ARMY RESEARCH LABORATORY

First Article Inspection of BSU-33B/B Bomb Fins

Marc S. Pepi

ARL-MR-378 NOVEMBER 1997

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Army Research Laboratory
Aberdeen Proving Ground, MD 21005-5066

ARL-MR-378 November 1997

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Weapons & Materials Research Directorate

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Abstract

A thorough examination of the manufacturing sequences involved in the fabrication of the BSU-33B/B bomb fins was performed by the U.S. Army Research Laboratory (ARL), Weapons and Materials Research Directorate (WMRD). The welding, zinc phosphate, and powder coating processes were evaluated with respect to the governing specifications, as was the finished product. With respect to the welding, the apparatus, procedures, and personnel all conformed to the governing requirements. The zinc phosphate process appeared suitable, as evidenced by the uniform coating on the First Article (FA) bomb fins. Also, coating weights of panels, which were run on the same production line as the FA bomb fins, met the governing requirement. The powder coating was applied according to the governing specification, and the physical attributes of the coating conformed to the requirements of this specification, with the exception of the fin wedges, which were slightly below the required thickness. Recommendations were offered as a result of this inspection.

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FIRST ARTICLE INSPECTION OF BSU-33B/B BOMB FINS

1. PURPOSE

The Naval Air Warfare Center (NAWC) requested the U.S. Army Research Laboratory (ARL) to provide technical support during a first article inspection (FAI) of BSU-33B/B bomb fins at Morris Tool and Die (MTD), Greeneville, Tennessee. ARL was asked to evaluate the welding, zinc phosphate, and powder coating processes, as well as the finished products. The recommendations listed are to provide completeness, rather than to indicate nonconformance.

2. CONCLUSIONS

2.1 Welding

MTD performed the welding operations for the BSU-33B/B in accordance with the governing specifications, and Mr. Scott Fawbush (the anticipated welder for the duration of the contract) was certified per MIL-STD-1595. The welding apparatus used by MTD also conformed to the governing requirements.

2.2 Zinc Phosphate

The five-stage spray zinc phosphate process at MTD conformed to the requirements of Federal specification TT-C-490. The coating weight and other stage measurements were all conducted in accordance with TT-C-490. Five fins subjected to the process while ARL representatives were present showed evidence of streaking and a minimal amount of white powder. MTD stated that this typically occurred to the first few fins which were coated with zinc phosphate and that once "warmed up," the coating is continuous and free from defects. Test panels that were run with the FAI bomb fins showed no evidence of streaking or white powder and conformed to TT-C-490.

2.3 Powder Coating

MTD performed the powder coating operations for the BSU-33B/B in accordance with the governing specification, WSD-C-0181. The coating process and equipment were inspected by ARL personnel. The physical attributes, including thickness, of the dried coating all conformed to WSD-C-0181 for all parts of the fin assembly except the fin wedges, which were slightly under the average thickness requirement of 3.0 to 5.0 mils (2.4 mils). The powder used was "out of date" according to the shelf life requirement; however, MTD experienced no application

difficulties, and ARL had no objections to its final characteristics. The powder was therefore determined to be adequate for the FAI as well as for the production of the bomb fins as long as application and appearance problems did not arise.

3. WELDING PROCESS

The BSU-33B/B bomb fins are welded in a number of locations, as summarized in Table 1.

Table 1

BSU-33B/B Weldments

Part	Drawing Number	Weld Specification
Spar Assembly, Conical Fin	2846770	MIL-W-12332
Ring, Adapter, Conical Fin	4902079	MIL-W-6873
Fin Assembly	923AS150	MIL-W-12332
Port, Fuze	923AS153	MIL-STD-2219
Skin, Conical Fin	923AS286	MIL-W-12332
Nut Assembly, Self-Locking	923AS292	MIL-W-6858
Fin Assembly, Bomb, BSU-33B/B	923AS641	MIL-STD-2219

ARL personnel witnessed pull testing performed on test coupons sectioned from the welded adapter ring (butt weld) and on the welded conical fin skin (seam weld). In addition, the welding apparatus was examined, as well as the MTD written weld procedures.

3.1 Pull Testing

Pull testing was performed on nine butt weld coupons sectioned from the adapter ring and on five seam weld coupons from the conical fin skin. The governing drawings required a pull load of 2,600 pounds per linear inch of coupon. This load was based upon a nominal carbon steel sheet thickness of 0.060 inch. However, the tolerance for this sheet is $\pm$0.006 inch. Therefore, the thickness could range from 0.054 inch to 0.066 inch. With any variation from the nominal thickness (and width), the final pull load must be adjusted accordingly. This interpolation was deemed acceptable by both the Government representatives and the MTD representatives present at the FAI. The carbon steel sheet with which the conical fin skin was fabricated was 0.057 inch thick, as measured during the FAI. The 0.057-inch thickness was 95% of the nominal 0.060

thickness. Therefore, each actual load was divided by 0.95 to calculate the adjusted load. The actual load of coupon 3D was also divided by 0.75, since the width was only 0.75 inch, rather than the nominal 1.0 inch. Table 2 lists the actual loads attained during MTD testing with ARL personnel present, as well as the adjusted loads (with accompanying comments). Appendix A contains the actual loads attained during testing at MTD. Table 3 contains the results of testing performed by MTD before ARL arrived. Pull testing was performed on a Baldwin 120,000-pound capacity tension/compression machine, No. 040-1984, Model No. 12-H. The machine was calibrated on 31 January 1996 and was due for calibration 30 January 1997. The pull rate used was approximately the required 0.5 inch/minute. The pull rate was manually controlled and difficult to maintain at exactly the required rate, especially once yielding occurred.

Table 2

Weldment Coupon Pull Loads
Testing Witnessed by ARL

Specimen	Weld Type	Actual Load (lb)	Width (inch)	Thickness (inch)	Adjusted Load (lb)	Failure Location	Comments
1B	Butt	2630	1.0	0.057	2770	Parent	Retest*
2A	Butt	2580	1.0	0.057	2715	Parent	Retest*
2C	Butt	2550	1.0	0.057	2685	Parent	
3A	Butt	2720	1.0	0.057	2865	Parent	~2.0"/min
3B	Butt	2620	1.0	0.057	2760	Parent	
3C	Butt	2620	1.0	0.057	2760	Parent	
5A	Butt	2510	1.0	0.057	2640	Parent	
5B	Butt	2615	1.0	0.057	2750	Parent	
5C	Butt	2530	1.0	0.057	2665	Parent	
4D	Seam	2650	1.0	0.057	2790	Parent	
4E	Seam	2730	1.0	0.057	2875	Parent	
5D	Seam	2680	1.0	0.057	2820	Parent	
5E	Seam	2740	1.0	0.057	2885	Parent	
3D	Seam	2030	0.75	0.057	2850	Parent	

* - Retested after grip slippage

Table 3

Weldment Coupon Pull Loads Testing Performed by
MTD Before ARL Arrived

Specimen	Weld Type	Actual Load (lb)	Width (inch)	Thickness (inch)	Adjusted Load (lb)	Failure Location
1A	Butt	2650	1.0	0.057	2790	Parent
1C	Butt	2620	1.0	0.057	2760	Parent
2B	Butt	2520	1.0	0.057	2655	Parent
4A	Butt	2630	1.0	0.057	2770	Parent
4B	Butt	2530	1.0	0.057	2665	Parent
4C	Butt	2630	1.0	0.057	2770	Parent
1D	Seam	2620	1.0	0.057	2760	Parent
1E	Seam	2570	1.0	0.057	2705	Parent
2D	Seam	2640	1.0	0.057	2780	Parent
2E	Seam	2650	1.0	0.057	2790	Parent
3E	Seam	2620	1.0	0.057	2760	Parent

3.2 Pull Testing Recommendations

1. It was observed that the grip faces used for testing were worn. This contributed to slippage during testing. These faces should be replaced to reduce slippage.

2. ARL recommended to Mr. Gary Kirk that specimens should be gripped closer to the weld to help avoid slippage. This technique was successful.

3. ARL also recommended conducting a series of tests in the future to assure that the 0.5-in./min pull rate was being achieved.

3.2.1 *Welding Apparatus*

A tour was conducted of the off-site MTD welding facility, which included inspection of the welding apparatus. Equipment included a resistance welding machine that was used to weld the ends of the fins, a subsequent Niagara 32-ton press which basically flattened each of the four fins in preparation for the projection welds, a Progressive welding machine which performed the conical fin skin seam weld, a T/W welding machine which was used to spot weld the spar assembly pieces (four total) together, an Allied spot welder used to join the self-locking nut assembly, and two Airco Dip-Pak 200-arc welding units used for the ring adapter weld and the

final welding of the fin to the conical skin. Each of the first four welding units inspected was equipped with an Entron 460V controller. Mock fins were subjected to the welding operation at each stage for ARL to witness.

3.2.2 *Review of MTD MIL-W-12332 Resistance Weld Procedure*

As shown in Table 1, the conical fin spar assembly, the fin assembly, and the conical fin skin are resistance welded in accordance with MIL-W-12332. The MTD welding procedures were compared to the major requirements of MIL-W-12332 for conformance:

- Paragraph 3.2: The welding procedure shall include

    a. Metal alloy composition
    b. Thickness range of the metal
    c. Weld time range
    d. Metal cleaning procedure
    e. Welding current range
    f. Roll spot or seam welding travel speed

- MTD: MTD provided ARL with a resistance welding manual for spot, projection and seam welding for low carbon steel, which was written in accordance with MIL-W-12332. This three-page manual listed the major requirements of MIL-W-12332. ARL was also provided with resistance weld procedures for eight different resistance welds on the BSU-33B/B bomb fin. The eight individual written procedures (see Appendix B) were BSU-33B/B specific and compared as follows:

a. Metal alloy composition	-Only type of material listed, not composition
b. Thickness range of the metal	-Conformance
c. Weld time range	-Conformance
d. Metal cleaning procedure	-Procedure says part shall be clean; no method
e. Welding current range	-Conformance
f. Welding travel speed	-None listed

- Paragraph 4.1: The maximum carbon content shall be less than 0.20%
  The maximum manganese content shall be less than 0.60%

- MTD: The maximum carbon content of components from the BSU-33B/B bomb fin is 0.10% and the maximum manganese content of components from the BSU-33B/B bomb fin is 0.50%. Both of these contents are within specification.

- Paragraph 5.1: The welding machine shall consist of the following:

    a. Suitable source of energy
    b. Suitable electrodes
    c. Means of adequately cooling the electrodes
    d. Means of reliably controlling the magnitude of the current, welding force, and the time of current flow

- MTD:

a. Suitable source of energy	-Conformance
b. Suitable electrodes	-Conformance
c. Means of adequately cooling the electrodes	-Conformance
d. Means of reliably controlling the magnitude of the current, welding force and the time of current flow	-Conformance

- Paragraphs 6.2 and 7.3.1: All welds shall be subject to visual inspection, and the outer surfaces of the welds shall be smooth and free of cracks, tip pickup, pits, metal expulsion and other defects.

- MTD: A total of six welded and unpainted fins were visually examined by ARL with no evidence of the aforementioned defects.

- Paragraph 6.3: The welded assembly or specimens shall be peel tested in accordance with paragraph 7.3.3.

- MTD: ARL was provided with the results of MTD peel testing of preproduction spot welds. The three spot welds failed at 3,700, 3,575, and 3,650 pounds, respectively, which conformed to the minimum requirement of 2,600 pounds. These results are listed in Appendix C. The MTD result sheet did not include the resultant nugget diameters as a result of this testing.

Recommendations Concerning MIL-W-12332:

1. MTD should include the "material composition" on the resistance welding procedure sheets.
2. MTD should include the "method of cleaning" on the resistance welding procedure sheets.
3. MTD should list the "roll spot or seam welding travel speed" requirement on the resistance welding procedure sheets.
4. MTD should include "nugget size" on the peel test result sheet.

3.2.3 *Review of MTD MIL-STD-2219 Fusion Weld Procedure*

As shown in Table 1, the fuze port and the fin assembly are fusion welded in accordance with MIL-STD-2219. The MTD welding procedures were compared to the major requirements of MIL-STD-2219 for conformance.

- Paragraph 1.2: Fusion welding shall be accomplished using flux cored arc welding (FCAW), gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), oxyfuel welding (OFW), plasma arc welding (PAW), submerged arc welding (SAW), or shielded metal arc welding (SMAW).

- MTD: MTD uses the GMAW procedure for BSU-33B/B fusion weldments.

- Paragraph 3.1.2: Operators shall be qualified per MIL-STD-1595.

- MTD: ARL was provided with the MTD welder certification sheet (see Appendix D). Mr. Scott Fawbush was the certified welder and the anticipated welder for the duration of the BSU-33B/B contract. The certification showed that Mr. Fawbush's specimens passed radiographic, magnetic particle, and visual inspection. The results of destructive testing of representative specimens welded by Mr. Fawbush met the required 2,600-pound pull force minimum (specimens F and G were 0.75 inch wide, and 0.057 inch thick for adjusted pull forces of 2,710 and 2,610 pounds, respectively). The certification sheet does not state that the welder was certified per MIL-STD-1595. However, when asked, MTD representatives stated that the qualification was per MIL-STD-1595.

- Paragraph 5.4.2.3: All Class B welds shall be radiographically inspected when specified on the drawing or in the contract.

- MTD: ARL was provided with the results of radiography performed by the Industrial NDT (nondestructive test) Company, a Liberty Technologies Inc. (see Appendix E). Test specimens, as well as bomb fin assemblies, were inspected. ARL also examined the radiographic films provided by the Industrial NDT Company and noted no nonconforming defects.

- Table 5-3: Minimum fillet weld sizes.

- MTD: The fillet weld sizes, as measured on the FAI bomb fins, met the minimum requirements of Table 5-3.

- Para 5.4.5.1: Any weldment with cracks in the base metal shall be rejected.

• MTD: Visual examination of the FAI bomb fins did not reveal any cracks in the weldments of the parent material.

3.2.4 *Weld Depth of Penetration*

A representative butt (Specimen 5B) and seam (Specimen 5E) weld pull test coupon were returned to ARL for examination of the penetration depth through metallography. The samples were sectioned, mounted, and metallographically prepared. The polished samples were etched with 1% nital in order to reveal the depth of penetration. Figures 1 and 2 show the butt and seam weld, respectively. The photomacrographs show an acceptable depth of penetration for each of the welds.

Recommendation concerning MIL-STD-2219:

1. MTD should ensure that the welder certification sheet states that the welder is certified per MIL-STD-1595.

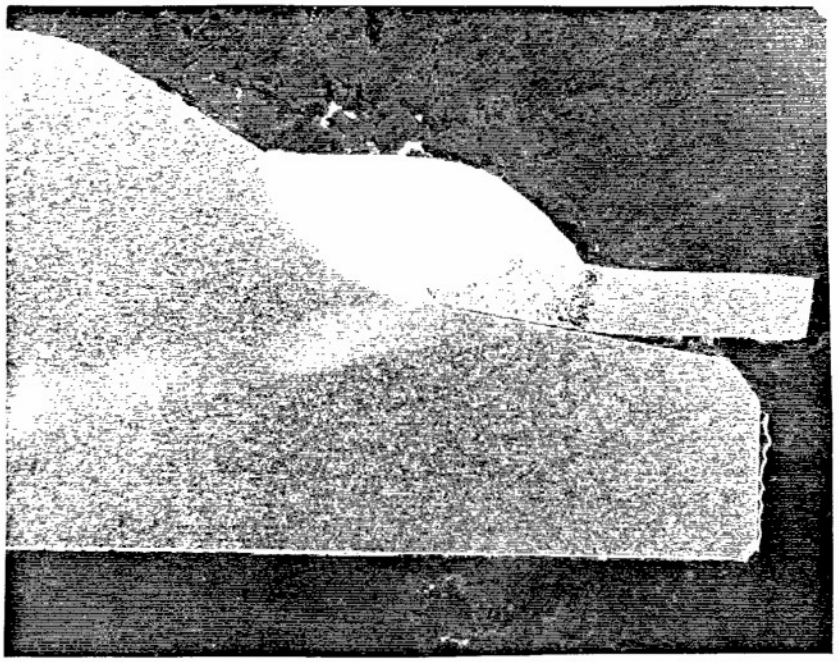

Figure 1. Macrograph of the Butt Weld From Pull Test Specimen No. 5B. (The depth of penetration was acceptable; magnification 7.5x.)

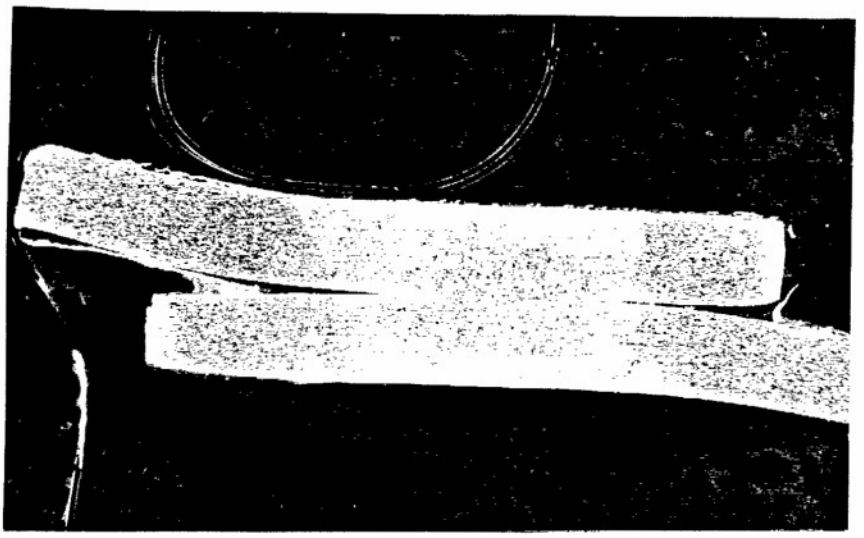

Figure 2. Macrograph of the Seam Weld From Pull Test Specimen No. 5E. (The depth of penetration was acceptable; magnification 10x.)

4. ZINC PHOSPHATE PROCESS

The BSU-33B/B bomb fins were required to be coated with zinc phosphate per the governing drawings. Although MTD was not involved in an actual production run at the time of the FAI, Mr. Joe Morris, Jr., ran a total of five bomb fins through the system. The process began with the hand wiping of each fin with a solution of Intex Product No. 405L (major component: toluene) mixed 10% 405L with 90% water. The bomb fins were hung on a conveyor system with the adapter ring end up and fuze support down. The conveyor system ran at a rate of 3 feet per minute. The zinc phosphate process encompassed a five-stage spray system. The first stage was hot alkaline cleaning with EZE No. 330C, followed by an ambient temperature clean water rinse with continuous overflow. The third stage was zinc phosphate with EZE Nos. 176 and 8695, followed by another ambient temperature clean water rinse with continuous overflow. The final stage was the application of a rust-inhibitive rinse EZE No. 8828. The five fins showed some evidence of streaking and minimal white powder after emerging from the zinc phosphate process, which, according to Mr. Kirk, is typical of the first few parts that are treated with zinc phosphate. These fins also exhibited a very light gray coating. The fifth fin was darker and showed less streaking and white powder than the first fin, suggesting that the process was getting progressively better. Mr. Kirk assured ARL that parts exhibiting any white powder are not subsequently top coated and are removed from the line. ARL also examined 4- by 6-inch panels that were treated with zinc phosphate, along with the FAI bomb fins. These panels showed no evidence of streaking

or white powder and were very uniform in color (dark gray). The MTD zinc phosphate procedure sheets and process were compared to the major requirements of TT-C-490:

- Paragraph 3.3a: Parts shall be free of oil, grease, dirt, scale, and foreign matter.

- MTD: The toluene hand wiping of the fins before the zinc phosphate process appeared to effectively eliminate foreign matter and welding smut from the fins.

- Paragraph 3.3b: Rinsing shall be performed to remove alkali or acid from the cleaning operation. The rinsing stations shall be tested for contaminants every 4 hours of production.

- MTD: Conformance.

- Paragraph 3.3c: Drying shall be the final stage of each cleaning process unless followed immediately by the Type I process.

- MTD: Parts are dried in a furnace at 285° to 310° F for approximately 10 minutes (310° F is optimal for the application of the powder coating). This drying stage immediately follows the five-stage zinc phosphate process.

- Paragraph 3.5.1a: Type I coatings shall be continuous.

- MTD: As mentioned previously, the first five fins that were treated with phosphate at the beginning of the day exhibited streaking and slight evidence of white powder; however, panels coated with the FAI fins (after the process had been running) conformed to Paragraph 3.5.1a.

- Paragraph 3.5.1c: The coating weight shall be tested at least every 4 hours of production.

- MTD: Conformance (see Appendix F for an example of the MTD panel coating weight test, as well as bath measurements).

- Paragraph 3.5.1d: Panels subjected to salt spray testing shall show no more than 1/8 inch creepage, blistering, or loss of adhesion from the scribe mark.

- MTD: The 1000-hour salt spray testing for the entire coating system (See Powder Coating Section) was in progress at the time of inspection. After approximately 600 hours of testing, only 1/16 inch creepage was noted from the scribe marks, and there was no evidence of blistering. It was anticipated that the panels would pass the requirements of Paragraph 3.5.1d.

- Paragraph 4.2.4.1: Total alkali contamination.

- MTD: Conformance.

- Paragraph 4.2.4.2: Total acid contamination.

- MTD: Conformance.

- Paragraph 4.2.6: Phosphate coating weights.

- MTD: The coating weight was measured in accordance with TT-C-490, and typical panel weights (as shown in Appendix F) showed conformance to Type I coating weights (150 to 500 mg/ft^2).

- Paragraph 6.5: Required stages of the zinc phosphate process.

- MTD: MTD met the minimum stage requirement listed in TT-C-490 (Appendix G is a copy of MTD's zinc phosphate description of process):

a. Stage 1:	Cleaning
b. Stage 2:	Rinse (125° to 180° F) with constant overflow of fresh water.
c. Stage 3:	Zinc phosphate
d. Stage 4:	Water rinse with constant overflow
e. Stage 5:	Acidified rinse

4.1 Other Zinc Phosphate Comments

The temperature controls on the alkali cleaner bath (Stage 1), the zinc phosphate bath (Stage 3), and the sealer bath (Stage 5) had not been calibrated since 1991. Joseph Morris, Jr., indicated that the temperatures were periodically measured manually with a hand-held thermometer for conformance.

5. POWDER COATING PROCESS

The BSU-33B/B bomb fins are required to be powder coated per the governing specifications. MTD powder coated a total of five bomb fins for ARL to witness and inspect. The bomb fins came to the coating station immediately after the 285° to 310° F drying stage following the phosphating process. Because of the minimal cooling time before powder coating, the bomb fins were coated at an elevated temperature conducive to good coating adhesion and appearance. The powder coating station consisted of Nordson spray equipment, a powder collection booth, powder collection filters, reclamation receptacles, and Valspar Powder Code No. 1007A77. The oversprayed powder can be blown out of the collection filters and reused. The sprayed parts were then transferred to a baking oven where they were baked at 380° to

400°F for approximately 20 to 25 minutes, which was adequate to cure the powder. In the interest of time and money, only the most pertinent performance requirements were verified for conformance. They included salt spray resistance, flexibility, knife testing, and adhesion testing. ARL examined three final article bomb fins and five cured powder coated bomb fins and was provided with 10 powder coated panels to test further.

5.1 Salt Spray Resistance

• Paragraph 3.13: A cured film shall show undercutting of no more than 6.3 mm (0.25 inch) from the lines scored to base metal. There shall also be no blistering, wrinkling, or loss of adhesion of the coating nor any general surface corrosion or pitting.

• Paragraph 4.7.10: Two panels shall be exposed in accordance with American Society for Testing and Materials (ASTM) B 117.

• Paragraph 4.7.10: Exposure time shall be 1000 hours minimum (4.7.10).

• MTD: These panels passed this test at ARL. The 1000-hour salt spray testing was in progress at MTD at the time of inspection. After approximately 600 hours of testing, only 1/16 inch creepage was noted from the scribe marks, and there was no evidence of blistering. It was anticipated that the panel would pass the requirements of Paragraph 4.7.10.

5.2 Film Properties

• Paragraph 3.4: a. Coatings shall have a total dry film thickness for interior and exterior surfaces of 3 to 5 mils.

b. Coating shall be free of runs, sags, and streaks.

• MTD: The MTD technician had the ability to apply a total dry film thickness (DFT) of 3 to 5 mils. All parts with the exception of the fin wedges (2.4 mils DFT) met this requirement. The coating appearance conformed to the requirement.

Triglycidyl Isocyanurate (TGIC)

Average Thickness	Area (mils)
Fin	3.2
Door	3.0
Wedge	2.4

5.3 Flexibility

• Paragraph 3.6: The cured film shall show no cracking or loss of adhesion in the bend areas.

• Paragraph 4.6.3: Coating shall be 3 mils ±0.5 mil thick.

• Paragraph 4.7.3: Panels bent 180° over a 0.5-inch mandrel in accordance with ASTM-D-1737.

• MTD: Conformance.

5.4 Knife Test

• Paragraph 3.7: The cured film shall adhere tightly and not flake, crack, or powder from the metal. The cut shall show beveled edges.

• Paragraph 4.7.4: Perform on flat portion of flexibility panel; use standard knife at ~30° angle.

• Paragraph 4.7.4: Procedure in accordance with FED-STD-141, Method 6304.

• MTD: Conformance.

5.5 Adhesion

• Paragraph 3.8: The cured film shall show no lifting, flaking or other signs of loss of adhesion when tested.

• Paragraph 4.7.5: Two parallel scratches shall be made through the coating 1 inch apart, no less than 2 inches long, using a stylus on two panels.

• Paragraph 4.7.5: A 1-inch wide strip of masking tape in accordance with ASTM D 3652 shall be placed perpendicular to scratches. The tape shall be pressed down using two passes of a 5-pound rubber roller.

• Paragraph 4.7.5: The tape shall be removed in one abrupt motion, at 90° to each panel.

• MTD: Conformance.

5.6 Recommendations Concerning the Powder Coating Process

a. The average coating thickness on the fin wedges should be increased from the present 2.4 mils to the requirement of 3 to 5 mils.

b. Overall, the coating thickness measurements were on the low end of the required range. ARL noticed that the spacing between the fins should be increased to allow sufficient time to apply a 3.0- to 5.0-mil coating DFT. However, even with the very first bomb fin, the average coating DFT was just over 3.0 mils. This suggests that the technician barely has enough time to apply a 3.0-mil coating DFT before the bomb fin leaves the spray station at the present line speed rate of 3 ft/min.

c. Written procedures were provided to ARL for the powder coating process; however, no stipulation is made to qualify the spray technician to the process. Establishing tighter control methods of the spray process appears to be necessary.

d. While the Valspar powder product appeared satisfactory at the time of the FAI, it is recommended that in the future the shelf life requirement be followed.

6. IMPROVEMENTS MADE SINCE THE 15 TO 18 APRIL 1991 MK83 FAI

*1991: No written welding procedures had been established.
*1996: Welding procedures were available for both the fusion and resistance welding processes.

*1991: No record of welder certification per MIL-STD-1595 existed.
*1996: ARL was provided with the welder certification sheet, but the sheet failed to state that the welder was certified per MIL-STD-1595.

*1991: Grease was observed on parts subjected to the zinc phosphate process, the results of poor prior cleaning.
*1996: No signs of grease were noted on the five fins subjected to the zinc phosphate process, indicating adequate prior cleaning.

*1991: Streaking and white powder were noted on the parts *during production.*
*1996: Streaking and white powder were noted on parts subjected to the zinc phosphate process, but, as mentioned earlier, this was not a production run, and MTD assured ARL that this condition would have merited adjustment of the accelerator concentration, and that the parts would not have been top coated. Also, test panels subjected to the zinc phosphate process with the FAI fins showed no evidence of streaking or white powder.

*1991: No temperature calibration was performed at the various stages of the zinc phosphate process.

*1996: Although the temperature controls have not been calibrated since 1991, manual temperature measurement is performed by MTD personnel at the appropriate intervals.

*1991: Bomb fins were allowed to collect dust and other shop debris before the primer and paint were applied.

*1996: Bomb fins on an overhead lift proceed from the hand clean operation to the zinc phosphate process, to the dry-off furnace and subsequently directly to the powder coating booth, allowing essentially no lag time where foreign matter could possibly collect.

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APPENDIX A

BSU-33 B/B FIN ASSEMBLY WELD TEST REPORT

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BSU-33 B/B FIN ASSEMBLY WELD TEST REPORT

CONTRACT NO.: DAAA09-93-C-0102

DRAWING NO: 923AS641 REV. D, BSU-33 B/B FIN ASSEMBLY

DATE 11-27-96 LOT NO First Article QUANTITY 5

SPECIMEN DESCRIPTION	ACTUAL TEST RESULTS - *2600 LB-FORCE MINIMUM				
	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5
A FIN SKIN TO ADAPTER RING	2650	2580	2720	2630	2510
B FIN SKIN TO ADAPTER RING	2630	2520	2620	2530	2615
C FIN SKIN TO ADAPTER RING	2620	2550	2620	2630	2530
D SIDE SEAM	2620	2640	2030	2650	2680
E SIDE SEAM	2570	2650	2620	2730	2740

*FORCE APPLIED AT 1/2"/MIN

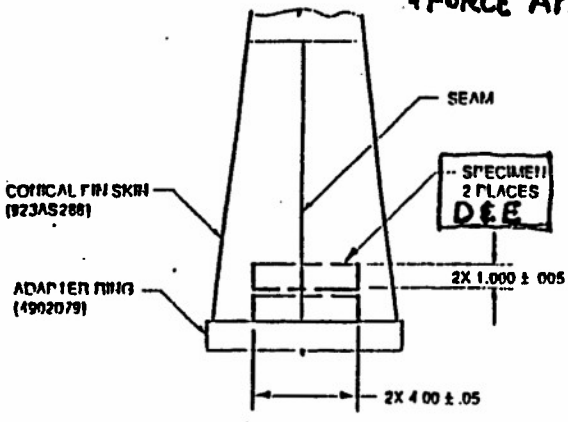
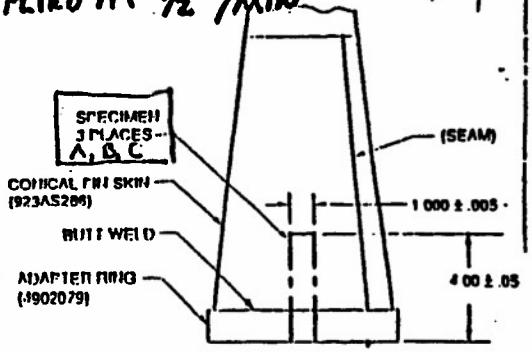


FIGURE 4 Size and location of seam weld specimens



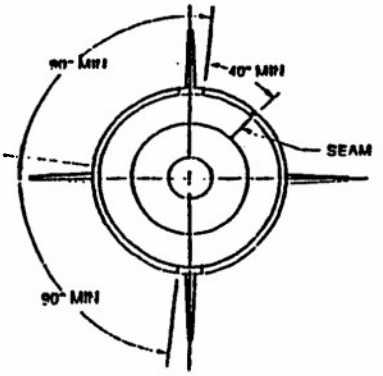


FIGURE 1. Size and location of specimens.

IDENTIFY ALL SPECIMENS WITH UNIT AND SPECIMEN NO. (5A, 5B, 5C etc)

PASS	FAIL
☒	☐

INSPECTOR Gary W. Kirk

DATE 11-27-96

12-3-96

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APPENDIX B

RESISTANCE WELDING PROCEDURES

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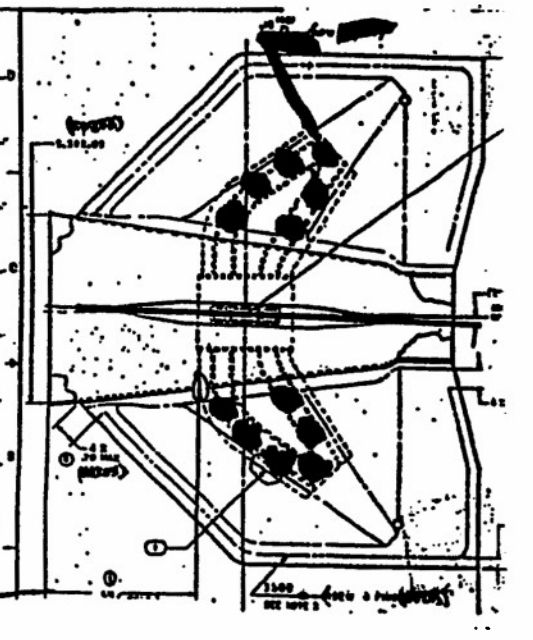
RESISTANCE WELDING PROCEDURES

DRAWING NO. 423AS150 REV. F

PART NAME FIN ASSEMBLY

DESCRIPTION OF WELD

RESISTANCE WELD SPAR TO FIN, 4 HITS - 48 PROJECTIONS.



MATERIAL USED

THICKEST PART .060 + .006

THINNEST PART .060 - .006

TYPE OF MATERIALS ASTM A1620

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME 82 MIN. SETTING 77 MAX. SETTING 87

WELD TIME 38 MIN. SETTING 33 MAX. SETTING 43

HOLD TIME 15 MIN. SETTING 10 MAX. SETTING 20

ELECTRODE FORCE (PSI on CYLINDER) 40

MIN. SETTING 30 MAX. SETTING 50

CURRENT SETTING 78 MIN. SETTING 73 MAX. SETTING 83

ELECTRODE USED COPPER ELECTRODE 4 x 6

MACHINE USED

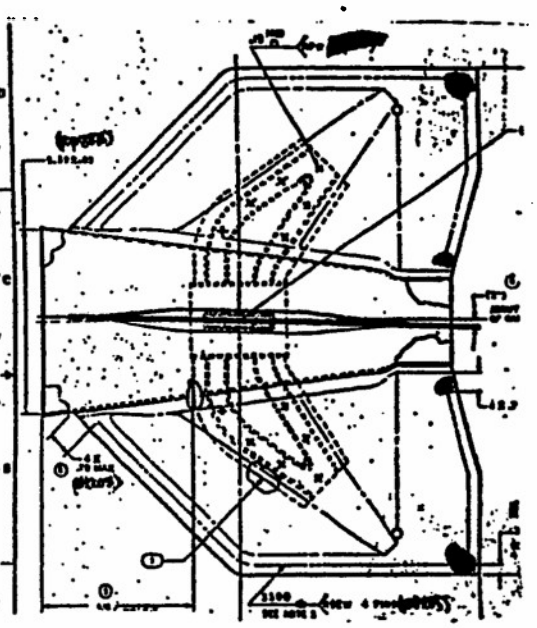
RESISTANCE WELDING PROCEDURES

DRAWING NO. 923AS150 REV. F

PART NAME FIN ASSEMBLY

DESCRIPTION OF WELD

SPOT EACH FIN AT LOCATIONS SHOWN (8 SPOTS TOTAL)



MATERIAL USED

THICKEST PART .060 + .006

THINNEST PART .060 − .006

TYPE OF MATERIALS ASTM A/620

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME 64 MIN. SETTING 59 MAX. SETTING 69

WELD TIME 43 MIN. SETTING 38 MAX. SETTING 48

HOLD TIME 30 MIN. SETTING 25 MAX. SETTING 35

ELECTRODE FORCE (PSI on CYLINDER) 25

MIN. SETTING 20 MAX. SETTING 30

CURRENT SETTING 50 MIN. SETTING 40 MAX. SETTING 60

ELECTRODE USED COPPER TIPPED ELECTRODE .300 DIA.

MACHINE USED

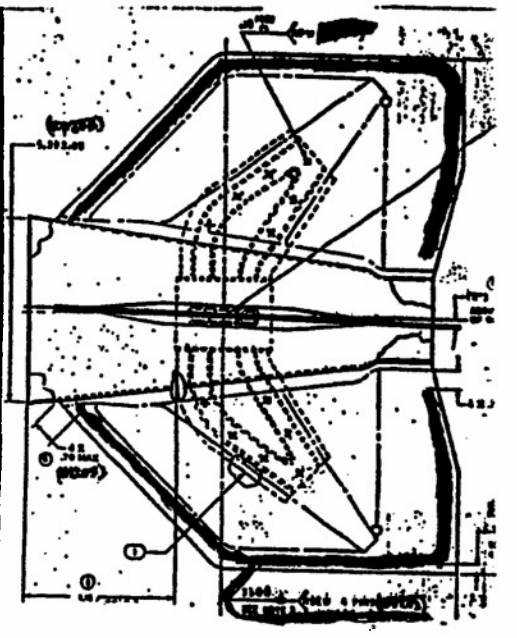
RESISTANCE WELDING PROCEDURES

DRAWING NO. 923AS150 REV. F

PART NAME FIN ASSEMBLY

DESCRIPTION OF WELD

RESISTANCE WELD FOUR (4) FINS PER ATTACHED DRAWING.



WELD SPEED - 60"/MIN.

MATERIAL USED

THICKEST PART .060 + .006

THINNEST PART .060 - .006

TYPE OF MATERIALS ASTM A/620

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME N/A MIN. SETTING _____ MAX. SETTING _____

WELD TIME 8 HEAT 4 COOL MIN. SETTING 7 HEAT 3 COOL MAX. SETTING 9 HEAT 5 COOL

HOLD TIME N/A MIN. SETTING _____ MAX. SETTING _____

ELECTRODE FORCE (PSI on CYLINDER) 70

MIN. SETTING 50 MAX. SETTING 90

CURRENT SETTING 58 MIN. SETTING 53 MAX. SETTING 63

ELECTRODE USED COPPER WHEEL WITH 5/16 WELDING FACE

MACHINE USED _____

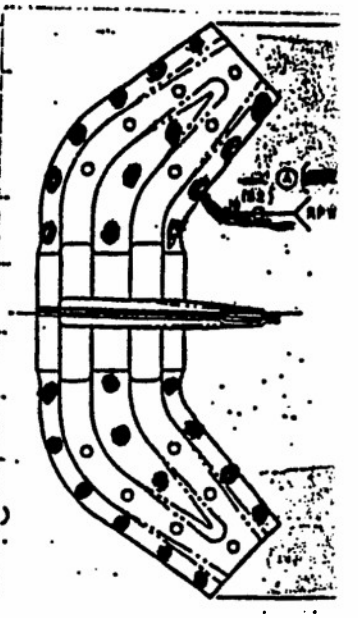
RESISTANCE WELDING PROCEDURES

DRAWING NO. 2846770 REV. G

PART NAME SPAR ASSEMBLY, CONICAL FIN

DESCRIPTION OF WELD

RESISTANCE WELD 4 SPAR SEGMENTS TOGETHER AT WELD PROTECTIONS AS INDICATED ON DRAWING (52 PLACES)



MATERIAL USED

THICKEST PART .060 ± .006

THINNEST PART .060 ± .006

TYPE OF MATERIALS

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME 85 MIN. SETTING 80 MAX. SETTING 90

WELD TIME 33 MIN. SETTING 28 MAX. SETTING 38

HOLD TIME 10 MIN. SETTING 05 MAX. SETTING 15

ELECTRODE FORCE (PSI on CYLINDER) 40

MIN. SETTING 30 MAX. SETTING 50

CURRENT SETTING 65 MIN. SETTING 60 MAX. SETTING 70

ELECTRODE USED

MACHINE USED

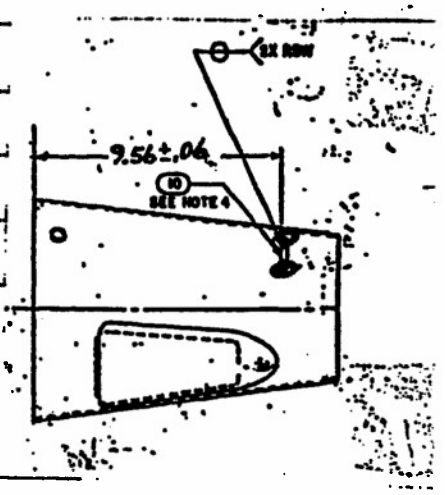
RESISTANCE WELDING PROCEDURES

DRAWING NO. 923A5275 REV. D

PART NAME WIRE GUIDE, ARMING

DESCRIPTION OF WELD

RESISTANCE WELD WIRE GUIDE TO SKIN I.A.W. NOTE #4. WELD PER DRAWING 923A5641 (SEE DIAGRAM) →



NOTE 3. RESISTANCE WELD IN ACCORDANCE WITH MIL-W-12332.

NOTE 4. ARMING WIRE GUIDE, ITEM 10, SHALL BE IN LINE WITH SNAP BUSHING HOLE, OR MAY BE MOVED TO MISS SEAM WELD.

MATERIAL USED

THICKEST PART .060 + .006

THINNEST PART .060 - .006

TYPE OF MATERIALS ASTM A/621

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME 64 MIN. SETTING 59 MAX. SETTING 69

WELD TIME 37 MIN. SETTING 32 MAX. SETTING 42

HOLD TIME 30 MIN. SETTING 25 MAX. SETTING 35

ELECTRODE FORCE (PSI on CYLINDER) 25

MIN. SETTING 20 MAX. SETTING 30

CURRENT SETTING 47 MIN. SETTING 42 MAX. SETTING 52

ELECTRODE USED COPPER TIPPED ELECTRODE .300 DIA.

MACHINE USED

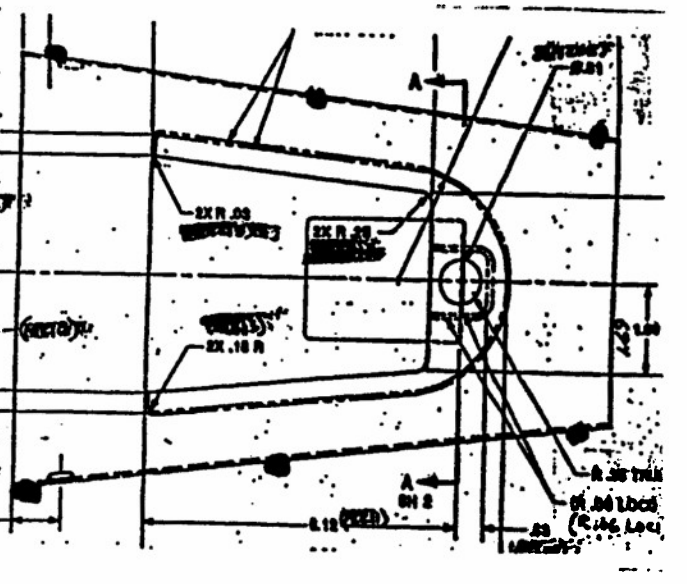
RESISTANCE WELDING PROCEDURES

DRAWING NO. 923AS286 REV. B

PART NAME SKIN, CONICAL FIN

DESCRIPTION OF WELD

SPOT SKINS TOGETHER AT BOTH ENDS AND MIDDLE PRIOR TO RESISTANCE WELDING (6 PLACES, 3 EACH SIDE)



MATERIAL USED

THICKEST PART .060 + .006

THINNEST PART .060 + .006

TYPE OF MATERIALS ASTM A/620

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME 84 MIN. SETTING 82 MAX. SETTING 86

WELD TIME 45 MIN. SETTING 40 MAX. SETTING 45

HOLD TIME 30 MIN. SETTING 30 MAX. SETTING 35

ELECTRODE FORCE (PSI on CYLINDER) 20

MIN. SETTING 10 MAX. SETTING 20

CURRENT SETTING 76 MIN. SETTING 72 MAX. SETTING 82

ELECTRODE USED COPPER TIPPED ELECTRODE .300 DIA.

MACHINE USED

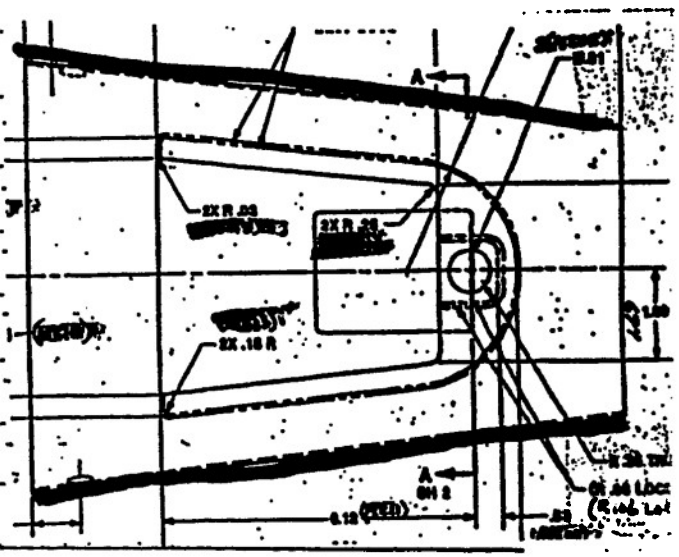
RESISTANCE WELDING PROCEDURES

DRAWING NO. 923A5286 REV. B

PART NAME SKIN, CONICAL FIN

DESCRIPTION OF WELD

RESISTANCE WELD SKINS TOGETHER, BOTH SIDES (2 WELDS)



MATERIAL USED

THICKEST PART .060 + .006

THINNEST PART .060 − .006

TYPE OF MATERIALS ASTM A/620

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME N/A MIN. SETTING — MAX. SETTING —

WELD TIME 6 HEAT 5 COOL MIN. SETTING 5 HEAT 4 COOL MAX. SETTING 7 HEAT 6 COOL

HOLD TIME N/A MIN. SETTING — MAX. SETTING —

ELECTRODE FORCE (PSI on CYLINDER) 45

MIN. SETTING 40 MAX. SETTING 50

CURRENT SETTING 20 MIN. SETTING 20 MAX. SETTING 25

ELECTRODE USED COPPER WHEEL WITH 5/16 WELDING FACE.

MACHINE USED

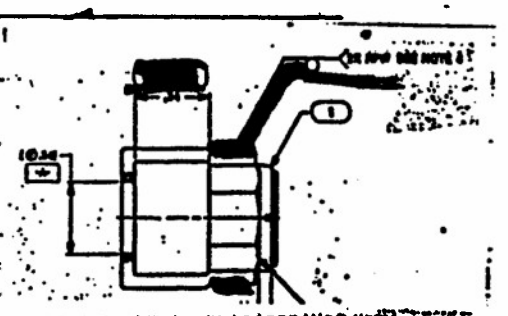
RESISTANCE WELDING PROCEDURES

DRAWING NO. 923AS292 REV. G

PART NAME NUT ASSEMBLY, SELF-LOCKING

DESCRIPTION OF WELD

PLACE NUT AND RETAINER IN SPECIAL HOLDING FIXTURE FOR ALIGNMENT AND RESISTANCE WELD.



NOTE 4. RESISTANCE PROJECTION WELD, IN ACCORDANCE WITH MIL-W-6858, GROUP 2, CLASS B, BEFORE ASSEMBLING AND CRIMPING INSERT, ITEM 3, IN PLACE. (AFTER WELDING THE THREADS SHALL SHOW NO EVIDENCE OF DISTORTION).

MATERIAL USED

THICKEST PART .1130

THINNEST PART .060

TYPE OF MATERIALS STAINLESS

PROCESSED CONDITION OF MATERIAL TO BE WELDED CLEAN (FREE OF DIRT AND OIL)

WELDING SEQUENCE TIMING SCHEDULE

SQUEEZE TIME 30 MIN. SETTING 25 MAX. SETTING 35

WELD TIME 52 MIN. SETTING 47 MAX. SETTING 57

HOLD TIME 20 MIN. SETTING 15 MAX. SETTING 25

ELECTRODE FORCE (PSI on CYLINDER)

MIN. SETTING 10 MAX. SETTING 20

CURRENT SETTING 50 MIN. SETTING 45 MAX. SETTING 55

ELECTRODE USED COPPER TIPPED ELECTRODE .300 DIA.

MACHINE USED

APPENDIX C

RESISTANCE WELD TEST RESULTS

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RESISTANCE WELD TEST RESULTS

Part No. 1380506 Rev E Description SKIN ASSEMBLY

Type of Weld-- Spot ☒ Projection ☐ Seam ☐

Tests Required

Visual ☒ Macroscopic ☐

Peal ☒ Shear-Peal ☐

Pull ☒

Thickest Part .090 Thinnest Part .075

Minimum Nugget Size .29

Minimum Pull Test N/A

Minimum Width of Seam N/A

Description of Weld

	PULL TEST
#1	3700
#2	3575
#3	3650

Pass ☒ Fail ☐

Signature Joe C. Moore

Date 4/6/88

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APPENDIX D

WELDER CERTIFICATION AND TEST REPORT FOR BSU-33 B/B

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WELDER CERTIFICATION AND TEST REPORT BSU-33 B/B

Name of Welder:	SCOTT FAWBUSH
PII Redacted [redacted]	[redacted]
Date of Test	11-27-96

Radiographic Test Results ☒ Pass ☐ Fail

Magnetic Particle Inspection ☒ Pass ☐ Fail

Visual Inspection ☒ Pass ☐ Fail

Destructive Tests

Specimen Number	Minimum Force	Actual Force
Adapter Ring to Fin Skin "A"	2600 #	2820
Adapter Ring to Fin Skin "B"	"	2770
Adapter Ring to Fin Skin "C"	"	2790
Fin Skin to Fin Quarter "D"	"	2630
Fin Skin to Fin Quarter "E"	"	2890
Fuze Support to Fin Qtr. "F"	"	1930
Fuze Support to Fin Qtr. "G"	"	1860 ← 3/4" Thick
Skin Support to Fin Skin "H"	Bend Test	Circle One: (Pass) Fail

3/4" [illegible]

.057" Thick

2610

Force to be Applied at a rate of ½ inch per minute

Welder is Certified to weld BSU-33 B/B Conical Fin Assembly

Inspector's Authorized Signature: Gary W. Kirk

Date: 11-27-96

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APPENDIX E

NDT EXAMINATION REPORT

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Industrial NDT Company

A Liberty Technologies Inc., Company

Corporate Headquarters
8550 Dorchester Road
N. Charleston, SC 29420
803-767-4636
803-552-9797 Fax

SAVANNAH, GA SHREVEPORT, LA RICHMOND, VA MOBILE, AL N. AUGUSTA, SC
CHARLESTON, SC JACKSONVILLE, FL HOUSTON, TX

MAGNETIC PARTICLE EXAMINATION REPORT ☐ Nuclear ☑ Non-Nuclear

To:	From:	Date:
	R Smoldt	12-2-96

Project: MAGNETIC PARTICLE INSPECTION OF MK83 CONICAL FIN ASSEMBLY CERTIFICATIONS

Contract No. or Purchase Order No.: | INDT Job No.: 38653

Item	Weld ☑	Structural ☐	Casting ☐	Machinery ☐	Mach. Parts ☐	Pipe ☐	N/A ☐	Other: N/A
	Non-Weld ☐	Plate ☐	Pipe ☐	Bar ☐	Casting ☐	Mach. Parts ☐	N/A ☐	Other N/A

Material	Size:	No. of Pieces	Type of Base Metal	Type of Filler Material	Weld
	N/A	2	CFe		☐ N/A ☐ Smooth ☑ As Welded

Location	Location:	System
	MTD, INC / LIBERTY KPT, TN	MK83 CERTIFICATION SPECIMENS

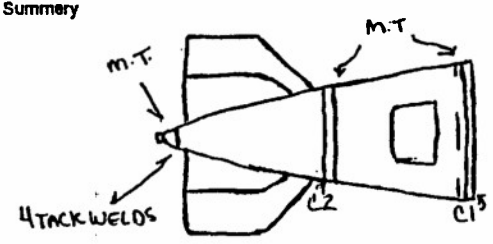
Acceptance Standards	Procedure
MIL-STD-2219	Q.C.P. 500

Type of Check	Initial	Plate Edge	In Process	Back Gouge	Root Pass	Repair	24 Hr.	7 Day	Final
	☒	☐	☐	☐	☐	☐	☐	☐	☒

Type of Inspection					Other:
	☒ Longitudinal	☐ Coil	☐ DC Probe	☒ Continuous	
	☒ Wet	☐ Dry	☐ Direct Contact	☐ Residual	
	☐ Circular	☐ AC Prod	☒ Yoke		

MT Equipment/Model	Surface Preparation Method
PARKER DA400	WIPE CLEAN
Inspection Medium/Color	**Demagnetization Method / Equipment**
WET FLUORESCENT	N/A

Reference: Summery ☐ See Attachment



Results of Inspection:
MK83 SPECIMENS
J. MEASE: 1 TACK WELD SHOWS 1 INDICATION 1/64" IN LENGTH
S. FAWBUSH: 3 OUT OF 4 TACK WELDS SHOW 1/64" INDICATIONS
ALSO 1/8" INDICATION ON C1 WELD

Copy To:	Requested By:	Reported By (Technician):
	JOE MORRIS	BLAND / CULBERTSON
	☐ Customer Specifications ☑ Accept ☐ Reject	NDT Supervisor: RC Smoldt

NOTICE:
THIS EXAMINATION REPORT IS A REPORT OF THE RESULTS OF THE NDT PROCEDURE ACTUALLY PERFORMED BY THIS COMPANY
IT IS SUBJECT TO THE LIMITATIONS OF THE TEST WHICH WERE UTILIZED. BY FURNISHING
THIS REPORT, *INDUSTRIAL NDT COMPANY* DOES TESTED SPECIMEN. INDT FORM: 500-1

LIBERTY Technical Services

Corporate Headquarters
8550 Dorchester Road
N. Charleston, SC 29420
(803) 767-4638

08742

CLIENT	INTERPRETER/LEVEL	RADIOGRAPHER	LTS JOB NO	P O NO	DATE
MTO	G. KEPLINGER II	D. Brand			11-27-96

ISOTOPE/X-RAY	DIA. X LEN/KV	CURIES/MA	FOCAL SPOT SIZE	DISTANCE	TIME	FILM PROCESSING	FILM TYPE	FILM TECHNIQUE	PB SCREENS
PANTAK	140KV	4MA	.060 x 2	21"	1min	MANUAL	AGFA D4	Single	010"v 010

WELD PROCESS	MATERIAL SPEC.	MATERIAL DIAMETER	MATERIAL THICKNESS	PENETRAMETER	SHIM	ACCEPTANCE STANDARD
GAW	CFE	Missel	.215"	Asme 12	N/A	MIL-STD-453 1595

DESCRIPTION: WELDER QUALIFICATION J.M. = J. MEASE
S.F = S. FAWBUSH

REMARKS:

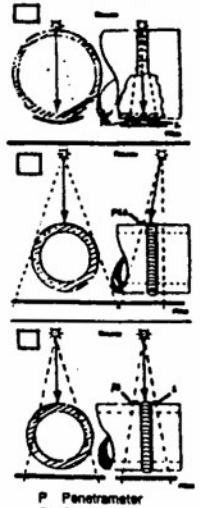
FITTING, SEAM OR JOINT NUMBER	FILM INTERVAL NUMBER	WELDER IDENTIFICATION	PENETRAMETER SIZE	PENETRAMETER QUALITY LEVEL	SLAG	POROSITY	POROSITY WITH TAIL	CRACK	LACK OF PEN	LACK FUSION	INTERNAL CONVEXITY	INTERNAL CONCAVITY	TUNGSTEN	MELT-THROUGH	BURN-THROUGH	CRATER-PIT	OXIDATION	INTERNAL UNDERCUT	EXTERNAL UNDERCUT	ALIGNED INDICATIONS	WELD CONTOUR	MIS-MATCH	NO DISCERNABLE INDICATION	VISUAL CONCERNS			SEE REMARKS	ACCEPT	REJECT
J.M	0-1		12	2t																								✓	
	1-2																											✓	
	2-3																											✓	
	3-4																											✓	
	4-5																											✓	
	5-6																											✓	
	6-0																											✓	
S.F	0-1		12	2t																								✓	
	1-2																											✓	
	2-3																											✓	
	3-4																											✓	
	4-5																											✓	
	5-6																											✓	
	6-0																											✓	

RADIOGRAPHIC TECHNIQUES

End View | Side View

SINGLE WALL

DOUBLE WALL



P Penetrameter
S Shim
L Location Marker
( ) OTHER

NOTE: THIS EXAMINATION REPORT IS A REPORT OF THE RESULTS OF THE NDT PROCEDURES ACTUALLY PERFORMED BY THIS COMPANY. IT IS SUBJECT TO THE LIMITATIONS OF THE TESTING SPECIFICATIONS AND PROCEDURES WHICH WERE UTILIZED BY FURNISHING THIS REPORT, LIBERTY TECHNICAL SERVICES DOES NOT GUARANTEE ANY CONDITION OF THE TESTED SPECIMEN.

REVIEWED AND ACCEPTED BY:

CUSTOMER'S REPRESENTATIVE _____ DATE _____

LTS FORM 2105

APPENDIX F

PHOSPHATE PROCESS CONTROL DATA SHEET

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MTD,INC. GREENEVILLE,TENNESSEE
PHOSPHATE PROCESS CONTROL DATA SHEET
PART NUMBER 923A5641 Rev.G **PART NAME** BSU-33 B/B
CONTROL NUMBER First Article **OPERATOR IN CHARGE** Dee Jones

DATE/TIME	Alkaline (PH) Tank # 1	Rinse (PH) Tank # 2	Zinc Phosphate Concentration Tank # 3	Zinc Phosphate Accelerator Tank # 3	Rinse (PH) Tank # 4	Rust Inhibiting Seal (PH) Tank # 5	Test Panel Coating Weight	Sample MG per Square Foot
12/2/96 0900	4.24	6.5	9.7 Ratio	2.090	6.0	8.5	① 424 mG	SQ/FT
							② 420 mG	SQFT
							③ 365 mG	SQ/FT

DATE/TIME	Alkaline (PH) Tank # 1	Rinse (PH) Tank # 2	Zinc Phosphate Concentration Tank # 3	Zinc Phosphate Accelerator Tank # 3	Rinse (PH) Tank # 4	Rust Inhibiting Seal (PH) Tank # 5	Test Panel Coating Weight	Sample MG per Square Foot

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APPENDIX G

PROCESS CONTROL FOR CLEANING AND METAL PREPARATION TO CONFORM TO MIL-STD-171D

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PROCESS CONTROL FOR CLEANING AND METAL PREPARATION TO CONFORM TO MIL-STD-171 D FINISH 5.1.1 (TT-C-490C, TYPE I)

1. Scope

This process control covers the cleaning and pre-treatment of ferrous metals for the application of organic coatings (paint, varnish, lacquer, enamel and etc.) The process is designed to clean, apply a zinc phosphate coating and final rinse chromic acid sealer.

2. Description of Process

The following process will be utilized to conform to the requirements of TT-C-490C, Method III, Type I.

2.1 Equipment - The process equipment will consist of a five stage spray system as follows:

EZE# (~~8648~~ 3300) Stage 1 - Hot alkaline cleaning at 130-150°F for a minimum of 1 minute.

Stage 2 - Ambient temperature clean water rinse with continuous overflow with fresh water entering at the bottom of the tank for a min. of 30 sec.

EZE# (#176 8695) Stage 3 - Application of zinc compound and zinc phosphate accelerator for 1 minute at 140-160°F.

Stage 4 - Ambient temperature clean water rinse with continuous overflow with fresh water entering at the bottom of the tank for a min. of 30 sec.

EZE# (8228) Stage 5 - Rust Preventative Rinse at 125-180°F with a ph of 8.5-9.0 for a minimum time of 30 seconds.

3. Chemicals to be Used

The chemicals to be utilized to comply with the requirements of TT-C-490C, Method III, Type I are set forth below.

Stage 1 - Alkaline Cleaning - EZE Product Number ~~8648~~ 330C will be used in Stage 1 at a concentration of 3-5%. (See attached Product Data Bulletin.)

Stage 2 - Clean Water Rinse - Clean tap water will be used in Stage 2. Constant overflow will be maintained to avoid excessive contamination.

Stage 3 - Zinc Phosphate - EZE Product No. #176 (Zinc Compound) and EZE Product No. 8695 (Zinc Phosphate Accelerator) will be utilized in Stage 3. Concentrations of #176 will be 1-2% free acid and 15-20% total acid. The concentration of IPN8695 will be maintained at 1-2%. (See attached Product Bulletins.)

Stage 4 - Clean Water Rinse - Clean tap water will be used in Stage 4. Constant overflow will be maintained to avoid excessive contamination.

Stage 5 - RUST PREVENTATIVE RINSE - EZE Product 8228 (RUST-PREVENTATIVE RINSE will be used in Stage 5. Concentration will be a Ph of 8.5 to 9.0. (See attached Product Bulletin.)

4. Quality Assurance Procedures

This section of this procedures is to set for the quality assurance procedures and tests necessary to comply with specification TT-C-490C, Method III, Type I. Tests required are as follows and each series of test will be set forth under the Test Procedures Section of this Process Control Procedure.

a. Chemical tests on the 5 stage cleaning and phosphating system.

(b) Phosphate coating weight test.

(c) Film thickness of organic coating (where required).

(d) Film adhesion of organic coating (where required).

(e) Salt spray resistance (where required).

4.1 Chemical Tests on the (5) Stage Cleaning and Phosphating System

4.1.1 Stage 1 - Alkaline Cleaning - Following the final rinse at least 2 test specimens shall be dried and examined for rust, corrosion products and soils. Frequency of this examination shall be every four hours. If the specimens show signs of soils or corrosion products all products processed since the last examination shall be rejected and corrective action taken. After corrective action tests will resume at a frequency of one hour until there is no sign of corrosive products or soil. Testing frequency will then revert to two specimens each four hours.

Tests on Stage 1 chemical concentration will be run at a frequency of once for each 4 hours operation as per Test Procedure No. CS-1 of this Process Control Procedure. Frequency of tests as per CS-1 and disposing of Stage 1 chemicals will depend upon the nature of the soil, amount of soil and contaminants, and hours of operation after initial production runs. Fixed times will be established for testing and chemical maintenence. Results of tests will be recorded and records maintained on MTD Form No. 22.

4.1.2 Stage 2 - Clear Water Rinse - Tests for chemical contamination of Stage 2 will be performed at a frequency of once each 4 hours of operation as per Test Procedure CS-2. When the

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NO. OF COPIES	ORGANIZATION
2	ADMINISTRATOR DEFENSE TECHNICAL INFO CENTER ATTN DTIC DDA 8725 JOHN J KINGMAN RD STE 0944 FT BELVOIR VA 22060-6218
1	DIRECTOR US ARMY RESEARCH LABORATORY ATTN AMSRL CS AL TA RECORDS MANAGEMENT 2800 POWDER MILL RD ADELPHI MD 20783-1197
1	DIRECTOR US ARMY RESEARCH LABORATORY ATTN AMSRL CI LL TECHNICAL LIBRARY 2800 POWDER MILL RD ADELPHI MD 207830-1197
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13. ABSTRACT *(Maximum 200 words)*

A thorough examination of the manufacturing sequences involved in the fabrication of the BSU-33B/B bomb fins was performed by the U.S. Army Research Laboratory (ARL), Weapons and Materials Research Directorate (WMRD). The welding, zinc phosphate, and powder coating processes were evaluated with respect to the governing specifications, as was the finished product. With respect to the welding, the apparatus, procedures, and personnel all conformed to the governing requirements. The zinc phosphate process appeared suitable, as evidenced by the uniform coating on the First Article (FA) bomb fins. Also, coating weights of panels, which were run in the same process as the FA bomb fins, met the governing requirement. The powder coating was applied according to the governing specification, and the physical attributes of the coating conformed to the requirements of this specification, with the exception of the fin wedges, which were slightly below the required thickness. Recommendations were offered as a result of this inspection.

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