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Loft Duct Project Report

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1. INTRODUCTION

1.1 Incident Description

On October 16, 1992, during a routine examination of the loft of Building 332, the Building Coordinator observed cracks in the welds of the duct work that services the fume hoods for Rooms 1313, 1321, and 1329. Further examination revealed cracks in the weld of the duct work that services the gloveboxes in Rooms 1321 and 1329.

1.2 Initial Response

Upon discovery of the cracked welds, facility management immediately took the following two actions:

- Because one crack in the fume hood exhaust extended 70% around the duct circumference, a 1-ton chain fall was used to secure the duct to the roof support structure to prevent the duct from falling if the duct completely fractured.
- The Facility Manager suspended plutonium handling operations in the gloveboxes and work in the fume hoods in the affected rooms until the situation could be thoroughly investigated.

1.3 Loft Duct Ventilation System

Building 332 is ventilated by drawing conditioned air from the building hallways into the laboratories, hoods, and gloveboxes. This air is filtered through two sets of high-efficiency particulate air (HEPA) filters before being exhausted from the facility. Figure 1 is a schematic of the typical air flow pattern for the facility. All affected duct work is located in the loft of the facility or pressure zone 4. This ducting is fabricated from 12-, 14- and 16-gauge, 304 stainless-steel sheet stock and joined by the Gas Tungsten Arc Welding (GTAW) process.

1.4 Scope

This report describes the results of the investigation and analyses of the loft duct work including:

- A thorough and documented investigation of the extent of the cracking.
- A literature search and series of interviews with facility personnel to determine the history of duct use, fabrication techniques, and material specifications.
- Metallurgical work to determine the cause of cracking.
- An analysis to determine the structural efficacy of the duct work for various geometries and service conditions under loading from a design basis earthquake (dbe).

Figure 1. Air Flow Schematic for Increment 1

2. INVESTIGATION

2.1 Weld Survey

2.1.1 Visual and Fluorescent Penetrant Inspection

The investigation began with a visual inspection of all welds in the duct work in the Increment 1 loft and in the rooms serviced by the duct work. This investigation was followed by a fluorescent penetrant examination of all the weld flaws identified in the visual inspection to determine if they were indeed cracks. Figure 2 is an example of the typical crack found in the duct work during the investigation.

Figure 2. Typical Crack in Duct.

To minimize the possibility of personnel contamination, the weld surfaces were not cleaned for the visual weld inspection. A Health and Safety (H&S) Technician was always available to survey the inspected areas for contamination.

2.1.2 Inspection Team

The visual inspection team from Plant Engineering was led by Roger Peterson. The inspection was performed by the following individuals who are qualified in accordance with requirements of the American Welding Society (AWS) D1.1:

- Roger Peterson, Certified Weld Inspector (CWI)
- Franklin Phillips, Certified Associate Weld Inspector (CAWI)
- Lonn Dayton, CAWI
- Narciso Alvarado, CAWI

The fluorescent penetrant inspections were performed by John Ambrosino and Dan Green of the Nondestructive Examination (NDE) Section of the Engineering Sciences Division. The welds were evaluated in accordance with standards in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section V. Because fluorescent penetrant examination requires physical contact with weld areas, these surfaces were surveyed by an H&S Technician for radioactive contamination before examination.

2.1.3 Subsystems Inspected

Welds in the following duct subsystems were inspected:

- Glovebox exhaust systems east and west.
- Fume hood exhaust duct for Rooms 1313, 1321, 1329, 1322, 1378, and 1305.
- Down-draft exhaust system.
- Room exhaust ducts.

The fume hood exhaust for Room 1305 was only visually inspected because this hood is no longer in service and is scheduled for removal.

Welds in the following room subsystems were inspected:

- Fume hood and glovebox exhaust duct in Rooms 1313, 1321, 1329, and 1378.
- Glovebox exhaust duct in Rooms 1337, 1370 and 1377.
- Down-draft exhaust duct in Room 1354.

The appendix contains a compilation of the results of these inspections and schematics of the loft ventilation systems showing joint locations developed for the weld survey.

2.2 Weld Survey—Radiography

2.2.1 Inspection

Because fluorescent penetrant analysis only indicates the presence of surface cracks, a radiographic survey was performed on some of the cracked welds to determine the condition of the cracks, welds, and adjacent weld areas.

Many of the weld flaws noted in Appendix A are described as “incomplete penetration,” “possible crack,” and “underfill”. Radiography also is used as a method of confirmation of these types of surface indicated flaws. Other weld flaws that cannot be visually observed also can be easily detected with radiography such as “tungsten/slag inclusions,” “porosity,” and “cracking/improper weld repair”.

Radiography also was performed on a randomly selected sample of duct welds throughout the loft. These results were used to assess the general condition of the welded duct work.

The ASME B&PV Code, Section V was used in the evaluation of the radiographs.

2.2. Film Densitometry

Film densitometry was used to estimate weld depth-of-penetration in the duct (see “Densitometry for Weld Depth-of-Penetration,” Internal Memo by Ken Dolan, LLNL, November 18, 1992). Results of the densitometry show that the weld penetration was nominally 80 to 90% of the wall thickness of the base material, 16-gauge, 0.0625-in. thick 304 stainless steel. The worst-case penetration was 75% of the wall thickness. Estimated accuracy of the results is $\pm 5\%$. This information was used to determine the structural efficacy of the duct work, (Subsection 2.3.6).

All radiographic and fluorescent penetrant examination was led by Ken Dolan of the NDE Section of the Engineering Sciences Division.

2.3 Ducts

2.3.1 History and Usage

An extensive review of the service history of the various duct subsystems for Increment 1 was conducted. The four systems examined were:

- Fume hood exhaust systems (which connect downstream to the room air exhaust system).
- Glovebox exhaust systems.
- Room air exhaust systems.
- Down-draft room system.

Extensive exposure to acids has occurred and continues to occur in the fume hood exhaust system serving Rooms 1321 and 1329. Minor acid and chlorinated solvent exposure occurred and continues in the fume hood exhaust duct for Rooms 1322 and 1330A. Exposure to acids may have occurred in the past but has been minor in recent years. Both of these systems exhaust into the room air exhaust system for Increment 1 where, obviously, diluted exposures are continuing.

Extensive exposure to acids occurred in the glovebox exhaust system from operations in Rooms 1321, 1329, 1370, and 1378, and to a somewhat lesser extent from corrosive gasses from operations in Room 1377.

From the above synopsis of acid operations within the facility, good correlation can be made between the rooms where acids have been used and cracking in the ducts that service these fume hoods and gloveboxes. In fact, all cracks (except for a throat crack in GB 53E) occurred in duct work servicing hood and glovebox exhaust systems that used corrosive materials.

2.3.2 Fabrication

The loft and room duct work primarily is welded construction. There are some flanged connections where the duct work is connected to floor feed-throughs, other ducts, and machinery.

The ducts for the fume hood exhaust, glovebox exhaust and the down-draft are circular cross section and are fabricated from 12-, 14- and 16-gauge 304 stainless steel. The sections were fabricated from sheet stock that was sheared, rolled to the proper diameter, and butt-welded. These spool pieces were then cut and mitered in the field to the proper dimensions and butt-welded to form the duct.

Interviews with personnel involved in the fabrication and installation of the spool pieces confirm that:

- The GTAW process was used.
- Purge gas was not used in the welding process.

Examination of the drawings for various Increment 1 duct work projects reveals no specific protocol for welding methods and processes. Welding processes were cited as “heliarc” or “shielded gas metal arc welding”. The standards cited vary from AWS D1.1 to ASME Section IX. AWS D1.1 is applicable to carbon steel only with thicknesses above 0.1875 in.

In addition, there has not been an acceptance-testing protocol formulated or used in determining the capability of the duct work to meet facility operational requirements.

2.3.4 Metallography and Material Properties

2.3.4.1 Method

Metallurgical work was performed on samples of the duct work to evaluate metallographic and material properties of the duct material. Metallography was used to determine the changes in microstructure of the duct material in the welds and heated affected zones (HAZs). These changes were analyzed to determine if they influenced the duct cracking. Figures 3 and 4 are, respectively, a magnified (37.5X) cross section of a weld joint section from HE3 in Figure 2 and a magnified (100X) cross section of the HAZ of the same weld joint from HE3. The lower portion of the picture in Figure 3 and the left-hand side of the picture in Figure 4 show the inner portion of the fume hood exhaust duct.

Figure 3. Typical Weld Joint, HE3.

Figure 4. Typical Intergranular Stress Corrosion Cracking in HAZ of HE3.

After determining that no radioactive contamination was present and that the fume hood system operation would be unaffected, several samples of duct weldment were removed from the fume hood exhaust for analysis.

2.3.4.2 Results

Results of the metallurgical analysis indicate that the cracks in the duct work were caused by a well characterized phenomenon called "intergranular stress corrosion cracking". This phenomenon occurs when the following three conditions exist:

- Cr-depleted regions adjacent to grain boundaries in the weld HAZ of GTA-welded Type 304 stainless steel.
- Significantly high stress fields, such as can be produced by residual weld stresses on the order of one tenth the material's yield strength.
- A corrosive environment, such as the presence of HCl fumes, H₂O, and O₂.

All the above conditions exist in the duct work that services the "wet chemistry" laboratories in the facility.

When Type 304 stainless steel is welded, the weld zone liquefies. As the weld cools, the chromium in the weld HAZ precipitates out of solution and reacts with the carbon present to form chromium carbide. This reduces the concentration of chromium in the adjacent material. Thus, the HAZs are much less corrosion resistant than the surrounding material.

If these areas are exposed to a corrosive environment, a loss of material results. The material loss usually takes place in the grain boundaries, resulting in cracks which will propagate in

the presence of a large tensile stress field. Figure 4 is a section of the weld HAZ of Figure 3 and is a typical example of intergranular stress corrosion cracking.

The residual stresses caused by welding also were measured to be as high as 40 ksi with nominal sample values on the order of 20 ksi. With material yield stresses on the order of 50 ksi, the value of the initiation stress for crack growth is about 5 ksi. The nominal residual stress values are well above this.

Use of low carbon stainless steel alloys, such as Types 304L or 316L correctly welded will minimize the loss of corrosion resistance and lower the susceptibility of the weld HAZ to intergranular stress corrosion cracking.

2.3.5 Literature Search

A literature search was conducted to determine the material and fabrication specifications and standards used by other Department of Energy (DOE) contractors for duct work serving their facilities. The contractors surveyed were:

- Rocky Flats
- Los Alamos National Laboratory
- Savannah River Westinghouse and DuPont

The survey showed that, in general, there is close but not exact agreement of the types of material used, for example:

- ASTM Type A-240 304L
- ASTM Type A-240 304L
- ASTM Type A-167 304L
- Types 304 and 304L

In some cases site-specific standards are used to evaluate corrosion resistance.

Welding standards also are site-specific because there is no nationally recognized code for welding thin wall stainless steel sections. There is, however, a document that specifies recommended practices, ANSI/AWS D10.4, *Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing*.

The acceptance criteria for welded ducts used by some of the sites surveyed lacks specificity. Both Savannah River sites quote a nationally recognized standard for both test method and acceptance criteria: ANSI N510 and the *Nuclear Air Cleaning Handbook*, ERDA 67-21, respectively.

2.3.6 Analysis

2.3.6.1 Failure Mechanisms Examined

The following load conditions were postulated at the outset of the project to explain the propagation of cracks in the ducts:

- Fatigue caused by:
 - Thermal cycling
 - Machinery vibration
 - Seismic action
- Residual weld stresses

Calculation and measurement of the duct stresses for fatigue loading yielded the following information:

- Thermal cycling, ± 26 psi.
- Machinery vibration were measured at 75 psi maximum at 60 Hz.
- Seismic cycling from seismic activity in the past 10 years:
 - 467 psi for 20 cycles from the 1980 earthquake.
 - 107 psi for 20 cycles from the 1989 earthquake.

Because of the low stresses involved, fatigue cracking was quickly discarded as a failure mechanism, especially for Type 304 stainless steel. This conclusion was reinforced when the initial sample of fume hood duct was removed and subjected to metallographic analysis. Even though the crack surfaces were corroded, no indications of striations or beach marks on the crack surfaces (which would be indications of fatigue) were observed even at the crack tip.

Therefore, the presence of residual weld stresses was the only source of high tensile stresses to initiate and propagate cracks. This conclusion was confirmed by analyzing a sample of the fume hood exhaust with x-ray diffraction techniques to determine the residual stresses and with the input from the metallurgical analysis mentioned above (see *Tec Report R-92-170, Lawrence Livermore National Laboratory, Residual Stress Summary, Tec Pon 33848*). The maximum measured residual weld stresses were 40 ksi. The average stresses are estimated to be 20 ksi for the purposes of calculation. The crack initiation stress value is generally about one tenth of the yield stress. For the material analyzed, the yield stress is about 50 ksi. Thus, the residual stresses were large enough to propagate cracks given the proper conditions.

2.3.6.2 Duct Structural Integrity

At this point the analytical effort focused on determining:

- Structural capability of corroded duct to a db
- Structural capability of the cuffed duct work to a db

The building response to a db was extracted from several seismic analyses of the facility performed by various contractors [see the 1989 H. J. Degenkolb Report, *Hazard Evaluation of Critical Systems in the Plutonium Facility (Building 332)*]. Volume 5 of this report was used to extract seismic loads that were in turn used to generate the moments and shear loads that were applied to the ducts and cuff.

Corroded duct analysis: An analysis was performed on the corroded duct geometry, subjecting the duct to a db in accordance with the 1989 H. J. Degenkolb Report. The following two worst-case conditions are applied simultaneously in the analysis:

- Partial penetration weld joints, stress concentrations, as determined from the densitometry measurements.
- Diminished yield strength in the weld area as determined by metallurgical analysis.

The calculations show a factor of safety of greater than 6 based upon the minimum yield strength of 21.5 ksi measured for the corroded material. This includes a stress concentration factor of 3.15 for an 80% penetration weld which is the lowest nominal penetration measured by the radiographic film densitometry.

Cuff analysis: A reinforced cuff was applied to all sections of the duct where:

- Cracks were verified.
- Coupons were removed for analysis.

The cuffs were designed at the beginning of the project to structurally reinforce the cracked portions of the duct and to maintain the containment envelope defined by the duct wall. Figure 5 is a schematic of the cuff installed over a section of the duct.

Figure 5. LLDP Cuff Schematic.

The cuffs are fabricated from Type 304 stainless steel, 21-gauge, 0.032-in. thick. They are a minimum of 7 in. wide and cut slightly longer than the circumference of the duct to which they are attached. They are reinforced by four equally spaced 304 stainless steel bars, 1 in. by 0.25 in. by 7 in. (minimum), spot-welded to the cuff. The cuff assemblies were lined with neoprene sheets to effect a gas seal between the duct and the cuff. In addition, a fire resistant sealant was used between the neoprene and the duct. The cuffs were installed around the cracks or coupon removal sites and clamped in place.

This cuff analysis does not assume any strength from the duct work; the loads are transmitted across the reinforcement bars welded to the cuffs exterior surface.

The following seismic loads used in this analysis were derived from the 1989 H. J. Degenkolb Report, Volumes 4 and 5:

Maximum Bending = 10549 in.- lb

Maximum Shear = 267 lb

These values are conservative in that they assume the duct supports are spaced at twice their actual distance. Assuming that the reinforcement bars carry these loads, the stresses in the bars become:

3014 psi in tension and compression

267 psi shear

The clamps, Type 304 stainless steel, transmit this stress/load back into the duct. Using a nominal yield stress of 30,000 psi and a factor of safety of 1 for seismic events, the minimum cross section of the clamp is 0.1 in.². The installed clamp and bolts and nuts that secure the clamp have sufficient tensile and shear area to withstand the dbc.

Because the above discussion confirms that all the loft duct work will survive a dbc, continued near-term usage is recommended.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

The investigation resulted in the following conclusions:

1. The physical survey of duct work and interviews with facility personnel show that cracks occur only in duct work that has been subjected to a corrosive environment.
2. Examination of the weld survey data shows that most cracking occurred in the HAZs of circumferential welds.
3. A majority of the weld cracks are found in areas of weld repair or patch work. This suggests a lack of control of essential weld variables, i.e., welding current and voltage, joint fit-up, and proper use of filler rod. This lack of control also is confirmed by the survey of job specifications for the loft duct work. There were no consistent quality control standards (i.e., welding codes and specifications or acceptance testing standards) employed throughout the duct construction and modification.

4. The literature search revealed that some DOE facilities use national standards but that there is no consensus on the standards used.
5. Metallurgical analysis showed that cracking was a result of intergranular stress corrosion cracking:
 - Type 304 stainless steel, which was selected for an application, was not the correct material because it was not resistance to corrosive environments when welded.
 - Even though parent material samples show negligible corrosion, the poor quality of the welds made their HAZs much more susceptible to intergranular stress corrosion cracking.
6. Analytical Results:
 - Those portions of the duct that are covered with the reinforced cuff will withstand a dbc.
 - All corroded duct work will survive a dbc. Parameters considered in the evaluation were the diminished cross section (stress concentration factor) caused by a lack of weld penetration as well as the diminished yield strength.
 - Noncorroded ducts will survive a dbc because their welds only diminished in cross section and not in yield strength.

3.2 Recommendations

The investigators recommend the following:

1. Establish an inspection and monitoring program to monitor existing cracks and their growth rates:
 - Conduct an initial inspection of the “wet chemistry” duct in 6 months.
 - Select the next inspection interval based on the findings of this survey and consultation with metallurgical personnel.
 - Use visual and fluorescent penetrant NDE protocol generated from survey information for this report.
 - Do not inspect the “dry” duct work.
2. Determine, with primary input from programmatic personnel, methods of reducing the amounts and kinds of acid vapors generated. Concentrate acid handling to specific gloveboxes and fume hoods. For example, because HCl is the most damaging acid to the present system, segregate HCl use to one particular air handling system.
3. Install devices (i.e., scrubbers and condensers) to remove corrosive materials and moisture from hood and glovebox effluents.

4. Perform all future fabrication and testing of glovebox and fume hood exhaust duct work in accordance with nationally recognized standards.
 - In lieu of a standards, derive appropriate specifications from existing literature.
 - For the purposes of this report, a welding specification for thin wall stainless steel pipe and tubing has been generated, *Welding of Stainless Steel Components for Building 332 Ventilation Duct Work*, Internal Document, LLNL, May 28, 1993.

4. ACRONYMS

ASME	American Society of Mechanical Engineers
AWS	American Welding Society
B&PV	boiler and pressure vessel
CAWI	Certified Associate Weld Inspector
CWI	Certified Weld Inspector
dbe	design basis earthquake
DOE	Department of Energy
GTAW	Gas Tungsten Arc Welding
HAZ	heat affected zone
HEPA	high-efficiency particulate air
H&S	Health and Safety
NDE	nondestructive evaluation

5. BIBLIOGRAPHY

Dalder, E.N.C., "Cause of Weld Heat-Affected Zone Cracks in Gas-Tungsten Arc Welded Type 304 Austenitic Stainless Steel In Bldg. 332 Loft Duct System," Internal Memo, LLNL, March 25, 1993.

Dalder, E.N.C. and Ron Michels, MEL 93-001814-00, *Welding of Stainless Steel Components for Bldg. 332 Ventilation Duct Work*, Internal Document, LLNL, May 28, 1993.

Dolan, Ken, "Densitometry for Weld Depth-of-Penetration," Internal Memo, LLNL, November 18, 1992.

Folkers, Charles, "Service History and Documentation of Increment I Exhaust Duct Systems," Internal Memo, LLNL, November 3, 1992.

Hazard Evaluation of Critical Systems in the Plutonium Facility (Building 332), for Lawrence Livermore National Laboratory by H.J. Degenkolb Associates, San Francisco, California, June 30, 1989, revised July 17, 1989.

Hazelton, W. S. and Koo, W. H., *Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping*, NUREG-0313, Rev. 2, Division of Engineering and Systems Technology, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C., 20556.

Kahle, Raymond, "Specification of Ventilation Ducting At Other DOE Sites," Internal Memo, LLNL, December 8, 1993.

Reed, John and Yun Chang, ENE 93-079, "Seismic Calculations for Bldg. 332 Loft Duct Work," Internal Document, LLNL, June 10, 1993.

Tec Report R-92-170, Lawrence Livermore National Laboratory, Residual Stress Summary, Tec Pon 33848, for Lawrence Livermore National Laboratory, Livermore, California, by Tec, 10737 Lexington Drive, P.O. Box 22996, Knoxville, Tennessee, December 14, 1992.

Appendix

Loft Ventilation System Schematics and Survey Data

APPENDIX

LOFT VENTILATION SYSTEM SCHEMATICS AND SURVEY DATA

This appendix contains the following schematics of the loft ventilation systems showing joint locations developed for the weld survey and a compilation of the results of the inspections:

AAA92-103861, Loft Glovebox Exhaust

AAA92-103871, Loft Fume Hood/Downdraft Exhaust

AAA92-103872, Loft Room Exhaust

A legend explaining the labels assigned to each visual weld flaw precedes the data gathered for the particular duct. In the cases where cracks were verified, documentation includes the following information: The length of the crack in inches, the diameter of the duct in question, and the percentage of the circumference that is cracked.

Inspection survey data for the following two subsystems are included in this report and show where weld defects were found:

Loft Weld Survey: Fume Hood Exhaust for Rooms 1313, 1321, and 1329

Loft Weld Survey: Glovebox Exhaust System

Inspection survey data for the following four subsystems are not included in this report because no weld defects were found in these subsystems:

Room Weld Survey

Loft Weld Survey: Room Exhaust Survey

Loft Weld Survey: Downdraft Exhaust System

Loft Weld Survey: Fume Hood Exhaust System for Rooms 1305, 1322, and 1378

NOTES
UNLESS OTHERWISE SPECIFIED:

- SEE ENGINEERING NOTE ENS-92-08 FOR DETAILED INFORMATION ON POSSIBLE WELD FLAW LABELS.

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CHK				THIS DOCUMENT IS THE PROPERTY OF THE UNIVERSITY OF CALIFORNIA		SUBASSY		LOFT GLOVE BOX EXHAUST	
APVD <i>John P. ...</i>		12-18		LAWRENCE LIVERMORE NATIONAL LAB.		DETAIL		WELD FLAW LOCATIONS	
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			AAA 92-103872-00	
			SCALE	SHEET 1 OF 1

LTR DWN CHK APVD DATE ZONE CHANGE

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**Loft Weld Survey
Fume Hood Exhaust System for Rooms 1313, 1321, 1329
Label Definition**

The following label definitions apply to the survey table on the following pages:

The first two characters identify the system:

HE — Fume Hood Exhaust

The next two characters identify the weld flaw:

01 — Flaw one

02 — Flaw two etc.

LABEL	LOCATION	VISUAL INSPECTION	NOTES	INSP	FLUORESCENT PENETRANT INSPECTION	DIA	%	RADIOGRAPH	COUPON REMOVED	CLIFF	COMMENTS
1 HE 01/02	JOINT 26	POSSIBLE CRACK		NHA	CRACK, 33 LG, BASE METAL	14	75	YES (1)		YES	BELLY BAND
2 HE 03	JOINT 36	POSSIBLE CRACK		NHA	CRACK, 2.5 LG, BASE METAL			YES (8)	3.75" x 5"	YES	REPAIR
3 HE 04	JOINT 18	POSSIBLE CRACK		RMP					2" X 3" (WELD CP)	YES	
4 HE 05	SEAM 1/JOINT 2	POSSIBLE CRACK		RP							
5 HE 06	JOINT 6	POSSIBLE CRACK		RP						YES	
6 HE 07	JOINT 7	POSSIBLE PINHOLE		RP							
7 HE 08	SEAM 11	POSSIBLE CRACK	ENTIRE WELD	RMP							
8 HE 09	JOINT 15	WELD COVERED BY SUPPORT	NOT INSP								
9 HE 10	JOINT 21	POROSITY AND RUST		NHA							
10 HE 11	JOINT 22	POSSIBLE CRACK		NHA	CRACK, 2.5 LG, BASE METAL	14	5.7			YES	REPAIR
11 HE 12	JOINT 29	POSSIBLE CRACK		RMP							
12 HE 13	JOINT 29	CRACK (REPAIRED WELD)		RMP	CRACK, 4.5 LG, BASE METAL	14	10.2			YES	START/STOP REPAIR
13 HE 14	JOINT 32	INCOMPLETE PENETRATION		OD							
14 HE 15	JOINT 33	INCOMPLETE PENETRATION		OD							
15 HE 16	JOINT 34	INCOMPLETE PENETRATION		OD							
16 HE 17	PATCH	POSSIBLE CRACK		NHA	CRACK, 3.5 LG, BASE METAL (ON A PATCH)	14	8	YES (1)	5.5" x 7.5"	YES	
17 HE 18	JOINT 45	INCOMPLETE PENETRATION		LP							
18 HE 19	DOP PORT	POSSIBLE CRACK		LD	CRACK (2), 1.75 LG EA, BASE METAL, 0 & 90 DEG	1 ips	5.4			YES	
19 HE 20	JOINT 60	POSSIBLE CRACK		LD							
20 HE 21	JOINT 62	POSSIBLE PINHOLE									
21 HE 22	DOP PORT	POSSIBLE CRACK		LD	CRACK, 4 LG, 180 DEG AROUND, BASE METAL	1 ips	73			YES	
22 HE 23	JOINT 74	POSSIBLE CRACK		LD							
23 HE 24	DOP PORT	POSSIBLE CRACK		JA	CRACK, 4 LG, 180 DEG AROUND, BASE METAL	1 ips	50			YES	
24 HE 25	JOINT 67	POSSIBLE PINHOLE		LD							
25 HE 26	JOINT 67	POSSIBLE CRACK		LD							
26 HE 27	JOINT 69	POSSIBLE PINHOLE		LD							
27 HE 28	SEAM 69	INCOMPLETE PENETRATION		LD							
28 HE 29	JOINT 88	HEAT DISTORTION		NHA							
29 HE 30	SEAM 84	POSSIBLE HOLE		NHA							
30 HE 31	JOINT 92	POSSIBLE PINHOLE		LD							
31 HE 32	JOINT 98	INCOMPLETE PENETRATION		LD							
32 HE 33	JOINT 98	POSSIBLE CRACK STARTING		LD							
33 HE 34	JOINT 100	INCOMPLETE PENETRATION		LD							
34 HE 35	SECTION 109	DRILLED HOLE	TAPED OVER	NHA							
35 HE 36	JOINT 108	UNDERCUT		NHA							
36 HE 37	JOINT 111	UNKNOWN		NHA							
37 HE 38	SEAM 113	POSSIBLE HOLE		NHA							
38 HE 39	JOINT 115	POSSIBLE CRACK		RP	CRACK, 2 LG, BASE METAL	14	4.5			YES	REPAIR
39 HE 40	JOINT 115	POSSIBLE CRACK		NHA	CRACK, 1 LG, BASE METAL	14	2.3			YES	REPAIR
40 HE 41	JOINT 117	UNDERCUT		NHA							
41 HE 42	JOINT 119	POSSIBLE HOLE		NHA							
42 HE 43	JOINT 121	POSSIBLE CRACK		RMP	CRACK, 1.5 LG, BASE METAL	14	3.4			YES	START/STOP REPAIR
43 HE 44	JOINT 130	ARC STRIKE		NHA							
44 HE 45	JOINT 136	POSSIBLE CRACK		RMP	CRACK, 2 LG, BASE METAL	14	4.5			YES	REPAIR
45 HE 46	JOINT 138	POSSIBLE HOLE		RMP							
46 HE 47	JOINT 141	POSSIBLE CRACK		RMP							
47 HE 48	JOINT 141	POROSITY		RMP							
48 HE 49	JOINT 142	POSSIBLE CRACKS (2)		RMP							
49 HE 50	JOINT 144	POROSITY		RMP							
50 HE 51	JOINT 145	POSSIBLE CRACK		RMP							
51 HE 52	JOINT 146	POSSIBLE PINHOLE		RMP							
52 HE 53	JOINT 148	POSSIBLE CRACK		RMP							
53 HE 54	JOINT 151	POSSIBLE CRACK		RMP							
54 HE 55	JOINT 150	UNKNOWN		RMP							

LABEL	LOCATION	VISUAL INSPECTION	NOTES	INSP	FLUORESCENT PENETRANT INSPECTION	DIA	%	RADIOGRAPH	COUPON REMOVED	CLIFF	COMMENTS
55 HE 56	SEAM 151	POSSIBLE PINHOLE		RWP							
56 HE 57	JOINT 152	UNKNOWN		RWP							
57 HE 58	FRESH SPRINKLER	MISSING WELD		RWP							
58 HE 59	JOINT 7	SAMPLE ONLY				14			3" X 8"	YES	
59 HE 60	JOINT 6	POSSIBLE CRACK		JA	CRACK, 2 LG. BASE METAL	14	4.5	YES (1)	4" X 4"	YES	REPAIR
60 HE 61	JOINT 17	SAMPLE ONLY				14			3" X 8"	YES	
61 HE 62	JOINT 19	SAMPLE ONLY				14			3" X 8"	YES	
62 HE 63	JOINT 23	SAMPLE ONLY				14			3" X 3"	YES	
63 HE 64	SEAM 20	SAMPLE ONLY				14			3" X 3"	YES	

**Loft Weld Survey
Glove Box Exhaust System
Label Definition**

The following label definitions apply to the survey table on the following pages:

The first two characters identify the system:

GB — Glovebox Exhaust

Second two or three characters identify the location:

21 — Room 1321 Exhaust Header

NE — Northeast Exhaust Header

NW — Northwest Exhaust Header

SE — Southeast Exhaust Header

SWM — Southwest Exhaust Header

ME — Main Glove Box Exhaust Header East

MW — Main Glove Box Exhaust Header West

The next one or two characters identify the weld flaw:

No character — first flaw

A through Z — second through the 27th possible flaw

AA or A1 — 28th possible flaw etc.

	LABEL	LOCATION	VISUAL INSPECTION	NOTES	INSP	FLUORESCENT PENETRANT INSPECTION	DIA	%	RADIOGRAPH	COUPON REMOVED	CLIFF	COMMENTS
1	GB 13	SEAM 1	INCOMPLETE PENETRATION		NHA							
2	GB 13 A	SEAM 7	INCOMPLETE PENETRATION		NHA							
3	GB 13 B	JOINT 8	POSSIBLE HOLE		NHA							
4	GB 13 C	JOINT 8	INCOMPLETE PENETRATION		NHA							
5	GB 13 D	JOINT 23	POSSIBILITY		NHA							
6	GB 13 E	JOINT 26	UNDERCUT		NHA							
7	GB 14	JOINT 4	INCOMPLETE PENETRATION		RWP							
8	GB 14 A	JOINT 5	INCOMPLETE PENETRATION		RWP							
9	GB 14 B	JOINT 6	POSSIBLE CRACK		RWP							
10	GB 14 C	JOINT 7	INCOMPLETE PENETRATION		RWP							
11	GB 14 D	JOINT 8	POSSIBLE CRACK		RWP							
12	GB 14 E	JOINT 9	POSSIBLE CRACK		RWP							
13	GB 14 F	JOINT 9	POSSIBLE CRACK		RWP							
14	GB 14 G	JOINT 11	INCOMPLETE PENETRATION		RWP							
15	GB 14 H	JOINT 12	INCOMPLETE PENETRATION	ENTIRE WELD	RWP							
16	GB 14 I	JOINT 13	INCOMPLETE PENETRATION	ENTIRE WELD	RWP							
17	GB 14 J	JOINT 14	INCOMPLETE PENETRATION	ENTIRE WELD	RWP							
18	GB 14 K	JOINT 24	POSSIBLE HOLE		RWP							
19	GB 21	JOINT 13 (BAND)	POSSIBLE CRACK		RWP	CRACK, 4.25 L, BASE METAL	8	17	YES (3)		YES	START/STOP REPAIR
20	GB 21 A	JOINT 3			RWP							
21	GB 21 B	JOINT 10	POSSIBLE CRACK		RWP							
22	GB 21 C	INSP PORT	POSSIBLE CRACK		RWP	CRACKS, 2.25 & 2.75 LG, 180 APART, BASE METAL	8	20			YES	START/STOP REPAIR
23	GB 21 D	PATCH	POSSIBLE CRACK		RWP	CRACK, 2.00 LG, BASE METAL	8	8			YES	START/STOP REPAIR
24	GB 21 E	JOINT 12	POSSIBLE CRACK		LD	CRACK, .75 LG, BASE METAL	8	3			YES	START/STOP REPAIR
25	GB 21 F	JOINT 13 (BAND)	POSSIBLE CRACK		PP	CRACK, 2.00 LG, BASE METAL	8	8			YES	START/STOP REPAIR
26	GB 21 G	JOINT 13 (BAND)	POSSIBLE CRACK		PP	CRACK, .50 LG, BASE METAL	8	2			YES	START/STOP REPAIR
27	GB 21 H	JOINT 15	POSSIBLE PINHOLE		PP				YES (3)			
28	GB 21 I	JOINT 16	UNDERCUT		PP							
29	GB 21 J	JOINT 18			PP							
30	GB 21 K	JOINTS 19/20	ARC STRIKE		PP							
31	GB 22		NO WELD FLAWS									
32	GB 29	SEAM 13	POSSIBLE CRACKS (3)		PP	CRACK, 4.00 LG, BASE METAL	8	16	YES (3)		YES	BELLY BAND
33	GB 29 A	JOINT/SEAM 11	POSSIBLE CRACK		PP							
34	GB 29 B	JOINT 4	POSSIBLE CRACK		PP							
35	GB 29 C	JOINT 11	POSSIBLE CRACK		PP							
36	GB 29 D	JOINT 9	INCOMPLETE PENETRATION		PP							
37	GB 29 E	JOINT 12	POSSIBLE CRACKS (2)		PP						YES	
38	GB 29 F	JOINT 16	POSSIBLE PINHOLES (2)		PP							
39	GB 29 G	JOINT 23	POSSIBLE PINHOLE		PP							
40	GB 30	JOINT 18	INCOMPLETE PENETRATION		PP							
41	GB 37	JOINT 6	POSSIBLE CRACK	ENTIRE WELD	PP							
42	GB 37 A	JOINT 30	POSSIBLE CRACK	ENTIRE WELD	PP							
43	GB 37 B	JOINT 29	POSSIBLE CRACK	ENTIRE WELD	PP							
44	GB 37 C	JOINT 21	UNDERWELD		PP							
45	GB 37 D	SEAM 37	INCOMPLETE PENETRATION		NHA							
46	GB 37 E	SEAM 54	INCOMPLETE PENETRATION	ENTIRE WELD	NHA							
47	GB 37 F	JOINT/SEAM 55	ARC STRIKE		NHA							
48	GB 37 G	SEAM 56	INCOMPLETE PENETRATION	ENTIRE WELD	NHA							
49	GB 37 H	JOINT 63	OLD LEAK FIX		PP							
50	GB 37 I	SEAM 67	INCOMPLETE PENETRATION	ENTIRE WELD	NHA							
51	GB 37 J	SEAM 60	INCOMPLETE PENETRATION		NHA							
52	GB 37 K	JOINT 61	INCOMPLETE PENETRATION		NHA							
53	GB 37 L	JOINT 62	INCOMPLETE PENETRATION	ENTIRE WELD	NHA							
54	GB 37 M	JOINT 63	DENT AT WELD		PP							

LABEL	LOCATION	VISUAL INSPECTION	NOTES	NSP	FLUORESCENT PENETRANT INSPECTION	DIA	%	RADIOGRAPH	COUPON REMOVED	CLIFF	COMMENTS
55 GB 37 N	JOINT 66/67	ARC STRIKE		N/A							
56 GB 38	JOINT 12	INCOMPLETE PENETRATION		RP							
57 GB 45	JOINT 11	POSSIBLE CRACK		LD				YES (2)			
58 GB 45 A	SEAM 5	POSSIBLE CRACK		LD				YES (1)			
59 GB 45 B	JOINT 6	POSSIBLE CRACK		LD				YES (1)			
60 GB 45 C	JOINT 8	POSSIBLE CRACKS (2)		LD				YES (1)			
61 GB 45 D	JOINT 1	INSUFFICIENT WELD		LD							
62 GB 45 E	JOINT 9	POSSIBLE CRACK		LD							
63 GB 45 F	SEAM 9/JOINT 10	INCOMPLETE PENETRATION		N/A							
64 GB 45 G	JOINT 7	POSSIBLE CRACK		LD							
65 GB 45 H	JOINT 8	POSSIBLE CRACK		LD							
66 GB 45 I	JOINT 8	POSSIBLE CRACK		LD							
67 GB 45 J	JOINT 9	POSSIBLE CRACK		LD							
68 GB 45 K	JOINT 7	POSSIBLE CRACK		LD							
69 GB 45 L	JOINT 11	POSSIBLE CRACK		LD							
70 GB 45 M	JOINT 11	POSSIBLE CRACK		LD							
71 GB 45 N	SEAM 11	INCOMPLETE PENETRATION		N/A							
72 GB 45 O	JOINT 12-14	ARC STRIKE		LD							
73 GB 46	SEAM 2	POSSIBLE SUB-SURFACE CRK		N/A							
74 GB 46 A	SEAM 3	POSSIBLE CRACK		N/A							
75 GB 46 B	JOINT 6	CRATER		N/A							
76 GB 46 C	SEAM 8	POSSIBLE CRACK	ENTIRE WELD	N/A							
77 GB 53	JOINT 2	POSSIBLE CRACK		RMP							
78 GB 53 A	JOINT 3	POSSIBLE CRACK		RMP							
79 GB 53 B	JOINT 7	POSSIBLE CRACK		RMP							
80 GB 53 C	JOINT 8	POSSIBLE CRACK		RMP							
81 GB 53 D	JOINT 6	POSSIBLE CRACK		RMP							
82 GB 53 E	JOINT 11	POSSIBLE CRACK		RMP	CRACK, .125 LG, CENTER OF WELD	8	0.05			YES	LACK OF FILL ROD
83 GB 53 F	SEAM 12	POSSIBLE CRACK		RMP							
84 GB 53 H	JOINT 23	CRACK (STARTING)		RMP							
85 GB 54	JOINT 9	WELD SPLATTER & IRREG.		FP							
86 GB 54 A	JOINT 10	WELD SPLATTER & IRREG.		FP							
87 GB 54 B	JOINT 11	WELD SPLATTER & IRREG.		FP							
88 GB 61	JOINT 4	POSSIBLE CRACK		FP							
89 GB 61 A	JOINT 4	POSSIBLE CRACK (2)		FP							
90 GB 61 B	SEAM 13	INCOMPLETE PENETRATION		LD							
91 GB 62	JOINT 4	POSSIBLE CRACK		RMP							
92 GB 62 A	JOINT 4	POSSIBLE CRACK		RMP							
93 GB 62 B	JOINT 5	POSSIBLE CRACK		RMP							
94 GB 62 C	JOINT 5	INCOMPLETE PENETRATION		RMP							
95 GB 62 D	JOINT 6	INCOMPLETE PENETRATION		RMP							
96 GB 62 E	JOINT 6	INCOMPLETE PENETRATION		RMP							
97 GB 62 F	JOINT 6	INCOMPLETE PENETRATION		RMP							
98 GB 62 G	JOINT 7	INCOMPLETE PENETRATION		RMP							
99 GB 62 H	JOINT 8	INCOMPLETE PENETRATION		RMP							
100 GB 62 I	JOINT 10	CRATER		RMP							
101 GB 62 J	JOINT 10	POSSIBLE CRACK		RMP							
102 GB 62 K	JOINT 14	POSSIBLE CRACK		RMP							
103 GB 62 L	JOINT 14	POSSIBLE CRACK		RMP							
104 GB 62 M	JOINT 16	POSSIBLE HOLE		RMP							
105 GB 62 N	JOINT 17	INCOMPLETE PENETRATION		RMP							
106 GB 62 O	JOINT 17	INCOMPLETE PENETRATION		RMP							
107 GB 62 P	JOINT 18	INCOMPLETE PENETRATION		RMP							
108 GB 69	JOINT 4	POSSIBLE CRACK (2)									

LABEL	LOCATION	VISUAL INSPECTION	NOTES	NSP	FLUORESCENT PENETRANT INSPECTION	DIA	%	RADIOGRAPH	COUPON REMOVED	CLIFF	COMMENTS
109 GB 69 A	JOINT 10	INCOMPLETE PENETRATION		LD							
110 GB 69 B	JOINT 11	INCOMPLETE PENETRATION		LD							
111 GB 69 C	JOINT 16	UNDERCUT		RP							
112 GB 70	SEAM2	INCOMPLETE PENETRATION		LD	CRACK, 225 LG, CRCMF, BASE METAL, WELD REPAIR	8	9	YES (4)		YES	POOR FIT UP/HEAT
113 GB 70 A	JOINT 9	INCOMPLETE PENETRATION		LD							
114 GB 70 B	JOINT 13	POSSIBLE CRACK		LD							
115 GB 77	JOINT 13	INCOMPLETE PENETRATION		LD							
116 GB 77 A	JOINT 22-25	POSSIBLE PIN-HOLE (6)		RD							
117 GB 78	JOINT 5	POSSIBLE CRACK		LD				YES (1)			
118 GB 78 A	SEAM4	INCOMPLETE PENETRATION		LD							
119 GB 78 B	SEAM5	INCOMPLETE PENETRATION		LD							
120 GB 78 C	JOINT 8	INCOMPLETE PENETRATION		LD							
121 GB 78 D	SEAM17	INCOMPLETE PENETRATION		M-H							
122 GBC A	JOINT 7	POSSIBLE CRACK		RP							
123 GBC B	JOINT 5	POSSIBLE PIN-HOLE		RP							
124 GBC C	JOINT 8	POSSIBLE CRACK		RP							
125 GBC D	JOINT 9	UNDERFILL		RP							
126 GBC E	JOINT 18	INCOMPLETE PENETRATION		RP							
127 GBC F	JOINT 18	INCOMPLETE PENETRATION		RP							
128 GBC G	JOINT 19	INCOMPLETE PENETRATION		RP							
129 GBC H	JOINT 22	INCOMPLETE PENETRATION		RP							
130 GBC I	JOINT 33	INCOMPLETE PENETRATION		RP							
131 GBC J	JOINT 33	POSSIBLE PIN-HOLE		NHA							
132 GBC K	JOINT 33	INCOMPLETE PENETRATION		RP							
133 GBC L	SEAM26	INCOMPLETE PENETRATION		RP							
134 GBC M	JOINT 23	INCOMPLETE PENETRATION		RP							
135 GBC N	JOINT 20	INCOMPLETE PENETRATION		RP							
136 GBC O	JOINT 17	INCOMPLETE PENETRATION		RP							
137 GBME	JOINT 2	POSSIBLE PIN-HOLE		RP							
138 GBME A	JOINT 2	INCOMPLETE PENETRATION		RP							
139 GBME B	JOINT 2	INCOMPLETE PENETRATION		RP							
140 GBME C	JOINT 18	POOR FITUP		NHA							
141 GBME D	JOINT 22A	POSSIBLE CRACK		RMP							
142 GB MW A	SEAM1	INCOMPLETE PENETRATION		NHA							
143 GB MW B	JOINT 4 (BAND)	POSSIBLE CRACK	WAS GBM1								
144 GB MW C	JOINT 5	POSSIBLE CRACK									
145 GB MW D	SEAM5	POSSIBLE PIN-HOLES (3)		RP							
146 GB MW E	JOINT 7	POSSIBLE CRACK		RP							
147 GBNE	JOINT 2	POSSIBLE HOLE		RMP							
148 GBNE A	JOINT 6	INCOMPLETE PENETRATION		RMP							
149 GBNE A1	JOINT 23	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
150 GBNE A2	JOINT 36	INCOMPLETE PENETRATION		RP							
151 GBNE B	JOINT 7	INCOMPLETE PENETRATION		RMP							
152 GBNE B1	SEAM23-24	POSSIBLE CRACK	ENTIRE WELD	RMP							
153 GBNE B2	JOINT 37	POSSIBLE CRACK		LD							
154 GBNE C	JOINT 8	INCOMPLETE PENETRATION		RMP							
155 GBNE C1	JOINT 18	INSUFFICIENT WELD		RP							
156 GBNE C2	JOINT 38	POSSIBLE CRACK		LD							
157 GBNE D	JOINT 9	INCOMPLETE PENETRATION		RMP							
158 GBNE D1	JOINT 19	INCOMPLETE PENETRATION		RP							
159 GBNE D2	JOINT 42	POSSIBLE PIN-HOLE		RP							
160 GBNE E	JOINT 10	INCOMPLETE PENETRATION		RMP							
161 GBNE E1	JOINT 20	INSUFFICIENT WELD		RP							
162 GBNE E2	JOINT 44	INCOMPLETE PENETRATION		RP							

LABEL	LOCATION	VISUAL INSPECTION	NOTES	NSP	FLUORESCENT PENETRANT INSPECTION	DIA	%	RADIOGRAPH	COUPON REMOVED	CLIFF	COMMENTS
163 GB NE F	JOINT 11	INSURFICIENT WELD		RP							
164 GB NE F1	JOINT 21	INSURFICIENT WELD		RP							
165 GB NE F2	JOINT 45	INCOMPLETE PENETRATION		RP							
166 GB NE G	JOINT 12	INSURFICIENT WELD		RP							
167 GB NE G1	JOINT 23	POSSIBLE HOLE		RMP							
168 GB NE G2	JOINT 51	INCOMPLETE PENETRATION		RMP							
169 GB NE H	JOINT 6	INSURFICIENT WELD		RP							
170 GB NE H1	JOINT 29	INCOMPLETE PENETRATION		RP							
171 GB NE H2	SEAM 53-54	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
172 GB NE I	JOINT 7	INSURFICIENT WELD		RP							
173 GB NE I1	JOINT 29	TUNGSTEN INCLUSION		RMP							
174 GB NE I2	JOINT 55	INCOMPLETE PENETRATION		RMP							
175 GB NE J	JOINT 8	INSURFICIENT WELD		RP							
176 GB NE J1	JOINT 30	POSSIBLE CRACK		RP							
177 GB NE J2	JOINT 59	INCOMPLETE PENETRATION		RMP							
178 GB NE K	JOINT 10	UNDER FILLED		RP							
179 GB NE K1	SEAM 30-31	CRATER		RP							
180 GB NE K2	JOINT 52	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
181 GB NE L	JOINT 14	INCOMPLETE PENETRATION		RMP							
182 GB NE L1	JOINT 33	POSSIBLE CRACK		RP							
183 GB NE L2	JOINT 55	CENTER PUNCH MARKS (2)		RP							
184 GB NE M	JOINT 15	INSURFICIENT WELD		RP							
185 GB NE M1	JOINT 31	ARC STRIKES		RP							
186 GB NE M2	JOINT 4	INCOMPLETE PENETRATION		RP							
187 GB NE N	NEXT TO JOINT 15	UNDER FILLED		RP							
188 GB NE N1	SEAM 36-37	POSSIBLE CRACK		LD							
189 GB NE O	JOINT 16	INSURFICIENT WELD		RP							
190 GB NE O1	SEAM 36-37	INCOMPLETE PENETRATION		LD							
191 GB NE P	JOINT 15	INSURFICIENT WELD		RP							
192 GB NE P1	SEAM 37-38	POSSIBLE CRACK		LD							
193 GB NE Q	JOINT 16	INSURFICIENT WELD		RP							
194 GB NE Q1	JOINT 40	POSSIBLE HOLE		RMP				YES (8)			
195 GB NE R	JOINT 16	POSSIBLE CRACK		RP							
196 GB NE R1	JOINT 43	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
197 GB NE S	JOINT 17	IRREGULARITY		RP							
198 GB NE S1	JOINT 44	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
199 GB NE T	JOINT 18	INSURFICIENT WELD		RP							
200 GB NE T1	JOINT 45	POSSIBLE CRACK		RMP							
201 GB NE U	JOINT 19	INCOMPLETE PENETRATION		RP							
202 GB NE U1	SEAM 45-46	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
203 GB NE V	JOINT 20	POSSIBLE CRACK		RMP							
201 GB NE V1	JOINT 47	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
202 GB NE W	JOINT 21	INSURFICIENT WELD		RP							
203 GB NE W1	SEAM 47-48	INCOMPLETE PENETRATION	MOST of WELD	LD							
204 GB NE X	JOINT 21	POSSIBLE CRACK		RMP							
205 GB NE X1	JOINT 49	INCOMPLETE PENETRATION	ENTIRE WELD	RMP							
206 GB NE Y	JOINT 21	POSSIBLE HOLES		RMP							
207 GB NE Y1	JOINT 49	POSSIBLE CRACK		LD							
208 GB NE Z	SEAM 22-23	POSSIBLE CRACK		RMP							
209 GB NE Z1	JOINT 50	POSSIBLE CRACK/PIN HOLES		LD							
210 GB NW	JOINT 2	INCOMPLETE PENETRATION		N/A							
211 GB NW A	JOINT 3	POSSIBLE CRACK		RP							
212 GB NW AA	JOINT 59	INSUF. PEN/HOLE	ENTIRE WELD	RMP							
213 GB NW B	JOINT 5	INCOMPLETE PENETRATION		RMP							

LABEL	LOCATION	VISUAL INSPECTION	NOTES	NSP	FLUORESCENT PENETRANT INSPECTION	DIA	%	RADIOGRAPH	COUPON REMOVED	CLIFF	COMMENTS
214 GB NW/BA	JOINT 60	INCOMPLETE PENETRATION	ENTIRE WELD	RWP							
215 GB NW/C	JOINT 7	POSSIBLE PINHOLE		PP							
216 GB NW/CA	SEAM 60	INCOMPLETE PENETRATION	ENTIRE WELD	NHA							
217 GB NW/D	SEAM 7	INCOMPLETE PENETRATION		NHA							
218 GB NW/DA	JOINT 61	INCOMPLETE PENETRATION	ENTIRE WELD	RWP							
219 GB NW/E	TRUNK	POSSIBLE CRACK									
220 GB NW/EA	JOINT 67	AHC STRIKE		NHA							
221 GB NW/F	JOINT 8	POSSIBLE PINHOLE									
222 GB NW/G	JOINT 10	INCOMPLETE PENETRATION		NHA							
223 GB NW/H	JOINT 11	POSSIBLE CRACK		LD							
224 GB NW/I	JOINT 12	INCOMPLETE PENETRATION	ENTIRE WELD	NHA							
225 GB NW/J	JOINT 13	INCOMPLETE PENETRATION	ENTIRE WELD	LD							
226 GB NW/K	JOINT 14	POROSTY		LD							
227 GB NW/L	JOINT 15	POSSIBLE CRACK		LD							
228 GB NW/M	JOINT 16	POSSIBLE CRACK		RWP							
229 GB NW/N	JOINT 18	INCOMPLETE PENETRATION	ENTIRE WELD	RWP							
230 GB NW/O	JOINT 19	INCOMPLETE PENETRATION									
231 GB NW/P	JOINT 21	INCOMPLETE PENETRATION									
232 GB NW/Q	JOINT 23	POSSIBLE CRACKS (2)		NHA							
233 GB NW/R	JOINT 26	POSSIBLE CRACK		NHA							
234 GB NW/S	JOINT 27	POSSIBLE P.H./CRACK/P.		NHA							
235 GB NW/T	JOINT 28	POSSIBLE CRACK		NHA							
236 GB NW/U	JOINT 35	POSSIBLE CRACK		NHA							
237 GB NW/V	JOINT 40	POSSIBLE P.H./P.		NHA							
238 GB NW/W	JOINT 43	UNDERFILL		NHA							
239 GB NW/X	JOINT 54	POROSTY/ARC STRIKE		NHA							
240 GB NW/Y	JOINT 56	UNDERFILL	ENTIRE WELD	NHA							
241 GB NW/Z	JOINT 58	INCOMPLETE PENETRATION	ENTIRE WELD	RWP							
242 GB SE	JOINT 8	WELD NEEDS TO BE CLEANED	NOT INSP								
243 GB SE A	JOINT 9	WELD NEEDS TO BE CLEANED	NOT INSP								
244 GB SE B	JOINT 9	CRATOR		RWP							
244 GB SEC	JOINT 10	WELD NEEDS TO BE CLEANED	NOT INSP	RWP							
245 GB SE D	JOINT 11	WELD NEEDS TO BE CLEANED	NOT INSP	RWP							
246 GB SE E	JOINT 12	WELD NEEDS TO BE CLEANED	NOT INSP	RWP							
247 GB SWM	SEAM 2	INCOMPLETE PENETRATION		NHA							
248 GB SWM A	JOINT 4	INCOMPLETE PENETRATION		NHA							
249 GB SWM B	JOINT 4	POSSIBLE PINHOLE		NHA							
250 GB SWM C	SEAM 3	POSSIBLE CRACK (2)		NHA							
251 GB SWM D	JOINT 5	POSSIBLE PINHOLE		NHA							
252 GB SWM E	JOINT 5	POSSIBLE CRACK		PP							
253 GB SWM F	SEAM 7	INCOMPLETE PENETRATION		NHA							
254 GB SWM G	JOINT 8	INSUFFIC. PEN & UNDERCUT		NHA							
255 GB SWM H	SEAM 9	INCOMPLETE PENETRATION		NHA							
256 GB SWM I	SEAM 11	INCOMPLETE PENETRATION		NHA							
257 GB SWM J	SEAM 4	POSSIBLE PINHOLE (TRUNK)		PP							
258 GB SWM K	SEAM 13	INCOMPLETE PENETRATION		NHA							
259 GB SWM L	JOINT 14	POSSIBLE CRK & UNDERFILL		NHA							
260 GB SWM M	SEAM 22	INCOMPLETE PENETRATION		NHA							
261 GB SWM N	JOINT 25	POROSTY		NHA							
262 GB SWM O	JOINT 25	POSSIBLE CRACK		NHA							
263 GB SWM P	JOINT 26	INSUFFICIENT WELD		NHA							
264 GB SWM Q	SEAM 28	INCOMPLETE PENETRATION		NHA							

**DATE
FILMED**

9/29/93