured, or other discrepant conditions occur, record the corrected lengths, locations. or distances on the Ultrasonic P-scan Data Report (Attachment 8) in the spaces provided.
- 8.5.3 If, during sizing, the area is determined <u>not to be flawed</u>, and the resultant reflector(s) is due to component/weld geometry or metallurgical structure, the true origin (e.g., root, mismatch, etc.) shall be documented and substantiated on the Ultrasonic P-scan Data Report.

### 8.6 Scanning Limitations

Record all limitations due to weld configurations, obstructions, single side access restrictions, etc., in the remarks section on the applicable Ultrasonic Data Report. Details as to specific length or area in relation to L (X) and/or W (Y) reference points should be recorded.

### 8.7 Flaw Evaluation

Reportable indications shall be evaluated by SDI Level III personnel prior to final report submittal.

### 8.8 Reporting Levels

All indications which meet the following conditions shall be reported by recording the indication information on the applicable data sheet:

- A. Pit depth exceeds 25% of the wall thickness.
- B. Wall thinning exceeds 10% of the wall thickness.
- C. Surface crack depths exceeding 0.18 inches.

# 8.9 Special Notification Requirements

The test director will be notified if any of the following conditions are found to exist:

- A. Pit depth exceeds 50% of the wall thickness.
- B. Wall thinning exceeds 20% of the wall thickness.
- C. Surface crack depths exceeding 0.18 inches.

### 9.0 REPORTS

- 9.1 An Automated Ultrasonic Thickness Data Report (Attachment 3) shall be prepared for each examination or series of examinations performed. This report shall include identity of equipment, the thickness measurements obtained, and should be referenced to the calibration sheet.
- 9.2 An Automated Ultrasonic Examination Calibration Sheet (Attachment 4) shall be prepared for each examination or series of examinations performed. This report shall include the materials and equipment used for examination.
- 9.3 An Automated Ultrasonic Examination Sketch Sheet (Attachment 5) should be prepared for each examination or series of examinations performed. This report should include identity of scanning equipment and a sketch of the component or item examined, identifying scan locations, including dimensions, reference points, and grid locations, where applicable.
- 9.4 An Ultrasonic Sizing Data Report (Attachment 8) shall be completed only when cracking is detected. Each report shall be related to the applicable Automated Ultrasonic Examination Calibration Sheet(s).
- 9.5 Whenever several locations are being examined on the same component, an Automated Ultrasonic Examination Report Cover Sheet (Attachment 1) and an Automated Ultrasonic Thickness Report Summary Sheet (Attachment 2) should be completed.
- 9.6 Final reports are to be distributed and maintained in accordance with the applicable contract.

### 10.0 ATTACHMENTS

- 10.1 Attachment 1: Examination Volume, Minimum Beam Directions and Extent of Examination.
- 10.2 Attachment 2: Sample Automated Report Summary Sheet.
- 10.3 Attachment 3: Sample Automated Ultrasonic Thickness Data Report.

10.4 Attachment 4: Sample Automated Ultrasonic Thickness Calibration Sheet.

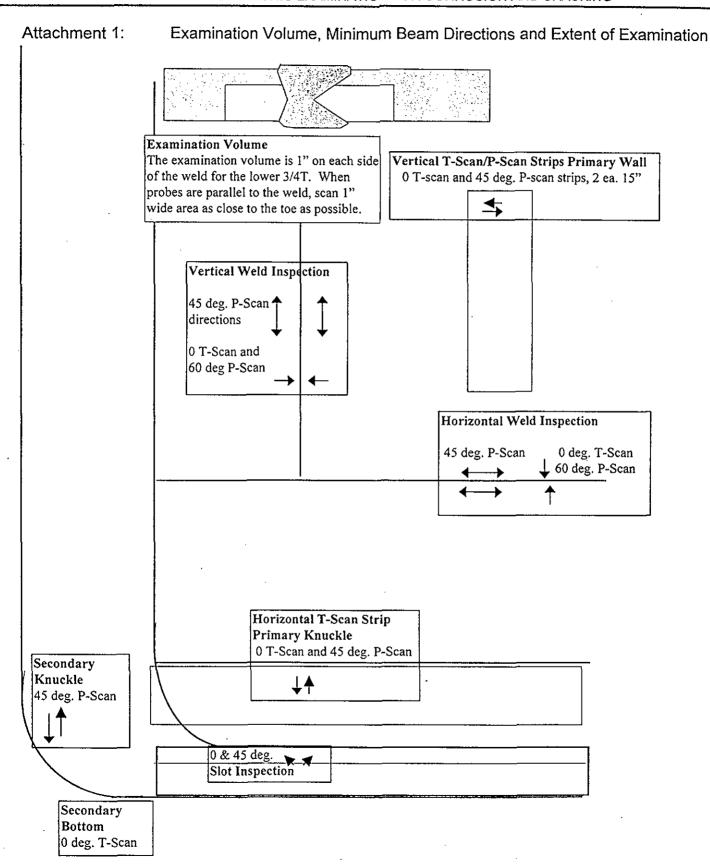
10.5 Attachment 5: Sample Examination Sketch Sheet

10.6 Attachment 6: Figure 1: Absolute Arrival Time Technique (AATT).

Figure 2: Relative Arrival Time Technique (RATT).

10.7 Attachment 7: Sample P-scan Calibration Data Sheet

10.8 Attachment 8: Sample Ultrasonic P-scan Data Report.



## Attachment 1 (continued): Extent of Examination

## Primary Tank Wall

<u>Vertical Strips</u> - Examine a vertical strip 30" x 35 feet long of the primary wall between the upper haunch transition and the lower knuckle for pits, cracks and wall thinning. Axial cracks on the tank inner wall surface shall be detected and sized. The vertical strip may be comprised of one or more strips whose total width is equal to 30 inches.

Weld Areas - Examine 20 feet of horizontal weld area (heat affected zone), at tank to knuckle weld. Examine one ~10 foot section of vertical weld joining the lowest shell course plates and one ~10 foot section of vertical weld joining the next to lowest shell course plates. Axial and circumferential cracks on the tank inner surface shall be detected and sized.

## **Primary Tank Knuckle**

Examine 20 feet of the primary tank lower knuckle in the circumferential direction to detect and size cracking in the circumferential direction and to detect pits and wall thinning. The area to be examined is from the weld joining the transition plate with the knuckle to the furthest reach of the transducer assembly that is allowed by geometric constraints.

### Secondary Tank

<u>Secondary Tank Lower Knuckle</u> – Examine a 20 foot length of the secondary tank knuckle over the entire area of the knuckle for the presence of circumferential cracks.

<u>Secondary Tank Bottom</u> – Examine the secondary tank bottom over an area of 10 ft<sup>2</sup> to detect and measure thickness and pits.

# **Primary Tank Bottom**

Examine the primary tank bottom for pits, wall thinning and cracks oriented in the circumferential direction (perpendicular to the air channels) in 16 air channels. The tank bottom is to be examined for a distance of 12 feet towards the tank center, starting seven inches inboard of the outside radius of the tank cylindrical section. The primary tank bottom scan head is designed to examine the accessible area in the air channel in one pass through the channel.

Attachment 2: Sample Automated Ultrasonic Thickness Report Summary Sheet

	AUTOMATE REPORT SU	REPORT#										
TANK/COMPONENT(S) EXAMINED												
ITEM	DATASHEET#	NOM. THK.	MIN. THK.	REPORTABLE INDICATION	COMMENTS							
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Attachment 3: Sample Automated Ultrasonic Thickness Data Report

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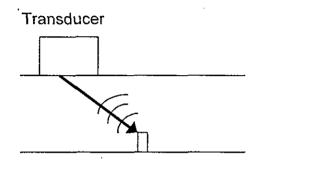
Attachment 4: Sample Automated Ultrasonic Thickness Calibration Sheet.

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Attachment 5: Sample Examination Sketch Sheet.

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ASSISTANT		SCANNER(S)	
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	SKETCH AREA: OBSTRUCTIONS, W	ELD LOCATIONS, ETC.	
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Attachment 6: Absolute Arrival Time Technique (AATT) & Relative Arrival Time Technique (RATT)



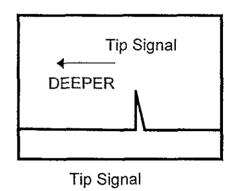
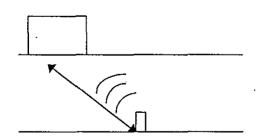
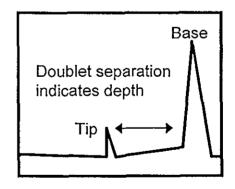


Figure 1 Absolute Arrival Time Technique

# Shear wave transducer





Flaw Tip and Base Signals

Figure 2 Relative Arrival Time Technique

Attachment 7:

Sample P-scan Calibration Sheet.

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Attachment 8:

Sample P-scan Data Report.

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#### **DISTRIBUTION SHEET** To From Page 1 1 of Distribution Tank Systems Integrity Engr'g Date 7/21/99 Project Title/Work Order EDT No. 623400 Final Results of Double-Shell Tank 241-AN-105 Ultrasonic Inspection ECN No. Text Attach./ EDT/ECN With All Appendix Name MSIN Text Only Only Attach. Only R. P. Anantatmula R1-30 D. L. Becker R3-73 Х B. G. Erlandson R1-51 E. A. Fredenburg R1-56 x H. R. Hopkins, III R2-58 х C. E. Jensen R1-56 Х L. J. Julyk R1-56 x P. C. Miller R1-51 ×

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M. L. Dexter

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