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Characterization of Flaws in U.S. Reactor Pressure Vessels

Density and Distribution of Flaw Indications in the Shoreham Vessel

Pacific Northwest National Laboratory

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Abstract

Characterization of Flaws in U.S. Reactor Pressure Vessels is a multi-volume report. Volume 3, this document, contains the density and distribution of flaw indications in material removed from the non-irradiated Shoreham nuclear reactor pressure vessel. The flaw indications were obtained from nondestructive evaluation (NDE) of weldment specimens. The first volume gives the density and distribution of flaw indications in the Pressure Vessel Research User Facility (PVRUF) vessel. Volume 2 contains a description of the removal of material from the PVRUF vessel, the conduct of confirmatory NDE techniques and metallographic analysis, and the confirmation of flaw rates for the vessel.

This volume provides the characteristics of the flaw indications in the Shoreham vessel and their density and distribution. This report also gives a description of the Shoreham vessel weldments and the approach to the research. The performance of the inspection system and the measurements made on the reactor pressure vessel (RPV) material are described.

Among the principal findings of this study are the more than 4000 detectable indications in the SAFT-UT inspections of the Shoreham RPV material. Where sizing results are reported, the SAFT-UT sizing rules were used to conservatively size indication zones to insure that all potentially large flaws would be included in the validation plan. Validation by destructive tests, construction radiographs, and complementary NDE techniques are planned for future work.

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Executive Summary

This report estimates the density and distribution of flaw indications in material removed from the non-irradiated Shoreham nuclear reactor pressure vessel (RPV). The flaw indications were obtained from non-destructive evaluation (NDE) of weldment specimens. This is Volume 3 of a multi-volume set. The first volume gives the density and distribution of flaw indications in the Pressure Vessel Research User Facility (PVRUF) vessel. Volume 2 describes the removal of material from the PVRUF vessel, the conduct of confirmatory NDE techniques and metallographic analysis, and the confirmation of flaw rates for the vessel.

This volume provides the characteristics of the flaw indications in the Shoreham vessel and their density and distribution. This report also gives a description of the Shoreham vessel weldments and the approach to the research. The performance of the inspection system and the measurements made on the RPV material are described. Twenty-five linear meters of weldment were inspected by nondestructive evaluation, including both circumferential welds (round seams) and axial welds (longitudinal seams) of the vessel. All of the available material was inspected and the inspection data were analyzed.

Flaw detection and sizing was performed using rule statements described in this report. The characteristics of the indications were evaluated and the results of this evaluation are the six characteristics that describe the indications found. Most of the flaw indications were small. Evidence of long lack of fusion was tabulated. Any indications that showed uniform response in their through-wall extent were characterized separately. Complex and simple clusters of indications were listed. Finally, indications whose estimated through-wall sizes were impacted by surface geometry were separated for further evaluation.

Among the principal findings of this study are the more than 4000 detectable indications in the SAFT-UT inspections of the Shoreham RPV material. Where sizing results are reported, the SAFT-UT sizing rules were used to conservatively size indication zones to insure that all potentially large flaws would be included in the validation plan. Confirmations obtained by destructive tests, construction radiographs, or complementary NDE techniques are not included in this report.

Previous work, on the PVRUF vessel, has shown that the ultrasonic indications found in RPV material are flaws. The flaws are mostly less than 4 mm in size (as predicted). The fusion surface (of the weld with the base metal) contains an elevated concentration of vertical planar discontinuities. The flaws greater than 8 mm in size are associated with repairs and their morphologies are complex (a combination of cracks, lack of fusion, slag, and voids).

A number of similarities between PVRUF and Shoreham flaws were readily apparent. Numerous small flaw indications were found on the fusion surfaces of the structural weld with the base metal. Indications larger than 6 mm were complex in shape.

There were two principal differences between the flaw densities of the Shoreham and PVRUF vessels as measured by the SAFT-UT weld normal inspections. The Shoreham vessel cumulative flaw rate is three time greater than that for the PVRUF vessel. The Shoreham vessel contained indications of long lack of fusions, up to 3 in. in length and the PVRUF vessel material did not. No measurable differences in cumulative flaw rates were seen between Shoreham axial welds and circumferential welds.

In this report, recommendations are given for validating the indication rates by selective destructive analysis. Larger indications are characterized and indication zones can be identified to guide the validation research on the Shoreham material.

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The authors wish to thank Mr. Robert Hardies of Baltimore Gas and Electric for providing the Shoreham RPV material. Stan T. Rosinski, Kim Kietzman, and Brian J. Rassler, of the EPRI NDE Center, provided access to the construction records and to the Shoreham material while it was at their facility.

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Abbreviations

BG&E	Baltimore Gas and Electric
BWR	boiling water reactor
EPRI	Electric Power Research Institute
FBH	flat bottom hole
HAZ	heat-affected zone
ID	inside diameter
ISI	in-service inspection
LOS	loss of signal
MT	magnetic particle testing
NDE	nondestructive evaluation
NRC	U.S. Nuclear Regulatory Commission
OD	outside diameter
PFM	probabilistic fracture mechanics
PNNL	Pacific Northwest National Laboratory
PT	dye penetrant testing
PTS	Pressurized Thermal Shock
PWR	pressurized water reactors
PVRUF	Pressure Vessel Research User Facility
RPV	reactor pressure vessels
RT	radiographic testing
SAFT-UT	Synthetic Aperture Focusing Technique for Ultrasonic Testing
SDH	side-drilled holes
UT	ultrasonic testing

1 inch = 25.4 mm

1 Introduction

The U.S. Nuclear Regulatory Commission (NRC) initiated a program at the Pacific Northwest National Laboratory (PNNL) with the major objective of estimating the rate of occurrence of fabrication flaws in U.S. light-water reactor pressure vessels (RPVs). PNNL's methodology for estimating the density and size distribution of fabrication flaws in U.S. reactor pressure vessels involves the nondestructive evaluation (NDE) of vessel material from cancelled nuclear plants and the destructive validation of detected flaws. NDE has been performed on pressurized water reactors (PWRs) vessels made by Babcock & Wilcox and Combustion Engineering (Schuster et al. 1998). Destructive validation of the flaws found in these vessels has been reported (Doctor et al. 1999; Chapman and Simonen 1998; Schuster et al. 1997). This report describes the results of NDE on weldment specimens removed from a boiling water reactor (BWR) vessel, the Shoreham vessel, and estimates the density and distribution of the detected flaw indications.

This work, on the Shoreham material, is part of a joint effort with the Electric Power Research Institute (EPRI) and Baltimore Gas and Electric (BG&E) to evaluate the nature of fabrication flaws in the Shoreham reactor pressure vessel (Rosinski et al. 1998). PNNL's work on extracting weldment specimens from the Shoreham vessel material and the estimation of the density and distribution of fabrication flaws in those specimens are reported here. Section 2 of this report describes the origin of the material, construction records, weld profile, and the sectioning of the material. Section 3 describes the performance of PNNL's inspection system, Synthetic Aperture Focusing Technique for Ultrasonic Testing (SAFT-UT), in terms of detection performance, sizing performance, transducer properties, focusing, and resolution. Section 4 describes the SAFT-UT data acquisition, analysis of the data, the measurements made, the recording and sizing rules, and the volume of material inspected. Section 5 describes how the flaw indications from the Shoreham vessel were characterized. Section 6 gives the distribution of the flaw indications flaw and the size dependence of the flaw indication density. Conclusions and recommendations are given in Sections 7 and 8, respectively. Finally, there are 21 appendices containing a listing of all flaw indications detected and SAFT-UT images of the larger indications.

1.1 Contents of Volumes 1 and 2

Volume 1 of this report, *Characterization of Flaws in U.S. Reactor Pressure Vessels: Density and Distribution of Flaw Indication in PVRUF* (Schuster et al. 1998), describes the nondestructive evaluation of fabrication flaws in a PWR vessel manufactured by Combustion Engineering. The details of the inspections of the material removed from the Midland vessel, manufactured by Babcock & Wilcox, were included as Appendix B. The report includes a discussion of those flaw characteristics that were predicted by fracture mechanics calculations to be most important for vessel integrity. Design and fabrication information on RPVs is presented especially on the subclass of vessels used in PWRs, along with the specifications for the PVRUF vessel. The report discusses the most significant indications found by the SAFT-UT inspections and documents their important features. The distributions of the indications in those categories important for vessel integrity were presented along with a methodology for fitting a parametric rate function to the distribution of indications in the NDE measurements.

Volume 2 of this report (in preparation), *Characterization of Flaws in U.S. Reactor Pressure Vessels: Validation of Flaw Density and Distribution in PVRUF*, will document the results of the destructive validation of the PVRUF flaw indications. The destructive validation is largely completed and the principle findings are: the 2500 indications are physical flaws; the flaws are mostly small (as predicted), the fusion line between the weld and the base metal contains an elevated concentration of small vertical planar discontinuities; flaws greater than 8 mm in size are associated with repairs; and all of the larger flaws are complex (a combination of cracks, lack of fusion, slag, and voids).

1.2 Principal Objectives

The objective of this research is to develop empirically based estimates of fabrication flaws in the RPVs of operating nuclear power plants for use in fracture mechanics structural integrity assessments. Structural assessments, such as those that predict vessel failure, are performed using computer codes that require, as input, accurate estimates of flaw rates. The likelihood of vessel failure is sensitive to flaw location, flaw type, flaw size, etc. The objective of this research is to estimate these and other relevant properties of fabrication flaws in U.S. reactor pressure vessels.

Estimates for flaw rates are an important input to structural assessments by fracture mechanics, such as evaluations relating to the Pressurized Thermal Shock (PTS) scenario. PTS is an issue of increasing concern as the present generation of operating nuclear power plants reach the middle of their license periods and the RPVs become more embrittled. The PTS issue is also a dominant factor in questions pertaining to plant life extension. Computer codes such as the VISA code (Simonen et al. 1986a) require accurate estimates of the flaw rates in the reactor vessel to determine the likelihood of a vessel rupture during a PTS event. The majority of past work in probabilistic fracture mechanics (PFM) considered cracks to be expressed in terms of a single crack size parameter (size in the depth dimension). A two-dimensional crack is much more realistic but considerably more complex. Some PFM codes are capable of treating two-dimensional cracks, and are based on the assumption that a two-dimensional crack is a semi-elliptical surface crack.

Fracture mechanics codes can provide the capability of considering more realistic and detailed flaw rate information. Because of the lack of empirical data on fabrication flaw distributions in U.S. RPVs, conservative assumptions are made about the initial flaw size distribution, aspect ratios, and through-wall locations. Studies (Simonen et. al. 1986b, Simonen and Khaleel 1995) have shown that the probability of vessel rupture is sensitive to the location of the flaw in the vessel (i.e., near the inner surface versus interior of the vessel wall); the flaw type (e.g., cracks, lack of fusion, porosity, inclusions, etc.); and the flaw aspect ratio (i.e., flaw length as well as depth). Therefore, it would be very useful to have flaw rate estimates that are based on empirical data.

Future work, in NRC JCN W6275, will gather information on vessel fabrication techniques to aid in producing generalized flaw density and size distributions for application to the entire population of vessels of all classes. An existing statistical model, as developed by Chapman (1993) in the U.K., is being evaluated for its ability to predict vessel-specific flaw densities and size distributions for use with and comparison to in-service inspection (ISI) results from operating reactors. The data from this project will be used to benchmark and calibrate Chapman's predictive model for U.S. fabrication processes of RPVs. A calibrated predictive model, such as the one developed by Chapman, should provide, when used with ISI data, a means of extrapolating the flaw rates from this project to the entire population of vessels in the U.S.

1.3 Background

Materials from four different reactor pressure vessels have been selected for study. The major vessel manufacturers and the major vessel designs have been considered in the selection. Figure 1.1 shows some of the material removed from the Shoreham vessel that is of a BWR design. The results of the NDE inspections of this material is the primary subject of this report.

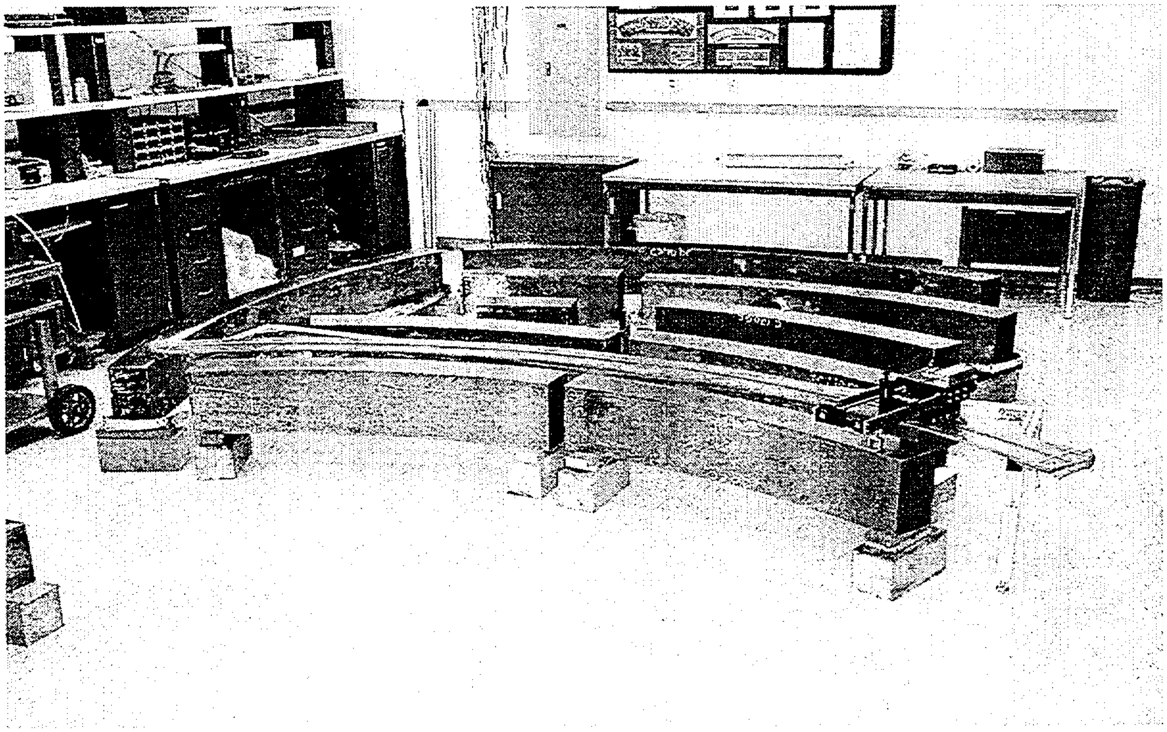

Figure 1.1 Shoreham circumferential weldment specimens at PNNL

The Laboratory's approach to this work is to inspect, using NDE methods, a large amount of material and then validate the characterized flaw indications using complementary NDE and destructive techniques.

The SAFT-UT inspection system, shown in Figure 1.2, is used for building research quality data sets on fabrication flaws (Doctor et al. 1996; Hall et al. 1988). In SAFT-UT, the focal properties of a large focused transducer are generated by digital signal processing of data collected over a large area using a small transducer with a diverging sound field. SAFT has an advantage over physical focusing techniques in that the resulting image is full-volume focused over the entire inspection area. Traditional physical focusing techniques provide focused images only over a limited zone at the depth of focus of the lens. A second benefit in SAFT processing is that the coherent summation for each image point involves shifting a locus of A-scans, within a regional aperture, by predicting time delays and summing the shifted A-scans. Each picture element is then a spatial average producing an enhanced signal-to-noise performance suitable for detection and characterization of small reflectors in heavy-section steel.

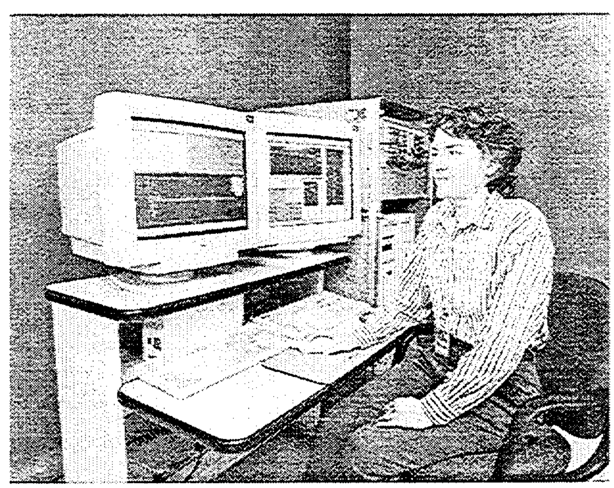

Figure 1.2 SAFT-UT field data acquisition system

Radiographic testing is used to better determine the presence and nature of a sample of the flaw indications previously found by ultrasonic testing. The vessel material is typically cut into 25-mm thick specimens for the radiography. The largest flaws are typically removed by sectioning horizontally to preserve the flaw length and width. Material containing flaws near the surface of the vessel are cut into 25-mm thick plates by removing the outer portion of the vessel. The material containing flaws at the weld fusion line is sectioned vertically so that the radiographic testing can measure the through-wall extent of the flaws.

Metallography, performed on a select portion of the flaws found, can show detailed flaw characterization. Flawed material, removed from the 25-mm plates, are typically formed into cubes. A 25-mm cube is a convenient size for the metallographic steps of grinding, polishing, and etching.

1.3.1 Modeling

The modeling approach uses both expert elicitation and mathematical modeling to build a computer code that simulates the weld manufacture and the errors that lead to creating different types of defects. In this way, the model attempts to predict a defect distribution and density for a given type or family of welds. The model has been applied to predict the flaws in the PVRUF vessel material. Good agreement was found between the predicted and measured flaw distributions for a range of flaw sizes extending to 17 mm in through-wall extent (the largest flaw measured). It was concluded that the computer code provides an acceptable mechanistic model to estimate the occurrence rates for flaw sizes larger than those in the database (Chapman and Simonen 1998).

1.3.2 Measurement Units

The units used in this report are driven by standard practice. All of the flaw indication locations are referenced to the vessel coordinates that are in the English units of inches. The flaw distribution and density units are consistent with the Marshall distribution and these are metric. It is expected that the reader can make conversions between units if needed by using the relationship that 1 inch equals 25.4 mm.

1.3.3 Summary

The research results are showing that combinations of NDE techniques and destructive analysis give reliable, and validated flaw distributions. The SAFT-UT inspections show concentrations of flaws along the weld fusion line and in weld repairs. Radiographic testing confirms the ultrasonic flaw indications to be discontinuities in mass density. Metallographic testing shows the flaws to be mostly lack of fusion with slag.

Modeling of the welding process can be used to predict the size distribution of flaws. Such a validated model can be used to extrapolate the size distribution, as measured in the NDE inspections, to the range of larger and more structurally significant flaws that are too infrequent to measure by empirical testing of limited material samples.

2 Description of the Shoreham Vessel

The Shoreham vessel was assembled by Combustion Engineering in the years 1968-1974. The vessel was installed at the Shoreham Nuclear Power station and the plant was made fully operational but did not produce electricity. When the plant was decommissioned, BG&E purchased portions of the Shoreham reactor vessel, specifically the upper 198 in. of the vessel plus portions of the top and bottom heads. This material includes the vessel flange, the upper shell course containing the steam outlet nozzles, and a portion of the upper-intermediate shell course. Figure 2.1 shows a vessel roll-out drawing with the identification of the weldments selected for study.

The Shoreham vessel was constructed of four shell courses and each shell course was constructed of three sections of formed plate. It is the density and distribution of fabrication flaws in these weldments that is the subject of this research. A middle section of material contains the four steam outlet nozzles and portions of the axial welds of the upper shell course identified as 1-308A, B, and C. Each of these three weld portions is 84-in. long and was shipped to PNNL. The weld 1-308C is between a pair of nozzles and was not removed for study. The weld portions 1-308A and B were removed for study. The lower portion of material contains girth weld 4-308A that joins the upper shell course with the upper-intermediate shell course. It also contains portions of axial welds 1-308A, B, C, D, E, and F.

2.1 Construction Records

Portions of the construction records were received from BG&E. Because BG&E purchased only the upper portion of the vessel and the construction records for that material, only these portions of the construction records were available. The remaining records are in the custody of ABB/Combustion Engineering. Table 2.1 shows the

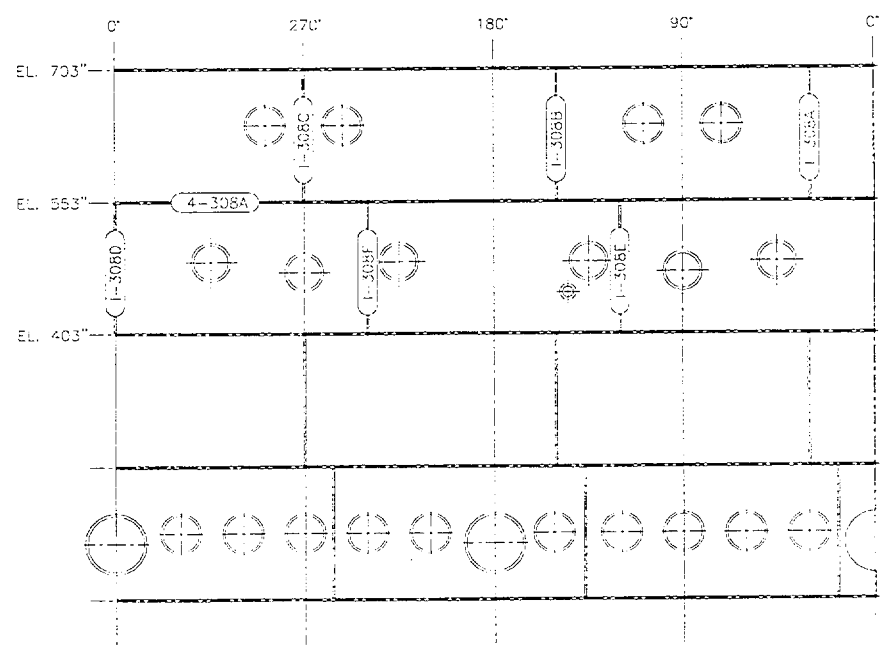

Figure 2.1 Schematic representation of weldments in four shell courses of the Shoreham vessel with the numbers of the welds in material studied

Table 2.1 Coverage and Date of Shoreham Construction Records		
Record Type	**Coverage**	**Year(s)**
Specification of Plates	All plates	1966
Plate Procurement Records	All plates	1968
Plate Test Certifications (supplier)	Upper shell and intermediate to upper shell plates	1968
Plate Material Tests (vessel manufacturer)	Upper shell and intermediate to upper shell plates	1969 - 1970
Assembly and Weld Procedures	Axial and circumferential welds	1968 - 1970
Weld Material Certification	Upper shell course (axial welds) and upper intermediate to upper shell assembly (circumferential weld)	1968 - 1973
Weld Inspection Records	Upper shell course (axial welds) and upper intermediate to upper shell assembly (circumferential weld)	1969 - 1971
Shop Travelers	Upper shell course (axial welds) and upper intermediate to upper shell assembly (circumferential weld)	1969 - 1972
Form N1	Completed vessel	1974

coverage and date of the portion of the construction records obtained by the Laboratory.

Specification of Plates. A written specification for the procurement of the plate material was included in the construction records entitled: Purchase Specification for 80,000 PSI Tensile Strength (A-533 Gr. B CL. 1) Plate for Heat Treatment by the Purchaser - ASME Section III. The specification gives "additions and deletions to ATSM Spec. A-533-65, Mn-Mo and Mn-Mo-Ni alloy steel plates, Quenched and Tempered, for Pressure Vessels." The plates were to be supplied to the vessel manufacturer in the as-rolled temper but with chemical and physical test results from the plate supplier on material removed from each heat.

Plate Procurement. The written purchase orders for the plates used in the four shell courses and the top and bottom head were included in the construction records. The purchase orders specified that the plate vendor be willing to negotiate defects. Defects were to be those detected by the vessel manufacturer using a 100% volumetric inspection after forming and heat treatment. A defect that caused any echo indication to exceed 50% of the indication in the calibration standard and that was continuous during movement of the transducer more than 3 in. in any direction was unacceptable. General Electric inspection and witness points were required at the plate supplier's facility.

Table 2.2 shows the location and vendor heat numbers for the base metal plates used in the assembly of the Shoreham vessel. In the upper shell course, the plate locations cannot be identified because registration was lost during assembly of this shell course. The plate number and weld number were noted at the time of fit-up but the identification was lost during machining after completion of the axial welds but before NDE of the axial welds. The plate location and the ability to identify plate repair locations has been lost.

Table 2.3 shows the rejection records and repair methods applied to the base metal plates as obtained from the Shoreham construction records.

Plate Testing by the Supplier. The plate supplier removed and tested coupons from each heat of plate material. The tests included a chemical

Table 2.2 Location and ID of Base-Metal Plates in the Shoreham Vessel			
Subassembly	**Location**	**Manufacturer Code**	**Vendor Heat Number**
Upper shell course	(unknown)	G-4403-1	C4134-1
	(unknown)	G-4403-2	C4909-2
	(unknown)	G-4403-3	C4773-1
Upper-intermediate	0-120° Azimuth	G-4403-7	C4806-1
	120-240° Azimuth	G-4403-6	C4765-1
	240-360° Azimuth	G-4403-5	C4766-1
Lower-intermediate	30-150° Azimuth	G-4403-4	C4765-2
	150-270° Azimuth	G-4404-1	(at manufacturer)
	270-30° Azimuth	G-4404-2	(at manufacturer)
Lower shell	20-140° Azimuth	G-4405-3	(at manufacturer)
	140-260° Azimuth	G-4405-2	(at manufacturer)
	260-20° Azimuth	G-4405-1	C4803-1
Bottom head	Upper peel	G-4407-1	(at manufacturer)
	Upper peel	G-4407-2	C4926-2
	Lower peel	G-4408	C4897-2
	Lower peel	G-4409	C4901-1
	Dome	G-4410	C4920-4
Closure head	Peel	G-4411-1	C4897-1
	Peel	G-4411-2	C4821-1
	Dome	G-4412	C4845-3

Table 2.3 Rejection and Repair of Base-Metal Plates			
Heat	**Defect**	**Size (inches)**	**Repair**
C4773-1	Snake	20L 2W 0.23D	Chipped out, ground smooth, magnafluxed okay, rolled to the inside during forming
C4773-1	Snake	7L 1W 0.18D	Chipped out, ground smooth, magnafluxed okay, rolled to the inside during forming
C4182-3	Snake	6L 5W 0.26D	Chipped out, ground smooth, magnafluxed okay, rolled to the inside during forming
C4803-2	Snake	(unknown)	Chipped out, ground smooth, magnafluxed okay, rolled to the inside during forming
C4134-1	Roll mark	88L 2W 0.22D	Rolled to the inside during forming
C4763-2	Roll mark	60L 3W 0.1D	Rolled to the inside during forming
C4806-2	Roll mark	103L 7W 0.25D	Rolled to the inside during forming

analysis of the minor constituents of the coupon and measurements of the physical properties of the coupon after heat treatment. The results of the chemical analysis, the heat treatment applied, and the physical properties of the coupons are given in the construction records.

Plate Testing by the Vessel Manufacturer. The plates were sent to the vessel manufacturer in the as-rolled temper. The manufacturer preformed the forming of the plates, heat treatment after forming, and mechanical tests including Charpy V-Notch tests. The test results were included in the construction records.

Weld Procedures and Qualification. Separate weld procedure specifications were written and applied to the axial and circumferential (girth) weldments.

For the axial welds, the weld procedure specified a sequence of single and tandem arc submerged metal arc weld passes with shielded metal arc (manual welding) specified for back-weld if required. For the girth weld, the weld procedure specified single arc submerged metal arc weld passes with shielded metal arc welding for the required back-grove.

The axial weld procedure specified 0.187-in. diameter wire be used, electrode type B4 modified, and flux type 1092. Preheat range was 250-500°F. The weld profile was double "U". A copper backing bar was installed and the first weld passes were made from the OD (to 1½-in. level) using single arc submerged metal arc welding. The second weld passes were single arc submerged metal arc made from the ID (to the 1-in. level). Next, the remainder of the ID was specified to be filled-in using tandem arcs. Then, the remainder of the OD was specified to be filled-in using tandem arcs. Shielded metal arc welding was specified for backfill if needed using 0.187-in. or 0.25-in. diameter wire, electrode type E-8018.

The qualification records for the axial welding procedure were included in the construction records. Reduced section transverse tension tests were reported giving the size of the specimens, load, stress, and character and location of failure. Charpy V-notch impact tests were reported for weld metal and heat-affected zone (HAZ).

The girth weld, 4-308A, specified 0.187-in. diameter wire, electrode type B4, and flux type 0091. The weld profile was straight wall with backing ring. All machine-made weld passes were specified to be made using a single arc from the OD. After completing the submerged arc welding, the backing ring was removed, a back-grove was specified to sound weld-metal, and shielded metal arc welding was specified using 0.187-in. or 0.25-in. diameter type E-8018C-3.

The qualification records for the girth welding procedure were included in the construction records.

Weld Material Testing. Testing records were available in the construction records for each heat (and lot) of welding material used in the axial welds of the upper shell course and for the circumferential weld between the upper shell course and upper to intermediate shell course. The test reports give the results of a chemical analysis of minor constituents and give the physical properties of a welded test specimen after heat treatment.

Weld Inspection Records. Weld inspections forms were available for the axial welds in the upper shell course, for the repairs to the those axial welds, for the circumferential weld between the upper shell and the upper intermediate shell, and for the repairs to that circumferential weld. Table 2.4 gives some of the inspection points for these welds.

Shop Travelers. Portions of the shop travelers for the assembly of the upper shell course (welding of axial seams) and the assembly of the upper to upper-intermediate shell course (welding of girth seam) were obtained from the construction records. These documents often indicate how unsatisfactory indications (defects) were detected and repaired.

A fairly complete copy of the shop traveler for assembly of upper shell course was obtained. Magnetic particle testing (MT) of the weld prepared surfaces for the axial seams showed a number of unsatisfactory indications, and repairs were made. The axial welds were made according to specification and an air arc gouge of the long seams was performed before non-destructive testing. A sketch of this air arc gouge (V-70190-10-60) is mentioned on the shop traveler but was not obtained by the Laboratory. The air arc gouge was ground for MT, and MT was performed followed by manual welding of the back-groove. The assembly was "bored and turned" on the ID and OD while maintaining a wall thickness of 5.875 in. MT and ultrasonic testing (UT) were performed on the

Table 2.4 Weld Inspection Points						
	Submerged Metal Arc			Shielded Metal Arc		
Weld #	Type	Diameter (inches)	Heat	Type	Diameter (inches)	Heat
1-308A	B4 modified	0.187	20291 &12008	8018	0.25	HADH
1-308B	B4 modified	0.187	20291 & 12008	8018	0.25	HADH
1-308C	B4 modified	0.187	20291 &12008	8018	0.25	HADH
Repair 1-308A				8018	0.187	LOEH
4-308A	B4	0.187	33A277	8018	0.312 0.25 0.25	GBCJ HOCJ ICJJ
Repair 4-308A				8018	0.187	JACJ

machined surfaces and no unacceptable indications were recorded. Radiographic testing (RT) was performed and one unsatisfactory indication was recorded in seam 1-308C. The indication was removed by air arc gouge but no sketch was mentioned or provided. The gouge was ground-out for MT and MT was performed followed by manual welding. This repaired section of axial seam 1-308C is in Shoreham Ring A and is still in the possession of BG&E. The assembly was clad and stress relieved. Dye penetrant testing (PT) was performed, PT indications were ground-out, and PT was repeated on the grind-outs. UT was performed and no indications were found. A photograph of the upper shell course was taken.

Portions of the shop traveler for assembly of upper shell and upper-intermediate shell courses were obtained from the construction records. The backing ring was installed after the fit-up and the girth weld was made according to procedure. In-process magnetic particle testing was done but for information only, and no records were obtained on the results of this testing. The assembly was clad and stress relieved. RT was performed and unsatisfactory indications were recorded in girth weld (seam 4-308A). The indications were removed by air arc gouge but no sketches were mentioned or provided. The gouge was ground-out for MT and MT was performed followed by manual welding. The continuation of this shop traveler (V-70193-017) was not obtained from the construction records. The approximate locations of the repairs to the girth weld were obtained in drawing SHM-REP-001 dated December 7, 1993.

Form N1. Form N1, Manufacturer's Data Report for Nuclear Vessels, was included in the construction records and gives the "year built" as 1974.

Summary. Vessel-to-vessel variations in the welding practice that was used can determine how to best apply measurements for determining fabrication flaw density and distribution. Construction records contain procedures that specify welding parameters, such as wire size and welding sequence. The weld profiles and frequency of manual welding can be found. Inspection and repair records can be obtained for both weldment and base metal.

2.2 Sectioning Plans

Figure 2.2 shows the cutting plan for the removal of a weldment specimen from a portion of axial weld 1-308A. The figure is an OD view of the portion of the Shoreham vessel between elevations of 623.8 in. and 665 in. and between azimuth of 17° and 43.3°. The weldment specimen removed is 5 in. wide and 41.2 in. long. The three specimens are identified on their OD surface as B0BA1-B0BB1, B0BA2-B0BB2, and B0BA3-B0BB3.

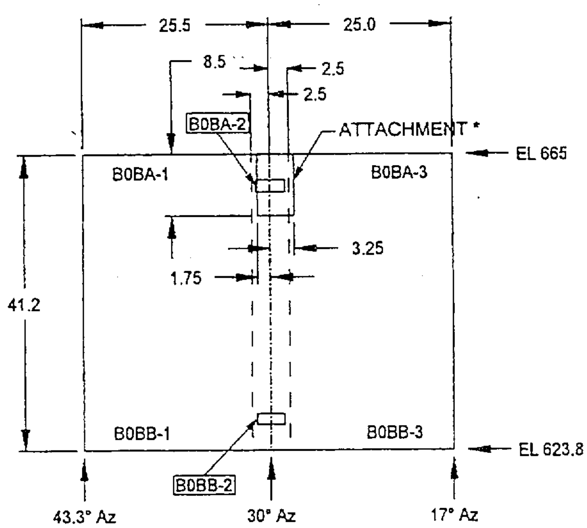

Figure 2.2 Sectioning of Shoreham specimen B0B showing removal of a portion of axial weld 1-308A at 30° of azimuth. Azimuth is given in degrees and other units are given in inches.

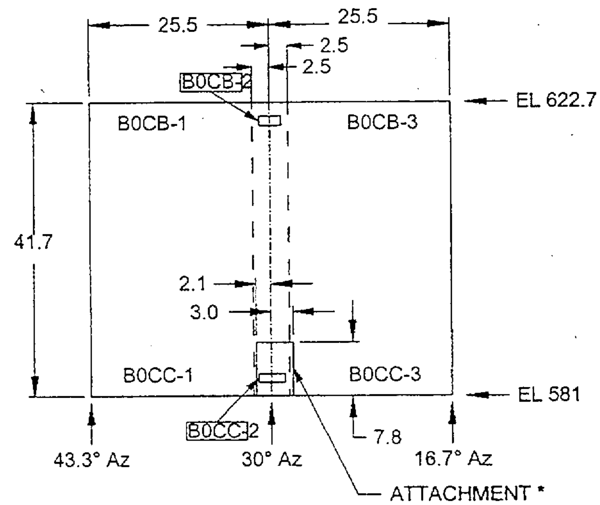

Figure 2.3 Sectioning of Shoreham specimen B0C showing removal of a portion of axial weld 1-308A at 30° of azimuth. Azimuth is given in degrees and other units are given in inches.

Figures 2.3, 2.4, and 2.5 show the cutting plan for the removal of weldment specimens from portions of axial welds 1-308A and 1-308B. The figures document the removal of three axial weldment specimens with dimensions similar to B0BA2-B0BB2 described above.

Figure 2.6 shows the cutting plan for the removal of weldment specimens from axial welds 1-308A and 1-308D and from girth weld 4-308A. The specimen shown in the figure is labeled "C0" and is an OD view of the portion of the Shoreham vessel between elevations of 505 in. and 581 in. and between azimuth coordinates of 330° to 40°. The figure shows that specimen "C0" has been sectioned into nine specimens labeled C0A, C0B, ..., C0I. C0A is a base-metal specimen with stamps C0AA and C0AB on the OD surface. C0AA identifies the edge at elevation 581 in. and C0AB identifies the edge at 558 in.

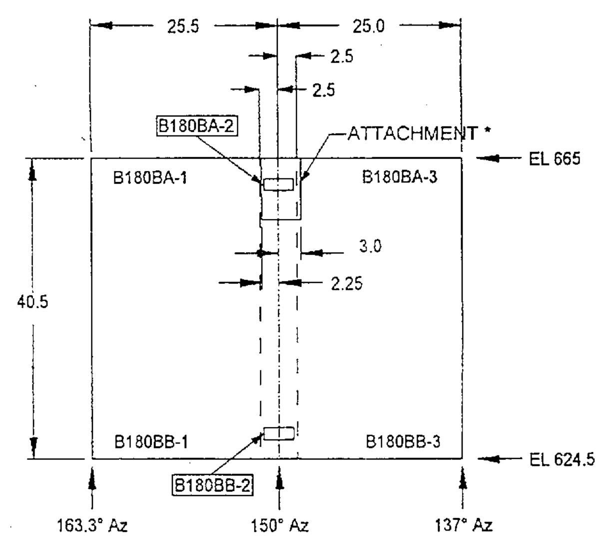

Figure 2.4 Sectioning of Shoreham specimen B180B showing removal of a portion of axial weld 1-308B at 150° of azimuth. Azimuth is given in degrees and other units are given in inches.

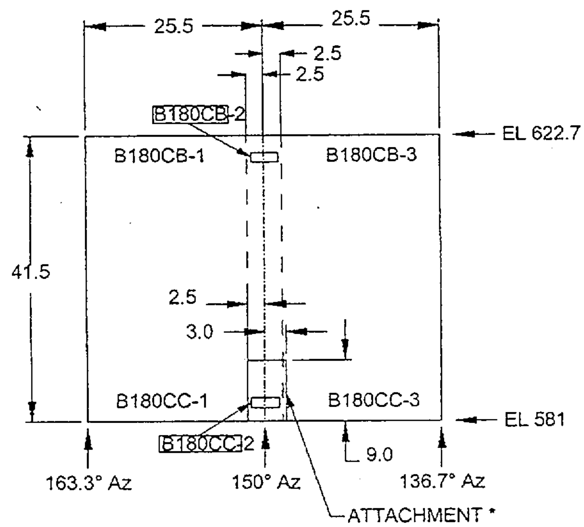

Figure 2.5 Sectioning of Shoreham specimen B180C showing removal of a portion of axial weld 1-308B at 150° of azimuth. Azimuth is given in degrees and other units are given in inches.

Figures 2.7 through 2.11 show the cutting plan for the removal of weldment specimens from axial welds 1-308B, C, E, and F and from girth weld 4-308A. The figures give the labels that were placed on each section of Shoreham material and the vessel coordinates for each section.

Table 2.5 shows a summary of all the weldment specimens that were removed from the Shoreham material. It also shows the weldment length of each specimen and the type of weld (axial or circumferential). Table 2.6 shows vessel coordinates for repair areas reported.

Table 2.5 The Shoreham Weldment Specimens

Segment ID	Weld Length (in.)	Type of Weld
C75B	100.5	Circumferential
C120D	22.5	Circumferential
C120B	32.5	Axial
C120E	53.6	Circumferential
C120F	54	Axial
C120G	54	Circumferential
C180B	71.7	Circumferential
C240B	32	Circumferential
C240C	54	Circumferential
C270D	117.4	Circumferential
C270B	32.5	Axial
C270E	18.1	Circumferential
C0D	19.4	Circumferential
C0B	33.8	Axial
C0E	55.2	Circumferential
C0F	52.7	Axial
C0G	58.4	Circumferential
B0B-2	41.2	Axial
B180B-2	40.5	Axial
B0C-2	41.7	Axial
B180C-2	41.5	Axial

Table 2.6 Location of Repair Areas in Shoreham Weldment Specimens

Specimen	Repair Area Location
C75B	67.8° to 77.6° Azimuth
C120E	141.7° to 146.7° Azimuth
C180B	186.1° to 210.8° Azimuth

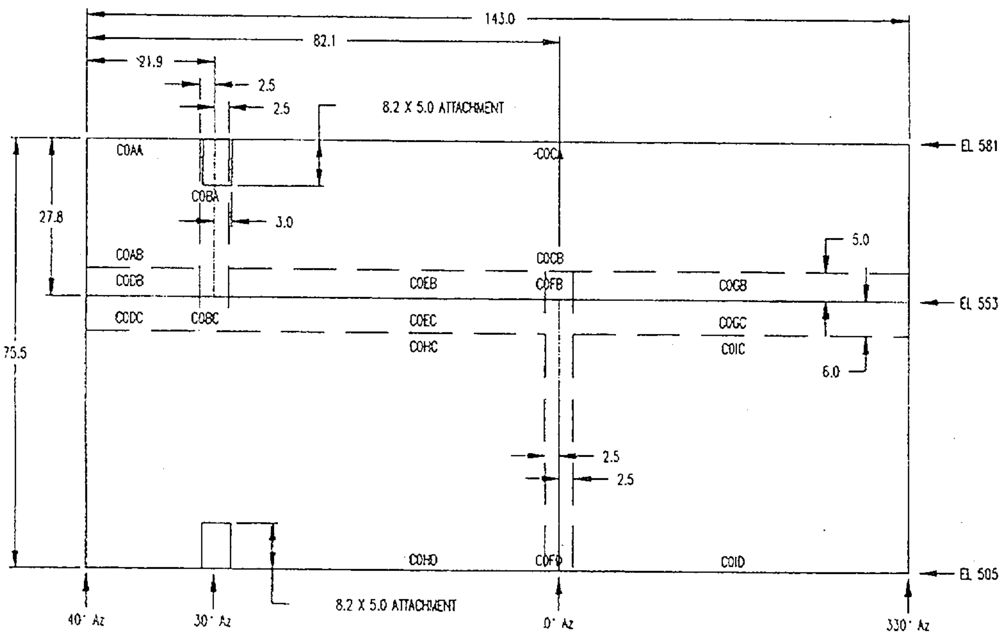

Figure 2.6 Sectioning of Shoreham specimen C0 showing removal of a portion of axial weld 1-308A at 30° of azimuth, three portions of girth weld 4-308A, and a portion of axial weld 1-308D at 0° of azimuth. Azimuth is given in degrees and other units are given in inches.

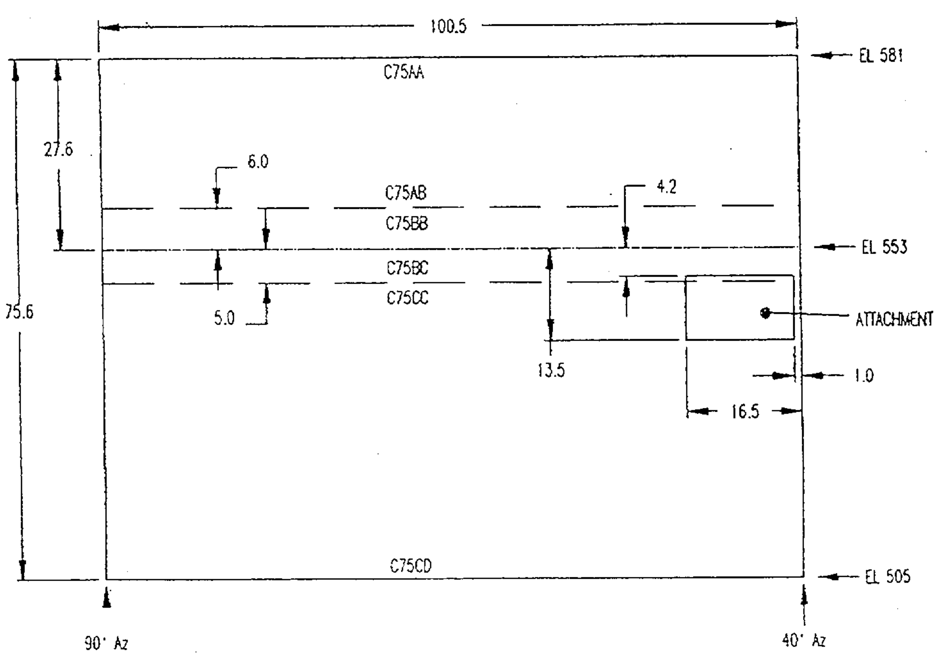

Figure 2.7 Sectioning of Shoreham specimen C75 showing removal of a portion of girth weld 4-308A. Azimuth is given in degrees and other units are given in inches.

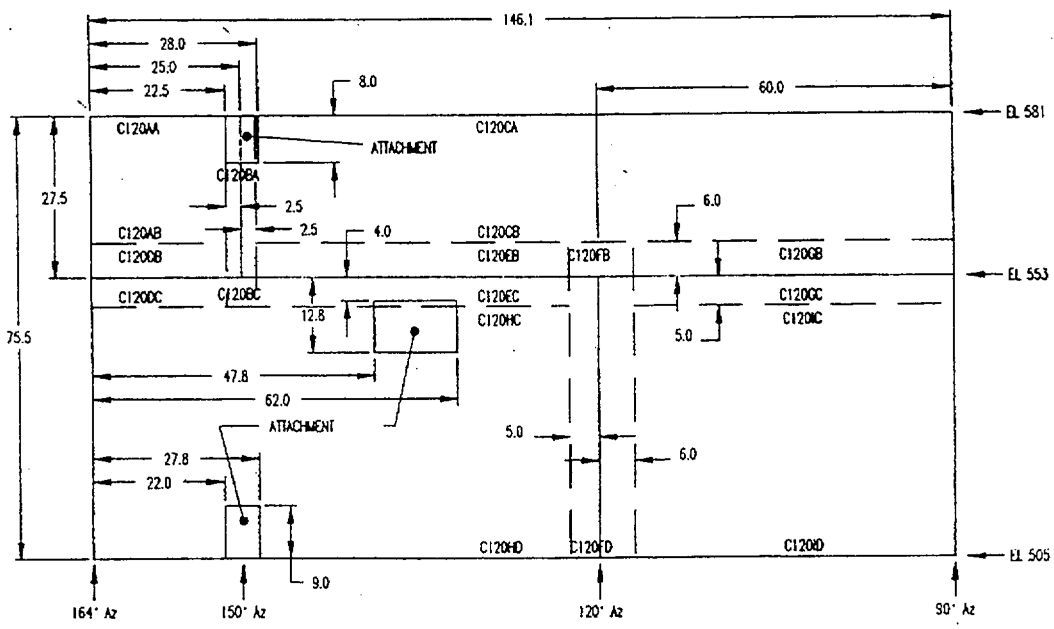

Figure 2.8 **Sectioning of Shoreham specimen C120 showing removal of a portion of axial weld 1-308B at 150° of azimuth, three portions of girth weld 4-308A, and a portion of axial weld 1-308E at 120° of azimuth. Azimuth is given in degrees and other units are given in inches.**

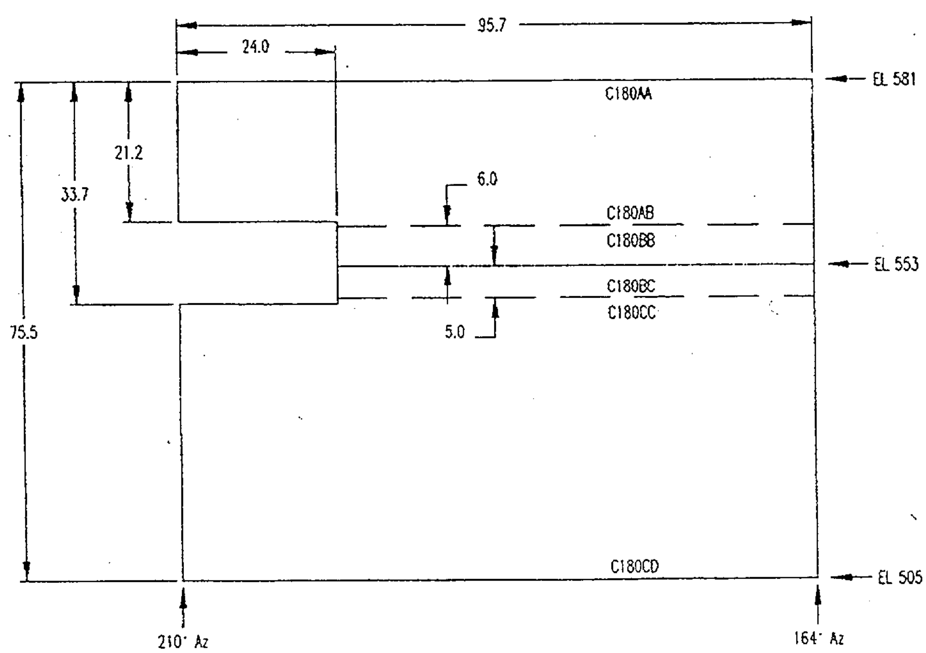

Figure 2.9 **Sectioning of Shoreham specimen C180 showing removal of a portion of girth weld 4-308A. Azimuth is given in degrees and other units are given in inches.**

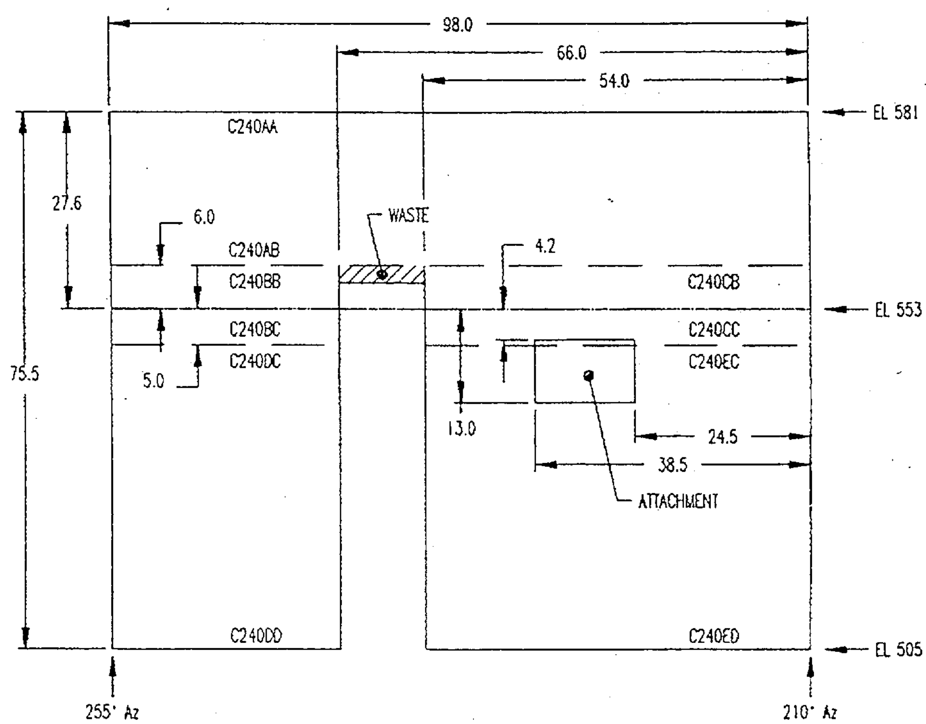

Figure 2.10 Sectioning of Shoreham specimen C240 showing removal of two portions of girth weld 4-308A. Azimuth is given in degrees and other units are given in inches.

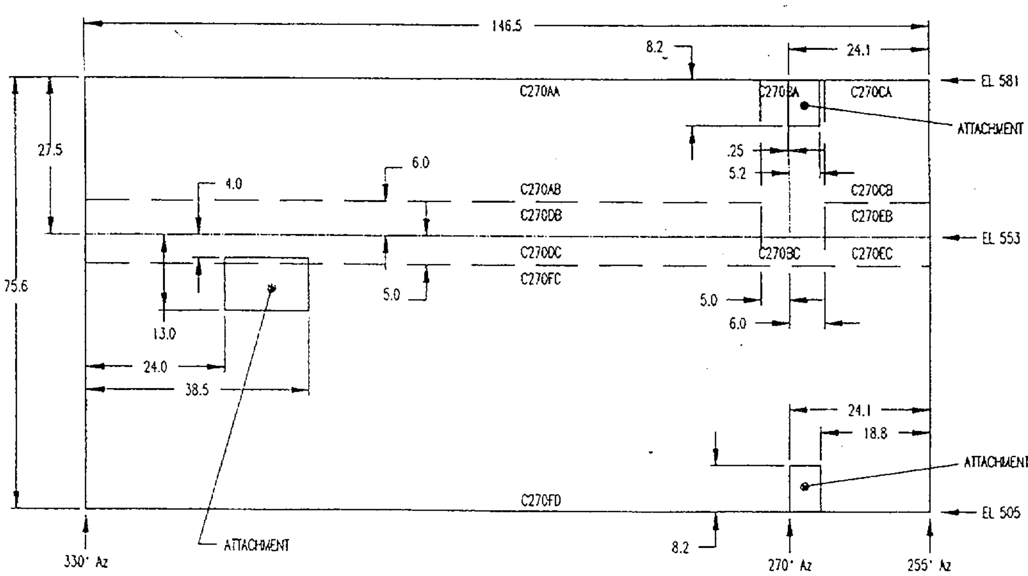

Figure 2.11 Sectioning of Shoreham specimen C270 showing removal of two portions of girth weld 4-308A and a portion of axial weld 1-308C. Azimuth is given in degrees and other units are given in inches.

3 Performance of SAFT-UT

During the PVRUF validation work, inspections from a weld normal surface were performed. This information was used for two primary purposes. First, there was a need to confirm the locations of the 2500 flaws that had been detected during the inspections conducted from the vessel clad surface. Second, there was a need to confirm that no large through-wall flaws were missed during the ID clad inspections. In the case of the Shoreham inspections, it was important to 1) measure what flaws could be detected when scanning from the weld normal surface, 2) measure the sizing capability of the technique to be employed (depth, length, remaining ligament and the influence of the aperture limitation associated with being 4 in. to 6 in. from the weld fusion lines), and 3) assess the inspection effectiveness from the weld normal surface for detecting flaws within the cladding. A series of test specimens were created to determine the "best" transducer parameters and to quantify the SAFT focusing performance. This section provides an overview of the studies conducted and what conclusions were drawn.

3.1 Reflectors and Transducers

A series of calibration blocks containing machined reflectors were created to determine inspection performance. Transducers were selected and procured for evaluation of detection and sizing capabilities.

Four pieces of PVRUF material were machined to have two surfaces parallel to the weld and to provide metal paths similar to what was planned for the Shoreham weldment inspections. Calibration reflectors were machined into these blocks and the blocks were examined with contact and immersion ultrasonic transducers. Six flat bottom holes (FBHs) with diameters between 1 mm and 8 mm were drilled into two blocks. Sizing data was acquired from these two blocks.

A series of near surface machined flaws (3 mm and 6 mm diameter FBHs and several sawcuts) were placed in both the ID and OD regions, primarily in one block. Two resolution blocks were available as well. One block had a series of 6-mm diameter FBHs with edge to edge separation from 1 mm to 8 mm. The other block, from a previous project, had a series of 6.35 mm (0.25 in.) FBHs with separation from 0.41 mm to 25.4 mm. The calibration reflectors are listed in Tables 3.1 trough 3.4. The drawings for these four calibration blocks are show in Figures 3.1 through 3.4.

Table 3.1 Calibration Reflectors for Sizing

FBHs for Sizing:		
Diameter (mm)	Metal Path (mm)	Ultrasonic Response (dB) (relative to calibration)
1.0	127.0	-19.6
2.0	127.0	-11.4
3.0	127.0	-5.3
4.0	127.0	-3.1
6.0	127.0	1.0
8.0	127.0	1.3

Table 3.2 Calibration Reflectors for Detection of Surface Connected Flaws

Surface Connected Flaws:		
Sawcut Depth (mm)	Metal Path to Flaw (mm)	Ultrasonic Response
OD		
2.03	127.00	Detected
4.06	127.00	Detected
ID		
2.03	109.22	Not detected
4.06	109.22	Not detected
6.10	109.22	Not detected
8.13[a]	127.00	Detected
10.16	127.00	Detected

[a]Not in the weld region.

Table 3.3 Calibration Reflectors for Detection of Near Surface Flaws		
Near Surface Flaws:		
Distance from Edge (mm) (edge-edge)	**Metal Path to Flaw (mm)**	**Ultrasonic Response (dB) (relative to calibration)**
3-mm OD FBH		
5.08	96.52	-10.6
5.08	121.92	-9.4
25.40	109.22	-4.2
19.05	109.22	-5.2
12.70	109.22	-7.1
10.16	109.22	-7.7
7.62	109.22	-9.3
5.08	109.22	-10.2
6-mm OD FBH		
25.40	109.22	1.0
19.05	109.22	0.8
12.70	109.22	1.3
10.16	109.22	0.8
7.62	109.22	0.5
5.08	109.22	-0.1
5.08	96.52	-1.3
5.08	121.92	-1.7
3-mm ID FBH		
3.58	109.22	Not detected
5.08	109.22	Not detected
7.62	109.22	Not detected
6-mm ID FBH		
25.40	109.22	0.9
19.05	109.22	1.8
12.70	109.22	1.6
10.16	109.22	0.0
7.62	109.22	-5.7
5.08	109.22	-13.3

Four transducers were evaluated to determine the SAFT system sizing capabilities. The first was a 5-MHz, 6.4-mm (0.25-in.) diameter contact transducer, also used in the PVRUF study (Schuster 1998). Because this probe had a known performance it established a baseline for comparison to other transducers. An improvement in lateral resolution is possible by decreasing the f-number (focal length/ probe aperture) of the probe or increasing the frequency (Busse 1984). The baseline transducer had an expected 3.2-mm resolution (equivalent f/8.8). The second contact transducer evaluated had a 3.2-mm diameter with an expected 1.6-mm resolution (equivalent f/4.4). The two f/4 immersion transducers had frequencies of 5 MHz and 7.5 MHz for expected resolutions of 1.4 mm and 1.0 mm, respectively.

Table 3.4 Calibration Reflectors for Resolution			
Resolution Blocks:			
6-mm Diameter Flat Bottom Holes		**6.35-mm Diameter Flat Bottom Holes**	
Edge to Edge Separation (mm)	**Metal Path (mm)**	**Edge to Edge Separation (mm)**	**Metal Path (mm)**
1.0	127.0	0.41	50.80
2.0	127.0	0.79	50.80
3.0	127.0	1.58	50.80
4.0	127.0	3.20	50.80
6.0	127.0	6.40	50.80
8.0	127.0	12.70	50.80
		25.40	50.80

3.2 Detection

The detection performance for the 5 MHz, 0.25-in. (6.4-mm) diameter contract transducer was quite effective in being able to detect all of the calibration reflectors as seen by the data reported in Tables 3.1 through 3.4. This transducer does require that there be at least a 20 dB dynamic range in order to detect the response from the 1-mm FBH relative to the larger calibration reflectors.

Baseline calibration was established on a 9-in.-thick section of PVRUF material containing three SDHs at depths of one quarter, one half, and three quarters of the total thickness (¼T, ½ T, and ¾ T).

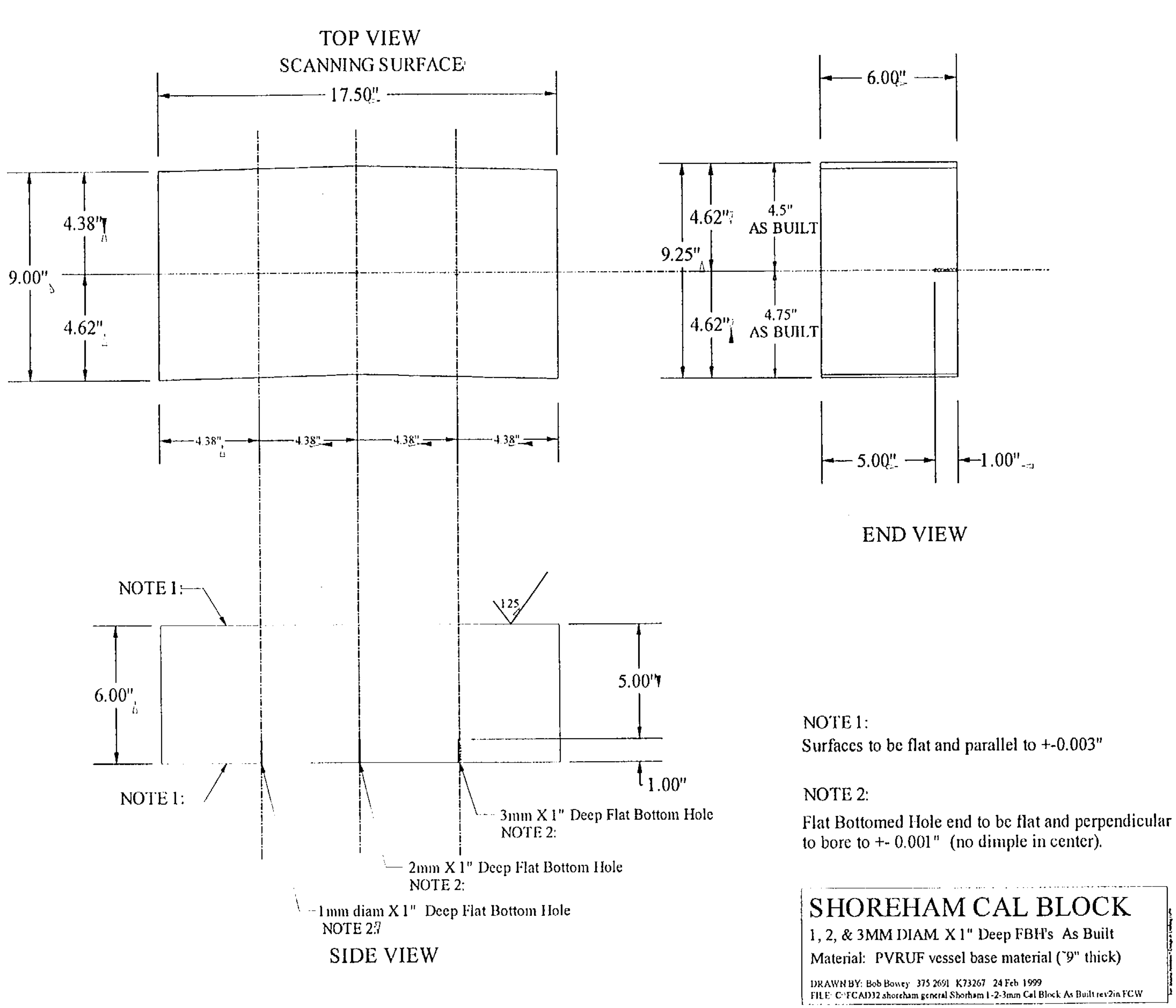

Figure 3.1 Shoreham calibration block with 1-, 2-, and 3-mm diameter FBHs for the sizing study

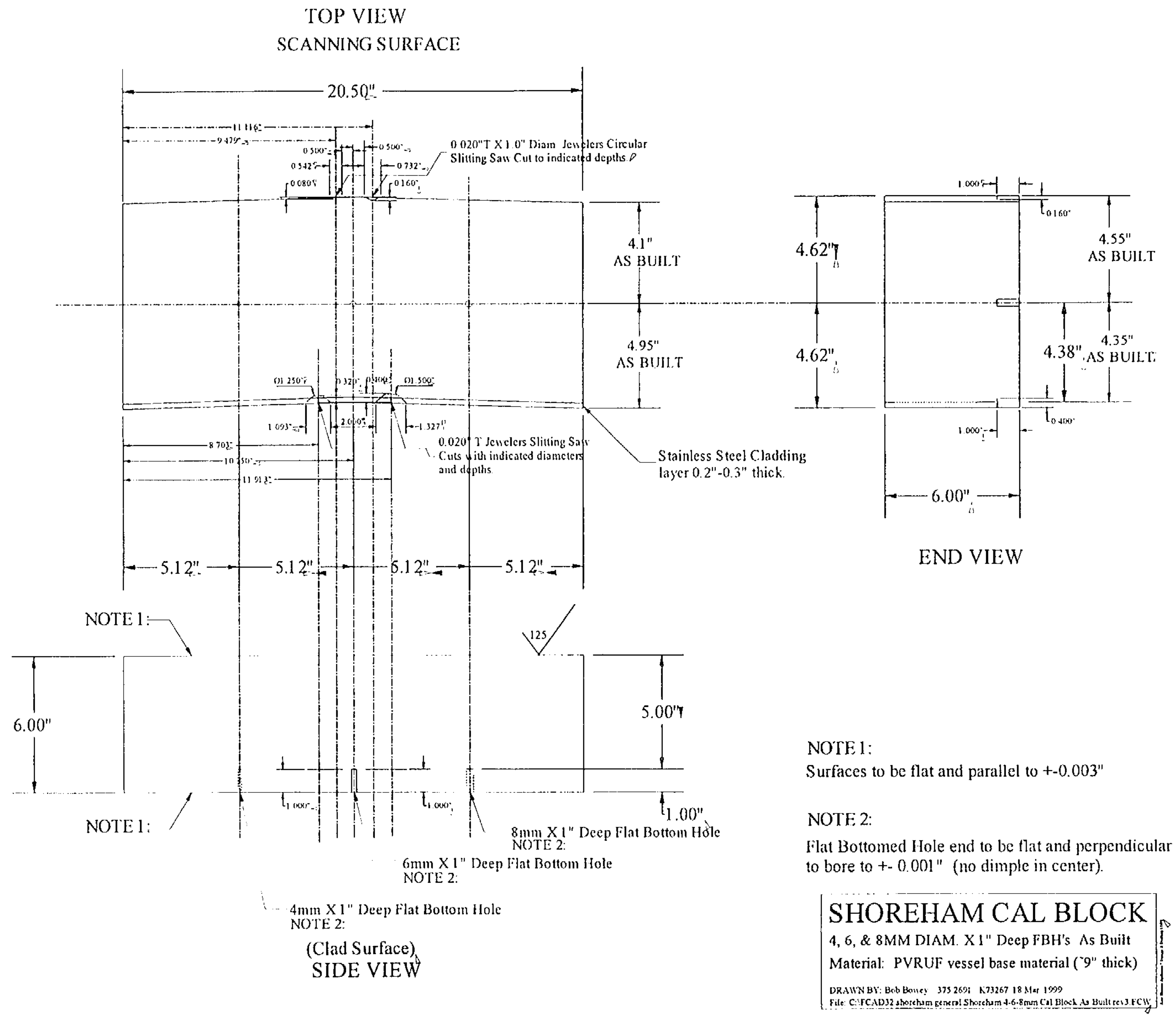

Figure 3.2 Shoreham calibration block with 4-, 6-, and 8-mm diameter FBHs for the sizing study and two OD and two ID sawcuts for the surface connected flaw study

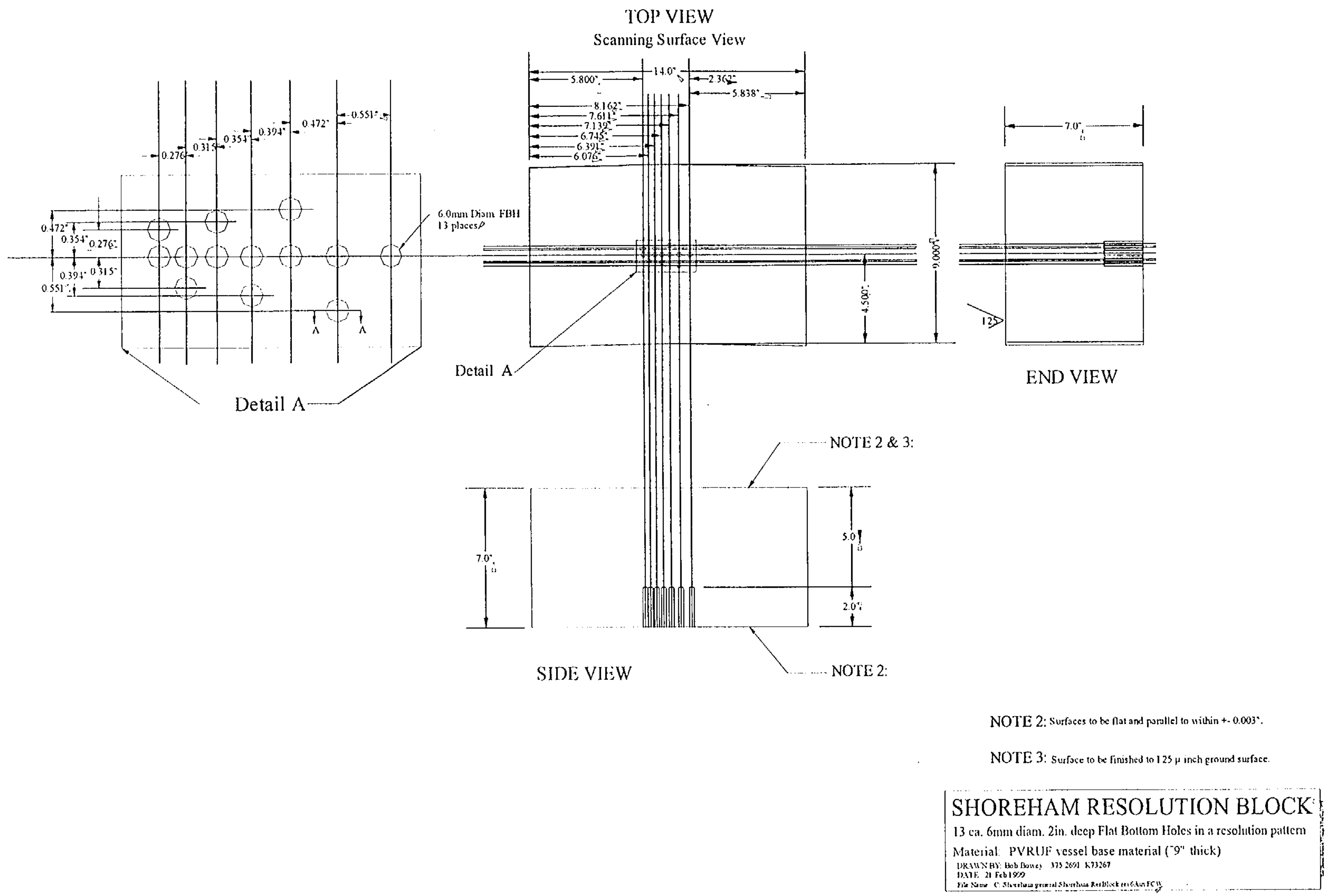

Figure 3.3 Shoreham resolution block

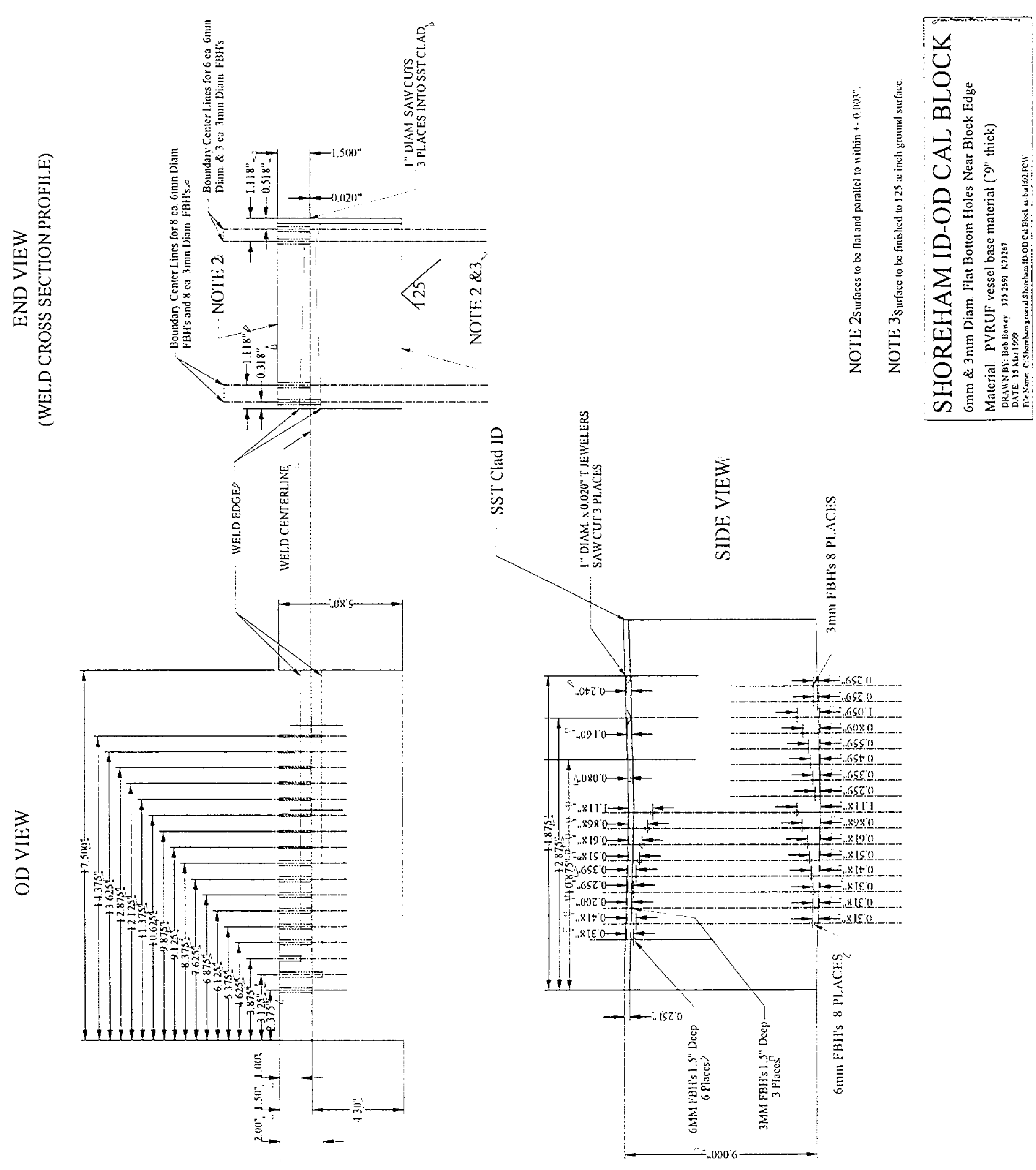

Figure 3.4 Shoreham ID-OD calibration block for the near surface and surface connected flaw study

3.3 Sizing

The sizing data from the 5-MHz, 6.4-mm (0.25-in.) diameter contact transducer is shown in Figure 3.5. All of the sizing-FBHs were detected. With the probe's 3.2-mm spot size, the expected resolution is 3 mm. Sizing by the 3 dB and 6 dB drop technique did not differentiate between the 1, 2, 3, or 4 mm FBHs. This probe had a similar performance on studies of the PVRUF material (Schuster 1998). Therefore flaws in the 1 mm to 4 mm range with a FBH-like behavior will be equally sized as 4 mm with this transducer. Its possible to refine the technique by sizing to a loss of signal (LOS) or to the ultrasonic response (Figure 3.5 and Figure 3.6, respectively). The noise level of this transducer is insignificant (approximately -90 dB) in this material at sensitivity levels appropriate for acquiring data from the Shoreham material. Even when the system sensitivity is increased to enhance detection of flaws in the 1-mm or less range, the signal to noise ratio is still acceptable at 9 dB. The ultrasonic response from larger flaws at this setting, however, would be saturated, and this is an undesirable condition for SAFT processing. The selected sensitivity level for acquiring Shoreham data avoids saturation yet allows detection of small flaws.

The aperture angle selected for the SAFT processing was determined by examining the unprocessed data and the sizing results of the SAFT-processed data. The unprocessed data from the three SDH calibration reflectors contained information out to 20°; however, the data from the FBH sizing reflectors was generally within 12°. Figure 3.7 shows results from processing the sizing FBH data at 6°, 12°, and 18°. Because the 18° processed data is closest to the true state and images show that the transducer is sensitive to 18°, this angle was chosen for all the SAFT processing of the normal incident data in the resolution study and for processing all SAFT data collected on the Shoreham blocks.

The other contact probe considered was a 5-MHz, 3.2-mm (0.125-in.) diameter transducer. The expected resolution for this transducer is half that of the 6.4-mm diameter probe or 1.6 mm. Data did not support this as shown in Figure 3.8. The sizing performance of these two contact transducers was similar, however, the sensitivities were not. The smaller probe did not detect the 1-mm FBH. A smaller element will both generate and receive less energy. Because this transducer is not as sensitive and shows no improvement in sizing performance, it was not studied further.

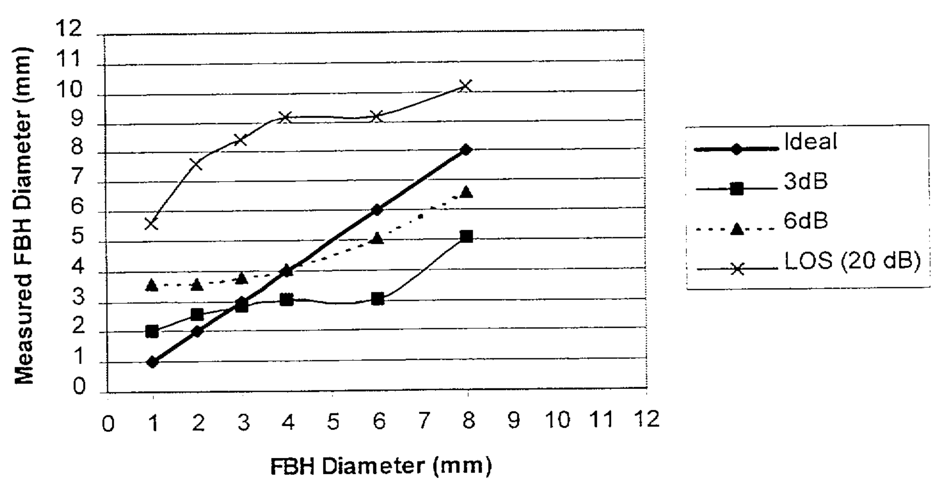

Figure 3.5 Sizing results with a 5 MHz, 0.25-in. (6.4-mm) diameter contact transducer from a series of FBHs at a 5-in. part path

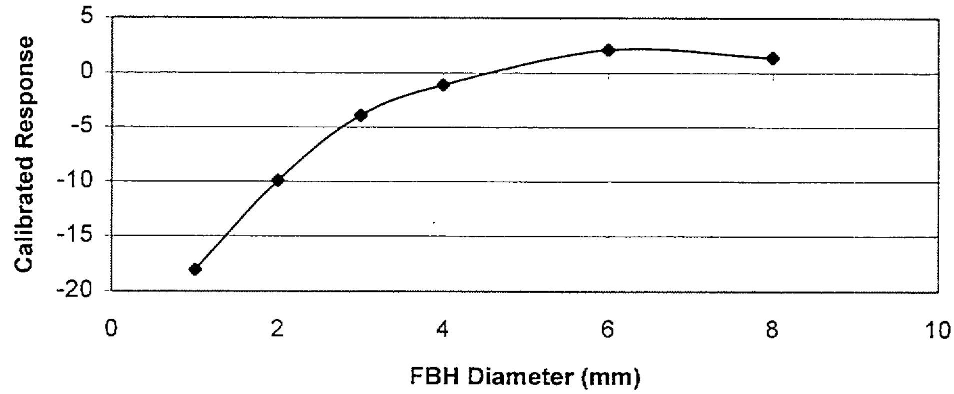

Figure 3.6 Response of a 5 MHz, 0.25-in. (6.4-mm) diameter contact transducer from a series of FBHs at a 5-in. part path

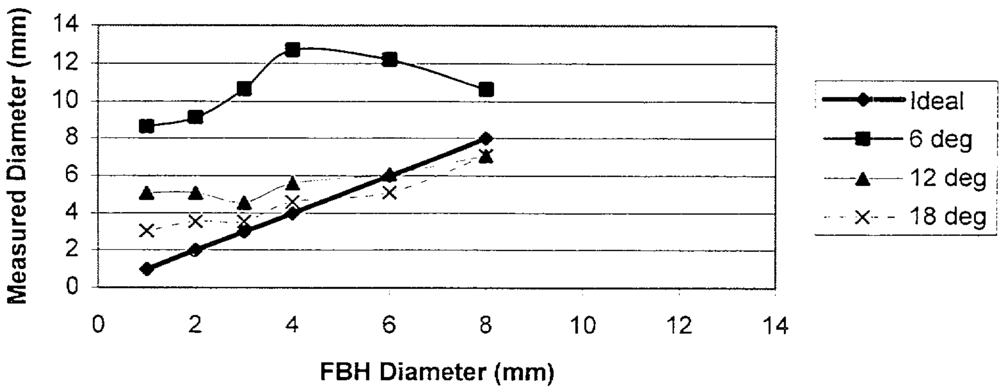

Figure 3.7 Effects of SAFT processing angle on sizing data from the series of FBHs

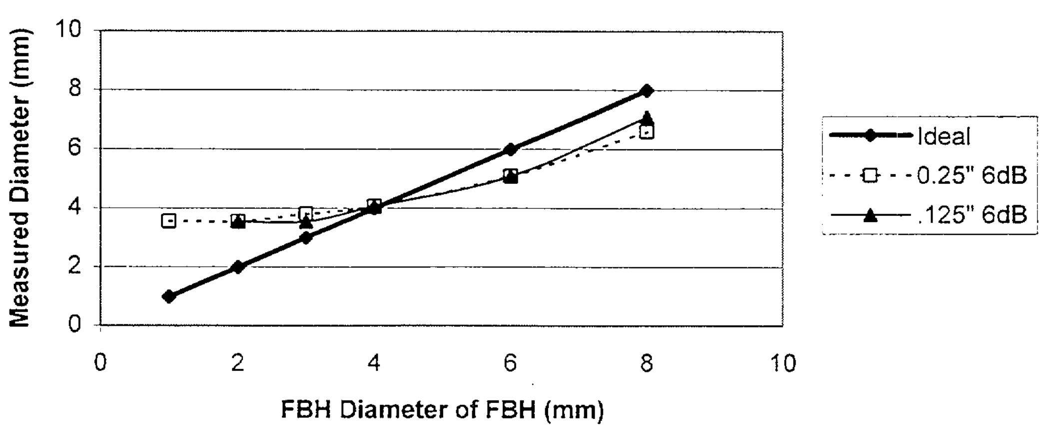

Figure 3.8 Comparison of sizing data from two 5-MHz transducers, one with a 6.4-mm diameter and one with a 3.2-mm diameter, 0.25-in. and 0.125-in., respectively

Both a 5-MHz and a 7.5-MHz f/4 immersion probe was evaluated next. The 5-MHz transducer had a 2-in. focus and 0.5-in. diameter. The ideal approach to an immersion study would be to immerse the parts in a water tank. Anti-corrosive chemicals are available to add to the water, but then the water must be treated as a toxic waste. This requires double containment and extensive procedures for clean up and disposal of the liquid. The large length of the Shoreham weldment pieces also causes a problem. These added difficulties proved prohibitive so an alternate approach was taken. The data was acquired with a water column attached to the scanner. Energy is transmitted through water, a rubber membrane and oil coupling to the calibration blocks. The sizing data acquired with a water column is shown in Figure 3.9 for the 5-MHz transducer. The expected resolution for this probe is 1.4 mm and the data does show an improvement in correlation of the 6-dB drop sizing technique to the true value, even down to the 1-mm FBH.

As in the 5-MHz contact probe, the response of this immersion transducer is also flaw sensitive. Figure 3.10 shows the response from the set of sizing reflectors, 1-mm to 8-mm diameter FBHs. The noise from the water column is significant at the 1-mm and 2-mm flaw levels. For these reflectors the noise is similar in strength to the signals of interest so these flaws would not be reliably detected. The 3-mm diameter and larger FBHs however show a 6 dB or greater separation between signal and noise. A larger system gain is required for the detection of the small flaws, but the noise is also amplified along with the signals of interest. The noise trend observed in Figure 3.10 shows the noise correlating to the ultrasonic system gain settings. Sensitivity for the 6-mm and 8-mm FBHs is such that the noise is constant at 30 dB below the signal level with this setting. Detection of flaws down to the 3-mm level would be assured but not smaller, based on the signal-to-noise ratio. This -25 dB noise level, relative to the calibration, is poor in comparison to the -90 dB noise level of the contact transducer.

The 7.5-MHz, f4 immersion transducer did not give the expected improvement in performance. Instead of producing a 1-mm resolution, it high-lighted difficulties with the water column because of an increase in acoustic noise. Noise in the water column significantly masked the response from the 1-mm FBH.

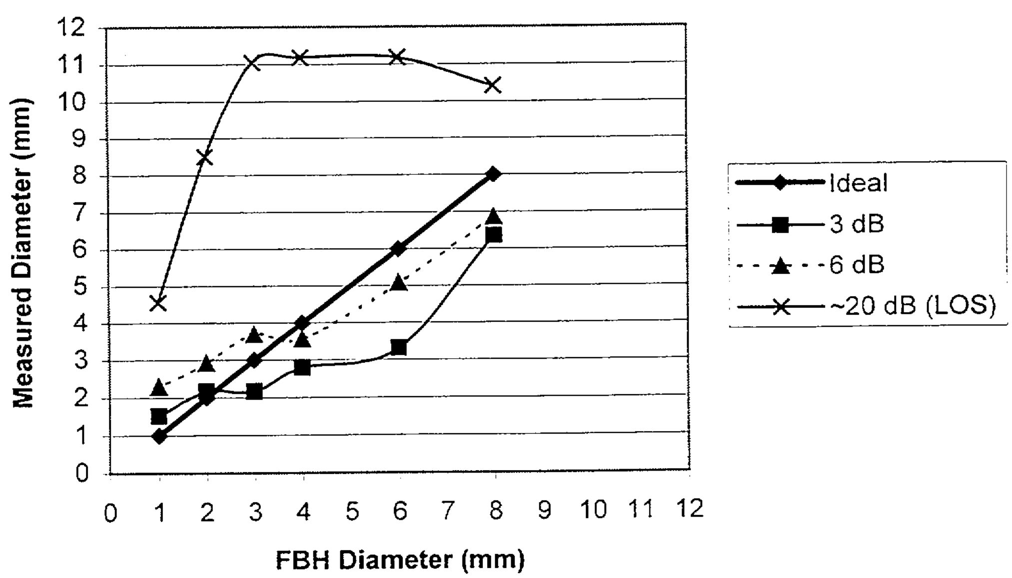

Figure 3.9 Sizing results of the 5 MHz, f/4 immersion transducer

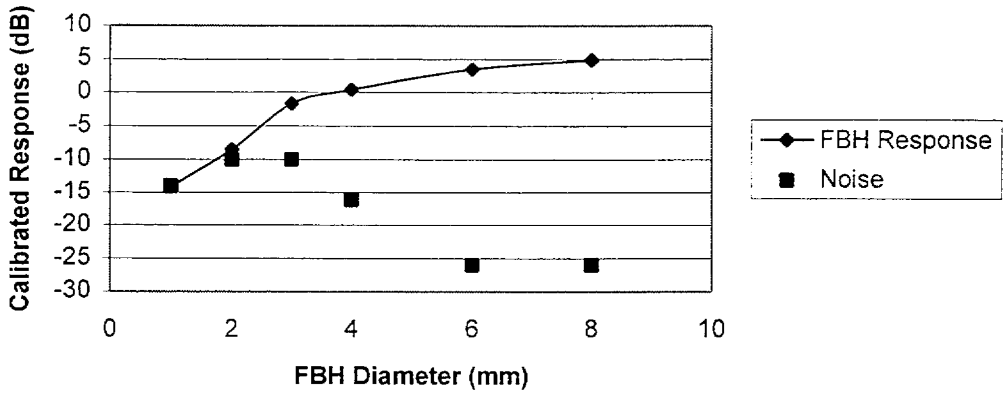

Figure 3.10 Response of 5 MHz f/4 immersion transducer

Another problem was transducer alignment to the flaw or scanning surface. The data acquisition setup would benefit from the addition of a gimbal to allow motion control in two dimensions, especially at this frequency. The present setup limited the control to one dimension.

3.4 Near-Surface and Surface-Connected Flaw Detection

The detection of near-surface and surface-connected flaws was evaluated with a series of FBHs and sawcuts, respectively, on both the ID (cladded inner diameter surface) and the OD (outer diameter). Tables 3.2 and 3.3 summarize the reflectors. All of the ID reflectors were placed in the weld region except the largest two sawcuts, as noted in Table 3.2. These two sawcuts were placed in a calibration block that did not contain a weld (see Figure 3.2). The remaining reflectors are in the ID-OD calibration block show in Figure 3.4. Ultrasonic data were acquired with the 5-MHz, 6.4-mm diameter contact transducer in the normal mode. All of the OD flaws were detected. The cladding is nominally 4-mm to 7-mm thick but in the weld region is up to 11-mm thick. The 3-mm ID FBHs were placed in the cladding in the weld region and were not detected. The 6-mm FBHs were all detected, even in the cladded weld region. Their response dropped by 13 dB, however. Finally the sawcuts were not detected until they were deep enough to penetrate the base metal, 8 mm and above. This would suggest that the cladding is not adequately inspected with this normal mode technique. Small flaws are not detected when they are located within the cladding.

3.5 Summary

A series of reflectors was machined into available PVRUF material. The part path to the reflectors was kept nearly equal to that of the Shoreham material. The study demonstrated that the 5-MHz, 6.4-mm diameter contact transducer has an excellent performance for detection of flaws down to 1 mm in diameter and sizing of flaws that are 4 mm and above. The signal-to-noise ratio is good even on a 1-mm flaw. Sizing improvements of the small flaws, 3 mm and below, was demonstrated with an immersion transducer but detection was limited to a 3-mm diameter flaw and larger due to water column noise. Near-surface and surface-connected flaws are not detected at normal incidence in the cladding until the flaw extends into the base metal. All near-surface and surface-connected OD flaws were detected.

The detection and sizing of near-surface and surface-connected flaws has not been adequately resolved with the investigated technique. A preliminary study with a 2-MHz, 70° refracted longitudinal wave transducer showed improved detection of the flaws. Also, since the data is primarily from the flaw tip, it does not allow one to determine if the flaw is surface connected. A tandem-SAFT data analysis or eddy-current inspection could determine if the flaw actually breaks the surface.

4 SAFT-UT Measurements of the Shoreham RPV

The SAFT-UT measurements of the Shoreham material are described in this section. Calibration and data acquisition parameters were established using the information reported in Section 3. Recording (detection) and sizing rules were established for use on all the data and were based on the results of previous work (Doctor et al. 1996; Schuster et al. 1998; to be published NUREG/CR-6471, Vol. 2).

The calibration and inspection settings were maintained on the inspection of all available Shoreham material. Weld cross-sections, measured from the ends of selected specimens, agree favorably with the descriptions provided in the construction records. These cross-sections are used to calculate the volume of weldment inspected. Example images from the inspections are presented to show the consistency of this estimate.

4.1 Measurement Approach

The calibration of the SAFT-UT system was maintained for the purposes of inspection reliability and interpretation of ultrasonic response. The data acquisition parameters were held constant to expedite the inspection and to permit comparing and contrasting flaw indications. Because it was important to be able to compare the Shoreham results to what was learned about the PVRUF weldments, detection sensitivity was set at a comparable level. The sizing rules were, in part, based on the images from reference reflectors. The knowledge of what flaws are in RPV material was also deemed relevant.

A calibration standard was chosen for use with the SAFT-UT system during the weld-normal inspection of the Shoreham material. The calibration standard was 23-cm thick and composed of A533B pressure vessel steel. Side-drilled holes were machined into the standard at one-quarter thickness (5.7 cm), half thickness (11.4 cm), and three-quarters thickness (17.1 cm). Use was made of an electronic distance-amplitude correction, a time variable gain amplifier, to adjust responses from the three reflectors to equal values in their unfocused images. Fully focused images of the side-drilled holes were created and the responses were entered in the SAFT-UT analysis software for the purpose of measuring the responses in the focused images of fabrication flaws relative to a calibration curve.

Data acquisition parameters were established from the inspections of the reference reflectors as described in Section 3. These parameters were very similar to those used in weld-normal inspections of the PVRUF material. The transducer center frequency was 5.0 MHz. The ultrasonic transients were sampled at 25 MHz. Step sizes for the inspections (raster scans) were 0.5 mm in the scan direction ("x") and 0.5 mm in the increment direction ("y").

A response threshold was used in the recording process. Indications with responses less than -30 dB of the calibration curve were not recorded. Table 4.1 shows some results of the recording (detection) process. Ultrasonic responses were selected, one at a time, in the SAFT-UT images and the flaw indication's coordinates (and other data) were transferred using the operating system's clipboard from the SAFT-UT application to a spreadsheet.

In Table 4.1 the indications are numbered based on increasing distance along the weld from a zero reference that was placed on each block. The second column represents the axial (circumferential) flaw location from the weld centerline of the circumferential (axial) welds. The third column is the distance in inches from the zero reference on each block to each flaw indication. The fourth column is the depth of the flaw indication from clad wetted surface. The fifth column is the amplitude response of the indication

Table 4.1 Partial Detection Record for Shoreham Specimen C180BB

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Material
1	-0.60	1	1.8	-27.3	Small	Fusion
2	-0.65	1.04	1.26	-21.5	Small	Fusion
3	-0.62	1.08	0.92	-25.5	Small	Fusion
4	-0.65	1.5	1.14	-4.9	LLOF[a]	Fusion
5	-0.58	1.38	4.1	-28.3	Small	Fusion
6	-0.58	1.84	5.62	-14.1	Small	Fusion
7	-0.69	2.32	0.66	-22.4	Small	Fusion
8	-0.58	3	5.66	-8.4	Small	Fusion
9	-0.58	3.3	4	-28.3	Small	Fusion
10	-0.58	3.26	1.2	-18.3	Small	Fusion
11	-0.58	4.2	1.14	-11.9	Small	Fusion
12	-0.58	4.38	5.64	-8	Small	Fusion
13	-0.60	4.6	2.14	-26.3	Small	Fusion
14	-0.53	4.82	4.24	-25.8	Small	Fusion
15	-0.51	4.7	4.92	-29.2	Small	Fusion
16	-0.58	4.82	1.14	-18	Small	Fusion
17	-0.58	5.36	1.16	-12.7	LLOF	Fusion
18	-0.51	5.82	4.22	-23.2	Small	Fusion
19	-0.58	5.74	1.02	-27.1	Small	Fusion
20	-0.58	6.2	1.16	-9.6	Small	Fusion
21	-0.58	6.7	1.16	-4.9	LLOF	Fusion
22	-0.60	7.22	1.12	-5.4	Small	Fusion
23	-0.61	7.74	3.96	-20.7	Small	Fusion
24	-0.47	7.56	4.9	-27.5	Small	Weld
25	-0.42	7.82	5.52	-25	Small	Weld
26	-0.58	8.2	2.54	-16.6	Small	Fusion
27	-0.47	8.82	4.92	-26.4	Small	Weld
28	-0.61	8.62	1.12	-6.1	LLOF	Fusion
29	-0.58	9.82	4.6	-25.2	Small	Fusion
30	-0.61	10.46	5.64	-19.8	Small	Fusion
31	-0.61	11.26	1.08	-14.2	Small	Fusion
32	-0.63	11.84	1.1	-12.8	Small	Fusion

[a]LLOF = long lack of fusion.

back relative to the calibration SDHs. The sixth column represents how PNNL characterized the indication, which is explained in detail in Section 5. The last column is the flaw location in the clad, gouge, weld-root, repair metal, base metal, weld metal, or the fusion line of the weld.

Sizing rules were consistently applied and linked to the characterization of the flaw indications. For images that showed continuous smooth responses along the through-wall dimension, the -6 dB response points relative to the image maximum were used to size the flaw indication. The results reported in Section 3 show the performance of this rule on flat-bottom holes. An adjustment is required to size flaw indications that are characterized as clusters. The local maxima at the through-wall edges of the cluster must be identified and the -6 dB points from these local maxima then establish the size of the cluster in this report.

Section 5 reports the methodology for characterizing the 4000 flaw indications in SAFT-UT inspections of the Shoreham material. Most of the flaw indications were small. Indications of long lack of fusion were tabulated. Some indications were characterized as clusters as described in Section 5.

4.2 Inspections Performed

The purpose of the inspections was to detect and characterize flaws to determine fabrication flaw density and distribution for input to structural integrity assessment. To speed the estimation of the density and distribution of fabrication flaws in the Shoreham vessel, the weldments were separated from most of the plate material. Figure 4.1 is a photograph of Shoreham weldment specimen C75B as it was prepared for weld-normal inspection.

The selected technique for the inspections utilized 5.0-MHz broadband ultrasonic longitudinal waves at normal incidence to the fusion surface of the structural weld with the base metal. Approximately 25.4 meters of weldment were inspected using this technique when the axial welds and circumferential welds are taken together. The technique generated 631 Mbytes of data per linear meter of weld. Scanning time of 85 hours was required for the single transducer operating in pulse-echo mode.

The axial weld cross section and circumferential weld cross section differ. The axial weld is a double "U" design with dimensions shown in Figure 4.2. The example SAFT-UT image, shown in Figure 4.3, taken from another specimen confirms the dimension of the axial weld cross-section. A micrograph of a polished steel slab

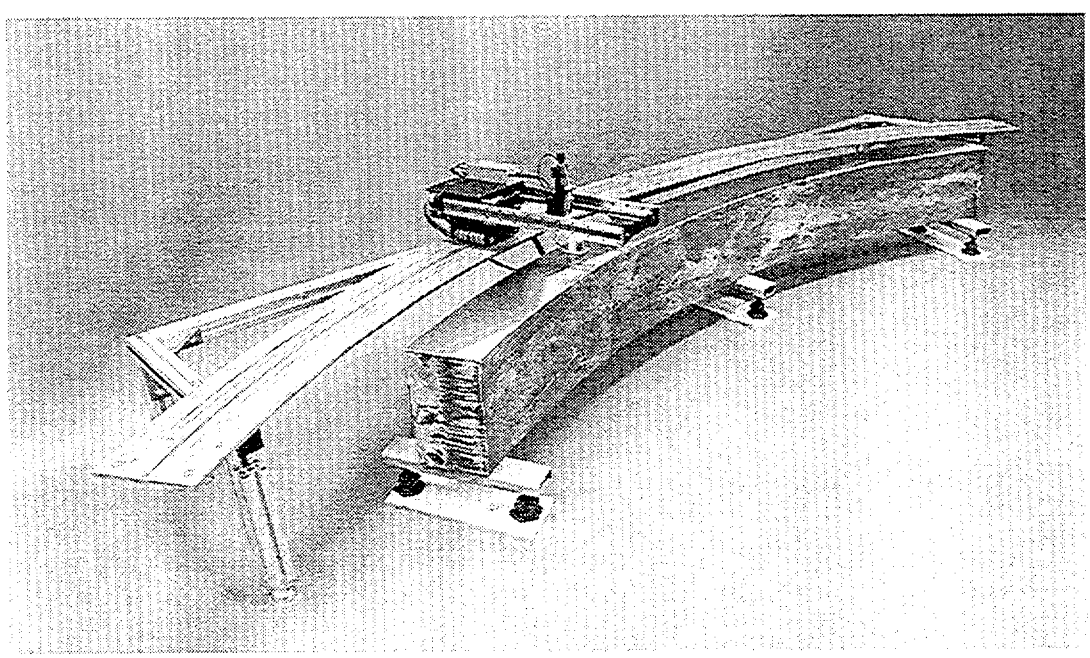

Figure 4.1 Shoreham weldment specimen C75 prepared for weld-normal inspection

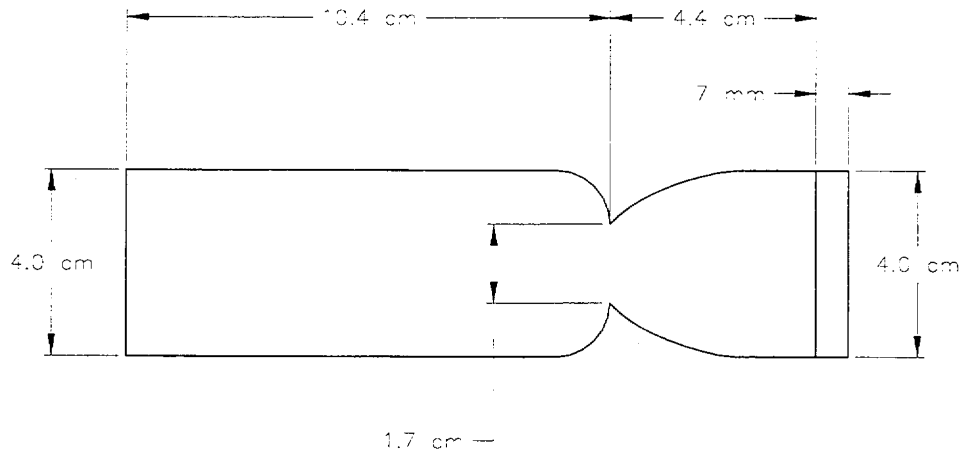

Figure 4.2 Measured dimensions for Shoreham axial weld cross section

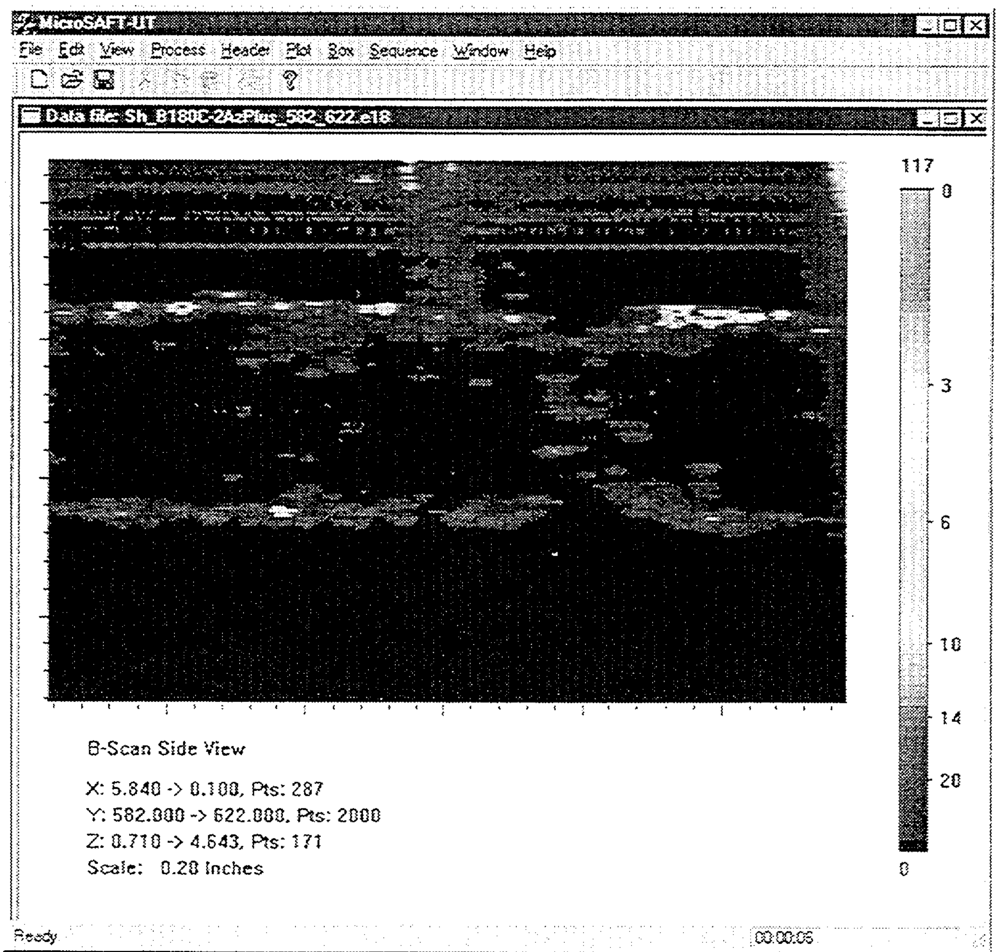

Figure 4.3 SAFT-UT image showing axial weld profile

removed from an axial weld is shown in Figure 4.4. The circumferential weld is a straight-wall design with dimensions shown in Figure 4.5 with an example SAFT-UT image shown in Figure 4.6. A micrograph of a polished slab removed from the circumferential weldment is shown in Figure 4.7. This location was selected because the cladding thickness was the largest at this site—17 mm. Examining locations on other blocks, the maximum cladding thickness was more typically 12-13 mm.

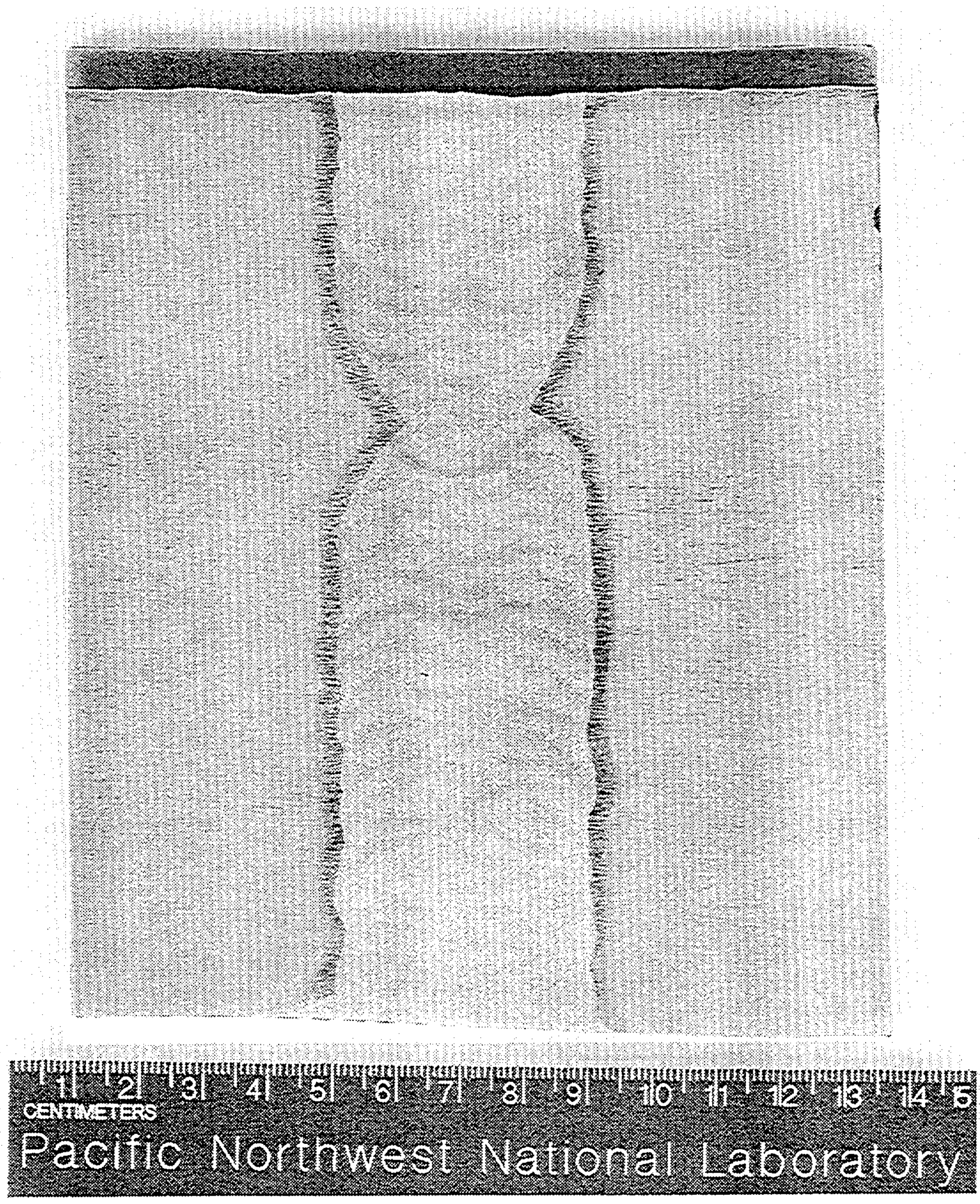

Figure 4.4 Micrograph of axial weld from Shoreham

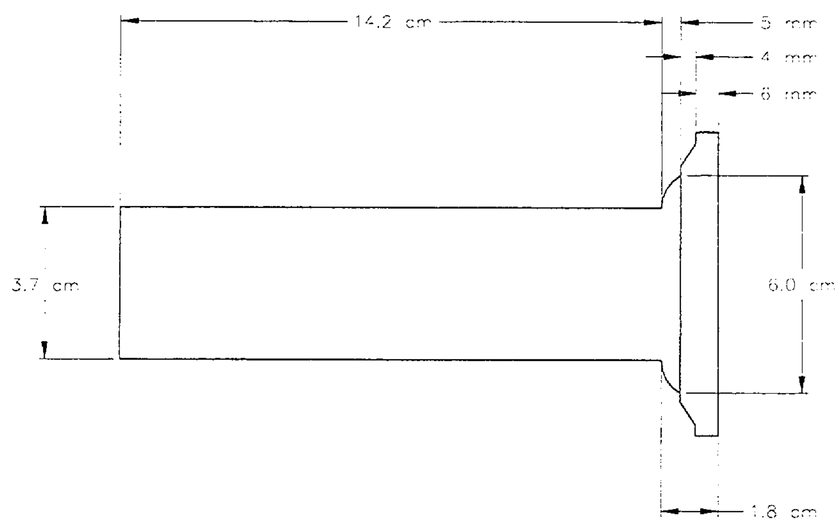

Figure 4.5 Measured dimensions of Shoreham circumferential weld cross section

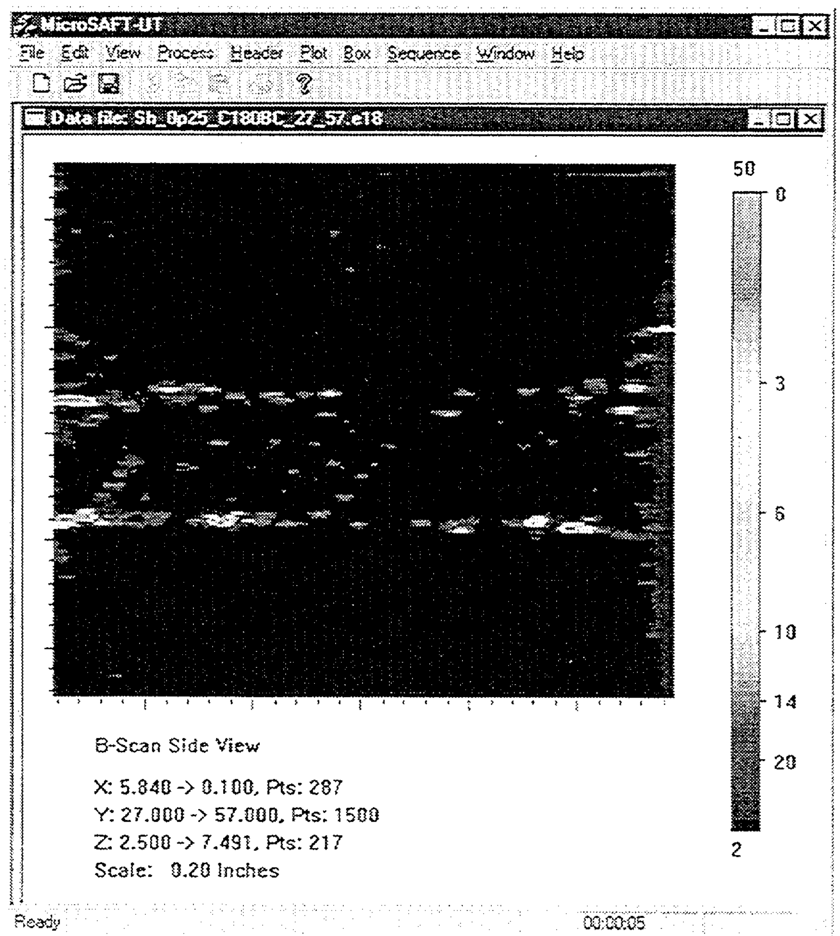

Figure 4.6 SAFT-UT image of circumferential weld cross section

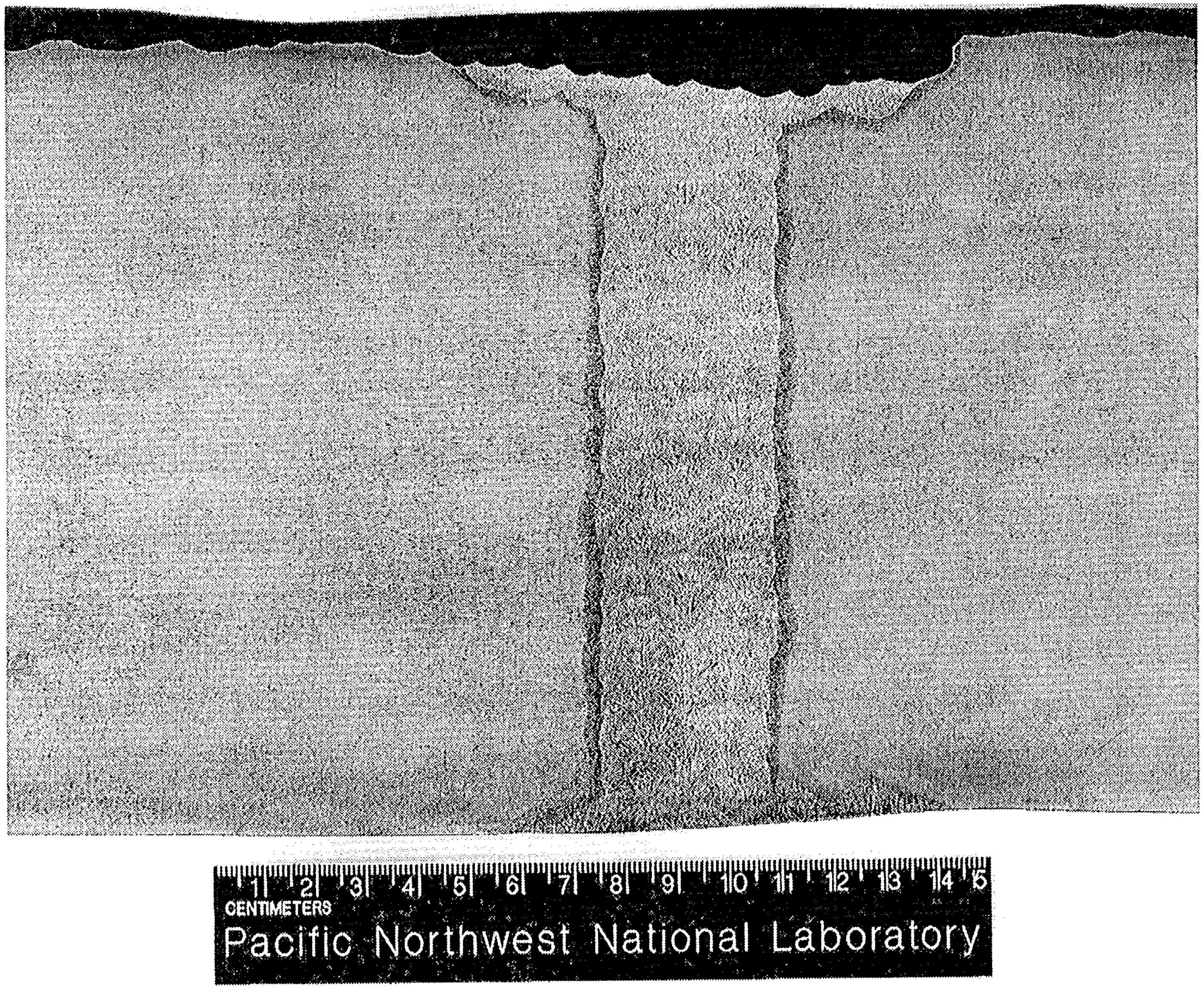

Figure 4.7 Micrograph of Shoreham circumferential weldment illustrating the greatest cladding thickness discovered on the exposed ends of the Shoreham weldment blocks

The amount of material inspected by SAFT-UT is shown in Table 4.2. The table gives the volumes with units of cubic meters and area with units of square meters for the weld metal and fusion surfaces, respectively. Axial welds and the circumferential weld are broken out separately in the table. The inner 25-mm, midwall, and outer 25-mm portions of vessel thickness are tabulated separately as well.

Table 4.2 Amount of Shoreham Material Inspected	
Axial Welds: inner 25 mm	
Weld	0.0066 cubic meters
Fusion surface	0.3 square meters
Axial Welds: mid-wall	
Root	0.009 cubic meters
Weld	0.028 cubic meters
Fusion surface	1.8 square meters
Axial Welds: outer 25 mm	
Weld	0.0091 cubic meters
Fusion surface	0.46 square meters
Circumferential Weld: inner 25 mm	
Gouge	0.013 cubic meters
Weld	0.003 cubic meters
Fusion	0.16 square meters
Circumferential Weld: mid-wall	
Weld	0.061 cubic meters
Fusion	3.3 square meters
Circumferential Weld: outer 25 mm	
Weld	0.015 cubic meters
Fusion	0.82 square meters
Total Weld Volume = 0.14 cubic meters Total Fusion Surface = 6.9 square meters	

5 Characteristics of Flaw Indications in the Shoreham RPV

This section describes the characterization of the flaw indications, found by SAFT-UT, in the Shoreham weldment specimens. The purpose of the characterization included providing a technical basis for the through-wall sizing of the flaw indications. Another function of the characterization was to define important features in the data for guidance to the destructive testing of the material.

5.1 Characteristics of the Small Flaw Indications

The small flaws formed the largest group and had the simplest shape and response properties. The location of these small flaw indications was primarily the fusion surface between the weld and the base metal. Research has shown that these flaws are not in the heat-affected zone of the base metal but rather just slightly (1 mm) inside the weld and that these flaw indications are lack of fusion with slag and porosity (Doctor et al. 1999). An example image of a small flaw is given in Figure 5.1.

The small flaws were easily characterized based on ultrasonic shape and response. The through-wall extent and length of the flaws in this category are estimated to be less than the resolution of the SAFT-UT inspection. The Laboratory's research on material removed from the PVRUF vessel showed indications of this kind in the PVRUF vessel to be vertical linear discontinuities, specifically, lack of fusion with slag (see the soon-to-be published NUREG/CR-6471, Vol. 2).

Of the 4000 indications recorded in the detection procedure, 97% were less than the SAFT-UT resolution limit of 3.5 mm in through-wall extent. The predominant shape was round, indicating that

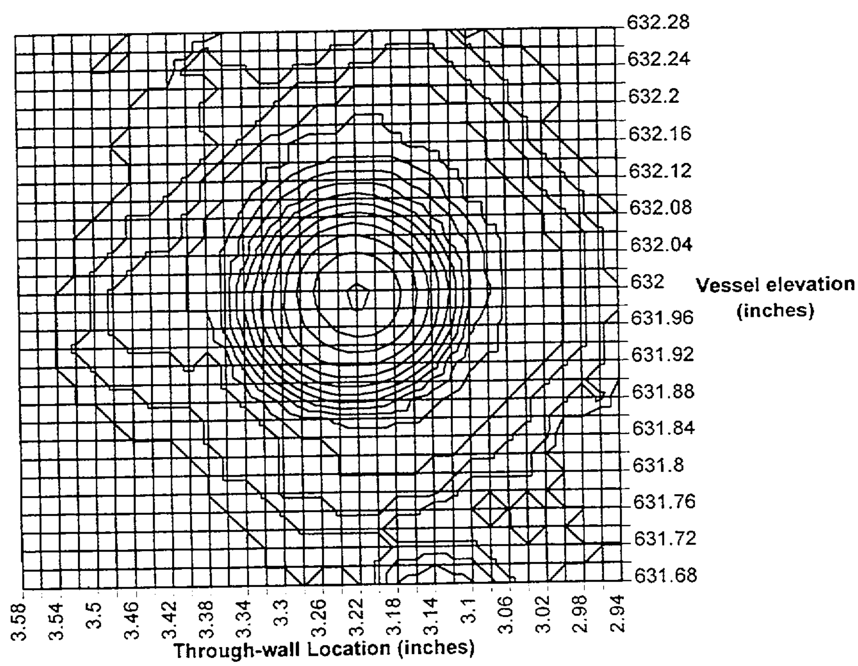

Figure 5.1 Log-scale contour plot of typical small flaw indication. Contour lines are separated by 2 dB. The through-wall extent is on the abscissa and is estimated from the -6 dB contour as 0.12 in. (3 mm).

these flaws (like those in PVRUF) were less than 3.5 mm in length as well. The response from the flaws in this category was as high as -2 dB of the reference reflectors described in Section 4. Indications with peak response less than -30 dB of the reference reflectors were considered "not detectable."

The maximum size of the flaws in this category is determined by the spatial resolution of the SAFT-UT system when operated with a 6-mm contact probe. In a fully focused image, the system resolution is determined by the minimum beam diameter of the sound field. For contact probes, this is approximately half of the crystal diameter or 3 mm in our case. The Laboratory's measurements on 1-, 2-, 3-, and 4-mm flat-bottom holes indicate a system resolution closer to 3.5 mm.

This kind of indication, on the fusion surface of the weld with the base-metal, was destructively analyzed in material removed from the PVRUF vessel. Thirty four plates of material, 25-mm thick, were cut from four PVRUF weld specimens that contained 41 weld-normal UT indications. These plates were tested using radiography and the 45 indications found were linear and vertically oriented with through-wall extents as small as 0.5 mm. Metallographic analysis confirmed lack of fusion with slag.

Figure 5.1 shows a typical small flaw indication on the fusion surface in the Shoreham material. The 2-dB contour lines in the figure are circular and the diameter of the -6 dB contour circle is 3 mm. This indicates that the image is created by a flaw that is less than or equal to the system's resolution element (a circle 3.5 mm in diameter).

5.2 Flaw Indications Characterized as Long Lack of Fusion

There are 93 flaw indications that were characterized as long lack of fusion. These indications were primarily distinguished by their lengths. As was the case with the small flaws, long lack of fusion was mostly located on the fusion surface of the weld with the base metal. An example (Figure 5.2) is discussed.

These flaw indications account for 60% of those that were greater than the SAFT-UT system resolution. Some of these indications were very long, up to 75 mm in length. The through-wall extents for the indications of long lack of fusion were all 4 mm. Flaw indications with greater through-wall extent were characterized as extended lack of fusion. Flaw indications with through-wall extents less than 4 mm were characterized as small flaw indications.

Figure 5.2 shows an ultrasonic response contour plot of a flaw indication characterized as long lack of fusion. The length sizing for these indications was performed to loss of signal and the indication shown has an estimated length of 25 mm. The through-wall size of the indication was made to the -6 dB points from the peak response.

5.3 Flaw Indications Characterized as Extended Lack of Fusion

Relatively few cases, 21, of extended lack of fusion were found. The flaw indications in this group were principally distinguished by continuous signal over 5 mm or more of through-wall extent. An example image (Figure 5.3) is presented.

These flaw indications account for 15% of those that were greater than the SAFT-UT system resolution. The range of through-wall extents for these indications is 5 mm to 6 mm. Flaw indications with through-wall extents greater than 6 mm did not have smooth continuous responses across their through-wall extents.

Figure 5.3 shows an ultrasonic response contour plot of a flaw indication characterized as extended lack of fusion. The through-wall size of the indication was made to the -6 dB points from the peak response. The ultrasonic response varies smoothly across the indication's through-wall extent.

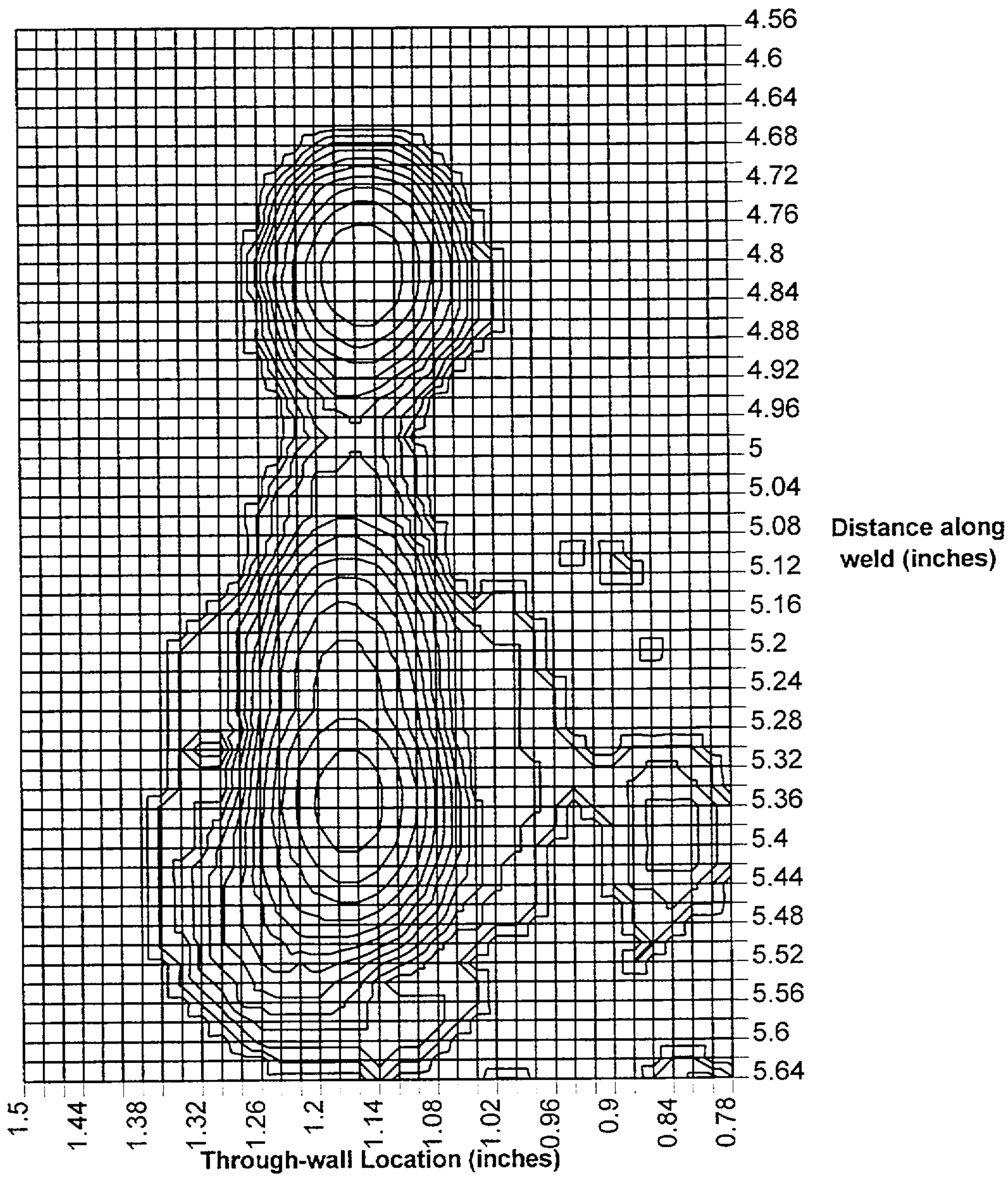

Figure 5.2 **Log-scale contour plot of indication characterized as long lack of fusion. The contour lines are separated by 2 dB. The through-wall extent is estimated from the -6 dB contour as 0.14 inches (3.6 mm). The length of the indication is estimated as 1.0 in. (25 mm) where loss of signal is used in the length estimate.**

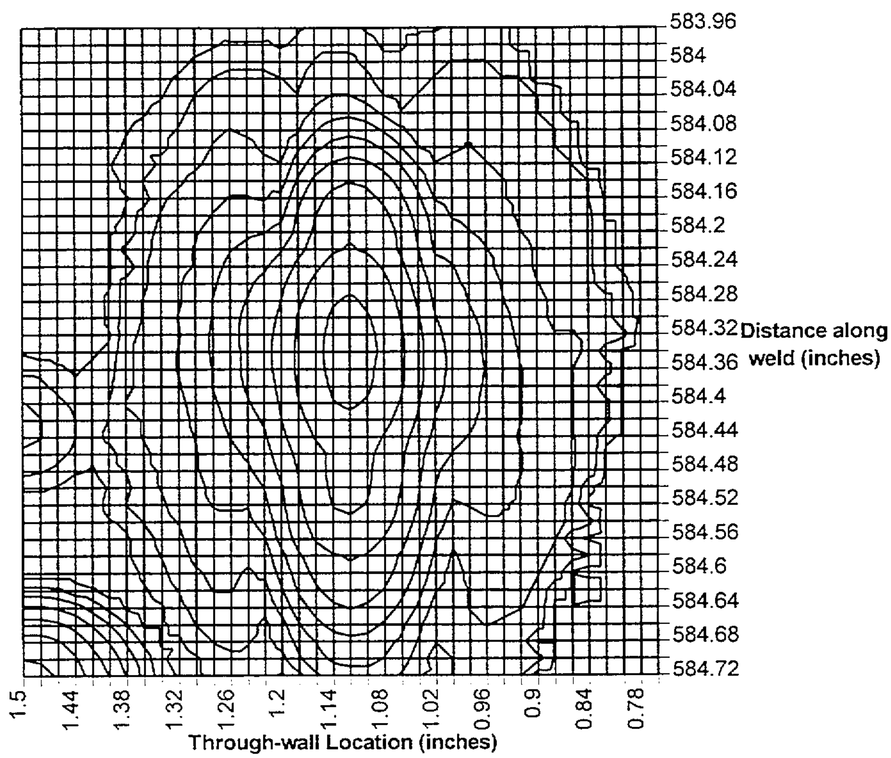

Figure 5.3 Log-scale contour plot of ultrasonic response from an indication characterized as extended lack of fusion. The contour lines are separated by 2 dB of ultrasonic response. The through-wall extent of the indication, taken from the -6 dB contour, is 0.18 in. (4.6 mm).

5.4 Flaw Indications Characterized as Simple Clusters

Simple clusters were characterized as single indications and nine of them were documented. These flaw indications were all located on the fusion surface. The principle feature of simple cluster indications is that they are composed of a few, typically two or three, mostly circular shapes, similar in size to the systems resolution element (3.5 mm) but not separated by loss of signal.

These flaw indications account for 6% of those that were greater than the SAFT-UT system resolution. The range of through-wall extents for these indications is 5 mm to 9 mm.

Figure 5.4 shows an ultrasonic response contour plot of a flaw indication characterized as a simple cluster. The through-wall size of the indication was made to the -6 dB points from the peak responses on the through-wall edges of the cluster.

5.5 Flaw Indications Characterized as Complex Clusters

Six cases of complex clusters were detected in the SAFT-UT data. Two of these were associated with a known repair, two were located on the fusion surface, and two are thought to be associated with an undocumented repair. These flaw indications are the largest in through-wall size and have features that include combinations of extended lack of fusion and long lack of fusion. All six detected complex clusters are shown in Figures 5.5 through 5.10.

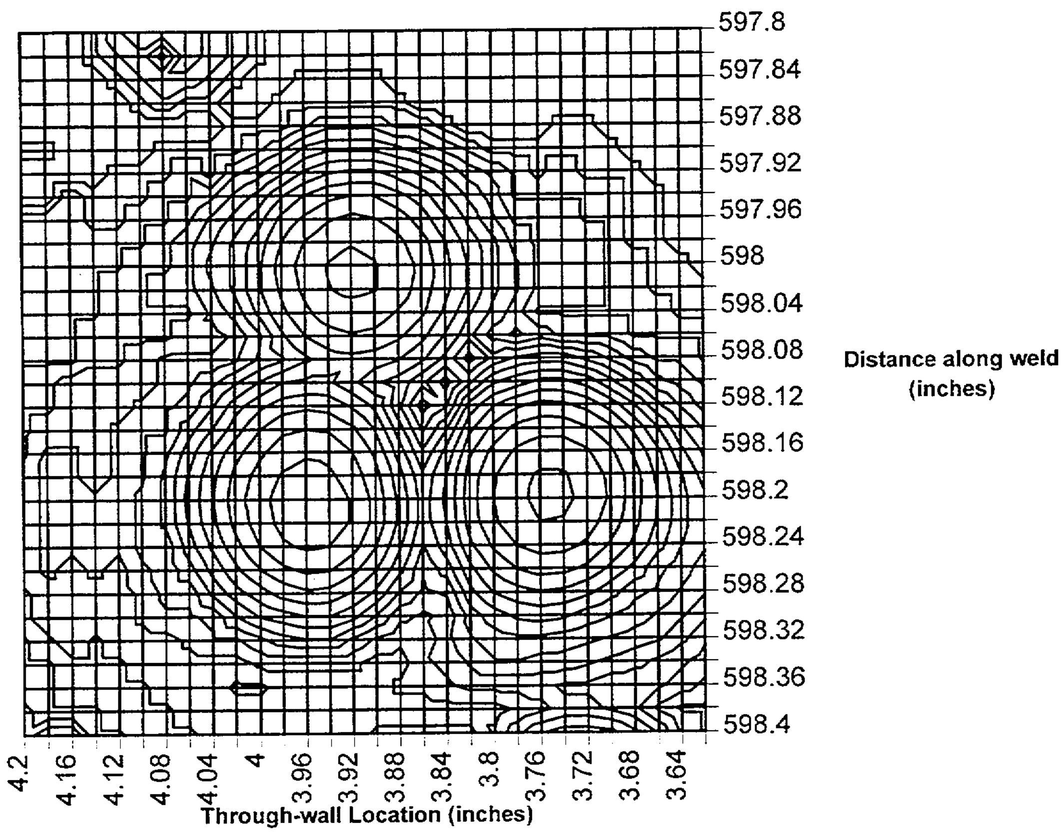

Figure 5.4 Log-scale contour plot of ultrasonic response from an indication characterized as a simple cluster. The contour lines are separated by 2 dB. The through-wall extent of the cluster is estimated as 9 mm from the -6 dB contour lines of the edges of the cluster.

These flaw indications account for 4% of those that were greater than the SAFT-UT system resolution. The range of through-wall extents for these indications is 7 mm to 32 mm. The through-wall sizes of the indications were made to the -6 dB points from the peak responses on the through-wall edges of the cluster.

5.6 Flaw Indications Showing Surface-Induced Reduction in Focus

This group of indications, there were 23 of them, had the property of presenting extra difficulty in interpretation. In some cases, the proximity of the flaw to the cladded surface or to the outside surface of the vessel, interfered with the focus of the ultrasound. The phenomenon was observed in the reference reflectors but a correction factor was difficult to obtain. An example (Figure 5.11) shows this exaggerated through-wall shape.

These flaw indications account for 15% of those that were greater than the SAFT-UT system resolution. The range of through-wall extents for these indications is 5 mm to 9 mm. Figure 5.11 shows an ultrasonic response contour plot of a flaw indication characterized as surface-elongated. The through-wall size of the indication was made to the -6 dB points from the peak response of the indication.

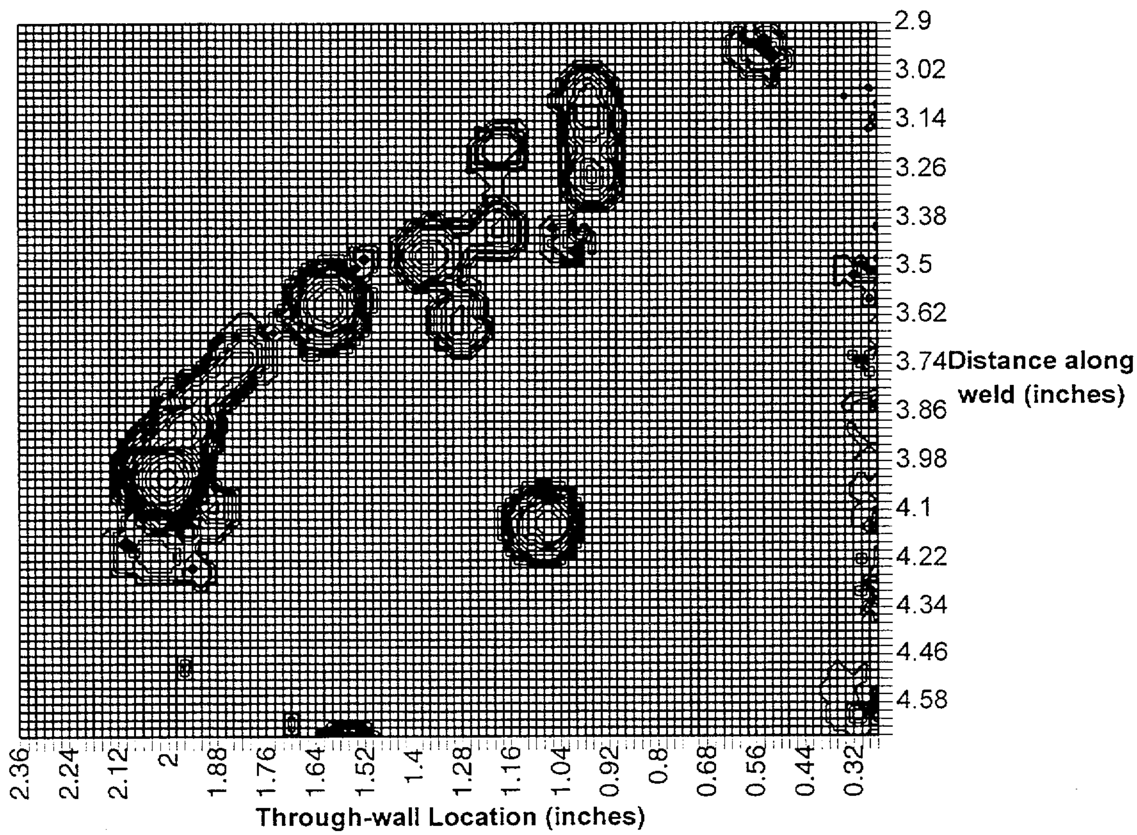

Figure 5.5 Log-scale contour plot of ultrasonic response from indication #2 in specimen C120E characterized as a complex cluster. The contour lines are separated by 2 dB. The through-wall extent of the cluster is estimated at 32 mm from the -6 dB contours of the edges of the cluster.

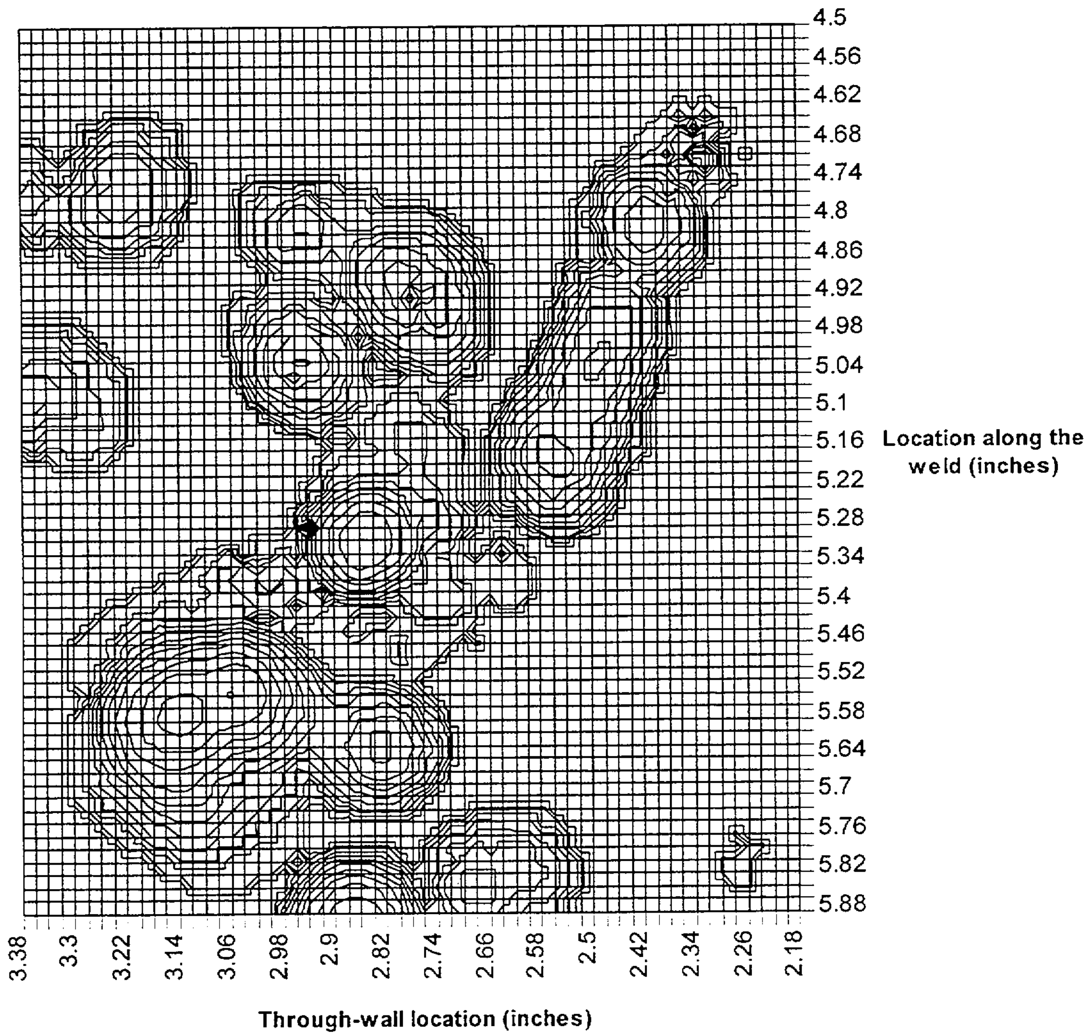

Figure 5.6 Log-scale contour plot of ultrasonic response from indication #10 in specimen C120E characterized as a complex cluster. The contour lines are separated by 2 dB. The through-wall extent of the cluster is estimated at 21 mm from the -6 dB contours of the edges of the cluster.

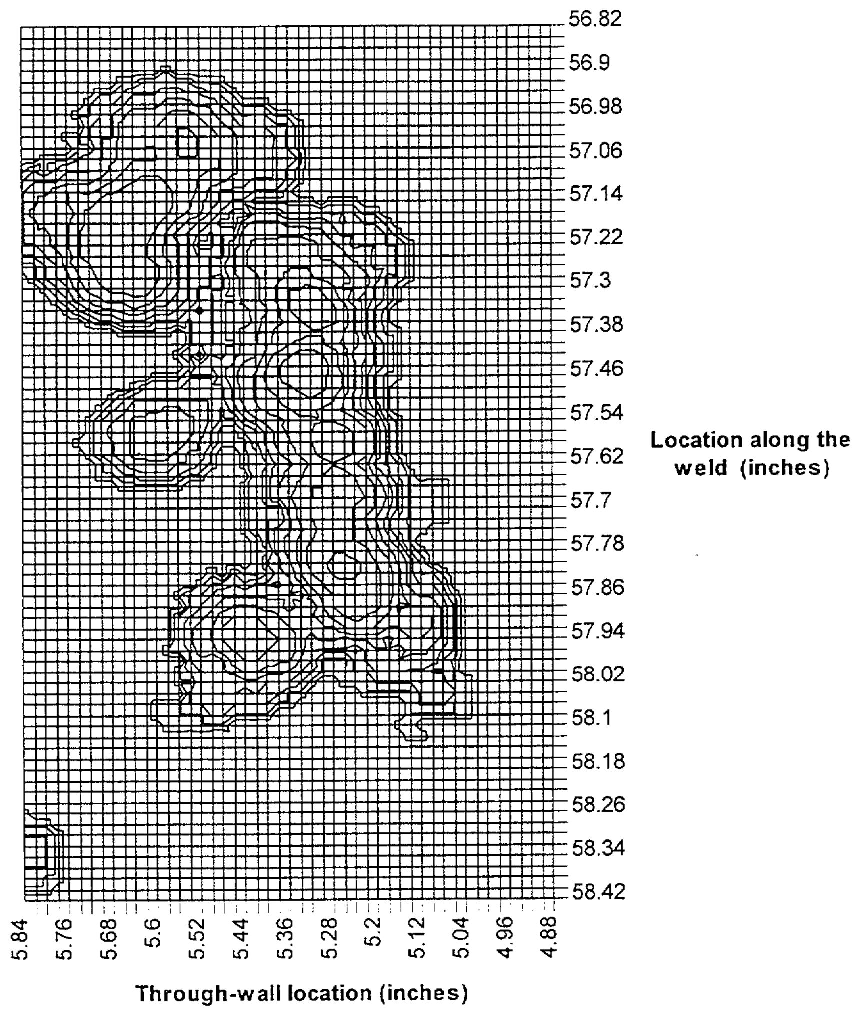

Figure 5.7 Log-scale contour plot of ultrasonic response from repair indication #1 in specimen C75B characterized as a complex cluster. The contour lines are separated by 2 dB. The through-wall extent of the cluster is estimated at 14 mm from the -6 dB contours of the edges of the cluster.

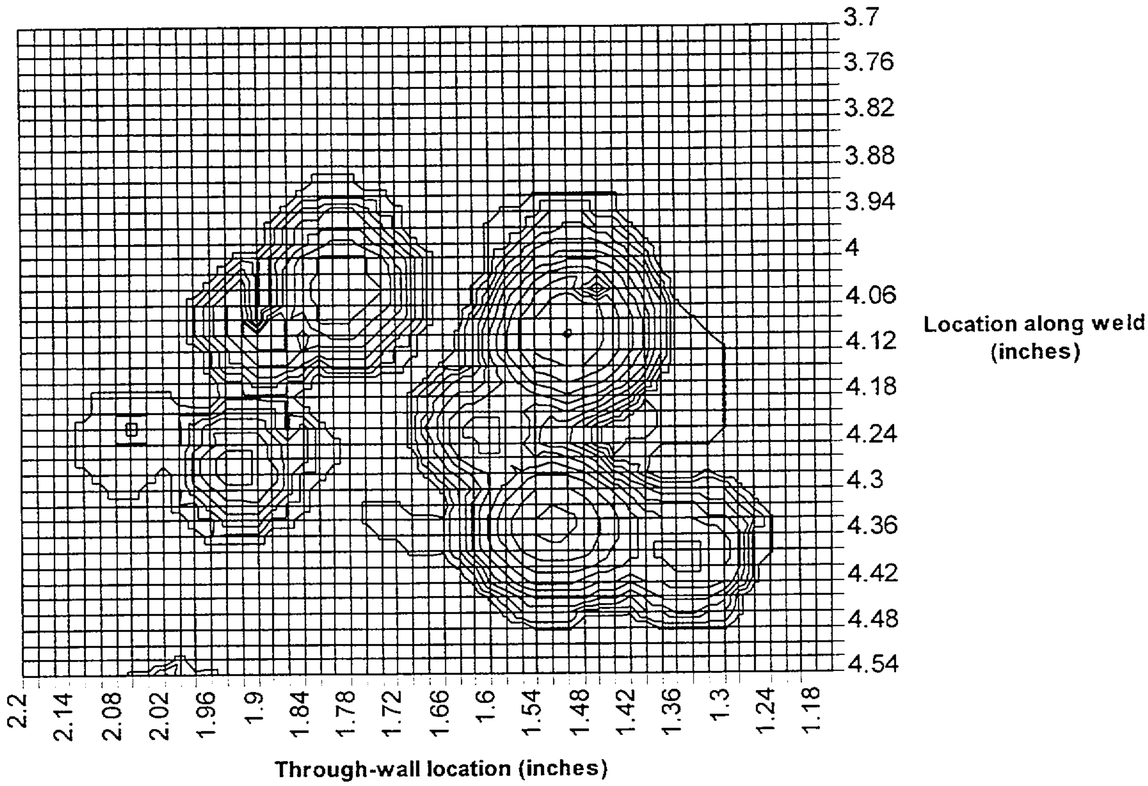

Figure 5.8 **Log-scale contour plot of ultrasonic response from indication #2 in specimen C120E characterized as a complex cluster. The contour lines are separated by 2 dB. The through-wall extent of the cluster is estimated at 10 mm from the -6 dB contours of the edges of the cluster.**

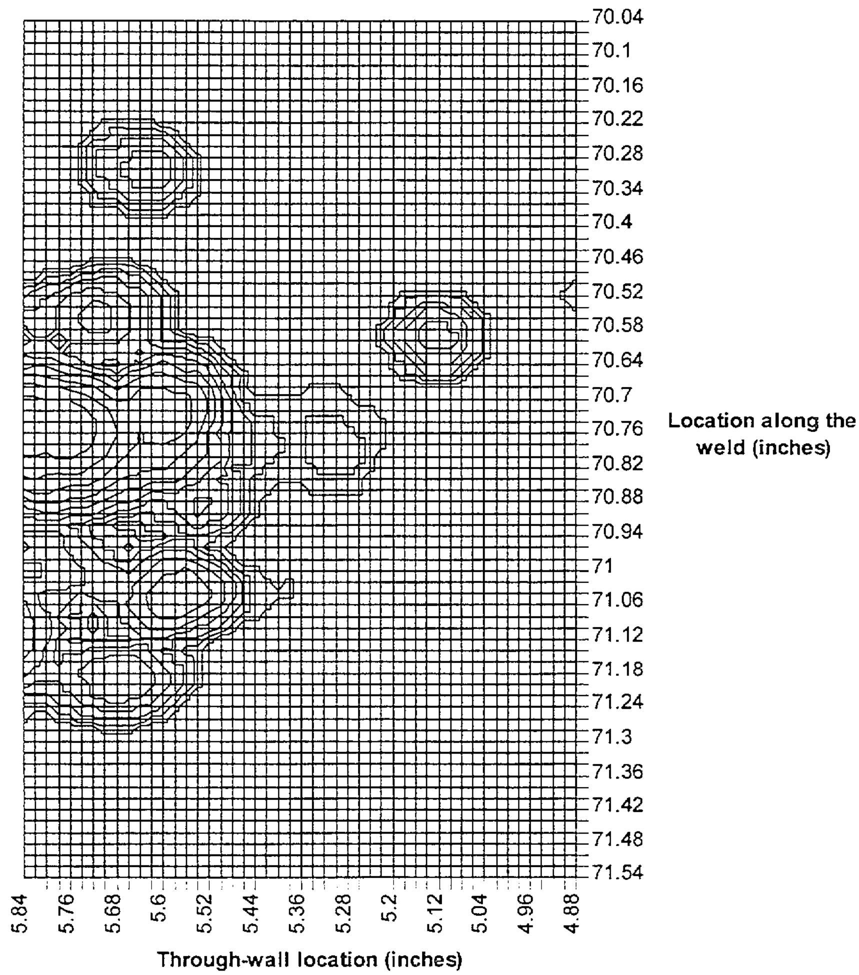

Figure 5.9 Log-scale contour plot of ultrasonic response from repair indication #2 in specimen C75B characterized as a complex cluster. The contour lines are separated by 2 dB. The through-wall extent of the cluster is estimated at 7 mm from the -6 dB contours of the edges of the cluster.

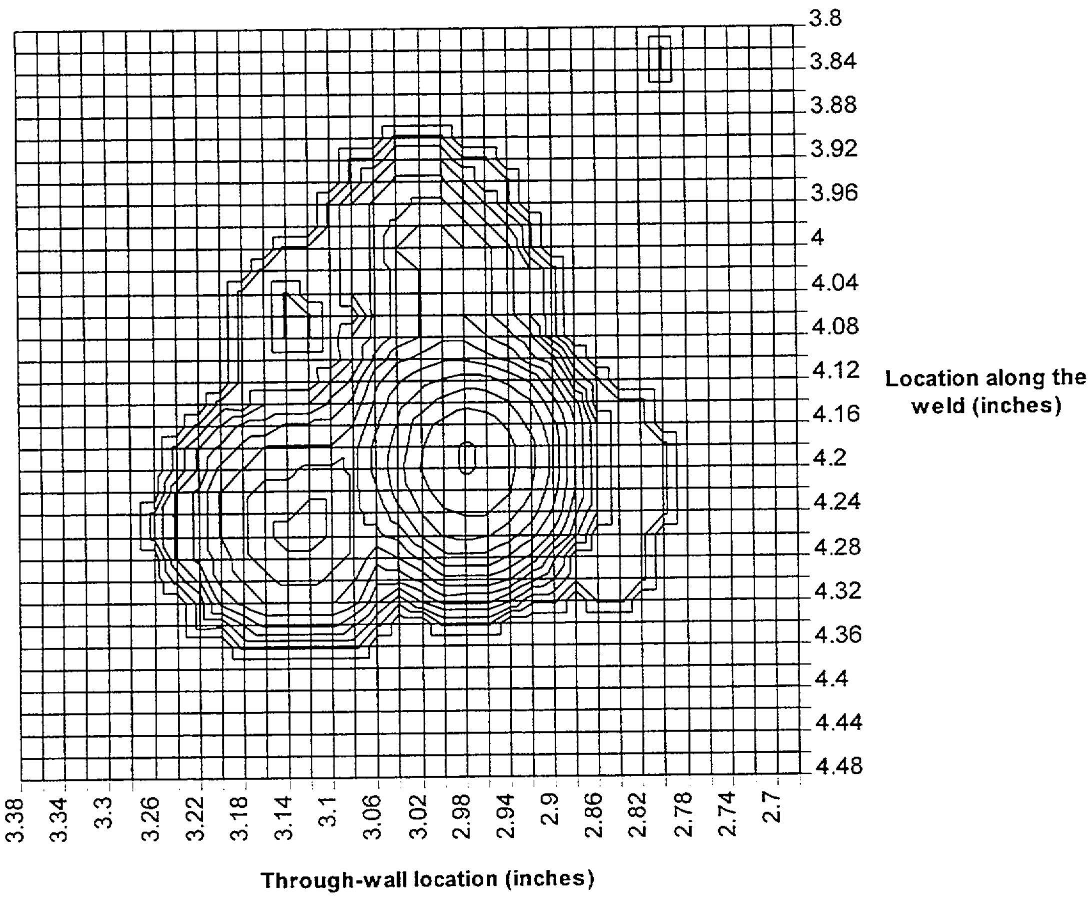

Figure 5.10 **Log-scale contour plot of ultrasonic response from indication #7 in specimen C120E characterized as a complex cluster. The contour lines are separated by 2 dB. The through-wall extent of the cluster is estimated at 7 mm from the -6 dB contours of the edges of the cluster.**

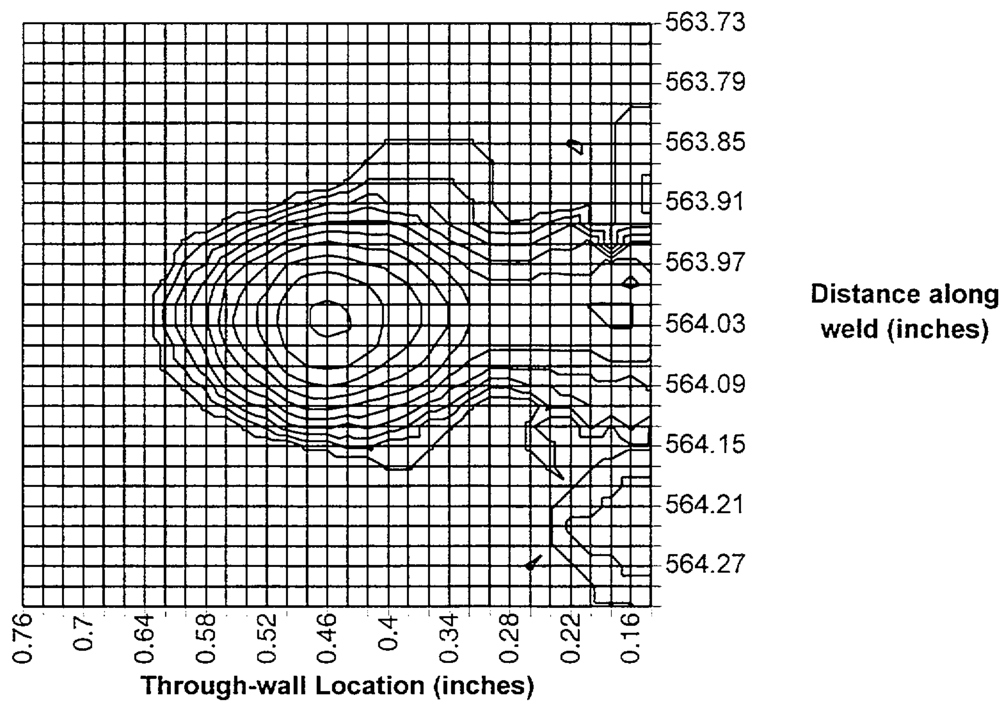

Figure 5.11 **Log-scale contour plot of ultrasonic response from an indication characterized as a surface-elongated indication. Surface-elongation is a geometrical condition that is unrelated to the flaw size. The through-wall extent of the indication is estimated from the -6 dB contour as 5 mm. The contour lines are separated by 2 dB.**

6 Density and Distribution of Flaw Indications in the Shoreham RPV

All of the data from the inspections of the Shoreham weld specimens were analyzed and all indications were characterized as described in Section 5. This section gives the through-wall size distribution for the flaw indications and their density using the discrete cumulative flaw rate function.

One set of joint frequency tables shows the through-wall size distribution for the continuous indication. These tables include the small flaws, the long lack of fusion, and the extended lack of fusion in one group. The through-wall size distribution of the complex clusters is given separately along with a discussion of what is known about the repairs to the Shoreham material. Simple clusters are categorized in terms of their location in the vessel and the surface-elongated flaw indications are distributed in through-wall size bins.

The density of flaw indications in the Shoreham vessel is described using the discrete cumulative flaw rate function and a comparison is made to the density detected and validated in the PVRUF vessel. Finally, data are shown on the density of flaw indications in the axial welds of the Shoreham material.

6.1 Distribution of Continuous Flaw Indications

The set of images of flaw indications that showed a continuous signal along the through-wall dimension includes all of the flaw indications characterized as small, long lack of fusion, and extended lack of fusion. The numbers of these continuous flaw indications are shown by the through-wall size categories in Tables 6.1, 6.2, and 6.3. Three regions of the vessel-wall thickness were identified for separate determinations of flaw-indication distributions. The inner 25 mm of the vessel, the mid-wall (middle 10 cm), and the outer 25 mm were considered to be distinctly interesting (Schuster 1998). Each of these regions was then broken up into separate material categories, such as clad, weld, fusion line, repair area, and base-metal.

The flaw indications are binned according to their through-wall sizes in the columns of Tables 6.1 through 6.3. These bins are centered on integer mm values. For example, the 4-mm column contains indications with DZ in the range of $3.5 \leq DZ < 4.5$ mm. The material types are broken out in the rows of the tables with the categories of clad, gouge, weld, weld-root, fusion line, repair metal, and base metal.

Table 6.1 gives the distribution of 471 continuous flaw indications in the inner 25 mm of the Shoreham specimens. Ninety-eight percent of these indications had through-wall sizes less than or equal to 3 mm. The row labeled *Clad* in the table includes only those flaws at the clad-to-base metal interface. One 6-mm through-wall flaw indication was recorded at the clad-to-base metal interface. The SAFT-UT inspections, which are described in Section 4, did not have sensitivity to flaws embedded in the cladding. The row labeled *Gouge* refers to a volume of manually applied weldment between the clad-to-base metal interface and the machine-made weld passes. The weld procedure is described in Section 2. The cross section of the gouge weldment was variable and such weldments were only found in the circumferential weld specimens. The row labeled *Weld* included flaw indications embedded within the machine-made weld passes but excluded flaws very close to the HAZ. These flaws are labeled *Fusion* rather than HAZ because no instances of heat-affected zone cracking has been found (to date). The row labeled *Repair* includes the flaw indications in the one confirmed repair location. Some base metal flaw indications were found, but their numbers are low in part because the weld-normal measurements were designed to inspect for welding flaws and the analysis focused on the weldment areas.

Table 6.2 gives the distribution of 2898 continuous flaw indications in the middle 10 cm of the Shoreham specimens. In addition to the categories described for Table 6.1, a row labeled *Root* has been added to identify flaw indications in the weld root passes of the axial weld specimens.

Table 6.3 gives the distribution of 661 continuous flaw indications in the outer 25 mm of the Shoreham specimens. As is the case with the first two distributions of continuous flaw indications, most are labeled *Fusion*.

6.2 Distribution of Complex Clusters of Flaw Indications

Tables 6.4, 6.5, and 6.6 give the distribution of complex clusters of indications in the inner 25 mm, outer 25 mm, and the mid-wall portion of the vessel thickness. Complex clusters are defined to be groups of more than three indications bound by proximity. There may be multiple small flaws close together, a faceted large flaw, or a combination. Without additional inspection or destructive testing, this cannot be resolved. They have been separately identified to highlight them for further

Table 6.1 Distribution of Continuous Flaw Indications in the Inner 25 mm of the Shoreham RPV

9/1/99	<4 mm	4 mm	5 mm	6 mm	7 mm	8 mm	9 mm	Total
Clad	59			1				60
Gouge	29							29
Weld	36	1						37
Fusion	326	6	1					333
Repair	9							9
Base	3							3
Total	462	7	1	1				471

Table 6.2 Distribution of Flaw Indications in the Middle 100 mm of the Shoreham RPV

9/1/99	<4 mm	4 mm	5 mm	6 mm	7 mm	8 mm	9 mm	Total
Weld	208							208
Root	154	2						156
Fusion	2419	66	9	2				2496
Repair	25							27
Base	10							10
Total	2816	68	9	2				2897

Table 6.3 Distribution of Continuous Flaw Indications in the Outer 25 mm of the Shoreham RPV

9/1/99	<4 mm	4 mm	5 mm	6 mm	7 mm	8 mm	9 mm	Total
Weld	124		1					125
Fusion	504	7	9	2				522
Repair	11							11
Base	5							5
Total	644	7	10	2				663

Table 6.4 Distribution of Complex Clusters in the Inner 25 mm of the Shoreham RPV							
9/1/99	5 mm	7 mm	9 mm	10 mm	14 mm	21 mm	32 mm
Fusion							1

Table 6.5 Distribution of Complex Clusters in the Middle 100 mm of the Shoreham RPV							
9/1/99	5 mm	7 mm	9 mm	10 mm	14 mm	21 mm	32 mm
Fusion		1				1	
Base				1			

Table 6.6 Distribution of Complex Clusters in the Outer 25 mm of the Shoreham RPV							
9/1/99	5 mm	7 mm	9 mm	10 mm	14 mm	21 mm	32 mm
Repair		1			1		

work. The flaw indications are binned according to the overall through-wall size of the cluster in the columns of the tables. Only discrete sizes rather than size ranges are represented in the tables: 5, 7, 9, 10, 14, 21, and 32 mm. The material types are broken out in the rows of the tables but only those material types that contained complex-clusters are listed.

Three Shoreham circumferential weld specimens were reported to contain repairs: C75B, C120E, and C180B. The repairs were identified only by the construction radiograph interval where the rejectable indications were found. The vessel coordinates for these are given in Section 2. One rejection notice, for C75B, was found in the construction records and that repair was found in the SAFT-UT inspection data. Two complex cluster indications for the repair in C75B are reported in Table 6.6 and labeled *Repair*. Two repair-like indications, 21 mm and 32 mm, were detected in specimen C120E but outside the reported repair location and these flaw indications are labeled *Fusion*. Although the radiograph for this area was made on the same day as all of the radiographs for repair areas, it is suspected to be a repaired area. Destructive testing is needed to confirm if a repair was made in this area.

6.3 Distribution of Simple Clusters of Flaw Indications

Tables 6.7 and 6.8 give the distribution of simple clusters of indications in the inner 25 mm and the mid-wall portion of the vessel thickness. Simple clusters are groups of two or three indications that are close together. The flaw indications are binned according to the overall through-wall size of the clusters in the columns of the tables.

6.4 Distribution of Surface-Elongated Indications

Tables 6.9 and 6.10 give the distribution of surface-elongated indications in the inner 25 mm, and outer 25 mm of the vessel thickness. Surface-elongated indications are continuous indications that appear to be distorted by an edge of the specimen. These indications are characterized separately because of the difficulty in applying the depth sizing rule to these indications.

Table 6.7 Distribution of Simple Clusters in the Inner 25 mm of the Shoreham RPV							
9/1/99	5 mm	6 mm	7 mm	8 mm	9 mm	10 mm	11 mm
Fusion			1		1		

Table 6.8 Distribution of Simple Clusters in the Mid-Wall of the Shoreham RPV							
9/1/99	5 mm	6 mm	7 mm	8 mm	9 mm	10 mm	11 mm
Fusion	2	1		2	2		

Table 6.9 Distribution of Surface-Elongated Indications in the Inner 25 mm of the Shoreham RPV

9/1/99	5 mm	6 mm	7 mm	8 mm	9 mm	10 mm	11 mm
Gouge	1		1				
Fusion	3		2	1		1	

Table 6.10 Distribution of Surface-Elongated Indications in the Outer 25 mm of the Shoreham RPV

9/1/99	5 mm	6 mm	7 mm	8 mm	9 mm	10 mm	11 mm
Weld	1						
Fusion	3	7		1	1		

6.5 Density of Shoreham Flaw Indications

Flaw rate estimates can be made from the joint frequency distribution tables reported above. Flaw rates are described by the discrete cumulative flaw rate function, which is just the sum of flaw indications greater than the size of interest divided by the volume of material inspected. The volume of material inspected in this case is the volume of weld inspected or 0.15 cubic meters for the Shoreham specimens. The data shown in Figure 6.1 are the total flaw indications greater than through-wall size on the abscissa divided by the volume of weld inspected.

The Shoreham cumulate flaw rate shown in Figure 6.1 uses all characterized flaw indications including the flaws characterized as clusters. The PVRUF cumulative flaw rate values shown in Figure 6.1 uses the validated flaw rates for the PVRUF vessel and an inspected weld volume of 0.17 cubic meters. The figure shows that the Shoreham cumulative flaw rate is consistently higher than PVRUF by a factor of about 3.

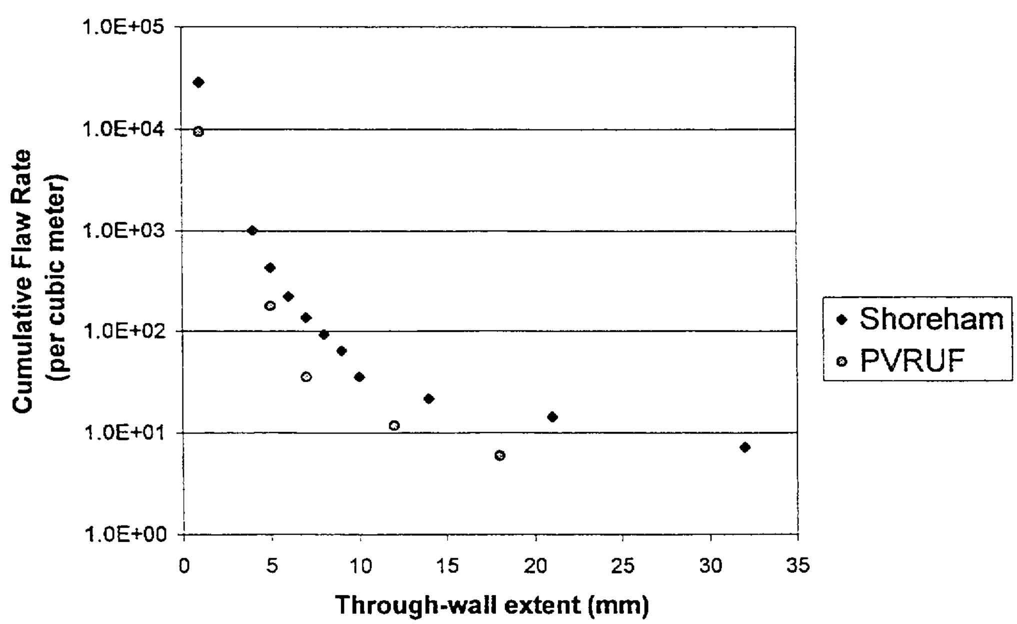

Figure 6.1 Comparison of Shoreham and PVRUF vessel cumulative flaw rate

6.6 Density of Flaw Indications in Axial Weldment

It was important to measure the flaw density for axial welds separately. Two axial weld specimens were especially suitable for this purpose. It was important to hold constant the inspection properties to permit comparisons to the circumferential welds. The flaws found in C120F and C270B, with their 11-in. thickness, were considered the best ones to use because most of the circumferential weld specimens have this thickness. The other axial weld specimens have a 5-in. thickness as described in Section 2.

A comparison of the axial welds to the circumferential weld is useful because there are documented differences and similarities in the welding procedure for the two designs (see Section 2). Figure 6.2 shows that cumulative flaw rate for axial weldment is not much different, and only slightly higher than that for the circumferential weldment.

6.7 Summary

The results of the analysis of the SAFT-UT inspections of the material removed from the Shoreham RPV are presented in Tables 6.1 through 6.10. Tables 6.1 through 6.3 show the distribution of indications that have a continuous signal across the indication. Proximity rules were not required for the estimate of through-wall extent for these indications. Tables 6.4 through 6.10 show the number of indication zones that contained clusters of indications and indications that appeared to be smeared (extended in size) by surface effects limiting the SAFT operation.

The through-wall size dependence of the density of flaw indications in the Shoreham material has been developed using the discrete cumulative flaw rate function. The Shoreham flaw indication rate is slightly higher than the rate for the PVRUF vessel by a factor of about three. The 4030 indications are roughly distributed uniformly through the vessel thickness. If the distribution was uniform there would be about 670 indications per inch of wall thickness: Table 6.1 has 471, Table 6.2 has 725, and Table 6.3 has 661.

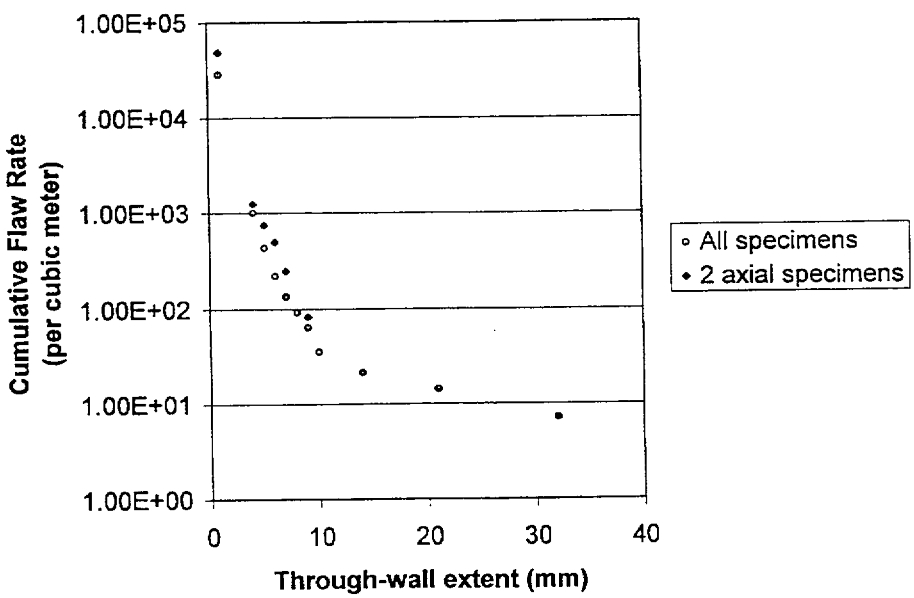

Figure 6.2 Comparison of Shoreham axial weld specimens C120F and C270B with that for all Shoreham material

7 Conclusions

A number of observations and conclusions have been drawn from the results of the SAFT-UT inspections of the Shoreham RPV material. In this work, analysis rules have been uniformly applied to all of the inspection data. One documented repair was found in the SAFT-UT images. Axial weld flaw density and distribution was not greatly different from that for the circumferential weldment. Similarities and differences between PVRUF and Shoreham RPV material have been found.

Detection and Sizing. Uniform detection and sizing rules were be applied to 4000 flaw indications. Of these indications, 97% of them were small (<3.5 mm in through-wall extent) and most were on the fusion surfaces of the structural weld with the base metal. A small portion, 151 flaw indications, were 4 mm in through-wall size or larger.

Characterization. Features could be extracted from the SAFT-UT images permitting the characterization of all indications. Indications with lengths and depth-sizes smaller than the system resolution (3.5 mm) filled the largest category. Indications with lengths greater than 4 mm and depth-sizes equal to 4 mm were characterized as long lack of fusion. Indications showing continuous intensity over its depth-size (in contrast with clustering) and depth sizes of 5 mm or greater were characterized as extended lack of fusion. Simple clusters were found that were composed of two or three circular shapes without loss of signal between them. Other indications with long and extended features in a cluster were characterized separately as complex flaw indications. Finally, indications showing a known geometrical condition that exaggerated the –6 dB through-wall size were placed in a separate group for further evaluation.

Repairs. Three Shoreham specimens were reported on an engineering drawing to contain repairs. For one of these specimens, a rejection notice was found in the construction records for the vessel. For that material with the rejected indication, the repair was also located in the SAFT-UT ultrasonic data. A second Shoreham specimen contained repair-like ultrasonic signals (complex cluster indications) but not at the location identified on the drawing. It is suspected that a repair was made in this area because the radiograph for this area was made on the same day that all repaired areas were radiographed. The third specimen did not contain detected repair-like indications but that specimen had 24 inches of repaired weldment that was previously removed by BG&E.

Axial Welds. A comparison of axial weldment from two Shoreham specimens, C120F and C270B, to the entire population of flaw indications showed that the cumulative flaw rate for axial weldment is only slightly higher than the rate for the circumferential welds.

Similarities to PVRUF. A number of similarities between PVRUF and Shoreham were readily apparent. Numerous small flaw indications were found on the fusion surfaces of the structural weld with the base metal. The largest flaw indications were complex in shape and related to repair areas.

Differences from PVRUF. There were two principal differences between the flaw densities of the Shoreham and PVRUF vessels as measured by the weld normal inspections. First, the cumulative flaw rate was about three times greater for the Shoreham vessel. Second, the Shoreham vessel contained indications consisting of long lack of fusions, up to 3 in. in length and the PVRUF vessel material did not.

In summary, specific conclusions can be drawn from the SAFT-UT inspections of the material removed from the Shoreham vessel. The development of consistent flaw data required that detection and sizing rules be uniformly applied to the inspection data to detect and size the

4000 flaw indications. Careful characterization of the larger flaw indications was needed to effectively describe what SAFT-UT found in the material. Comparison of Shoreham and PVRUF results show both similarities and differences in their respective flaw density and size distributions.

8 Recommendations

PNNL's recommendations address the destructive analysis of the Shoreham weldment specimens, continued non-destructive evaluation for surface connected flaws, future measurements of density and distribution of flaws in base metal, and improvements to the performance of the SAFT-UT field system.

An efficient mechanism for the validation of the density and distribution of flaw indications can be achieved by using the features and characteristics of the indications documented in this report. Complex clusters are most interesting and their association with repairs should be evaluated. Extended lack of fusions should be verified by measurements of sizes and compositions because these flaws are relevant to the integrity of individual machine-made weld beads. Simple clusters are interesting because additional measurements can show the interaction of small flaws. Surface-elongated indications should be evaluated to remove the geometrical factor that influences their size estimate. Long lack of fusions should be evaluated to establish its origin, such as dirty base metal (Thielsch 1977). The planar nature, number density, and size distribution of the small flaw indications should be confirmed by radiography and metallographic analysis (Doctor 1999).

The density and distribution of surface-connected flaws is important for the assessment of vessel structural integrity. The presence of repairs may be a principal determinant of this distribution. Repairs should be studied further. The inner surface region of the base metal should be studied further because it is large in volume compared to the volume of the structural welds. Reevaluation by non-destructive evaluation of the structural welds near the surface of the specimens should be considered as a part of the destructive evaluation.

The density and distribution of vertical-planar flaws in base metal is not well known. The inner third of the base metal is relevant to concerns for surface-connected flaws. Mechanisms for introducing vertical-planar flaws in base metal regions include repairs, seam, laps, and under-clad cracking.

Improvements and new functionality have been added to the SAFT-UT field data acquisition system and this trend should continue. Improvements to inspection speed, dynamic range, and ultrasonic electronics have made this work possible and promising. The generation of reusable data sets and data bases of results has only started and much remains to be done. The application of the theory of ultrasonic wave propagation to SAFT-UT measurements has started (on other projects) and PNNL expects to deploy it in future systems.

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Appendix A

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen B0B-2

Table A.1 lists all detectable flaw indications in Shoreham specimen B0B-2. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen B0B-2 is given in Section 2. The characterization of SAFT-UT indication is described in Section 5 and is summarized as follows:

- Small: less than 3.5 mm in through-wall size (see Section 5.1).
- Long: long indications with through-wall extent between 3.5 and 4.5 mm in through-wall size (see Section 5.2).
- Extended: indications with smooth, continuous response and through-wall size greater than 4.5 mm (see Section 5.3).
- Simple clusters: two or three mostly circular shapes not separated by loss of signal (see Section 5.4).
- Complex clusters: combinations of long and extended shapes that are connected by signal or proximity (see Section 5.4).
- Surface-elongated: indications with a surface-induced reduction in focus (see Section 5.5).

Figures A.1 through A.14 show the SAFT-UT images of the larger indications in specimen B0B-2. The figure captions describe the location and size of the individual flaw indications.

Table A.1 List of all indications for Shoreham specimen B0B-2

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.74	625.88	5.46	-11.4	small	fusion
2	-0.80	625.6	5.38	-23.4	small	fusion
3	-0.78	625.58	4.28	-23.4	small	fusion
4	-0.74	625.72	3.08	-19.9	small	fusion
5	-0.69	625.86	1.74	-15.9	small	fusion
6	-0.74	626.08	3.44	-21	small	fusion
7	-0.75	626.14	3.88	-17.7	small	fusion
8	-0.70	626.36	3.02	-18.9	small	fusion
9	-0.75	626.52	3.28	-22.9	small	fusion
10	-0.75	626.52	1.3	-20.6	small	fusion

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
11	-0.77	626.4	0.9	-25.2	small	fusion
12	-0.75	626.52	1.32	-20.2	small	fusion
13	-0.71	626.86	1.72	-8.6	small	fusion
14	-0.72	627.14	1.72	-25.9	small	fusion
15	-0.74	627	3.24	-20.2	small	fusion
16	-0.74	627.28	3.64	-15.7	small	fusion
17	-0.75	627.42	3.24	-25.2	small	fusion
18	-0.74	626.92	4.38	-25.9	small	fusion
19	-0.74	626.9	5.62	-22.9	small	fusion
20	-0.75	627.86	5.46	-16.1	small	fusion
21	-0.76	628.16	3.08	-18.5	small	fusion
22	-0.76	628.34	3.66	-20.6	small	fusion
23	-0.75	628.84	5.46	-22.9	small	fusion
24	-0.57	629.1	2.62	-25.2	small	ROOT
25	-0.73	629.2	1.68	-25.9	small	fusion
26	-0.73	629.4	3.18	-8.4	long	fusion
27	-0.78	629.44	3.7	-21.9	small	fusion
28	-0.74	629.56	5.4	-18.2	small	fusion
29	-0.74	629.58	1.7	-18.5	small	fusion
30	-0.76	629.68	3.64	-16.1	small	fusion
31	-0.74	629.76	4.32	-15.4	small	fusion
32	-0.74	629.88	3.24	-18.2	small	fusion
33	-0.77	629.98	4.06	-22.9	small	fusion
34	-0.75	630.32	3.62	-21.9	small	fusion
35	-0.78	630.44	4.98	-25.2	small	fusion
36	-0.76	630.6	3.46	-21	small	fusion
37	-0.71	630.84	3.4	-13.7	small	fusion
38	-0.76	630.92	1.14	-15.2	small	fusion
39	-0.68	631.34	3.94	-15.2	small	fusion
40	-0.77	631.42	5.34	-19.2	small	fusion
41	-0.63	631.52	1.82	-22.9	small	fusion
42	-0.73	631.66	4	-14	small	fusion
43	-0.76	632	3.22	-9.8	small	fusion
44	-0.77	632.44	3.7	-17.7	small	fusion
45	-0.77	632.58	5.32	-24.6	small	fusion
46	-0.72	632.64	3.4	-18.9	small	fusion
47	-0.77	632.7	3.64	-20.6	small	fusion
48	-0.77	632.7	1.16	-9.4	small	fusion
49	-0.75	632.9	4.3	-26.7	small	fusion
50	-0.73	633.08	3.42	-25.9	small	fusion
51	-0.71	633.1	1.36	-22.4	small	fusion
52	-1.10	633.22	0.18	-26.7	small	clad
53	-0.78	633.3	4.96	-26.7	small	fusion

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
54	-0.71	633.4	4	-23.4	small	fusion
55	-0.77	633.7	5.44	-17.7	small	fusion
56	-0.72	633.72	3.38	-16.9	small	fusion
57	-0.63	633.84	1.82	-26.7	small	fusion
58	-0.75	634.2	5.6	-21	small	fusion
59	-0.78	634.3	3.44	-19.5	small	fusion
60	-0.73	634.26	3.2	-14	small	fusion
61	-0.78	634.44	4.96	-21.9	small	fusion
62	-0.74	635.08	5.46	-20.6	small	fusion
63	-0.77	635.28	4.16	-17.9	small	fusion
64	-0.77	635.38	3.62	-19.9	small	fusion
65	-0.75	635.5	5.38	-12.4	long	fusion
66	-0.75	635.5	3.42	-17.4	small	fusion
67	-0.71	635.66	3.36	-16.6	small	fusion
68	-0.73	635.8	2.98	-19.2	small	fusion
69	-0.77	636.34	3.24	-26.7	small	fusion
70	-0.75	636.56	4.14	-14.4	small	fusion
71	-0.75	636.66	5.46	-19.2	small	fusion
72	-0.73	636.66	3.36	-19.2	small	fusion
73	-0.75	636.66	3.06	-25.9	small	fusion
74	-0.76	637.14	5.48	-18.9	small	fusion
75	-0.76	637.32	3.38	-17.1	small	fusion
76	-0.77	637.9	0.5	-23.4	small	fusion
77	-0.77	637.9	3.3	-24.6	small	fusion
78	-0.82	638.02	5.36	-21.9	small	fusion
79	-0.76	638.46	4.98	-26.7	small	fusion
80	-0.74	638.52	4.18	-4.5	small	fusion
81	-0.76	638.42	3.42	-21.5	small	fusion
82	-0.74	638.64	3.2	-21.9	small	fusion
83	-0.72	638.94	1.68	-16.9	small	fusion
84	-0.77	639.14	1.22	-19.5	small	fusion
85	-0.72	638.98	3.96	-10	small	fusion
86	-0.80	639.38	5.44	-11.5	small	fusion
87	-0.78	639.56	3.1	-22.4	small	fusion
88	-0.76	640.12	3.08	-22.9	small	fusion
89	-0.72	640.24	1.68	-19.9	small	fusion
90	-0.75	640.54	3.18	-11.4	small	fusion
91	-0.70	640.6	1.72	-22.4	small	fusion
92	-0.78	640.8	5.48	-21.9	small	fusion
93	-0.74	641.3	3.4	-14.8	small	fusion
94	-0.80	641.98	5.36	-19.9	small	fusion
95	-0.75	641.98	3.2	-24	small	fusion

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
96	-0.71	642.02	3	-22.4	small	fusion
97	-0.73	642.02	1.32	-22.9	small	fusion
98	-0.76	642.7	5.46	-14.8	long	fusion
99	-0.77	642.96	4	-16.9	small	fusion
100	-0.74	642.76	1.18	-20.6	small	fusion
101	-0.70	643.2	2.98	-20.2	small	fusion
102	-0.75	643.2	3.42	-14.6	small	fusion
103	-0.75	643.32	3.8	-20.2	small	fusion
104	-0.73	643.38	1.68	-23.4	small	fusion
105	-0.76	643.64	1.66	-22.9	small	fusion
106	-0.76	643.6	5.44	-24.6	small	fusion
107	-0.72	643.82	3.96	-24	small	fusion
108	-0.74	643.92	3.8	-24	small	fusion
109	-0.72	644.1	1.72	-19.9	small	fusion
110	-0.74	644.12	3.06	-22.4	small	fusion
111	-0.75	644.22	3.6	-22.4	small	fusion
112	-0.73	644.38	3	-25.9	small	fusion
113	-0.70	644.42	1.54	-19.5	small	fusion
114	-0.75	644.68	3.2	-21.9	small	fusion
115	-0.78	644.7	4.9	-25.2	small	fusion
116	-0.76	644.82	5.44	-17.4	small	fusion
117	-0.74	645.08	1.68	-18.2	small	fusion
118	-0.74	645.12	4.32	-19.5	small	fusion
119	-0.77	645.38	5.48	-22.4	small	fusion
120	-0.73	645.62	1.68	-17.9	small	fusion
121	-0.73	645.7	4.3	-22.4	small	fusion
122	-0.75	645.72	1.34	-17.9	small	fusion
123	-0.78	645.88	5.46	-12.5	small	fusion
124	-0.76	646.02	3.24	-8.8	long	fusion
125	-0.78	647.22	5.4	-12.1	small	fusion
126	-0.76	647.8	5.4	-15.9	extended	fusion
127	-0.77	647.9	3.82	-14.8	small	fusion
128	-0.75	648.52	3.22	-15.2	small	fusion
129	-0.80	648.68	3.86	-21.9	small	fusion
130	-0.76	648.7	3.04	-10.4	small	fusion
131	-0.78	648.72	1.48	-22.4	small	fusion
132	-0.74	649.12	4.16	-11.5	small	fusion
133	-0.75	649.76	3.9	-22.8	small	fusion
134	-0.76	649.96	3.62	-23.9	small	fusion
135	-0.76	650.16	1.32	-21.8	small	fusion
136	-0.74	650.32	3.04	-23.3	small	fusion
137	-0.83	650.4	5.34	-21	small	fusion

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
138	-0.77	650.7	5.5	-21.8	small	fusion
139	-0.80	650.9	1.3	-23.4	small	fusion
140	-0.78	651.16	5.4	-26.6	small	fusion
141	-0.76	651.5	3.04	-16.2	small	fusion
142	-0.79	651.82	4.04	-21.8	small	fusion
143	-0.77	651.86	5.48	-15.7	small	fusion
144	-0.73	652.32	4.04	-25	small	fusion
145	-0.71	652.76	3.38	-26.4	small	fusion
146	-0.77	653.04	3.22	-17.5	small	fusion
147	-0.70	653	3.94	-19.9	small	fusion
148	-0.77	653.02	4.16	-19	small	fusion
149	-0.77	653.22	5.4	-14.4	small	fusion
150	-0.75	653.7	5.34	-25	small	fusion
151	-0.76	653.96	3.4	-19.6	small	fusion
152	-0.72	654.2	3.96	-24.9	small	fusion
153	-0.77	654.7	3.8	-20	small	fusion
154	-0.76	655.5	1.34	-25.6	small	fusion
155	-0.74	655.62	4.3	-14.1	small	fusion
156	-0.73	656.24	5.2	-23.6	small	fusion
157	-0.78	656.54	3.26	-17.1	small	fusion
158	-0.74	656.54	1.34	-24.8	small	fusion
159	-0.78	656.66	3.06	-22.1	small	fusion
160	-0.79	657.04	3.24	-15.8	long	fusion
161	-0.80	657.46	4.02	-21.6	small	fusion
162	-0.78	657.68	3.24	-24.2	small	fusion
163	-0.78	657.68	1.46	-15.1	small	fusion
164	-0.79	658.02	3.84	-19.5	small	fusion
165	-0.79	658.26	3.78	-19.5	small	fusion
166	-0.79	658.4	3.42	-25.6	small	fusion
167	-0.77	658.48	3.24	-20.6	small	fusion
168	-1.03	658.72	0.26	-25.9	small	clad
169	-0.77	660	5.42	-10.4	small	fusion
170	-0.75	660.02	1.72	-21	small	fusion
171	-0.78	660.14	1.34	-18.7	small	fusion
172	-0.76	660.32	3.04	-9.5	small	fusion
173	-0.83	660.3	5.28	-25.6	small	fusion
174	-0.81	660.6	1.3	-21.1	small	fusion
175	-0.77	661.28	3.04	-14.1	small	fusion
176	-0.82	661.5	5.34	-16.2	small	fusion
177	-0.78	661.66	3.4	-23.5	small	fusion
178	-0.79	661.92	3.04	-23.5	small	fusion
179	-0.81	661.98	1.48	-19.1	small	fusion

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
180	-0.78	662.6	3.94	-16.3	small	fusion
181	-0.77	662.56	3.74	-22.3	small	fusion
182	-0.78	662.7	3.22	-7.5	small	fusion
183	-0.80	662.6	1.32	-21.9	small	fusion
184	-0.83	663.16	5.38	-14.2	extended	fusion
185	-0.75	663.6	3.18	-15.7	small	fusion
186	-0.77	663.82	4.14	-15.3	small	fusion
187	0.70	625.16	1.54	-18.1	small	fusion
188	0.68	625.12	2.8	-21.5	small	fusion
189	0.76	625.34	4.78	-22.5	small	fusion
190	0.74	625.48	3.84	-24.8	small	fusion
191	0.74	625.62	4.22	-18.4	small	fusion
192	0.76	625.62	3.08	-27.8	small	fusion
193	0.69	625.76	2.82	-25.8	small	fusion
194	0.69	625.8	1.7	-22.6	small	fusion
195	0.75	625.88	3.86	-22.5	small	fusion
196	0.73	625.94	4.66	-22.5	small	fusion
197	0.75	626.12	5.5	-25.6	small	fusion
198	0.77	626.2	3.64	-26.6	small	fusion
199	0.61	626.3	1.44	-28.2	small	fusion
200	0.72	626.42	4	-27.9	small	fusion
201	0.69	626.64	1.7	-26.8	small	fusion
202	0.76	627.08	4.84	-25.6	small	fusion
203	0.66	627.02	1.6	-22.6	small	fusion
204	0.73	627.08	1.04	-20.1	small	fusion
205	0.70	627.54	3.02	-23.2	small	fusion
206	0.75	627.64	2.84	-21.7	small	fusion
207	0.77	627.72	3.64	-19.5	small	fusion
208	0.72	627.74	1.14	-16.8	small	fusion
209	0.77	627.64	5.58	-22.3	small	fusion
210	0.78	628.08	3.66	-18.5	small	fusion
211	0.73	628.32	3.26	-23.1	small	fusion
212	0.78	628.46	3.84	-10.9	small	fusion
213	0.64	628.58	1.72	-28	small	fusion
214	0.75	628.72	4.02	-20	small	fusion
215	0.77	629	4	-14.7	small	fusion
216	0.74	629.28	3.78	-18.6	small	fusion
217	0.70	629.08	1.52	-25.6	small	fusion
218	0.74	629.26	3.78	-18.2	small	fusion
219	0.74	629.4	2.82	-12.3	small	fusion
220	0.74	629.52	3.62	-20.5	small	fusion
221	0.76	629.48	5.7	-17.7	small	fusion

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
222	0.72	630.18	1.18	-19	long	fusion
223	0.79	630.52	3.9	-24.4	small	fusion
224	0.62	630.8	1.74	-25.8	small	fusion
225	0.76	630.8	1.2	-27.6	small	fusion
226	0.79	631.44	3.62	-17.5	small	fusion
227	0.79	631.82	3.92	-26.3	small	fusion
228	0.76	632.12	4.22	-22.1	small	fusion
229	0.60	632.02	1.44	-28	small	fusion
230	0.73	632.22	1.14	-22.9	small	fusion
231	0.75	632.52	4.78	-20.9	long	fusion
232	0.61	632.56	1.88	-20.7	small	fusion
233	0.74	633.08	3.96	-15.1	long	fusion
234	0.69	633.26	1.56	-30.6	small	fusion
235	0.77	633.96	3.82	-20.7	small	fusion
236	0.72	634.24	1.46	-28.8	small	fusion
237	0.72	634.32	0.38	-26.3	small	fusion
238	0.69	634.48	1.68	-30.5	small	fusion
239	0.74	634.44	4.2	-24.3	small	fusion
240	0.66	635.08	1.7	-26.5	small	fusion
241	0.74	635.86	4.62	-28.7	small	fusion
242	0.74	635.92	1.16	-23.4	small	fusion
243	0.73	636	1.34	-25.2	small	fusion
244	0.79	636.5	3.66	-21.8	small	fusion
245	0.75	636.58	1.12	-22.6	small	fusion
246	0.80	637.42	3.48	-21	small	fusion
247	0.78	637.5	4.04	-16.4	small	fusion
248	0.61	637.62	1.84	-30.6	small	fusion
249	0.76	638.36	4.04	-28.5	small	fusion
250	0.69	638.58	3.94	-27.4	small	fusion
251	0.74	638.54	1.46	-25	small	fusion
252	0.75	638.86	4.14	-27.1	small	fusion
253	0.15	638.94	1.94	-28.8	small	weld
254	0.75	639	3.9	-28.5	small	fusion
255	0.74	639.34	4.78	-20.5	small	fusion
256	0.77	639.4	3.98	-20.4	extended	fusion
257	0.70	639.38	2.8	-27.3	small	fusion
258	0.51	639.68	2.04	-22.5	long	ROOT
259	0.76	639.78	4.76	-18.9	small	fusion
260	0.78	639.96	1.22	-25.8	small	fusion
261	0.78	641.04	4.04	-19.2	small	fusion
262	0.73	641.28	3.8	-24.9	small	fusion
263	0.50	641.28	2.06	-25.6	small	ROOT

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
264	0.66	641.26	1.7	-18.6	small	fusion
265	0.73	641.52	1.14	-22.4	small	fusion
266	0.75	641.64	4.78	-25.8	small	fusion
267	0.77	641.72	3.48	-24.7	small	fusion
268	0.77	641.88	2.88	-23	small	fusion
269	0.76	642.06	4	-21.5	small	fusion
270	0.76	642.1	4.76	-21.5	small	fusion
271	0.76	642.36	4.02	-24.7	small	fusion
272	0.74	642.4	1.1	-19.3	cluster	fusion
273	0.77	642.92	1.02	-25.7	small	fusion
274	0.30	643.46	1.7	-29.6	small	weld
275	0.74	643.46	0.74	-22.2	small	fusion
276	0.71	643.64	1.56	-22.3	small	fusion
277	0.73	643.8	1.52	-23	small	fusion
278	0.77	644.26	1.34	-15.4	small	fusion
279	0.75	644.24	2.84	-23.7	small	fusion
280	0.75	644.38	4	-24.7	small	fusion
281	0.76	644.96	4	-21.4	small	fusion
282	0.78	645.26	4.04	-26.7	small	fusion
283	0.77	645.58	4	-22	small	fusion
284	0.75	645.66	2.82	-26.8	small	fusion
285	0.63	645.5	1.76	-26	small	fusion
286	0.76	646.1	4.16	-22	small	fusion
287	0.76	646.3	4.22	-21.3	small	fusion
288	0.78	646.36	3	-29.5	small	fusion
289	0.75	646.66	4.16	-22	small	fusion
290	0.75	646.94	3.92	-28	small	fusion
291	0.77	646.96	3.44	-20.6	small	fusion
292	0.75	646.86	1.16	-25.5	small	fusion
293	0.79	647.18	4.82	-24.4	small	fusion
294	0.72	647.28	1.58	-25.6	small	fusion
295	0.69	647.56	1.7	-26.8	small	fusion
296	0.75	648.28	1.54	-24.4	small	fusion
297	0.76	648.52	3.84	-26.5	small	fusion
298	0.72	648.66	4.12	-25.5	small	fusion
299	0.76	648.82	3.82	-23.4	small	fusion
300	0.78	648.92	3.24	-22.5	small	fusion
301	0.48	648.94	2.18	-30.3	small	ROOT
302	0.77	649.54	1.34	-22.5	small	fusion
303	0.79	649.9	5.42	-27.7	small	fusion
304	0.76	650.06	3.62	-24.3	small	fusion
305	0.71	650.02	1.7	-25.5	small	fusion

Table A.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
306	0.71	650.36	1.54	-26.6	small	fusion
307	0.76	651.16	4.92	-25.2	small	fusion
308	0.75	652.04	3.02	-20.4	small	fusion
309	0.81	652.16	3.32	-18	small	fusion
310	0.79	652.16	4.76	-25.1	small	fusion
311	0.76	652.42	4.76	-23.2	small	fusion
312	0.78	652.58	1.3	-21.6	small	fusion
313	0.70	653.2	1.06	-25.3	small	fusion
314	0.77	653.42	3.28	-26.2	small	fusion
315	0.76	653.76	1.48	-23.1	small	fusion
316	0.64	654.06	1.74	-24.4	small	fusion
317	0.73	654.12	1.56	-25.2	small	fusion
318	0.73	654.28	4.14	-24.1	small	fusion
319	0.48	654.4	2.1	-23.2	small	ROOT
320	0.49	654.74	2.06	-21.7	small	ROOT
321	-0.11	654.8	2.36	-21.1	small	ROOT
322	0.79	654.86	4.74	-23.9	small	fusion
323	0.74	655.08	1.14	-21.6	small	fusion
324	0.76	655.12	0.74	-21.5	small	fusion
325	0.78	655.32	4.04	-23	small	fusion
326	0.80	655.66	4.02	-18.8	small	fusion
327	0.74	656.44	1.54	-17	small	fusion
328	0.68	656.86	1.74	-21.6	small	fusion
329	0.71	656.98	1.54	-25.1	small	fusion
330	0.77	657.24	2.82	-23.8	small	fusion
331	0.79	657.36	3.28	-21.2	small	fusion
332	-0.11	657.64	2.36	-30	small	ROOT
333	0.63	657.58	1.76	-27.8	small	fusion
334	0.78	657.9	3.26	-23.7	small	fusion
335	-0.14	658.16	2.36	-25.6	small	ROOT
336	-0.13	658.76	2.34	-20	small	ROOT
337	-0.12	659.22	2.34	-22.6	small	ROOT
338	0.80	659.4	3.84	-18	small	fusion
339	0.80	659.52	3.44	-25.7	small	fusion
340	0.82	659.66	3.64	-24.5	small	fusion
341	0.84	659.86	3.72	-21.6	small	fusion
342	0.77	659.84	1.52	-15.9	small	fusion
343	0.74	660.18	1.38	-22.8	small	fusion
344	0.76	660.38	1.14	-23.6	small	fusion
345	0.78	660.72	5.48	-9.4	long	fusion
346	0.80	660.72	3.64	-17.5	small	fusion
347	0.76	660.6	3.02	-25.8	small	fusion

Table A.1 (contd)							
	Peak Coordinates (Specimen)						
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
348	0.77	660.82	1.16	-14.3	small	fusion
349	0.77	661.2	1.5	-21.8	small	fusion
350	0.78	661.6	3.24	-25.7	small	fusion
351	0.71	661.8	2.78	-24.7	small	fusion
352	0.75	662.2	4.14	-24.6	small	fusion
353	0.79	662.28	3.8	-18.4	small	fusion
354	0.77	662.2	2.82	-21	small	fusion
355	0.70	662.28	1.72	-24.7	small	fusion
356	0.81	662.8	3.86	-24.3	small	fusion
357	0.78	663	2.84	-15.6	small	fusion
358	-0.09	662.94	2.36	-26.2	small	ROOT
359	0.76	663.06	4.1	-9.9	small	fusion
360	0.77	663.42	4.72	-18.4	small	fusion
361	0.80	663.44	4.12	-25.5	small	fusion
362	0.80	663.48	3.6	-24.3	small	fusion
363	0.79	663.68	4.7	-26.8	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for Azimuth greater than 30 degrees.

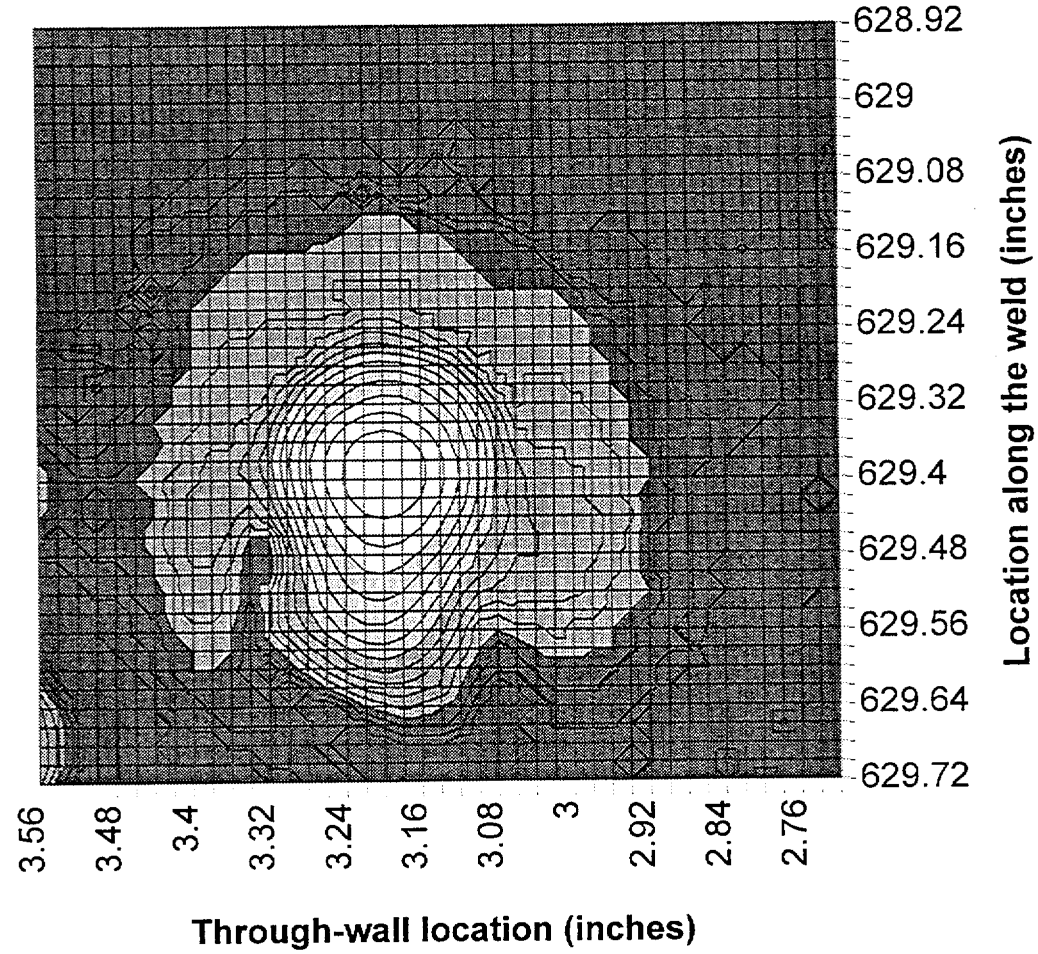

Figure A.1 **Log-scale contour plot of indication #26 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.73 inches below (minus angle) of 30.0 degrees of vessel azimuth.**

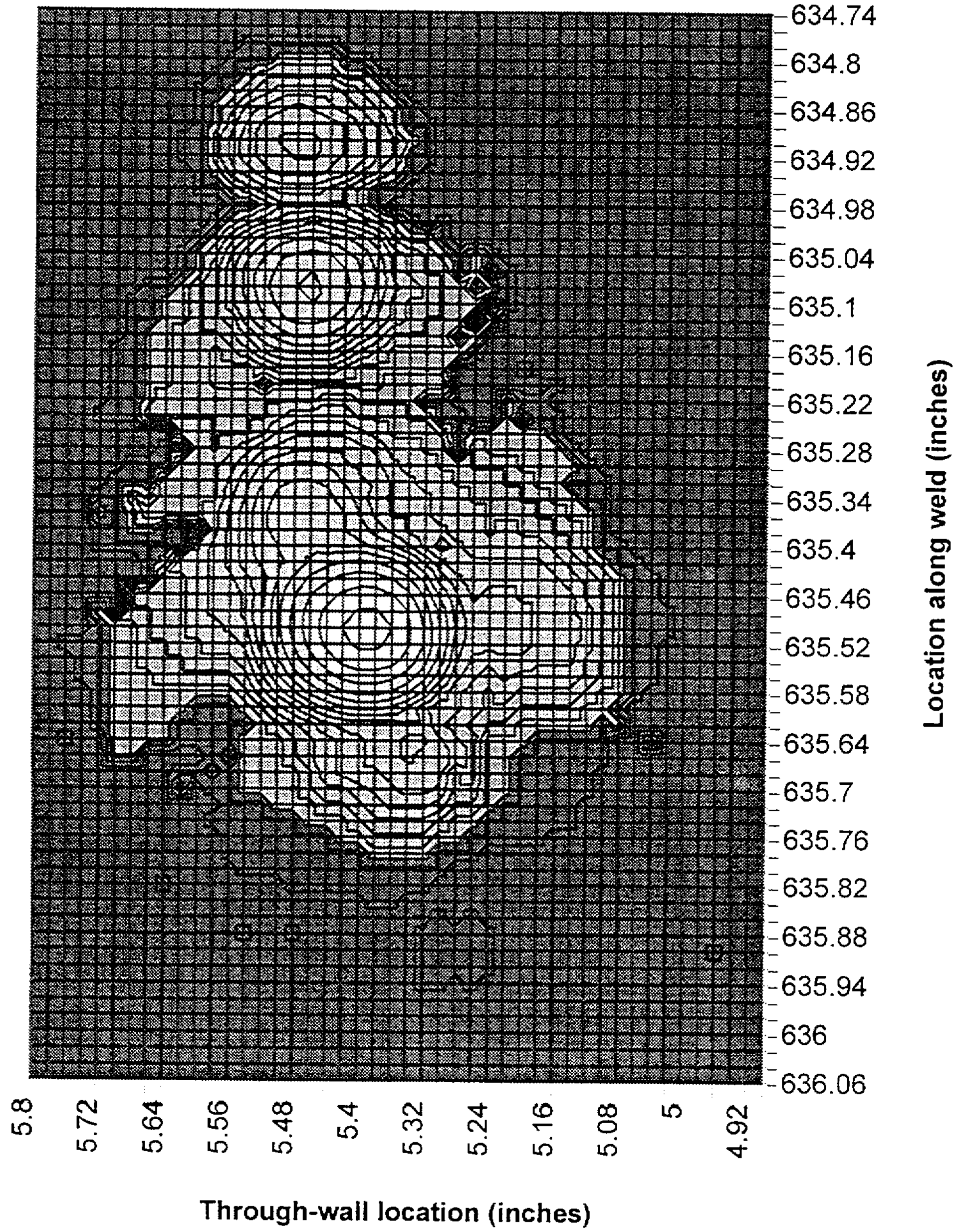

Figure A.2 **Log-scale contour plot of indication #65 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is outer 25 mm. The length is 25 mm measured to loss of signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.75 inches below (minus angle) of 30.0 degrees of vessel azimuth.**

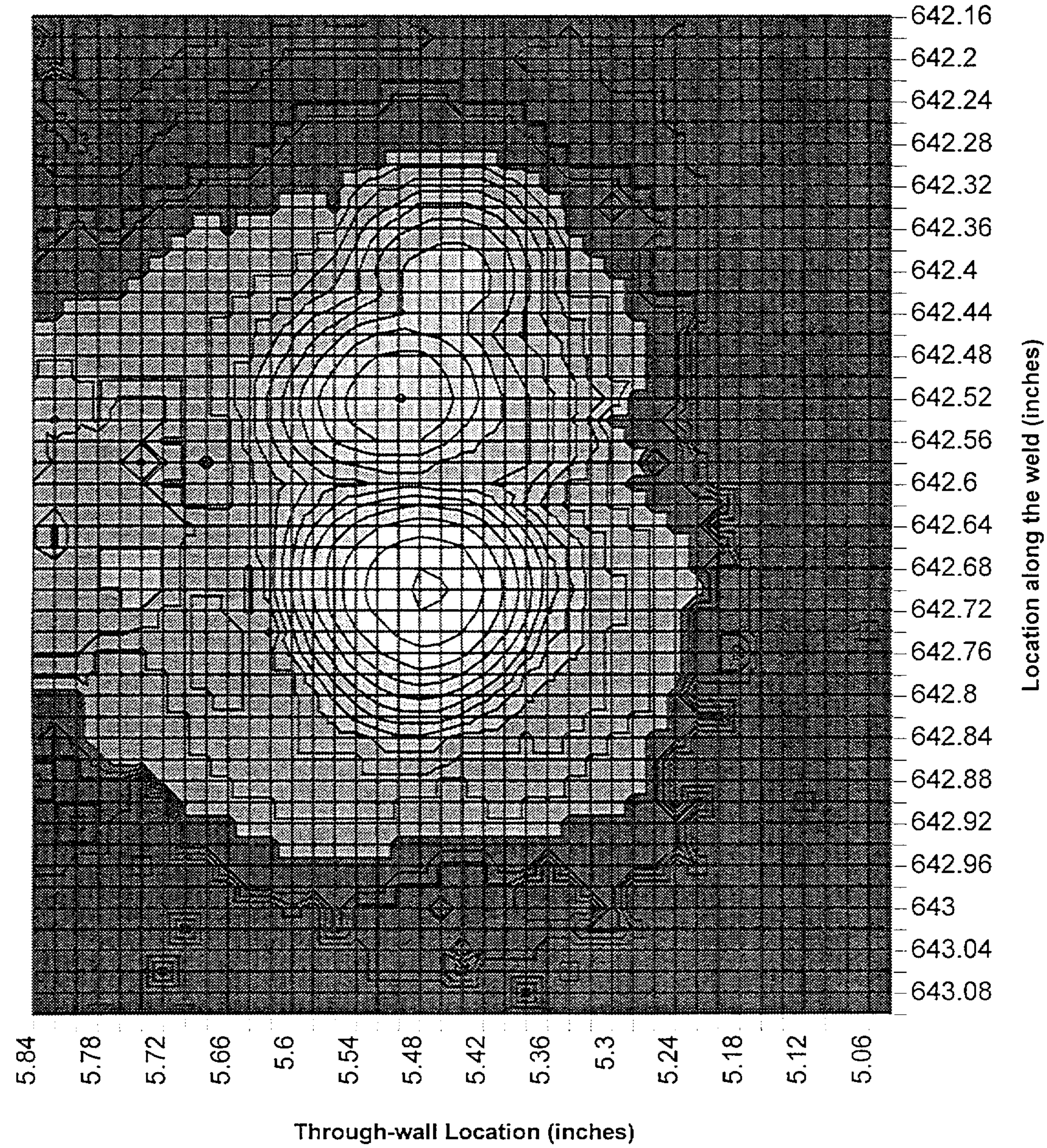

Figure A.3 Log-scale contour plot of indication #98 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.76 inches below (minus angle) of 30.0 degrees of vessel azimuth.

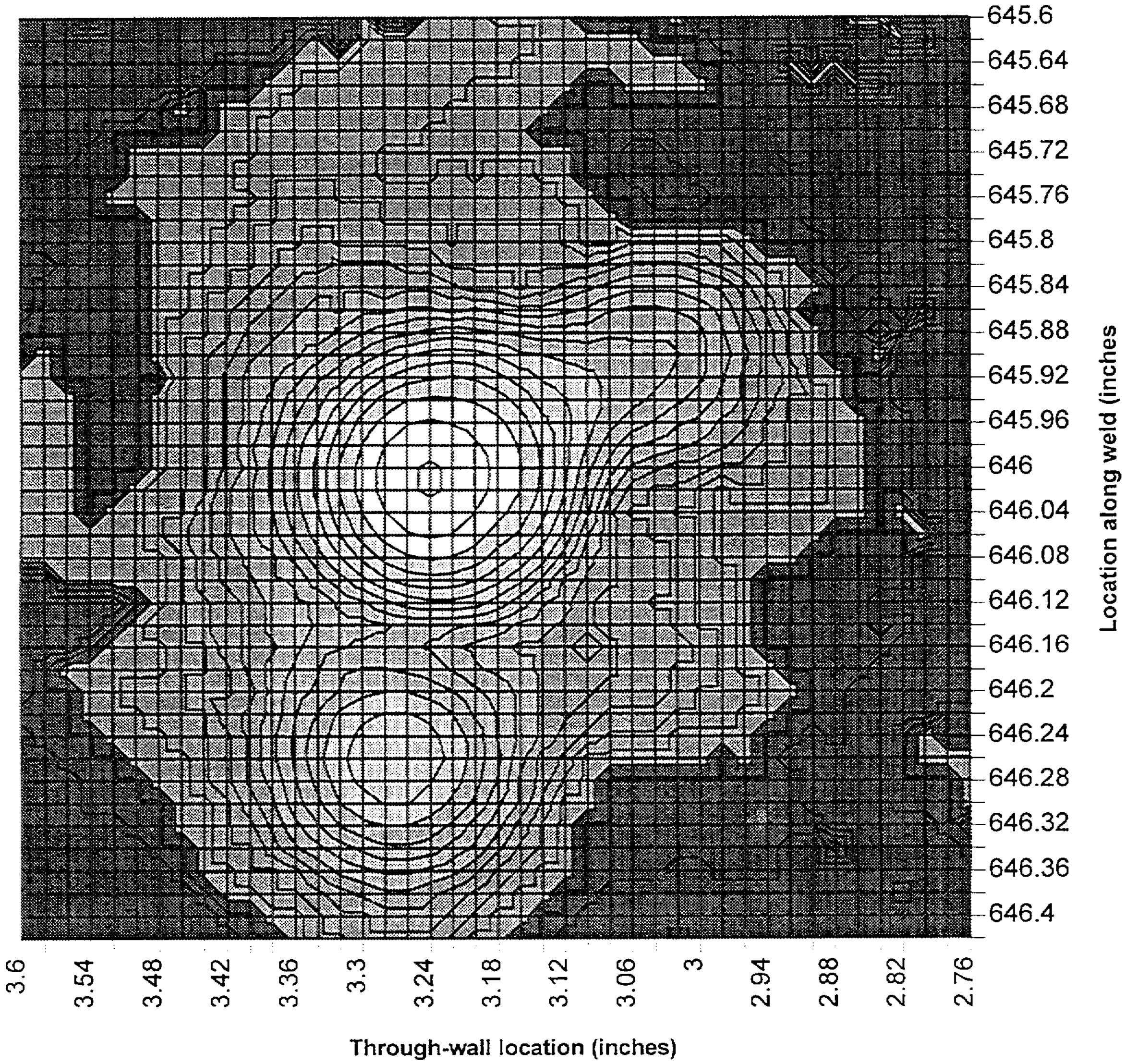

Figure A.4 **Log-scale contour plot of indication #124 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.76 inches below (minus angle) of 30.0 degrees of vessel azimuth.**

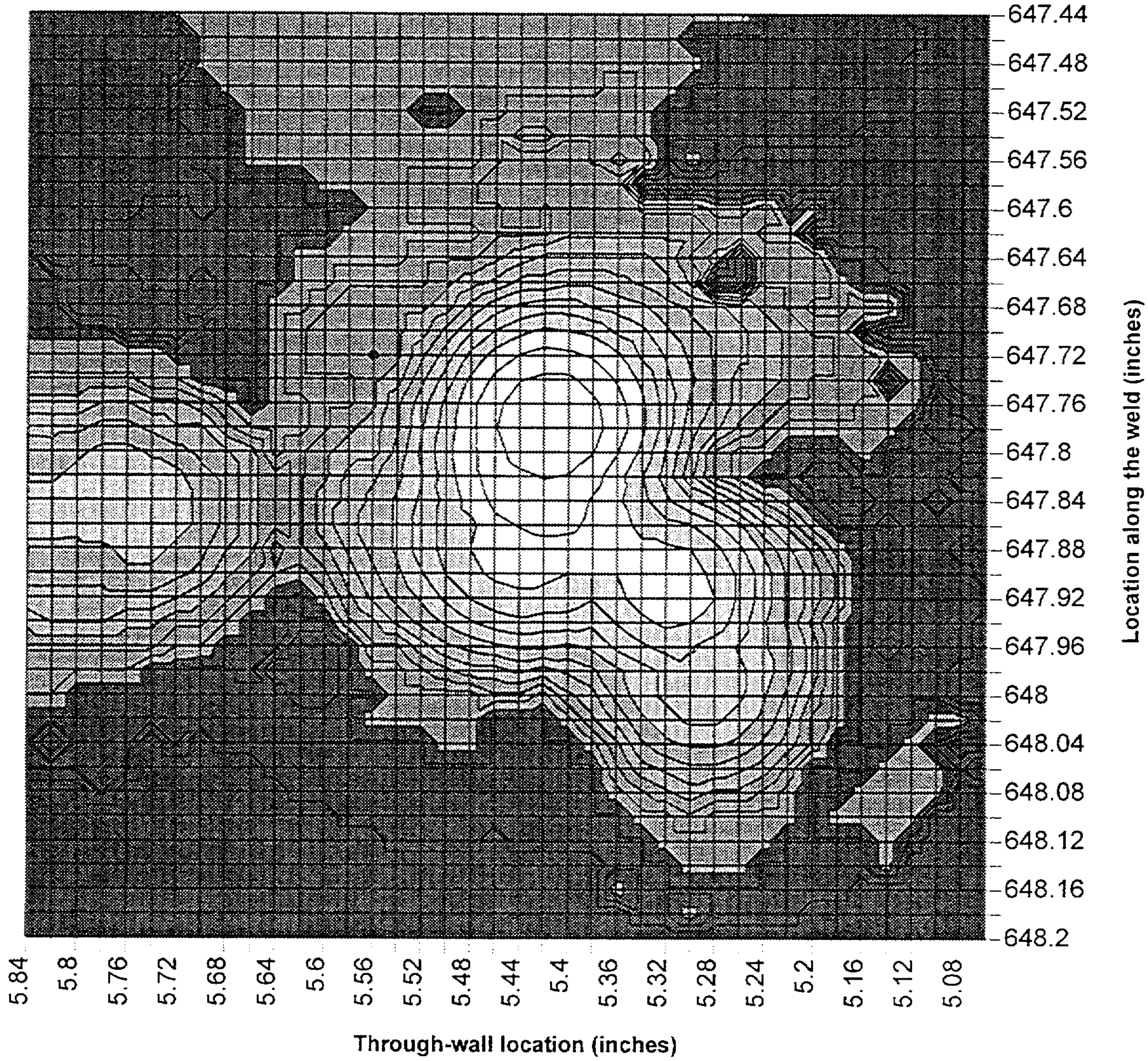

Figure A.5 Log-scale contour plot of indication #126 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.76 inches below (minus angle) of 30.0 degrees of vessel azimuth.

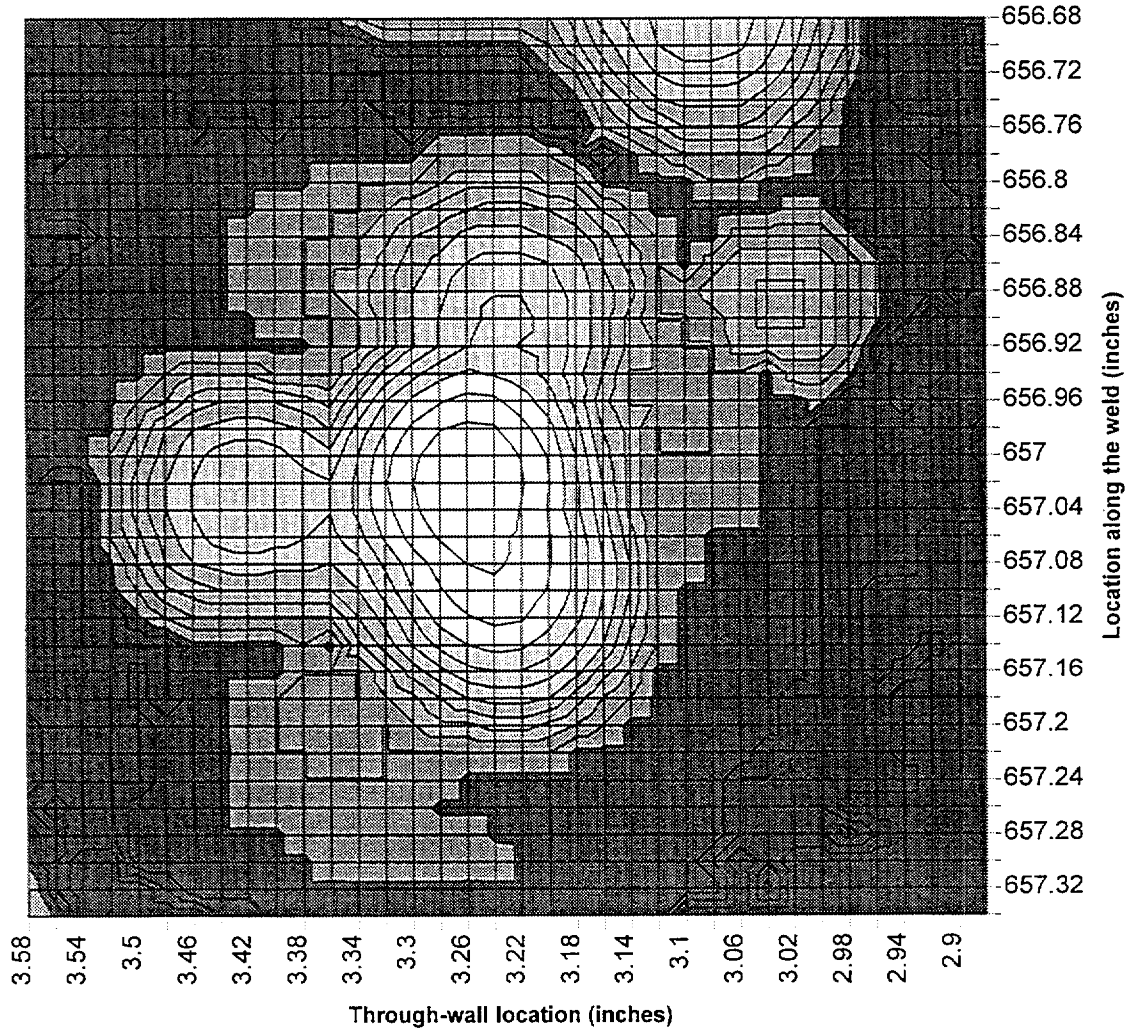

Figure A.6 Log-scale contour plot of indication #160 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.79 inches below (minus angle) of 30.0 degrees of vessel azimuth.

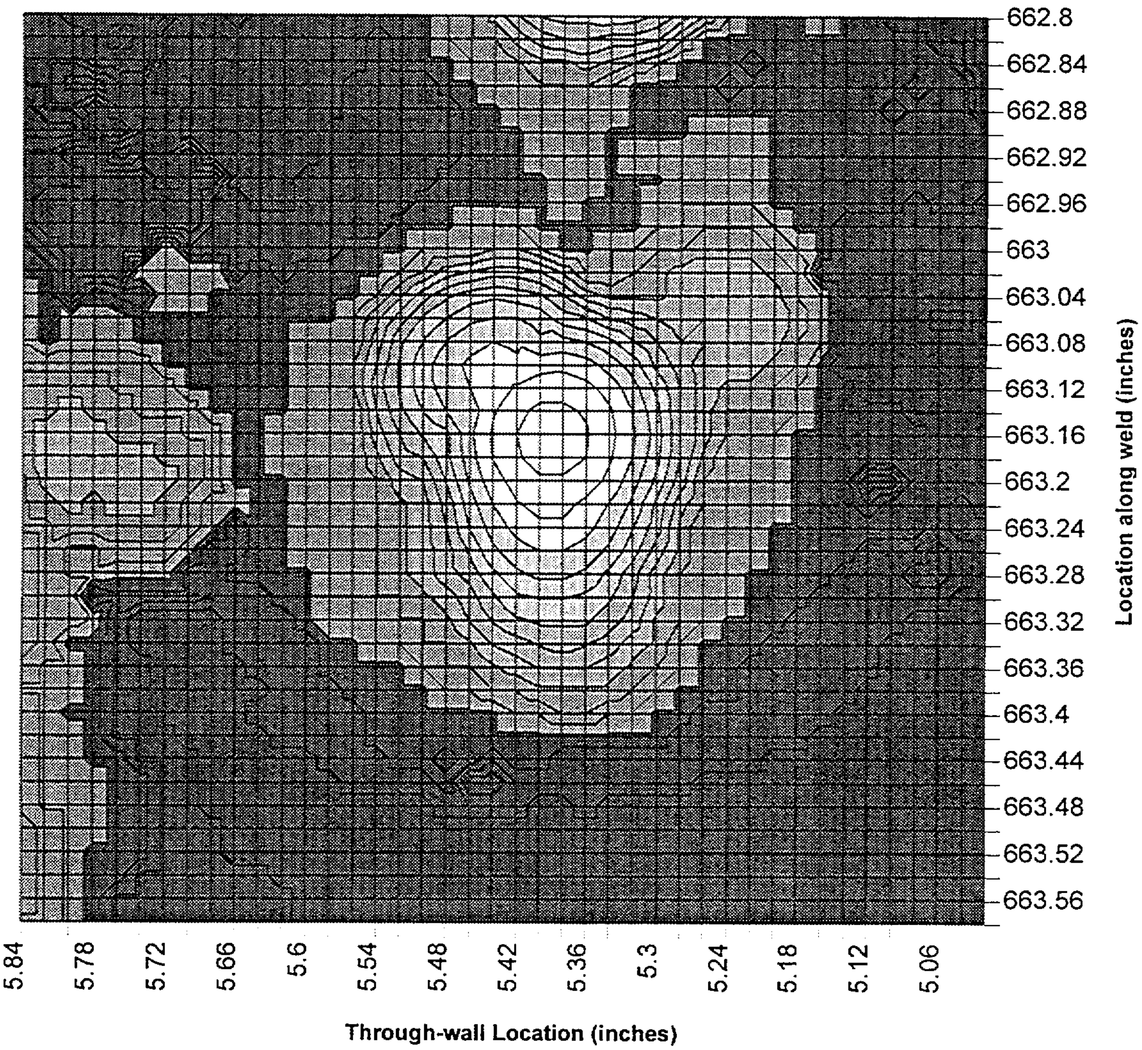

Figure A.7 Log-scale contour plot of indication #184 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.83 inches below (minus angle) of 30.0 degrees of vessel azimuth.

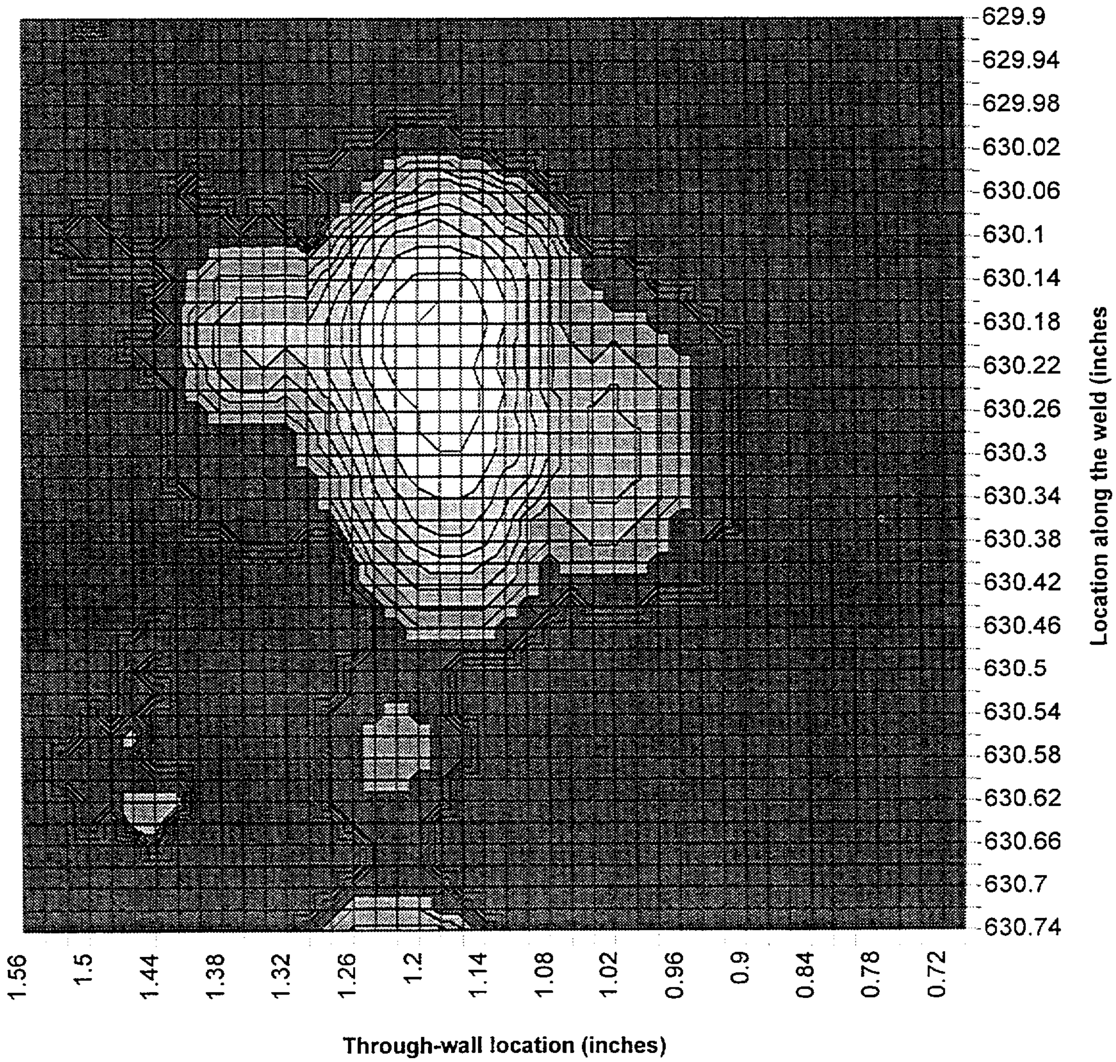

Figure A.8 **Log-scale contour plot of indication #222 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is midwall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.72 inches above (positive angle) 30.0 degrees of vessel azimuth.**

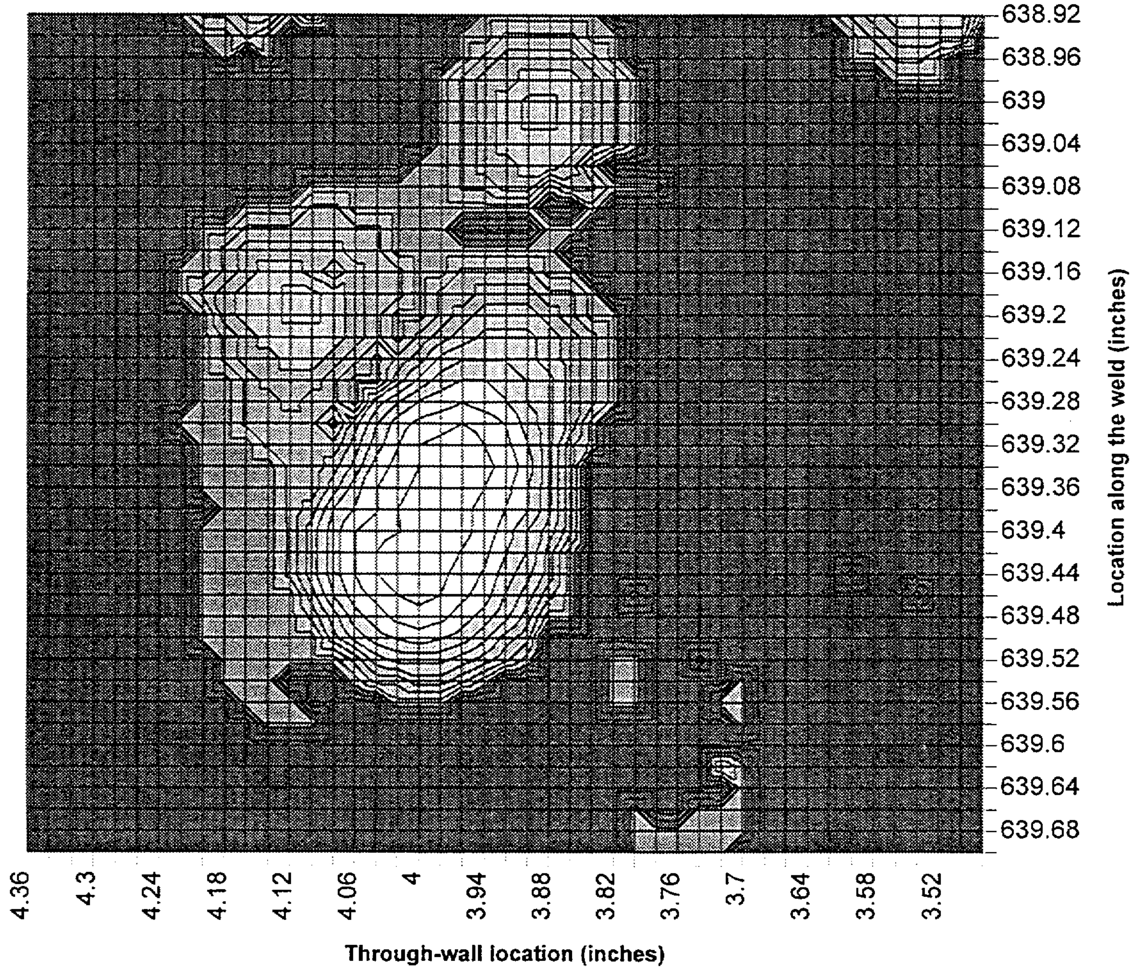

Figure A.9 **Log-scale contour plot of indication #256 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.77 inches above (positive angle) 30.0 degrees of vessel azimuth.**

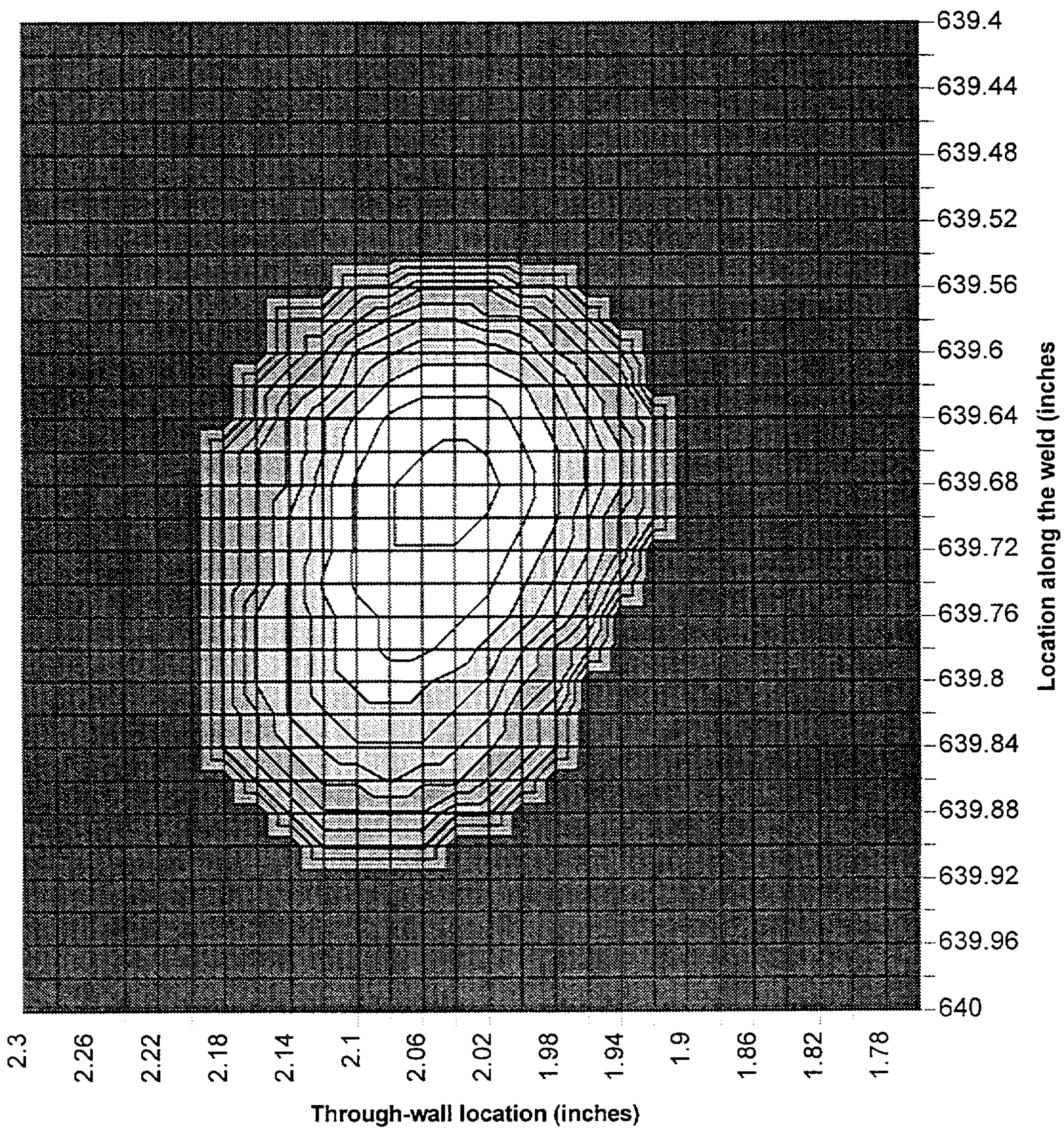

Figure A.10 **Log-scale contour plot of indication #258 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -22.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in the weld root at 0.51 inches above (positive angle) 30.0 degrees of vessel azimuth.**

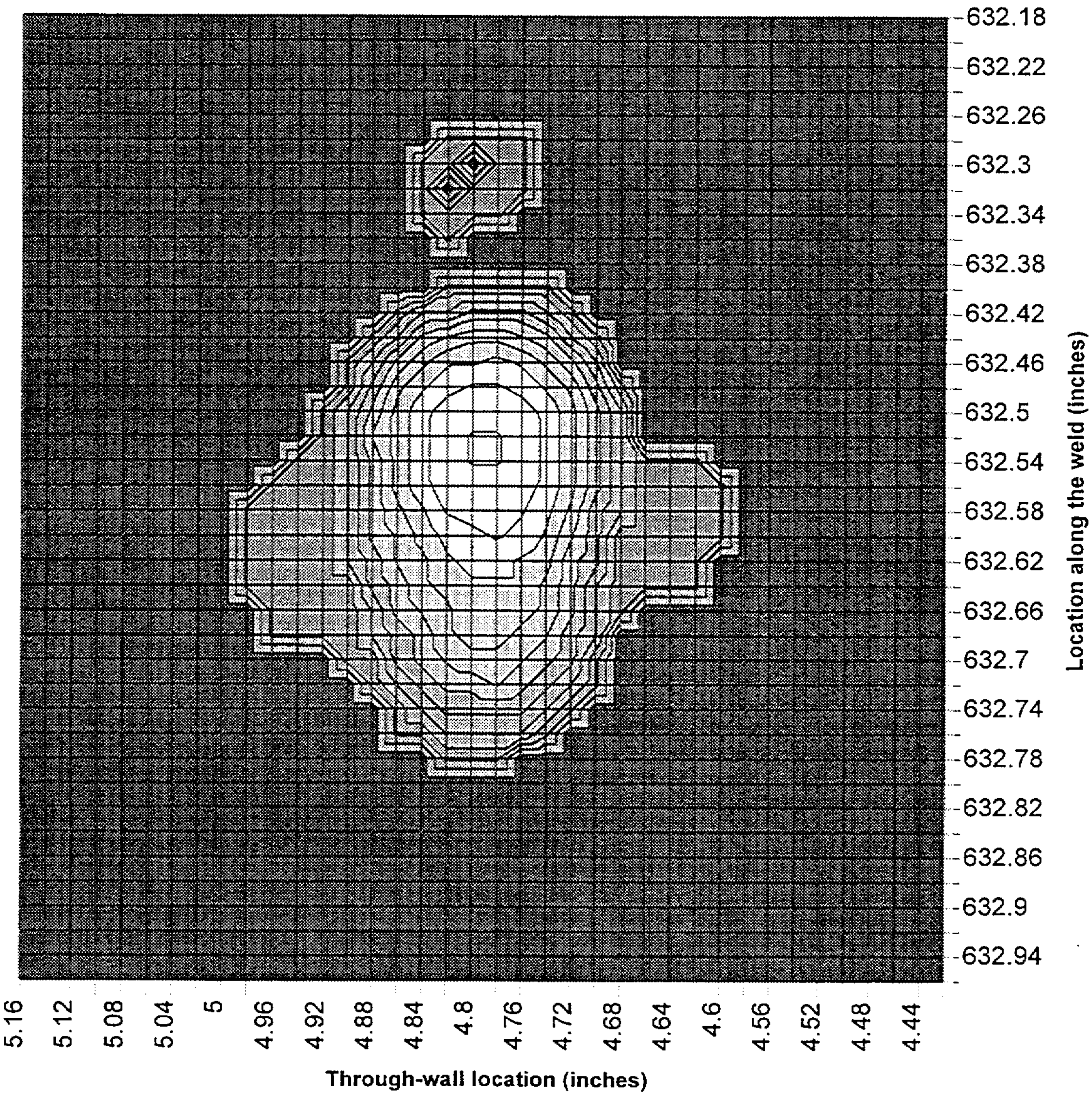

Figure A.11 **Log-scale contour plot of indication #231 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is midwall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.75 inches above (positive angle) 30.0 degrees of vessel azimuth.**

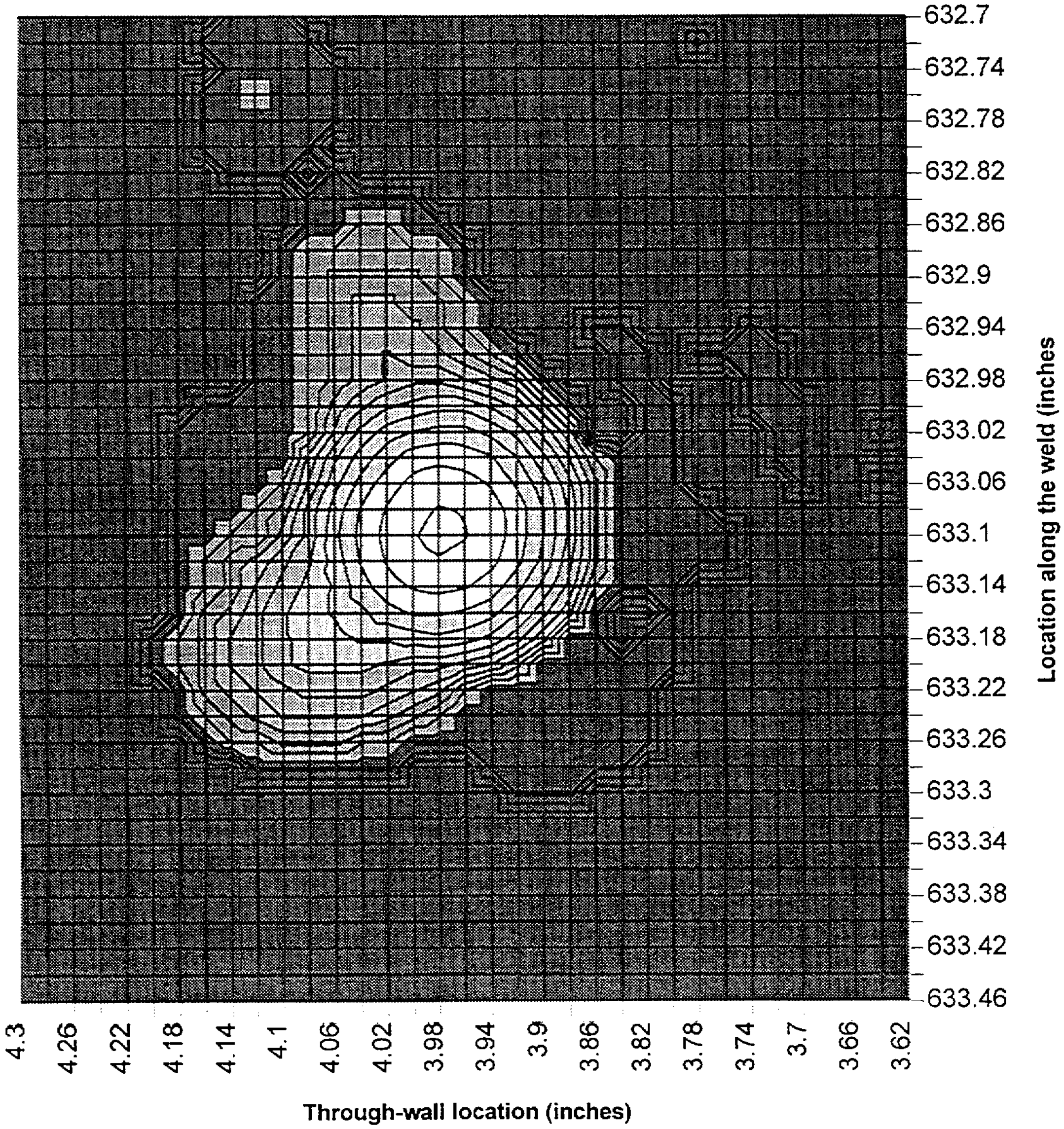

Figure A.12 **Log-scale contour plot of indication #233 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.74 inches above (positive angle) 30.0 degrees of vessel azimuth.**

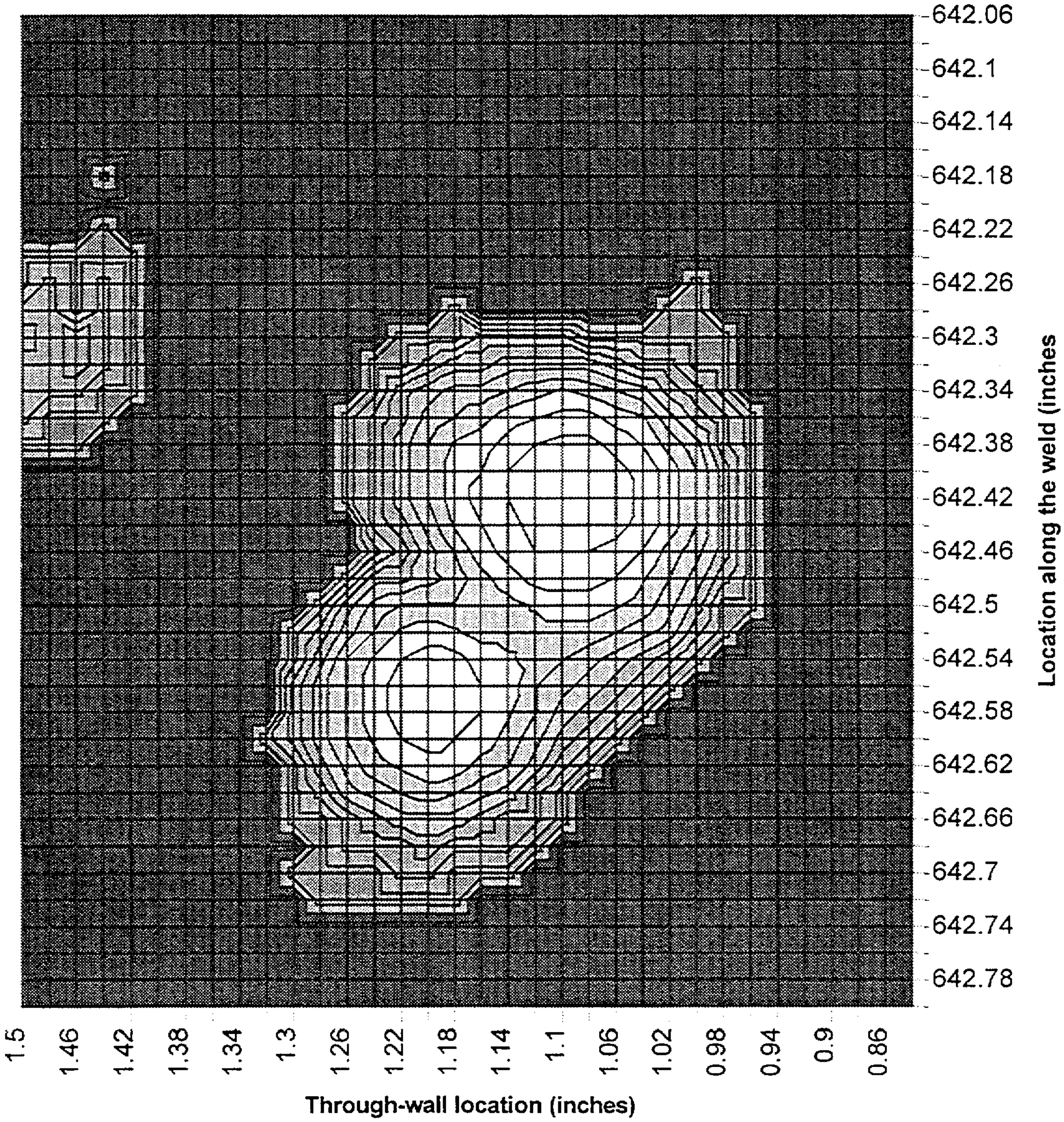

Figure A.13 Log-scale contour plot of indication #272 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as a simple cluster, is located in on the fusion surface at 0.74 inches above (positive angle) 30.0 degrees of vessel azimuth.

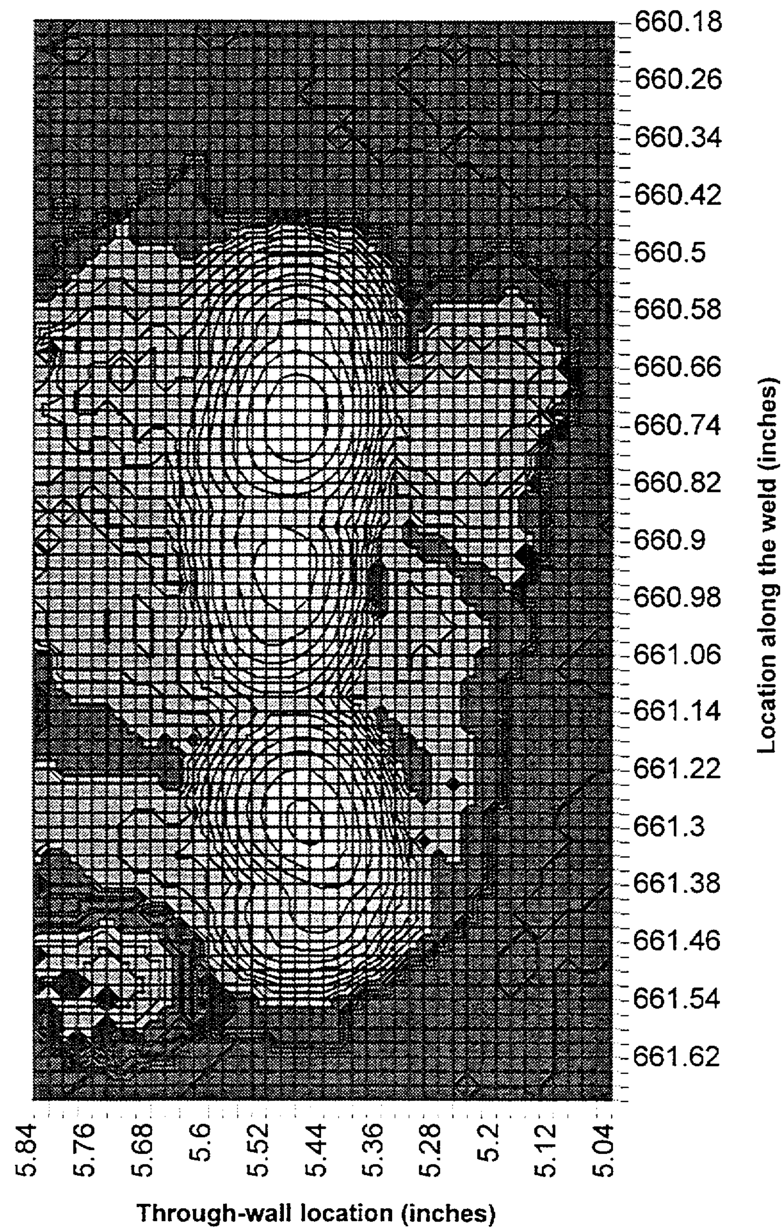

Figure A.14 Log-scale contour plot of indication #345 in Shoreham specimen B0B-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is outer 25 mm. The length is 30 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.78 inches above (positive angle) 30.0 degrees of vessel azimuth.

Appendix B

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen B0C-2

Table B.1 lists all detectable flaw indications in Shoreham specimen B0C-2. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen B0C-2 is given in Section 2. Figures B.1 through B.12 show the SAFT-UT images of the larger indications in the specimen. The figure captions describe the location and size of the individual flaw indications.

Table B.1 List of all indications for Shoreham specimen B0C-2

#	Peak Coordinates (Specimen)			Response (dB)	Characterization	Type (material)
	Weld Center (inches)	Along Weld (inches)	Depth (inches)			
1	-0.70	582.1	3.86	-18.2	small	fusion
2	-0.68	582.2	1.48	-23.4	small	fusion
3	-0.75	582.38	4.46	-15.7	small	fusion
4	-0.70	582.42	1.46	-16.4	small	fusion
5	-0.70	582.56	3.04	-23.4	small	fusion
6	-0.80	582.7	3.6	-19.5	small	fusion
7	-0.73	582.68	4.28	-16.9	small	fusion
8	-0.75	582.7	4.62	-20.6	small	fusion
9	-0.71	582.84	1.18	-10.3	small	fusion
10	-0.73	582.94	3.7	-13.9	small	fusion
11	-0.75	583.04	4.06	-21.9	small	fusion
12	-0.78	583.2	3.34	-17.9	small	fusion
13	-0.76	583.3	4.5	-14.6	small	fusion
14	-0.69	583.44	1.32	-21.9	small	fusion
15	-0.76	583.72	3.16	-3.8	small	fusion
16	-0.76	583.88	4.46	-7.1	long	fusion
17	-0.72	584.34	1.12	-3.9	extended	fusion
18	-0.76	584.44	2.98	-9.9	small	fusion
19	-0.74	584.62	4.44	-8	small	fusion
20	-0.77	584.72	3.94	-16.9	small	fusion
21	-0.79	584.68	3.76	-16.4	small	fusion
22	-0.70	584.72	1.48	-10.3	small	fusion
23	-0.77	585.08	3.94	-13	small	fusion
24	-0.75	585.22	4.52	-17.7	small	fusion
25	-0.77	585.34	3.38	-11.9	small	fusion
26	-0.56	585.48	1.82	-20.6	small	ROOT
27	-0.70	585.38	1.38	-23.4	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.77	585.58	2.98	-18.2	small	fusion
29	-0.77	585.58	3.98	-21	small	fusion
30	-0.77	585.9	3.54	-6	small	fusion
31	-0.75	586.28	3.34	-14	small	fusion
32	-0.75	586.36	3.92	-17.9	small	fusion
33	-0.76	586.58	4.06	-16.4	small	fusion
34	-0.78	586.68	4.48	-10.5	small	fusion
35	-0.69	586.62	1.06	-6	small	fusion
36	-0.73	586.74	2.74	-16.1	small	fusion
37	-0.76	586.88	3.52	-22.9	small	fusion
38	-0.76	587.12	3.52	-18.9	small	fusion
39	-0.76	587.06	2.94	-13.2	small	fusion
40	-0.69	587.18	1.46	-14.2	small	fusion
41	-0.74	587.44	1.38	-18.5	small	fusion
42	-0.72	587.8	3.72	-19.2	small	fusion
43	-0.74	587.86	4.08	-13.2	small	fusion
44	-0.74	587.78	4.34	-18.2	small	fusion
45	-0.72	587.96	1.16	-7.5	small	fusion
46	-0.77	588.12	3.96	-16.6	small	fusion
47	-0.74	588.18	4.34	-20.6	small	fusion
48	-0.77	588.42	3.36	-18.5	small	fusion
49	-0.70	588.5	2.72	-22.9	small	fusion
50	-0.68	588.46	1.28	-22.9	small	fusion
51	-0.75	588.84	3.36	-13	small	fusion
52	-0.75	588.92	3.88	-8	small	fusion
53	-0.73	589.06	3.32	-17.7	small	fusion
54	-0.73	589.1	2.94	-15.9	small	fusion
55	-0.70	588.92	1.42	-18.9	small	fusion
56	-0.71	589.18	1.42	-16.6	small	fusion
57	-0.73	589.1	2.92	-16.1	small	fusion
58	-0.75	589.34	2.96	-17.1	small	fusion
59	-0.75	589.44	4.08	-15.9	small	fusion
60	-0.75	589.16	5.52	-20.2	small	fusion
61	-0.75	589.6	3.52	-22.4	small	fusion
62	-0.75	589.68	4.06	-19.9	small	fusion
63	-0.76	589.72	4.36	-20.2	small	fusion
64	-0.78	589.8	5.5	-24	small	fusion
65	-0.46	589.78	1.96	-19.5	small	ROOT
66	-0.69	590.18	2.68	-20.2	small	fusion
67	-0.69	590.3	1.02	-11.6	small	fusion
68	-0.65	590.4	1.62	-17.7	small	fusion
69	-0.69	590.82	2.7	-17.7	small	fusion
70	-0.72	590.68	3.5	-14.4	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	**Weld Center (inches)**	**Along Weld (inches)**	**Depth (inches)**	**Response (dB)**	**Characterization**	**Type (material)**
71	-0.74	590.86	3.14	-16.9	small	fusion
72	-0.69	590.8	2.7	-18.2	small	fusion
73	-0.72	591.08	1.06	-7.4	long	fusion
74	-0.70	591.42	1.56	-10.7	small	fusion
75	-0.72	591.18	2.7	-21.5	small	fusion
76	-0.74	591.26	3.74	-20.6	small	fusion
77	-0.79	591.58	3.78	-22.4	small	fusion
78	-0.75	591.82	3.14	-17.1	small	fusion
79	-0.72	591.86	4.12	-15.2	small	fusion
80	-0.70	591.98	0.54	-16.1	small	fusion
81	-0.73	592.4	2.9	-8.7	small	fusion
82	-0.73	592.46	1.22	-12.2	small	fusion
83	-0.75	592.62	2.88	-14.2	small	fusion
84	-0.50	592.8	2.56	-24.6	small	ROOT
85	-0.73	592.92	2.84	-24.6	small	fusion
86	-0.69	592.86	0.9	-21.5	small	fusion
87	-0.73	593.18	1.32	-19.9	small	fusion
88	-0.78	593.22	3.74	-16.1	small	fusion
89	-0.71	593.3	3.5	-23.4	small	fusion
90	-0.64	593.44	1.62	-19.9	small	fusion
91	-0.71	593.44	3.1	-20.2	small	fusion
92	-0.64	593.44	1.6	-20.2	small	fusion
93	-0.74	593.48	1.2	-17.9	small	fusion
94	-0.67	593.76	3.06	-19.9	small	fusion
95	-0.76	593.78	5.38	-18.5	small	fusion
96	-0.74	594.14	2.96	-22.4	small	fusion
97	-0.72	594.14	1.4	-17.4	small	fusion
98	-0.67	594.42	1.56	-15.7	small	fusion
99	-0.70	594.38	2.46	-22.9	small	fusion
100	-0.70	594.74	1.08	-14.4	small	fusion
101	-0.72	594.8	2.72	-10.7	small	fusion
102	-0.77	594.78	3.92	-16.1	small	fusion
103	-0.79	594.88	5.58	-6.2	small	fusion
104	-0.75	595.42	3.92	-12.5	small	fusion
105	-0.73	595.48	2.7	-15.4	small	fusion
106	-0.71	595.66	2.72	-15.7	small	fusion
107	-0.75	595.66	3.36	-20.2	small	fusion
108	-0.75	595.72	3.72	-18.9	small	fusion
109	-0.73	595.8	4.9	-17.4	small	fusion
110	-0.78	595.98	5.6	-18.5	small	fusion
111	-0.71	596.14	4.7	-13.9	small	fusion
112	-0.78	595.98	4.28	-15.2	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	-0.76	596.18	4.1	-9.8	small	fusion
114	-0.73	596.2	3.88	-10.1	small	fusion
115	-0.74	596.68	4.1	-11.5	small	fusion
116	-0.71	596.78	0.8	-21	small	fusion
117	-0.72	597	3.92	-19.9	small	fusion
118	-0.74	597.36	2.94	-19.5	small	fusion
119	-0.79	597.44	3.38	-16.1	small	fusion
120	-0.79	597.48	5.64	-19.2	small	fusion
121	-0.75	597.92	2.94	-13.7	small	fusion
122	-0.75	597.92	1.26	-14.2	small	fusion
123	-0.79	598.22	3.86	-24	cluster	fusion
124	-0.77	598.2	4.54	-13.9	small	fusion
125	-0.77	598.78	3.4	-8.8	small	fusion
126	-0.73	598.74	3.08	-21.9	small	fusion
127	-0.71	599.12	3.46	-24.6	small	fusion
128	-0.73	599.06	1.44	-25.2	small	fusion
129	-0.75	599.16	1.28	-24	small	fusion
130	-1.10	598.76	0.14	-25.9	small	clad
131	-0.76	599.36	3.92	-16.9	small	fusion
132	-0.76	599.56	3.38	-21.5	small	fusion
133	-0.62	599.54	2.64	-21.9	small	fusion
134	-0.76	599.72	4.7	-24	small	fusion
135	-0.67	599.88	3.04	-25.9	small	fusion
136	-0.69	599.88	0.98	-17.9	small	fusion
137	-0.67	599.9	3.06	-25.9	small	fusion
138	-0.76	600.06	4.1	-19.5	small	fusion
139	-0.76	600.34	3.92	-13.3	small	fusion
140	-0.76	600.46	4.68	-14.8	small	fusion
141	-0.72	600.56	2.94	-21.9	small	fusion
142	-0.60	600.64	2.62	-24	small	fusion
143	-0.67	600.8	1.66	-24.6	small	fusion
144	-0.74	600.9	3.76	-22.4	small	fusion
145	-0.70	601.02	0.8	-23.4	small	fusion
146	-0.77	601.32	3.56	-8.4	small	fusion
147	-0.75	601.56	5.36	-18.9	small	fusion
148	-0.77	601.86	5.64	-18.2	small	fusion
149	-0.75	602.14	5.48	-18.2	small	fusion
150	-0.77	602.02	4.72	-22.9	small	fusion
151	-0.75	602.06	1.26	-12.5	small	fusion
152	-0.75	602.38	3.74	-15.9	small	fusion
153	-0.73	602.4	3.92	-17.4	small	fusion
154	-0.78	602.4	3.2	-22.4	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	-0.59	602.54	2.6	-21.9	small	ROOT
156	-0.73	602.42	1.26	-24	small	fusion
157	-0.80	602.74	2.98	-26.7	small	fusion
158	-0.76	603	3.74	-8.6	long	fusion
159	-0.76	603.14	3.16	-12.1	small	fusion
160	-0.62	603.34	2.6	-24.6	small	fusion
161	-0.72	603.48	1.28	-21.5	small	fusion
162	-0.76	603.5	5.62	-23.4	small	fusion
163	-0.67	603.8	2.72	-18.2	small	fusion
164	-0.70	604.02	2.9	-21	small	fusion
165	-0.72	604.06	3.32	-23.4	small	fusion
166	-0.79	604.16	3.8	-20.6	small	fusion
167	-0.77	604.38	3.94	-20.6	small	fusion
168	-0.75	604.38	4.66	-24	small	fusion
169	-0.68	604.66	1.66	-16.6	small	fusion
170	-1.07	604.7	3.02	-24.6	small	base
171	-0.68	604.94	2.72	-18.9	small	fusion
172	-0.77	605.08	3.18	-5.3	small	fusion
173	-0.75	605.56	3.36	-21	small	fusion
174	-0.78	605.66	4.58	-14.8	small	fusion
175	-0.69	605.68	1.24	-24.6	small	fusion
176	-0.69	606.06	2.88	-25.2	small	fusion
177	-0.78	606.12	3.42	-21.5	small	fusion
178	-0.62	606.26	1.66	-25.2	small	fusion
179	-0.72	606.78	1.42	-22.4	small	fusion
180	-0.70	607.06	0.68	-19.9	small	fusion
181	-0.72	607.28	1.08	-21.5	small	fusion
182	-0.72	607.48	2.94	-14.4	small	fusion
183	-0.70	607.6	1.28	-19.5	small	fusion
184	-0.72	607.94	1.24	-13.2	small	fusion
185	-0.75	608	3.38	-11.5	small	fusion
186	-1.17	608.42	0.18	-25.2	small	clad
187	-0.75	608.3	4.1	-15.9	small	fusion
188	-0.75	608.4	3.76	-19.2	small	fusion
189	-0.73	608.84	1.22	-24	small	fusion
190	-0.76	609	3.18	-13.5	small	fusion
191	-0.76	609.26	3.02	-22.9	small	fusion
192	-0.71	609.48	4.1	-24.6	small	fusion
193	-0.72	609.78	3.5	-25.2	small	fusion
194	-0.74	609.76	1.18	-21.5	small	fusion
195	-0.65	609.92	1.66	-23.4	small	fusion
196	-0.74	610.06	4.98	-22.4	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
197	-0.79	610.2	3.6	-13.2	cluster	fusion
198	-0.81	610.56	4.62	-12.2	small	fusion
199	-0.95	610.84	0.14	-24.6	small	clad
200	-0.65	610.98	1.32	-21.9	small	fusion
201	-0.75	611.16	4.1	-17.7	small	fusion
202	-0.77	611.26	5.64	-20.2	small	fusion
203	-0.66	611.48	1.62	-17.1	small	fusion
204	-0.71	611.62	2.78	-23.4	small	fusion
205	-0.78	611.84	3.2	-9.6	small	fusion
206	-0.66	611.82	1.56	-22.9	small	fusion
207	-0.78	611.92	4.72	-21.9	small	fusion
208	-0.78	611.86	5.62	-21.9	small	fusion
209	-0.66	612.2	1.6	-19.2	small	fusion
210	-0.82	612.26	4.64	-15.2	small	fusion
211	-0.69	612.38	1.1	-17.7	small	fusion
212	-0.76	612.38	3.8	-21.5	small	fusion
213	-0.78	612.6	3.96	-22.4	small	fusion
214	-0.69	612.76	0.78	-19.5	small	fusion
215	-0.72	613.26	1.34	-25.9	small	fusion
216	-0.76	613.38	4.74	-20.2	small	fusion
217	-0.70	613.48	3.32	-25.9	small	fusion
218	-0.72	613.54	1.34	-25.9	small	fusion
219	-0.79	614.08	3.62	-21.9	small	fusion
220	-0.77	614.36	3.44	-17.9	small	fusion
221	-0.77	614.52	4.7	-7.5	small	fusion
222	-0.77	614.62	3.98	-14.6	small	fusion
223	-0.73	614.76	1.34	-21.9	small	fusion
224	-0.71	614.96	2.94	-15.9	small	fusion
225	-0.64	615.68	1.62	-21.5	small	fusion
226	-0.71	615.66	1.4	-15.9	small	fusion
227	-0.71	615.68	0.48	-19.2	small	fusion
228	-0.71	615.82	1.08	-15	small	fusion
229	-0.76	615.98	4.22	-22.4	small	fusion
230	-0.60	616.12	1.78	-25.2	small	ROOT
231	-0.76	616.24	3.76	-16.4	small	fusion
232	-0.78	616.28	5.04	-19.5	small	fusion
233	-0.60	616.3	1.72	-23.4	small	fusion
234	-0.81	616.56	3.64	-17.4	small	fusion
235	-0.77	616.94	4.14	-14.6	small	fusion
236	-0.72	617.16	0.88	-22.9	small	fusion
237	-0.77	617.28	3.44	-19.5	small	fusion
238	-0.70	617.54	0.98	-21.5	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
239	-0.73	617.72	1.38	-24	small	fusion
240	-0.73	617.84	1.1	-22.4	small	fusion
241	-0.75	617.94	3.96	-8.7	small	fusion
242	-0.80	618.06	3.64	-22.9	small	fusion
243	-0.73	618.52	2.98	-17.1	small	fusion
244	-0.71	618.42	1.1	-22.9	small	fusion
245	-0.76	618.62	4.1	-24.6	small	fusion
246	-0.69	618.92	1.6	-18.2	small	fusion
247	-0.71	619.26	3.96	-17.4	small	fusion
248	-0.76	619.48	3.82	-18.5	small	fusion
249	-0.79	619.52	3.46	-24	small	fusion
250	-0.62	619.38	1.64	-24	small	fusion
251	-0.67	619.32	1.34	-22.9	small	fusion
252	-0.72	619.8	1.44	-20.6	small	fusion
253	-0.74	620.04	3.02	-13.5	small	fusion
254	-0.75	620.5	3.94	-15	small	fusion
255	-0.77	620.88	3.82	-6.6	small	fusion
256	-0.77	620.82	3.42	-20.2	small	fusion
257	-0.59	620.78	1.8	-25.2	small	ROOT
258	0.75	582.1	3.3	-24.2	small	fusion
259	0.77	582.34	3.92	-28	small	fusion
260	0.79	582.48	4.36	-23.3	small	fusion
261	0.79	582.52	1.44	-21.9	small	fusion
262	0.81	583.32	1.18	-13	small	fusion
263	0.74	583.54	1.68	-25.9	small	fusion
264	0.76	583.64	1.26	-28	small	fusion
265	0.76	583.84	5.56	-24.1	small	fusion
266	0.76	584.16	3.56	-25.8	small	fusion
267	0.59	584.62	3.56	-27.3	small	fusion
268	0.80	584.94	1.18	-25.7	small	fusion
269	0.70	585.1	2.9	-22.1	small	fusion
270	0.77	585.24	5.06	-18.8	small	fusion
271	0.75	585.4	3.48	-22.6	small	fusion
272	0.72	585.48	3.08	-19.9	small	fusion
273	0.75	585.76	3.06	-23.3	small	fusion
274	0.74	586.72	4.06	-5.6	long	fusion
275	0.73	587.3	2.92	-22.6	small	fusion
276	0.73	587.38	4.08	-7.5	small	fusion
277	0.78	587.66	3.8	-26.7	small	fusion
278	0.64	587.78	1.76	-28.3	small	fusion
279	0.73	587.64	1.34	-29.4	small	fusion
280	0.75	587.96	5.74	-26.8	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
281	0.77	588.26	4.72	-15.9	small	fusion
282	0.73	588.2	4.28	-29.4	small	fusion
283	0.75	588.24	1.24	-24.9	small	fusion
284	0.77	588.32	3.14	-29.2	small	fusion
285	0.72	588.62	5.14	-22.6	small	fusion
286	0.72	588.72	4.02	-12.1	long	fusion
287	0.77	588.72	3.16	-23.2	small	fusion
288	0.79	588.94	1.32	-24.7	small	fusion
289	0.72	589.36	3.9	-15.7	small	fusion
290	0.70	589.46	3.26	-28.1	small	fusion
291	0.72	589.56	4.06	-28	small	fusion
292	0.74	589.64	5.76	-25.8	small	fusion
293	0.71	590	4.08	-18.9	long	fusion
294	0.44	590.4	3.74	-24.1	small	weld
295	0.73	590.6	1.58	-24.9	small	fusion
296	0.78	590.92	3.56	-24.7	small	fusion
297	0.75	590.96	3.12	-16.5	small	fusion
298	0.27	591.38	2.56	-26.1	small	ROOT
299	0.77	591.72	3.16	-25.6	small	fusion
300	0.75	591.98	3.14	-24.8	small	fusion
301	0.40	592.02	3.74	-25.7	small	weld
302	0.72	592.22	5.26	-15.9	small	fusion
303	0.70	592.28	1.62	-25.8	small	fusion
304	0.72	592.64	4.1	-19.3	small	fusion
305	0.74	592.94	3.9	-25.7	small	fusion
306	0.74	593.16	2.96	-24	small	fusion
307	0.76	593.28	3.18	-20.6	small	fusion
308	0.78	593.78	3	-18.2	small	fusion
309	0.73	593.84	3.5	-20.7	small	fusion
310	0.73	594.2	4.08	-3.4	long	fusion
311	0.75	594.28	3.56	-21.8	small	fusion
312	0.76	593.98	4.76	-27.8	small	fusion
313	0.75	594.62	5.22	-26.7	small	fusion
314	0.72	595.02	2.92	-25.7	small	fusion
315	0.75	595.06	3.36	-26.7	small	fusion
316	0.74	595.46	2.98	-27.8	small	fusion
317	0.72	595.92	4.08	-15.3	long	fusion
318	0.76	596.3	1.44	-26.6	small	fusion
319	0.74	596.44	3.3	-26.7	small	fusion
320	0.69	596.5	3.92	-26.8	small	fusion
321	0.78	596.5	1.14	-14.8	small	fusion
322	0.76	596.66	3	-26.6	small	fusion

Table B.1 (contd)						
#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
323	0.73	596.82	3.34	-22.5	small	fusion
324	0.71	596.84	4.08	-23.2	small	fusion
325	0.71	597.04	3.52	-20.7	small	fusion
326	0.76	597.14	3.72	-23.1	small	fusion
327	0.71	597.18	1.72	-27.9	small	fusion
328	0.73	597.1	0.9	-27.8	small	fusion
329	0.71	597.54	3.1	-21.3	small	fusion
330	0.71	597.76	3.9	-20.2	small	fusion
331	0.75	597.9	3.14	-26.6	small	fusion
332	0.50	597.98	2.3	-26.3	small	ROOT
333	0.68	598.24	1.78	-24.9	small	fusion
334	0.75	598.3	1.48	-20.1	small	fusion
335	0.72	598.32	4.12	-19.2	small	fusion
336	0.72	598.7	3.5	-18.7	small	fusion
337	0.72	598.7	2.92	-23.9	small	fusion
338	0.72	598.84	4.14	-12.7	long	fusion
339	0.74	598.9	4.7	-26.6	small	fusion
340	0.74	598.88	3.74	-26.6	small	fusion
341	0.31	598.94	2.42	-26.8	small	ROOT
342	0.72	599	1.52	-24.7	small	fusion
343	0.37	599.14	3.7	-25.7	small	weld
344	0.69	599.3	3.9	-21.3	small	fusion
345	0.71	599.6	3.52	-21.8	small	fusion
346	0.74	599.72	5.38	-21.1	small	fusion
347	0.69	599.78	3.9	-18.8	small	fusion
348	0.71	599.66	1.72	-25.6	small	fusion
349	0.18	599.96	2.44	-27	small	ROOT
350	0.39	600.1	1.94	-24	small	ROOT
351	0.73	600.16	3.3	-21.7	small	fusion
352	0.80	600.28	5.06	-20.9	small	fusion
353	0.29	600.48	2.5	-25	small	ROOT
354	0.38	600.82	1.92	-26.5	small	ROOT
355	0.73	600.92	4.12	-22.4	small	fusion
356	0.73	601.06	5.3	-23.8	small	fusion
357	0.73	601.02	3.32	-23.1	small	fusion
358	0.75	601.16	3	-27.7	small	fusion
359	0.75	601.78	4.84	-26.5	small	fusion
360	0.35	601.84	3.72	-27.6	small	weld
361	0.74	602	3.94	-24.6	small	fusion
362	0.38	602.04	1.88	-21.5	small	ROOT
363	0.72	602.48	3.52	-23.8	small	fusion
364	0.74	602.52	5.52	-25.5	small	fusion

Table B.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
365	0.72	602.74	5.38	-20.1	small	fusion
366	0.37	602.76	1.88	-25.6	small	ROOT
367	0.76	603.1	3.54	-25.4	small	fusion
368	0.74	603.2	3.12	-26.5	small	fusion
369	0.73	603.64	3.72	-23	small	fusion
370	0.73	604.14	5.4	-24.6	small	fusion
371	0.75	604.66	1.32	-25.4	small	fusion
372	0.72	604.96	5.38	-14.8	small	fusion
373	0.72	605.2	5.32	-21.1	small	fusion
374	0.72	605.32	2.92	-21.7	small	fusion
375	0.71	606.02	5.38	-13.7	small	fusion
376	0.76	605.96	4.14	-22.9	small	fusion
377	0.76	606.16	3	-25.4	small	fusion
378	0.71	607	3.54	-24.6	small	fusion
379	0.75	607.18	1.44	-23.6	small	fusion
380	0.70	607.4	3.1	-23	small	fusion
381	0.73	607.34	4.84	-21	small	fusion
382	0.75	607.64	3.16	-23.6	small	fusion
383	0.24	607.8	3.36	-22.9	small	weld
384	0.74	608.36	4.16	-24.5	small	fusion
385	0.79	609	1.36	-6.4	small	fusion
386	0.72	609.04	1.64	-21.6	small	fusion
387	0.71	609.26	3.12	-27.6	small	fusion
388	0.74	609.3	4.62	-24.5	small	fusion
389	0.71	609.78	4.12	-24.5	small	fusion
390	0.76	609.9	3.36	-27.5	small	fusion
391	0.73	610.36	1.44	-23.6	small	fusion
392	0.71	610.52	2.92	-24.5	small	fusion
393	0.74	611.58	4.9	-20.9	small	fusion
394	0.74	611.52	5.28	-26.3	small	fusion
395	0.74	611.72	3.56	-25.3	small	fusion
396	0.74	612.02	3.58	-23.6	small	fusion
397	0.79	612.22	5.28	-21.3	small	fusion
398	0.72	612.34	4.16	-26.4	small	fusion
399	0.71	612.72	3.52	-20.4	small	fusion
400	0.74	612.76	2.96	-22.1	small	fusion
401	0.73	613.14	3.12	-21.5	small	fusion
402	0.73	613.56	3.34	-24.4	small	fusion
403	0.70	614.18	3.48	-22.9	small	fusion
404	0.73	614.1	1.26	-23.6	small	fusion
405	0.79	614.64	1.18	-21.3	small	fusion
406	0.72	614.94	5.4	-20.9	small	fusion

Table B.1 (contd)						
#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
407	0.74	615.16	3.2	-25.2	small	fusion
408	0.74	615.58	3.92	-22.7	small	fusion
409	0.76	615.98	3.6	-20.7	small	fusion
410	0.71	616.12	1.26	-24.4	small	fusion
411	0.76	616.26	4.2	-21.3	small	fusion
412	0.71	616.8	3.72	-25.3	small	fusion
413	0.73	617.06	5.44	-19.7	small	fusion
414	0.75	617.3	3.38	-24.3	small	fusion
415	0.74	617.9	4	-21.3	small	fusion
416	0.76	618.58	3.22	-26.1	small	fusion
417	0.67	618.48	1.66	-25.4	small	fusion
418	0.76	618.6	3.18	-27.3	small	fusion
419	0.71	619.32	1.62	-24.3	small	fusion
420	0.73	619.96	3.58	-21.3	small	fusion
421	0.73	620.06	4.2	-22	small	fusion
422	0.73	620.34	5.44	-19.6	small	fusion
423	0.68	620.34	1.68	-24.4	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

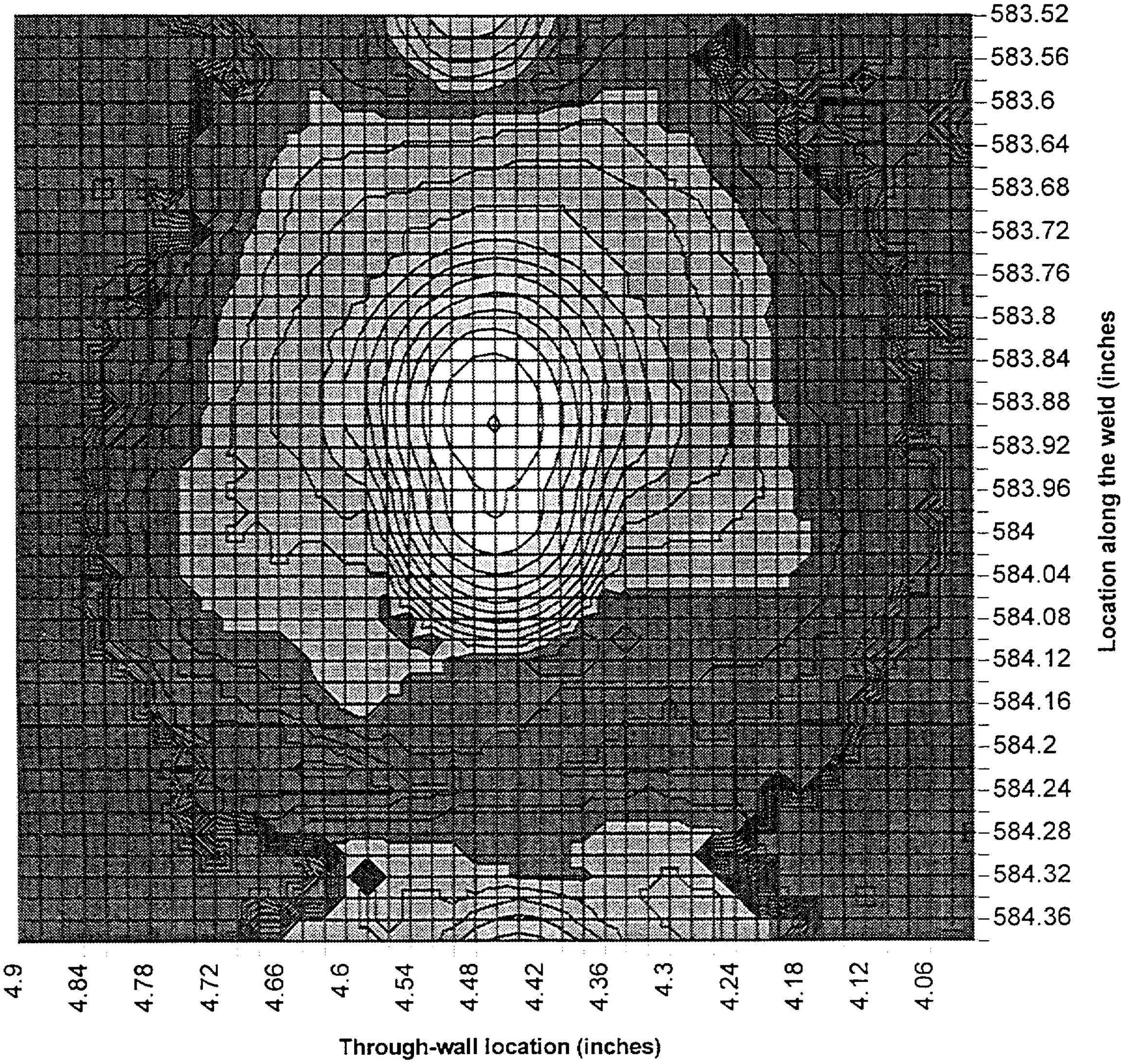

Figure B.1 **Log-scale contour plot of indication #16 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.76 inches above (positive angle) 30.0 degrees of vessel azimuth.**

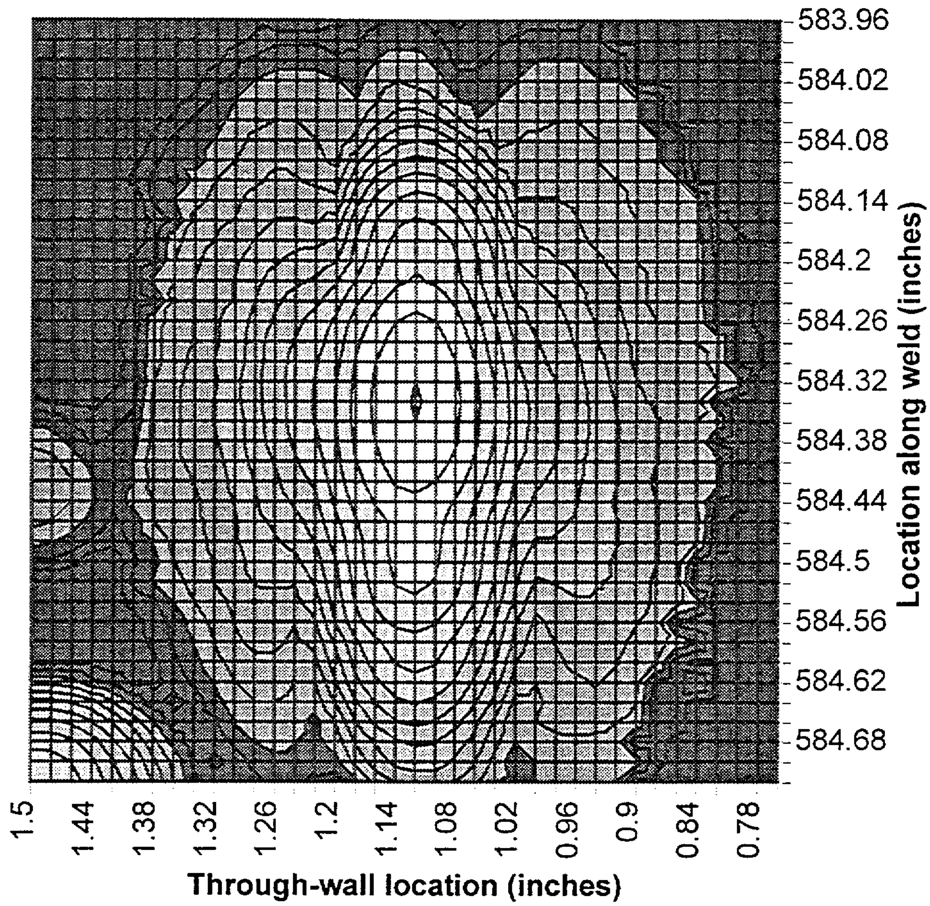

Figure B.2 **Log-scale contour plot of indication #17 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -3.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located in on the fusion surface at 0.72 inches above (positive angle) 30.0 degrees of vessel azimuth.**

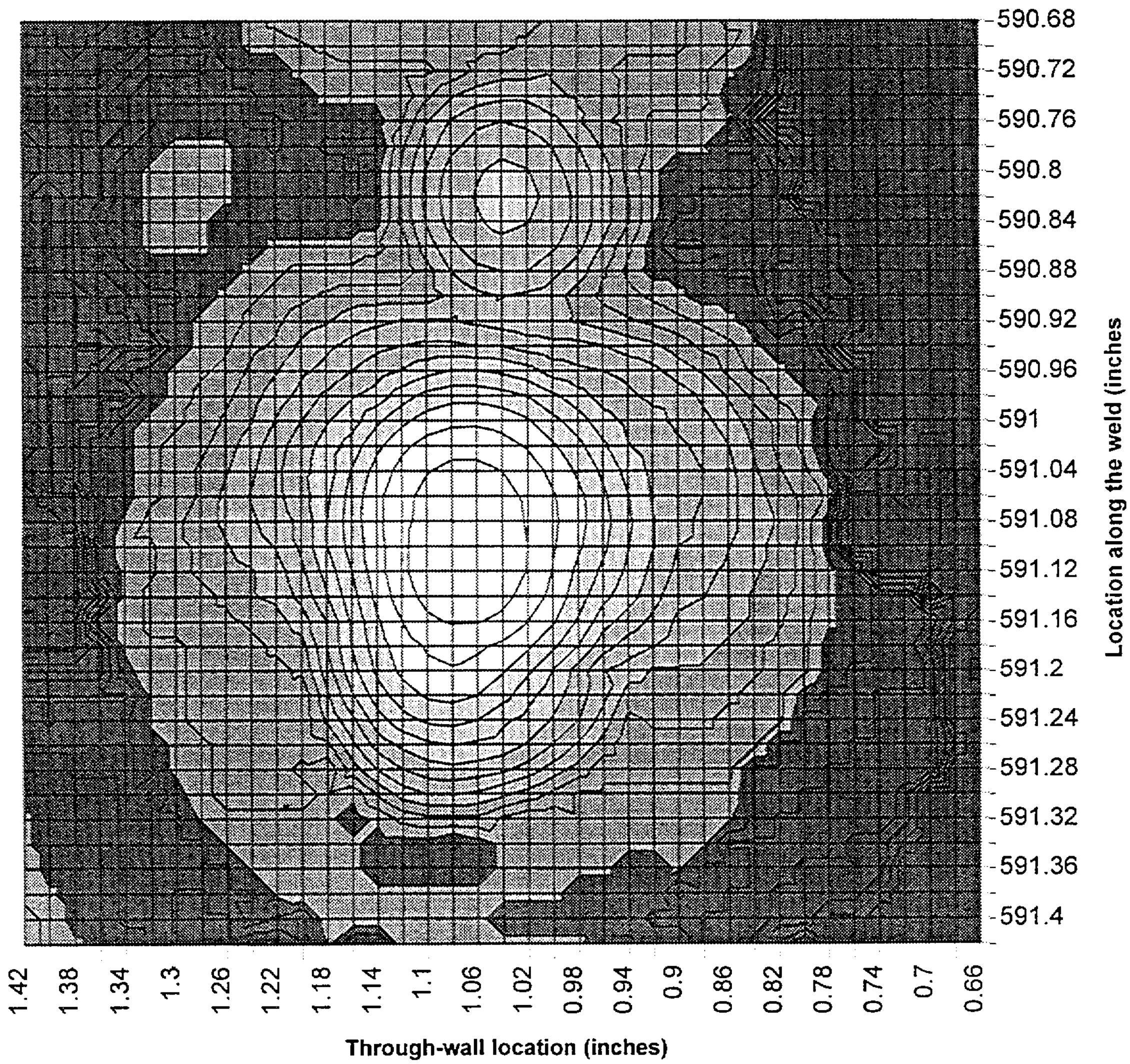

Figure B.3 **Log-scale contour plot of indication #73 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.72 inches above (positive angle) 30.0 degrees of vessel azimuth.**

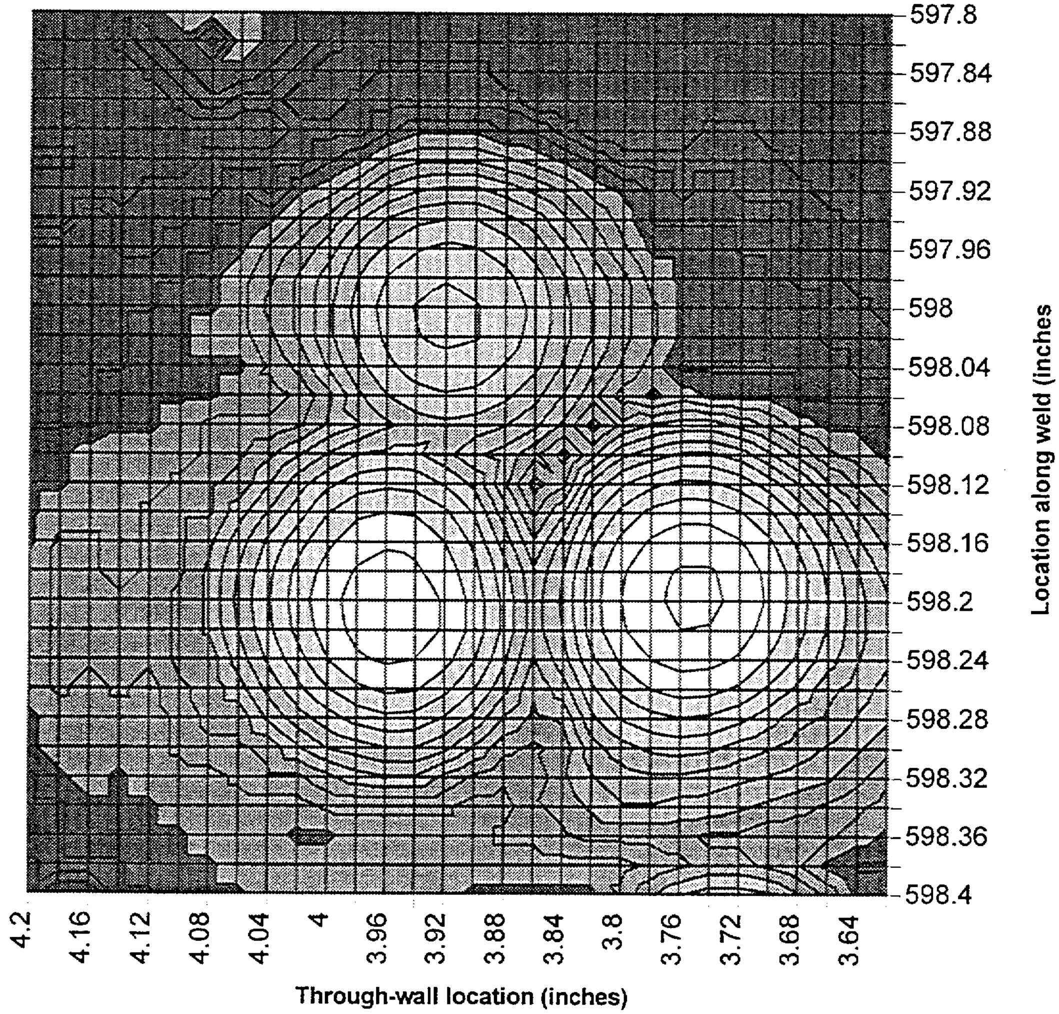

Figure B.4 **Log-scale contour plot of indication #123 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -10.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 9 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as simple cluster, is located in on the fusion surface at 0.79 inches above (positive angle) 30.0 degrees of vessel azimuth.**

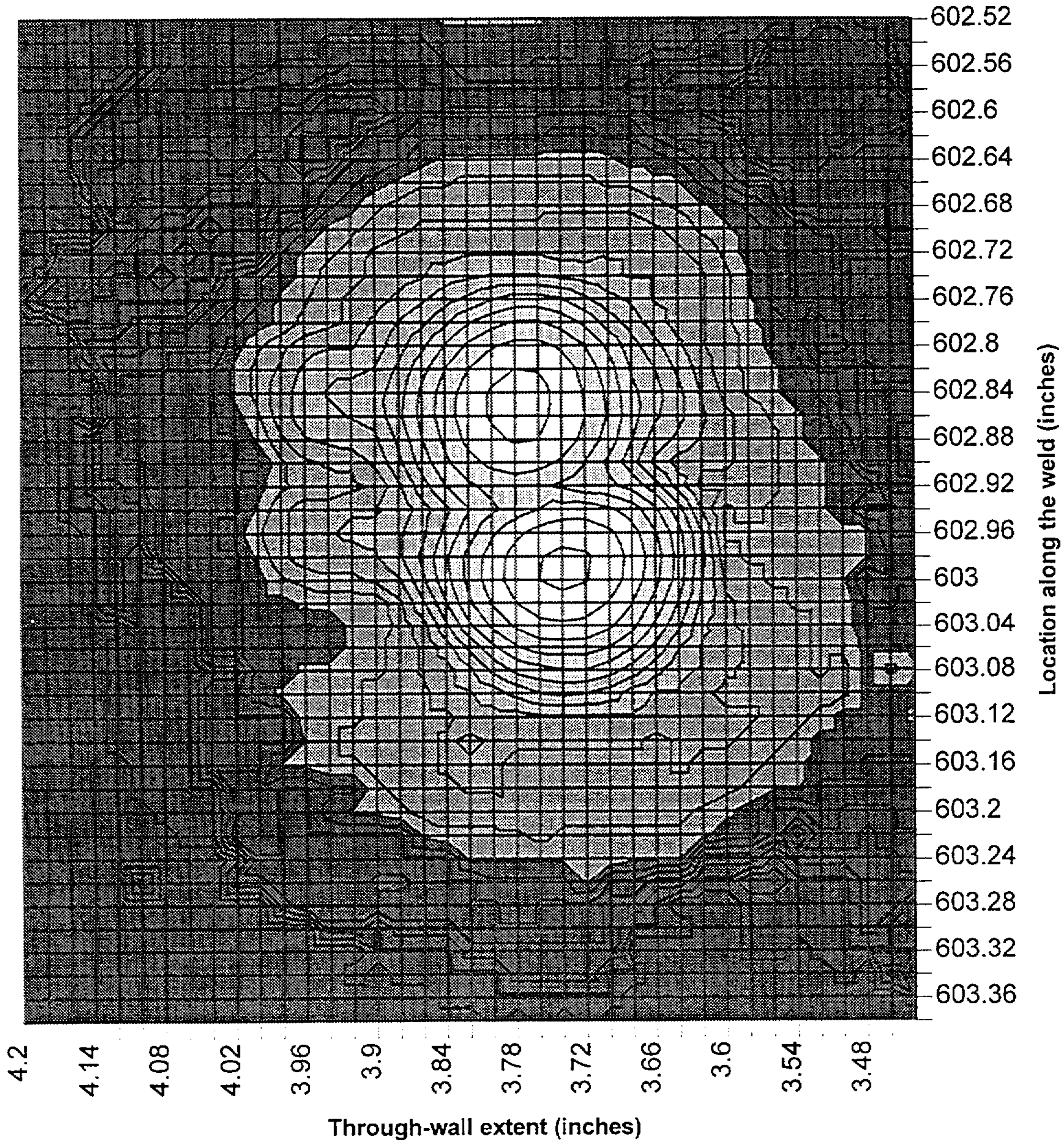

Figure B.5 Log-scale contour plot of indication #158 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.76 inches above (positive angle) 30.0 degrees of vessel azimuth.

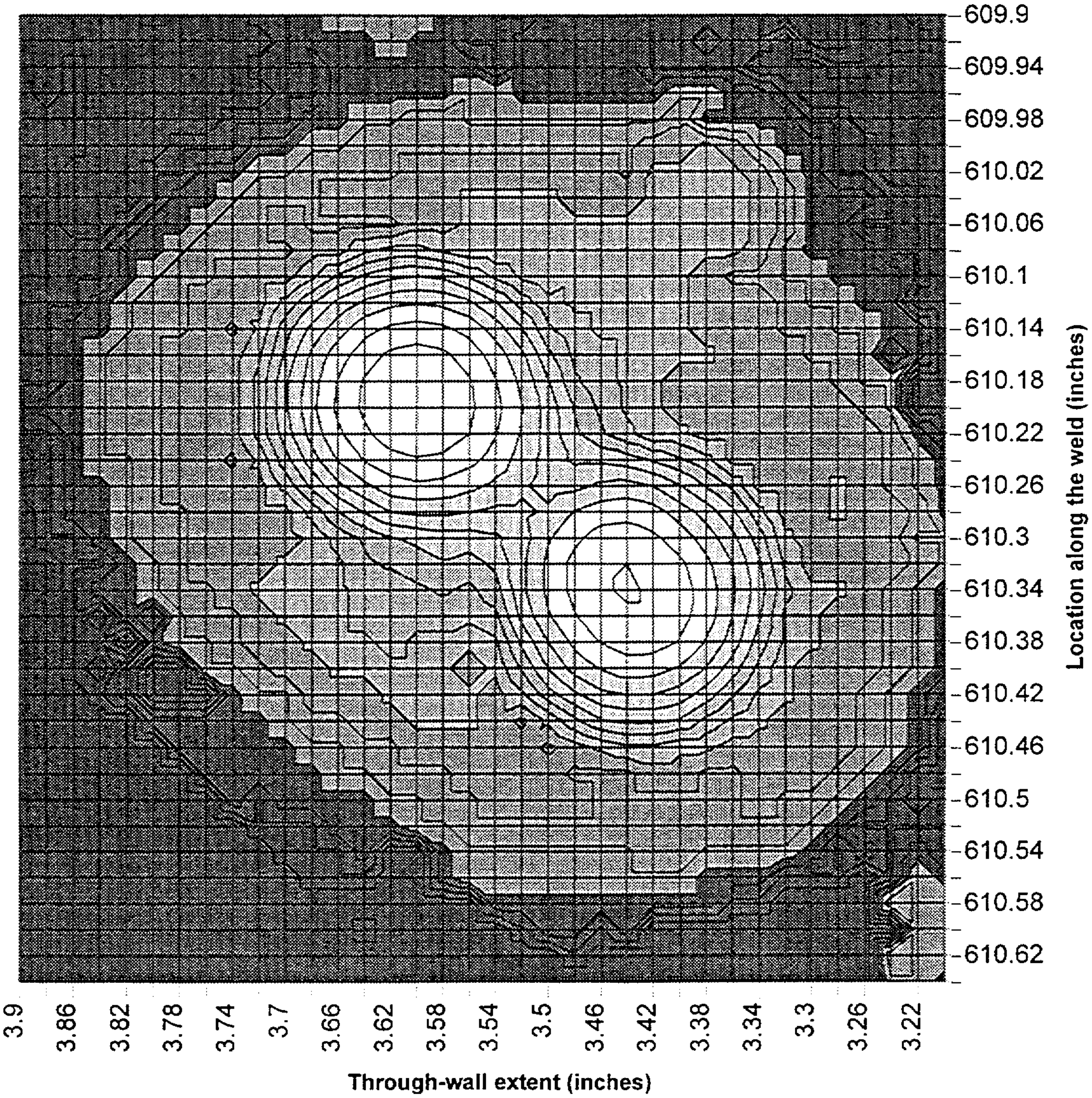

Figure B.6 Log-scale contour plot of indication #197 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -13.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 8 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as simple cluster, is located in on the fusion surface at 0.79 inches above (positive angle) 30.0 degrees of vessel azimuth.

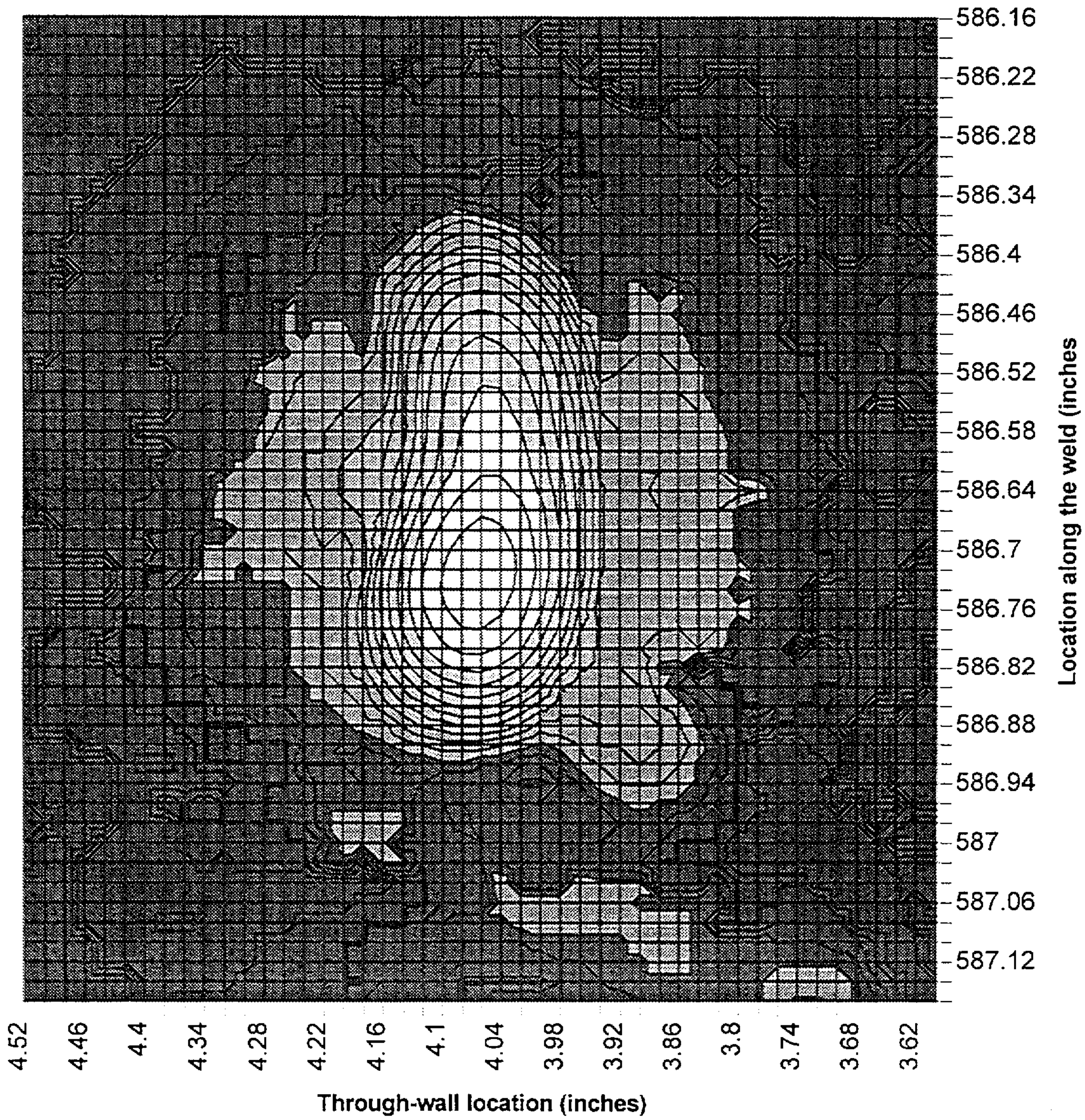

Figure B.7 **Log-scale contour plot of indication #274 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 14 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.74 inches below (negative angle) 30.0 degrees of vessel azimuth.**

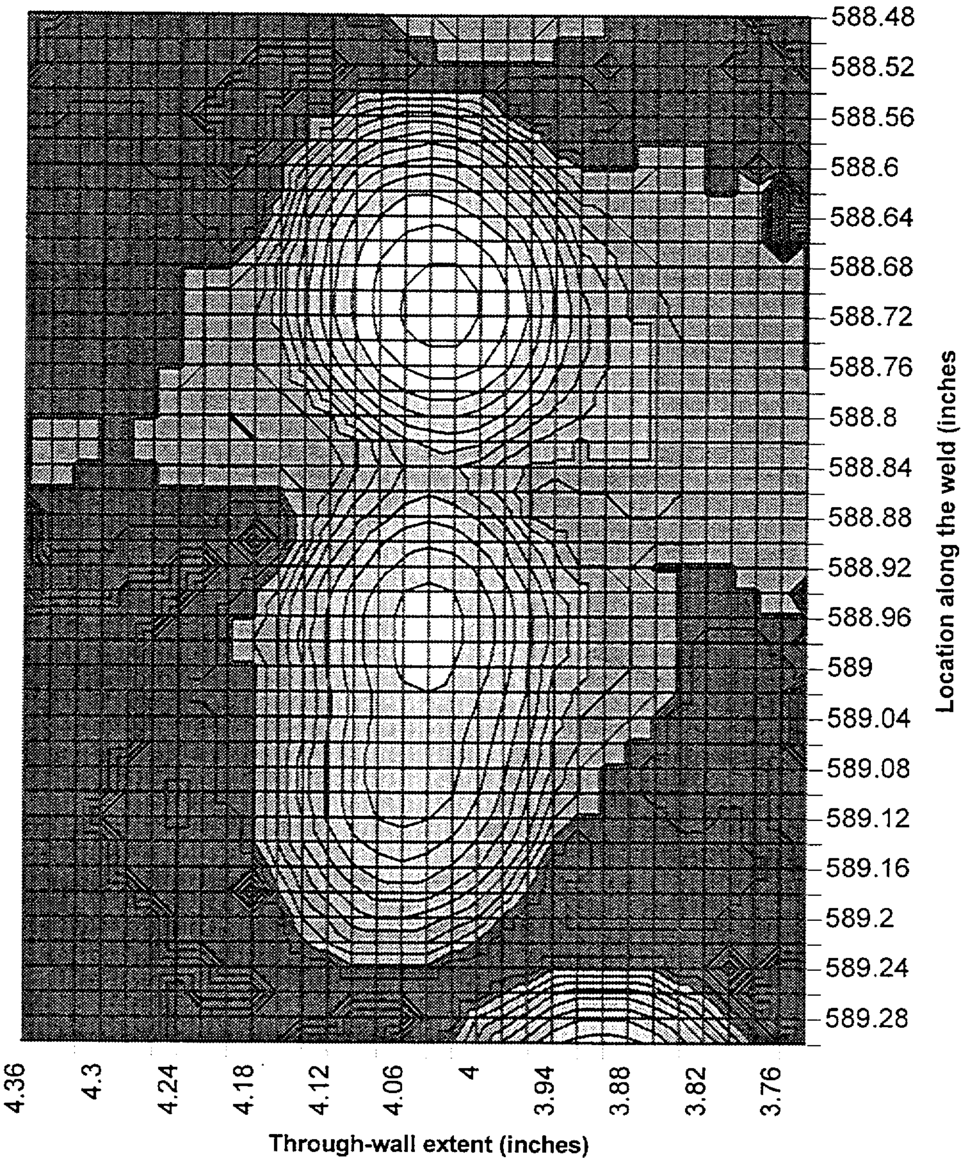

Figure B.8 **Log-scale contour plot of indication #286 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 22 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.72 inches below (negative angle) 30.0 degrees of vessel azimuth.**

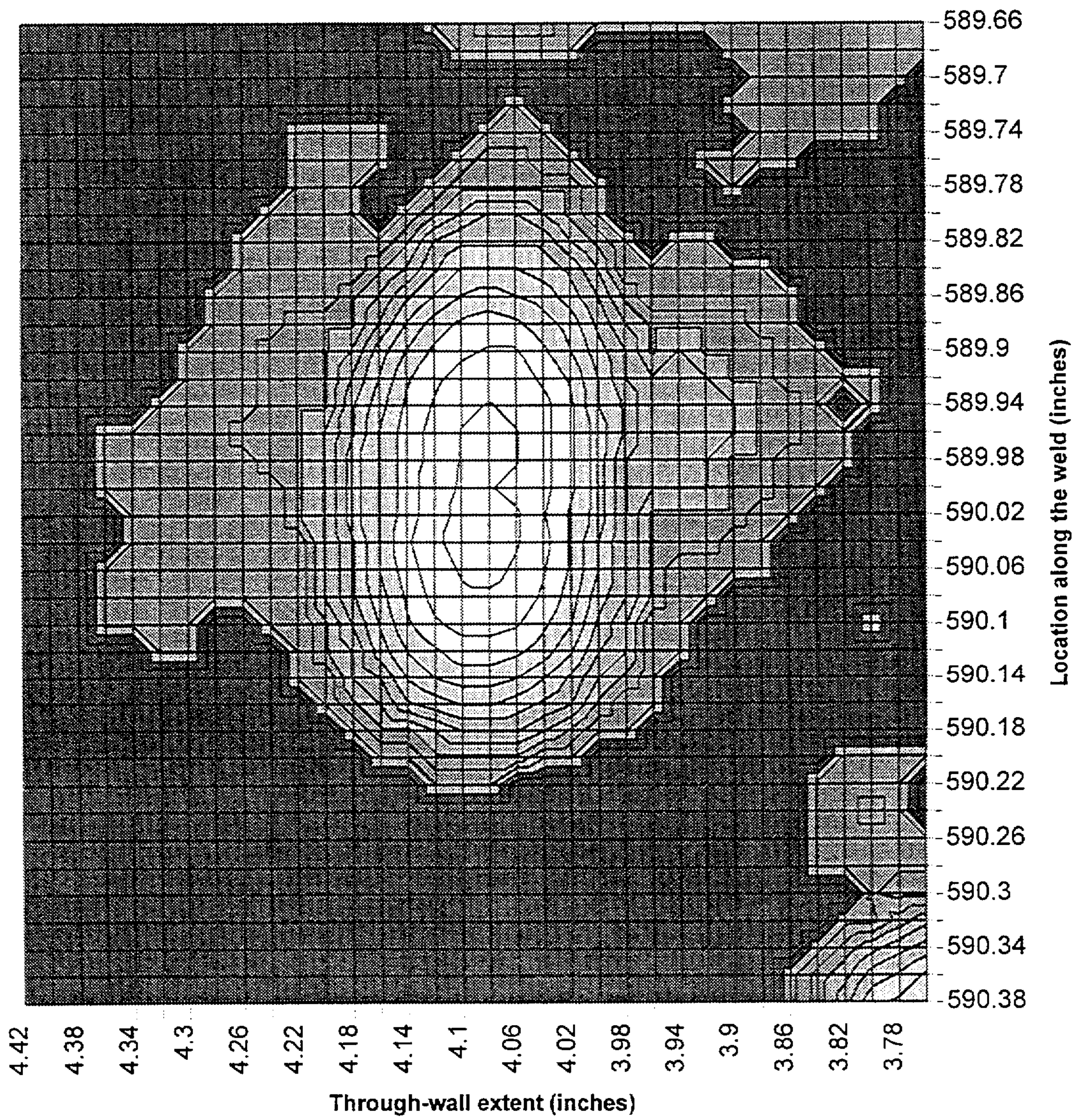

Figure B.9 Log-scale contour plot of indication #293 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -18.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.71 inches below (negative angle) 30.0 degrees of vessel azimuth.

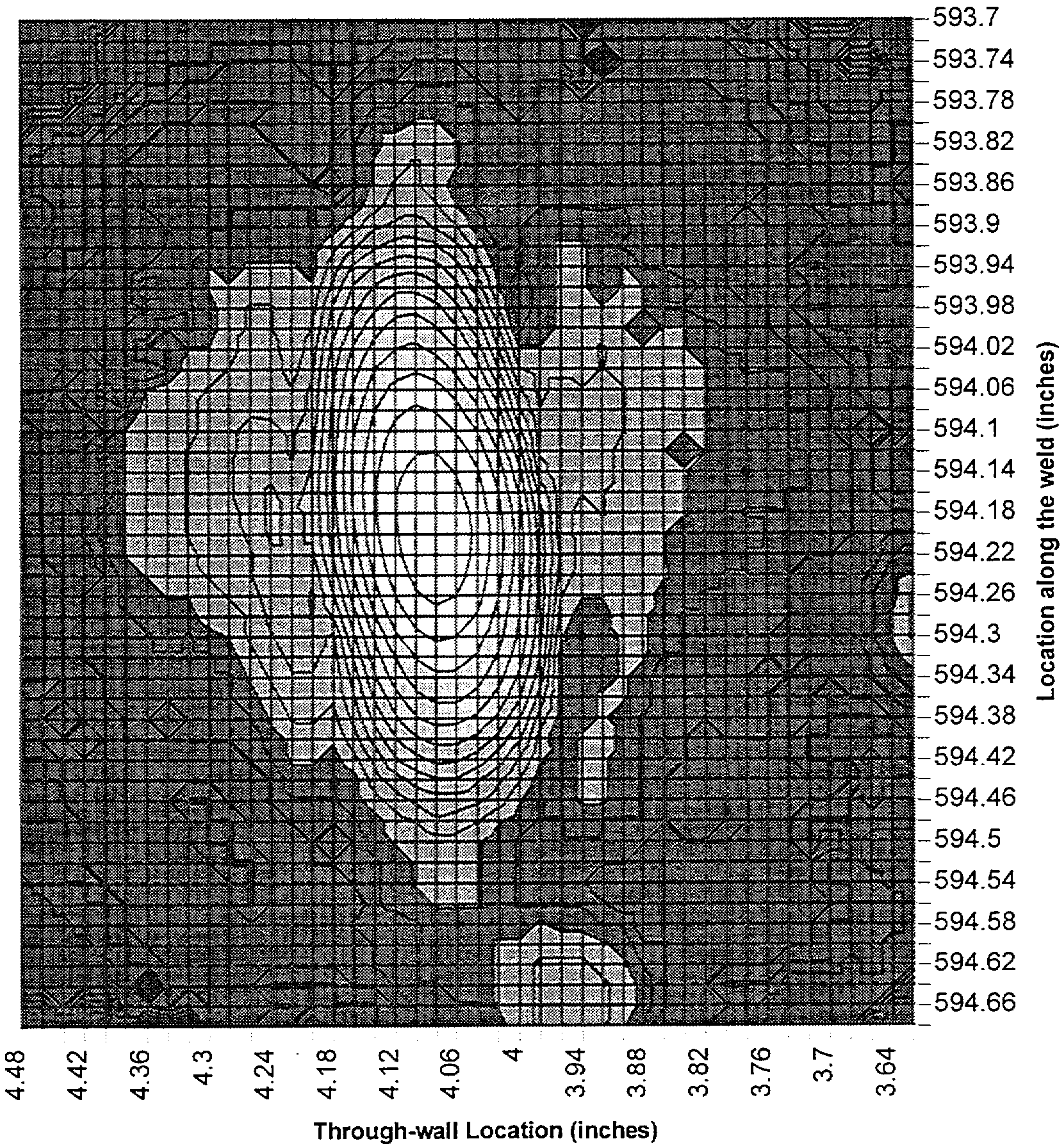

Figure B.10 Log-scale contour plot of indication #310 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -3.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.73 inches below (negative angle) 30.0 degrees of vessel azimuth.

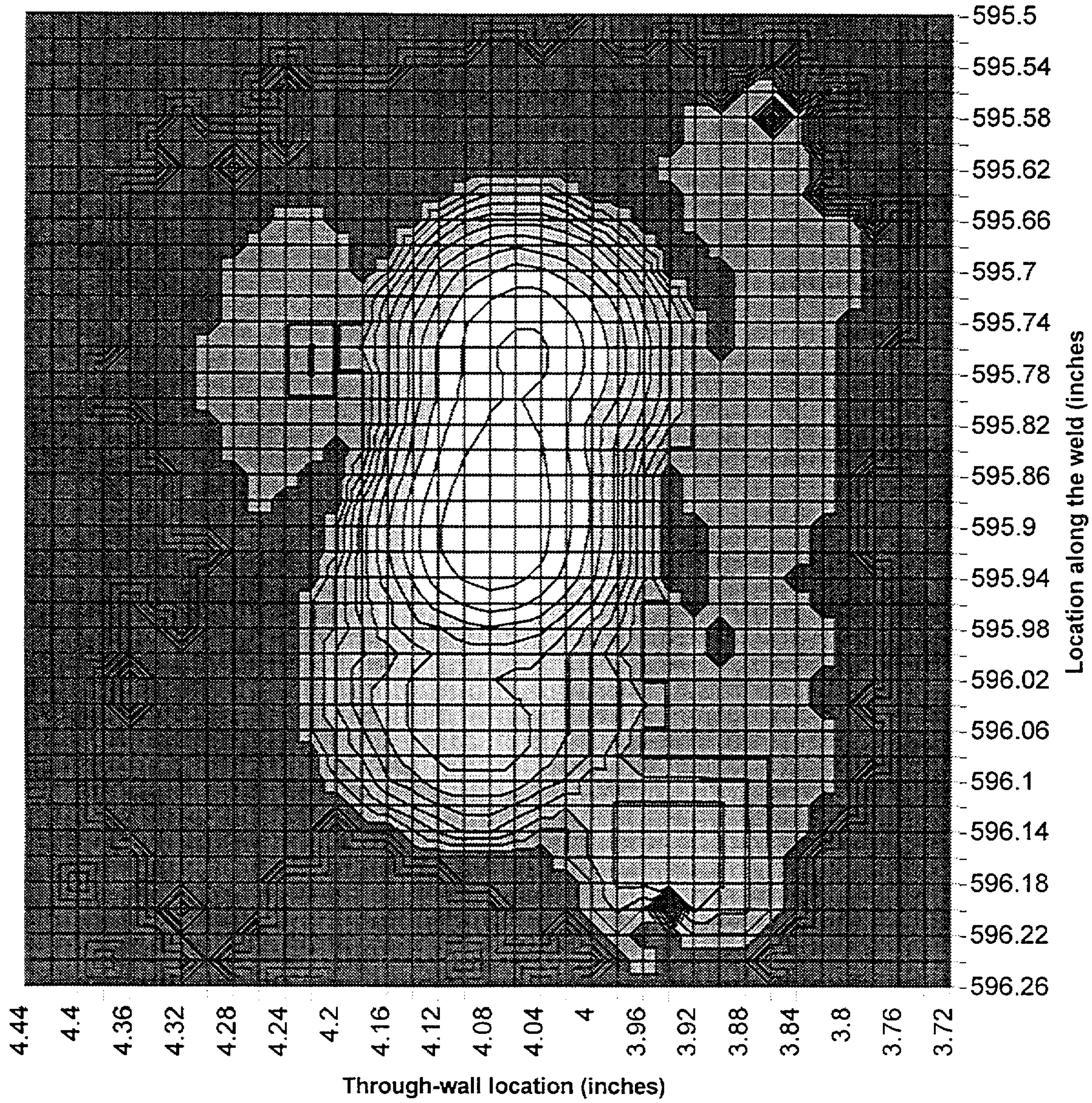

Figure B.11 **Log-scale contour plot of indication #317 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.72 inches below (negative angle) 30.0 degrees of vessel azimuth.**

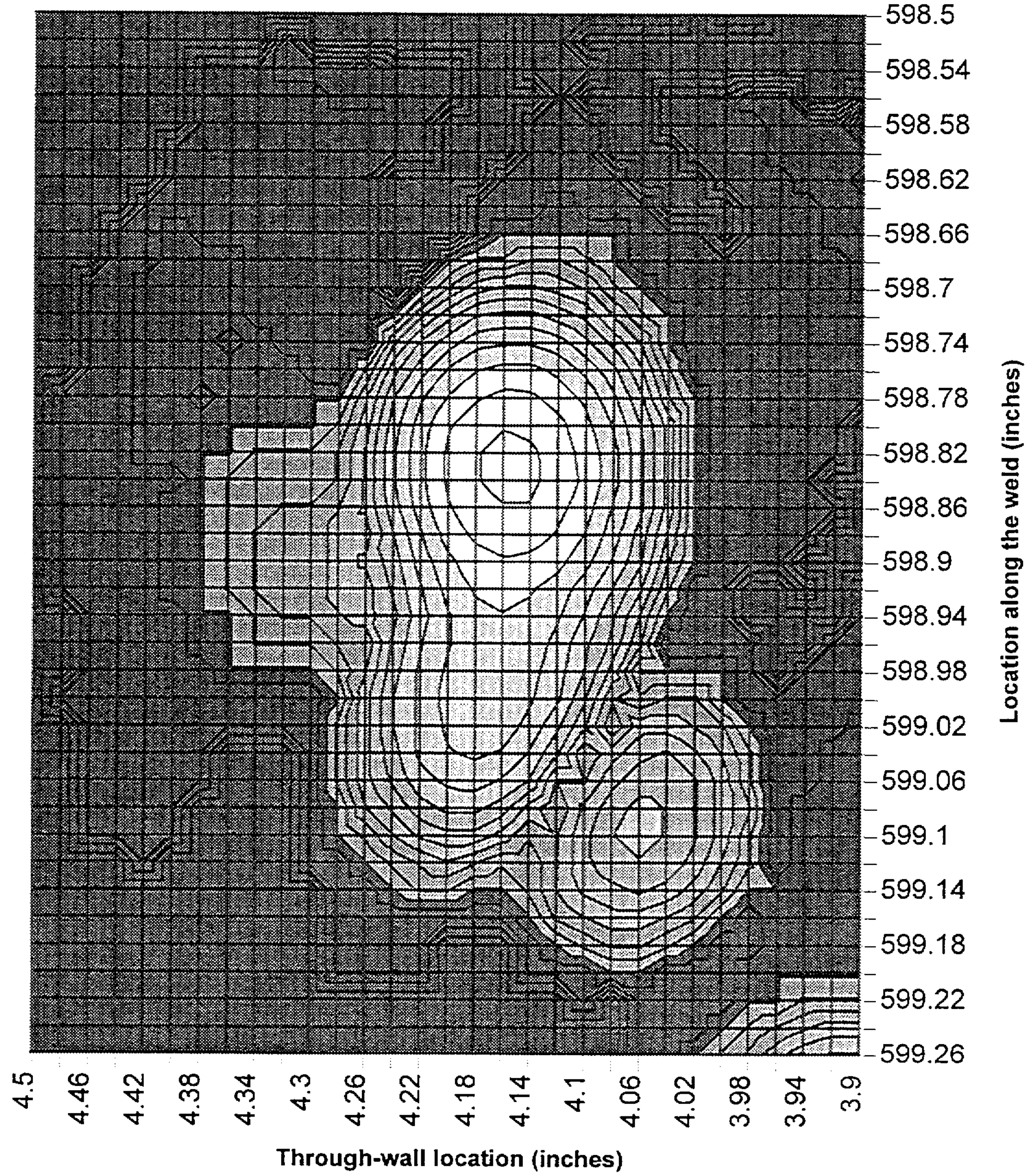

Figure B.12 **Log-scale contour plot of indication #338 in Shoreham specimen B0C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.72 inches below (negative angle) 30.0 degrees of vessel azimuth.**

Appendix C

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen B180B-2

Table C.1 lists all detectable flaw indications in Shoreham specimen B180B-2. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen B180B-2 is given in Section 2. Only small indications were recorded in the specimen.

Table C.1 List of all indications for Shoreham specimen B180B-2

	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.74	629.68	4.94	-22.4	small	fusion
2	-0.65	629.98	1.44	-20.6	small	fusion
3	-0.68	631.14	2.58	-21.5	small	fusion
4	-0.68	631.24	1.40	-16.4	small	fusion
5	-0.70	631.50	1.40	-16.9	small	fusion
6	-0.68	631.94	1.48	-23.4	small	fusion
7	-0.73	632.70	5.84	-11.6	small	fusion
8	-0.73	634.12	5.84	-13.9	small	fusion
9	-0.75	633.98	3.40	-21.5	small	fusion
10	-1.12	633.52	0.12	-22.4	small	clad
11	-0.68	634.24	1.42	-19.9	small	fusion
12	-0.76	635.94	5.00	-11.4	small	fusion
13	-0.74	636.86	5.84	-6.0	small	fusion
14	-0.71	637.66	1.34	-15.4	small	fusion
15	-0.67	639.48	1.56	-19.2	small	fusion
16	-0.76	640.14	5.78	-18.5	small	fusion
17	-0.72	641.30	5.30	-11.4	small	fusion
18	-0.72	641.72	5.48	-12.8	small	fusion
19	-0.73	645.16	5.36	-16.4	small	fusion
20	-0.73	647.22	3.68	-18.5	small	fusion
21	-0.73	647.20	1.06	-17.9	small	fusion
22	-0.76	648.24	5.58	-19.9	small	fusion
23	-0.74	648.64	5.82	-17.9	small	fusion
24	-0.69	648.76	1.04	-17.9	small	fusion
25	-0.71	649.64	5.02	-19.2	small	fusion
26	-0.81	649.98	4.68	-14.2	small	fusion
27	-0.77	653.16	4.86	-15.4	small	fusion

Table C.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.74	653.30	4.06	-19.9	small	fusion
29	-0.75	653.82	5.66	-11.9	small	fusion
30	-0.75	655.16	5.50	-19.9	small	fusion
31	-0.73	655.96	5.82	-19.2	small	fusion
32	-0.75	656.86	5.82	-16.9	small	fusion
33	-0.75	657.26	3.48	-19.2	small	fusion
34	-0.73	658.06	5.34	-17.9	small	fusion
35	-0.75	658.50	4.98	-16.4	small	fusion
36	-0.76	659.12	5.16	-12.5	small	fusion
37	-0.76	659.52	5.46	-19.2	small	fusion
38	-0.76	659.94	5.84	-15.0	small	fusion
39	-0.74	660.44	5.82	-16.4	small	fusion
40	-0.71	661.56	1.12	-15.9	small	fusion
41	-0.76	662.74	4.88	-15.4	small	fusion
42	-0.74	664.14	4.76	-12.5	small	fusion
43	0.74	625.32	1.30	-18.0	small	fusion
44	0.71	626.54	5.40	-18.9	small	fusion
45	0.71	627.58	5.50	-16.6	small	fusion
46	0.69	627.70	4.12	-20.9	small	fusion
47	0.75	630.02	3.82	-17.9	small	fusion
48	0.70	631.50	5.36	-18.1	small	fusion
49	0.70	633.58	4.58	-20.8	small	fusion
50	0.70	634.24	5.52	-22.0	small	fusion
51	0.69	635.36	3.38	-22.0	small	fusion
52	0.75	639.74	4.04	-15.2	small	fusion
53	0.72	646.58	5.38	-16.5	small	fusion
54	0.70	653.90	5.82	-11.2	small	fusion
55	0.76	660.72	5.34	-20.5	small	fusion
56	0.76	662.52	4.00	-19.5	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for Azimuth less than 150 degrees.

Appendix D

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen B180C-2

Table D.1 lists all detectable flaw indications in Shoreham specimen B180C-2. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen B180C-2 is given in Section 2. Figures D.1 through D.4 show the images of the larger indications in the specimen.

Table D.1 List of all indications for Shoreham specimen B180C-2

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.72	582.30	0.80	-21.9	small	fusion
2	-0.70	582.62	1.34	-12.8	small	fusion
3	-0.70	582.82	1.08	-13.7	small	fusion
4	-0.68	582.98	1.34	-18.2	small	fusion
5	-0.72	583.16	1.00	-20.6	small	fusion
6	-0.72	583.32	5.26	-22.9	small	fusion
7	-0.65	584.46	0.30	-18.2	small	fusion
8	-0.67	584.64	0.86	-19.2	small	fusion
9	-0.69	585.50	1.34	-12.1	small	fusion
10	-0.76	585.52	3.30	-25.2	small	fusion
11	-0.72	585.92	1.32	-15.4	small	fusion
12	-0.67	586.54	1.52	-25.9	small	fusion
13	-0.71	586.98	1.30	-6.4	small	fusion
14	-0.67	587.00	1.54	-20.6	small	fusion
15	-0.71	588.06	0.38	-22.4	small	fusion
16	-0.66	588.30	1.56	-19.9	small	fusion
17	-0.69	588.34	1.08	-20.2	small	fusion
18	-0.71	588.42	0.84	-15.9	small	fusion
19	-0.66	588.50	3.12	-25.9	small	fusion
20	-0.78	588.62	4.94	-22.9	small	fusion
21	-0.69	588.64	1.40	-21.0	small	fusion
22	-0.71	589.02	1.34	-10.1	long	fusion
23	-0.78	589.10	5.16	-23.4	small	fusion
24	-0.78	589.58	4.94	-23.4	small	fusion
25	-0.71	589.94	1.34	-22.9	small	fusion
26	-0.75	589.98	5.74	-21.5	small	fusion
27	-0.71	590.06	0.40	-24.0	small	fusion

Table D.1 (contd)							
#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.73	590.18	1.28	-22.9	small	fusion
29	-0.77	590.36	5.34	-20.2	small	fusion
30	-0.66	590.70	1.42	-19.9	small	fusion
31	-0.73	591.08	3.04	-19.5	small	fusion
32	-0.70	591.22	2.66	-25.2	small	fusion
33	-0.77	591.44	4.94	-21.5	small	fusion
34	-0.73	591.60	1.34	-15.0	long	fusion
35	-0.75	591.76	5.74	-19.9	small	fusion
36	-0.70	591.90	2.66	-21.0	small	fusion
37	-0.77	592.06	4.88	-16.6	small	fusion
38	-0.68	592.02	1.42	-15.4	small	fusion
39	-0.66	592.32	1.40	-22.9	small	fusion
40	-0.70	592.34	1.04	-19.5	small	fusion
41	-0.72	592.44	0.60	-24.6	small	fusion
42	-0.72	592.56	1.32	-19.9	small	fusion
43	-0.59	592.74	1.24	-23.4	small	weld
44	-0.70	592.78	0.98	-15.0	small	fusion
45	-0.70	593.06	1.06	-16.9	small	fusion
46	-1.32	594.14	1.68	-999.0	small	base
47	-0.74	594.14	1.06	-18.5	small	fusion
48	-0.72	594.54	1.34	-21.0	small	fusion
49	-0.63	594.58	3.86	-25.2	small	fusion
50	-0.74	594.48	5.40	-17.9	small	fusion
51	-0.74	594.82	3.04	-24.0	small	fusion
52	-0.77	594.96	4.94	-22.4	small	fusion
53	-0.70	594.96	0.26	-22.4	small	clad
54	-0.76	595.64	3.44	-15.2	small	fusion
55	-0.69	595.68	0.98	-16.9	small	fusion
56	-0.69	596.20	3.92	-25.2	small	fusion
57	-0.76	596.48	5.66	-22.9	small	fusion
58	-0.69	596.54	0.94	-21.0	small	fusion
59	-0.69	596.68	1.34	-16.6	small	fusion
60	-0.67	597.40	2.58	-27.5	small	fusion
61	-0.67	597.66	1.34	-21.5	small	fusion
62	-0.71	598.22	1.34	-21.5	small	fusion
63	-0.71	598.46	1.30	-19.9	small	fusion
64	-0.71	598.48	0.90	-10.7	small	fusion
65	-0.73	598.62	3.92	-21.9	small	fusion
66	-1.29	599.10	0.14	-23.4	small	clad
67	-0.59	599.56	1.68	-24.6	small	ROOT
68	-0.71	599.82	0.38	-25.9	small	fusion
69	-1.31	600.60	3.04	-26.7	small	base
70	-0.64	601.18	1.66	-25.9	small	fusion

Table D.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	-0.68	601.40	2.56	-22.4	small	fusion
72	-0.80	601.50	4.42	-16.6	small	fusion
73	-0.73	602.36	0.90	-16.9	small	fusion
74	-0.70	602.50	1.14	-18.5	small	fusion
75	-0.70	602.84	0.22	-23.4	small	clad
76	-0.68	603.00	1.38	-21.9	small	fusion
77	-0.77	603.58	4.18	-16.6	small	fusion
78	-0.68	604.02	2.70	-24.0	small	fusion
79	-0.70	604.26	0.96	-21.0	small	fusion
80	-0.70	604.36	0.82	-24.6	small	fusion
81	-0.72	604.64	1.38	-23.4	small	fusion
82	-0.72	604.64	4.10	-23.4	small	fusion
83	-0.74	604.72	4.82	-22.4	small	fusion
84	-0.76	606.20	4.90	-7.5	small	fusion
85	-0.99	606.18	2.86	-25.2	small	base
86	-0.63	606.14	1.62	-25.9	small	fusion
87	-0.72	606.22	1.38	-15.9	small	fusion
88	-0.69	606.52	1.34	-17.9	small	fusion
89	-0.74	606.90	1.30	-25.9	small	fusion
90	-0.62	606.98	3.26	-25.9	small	fusion
91	-0.74	607.28	5.38	-25.2	small	fusion
92	-0.78	607.50	4.52	-21.9	small	fusion
93	-0.74	607.58	1.30	-24.0	small	fusion
94	-0.60	607.98	1.74	-21.0	small	ROOT
95	-0.71	608.12	3.64	-24.6	small	fusion
96	-0.62	608.18	1.22	-26.7	small	fusion
97	-0.71	608.40	1.32	-22.4	small	fusion
98	-0.76	608.74	3.44	-14.8	small	fusion
99	-0.64	608.72	1.56	-21.0	small	fusion
100	-0.69	608.98	0.40	-25.2	small	fusion
101	-0.69	609.06	5.20	-26.7	small	fusion
102	-0.76	609.42	5.28	-13.5	small	fusion
103	-0.73	609.20	5.04	-22.4	small	fusion
104	-0.69	609.34	1.36	-22.4	small	fusion
105	-0.67	609.56	1.34	-24.6	small	fusion
106	-0.66	610.48	1.14	-17.1	small	fusion
107	-0.64	610.44	1.52	-25.2	small	fusion
108	-0.66	610.76	2.92	-22.9	small	fusion
109	-0.71	611.02	1.10	-21.9	small	fusion
110	-0.64	611.38	1.38	-23.4	small	fusion
111	-0.71	611.60	1.34	-18.5	small	fusion
112	-0.71	612.24	2.60	-21.9	small	fusion

Table D.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	-0.68	612.36	0.76	-10.0	cluster	fusion
114	-0.73	612.34	5.80	-24.0	small	fusion
115	-0.75	612.78	4.84	-27.5	small	fusion
116	-0.73	612.80	1.24	-21.9	small	fusion
117	-0.70	613.30	0.92	-24.0	small	fusion
118	-0.72	614.00	3.92	-19.5	small	fusion
119	-0.70	614.56	0.94	-21.0	small	fusion
120	-0.70	614.80	0.92	-11.2	cluster	fusion
121	-0.77	614.58	4.74	-25.9	small	fusion
122	-0.72	614.72	4.90	-21.9	small	fusion
123	-0.63	614.78	3.46	-26.7	small	fusion
124	-0.68	615.10	2.72	-26.7	small	fusion
125	-0.63	615.26	1.56	-22.4	small	fusion
126	-0.72	615.44	3.56	-16.6	small	fusion
127	-0.70	615.48	3.12	-24.0	small	fusion
128	-0.74	615.42	1.10	-24.0	small	fusion
129	-0.70	615.76	1.32	-10.2	small	fusion
130	-0.74	616.74	4.94	-24.6	small	fusion
131	-0.72	616.76	2.96	-27.5	small	fusion
132	-0.70	616.80	1.34	-23.4	small	fusion
133	-0.65	617.16	1.36	-21.9	small	fusion
134	-0.69	617.12	0.96	-23.4	small	fusion
135	-0.76	617.62	3.94	-16.1	small	fusion
136	-0.65	617.72	1.36	-24.0	small	fusion
137	-0.67	618.24	1.52	-24.6	small	fusion
138	-0.67	618.38	2.52	-16.6	small	fusion
139	-0.83	618.30	4.54	-18.2	small	fusion
140	-0.71	619.62	0.96	-11.6	small	fusion
141	-0.71	619.82	1.10	-20.6	small	fusion
142	-0.67	619.98	2.74	-20.6	small	fusion
143	-0.67	619.60	3.82	-25.2	small	fusion
144	-0.66	621.12	1.34	-20.6	small	fusion
145	-0.71	621.68	1.34	-7.8	small	fusion
146	0.75	582.34	0.90	-18.6	small	fusion
147	0.73	582.78	4.00	-23.1	small	fusion
148	0.73	583.54	4.14	-24.7	small	fusion
149	0.71	583.76	4.66	-17.9	small	fusion
150	0.71	584.16	2.86	-24.8	small	fusion
151	0.75	584.18	1.16	-23.8	small	fusion
152	0.73	584.88	5.12	-24.7	small	fusion
153	0.71	586.04	4.00	-20.2	small	fusion
154	0.69	586.00	2.84	-18.4	small	fusion

Table D.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	0.71	586.60	3.98	-23.9	small	fusion
156	0.67	586.60	1.62	-26.8	small	fusion
157	0.74	587.26	2.54	-20.6	small	fusion
158	0.76	587.36	1.28	-26.6	small	fusion
159	0.74	587.34	4.20	-27.8	small	fusion
160	0.69	587.84	2.44	-23.2	small	fusion
161	0.69	588.14	2.48	-25.7	small	fusion
162	0.72	588.30	2.52	-20.2	small	fusion
163	0.72	588.54	2.52	-25.7	small	fusion
164	0.72	589.14	2.58	-26.7	small	fusion
165	0.72	589.16	1.40	-27.9	small	fusion
166	0.70	589.36	2.46	-25.7	small	fusion
167	0.72	589.56	3.30	-22.5	small	fusion
168	0.72	589.62	1.32	-26.7	small	fusion
169	0.74	589.94	2.64	-27.8	small	fusion
170	0.70	590.34	5.44	-24.8	small	fusion
171	0.74	590.36	2.92	-27.8	small	fusion
172	0.67	590.52	1.56	-26.8	small	fusion
173	0.68	590.88	4.12	-24.1	small	fusion
174	0.72	591.42	4.64	-24.8	small	fusion
175	0.75	591.64	1.32	-25.6	small	fusion
176	0.70	591.98	2.46	-26.8	small	fusion
177	0.65	592.12	4.36	-25.9	small	fusion
178	0.70	592.12	4.66	-19.7	small	fusion
179	0.75	592.70	1.12	-27.8	small	fusion
180	0.73	593.32	1.28	-27.9	small	fusion
181	0.68	593.50	4.12	-24.1	small	fusion
182	0.73	594.34	2.70	-21.2	small	fusion
183	0.68	594.40	4.26	-20.8	small	fusion
184	0.75	594.70	1.06	-25.6	small	fusion
185	0.55	594.90	1.68	-27.2	small	ROOT
186	0.71	595.54	4.26	-26.8	small	fusion
187	0.75	595.68	1.24	-27.8	small	fusion
188	0.71	595.92	4.92	-27.9	small	fusion
189	0.71	596.12	5.12	-27.9	small	fusion
190	0.67	597.44	5.24	-23.4	small	fusion
191	0.74	597.42	3.98	-27.9	small	fusion
192	0.74	597.78	1.14	-23.2	small	fusion
193	0.71	598.06	1.16	-20.2	small	fusion
194	0.69	598.10	5.28	-20.8	small	fusion
195	0.71	598.26	5.52	-21.3	small	fusion
196	0.69	598.54	1.32	-25.8	small	fusion

Table D.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
197	0.72	599.32	5.30	-17.2	small	fusion
198	0.72	601.66	0.54	-24.0	small	fusion
199	0.70	602.62	4.10	-26.8	small	fusion
200	0.72	602.90	5.34	-24.8	small	fusion
201	0.68	602.92	1.40	-24.1	small	fusion
202	0.68	603.62	5.80	-25.9	small	fusion
203	0.73	604.30	4.14	-24.8	small	fusion
204	0.71	605.18	4.32	-24.9	small	fusion
205	0.68	605.58	4.58	-25.0	small	fusion
206	0.73	605.68	2.80	-24.8	small	fusion
207	0.75	605.80	0.52	-25.7	small	fusion
208	0.71	605.96	1.36	-23.3	small	fusion
209	0.73	606.32	1.26	-25.7	small	fusion
210	0.73	607.62	3.56	-23.2	small	fusion
211	0.73	607.74	4.16	-25.7	small	fusion
212	0.69	607.76	5.28	-25.9	small	fusion
213	0.71	608.04	3.56	-24.9	small	fusion
214	0.76	608.56	0.94	-22.5	small	fusion
215	0.71	608.74	4.14	-15.1	small	fusion
216	0.69	609.26	3.38	-24.1	small	fusion
217	0.76	610.40	1.08	-15.8	small	fusion
218	0.72	610.26	4.26	-24.9	small	fusion
219	0.72	610.50	4.16	-9.3	small	fusion
220	0.67	610.92	3.36	-25.0	small	fusion
221	0.72	611.06	4.12	-24.9	small	fusion
222	0.28	611.60	2.20	-18.8	small	ROOT
223	0.74	611.56	1.30	-21.3	small	fusion
224	0.72	611.68	4.92	-24.9	small	fusion
225	0.72	612.14	4.14	-13.5	small	fusion
226	0.68	613.10	1.32	-24.2	small	fusion
227	0.68	613.60	5.42	-20.4	small	fusion
228	0.72	614.10	1.30	-22.0	small	fusion
229	0.75	614.84	2.80	-25.7	small	fusion
230	0.70	615.34	2.78	-23.4	small	fusion
231	0.64	615.36	1.58	-25.1	small	fusion
232	0.68	615.52	4.08	-23.4	small	fusion
233	0.68	615.72	4.16	-22.7	small	fusion
234	0.64	615.86	1.58	-25.1	small	fusion
235	0.71	615.94	4.12	-25.0	small	fusion
236	0.73	616.42	3.76	-22.6	small	fusion
237	0.71	616.98	4.26	-26.9	small	fusion
238	0.69	617.32	4.08	-24.2	small	fusion

Table D.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
239	0.73	617.84	0.94	-24.9	small	fusion
240	0.41	618.12	1.12	-24.9	small	weld
241	0.64	618.82	4.08	-23.5	small	fusion
242	0.76	618.84	0.64	-23.2	small	fusion
243	0.74	619.24	1.32	-24.1	small	fusion
244	0.74	619.52	0.96	-28.0	small	fusion
245	0.67	619.48	5.26	-24.2	small	fusion
246	0.74	619.90	4.92	-18.4	small	fusion
247	0.67	620.02	1.56	-21.0	small	fusion
248	0.74	620.28	3.74	-24.1	small	fusion
249	0.69	620.58	1.54	-27.0	small	fusion
250	0.67	620.80	1.56	-18.6	small	fusion
251	0.72	621.46	1.32	-28.0	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for Azimuth less than 150 degrees.

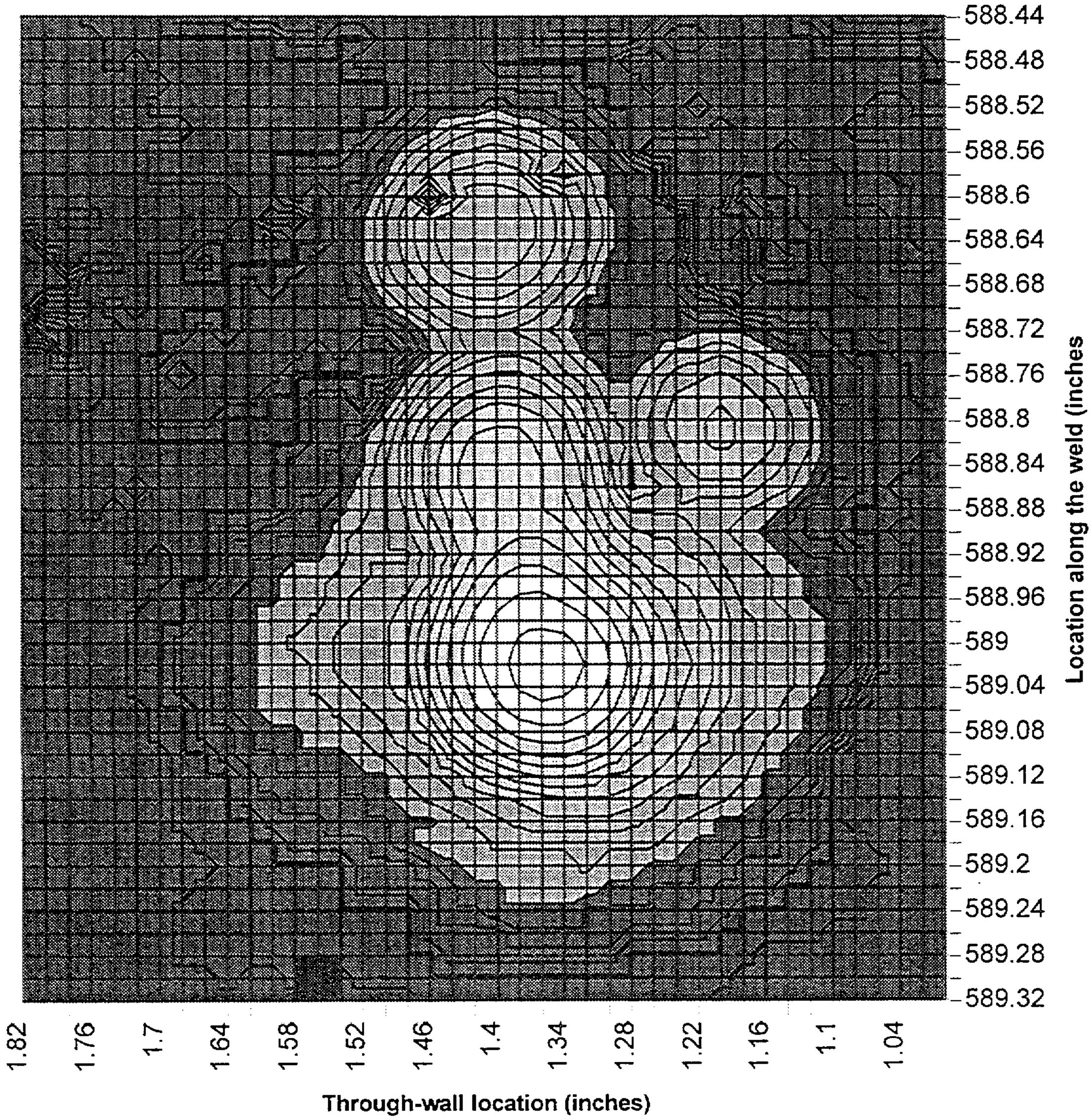

Figure D.1 Log-scale contour plot of indication #22 in Shoreham specimen B180C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -10.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.71 inches above (positive angle) 150.0 degrees of vessel azimuth.

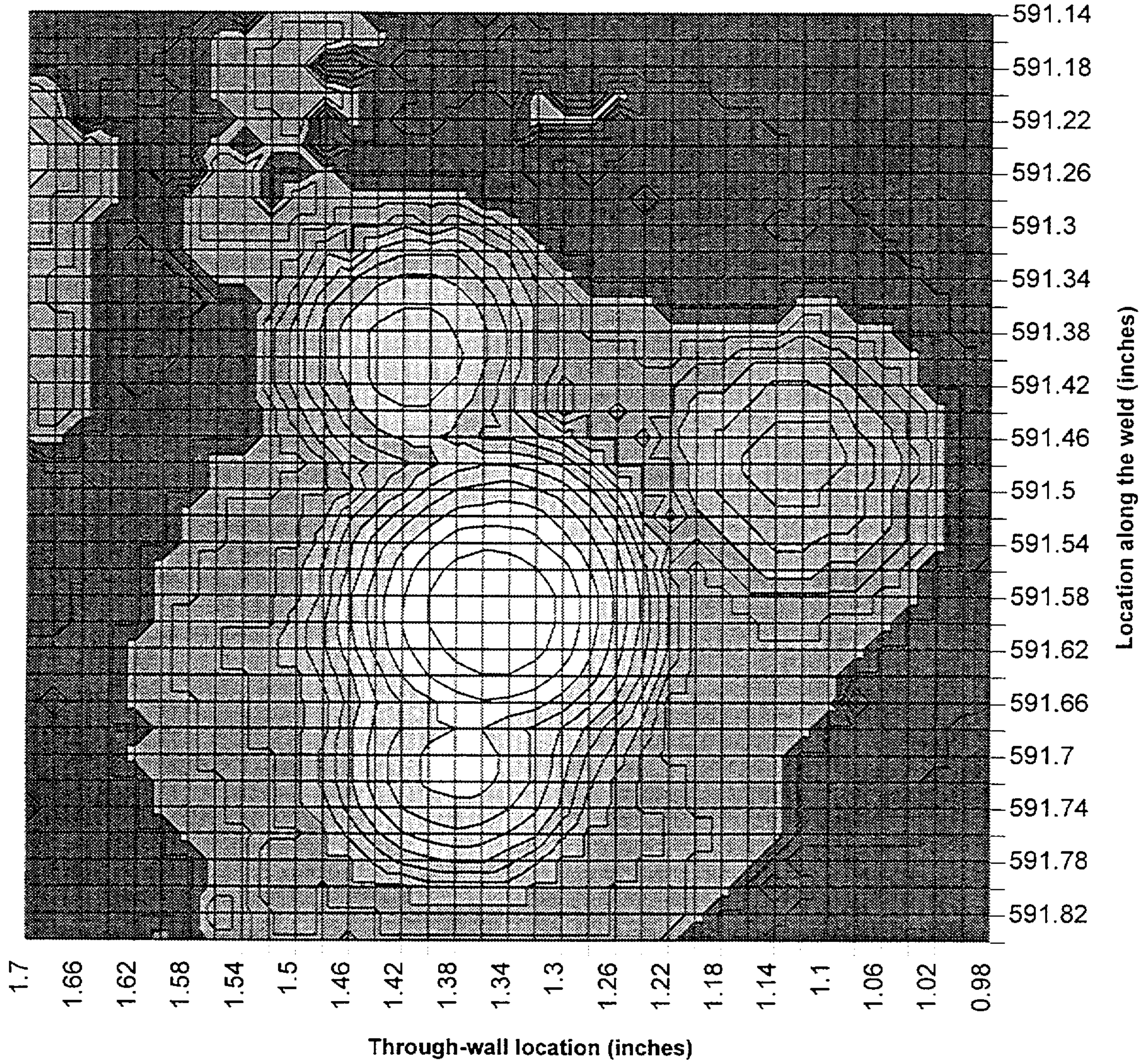

Figure D.2 Log-scale contour plot of indication #34 in Shoreham specimen B180C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located in on the fusion surface at 0.73 inches above (positive angle) 150.0 degrees of vessel azimuth.

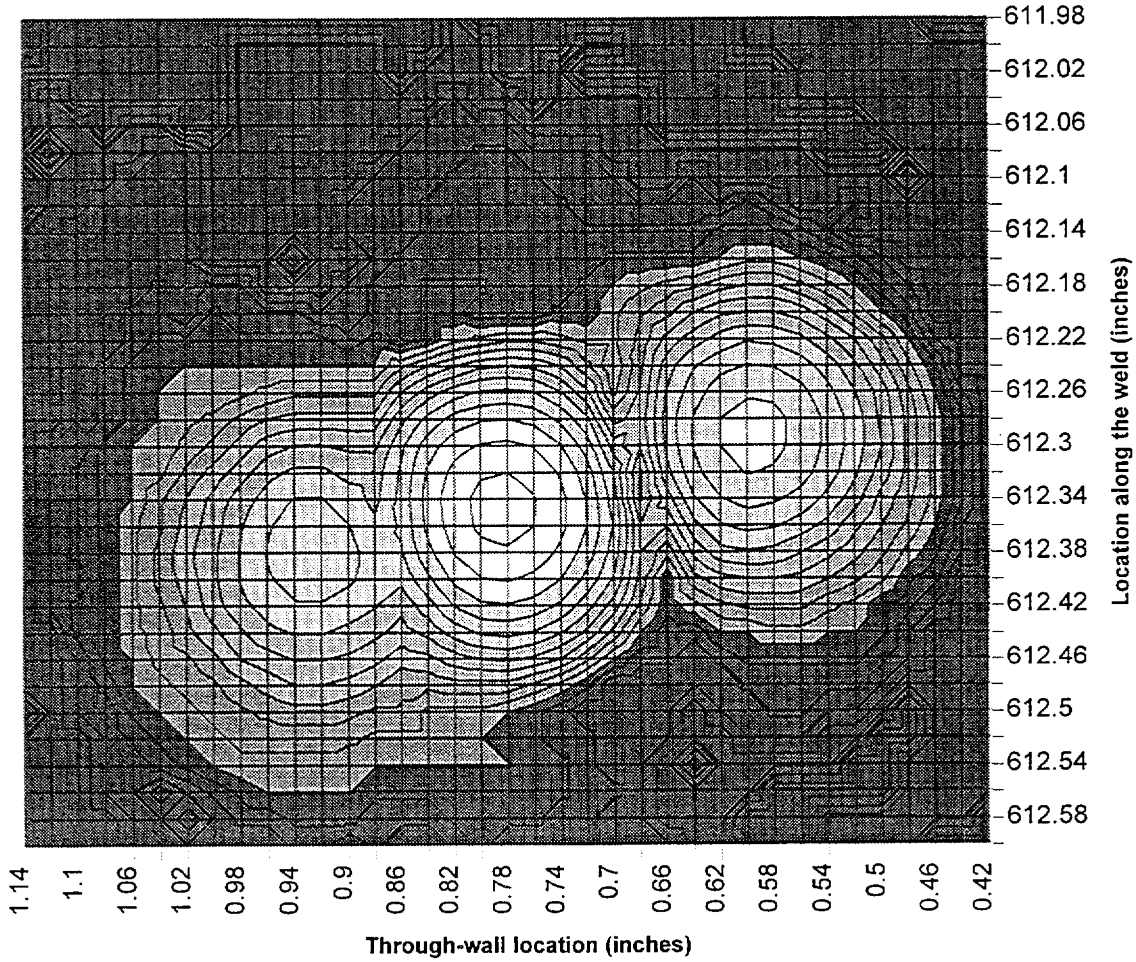

Figure D.3 **Log-scale contour plot of indication #113 in Shoreham specimen B180C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 7 mm. The through-wall location is inner 25 mm. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as simple cluster, is located in on the fusion surface at 0.68 inches above (positive angle) 150.0 degrees of vessel azimuth.**

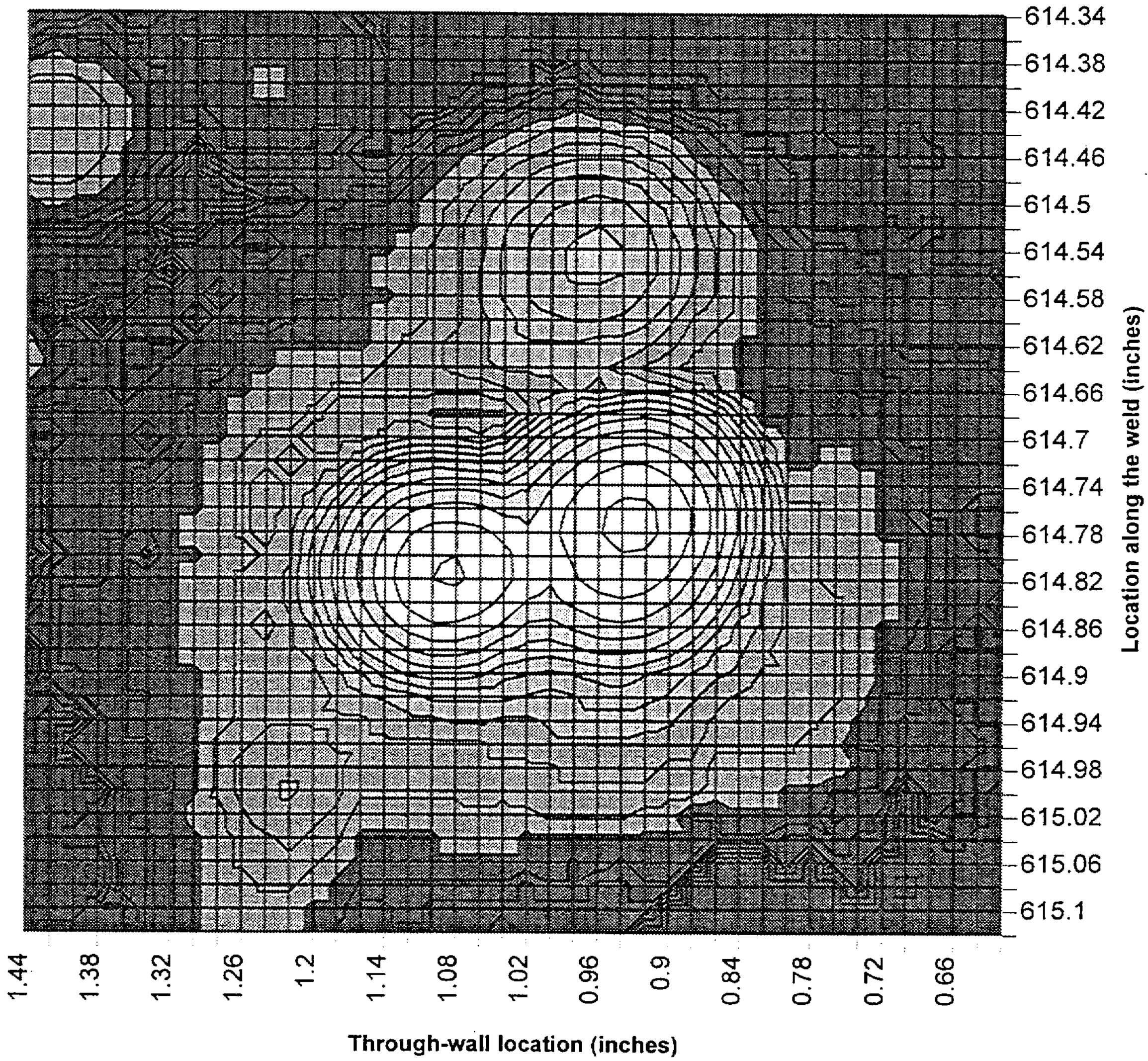

Figure D.4 Log-scale contour plot of indication #120 in Shoreham specimen B180C-2. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -10.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 9 mm. The through-wall location is inner 25 mm. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as simple cluster, is located in on the fusion surface at 0.68 inches above (positive angle) 150.0 degrees of vessel azimuth.

Appendix E

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C0B

Table E.1 lists all detectable flaw indications in Shoreham specimen C0B. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C0B is given in Section 2. Figures E.1 through E.7 show the images of the larger indications in the specimen.

Table E.1 List of all indications for Shoreham specimen C0B

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.81	573.31	5.26	-23.1	small	fusion
2	-0.76	573.41	3.32	-21.4	small	fusion
3	-0.78	573.45	1.72	-23.4	small	fusion
4	-0.76	573.61	3.08	-17.8	small	fusion
5	-0.76	573.75	2.92	-16.5	small	fusion
6	-0.76	573.77	3.54	-22.8	small	fusion
7	-0.76	573.89	3.3	-15.9	small	fusion
8	-0.79	574.31	3.86	-21.4	small	fusion
9	-0.86	574.35	1.1	-26.7	small	fusion
10	-0.81	574.43	3	-28.8	small	fusion
11	-0.79	574.53	3.5	-17.8	small	fusion
12	-0.74	574.55	4.3	-24	small	fusion
13	-0.79	574.77	5.24	-20.1	small	fusion
14	-0.83	574.73	1.26	-14.3	small	fusion
15	-0.77	574.97	3.1	-11	small	fusion
16	-0.77	575.27	5.32	-18.7	small	fusion
17	-0.79	575.33	3.54	-11.8	small	fusion
18	-0.77	575.51	2.8	-26.7	small	fusion
19	-0.79	575.59	3.72	-25.5	small	fusion
20	-0.77	575.87	3.28	-23.7	small	fusion
21	-0.70	575.75	1.76	-26.3	small	fusion
22	-0.77	575.91	5.28	-19.9	small	fusion
23	-0.77	576.09	3.52	-23.4	small	fusion
24	-0.73	576.29	5.26	-29.4	small	fusion
25	-0.73	576.31	3.44	-14.5	small	fusion
26	-0.77	576.29	3.14	-24	small	fusion
27	-0.79	576.21	1.32	-28.8	small	fusion

Table E.1 (contd)						
	Peak Coordinates (Specimen)					
#	**Weld Center (inches)**	**Along Weld (inches)**	**Depth (inches)**	**Response (dB)**	**Characterization**	**Type (material)**
28	-0.89	576.23	0.86	-27.2	small	fusion
29	-0.79	576.47	3.28	-18.9	small	fusion
30	-0.77	576.89	3.8	-16.5	extended	fusion
31	-0.77	577.29	2.9	-13.2	cluster	fusion
32	-0.80	577.41	3.56	-25.9	small	fusion
33	-0.78	577.81	3.26	-12.2	small	fusion
34	-0.75	577.95	5.44	-23.7	small	fusion
35	-0.87	578.01	1.24	-18	small	fusion
36	-0.75	578.19	5.34	-20.3	small	fusion
37	-0.78	578.37	5.8	-26.3	small	fusion
38	-0.80	578.43	3.5	-16.9	small	fusion
39	-0.80	578.37	3.2	-24.7	small	fusion
40	-0.80	578.39	2.94	-22.8	small	fusion
41	-0.89	578.45	1.02	-20.7	small	fusion
42	-0.76	578.63	2.88	-23.7	small	fusion
43	-0.76	578.81	5.34	-17.8	small	fusion
44	-0.76	578.73	4.88	-27.7	small	fusion
45	-0.78	578.91	3.5	-25.5	small	fusion
46	-0.76	578.89	2.86	-26.7	small	fusion
47	-0.78	579.11	3.92	-25.5	small	fusion
48	-0.71	553.61	3.02	-19.1	small	fusion
49	-0.76	553.63	3.6	-23.1	small	fusion
50	-0.74	553.73	3.18	-17.7	small	fusion
51	-0.81	553.97	1.34	-20.3	small	fusion
52	-0.74	553.99	3.36	-14	small	fusion
53	-0.76	554.29	3.14	-18.7	small	fusion
54	-0.76	554.35	1.32	-15.2	small	fusion
55	-0.76	554.47	3.6	-17.7	small	fusion
56	-0.74	554.65	3.56	-12.8	small	fusion
57	-0.76	554.65	3.24	-16.8	small	fusion
58	-0.74	554.61	1.76	-25.9	small	fusion
59	-0.74	555.19	3.02	-21.4	small	fusion
60	-0.77	555.31	4.84	-15.9	small	fusion
61	-0.77	555.45	4	-25.9	small	fusion
62	-0.77	555.87	4.3	-24.7	small	fusion
63	-0.77	555.87	3.56	-16.8	small	fusion
64	-0.72	556.23	3.36	-17.2	long	fusion
65	-0.77	556.29	4.02	-22	small	fusion
66	-0.77	556.11	1.26	-24	small	fusion
67	-0.79	556.29	1.36	-25.9	small	fusion
68	-0.75	556.41	3.02	-24	small	fusion
69	-0.77	556.59	3.04	-25.5	small	fusion
70	-0.72	556.63	3.72	-15.8	small	fusion

Table E.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	-0.77	556.71	4.28	-18	small	fusion
72	-0.75	556.83	1.76	-21.2	small	fusion
73	-0.75	556.73	1.4	-22.2	small	fusion
74	-0.79	556.81	1.28	-21.7	small	fusion
75	-0.77	556.97	3.76	-20.1	small	fusion
76	-0.77	557.07	3.28	-23.7	small	fusion
77	-0.77	557.13	3.96	-16.5	small	fusion
78	-0.77	557.17	3.6	-14.3	small	fusion
79	-0.77	557.05	3.28	-24	small	fusion
80	-0.77	557.27	3.26	-24.7	small	fusion
81	-0.80	558.13	1.38	-12.5	small	fusion
82	-0.78	558.31	3.18	-17.4	small	fusion
83	-0.80	558.99	4.6	-7.3	extended	fusion
84	-0.78	558.71	3.4	-14.3	small	fusion
85	-0.78	559.07	5.36	-7.2	small	fusion
86	-0.78	559.17	4.06	-16.9	small	fusion
87	-0.80	558.99	3.8	-15.1	small	fusion
88	-0.78	559.45	3.58	-19.7	small	fusion
89	-0.76	559.57	2.98	-9.1	small	fusion
90	-0.74	559.61	1.44	-23.7	small	fusion
91	-0.76	559.95	3.02	-20.3	small	fusion
92	-0.78	560.17	4.06	-9.2	small	fusion
93	-0.78	560.41	3.36	-21.2	small	fusion
94	-0.78	560.57	1.74	-16.8	small	fusion
95	-0.76	560.59	1.44	-24	small	fusion
96	-0.78	560.69	5.34	-13.5	small	fusion
97	-0.81	560.77	4.28	-25.9	small	fusion
98	-0.74	560.99	3.88	-24	small	fusion
99	-0.81	561.13	3.38	-19.7	small	fusion
100	-0.79	561.07	3.02	-20.3	small	fusion
101	-0.79	561.25	1.74	-8.5	small	fusion
102	-0.81	561.43	3.12	-23.1	small	fusion
103	-0.83	561.57	1.36	-9.1	small	fusion
104	-0.77	561.83	3.16	-20.3	small	fusion
105	-0.83	561.77	5.78	-18.2	small	fusion
106	-0.77	562.37	3.14	-9.8	small	fusion
107	-0.79	562.47	1.74	-12.7	small	fusion
108	-0.81	562.63	3.22	-10.5	small	fusion
109	-0.82	562.93	3.2	-20.7	small	fusion
110	-0.75	563.23	1.78	-19.1	small	fusion
111	-0.73	563.41	1.46	-22.2	small	fusion
112	-0.84	563.49	3.94	-19.5	small	fusion

Table E.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	-0.80	563.75	3.14	-13.7	small	fusion
114	-0.80	564.09	2.98	-12.9	small	fusion
115	-0.87	563.99	1.32	-23.1	small	fusion
116	-0.82	564.17	1.7	-18.9	small	fusion
117	-0.82	564.51	2.98	-14.3	small	fusion
118	-0.85	564.79	3.04	-21.7	small	fusion
119	-0.85	565.33	3.9	-9.2	long	fusion
120	-0.85	565.31	3.16	-11.7	small	fusion
121	-0.80	565.39	1.42	-19.1	small	fusion
122	-0.89	565.53	1.26	-18.3	small	fusion
123	-0.85	565.65	0.78	-24	small	fusion
124	-0.80	565.97	2.96	-23.4	small	fusion
125	-0.83	565.91	3.14	-23.1	small	fusion
126	-0.85	565.93	4.48	-28.8	small	fusion
127	-0.83	565.85	4.82	-25.9	small	fusion
128	-0.80	566.17	5.3	-25.5	small	fusion
129	-0.83	566.21	3.76	-23.4	small	fusion
130	-0.81	566.61	2.94	-19.3	small	fusion
131	-0.81	566.65	5.32	-17.4	small	fusion
132	-0.90	566.81	1.12	-13.6	small	fusion
133	-0.83	567.21	2.98	-16.8	small	fusion
134	-0.83	567.47	3.12	-11.3	small	fusion
135	-0.79	567.49	1.72	-18.5	small	fusion
136	-0.81	567.79	3.7	-18.7	small	fusion
137	-0.79	568.07	1.4	-23.1	small	fusion
138	-0.79	568.33	3.06	-13	small	fusion
139	-0.84	568.47	3.76	-22	small	fusion
140	-0.84	568.63	4.54	-22.2	small	fusion
141	-0.79	568.69	3.32	-26.3	small	fusion
142	-0.79	569.11	2.94	-12.7	small	fusion
143	-0.82	569.31	3.34	-19.3	small	fusion
144	-0.84	569.71	3.8	-19.5	small	fusion
145	-0.79	569.77	2.96	-24.7	small	fusion
146	-0.86	569.69	1.1	-17.7	small	fusion
147	-0.89	570.15	1.26	-21	small	fusion
148	-0.80	570.47	1.66	-16.2	small	fusion
149	-0.91	570.45	0.18	-15.7	small	clad
150	-0.84	570.71	1.3	-23.4	small	fusion
151	-0.75	570.73	2.72	-23.1	small	fusion
152	-0.75	570.85	2.9	-20.3	small	fusion
153	-0.80	571.13	3.78	-23.7	small	fusion
154	-0.80	571.65	3.54	-19.9	small	fusion

Table E.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	-0.87	571.81	1.1	-7.4	small	fusion
156	-0.76	572.15	1.86	-23.7	small	fusion
157	-0.78	572.23	3.9	-23.7	small	fusion
158	-0.80	572.79	5.26	-23.4	small	fusion
159	-0.83	572.75	5.78	-15.7	small	fusion
160	-0.76	572.97	2.94	-11.3	small	fusion
161	-0.81	572.97	3.54	-21	small	fusion
162	0.46	553.59	2.4	-31.3	small	ROOT
163	0.83	553.75	3.02	-26.8	small	fusion
164	0.55	553.85	2.14	-21.5	small	ROOT
165	0.71	554.17	1.84	-27.9	small	fusion
166	0.82	554.47	4.62	-13.7	small	fusion
167	0.82	554.57	3.78	-30	small	fusion
168	0.80	555.01	4.8	-18.3	small	fusion
169	0.80	555.05	2.8	-20.6	small	fusion
170	0.78	555.13	1.38	-26.3	small	fusion
171	0.73	555.57	2.78	-30.4	small	fusion
172	0.77	555.59	1.58	-25.8	small	fusion
173	0.77	556.21	2.76	-21.7	small	fusion
174	0.82	556.71	3.24	-26.8	small	fusion
175	0.79	556.73	3.76	-26.9	small	fusion
176	0.84	557.25	3.66	-26.7	small	fusion
177	0.79	557.25	5.58	-26.3	small	fusion
178	0.74	557.57	2.82	-16.5	small	fusion
179	0.72	557.69	1.44	-25.9	small	fusion
180	0.74	557.93	1.4	-29.4	small	fusion
181	0.79	558.25	3.94	-19.6	small	fusion
182	0.81	558.57	3.78	-27.5	small	fusion
183	0.79	558.85	1.32	-26.9	small	fusion
184	0.71	559.37	1.38	-22.6	small	fusion
185	0.76	559.65	3.96	-26.3	small	fusion
186	0.69	560.01	1.4	-24.9	small	fusion
187	0.67	560.13	1.58	-28.8	small	fusion
188	0.71	560.25	1.38	-27.9	small	fusion
189	0.71	560.33	3.9	-31.4	small	fusion
190	0.73	560.75	3.88	-25.8	small	fusion
191	0.69	560.87	1.38	-31.5	small	fusion
192	0.48	561.17	2.06	-34.7	small	ROOT
193	0.57	561.27	1.5	-30.9	small	weld
194	0.75	561.91	3.54	-24.2	small	fusion
195	0.75	562.01	3.74	-24.7	small	fusion
196	0.61	562.25	1.78	-26.3	small	fusion

Table E.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
197	0.54	562.39	1.94	-30	small	ROOT
198	0.77	562.63	3.24	-30.1	small	fusion
199	0.77	562.51	4.48	-23.6	small	fusion
200	0.73	562.75	4.48	-23.3	small	fusion
201	0.77	562.79	3.26	-28.4	small	fusion
202	0.61	562.93	1.78	-29.8	small	fusion
203	0.68	563.09	0.74	-22.7	small	fusion
204	0.61	563.25	2.7	-29	small	fusion
205	0.68	563.33	3.16	-27.3	small	fusion
206	0.75	563.37	3.74	-21.3	small	fusion
207	0.68	563.63	1.6	-22.7	small	fusion
208	0.65	564.03	0.46	-19.5	surface-elong.	fusion
209	0.68	563.09	0.74	-22.7	small	fusion
210	0.56	564.11	1.8	-28.4	small	ROOT
211	0.60	564.55	1.42	-29.8	small	fusion
212	0.60	564.65	1.7	-27.5	small	fusion
213	0.74	564.63	5.56	-24.7	small	fusion
214	0.72	565.01	3.18	-28.5	small	fusion
215	0.74	565.25	3.2	-26.3	small	fusion
216	0.69	565.57	3.64	-27.2	small	fusion
217	0.62	565.57	1.34	-20.5	small	fusion
218	0.69	565.89	2.94	-27.9	small	fusion
219	0.78	566.47	4.42	-25.6	small	fusion
220	0.57	566.69	1.68	-25.3	small	ROOT
221	0.73	567.05	3.16	-23.7	small	fusion
222	0.62	567.25	1.5	-23.7	small	fusion
223	0.62	567.77	1.62	-29.7	small	fusion
224	0.71	567.93	3.46	-26.4	small	fusion
225	0.68	567.99	4.04	-24.3	small	fusion
226	0.64	568.39	0.86	-21.3	small	fusion
227	0.66	568.51	1.14	-31.5	small	fusion
228	0.77	568.45	3.26	-31	small	fusion
229	0.75	568.47	3.56	-26.9	small	fusion
230	0.71	568.61	3.32	-29.4	small	fusion
231	0.75	568.71	3.04	-29.2	small	fusion
232	0.64	568.73	0.54	-24	small	fusion
233	0.61	568.91	1.64	-25.6	small	fusion
234	0.73	569.17	3.46	-32.4	small	fusion
235	0.75	569.37	4.06	-21.9	small	fusion
236	0.77	569.55	3.2	-25.6	small	fusion
237	0.61	569.77	1.64	-24.6	small	fusion
238	0.65	569.81	0.98	-26	small	fusion

Table E.1 (contd)						
#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
239	0.75	569.85	5.54	-19.6	small	fusion
240	0.75	570.09	4.06	-28.4	small	fusion
241	0.72	570.07	3.1	-27.7	small	fusion
242	0.65	570.11	2.66	-26	small	fusion
243	0.63	570.21	1.6	-30.5	small	fusion
244	0.77	570.15	5.6	-25	small	fusion
245	0.77	570.53	3.58	-30	small	fusion
246	0.38	570.57	2.14	-33.6	small	ROOT
247	0.58	570.65	1.32	-32.9	small	weld
248	0.65	570.89	1.24	-26.6	small	fusion
249	0.67	571.05	3.58	-28.6	small	fusion
250	0.65	571.25	1.24	-16.9	small	fusion
251	0.65	571.39	1.58	-27.3	small	fusion
252	0.58	571.85	1.62	-24.7	small	ROOT
253	0.79	571.97	3.78	-32.1	small	fusion
254	0.74	572.07	3.94	-26.9	small	fusion
255	0.76	572.45	3.52	-23.5	small	fusion
256	0.67	572.81	2.68	-27.9	small	fusion
257	0.78	572.91	3.78	-26.1	small	fusion
258	0.69	573.61	1.22	-24.8	small	fusion
259	0.69	573.99	1.18	-31.3	small	fusion
260	0.18	574.19	0.18	-45.1	small	clad
261	0.64	574.33	1.58	-29.5	small	fusion
262	0.68	574.71	1.44	-25.8	small	fusion
263	0.64	574.97	0.42	-26	small	fusion
264	0.77	574.99	3.18	-32.1	small	fusion
265	0.75	575.09	4.68	-23.1	small	fusion
266	0.59	575.29	1.66	-25.1	small	ROOT
267	0.75	575.63	4.36	-24.5	small	fusion
268	0.66	575.81	1.24	-24.3	small	fusion
269	0.63	576.01	0.78	-29.5	small	fusion
270	0.63	576.29	2.42	-26	small	fusion
271	0.75	576.47	3.82	-23.1	small	fusion
272	0.61	576.73	1.62	-23.2	small	fusion
273	0.63	576.91	1.02	-30.4	small	fusion
274	0.63	577.25	2.4	-30.4	small	fusion
275	0.67	577.61	2.48	-28.5	small	fusion
276	0.74	577.67	3.86	-18.7	small	fusion
277	0.63	577.71	1.42	-17.1	small	fusion
278	0.72	577.85	2.7	-30.1	small	fusion
279	0.76	577.89	3.18	-29.9	small	fusion
280	0.67	578.25	3.58	-28.5	small	fusion

Table E.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
281	0.74	578.65	2.9	-30	small	fusion
282	0.65	579.05	1.04	-23.9	small	fusion
283	0.64	579.25	1.12	-24.3	small	fusion
284	0.78	579.31	3.72	-14.3	extended	fusion
285	0.64	579.77	0.82	-23.9	small	fusion
286	0.78	579.87	3.78	-24.3	small	fusion
287	0.57	579.57	0.26	-28.9	small	clad
Note 1: Depth is measured from wetted clad surface.						
Note 2: Weld center is positive for Azimuth greater than 30 degrees.						

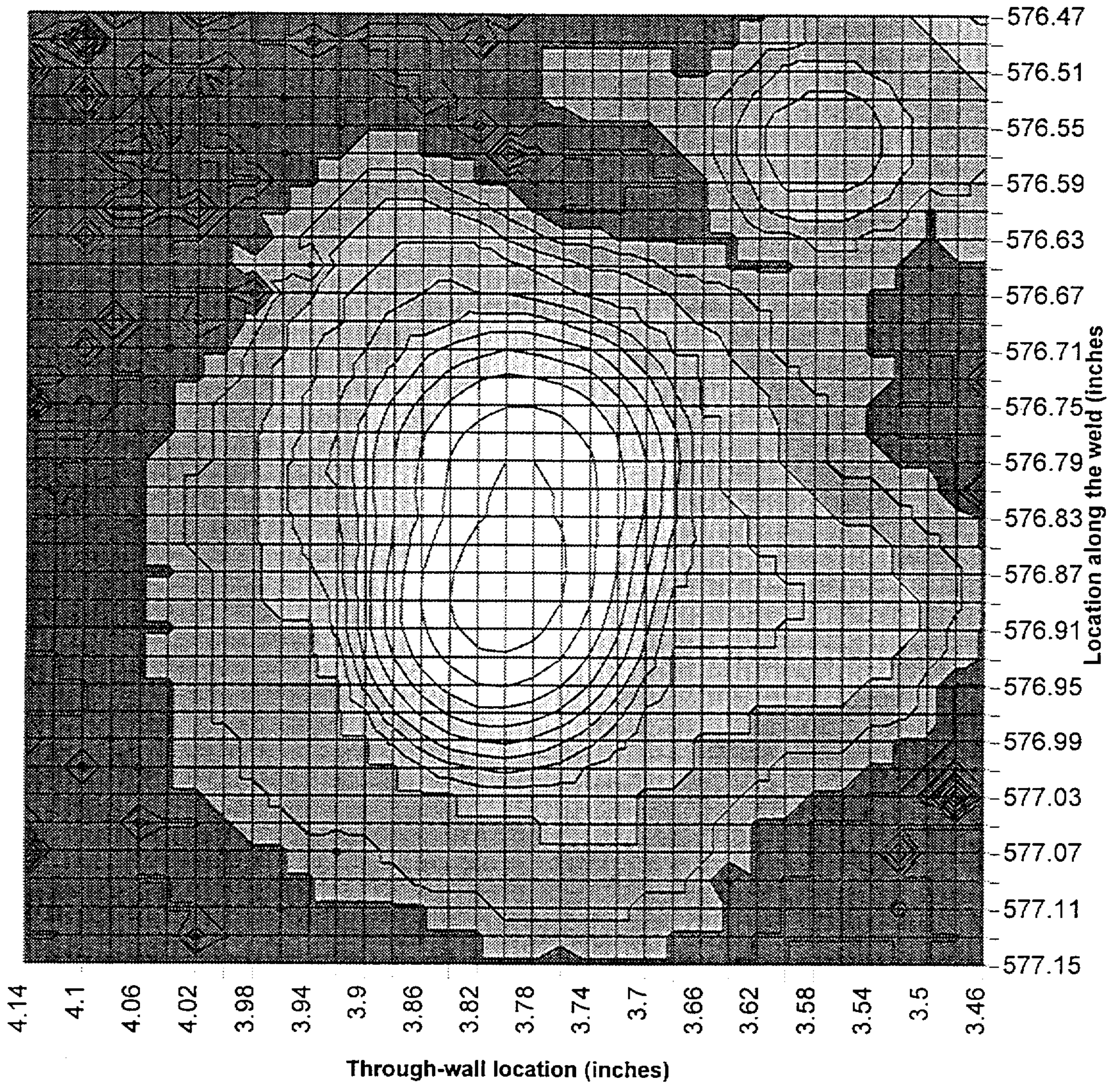

Figure E.1 **Log-scale contour plot of indication #30 in Shoreham specimen C0B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -16.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.77 inches below (negative angle) 30.0 degrees of vessel azimuth.**

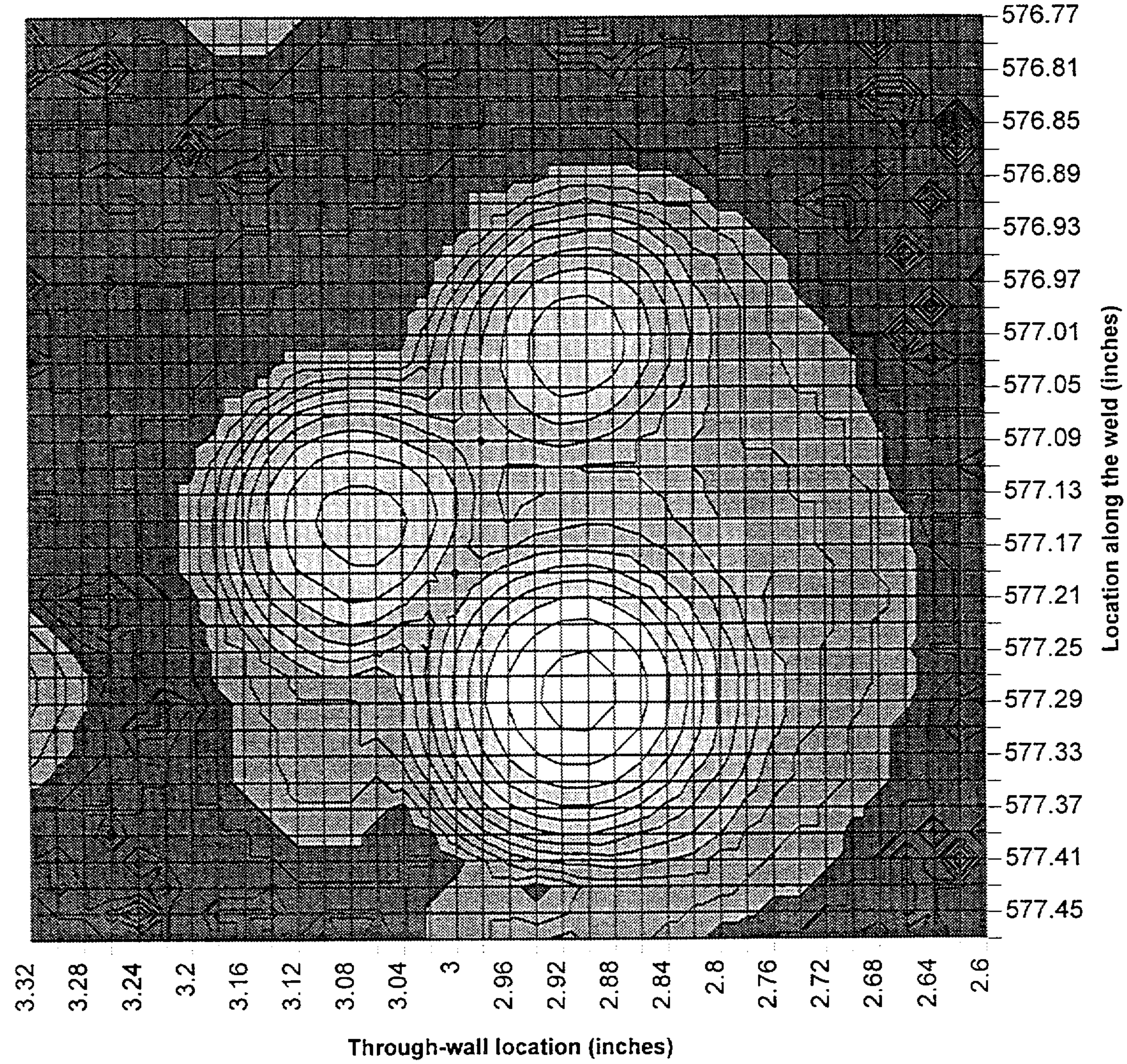

Figure E.2 Log-scale contour plot of indication #31 in Shoreham specimen C0B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -13.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 8 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as a simple cluster, is located on the fusion surface at 0.77 inches below (negative angle) 30.0 degrees of vessel azimuth.

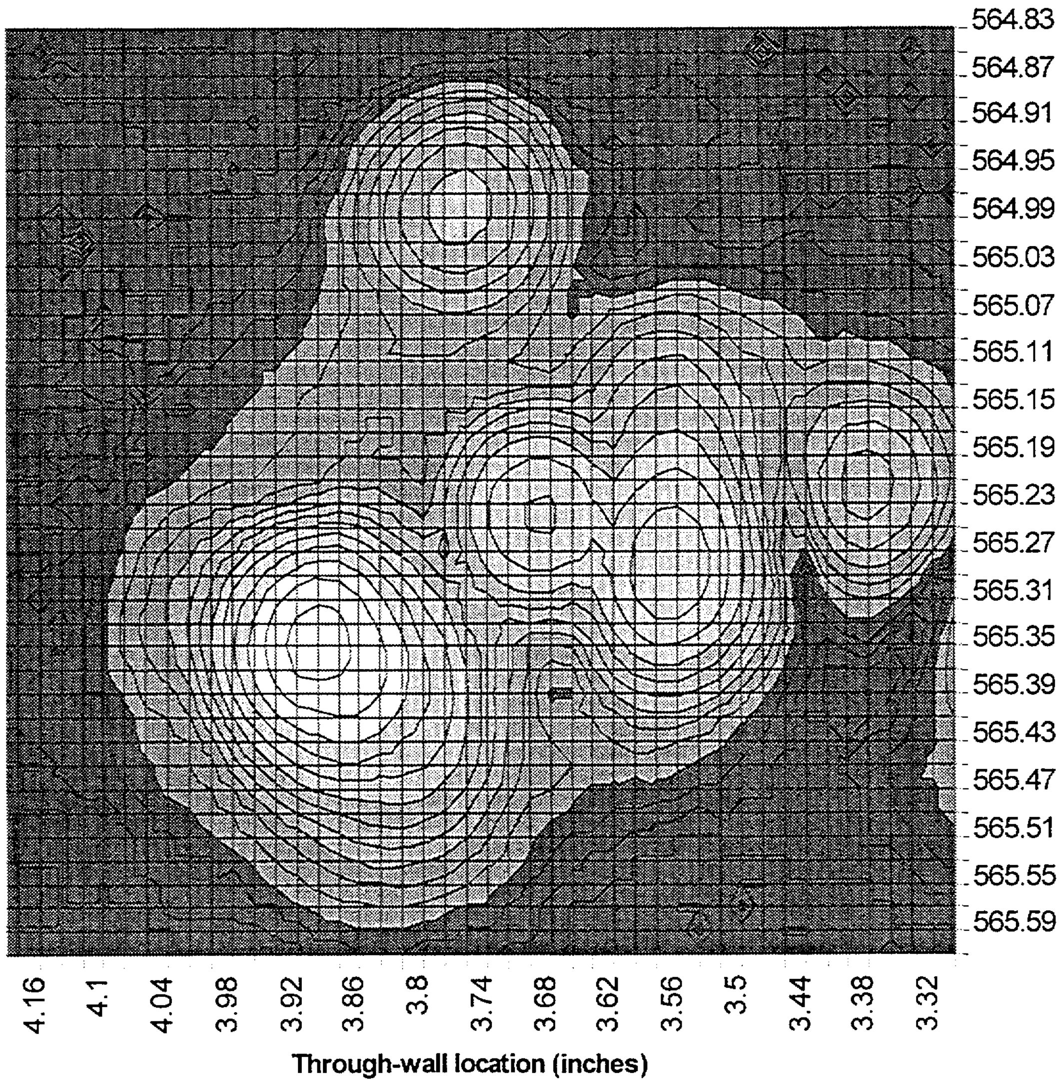

Figure E.3 Log-scale contour plot of indication #64 in Shoreham specimen C0B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -17.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.72 inches below (negative angle) 30.0 degrees of vessel azimuth.

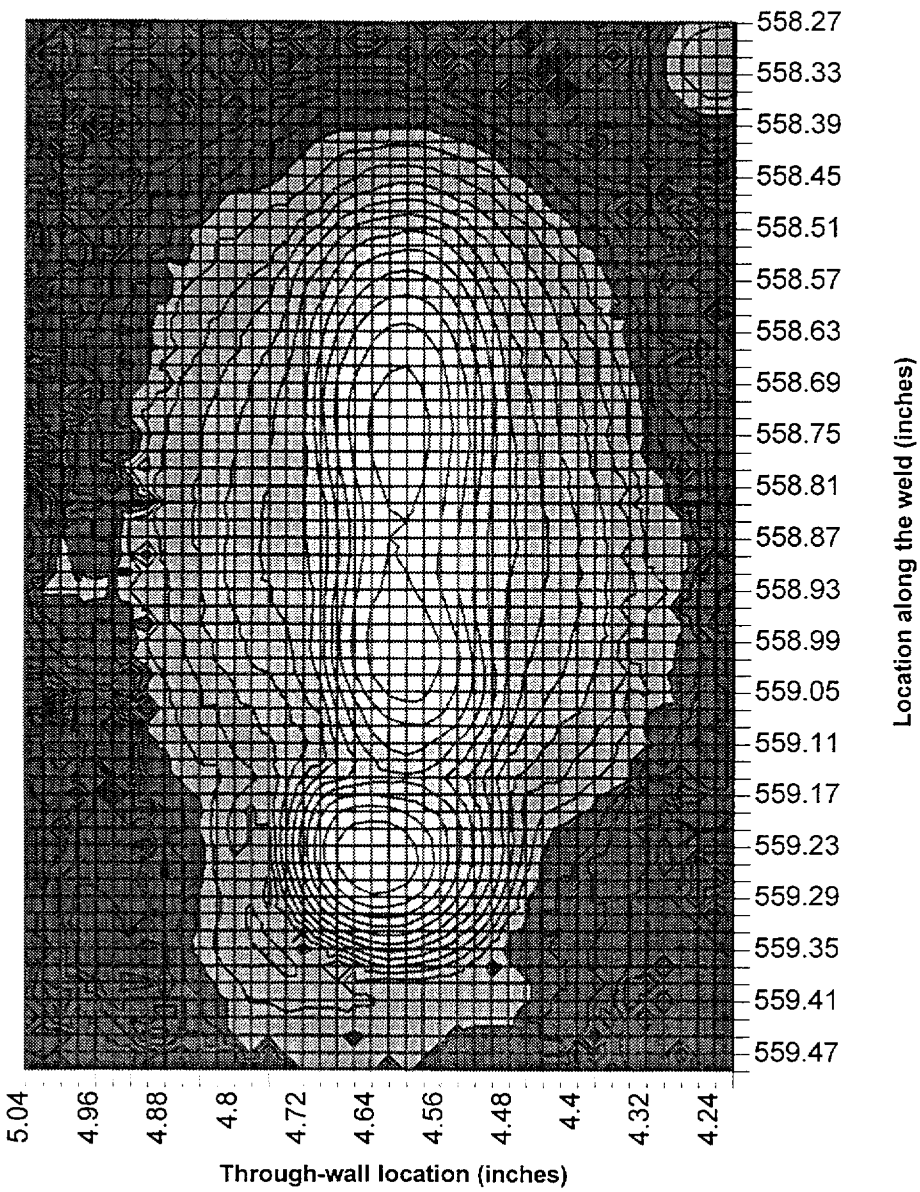

Figure E.4 **Log-scale contour plot of indication #83 in Shoreham specimen C0B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 23 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.80 inches below (negative angle) 30.0 degrees of vessel azimuth.**

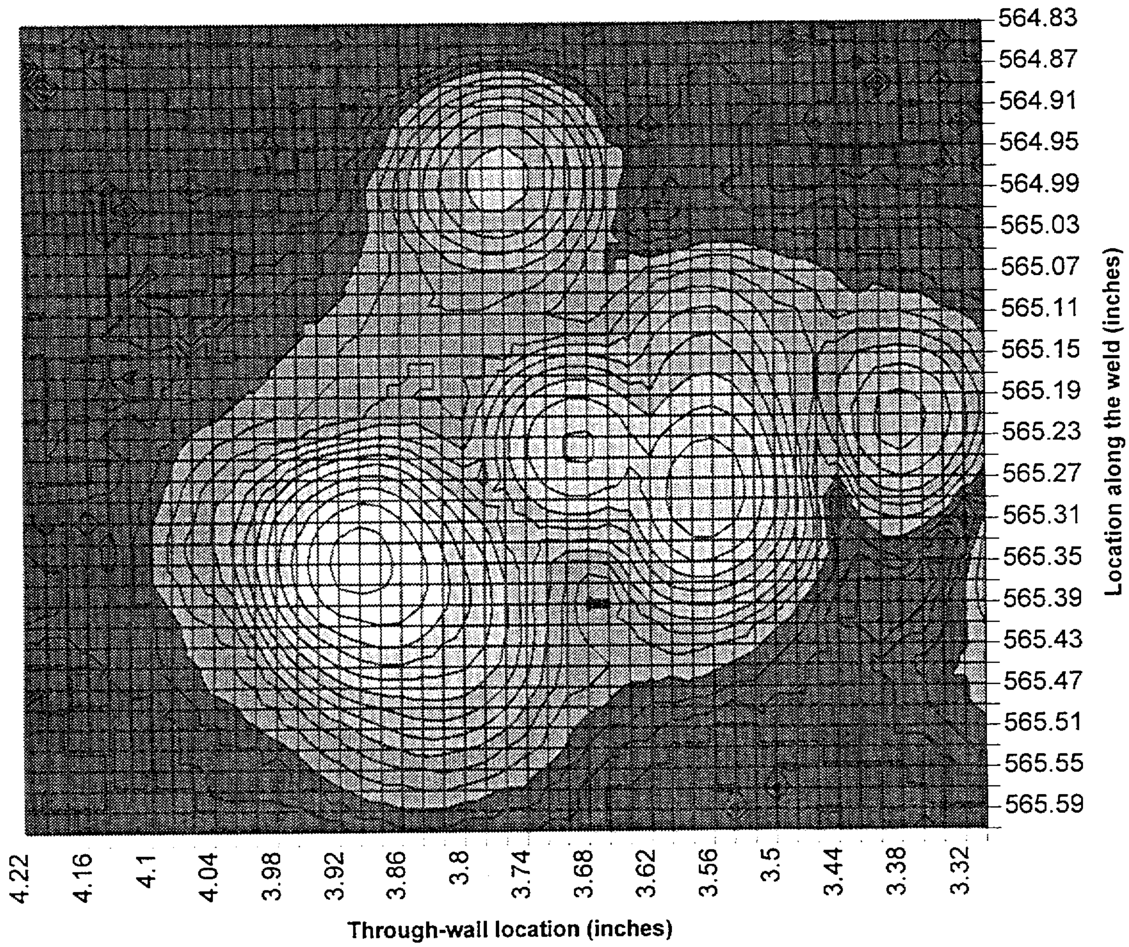

Figure E.5 **Log-scale contour plot of indication #119 in Shoreham specimen C0B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.85 inches below (negative angle) 30.0 degrees of vessel azimuth.**

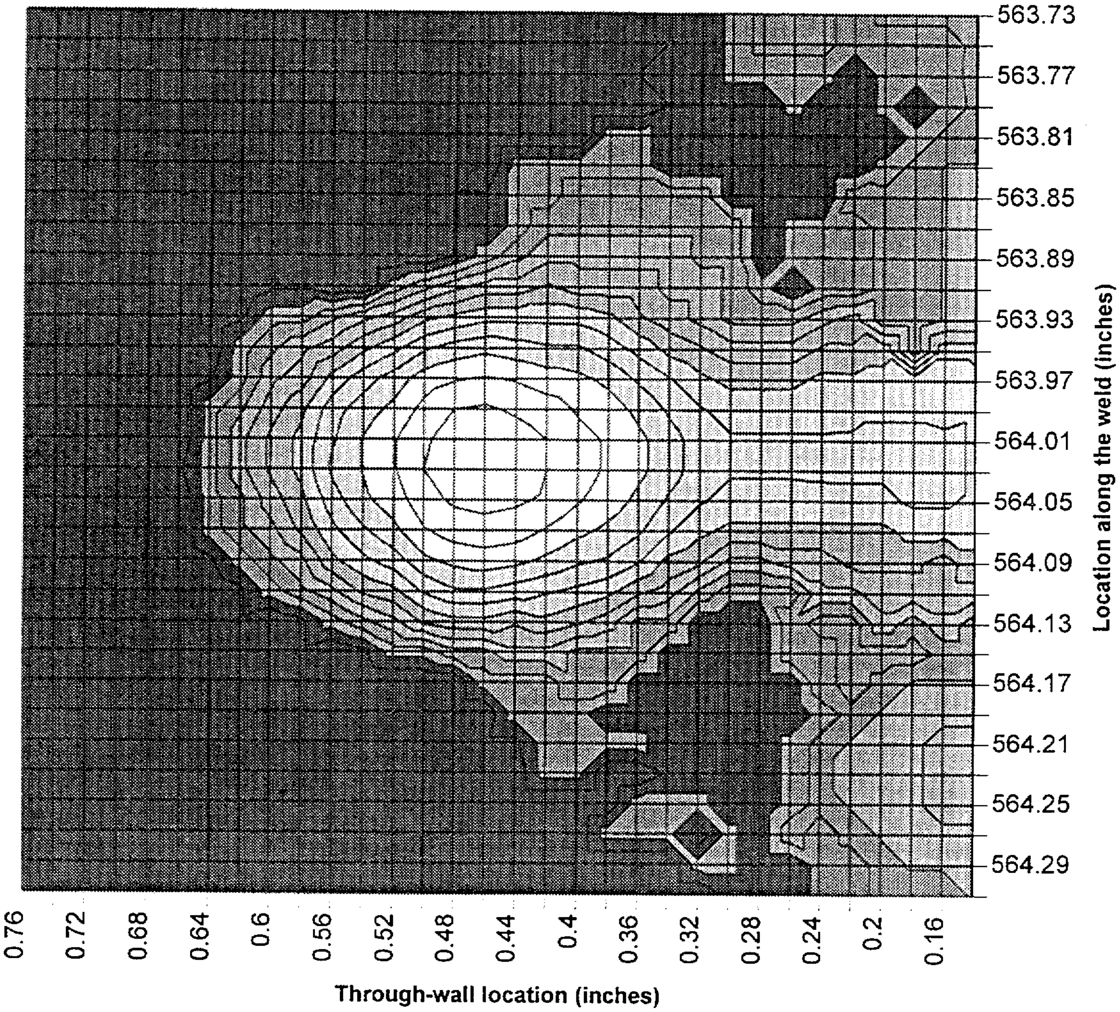

Figure E.6 **Log-scale contour plot of indication #208 in Shoreham specimen C0B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is inner 25 mm. The length is 7 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as surface-elongated, is located on the fusion surface at 0.65 inches above (positive angle) 30.0 degrees of vessel azimuth.**

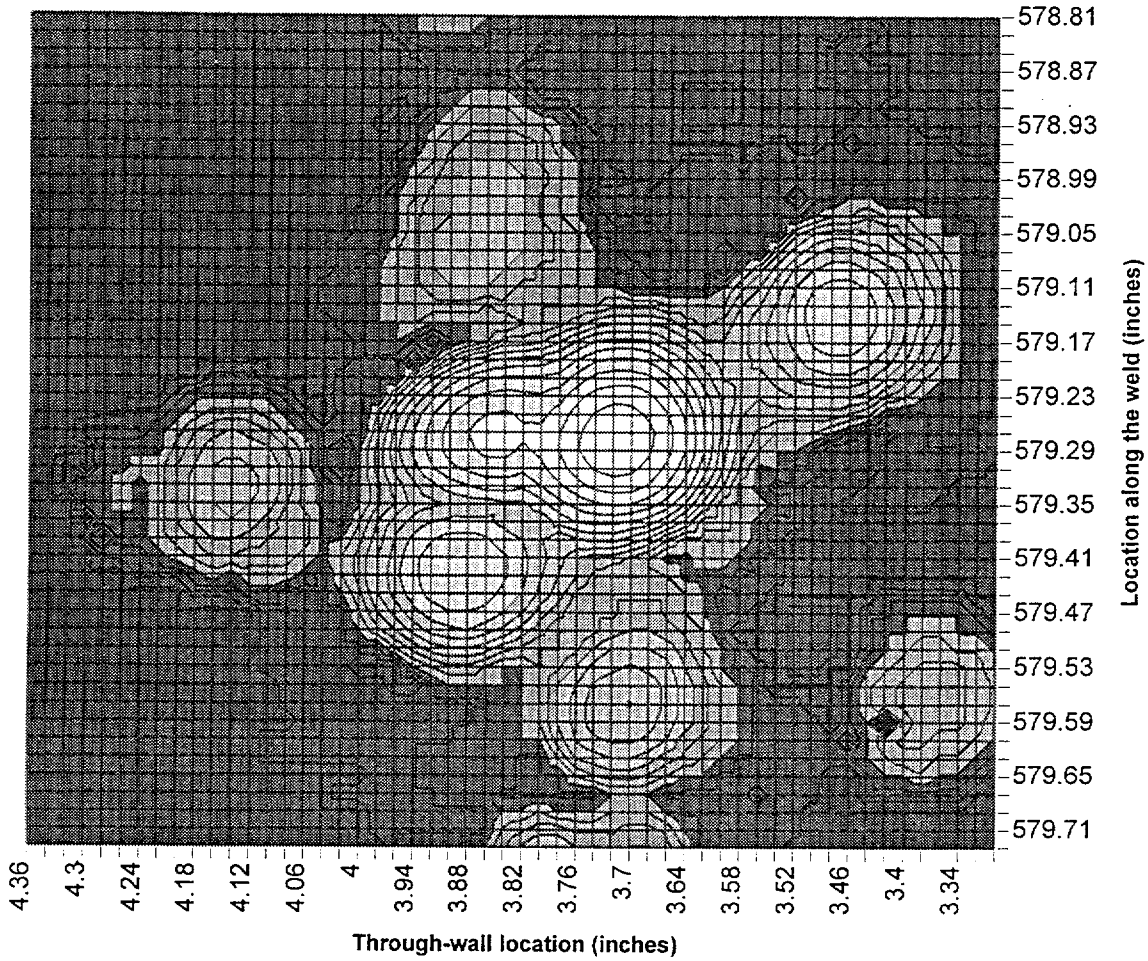

Figure E.7 Log-scale contour plot of indication #284 in Shoreham specimen C0B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.78 inches above (positive angle) 30.0 degrees of vessel azimuth.

Appendix F

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C0D

Table F.1 lists all detectable flaw indications in Shoreham specimen C0D. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C0D is given in Section 2. Figures F.1 and F.2 show the images of the larger indications in the specimen.

Table F.1 List of all indications for Shoreham specimen C0D

#	Peak Coordinates (Specimen) Weld Center (inches)	Peak Coordinates (Specimen) Along Weld (inches)	Peak Coordinates (Specimen) Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.56	0.62	4.22	-23.7	small	fusion
2	-0.53	3.66	3.94	-25.5	small	fusion
3	-0.60	6.02	4.34	-21.8	small	fusion
4	-0.35	6.1	4.02	-14.6	small	weld
5	-1.22	5.96	0.32	-29.8	small	GOUGE
6	-0.35	6.1	4.02	-14.6	small	weld
7	-0.60	6.02	4.34	-21.8	small	fusion
8	-0.35	6.34	4	-21.3	small	weld
9	-0.63	6.54	0.78	-25.9	small	fusion
10	-0.57	7.22	2.44	-22.4	small	fusion
11	-0.62	7.62	4.74	-18.5	small	fusion
12	-1.29	8.02	0.36	-30	small	GOUGE
13	-1.31	9.26	0.32	-27.8	small	GOUGE
14	-1.29	9.74	0.3	-28.7	small	GOUGE
15	-0.58	10.52	1.26	-22.3	small	fusion
16	-0.63	10.46	3.1	-21.6	small	fusion
17	-1.28	10.72	0.36	-28.6	small	GOUGE
18	-0.62	11.22	3.08	-22.4	small	fusion
19	-1.42	11.6	0.46	-29.3	small	GOUGE
20	-0.60	12.12	2.94	-18.8	small	fusion
21	-0.59	13.12	1.1	-18.2	small	fusion
22	-0.62	13.54	1.12	-18.3	small	fusion
23	-0.60	13.98	1.86	-24.2	small	fusion
24	0.46	3.52	2.42	-18.4	small	weld
25	0.67	5.22	0.72	-16.5	long	fusion
26	0.65	5.68	0.7	-25.6	small	fusion
27	0.66	6.08	0.72	-22	small	fusion

Table F.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	0.62	5.94	4.76	-19.6	small	fusion
29	0.53	5.68	5.16	-27.3	small	fusion
30	0.47	7.26	2.42	-24.4	small	weld
31	0.65	7.46	4.3	-25.6	small	fusion
32	0.52	8.4	5.48	-17.7	surface-elong.	fusion
33	0.42	9.22	2.46	-18.4	small	weld
34	0.66	10.02	3.22	-20.2	small	fusion
35	1.07	12.44	0.68	-26.6	small	GOUGE
36	0.45	12.88	2.58	-19	small	weld
37	0.66	16.32	1.48	-27	small	fusion
38	0.63	16.48	0.86	-20.2	small	fusion
39	0.63	17.08	1.5	-11.8	small	fusion
40	0.58	17	5.38	-27.1	small	fusion
41	0.57	17.82	1.82	-19.5	small	fusion
Note 1: Depth is measured from wetted clad surface.						
Note 2: Weld center is positive for elevation greater than 553 inches.						

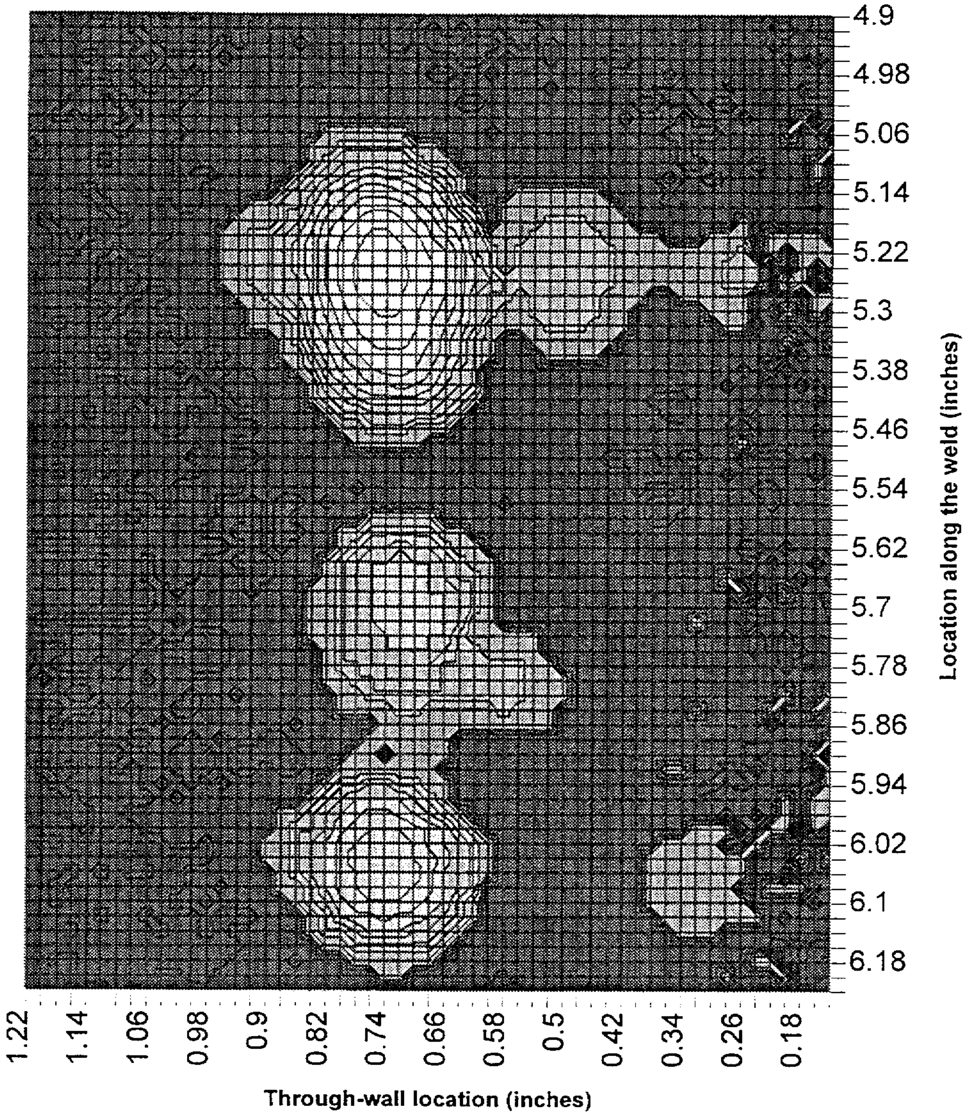

Figure F.1 **Log-scale contour plot of indication #25 in Shoreham specimen COD. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -16.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is inner 25 mm. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.67 inches below 553 inches of vessel elevation.**

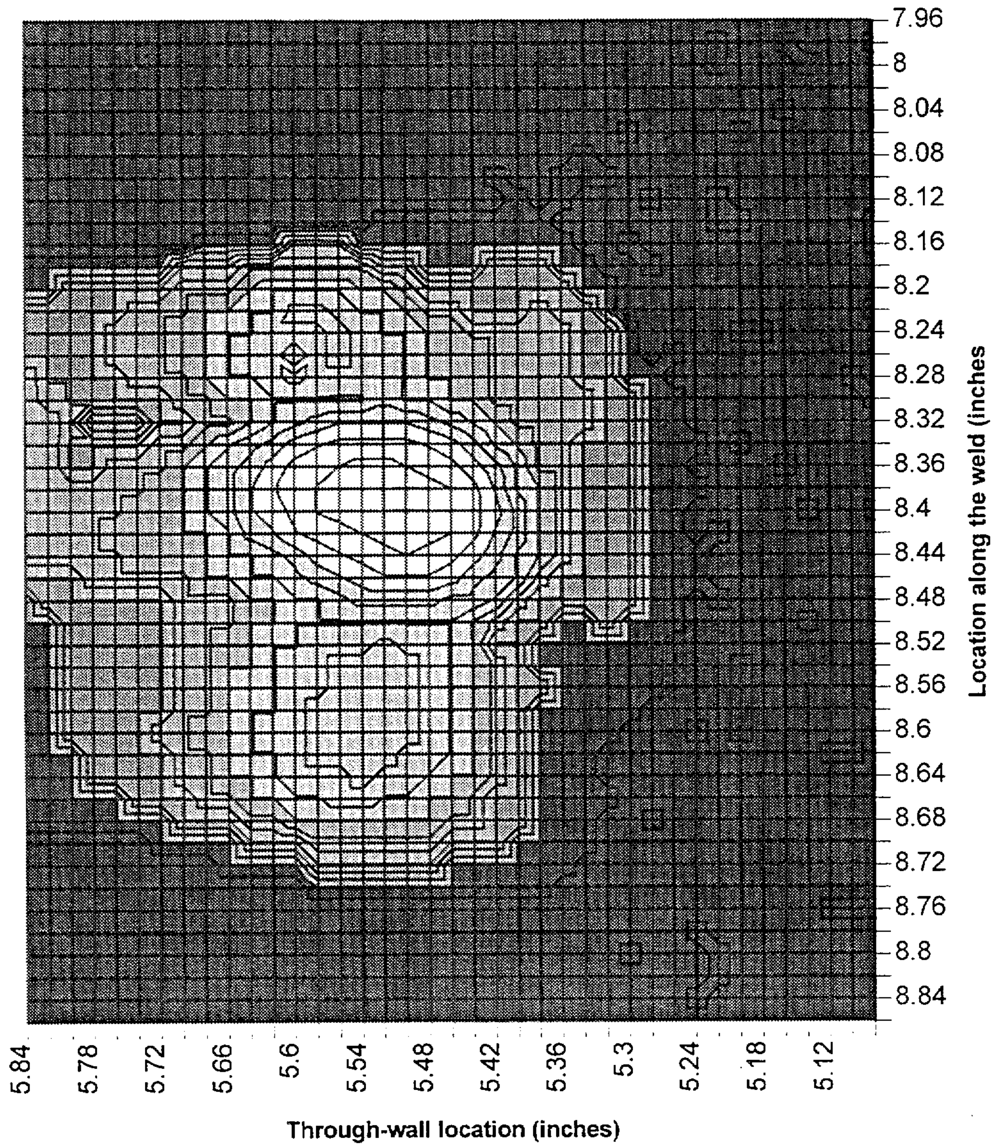

Figure F.2 Log-scale contour plot of indication #32 in Shoreham specimen C0D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -18.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as surface-elongated, is located on the fusion surface at 0.52 inches below 553 inches of vessel elevation.

Appendix G

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C0E

Table G.1 lists all detectable flaw indications in Shoreham specimen C0E. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C0E is given in Section 2. Figures G.1 through G.5 show the images of the larger indications in the specimen.

Table G.1 List of all indications for Shoreham specimen C0E

#	Peak Coordinates (Specimen)			Response (dB)	Characterization	Type (material)
	Weld Center (inches)	Along Weld (inches)	Depth (inches)			
1	-0.98	0.82	0.24	-21.8	extended	clad
2	-0.70	0.66	0.9	-27.9	small	fusion
3	-0.63	1.42	5.52	-21	small	fusion
4	-0.65	1.86	2.34	-29.8	small	fusion
5	-0.58	2	5.66	-29.5	small	fusion
6	-0.63	2.18	5.12	-27.5	small	fusion
7	-1.27	2.36	0.26	-32.6	small	clad
8	-0.65	3.18	5.2	-26.7	small	fusion
9	-0.67	3.46	0.84	-30	small	fusion
10	-0.62	4.04	3.82	-22	small	fusion
11	-0.41	4.32	5.14	-26.4	small	weld
12	-0.62	4.24	5.42	-25.8	small	fusion
13	-0.66	5.76	0.94	-28.8	small	fusion
14	-0.57	5.64	5.66	-24.1	small	fusion
15	-0.66	5.74	0.96	-28.8	small	fusion
16	-0.54	7.3	4.22	-29.3	small	fusion
17	-0.54	7.36	3.24	-25.4	small	fusion
18	-0.59	7.5	3.72	-24.9	small	fusion
19	-0.63	7.5	2.78	-23.8	small	fusion
20	-0.52	7.88	5.26	-27	small	fusion
21	-0.68	7.9	0.94	-26.2	small	fusion
22	-0.70	8.48	1.82	-25.5	small	fusion
23	-0.65	9.68	2.8	-25.3	small	fusion
24	-0.70	9.6	2.12	-23.6	small	fusion
25	-0.63	9.62	1.58	-26.7	small	fusion
26	-0.58	10.4	4.4	-28.4	small	fusion
27	-0.62	11.2	2.94	-28.7	small	fusion

Table G.1 (contd)

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.60	11.66	4.78	-17.1	small	fusion
29	-0.60	12.38	5.54	-28.6	small	fusion
30	-0.57	12.72	4.28	-18.2	small	fusion
31	-0.59	13.14	2.88	-28.6	small	fusion
32	-0.57	13.64	5.42	-25.7	small	fusion
33	-0.59	14.06	4.1	-20.2	small	fusion
34	-0.66	13.86	0.94	-26.2	small	fusion
35	-0.63	15.18	1.16	-28.8	small	fusion
36	-0.56	15.86	3.82	-23.6	small	fusion
37	-0.59	15.92	5.18	-22.5	small	fusion
38	-1.11	16.36	0.2	-32.2	small	clad
39	-0.61	17.08	2.94	-27.7	small	fusion
40	-0.61	17.34	5.24	-23.2	small	fusion
41	-0.60	17.92	2.4	-25.9	small	fusion
42	-0.58	18.72	4.12	-22.5	small	fusion
43	-0.55	19.88	3.84	-29.6	small	fusion
44	-0.55	20.02	4.86	-25.7	small	fusion
45	-0.57	21.14	4.32	-14.8	small	fusion
46	-0.61	22.36	0.96	-25.3	small	fusion
47	-0.61	22.72	2.5	-22.8	small	fusion
48	-0.64	22.82	1.02	-15.6	small	fusion
49	-0.57	22.92	5.7	-28.6	small	fusion
50	-0.63	24.46	1.04	-30.1	small	fusion
51	-0.54	25.26	5.22	-7.4	long	fusion
52	-0.58	25.24	2.96	-28.7	small	fusion
53	-0.63	25.42	1.56	-27	small	fusion
54	-1.16	25.2	0.16	-32.4	small	clad
55	-0.49	26.06	4.24	-24.7	small	weld
56	-0.60	26.76	2.4	-16.5	small	fusion
57	-0.64	29.2	1.08	-12.6	small	fusion
58	-0.55	28.86	5.46	-4.6	extended	fusion
59	0.59	1.2	3	-25	small	fusion
60	0.64	1.7	5.66	-26.1	small	fusion
61	0.62	4.1	1.28	-18.4	small	fusion
62	0.83	4.28	0.32	-27.2	small	GOUGE
63	0.25	4.36	5.58	-27.9	small	weld
64	0.30	5.86	5.58	-27.8	small	weld
65	0.61	6.46	1.04	-25	small	fusion
66	0.63	8.16	1.92	-17.4	small	fusion
67	0.33	8.46	1.24	-22.5	small	weld
68	0.64	9.76	3.62	-23.9	small	fusion
69	0.63	15.34	5.16	-27.5	small	fusion
70	0.49	15.94	4.34	-24.1	small	weld

Table G.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	0.64	19.04	4.64	-26.1	small	fusion
72	0.67	19.52	4.64	-17.9	small	fusion
73	0.62	19.72	4.74	-27.5	small	fusion
74	0.67	21.76	4.54	-22.2	small	fusion
75	0.68	23.7	4.82	-23	small	fusion
76	-0.09	28.7	5.78	-24.9	small	weld
77	0.72	29.68	4.54	-23.9	small	fusion
78	-0.57	30.12	4.1	-22.7	small	fusion
79	-0.70	30.94	1.08	-5	long	fusion
80	-0.75	32.6	1.04	-13.9	small	fusion
81	-0.53	33.9	2.74	-29.7	small	fusion
82	-0.65	34	1.08	-23.7	small	fusion
83	-0.69	34.24	1.08	-22.3	small	fusion
84	-0.60	34.8	1.08	-30.1	small	fusion
85	-0.69	37.58	0.74	-23.4	small	fusion
86	-0.64	37.8	0.92	-25.6	small	fusion
87	-0.71	38.14	0.72	-29.5	small	fusion
88	-0.54	38.74	2.28	-28.7	small	fusion
89	-0.58	42.26	3.86	-27	small	fusion
90	-0.56	42.46	3.34	-24.6	small	fusion
91	-1.50	42.68	0.12	-33.8	small	clad
92	-0.55	43.62	3.08	-30	small	fusion
93	-0.50	45.72	5.3	-26.6	small	fusion
94	-0.59	46.92	2.62	-27.1	small	fusion
95	-0.61	47.18	0.98	-21.2	small	fusion
96	-0.59	47.3	2.48	-28	small	fusion
97	-0.59	47.92	2.56	-16.7	small	fusion
98	-0.56	49.22	5	-30.1	small	fusion
99	-0.63	50.08	0.98	-29.3	small	fusion
100	-1.20	51.88	0.3	-32.9	small	GOUGE
101	-0.41	52.52	5.32	-28.2	small	weld
102	0.70	30.1	4.56	-24.9	small	fusion
103	0.17	31.02	0.76	-29.7	small	weld
104	0.72	32.08	4.54	-20.7	small	fusion
105	0.71	34.06	4.6	-29	small	fusion
106	0.64	34.74	0.6	-29.1	small	fusion
107	0.65	36.42	0.42	-27.5	small	fusion
108	0.47	37.8	2.26	-24.2	small	weld
109	0.58	38.9	4.28	-26.3	small	fusion
110	0.68	40	4.56	-24	small	fusion
111	0.45	40.72	2.3	-19.3	small	weld
112	0.71	42	2.92	-26.1	small	fusion

Table G.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	0.71	42.52	4.54	-27.5	small	fusion
114	0.57	42.62	4.34	-22.4	small	fusion
115	0.69	42.78	2.92	-26.1	small	fusion
116	0.69	43.34	4.7	-29.1	small	fusion
117	0.69	44.26	4.68	-20.8	small	fusion
118	0.58	44.74	4.36	-29.2	small	fusion
119	0.58	46.82	4.4	-24.1	small	fusion
120	0.59	48.08	4.4	-26.3	small	fusion
121	0.61	49.14	0.72	-19.6	long	fusion
122	0.57	51.48	4.4	-26.3	small	fusion
123	0.69	50.74	5.7	-27.5	small	fusion
124	0.57	51.46	4.4	-26.3	small	fusion
125	0.88	52.56	0.44	-28.9	small	GOUGE

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

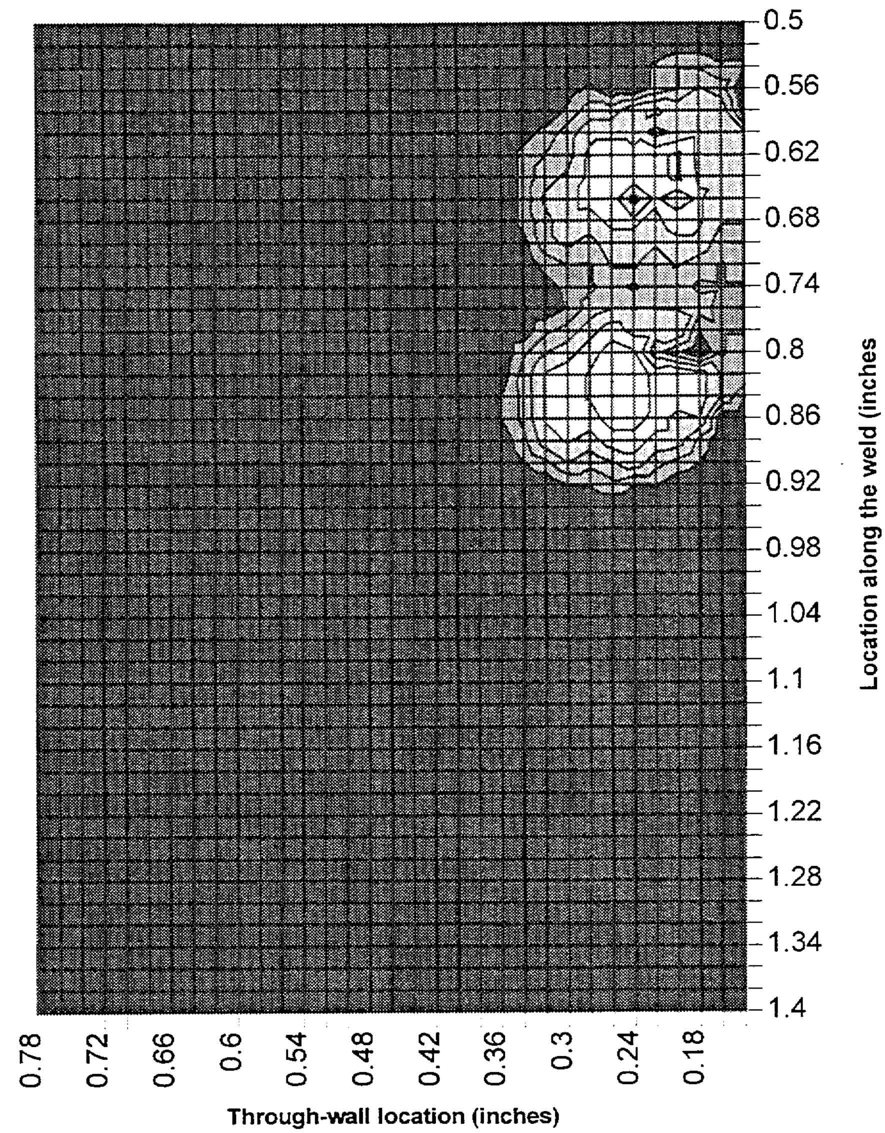

Figure G.1 **Log-scale contour plot of indication #1 in Shoreham specimen C0E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -21.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is inner 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located at the clad to base metal interface at 0.98 inches above 553 inches of vessel elevation.**

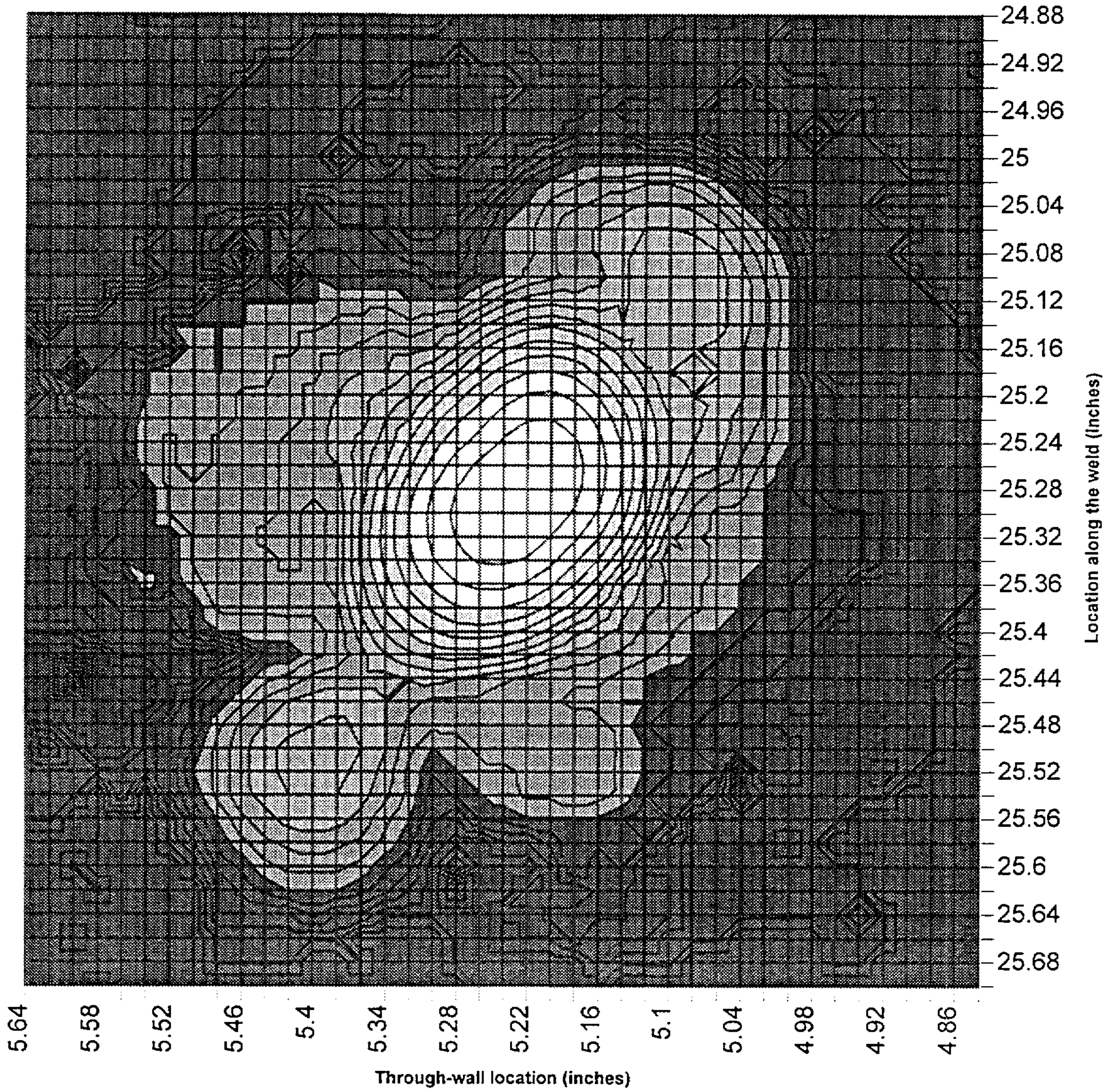

Figure G.2 Log-scale contour plot of indication #51 in Shoreham specimen C0E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is outer 25 mm. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.54 inches above 553 inches of vessel elevation.

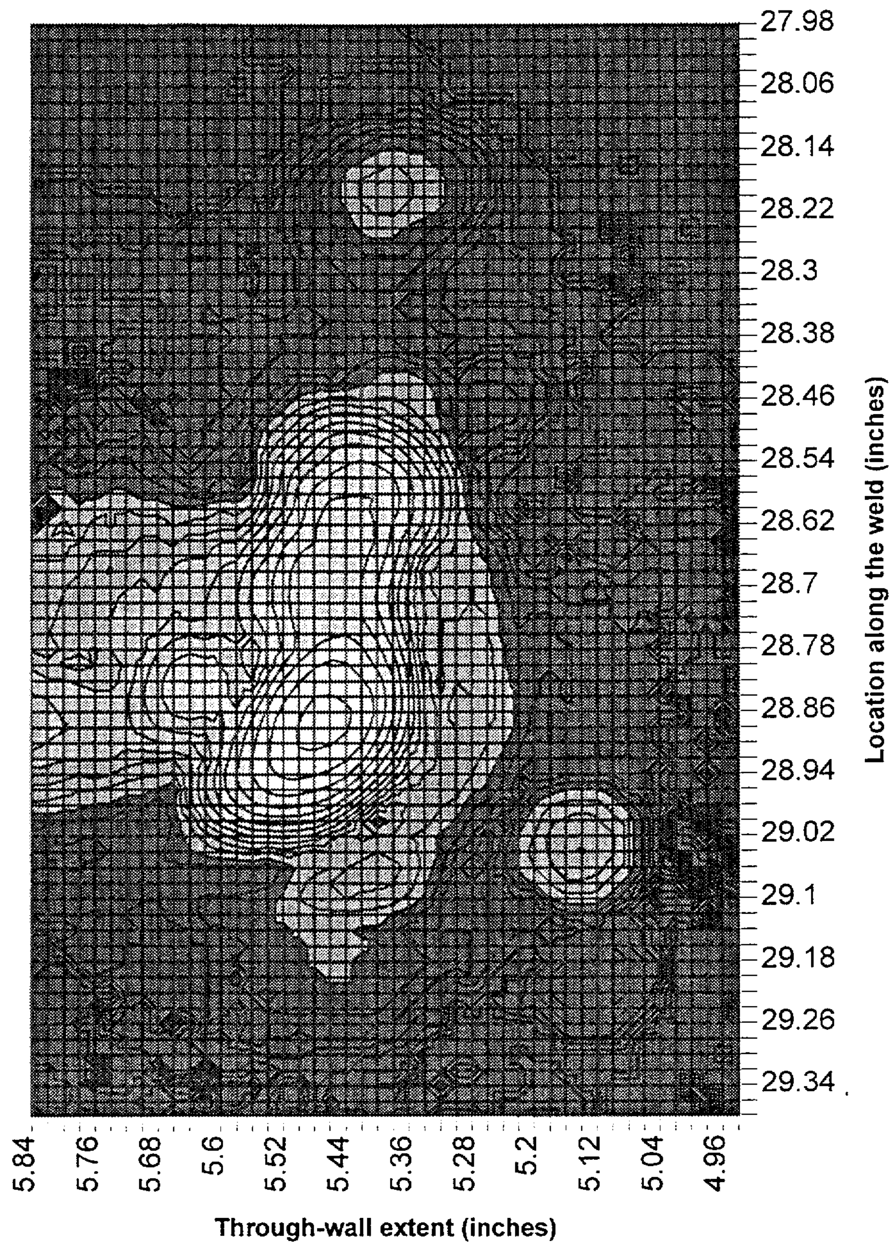

Figure G.3 Log-scale contour plot of indication #58 in Shoreham specimen C0E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -4.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.55 inches above 553 inches of vessel elevation.

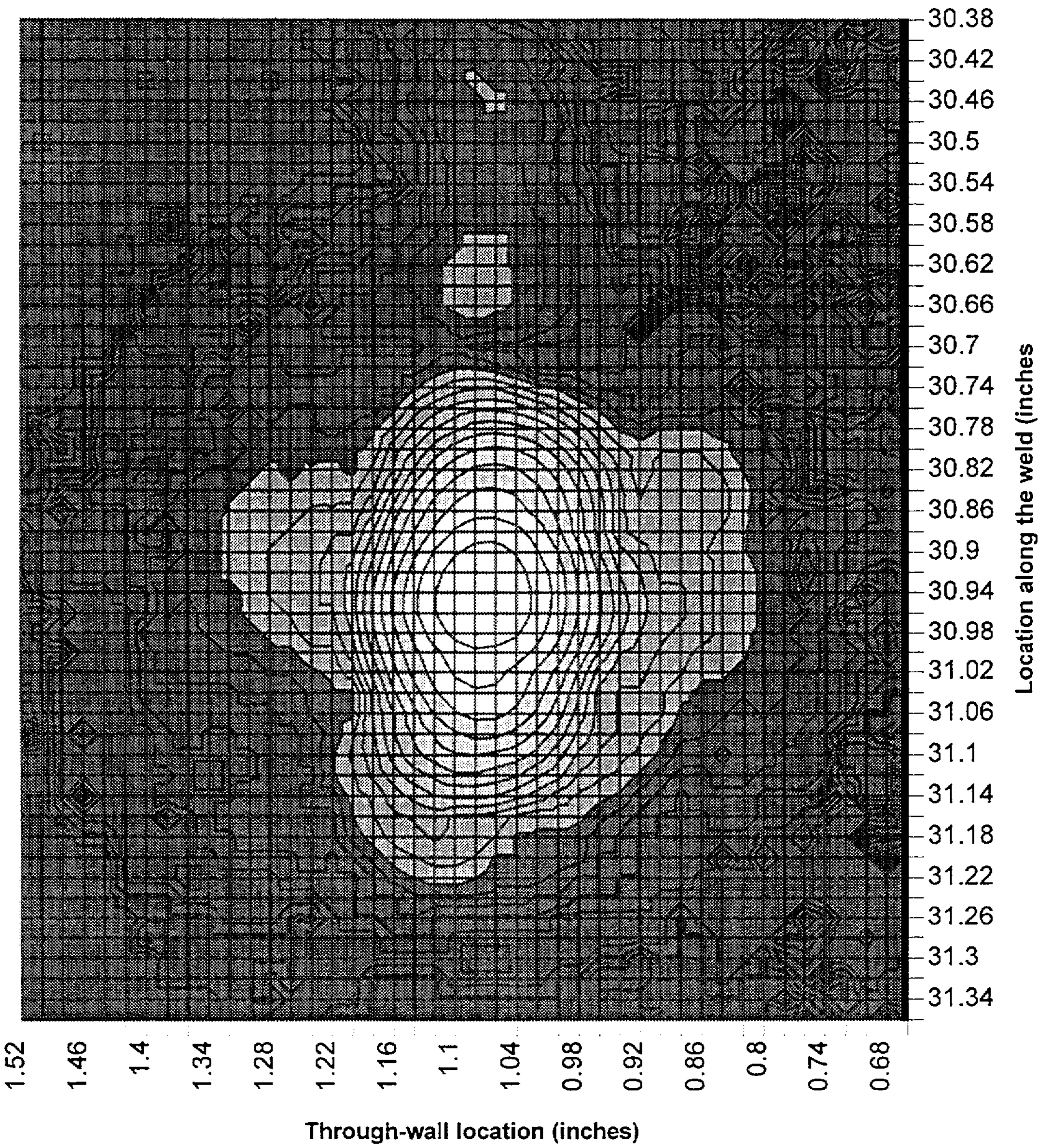

Figure G.4 Log-scale contour plot of indication #79 in Shoreham specimen C0E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.70 inches above 553 inches of vessel elevation.

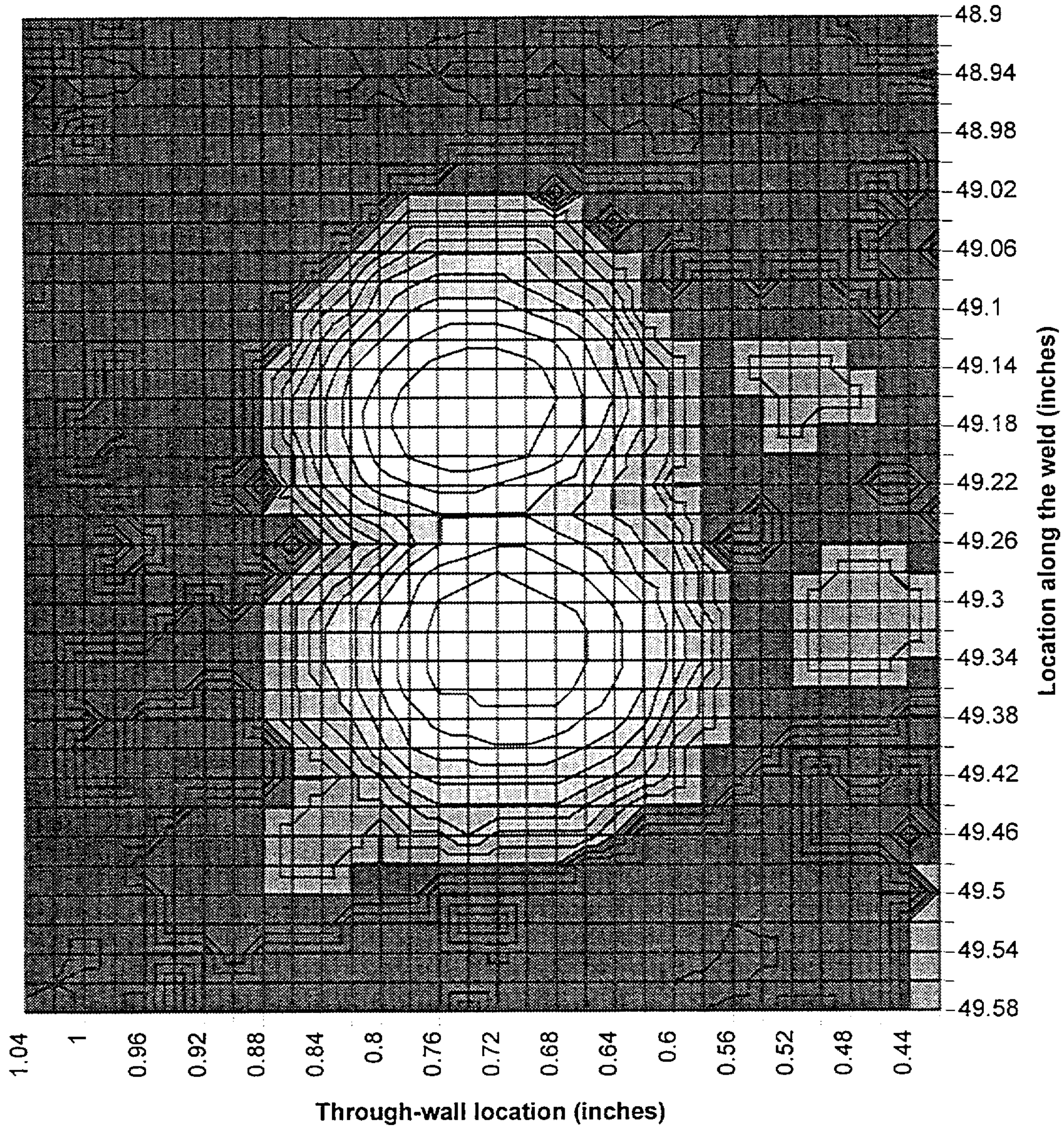

Figure G.5 **Log-scale contour plot of indication #121 in Shoreham specimen C0E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is inner 25 mm. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.61 inches below 553 inches of vessel elevation.**

Appendix H

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C0F

Table H.1 lists all detectable flaw indications in Shoreham specimen C0F. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C0F is given in Section 2. Figures H.1 through H.10 show the images of the larger indications in the specimen.

Table H.1 List of all indications for Shoreham specimen C0F

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.74	506.52	4.14	-18.6	small	fusion
2	-0.69	506.96	3.38	-29	small	fusion
3	-0.66	507.04	2.6	-27.9	small	fusion
4	-1.33	507.26	0.3	-22.4	small	GOUGE
5	-0.59	508.62	2.46	-29	small	ROOT
6	-0.78	509.92	4.36	-22.2	small	fusion
7	-0.68	510.38	3.22	-22.7	small	fusion
8	-0.70	510.68	4.06	-17.6	small	fusion
9	-0.75	512	3.88	-16.4	small	fusion
10	-0.66	512.02	2.78	-19.8	small	fusion
11	-0.65	512.6	0.92	-14.6	surface-elong.	fusion
12	-0.73	513.54	3.82	-16.1	long	fusion
13	-0.79	513.8	5.58	-23.5	small	fusion
14	-0.72	514.06	3.3	-18.7	small	fusion
15	-0.67	514.44	1.24	-14.7	small	fusion
16	-0.67	514.54	2.8	-20	small	fusion
17	-0.67	515.82	1.4	-18.2	small	fusion
18	-0.77	518.62	3.82	-6.2	long	fusion
19	-0.73	519.5	3.8	-13.3	small	fusion
20	-0.78	519.56	4.88	-27.5	small	fusion
21	-0.74	520.26	3.8	-13.4	small	fusion
22	-0.72	520.16	3.44	-28.4	small	fusion
23	-0.65	519.06	0.54	-25.1	small	fusion
24	-0.81	520.58	4.72	-12.3	small	fusion
25	-0.74	520.78	4.8	-17.2	small	fusion
26	-0.76	521	4.96	-17.8	small	fusion
27	-0.73	521.3	3.42	-18.2	small	fusion

Table H.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.75	521.54	3.8	-14.3	small	fusion
29	-0.74	522.36	3.84	-11	long	fusion
30	-0.73	522.44	2.82	-24.7	small	fusion
31	-0.73	522.78	3.28	-27.9	small	fusion
32	-0.80	522.82	4.1	-9.4	small	fusion
33	-0.75	523.2	3.78	-17	small	fusion
34	-0.74	523.5	3.78	-25.1	small	fusion
35	-0.80	524.2	4.46	-23.2	small	fusion
36	-0.52	524.6	2.34	-28.4	small	ROOT
37	-0.74	525.32	2.9	-27.5	small	fusion
38	-0.74	525.48	3.8	-17.2	small	fusion
39	-0.80	525.48	4.26	-20.8	small	fusion
40	-0.75	526.06	3.8	-9.1	extended	fusion
41	-0.75	527.96	3.76	-9.9	small	fusion
42	-0.81	526.96	4.14	-18.7	small	fusion
43	-0.83	527.14	4.7	-21.4	small	fusion
44	-0.74	528.32	3.26	-14.4	small	fusion
45	-0.65	528.3	2.66	-22.4	small	fusion
46	-0.59	527.48	2.4	-26.6	small	ROOT
47	-0.71	528.64	1.08	-18.2	small	fusion
48	-0.67	528.12	1.06	-25.8	small	fusion
49	-0.68	527.82	1.1	-29.5	small	fusion
50	-0.75	529.2	3.24	-15	small	fusion
51	-0.77	529.56	3.74	-12.8	extended	fusion
52	-0.78	530.06	3.76	-6	long	fusion
53	-0.74	529.96	3.26	-19.6	small	fusion
54	-0.73	530.24	2.78	-10	small	fusion
55	-0.82	530.66	4.64	-24.4	small	fusion
56	-0.77	531.14	3.74	-21.7	small	fusion
57	-0.74	531.16	2.8	-17.6	small	fusion
58	-0.76	531.38	3.8	-20	small	fusion
59	-0.73	533.96	0.5	-14.2	small	fusion
60	-0.01	507.42	2.24	-22.4	small	ROOT
61	-0.05	507.82	2.24	-20.3	small	ROOT
62	-0.02	508.3	2.22	-17.5	small	ROOT
63	-0.38	508.86	2.2	-24.4	small	ROOT
64	-0.39	511.32	2.18	-27	small	ROOT
65	0.59	513.94	5.22	-25.6	small	fusion
66	0.67	515.08	3.36	-24.5	small	fusion
67	0.68	515.24	3.34	-24.9	small	fusion
68	0.76	517.98	1.08	-22.4	small	fusion
69	0.79	518.12	1.24	-24.3	small	fusion
70	0.04	520.38	2.26	-26.6	small	ROOT

Table H.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	-0.07	520.88	2.26	-19.5	small	ROOT
72	0.71	521.84	3.38	-19.4	small	fusion
73	0.61	523.38	5.44	-24.3	small	fusion
74	-0.07	525.64	2.28	-23.5	small	ROOT
75	0.69	525.64	3.42	-25.4	small	fusion
76	0.67	525.9	3.94	-26.4	small	fusion
77	0.63	525.84	4.94	-27.1	small	fusion
78	0.60	525.88	5.44	-26.6	small	fusion
79	0.72	527.36	3.36	-17	small	fusion
80	0.72	527.64	3.38	-23.7	small	fusion
81	0.70	527.9	3.4	-23.8	small	fusion
82	0.73	528.28	3.32	-26.4	small	fusion
83	0.72	527.66	2.88	-17.2	small	fusion
84	0.79	527.34	1.04	-24.7	small	fusion
85	0.81	527.26	0.88	-23.4	small	fusion
86	0.68	529.68	3.36	-21.1	small	fusion
87	0.64	529.62	5.3	-27.2	small	fusion
88	-0.09	530.56	2.26	-24.7	small	ROOT
89	0.72	531.84	3.34	-14.7	small	fusion
90	0.86	532.14	0.46	-23.9	small	fusion
91	0.72	533.72	3.36	-23.3	small	fusion
92	0.73	534.7	4.2	-25.7	small	fusion
93	-0.83	533.18	5.52	-24.4	small	fusion
94	-0.74	534.56	1.18	-26.6	small	fusion
95	-0.72	535.58	0.96	-22.2	small	fusion
96	-0.73	535.46	1.42	-25.8	small	fusion
97	-0.79	535.86	3.92	-29.5	small	fusion
98	-0.83	536.44	5.04	-25.4	small	fusion
99	-0.84	536.82	4.3	-24.4	small	fusion
100	-0.70	537.48	0.88	-13.8	small	fusion
101	-0.86	537.44	4.38	-29.5	small	fusion
102	-0.76	537.58	3.78	-29.5	small	fusion
103	-0.80	538.12	3.82	-21.2	small	fusion
104	-0.84	538.6	5.78	-11.1	small	fusion
105	-0.79	539.04	3.78	-7	long	fusion
106	-0.81	539.14	4.9	-29.5	small	fusion
107	-0.80	539.48	5.02	-26.2	small	fusion
108	-0.87	539.64	5.76	-20	small	fusion
109	-0.78	539.86	3.78	-14.2	small	fusion
110	-0.79	540.26	3.78	-7.5	small	fusion
111	-0.81	540.88	3.78	-10.4	small	fusion
112	-0.81	540.78	3.16	-14	small	fusion

Table H.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	-0.82	541.58	3.8	-22.2	small	fusion
114	-0.86	541.72	4.56	-18.4	small	fusion
115	-0.82	541.66	5.76	-22.9	small	fusion
116	-0.87	542.68	5.8	-17.2	small	fusion
117	-0.76	542.64	3.24	-7.7	small	fusion
118	-0.77	543.06	3.36	-15.2	small	fusion
119	-0.81	543.54	3.86	-18.6	small	fusion
120	-0.85	543.88	4.04	-17.8	small	fusion
121	-0.78	543.98	3.32	-19.4	small	fusion
122	-0.87	544.72	4.04	-16.8	small	fusion
123	-0.75	544.54	1.14	-19.2	small	fusion
124	-0.77	544.94	3.2	-25.4	small	fusion
125	-0.92	545.42	5.82	-15.8	small	fusion
126	-0.81	545.56	3.78	-19.8	small	fusion
127	-0.73	545.78	1.42	-11.8	small	fusion
128	-0.74	545.74	0.92	-12.5	small	fusion
129	-0.64	546.16	1.76	-25.8	small	weld
130	-0.73	546.32	3.22	-27.9	small	fusion
131	-0.73	547.5	1.38	-12.4	small	fusion
132	-0.76	547.44	0.72	-13.5	small	fusion
133	-0.75	547.82	3.22	-13.2	small	fusion
134	-0.77	548.04	3.26	-12.2	small	fusion
135	-0.82	548	3.76	-10.4	small	fusion
136	-0.78	548.68	3.38	-17.5	small	fusion
137	-0.71	549.08	2.86	-20.8	small	fusion
138	-0.64	549.32	2.4	-22.4	small	ROOT
139	-0.83	550.12	5.06	-7.3	extended	fusion
140	-0.76	550.18	3.12	-16.1	small	fusion
141	-0.78	550.5	3.3	-16	small	fusion
142	-0.57	550.64	2.28	-27	small	ROOT
143	-0.87	550.72	5.82	-15.8	small	fusion
144	-0.80	550.76	0.5	-5.4	surface-elongated	fusion
145	-0.65	551.26	1.72	-13.5	small	fusion
146	-0.72	551.18	2.58	-18.9	small	fusion
147	-0.77	551.16	3.14	-14.2	small	fusion
148	-0.76	552.08	3.14	-8.2	small	fusion
149	-0.61	552.44	2.2	-25.8	small	ROOT
150	-0.84	552.68	2.5	-30.8	small	fusion
151	-0.70	537.48	0.9	-13.9	small	fusion
152	-0.60	537.94	1.72	-25.1	small	ROOT
153	0.66	539.06	5.3	-17.3	small	fusion
154	0.59	538.88	5.8	-24.3	small	fusion

Table H.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	0.82	539.2	1.22	-22.6	small	fusion
156	-0.57	539.48	2.4	-27	small	ROOT
157	0.81	539.74	1.36	-23	small	fusion
158	-0.63	540.3	1.7	-23.2	small	ROOT
159	0.81	541.24	1.26	-20.7	small	fusion
160	-0.55	541.06	1.48	-24.7	small	ROOT
161	0.79	541.7	2.86	-25.4	small	fusion
162	-0.35	542.08	2.22	-22.2	small	ROOT
163	0.69	542.52	3.28	-21.6	small	fusion
164	0.69	542.56	5.76	-25.3	small	fusion
165	0.81	542.84	1.2	-20.3	small	fusion
166	0.30	544.46	2.26	-25.3	small	ROOT
167	0.84	544.88	1.2	-18.1	small	fusion
168	0.76	546.04	3.28	-26.1	small	fusion
169	0.82	546.8	1.34	-22.3	small	fusion
170	-0.37	547.1	2.2	-20	small	ROOT
171	-0.34	547.34	2.22	-13.9	small	ROOT
172	0.85	547.48	1.22	-15.2	small	fusion
173	0.79	547.74	2.86	-23	small	fusion
174	0.84	548.04	1.22	-16.1	small	fusion
175	-0.56	548.26	3.24	-27.5	small	weld
176	-0.44	548.5	4.46	-23.5	small	weld
177	0.86	549.3	1.34	-28.6	small	fusion
178	0.40	549.74	4.56	-25.2	small	weld
179	-0.53	550.12	3.28	-29.5	small	weld
180	-0.52	550.64	2.26	-28.4	small	ROOT
181	-0.50	550.84	5.8	-25.4	small	weld
182	-0.52	551.22	3.2	-22.2	small	weld
183	-0.32	551.8	2.12	-21.7	small	ROOT
184	0.76	551.82	4.88	-24.7	small	fusion
185	0.76	551.98	5.8	-29.7	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for Azimuth less than 0 degrees.

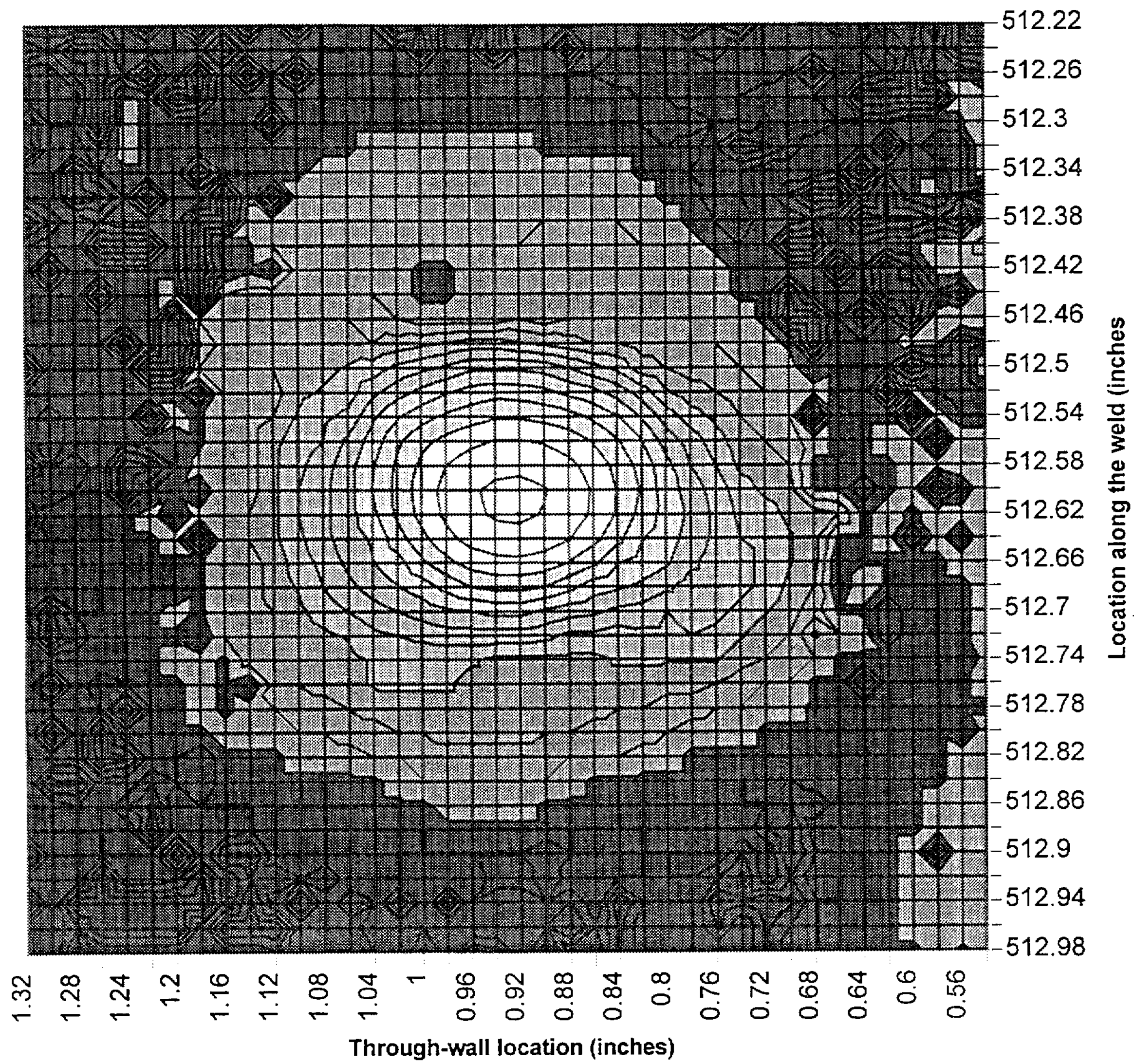

Figure H.1 Log-scale contour plot of indication #11 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is inner 25 mm. The length is 7 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as surface elongated, is located on the fusion surface at 0.65 inches above (positive angle) 0.0 degrees of vessel azimuth.

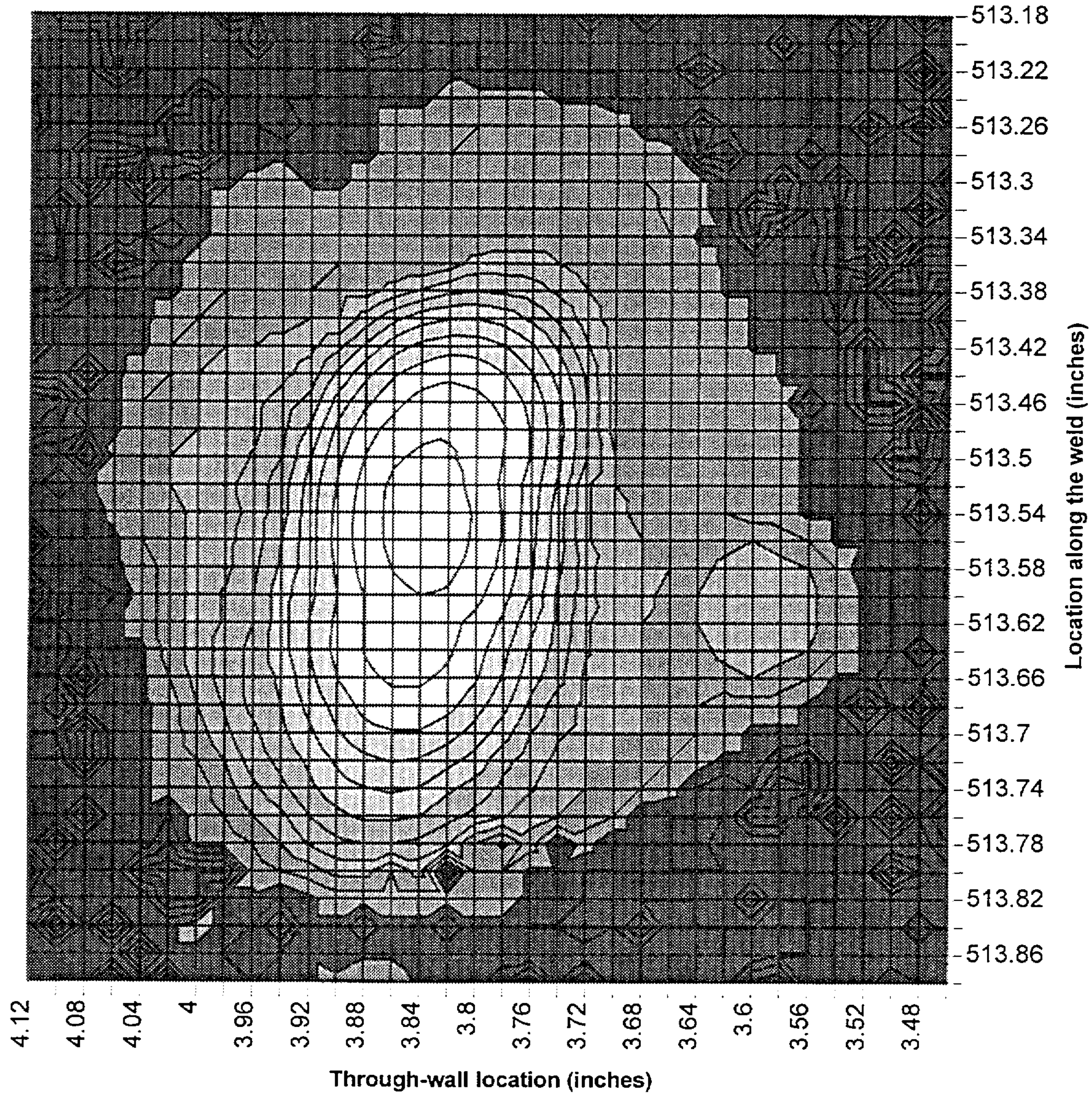

Figure H.2 Log-scale contour plot of indication #12 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -16.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is midwall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.73 inches above (positive angle) 0.0 degrees of vessel azimuth.

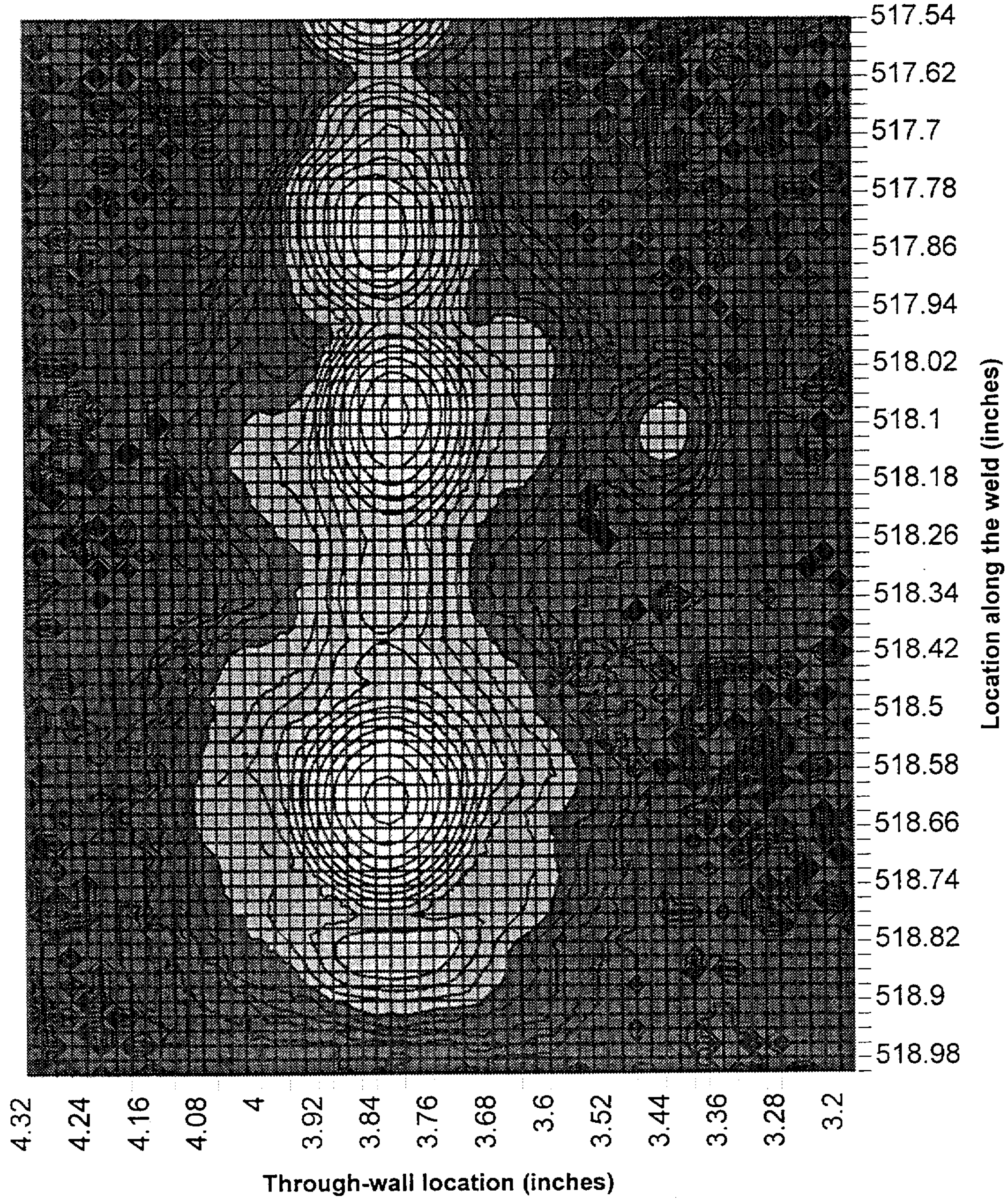

Figure H.3 Log-scale contour plot of indication #18 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 33 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.77 inches above (positive angle) 0.0 degrees of vessel azimuth.

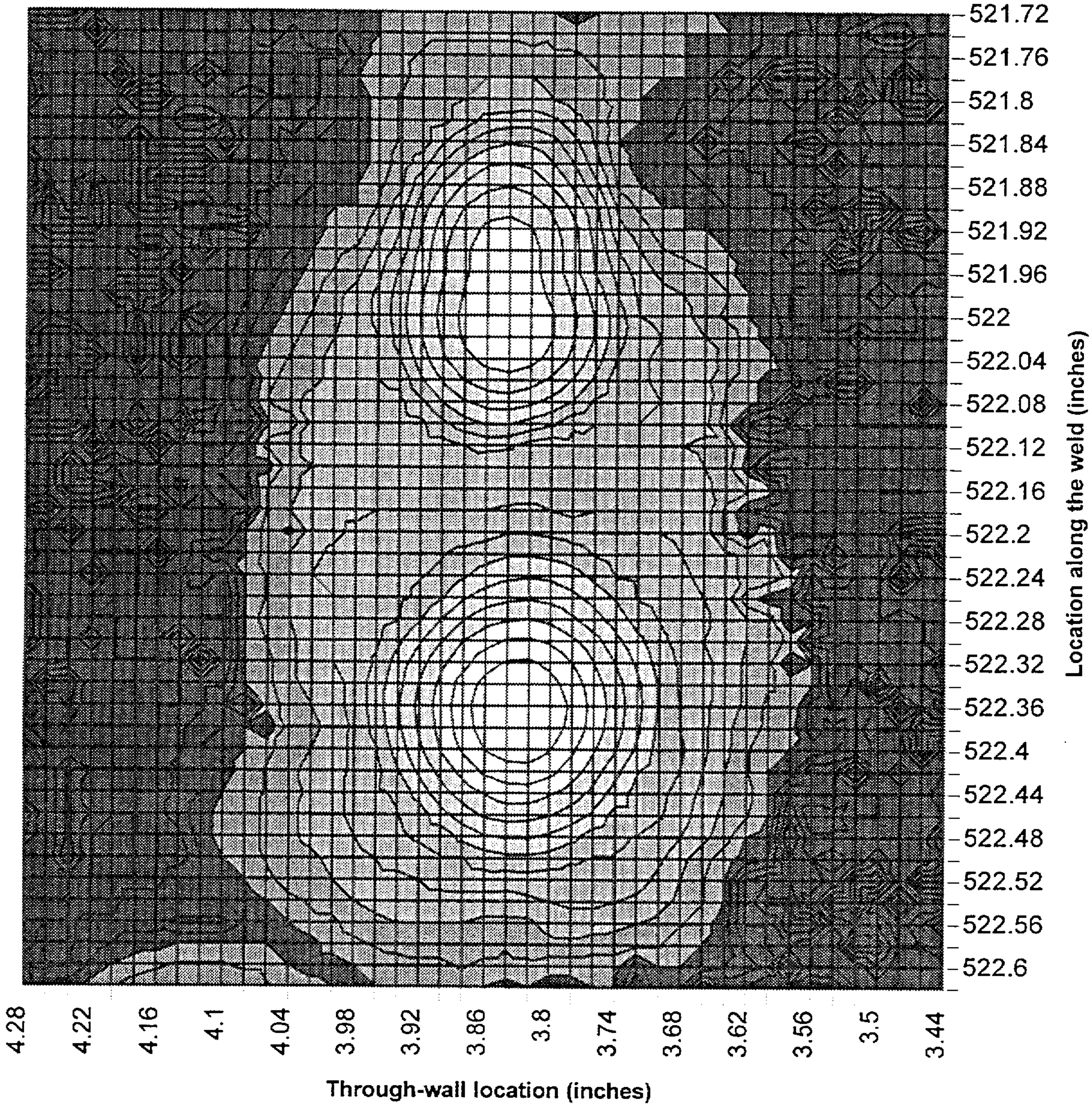

Figure H.4 Log-scale contour plot of indication #29 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -11.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.74 inches above (positive angle) 0.0 degrees of vessel azimuth.

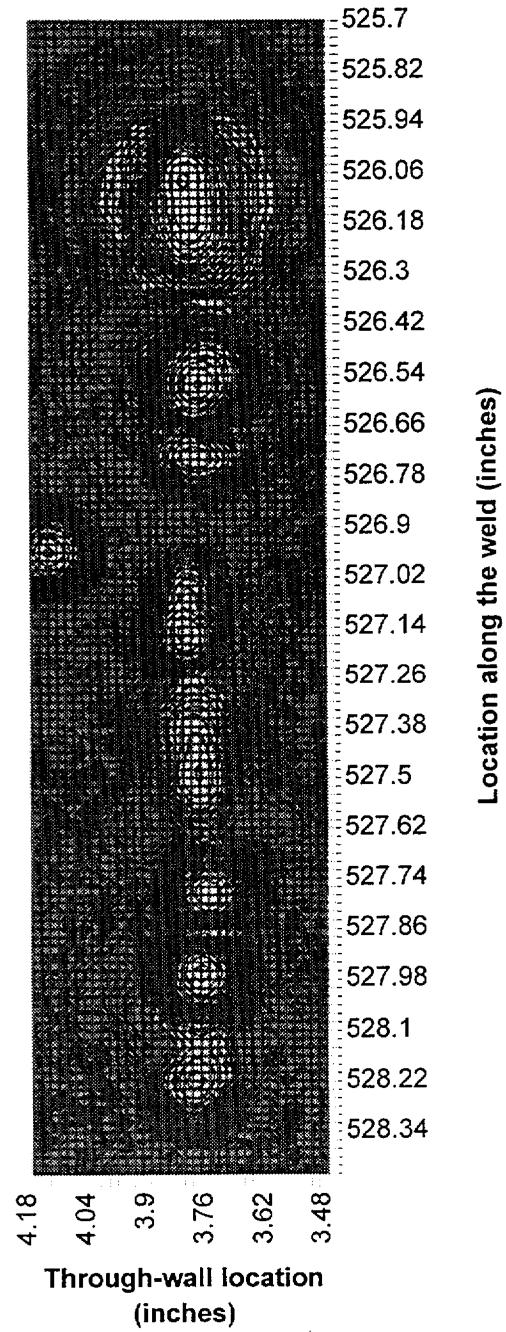

Figure H.5 **Log-scale contour plot of indication #40 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 61 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.75 inches above (positive angle) 0.0 degrees of vessel azimuth.**

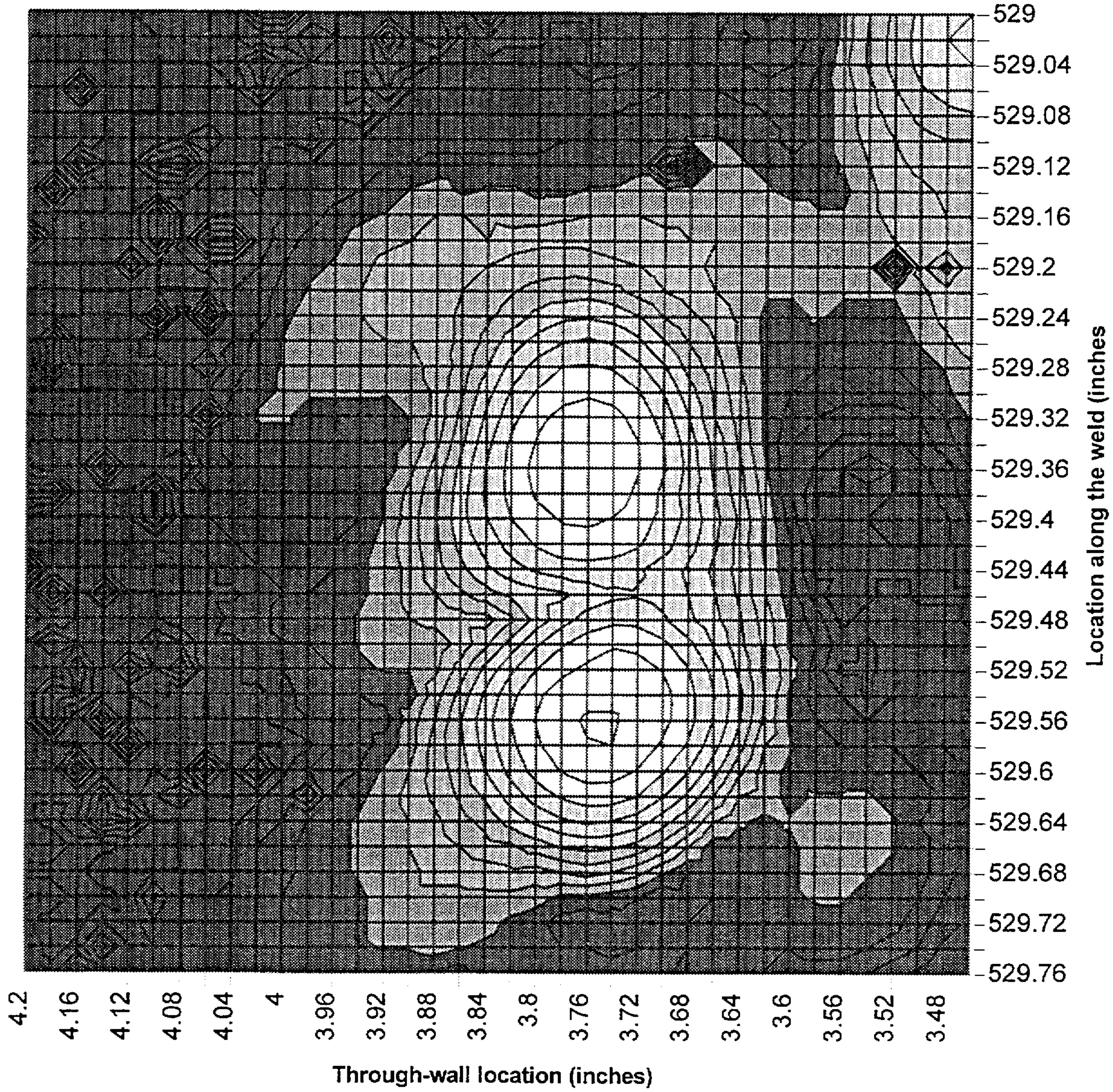

Figure H.6 Log-scale contour plot of indication #51 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 14 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.77 inches above (positive angle) 0.0 degrees of vessel azimuth.

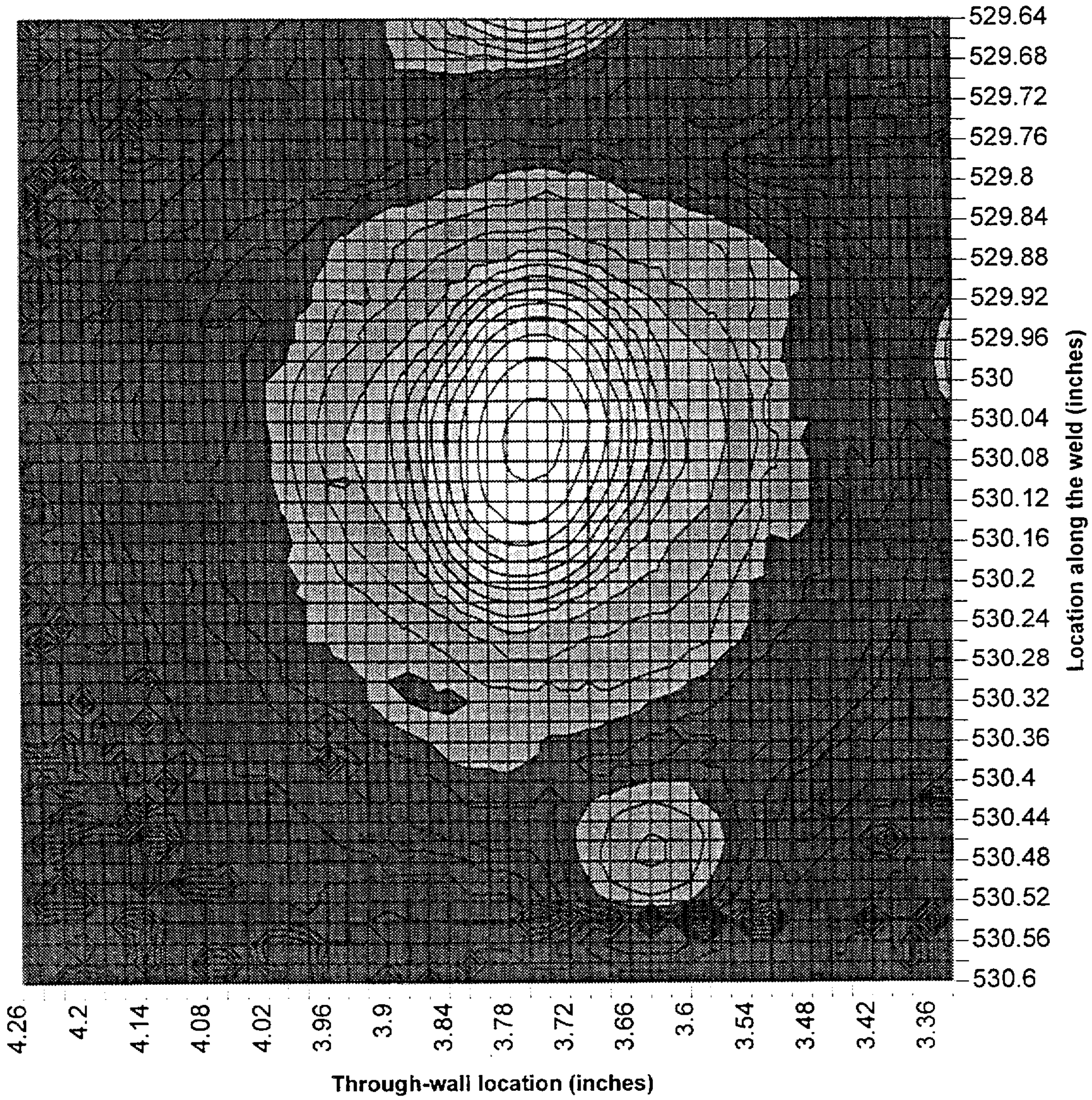

Figure H.7 **Log-scale contour plot of indication #52 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.78 inches above (positive angle) 0.0 degrees of vessel azimuth.**

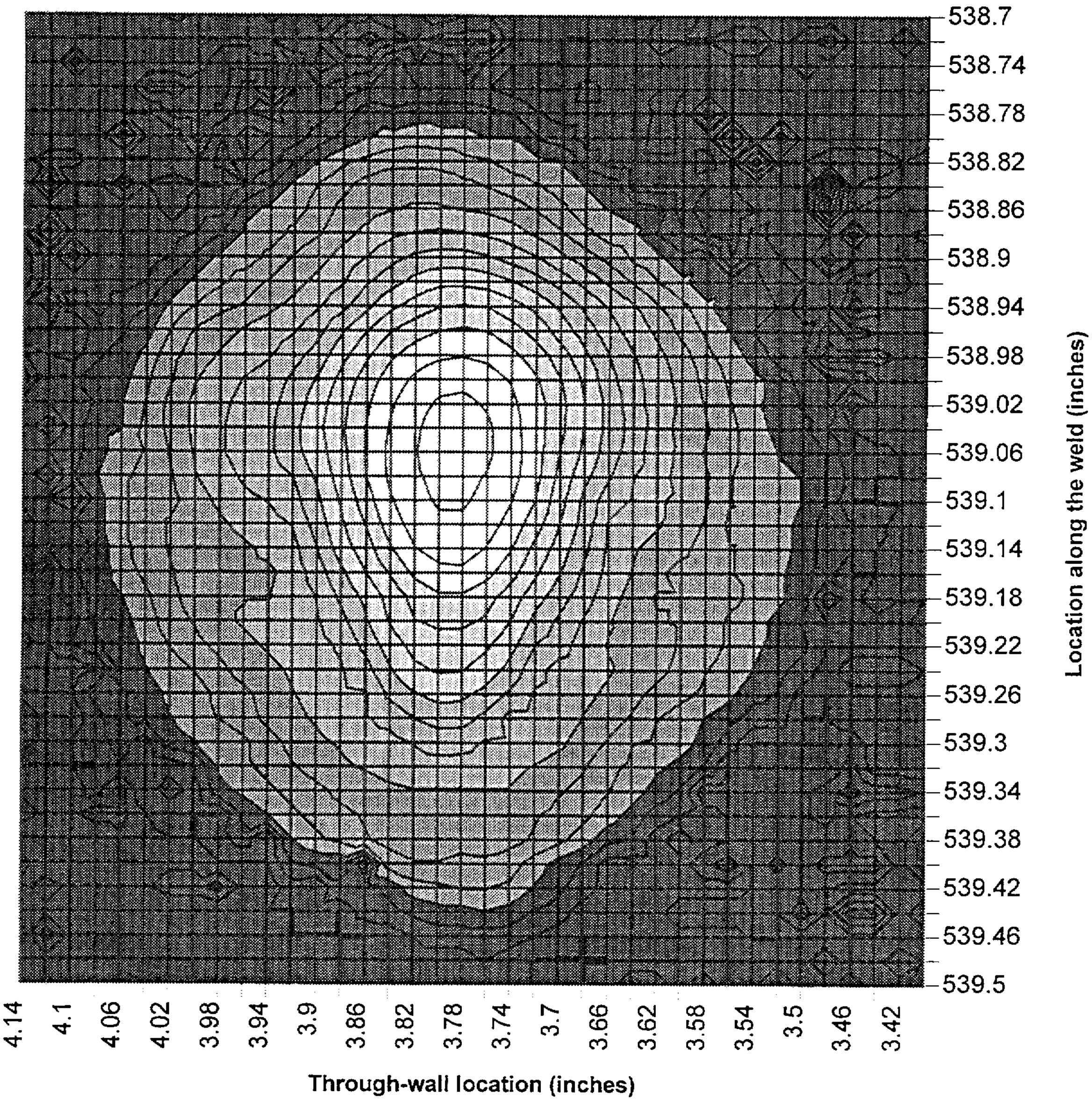

Figure H.8 Log-scale contour plot of indication #105 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.79 inches above (positive angle) 0.0 degrees of vessel azimuth.

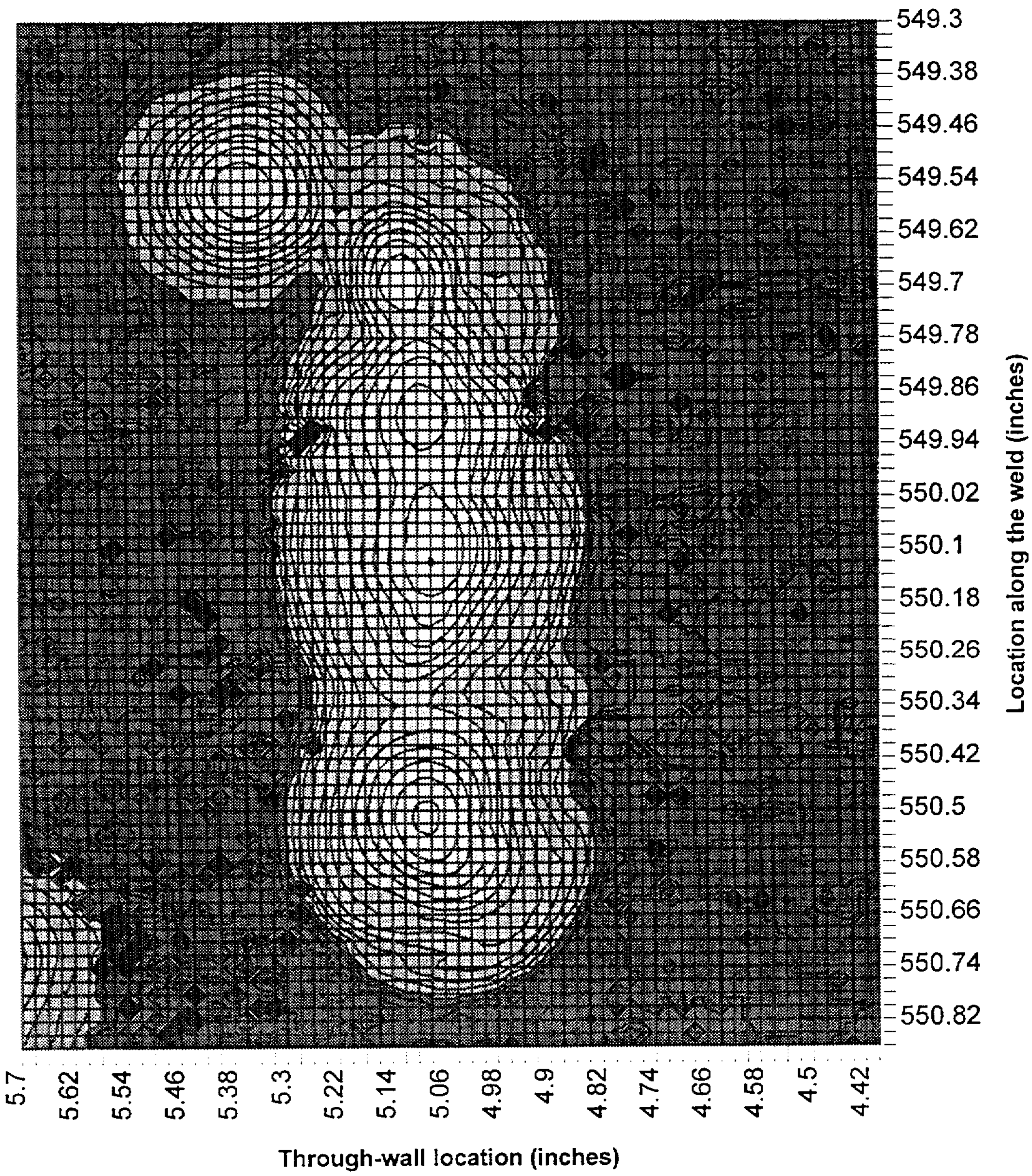

Figure H.9 **Log-scale contour plot of indication #139 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 36 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.83 inches above (positive angle) 0.0 degrees of vessel azimuth.**

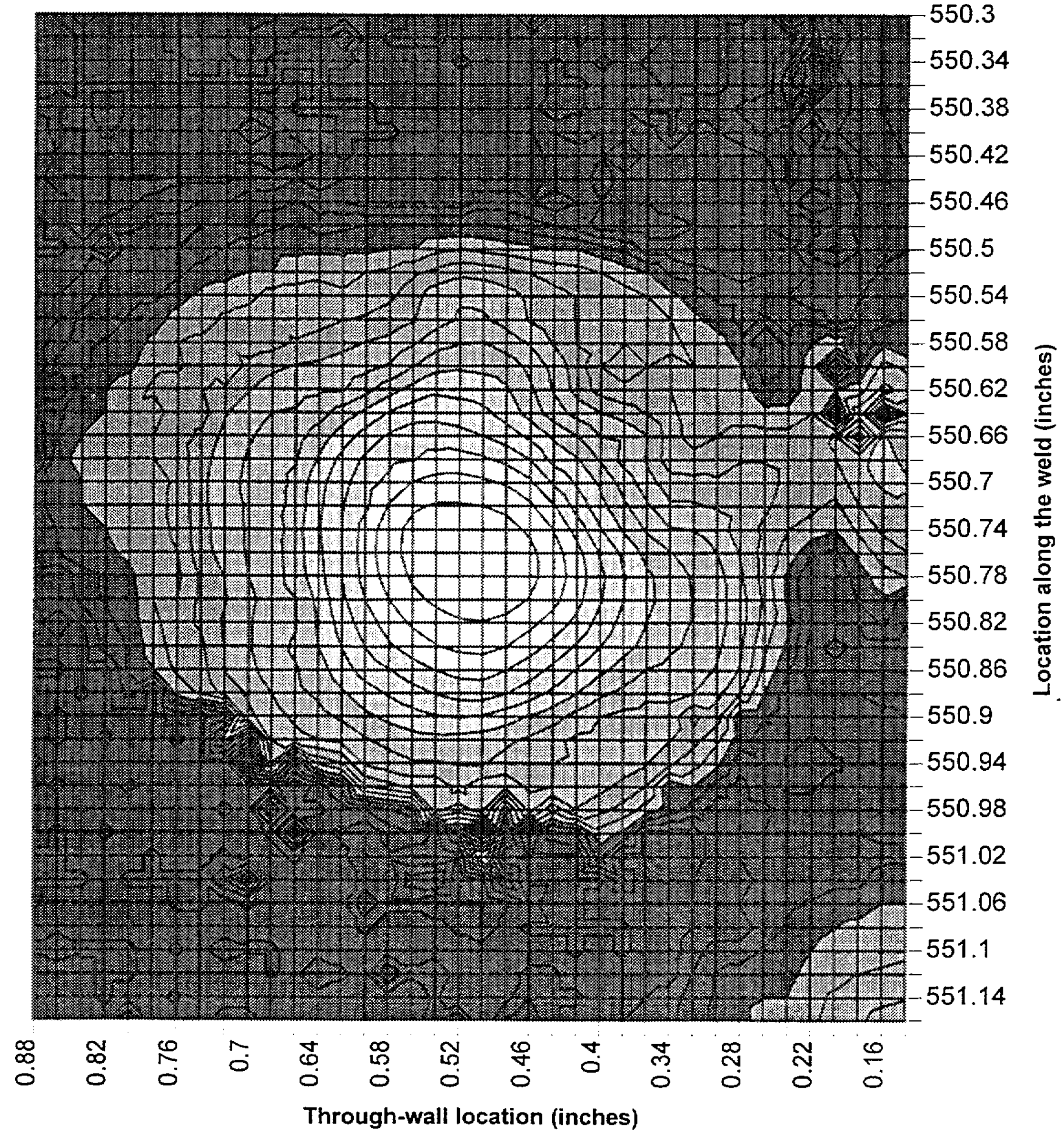

Figure H.10 **Log-scale contour plot of indication #144 in Shoreham specimen C0F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is inner 25 mm. The length is 7 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as surface elongated, is located on the fusion surface at 0.80 inches above (positive angle) 0.0 degrees of vessel azimuth.**

Appendix I

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C0G

Table I.1 lists all detectable flaw indications in Shoreham specimen C0G. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C0G is given in Section 2. Figures I.1 through I.6 show the images of the larger indications in the specimen.

Table I.1 List of all indications for Shoreham specimen C0G

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.57	0.94	4.62	-29.8	small	fusion
2	-0.63	1.14	1.46	-23.6	small	fusion
3	-0.59	1.04	1.02	-26.9	small	fusion
4	-0.61	2.08	2.2	-30.1	small	fusion
5	-0.61	3.52	2.02	-16.4	small	fusion
6	-0.57	4.02	2.44	-28.7	small	fusion
7	-0.63	5.2	2.94	-29	small	fusion
8	-0.59	5.16	0.98	-21.8	small	fusion
9	-0.36	5.18	1.5	-28.7	small	weld
10	-0.63	5.18	2.94	-29	small	fusion
11	-0.56	5.64	5.4	-26.7	small	fusion
12	-0.63	6.3	4.2	-27.1	small	fusion
13	-0.61	7.88	1.02	-27	small	fusion
14	-0.63	8.18	5.54	-19.5	small	fusion
15	-0.63	10.68	2.04	-24.2	small	fusion
16	-0.63	10.6	2.46	-24.2	small	fusion
17	-0.63	11.4	4.42	-13.7	small	fusion
18	-0.63	12.4	4.98	-28	small	fusion
19	-0.61	13.8	0.96	-28.9	small	fusion
20	-0.47	14.64	5.3	-29.3	small	weld
21	-0.65	14.58	5.74	-24.9	small	fusion
22	-0.61	15.66	3.84	-30.1	small	fusion
23	-0.65	16.54	5.68	-23.7	small	fusion
24	-0.63	16.9	2.56	-22.5	small	fusion
25	-0.47	17.08	5.3	-28.2	small	weld
26	-0.65	17.24	5.72	-20.4	small	fusion
27	-0.58	20.74	4.1	-28.8	small	fusion

Table I.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.65	20.74	5.76	-22.6	small	fusion
29	-0.63	21.82	5.48	-29	small	fusion
30	-0.65	22.84	5.18	-26.4	small	fusion
31	-0.63	24.24	5.42	-28	small	fusion
32	-0.65	25.06	1.8	-27.2	small	fusion
33	-0.44	25.88	5.34	-26.1	small	weld
34	-0.60	26.32	2.34	-28.9	small	fusion
35	-0.65	26.62	5.32	-28.1	small	fusion
36	-0.60	27.5	1.64	-24.1	small	fusion
37	-0.63	29.42	2.6	-27.1	small	fusion
38	-0.60	28.6	4.4	-28.9	small	fusion
39	-0.63	29.36	5.78	-17.6	small	fusion
40	-0.63	29.68	5.78	-16	small	fusion
41	0.31	1.22	5.64	-20	small	weld
42	0.29	3.38	5.58	-28	small	weld
43	-0.15	3.46	1.16	-30.3	small	weld
44	-0.36	5.18	1.5	-28.7	small	weld
45	0.22	5.16	2.26	-29.6	small	weld
46	-0.29	4.92	4.14	-29.6	small	weld
47	0.65	4.94	4.8	-25	small	fusion
48	0.91	5.92	0.68	-27.2	small	GOUGE
49	0.26	6.32	5.62	-18.9	small	weld
50	0.56	6.9	5.5	-26.3	small	fusion
51	0.26	7.92	5.62	-26.6	small	weld
52	0.59	9	5.78	-24.1	small	fusion
53	0.59	9.72	4.9	-26.2	small	fusion
54	0.68	10.78	1.12	-27.5	small	fusion
55	-0.31	11.28	1.52	-31.3	small	weld
56	0.73	11.22	1.64	-43	small	fusion
57	0.63	11.56	4.94	-20.2	small	fusion
58	0.68	11.88	4.66	-29	small	fusion
59	0.91	13.68	0.7	-28.7	small	GOUGE
60	0.24	17.14	5.64	-22.7	small	weld
61	0.80	18.68	0.76	-15.3	surface-elongated	GOUGE
62	0.41	18.94	2.54	-29.4	small	weld
63	0.52	18.86	4.44	-21.6	small	weld
64	0.27	19.5	5.62	-17.5	small	weld
65	0.27	19.7	5.6	-28	small	weld
66	0.57	20.72	5.5	-29.2	small	fusion
67	0.48	21.62	4.4	-26.4	small	weld
68	0.27	22.08	5.6	-21.3	small	weld
69	0.15	22.14	2.5	-28.1	small	weld
70	0.50	22.6	4.42	-15.7	small	weld

Table I.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	0.13	22.8	2.46	-29.7	small	weld
72	0.25	24.18	5.62	-17.1	small	weld
73	0.59	25.38	5.26	-26.2	small	fusion
74	0.59	26.02	5.26	-23.1	small	fusion
75	0.57	28.78	5.64	-29.2	small	fusion
76	0.59	29.6	4.76	-4.3	small	fusion
77	-0.63	30.08	5.78	-17.6	small	fusion
78	-0.63	30.72	5.74	-4.9	extended	fusion
79	-0.63	31.48	5.74	-12.4	small	fusion
80	-0.63	32.3	5.72	-5.5	small	fusion
81	-0.60	31.96	1.06	-27.9	small	fusion
82	-0.58	33.88	4.34	-27.8	small	fusion
83	-0.58	34.1	5.4	-27.8	small	fusion
84	-0.65	34.16	1.46	-26.4	small	fusion
85	-0.65	35.16	0.78	-21.2	small	fusion
86	-0.58	35.46	2.42	-28.8	small	fusion
87	-0.62	35.62	1.06	-27.1	small	fusion
88	-0.65	35.98	5.6	-23.1	small	fusion
89	-0.60	36.22	2.4	-23.5	small	fusion
90	-0.62	36.76	4.16	-23	small	fusion
91	-0.65	37.64	5.5	-23.7	small	fusion
92	-0.60	37.88	0.9	-15.6	small	fusion
93	-0.60	38.4	2.4	-27	small	fusion
94	-0.62	38.4	5.72	-20.7	small	fusion
95	-0.58	38.54	5.32	-26	small	fusion
96	-0.60	38.38	2.42	-26.2	small	fusion
97	-0.62	38.86	1.42	-28	small	fusion
98	-0.65	40.9	4.4	-24.9	small	fusion
99	-0.60	41.3	2.34	-22.4	small	fusion
100	-0.58	41.7	4.36	-23.9	small	fusion
101	-0.60	41.86	2.42	-27	small	fusion
102	-0.65	43.04	5.4	-24.3	small	fusion
103	-0.62	43.12	1.02	-26.3	small	fusion
104	-0.65	43.78	5.44	-28.1	small	fusion
105	-0.67	44.3	5.32	-27.3	small	fusion
106	-0.60	44.24	1.1	-31.4	small	fusion
107	-0.62	46.24	5.72	-19.1	extended	fusion
108	-0.62	46.26	5.18	-29	small	fusion
109	-0.60	46.52	3.5	-15.2	small	fusion
110	-0.55	46.72	5.62	-24.5	small	fusion
111	-0.58	47.28	5.74	-21.3	extended	fusion
112	-0.64	47.48	5.28	-16.8	small	fusion

Table I.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	-0.60	47.22	2.66	-28.9	small	fusion
114	-0.48	48.42	5.32	-24.1	small	weld
115	-0.64	49.12	5.68	-18.6	small	fusion
116	-0.62	49.9	5.26	-18.5	extended	fusion
117	-0.60	50.34	4.64	-21.4	small	fusion
118	-0.57	51.04	2.86	-26	small	fusion
119	-0.55	51.02	0.92	-25.2	small	fusion
120	-0.64	50.68	0.84	-29.1	small	fusion
121	-0.57	51.88	5.74	-23.9	small	fusion
122	-0.78	52.1	0.24	-29.8	small	clad
123	-0.62	52.92	5.28	-27.1	small	fusion
124	-0.57	53.52	5.72	-24.6	small	fusion
125	-0.67	53.6	0.7	-25	small	fusion
126	-0.60	54.3	5.22	-26.2	small	fusion
127	-0.60	54.9	1.58	-12.3	small	fusion
128	0.57	30.58	4.74	-10.9	small	fusion
129	0.55	30.94	4.78	-22.4	small	fusion
130	0.55	31.22	4.74	-21.6	small	fusion
131	0.62	31.16	3.7	-25	small	fusion
132	0.48	32.44	4.44	-25.2	small	weld
133	0.48	33.26	4.46	-23.3	small	weld
134	0.62	34.18	4.78	-15.5	small	fusion
135	0.48	34.44	4.48	-21	small	weld
136	0.62	36.6	4.74	-22.3	small	fusion
137	0.48	37.64	5.42	-26.4	small	weld
138	0.92	38.5	0.52	-18.6	surface-elongated	GOUGE
139	0.53	39.62	4.4	-22.4	small	weld
140	0.60	41.72	4.76	-25.1	small	fusion
141	0.50	42.08	4.44	-24.2	small	weld
142	0.50	42.34	4.42	-21	small	weld
143	0.62	42.72	4.74	-24	small	fusion
144	0.50	43	4.4	-20.3	small	weld
145	0.60	43.62	4.72	-25.1	small	fusion
146	0.50	44	4.4	-25.2	small	weld
147	0.48	45.74	4.44	-23.3	small	weld
148	0.71	45.9	2.72	-26.1	small	fusion
149	0.67	45.56	0.94	-26.1	small	fusion
150	0.64	46.88	4.68	-18	small	fusion
151	0.53	49.08	4.44	-19.1	small	weld
152	-0.28	49.44	3.42	-24.3	small	weld
153	0.64	50.54	4.74	-14.8	small	fusion
154	0.71	51.32	1.66	-23.9	small	fusion

Table I.1 (contd)						
	Peak Coordinates (Specimen)					
#	**Weld Center (inches)**	**Along Weld (inches)**	**Depth (inches)**	**Response (dB)**	**Characterization**	**Type (material)**
155	0.55	52.06	4.42	-25.1	small	fusion
156	0.53	53.32	4.44	-26.3	small	weld
157	0.67	54.2	0.88	-26.1	small	fusion
158	0.69	56.18	2.82	-16.2	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

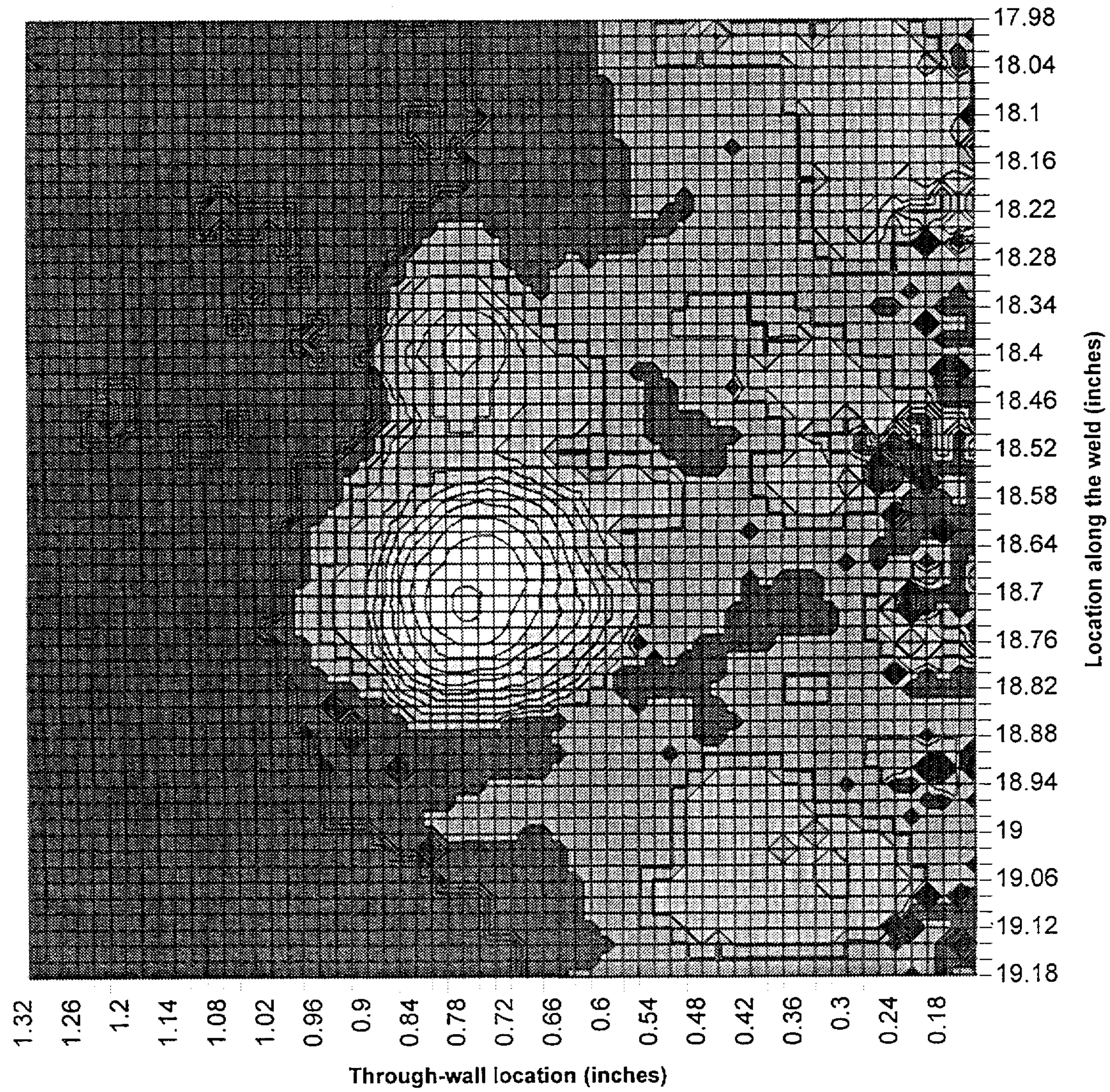

Figure I.1 **Log-scale contour plot of indication #61 in Shoreham specimen C0G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is inner 25 mm. The length is 14 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the weld back-gouge at 0.80 inches below 553 inches of vessel elevation.**

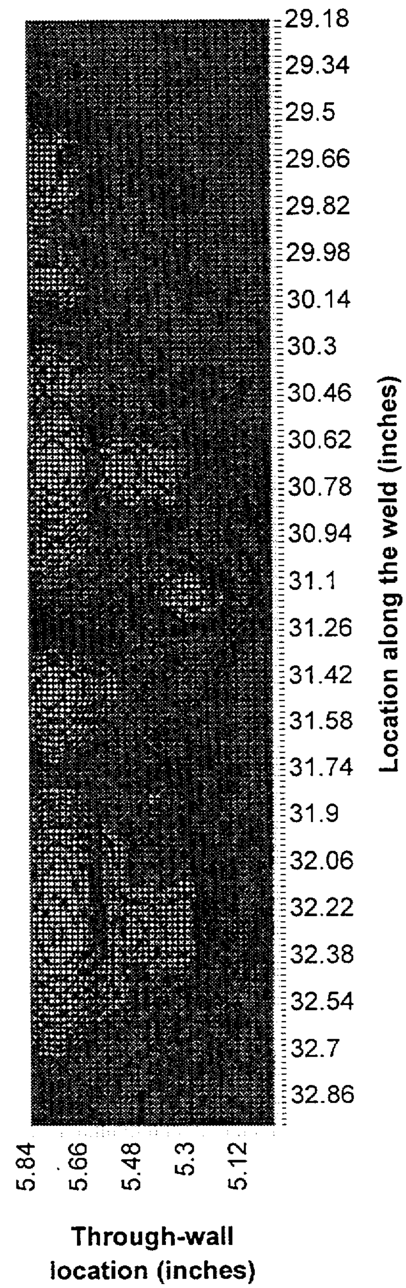

Figure I.2 Log-scale contour plot of indication #78 in Shoreham specimen C0G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -4.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 81 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.63 inches above 553 inches of vessel elevation.

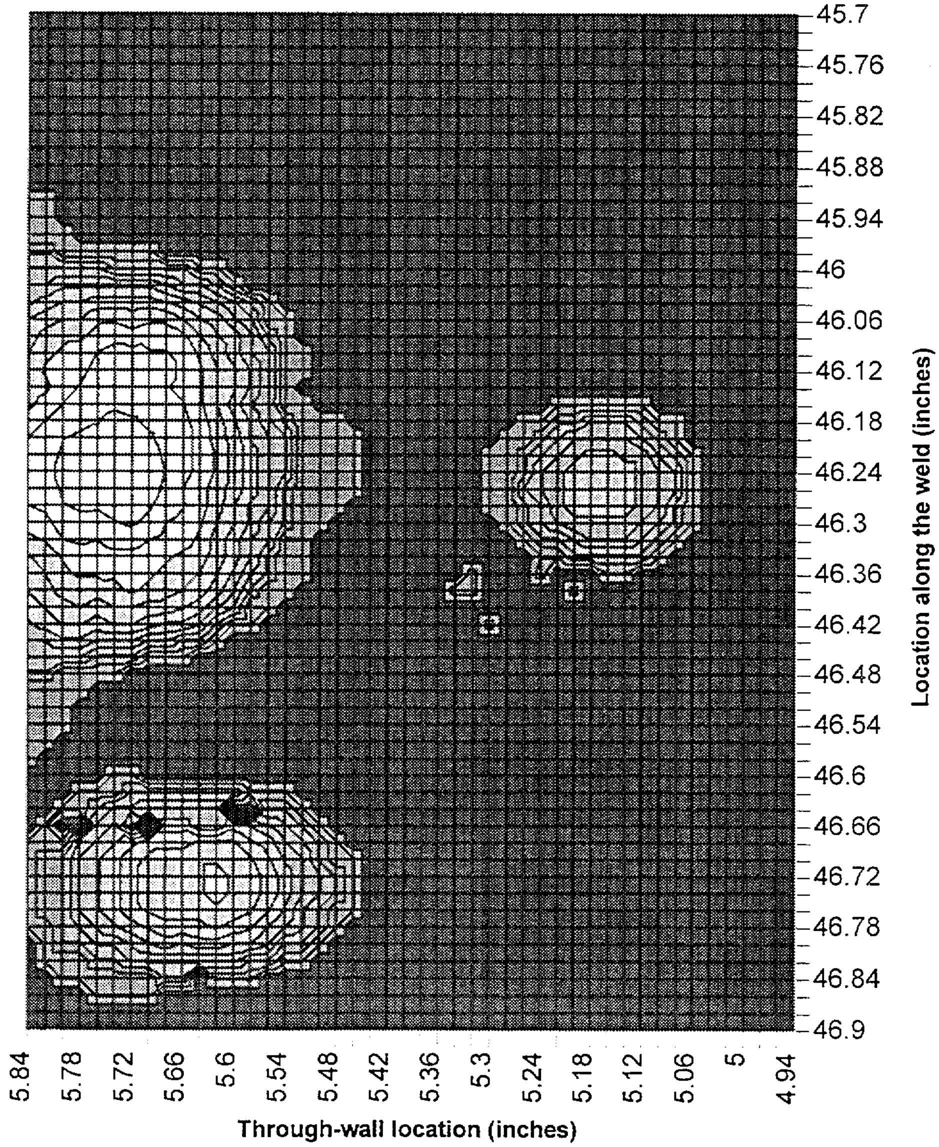

Figure I.3 Log-scale contour plot of indication #107 in Shoreham specimen C0G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.62 inches above 553 inches of vessel elevation.

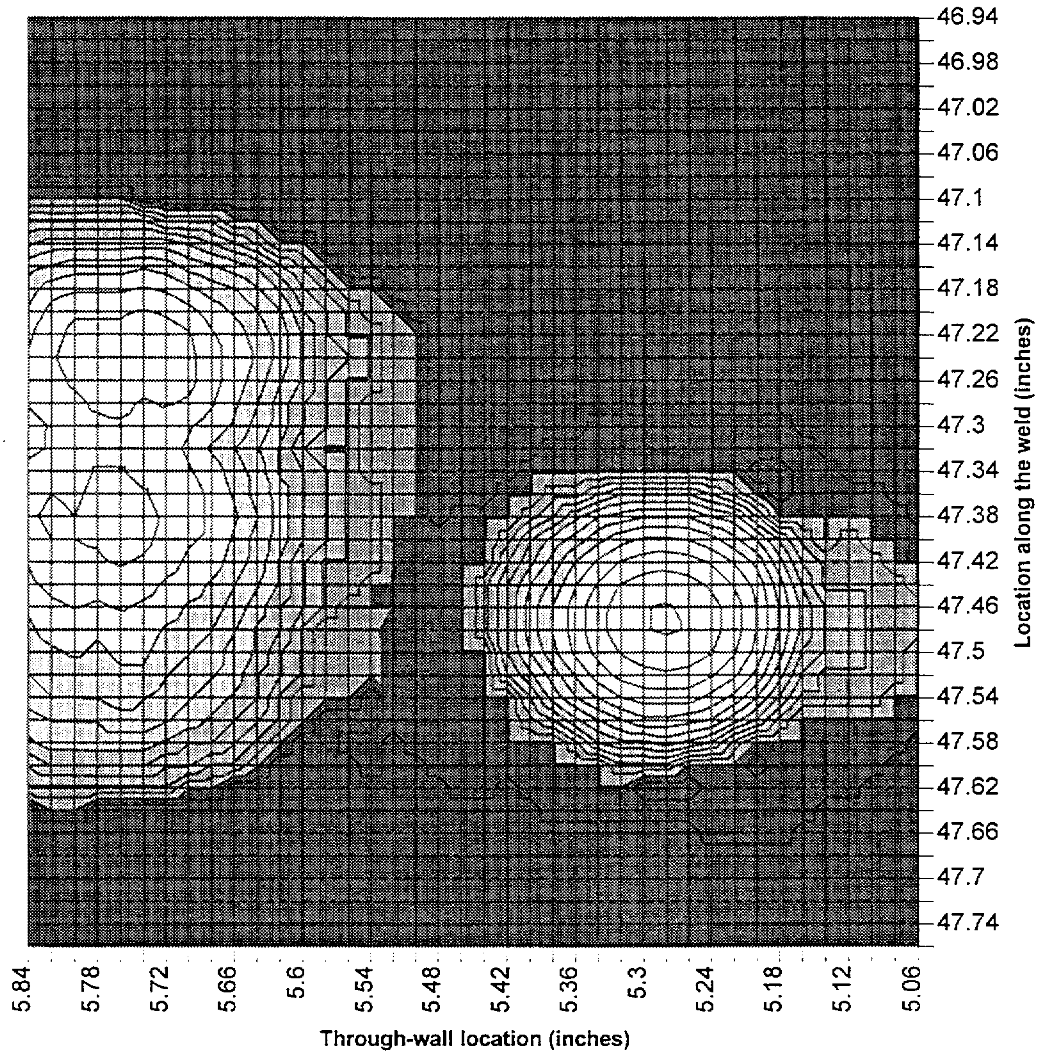

Figure I.4 Log-scale contour plot of indication #111 in Shoreham specimen C0G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -21.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.58 inches above 553 inches of vessel elevation.

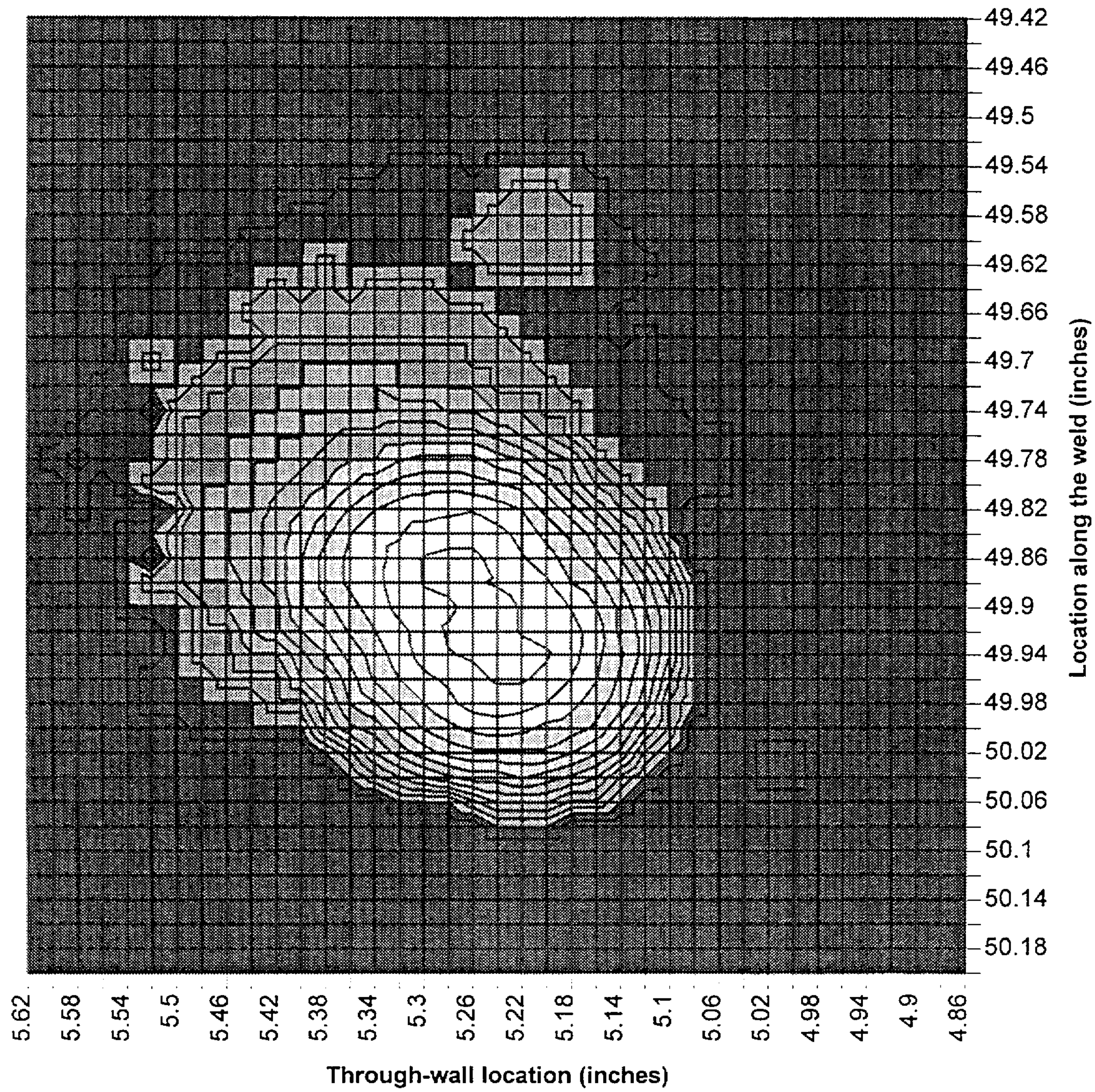

Figure I.5 **Log-scale contour plot of indication #116 in Shoreham specimen C0G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -18.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.62 inches above 553 inches of vessel elevation.**

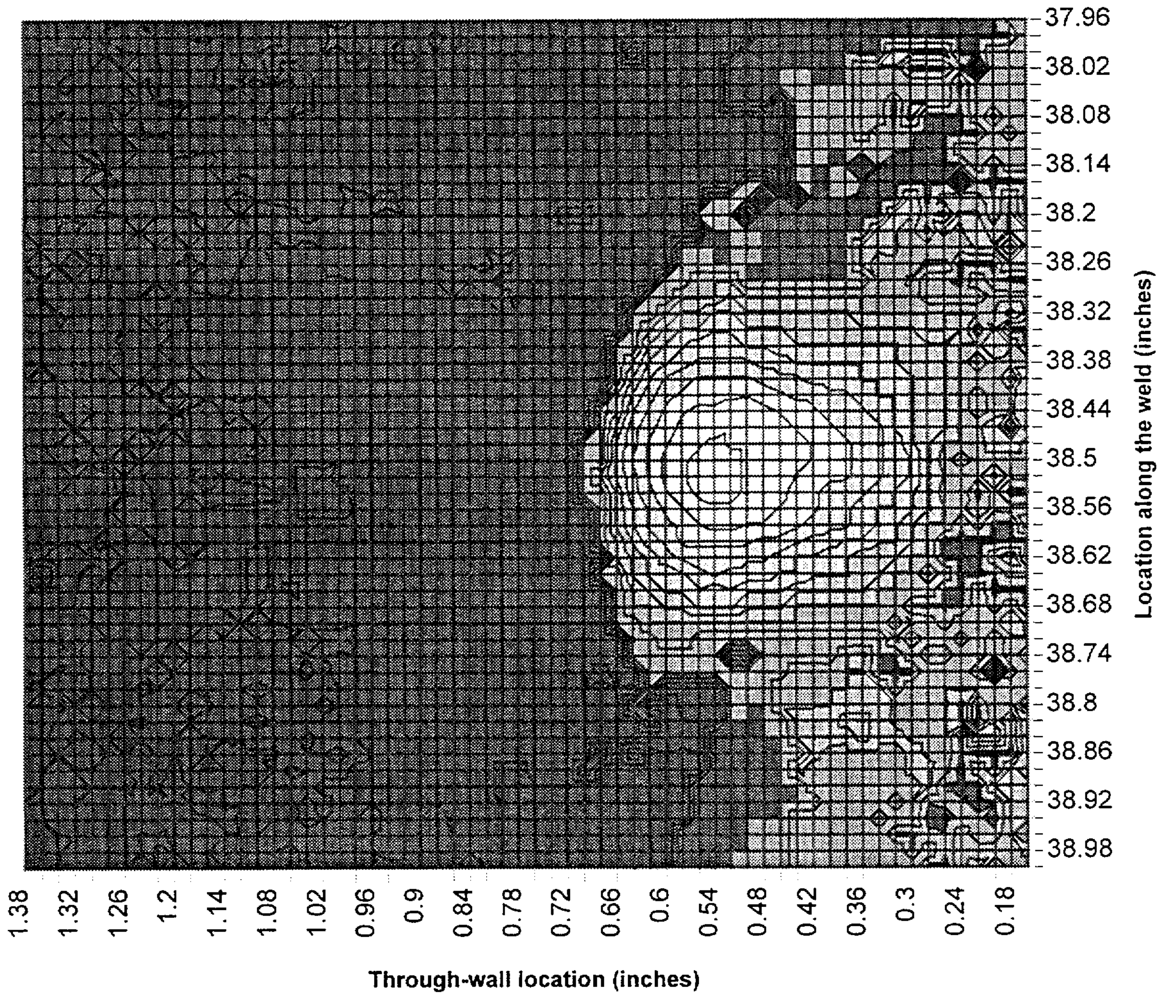

Figure I.6 Log-scale contour plot of indication #138 in Shoreham specimen C0G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -18.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 7 mm. The through-wall location is inner 25 mm. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located in the weld back-gouge at 0.92 inches below 553 inches of vessel elevation.

Appendix J

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C75B

Table J.1 lists all detectable flaw indications in Shoreham specimen C75B. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C75B is given in Section 2. Figures J.1 through J.9 show the images of the larger indications in the specimen.

Table J.1 List of all indications for Shoreham specimen C75B

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.61	4.54	1.3	-19	small	fusion
2	0.67	5.28	2.4	-25.1	small	fusion
3	0.71	4.72	3.42	-23.5	small	fusion
4	-0.61	1.94	3.18	-24.7	small	fusion
5	0.67	4.64	5.84	-17.5	small	fusion
6	0.68	8.3	4.2	-18.3	small	fusion
7	0.67	8.72	0.7	-21	small	fusion
8	0.64	9.04	2.8	-19.1	small	fusion
9	-0.38	9.6	2.62	-23	small	weld
10	0.66	10.3	1.26	-23.6	small	fusion
11	-0.17	10.44	2.36	-23.5	small	weld
12	-0.16	10.98	5.26	-20.2	small	weld
13	0.64	12.78	2.72	-15	small	fusion
14	0.67	13.02	1.22	-20.5	small	fusion
15	0.64	14.46	4.66	-24.3	small	fusion
16	0.66	14.9	5.32	-18.3	small	fusion
17	0.64	15.08	2.62	-15.6	small	fusion
18	0.66	15.36	5.76	-23.6	small	fusion
19	0.66	15.6	1.28	-10.8	small	fusion
20	-0.57	16.12	4.32	-20.6	small	fusion
21	0.66	16.38	4.86	-17.9	small	fusion
22	-0.08	16.24	3.16	-24.1	small	weld
23	-0.57	17.64	4.3	-22.6	small	fusion
24	-0.57	21.24	4.86	-17.9	small	fusion
25	0.64	21.56	4.26	-12.9	small	fusion
26	-0.38	21.48	2.56	-22.4	small	weld
27	-0.45	22.34	4.54	-20.4	small	weld

Table J.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	0.05	22.46	3.7	-24	small	weld
29	0.63	22.72	2.68	-20.1	small	fusion
30	0.66	24.24	5.32	-23.6	small	fusion
31	0.50	24.66	2.56	-15.1	small	fusion
32	-0.61	24.76	3.26	-26.3	small	fusion
33	0.64	25.3	2.62	-19.1	small	fusion
34	-0.43	25.58	4.54	-25.1	small	weld
35	-0.57	26.58	4.86	-23.9	small	fusion
36	0.66	26.68	1.22	-24.3	small	fusion
37	-1.80	26.7	0.32	-26.8	small	base
38	-0.45	27.14	4.56	-21.9	small	weld
39	-0.45	27.74	4.54	-25.1	small	weld
40	-0.43	28	4.54	-20.8	small	weld
41	-1.33	28.6	0.4	-26.8	small	gouge
42	-0.43	28.6	4.6	-25.1	small	weld
43	0.63	29.6	2.66	-23.6	small	fusion
44	-1.73	30.66	0.32	-27.4	small	gouge
45	-1.72	30.94	0.32	-26	small	gouge
46	0.64	30.68	2.62	-18.7	small	fusion
47	0.63	30.82	2.68	-22.2	small	fusion
48	0.63	30.9	5.22	-13.1	small	fusion
49	-0.61	31.66	3.36	-24.7	small	fusion
50	-0.43	32	4.68	-19.5	small	weld
51	-0.65	32.78	3.64	-9	small	fusion
52	0.63	32.82	4.78	-22.9	small	fusion
53	-0.41	33.14	2.62	-18	small	weld
54	-0.59	33.2	4.94	-24.6	small	fusion
55	0.04	33.42	3.22	-24.8	small	weld
56	-0.60	33.6	4.94	-22.1	small	fusion
57	-0.41	33.7	2.62	-20.8	small	weld
58	-0.43	33.96	4.68	-13.7	small	weld
59	-0.61	33.84	0.96	-20.2	small	fusion
60	-0.57	34.2	3.46	-8.9	small	fusion
61	0.67	35.16	1.36	-23.5	small	fusion
62	-0.46	35.4	4.7	-18.4	small	weld
63	0.66	36.5	5.8	-22.2	small	fusion
64	0.64	36.58	4.28	-17.9	small	fusion
65	-0.40	37.2	2.52	-16.7	small	weld
66	0.61	38.62	2.58	-20.1	small	fusion
67	-1.59	38.94	0.46	-26.5	small	gouge
68	0.64	39.86	2.76	-14	small	fusion
69	0.64	40.38	4.58	-21.1	small	fusion
70	0.61	41.04	1.82	-18.7	small	fusion

Table J.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	-0.63	42.6	1.64	-21.2	small	fusion
72	0.61	42.7	4.12	-19.6	small	fusion
73	0.64	43.02	2.58	-20.5	small	fusion
74	-1.62	44.42	0.28	-26.5	small	clad
75	-1.66	46.06	0.2	-25.9	small	clad
76	0.61	46.94	4.96	-12.9	small	fusion
77	-1.78	47.08	0.3	-25.4	small	gouge
78	-1.82	47.66	0.26	-26.8	small	clad
79	-0.58	47.44	5.52	-12.9	small	fusion
80	-0.47	47.74	4.64	-23.7	small	weld
81	0.61	48.24	5.12	-17.9	small	fusion
82	-1.80	48.32	0.3	-26.8	small	gouge
83	0.64	49.44	4.6	-21.1	small	fusion
84	0.48	49.76	0.9	-23.7	small	weld
85	-1.29	49.86	0.3	-26	small	gouge
86	-0.63	51.24	5.12	-24.7	small	fusion
87	0.61	52.48	5.2	-23.6	small	fusion
88	-0.58	52.62	5.52	-20.6	small	fusion
89	0.64	52.96	5.54	-21.1	small	fusion
90	0.59	53.02	4.12	-21.1	small	fusion
91	-0.33	53.34	5.16	-17.2	small	weld
92	-0.67	53.52	0.96	-4.4	small	fusion
93	-1.69	53.44	0.26	-25.9	small	clad
94	-0.51	54.46	0.52	-25.2	small	fusion
95	-0.58	53.88	5.38	-8.6	small	fusion
96	0.64	54.68	1.22	-14.5	small	fusion
97	-0.33	55.54	5.14	-24.3	small	weld
98	0.64	55.8	2.62	-5.5	long	fusion
99	1.30	56.16	1.24	-22.3	small	base
100	0.89	56	0.58	-24.1	small	gouge
101	0.59	56.76	0.58	-24.4	small	fusion
102	0.59	57.08	3.1	-12	long	fusion
103	0.11	57.44	5.34	-19.5	complex cluster	weld
104	0.91	57.58	2.42	-20.8	small	base
105	0.32	57.8	0.98	-20.3	small	weld
106	0.29	58.48	1.16	-22.5	small	weld
107	0.57	58.52	4.12	-23.6	small	fusion
108	0.29	58.92	4.9	-21.9	small	weld
109	-1.52	59.02	0.28	-27.1	small	clad
110	0.84	59.26	2.14	-22.1	small	base
111	0.91	59.52	0.8	-21.4	small	gouge
112	0.22	59.54	0.56	-24.6	small	weld

Table J.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	0.57	59.58	3.02	-8.6	long	fusion
114	0.15	59.78	3.44	-19.5	small	weld
115	0.91	59.68	5.38	-22.7	small	base
116	0.32	59.96	0.64	-24.6	small	weld
117	-1.71	59.98	0.28	-26.7	small	clad
118	1.24	60.9	3.56	-6	small	base
119	0.75	60.74	3.22	-22.1	small	fusion
120	-0.47	61.16	5.52	-16.1	small	weld
121	-0.37	61.76	3.44	-12.8	small	weld
122	-0.60	61.88	4.9	-24	small	fusion
123	-0.60	62.28	4.48	-12.3	small	fusion
124	0.61	62.52	1.68	-16.2	small	fusion
125	-0.42	63.5	3.1	-19.5	small	weld
126	-0.44	63.8	3.08	-19.9	small	weld
127	-0.49	64.16	3.54	-20.9	small	fusion
128	-0.88	64.44	0.64	-17	small	gouge
129	-0.47	64.44	3.6	-24.4	small	weld
130	0.02	64.42	5.44	-20	small	weld
131	0.34	64.66	5.76	-21.9	small	weld
132	0.61	64.84	1.7	-6.1	small	fusion
133	0.61	64.86	1.22	-22.2	small	fusion
134	-0.47	65.32	3.2	-22.4	small	weld
135	0.71	65.44	5.28	-18.7	small	fusion
136	0.32	65.48	5.8	-24.6	small	weld
137	-0.19	66.44	4.62	-22.8	small	weld
138	0.71	66.62	1.14	-23.5	small	fusion
139	-1.32	66.84	0.3	-26	small	gouge
140	-1.78	67.62	0.38	-8.5	small	gouge
141	-0.51	67.78	3.58	-25.2	small	fusion
142	-0.47	68.56	3.44	-17.3	small	weld
143	0.64	69.02	1.44	-13.8	small	fusion
144	-0.60	69.92	1.66	-24.7	small	fusion
145	-0.56	69.94	5.18	-18.9	small	fusion
146	-0.60	70.3	5.48	-21.6	small	fusion
147	-0.58	70.38	5.3	-22.7	small	fusion
148	0.20	70.76	5.76	-17.2	complex cluster	weld
149	0.59	71.34	2.94	-5.4	long	fusion
150	-0.58	72.84	5.16	-19.3	small	fusion
151	0.61	73.26	2.9	-6.7	long	fusion
152	0.66	74.9	4.8	-19.1	small	fusion
153	0.59	75.02	2.92	-8.8	long	fusion
154	0.55	75.48	0.78	-18.8	small	fusion

Table J.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	-1.85	75.46	0.2	-26.2	small	clad
156	1.17	75.68	1.06	-23.9	small	base
157	1.07	75.84	0.68	-24	small	gouge
158	-0.60	76.24	2.14	-7.5	small	fusion
159	0.64	76.62	1.2	-24.3	small	fusion
160	-1.82	76.72	0.2	-27.6	small	clad
161	-0.60	77.38	5.06	-8.9	small	fusion
162	0.59	78.74	4.02	-24.4	small	fusion
163	-0.63	80.28	4.76	-22.2	small	fusion
164	0.59	80.36	3.02	-8.8	long	fusion
165	-0.47	80.52	4.46	-24.4	small	weld
166	-0.63	80.8	5.2	-19	small	fusion
167	0.61	80.9	5.3	-23.6	small	fusion
168	-0.60	81.18	5.6	-22.2	small	fusion
169	0.57	81.36	3.98	-22.3	small	fusion
170	-1.41	81.34	0.22	-26.9	small	clad
171	-0.63	81.74	1.72	-17	small	fusion
172	0.61	82.16	1.18	-22.9	small	fusion
173	0.20	82.78	0.52	-23.2	small	weld
174	0.61	83.84	1.16	-17.2	small	fusion
175	-0.35	84.04	1.5	-25.1	small	weld
176	0.59	84.98	5	-15.9	small	fusion
177	0.66	85.28	4.84	-21.6	small	fusion
178	-0.65	85.54	5.46	-21.7	small	fusion
179	-0.60	85.78	4.14	-23.3	small	fusion
180	0.61	86.46	4.02	-23.6	small	fusion
181	-0.58	86.54	1.28	-24.6	small	fusion
182	0.61	86.94	1.12	-17.6	small	fusion
183	0.68	87.02	2.26	-16.8	small	fusion
184	-0.05	87.52	4.84	-17.4	small	weld
185	-0.63	87.68	2.02	-21.2	small	fusion
186	-0.63	88.24	2.02	-13.6	small	fusion
187	0.64	90.04	1.54	-24.3	small	fusion
188	-0.63	90.12	2	-13	small	fusion
189	0.64	90.14	2.66	-22.2	small	fusion
190	-0.63	90.34	1.64	-18	small	fusion
191	0.64	90.78	2.88	-15.3	small	fusion
192	-0.44	90.86	4.36	-18	small	weld
193	0.61	91.48	4.96	-22.9	small	fusion
194	0.59	93	2.44	-19.6	small	fusion
195	-1.92	92.24	0.28	-27.7	small	clad
196	-1.92	93.74	0.28	-27.7	small	clad

Table J.1 (contd)						
#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
197	-0.49	94.02	4.28	-18	small	fusion
198	-1.85	94.42	0.18	-26.2	small	clad
199	0.57	94.8	2.36	-24.4	small	fusion
200	-1.96	95	0.46	-27.8	small	gouge
201	-0.49	95.46	4.28	-14.4	small	fusion
202	-0.63	95.76	5.32	-18.3	small	fusion
203	-1.92	95.78	0.3	-25.6	small	gouge
204	-0.65	96.1	5.36	-14.7	small	fusion
205	-0.17	96.34	3.38	-23.5	small	weld
206	0.61	96.96	2.48	-22.2	small	fusion
207	0.66	97.56	2.24	-22.9	small	fusion
208	-1.75	97.86	0.2	-27.5	small	clad
209	-0.56	98.38	5.26	-24.6	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

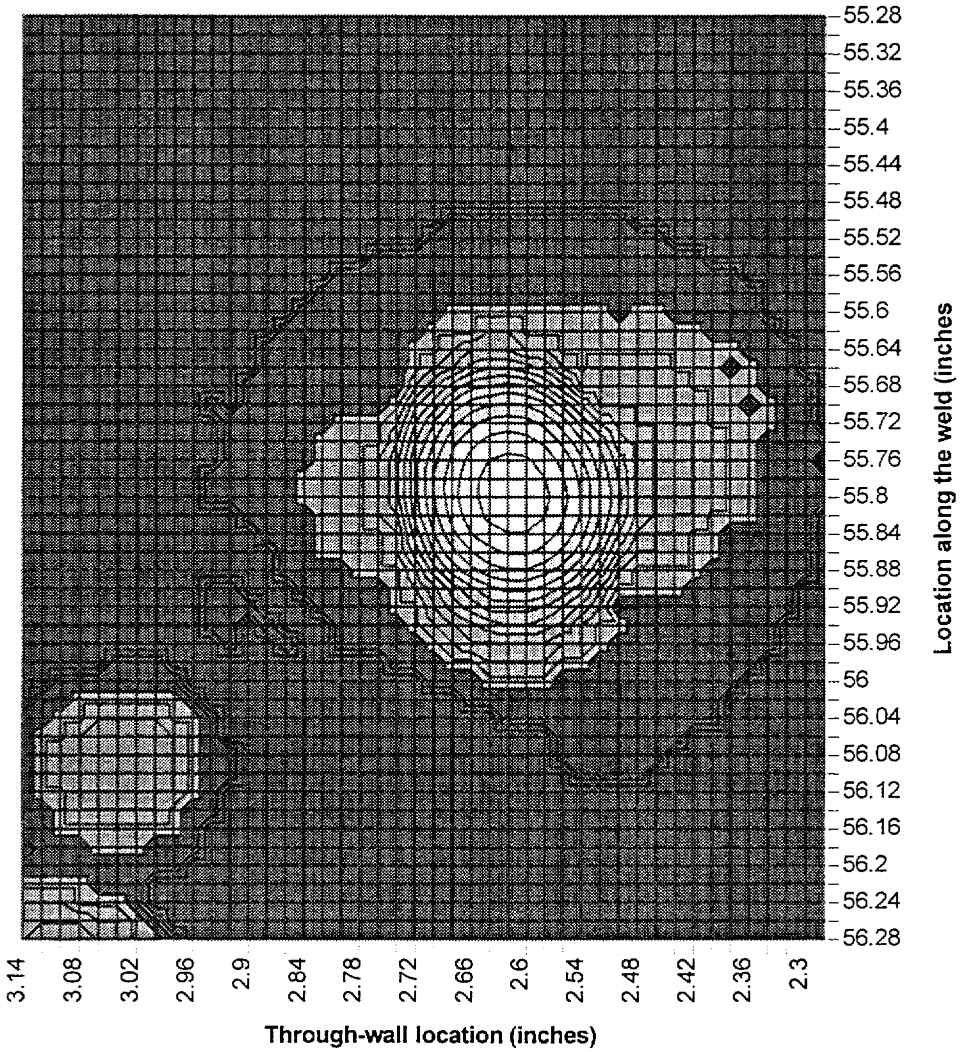

Figure J.1 Log-scale contour plot of indication #98 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.64 inches below 553 inches of vessel elevation.

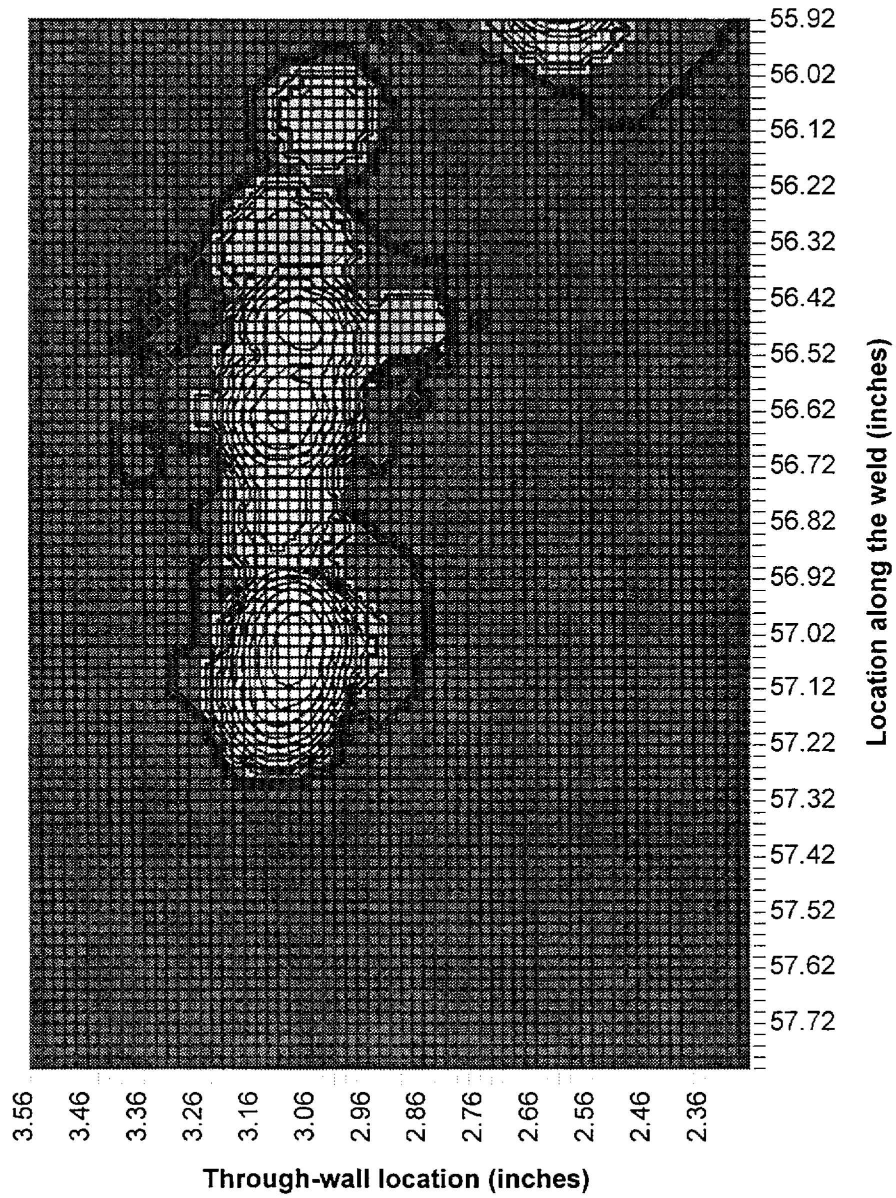

Figure J.2 Log-scale contour plot of indication #102 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 30 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.59 inches below 553 inches of vessel elevation.

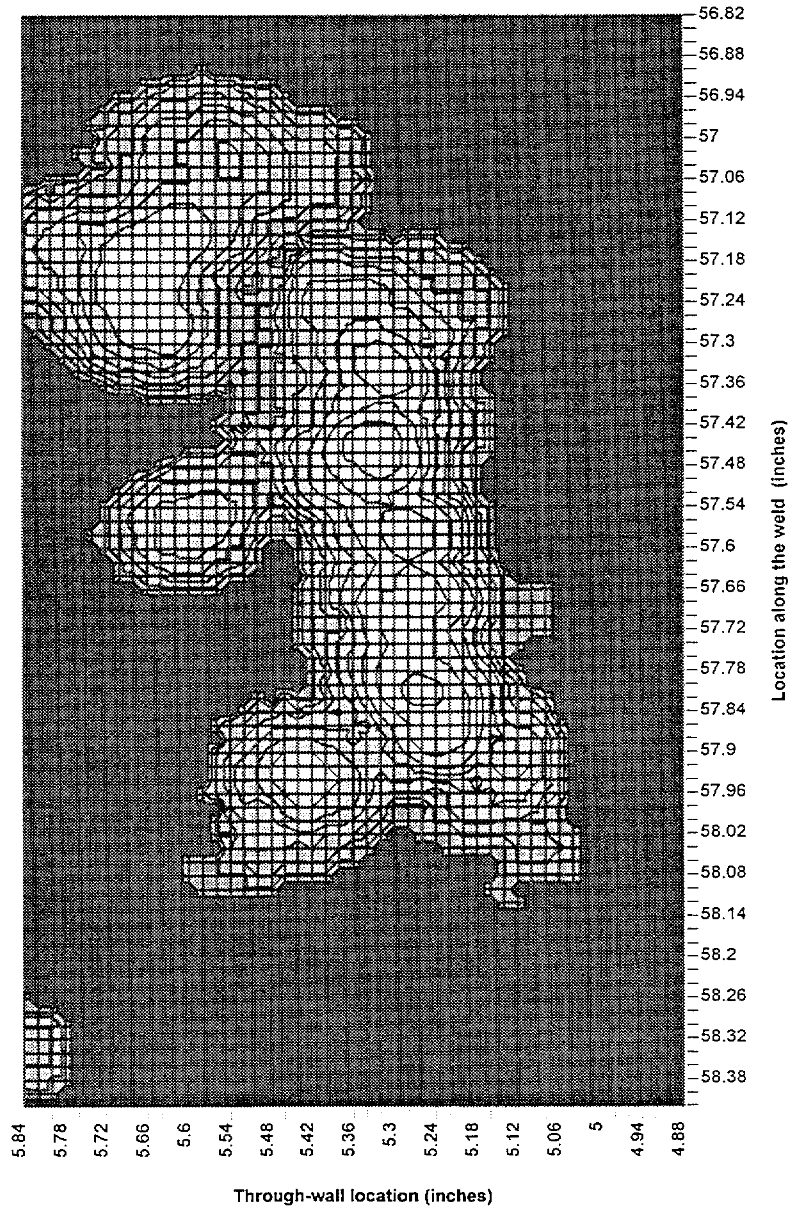

Figure J.3 **Log-scale contour plot of indication #103 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 14 mm. The through-wall location is outer 25 mm. The length is 30 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as complex cluster, is located in the weld at 0.11 inches below 553 inches of vessel elevation.**

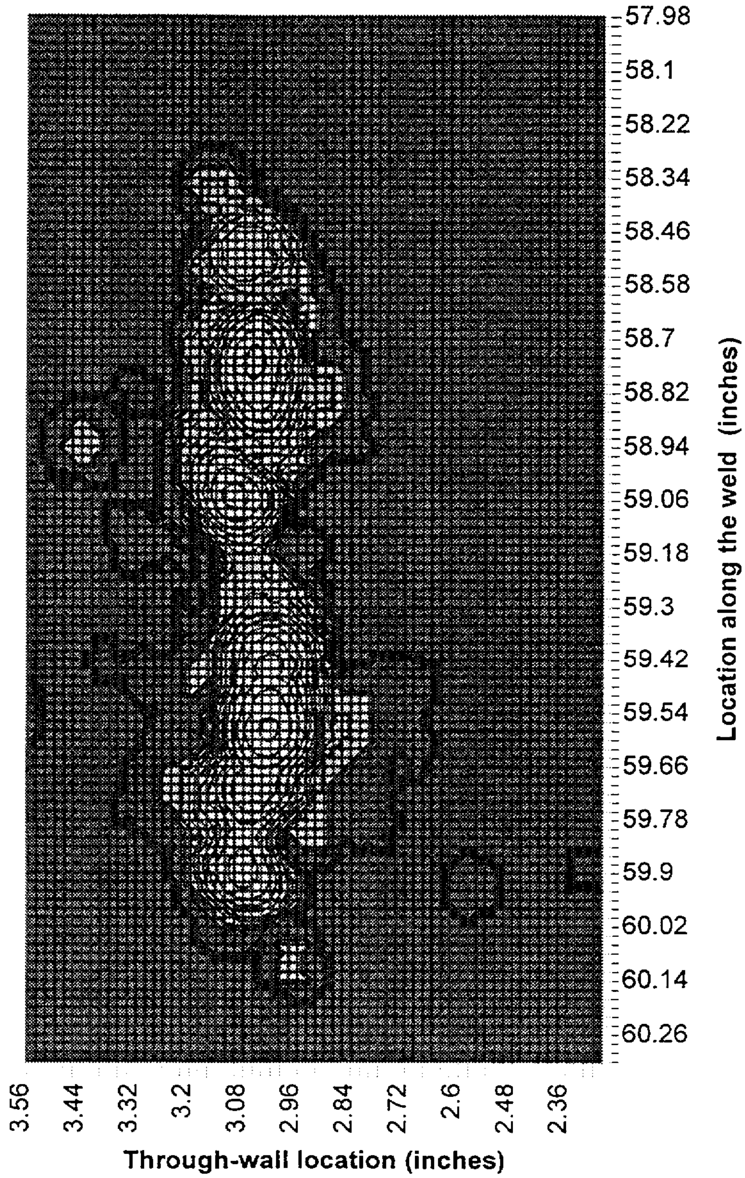

Figure J.4 Log-scale contour plot of indication #113 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 41 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.57 inches below 553 inches of vessel elevation.

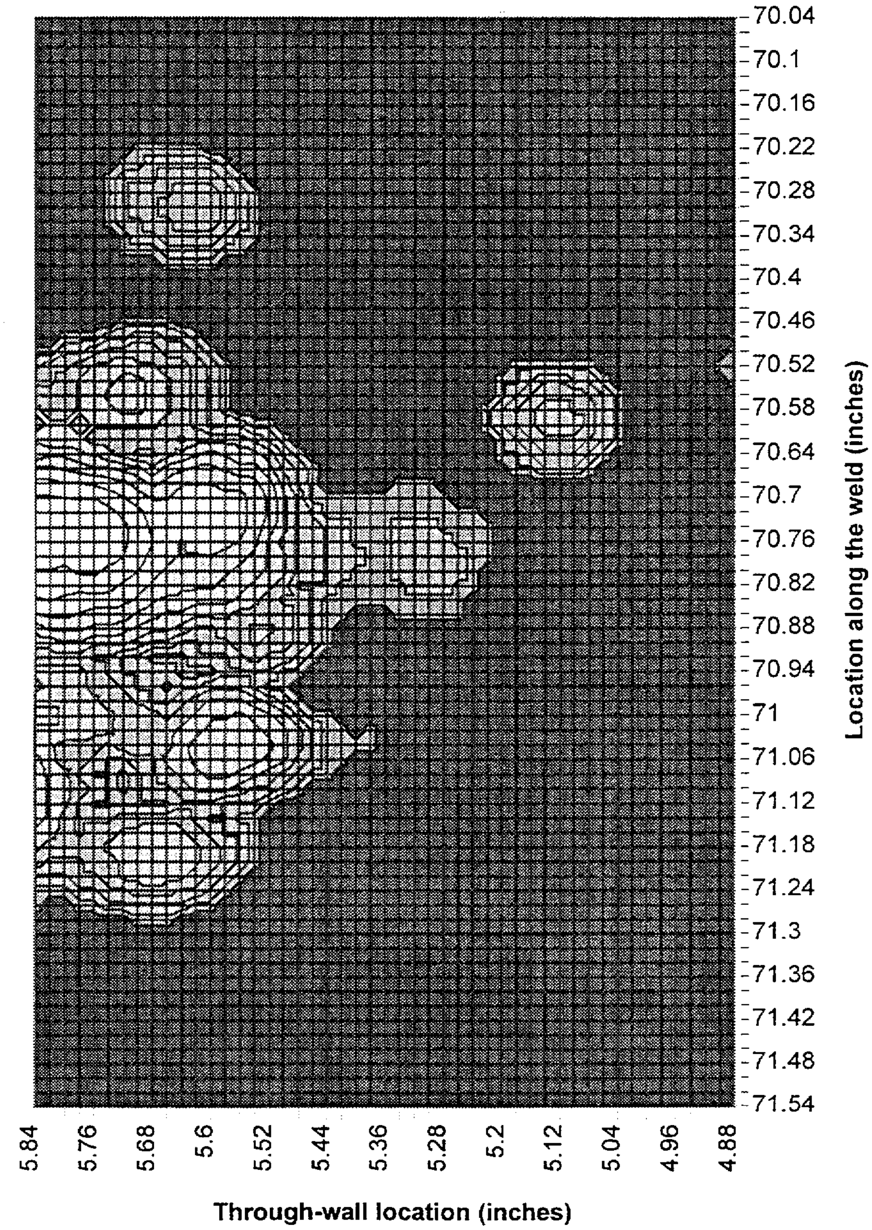

Figure J.5 Log-scale contour plot of indication #148 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 7 mm. The through-wall location is outer 25 mm. The length is 20 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as complex cluster, is located in the weld at 0.20 inches below 553 inches of vessel elevation.

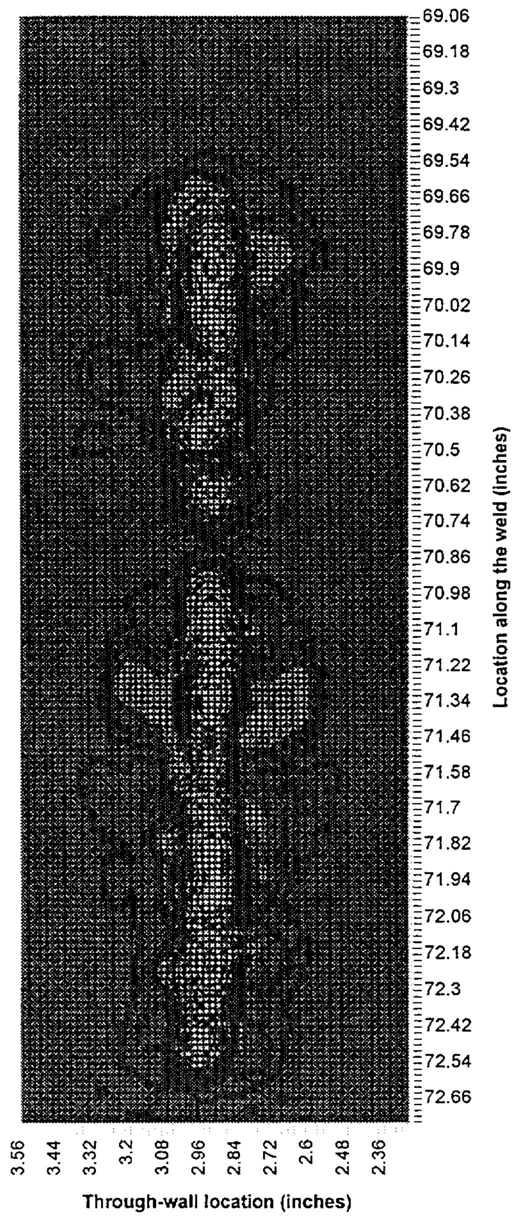

Figure J.6 **Log-scale contour plot of indication #149 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 76 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.59 inches below 553 inches of vessel elevation.**

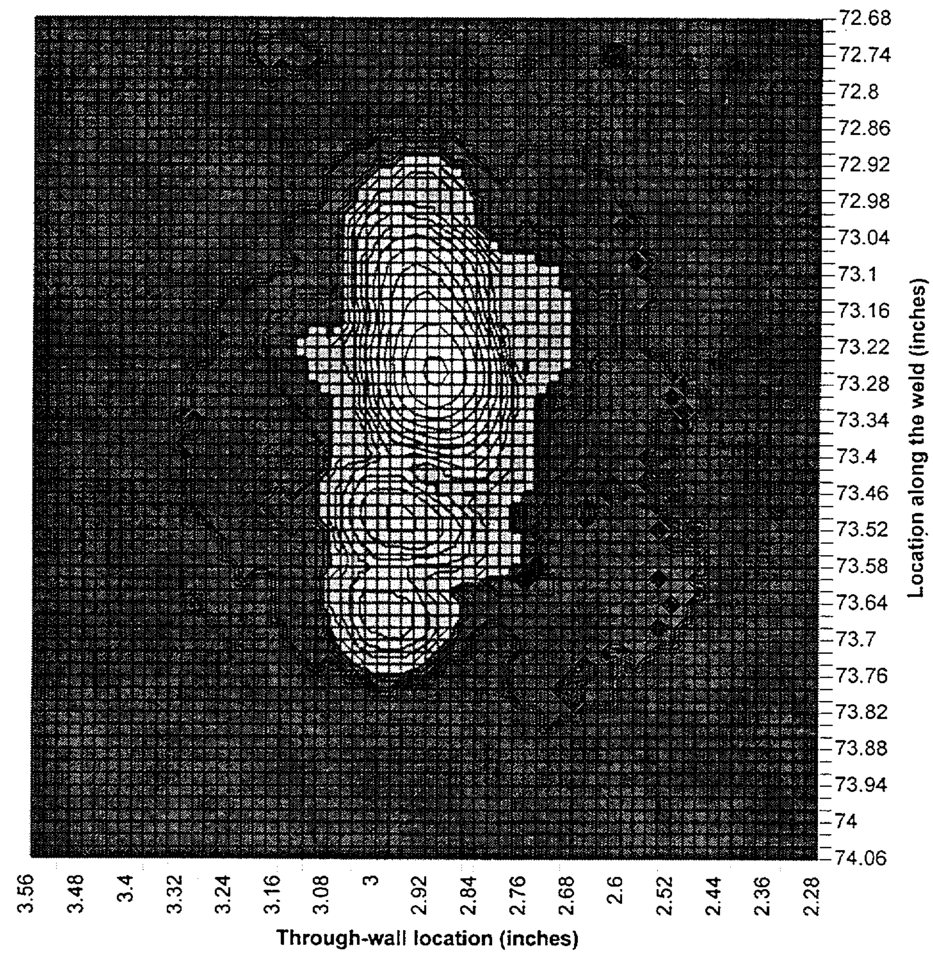

Figure J.7 **Log-scale contour plot of indication #151 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6.7 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.61 inches below 553 inches of vessel elevation.**

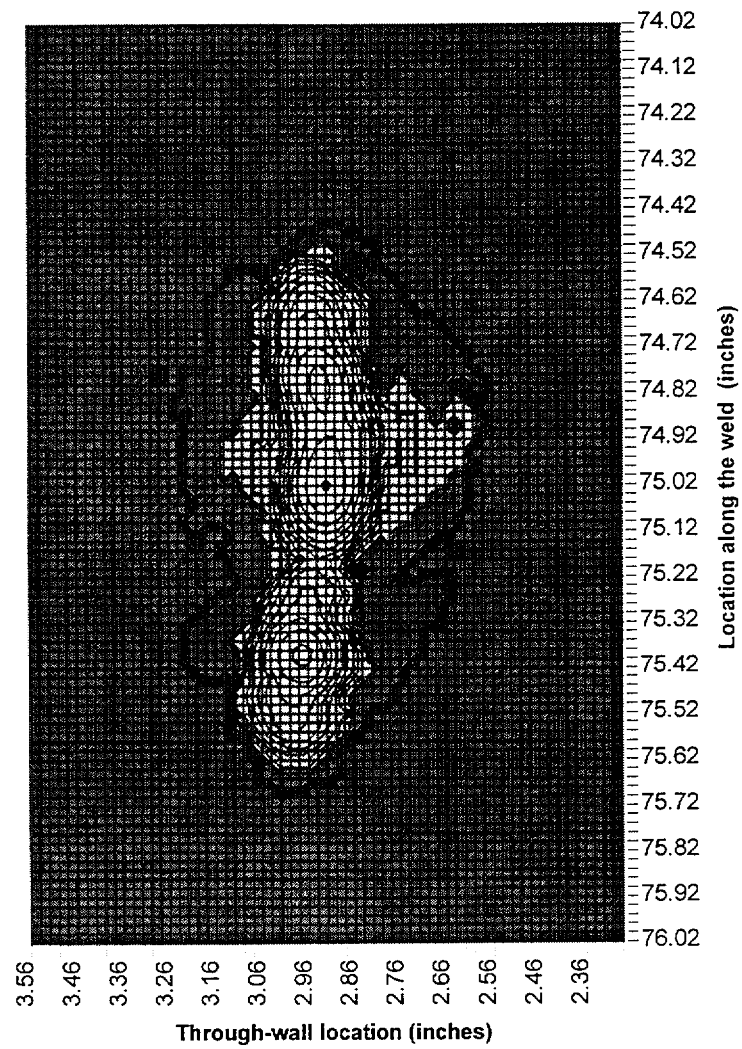

Figure J.8 **Log-scale contour plot of indication #153 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 28 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.59 inches below 553 inches of vessel elevation.**

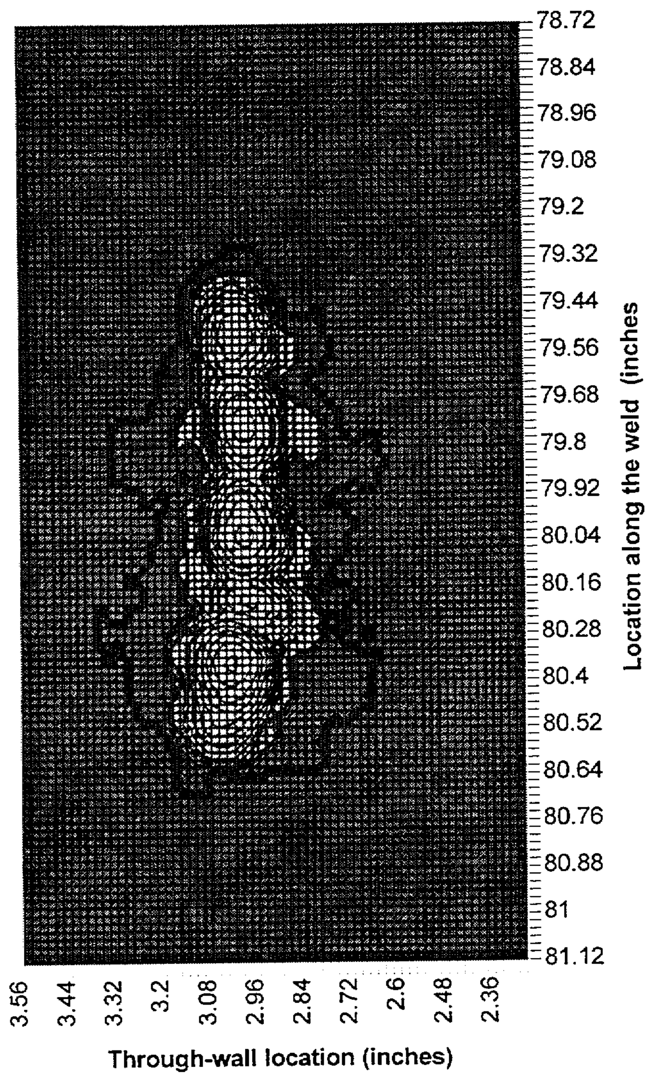

Figure J.9 **Log-scale contour plot of indication #164 in Shoreham specimen C75B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 30 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.59 inches below 553 inches of vessel elevation.**

Appendix K

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C120B

Table K.1 lists all detectable flaw indications in Shoreham specimen C120B. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C120B is given in Section 2. Figures K.1 and K.2 show the images of the larger indications in the specimen.

Table K.1 List of all indications for Shoreham specimen C120B

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-1.15	552.53	5.3	-19.4	small	base
2	-1.20	552.49	5	-24.8	small	base
3	-1.13	552.47	1.18	-28.5	small	base
4	-0.62	553.47	5.28	-24.7	small	fusion
5	-0.75	553.75	2.88	-26	small	fusion
6	-0.75	553.71	1.32	-19.6	small	fusion
7	-0.77	554.07	1.46	-25.2	small	fusion
8	-0.77	554.21	2.9	-29.8	small	fusion
9	-0.77	554.03	5.3	-18.2	small	fusion
10	-0.80	553.87	5.52	-24.8	small	fusion
11	-0.75	554.41	4.38	-6.5	small	fusion
12	-0.72	555.07	1.34	-26	small	fusion
13	-0.58	555.41	3.96	-25.1	small	weld
14	-0.74	555.45	2.52	-26.9	small	fusion
15	-0.79	555.53	1.3	-25.2	small	fusion
16	-0.76	555.73	4.06	-25.6	small	fusion
17	-0.76	555.87	4.42	-26	small	fusion
18	-0.76	555.91	2.56	-29.8	small	fusion
19	-0.76	556.01	1.46	-27.4	small	fusion
20	-0.80	556.37	1.28	-15.5	small	fusion
21	-0.75	557.05	4.58	-27.4	small	fusion
22	-0.73	557.11	1.54	-26	small	fusion
23	-0.75	557.47	2.74	-28	small	fusion
24	-0.77	557.57	1.46	-27.4	small	fusion
25	-0.75	557.85	2.68	-29.1	small	fusion
26	-0.81	559.21	1.44	-16.3	small	fusion
27	-0.81	559.69	1.14	-24.4	small	fusion

Table K.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.74	559.17	5.76	-22.2	small	fusion
29	-0.78	560.19	1.48	-24.8	small	fusion
30	-0.83	560.47	1.42	-25.2	small	fusion
31	-0.74	560.43	3.42	-25.2	small	fusion
32	-0.78	560.65	3.42	-18.8	small	fusion
33	-0.78	560.85	3.98	-24.1	small	fusion
34	-0.82	560.89	1.44	-21.4	small	fusion
35	-0.80	561.13	1.3	-13.1	small	fusion
36	-0.73	561.37	2.48	-26.9	small	fusion
37	-0.80	561.77	1.6	-23.1	small	fusion
38	-0.84	561.97	0.92	-31.2	small	fusion
39	-0.73	561.91	4.08	-20.7	small	fusion
40	-0.75	562.35	5.58	-17.4	small	fusion
41	-0.77	562.47	4.1	-14.7	small	fusion
42	-0.75	562.61	3.04	-17.2	small	fusion
43	-0.79	562.77	1.24	-26.5	small	fusion
44	-0.81	562.93	1.38	-25.2	small	fusion
45	-0.72	563.15	2.42	-27.4	small	fusion
46	-0.72	563.21	5.34	-24.4	small	fusion
47	-0.76	563.69	3.96	-23.8	small	fusion
48	-0.71	564.01	5.66	-27.4	small	fusion
49	-0.81	564.07	1.44	-12.7	small	fusion
50	-0.78	564.51	1.48	-24.4	small	fusion
51	-0.78	564.61	3.24	-20.9	small	fusion
52	-0.78	564.89	1.48	-22.2	small	fusion
53	-0.73	565.03	4.08	-18.8	small	fusion
54	-0.73	565.25	2.52	-24.4	small	fusion
55	-0.71	565.29	1.52	-26	small	fusion
56	-0.78	565.33	1.3	-25.2	small	fusion
57	-0.73	565.81	5.36	-14	small	fusion
58	-0.75	566.35	4	-27.4	small	fusion
59	-0.74	567.01	3.38	-24.1	small	fusion
60	-0.74	567.59	3.16	-22.2	small	fusion
61	-0.76	567.87	3.2	-26	small	fusion
62	-0.69	568.15	5.36	-24.1	small	fusion
63	-0.76	568.41	3	-23.4	small	fusion
64	-0.73	568.53	2.58	-23.1	small	fusion
65	-0.73	568.49	5.72	-12.5	extended	fusion
66	-0.75	569.19	2.84	-22.2	small	fusion
67	-0.75	569.41	3.36	-17.6	small	fusion
68	-0.70	569.61	4.06	-24.8	small	fusion
69	-0.68	569.71	2.58	-23.8	small	fusion
70	-0.77	569.55	1.18	-26.9	small	fusion

Table K.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	-0.79	569.89	1.06	-23.4	small	fusion
72	-0.54	570.57	3.94	-24	small	weld
73	-0.83	572.37	0.7	-23.4	small	fusion
74	-0.71	572.31	4.18	-24.4	small	fusion
75	-0.71	573.07	4.18	-24.4	small	fusion
76	-0.66	572.91	5.54	-23.4	small	fusion
77	-0.79	573.75	1.24	-22.2	small	fusion
78	-0.72	574.69	4.08	-24.8	small	fusion
79	-0.72	575.27	5.04	-26.9	small	fusion
80	-0.74	575.77	4.08	-15.3	small	fusion
81	-0.62	576.11	2.66	-26.9	small	fusion
82	-0.80	576.19	1.2	-24.1	small	fusion
83	-0.87	576.45	0.42	-23.1	small	fusion
84	-0.78	576.73	1.08	-13.5	small	fusion
85	-0.75	576.87	2.82	-22.2	small	fusion
86	-0.68	577.21	4.02	-22.5	small	fusion
87	-0.71	577.21	1.5	-22.2	small	fusion
88	-0.68	577.39	2.34	-20.7	small	fusion
89	-0.75	577.51	2.78	-17.2	small	fusion
90	-0.73	577.73	1.42	-26	small	fusion
91	-0.66	577.89	5.16	-24.1	small	fusion
92	-0.79	577.87	0.84	-22.8	small	fusion
93	-0.72	578.93	4.08	-28	small	fusion
94	-0.72	579.31	2.42	-19.4	small	fusion
95	-0.67	579.45	4.58	-14.1	small	fusion
96	-0.69	579.69	4.02	-16.1	small	fusion
97	-0.78	580.01	1.12	-21.7	small	fusion
98	-0.78	580.03	0.78	-26.9	small	fusion
99	0.97	553.51	5.3	-25.4	small	base
100	0.28	553.59	4.76	-25.1	small	weld
101	0.79	553.71	4.22	-23.4	small	fusion
102	0.05	553.87	2.2	-24.6	small	weld
103	0.70	554.05	1.64	-27	small	fusion
104	0.75	554.25	1.48	-15.2	small	fusion
105	0.75	554.31	5.82	-9	small	fusion
106	0.68	554.57	2.96	-24.9	small	fusion
107	-0.54	554.67	3.94	-28.9	small	weld
108	0.75	554.75	4.82	-22.3	small	fusion
109	0.75	554.67	1.24	-22.6	small	fusion
110	0.04	554.87	2.18	-25.9	small	ROOT
111	0.68	555.09	1.72	-21.4	small	fusion
112	0.77	555.15	4.84	-17.2	small	fusion

Table K.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	0.73	555.21	2.86	-25.3	small	fusion
114	-0.58	555.43	3.96	-25.1	small	weld
115	0.68	555.45	1.7	-24.4	small	fusion
116	0.71	555.59	1.52	-23.9	small	fusion
117	0.69	556.49	1.68	-15.5	small	fusion
118	0.70	557.35	1.48	-17.3	small	fusion
119	0.70	557.77	1.52	-23.1	small	fusion
120	0.79	558.41	5.82	-14.7	small	fusion
121	0.73	558.97	3.04	-21.7	small	fusion
122	0.78	559.17	4.84	-19.8	small	fusion
123	0.73	559.09	1.48	-27.7	small	fusion
124	0.66	559.69	4	-32	small	fusion
125	0.67	559.99	1.52	-17.6	long	fusion
126	-0.55	560.09	3.96	-32.8	small	weld
127	0.60	560.31	2.74	-32.1	small	fusion
128	0.65	560.87	3.98	-26	small	fusion
129	0.76	561.21	3.94	-18.6	small	fusion
130	0.70	561.45	1.5	-24.9	small	fusion
131	-0.54	561.85	3.96	-32.8	small	weld
132	0.68	562.23	3.96	-33.2	small	fusion
133	0.70	562.41	1.26	-20.5	small	fusion
134	0.68	562.51	0.38	-23.6	small	fusion
135	0.20	562.61	2.34	-28.6	small	ROOT
136	-0.14	563.19	2.04	-30.5	small	ROOT
137	0.71	563.15	1.22	-21.7	small	fusion
138	-0.39	563.89	1.86	-19.9	small	ROOT
139	0.48	564.39	5.5	-18	small	weld
140	0.60	565.03	1.78	-21.9	small	fusion
141	0.76	565.01	5.26	-21	small	fusion
142	0.74	565.31	5.14	-25.4	small	fusion
143	0.60	565.27	1.74	-21.6	small	fusion
144	0.56	565.43	1.86	-19.7	small	ROOT
145	0.65	565.73	1.5	-25	small	fusion
146	0.58	565.83	1.84	-25.7	small	ROOT
147	0.70	566.39	1.22	-23.6	small	fusion
148	0.68	566.59	1.48	-22.2	small	fusion
149	0.73	566.65	4.04	-24.5	small	fusion
150	0.70	566.41	5.14	-22.5	small	fusion
151	0.78	567.89	4.84	-19.1	small	fusion
152	-0.46	568.53	5.84	-20.3	small	weld
153	-0.46	568.81	1.18	-30.3	small	weld
154	-0.48	569.03	1.18	-29	small	weld

Table K.1 (contd)						
#	Peak Coordinates (Specimen)			Response (dB)	Characterization	Type (material)
	Weld Center (inches)	Along Weld (inches)	Depth (inches)			
155	0.70	570.21	1.36	-22.5	small	fusion
156	0.06	570.65	4	-27.1	small	weld
157	-0.42	571.21	1.16	-28.3	small	weld
158	0.76	571.87	5.18	-24	small	fusion
159	0.78	572.25	3.78	-22.8	small	fusion
160	0.64	572.09	1.18	-25.1	small	fusion
161	0.69	571.97	0.4	-23.3	small	fusion
162	1.20	572.75	5.8	-10.3	small	base
163	0.65	572.83	1.34	-23	small	fusion
164	0.66	573.89	0.2	-21.3	small	clad
165	0.75	573.77	3.92	-23.6	small	fusion
166	0.68	574.33	1.08	-24.2	small	fusion
167	0.64	574.49	2.56	-25.7	small	fusion
168	0.82	574.39	4.86	-24.4	small	fusion
169	0.68	574.67	1.28	-16	small	fusion
170	0.66	574.91	0.92	-22.3	small	fusion
171	0.66	575.15	1.28	-21.9	small	fusion
172	0.75	575.19	5.82	-22.1	small	fusion
173	0.74	576.03	3.96	-25.5	small	fusion
174	0.64	576.05	1.46	-22.3	small	fusion
175	0.62	576.43	1.46	-26.2	small	fusion
176	0.67	576.61	1.4	-24.7	small	fusion
177	0.70	576.77	0.84	-23	small	fusion
178	0.77	576.97	3.52	-20	small	fusion
179	0.65	577.11	2.5	-23.8	small	fusion
180	0.68	577.59	0.98	-19.9	small	fusion
181	0.61	577.77	1.32	-23.9	small	fusion
182	0.80	578.21	4.84	-17.8	small	fusion
183	0.77	578.45	2.92	-27.8	small	fusion
184	0.64	578.85	1	-23.5	small	fusion
185	0.74	579.71	2.72	-23.3	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for Azimuth greater than 150 degrees.

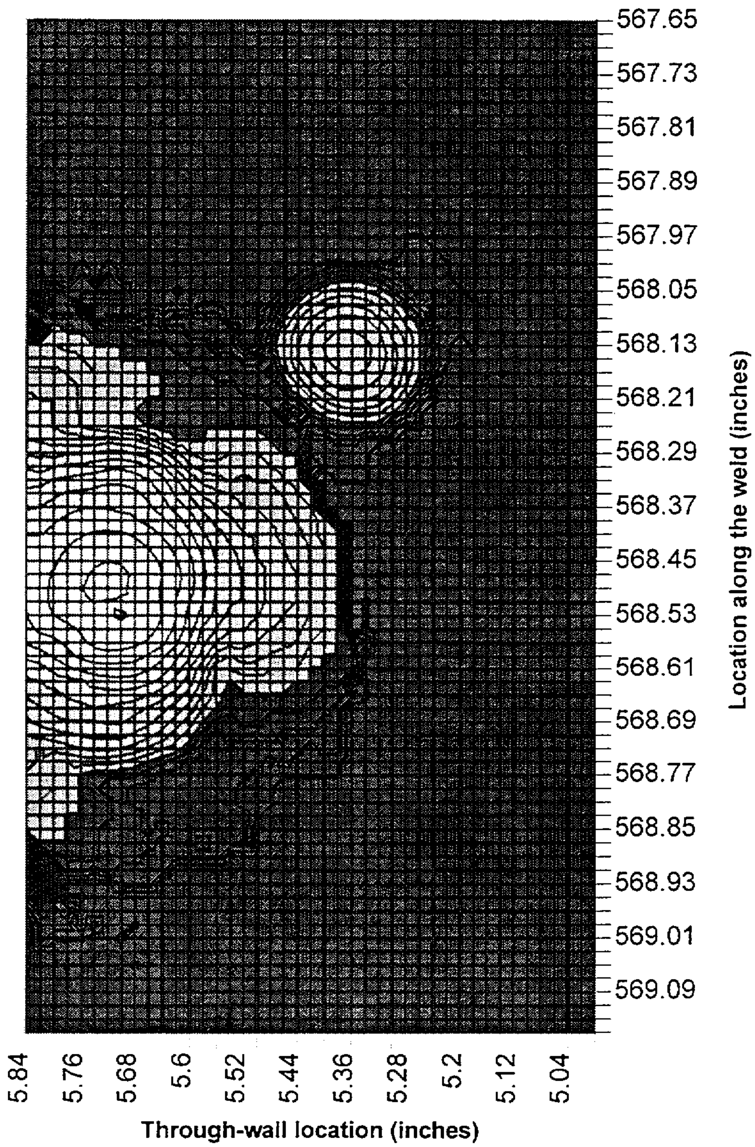

Figure K.1 Log-scale contour plot of indication #65 in Shoreham specimen C120B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion, is located on the fusion line at 0.73 inches below (minus angle) of 150.0 degrees of vessel azimuth.

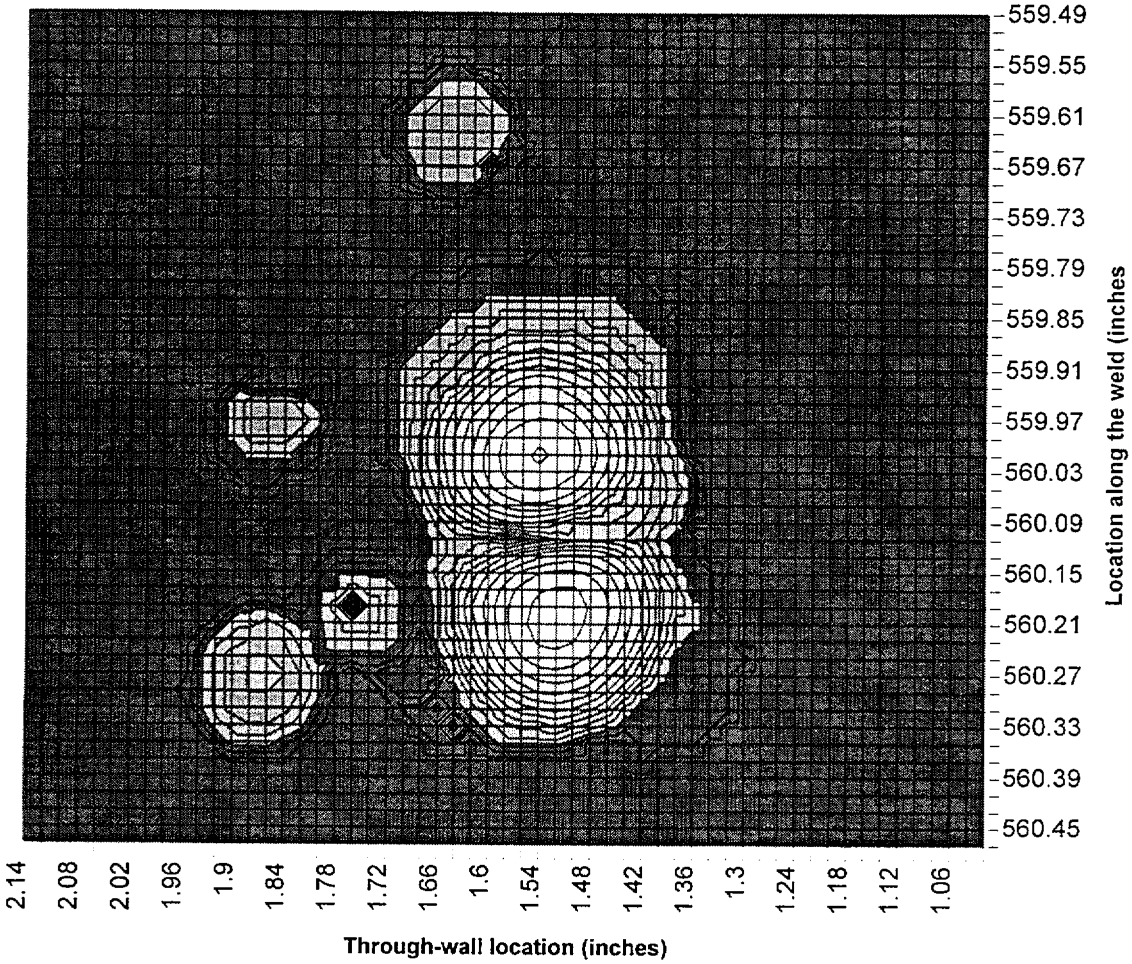

Figure K.2 Log-scale contour plot of indication #125 in Shoreham specimen C120B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -17.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion line at 0.67 inches above (positive angle) of 150.0 degrees of vessel azimuth.

Appendix L

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C120D

Table L.1 lists all detectable flaw indications in Shoreham specimen C120D. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C120D is given in Section 2. Figure L.1 shows the image of the larger indication in the specimen.

Table L.1 List of all indications for Shoreham specimen C120D

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.69	1.38	0.54	-22.9	small	fusion
2	-0.56	3.4	4.54	-28.8	small	fusion
3	-0.63	3.5	0.9	-27.7	small	fusion
4	-0.75	3.44	0.32	-20.5	small	fusion
5	-0.32	8.04	3.4	-28.1	small	weld
6	-0.48	8.32	4.8	-28.3	small	weld
7	-0.60	9.18	4.76	-28.8	small	fusion
8	-0.50	10.62	5.16	-23.2	small	weld
9	-0.36	10.66	2.24	-26.6	small	weld
10	-0.62	15.4	0.36	-19.1	small	fusion
11	-0.58	16.12	4.28	-21.5	small	fusion
12	-0.62	19.3	4.98	-28.4	small	fusion
13	-0.63	20.38	4.94	-28.4	small	fusion
14	-0.47	20.62	0.74	-22.2	small	weld
15	0.72	0.96	2.08	-24.1	small	fusion
16	0.71	1.46	5.5	-21	small	fusion
17	0.66	3.14	4.68	-24.2	small	fusion
18	0.67	3.8	3.84	-17.5	small	fusion
19	0.67	4.06	2.9	-19.5	small	fusion
20	0.71	5.2	5.68	-15.4	small	fusion
21	0.67	5.02	0.88	-25.5	small	fusion
22	0.50	6.1	5.36	-27.3	small	fusion
23	0.74	7.5	0.78	-20.1	small	fusion
24	0.67	7.68	2.84	-27.1	small	fusion
25	0.69	7.86	5.62	-15.4	small	fusion
26	0.67	8.08	2.8	-14.6	small	fusion
27	0.74	8.38	2.1	-21.9	small	fusion

Table L.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	0.67	8.58	2.88	-27.1	small	fusion
29	0.66	9.7	1.08	-20.2	small	fusion
30	0.70	10.5	1.68	-27	small	fusion
31	0.68	10.7	5.72	-21	small	fusion
32	0.65	11.24	2.8	-17	small	fusion
33	0.69	11.64	2.16	-25.4	small	fusion
34	0.73	12.58	2	-22.9	small	fusion
35	0.61	13.4	1.02	-27.1	small	fusion
36	0.61	13.76	1	-27.1	small	fusion
37	0.68	17.52	5.24	-13	small	fusion
38	0.59	17.64	0.98	-20.2	small	fusion
39	0.62	19.3	5.68	-14.6	surface-elongated	fusion
40	0.62	19.26	2.66	-25.4	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

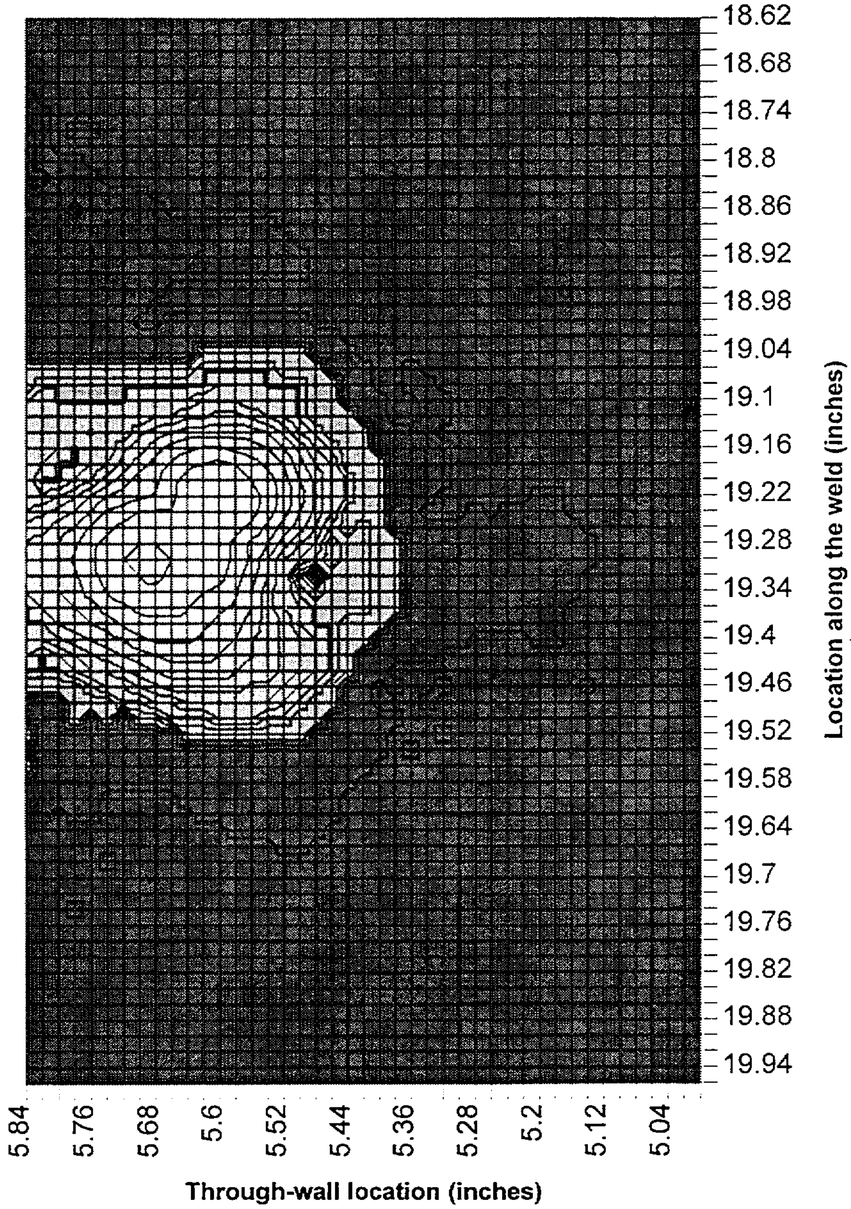

Figure L.1 **Log-scale contour plot of indication #39 in Shoreham specimen C120D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 9 mm. The through-wall location is outer 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.62 inches above 553 inches of vessel elevation.**

Appendix M

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C120E

Table M.1 lists all detectable flaw indications in Shoreham specimen C120E. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C120E is given in Section 2. Figures M.1 through M.11 show the images of the larger indications in the specimen.

Table M.1 List of all indications for Shoreham specimen C120E

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-1.09	1.4	3.88	-30.4	small	base
2	-1.10	4.1	1.5	-22.9	complex cluster	base
3	-0.67	1.2	4.98	-28.5	small	fusion
4	-0.43	2.46	0.6	-21.1	small	weld
5	-0.64	4.02	1.98	-20.7	complex cluster	fusion
6	-0.43	4.14	1.06	-26.1	small	weld
7	-0.66	4.2	2.98	-18.8	complex cluster	fusion
8	-0.71	4.18	4.68	-25.8	small	fusion
9	-0.60	4.9	2.78	-27	small	fusion
10	-0.58	5.16	2.54	-26.8	small	fusion
11	-0.62	4.88	2.78	-26.2	small	fusion
12	-0.60	5.3	2.84	-23.1	small	fusion
13	-0.76	5.56	3.14	-20	complex cluster	fusion
14	-0.65	5.88	4.52	-25.5	small	fusion
15	-0.65	5.9	2.86	-23.4	small	fusion
16	-0.70	6.54	3.52	-20.1	small	fusion
17	-0.65	6.96	3.02	-25.5	small	fusion
18	-0.66	7.08	4.48	-15.4	small	fusion
19	-0.49	6.9	1.44	-21.3	small	weld
20	-0.61	7.8	5.64	-16.2	small	fusion
21	-0.61	7.82	5.28	-16.5	small	fusion
22	-0.64	8.08	4.62	-6.3	long	fusion
23	-0.62	8.24	5.7	-22	small	fusion
24	-0.57	8.6	5.34	-15.2	extended	fusion
25	-0.62	8.78	1.9	-24.5	small	fusion
26	-0.51	9.86	4.22	-12.5	small	fusion
27	-0.60	10.1	5.38	-23	small	fusion

Table M.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.60	10.64	1.88	-18	small	fusion
29	-0.58	11.14	5.46	-27.7	small	fusion
30	-0.52	11.42	4.22	-26.3	small	fusion
31	-0.59	11.5	5.44	-25	small	fusion
32	-0.61	11.98	1.9	-19.5	long	fusion
33	-0.61	12.68	5	-19.5	small	fusion
34	-0.62	14.1	5.54	-21.8	small	fusion
35	-0.62	14.14	4.5	-23	small	fusion
36	-0.64	14.18	1.9	-24.5	small	fusion
37	-0.60	15.02	4.62	-25.8	small	fusion
38	-0.44	14.72	2.18	-24.9	small	weld
39	-0.62	18.22	4.42	-22.9	small	fusion
40	-0.71	18.2	1.82	-19.5	small	fusion
41	-0.60	19.64	4.48	-26.6	small	fusion
42	-0.59	21.06	5.38	-24	small	fusion
43	-0.76	23.26	1.32	-21.3	small	fusion
44	-0.54	26.38	4.6	-23.6	small	fusion
45	-0.57	27.92	5.34	-18.8	small	fusion
46	-0.72	28.56	0.94	-26.1	small	fusion
47	-0.58	28.96	5.5	-24.5	small	fusion
48	0.47	2.2	5.24	-29.1	small	weld
49	-0.06	3.7	1.24	-13.1	small	weld
50	-0.11	4.08	1.68	-17	small	weld
51	-0.04	4.4	1.46	-26.8	small	weld
52	0.00	4.6	1.2	-19.6	small	weld
53	-0.07	4.66	1.72	-21.5	small	weld
54	-0.02	4.88	1.5	-19.6	small	weld
55	-0.14	5.58	2.18	-25.8	small	weld
56	0.02	5.88	1.22	-23.7	small	weld
57	0.02	6.22	1.48	-26.7	small	weld
58	0.09	6.08	1.06	-26.7	small	weld
59	0.02	6.2	1.48	-26.7	small	weld
60	-0.15	7.24	1.54	-27	small	weld
61	0.30	9.82	3	-26.4	small	weld
62	0.25	10.3	0.36	-25.3	small	weld
63	-0.38	16.7	4.66	-28.9	small	weld
64	0.35	23.1	0.32	-27.5	small	weld
65	-0.13	26.84	3.5	-28.1	small	weld
66	0.64	1.38	4.44	-17.3	small	fusion
67	0.61	2.34	4.42	-26	small	fusion
68	0.63	3.36	5.5	-11	surface elongated	fusion
69	0.58	3.64	5.2	-20	small	fusion
70	0.65	3.76	3.38	-24.7	small	fusion

Table M.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	0.67	4	0.86	-24.7	small	fusion
72	0.66	5.82	1.68	-23.7	small	fusion
73	0.68	7.52	0.8	-23.7	small	fusion
74	0.63	7.68	1.02	-23.7	small	fusion
75	0.61	7.5	5.16	-24.8	small	fusion
76	0.51	7.98	5.48	-29	small	fusion
77	0.49	8.42	5.46	-27.4	small	weld
78	0.65	8.4	4.26	-28.8	small	fusion
79	0.30	9.82	3	-26.4	small	weld
80	0.66	10.5	2.3	-24.7	small	fusion
81	0.25	10.32	0.36	-25.3	small	weld
82	0.68	12.1	2.92	-28.7	small	fusion
83	0.61	12.32	5.14	-25.9	small	fusion
84	0.67	12.64	4.28	-25.8	small	fusion
85	0.67	12.86	3.84	-23.6	small	fusion
86	0.53	18.6	0.8	-27.3	small	fusion
87	0.57	19.6	0.76	-24.7	small	fusion
88	0.64	20.38	4.68	-20.4	small	fusion
89	0.61	20.5	0.6	-27.2	small	fusion
90	0.61	21.66	3.6	-28.8	small	fusion
91	0.63	21.76	1.5	-24.7	small	fusion
92	0.65	22.72	4.68	-22.7	small	fusion
93	0.62	22.78	1.94	-25.8	small	fusion
94	0.55	22.88	0.82	-22	small	fusion
95	0.59	24.36	0.64	-25.8	small	fusion
96	0.61	24.72	2.12	-19.2	small	fusion
97	0.52	24.68	0.76	-25.9	small	fusion
98	0.58	26.58	0.66	-25.8	small	fusion
99	0.67	27.76	4.84	-16.2	small	fusion
100	-0.50	27.86	5.12	-28.6	small	fusion
101	-0.58	28.18	5.34	-19	small	fusion
102	-0.72	28.8	0.92	-26.4	small	fusion
103	-0.58	29.18	5.5	-23.8	small	fusion
104	-0.48	31.78	4.12	-22.4	small	weld
105	-0.58	33.14	5.48	-16.1	small	fusion
106	-0.74	33.5	0.52	-24.7	small	fusion
107	-0.56	33.74	5.54	-22.7	small	fusion
108	-0.58	34.12	5.56	-23.6	small	fusion
109	-0.60	34.2	4.74	-25.5	small	fusion
110	-0.61	34.64	5.32	-26.5	small	fusion
111	-0.56	38.46	5.36	-16.5	small	fusion
112	-0.56	39.26	4.1	-24.1	small	fusion

Table M.1 (contd)						
#	Peak Coordinates (Specimen)			Response (dB)	Characterization	Type (material)
	Weld Center (inches)	Along Weld (inches)	Depth (inches)			
113	-0.47	40.12	0.52	-23.1	small	weld
114	-0.62	42.12	4.86	-12.6	small	fusion
115	-0.58	42.96	5.34	-25	small	fusion
116	-0.54	44.8	5.34	-13.6	small	fusion
117	-0.54	48.32	0.32	-15.3	surface elongated	fusion
118	-0.52	48.86	5.24	-27	small	fusion
119	-0.57	51.18	5.46	-28.4	small	fusion
120	-0.67	51.42	2.68	-23.6	small	fusion
121	0.67	28	4.86	-15.7	small	fusion
122	0.64	29.14	4.68	-27	small	fusion
123	0.50	29.6	4.42	-28.8	small	weld
124	0.61	30.08	5.5	-12.8	surface elongated	fusion
125	0.43	29.92	5.06	-27.3	small	weld
126	0.63	30.14	4.56	-27	small	fusion
127	0.63	30.48	1.96	-25.7	small	fusion
128	0.61	31.32	0.6	-27	small	fusion
129	0.63	31.8	1.94	-25.7	small	fusion
130	0.55	32.52	0.8	-24.6	small	fusion
131	0.62	32.7	3.88	-25.7	small	fusion
132	0.67	33.06	5.4	-14.5	surface elongated	fusion
133	0.69	33.5	5.5	-25.6	small	fusion
134	0.62	33.72	4.56	-23.5	small	fusion
135	0.66	34.36	5.2	-22.5	small	fusion
136	0.61	35.04	2.34	-24.5	small	fusion
137	0.58	35.82	4.62	-28.6	small	fusion
138	0.60	36.06	4.6	-27	small	fusion
139	0.63	36.38	4.6	-24.5	small	fusion
140	0.67	36.58	2.92	-18.9	small	fusion
141	0.57	37.7	0.84	-27	small	fusion
142	0.62	37.86	0.62	-24.5	small	fusion
143	0.66	37.92	1.94	-28.5	small	fusion
144	0.54	38.92	4.08	-20.3	small	fusion
145	0.61	39.42	0.62	-23.4	small	fusion
146	0.61	39.7	1.96	-28.6	small	fusion
147	0.63	40.2	3.72	-23.4	small	fusion
148	0.63	41	4.7	-28.5	small	fusion
149	0.65	41.6	2.04	-22.5	small	fusion
150	0.60	41.62	0.62	-25.6	small	fusion
151	0.62	41.98	0.62	-24.4	small	fusion
152	0.62	42.4	1.96	-28.5	small	fusion
153	0.20	43.44	0.34	-27.5	small	weld
154	0.68	44.04	0.44	-16	small	fusion

Table M.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	0.63	44.1	3.74	-21.6	small	fusion
156	0.66	43.56	4.66	-23.4	small	fusion
157	0.34	43.6	5.04	-24.8	small	weld
158	0.65	44.68	3.7	-25.5	small	fusion
159	0.65	45.34	0.68	-22.4	small	fusion
160	0.56	45.88	0.76	-23.5	small	fusion
161	0.65	46.4	1.94	-25.5	small	fusion
162	0.58	46.24	5.54	-17	small	fusion
163	0.66	48	4.22	-24.3	small	fusion
164	0.66	48.5	4.26	-24.3	small	fusion
165	0.64	48.2	3.78	-24.4	small	fusion
166	0.68	48.1	0.44	-21.5	small	fusion
167	0.67	50.4	0.68	-20.8	small	fusion
168	0.65	49.36	4.76	-18.9	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

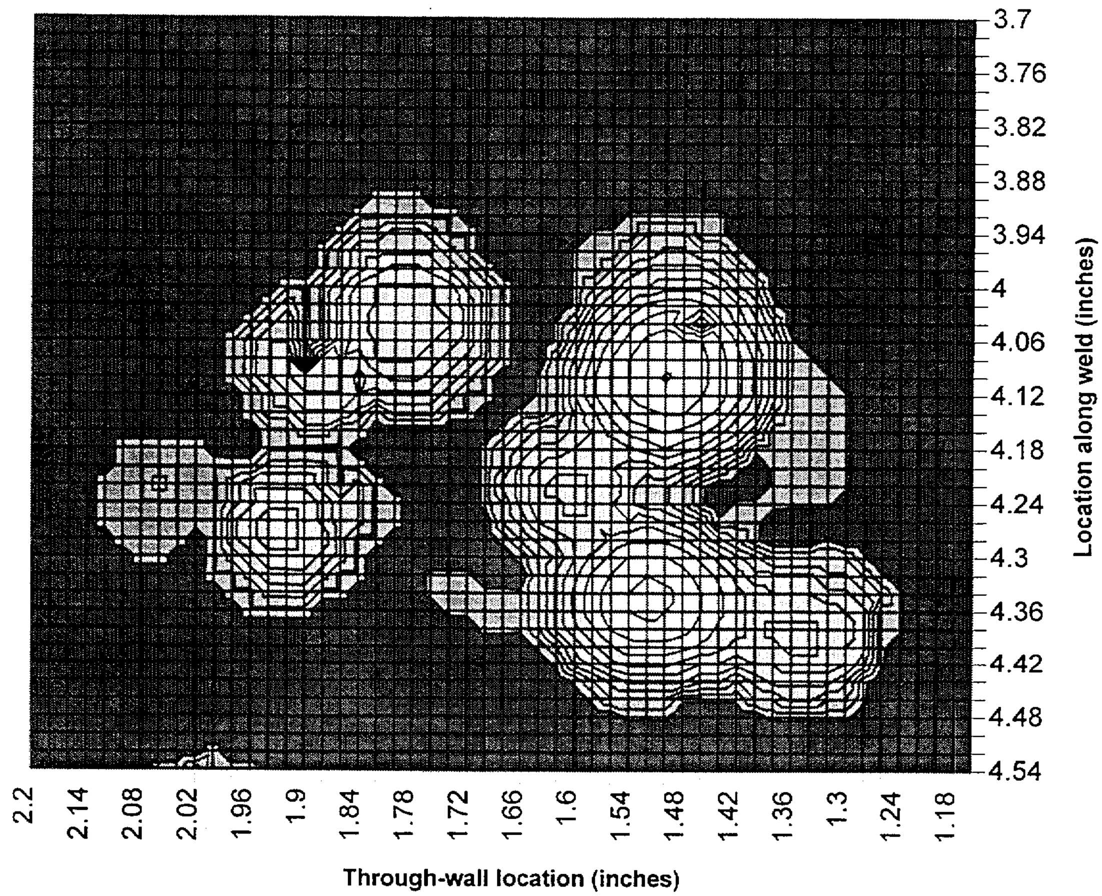

Figure M.1 **Log-scale contour plot of indication #2 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -22.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 10 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as simple cluster, is located in the base metal at 1.10 inches below 553 inches of vessel elevation.**

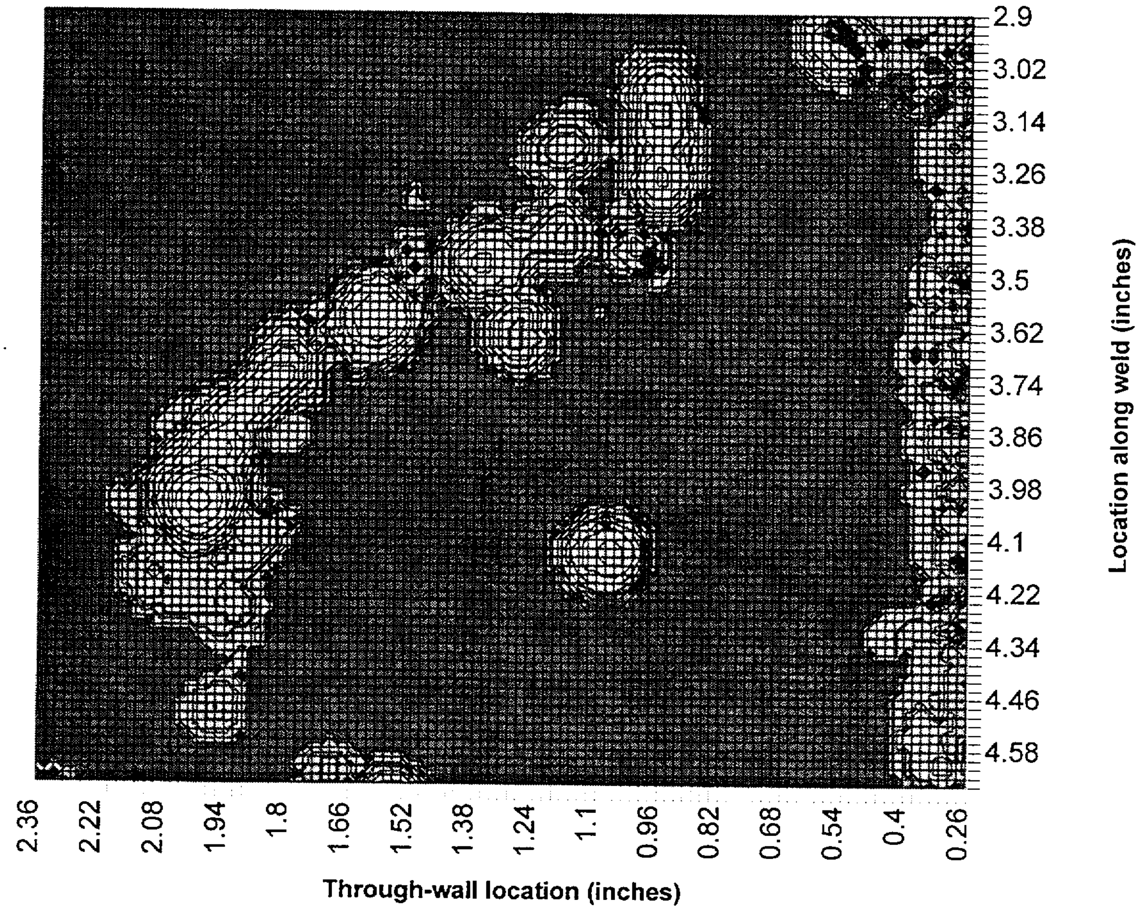

Figure M.2 Log-scale contour plot of indication #5 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.7 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 32 mm. The through-wall location is inner 25 mm. The length is 38 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as complex cluster, is located on the fusion surface at 0.64 inches below 553 inches of vessel elevation.

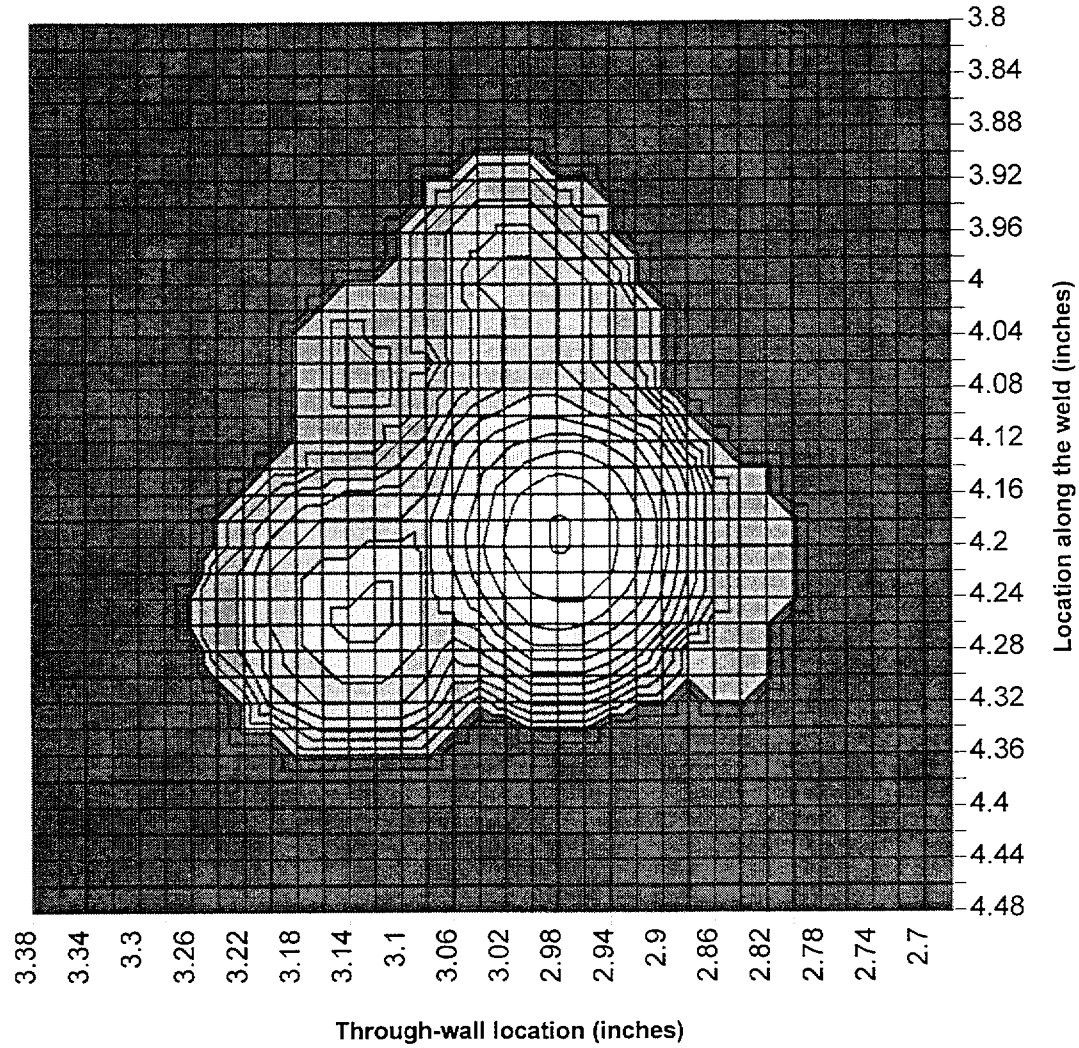

Figure M.3 **Log-scale contour plot of indication #7 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -18.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 7 mm. The through-wall location is mid-wall. The length is 12 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as simple cluster, is located on the fusion surface at 0.66 inches below 553 inches of vessel elevation.**

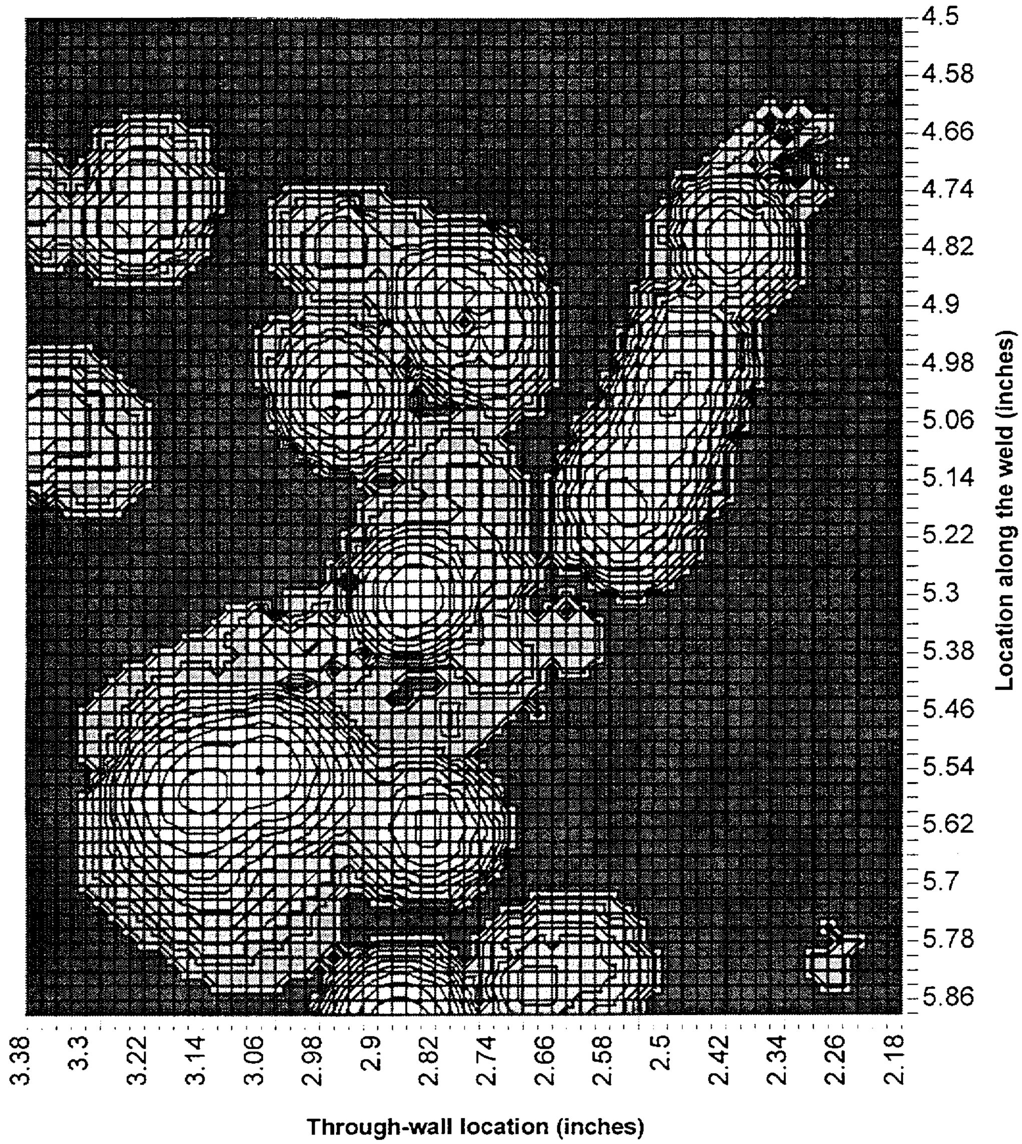

Figure M.4 **Log-scale contour plot of indication #13 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 21 mm. The through-wall location is mid-wall. The length is 28 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as complex cluster, is located on the fusion surface at 0.76 inches below 553 inches of vessel elevation.**

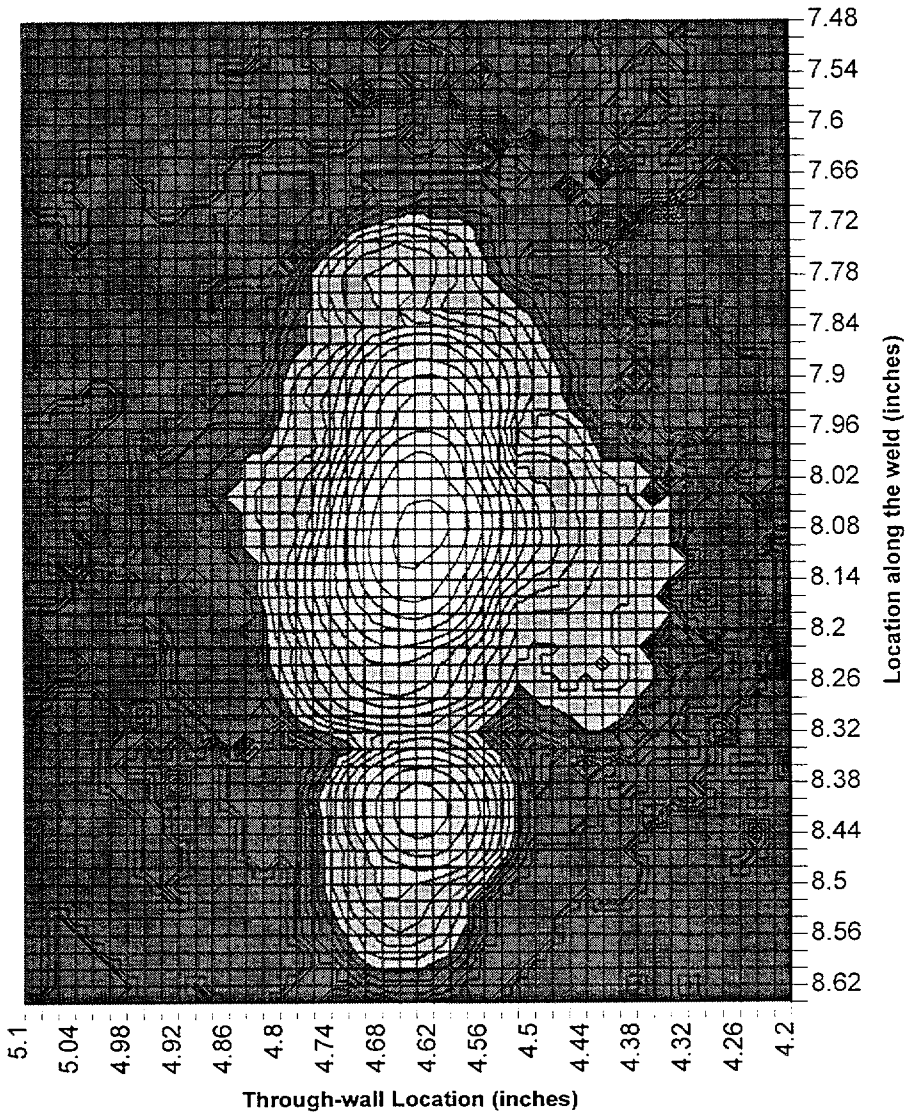

Figure M.5 **Log-scale contour plot of indication #22 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 23 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.64 inches below 553 inches of vessel elevation.**

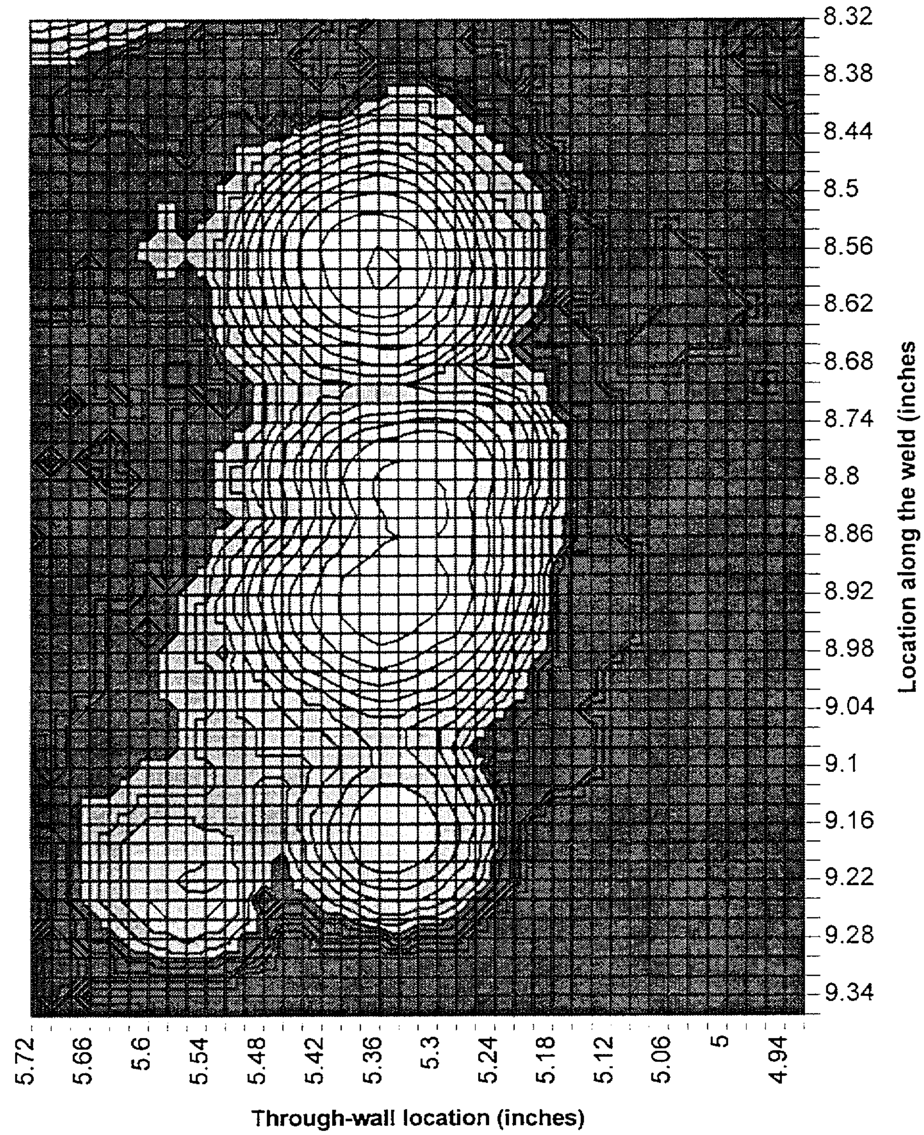

Figure M.6 **Log-scale contour plot of indication #24 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 22 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.57 inches below 553 inches of vessel elevation.**

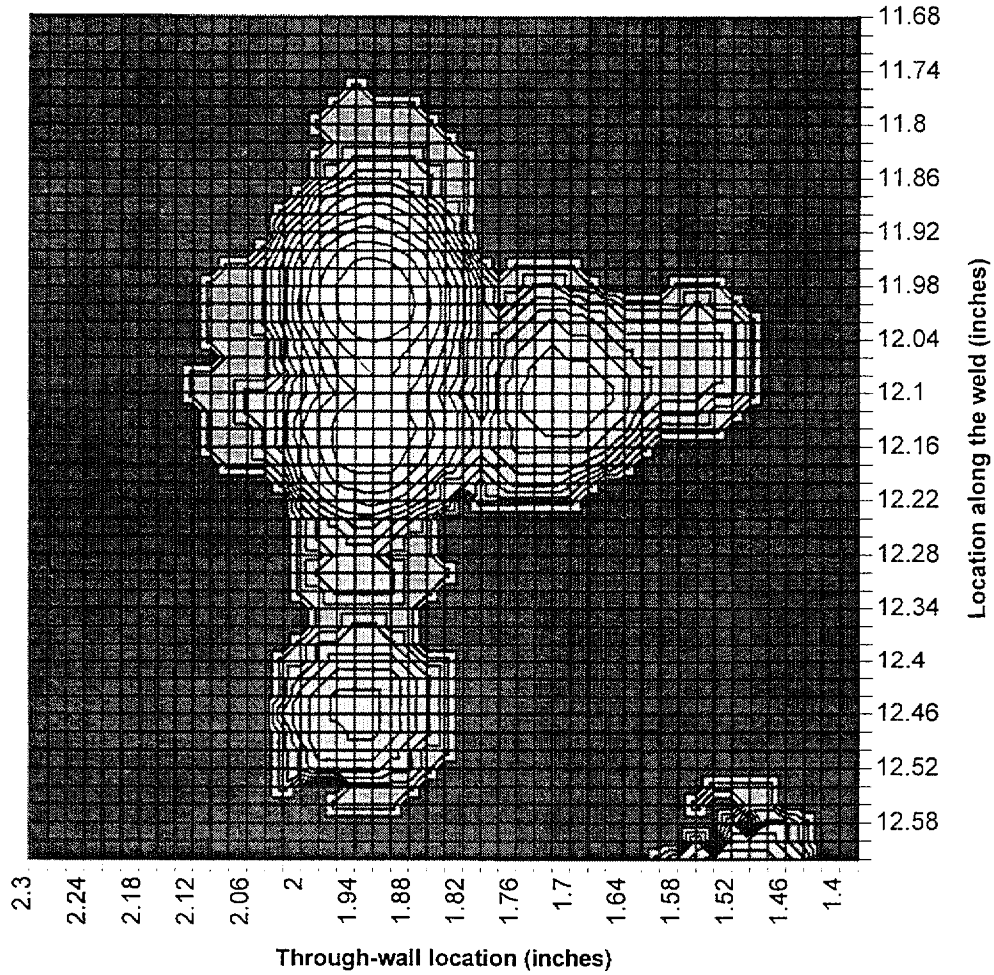

Figure M.7 **Log-scale contour plot of indication #32 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.61 inches below 553 inches of vessel elevation.**

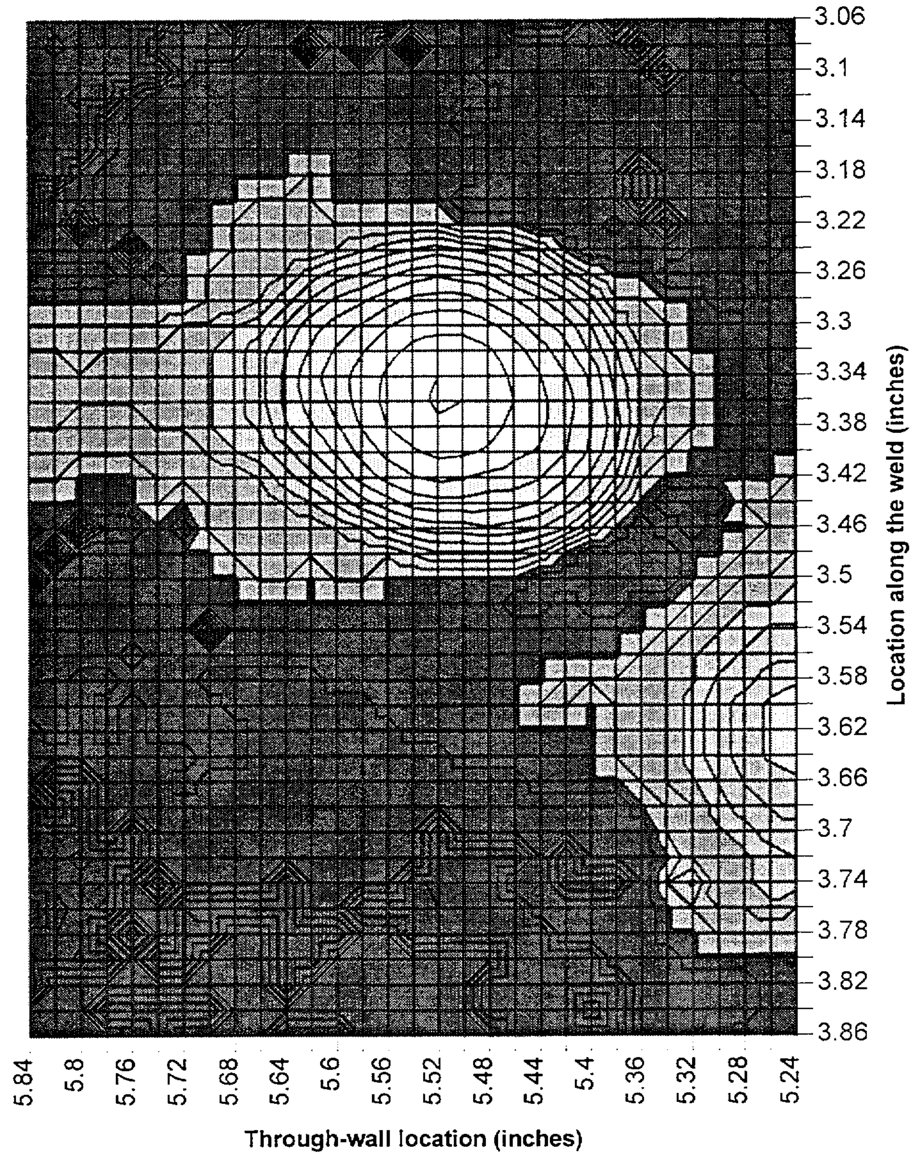

Figure M.8 **Log-scale contour plot of indication #68 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -11.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 8 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.63 inches above 553 inches of vessel elevation.**

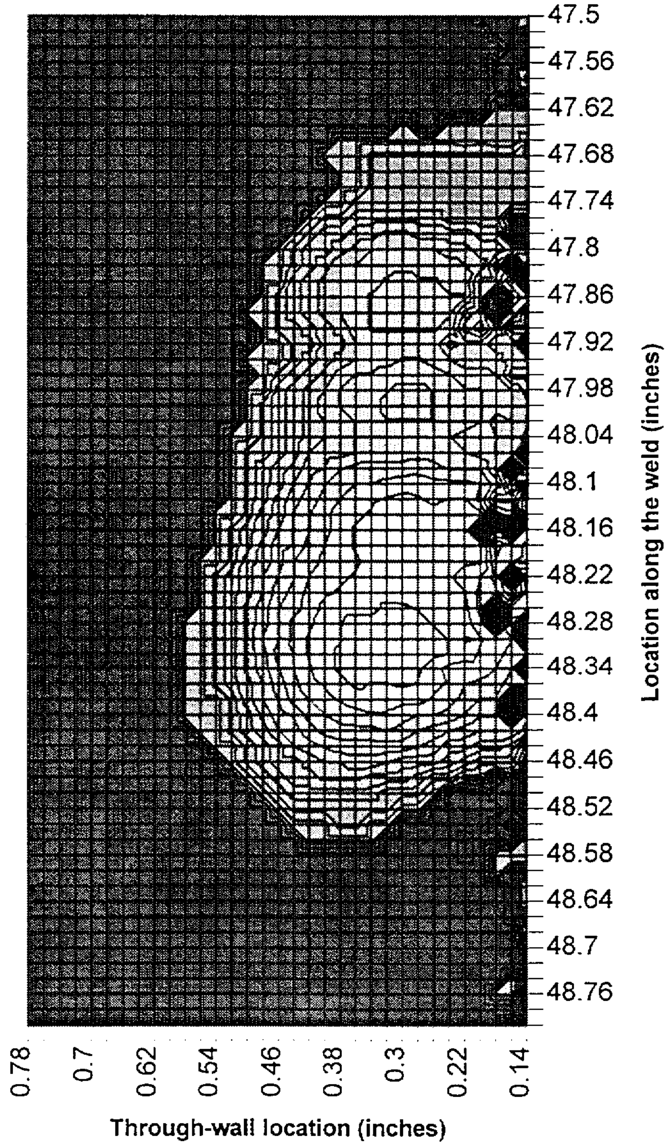

Figure M.9 **Log-scale contour plot of indication #117 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 7 mm. The through-wall location is inner 25 mm. The length is 20 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.54 inches below 553 inches of vessel elevation.**

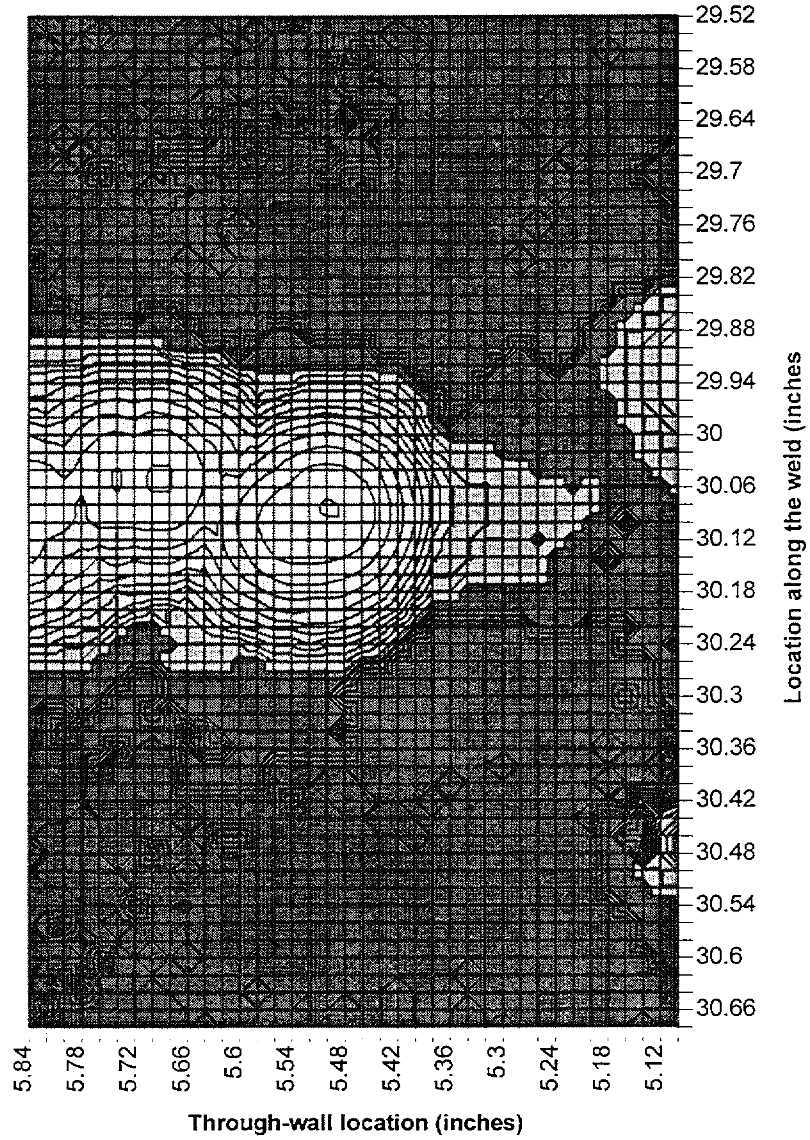

Figure M.10 **Log-scale contour plot of indication #124 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.61 inches above 553 inches of vessel elevation.**

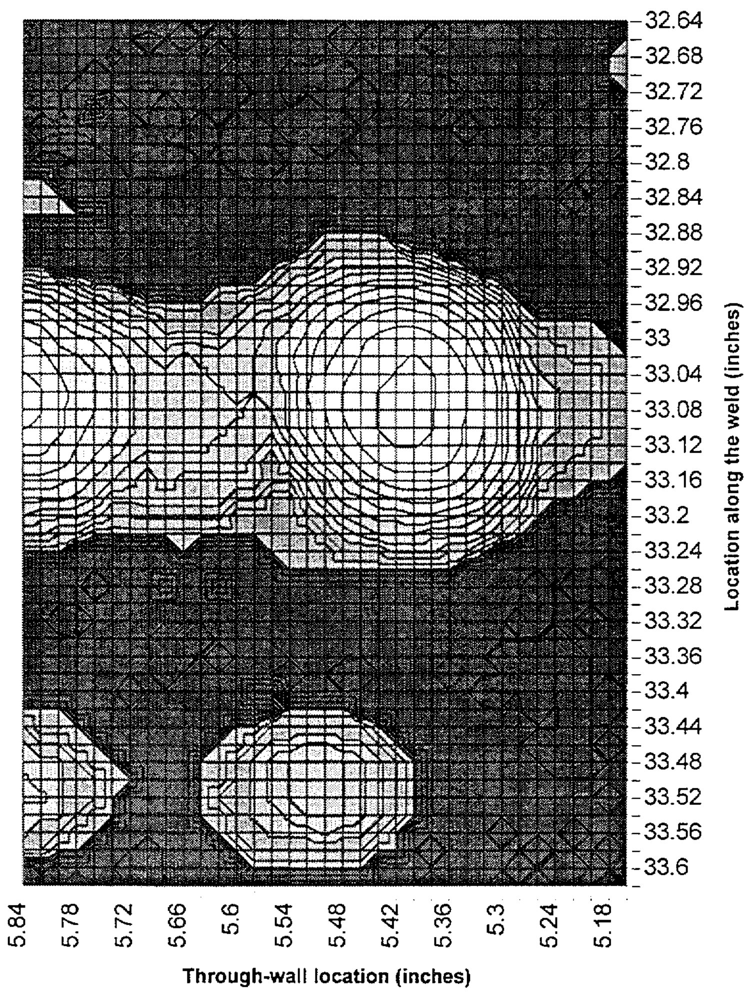

Figure M.11 Log-scale contour plot of indication #132 in Shoreham specimen C120E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.67 inches above 553 inches of vessel elevation.

Appendix N

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C120F

Table N.1 lists all detectable flaw indications in Shoreham specimen C120F. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C120F is given in Section 2. Figures N.1 through N.8 show the images of the larger indications in the specimen.

Table N.1 List of all indications for Shoreham specimen C120F

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.52	505.98	0.72	-29.6	small	weld
2	-0.61	506.56	1.82	-25.2	small	fusion
3	-0.72	506.56	3.92	-29.5	small	fusion
4	-0.72	506.54	5.74	-26.3	small	fusion
5	-0.61	506.86	1.7	-25.8	small	fusion
6	-0.72	507.06	4.26	-30.5	small	fusion
7	-0.68	507.32	3.26	-23.3	small	fusion
8	-0.59	507.44	2.1	-28.9	small	ROOT
9	-0.75	507.54	5.28	-9.6	small	fusion
10	-0.72	507.76	5.08	-16.5	small	fusion
11	-0.73	508.28	4.26	-23	small	fusion
12	-0.66	508.56	3.24	-29.2	small	fusion
13	-0.66	509.26	1.14	-29.2	small	fusion
14	-0.57	509.28	0.68	-27.1	small	weld
15	-0.68	509.48	4.2	-28.4	small	fusion
16	-0.75	511.5	5.18	-27.1	small	fusion
17	-0.73	511.86	4.32	-27	small	fusion
18	-0.75	513.34	4.9	-16.9	small	fusion
19	-0.62	513.34	0.52	-24	small	fusion
20	-0.62	513.84	0.62	-25.2	small	fusion
21	-0.73	514	5.54	-27	small	fusion
22	-0.76	514.82	4.26	-28.7	small	fusion
23	-0.73	516.6	4.28	-21.4	small	fusion
24	-0.76	516.7	5.2	-25.8	small	fusion
25	-0.76	516.8	4.58	-27.1	small	fusion
26	-0.76	517.2	5.76	-27.9	small	fusion
27	-0.62	517.5	2.24	-30	small	fusion

Table N.1 (contd)						
#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.74	517.98	5.82	-16.5	small	fusion
29	-0.71	518.36	3.4	-22.5	small	fusion
30	-0.74	520.24	5.28	-20	small	fusion
31	-0.74	520.64	5.78	-27	small	fusion
32	-0.74	520.72	4.82	-31.7	small	fusion
33	-0.76	521.26	5.52	-21.8	small	fusion
34	-0.74	521.26	5.3	-21.4	small	fusion
35	-0.74	521.76	4.8	-29.5	small	fusion
36	-0.76	522.46	5.14	-18.1	small	fusion
37	-0.74	522.8	4.68	-25.7	small	fusion
38	-0.72	525.16	4.64	-26.9	small	fusion
39	-0.74	525.76	4.3	-27.8	simple cluster	fusion
40	-0.65	525.76	3.32	-27.4	small	fusion
41	-0.65	525.9	1.92	-29.1	small	fusion
42	-0.74	526.88	4.38	-20	simple cluster	fusion
43	-0.72	527	4.62	-20.9	small	fusion
44	-0.72	527.8	4.58	-25.6	small	fusion
45	-0.75	527.88	4.38	-27.8	small	fusion
46	-0.72	529.04	3.28	-23.4	small	fusion
47	-0.72	529.68	4.58	-15.8	simple cluster	fusion
48	-0.75	529.92	4.34	-30.5	small	fusion
49	-0.75	530.32	5.6	-25.1	small	fusion
50	-0.75	530.86	4.38	-31.7	small	fusion
51	-0.75	531.16	4.48	-31.7	small	fusion
52	-0.66	531.24	1.82	-14.9	small	fusion
53	-0.61	531.18	0.98	-29.9	small	fusion
54	-0.61	531.66	0.94	-28	small	fusion
55	-0.75	532.12	4.62	-16.8	small	fusion
56	-0.61	532.32	2.16	-27.2	small	fusion
57	-0.63	532.22	1.44	-30	small	fusion
58	-0.82	532.36	5.16	-17.3	small	fusion
59	-0.82	532.6	5.42	-29.8	small	fusion
60	-0.89	532.72	5.16	-19.6	small	fusion
61	-0.73	533.16	4.62	-18.4	small	fusion
62	-0.77	533.52	4.84	-20.4	small	fusion
63	-0.75	533.92	4.74	-22.1	small	fusion
64	-0.59	534.24	0.28	-29.8	small	clad
65	-0.64	534.54	0.72	-30	small	fusion
66	0.52	505.86	2.24	-23.5	small	ROOT
67	0.70	505.88	1.06	-21.7	small	fusion
68	-0.52	505.98	0.7	-29.6	small	weld
69	0.70	506.08	4.14	-27.7	small	fusion
70	0.73	506.28	1.1	-14.9	small	fusion

Table N.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	0.52	506.54	2.22	-23.5	small	ROOT
72	0.66	507	2.02	-21	small	fusion
73	0.70	507.02	4.42	-22.4	small	fusion
74	0.63	507.26	5.02	-19.2	small	fusion
75	0.66	507.7	5.08	-23.3	small	fusion
76	0.70	507.84	4.78	-18.1	small	fusion
77	0.68	508.02	4.14	-19.8	small	fusion
78	0.66	508	5.08	-26.4	small	fusion
79	0.70	507.1	1.12	-12.6	small	fusion
80	0.79	507.08	0.36	-25.1	small	fusion
81	0.72	507.8	1.14	-9.4	long	fusion
82	0.75	508.04	0.72	-12.3	small	fusion
83	0.72	508.16	1.14	-11	small	fusion
84	0.63	509.08	0.98	-27.8	small	fusion
85	-0.54	509.26	0.7	-28.7	small	weld
86	0.68	509.54	1.14	-16.4	small	fusion
87	0.52	509.46	2.24	-17.9	small	ROOT
88	0.54	509.98	2.24	-16.2	small	ROOT
89	0.74	511.08	0.72	-13.9	small	fusion
90	0.58	511.2	2.22	-22.6	small	ROOT
91	0.77	512.26	0.8	-27.6	small	fusion
92	0.74	513.64	0.7	-23.2	small	fusion
93	0.72	513.78	1.66	-23.2	small	fusion
94	0.72	514.44	4.36	-19.1	small	fusion
95	0.67	514.7	5.58	-24.2	small	fusion
96	0.53	515.46	2.18	-19.4	small	ROOT
97	0.74	515.56	0.74	-18.6	small	fusion
98	0.74	515.86	0.76	-14.6	small	fusion
99	0.65	515.92	1.68	-24.2	small	fusion
100	0.67	516.3	5.1	-17.7	small	fusion
101	0.62	516.6	5.84	-14.1	surface elongated	fusion
102	0.67	517.08	5.12	-17.3	small	fusion
103	0.67	516.98	4.16	-26.4	small	fusion
104	0.30	516.9	2.74	-28.2	small	ROOT
105	0.76	517.8	0.76	-20.9	small	fusion
106	-0.44	519.22	2.68	-24.9	small	ROOT
107	0.64	519.5	2.08	-26.4	small	fusion
108	0.73	519.68	3.84	-27.6	small	fusion
109	0.71	521.36	3.96	-22.4	small	fusion
110	0.18	521.9	3.72	-29.9	small	weld
111	-0.56	522.42	1.56	-32.2	small	ROOT
112	0.66	522.78	5.1	-21	small	fusion

Table N.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	0.75	523.16	0.8	-24.1	small	fusion
114	0.73	523.8	4.2	-24.1	small	fusion
115	0.75	523.8	0.76	-25.1	small	fusion
116	0.68	524.16	5.58	-27.7	small	fusion
117	0.68	524.36	3.66	-26.3	small	fusion
118	0.75	524.42	0.78	-25.1	small	fusion
119	0.78	524.64	0.56	-25.1	small	fusion
120	0.75	524.78	4.08	-24.1	small	fusion
121	0.68	525.12	3.78	-23.2	small	fusion
122	-0.54	525.24	0.52	-33.7	small	weld
123	0.68	525.7	5.12	-15.6	long	fusion
124	0.71	526.06	3.94	-19.7	small	fusion
125	0.71	526.08	5.04	-26.3	small	fusion
126	0.70	526.54	5.12	-26.3	small	fusion
127	0.80	527.14	1.12	-29.1	small	fusion
128	0.68	527.72	5.12	-19.2	small	fusion
129	0.68	529.16	5.32	-25.2	small	fusion
130	0.38	529.44	2.56	-29.6	small	ROOT
131	0.70	530.66	5.12	-21.6	small	fusion
132	0.01	530.88	2.78	-29	small	ROOT
133	0.77	530.98	0.84	-23.1	small	fusion
134	0.70	531.64	5.12	-17.2	small	fusion
135	0.79	531.56	3.38	-20.2	small	fusion
136	0.77	532.04	0.86	-13	small	fusion
137	0.77	532.46	0.44	-18.5	small	fusion
138	0.70	532.52	5.1	-13.7	small	fusion
139	0.72	533.46	5.04	-7.1	small	fusion
140	0.65	533.48	2.08	-25.2	small	fusion
141	-0.57	534.26	0.3	-28.7	small	weld
142	-0.64	535.12	0.7	-23	small	fusion
143	-0.75	535.42	4.64	-23.5	small	fusion
144	-0.62	536.12	2.18	-28.9	small	fusion
145	-0.73	537.52	3.2	-18.1	small	fusion
146	-0.76	537.68	4.58	-29.5	small	fusion
147	-0.78	538.56	4.4	-25.8	small	fusion
148	-0.78	538.8	4.86	-10	small	fusion
149	-0.67	539.28	0.38	-19.6	small	fusion
150	-0.78	539.34	5.62	-9.6	small	fusion
151	-0.64	540.52	0.88	-25.8	small	fusion
152	-0.67	540.88	0.94	-22.6	small	fusion
153	-0.81	541.42	5.46	-12.5	small	fusion
154	-0.64	541.7	2.24	-29	small	fusion

Table N.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	-0.60	541.88	2.3	-27.1	small	ROOT
156	-0.76	542.18	4.56	-21.7	small	fusion
157	-0.81	542.1	5	-19	small	fusion
158	-0.81	543.56	4.36	-26.5	small	fusion
159	-0.81	543.98	4.8	-27.2	small	fusion
160	-0.79	545.06	5.64	-30.6	small	fusion
161	-0.65	545.48	1.14	-18	small	fusion
162	-0.65	545.6	0.5	-22.5	small	fusion
163	-0.58	546.2	3.74	-30.9	small	weld
164	-0.60	546.7	2.14	-17	small	fusion
165	-0.65	547.18	1.06	-27.3	small	fusion
166	-0.83	547.64	4.32	-20.6	small	fusion
167	-0.70	548.14	1.08	-30.2	small	fusion
168	-0.81	548.5	4.42	-25.9	small	fusion
169	-0.65	548.96	0.82	-24	small	fusion
170	-0.84	549.62	4.36	-20.6	small	fusion
171	-0.65	549.6	0.92	-26.5	small	fusion
172	-0.68	550.08	1.02	-22.2	small	fusion
173	-0.63	550.16	0.56	-14.2	small	fusion
174	-0.68	550.68	1.04	-16.4	small	fusion
175	-0.77	550.78	3.3	-18	small	fusion
176	-0.84	550.74	4.28	-19	small	fusion
177	-0.84	551.06	4.96	-20.2	small	fusion
178	-0.79	551.32	3.36	-19.7	small	fusion
179	-0.68	551.8	1.98	-19.9	small	fusion
180	-0.84	552.16	4.34	-17.1	small	fusion
181	-0.64	534.72	0.78	-29	small	fusion
182	-0.64	535.12	0.7	-23	small	fusion
183	0.28	535.8	2.48	-25.7	small	ROOT
184	-0.62	536.12	2.2	-28	small	fusion
185	0.72	536.4	5.82	-21.6	small	fusion
186	0.81	536.56	0.56	-8.3	surface elongated	fusion
187	0.69	536.92	1.3	-24.1	small	fusion
188	0.72	537.3	5.16	-20.9	small	fusion
189	0.79	537.56	1	-8.9	small	fusion
190	0.83	537.56	0.3	-24	small	fusion
191	-0.62	537.82	1.08	-29.9	small	fusion
192	0.76	538.08	0.98	-20.8	small	fusion
193	0.78	538.24	3.4	-13.6	small	fusion
194	0.72	538.16	5.76	-23.2	small	fusion
195	0.76	539.12	1	-17.6	small	fusion
196	-0.64	539.28	0.34	-21.6	extended	fusion

Table N.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
197	0.69	540.52	3.02	-25.2	small	fusion
198	-0.64	540.54	0.86	-26.5	small	fusion
199	-0.64	540.88	0.92	-28.1	small	fusion
200	0.76	541.08	3.4	-21.5	small	fusion
201	-0.64	541.7	2.26	-29	small	fusion
202	0.78	541.94	1.94	-13.3	small	fusion
203	0.78	542.42	3.4	-25	small	fusion
204	0.80	543.46	4.14	-24	small	fusion
205	0.71	544.02	5.76	-22.4	small	fusion
206	0.78	544.1	1.14	-25	small	fusion
207	-0.65	545.48	1.14	-18	small	fusion
208	-0.65	545.58	0.52	-21.6	small	fusion
209	0.78	545.82	5.06	-20.2	small	fusion
210	-0.58	546.22	3.78	-29.7	small	weld
211	0.80	546.5	3.52	-25	small	fusion
212	-0.60	546.7	2.14	-17	small	fusion
213	-0.03	547.08	4.42	-26.7	small	weld
214	0.80	547.2	4.16	-23.1	small	fusion
215	0.78	547.44	3.4	-24	small	fusion
216	-0.65	547.2	1.06	-28.1	small	fusion
217	0.78	547.54	0.94	-22.3	small	fusion
218	-0.44	547.88	2.74	-27.1	small	ROOT
219	0.80	547.94	3.34	-16.2	small	fusion
220	0.77	547.86	4.62	-21.5	small	fusion
221	0.80	548.1	5.08	-18.5	small	fusion
222	0.66	548.22	2.28	-19.7	small	fusion
223	0.82	548.4	0.88	-14.4	small	fusion
224	-0.65	548.98	0.82	-25.2	small	fusion
225	0.84	549.18	3.42	-23.9	small	fusion
226	0.80	549.46	5.08	-13	small	fusion
227	-0.65	549.6	0.9	-27.3	small	fusion
228	-0.65	550.08	1	-25.2	small	fusion
229	-0.63	550.16	0.56	-14.2	small	fusion
230	-0.65	550.7	1.06	-19.5	small	fusion
231	0.84	551.24	0.76	-12.9	small	fusion
232	-0.66	551.8	2	-24	small	fusion
233	0.82	552.2	4.24	-20.8	small	fusion
234	-0.17	553.6	4.88	-24.8	small	weld
235	0.03	553.58	5.4	-24.3	small	weld
236	0.82	553.26	1.36	-23	small	fusion
237	-0.47	553.54	0.86	-21.2	small	weld

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for Azimuth less than 120 degrees.

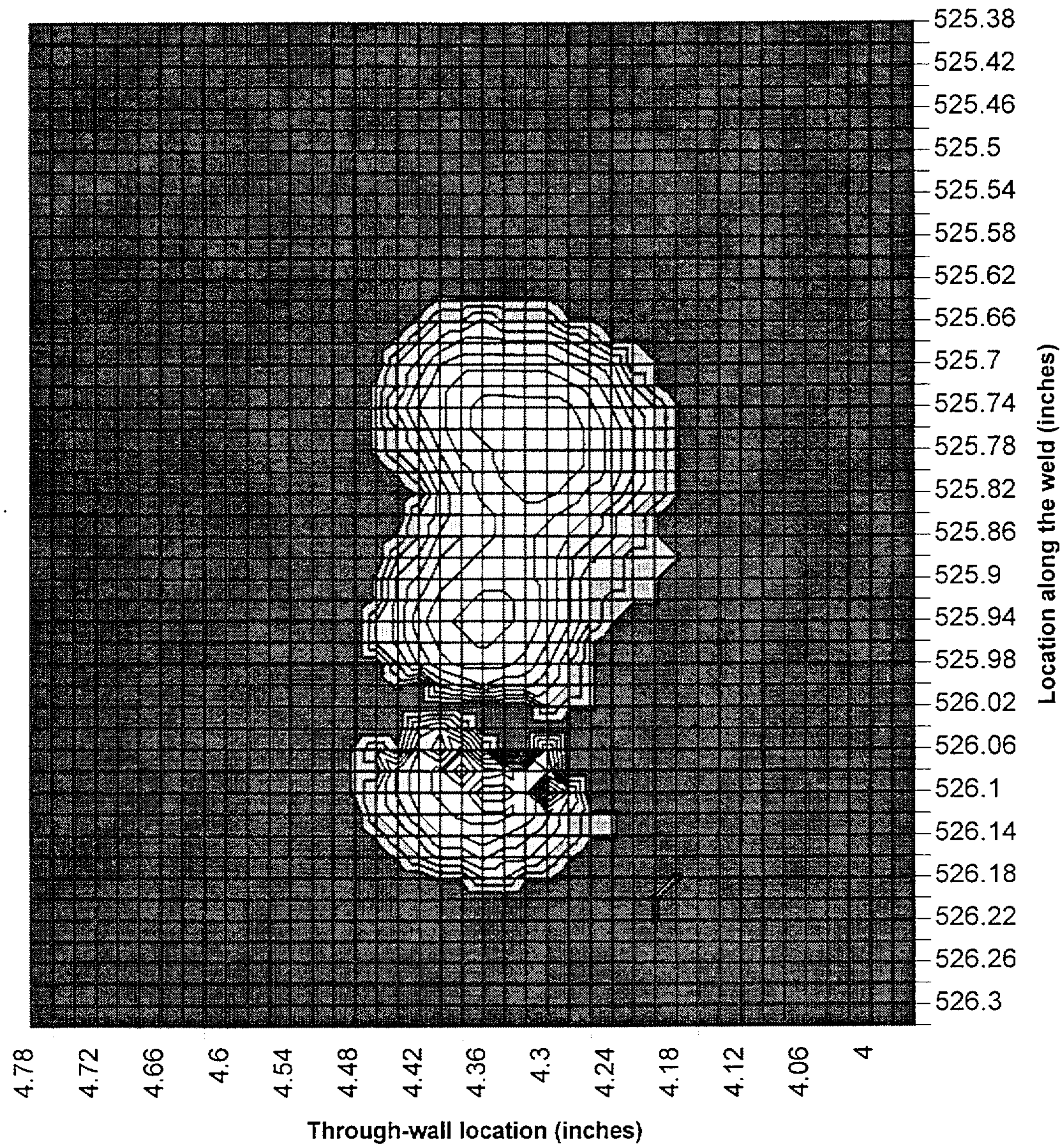

Figure N.1 **Log-scale contour plot of indication #39 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -27.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 14 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as simple cluster, is located on the fusion surface at 0.74 inches above (plus angle) 120 degrees of vessel azimuth.**

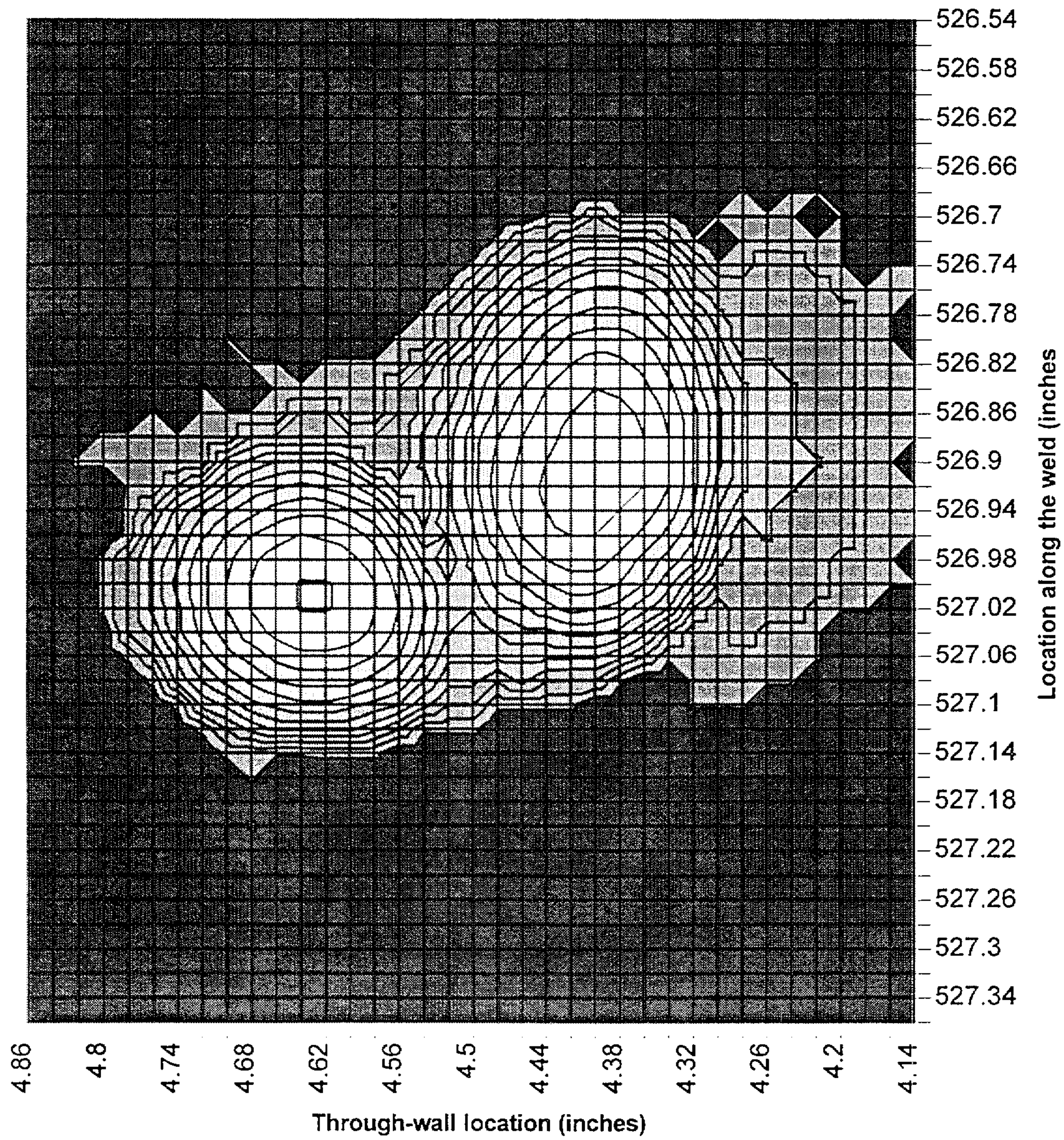

Figure N.2 Log-scale contour plot of indication #42 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 9 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as simple cluster, is located on the fusion surface at 0.74 inches above (plus angle) 120 degrees of vessel azimuth.

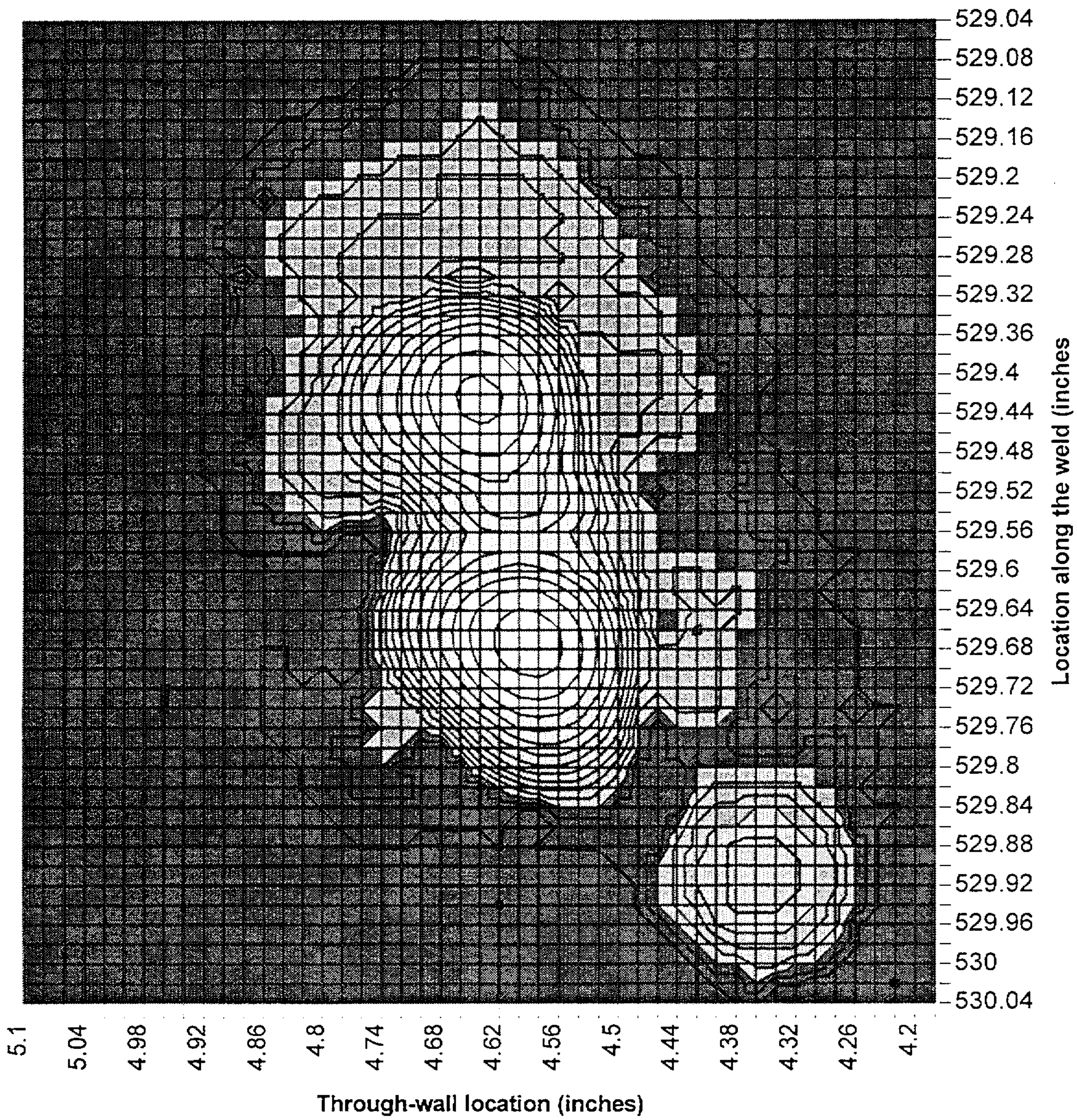

Figure N.3 **Log-scale contour plot of indication #47 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 14 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as simple cluster, is located on the fusion surface at 0.742 inches above (plus angle) 120 degrees of vessel azimuth.**

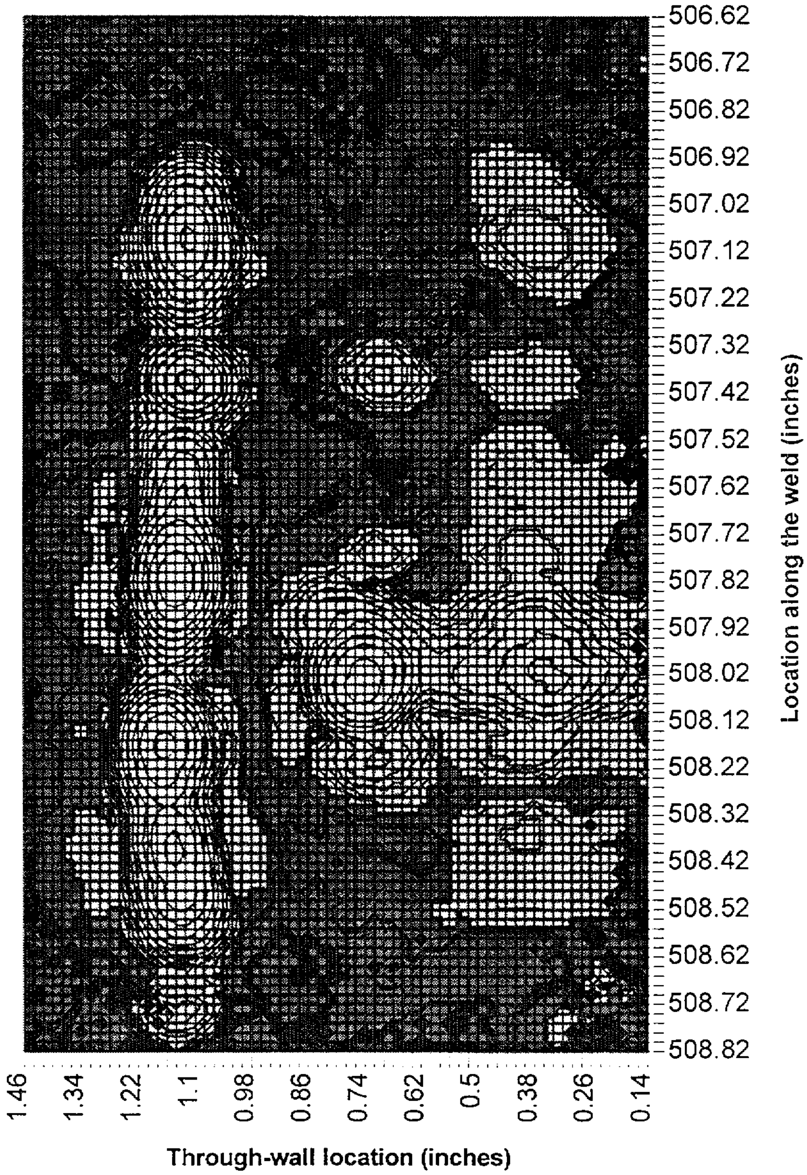

Figure N.4 Log-scale contour plot of indication #81 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 51 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion is located on the fusion surface at 0.72 inches above (plus angle) 120 degrees of vessel azimuth.

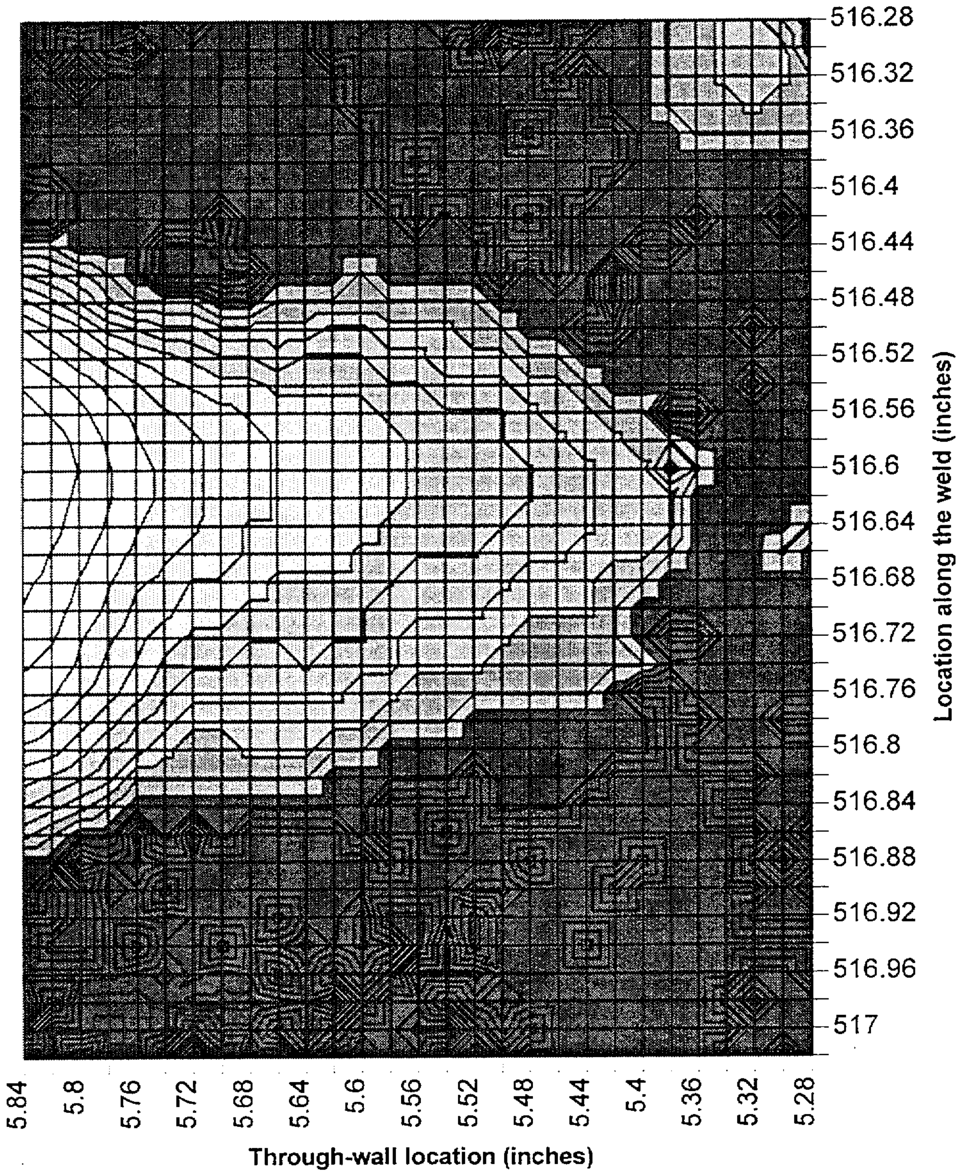

Figure N.5 **Log-scale contour plot of indication #101 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as surface-elongated, is located on the fusion surface at 0.62 inches below (minus angle) 120 degrees of vessel azimuth.**

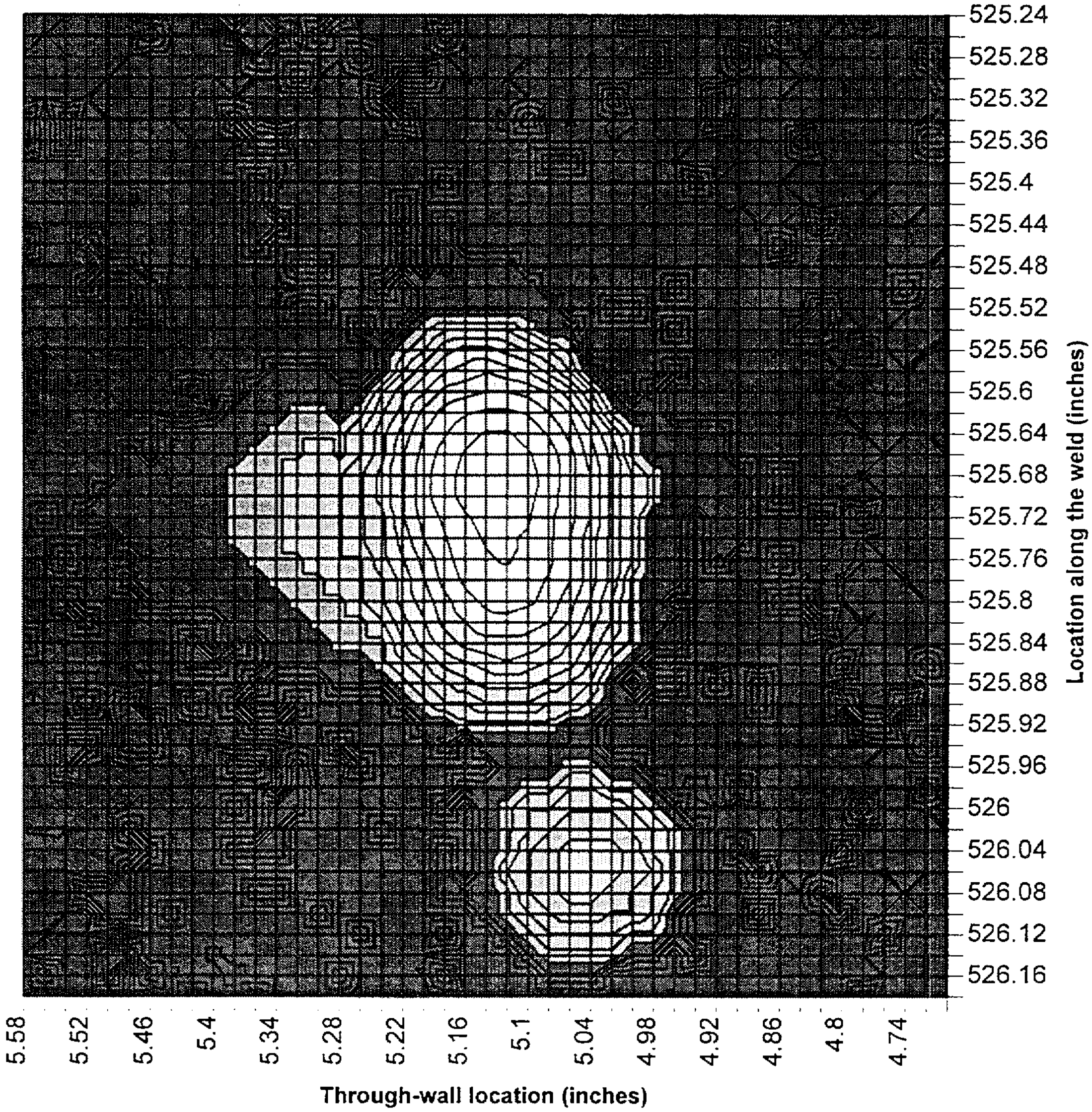

Figure N.6 **Log-scale contour plot of indication #123 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is outer 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.74 inches above (plus angle) 120 degrees of vessel azimuth.**

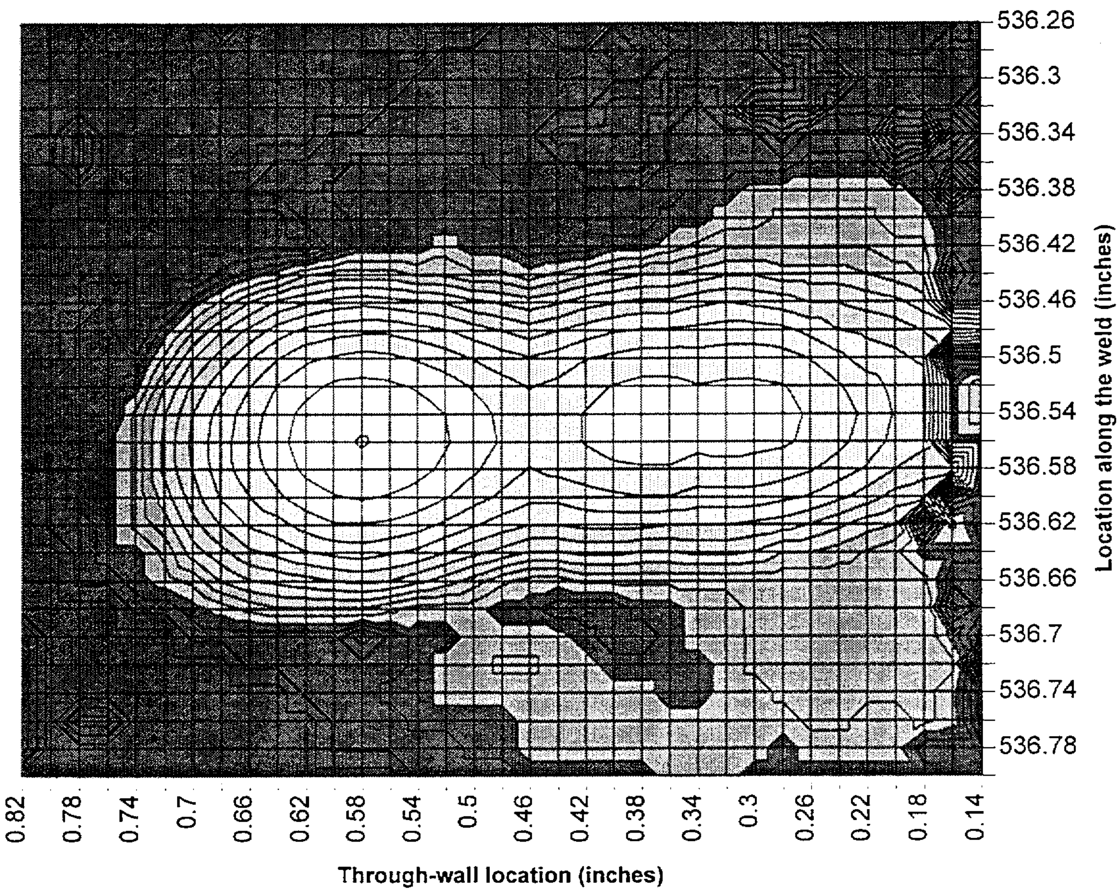

Figure N.7 Log-scale contour plot of indication #186 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 10 mm. The through-wall location is inner 25 mm. The length is 6 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as surface elongated, is located on the fusion surface at 0.81 inches below (minus angle) 120 degrees of vessel azimuth.

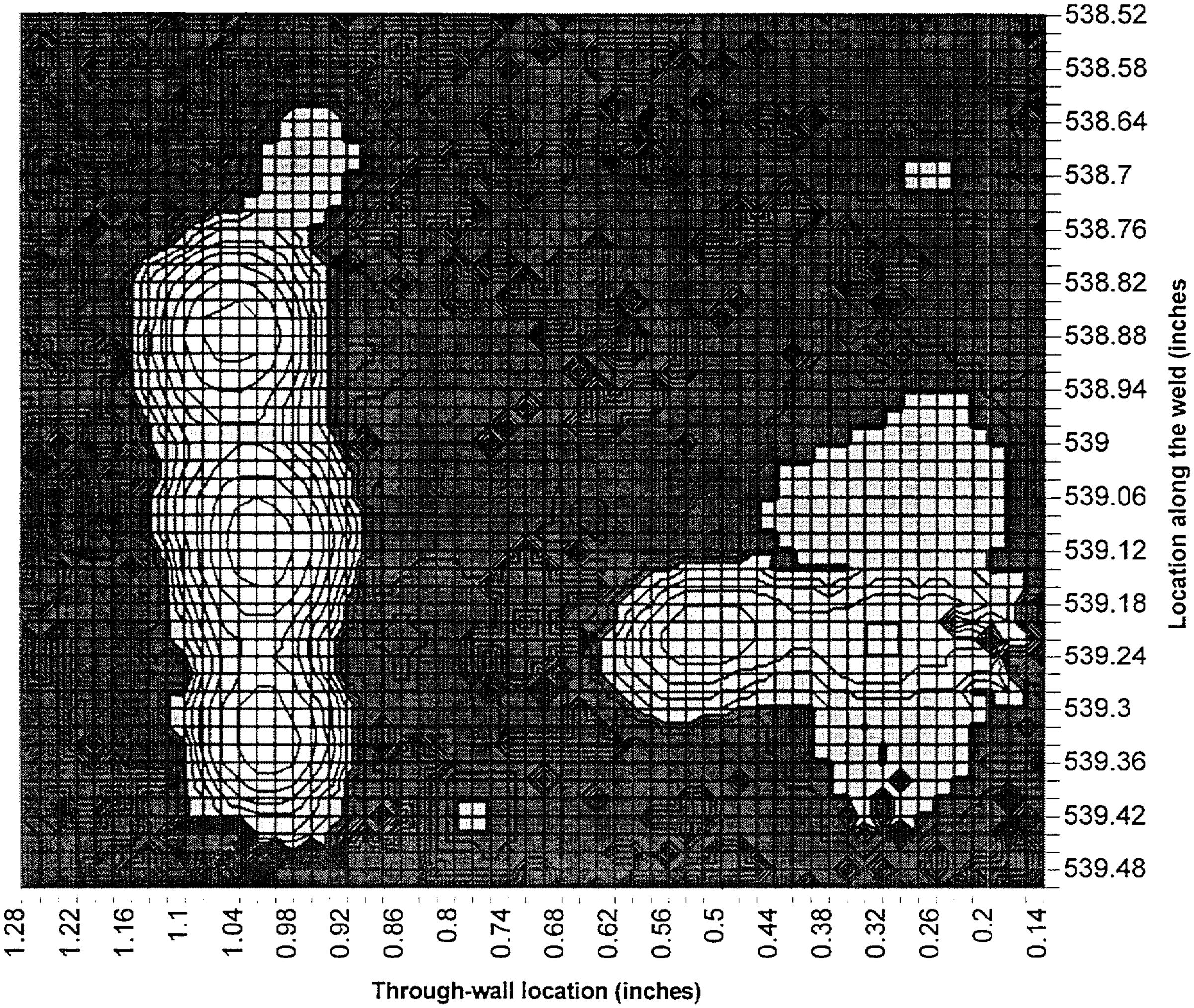

Figure N.8 Log-scale contour plot of indication #196 in Shoreham specimen C120F. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -21.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is inner 25 mm. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion is located on the fusion surface at 0.64 inches above (plus angle) 120 degrees of vessel azimuth.

Appendix O

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C120G

Table O.1 lists all detectable flaw indications in Shoreham specimen C120G. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C120G is given in Section 2. Figures O.1 through O.4 show the images of the larger indications in the specimen.

Table O.1 List of all indications for Shoreham specimen C120G

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.62	2.38	4.62	-28.1	small	fusion
2	-0.53	3.04	5.02	-19	small	fusion
3	-0.45	3.3	4.36	-26.6	small	weld
4	-0.60	4.2	4.62	-29.7	small	fusion
5	-0.45	5	4.32	-26.6	small	weld
6	-0.57	6.8	4.6	-29.6	small	fusion
7	-0.46	7.14	4.3	-24.4	small	weld
8	-0.63	8.72	3.12	-13.1	small	fusion
9	-0.50	9.22	1.98	-29.6	small	fusion
10	-0.54	9.96	3.14	-26.7	small	fusion
11	-0.59	10.92	5.74	-25.6	small	fusion
12	-0.61	14.04	1.7	-17.3	small	fusion
13	-0.61	15.86	5.7	-28.2	small	fusion
14	-0.47	21.26	5.4	-29.6	small	weld
15	-0.62	22.2	2.86	-28.2	small	fusion
16	-0.64	24.62	0.98	-28.2	small	fusion
17	-0.60	25.54	1.96	-2.3	long	fusion
18	-0.47	26.68	5.4	-28	small	weld
19	-0.52	28	3.78	-25.6	small	fusion
20	-0.59	28.9	4.76	-22.2	small	fusion
21	0.68	1.62	3.66	-26.4	small	fusion
22	0.69	4.28	3.18	-25	small	fusion
23	0.65	4.54	3.88	-23.9	small	fusion
24	0.66	5.5	3.4	-19	small	fusion
25	-0.22	6.06	5.46	-25.1	small	weld
26	0.41	7.24	0.84	-25.4	small	weld
27	0.65	8.56	3.84	-26.4	small	fusion

Table O.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	0.65	9.06	4.84	-21.2	small	fusion
29	0.66	10.26	5.44	-19.7	small	fusion
30	0.63	12.28	4.82	-22.1	small	fusion
31	-0.08	14.58	4.7	-25	small	weld
32	0.64	14.72	2.58	-26.5	small	fusion
33	0.60	14.74	1.08	-20.5	small	fusion
34	-0.31	16.82	4.84	-27.8	small	weld
35	0.69	17.46	5.58	-16.9	small	fusion
36	0.54	17.84	4	-28.2	small	fusion
37	-0.13	20.7	0.64	-21.6	small	weld
38	0.69	21.64	4.96	-25.1	small	fusion
39	0.65	21.62	2.6	-11.2	small	fusion
40	0.69	22.74	4.08	-24	small	fusion
41	0.68	23.32	5.52	-22.1	small	fusion
42	0.60	23.84	3.6	-6.3	small	fusion
43	0.66	24.14	3.72	-23	small	fusion
44	0.64	24.48	2.34	-10.7	small	fusion
45	-0.24	24.62	1.02	-27.7	small	weld
46	0.68	24.92	4.06	-26.5	small	fusion
47	0.10	26.78	1.12	-27.3	small	weld
48	0.60	28.48	2.6	-5.3	long	fusion
49	0.66	28.6	4.04	-22.1	small	fusion
50	-0.94	42.14	0.48	-21.2	small	GOUGE
51	-1.07	42.34	0.52	-22.6	small	GOUGE
52	-0.57	30.32	5.68	-18.6	small	fusion
53	-0.45	30.6	5.4	-29.6	small	weld
54	-0.43	30.78	5.38	-29.6	small	weld
55	-0.44	34.68	4.14	-25.5	small	weld
56	-0.62	35.88	4.7	-24.7	small	fusion
57	-0.65	38.96	4.64	-24.8	small	fusion
58	-0.46	40.62	4.34	-29.7	small	weld
59	-0.60	40.84	5.52	-29.8	small	fusion
60	-0.50	41.98	5.3	-24.6	small	fusion
61	-0.80	41.68	0.4	-21.5	small	GOUGE
62	-0.61	42.88	5.66	-27	small	fusion
63	-0.45	43.42	5.22	-28.1	small	weld
64	-0.56	44.32	0.48	-19.7	small	fusion
65	-0.70	44.76	0.5	-23.1	small	fusion
66	-0.69	45.42	0.48	-23.1	small	fusion
67	-0.51	46.04	4.34	-20.8	small	fusion
68	-0.69	46.96	0.82	-22.4	small	fusion
69	-0.50	47.18	4.34	-22.2	small	fusion
70	-0.59	48.34	5.08	-25.8	small	fusion

Table O.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	-0.70	48.38	0.68	-27.1	small	fusion
72	-0.57	48.66	1.14	-23.8	small	fusion
73	-0.68	49.22	1.56	-27.1	small	fusion
74	-0.63	49.36	5.38	-22.3	small	fusion
75	-0.54	49.46	4.34	-26.9	small	fusion
76	-0.54	50.48	5.26	-29.8	small	fusion
77	-0.56	51.16	5.3	-29.8	small	fusion
78	0.33	31.22	0.82	-21	small	weld
79	-0.32	35.46	1.52	-27.9	small	weld
80	0.11	39.16	3.02	-29	small	weld
81	0.21	47.1	0.54	-27.3	small	weld
82	0.70	31.06	5.6	-17.5	small	fusion
83	0.68	31.56	5.08	-13.2	small	fusion
84	0.44	30.86	0.82	-24.4	small	weld
85	0.33	31.22	0.82	-21	small	weld
86	0.70	31.52	2.06	-24	small	fusion
87	0.66	33.78	5	-21.3	small	fusion
88	0.66	34.28	5.52	-24.1	small	fusion
89	0.67	34.8	2.16	-23	small	fusion
90	0.62	35.14	1.54	-23.1	small	fusion
91	0.67	36.34	2.46	-23	small	fusion
92	0.54	37.7	0.48	-23.2	small	fusion
93	0.68	37.66	5.56	-22.1	small	fusion
94	0.48	39.04	5.24	-25.5	small	weld
95	0.66	39.96	3.16	-28.2	small	fusion
96	0.43	40.14	0.56	-28.5	small	weld
97	0.65	42.06	2.12	-20.6	small	fusion
98	0.51	42.52	3.38	-21.6	small	fusion
99	0.63	43.14	1.46	-21.4	small	fusion
100	0.59	44.18	2.32	-20	long	fusion
101	0.61	44.22	1.06	-26.7	small	fusion
102	0.66	44.74	0.9	-22.2	small	fusion
103	0.64	44.98	5.36	-20.6	small	fusion
104	0.60	45.78	3.92	-18.2	small	fusion
105	0.64	46.42	4.92	-15	small	fusion
106	0.67	47.34	1.88	-23.1	small	fusion
107	0.58	48.26	1.42	-25.4	small	fusion
108	0.65	48.92	4.34	-18.1	small	fusion
109	0.66	50.32	5.54	-19.3	small	fusion
110	0.55	50.56	2.32	-23.3	small	fusion

Table O.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
111	0.66	50.78	1.84	-25.3	small	fusion
112	0.57	51.12	1.52	-15.1	long	fusion
113	0.64	51.38	4.76	-19.3	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

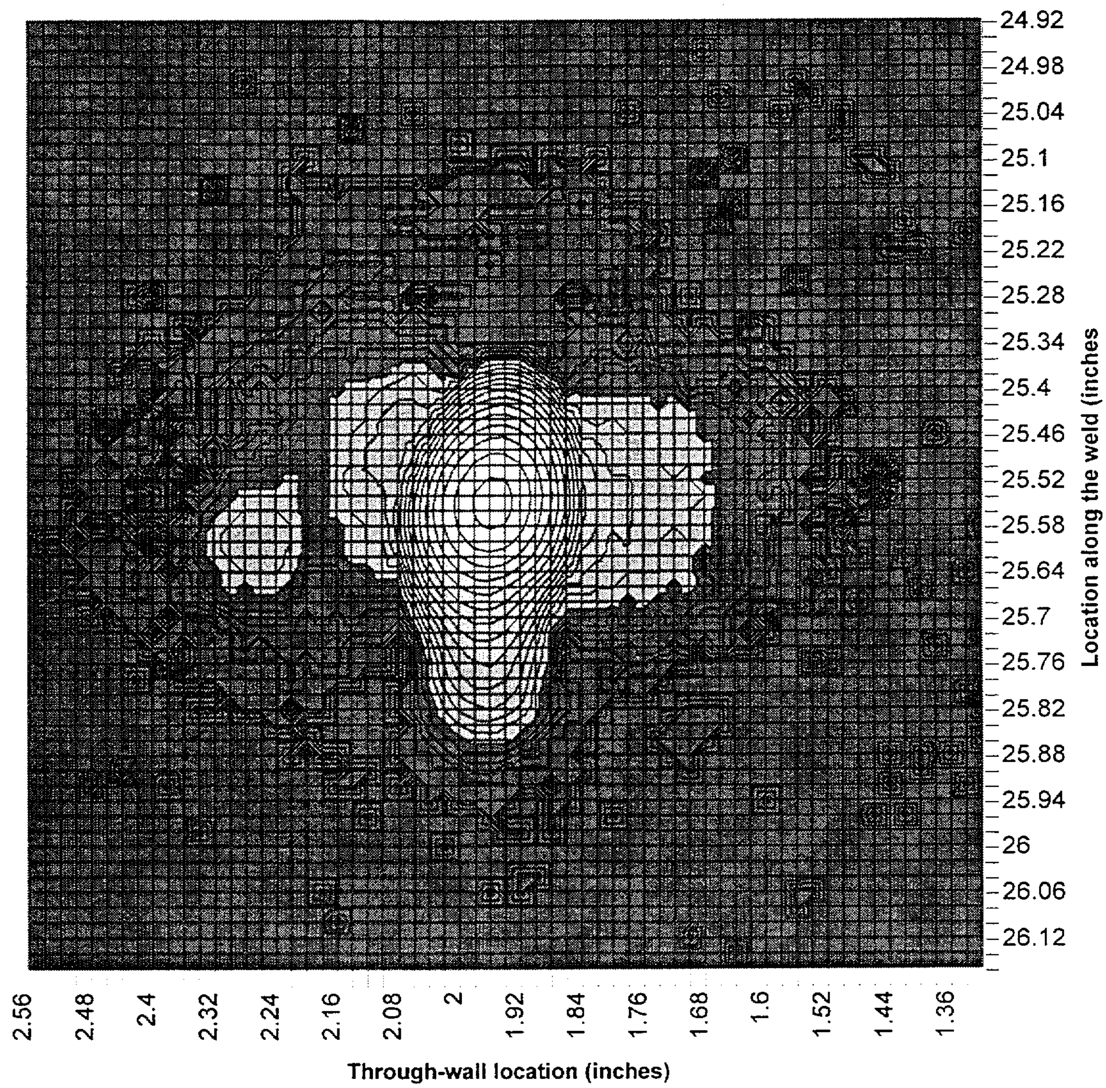

Figure O.1 **Log-scale contour plot of indication #17 in Shoreham specimen C120G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -2.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.60 inches below 553 inches of vessel elevation.**

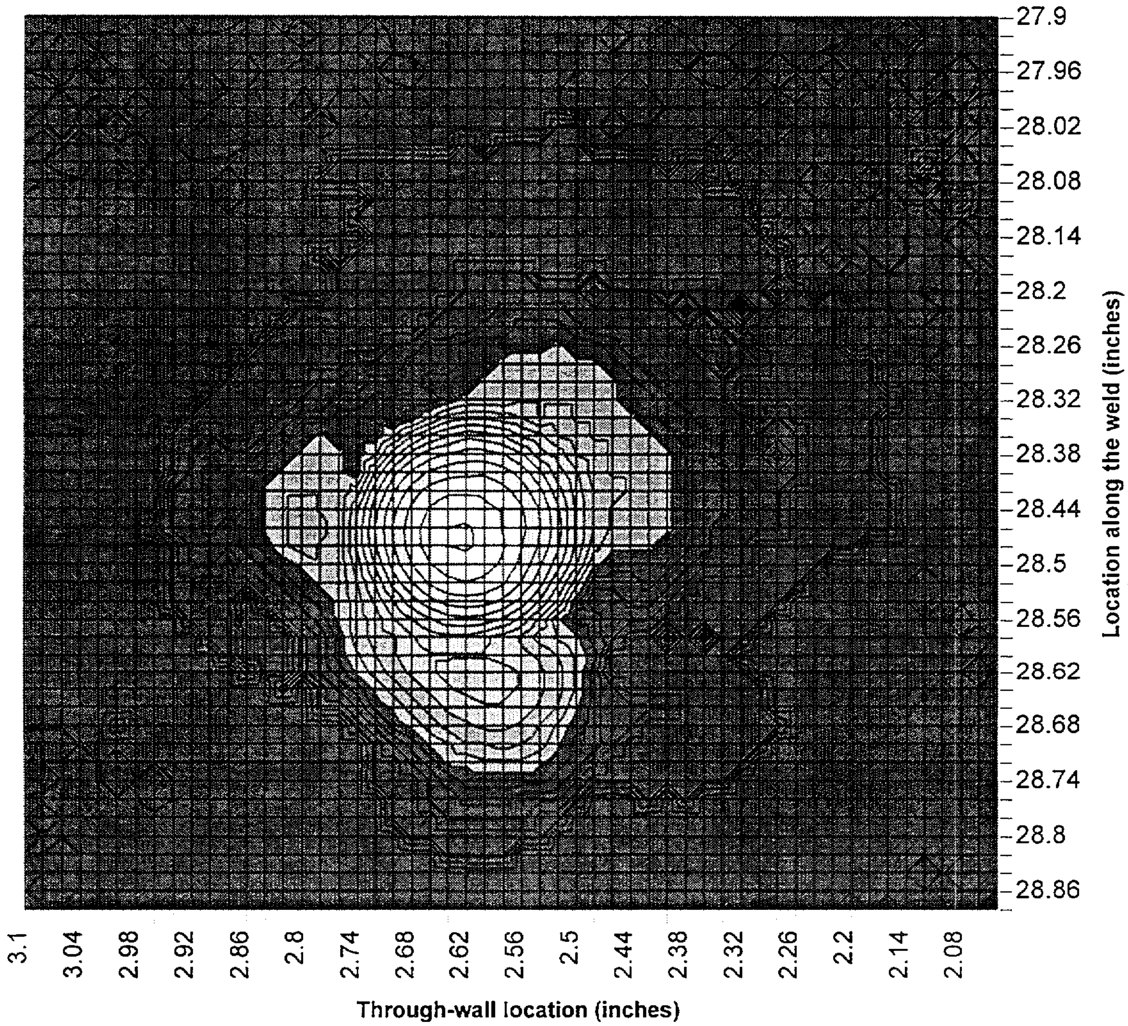

Figure O.2 Log-scale contour plot of indication #48 in Shoreham specimen C120G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.60 inches above 553 inches of vessel elevation.

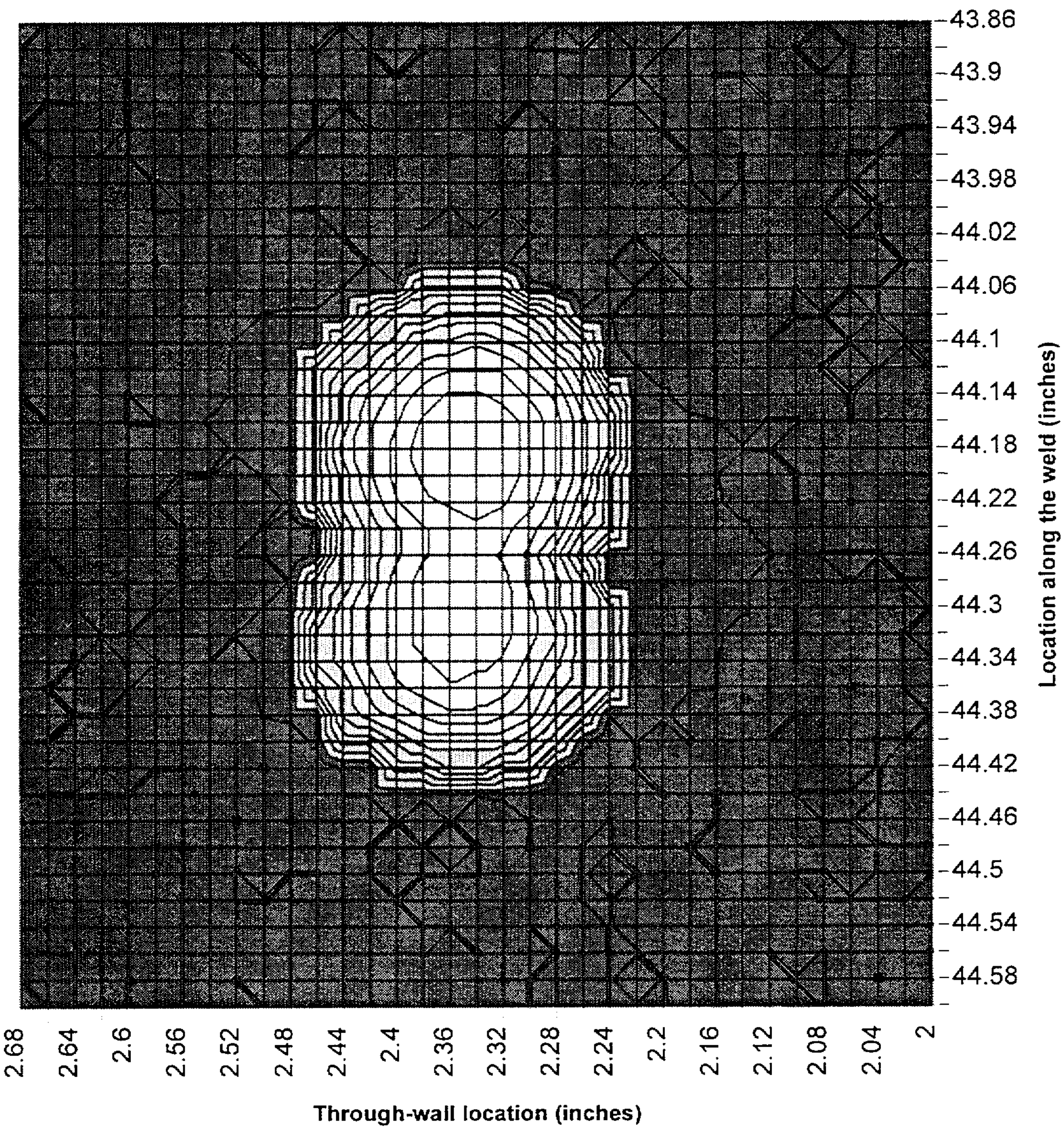

Figure O.3 Log-scale contour plot of indication #100 in Shoreham specimen C120G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.59 inches above 553 inches of vessel elevation.

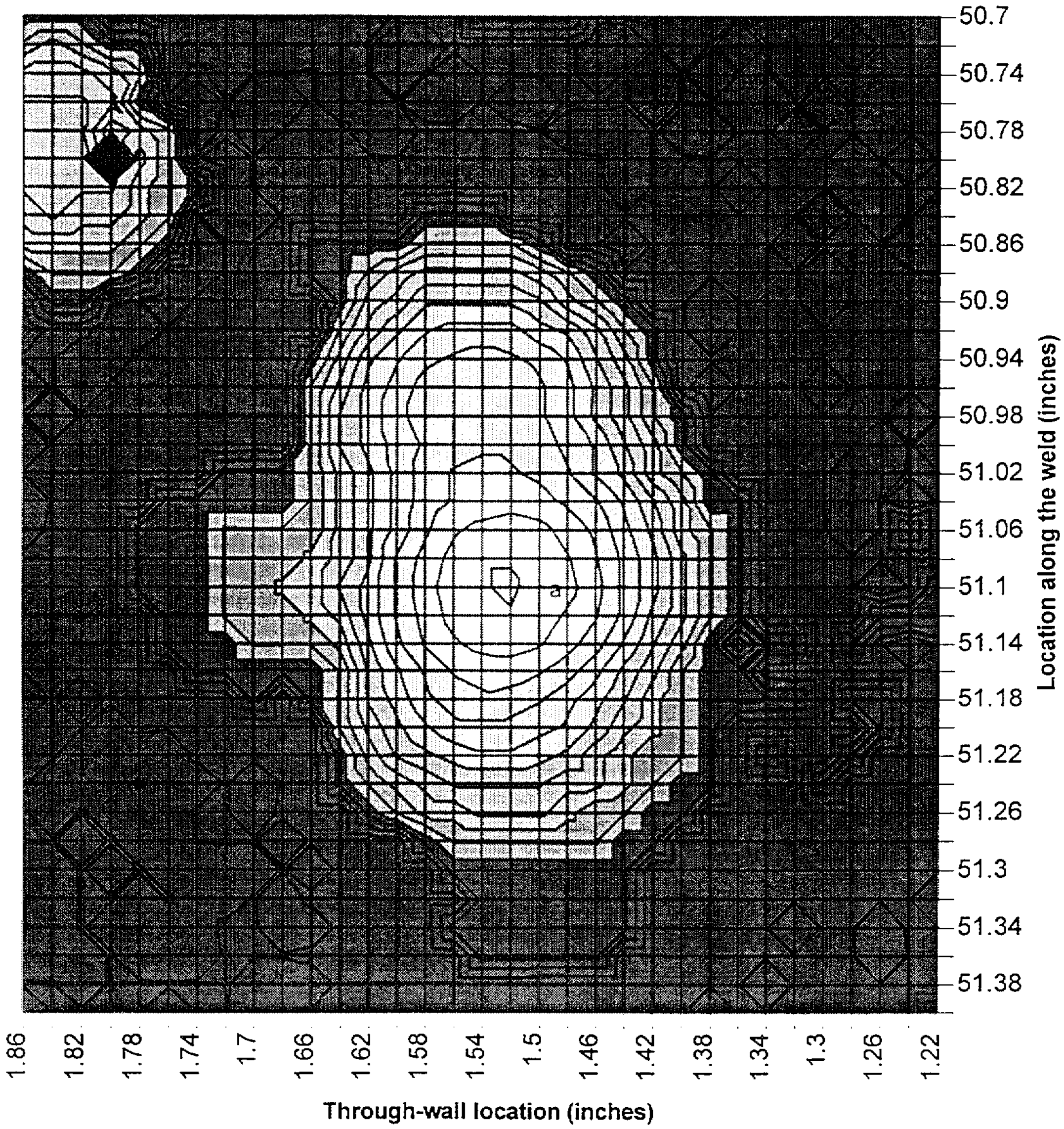

Figure O.4 **Log-scale contour plot of indication #112 in Shoreham specimen C120G. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.57 inches above 553 inches of vessel elevation.**

Appendix P

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C180B

Table P.1 lists all detectable flaw indications in Shoreham specimen C180B. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C180B is given in Section 2. Figures P.1 through P.24 show the images of the larger indications in the specimen.

Table P.1 List of all indications for Shoreham specimen C180B

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.60	1	1.8	-27.3	small	fusion
2	-0.65	1.04	1.26	-21.5	small	fusion
3	-0.62	1.08	0.92	-25.5	small	fusion
4	-0.65	1.5	1.14	-4.9	long	fusion
5	-0.58	1.38	4.1	-28.3	small	fusion
6	-0.58	1.84	5.62	-14.1	surface elongated	fusion
7	-0.69	2.32	0.66	-22.4	small	fusion
8	-0.58	3	5.66	-8.4	surface elongated	fusion
9	-0.58	3.3	4	-28.3	small	fusion
10	-0.58	3.26	1.2	-18.3	small	fusion
11	-0.58	4.2	1.14	-11.9	small	fusion
12	-0.58	4.38	5.64	-8	small	fusion
13	-0.60	4.6	2.14	-26.3	small	fusion
14	-0.53	4.82	4.24	-25.8	small	fusion
15	-0.51	4.7	4.92	-29.2	small	fusion
16	-0.58	4.82	1.14	-18	small	fusion
17	-0.58	5.36	1.16	-12.7	long	fusion
18	-0.51	5.82	4.22	-23.2	small	fusion
19	-0.58	5.74	1.02	-27.1	small	fusion
20	-0.58	6.2	1.16	-9.6	small	fusion
21	-0.58	6.7	1.16	-4.9	long	fusion
22	-0.60	7.22	1.12	-5.4	small	fusion
23	-0.61	7.74	3.96	-20.7	small	fusion
24	-0.47	7.56	4.9	-27.5	small	weld
25	-0.42	7.82	5.52	-25	small	weld
26	-0.58	8.2	2.54	-16.6	small	fusion
27	-0.47	8.82	4.92	-26.4	small	weld

Table P.1 (contd)							
	Peak Coordinates (Specimen)						
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.61	8.62	1.12	-6.1	long	fusion
29	-0.58	9.82	4.6	-25.2	small	fusion
30	-0.61	10.46	5.64	-19.8	small	fusion
31	-0.61	11.26	1.08	-14.2	small	fusion
32	-0.63	11.84	1.1	-12.8	small	fusion
33	-0.54	11.62	3.96	-28	small	fusion
34	-0.63	12.86	1.04	-9.6	long	fusion
35	-0.61	12.94	2.1	-31.4	small	fusion
36	-0.56	13.54	3.44	-28.1	small	fusion
37	-0.61	13.32	5.56	-7.8	surface elongated	fusion
38	-0.66	13.98	1.1	-19.2	long	fusion
39	-0.63	14.96	1.12	-12.6	long	fusion
40	-0.45	14.66	5.46	-28.7	small	weld
41	-0.59	15.98	2.48	-25.2	small	fusion
42	-0.63	15.7	1.14	-14.8	long	fusion
43	-0.64	16.72	1.08	-13.9	small	fusion
44	-0.59	17.44	4.5	-21.1	small	fusion
45	-0.64	17.44	1.1	-14.1	long	fusion
46	-0.61	18.1	2.12	-23.8	small	fusion
47	-0.66	18.16	1.12	-8.8	long	fusion
48	-0.57	18.6	4	-12.8	small	fusion
49	-0.66	18.76	1.12	-17	long	fusion
50	-0.57	19.18	4.5	-27	small	fusion
51	-0.59	19.08	5.1	-24.4	small	fusion
52	-0.66	19.64	0.74	-28.7	small	fusion
53	-0.66	20.22	1.14	-18.4	small	fusion
54	-0.62	20.52	5.8	-25.3	small	fusion
55	-0.66	20.8	1.14	-14	long	fusion
56	-0.71	22.6	0.96	-27.8	small	fusion
57	-0.64	23.14	1.14	-22.6	small	fusion
58	-0.55	23.08	5	-28	small	fusion
59	-0.66	23.48	1.12	-21.5	small	fusion
60	-0.64	23.98	2.18	-23.2	small	fusion
61	-0.67	24.48	1.08	-14.3	small	fusion
62	-0.55	24.7	5.26	-24.9	small	fusion
63	-0.57	24.98	3.96	-25.1	small	fusion
64	-0.62	25.92	2.1	-23.8	small	fusion
65	-0.67	25.94	1.14	-8.5	long	fusion
66	-0.64	26.22	2.14	-24.7	small	fusion
67	-0.67	26.84	1.12	-12.6	long	fusion
68	-0.62	27.24	5.48	-17	small	fusion
69	-0.64	27.46	1.12	-15.1	small	fusion
70	-0.71	27.66	0.66	-26.8	small	fusion

Table P.1 (contd)

#	Peak Coordinates (Specimen)			Response (dB)	Characterization	Type (material)
	Weld Center (inches)	Along Weld (inches)	Depth (inches)			
71	-0.62	27.7	4.32	-14.5	small	fusion
72	-0.67	27.86	2.12	-21.5	small	fusion
73	-0.69	28.04	1.06	-19.3	small	fusion
74	-0.58	29.24	4.4	-5.9	extended	fusion
75	0.50	2.08	3.32	-27.3	small	fusion
76	0.64	2.74	3.76	-27.1	small	fusion
77	-0.35	2.86	5.5	-19.3	small	weld
78	-0.37	3.48	2.46	-25.9	small	weld
79	0.46	4.58	1.04	-20	small	weld
80	0.62	5.02	4.94	-27.2	small	fusion
81	0.50	6.5	0.76	-27.3	small	fusion
82	0.57	7.22	0.32	-23.7	small	fusion
83	0.50	7.88	0.68	-15.6	small	fusion
84	0.50	8.7	0.64	-18.3	small	fusion
85	0.61	6.78	2.96	-27.2	small	fusion
86	0.64	6.88	4.76	-24.6	small	fusion
87	-0.47	7.56	4.9	-27.5	small	weld
88	-0.42	7.8	5.5	-25	small	weld
89	0.59	7.92	4.74	-27.2	small	fusion
90	0.31	8.28	5.14	-23.1	small	weld
91	0.59	8.48	4.74	-27.2	small	fusion
92	-0.47	8.82	4.92	-26.4	small	weld
93	0.89	9.24	0.4	-24.3	small	base
94	0.64	9.64	1.86	-24.6	small	fusion
95	0.52	9.78	0.64	-23.8	small	fusion
96	0.45	10.96	0.54	-26	small	weld
97	0.50	11.22	0.56	-26	small	fusion
98	0.47	11.6	0.56	-27.3	small	weld
99	0.43	11.78	2.28	-16.5	small	weld
100	0.66	11.92	0.88	-20.4	small	fusion
101	0.50	11.98	5.6	-22.9	small	fusion
102	0.54	12.32	5.2	-27.3	small	fusion
103	0.43	12.66	2.26	-23.9	small	weld
104	0.63	12.74	0.84	-16.2	small	fusion
105	0.59	12.86	1.9	-24.7	small	fusion
106	0.40	12.86	3.22	-24.9	small	weld
107	0.63	13.44	0.82	-27.1	small	fusion
108	0.68	13.98	0.86	-18	small	fusion
109	0.72	14.36	0.62	-25.7	small	fusion
110	0.59	14.4	3.48	-25.9	small	fusion
111	0.52	14.76	5.68	-22.8	small	fusion
112	0.52	15.06	5.66	-12.7	surface elongated	fusion

Table P.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	0.65	15	3.94	-23.6	small	fusion
114	0.63	16.02	0.82	-18.1	small	fusion
115	0.51	16.4	4.12	-24.8	small	fusion
116	0.42	17.18	2.3	-19.4	small	weld
117	0.58	17.22	4.72	-25.9	small	fusion
118	0.63	17.42	3.86	-25.8	small	fusion
119	0.65	17.94	0.88	-28.7	small	fusion
120	0.58	17.96	4.8	-20.5	small	fusion
121	0.51	17.96	5.26	-27.3	small	fusion
122	-0.43	17.8	5.56	-27.2	small	weld
123	0.65	18.34	2.94	-22.7	small	fusion
124	0.63	18.32	0.88	-24.6	small	fusion
125	0.49	18.38	0.56	-14.9	small	fusion
126	0.60	19	3.88	-27.2	small	fusion
127	0.51	18.88	5.66	-24.8	small	fusion
128	0.49	19.22	5.7	-12.8	small	fusion
129	0.42	19.14	2.32	-26.1	small	weld
130	0.63	19.34	0.88	-28.7	small	fusion
131	-0.36	19.4	3.54	-28.4	small	weld
132	0.28	19.58	3.42	-24.1	small	weld
133	0.12	19.56	2.78	-26.5	small	weld
134	0.67	20	0.92	-21	small	fusion
135	0.63	20.8	4.84	-11.6	small	fusion
136	0.53	21.04	5.78	-27.3	small	fusion
137	0.63	21.88	0.94	-19.2	small	fusion
138	0.62	22.24	4.78	-23.6	small	fusion
139	0.51	22.62	5.68	-23.8	small	fusion
140	0.62	22.62	0.9	-15.5	small	fusion
141	0.46	22.92	0.6	-16.9	small	weld
142	0.46	23.3	0.56	-20.6	small	weld
143	0.62	23.72	0.88	-19.2	small	fusion
144	0.42	24.08	1.42	-26.1	small	weld
145	0.55	24.58	5.02	-27.2	small	fusion
146	0.58	24.96	4.76	-27.2	small	fusion
147	0.62	25.1	0.82	-18.1	small	fusion
148	0.53	25.3	5.64	-13.6	small	fusion
149	0.62	25.38	4.8	-25.8	small	fusion
150	0.69	26.1	4.62	-28.6	small	fusion
151	0.41	26.42	2.26	-26.1	small	weld
152	0.62	26.46	0.82	-21.1	small	fusion
153	0.51	26.68	5.64	-7.6	surface elongated	fusion
154	0.51	27.54	5.62	-14.2	small	fusion

Table P.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	0.55	28.12	3.8	-19.9	small	fusion
156	0.94	28.08	0.44	-22.2	small	GOUGE
157	0.50	28.22	5.22	-22.8	small	fusion
158	0.53	28.54	5.66	-10.8	small	fusion
159	0.60	28.7	4.82	-21.1	small	fusion
160	1.22	29.14	0.32	-19.6	small	GOUGE
161	0.46	29.52	1.1	-22.1	small	weld
162	-0.65	30.34	4.48	-27.4	small	fusion
163	-0.60	30.28	2.08	-27.1	small	fusion
164	-0.60	30.8	4.58	-25.2	small	fusion
165	-0.63	31.76	3.12	-27.3	small	fusion
166	-0.65	32.58	1.16	-20.4	small	fusion
167	-0.63	32.7	5.48	-19.8	small	fusion
168	-0.70	34.3	1.04	-24.9	small	fusion
169	-0.67	34.94	1	-10.8	small	fusion
170	-0.67	35.22	1.14	-18	small	fusion
171	-0.67	35.32	2.18	-13.8	small	fusion
172	-0.61	35.3	4.02	-21.1	small	fusion
173	-0.56	35.14	4.48	-15.7	small	fusion
174	-0.63	35.2	5.82	-11.5	small	fusion
175	-0.56	35.86	5.04	-23.3	small	fusion
176	-0.63	35.9	1.5	-10.7	long	fusion
177	-0.56	37.5	4.02	-18.9	small	fusion
178	-0.65	37.48	2.22	-27.4	small	fusion
179	-0.63	38.22	2.22	-21.8	small	fusion
180	-0.65	40.06	0.36	-27.4	small	fusion
181	-0.54	40.84	3.48	-23.9	small	fusion
182	-0.54	40.96	4.24	-21.8	small	fusion
183	-0.61	41.7	2.18	-24.4	small	fusion
184	-0.66	41.94	1.5	-22	small	fusion
185	-0.61	42.76	0.98	-28.3	small	fusion
186	-0.59	42.86	5.66	-24.2	small	fusion
187	-0.61	43.96	2.5	-28.3	small	fusion
188	-0.52	44.1	5.5	-23.8	small	fusion
189	-0.66	47.28	1.02	-22.6	small	fusion
190	-0.66	47.74	1.02	-16.9	small	fusion
191	-0.55	47.9	3.94	-26.7	small	fusion
192	-0.59	49.4	4.06	-21	small	fusion
193	-0.57	49.24	4.96	-26.8	small	fusion
194	-0.62	50.06	5.46	-25.2	small	fusion
195	-0.60	51.48	5.66	-2.4	small	fusion
196	-0.55	53.16	4.9	-27.9	small	fusion

Table P.1 (contd)						
#	Peak Coordinates (Specimen)			Response (dB)	Characterization	Type (material)
	Weld Center (inches)	Along Weld (inches)	Depth (inches)			
197	-0.62	54.42	1.62	-29.6	small	fusion
198	-0.60	55.4	0.92	-21.5	small	fusion
199	-0.65	55.92	2.16	-27.3	small	fusion
200	0.53	31.54	5.64	-11.5	small	fusion
201	0.66	31.9	0.54	-16.6	small	fusion
202	0.52	32.68	5.66	-9	small	fusion
203	0.16	33.56	4.42	-25.2	small	weld
204	0.43	33.72	2.26	-29	small	weld
205	0.59	34.68	3.94	-22.7	small	fusion
206	0.61	34.8	3.4	-19.8	small	fusion
207	0.50	36.18	5.64	-5.6	surface elongated	fusion
208	0.52	37.8	5.72	-17.2	small	fusion
209	0.63	40.46	2.18	-25.8	small	fusion
210	0.56	40.64	1.06	-24.7	small	fusion
211	0.63	41.14	4.88	-18	small	fusion
212	-0.08	41.62	5.22	-20.1	small	weld
213	0.61	41.78	4.82	-25.8	small	fusion
214	0.49	42.28	5.68	-5.2	surface elongated	fusion
215	0.59	42.4	4.76	-23.6	small	fusion
216	0.59	42.36	4.24	-25.8	small	fusion
217	0.65	43.62	4.86	-24.6	small	fusion
218	0.45	43.86	0.6	-24.8	small	weld
219	0.63	44.14	4.8	-22.7	small	fusion
220	0.63	44.12	4.44	-22.7	small	fusion
221	0.65	44.86	4.92	-21.8	small	fusion
222	0.44	45.22	0.56	-16.5	small	weld
223	0.38	45.8	5.5	-24.9	small	weld
224	0.65	46.54	0.88	-16.2	small	fusion
225	0.58	46.56	4.72	-27.2	small	fusion
226	0.49	47	5.2	-23.8	small	fusion
227	0.49	47.38	5.58	-25.9	small	fusion
228	0.67	49.58	4.86	-24.5	small	fusion
229	0.49	49.74	5.56	-17.3	small	fusion
230	0.58	50.76	4.7	-24.7	small	fusion
231	0.37	51.24	3.34	-24.9	small	weld
232	0.62	51.38	4.88	-21.8	small	fusion
233	-0.18	51.56	5.26	-28.1	small	weld
234	0.62	52.38	4.72	-23.6	small	fusion
235	0.39	52.48	0.38	-24.9	small	weld
236	0.62	56.04	4.88	-22.7	small	fusion
237	-0.60	56.84	0.92	-24.2	small	fusion
238	-0.65	57.04	0.96	-27.3	small	fusion

Table P.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
239	-0.60	57.04	4.4	-26	small	fusion
240	-0.56	59.52	4.86	-25.7	small	fusion
241	-0.44	59.86	5.54	-25.9	small	weld
242	-0.47	61.12	5.5	-25	small	weld
243	-0.93	61.28	0.22	-28.8	small	clad
244	-0.47	61.1	5.52	-25	small	weld
245	-0.63	61.46	5.74	-25.2	small	fusion
246	-0.47	62	5.48	-25	small	weld
247	-0.65	62.16	2.1	-27.3	small	fusion
248	-0.88	64	0.38	-22.6	small	GOUGE
249	-0.49	64.04	5.54	-24.3	small	fusion
250	-0.63	64.42	5.68	-22.9	small	fusion
251	-0.65	64.7	2.16	-23.1	small	fusion
252	-0.38	67.02	5.42	-16.7	small	weld
253	-0.65	67.8	2.68	-23.8	small	fusion
254	-0.61	68.14	5.72	-15.2	small	fusion
255	-0.38	68.36	5.38	-12.6	small	weld
256	-0.47	69	5.58	-23.3	small	weld
257	0.62	56.34	4.88	-24.6	small	fusion
258	0.67	56.88	5.76	-27	small	fusion
259	0.52	60.08	4.88	-19.9	small	fusion
260	1.01	61.08	5.54	-21.3	small	base
261	0.98	61.82	5.48	-23.1	small	base
262	0.61	62.06	1.6	-14.7	long	fusion
263	0.34	62.34	5.62	-20.8	small	weld
264	0.66	64.92	2.9	-25.7	small	fusion
265	0.54	65.4	4.96	-27.2	small	fusion
266	0.47	65.56	1.36	-23.8	small	weld
267	0.66	67.04	4.72	-24.5	small	fusion
268	0.54	67.62	4.88	-27.2	small	fusion
269	0.66	68.4	4.66	-27	small	fusion
270	0.70	70.08	4.44	-27	small	fusion
271	0.47	70.34	5.54	-23.8	small	weld

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

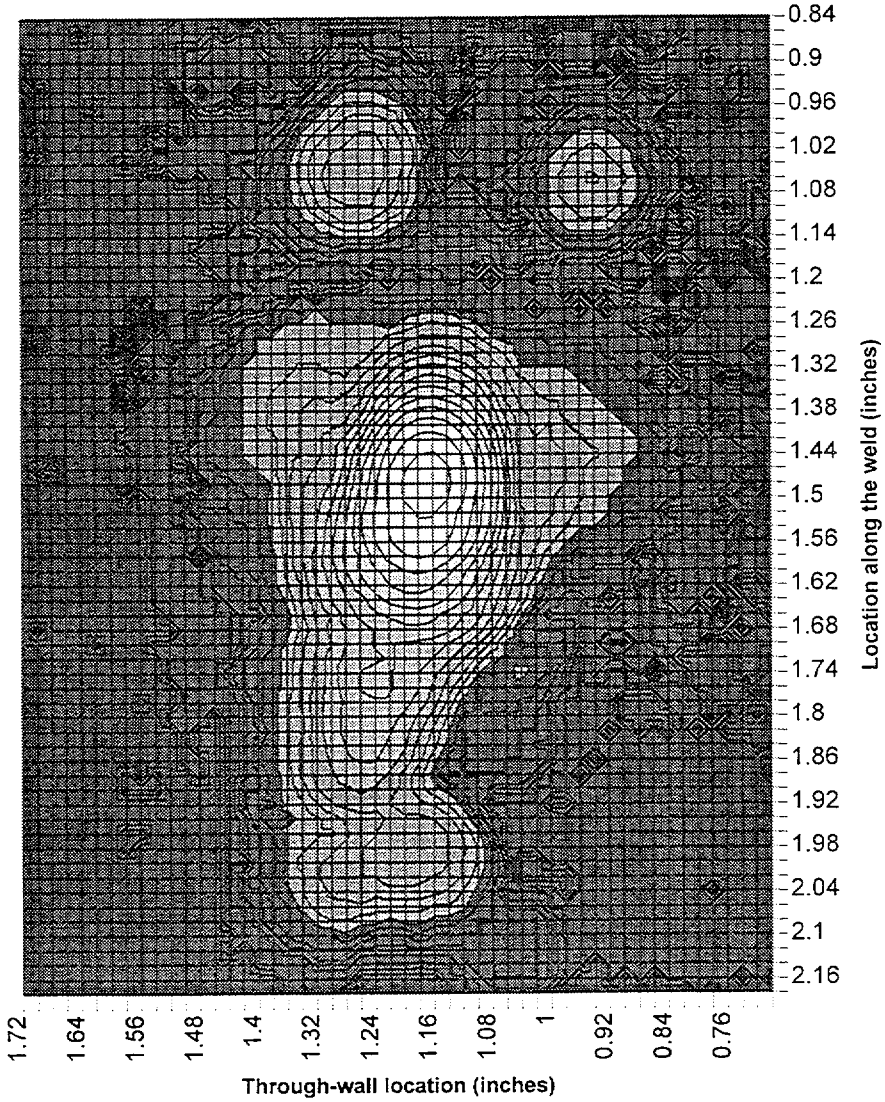

Figure P.1 **Log-scale contour plot of indication #4 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -4.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.57 inches below 553 inches of vessel elevation.**

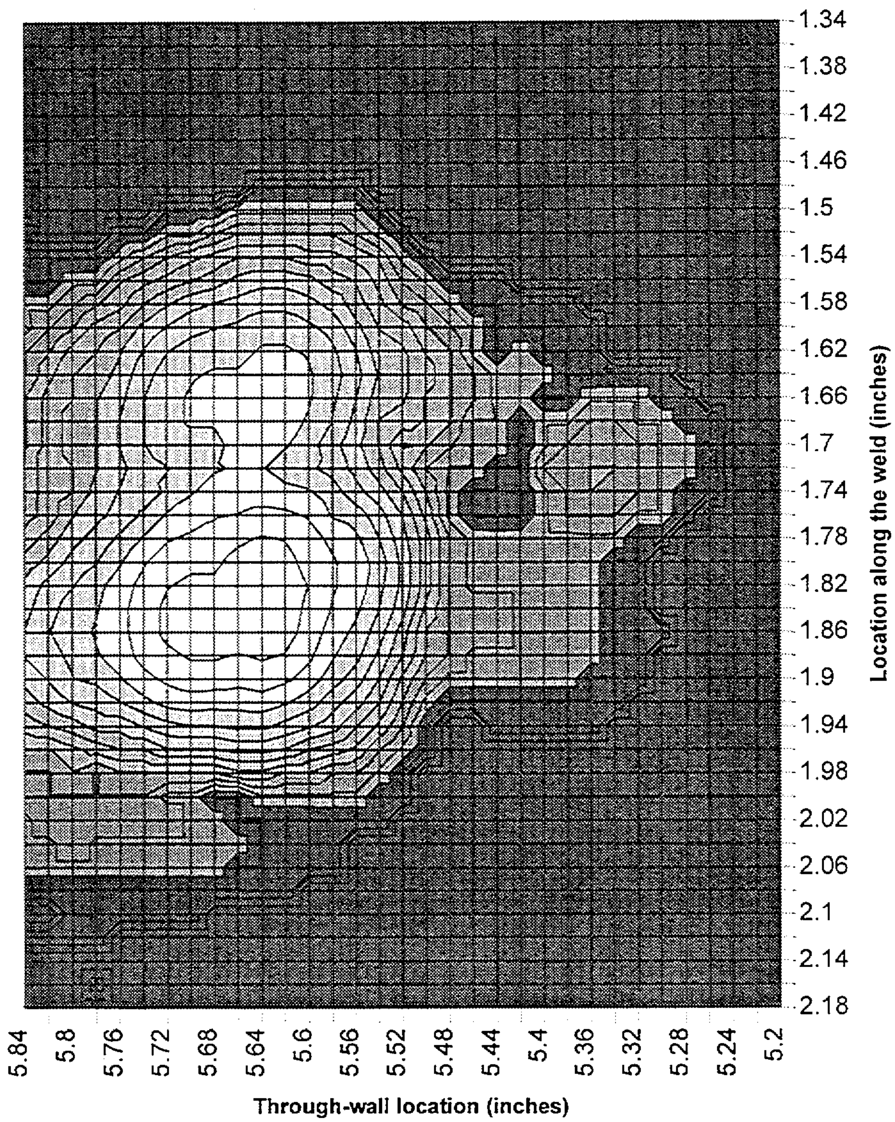

Figure P.2 **Log-scale contour plot of indication #6 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.58 inches below 553 inches of vessel elevation.**

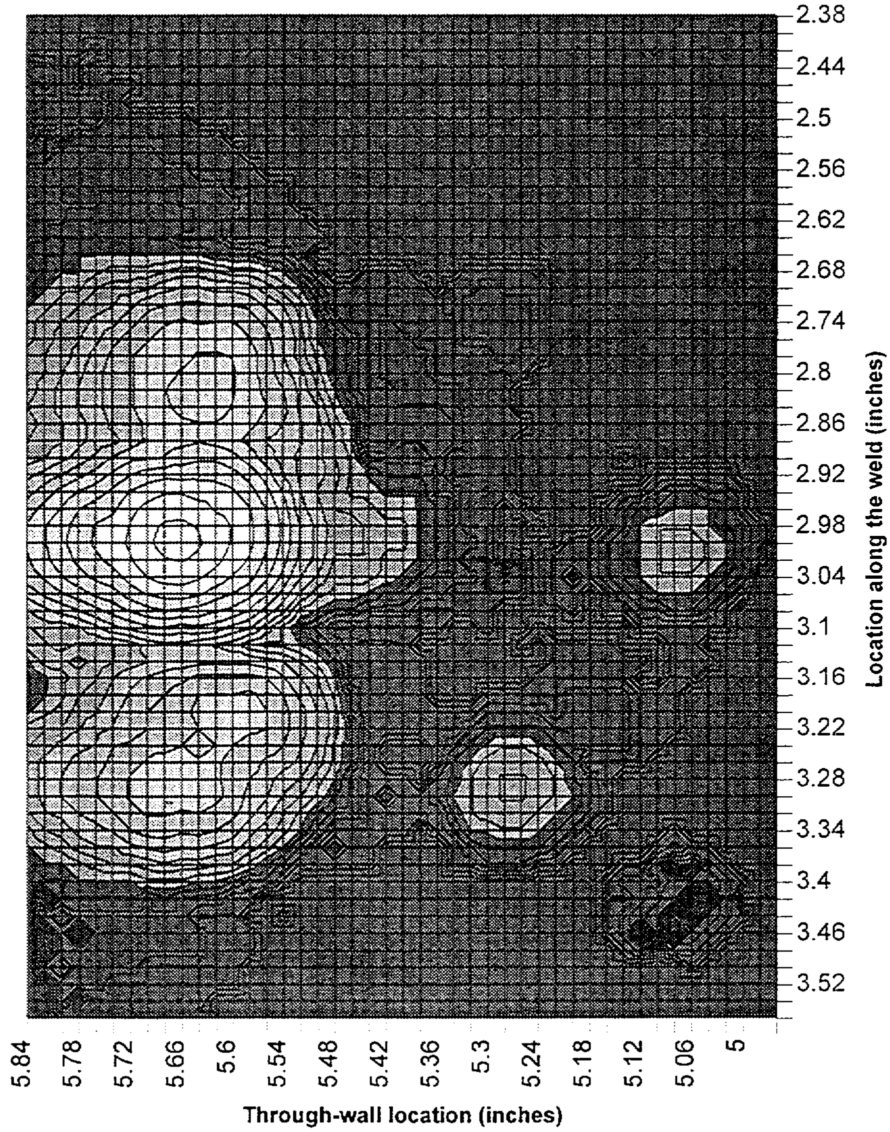

Figure P.3 **Log-scale contour plot of indication #8 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.58 inches below 553 inches of vessel elevation.**

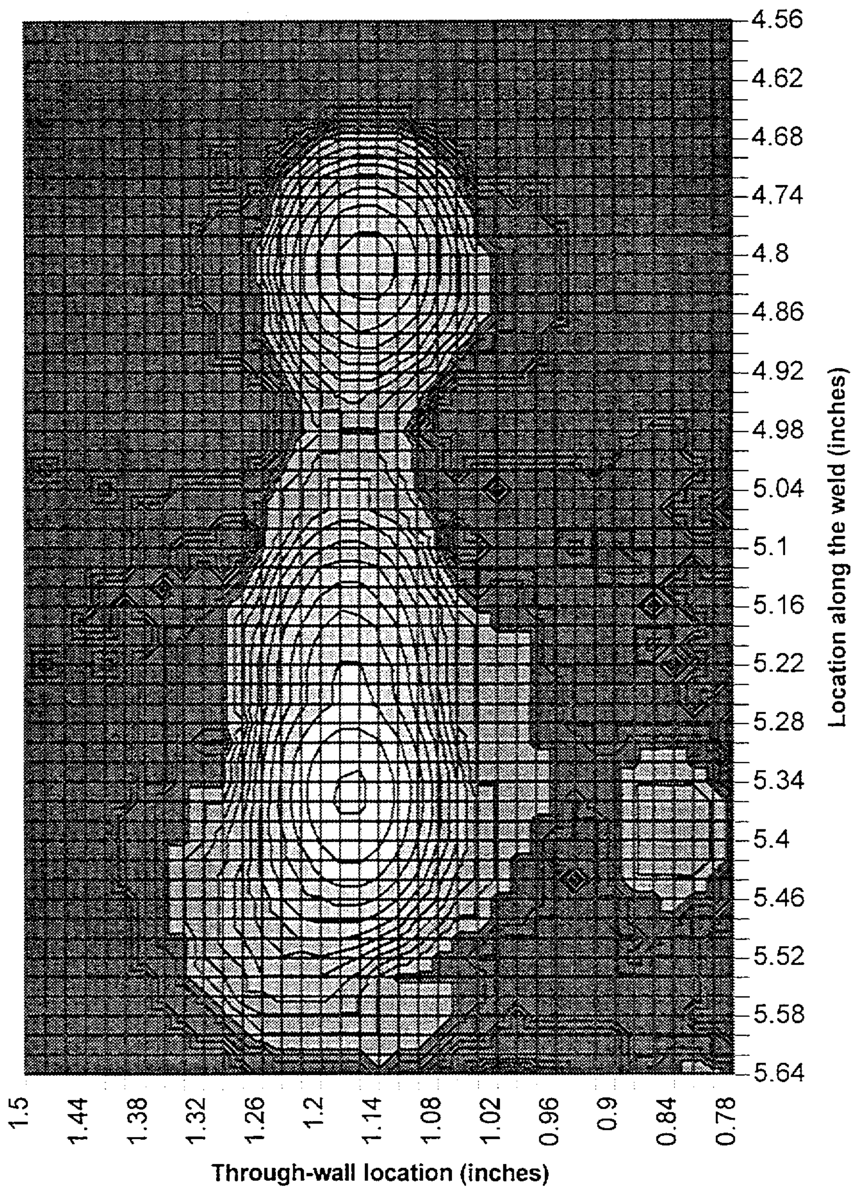

Figure P.4 Log-scale contour plot of indication #17 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.7 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 22 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.58 inches below 553 inches of vessel elevation.

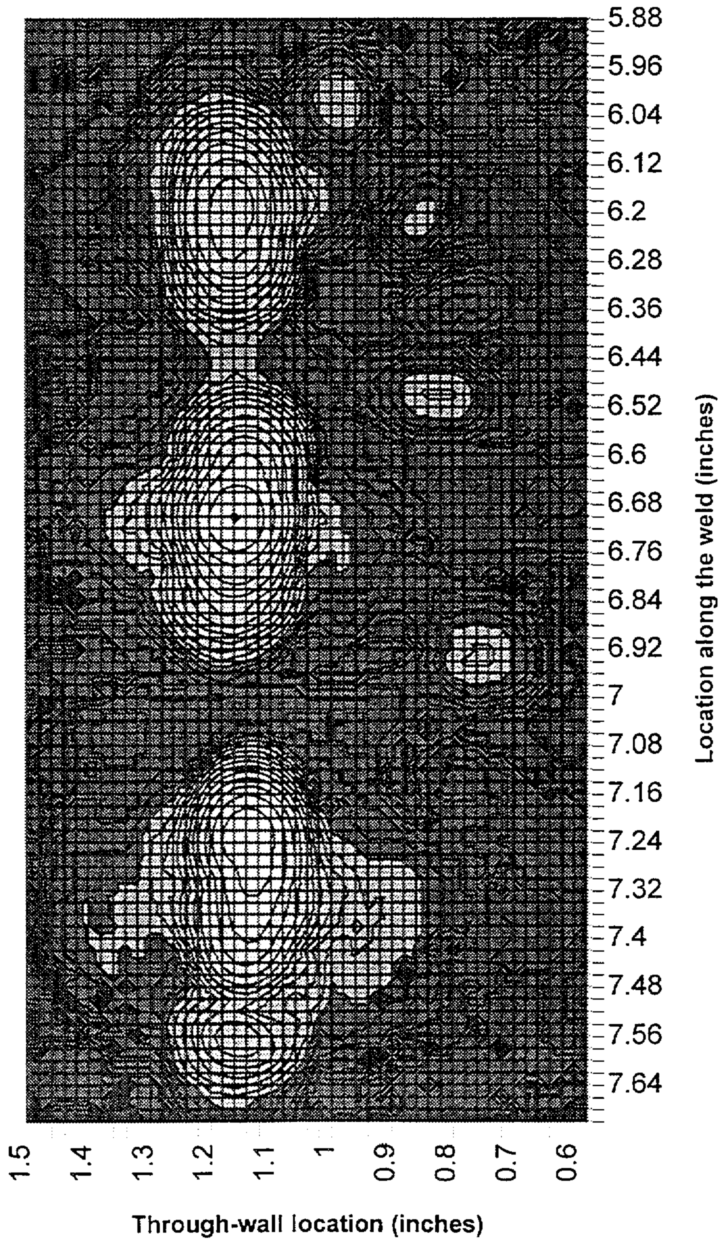

Figure P.5 Log-scale contour plot of indication #21 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -4.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 14 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.58 inches below 553 inches of vessel elevation.

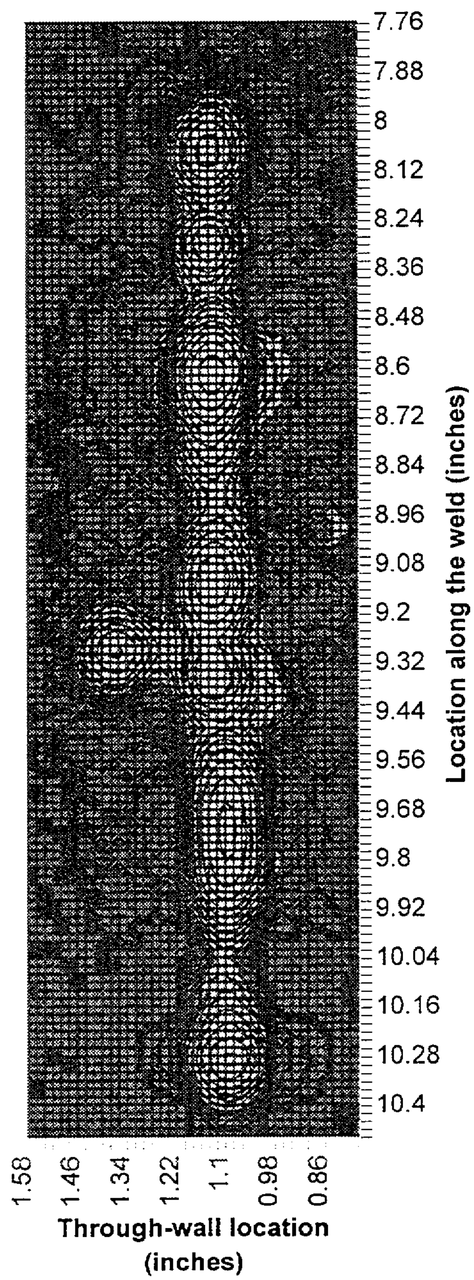

Figure P.6 **Log-scale contour plot of indication #28 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 64 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.61 inches below 553 inches of vessel elevation.**

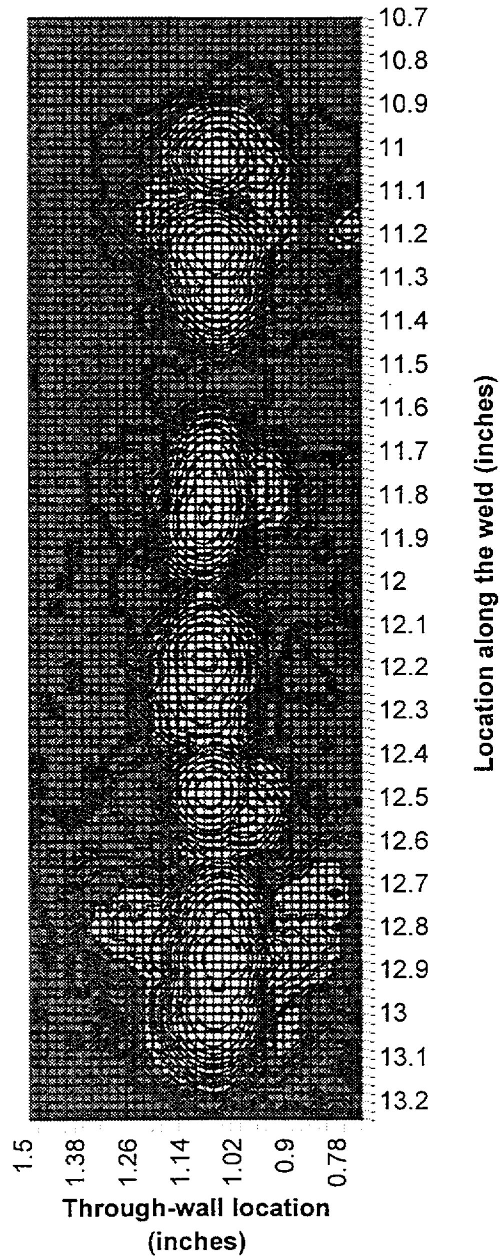

Figure P.7 Log-scale contour plot of indication #34 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 57 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.63 inches below 553 inches of vessel elevation.

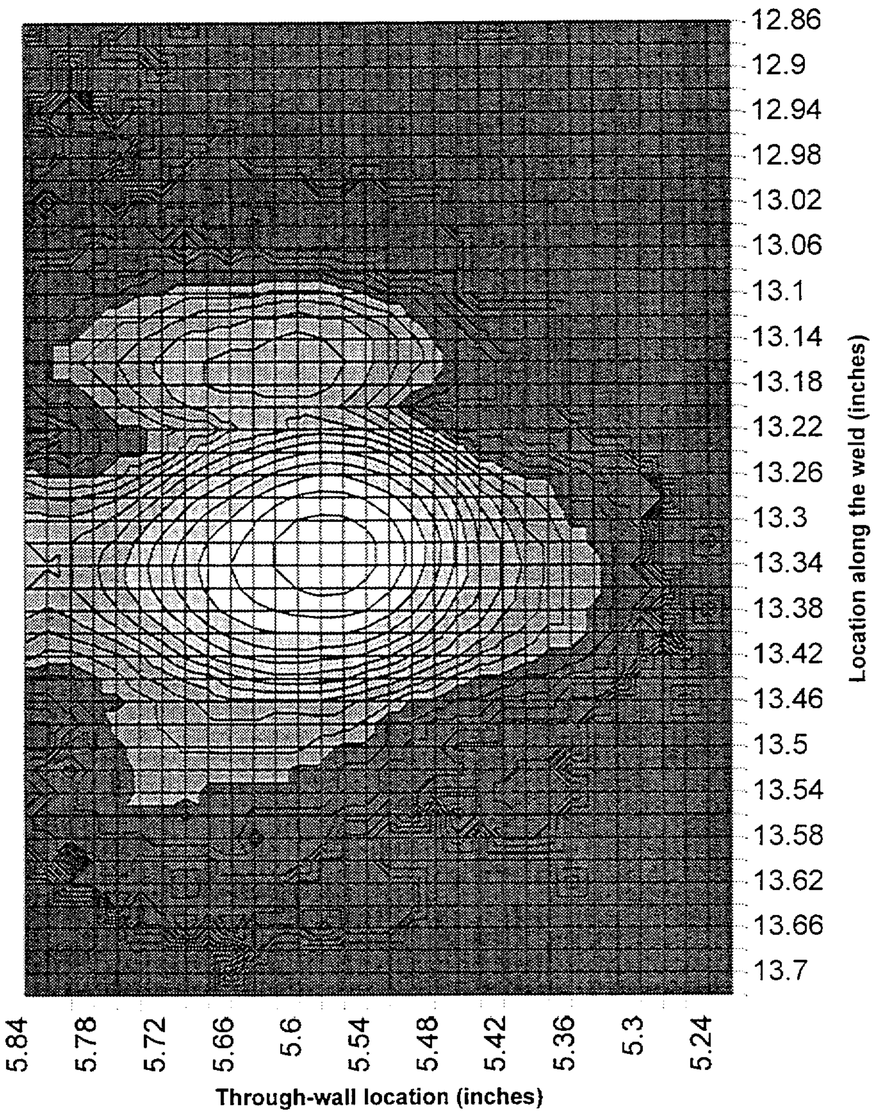

Figure P.8 **Log-scale contour plot of indication #37 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.61 inches below 553 inches of vessel elevation.**

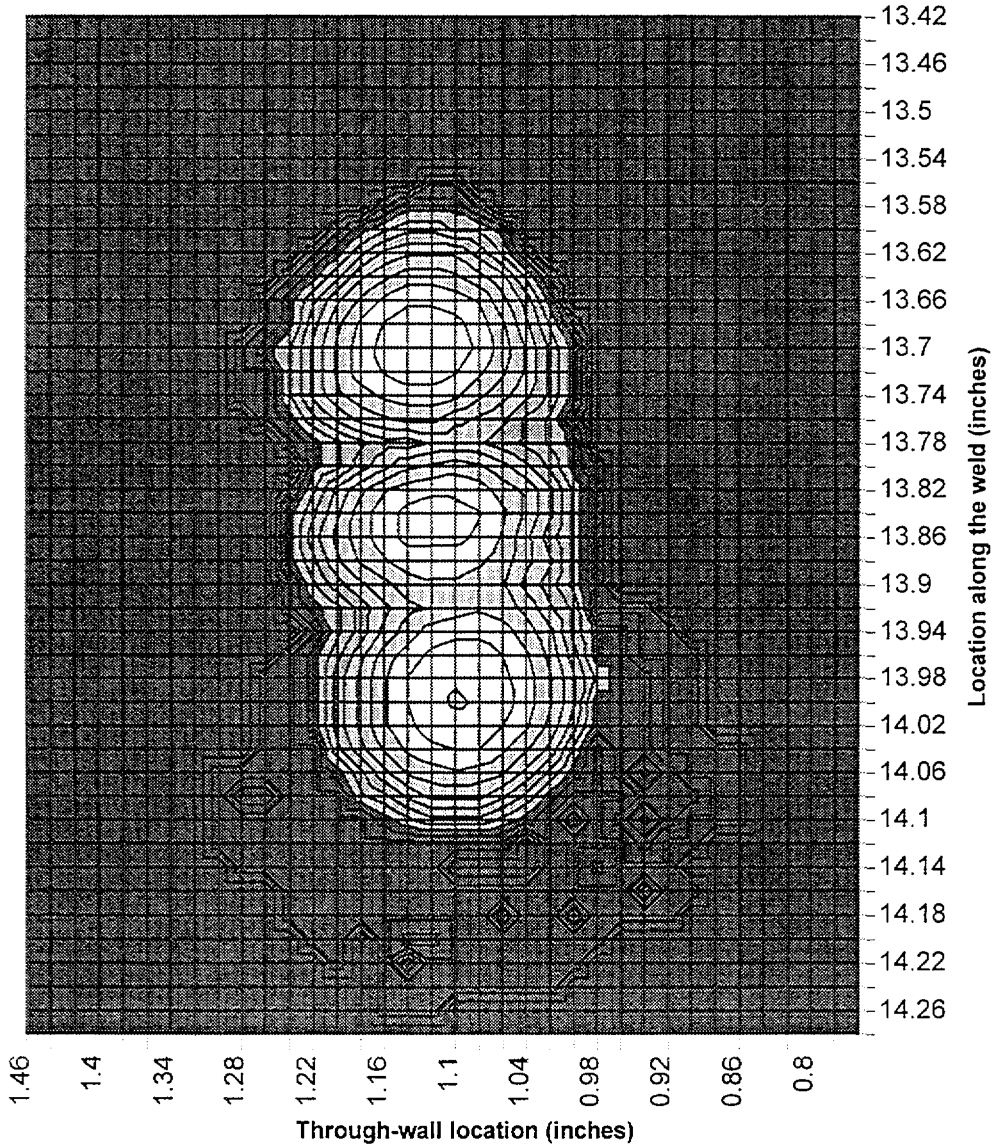

Figure P.9 Log-scale contour plot of indication #38 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.66 inches below 553 inches of vessel elevation.

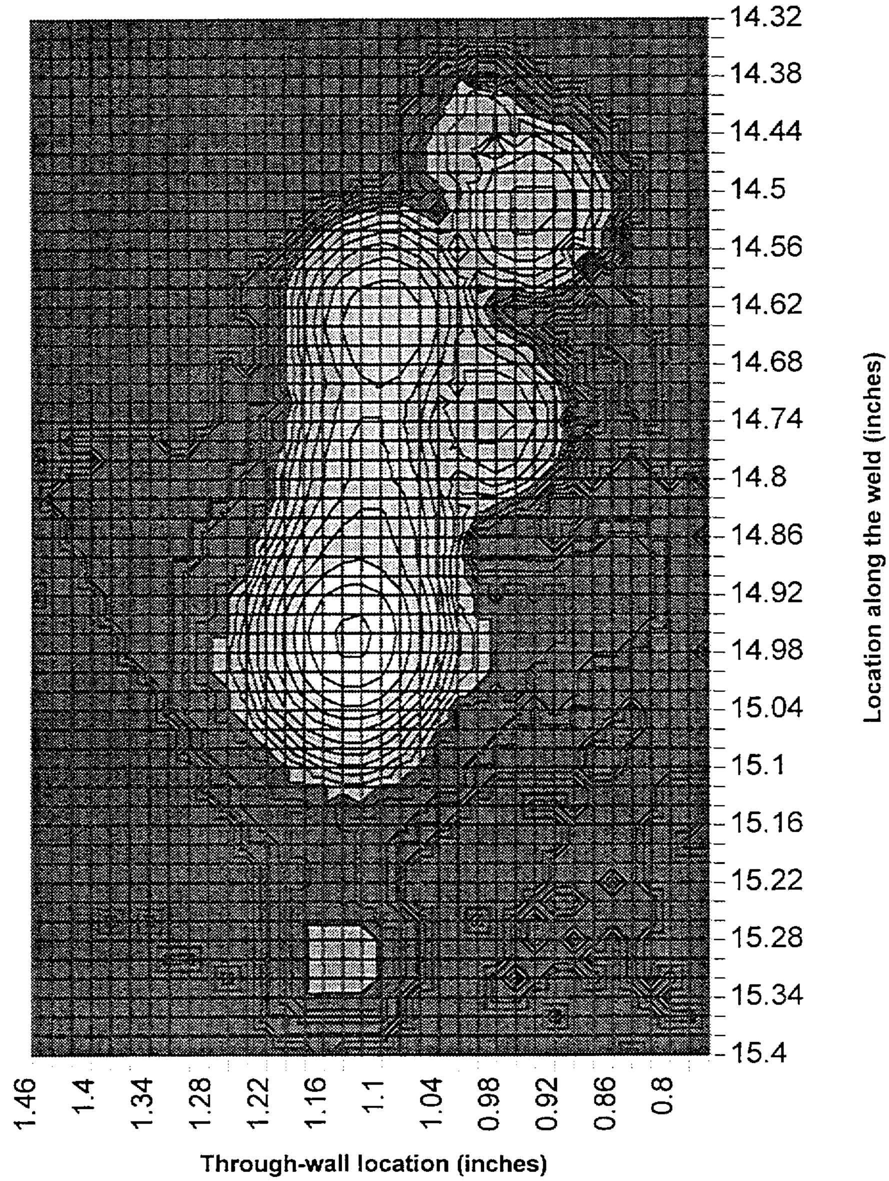

Figure P.10 Log-scale contour plot of indication #39 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.63 inches below 553 inches of vessel elevation.

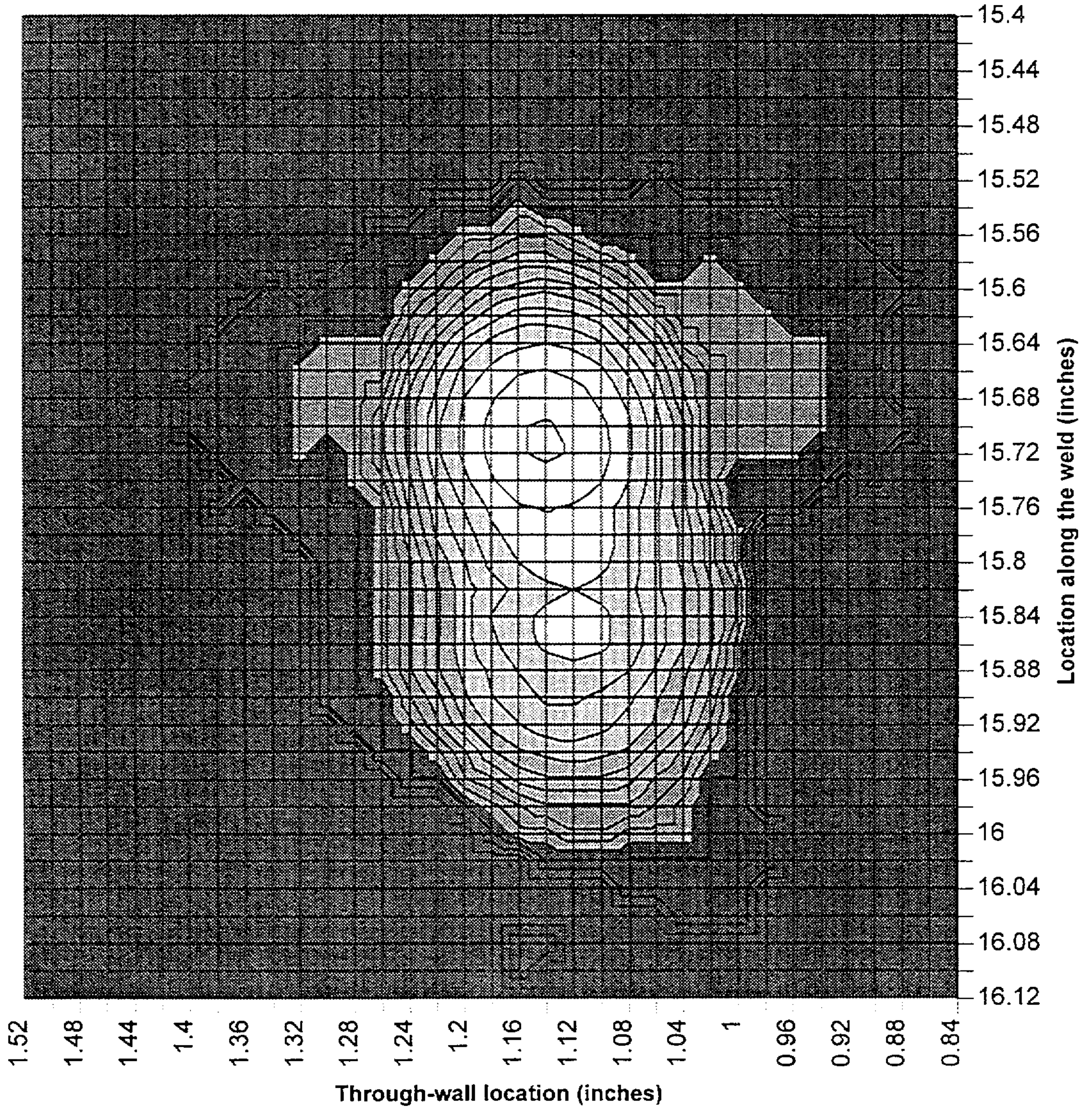

Figure P.11 **Log-scale contour plot of indication #42 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.63 inches below 553 inches of vessel elevation.**

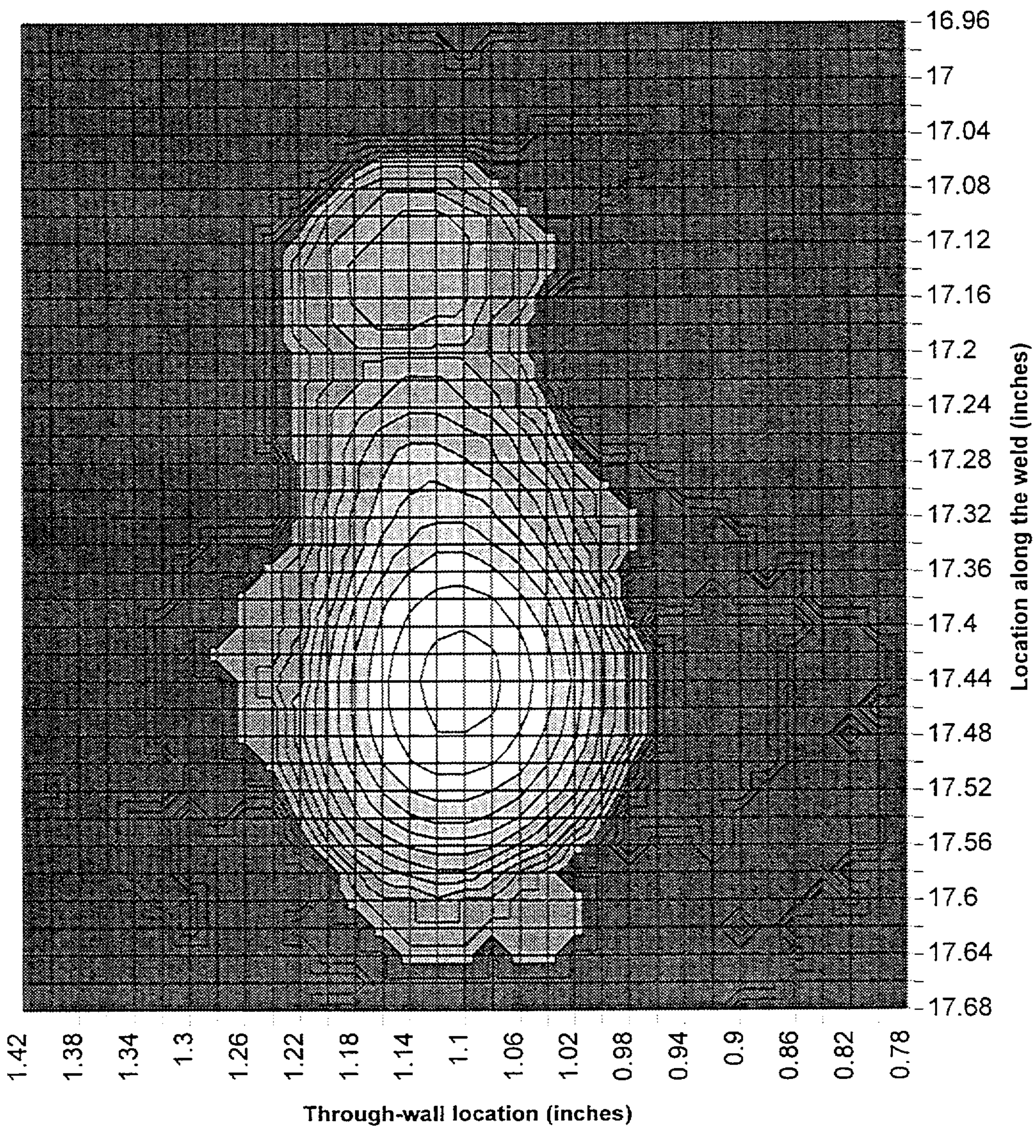

Figure P.12 **Log-scale contour plot of indication #45 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.64 inches below 553 inches of vessel elevation.**

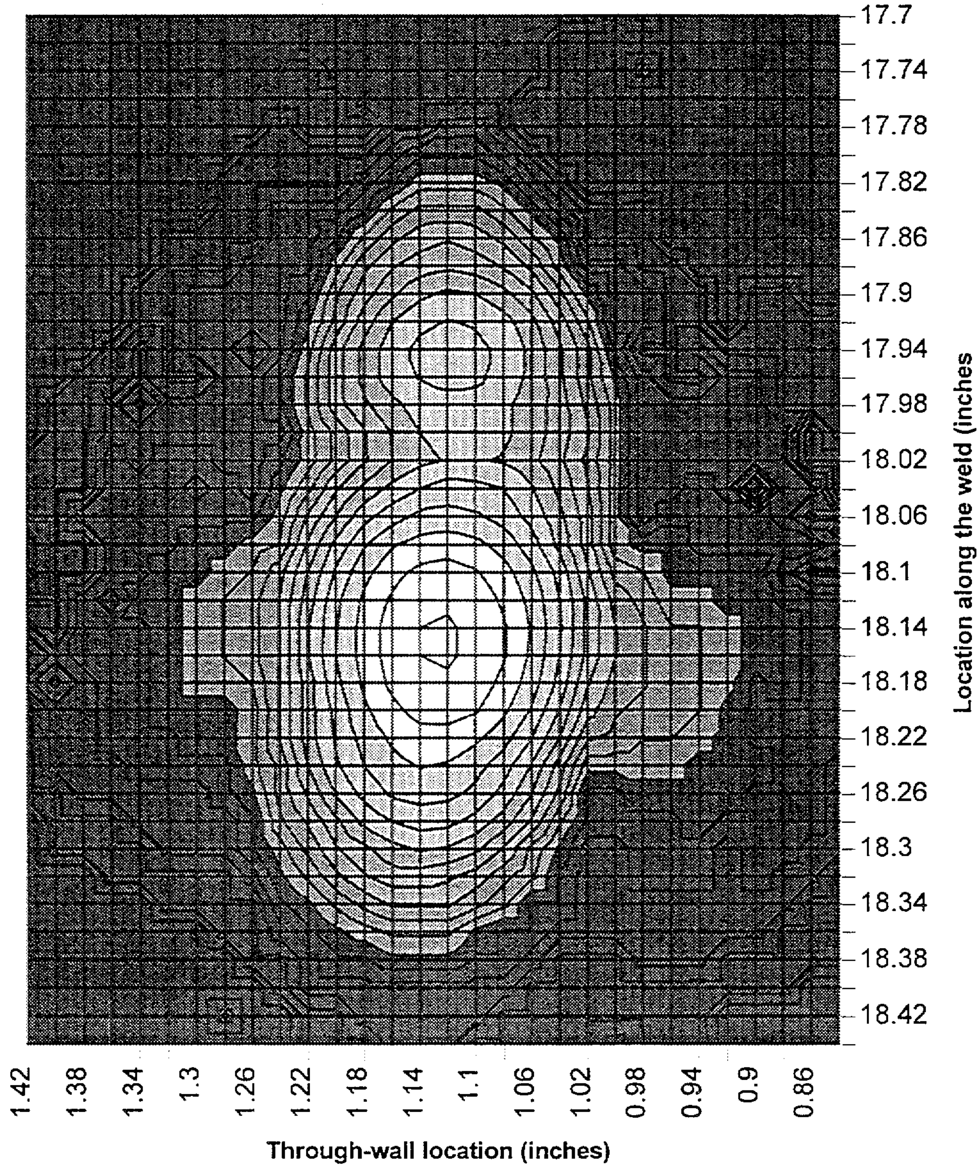

Figure P.13 **Log-scale contour plot of indication #47 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.66 inches below 553 inches of vessel elevation.**

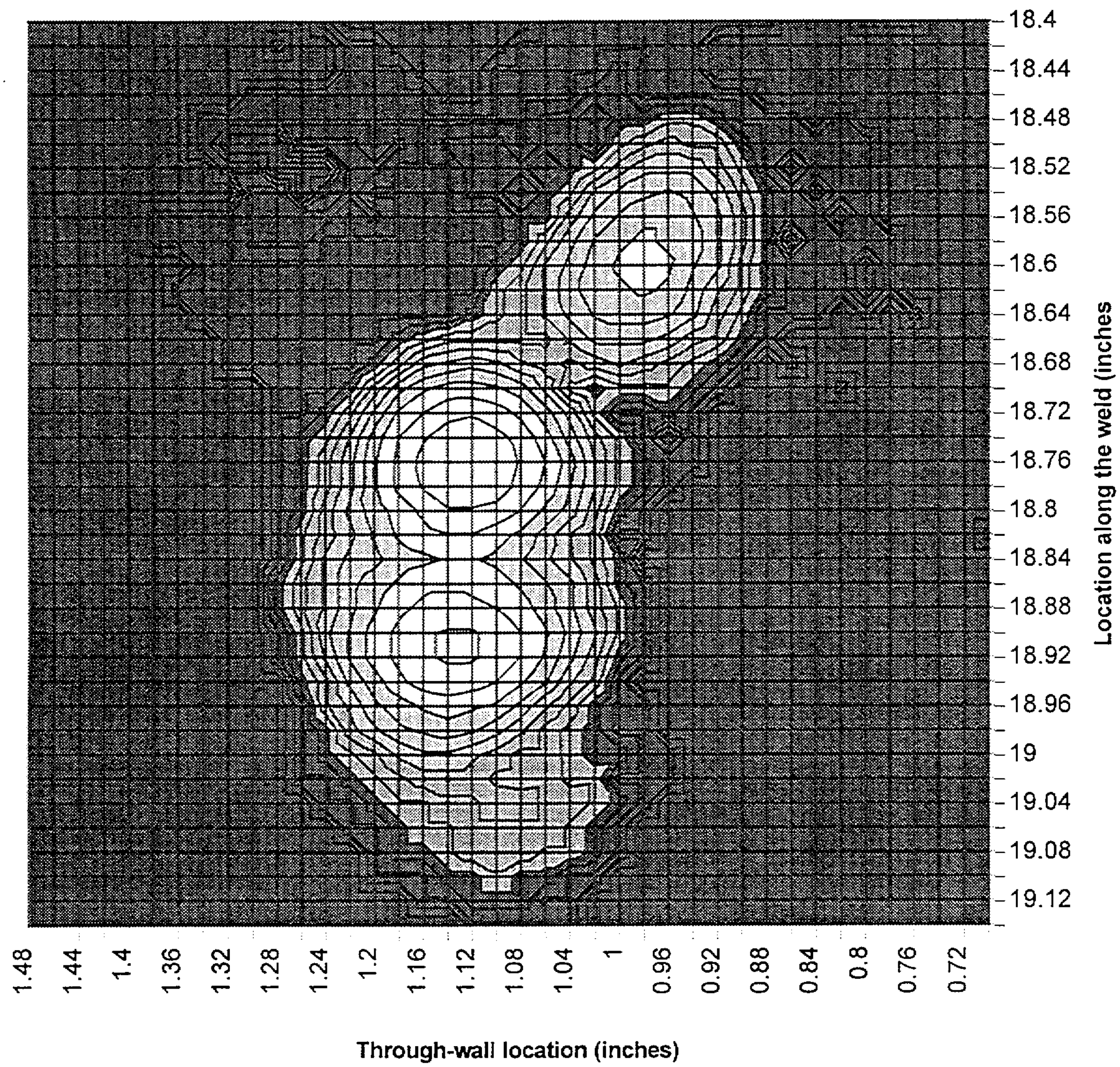

Figure P.14 Log-scale contour plot of indication #49 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -17.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.66 inches below 553 inches of vessel elevation.

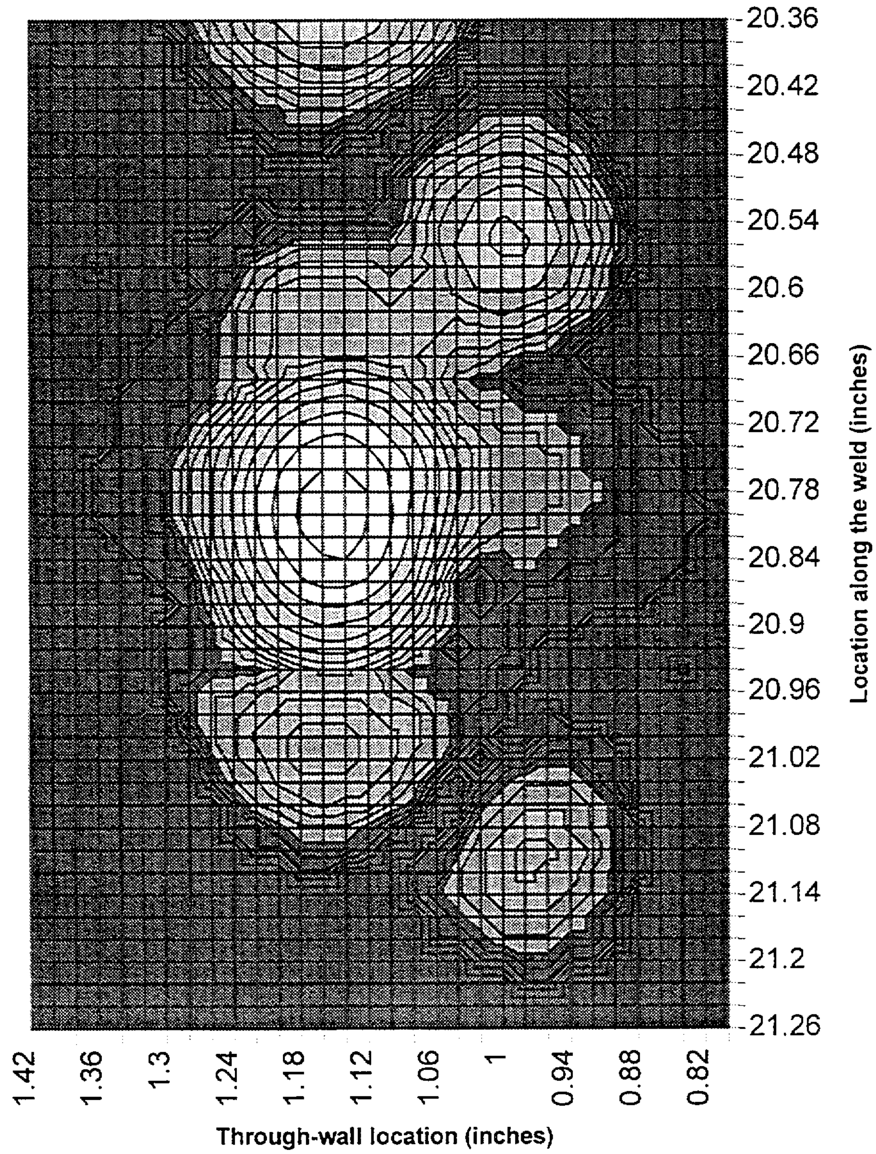

Figure P.15 **Log-scale contour plot of indication #55 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 19 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.66 inches below 553 inches of vessel elevation.**

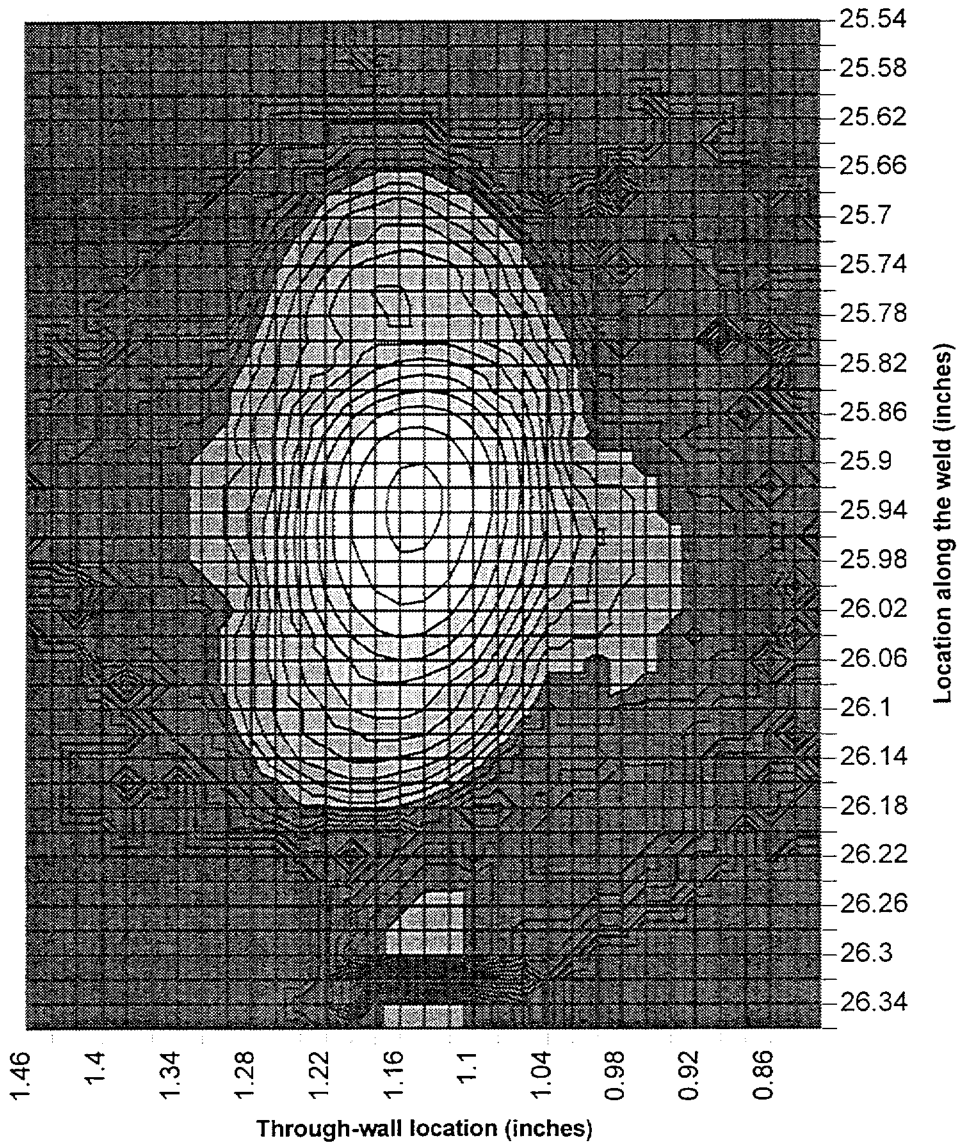

Figure P.16 Log-scale contour plot of indication #65 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.67 inches below 553 inches of vessel elevation.

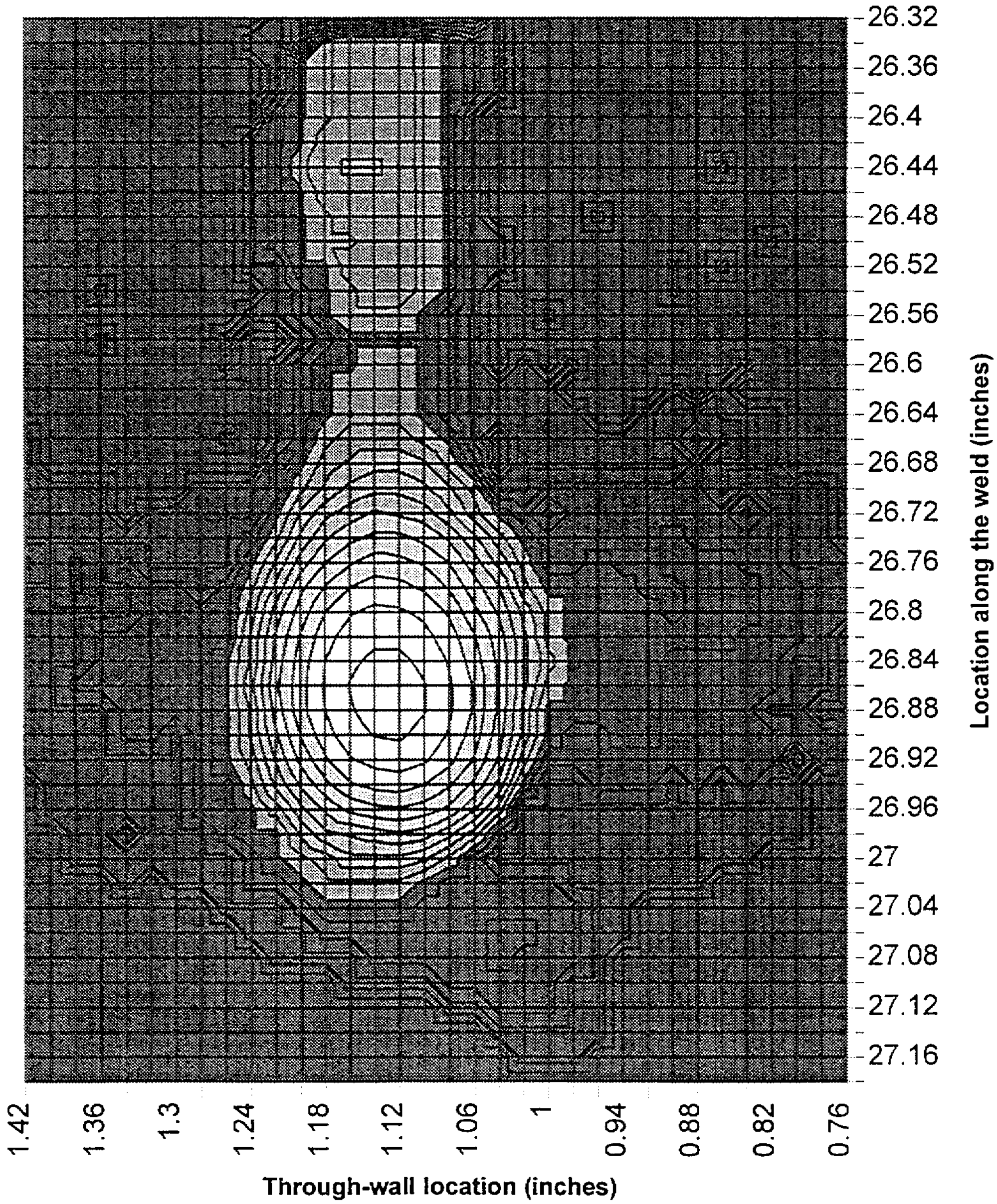

Figure P.17 Log-scale contour plot of indication #67 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.67 inches below 553 inches of vessel elevation.

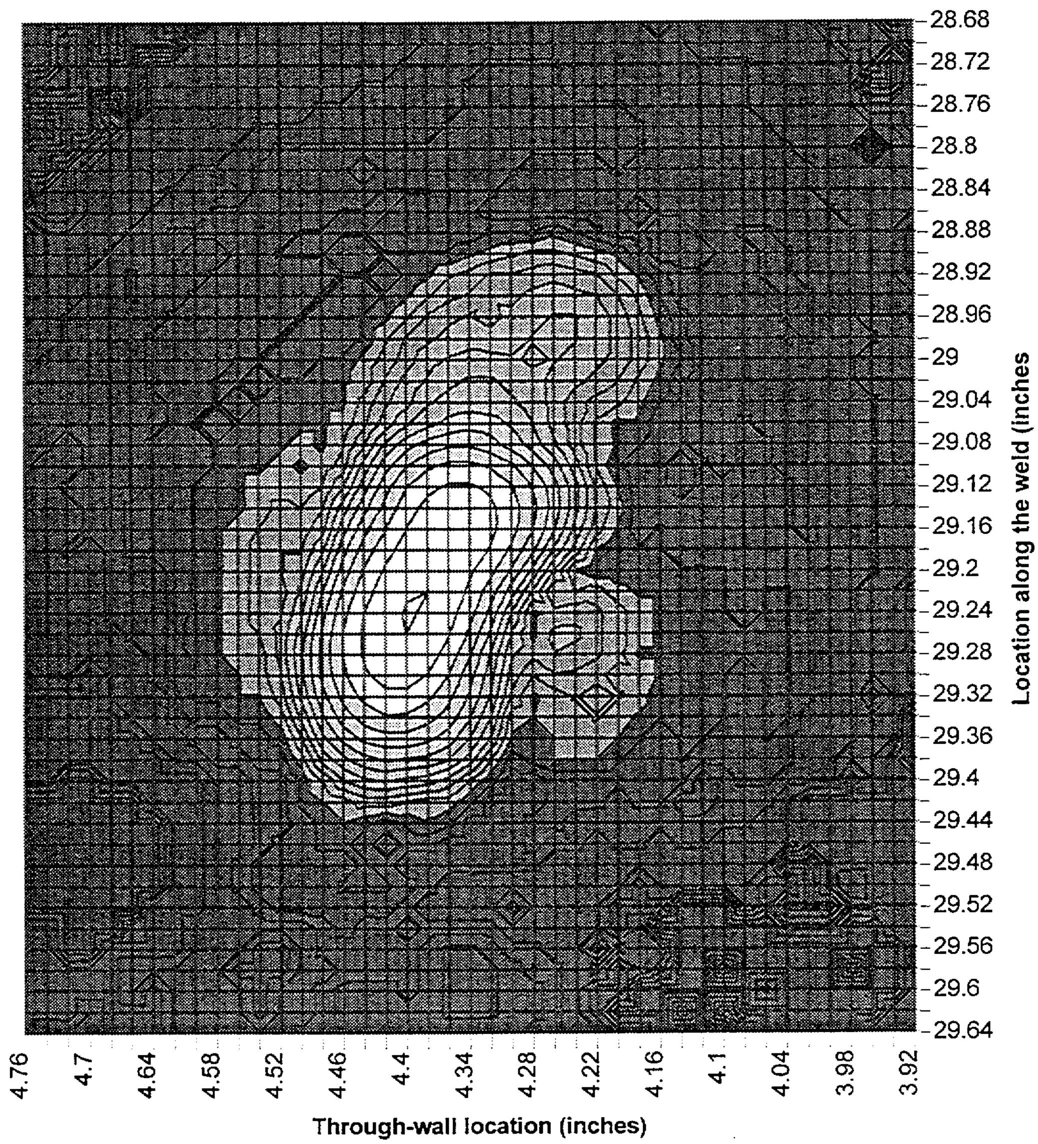

Figure P.18 **Log-scale contour plot of indication #74 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.58 inches below 553 inches of vessel elevation.**

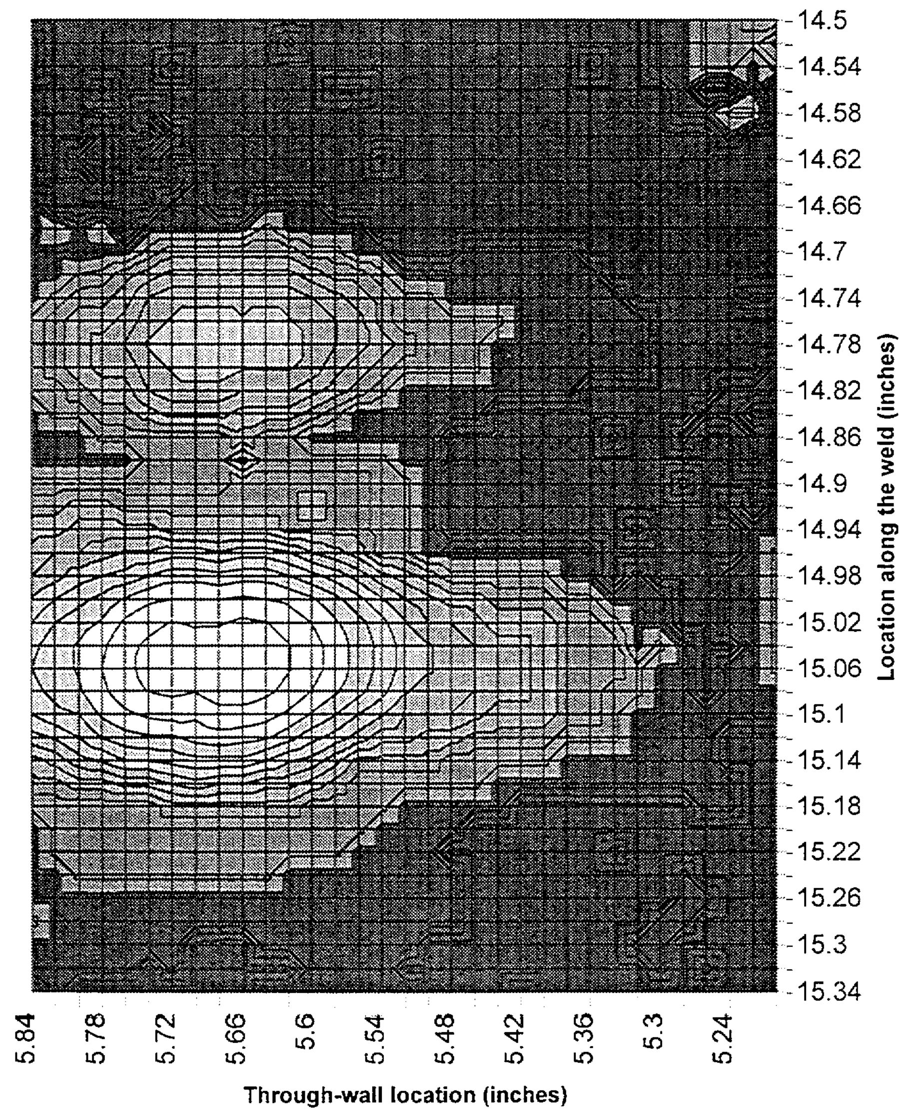

Figure P.19 **Log-scale contour plot of indication #112 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.7 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.52 inches above 553 inches of vessel elevation.**

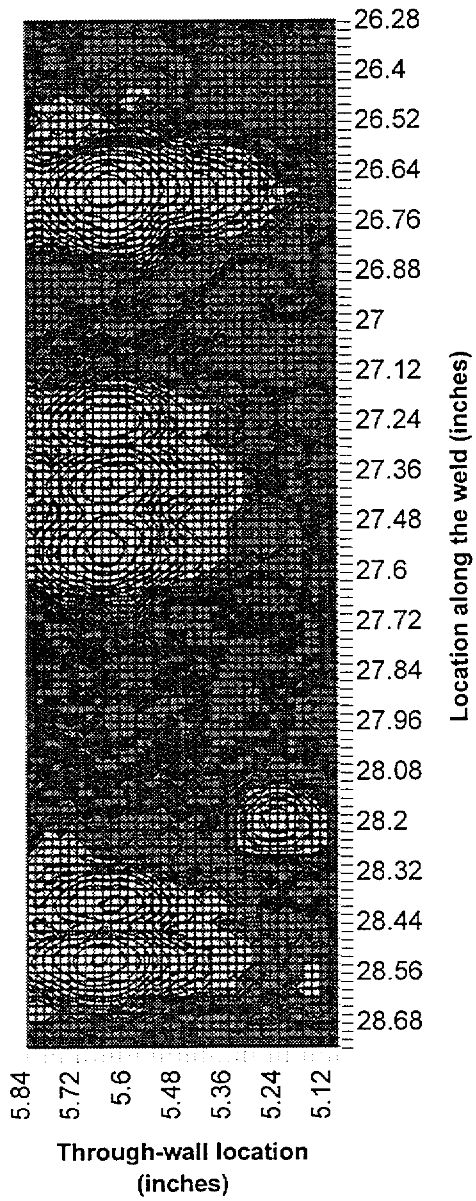

Figure P.20 Log-scale contour plot of indication #153 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 8 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.51 inches above 553 inches of vessel elevation.

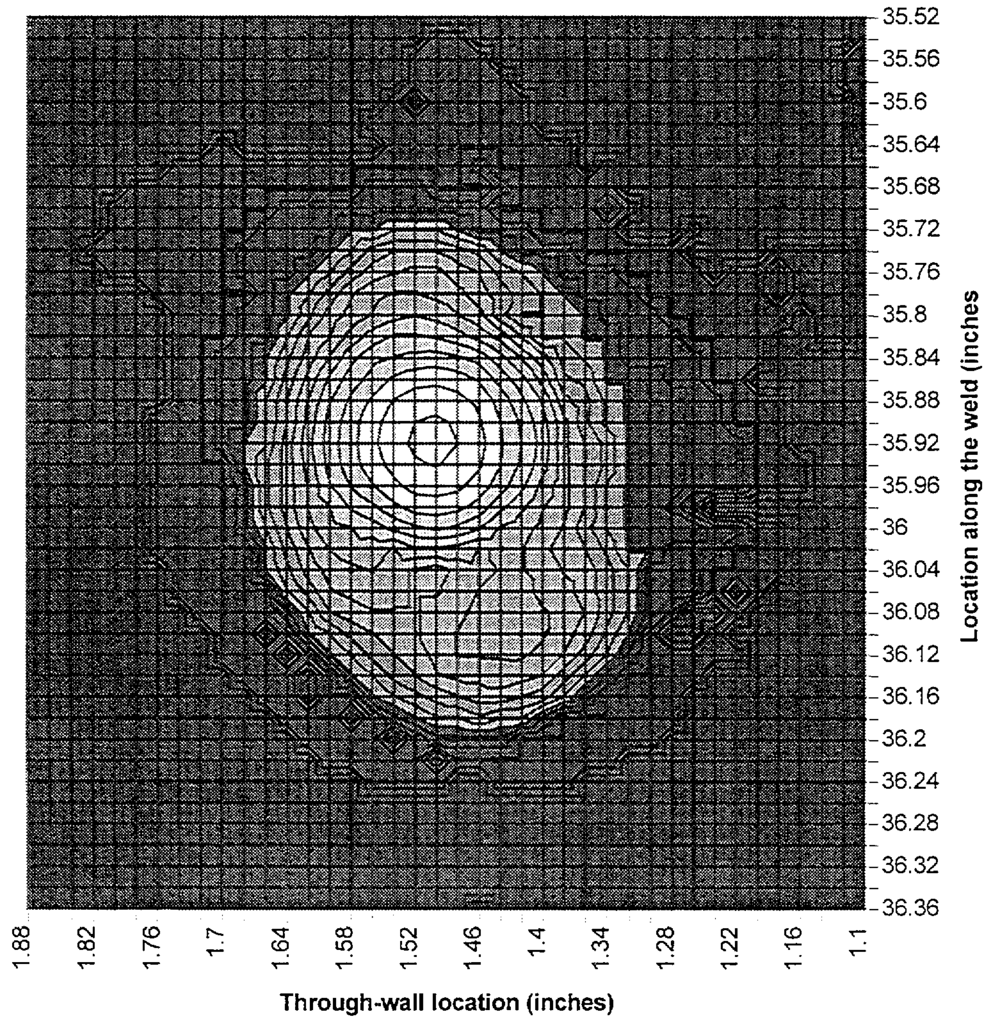

Figure P.21 **Log-scale contour plot of indication #176 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -10.7 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.63 inches below 553 inches of vessel elevation.**

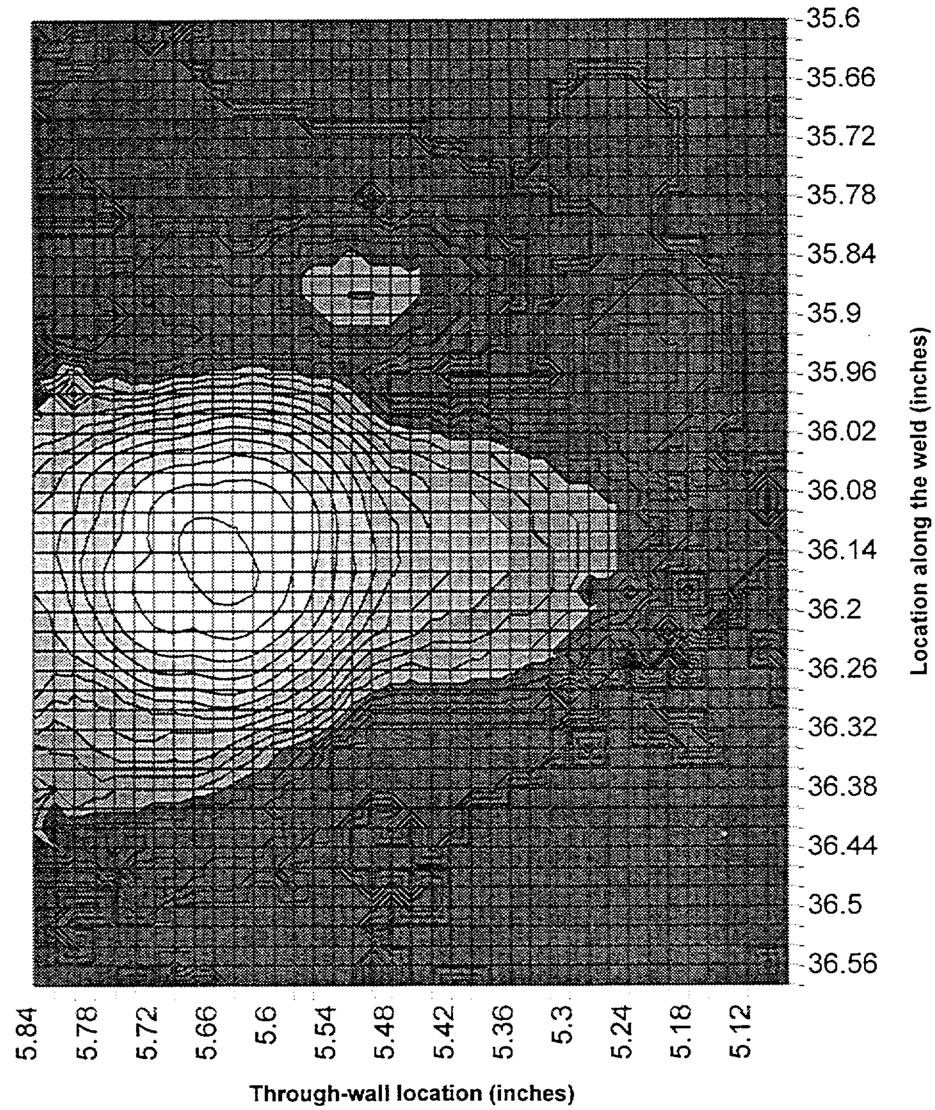

Figure P.22 **Log-scale contour plot of indication #207 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.49 inches above 553 inches of vessel elevation.**

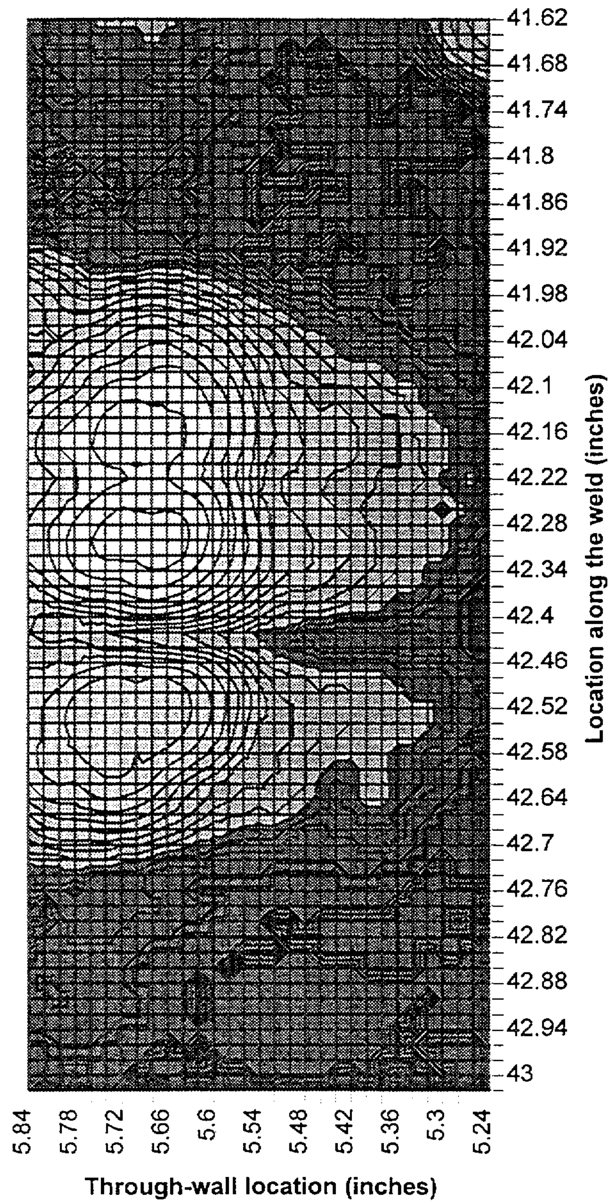

Figure P.23 Log-scale contour plot of indication #214 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is outer 25 mm. The length is 20 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface-elongated, is located on the fusion surface at 0.49 inches above 553 inches of vessel elevation.

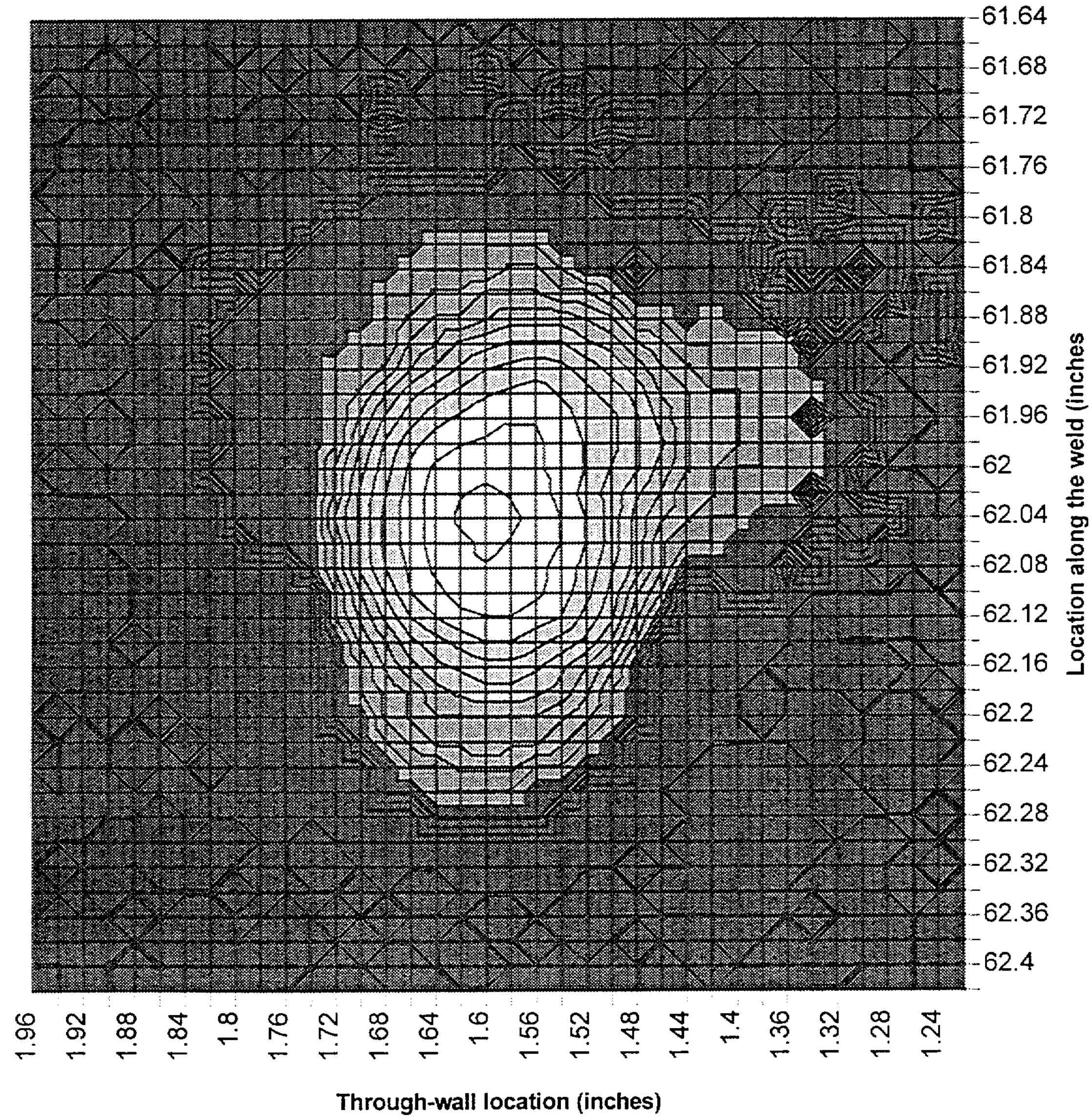

Figure P.24 Log-scale contour plot of indication #262 in Shoreham specimen C180B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -23.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.61 inches above 553 inches of vessel elevation.

Appendix Q

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C240B

Table Q.1 lists all detectable flaw indications in Shoreham specimen C240B. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C240B is given in Section 2. Figure Q.1 shows the image of the large indication in the specimen.

Table Q.1 List of all indications for Shoreham specimen C240B

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-1.17	4.78	0.5	-26.4	small	GOUGE
2	-0.58	9.04	5.16	-24.6	small	fusion
3	-0.67	8.92	1.84	-23.8	small	fusion
4	-0.59	11.1	5.16	-13.3	small	fusion
5	-0.68	13.94	1.78	-23.9	small	fusion
6	-0.56	15.7	3.46	-22.9	small	fusion
7	-0.68	16.84	4.7	-16.7	small	fusion
8	-0.63	18.28	3.1	-8.9	extended	fusion
9	-0.68	21.04	1.8	-18.9	small	fusion
10	-0.60	25.74	3.68	-27.1	small	fusion
11	-0.67	27.2	4.82	-18.2	small	fusion
12	-0.64	28.46	4.84	-19.5	small	fusion
13	-0.69	28.68	3.26	-26.8	small	fusion
14	0.54	1.12	4.98	-26.4	small	fusion
15	-0.04	4.96	1.46	-26	small	weld
16	-0.26	5.94	5.54	-25.1	small	weld
17	0.59	8.64	2.1	-26.5	small	fusion
18	0.57	9.04	1.04	-26.5	small	fusion
19	0.62	10.32	2.16	-28.1	small	fusion
20	0.63	10.92	4.38	-21.2	small	fusion
21	0.61	12.32	2.14	-25.2	small	fusion
22	0.65	12.4	2.92	-22.1	small	fusion
23	0.36	12.44	3.14	-25.6	small	weld
24	0.58	13.38	4.36	-17.6	small	fusion
25	0.60	14.72	1.14	-16.2	small	fusion
26	0.57	15.62	3.94	-24.2	small	fusion
27	0.61	16.54	1.46	-16.2	small	fusion

Table Q.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	0.61	16.64	1.08	-23.2	small	fusion
29	0.55	17.04	4.84	-21.5	small	fusion
30	0.61	17.02	5.84	-14.6	small	fusion
31	0.60	20.22	5.1	-22.3	small	fusion
32	0.54	21	4.36	-24.4	small	fusion
33	0.56	22.3	3.56	-24.4	small	fusion
34	0.61	22.48	5.36	-26.8	small	fusion
35	0.30	27.3	5.56	-26	small	weld
36	0.03	27.74	4.76	-26.4	small	weld
37	0.61	27.66	4	-20.2	small	fusion
38	0.64	28.02	2.18	-24.4	small	fusion
39	0.32	28.48	5.56	-24.8	small	weld
40	0.63	30.68	1.18	-25.6	small	fusion
Note 1: Depth is measured from wetted clad surface.						
Note 2: Weld center is positive for elevation greater than 553 inches.						

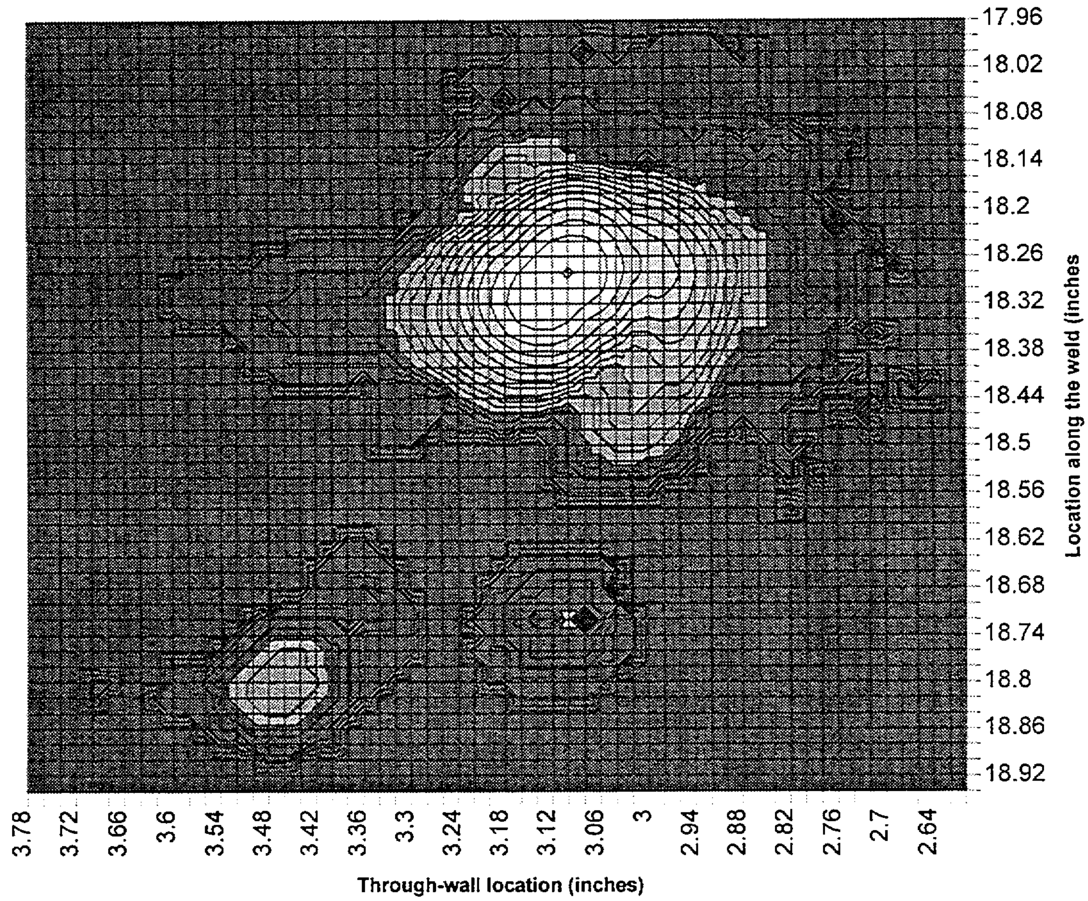

Figure Q.1 Log-scale contour plot of indication #8 in Shoreham specimen C240B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.63 inches below 553 inches of vessel elevation.

Appendix R

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C240C

Table R.1 lists all detectable flaw indications in Shoreham specimen C240C. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C240C is given in Section 2. Figures R.1 through R.4 show the images of the larger indications in the specimen.

Table R.1 List of all indications for Shoreham specimen C240C

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.67	1.5	0.28	-23.5	small	clad
2	-0.50	2.14	5.5	-5	extended	fusion
3	-0.78	2.4	0.3	-27.3	small	GOUGE
4	-0.56	3.6	4.54	-30.3	small	fusion
5	-0.51	5	5.34	-23.4	small	fusion
6	-0.56	4.98	5.54	-26.4	small	fusion
7	-0.53	5.42	4.76	-29	small	fusion
8	-0.52	7.14	5.74	-24.8	small	fusion
9	-0.58	9.16	4.62	-25.1	small	fusion
10	-0.66	9.9	0.9	-23.8	small	fusion
11	-0.50	10.7	5.32	-20.2	small	fusion
12	-0.59	15.02	4.56	-28.5	small	fusion
13	-0.65	16.86	4.54	-24.4	small	fusion
14	-0.57	18.82	5.04	-20	small	fusion
15	-0.52	18.86	4.28	-30.5	small	fusion
16	-0.59	19.24	4.62	-26.2	small	fusion
17	-0.63	19.3	2.6	-32.4	small	fusion
18	-0.70	19.68	0.58	-29.2	small	fusion
19	-0.65	21.12	1.54	-24	small	fusion
20	-0.59	22.18	1.72	-21.4	small	fusion
21	-0.57	22.72	5.1	-32.2	small	fusion
22	-0.55	26.52	5.78	-29.7	small	fusion
23	-0.57	27.04	3.28	-28.8	small	fusion
24	-0.52	27.18	1.84	-29.6	small	fusion
25	-0.56	28.36	5.4	-27	small	fusion
26	-0.56	28.74	4.46	-28.8	small	fusion
27	0.53	1.1	5.18	-21.7	small	fusion

Table R.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	0.49	1.94	5.56	-23.4	small	fusion
29	0.51	2.52	5.64	-23.3	small	fusion
30	0.66	3.8	5.6	-21.6	small	fusion
31	0.52	4.46	5.14	-21.8	small	fusion
32	0.50	5.16	5.14	-21.1	small	fusion
33	0.51	5.4	5.14	-18.8	small	fusion
34	0.62	5.54	2.42	-29.2	small	fusion
35	0.51	5.96	5.14	-24.3	small	fusion
36	0.51	6.48	5.14	-18.3	small	fusion
37	0.51	7	5.18	-16.9	small	fusion
38	0.50	7.7	5.18	-12.3	long	fusion
39	0.50	9.28	5.26	-15.4	small	fusion
40	0.51	10.38	5.28	-16.2	small	fusion
41	0.70	10.92	4.04	-7	small	fusion
42	0.65	10.84	1.32	-19.7	small	fusion
43	0.65	11.28	3.88	-21.6	small	fusion
44	0.52	11.46	5.26	-10.7	small	fusion
45	0.50	13.02	5.16	-22.6	small	fusion
46	0.66	13.08	4.86	-15.3	small	fusion
47	0.69	13.34	5.32	-27.6	small	fusion
48	0.58	13.56	5.32	-27.8	small	fusion
49	0.58	13.94	5.34	-26.4	small	fusion
50	0.53	14.12	5.36	-24.3	small	fusion
51	0.49	14.76	5.22	-25.4	small	fusion
52	0.56	15.02	5.34	-19.8	small	fusion
53	0.52	15.54	5.3	-26.5	small	fusion
54	0.50	15.82	5.2	-21.9	small	fusion
55	0.50	16.42	5.2	-24.4	small	fusion
56	0.59	16.74	5.34	-23.3	small	fusion
57	0.69	17.12	2.02	-25.2	small	fusion
58	0.48	17.38	5.18	-23.5	small	fusion
59	0.60	18.56	4.6	-26.4	small	fusion
60	0.61	18.9	0.82	-24.3	small	fusion
61	0.65	19.1	1.44	-27.7	small	fusion
62	0.68	19.38	5	-15.6	small	fusion
63	0.64	20.9	0.92	-24.2	small	fusion
64	0.67	22.72	0.98	-24.2	small	fusion
65	0.68	23.04	5.5	-23.3	small	fusion
66	0.63	23.52	0.88	-20.4	small	fusion
67	0.66	24.14	3.1	-27.7	small	fusion
68	0.41	24.3	5.8	-28.1	small	weld
69	0.55	24.6	4.88	-29.5	small	fusion
70	-0.16	25.08	1.96	-28.8	small	weld

Table R.1 (contd)						
	Peak Coordinates (Specimen)					
#	**Weld Center (inches)**	**Along Weld (inches)**	**Depth (inches)**	**Response (dB)**	**Characterization**	**Type (material)**
71	0.69	25.14	1.76	-25.2	small	fusion
72	0.64	25.4	1.4	-22.5	small	fusion
73	0.67	25.54	1.12	-18.7	small	fusion
74	0.60	26.52	3.44	-26.5	small	fusion
75	-0.53	29.84	2.54	-29.7	small	fusion
76	-0.65	32.16	4.6	-25.4	small	fusion
77	-0.63	32.62	4.54	-30.2	small	fusion
78	-0.46	33	4.32	-28.4	small	weld
79	-0.53	33.78	5.72	-6.3	surface elongated	fusion
80	-0.48	34.36	4.28	-27.6	small	weld
81	-0.45	34.72	4.28	-25.9	small	weld
82	-0.54	35.06	5.7	-21.1	small	fusion
83	-0.54	35.58	5.66	-23.9	small	fusion
84	-0.60	36.48	4.54	-27.4	small	fusion
85	-0.58	36.66	1.18	-30.1	small	fusion
86	-0.58	36.82	5.08	-29.1	small	fusion
87	-0.60	37.42	4.52	-30.2	small	fusion
88	-0.57	39.2	4.74	-26.6	small	fusion
89	-0.65	40.7	1.44	-30.5	small	fusion
90	-0.60	41.02	1.58	-29.3	small	fusion
91	-0.56	44	1.12	-31.4	small	fusion
92	-0.53	44.6	5.22	-22.1	small	fusion
93	-0.65	44.72	1.56	-23.1	small	fusion
94	-0.69	45.58	1.7	-15.8	long	fusion
95	-0.47	47.32	1.74	-31	small	weld
96	-0.62	49.08	1.9	-17.8	small	fusion
97	-0.59	50.46	1.74	-31.7	small	fusion
98	-0.59	50.62	2.8	-29.5	small	fusion
99	-0.48	50.76	4.18	-31.2	small	weld
100	-0.52	51.58	5.6	-18.4	small	fusion
101	0.67	29.88	0.74	-25.3	small	fusion
102	0.69	30.04	0.74	-25.2	small	fusion
103	0.67	30.4	0.76	-24.3	small	fusion
104	-0.29	31.24	1.48	-28.5	small	weld
105	0.70	31.3	2.12	-27.7	small	fusion
106	0.63	31.86	1.58	-26.5	small	fusion
107	0.64	32.24	1.28	-22.6	small	fusion
108	0.71	32.78	0.78	-26.4	small	fusion
109	0.64	32.88	4.22	-23.4	small	fusion
110	0.64	33.24	0.98	-26.5	small	fusion
111	0.64	33.52	0.96	-27.8	small	fusion
112	0.62	33.64	3.7	-27.9	small	fusion

Table R.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	0.69	34.06	1.42	-13	small	fusion
114	0.60	34.2	3.72	-25.4	small	fusion
115	-0.23	34.4	2.08	-30.8	small	weld
116	0.70	34.7	2.08	-25.3	small	fusion
117	-0.38	34.8	4.32	-30.3	small	weld
118	0.12	34.94	4.64	-25.1	small	weld
119	0.70	35.3	0.74	-22.5	small	fusion
120	0.72	35.62	2.14	-27.7	small	fusion
121	0.69	37.04	1.42	-22.5	small	fusion
122	0.62	37.46	3.68	-23.5	small	fusion
123	0.62	37.86	2.88	-21.9	small	fusion
124	0.67	38.38	0.86	-21.1	small	fusion
125	0.65	38.78	1.2	-29.4	small	fusion
126	0.70	38.66	5.04	-24.3	small	fusion
127	-0.01	39.28	5.14	-27.2	small	weld
128	0.70	39.62	5.24	-27.8	small	fusion
129	0.63	39.9	1.54	-2.4	small	fusion
130	0.66	40.24	4.76	-21.8	small	fusion
131	0.64	40.78	5.48	-31.4	small	fusion
132	0.62	41.22	2.82	-31.4	small	fusion
133	0.57	41.42	5.1	-28	small	fusion
134	0.69	42.04	0.76	-22.6	small	fusion
135	-0.15	42.82	1.36	-32.2	small	weld
136	0.68	43.36	1.36	-18.3	small	fusion
137	0.66	44.18	1.4	-22.6	small	fusion
138	0.68	44.38	5.38	-5.4	small	fusion
139	0.64	44.92	0.88	-25.4	small	fusion
140	0.67	45.48	0.9	-27.9	small	fusion
141	0.67	45.56	1.34	-25.4	small	fusion
142	0.69	46.02	0.64	-24.3	small	fusion
143	0.63	46.82	3.86	-23.5	small	fusion
144	0.68	47.28	5.02	-18.4	small	fusion
145	0.63	47.26	1.44	-22.7	small	fusion
146	0.63	47.48	5.18	-16.3	small	fusion
147	0.71	48.38	2.02	-25.4	small	fusion
148	0.62	48.86	0.84	-25.5	small	fusion
149	0.48	49.56	3.68	-26.8	small	fusion
150	0.67	49.64	4.22	-26.6	small	fusion
151	0.65	50.04	3.3	-26.6	small	fusion
152	0.69	50.08	3	-26.6	small	fusion
153	0.65	50.8	1.06	-23.5	small	fusion
154	0.06	51.76	0.52	-23.7	small	weld

Table R.1 (contd)							
#	Peak Coordinates (Specimen)			Response (dB)	Characterization	Type (material)
	Weld Center (inches)	Along Weld (inches)	Depth (inches)			
155	0.64	52.18	1.54	-24.5	small	fusion
156	0.68	52.44	5.24	-20.6	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

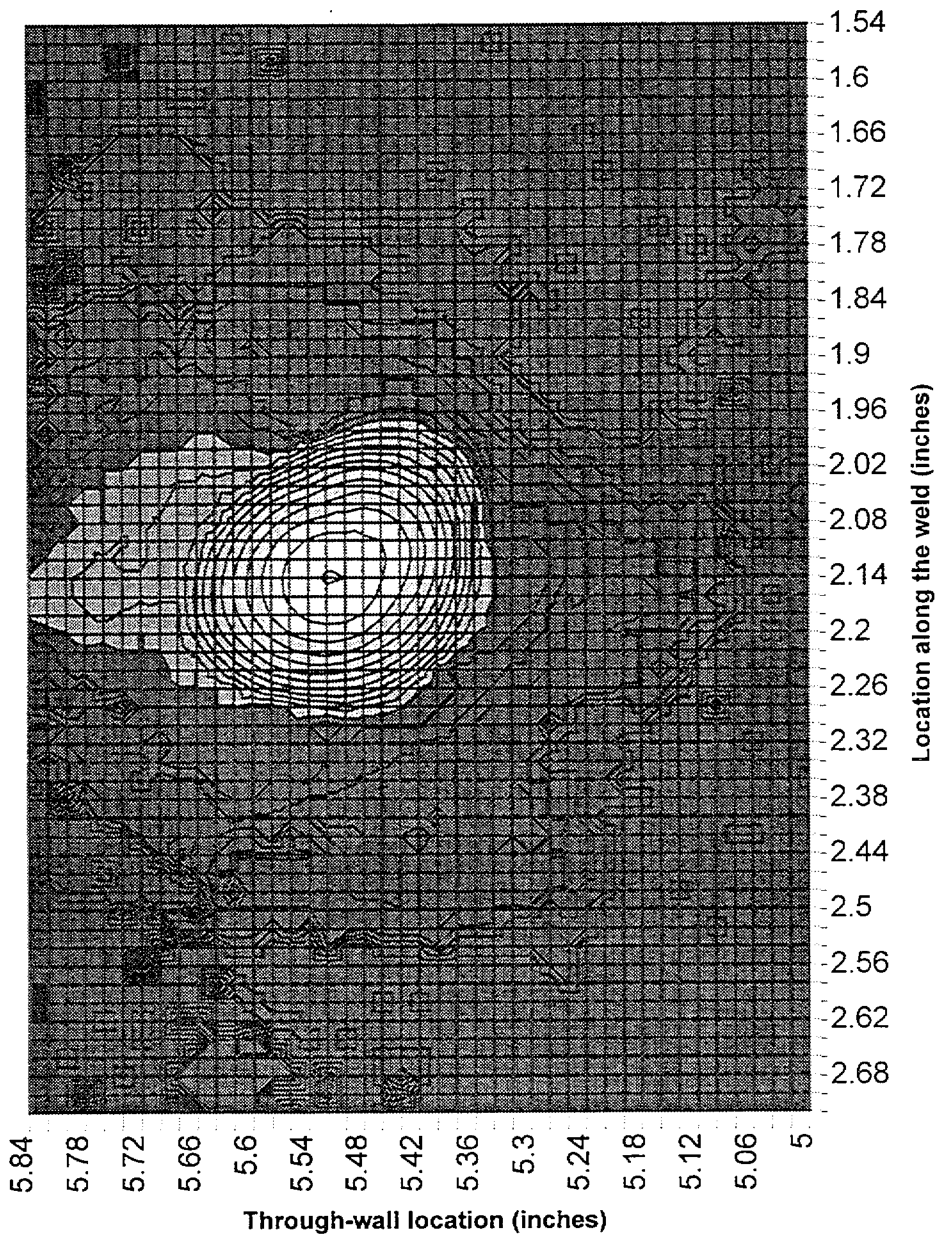

Figure R.1 **Log-scale contour plot of indication #2 in Shoreham specimen C240C. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -5.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located on the fusion surface at 0.50 inches below 553 inches of vessel elevation.**

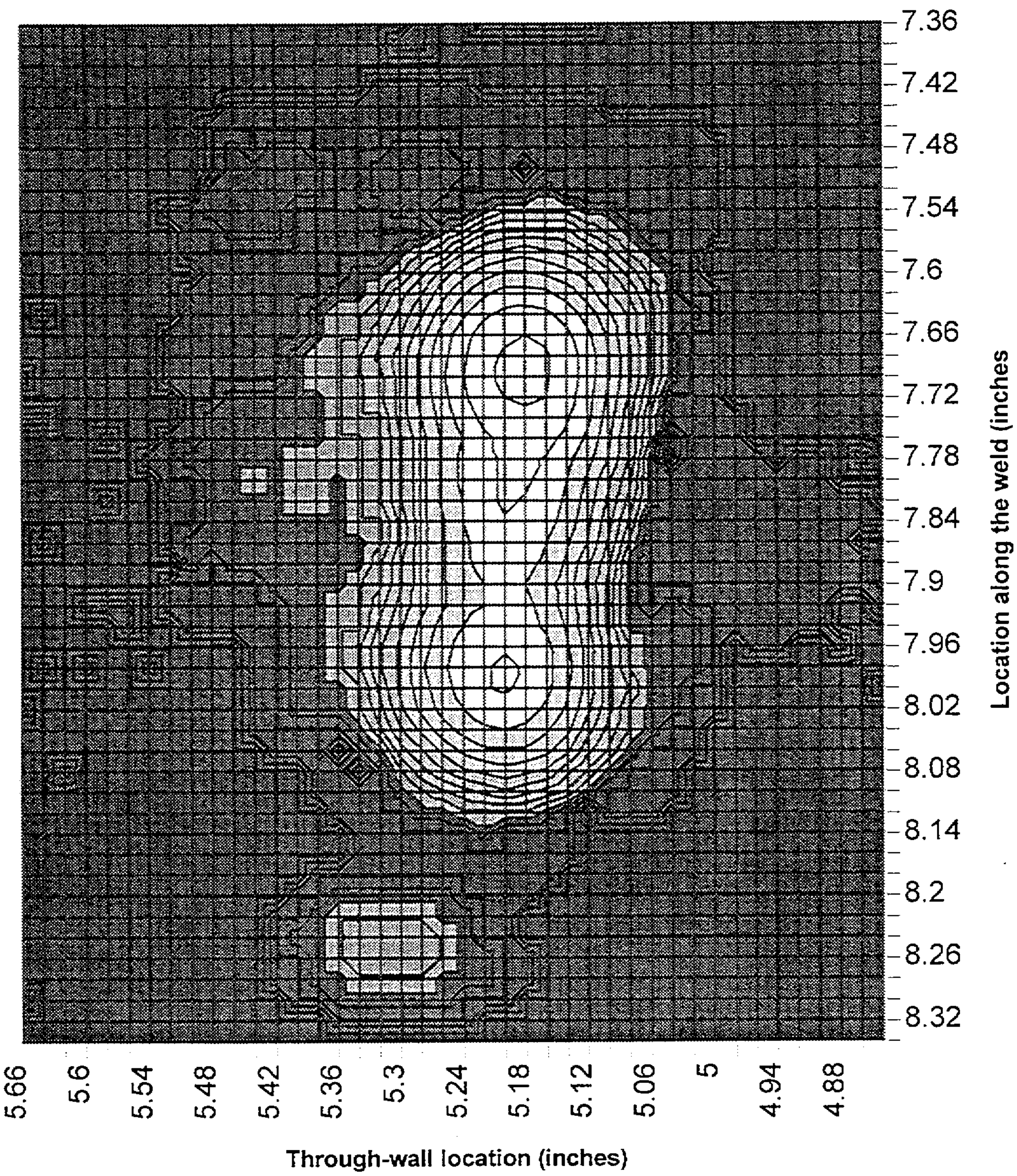

Figure R.2 Log-scale contour plot of indication #38 in Shoreham specimen C240C. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is outer 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.50 inches above 553 inches of vessel elevation.

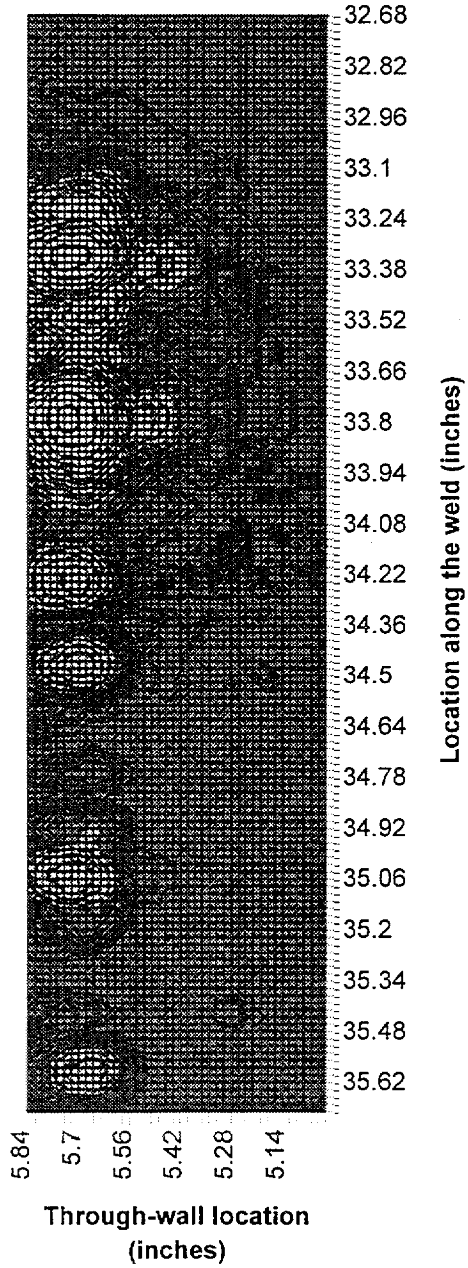

Figure R.3 **Log-scale contour plot of indication #79 in Shoreham specimen C240C. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 25 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.53 inches below 553 inches of vessel elevation.**

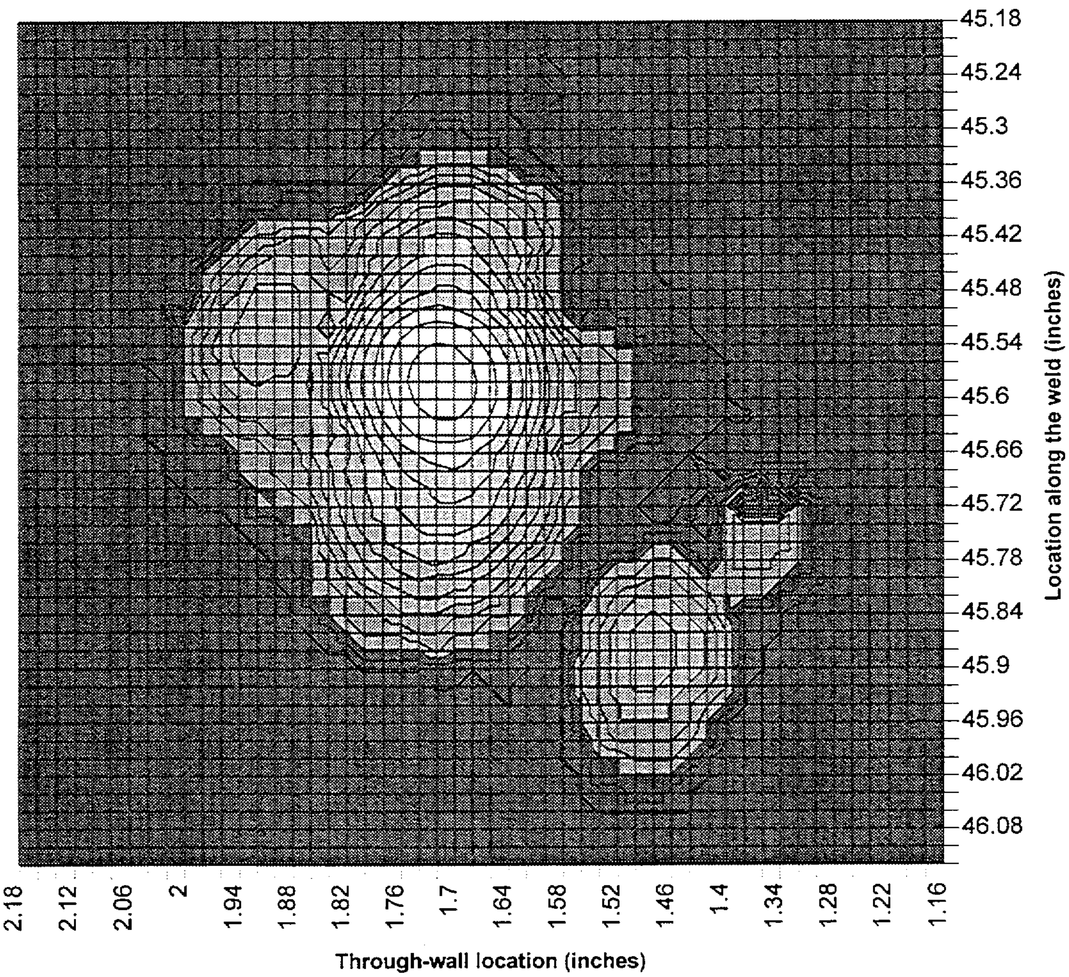

Figure R.4 Log-scale contour plot of indication #94 in Shoreham specimen C240C. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.69 inches below 553 inches of vessel elevation.

Appendix S

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C270B

Table S.1 lists all detectable flaw indications in Shoreham specimen C270B. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C270B is given in Section 2. Figures S.1 through S.7 show the images of the larger indications in the specimen.

Table S.1 List of all indications for Shoreham specimen C270B

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-1.47	550.86	0.64	-17.6	n.a.	geometry
2	-0.94	551.96	5.44	-29.6	small	fusion
3	-0.91	552.96	5.44	-26.3	small	fusion
4	-0.85	553.14	3.36	-29.1	small	fusion
5	-0.80	553.3	1.82	-27.6	small	fusion
6	-0.77	553.56	1.84	-27.5	small	fusion
7	-0.87	553.58	3.06	-29.2	small	fusion
8	-0.75	553.64	3.7	-28.5	small	fusion
9	-0.75	553.98	3.7	-27.3	small	fusion
10	-0.86	554.2	3.06	-20.5	small	fusion
11	-0.82	554.28	3.94	-25	small	fusion
12	-0.84	554.34	5.62	-25.1	small	fusion
13	-0.82	554.48	4.8	-26.7	small	fusion
14	-0.75	554.58	3.48	-20.3	small	fusion
15	-0.86	554.72	3.06	-16.8	small	fusion
16	-0.86	554.96	3.1	-18.5	small	fusion
17	-0.82	555.2	3.28	-21.7	small	fusion
18	-0.82	555.44	3.6	-21.7	small	fusion
19	-0.86	555.54	3.18	-21	small	fusion
20	-0.84	555.74	3.62	-27.9	small	fusion
21	-0.81	555.94	4.12	-21.7	small	fusion
22	-0.86	556.34	4.26	-11.8	small	fusion
23	-0.74	556.42	3.68	-23.8	small	fusion
24	-0.84	556.42	3.1	-23	small	fusion
25	-0.83	556.74	3.04	-26.9	small	fusion
26	-0.83	556.9	4.6	-19.5	small	fusion
27	-0.81	557.02	3.4	-17.9	small	fusion

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	-0.83	557.1	3	-19.1	small	fusion
29	-0.81	557.3	3.92	-18.6	small	fusion
30	-0.79	557.38	3.26	-22.2	small	fusion
31	-0.72	557.44	1.94	-19.7	small	fusion
32	-0.83	557.68	3.04	-13.3	small	fusion
33	-0.72	557.96	3.48	-25.3	small	fusion
34	-0.83	558.02	4.16	-24.4	small	fusion
35	-0.83	558.04	3.14	-21.9	small	fusion
36	-0.81	558.22	4.48	-19.4	small	fusion
37	-0.81	558.34	3.1	-23.5	small	fusion
38	-0.81	558.62	3.02	-21.2	small	fusion
39	-0.80	558.82	3.12	-21.2	small	fusion
40	-0.76	559.02	1.88	-17.6	small	fusion
41	-0.83	559.1	3.04	-23.7	small	fusion
42	-0.76	559.5	1.92	-19.5	small	fusion
43	-0.76	559.82	1.94	-18.7	small	fusion
44	-0.78	559.86	3.22	-24.9	small	fusion
45	-0.85	560.04	4.5	-18.1	small	fusion
46	-0.82	560.3	3.14	-16.4	small	fusion
47	-0.75	560.24	1.86	-24	small	fusion
48	-0.78	560.06	0.52	-21.1	small	fusion
49	-0.78	560.48	0.82	-20.1	small	fusion
50	-0.80	560.64	1.24	-18.6	small	fusion
51	-0.78	560.6	1.86	-21.6	small	fusion
52	-0.84	560.7	3.06	-18.8	small	fusion
53	-0.77	561.32	3.08	-18.5	small	fusion
54	-0.73	561.48	1.58	-28.5	small	fusion
55	-0.73	561.62	2.02	-28.5	small	fusion
56	-0.84	561.86	4.18	-25.3	small	fusion
57	-0.82	562.16	4.8	-16.1	small	fusion
58	-0.79	562.44	3.24	-22.9	small	fusion
59	-0.79	562.66	3.56	-19.8	small	fusion
60	-0.75	562.78	0.44	-22	small	fusion
61	-0.81	563.1	3.12	-13.7	small	fusion
62	-0.77	563.48	3.08	-17.1	small	fusion
63	-0.81	563.62	3.44	-26	small	fusion
64	-0.83	564.04	3.86	-11.3	small	fusion
65	-0.74	564.2	1.84	-20.4	small	fusion
66	-0.79	564.46	3.06	-17.9	small	fusion
67	-0.76	564.72	1.82	-15.1	small	fusion
68	-0.86	564.76	3.12	-18.3	small	fusion
69	-0.72	564.7	4.6	-20.8	small	fusion

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
70	-0.81	564.98	3.12	-14.4	small	fusion
71	-0.85	565.2	3.04	-20.2	small	fusion
72	-0.81	565.3	3.24	-24.4	small	fusion
73	-0.83	565.68	3.06	-28	small	fusion
74	-0.76	565.74	4.6	-25.7	small	fusion
75	-0.81	565.74	4.88	-27.9	small	fusion
76	-0.81	566.16	3.14	-19.5	small	fusion
77	-0.71	566.16	3.84	-27.3	small	fusion
78	-0.74	566.4	0.42	-24.7	small	fusion
79	-0.83	566.46	3.06	-26.1	small	fusion
80	-0.69	566.4	3.84	-26.2	small	weld
81	-0.80	566.66	4.64	-19.9	small	fusion
82	-0.71	566.84	4.08	-27.3	small	fusion
83	-0.83	567.08	3.9	-23.8	small	fusion
84	-0.80	567.14	2.96	-26	small	fusion
85	-0.73	567.04	1.72	-23.3	small	fusion
86	-0.82	568.34	5.8	-26.1	small	fusion
87	-0.68	568.6	1.96	-23.7	small	ROOT
88	-0.82	568.6	3.82	-24.5	small	fusion
89	-0.64	568.8	2.06	-20.9	small	ROOT
90	-0.64	569.08	2.06	-19.9	small	ROOT
91	-0.75	569.28	3.06	-21.6	small	fusion
92	-0.84	569.4	3.62	-19.4	small	fusion
93	-0.66	569.38	1.98	-22.2	small	ROOT
94	-0.63	569.64	2	-25	small	ROOT
95	-0.77	570	3.04	-15.5	long	fusion
96	-0.79	570	4.62	-14.8	small	fusion
97	-0.72	570.12	3.66	-26.5	small	fusion
98	-0.79	570.28	3.94	-26	small	fusion
99	-0.72	570.44	3.66	-24.7	small	fusion
100	-0.84	570.52	3.04	-23.9	small	fusion
101	-0.75	570.84	3.02	-20.6	small	fusion
102	-0.68	570.96	1.94	-24.4	small	ROOT
103	-0.72	571.04	1.74	-22	small	fusion
104	-0.72	571.16	2.86	-27.5	small	fusion
105	-0.79	571.26	3.74	-23	small	fusion
106	-0.67	571.38	3.12	-27.2	small	weld
107	-0.79	571.7	3.06	-20.8	small	fusion
108	-0.81	572.14	3.8	-15.5	small	fusion
109	-0.83	572.2	4.3	-21.6	small	fusion
110	-0.76	571.96	4.44	-25	small	fusion
111	-0.79	572.78	3.02	-16.4	extended	fusion

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
112	-0.67	572.68	1.9	-23	small	ROOT
113	-0.72	572.44	0.92	-20.9	small	fusion
114	-0.72	572.22	0.32	-26.5	small	fusion
115	-0.76	572.72	0.94	-26.7	small	fusion
116	-0.71	573.14	1.02	-17.3	small	fusion
117	-0.69	573.42	1.72	-13.2	small	weld
118	-0.81	573.44	2.98	-17.5	small	fusion
119	-0.81	573.34	4.32	-18.8	small	fusion
120	-0.78	573.42	5.44	-26	small	fusion
121	-0.74	573.88	1.7	-21.6	small	fusion
122	-0.74	574.1	0.34	-24.9	small	fusion
123	-0.64	573.94	1.98	-22.2	small	ROOT
124	-0.69	574.26	1.74	-21.9	small	weld
125	-0.78	574.42	3.02	-16.1	small	fusion
126	-0.78	574.52	4.82	-17.7	small	fusion
127	-0.78	574.56	2.9	-21.9	small	fusion
128	-0.69	574.62	1.72	-19.8	small	weld
129	-0.80	574.78	3.2	-23.8	small	fusion
130	-0.73	574.78	3.46	-27.6	small	fusion
131	-0.66	575	3.08	-24.4	small	weld
132	-0.66	575.16	1.86	-20.7	small	ROOT
133	-0.78	575.4	3.02	-18	small	fusion
134	-0.82	575.74	3.22	-17.6	small	fusion
135	-0.78	575.62	4.28	-27.9	small	fusion
136	-0.71	575.72	4.04	-27.5	small	fusion
137	-0.78	575.78	3.04	-13.1	small	fusion
138	-0.80	575.94	3.36	-20.5	small	fusion
139	-0.75	576.08	3.02	-17.5	small	fusion
140	-0.68	576.06	1.84	-19	small	ROOT
141	-0.71	575.96	1.68	-22	small	fusion
142	-0.82	576.26	4.2	-25.4	small	fusion
143	-0.82	576.34	3.24	-24.6	small	fusion
144	-0.82	576.34	3	-26.2	small	fusion
145	-0.68	576.34	1.86	-24.6	small	ROOT
146	-0.77	576.46	4.56	-19.5	small	fusion
147	-0.73	576.42	0.86	-19.2	small	fusion
148	-0.64	576.6	1.86	-22.2	small	ROOT
149	-0.75	576.64	3	-19	small	fusion
150	-0.82	576.8	4.34	-23.3	small	fusion
151	-0.84	577.02	3.02	-18.7	small	fusion
152	-0.45	577.06	2.22	-23.1	small	ROOT
153	-0.73	577.14	0.84	-21.6	small	fusion

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
154	-0.70	577.18	3.44	-25.6	small	fusion
155	-0.68	577.36	1.84	-21.3	small	ROOT
156	-0.79	577.32	4.76	-23.2	small	fusion
157	-0.79	577.42	2.94	-16.8	extended	fusion
158	-0.73	577.28	3.62	-28.8	small	fusion
159	-0.68	577.4	3.8	-28.5	small	weld
160	-0.63	577.52	1.88	-22.2	small	ROOT
161	-0.77	577.74	3.3	-25.1	small	fusion
162	-0.68	577.8	0.32	-22.5	small	weld
163	-0.84	577.88	2.96	-21.7	small	fusion
164	-0.72	577.98	3.64	-23.4	small	fusion
165	-0.79	578.12	3.74	-21.5	small	fusion
166	-0.63	578.3	1.88	-15	small	ROOT
167	-0.81	578.4	3.	-23.3	small	fusion
168	-0.77	578.62	3.04	-19.5	small	fusion
169	-0.74	578.84	3.24	-26.7	small	fusion
170	-0.65	578.88	3.06	-26.2	small	weld
171	-0.70	579	3.14	-26.5	small	weld
172	-0.72	579.04	3.62	-26.6	small	fusion
173	-0.77	579.18	5.38	-25.1	small	fusion
174	-0.79	579.26	3.08	-22	small	fusion
175	0.94	551.78	3.72	-28	small	fusion
176	0.00	552.48	1.32	-23.3	small	weld
177	-0.25	552.96	5.44	-25.5	small	weld
178	0.37	553.18	1.88	-19.3	small	ROOT
179	0.79	553.28	1.66	-24.2	small	fusion
180	0.26	553.2	2.34	-27.4	small	ROOT
181	0.77	553.46	3.76	-22.3	small	fusion
182	0.10	553.56	2.6	-26.3	small	ROOT
183	0.70	553.8	3.7	-20.1	small	weld
184	0.01	553.76	2.56	-25.2	small	ROOT
185	0.24	553.9	2.32	-21.4	small	ROOT
186	0.79	553.8	1.7	-24.2	small	fusion
187	0.81	554.04	1.68	-16.6	small	fusion
188	0.79	554.5	3.62	-16.7	small	fusion
189	0.77	554.6	1.74	-20	small	fusion
190	0.79	554.72	3.64	-18.7	small	fusion
191	0.82	554.88	1.7	-19.9	small	fusion
192	0.26	554.96	2.32	-23.9	small	ROOT
193	0.84	555.14	1.62	-11	small	fusion
194	0.79	555.04	5.76	-18.2	small	fusion
195	0.59	555.12	3.94	-25.6	small	weld

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
196	0.84	555.14	1.62	-11	small	fusion
197	0.27	555.28	2.32	-26.1	small	ROOT
198	0.84	555.56	1.66	-15.3	small	fusion
199	0.84	555.34	0.36	-19.2	small	fusion
200	0.84	555.84	0.5	-11.8	surface-elongate	fusion
201	0.31	555.98	2.32	-17.3	small	ROOT
202	0.80	555.84	3.02	-21.4	small	fusion
203	0.82	556.2	1.54	-13.9	small	fusion
204	0.22	556.48	2.22	-18.9	small	ROOT
205	0.75	556.5	3.62	-21.5	small	fusion
206	0.77	556.42	5.78	-19.3	small	fusion
207	0.80	556.62	4.6	-22.2	small	fusion
208	0.78	556.66	3.76	-20	small	fusion
209	0.29	556.78	2.32	-18.3	small	ROOT
210	0.32	556.76	2.06	-21.3	small	weld
211	0.80	556.68	1.52	-18.7	small	fusion
212	0.80	556.96	4.4	-26.7	small	fusion
213	0.78	556.96	3.92	-20	small	fusion
214	0.78	557.08	3.64	-23.2	small	fusion
215	0.82	557.2	3.46	-17.6	small	fusion
216	0.75	556.96	3.14	-32.8	small	fusion
217	0.73	557.04	2.76	-25.4	small	fusion
218	0.25	557	2.36	-21.4	small	ROOT
219	0.29	557	2.04	-27.4	small	ROOT
220	0.25	557.34	2.38	-20.1	small	ROOT
221	0.80	557.22	1.7	-17.1	small	fusion
222	0.82	557.16	0.34	-19.3	small	fusion
223	-0.14	557.66	2.48	-24.4	small	ROOT
224	0.73	557.68	3.34	-28.4	small	fusion
225	0.80	557.96	3.22	-23.2	small	fusion
226	0.69	558.06	3.72	-42.4	small	weld
227	0.78	557.92	5.28	-25.4	small	fusion
228	0.83	558.38	0.98	-22.2	small	fusion
229	0.32	558.42	2.08	-26	small	ROOT
230	0.28	558.4	2.36	-27.4	small	ROOT
231	0.16	558.56	2.54	-29.1	small	ROOT
232	0.39	558.64	2.06	-21.2	small	ROOT
233	0.81	558.76	1.7	-21.4	small	fusion
234	0.07	558.8	2.58	-25.2	small	ROOT
235	0.30	559.02	2.38	-26	small	ROOT
236	0.28	559.26	2.38	-22.1	small	ROOT
237	0.83	559.28	3.48	-18.7	small	fusion

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
238	0.81	559.42	3.08	-21.4	small	fusion
239	0.30	559.64	2.34	-16.1	long	ROOT
240	0.78	559.68	2.82	-22.3	small	fusion
241	0.26	559.86	2.34	-23	small	ROOT
242	0.28	560.18	2.34	-22.1	small	ROOT
243	0.79	560.36	3.02	-25.4	small	fusion
244	0.74	560.24	3.74	-17.7	small	fusion
245	0.79	560.7	3.8	-20	small	fusion
246	0.77	560.94	2.8	-22.3	small	fusion
247	0.72	561	3.74	-22.4	small	fusion
248	0.26	561.24	2.32	-17.9	small	ROOT
249	0.77	561.92	3.98	-22.3	small	fusion
250	0.65	561.98	3.5	-26.9	small	weld
251	0.77	562.12	3.82	-22.3	small	fusion
252	0.33	562.32	2.3	-23.8	small	ROOT
253	0.79	562.66	3.26	-22.3	small	fusion
254	0.31	562.94	2.28	-20.7	small	ROOT
255	0.29	562.84	2.06	-26.1	small	ROOT
256	0.77	563.22	4	-19.4	small	fusion
257	0.31	563.58	2.28	-21.3	small	ROOT
258	0.82	563.92	3.5	-21.4	small	fusion
259	0.78	564.24	3.98	-25.4	small	fusion
260	0.78	564.28	3.04	-18.2	small	fusion
261	0.32	564.38	2.26	-13.7	small	ROOT
262	0.59	564.62	3.98	-27	small	weld
263	0.32	564.84	2.24	-22.1	small	ROOT
264	0.76	565.26	4.7	-21.5	small	fusion
265	0.55	565.42	5.78	-24.6	small	weld
266	0.64	565.46	4	-28.5	small	weld
267	0.73	565.72	5.8	-26.8	small	fusion
268	0.67	565.82	3.5	-28.5	small	weld
269	0.30	565.96	2.24	-26.1	small	ROOT
270	0.28	566.34	2.22	-23	small	ROOT
271	0.28	566.52	2.24	-21.4	small	ROOT
272	0.58	566.72	3.98	-27	small	weld
273	0.62	566.98	4.52	-17.4	small	weld
274	0.74	566.92	3.94	-21.5	small	fusion
275	0.74	566.96	3.6	-23.3	small	fusion
276	0.81	567.18	3.28	-25.4	small	fusion
277	0.32	567.22	2.2	-23.8	small	ROOT
278	0.03	568.24	5.26	-21	small	weld
279	0.81	568.42	1.62	-21.4	small	fusion

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
280	0.28	568.46	2.24	-20.7	small	ROOT
281	0.84	568.68	3.06	-19.3	small	fusion
282	-0.08	569.06	2.34	-12.8	small	ROOT
283	0.79	569.04	3.66	-21.5	small	fusion
284	0.70	569.56	3.94	-23.3	small	fusion
285	0.70	569.46	2.94	-26.9	small	weld
286	0.03	569.5	2.46	-24.2	small	ROOT
287	0.82	569.6	1.5	-22.3	small	fusion
288	0.03	569.84	2.46	-25.3	small	ROOT
289	0.82	569.9	3.26	-21.4	small	fusion
290	0.31	570.02	2.14	-24.9	small	ROOT
291	0.75	570.24	3.94	-16.3	small	fusion
292	0.56	570.22	4.26	-21	small	weld
293	-0.13	570.3	2.3	-21.2	small	ROOT
294	0.80	570.82	1.56	-17.2	small	fusion
295	0.75	571	3.4	-16.8	small	fusion
296	0.80	571.1	3.02	-19.4	small	fusion
297	0.29	571.14	2.1	-21.4	small	ROOT
298	0.84	571.28	1.52	-13.6	small	fusion
299	0.82	571.7	1.52	-16.2	small	fusion
300	0.29	571.9	2.1	-22.2	small	ROOT
301	0.82	571.92	3.46	-22.3	small	fusion
302	0.27	572.16	4.76	-23.9	small	weld
303	0.55	572.26	5.12	-21.1	small	weld
304	0.78	572.56	3.64	-23.3	small	fusion
305	0.27	572.7	2.12	-22.2	small	ROOT
306	0.00	573.2	2.24	-24.3	small	ROOT
307	0.76	573.14	4.58	-16.8	small	fusion
308	-0.09	573.48	2.2	-11.9	small	ROOT
309	-0.07	573.74	2.18	-21.2	small	ROOT
310	0.76	573.54	4.6	-12	small	fusion
311	0.74	573.74	4.64	-13.8	small	fusion
312	0.14	573.84	2.32	-20.3	small	ROOT
313	0.83	574.08	1.4	-20.7	small	fusion
314	-0.05	574.08	2.2	-24.3	small	ROOT
315	0.76	574.18	2.68	-19.4	small	fusion
316	0.78	574.18	3.6	-21.5	small	fusion
317	0.05	574.54	2.32	-23.3	small	ROOT
318	0.74	574.8	4.62	-6.8	long	fusion
319	0.74	574.84	5.2	-14.1	small	fusion
320	0.81	575.14	2.98	-16.3	small	fusion
321	0.76	575.02	2.7	-20.1	small	fusion

Table S.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
322	0.03	574.9	2.3	-25.3	small	ROOT
323	0.28	575.18	2.06	-22.2	small	ROOT
324	0.81	574.96	1.44	-21.5	small	fusion
325	0.76	575.42	5.8	-14.4	small	fusion
326	0.72	575.48	3.92	-23.3	small	fusion
327	0.77	576.06	4.58	-12.8	small	fusion
328	0.70	576.48	3.84	-18.4	small	weld
329	0.84	576.48	1.42	-9.6	small	fusion
330	0.79	577.06	3.36	-8.4	small	fusion
331	0.77	577.18	2.94	-16.3	small	fusion
332	0.33	577.16	2.06	-15.4	small	ROOT
333	0.81	577	0.54	-21.5	small	fusion
334	0.79	577.3	4.54	-8.2	long	fusion
335	0.77	577.28	3.92	-20.1	small	fusion
336	0.75	577.48	3.54	-20.8	small	fusion
337	0.84	577.66	1.42	-15.4	small	fusion
338	0.84	577.94	1.44	-18.2	small	fusion
339	0.77	578.42	3.78	-16.8	small	fusion
340	0.11	578.44	2.3	-23.3	small	ROOT
341	0.82	579.02	1.3	-9	small	fusion
342	0.73	579.04	3.94	-14.5	small	fusion
343	0.75	579.32	4.6	-3.3	small	fusion
Note 1: Depth is measured from wetted clad surface.						
Note 2: Weld center is positive for Azimuth less than 270 degrees.						

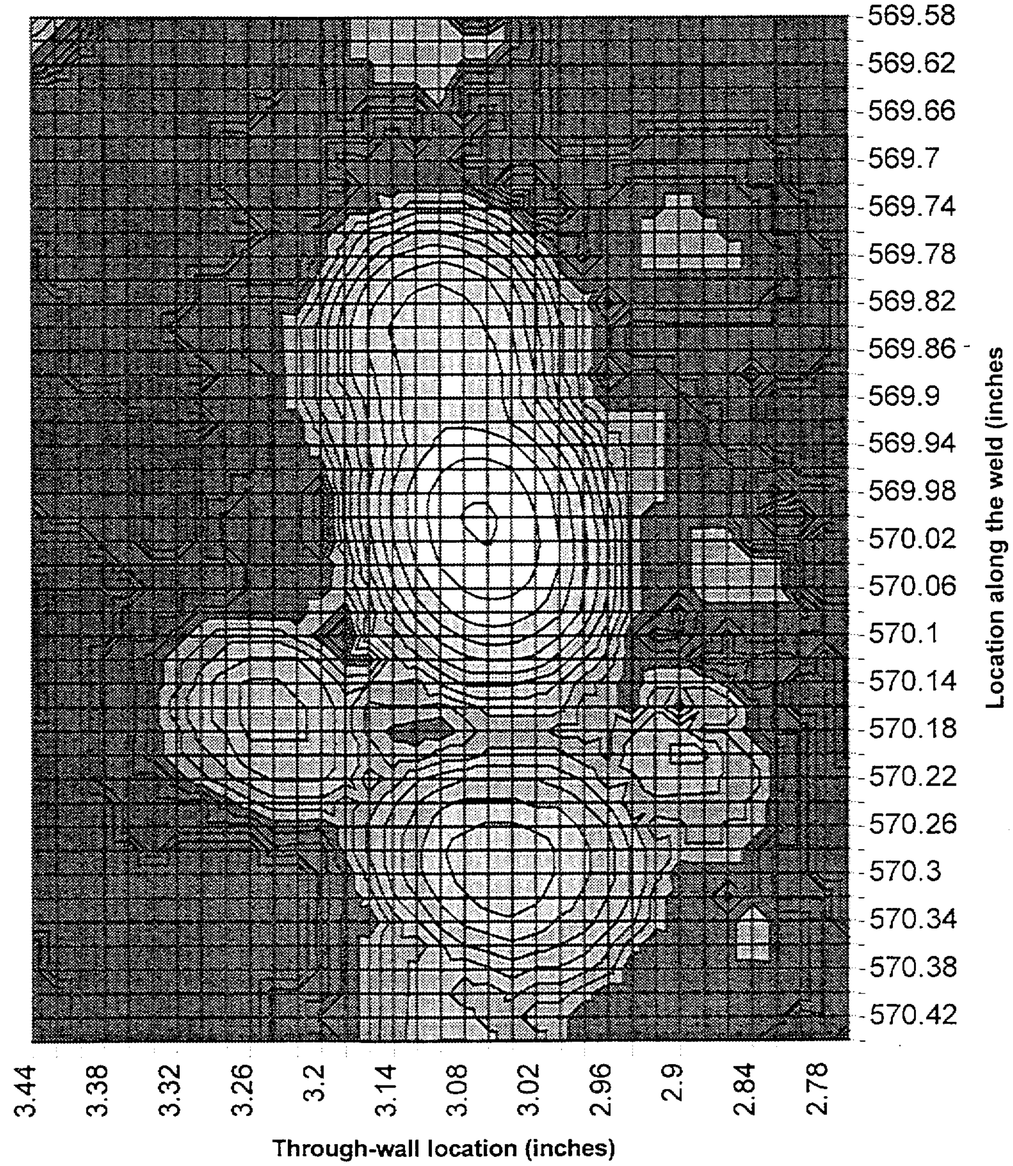

Figure S.1 Log-scale contour plot of indication #95 in Shoreham specimen C270B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -15.5 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion is located on the fusion surface at 0.77 inches above (plus angle) 270 degrees of vessel azimuth.

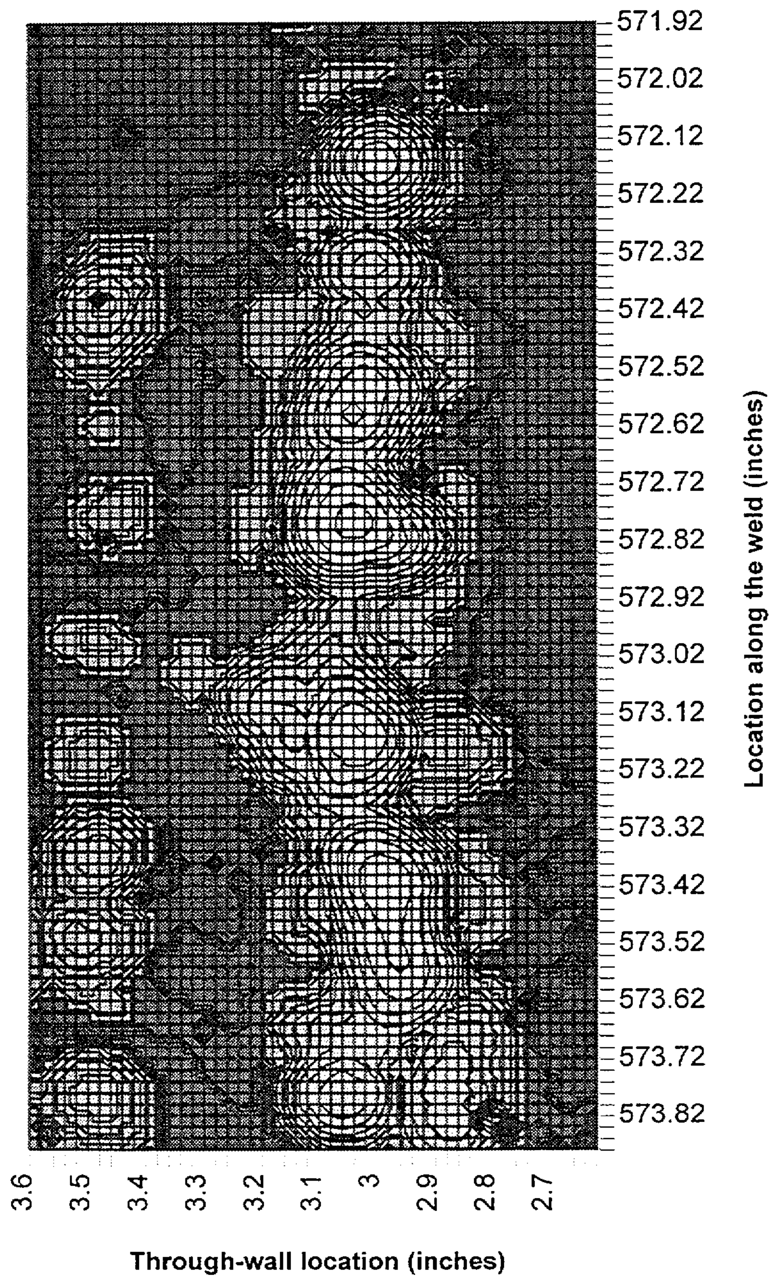

Figure S.2 **Log-scale contour plot of indication #111 in Shoreham specimen C270B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -16.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is mid-wall. The length is 48 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion is located on the fusion surface at 0.79 inches above (plus angle) 120 degrees of vessel azimuth.**

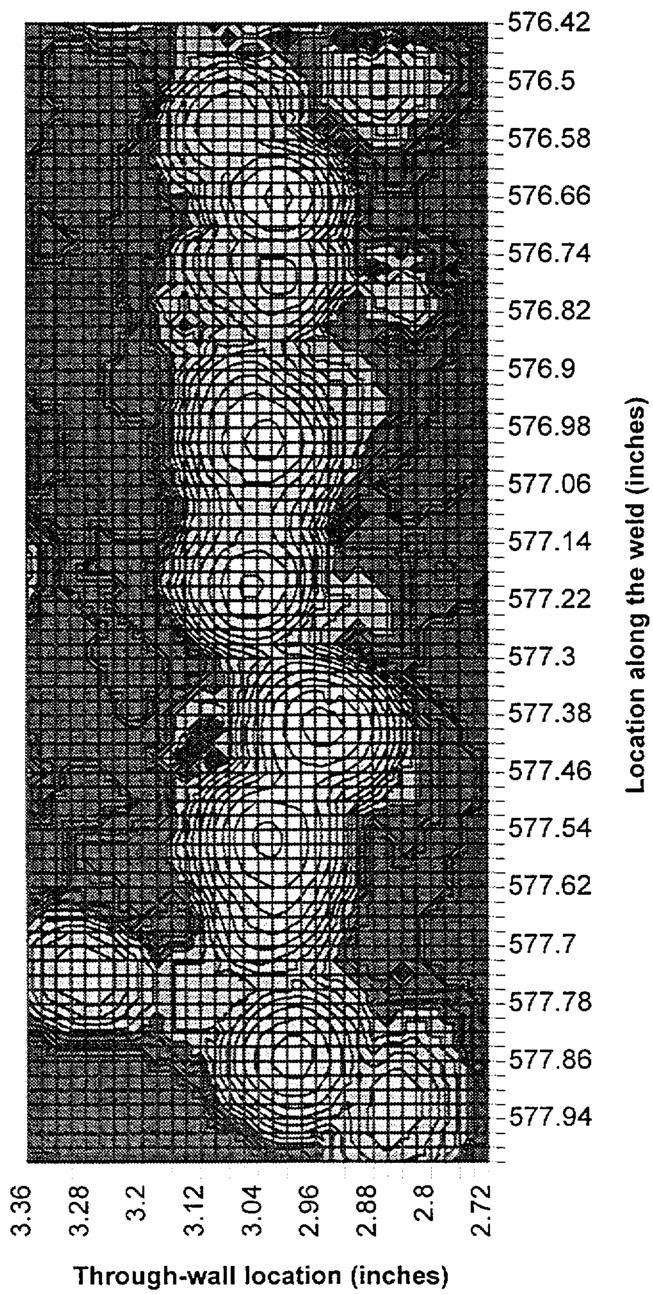

Figure S.3 **Log-scale contour plot of indication #157 in Shoreham specimen C270B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -16.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 6 mm. The through-wall location is mid-wall. The length is 38 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as extended lack of fusion is located on the fusion surface at 0.79 inches above (plus angle) 270 degrees of vessel azimuth.**

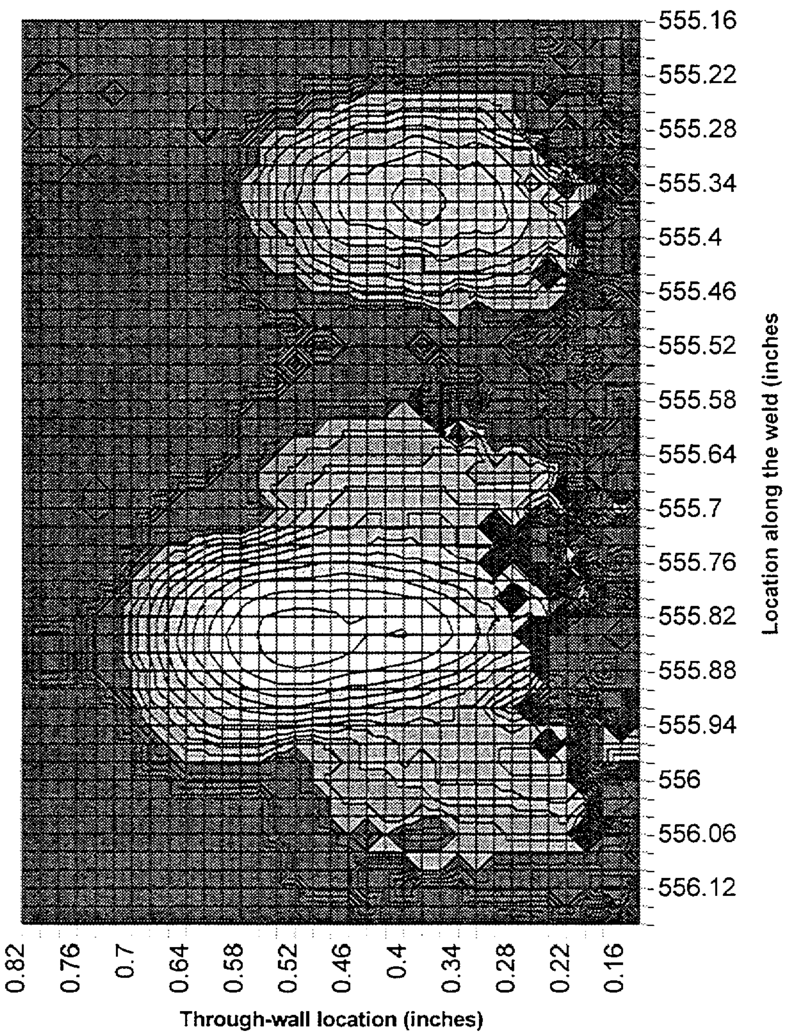

Figure S.4 Log-scale contour plot of indication #200 in Shoreham specimen C270B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -11.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 7 mm. The through-wall location is inner 25 mm. The length is 8 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as surface elongated, is located on the fusion surface at 0.84 inches below (minus angle) 270 degrees of vessel azimuth.

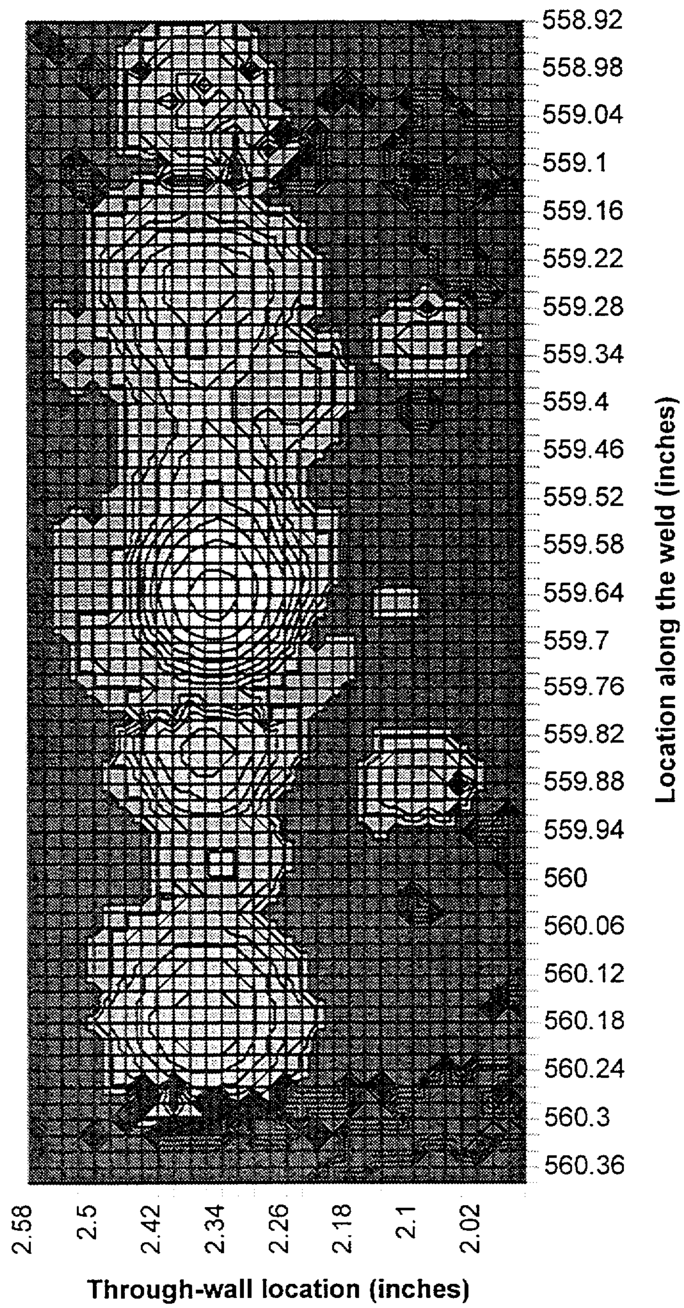

Figure S.5 **Log-scale contour plot of indication #239 in Shoreham specimen C270B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -16.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 30 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion, is located on in the weld root at 0.30 inches below (minus angle) 270 degrees of vessel azimuth.**

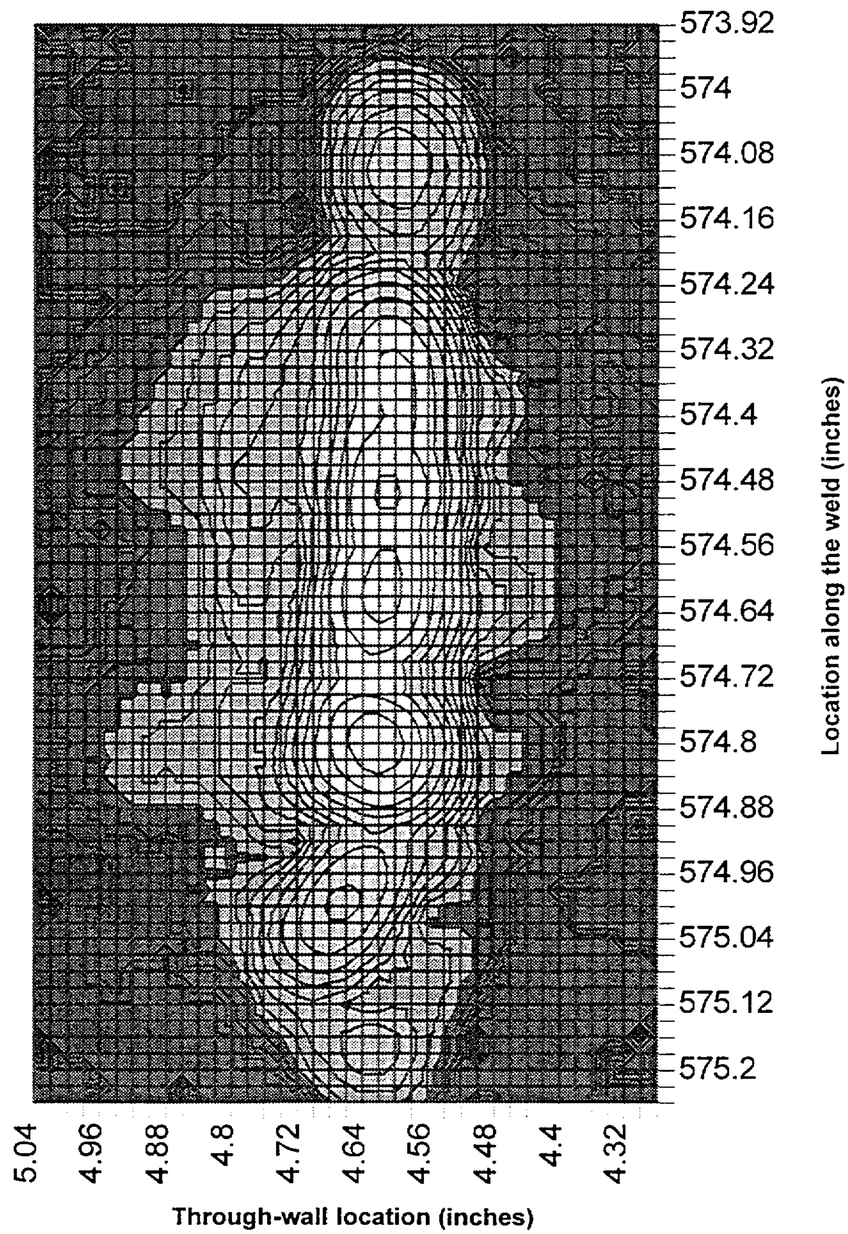

Figure S.6 Log-scale contour plot of indication #318 in Shoreham specimen C270B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 30 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion is located on the fusion surface at 0.79 inches below (minus angle) 270 degrees of vessel azimuth.

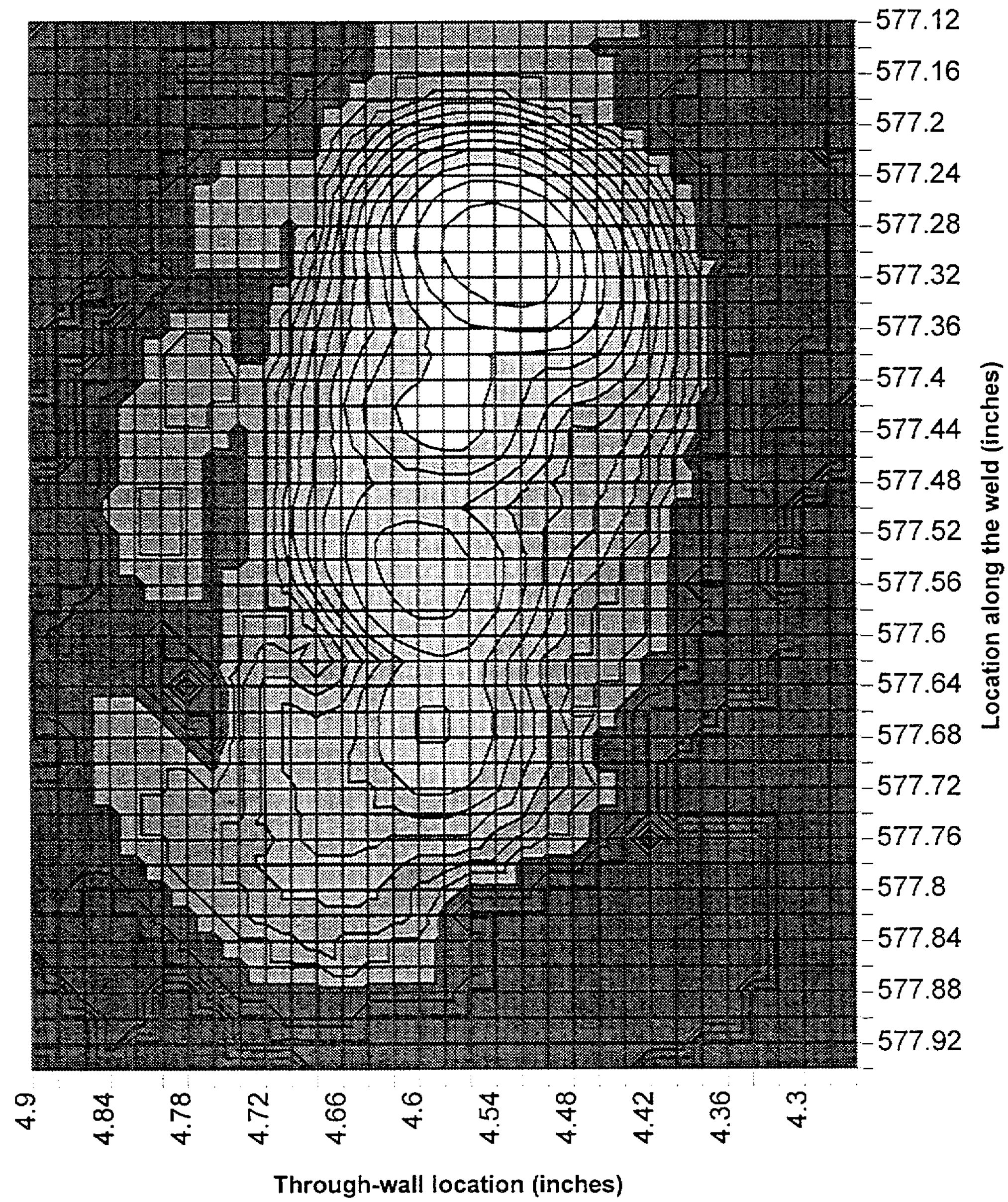

Figure S.7 Log-scale contour plot of indication #334 in Shoreham specimen C270B. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -8.2 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in vessel coordinates, inches of elevation. This indication, characterized as long lack of fusion is located on the fusion surface at 0.79 inches below (minus angle) 270 degrees of vessel azimuth.

Appendix T

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C270D

Table T.1 lists all detectable flaw indications in Shoreham specimen C270D. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C270D is given in Section 2. Figures T.1 through T.13 show the images of the larger indications in the specimen.

Table T.1 List of all indications in Shoreham specimen C270D

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-1.93	4.62	0.18	-19.7	small	clad
2	-1.93	4.98	0.18	-27.1	small	clad
3	-1.67	5.24	0.18	-25.4	small	clad
4	-1.76	6.14	0.16	-27.6	small	clad
5	-1.77	10.72	0.22	-25.8	small	clad
6	-1.84	11.4	0.22	-25.5	small	clad
7	-1.81	11.84	0.24	-25.5	small	clad
8	-1.77	12.16	0.18	-24.9	small	clad
9	-1.79	13.34	0.24	-23.6	small	clad
10	-1.87	17.12	0.22	-26.1	small	clad
11	-1.80	22.96	0.18	-26	small	clad
12	-1.84	24.26	0.18	-27.5	small	clad
13	-1.91	25.56	0.2	-27.2	small	clad
14	-1.58	26.52	0.24	-26.8	small	clad
15	-0.62	5.04	3.98	-24.5	small	fusion
16	-0.65	7.64	4.5	-24.1	small	fusion
17	-0.63	8.02	4.94	-29.5	small	fusion
18	-0.67	9.16	1.48	-25.5	small	fusion
19	-0.62	10.66	4.92	-16.6	small	fusion
20	-0.64	11.26	4.62	-17.5	small	fusion
21	-0.34	11.3	5.36	-21	small	weld
22	-0.62	11.62	4.94	-16.6	long	fusion
23	-0.48	12.68	1.3	-25.2	small	weld
24	-0.65	15.74	5	-27.7	small	fusion
25	-0.65	16.2	4.98	-13.9	small	fusion
26	-0.60	18.5	5.26	-21.5	small	fusion
27	-0.66	21.16	0.88	-18.3	small	fusion
28	-0.52	21.82	0.66	-21.2	small	fusion

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
29	-0.52	22.02	0.64	-25.6	small	fusion
30	-0.69	24.68	2.84	-31.2	small	fusion
31	-0.72	24.96	4.08	-25.2	small	fusion
32	-0.69	24.62	5.44	-25.8	small	fusion
33	-0.71	25.68	0.94	-25.2	small	fusion
34	-0.80	27.16	2.16	-23	small	fusion
35	-0.68	27.44	0.84	-26.5	small	fusion
36	0.62	1.92	3.8	-19.1	small	fusion
37	0.62	3.3	1.58	-25.1	small	fusion
38	0.67	3.8	4.58	-20.9	small	fusion
39	0.67	5.98	2.48	-29.2	small	fusion
40	0.72	5.76	1.36	-29.1	small	fusion
41	0.08	7.06	1.12	-28.3	small	weld
42	-0.10	8	1.2	-29	small	weld
43	0.18	8.78	1.1	-26.9	small	weld
44	0.25	9.6	1.24	-24.6	small	weld
45	0.64	10.86	1.18	-18.1	small	fusion
46	0.65	12.38	2.44	-17.2	small	fusion
47	0.31	13.58	1.42	-25.6	small	weld
48	0.29	15.5	1.46	-25.6	small	weld
49	0.20	15.44	3.24	-28.2	small	weld
50	0.08	15.96	2.28	-25.8	small	weld
51	0.62	16.76	2	-27.7	small	fusion
52	0.52	16.78	1.4	-29.4	small	fusion
53	-0.12	17.06	4.6	-26.8	small	weld
54	0.55	17.04	5.68	-26.4	small	fusion
55	0.57	17.54	4.04	-27.7	small	fusion
56	0.55	17.62	5.44	-24.3	small	fusion
57	0.55	18.72	4.32	-22.5	small	fusion
58	0.53	19.36	5.68	-21.1	small	fusion
59	0.35	20.14	5.18	-28	small	weld
60	0.42	20.82	3.72	-27.9	small	weld
61	0.61	20.94	0.7	-29.3	small	fusion
62	-0.15	21.4	4.7	-29.6	small	weld
63	0.40	21.46	4.12	-29.6	small	weld
64	-0.19	23.3	4.7	-31.4	small	weld
65	0.31	23.5	5.18	-28.1	small	weld
66	0.52	23.66	3.86	-26.5	small	fusion
67	0.52	23.98	5.48	-27.8	small	fusion
68	0.43	24.34	5.3	-22.7	small	weld
69	0.53	24.72	4.1	-15.1	small	fusion
70	0.46	26.06	5.7	-21.9	small	weld

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
71	0.53	26.48	5.4	-25.3	small	fusion
72	0.46	26.64	5.6	-25.4	small	weld
73	0.53	26.7	5.36	-13.9	small	fusion
74	0.46	26.9	5.72	-26.6	small	weld
75	0.30	27.34	5.2	-26.8	small	weld
76	0.42	27.9	5.32	-25.5	small	weld
77	0.61	28.18	2.22	-19.2	small	fusion
78	0.49	28.24	2.8	-23.5	small	fusion
79	0.47	28.8	3.34	-23.5	small	weld
80	0.59	29.44	2.1	-24.3	small	fusion
81	-1.67	35.02	0.24	-25.7	small	clad
82	-1.69	35.66	0.24	-25.8	small	clad
83	-1.63	47.84	0.24	-25.7	small	clad
84	-1.70	49.6	0.34	-25.5	small	GOUGE
85	-0.78	27.34	2.16	-22	small	fusion
86	-0.68	27.6	0.88	-25.1	small	fusion
87	-0.72	30.7	3.58	-27.4	small	fusion
88	-0.76	32.74	2.18	-24.9	small	fusion
89	-0.78	35.3	4.08	-19.3	small	fusion
90	-0.43	43.64	5.48	-25.5	small	weld
91	-0.74	46.2	4.82	-29.5	small	fusion
92	-0.51	46.78	2.74	-27.5	small	fusion
93	-0.78	48.92	5.62	-26.5	small	fusion
94	-0.43	49.54	5.54	-13.9	small	weld
95	-0.80	50.1	4.58	-24.8	small	fusion
96	-0.75	50.42	1.04	-25.1	small	fusion
97	-0.41	50.48	5.58	-25.5	small	weld
98	-0.45	50.9	5.54	-23.2	small	weld
99	-0.77	50.98	2.28	-20.5	small	fusion
100	-0.47	53.48	5.56	-20.6	small	weld
101	-0.60	55.44	4.4	-29	small	fusion
102	-0.60	56.02	4.4	-25.8	small	fusion
103	-0.78	56.14	1.5	-24.2	small	fusion
104	0.57	30.1	0.96	-24.3	small	fusion
105	0.45	30.3	5.74	-22.7	small	weld
106	0.57	30.58	1.04	-24.3	small	fusion
107	0.41	30.9	5.72	-20.6	small	weld
108	0.57	32	0.98	-25.3	small	fusion
109	0.43	32.28	5.3	-18.4	small	weld
110	0.53	32.86	3.86	-15.5	small	fusion
111	0.60	32.72	0.72	-22.5	small	fusion
112	0.44	33.26	5.72	-14.3	extended	weld

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
113	0.44	33.68	5.72	-15.2	small	weld
114	0.58	33.84	0.86	-18.8	long	fusion
115	0.53	34.9	1.02	-29.4	small	fusion
116	0.56	35.3	1.42	-24.3	small	fusion
117	0.51	35.38	5.32	-15.5	small	fusion
118	0.49	35.66	5.7	-13.9	small	fusion
119	0.54	36.76	0.94	-24.3	small	fusion
120	0.45	36.84	5.74	-18.9	small	weld
121	0.36	37.16	5.32	-24.6	small	weld
122	0.54	37.46	0.98	-18.3	small	fusion
123	0.54	37.54	1.64	-22.6	small	fusion
124	0.50	37.44	3.86	-23.5	small	fusion
125	0.47	37.86	3.92	-21.9	small	weld
126	0.50	38.24	5.26	-19.4	small	fusion
127	0.36	38.56	5.62	-26.8	small	weld
128	0.50	39.06	4.6	-20	small	fusion
129	0.11	39.6	2.44	-30	small	weld
130	0.25	39.98	3.02	-24.7	small	weld
131	0.53	40.24	2.8	-29.5	small	fusion
132	0.53	40.24	0.98	-29.5	small	fusion
133	0.48	40.68	3.78	-25.5	small	fusion
134	0.46	40.9	4.38	-29.6	small	weld
135	0.28	41.26	5.22	-28.2	small	weld
136	0.53	41.38	1.52	-23.5	small	fusion
137	0.49	42.08	3.92	-23.5	small	fusion
138	-0.39	42.02	5.48	-32.9	small	weld
139	0.35	42.74	5.2	-25.6	small	weld
140	0.40	43.16	5.04	-26.7	small	weld
141	0.51	43.18	0.94	-25.4	small	fusion
142	0.47	43.42	0.82	-22.7	small	weld
143	0.42	43.78	4.28	-26.7	small	weld
144	0.38	43.9	3.74	-25.6	small	weld
145	-0.06	44.26	2.34	-22.1	small	weld
146	0.52	44.68	1	-20.6	small	fusion
147	0.40	44.88	4.28	-29.6	small	weld
148	0.48	45.9	5.68	-13.7	small	weld
149	0.43	46.24	4	-28	small	weld
150	0.46	47.82	3.86	-29.6	small	weld
151	-0.18	48.08	3.18	-27.8	small	weld
152	0.53	48.46	3.86	-19.4	small	fusion
153	0.46	48.5	4.1	-26.7	small	weld
154	0.51	48.78	3.86	-27.9	small	fusion

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
155	0.44	49.32	5.48	-28	small	weld
156	0.49	50.98	3.9	-25.5	small	fusion
157	0.22	52.26	5.32	-29.9	small	weld
158	0.41	52.72	5.8	-20.1	small	weld
159	0.41	53	5.82	-17.6	small	weld
160	0.55	53.64	1.7	-22.7	small	fusion
161	0.55	53.36	1.04	-19.4	small	fusion
162	0.53	56.18	2.7	-22.7	small	fusion
163	-0.72	61.36	0.96	-13.5	small	fusion
164	-0.74	60.72	5.48	-28.8	small	fusion
165	-0.78	61.94	4.88	-29.9	small	fusion
166	-0.78	62.9	5.4	-18.6	small	fusion
167	-1.28	64.42	0.34	-29.2	small	GOUGE
168	-0.61	65.66	4.34	-21.8	small	fusion
169	-1.32	66.32	0.46	-31.9	small	GOUGE
170	-1.18	66.64	0.44	-31.4	small	GOUGE
171	-0.58	68.24	4.3	-29.1	small	fusion
172	-0.58	68.8	4.3	-24.6	small	fusion
173	-0.60	70.2	4.3	-20	long	fusion
174	-0.75	72.2	5.34	-20	small	fusion
175	-1.26	72.72	0.34	-30.8	small	GOUGE
176	-0.72	75.26	5.22	-22.8	small	fusion
177	-0.60	76.14	4.28	-20.1	long	fusion
178	-0.58	76.4	4.28	-24.7	small	fusion
179	-0.58	77.14	4.24	-26	small	fusion
180	-0.59	78.5	4.28	-19.7	long	fusion
181	-0.73	79.16	5.38	-22.9	small	fusion
182	-0.59	80.98	4.28	-19.1	small	fusion
183	-0.72	81.28	0.42	-28.9	small	fusion
184	-0.72	81.76	4.82	-20	small	fusion
185	0.49	57.38	4.16	-26.7	small	fusion
186	0.56	57.96	1.48	-26.6	small	fusion
187	0.59	58.42	0.94	-24.4	small	fusion
188	-0.45	58.54	5.6	-23.3	small	weld
189	-0.47	58.9	5.6	-10.7	small	weld
190	0.54	59.46	1.12	-20.6	small	fusion
191	-0.45	59.62	5.58	-23.3	small	weld
192	0.50	59.9	3.96	-24.5	small	fusion
193	-0.45	59.86	5.56	-31.8	small	weld
194	0.52	60.84	1	-24.5	small	fusion
195	0.62	61.1	0.94	-22.6	small	fusion
196	0.62	61.28	0.88	-19.9	small	fusion

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
197	0.50	61.36	3.4	-25.5	small	fusion
198	-0.44	61.22	5.56	-26.6	small	weld
199	0.48	62.18	3.98	-23.6	small	fusion
200	-0.46	62.12	5.56	-25.2	small	weld
201	0.53	62.56	0.92	-26.6	small	fusion
202	-0.46	62.94	5.52	-26.7	small	weld
203	-0.30	62.86	2.98	-32.7	small	weld
204	0.55	63.08	2.14	-26.6	small	fusion
205	0.53	63.18	0.96	-28	small	fusion
206	-0.48	63.58	5.56	-19.7	surface-elongated	weld
207	0.56	63.9	0.94	-21.9	small	fusion
208	0.58	64.54	0.76	-25.4	small	fusion
209	0.56	65.34	0.96	-22.7	small	fusion
210	0.54	66.02	1.04	-18.9	small	fusion
211	-0.47	66.06	5.5	-27.6	small	weld
212	-0.44	67.56	5.48	-14.5	small	weld
213	-0.47	67.68	1.96	-25.4	small	weld
214	0.61	67.82	0.74	-22.6	small	fusion
215	0.59	68.2	0.72	-21.9	small	fusion
216	-0.46	69.02	5.48	-17.8	small	weld
217	-0.55	68.92	4.32	-29	small	fusion
218	-0.46	70.08	5.44	-17.8	small	weld
219	0.51	70.22	4.46	-22	small	fusion
220	0.55	70.8	1.96	-22.7	small	fusion
221	0.56	70.96	1.22	-20	small	fusion
222	0.56	71.4	0.84	-20	small	fusion
223	-0.43	72.46	5.44	-21.1	small	weld
224	0.54	72.74	3.82	-19.5	small	fusion
225	0.56	72.62	1.26	-24.5	small	fusion
226	0.59	73.16	1	-19.4	small	fusion
227	-0.45	73.9	5.46	-19.7	small	weld
228	-0.42	74.5	5.44	-26.7	small	weld
229	0.57	75.22	0.84	-20.6	small	fusion
230	-0.44	75.36	5.44	-15.2	small	weld
231	-0.44	76.12	5.44	-19.3	small	weld
232	0.53	76.1	3.24	-20.7	small	fusion
233	0.59	75.86	1.36	-27.9	small	fusion
234	0.53	76.24	0.82	-25.5	small	fusion
235	0.66	76.46	0.44	-22.6	small	fusion
236	-0.21	76.74	4.54	-30.9	small	weld
237	0.53	77.1	5.14	-24.5	small	fusion
238	-0.44	77.18	5.44	-29.6	small	weld

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
239	-0.44	77.7	5.4	-30.7	small	weld
240	-0.43	78.52	5.44	-23.5	small	weld
241	-0.07	78.4	4.62	-28.8	small	weld
242	0.58	78.44	0.94	-22.7	small	fusion
243	-0.43	79.5	5.44	-16	small	weld
244	0.58	80.2	0.92	-23.5	small	fusion
245	0.54	81.32	0.8	-20.1	small	fusion
246	0.54	81.52	4.94	-22	small	fusion
247	-0.44	82.06	5.46	-21.3	small	weld
248	0.48	83.6	4.26	-29.7	small	fusion
249	-0.44	82.36	5.48	-20.9	small	weld
250	-0.44	84.3	5.1	-28.7	small	weld
251	-0.57	84.62	4.3	-26.8	small	fusion
252	-0.57	85.1	4.3	-29.3	small	fusion
253	-0.55	85.32	4.28	-17.9	small	fusion
254	-0.39	85.64	5.48	-28.4	small	weld
255	-0.36	86.32	5.5	-28.3	small	weld
256	-0.54	87.1	4.28	-21.8	small	fusion
257	-0.54	88.8	4.34	-22.2	small	fusion
258	-0.37	91.54	5.52	-21.5	small	weld
259	-0.66	94.2	4.9	-29.8	small	fusion
260	-0.56	97.84	4.4	-24.9	small	fusion
261	-0.65	98.38	4.76	-29.8	small	fusion
262	-0.64	99.14	4.76	-28.8	small	fusion
263	-0.64	99.5	4.76	-30.8	small	fusion
264	-0.53	100.18	4.44	-28.4	small	fusion
265	-0.59	100.4	0.52	-28.7	small	fusion
266	-0.59	100.6	4.92	-30.6	small	fusion
267	-0.62	100.84	4.64	-23.2	small	fusion
268	-0.48	101.14	0.48	-22.1	long	weld
269	-0.50	101.14	4.42	-28.3	small	fusion
270	-0.68	101.74	4.58	-26.1	small	fusion
271	-0.59	101.8	4.84	-19.1	small	fusion
272	-0.66	102.92	4.68	-22.9	small	fusion
273	-0.33	104.28	4.12	-25.9	small	weld
274	-0.51	104.26	1.84	-27.5	small	fusion
275	-0.74	104.56	4.36	-20.4	small	fusion
276	-0.58	105	5.1	-25.7	small	fusion
277	-0.60	105.24	5.48	-29.7	small	fusion
278	-0.62	106.3	4.62	-28.8	small	fusion
279	-0.62	106.94	4.64	-30.8	small	fusion
280	-0.62	107.78	4.6	-28	small	fusion

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
281	-0.64	108	4.64	-26	small	fusion
282	-0.29	109.04	4.12	-29.3	small	weld
283	-0.54	111.42	4.52	-30.5	small	fusion
284	-0.21	111.86	5.54	-22.5	small	weld
285	-0.56	112.3	4.6	-30.6	small	fusion
286	-0.69	113.14	0.58	-27.6	small	fusion
287	-0.55	113.4	5.16	-28.7	small	fusion
288	-0.30	114.48	2.3	-29.5	small	weld
289	-0.20	114.76	5.6	-28	small	weld
290	0.69	83.84	0.5	-24.3	small	fusion
291	0.69	84.14	0.46	-25.4	small	fusion
292	0.48	83.94	4.3	-29.7	small	fusion
293	-0.23	84.52	2.46	-31.1	small	weld
294	0.56	85.84	4.38	-25.5	small	fusion
295	0.72	85.98	0.42	-23.4	surface-elongated	fusion
296	0.56	87	3.9	-18.5	small	fusion
297	0.54	87.04	1.54	-22	small	fusion
298	0.61	87.44	2.04	-29.6	small	fusion
299	0.61	89.16	1.92	-11.3	long	fusion
300	0.71	89.54	0.42	-20.5	small	fusion
301	0.59	89.94	1.98	-21.3	small	fusion
302	0.52	89.78	4.3	-24.6	small	fusion
303	0.52	90.52	4.74	-28.1	small	fusion
304	0.62	91.54	2.8	-29.6	small	fusion
305	0.65	92.4	0.72	-26.6	small	fusion
306	0.58	93.74	4.42	-25.5	small	fusion
307	0.63	94.36	2.6	-24.5	small	fusion
308	0.70	94.58	0.36	-29.5	small	fusion
309	0.65	95.16	0.88	-18.4	small	fusion
310	0.49	95.66	5.36	-21.4	small	fusion
311	0.59	95.74	3.92	-28	small	fusion
312	0.22	96.08	1.68	-28.6	small	weld
313	0.66	95.86	1	-21.9	small	fusion
314	0.57	97.08	3.96	-12.7	small	fusion
315	0.71	97.2	1.54	-27.9	small	fusion
316	0.59	97.58	4.4	-28	small	fusion
317	0.57	97.96	4.78	-22.8	small	fusion
318	-0.12	98.04	3.78	-32.4	small	weld
319	0.73	97.98	0.44	-29.4	small	fusion
320	0.55	98.24	4.82	-29.7	small	fusion
321	0.53	98.88	5.46	-28.1	small	fusion
322	0.60	100.3	5.56	-28	small	fusion

Table T.1 (contd)						
	Peak Coordinates (Specimen)					
#	**Weld Center (inches)**	**Along Weld (inches)**	**Depth (inches)**	**Response (dB)**	**Characterization**	**Type (material)**
323	-0.16	100	3.38	-31	small	weld
324	0.67	100.08	2.78	-29.5	small	fusion
325	0.69	100.58	1.32	-26.6	small	fusion
326	0.69	100.68	3.3	-26.6	small	fusion
327	0.63	101.06	5	-15.6	small	fusion
328	0.63	101.32	1.56	-22	small	fusion
329	0.68	101.92	0.68	-24.4	small	fusion
330	0.03	102.14	0.48	-20.4	small	weld
331	0.79	102.74	0.46	-22.5	small	fusion
332	0.63	102.62	4.96	-20	small	fusion
333	0.66	103.02	4.58	-16.7	small	fusion
334	0.68	103.06	3.88	-26.6	small	fusion
335	0.61	104.08	5.66	-28	small	fusion
336	0.68	104.7	0.84	-13.4	long	fusion
337	0.64	105.3	5.52	-19.5	small	fusion
338	0.69	106.18	2.64	-26.6	small	fusion
339	0.67	106.74	5.24	-18.4	small	fusion
340	0.74	107.38	0.86	-6	long	fusion
341	0.65	108.48	4.26	-19.5	small	fusion
342	0.77	108.9	2.06	-21.8	small	fusion
343	0.72	109.88	0.82	-7.4	long	fusion
344	0.75	110.48	0.86	-21.2	small	fusion
345	0.78	112.9	0.86	-14.8	small	fusion
346	0.69	113.02	4.08	-21.3	small	fusion
347	0.76	113.22	0.88	-17	small	fusion
348	0.78	114.48	0.84	-6	small	fusion
349	0.76	114.94	0.82	-8.8	small	fusion
350	0.79	115.72	0.82	-6.4	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

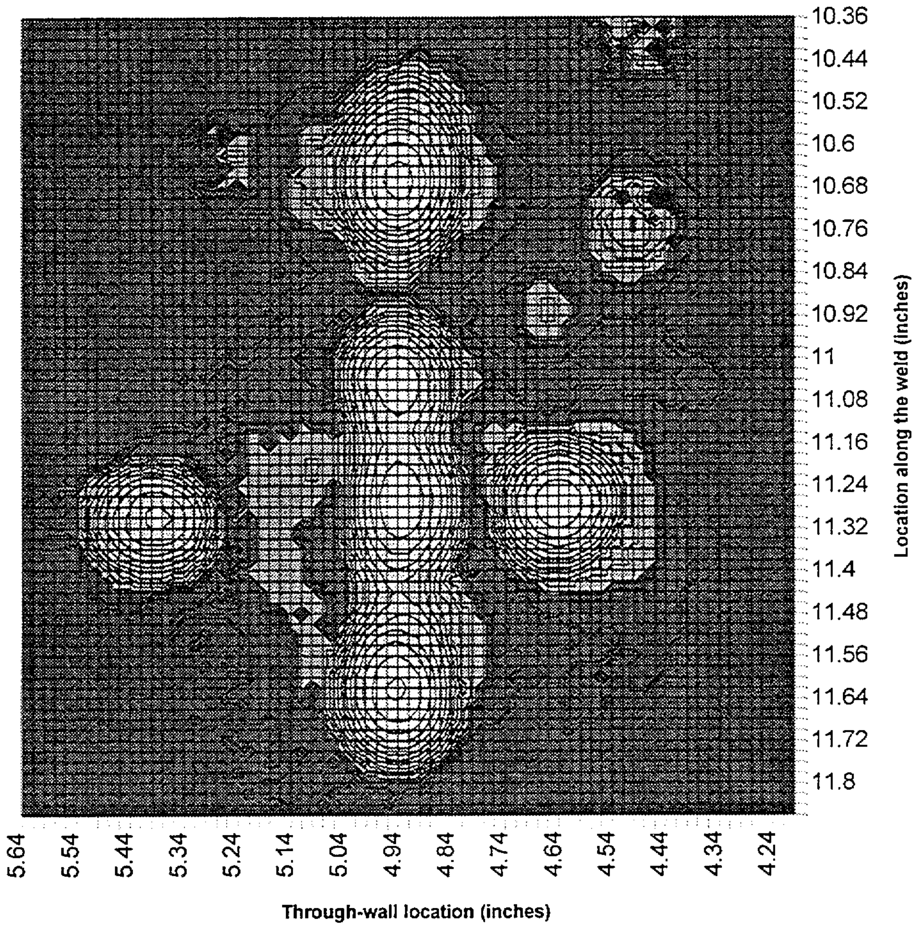

Figure T.1 Log-scale contour plot of indication #22 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -16.6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 36 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.62 inches below 553 inches of vessel elevation.

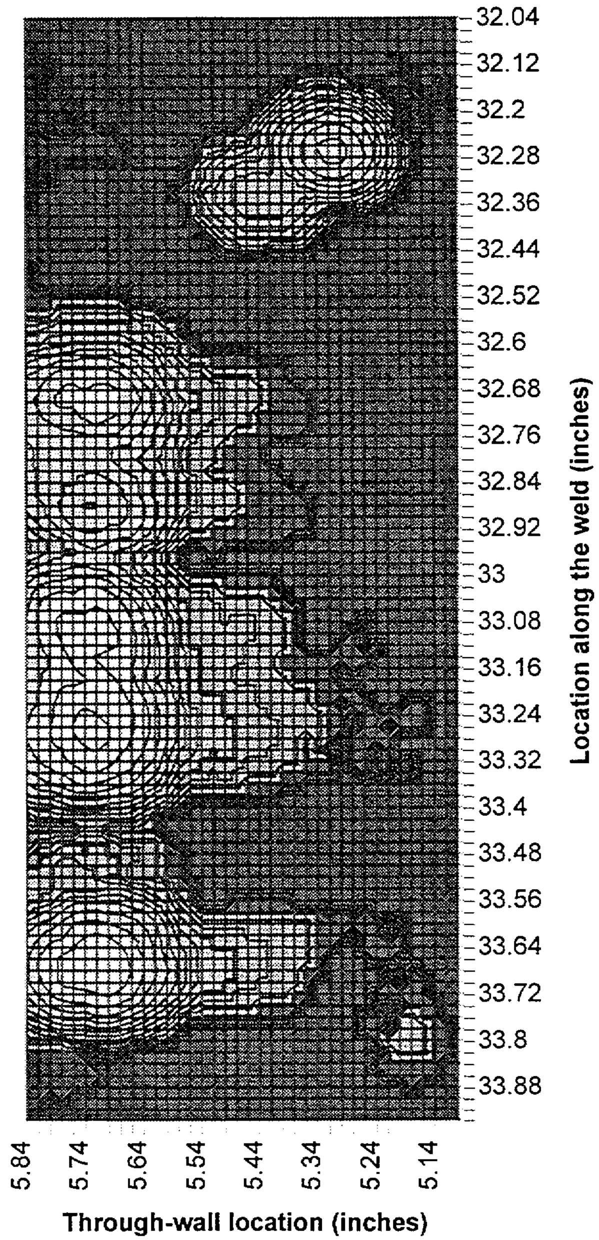

Figure T.2 Log-scale contour plot of indication #112 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -14.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 33 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as extended lack of fusion, is located in the weld at 0.44 inches above 553 inches of vessel elevation.

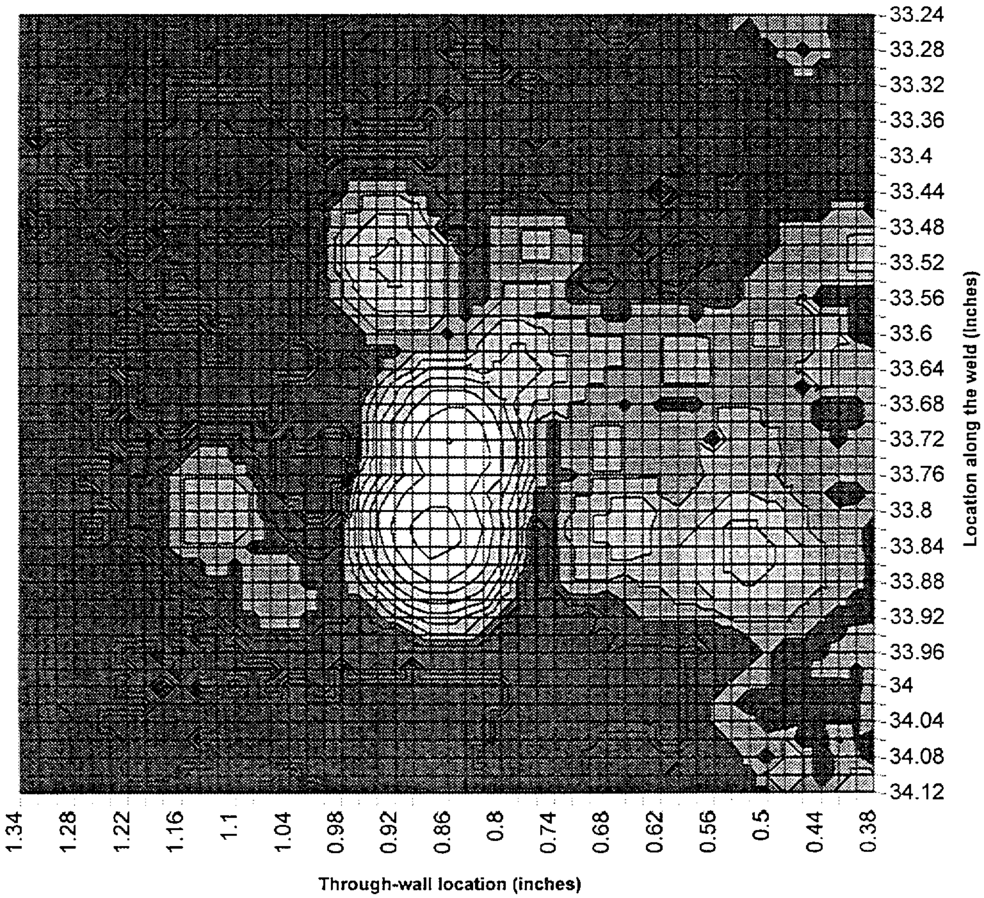

Figure T.3 Log-scale contour plot of indication #114 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -18.8 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is inner 25 mm. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.58 inches above 553 inches of vessel elevation.

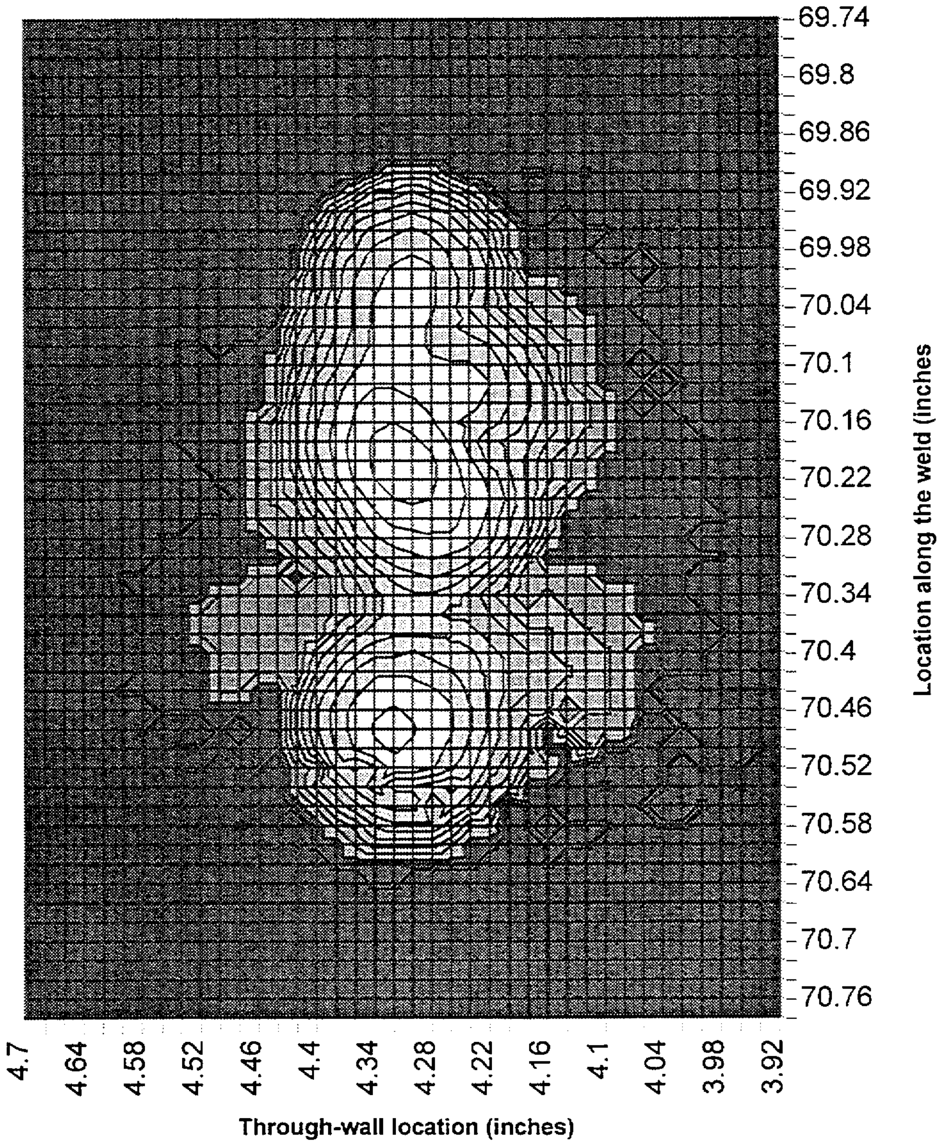

Figure T.4 Log-scale contour plot of indication #173 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.0 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.60 inches below 553 inches of vessel elevation.

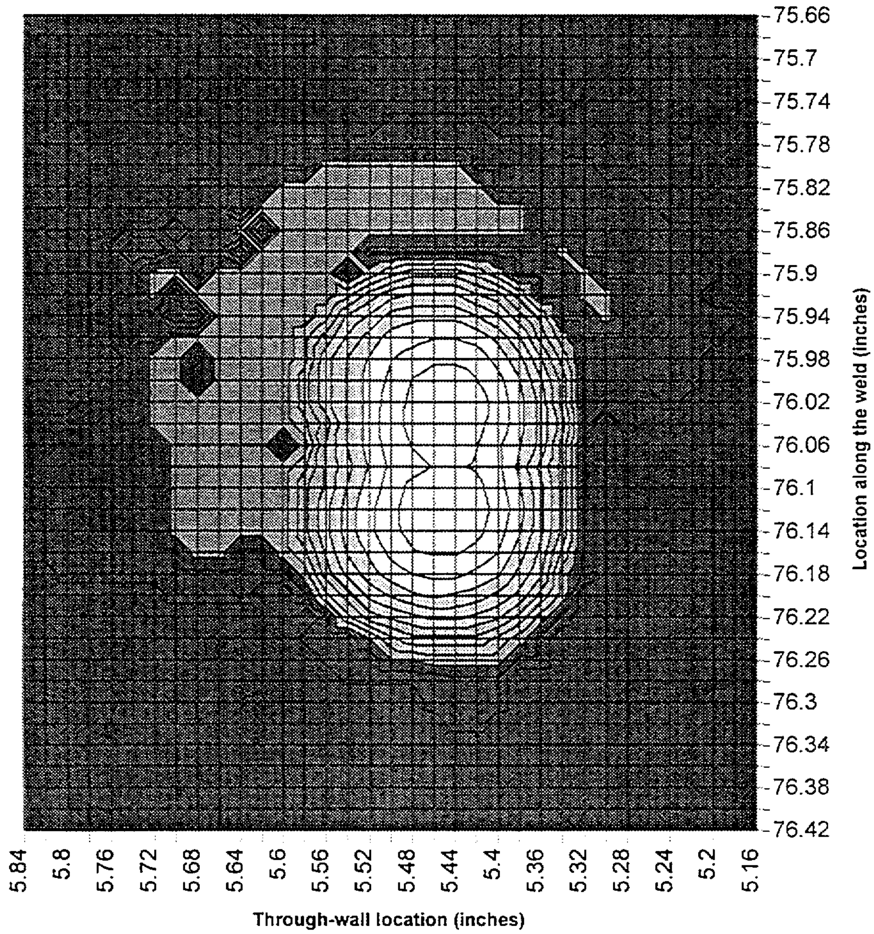

Figure T.5 Log-scale contour plot of indication #177 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -20.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4mm. The through-wall location is mid-wall. The length is 9 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.60 inches below 553 inches of vessel elevation.

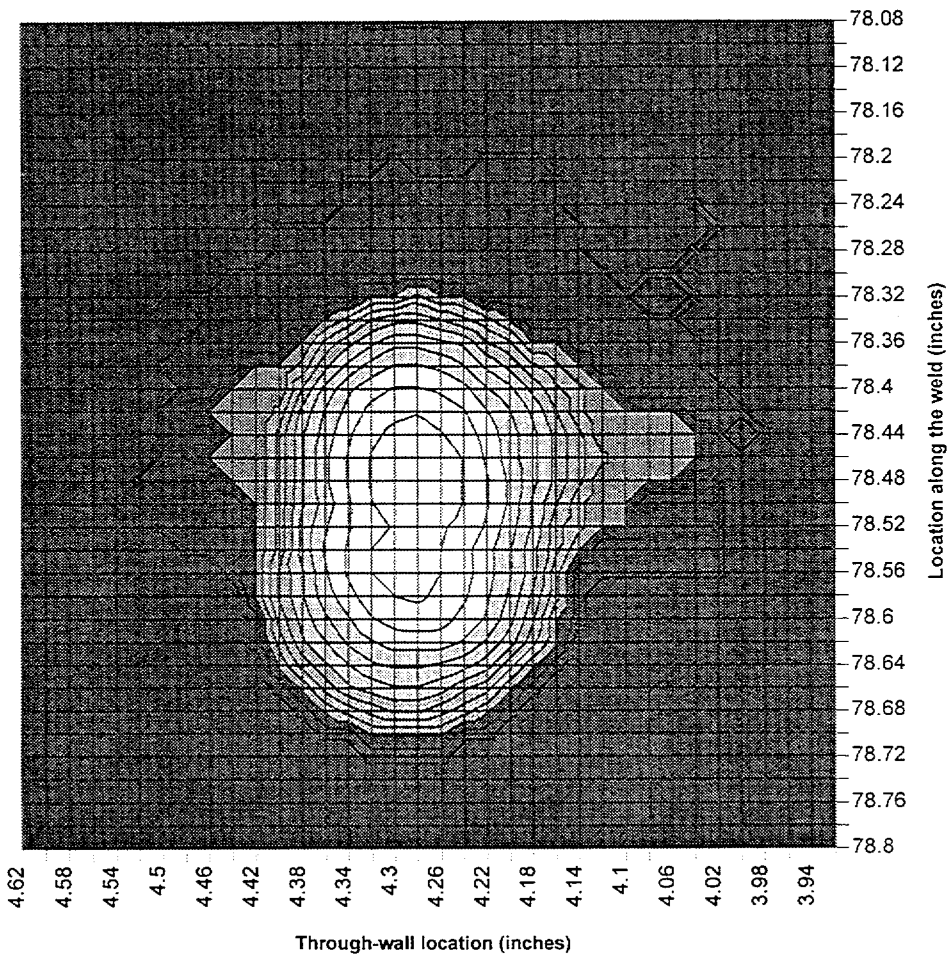

Figure T.6 Log-scale contour plot of indication #180 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.7 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.59 inches below 553 inches of vessel elevation.

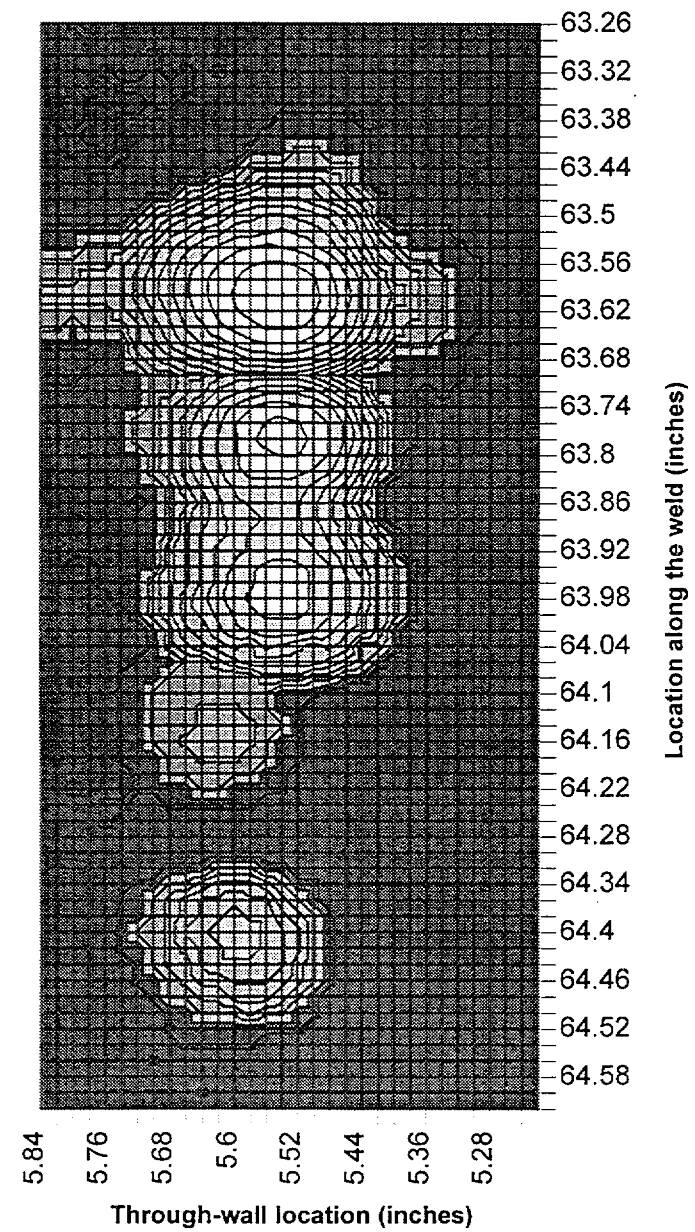

Figure T.7 Log-scale contour plot of indication #206 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -19.7 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 5 mm. The through-wall location is outer 25 mm. The length is 18 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located in the weld at 0.48 inches below 553 inches of vessel elevation.

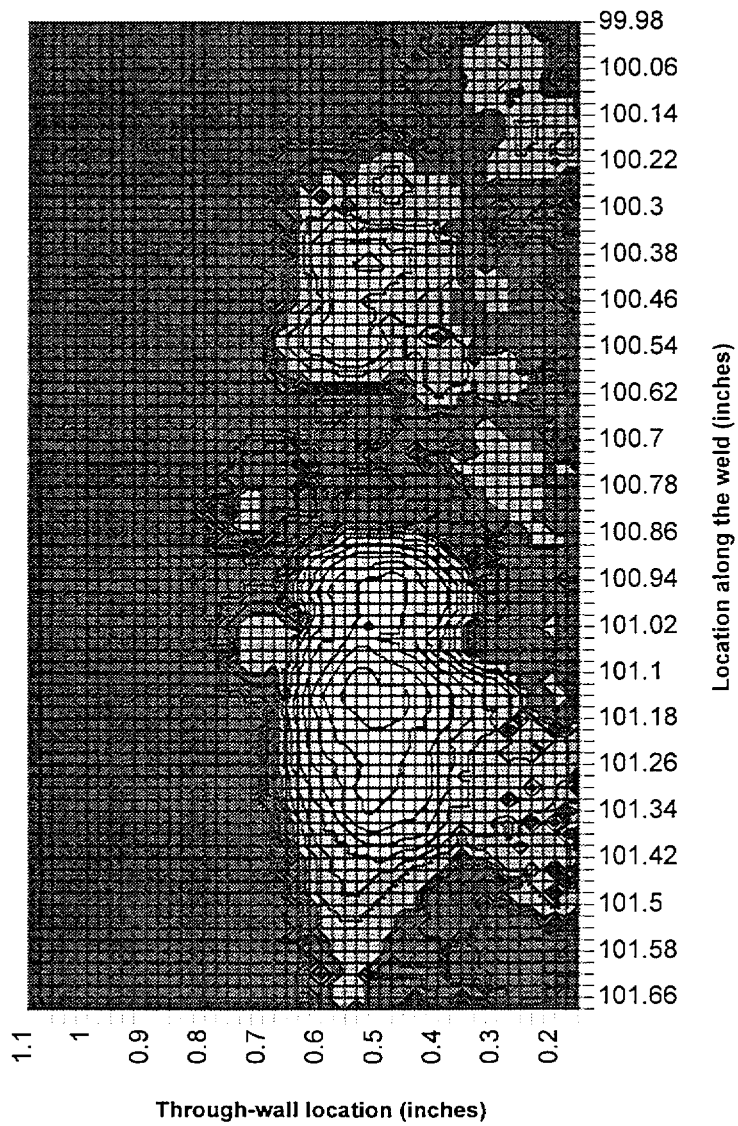

Figure T.8 Log-scale contour plot of indication #268 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -22.1 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is inner 25 mm. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located in the weld at 0.48 inches below 553 inches of vessel elevation.

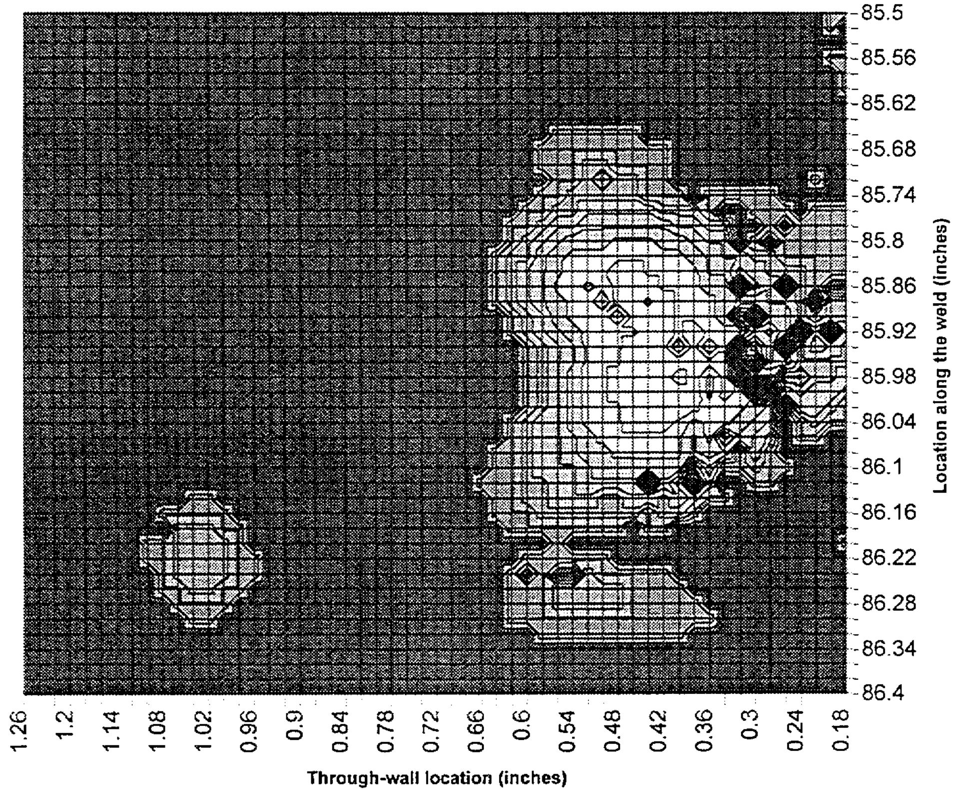

Figure T.9 **Log-scale contour plot of indication #295 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -23.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 8 mm. The through-wall location is outer 25 mm. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as surface elongated, is located on the fusion surface at 0.72 inches above 553 inches of vessel elevation.**

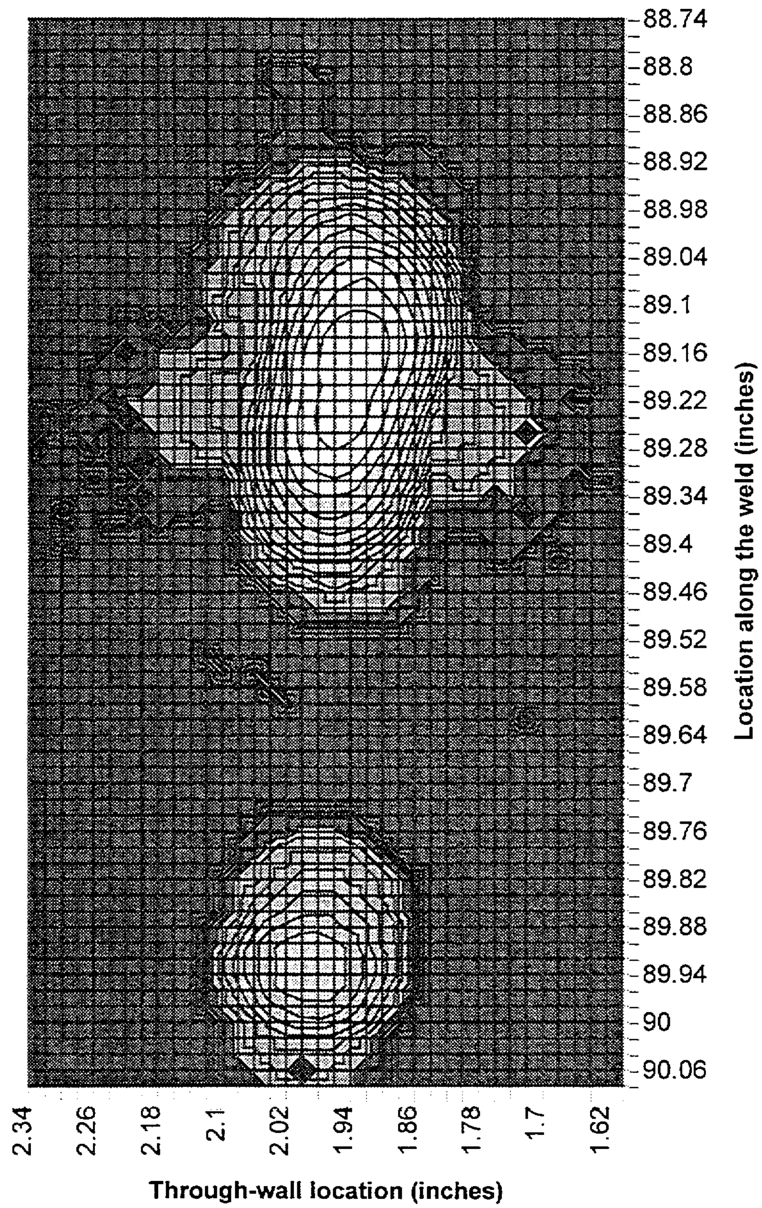

Figure T.10 **Log-scale contour plot of indication #299 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -11.3 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 15 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.61 inches above 553 inches of vessel elevation.**

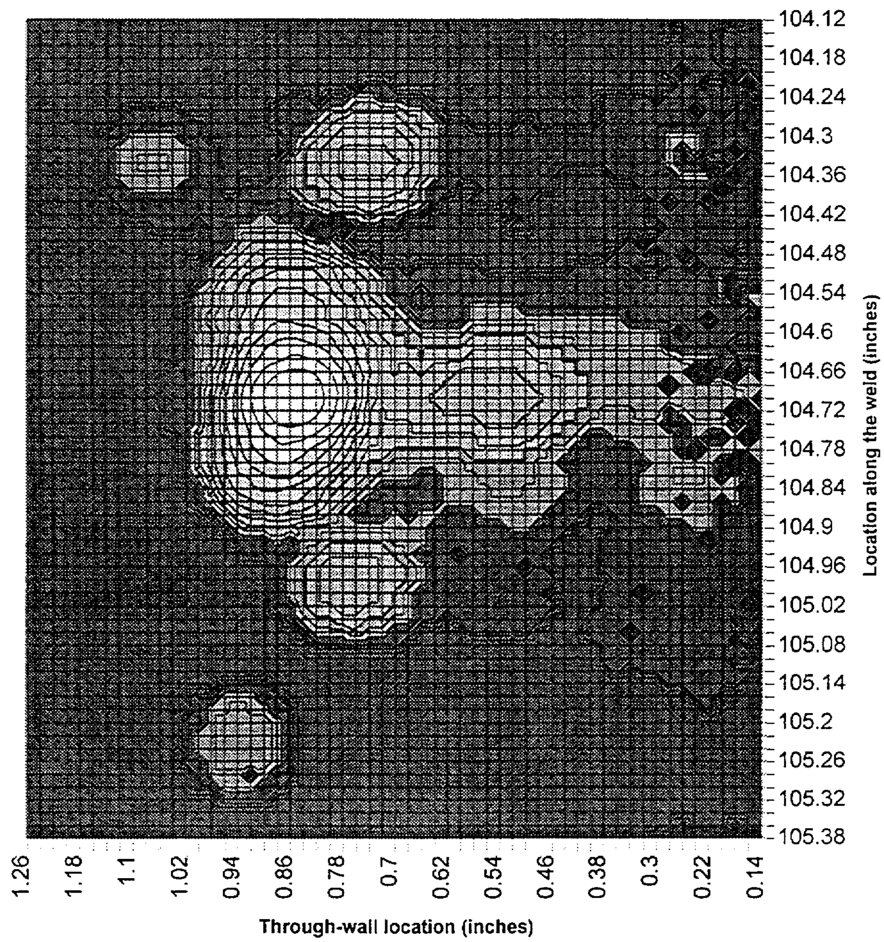

Figure T.11 Log-scale contour plot of indication #336 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -13.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is inner 25 mm. The length is 13 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.68 inches below 553 inches of vessel elevation.

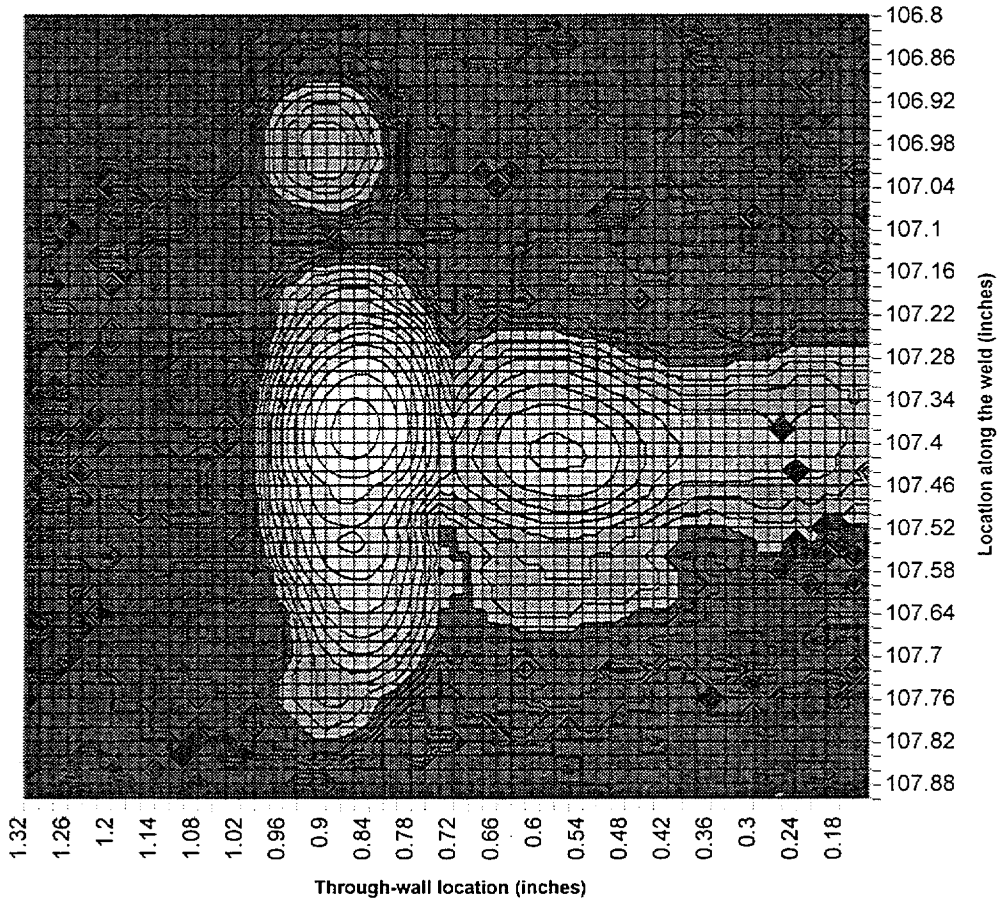

Figure T.12 Log-scale contour plot of indication #340 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -6 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is inner 25 mm. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.74 inches above 553 inches of vessel elevation.

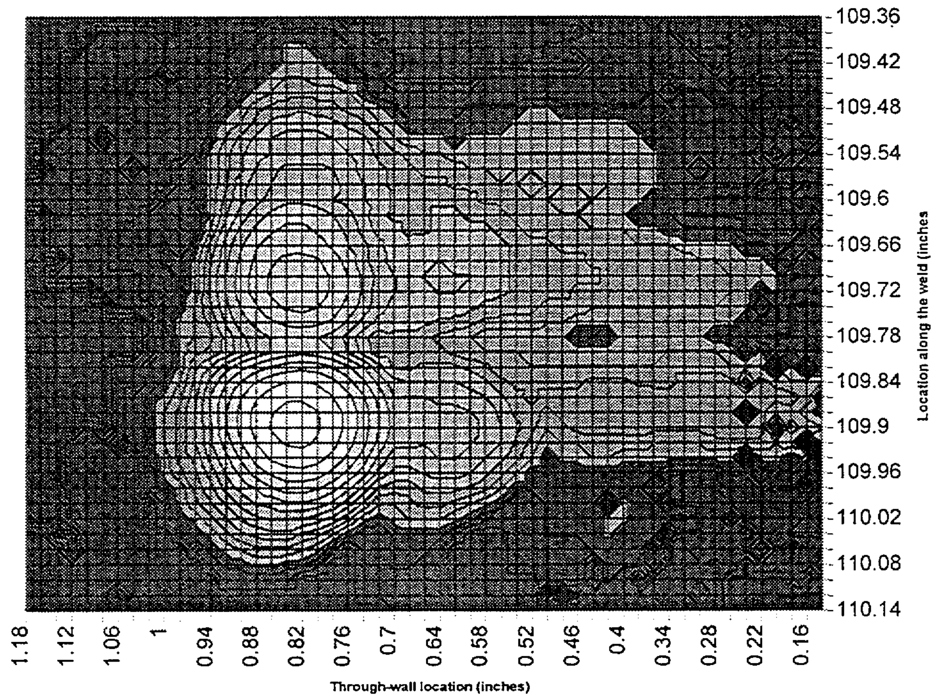

Figure T.13 Log-scale contour plot of indication #343 in Shoreham specimen C270D. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -7.4 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is inner 25 mm. The length is 16 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.72 inches above 553 inches of vessel elevation.

Appendix U

Detection Record and SAFT-UT Images of the Larger Indications in Shoreham Specimen C270E

Table U.1 lists all detectable flaw indications in Shoreham specimen C270E. The coordinates, ultrasonic response, characterization, and type of each indication are given. A description of Shoreham specimen C270E is given in Section 2. Figures U.1 and U.2 show the images of the larger indications in the specimen.

Table U.1 List of all indications for Shoreham specimen C270E

#	Peak Coordinates (Specimen) Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
1	-0.67	0.78	3.08	-29.9	small	fusion
2	-0.53	4.64	5.46	-25	small	fusion
3	-0.62	5.56	5.3	-28.7	small	fusion
4	-0.62	5.72	4.64	-29.7	small	fusion
5	-0.55	8.5	5.46	-28.4	small	fusion
6	-0.53	9.12	5.1	-29.3	small	fusion
7	-0.64	9.58	3.44	-15.4	small	fusion
8	-0.67	10.24	2.44	-20.7	small	fusion
9	-0.67	10.84	1.74	-19	small	fusion
10	-0.58	11.7	5.56	-18.3	small	fusion
11	-0.64	12.16	1	-29.8	small	fusion
12	-0.60	13.04	5.54	-25.4	small	fusion
13	-0.62	14.3	4.78	-28.7	small	fusion
14	-0.64	15.62	0.92	-23.8	small	fusion
15	-0.62	16.36	4.68	-24.2	small	fusion
16	0.67	2.32	2.28	-24.1	small	fusion
17	0.67	3.2	2.64	-8.7	small	fusion
18	0.60	3.5	4.52	-12.9	long	fusion
19	0.62	3.14	5.78	-14	small	fusion
20	-0.30	4.24	0.54	-29.2	small	weld
21	0.64	5.9	1.5	-17.7	small	fusion
22	0.64	9.22	5.76	-11.2	small	fusion
23	0.60	9.8	3	-9.9	long	fusion
24	0.64	9.94	5.62	-24.2	small	fusion
25	0.62	10.74	0.78	-19.2	small	fusion
26	0.64	11.12	2.16	-24.2	small	fusion
27	0.67	14.24	5.8	-24.1	small	fusion

Table U.1 (contd)						
	Peak Coordinates (Specimen)					
#	Weld Center (inches)	Along Weld (inches)	Depth (inches)	Response (dB)	Characterization	Type (material)
28	0.62	14.46	3.88	-29.3	small	fusion
29	0.60	15	3.96	-29.3	small	fusion
30	0.62	15.28	3	-15.3	small	fusion
31	0.64	16.78	1.72	-21.7	small	fusion

Note 1: Depth is measured from wetted clad surface.
Note 2: Weld center is positive for elevation greater than 553 inches.

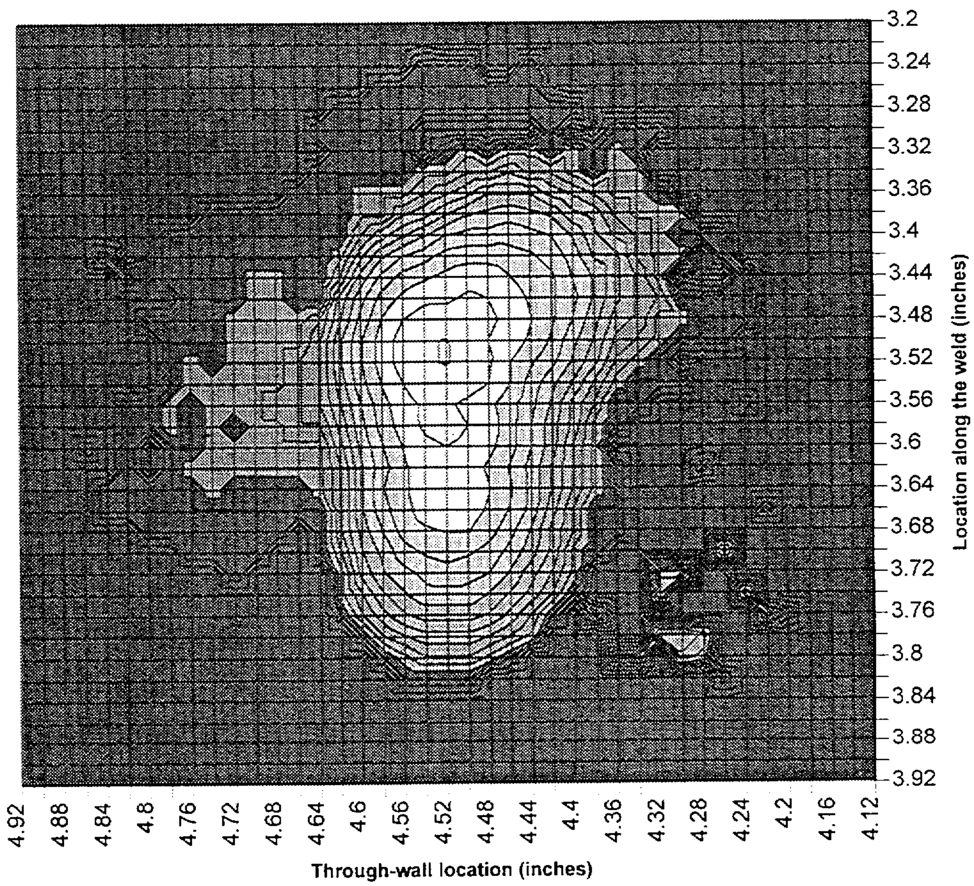

Figure U.1 Log-scale contour plot of indication #18 in Shoreham specimen C270E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -12.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 11 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.60 inches below 553 inches of vessel elevation.

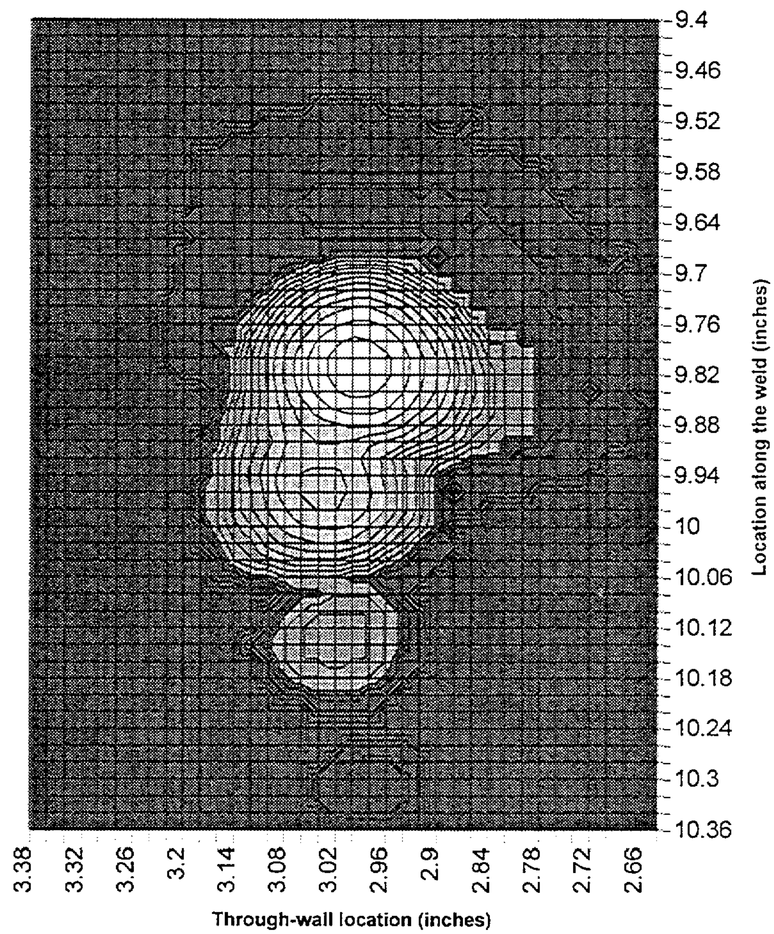

Figure U.2 Log-scale contour plot of indication #23 in Shoreham specimen C270E. The contour lines are separated by 2 dB of ultrasonic response. The peak response from the indication is -9.9 dB of the response from the calibration reflectors. The -6 dB through-wall size of the indication is 4 mm. The through-wall location is mid-wall. The length is 10 mm measured to loss of coherent signal. The plot's ordinate is given in specimen coordinates, inches from the end of the specimen, as measured on the OD of the specimen, and increasing in the direction of increasing vessel azimuth. This indication, characterized as long lack of fusion, is located on the fusion surface at 0.60 inches above 553 inches of vessel elevation.

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10. SUPPLEMENTARY NOTES

D.A. Jackson, NRC Project Manager

11. ABSTRACT *(200 words or less)*

Characterization of Flaws in U.S. Reactor Pressure Vessels is a multi-volume report. Volume 3, this document, contains the density and distribution of flaw indications in material removed from the non-irradiated Shoreham Nuclear Reactor Pressure Vessel. The flaw indications were obtained from nondestructive evaluation (NDE) of weldment specimens. The first volume gives the density and distribution of flaw indications in the Pressure Vessel Research User Facility (PVRUF) vessel. Volume 2 contains a description of the removal of material from the PVRUF vessel, the conduct of confirmatory NDE techniques and metallographic analysis, and the confirmation of flaw rates for the vessel.

This volume provides the characteristics of the flaw indications in the Shoreham vessel and their density and distribution. This report also gives a description of the Shoreham vessel weldments and the approach to the research. The performance of the inspection system and the measurements made on the reactor pressure vessel (RPV) material are described.

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