R and D TARADCOM LABORATORY

TECHNICAL REPORT

NO. 12311

JOINING STEEL ARMOR - INTERMIX

March 1979

by B. A. SCHEVO

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U.S. ARMY TANK-AUTOMOTIVE
RESEARCH AND DEVELOPMENT COMMAND
Warren, Michigan 48090

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March 1979

AMS: 3197.6D.4329

TARADCOM

ARMOR AND COMPONENTS FUNCTION

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ABSTRACT

Several welding processes were used to deposit weld metal into full penetration joints in standard armor. The optimum process, or combination thereof, determined by results of ballistic firing tests, was used to join armors of different types and hardnesses. The types were: (1) standard, (2) high hardness, and (3) Electro Slag Remelt (ESR). The combinations used were: standard to high hardness, standard to ESR, and ESR to high hardness. A mock hull was fabricated of these armors to determine their compatibility in a single structure. Radiography revealed the hull to be free of flaws.

FOREWORD

This project has been performed as part of the U. S. Army Manufacturing Methods and Technology Program for the timely establishment of manufacturing processes and the efficient production of current or future defense programs.

First, an optimum welding procedure was developed and tested. The procedure was then applied in joining various types of steel armor test plates, followed by satisfactory fabrication of a mock hull containing all the armors.

INTRODUCTION

Welding steel armor in production has been conventionally performed using only one method - the stick electrode. Development programs have shown that the gas metal arc (MIG) process may also be used. The possibility of merging these processes could result in weldments being produced using the best qualities of both, plus a bonus of speed inherent in the MIG process. The high energy processes, such as the electron beam and laser are not considered here.

Joining armors of differing properties, such as higher hardness, greater purity and richer chemistry has not been investigated to a great extent.

A preheat temperature which would be compatible to the three armors would markedly simplify joining techniques when all are used in a single structure.

This report will determine the proper welding procedures to permit joining of the armors.

OBJECTIVE

This project will provide methods for manufacturing steel armored vehicles with a higher level of ballistic protection than that offered to present, or to meet present requirements with a reduction in weight. Joining methods will be established on a production application basis so that they may be utilized early in the design stage. Availability of proven production techniques will reduce lead time in the application of new weight having armor materials and illustrate how the various combinations may be joined.

SUMMARY

Several welding processes in a single weldment may be accomplished very readily. Welding open groove joints with stick electrodes for the root pass and the gas

metal arc process for the remaining passes proved to be the method freest of complications and most likely to be high quality. It was also the fastest. The gas metal arc and shielded metal arc processes were used.

Armors of different hardness and chemical compositions were successfully welded into single ballistic H-plate test specimens. In addition, a mock hull was welded from the various armors. It met radiographic inspection requirements very readily.

CONCLUSIONS

The combination of welding processes which produced the most consistent high quality weldments in the least time was that in which the root pass was deposited with a stick electrode and the remaining passes with the gas metal arc (MIG) process, either the standard or pulsed.

Combinations of the three types of armors tested could be joined with the above welding procedure. This procedure also required the least time to manually complete a weld joint. It was applied successfully in welding a mock hull.

RECOMMENDATIONS

As new armor types are developed, attempt to join them with those already in the system.

Revise the armor welding Spec MIL-W-46086 to include all the processes available today.

MATERIALS/EQUIPMENT

a. Armor:

1. Standard armor Spec MIL-S-12560

2. High Hardness armor Spec MIL-S-46100

3. ESR Armor SAE-4340

b. Electrodes:

1. Spec MIL-E-19822, Type MIL-B88

2. Spec MIL-E-18038, Type MIL-10016

3. Spec MIL-E-13080, Type MIL-307-16

c. Welding Machines:

1. Rectifier, 400 amp

2. Standard MIG CV, 500 amp

3. Pulsed arc MIG CV, 300 amp

4. Short arc MIG CV, 250 amp

TEST PROCEDURES - INTERMIXED PROCESSES

Welding test were conducted on 1-1/2 inch I-plates which are weldments resulting from joining two 6 x 12 inch I-plates on the long dimension. Various combinations of welding processes and types of electrodes were used. After a variety of designs, it was decided, based on radiographic inspection and macroscopic examination, to test ballistic specimens which contained 60° double bevels in standard armor as follows:

Plate 1A - All ferritic. Root pass vertical - up with short arc process. All other passes MIG in flat position.

Plate 2A - Root pass ferritic stick electrode (includes plates 3A thru 6A). All other passes ferritic MIG.

Plate 3A - Except for root, all inside passes ferritic MIG - cover passes austenitic stick.

Plate 4A - One side MIG - other stick - all ferritic.

Plate 5A - One side ferritic MIG - Other side austenitic stick.

Plate 6A - Offset double bevel - root pass ferritic stick - all others ferritic MIG.

(See Table I and Armor Data Sheets, Figures 1 thru 43).

TEST PROCEDURE - INTERMIXED ARMOR

Three types of steel armor were acquired and welded into one inch thick I-plates. The intermixed process developed above worked out satisfactorily, based on radiographic examination and macroscopic investigation. The welding procedure was then translated to ballistic H-plates. The following combinations of armor were used:

a. Standard to high hardness

b. Standard to ESR

c. ESR to high hardness

Ballistic firing was performed in accordance with Spec MIL-W-46086. The results are recorded in Firing Record AR34163.

As a whole, the ballistic test plates performed very well when fired at specification velocity and sub-zero temperatures of -23 to 28°F (5° to 2.5°C). At ambient temperatures, the ESR to high hardness and standard to high hardness armors performed best. The ESR to standard armor broke catastrophically in the ESR materials in Plate 6X. The other plate (7X), excluding the sub-zero one shot, barely missed being acceptable by about 1/2-inch. It had been fired considerably (16%) over the specification velocity.

H-plates 7X and 10X failed to meet radiographic standards because of a transverse crack in the cross bar (ESR) and a transverse crack in the lower right leg (homo armor), respectively.

These flaws did not adversely affect the ballistic results of the test plates. Neither did the flaws propagate.

Weld parameters covering these plates are contained in Figures 10 thru 33.

MOCK HULL

In an effort to determine how well the three types of armor would function in a structure, a mock hull was fabricated by welding with the procedures developed herein. Figures 34, 35, 36 and 37, show the hull during construction. Joint design is illustrated in Figure 38.

RESULTS AND DISCUSSION

Edge Preparation - All plate edge preparations were performed with oxy-acetylene flame cutting equipment followed by light grinding to remove scale formed by the cutting. Dye penetrant inspection showed this to be a flaw-free procedure for the standard and high hardness armors. The ESR steel cracked on several occasions when cut at room temperature. The cracks were transverse and occurred on the beveled edges, sometimes penetrating as deep as one inch. On other occasions, while making a cut, the flame would flare up and gouge the plate as if an inclusion had been hit. Sometimes a cleanup cut made about 1/2-inch back would produce the desired joint edge, and sometimes not. The ESR material seemed quite temperamental. It probably comes from its history of having been rolled and rerolled from previous sizes to produce material needed for this program. At the time of procurement, ESR steel was rather rare and not readily available.

A preheat of 200F (93C) seemed to be beneficial, producing good cuts. But the same plate, when cooled, could be recut at room temperature and again give a good cut.

INTERMIXED PROCESSES

Procedure test plates were welded for establishing joint geometry and weld pass sequence. A 60° included angle joint was used to permit manipulation of the welding gun. A low preheat, 105F (40C) was used to impose severity on the test plates, which were 1-1/2 inches thick standard armor.

Several welding processes were used for depositing metal into the weld joints. In addition to being the most important, the root pass is the most difficult to deposit satisfactorily in an open groove fitted with a back-up bar. It's hard enough with a stick electrode, let alone a MIG gun. At least with the stick electrode, there is a puddle of slag (melted coating) on which the depositing weld metal can ride. With the MIG process, there is nothing but back-up bar on which to ride; hence, the chance of poor fusion or back-up bar pick-up. A root pass weld can be deposited in a weld joint having a 3/32 inch maximum root opening without a back-up bar; however, a high degree of skill is required. To eliminate this need for very high skill, it was decided that the root pass be deposited with stick electrode in the flat position.

The deposition rates for the standard and pulsed gas metal arc processes are practically identical. Table II shows the similarity based on test plates totalling 33 feet (990 cm) of welding.

Procedure plates nos. 1 and 2 were welded similarly except for the root passes. On plate no. 1 the root pass was welded ferritically vertical-up with the dip transfer process. This process, used in the vertical-up position, produces a higher quality weld than when used in the flat position, in a groove weld. It virtually eliminates the occurrence of flaws and obviates the need for a back-up bar. But it is very time consuming, depositing at a rate in the root pass of about one inch per minute (25mm/min) compared to 3.3 inch per minute (84mm min) for the austenitic stick electrodes and 2.4 inch per minute (61mm/min)

for the ferritic stick electrodes in the flat position. Ferritic stick electrodes were used for the root pass in plate no. 2. Some plates contained as many as three welding processes. (See Table I)

Plate no. 3, for instance, contained the stick, standard MIG and pulsed MIG processes. The root passes were consistently deposited with stick electrodes in all but the first plate. The subsequent passes were all mixed up. Sometimes all MIG, sometimes MIG and stick. The MIG deposits were always ferritic while the stick electrode deposits were either ferritic, austenitic or both. On this plate the capping passes were austenitic. The others were ferritic.

Plate no. 4 was welded with ferritic stick electrodes for the root pass on both sides of the plate vertexes, plus the capping passes. The remaining passes were deposited using the MIG process.

Plate no. 5 was welded half and half. One side was all stick, the other side all MIG. The stick welded side was considered to be the front.

A different joint design was used for Plate no. 6. It was an off-set double-bevel with the vertex located 1/2-inch from the bottom side. Because of the uneven weld deposit, this plate was fired from both sides. The results were rather surprising. The plate performed badly on a hit on the front side. It performed very well on a back side hit. Other than the root pass, all welding on this plate was either standard or pulsed MIG. The side with the deeper bevel (one inch) was the front for testing purposes.

INTERMIXED ARMOR

Ballistic Test Plates, one inch thick, of three different armor types were welded using one procedure. The armor combinations consisted of (1) high hardness to ESR, (2) ESR to standard homogeneous, and (3) high hardness to standard homogeneous. Identical welding procedures were used in all of these plates. According to Specification MIL-W-46086, only one type of armor may be used in a

ballistic H-plate. We, however, mixed them up. One wing and one center plate were matched for one type of armor, resulting in a balanced mix of two armor types per test plate.

Preliminary tests on standard to high hardness armor I-plates, (created by welding two 6 X 12-inch (152 X 305mm) plates together on the long dimension) showed 105F (40C) to be an acceptable interpass temperature at which to weld. An H-plate was started at 105F preheat and interpass temperatures. During welding of the second leg, a crack occurred. This prompted a raise of interpass temperature to 125F (52C) for welding of the cross bar. The other two sets of H-plates contained ESR materials as one of the steels. Since the ESR carbon content was 0.45% it was decided to play safe and weld the test plates at 125F preheat and interpass temperatures. Its supposed purity did not appear to enhance its weldability. The ESR armor was found to be more difficult to weld than the high hardness or standard armors. A higher preheat was needed to eliminate crack formation.

To determine if there were any differences in weld deposits of the conventional MIG spray and the MIG pulsed, a test plate of each process was welded. The joint geometry is shown in Figure 39.

Figures 40 and 41 are photomicrographs of cross-sections of the weld deposits. The photos are practically identical. It can be seen how the "normalizing bead technique" (the center pass of the three pass cover layer is deposited last) tends to soften the weld toes. The toes are those areas of the base metal adjacent to the weld deposit.

Photographs Figures 42 - 55 are photomicrographs of standard armor and high hardness armor welds. The welds in Plate 18 (Figure 40) were deposited with the standard process. There appears to be little difference in the transition from base metal to heat affected zone to weld in either the armors (high hardness and standard) or the welding process.

Figure 42 shows the martensitic structure of the high hardness C, Ni Mo armor. Figure 43 illustrates the change in structure. The pearlite has changed to austenite and the ferrite started to dissolve in the austenite. The subsequent cooling caused the pearlite to precipitate as scattered grains. As the fusion line is neared, Figure 44, the higher temperatures to which the steel was heated resulted in gradually coarsened grain size. A similar transformation is shown for standard homogenious armor, Mn, Mo, in Figure 45, 46 and 47.

Figure 48 shows the deposited weld metal. Figure 49 thru 55 are similar to the preceding group of Figures 42 to 48 except that they were made from a different test plate which was welded with the pulsed gas metal arc process, Figure 41 whereas the preceding group was welded with the standard gas metal arc process. Figure 40.

Figure 56 shows hardnesses in cross-sections of the standard spray MIG and the pulsed MIG welds in high hardness to standard armor joints. The weld deposits are of similar hardness and structure. It is interesting that the heat-affected zones of the high hardness halves of the specimens are slightly softer than those of the standard armor. It shows that the heat of welding provided a tempering action. To determine the extent of the softening, hardness values were taken adjacent to the weld deposits on the plate surfaces of the mock hull. Figures 57 and 58 show the various joints and indicate the distance from the weld toe at which the base plate returns to original base plate hardness. The number at the end of the measurement is the R/C hardness. ND means there was no difference. The plate had not lost any hardness. The farthest distance from the toe of a weld for a plate to return to hardness was 3/4 inch (19mm) for one-inch (25.4mm) armor, and 1/2 inch (13mm) for 1-1/2 inch (38mm) armor. These results are considered typical since the mock hull was fabricated under production conditions. A preheat of 175 F (80 C) was used with full penetration joints welded in the flat position.

Radiography of the mock hull was performed in the locations identified in Figure 59. Figure 60 shows the angles of radiation.

The specimen H-plates were sent to APG for ballistic firing. Results are tabulated in Firing Directive AR-31871, 16-18 July 74. All the plates passed the ballistic tests. The best performers were plates Nos. 1A, 5A and 6A. Plate No. 6A was unusually interesting. After the root pass was deposited, the opposite side, which had only a 1/2-inch deep bevel, was welded to completion. The plate was flat after welding. Preliminary tests had shown that a plate welded with this procedure would remain flat. This is contrary to expectations. When fired at the front side (deep bevel) it failed. However, when fired at the shallow bevel back side, it performed admirably.

TABLE I WELDING PROCESSES USED FOR 1-1/2 INCH H-PLATES

	TEST PLATE NUMBER					
PASS	1A	2A	3A	4A	5A	6A
1	SF	KF	KF	KF	KF	KF
2	MF	MF	KF	PF	PF	PF
3	MF	MF	MF	SF	KA	PF
4	MF	MF	MF	PF	PF	PF
5	MF	MF	MF	KF	KA	PF
6	MF	MF	MF	PF	PF	PF
7	PF	PF	PF	KF	KA	PF
8	PF	PF	PF	KF	KA	PF
9	PF	PF	PF	PF	PF	MF
10	PF	PF	PF	PF	PF	MF
11	PF	PF	KA	KF	KA	MF
12	PF	PF	KA	KF	KA	MF
13	PF	PF	KA	KF	KA	MF
14	PF	PF	KA	PF	PF	MF
15	PF	PF	KA	PF	PF	MF
16	PF	PF	KA	PF	PF	MF

CODE		PROCESS
M	=	Std MIG Spray
P	=	Pulsed arc MIG
S	=	Short arc MIG
K	=	Stick electrode
F	=	Ferritic electrode
A	=	Austenitic electrode

See Figure 6 for weld pass sequence.

TABLE II ARC TIME

PASS	MIG PROCESS Time in Arc Sec/Ft of Weld STANDARD	PULSED
1*	-	-
2	77.1	77.4
3	89.2	87.6
4	95.8	88.6
5	100.2	101.1
6	102.0	115.9
7	80.9	73.3
8	96.4	77.7
9	90.3	83.5
10	95.2	90.0
11	69,8	71.5
12	65.6	67.7
13	92.2	88.8
14	76.3	74.1
15	72.9	67.7
16	83.8	82.5

Electrode B88

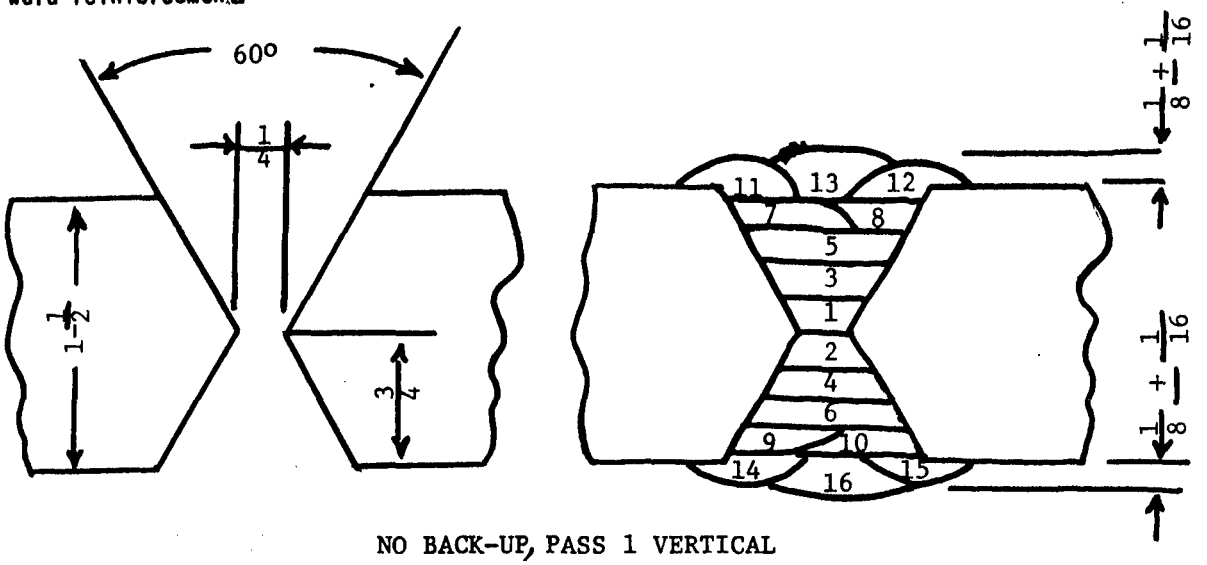
Size 1/16" diam (1.6mm)
Amp 330
Volt 29
*Deposited with stick electrode

SHEET #1 ORD-SIP-CS-13	REPORT NO.
	SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 1A	SUBMITTED BY USATACOM
DATE 8 Nov 72	
TYPE Rolled Homo	ADDRESS Warren, Michigan 48090
THICKNESS 1.5 inch	
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Welding Development	

On a dimension sketch of the Groove and Weldment, indicate: (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



NO BACK-UP, PASS 1 VERTICAL

Weld reinforcement (has) (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - [illegible] - Grinding - [illegible]

POSITION OF WELDING: Flat - [illegible]

WELDING: [illegible] - Hand Semi POLARITY: [illegible] - Rev - [illegible] - DC

PREHEAT	85F	POSTHEAT	No
PEENING	No	BUTTERING	No

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/. IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F-G
1	.035	B	105	20	No	No		85	85	85
2	.062	B	320	30	No			105	105	105
3	.062	W	320	30	No			105	105	105
4	.062	W	320	30	No			105	100	105
5	.062	W	320	30	No			85	85	105
6	.062	W	320	30	No			105	105	100
7	.062	W	315	29	No			100	100	105
8	.062	W	315	29	No			105	105	105
9	.062	W	315	29	No			105	105	105
10	.062	W	315	29	No			105	105	105
11	.062	W	315	29	No			85	85	85
12	.062	W	315	29	No			105	105	105
13	.062	W	315	29	No			105	105	105
14	.062	W	315	29	No			105	105	105
15	.062	W	315	29	No			105	105	105
16	.062	W	315	29	No			105	105	105

B-BEADING PASS W-WEAVING PASS

FIGURE 1

Form OROMX-1 746B
19 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 1A

	PLATE "A"	PLATE "B"
MANUFACTURER	J & L	
TYPE	Rolled Homo	
THICKNESS	1.5	
HEAT	JL JL 1348	
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION — CU — BHN

	C	MN	SI	P	S	CR	NI	MO	ZR/	V	FACE	BACK
PLATE "A"	.26	1.90	.25	.010	.021	.05	.02	.67	.05	Tr	285	293
PLATE "B"												

"TACOM Analysis

HEAT TREATING DATA

HEAT TREATED BY Jones & Laughlin

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	HEAT XCLASS
.035	Airco Welding Products	Airco A 632	B88	ST0712
.062	Airco Welding Products	Airco A 632	B88	ST2900

TABLE 2

MANUFACTURER TRADE NAME AND SIZE	CHEMICAL ANALYSIS	C	MN	SI	S	P	CR	NI	MO	COATING
.035 Airco A632	CORE WIRE	Spec MIL-E-19822								
	WELD METAL									
.062 Airco A 632	CORE WIRE	Spec MIL-E-19822								
	WELD METAL									
	CORE WIRE									
	WELD METAL									
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) (~~is not~~) the same as the procedure used in fabricating the leg welds.

Arc Time - 3.6 hours

Shielding Gas Flow, 50CFH:
First pass - 75% A +25 CO_2
All other passes - 98% A + 2% O_2

Forehand welding technique all passes

FABRICATOR REPRESENTATIVE
P.A. Schevo

RESIDENCE INSPECTOR OF ORDNANCE

FIGURE 2

FORM ORDMX-IN 746c 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. 2869-1

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
TACOM	1A	MIL-R-11468

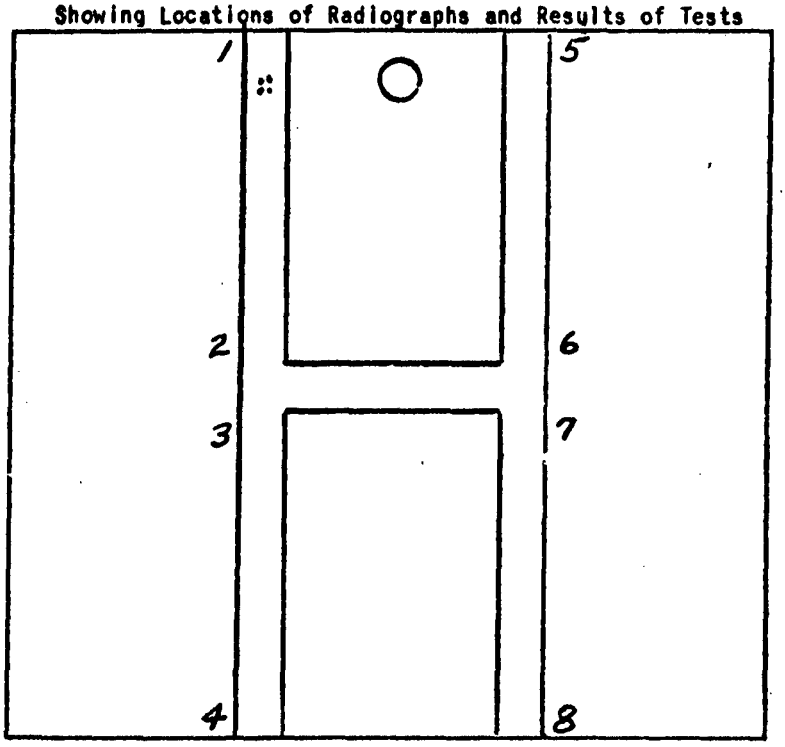
(6) RADIOGRAPHED BY	(7) DATE
TACOM	28 Nov 72

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1-1/2"	1000	3	4 Min	8 Ft

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-T	F = .020 B = .010

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2	-	Clustered Porosity	-	Std 1
3-4	-	Sound		
5-6	-	"		
7-8	-	"		
X-Bar	-	"		

FIGURE 3

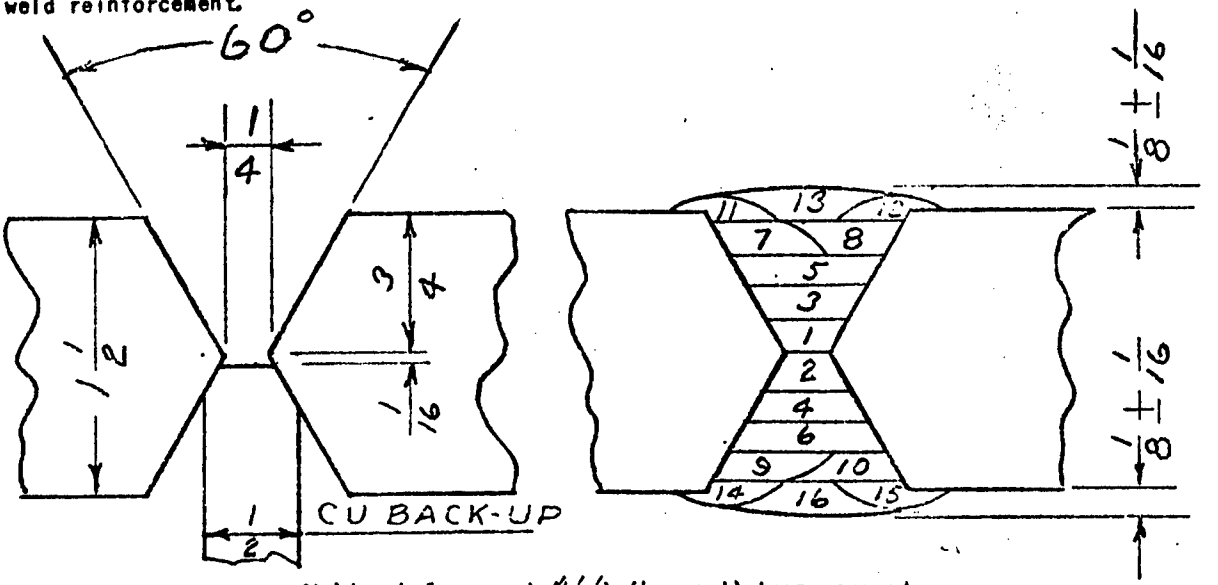
(17) NEGATIVES READ BY W. F. WILF

FORM ORDMX-1 10 OCT 50 746A	SHEET #1 ORD-SIP-CS-13	ORDNANCE CORPS OTAC	REPORT NO.
			SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 2A	SUBMITTED BY USATACOM
DATE 19 Dec 72	
TYPE Rolled Homo	ADDRESS Warren, Michigan 48090
THICKNESS 1.5 in	
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Welding Development	

On a dimension sketch of the Groove and Weldment, indicate: (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - Machining - Grinding - Welding

POSITION OF WELDING: Flat - Horizontal - Vertical - Overhead

WELDING: Automatic - Hand Semi POLARITY: Str - Rev - AC - DC

PREHEAT 105F	POSTHEAT No
PEENING No	BUTTERING No

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/. IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F-G
1	.187	B	220	22	No	No		105	105	105
2	.062	B	320	30	No			105	105	105
3	.062	W	320	30	No			105	105	105
4	.062	W	320	30	No			105	105	105
5	.062	W	320	30	No			105	105	105
6	.062	W	320	30	No			105	105	105
7	.062	W	315	29	No			105	105	105
8	.062	W	315	29	No			105	105	105
9	.062	W	315	29	No			105	105	105
10	.062	W	315	29	No			105	105	105
11	.062	W	315	29	No			105	105	105
12	.062	W	315	29	No			105	105	105
13	.062	W	315	29	No			105	105	105
14	.062	W	315	29	No			105	105	105
15	.062	W	315	29	No			105	105	105
16	.062	W	315	29	No			105	105	105

B-BEADING PASS W-WEAVING PASS

FIGURE 4

Form ORDMX-1 7468
10 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 2A

	PLATE "A"	PLATE "B"
MANUFACTURER	J & L	
TYPE	Rolled Homo	
THICKNESS	1.5	
HEAT	JL - JL 1348	
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION

	C	MN	SI	P	S	CR	NI	MO	CU ZR	V	BHN FACE	BHN BACK
PLATE "A"	.26	1.30	.25	010	.021	.05	.02	.67	.05	Tr	285	2[illegible]3
PLATE "B"												

COM
alysis

HEAT TREATING DATA

HEAT TREATED BY Jones & Laughlin

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	HEAT ~~LOT~~
.187	Arcrods Co.	P & H 12-2	MIL-100	DH47043
.062	Airco Welding Products	Airco A632	B88	ST2960

TABLE 2

MANUFACTURER TRADE NAME AND SIZE		CHEMICAL ANALYSIS C	MN	SI	S	P	CR	NI	MO	COATING
.187 P & H 12-2	CORE WIRE									
	WELD METAL	SPEC MIL-E-18038								
.062 Airco A632	CORE WIRE	Spec MIL-E-19822								
	WELD METAL									
	CORE WIRE									
	WELD METAL									
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) ~~(is not)~~ the same as the procedure used in fabricating the leg welds.

Arc Time - 3.1 hrs
Shielding gas flow - 98% O_2 +2% O_2 @ 50 CFH
Welding technique:
1st pass - back hand
All other passes - forehand

FABRICATOR REPRESENTATIVE

RESIDENCE INSPECTOR OF ORDNANCE

Figure 5

Form ORDMX-1 746c 10 Oct 50	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. 2869-2

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATACOM	2A	MIL-R-11468

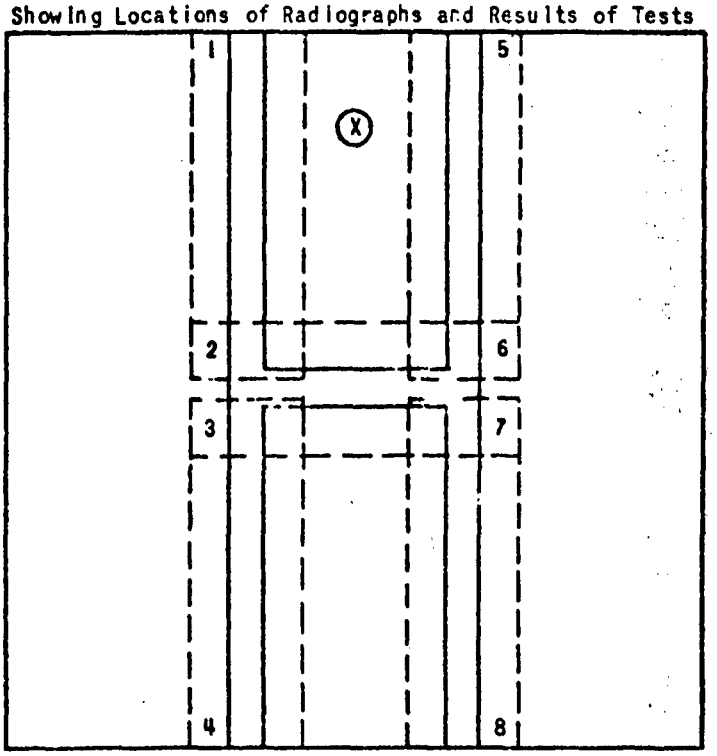
(6) RADIOGRAPHED BY	(7) DATE
USATACOM	3 Jan 73

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST
1-1/2"	250	10	10 min	30"

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK A	.010 F & B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS:

1-2	Sound
3-4	Sound
5-6	Sound
7-8	Sound
CROSS BAR	Scattered Porosity Std 1

FIGURE 6

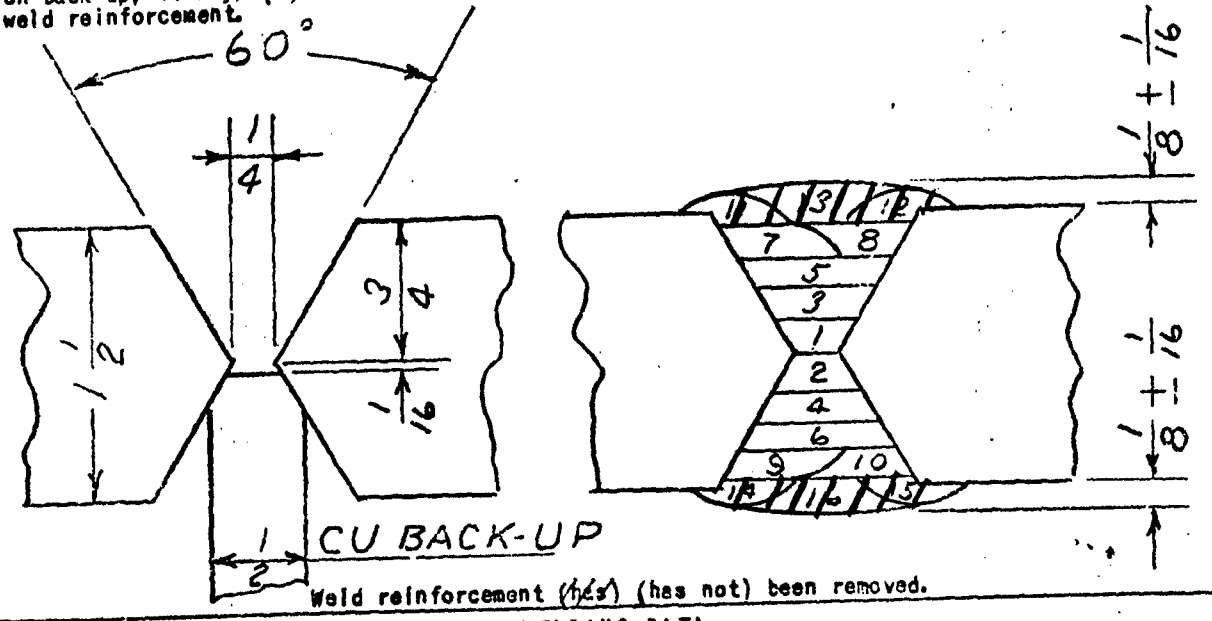
(17) NEGATIVES READ BY Melvin V. Pyktila

FORM ORDMX-1 7-68A 10 OCT 50	SHEET #1 ORD-SIP-CS-13	ORDNANCE CORPS OTAC	REPORT NO.
			SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 3A	SUBMITTED BY USATACOM
DATE 4 May 73	
TYPE Rolled Homo	ADDRESS Warren, Michigan 48090
THICKNESS 1.5 in	
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Welding Development	

On a dimension sketch of the Groove and Weldment, indicate; (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement (~~has~~) (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - ~~Shape Cutting~~ - Grinding - ~~Machining~~

POSITION OF WELDING: Flat - ~~Horizontal~~ ~~Vertical~~ ~~Overhead~~

WELDING: ~~Automatic~~ - Hand Semi POLARITY: ~~SP~~ - Rev ~~Arc~~ DC

PREHEAT 105F POSTHEAT No

PEENING No BUTTERING No

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/. IN	INTERPASS TEMP. (deg. Fahr.) A-B	C-D	E-S
1	.187	B	220	22	No	No		105	105	105
2	.187	B	220	22	No			105	105	105
3	.062	W	320	30	NO			105	105	105
4	.062	W	320	30	No			105	105	105
5	.062	W	320	30	No			105	105	105
6	.062	W	320	30	No			105	105	105
7	.062	W	315	29	No			105	105	105
8	.062	W	315	29	No			105	105	105
9	.062	W	315	29	No			105	105	105
10	.062	W	315	29	No			105	105	105
11	.25	W	230	22	No			105	105	105
12	.25	W	230	22	No			105	105	105
13	.25	W	230	22	No			105	105	105
14	.25	W	230	22	No			105	105	105
15	.25	W	230	22	No			105	105	105
16	.25	W	230	22	No			105	105	105

S-BEADING PASS W-WEAVING PASS

Figure 7

Form OROMX-1 7468
10 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 3A

	PLATE "A"	PLATE "B"
MANUFACTURER	J & L	
TYPE	Rolled Homo	
THICKNESS	1.5	
HEAT	JL - JL 1348	
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION

	C	MN	SI	P	S	CR	NI	MO	CU ZRX	V	BHN FACE	BHN BACK
PLATE "A"	.26	1.90	.25	.010	.021	.05	.02	.67	.05	Tr	285	293
PLATE "B"												

FACOM Analysis

HEAT TREATING DATA

HEAT TREATED BY Jones & Laughlin

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	HEAT CLASS
.187	Arc Rods Co.	Murex HTS100	MIL-100	26B2C
.062	Airco Welding Products	Murex Hyloy	B-88	BT2037
.25	McKay Co.	Armorloy A-8	MIL-307	L30688

TABLE 2

MANUFACTURER TRADE NAME AND SIZE		C	MN	SI	S	P	CR	NI	MO	COATING
.187 Murex HTS 100	CORE WIRE									
	WELD METAL	Spec MIL-E-18038								
.062 Murex Hyloy	CORE WIRE	Spec MIL-E-19812								
	WELD METAL									
.25 Armorloy A-8	CORE WIRE									
	WELD METAL	Spec MIL-E-13080								
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) ~~(is not)~~ the same as the procedure used in fabricating the leg welds.

Arc Time - 3.04 hr
Shielding gas flow - 98% A +2% O_2 @ 50CFH
Welding technique:
Stick - backhand
Mig - forehand

FABRICATOR REPRESENTATIVE

RESIDENCE INSPECTOR OF ORDNANCE

Figure 8

Form ORDNX-1 10 Oct 50 7:5c	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R-2898

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATACOM	3 A	Mil-R-11468

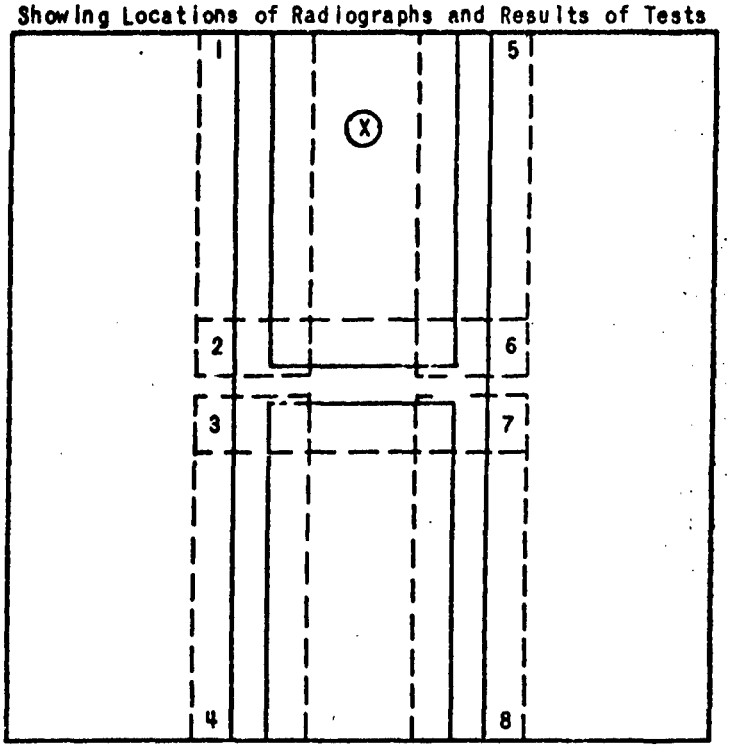
(6) RADIOGRAPHED BY	(7) DATE
USATACOM	17 Aug. 73

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1½"	15 Mev.	1	6 Min.	16 Ft.

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-M	.060 F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS:

1-2	Sound
3-4	Sound
5-6	Sound
7-8	Sound
CROSS BAR	Sound

(17) NEGATIVES READ BY W.F. Wulf

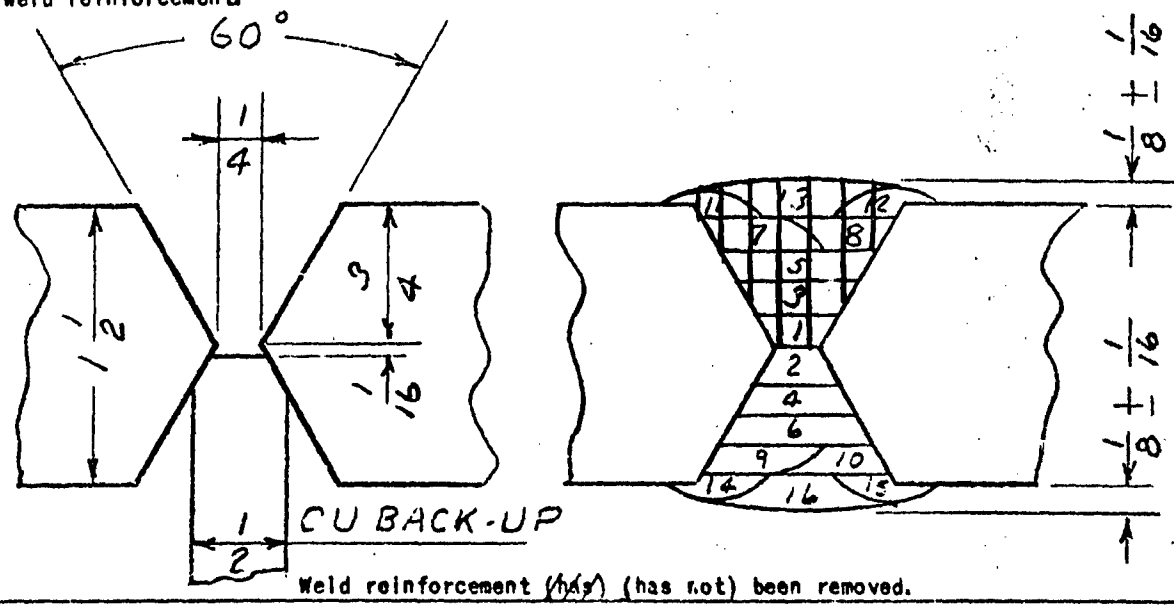
FIGURE 9

FORM ORDMX-1 10 OCT 50 746A	SHEET #1 ORD-SIP-CS-13	ORDNANCE CORPS OTAC	REPORT NO.
			SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 4A	SUBMITTED BY USATACOM
DATE 20 Sep 73	
TYPE Rolled Homo	ADDRESS Warren, Mich. 48090
THICKNESS 1.5 in	
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Welding Development	

On a dimension sketch of the Groove and Weldment, indicate; (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement (has) (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - [illegible] - Grinding - [illegible]

POSITION OF WELDING: Flat - [illegible]

WELDING: [illegible] Hand Semi POLARITY: Str - Rev - AC - DC

PREHEAT 105F POSTHEAT No

PEENING No BUTTERING No

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/. IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F
1	.187	B	220	22	No	No		105	105	105
2	.062	B	315	29	No			105	105	105
3	.187	W	220	22	No			105	105	105
4	.062	W	315	29	No			105	105	105
5	.25	W	320	22	No			105	105	105
6	.062	W	315	29	No			105	105	105
7	.25	W	320	22	No			105	105	105
8	.25	W	320	22	No			105	105	105
9	.062	W	315	29	No			105	105	105
10	.062	W	315	29	No			105	105	105
11	.187	W	220	22	No			105	105	105
12	.187	W	220	22	No			105	105	105
13	.187	W	220	22	No			105	105	105
14	.062	W	315	29	No			105	105	105
15	.062	W	315	29	No			105	105	105
16	.062	W	315	29	No			105	105	105

B-BEADING PASS W-WEAVING PASS

Figure 10

Form ORDMX-1 10 Oct 50 746B

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 4A

	PLATE "A"	PLATE "B"
MANUFACTURER	J & L	
TYPE	Rolled Homo	
THICKNESS	1.5	
HEAT	JL-JL1348	
LOT	-	
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION — CU — BHN

	C	MN	SI	P	S	CR	NI	MO	/ZR/	V	FACE	BACK
PLATE "A"	.26	1.90	.25	.010	.021	.05	.02	.57	.05	Tr	285	293
PLATE "B"												

TACOM Analysis

HEAT TREATING DATA

HEAT TREATED BY Jones & Laughlin

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	HEAT CLASS
.187	ArcRods Co.	Murex HTS100	MIL-100	26B2C
.062	Airco Welding Products	Airco A632	B 88	ST2960
. 25	Arcrods Co.	P & H 12-2	MIL-100	58899

TABLE 2

MANUFACTURER TRADE NAME AND SIZE		CHEMICAL ANALYSIS								
		C	MN	SI	S	P	CR	NI	MO	COATING
.187 Murex HTS100	CORE WIRE									
	WELD METAL	Spec MIL-E-18038								
.062 Airco A632	CORE WIRE	Spec MIL- E-19422								
	WELD METAL									
. 25 P & H 12-2	CORE WIRE									
	WELD METAL	Spec MIL-E-15038								
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) (~~is not~~) the same as the procedure used in fabricating the leg welds.

Arc Time 3.62 hr
Shielding gas flow - 98%, A +2% O_2 @ 50 CFH
Welding technique:
Stick - back hand
Mig - forehand

FABRICATOR REPRESENTATIVE
B. A. SCHEVO

RESIDENCE INSPECTOR OF ORDNANCE

Figure 11

Form ORDNX-1 10 Oct 50 745c	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R-2869

WELD RADIOGRAPHIC REPORT

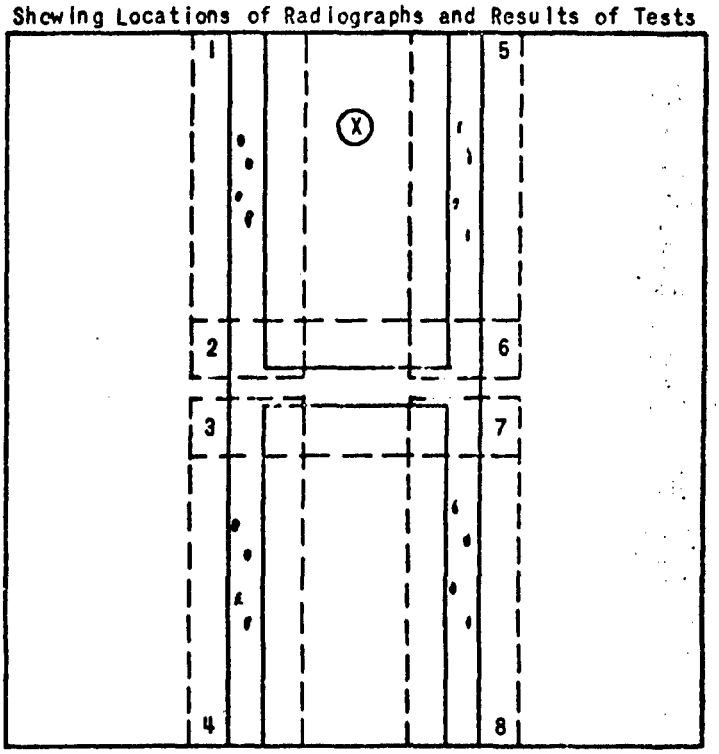
(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATACOM	4A	MIL-R-11468
(6) RADIOGRAPHED BY		(7) DATE
USATACOM		16 Oct 73

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST
1½"	15 Mev	1	5 Min	12 Ft

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK M	.030 F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS:

1-2 - Porosity--Std. 1

3-4 -Porosity--Std. 1

5-6 -Porsity--Std. 1

7-8 -Porosity-Std. 1

CROSS BAR - Sound

(17) NEGATIVES READ BY Melvin R. Pylkila

FIGURE 12

FORM ORDMX-1 746A
10 OCT 50

SHEET #1
ORD-SIP-C3-13

ORDNANCE CORPS
OTAC

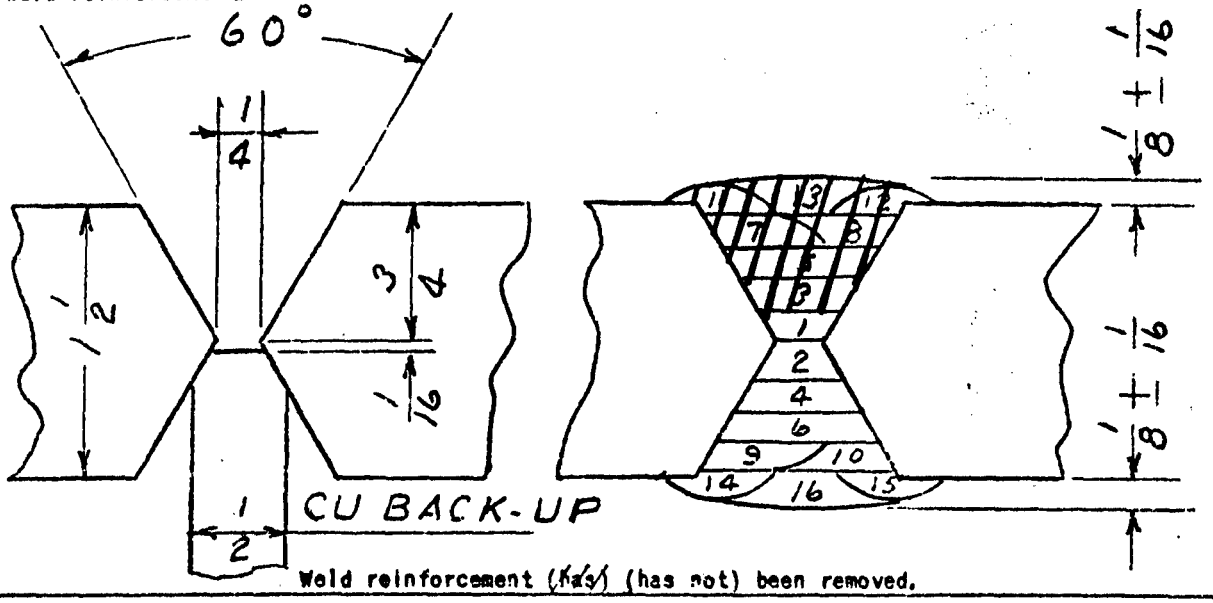
REPORT NO.

SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 5A	SUBMITTED BY USATACOM
DATE 25 Oct 73	
TYPE Rolled Homo	ADDRESS Warren, Michigan 48090
THICKNESS 1.5 in	
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Welding Development	

On a dimension sketch of the Groove and Weldment, indicate: (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement (has) (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - ~~Plate Beveling~~ Grinding - ~~Machining~~

POSITION OF WELDING: Flat - ~~Horizontal~~ ~~Vertical~~ ~~Overhead~~

WELDING: ~~Automatic~~ - Hand Semi POLARITY: ~~Str~~ - Rev - ~~AC~~ - DC

PREHEAT 105F | POSTHEAT No

PEENING No | BUTTERING No

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/. IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F-G
1	.187	B	220	22	No	No		105	105	105
2	.062	B	325	29	No			105	105	105
3	.187	W	180	22	No			105	105	105
4	.062	W	325	29	No			105	105	105
5	.25	W	230	22	No			105	105	105
6	.062	W	325	29	No			105	105	105
7	.25	W	230	22	No			105	105	105
8	.25	W	230	22	No			105	105	105
9	.062	W	325	29	No			105	105	105
10	.062	W	325	29	No			105	105	105
11	.187	W	180	22	No			105	105	105
12	.187	W	180	22	No			105	105	105
13	.187	W	180	22	No			105	105	105
14	.062	W	325	29	No			105	105	105
15	.062	W	325	29	No			105	105	105
16	.062	W	325	29	No			105	105	105

B-BEADING PASS W-WEAVING PASS

Figure 13

Form ORD(MX-1 7468
10 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 5A

	PLATE "A"	PLATE "B"
MANUFACTURER	J & L	
TYPE	Rolled Homo	
THICKNESS	1.5	
HEAT	JL - JL 1348	
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION

TACOM Analysis

	C	MN	SI	P	S	CR	NI	MO	ZR	V	BHN FACE	BHN BACK
PLATE "A"	.26	1.90	.25	.010	.021	.05	.02	.67	.05	Tr	285	293
PLATE "B"												

HEAT TREATING DATA

HEAT TREATED BY Jones & Laughlin

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	HEAT ~~CLASS~~
.187	Arcrods Co.	Murex HTS100	MIL-100	26B2C
.062	Airco Welding Products	Airco A632	B 90	CT2960
. 25	McKay Co.	Armorloy A-8	MIL-30[illegible]	L 30699

TABLE 2

MANUFACTURER TRADE NAME AND SIZE		CHEMICAL ANALYSIS C	MN	SI	S	P	CR	NI	MO	COATING
.187 Murex HTS100	CORE WIRE									
	WELD METAL	Spec MIL-E-13033								
.062 Airco A632	CORE WIRE	Spec MIL-E-19822								
	WELD METAL									
. 25 Armorloy A-8	CORE WIRE									
	WELD METAL	Spec MIL-E-13080								
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) ~~(is not)~~ the same as the procedure used in fabricating the leg welds.

Arc Time - 3.41 hr

Shielding gas flow - 98% A+ 2% O_2 @ 50 CFH

Welding technique:

Stick - backhand

Mig - forehand

FABRICATOR REPRESENTATIVE
B. A. SCHEVO

RESIDENCE INSPECTOR OF ORDNANCE

Figure 14

Form ORDMX-1 746C
10 Oct 50

SHEET #3
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

(1) REPORT NO.

SHEET NO. OF

(2) X-RAY SERIAL NO.

R-2869-5

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATACOM	5 A	MIL-R-11468

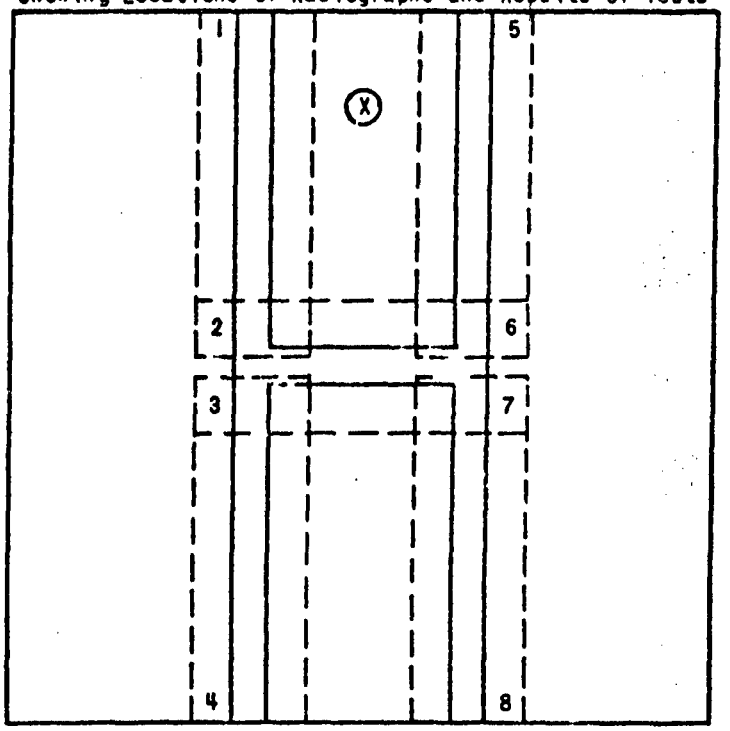
(6) RADIOGRAPHED BY	(7) DATE
USATACOM	16 Nov 73

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1-1/2"	15 MEV	1	5 min	12 ft.

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-M	.030 F & B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS:

1-2	Scattered Porosity	Std 1
3-4	Sound	
5-6	Scattered Porosity	Std 1
7-8	Scattered Porosity	Std 1
CROSS BAR	Scattered Porosity	Std 1

(17) NEGATIVES READ BY Melvin V. Pykitta

FIGURE 15

FORM ORDMX-1 746A
10 OCT 50

SHEET #1
ORD-SIP-C5-13

ORDNANCE CORPS
OTAC

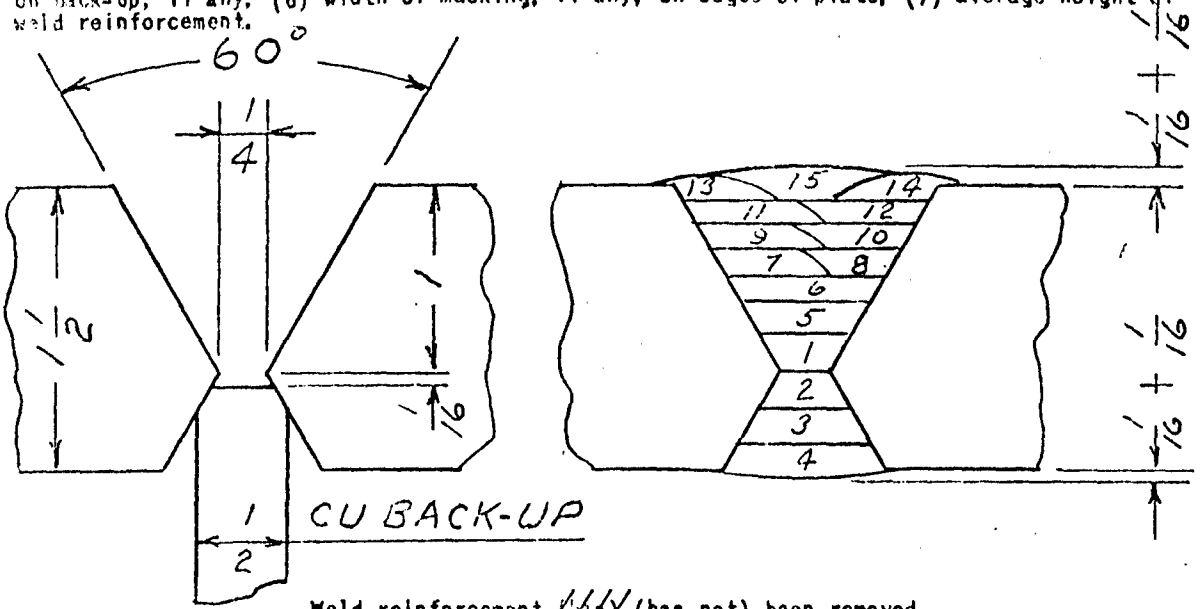
REPORT NO.

SHEET NO. 05

WELDED ARMOR DATA

PLATE NO. 6A	SUBMITTED BY USATACOM
DATE 13 Feb 74	
TYPE Rolled Homo	ADDRESS Warren, MI 48090
THICKNESS 1.5	
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED	Steel Armored Vehicles
WELDED BY A. Krzemecki	
OBJECT Welding Development	

On a dimension sketch of the Groove and Weldment, indicate; (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement [illegible] (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - [illegible]

POSITION OF WELDING: Flat - [illegible]

WELDING: [illegible] Hand Semi POLARITY: [illegible]

PREHEAT 105F

POSTHEAT no

PEENING no

BUTTERING no

PASS	ELEC SIZE	TYPE CLASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/. IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F-G
1	.187	B	220	22	No	No		105	105	105
2	.062	B	330	29	No			105	105	105
3	.062	W	330	29	No			105	105	105
4	.062	W	330	29	No			105	105	105
5	.062	W	330	29	No			105	105	105
6	.062	W	330	29	No			105	105	105
7	.062	W	330	29	No			105	105	105
8	.062	W	330	29	No			105	105	105
9	.062	W	330	29	No			105	105	105
10	.062	W	330	29	No			105	105	105
11	.062	W	330	29	No			105	105	105
12	.062	W	330	29	No			105	105	105
13	.062	W	330	29	No			105	105	105
14	.062	W	330	29	No			105	105	105
15	.062	W	330	29	No			105	105	105
16	.062	W	330	29	No			105	105	105
17										

B-BEADING PASS W-WEAVING PASS

Figure 16

Form ORDMX-1 7460
10 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 6A

	PLATE "A"	PLATE "B"
MANUFACTURER	J&L	
TYPE	Rolled Homo	
THICKNESS	1.5	
HEAT	JL-JL 1348	
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION

TACOM ANALYSIS

	C	MN	SI	P	S	CR	NI	MO	CU/ZR	/V	BHN FACE	BHN BACK
PLATE "A"	.26	1.90	.25	.010	.021	.05	.02	.67	.05	Tr	285	293
PLATE "B"												

HEAT TREATING DATA

HEAT TREATED BY Jones & Laughlin

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	HEAT CLASS
.187	ARC Rods Co.	Murex HTS100	MIL-100	26[illegible]
.062	Airco Welding Prod.	Airco A632	B-88	[illegible]

TABLE 2

MANUFACTURER TRADE NAME AND SIZE		CHEMICAL ANALYSIS C	MN	SI	S	P	CR	NI	MO	COATING
.187 Murex HTS100	CORE WIRE									
	WELD METAL	SPEC MIL-E-18038								
.062 Airco A632	CORE WIRE	SPEC MIL-E-19822								
	WELD METAL									
	CORE WIRE									
	WELD METAL									
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) (is not) the same as the procedure used in fabricating the leg welds.

ARC TIME - 2.78 hrs.

Shielding gas flow - 98% A + 2% O_2 @ 50CFH

Welding Technique

Stick - backhand

Mig - forehand

FABRICATOR REPRESENTATIVE
B.A. SCHEVO

RESIDENCE INSPECTOR OF ORDNANCE

Form ORDMX-1 745c 10 Oct 50	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. 1 OF 1

(2) X-RAY SERIAL NO. R-2869-7

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USTACOM	6A	MIL-R-11468

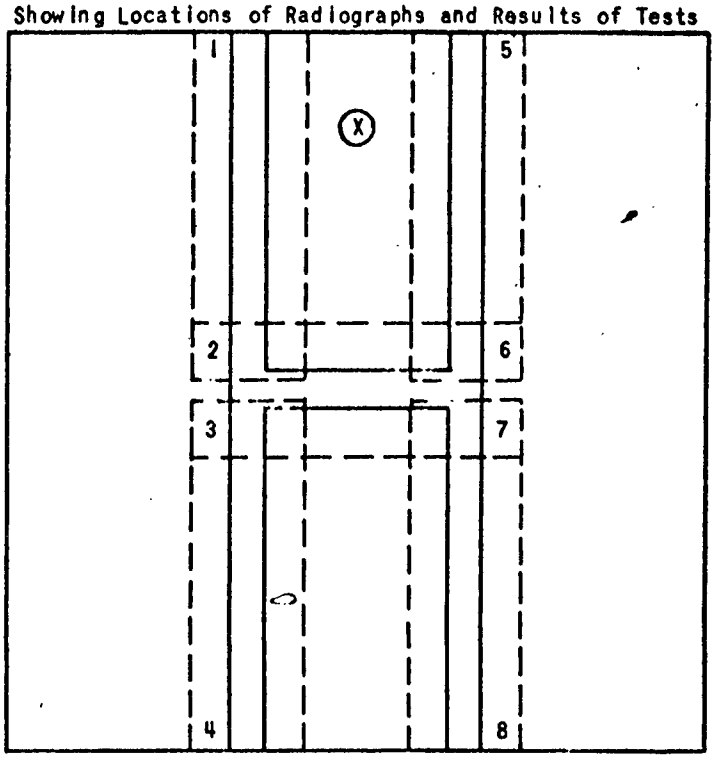
(6) RADIOGRAPHED BY	(7) DATE
USATACOM	21 Jan 71

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST
1-1/2"	1000	3	3-1/2	3 Ft.

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-T	.010 F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS:

1-2	Scattered Porosity	Std 1
3-4	Coarse Scattered Porosity	Std 2
5-6	Fine Scattered Porosity	Std 1
7-8	Fine Scattered Porosity	Std 1
CROSS BAR	Scattered Porosity	Std 1

FIGURE 18

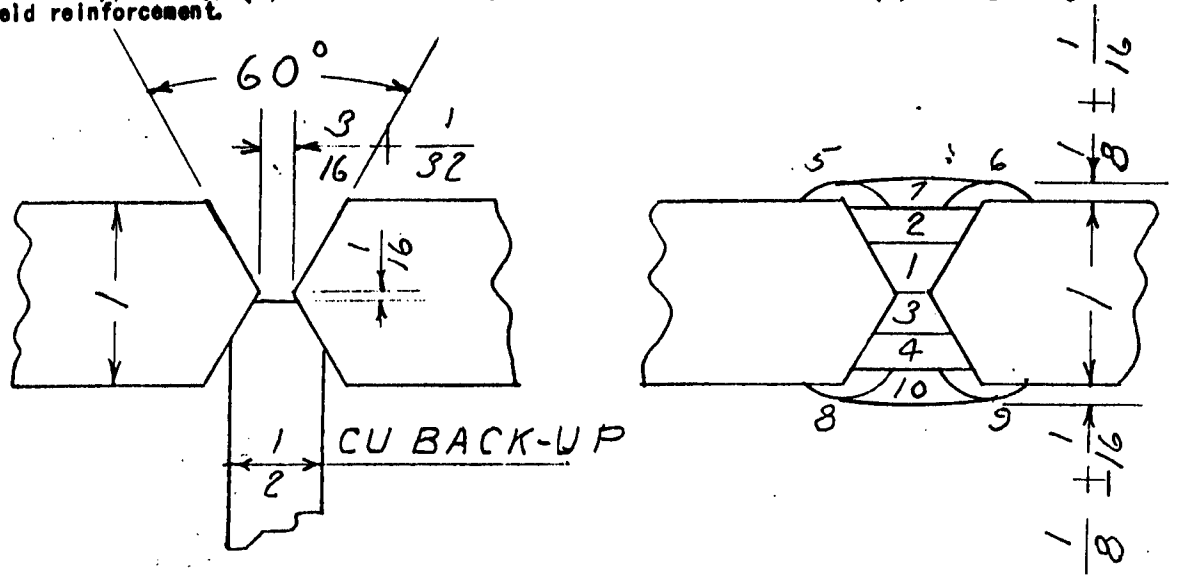
(17) NEGATIVES READ BY Melvin R. Pyhtila

FORM ORDMX-1 10 OCT 50 746A	SHEET #1 ORD-SIP-CS-18	ORDNANCE CORPS OTAC	REPORT NO.
			SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 3X, 4X 5X	SUBMITTED BY XXXXXXXXXXXXXX USATARADCOM
DATE Feb, Mar 1976	
TYPE High Hard/ESR	ADDRESS 6501 11 mile Rd.
THICKNESS 1.0	Warren, Michigan 48090
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Development	

On a dimension sketch of the Groove and Weldment, indicate: (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement (XXX) (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - XXXXXXXXXXXXX - XXXXXXXX XXXXXXXXX

POSITION OF WELDING: Flat - XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

WELDING: Automatic - Hand Semi POLARITY: XXX- Rev -XXX- DC

PREHEAT 125F POSTHEAT none

PEENING none BUTTERING none

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/.IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F-G
1	.187	B	220	22	No	No		125	125	125
2	.062	W	270	24	"	"		"	"	"
3	.062	B	270	24	"	"		"	"	"
4	.062	W	270	24	"	"		"	"	"
5	.062	B	270	24	"	"		"	"	"
6	.062	B	270	24	"	"		"	"	"
7	.062	W	270	24	"	"		"	"	"
8	.062	B	270	24	"	"		"	"	"
9	.062	B	270	24	"	"		"	"	"
10	.062	W	270	24	"	"		"	"	"
11										
12										
13										
14										
15										
16										

B-BEADING PASS W-WEAVING PASS

FIGURE 19

Form ORDMX-1 746B
10 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 3X, 4X, 5X

	PLATE "A"	PLATE "B"
MANUFACTURER	USSteel	Jessop
TYPE	High hardness	ESR
THICKNESS	1.0	1.0
HEAT	5P 6750	R 0701
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION

	C	MN	SI	P	S	CR	NI	MO	ZR	V	BHN FACE	BHN BACK
PLATE "A"	.34	.79	.39	.01	.01	.51	.9 3	.38	--	.02	388	415
PLATE "B"	.45	.62	.31	.01	.01	.72	.76	.19	--	Tr	363	415

HEAT TREATING DATA

HEAT TREATED BY A - USS/B-Jessop

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	CLASS
.187	Murex	HTS 10016	MIL-100	26B2C
.062	Airco	A632	B-88	8T3451

TABLE 2

MANUFACTURER TRADE NAME AND SIZE	CHEMICAL ANALYSIS	C	MN	SI	S	P	CR	NI	MO	COATING
.187 Murex HTS100	CORE WIRE									
	WELD METAL		Spec MIL-E-18038							
.062 Airco A632	CORE WIRE									
	WELD METAL		Spec MIL-E-19822							
	CORE WIRE									
	WELD METAL									
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) (is not) the same as the procedure used in fabricating the leg welds.

Shield gas flow - 97% A + 3% O_2 @ 50CFH

Welding Technique:

Stick-back hand

Mig - fore hand

FABRICATOR REPRESENTATIVE
B. A. SCHEVO

RESIDENCE INSPECTOR OF ORDNANCE

FIGURE 20

FORM ORDMX-IN 746c 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R-2914

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATACOM	3X	MIL-R-11468

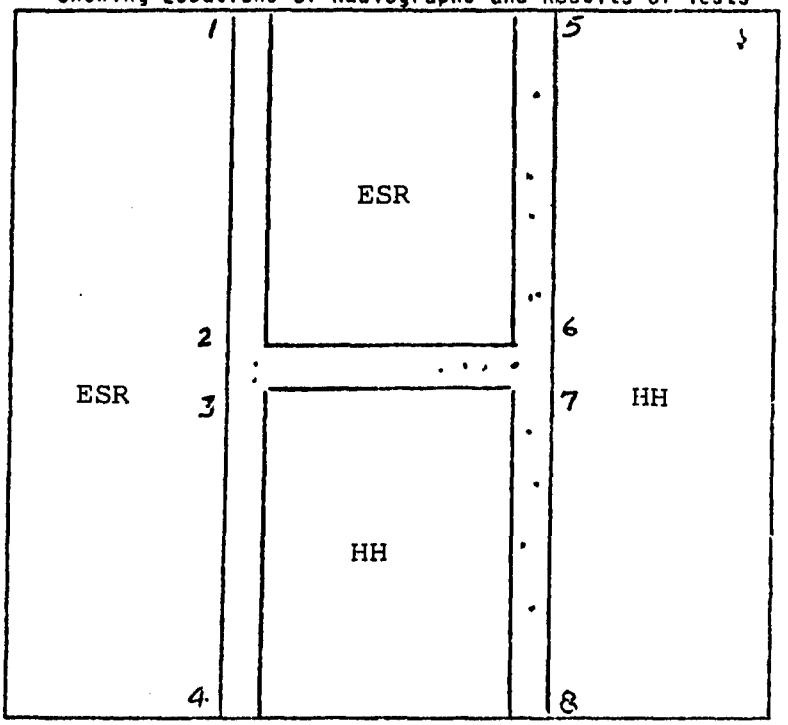
(6) RADIOGRAPHED BY	(7) DATE
USATACOM	18 Feb 76

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIS
1 Inch	250	10	4 Min	4 Ft

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-AA	.010 F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION

POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2	Sound
3-4	Sound
5-6	Scattered porosity - Std 1
7-8	Scattered porosity - Std 1
Cross Bar	Scattered porosity - Std 1

FIGURE 21

(17) NEGATIVES READ BY Jim A Mancuso

FORM ORDMX-IN 746c 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO. SHEET NO. OF

(2) X-RAY SERIAL NO. R-2914

WELD RADIOGRAPHIC REPORT

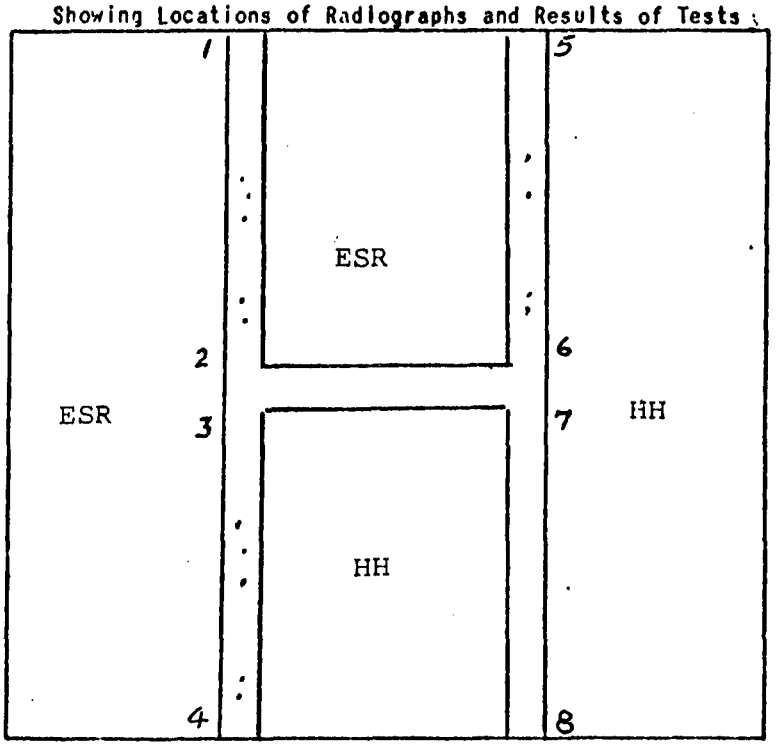
(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATADC	4X	MIL-R-11468
(6) RADIOGRAPHED BY USATADC		(7) DATE 6 Apr 76

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1 Inch	250	10	3 min.	4 ft.

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-AA	.010" F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION

POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2 - Scattered Porosity - Std 1
3-4 - " " - Std 1
5-6 - " " - Std 1
7-8 - Sound

X-Bar - Sound

FIGURE 22

FORM ORDMX-IN 746c 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R - 2914

WELD RADIOGRAPHIC REPORT

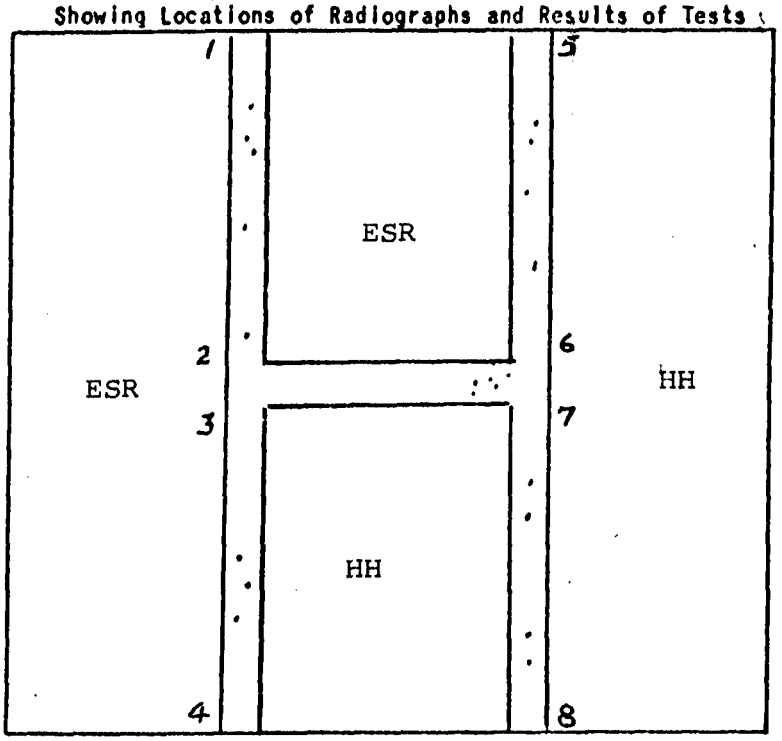
(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATADC	5X	MIL-R-11468
(6) RADIOGRAPHED BY		(7) DATE
USATADC		7 Apr 76

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1 Inch	250	10	3 Min	4 Foot

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-AA	.010" F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION

POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2 - Scattered porosity - Std 1
3-4 - " " - Std 1
5-6 - " " - Std 1
7-8 - " " - Std 1

X-Bar - " " - Std 1

FIGURE 13

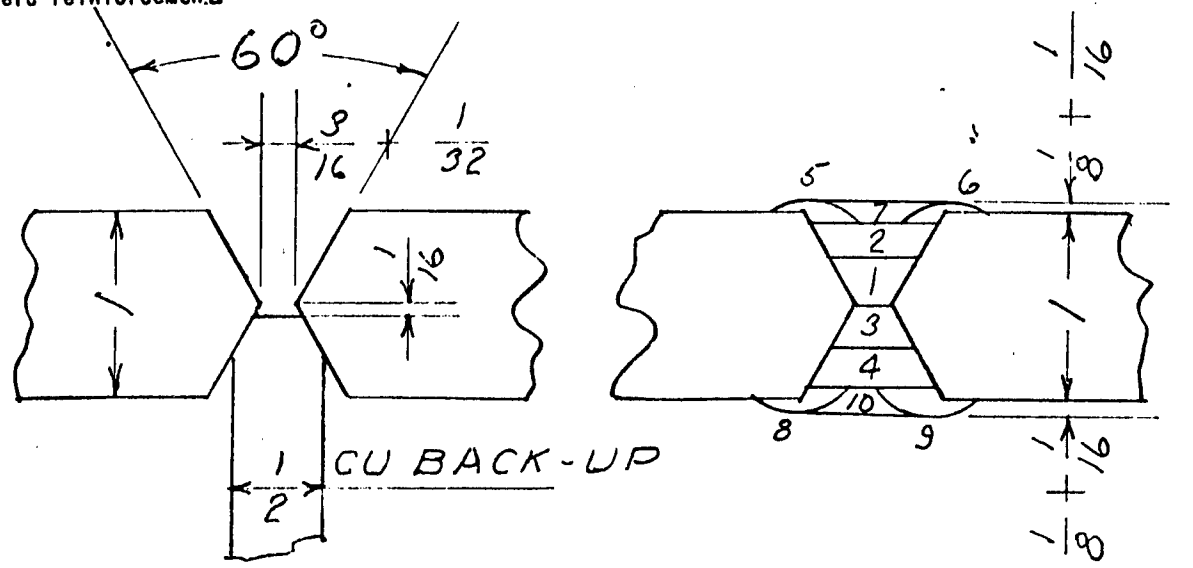
SHEET #1
ORD-SIP-CS-13

REPORT NO.
SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 6X, 7X, 9X	SUBMITTED BY TARADCOM
DATE MAR-MAY 1976	
TYPE ESR / HOMO	ADDRESS 6501 11 MILE RD
THICKNESS 1.0	Warren, MI
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Development	

On a dimension sketch of the Groove and Weldment, indicate; (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement (~~has~~) (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - ~~Flame Softening - Grinding - Machining~~

POSITION OF WELDING: Flat - ~~Horizontal - Verticle - Overhead~~

WELDING: Automatic - Hand, Semi POLARITY: ~~Str~~ - Rev - ~~AC~~ - DC

PREHEAT	125 F	POSTHEAT	No
PEENING	No	BUTTERING	No

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/.IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F-G
1	.187	B	220	22	No	No		125	125	125
2	.062	W	270	24						
3	.062	B	270	24						
4	"	W	"	"	"	"		"	"	"
5	"	B	"	"	"	"		"	"	"
6	"	B	"	"	"	"		"	"	"
7	"	W	"	"	"	"		"	"	"
8	"	B	"	"	"	"		"	"	"
9	"	B	"	"	"	"		"	"	"
10	.062	W	270	24						
11										
12										
13										
14										
15										
16										

B-BEADING PASS W-WEAVING PASS

FIGURE 24

Form ORDMX-1 746B
10 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 6X, 7X, 9X

	PLATE "A"	PLATE "B"
MANUFACTURER	US Steel	Jessop
TYPE	Homo	ESR
THICKNESS	1.0	1.0
HEAT	0254947A2	R0701
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION

	C	MN	SI	P	S	CR	NI	MO	ZR	V	BHN FACE	BHN BACK
PLATE "A"	.34	.23	.20	.01	.02	1.14	3.18	.30	-	.01	331	321
PLATE "B"	.45	.62	.31	.01	.01	.72	1.76	.19	-	Tr	363	415

HEAT TREATING DATA

HEAT TREATED BY A-USS/B-Jessop

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	CLASS
.187	Murex	HTS 10016	MIL-100	26B2C
.062	Airco	A632	B-88	8T3451

TABLE 2

MANUFACTURER TRADE NAME AND SIZE	CHEMICAL ANALYSIS	C	MN	SI	S	P	CR	NI	MO	COATING
.187 Murex HT5100	CORE WIRE									
	WELD METAL	SPEC		MIL-E-18038						
.062 Airco A632	CORE WIRE									
	WELD METAL	SPEC		MIL-E-19822						
	CORE WIRE									
	WELD METAL									
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) (is not) the same as the procedure used in fabricating the leg welds.

Shielding gas flow - 97% A + 3% O_2 @ 50CFH

Welding technique:

Stick - back hand

Mig - fore hand

FABRICATOR REPRESENTATIVE
B. A. SCHEVO

RESIDENCE INSPECTOR OF ORDNANCE

FIGURE 25

FORM ORDMX-IN 746C 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R-2914

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
USATADC	6X	MIL-R-11468

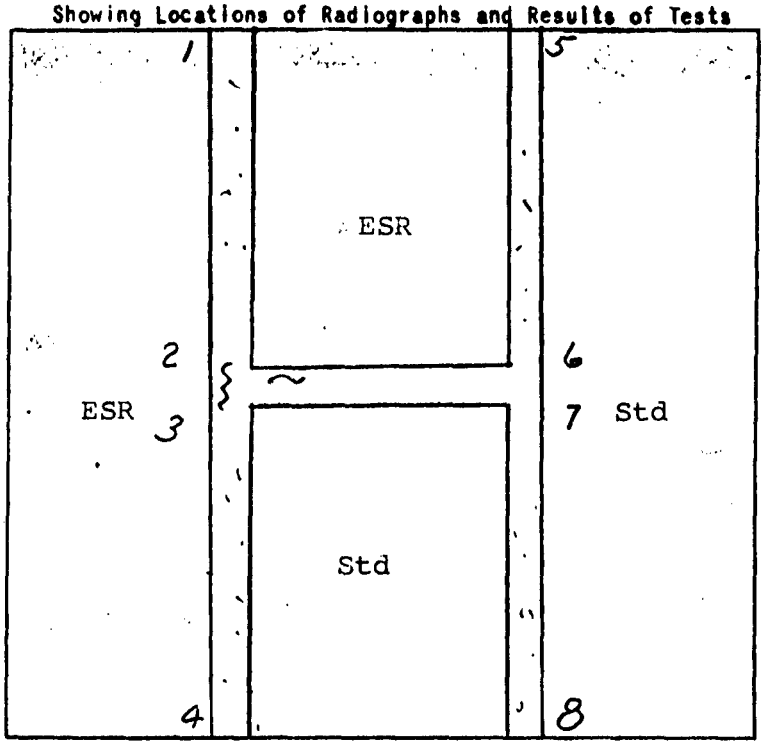
(6) RADIOGRAPHED BY	(7) DATE
USATADC	22 Apr 76

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1 Inch	250	10		4 ft.

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-AA	.010" F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION

POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2 - Scattered porosity - Std 2
3-4 - " " - Std 2
5-6 - " " - Std 2
7-8 - " " - Std 1

X-Bar - Two crack indications - Fails all Stds.
Repaired - slight porosity - Std I

(17) NEGATIVES READ BY Wm. A. Moncoief

FIGURE 26

FORM ORDMX-1N 746c 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R-2914B

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
TARADCOM	7X	MIL-R-11468

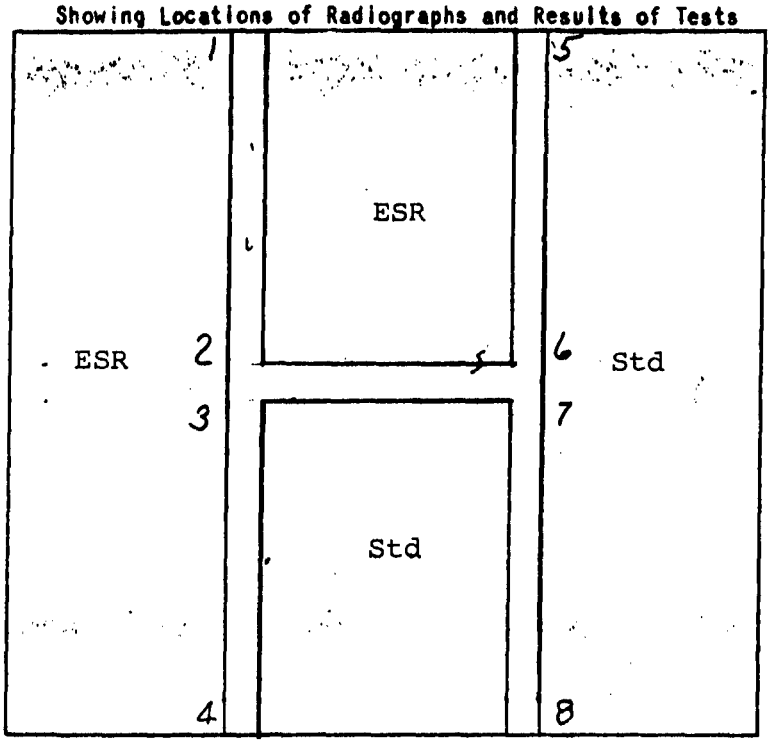
(6) RADIOGRAPHED BY	(7) DATE
TARADCOM	7 July 76

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1 Inch	250	10	3 Min	4 ft.

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-AA	.010" F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2 - slight porosity - Stdl

3-4 - 1/4" transverse crack - Fails all Stds.
3-4 - (Repair _____ sound)
5-6 - sound

7-8 - sound

X-Bar - Lack of fusion 1 " long - Fails
X-Bar-(Repair - 1/4" transverse crack repair area) - Fails

(17) NEGATIVES READ BY M. V. Pyhtila

FIGURE 27

FORM ORDMX-IN 746c 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R-2914B

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
TARADCOM	9X	MIL-R-11468

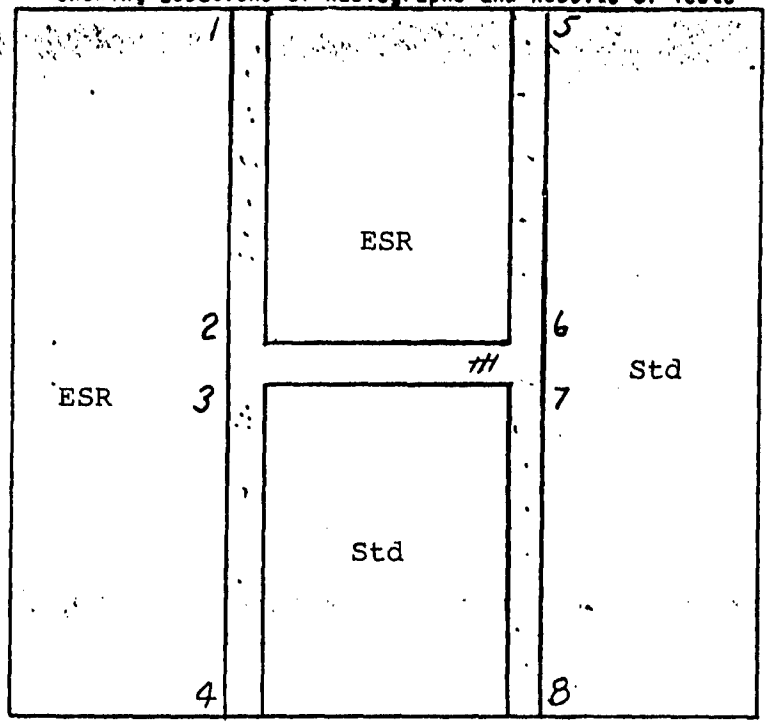
(6) RADIOGRAPHED BY	(7) DATE
TARADCOM	7 July 76

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1 Inch	250	10	3 Min	4 ft.

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-AA	.010" F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION

POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2 - scattered porosity - Std II

3-4 - clustered porosity - Std I

5-6 - scattered porosity - Std I

7-8 - scattered porosity - Std I

X-Bar - 9/16" long lack of fusion - Std III

(17) NEGATIVES READ BY W. V. Pyhtila

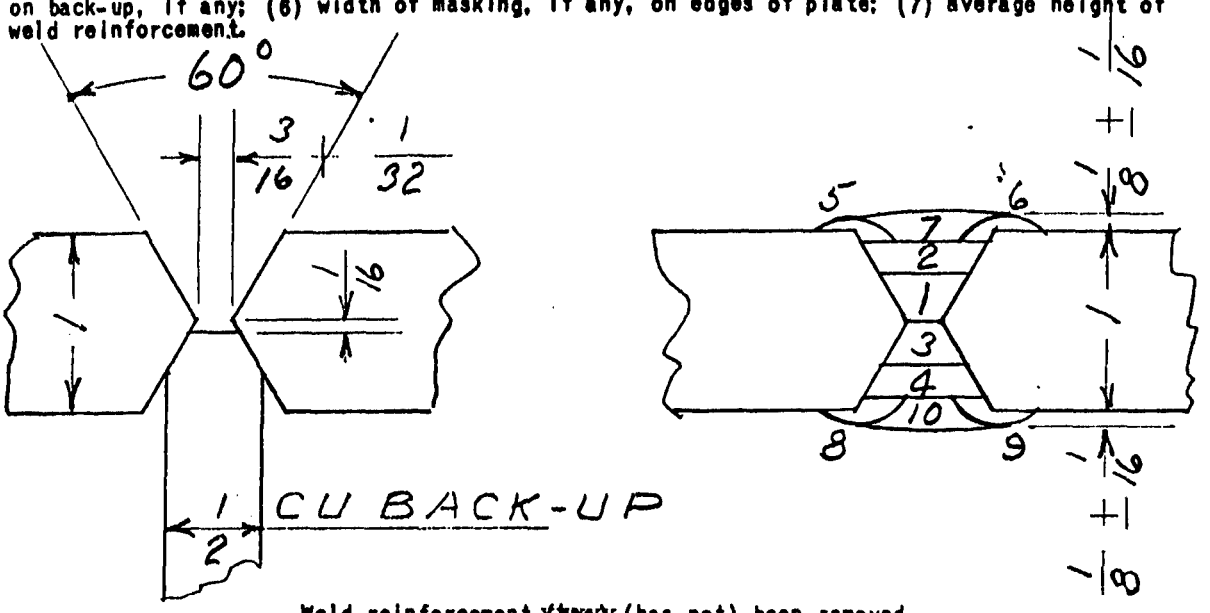
FIGURE 28

SHEET #1 ORD-SIP-CS-13	REPORT NO. SHEET NO. OF

WELDED ARMOR DATA

PLATE NO. 10X, 11X, 13X	SUBMITTED BY USATARADCOM
DATE Jul, Aug 1976	
TYPE High Hard/Homo	ADDRESS 6501 11 Mile Rd.
THICKNESS 1.0	Warren, Michigan 48090
SPECIFICATION MIL-W-46086	CONTRACT NO.
ORDNANCE MATERIAL CONCERNED Steel Armored Vehicles	
WELDED BY A. Krzemecki	
OBJECT Development	

On a dimension sketch of the Groove and Weldment, indicate; (1) the included angle; (2) the root opening; (3) the root face; (4) the bead sequence; (5) additional sketch of spacer strip on back-up, if any; (6) width of masking, if any, on edges of plate; (7) average height of weld reinforcement.



Weld reinforcement XXXX (has not) been removed.

WELDING DATA

PLATE PREPARATION: Flame Cutting - XXXXXXXXXXXXXXXX - XXXXXXXXX- XXXXXXXX

POSITION OF WELDING: Flat - XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

WELDING: Automatic - Hand Semi POLARITY: XXX- Rev - XX - DC

PREHEAT 125F POSTHEAT None

PEENING None BUTTERING None

PASS	ELEC SIZE	TYPE PASS	AMPS	VOLTS	CRACKING	CHIP OR GRIND	SPEED IN/.IN	INTERPASS TEMP. (deg. Fahr) A-B	C-D	E-F-G
1	.187	B	220	22	No	No		125	125	125
2	.062	W	270	24	"	"		"	"	"
3	.062	B	270	24	"	"		"	"	"
4	.062	W	270	24	"	"		"	"	"
5	.062	B	270	24	"	"		"	"	"
6	.062	B	270	24	"	"		"	"	"
7	.062	W	270	24	"	"		"	"	"
8	.062	B	270	24	"	"		"	"	"
9	.062	B	270	24	"	"		"	"	"
10	.062	W	270	24	"	"		"	"	"
11										
12										
13										
14										
15										
16										

B-BEADING PASS W-WEAVING PASS

FIGURE 29

Form ORDMX-1 7468
10 Oct 50

SHEET #2
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

REPORT NO.

SHEET NO. OF

ARMOR PLATE DATA

PLATE NO. 10X, 11X, 13X

	PLATE "A"	PLATE "B"
MANUFACTURER	US Steel	US Steel
TYPE	Homo	High hardness
THICKNESS	1.0	1.00
HEAT	0254947A2	R0701
LOT		
PROCESS	O.H. ELEC. ACID, BASIC	O.H. ELEC. ACID, BASIC

CHEMICAL COMPOSITION

	C	MN	SI	P	S	CR	NI	MO	ZR	V	BHN FACE	BHN BACK
PLATE "A"	.34	.23	.20	.01	.02	1.14	3.18	.30	–	.01	331	321
PLATE "B"	.34	.79	.39	.01	.01	.51	.93	.38	–	.02	388	415

HEAT TREATING DATA

HEAT TREATED BY A – USS/B-USS

ELECTRODE DATA

TABLE 1

SIZE	MANUFACTURER	TRADE NAME	TYPE	CLASS
.187	Murex	Hts 10016	MIL-100	26B2C
.062	Airco	A 632	B-88	8T3451

TABLE 2

MANUFACTURER TRADE NAME AND SIZE	CHEMICAL ANALYSIS	C	MN	SI	S	P	CR	NI	MO	COATING
.187 Murex Hts 100	CORE WIRE									
	WELD METAL	SPEC MIL-E-18038								
.062 Airco A632	CORE WIRE									
	WELD METAL	SPEC MIL-E-19822								
	CORE WIRE									
	WELD METAL									
	CORE WIRE									
	WELD METAL									

TABLE 3 (AUTOMATIC WELDING)

MANUFACTURER	TRADE NAME	SIZE	FLUX

RADIOGRAPHED BY

RADIOGRAPH SERIAL NO.

REMARKS: The procedure used in fabricating the crossbar weld (is) (is not) the same as the procedure used in fabricating the leg welds.

Shielding gas flow – 97% A + 3% O_2 @ 50 CFH

Welding Technique

Stick – back hand

Mig – fore hand

Preheat

Plate 10X: legs 105F, X bar 125F

Plate 11X: legs and X bar 105F

Plate 13X: legs and X bar 125F

FABRICATOR REPRESENTATIVE
B. A. SCHEVO

RESIDENCE INSPECTOR OF ORDNANCE
41

FIGURE 30

FORM ORDMX-IN 746c
18 JUL 52

SHEET #3
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

(1) REPORT NO.

SHEET NO. OF

(2) X-RAY SERIAL NO.

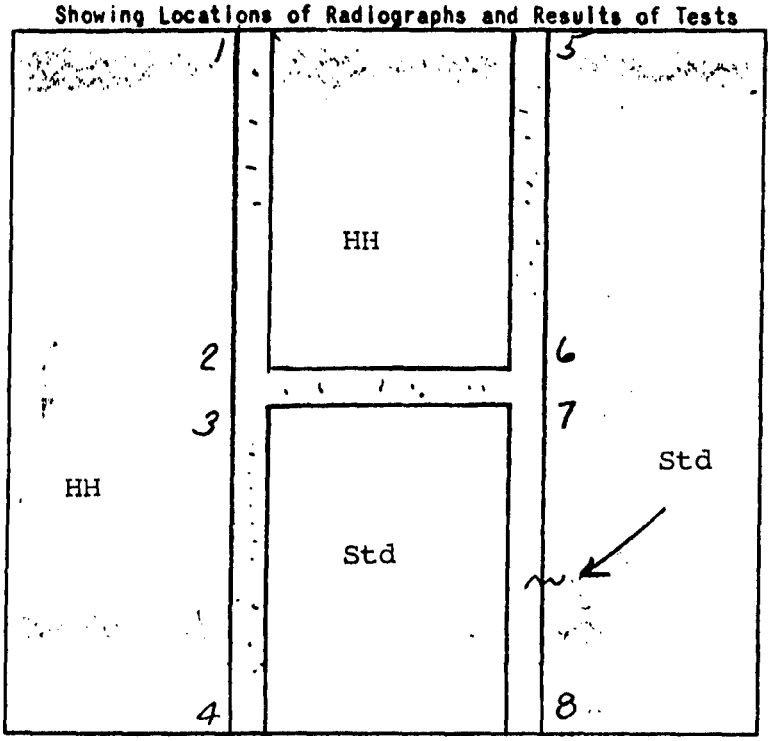
R 291r-B

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY TARADCOM		(4) PLATE NO. 10X		(5) SPEC. MIL-R-11468
(6) RADIOGRAPHED BY TARADCOM				(7) DATE 9 July 76
(8) PLATE THICKNESS 1 Inch	(9) KV 250	(10) MA 10	(11) TIME 3 min	(12) FOCAL DIST. 4 ft.
(13) TYPE OF FILM EK-AA			(14) SCREENS OR FILTERS	

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION

POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2 - scattered porosity - Std I

3-4 - linear & scattered porosity - Std II

5-6 - scattered porosity - Std II

7-8 - transverse crack - Fails all Std

X-Bar - porosity in legs areas of cross bar - Std I

(17) NEGATIVES READ BY Wm. A. Moncoief

FIGURE 31

FORM ORDMX-IN 746C
18 JUL 52

SHEET #3
ORD-SIP-CS-13

ORDNANCE CORPS
DETROIT ARSENAL

(1) REPORT NO.

SHEET NO. OF

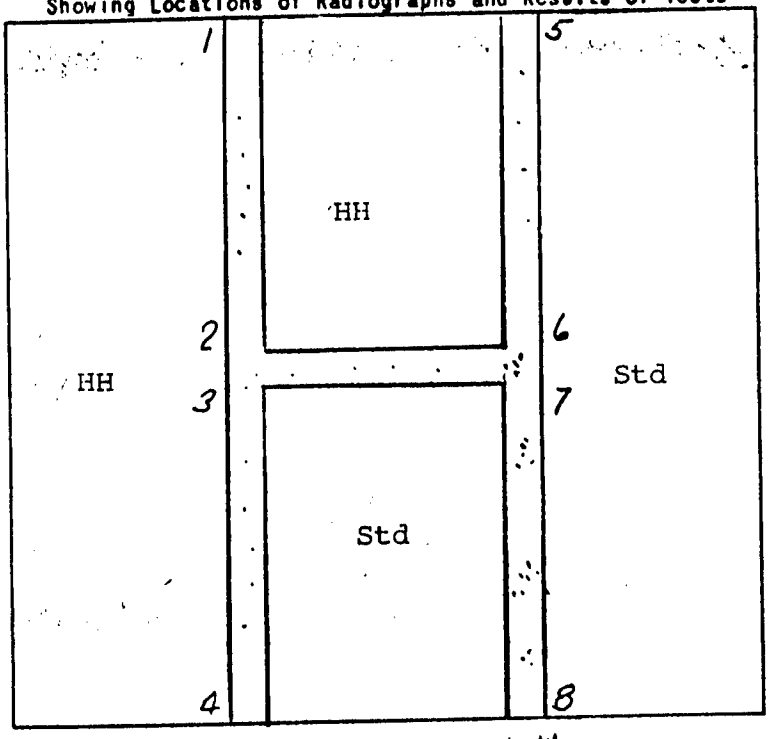
(2) X-RAY SERIAL NO.
R-2914B

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY: TARADCOM	(4) PLATE NO.: 11X	(5) SPEC.: MIL-R-11468	
(6) RADIOGRAPHED BY: TARADCOM		(7) DATE: 19 July 76	
(8) PLATE THICKNESS: 1 Inch	(9) KV: 250	(10) MA: 10	(11) TIME: 3 Min
(12) FOCAL DIST.: 4 ft.			
(13) TYPE OF FILM: EK-AA		(14) SCREENS OR FILTERS: .010" F&B	

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION
POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

1-2 - scattered porosity - Std I

3-4 - scattered porosity - Std I

5-6 - scattered porosity - Std I

7-8 - Cluster & scattered porosity - Std II

X-Bar - scattered porosity - Std I

(17) NEGATIVES READ BY Wm. A. Moncoief

FIGURE 32

FORM ORDMX-IN 746c 18 JUL 52	SHEET #3 ORD-SIP-CS-13	ORDNANCE CORPS DETROIT ARSENAL	(1) REPORT NO.
			SHEET NO. OF

(2) X-RAY SERIAL NO. R-2914-B

WELD RADIOGRAPHIC REPORT

(3) PLATE SUBMITTED BY	(4) PLATE NO.	(5) SPEC.
TARADCOM	13X	MIL-R-11468

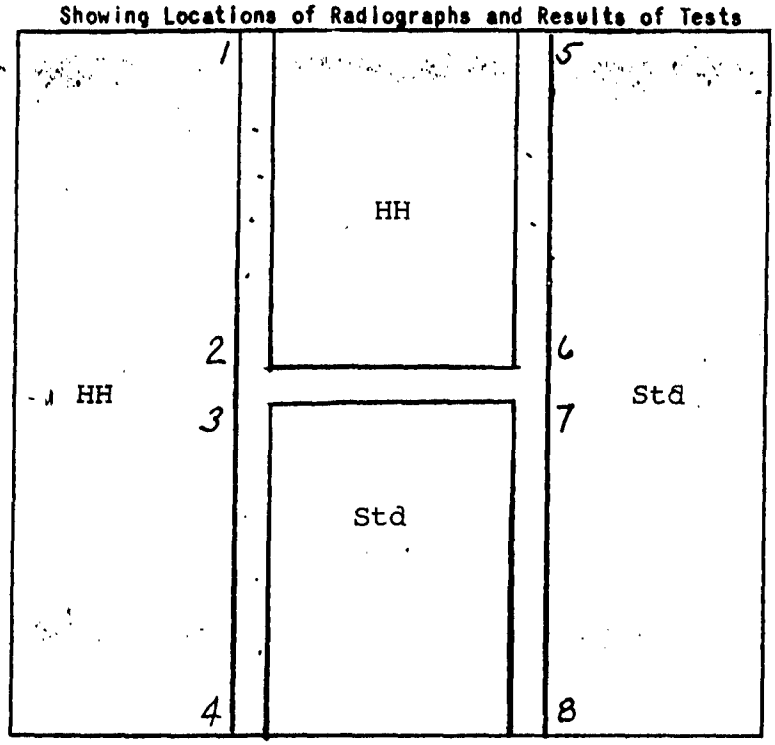
(6) RADIOGRAPHED BY	(7) DATE
TARADCOM	20Aug 76

(8) PLATE THICKNESS	(9) KV	(10) MA	(11) TIME	(12) FOCAL DIST.
1"	250		3 Min	4 ft

(13) TYPE OF FILM	(14) SCREENS OR FILTERS
EK-AA	.010 F&B

SHOCK TEST PLATE

Showing Locations of Radiographs and Results of Tests



(15) CRACK INCOMPLETE FUSION INCOMPLETE PENETRATION

POROSITY AND SLAG INCLUSIONS UNDERCUTTING

(16) RESULTS

Pos

1-2 - scattered porosity - Std I

3-4 - slight scattered porosity - Std I

5-6 - no flaws - sound

7-8 - slight scattered porosity - Std I

X-Bar - slight porosity in leg areas - Std I

(17) NEGATIVES READ BY Melvin V. Pyktila

FIGURE 33

Mock Hull - Front 3/4 View

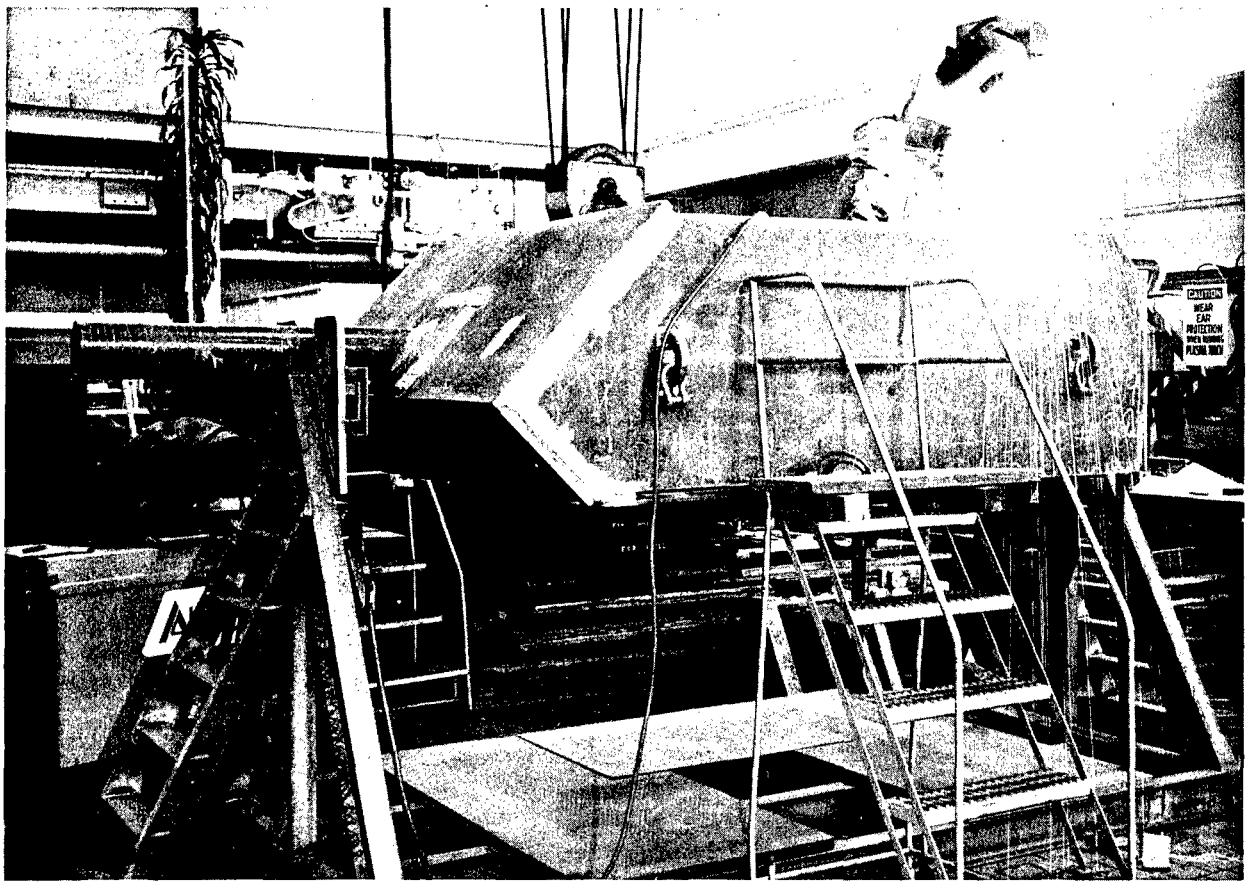


Figure 34

Mock Hull - Rear View

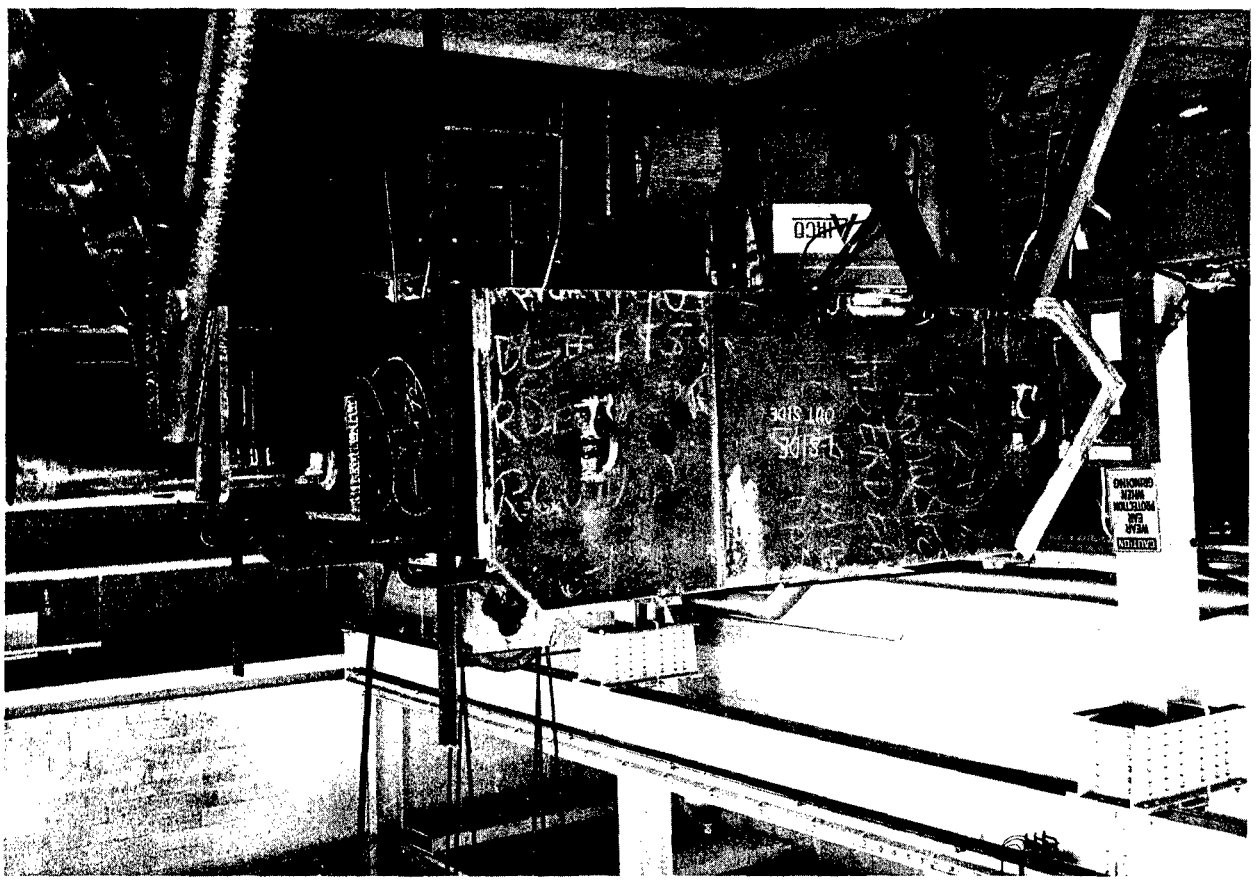


Figure 35

Mock Hull - Underside View

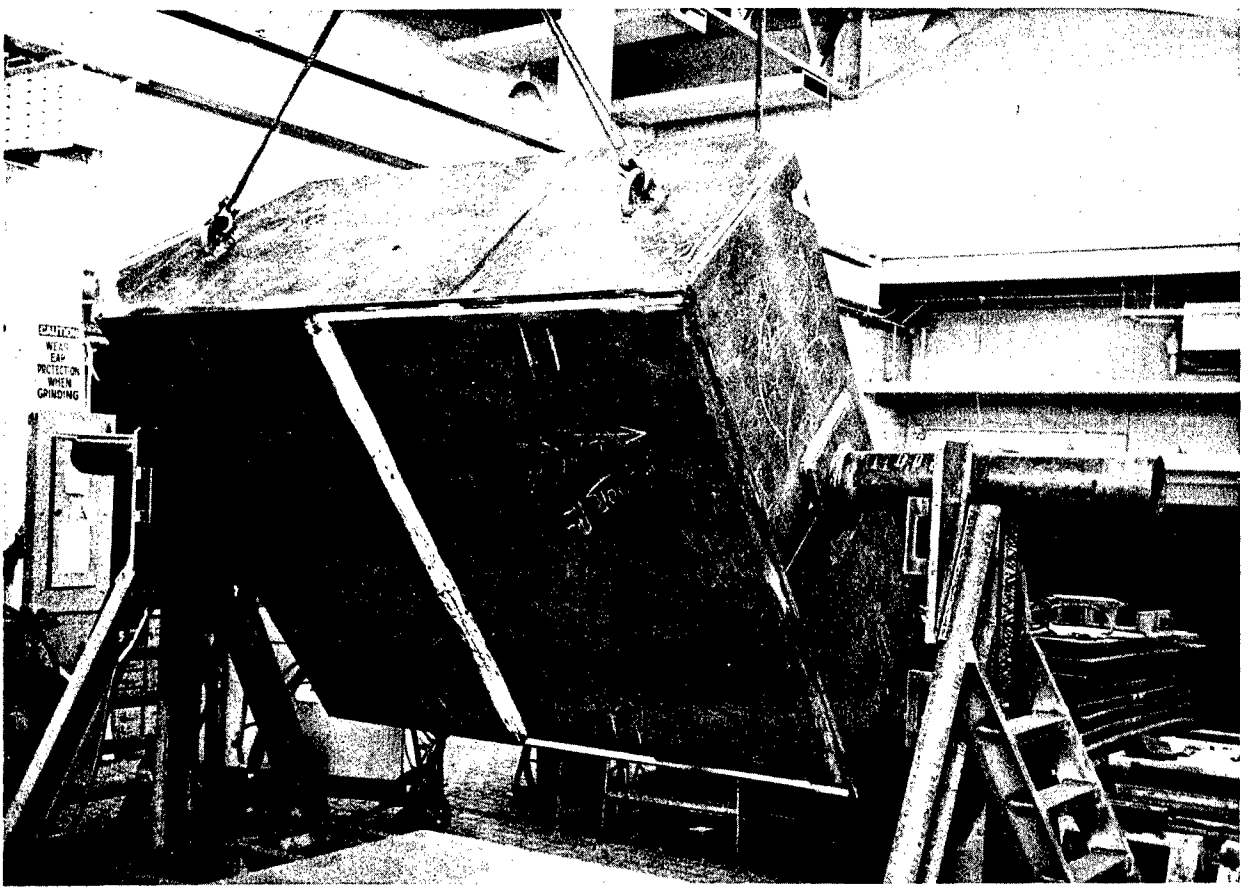


Figure 36

Mock Hull - Inside View

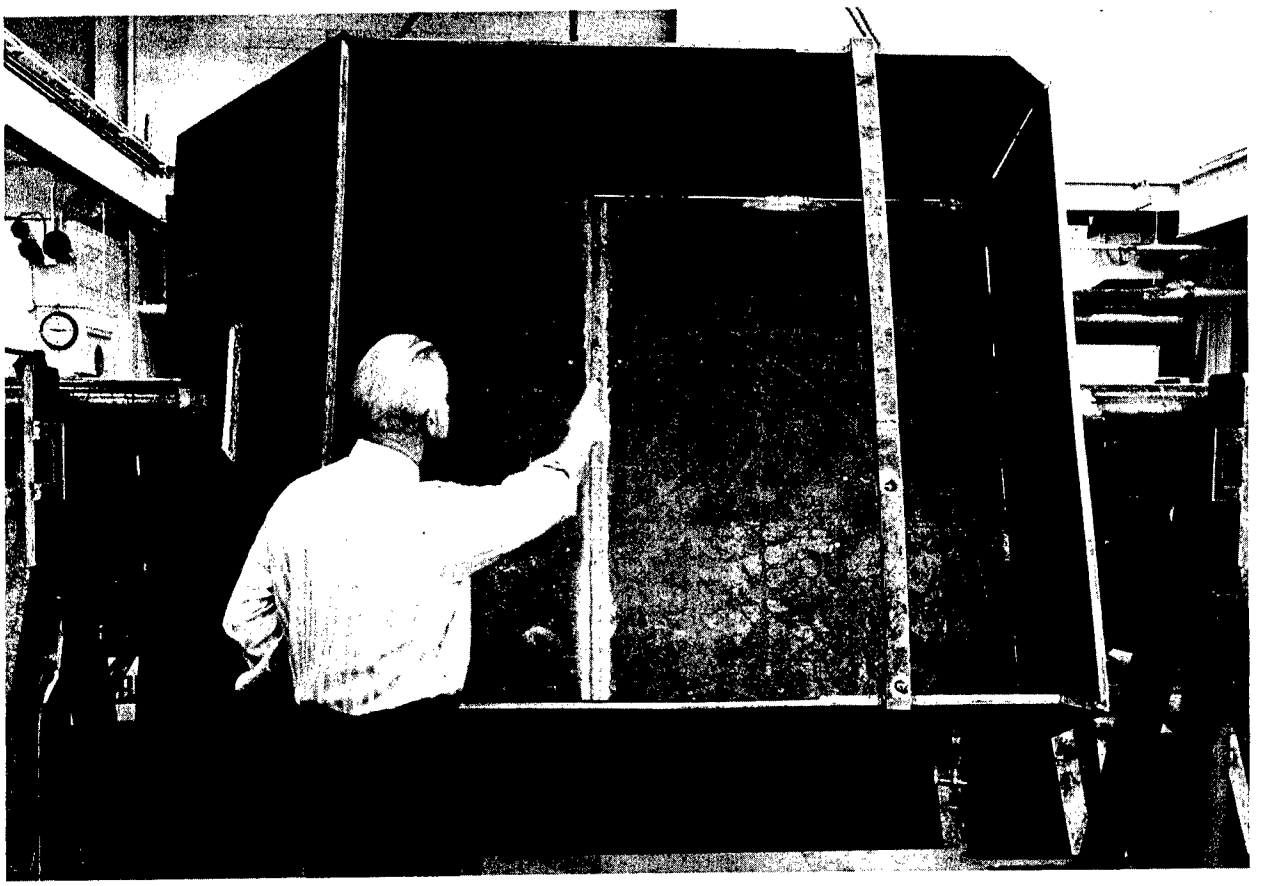
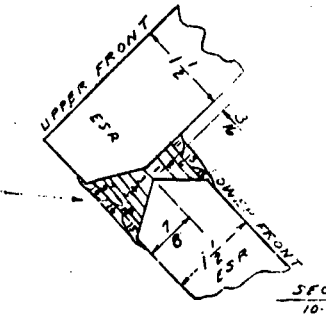


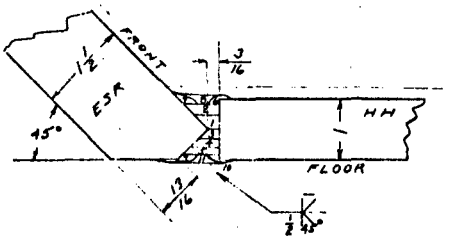
Figure 37

FIRST PASS
3/16 MIL-10016
220 AMP 21VOLTS DCRP

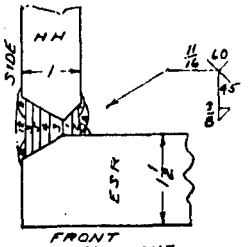
ALL OTHER PASSES
MIG PULSED ARC
ELECT 1/16 AIRCO AL32
290 AMP 26VOLTS
SHIELDING - M3 @ 50CFH
PULSE RATE SWITCH -120
PULSE AVE - 60
PREHEAT & INTERPASS 175 F



SEC G-G
10-27-76

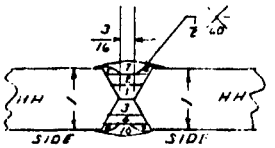


SEC H-H
12-8-76



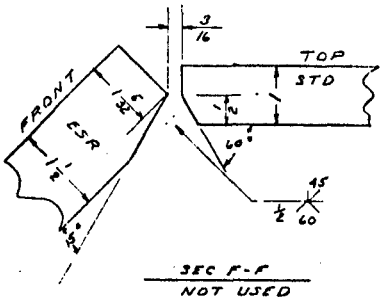
12-1-76 RIGHT
12-6-76 LEFT

SEC D-D

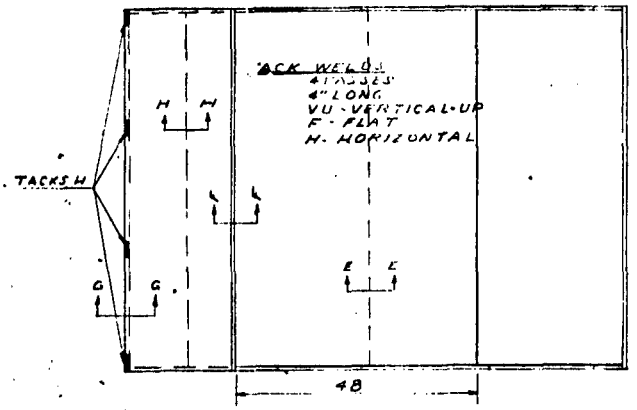


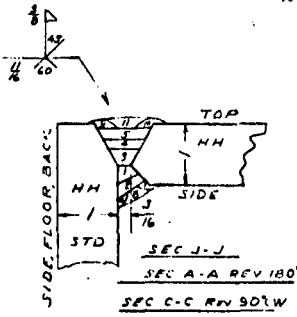
SEC E-E

LEFT EXTENSION 10-5-76
RIGHT " 10-7-76
FRONT & REAR FLOOR 10-15-76

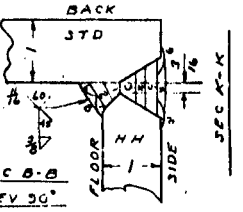


SEC F-F
NOT USED





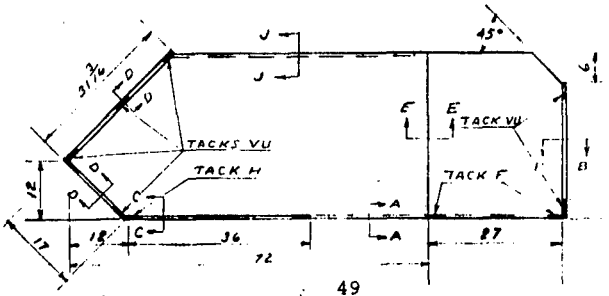
SEC J-J

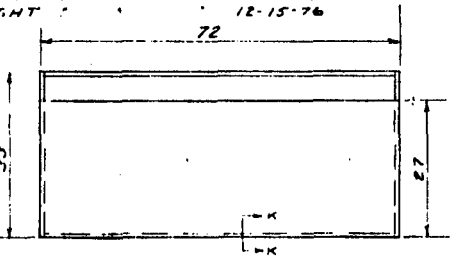


SEC K-K

SEC A-A REV 180° SEC B-B
SEC C-C RH 90° LH REV 30°

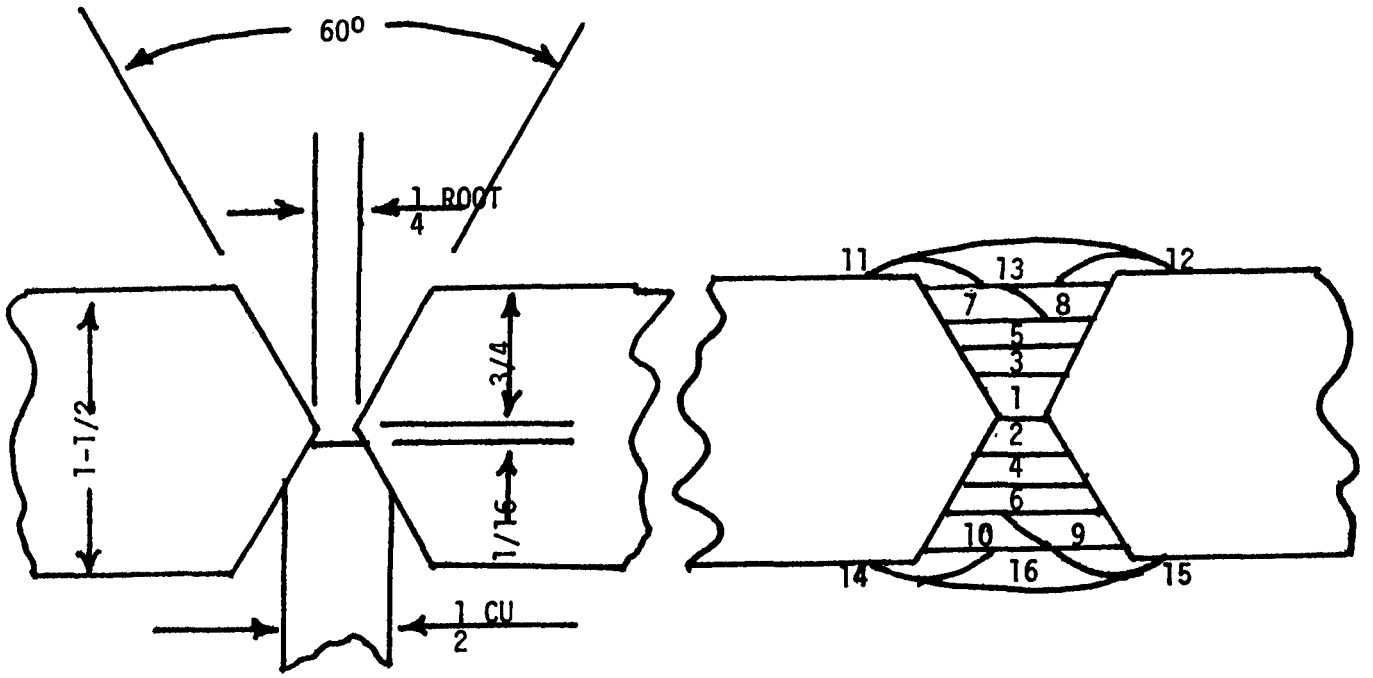
BACK / FLOOR 12-20-76 12-27-76 LEFT
LEFT SIDE / FRONT FLOOR 12-9-76 12-28-76 RIGHT
RIGHT " " 12-10-76
LEFT " REAR " 12-13-76
RIGHT " " 12-15-76





MOCK HULL
INTERMIX
M.A. SCHAVO

Figure 38



PREHEAT & INTERPASS			105F (221C)
PASS	AMPS	VOLTS	ELECTRODE
1	220	22	10016, 3/16"
2-16	330	29	B88, 1/16"

PROCEDURE FOR STD & PULSED
MIG COMPARISON

Figure 39

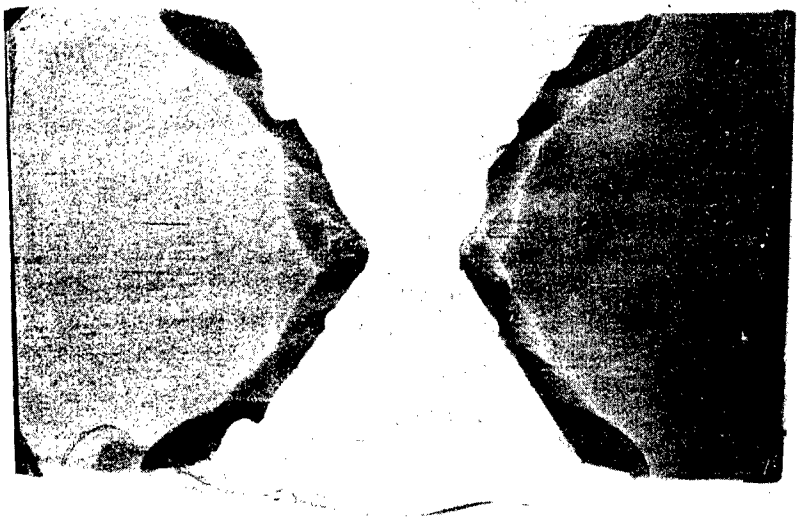


Figure 40- Cross-section of Standard Spray MIG Weld.

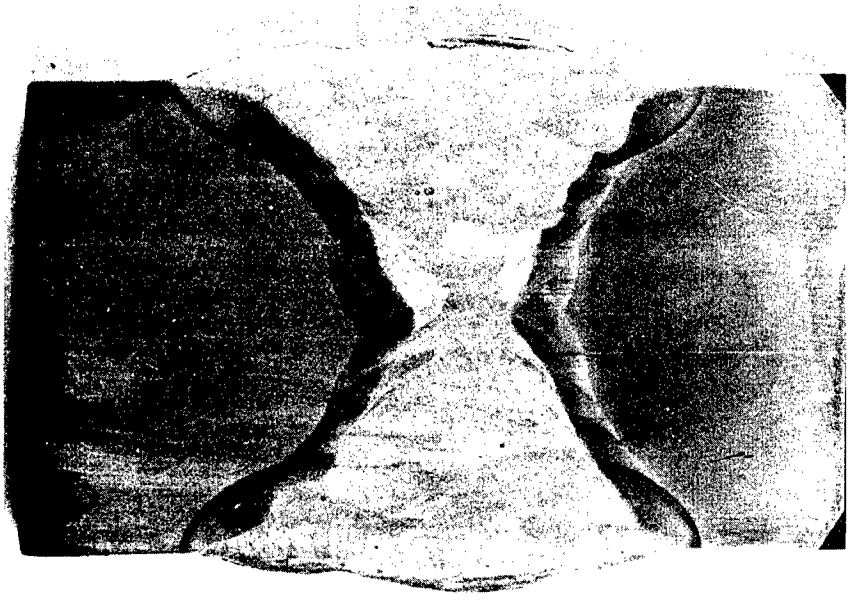
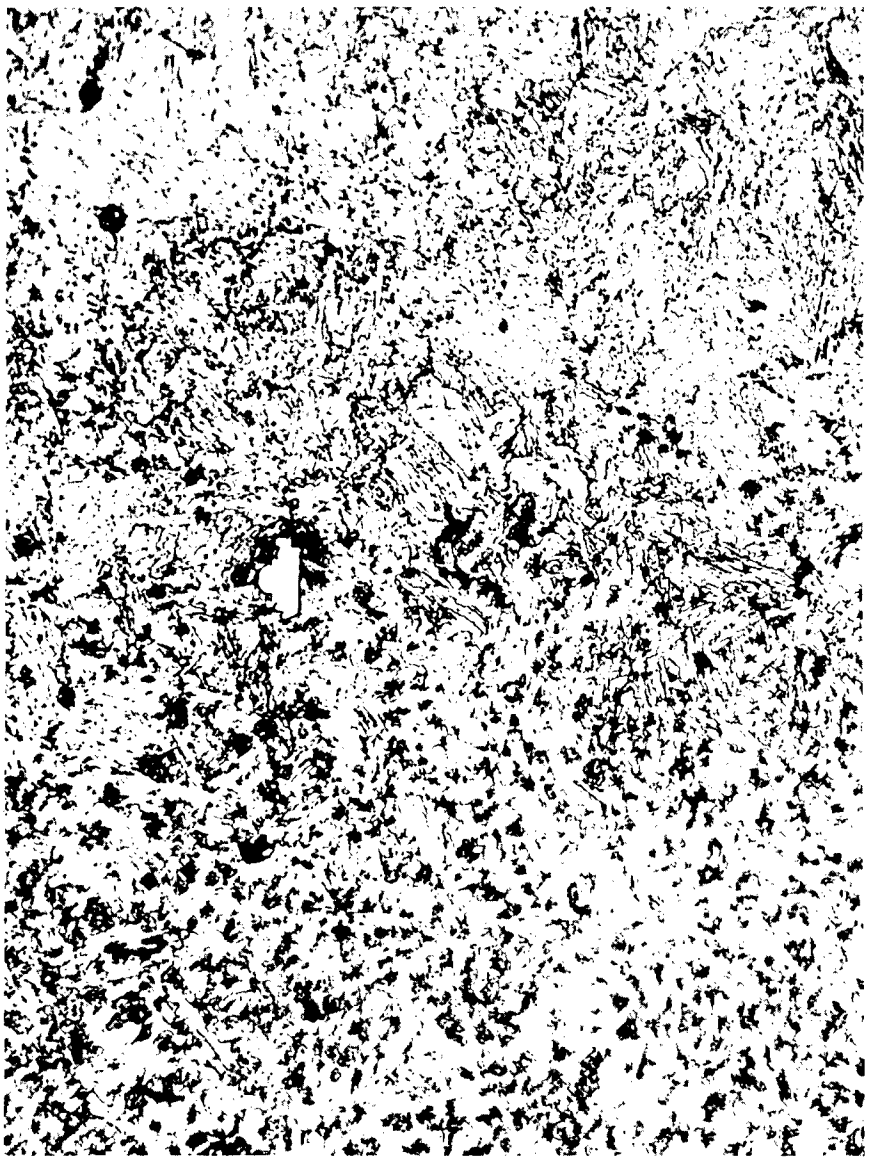


Figure 41 - Cross-section of Pulsed MIG Weld.

Figure 42

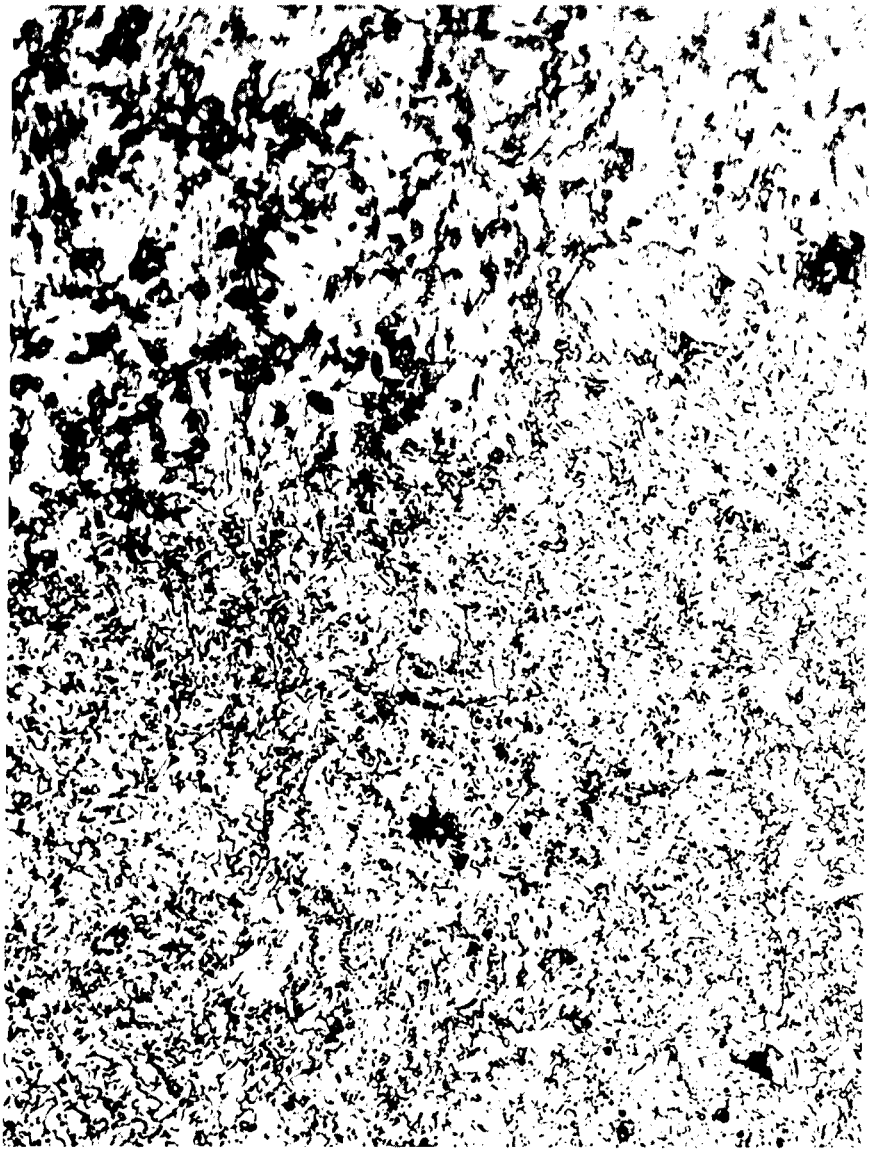
PL 18, High Hardness Armor, Base Metal, (500x, 2% Nital Etch)

Figure 43



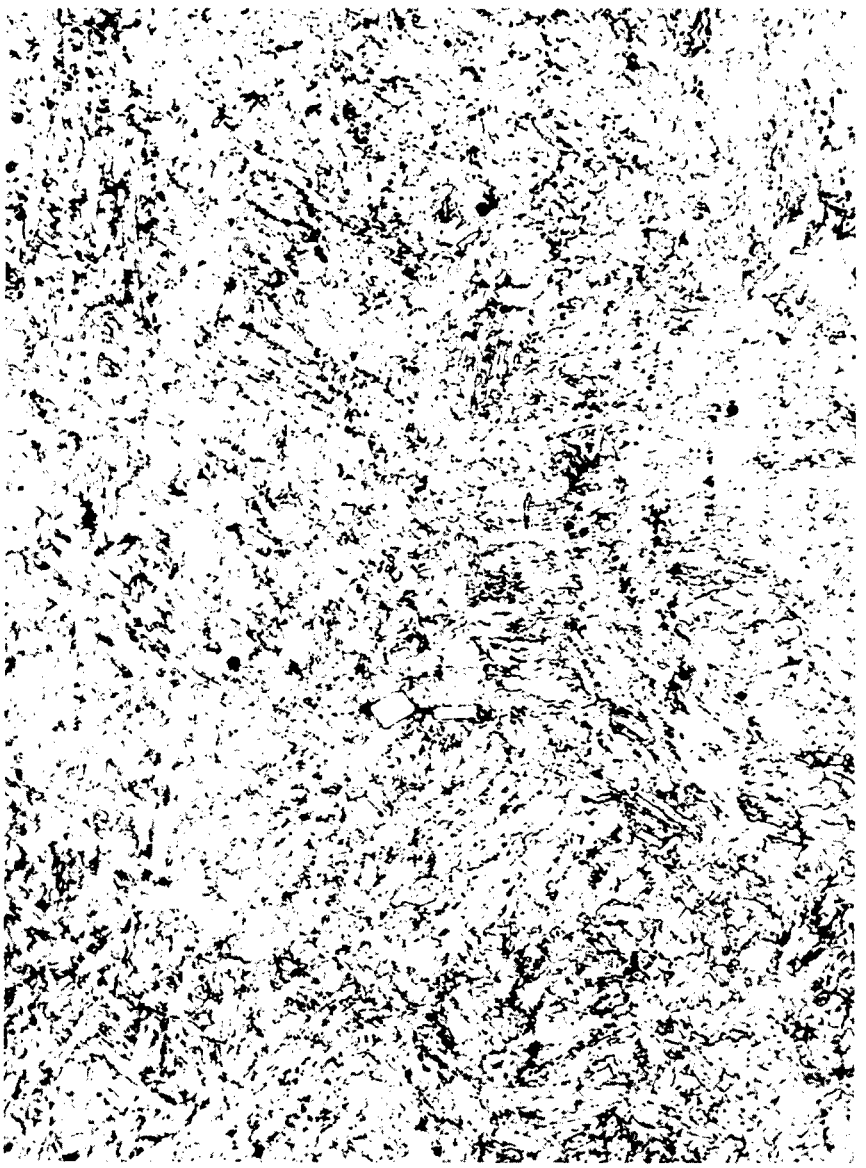
PL 18, High Hardness Armor, Base Metal to HAZ Transition, (500x, 2% Nital Etch)

Figure 44



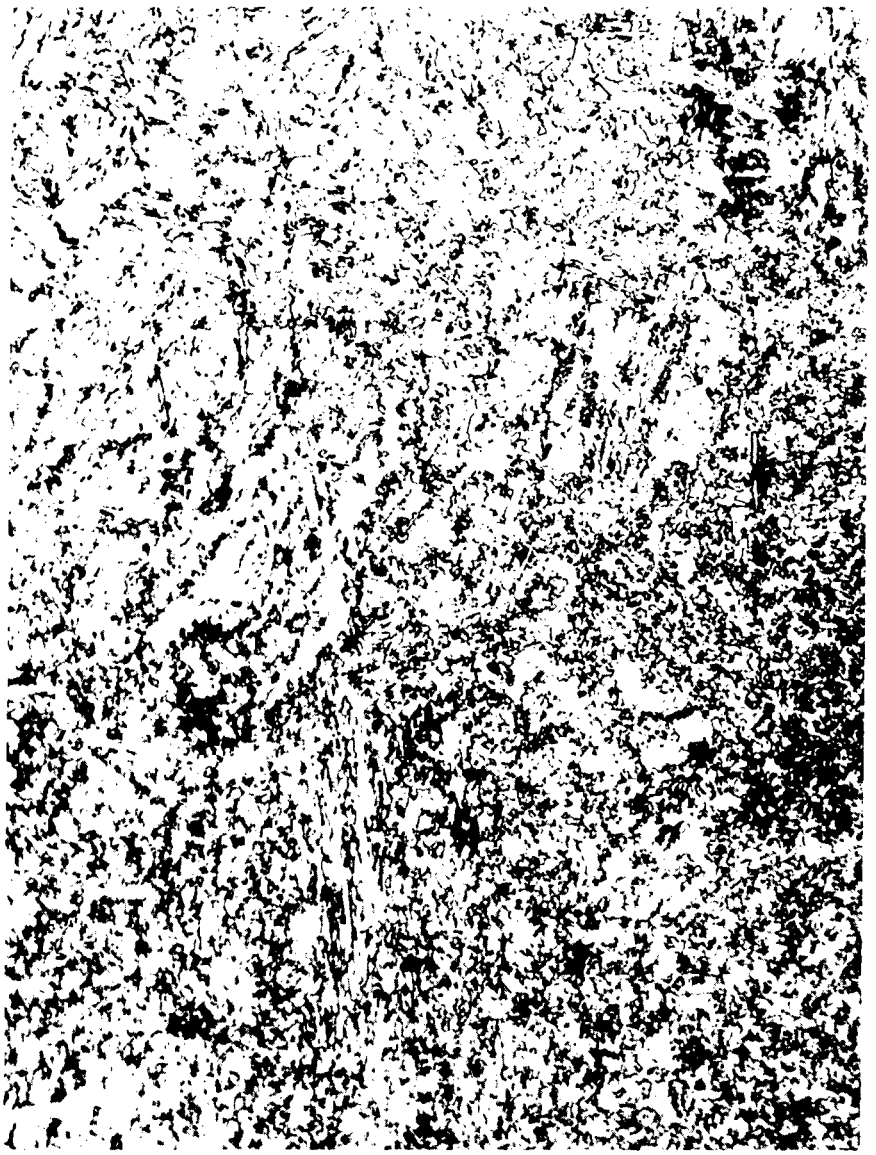
PL 18, High Hardness Armor, HAZ to Weld Metal Transition, (500x, 2% Nital Etch)

Figure 45



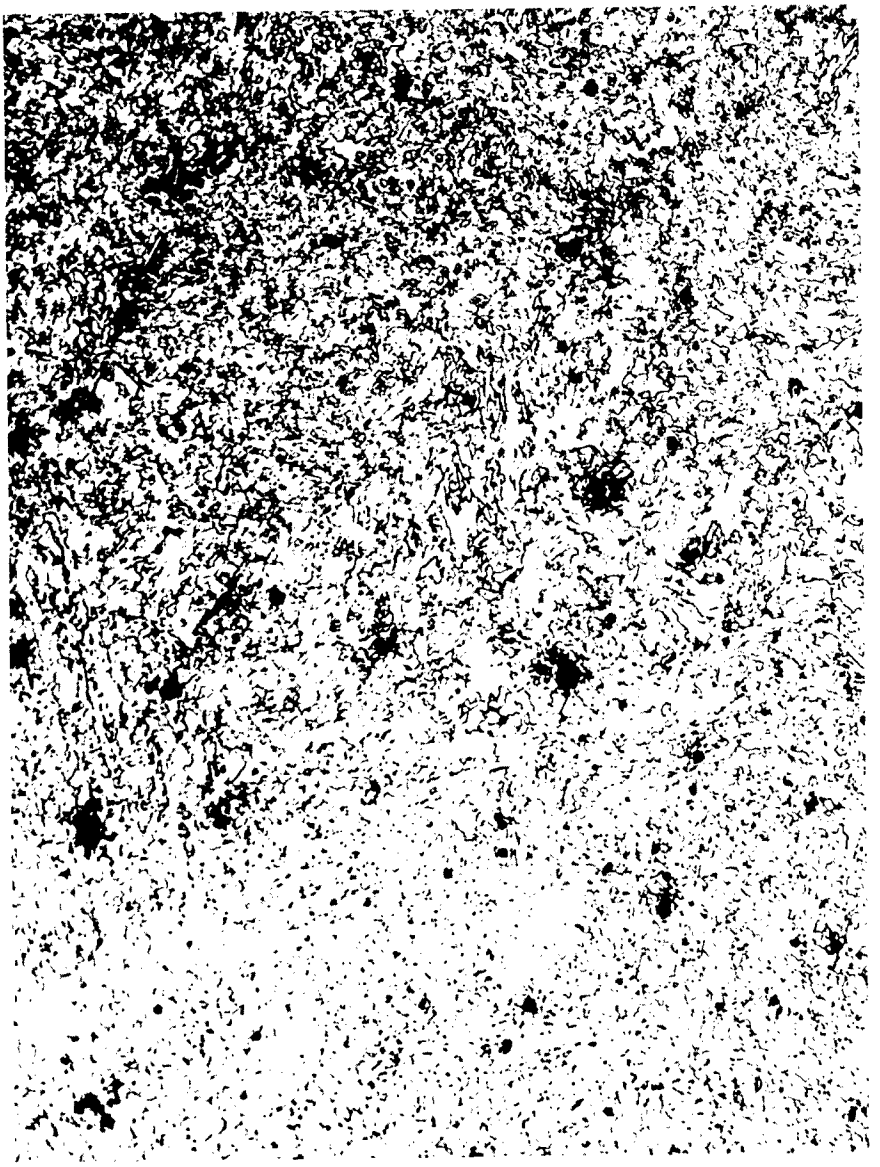
PL 10, Standard Armor, Base Metal, (500x, 2% Nital Etch)

Figure 46



PL 18, Standard Armor, Base Metal to HAZ Transition (500x, 2% Nital Etch)

Figure 47



PL 18, Standard Armor, HAZ to Weld Metal Transition
(500X, 2% Nital Etch)

Figure 48

PL 18, Weld Metal, (500x, 2% Nital Etch)

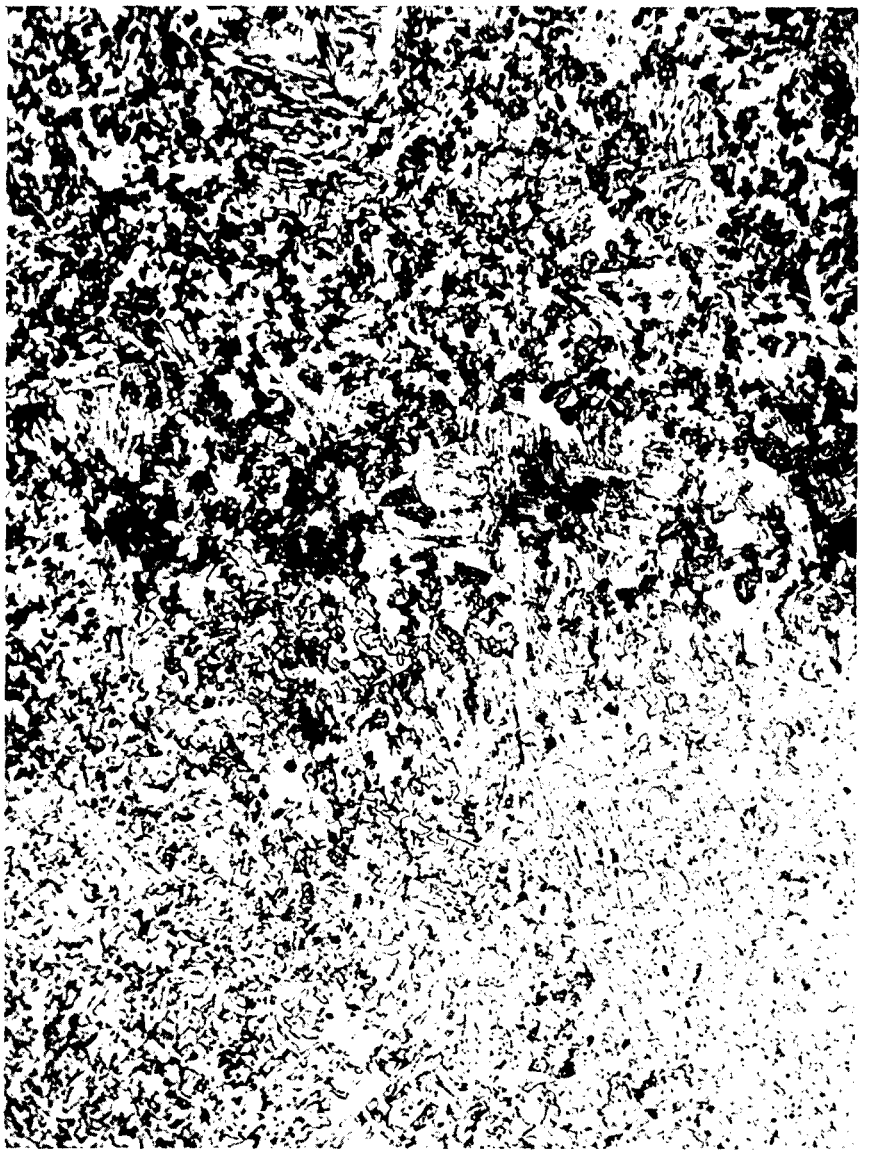
Figure 49

PL 19, High Hardness Armor, Base Metal, (500x, 2% Nital Etch)

Figure 50

PL 19, High Hardness Armor, Base Metal to HAZ Transition
(500x, 2% Nital Etch)

Figure 51



PL 19, High Hardness Armor, HAZ to Weld Metal Transition
(500x, 2% Nital Etch)

Figure 52

PL18, Standard Armor, Base Metal, (500x, 2% Nital Etch)

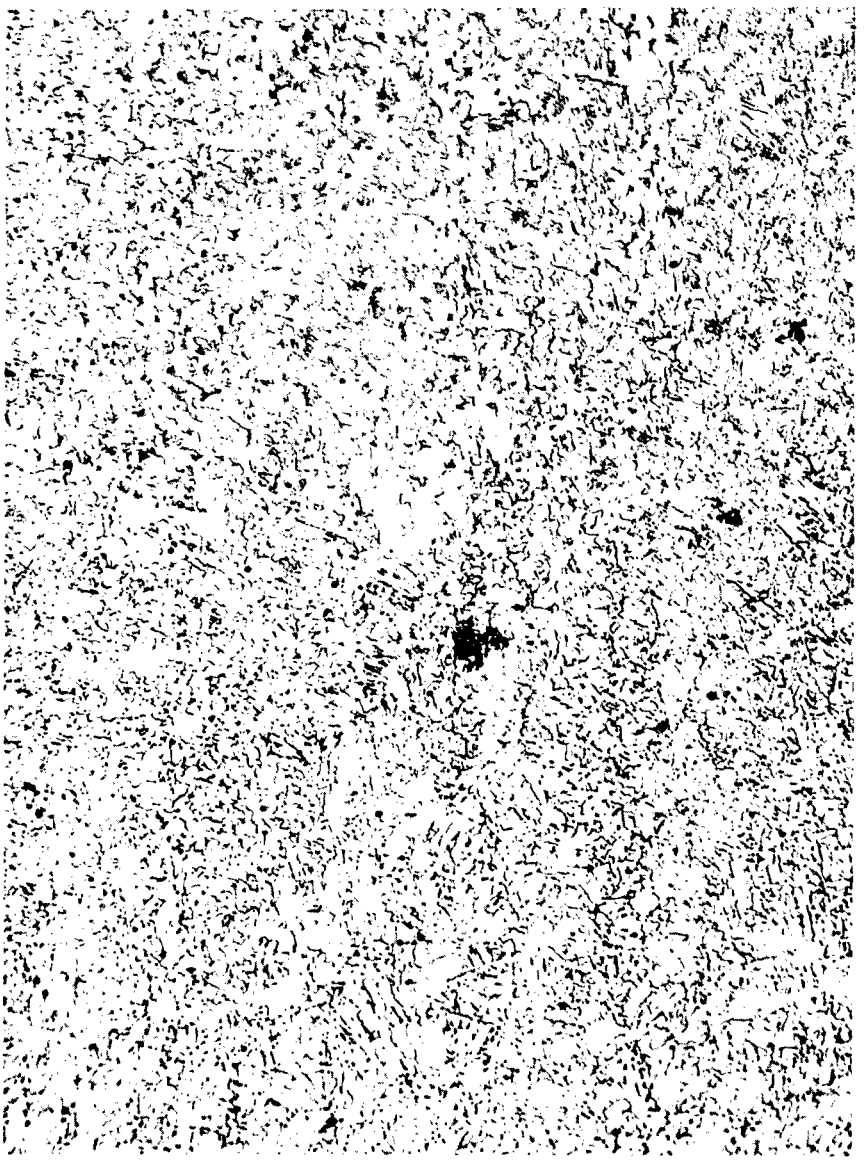
Figure 53

PL 19, Standard Armor, Base Metal to HAZ Transition
(500x, 2% Nital Etch)

Figure 54

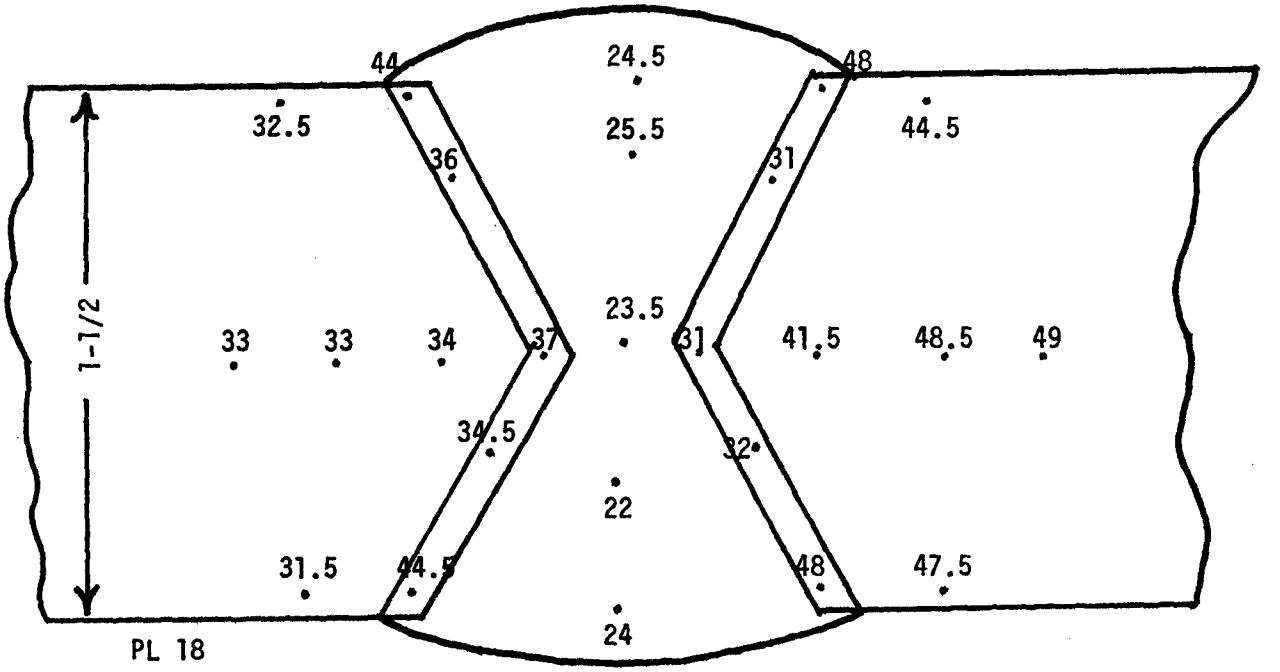
PL 19, Standard Armor, HAZ to Weld Metal Transition, (500x, 2% Nital Etch)

Figure 55

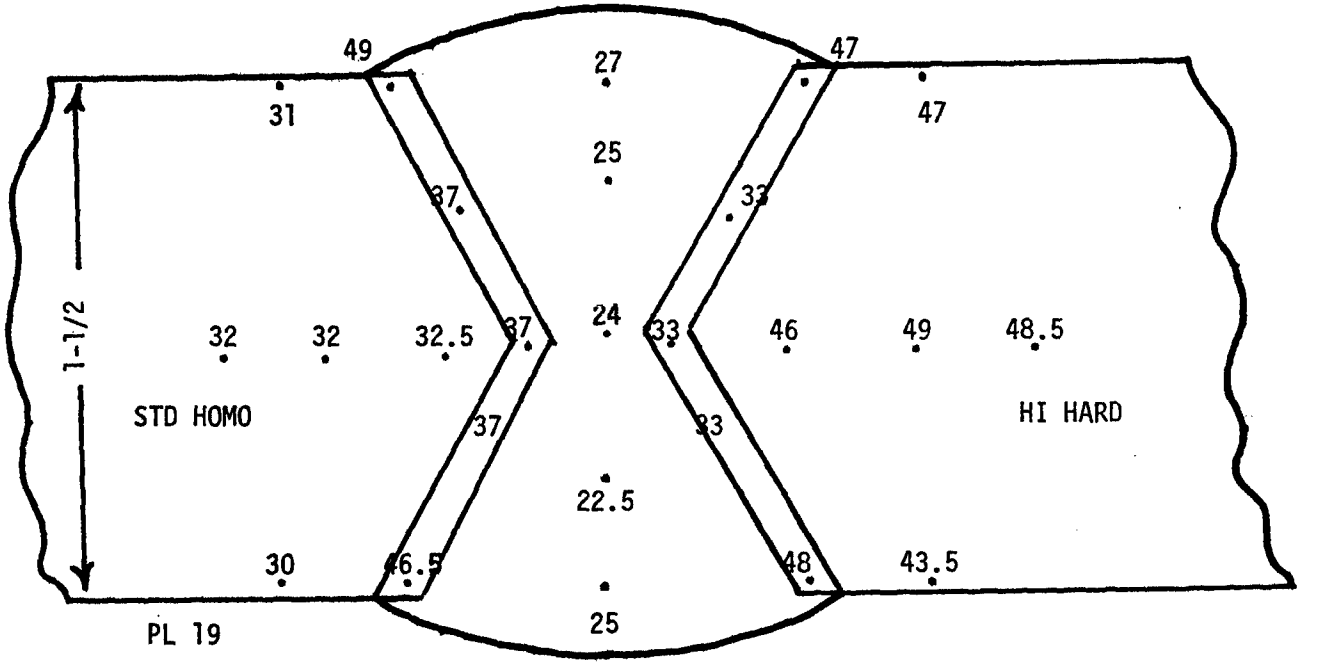


PL 19, Weld Metal, (500x, 2% Nital Etch)

Figure 56

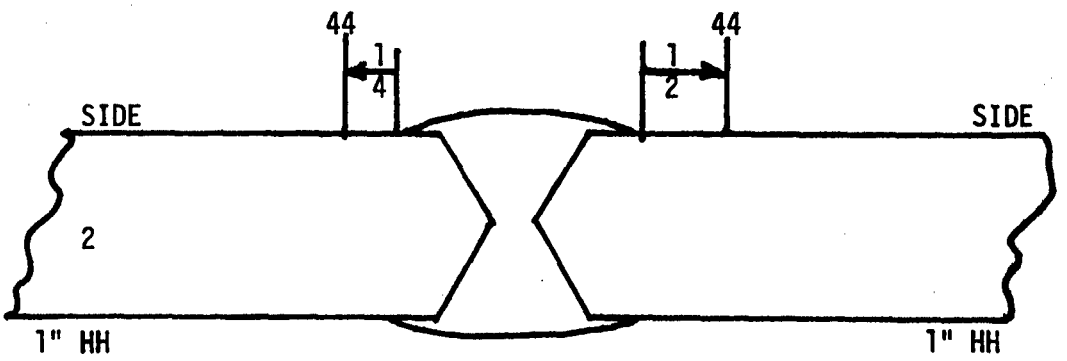


STD MIG SPRAY



MIG PULSED

HARDNESS VALUES R/C



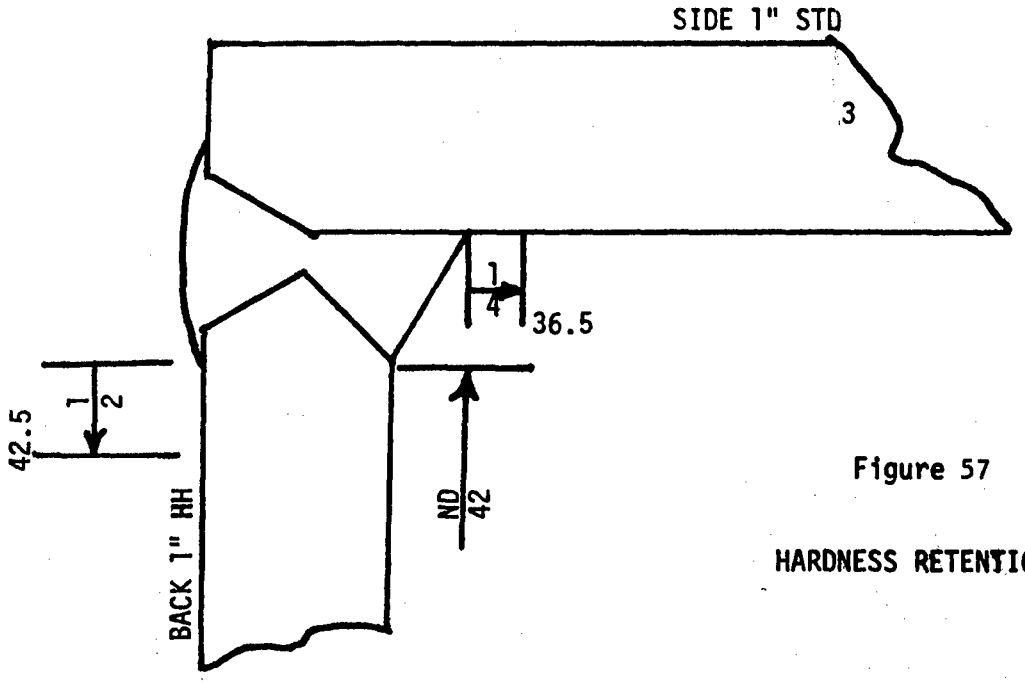
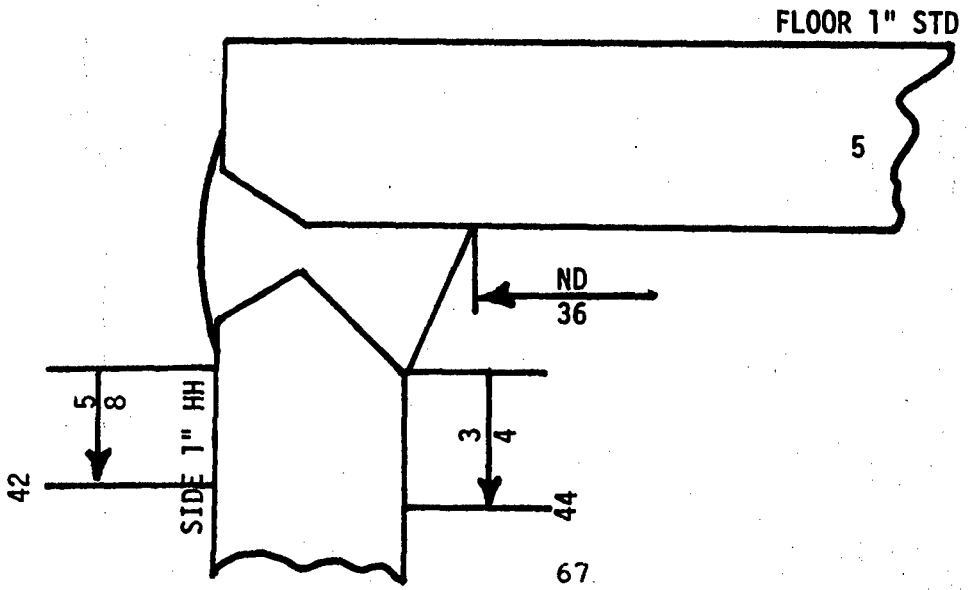


Figure 57

HARDNESS RETENTION



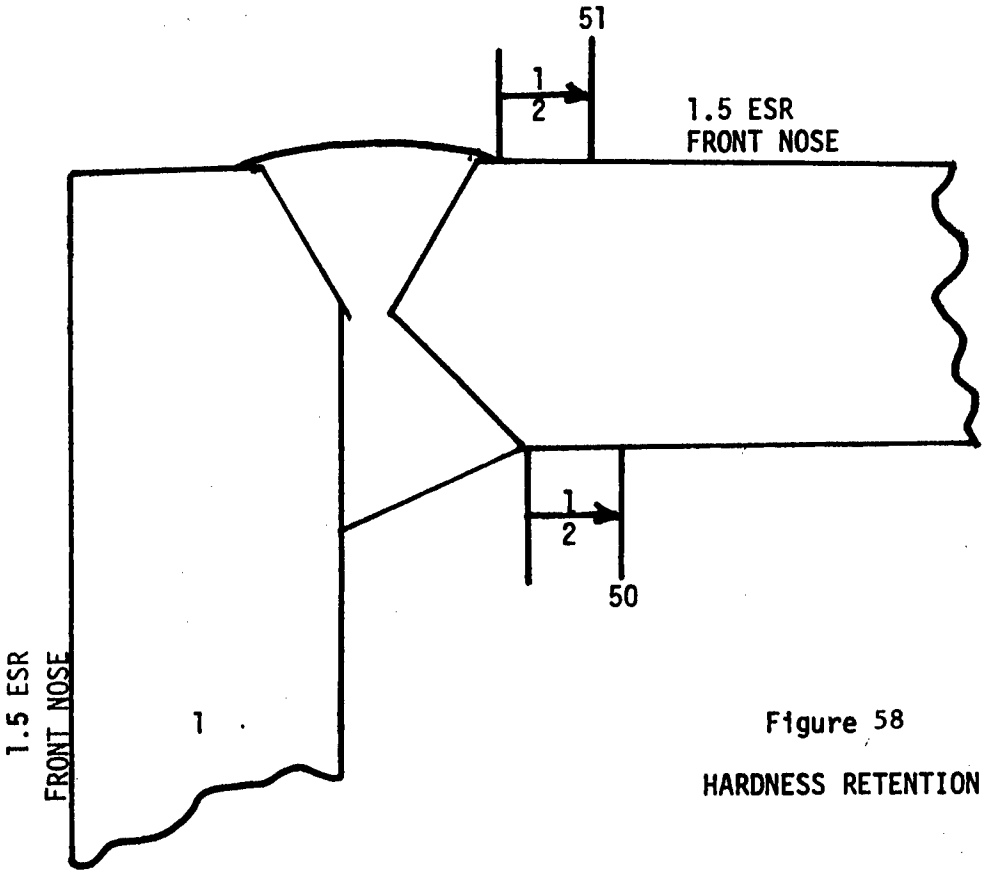
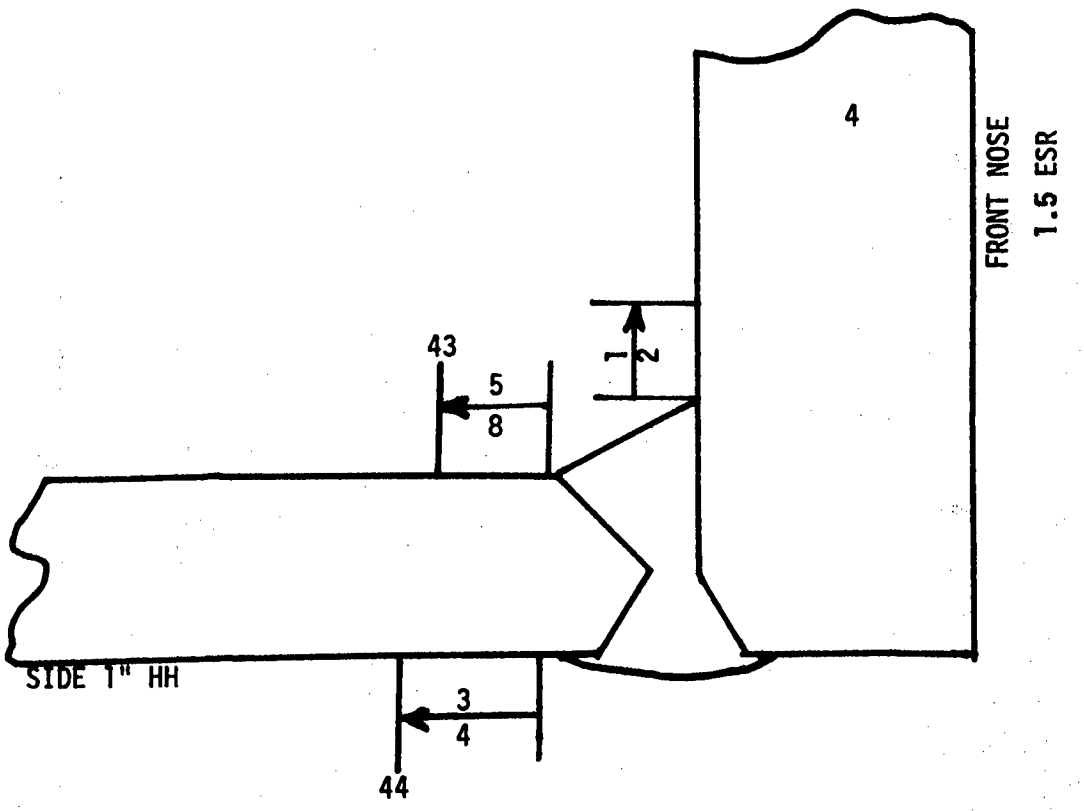
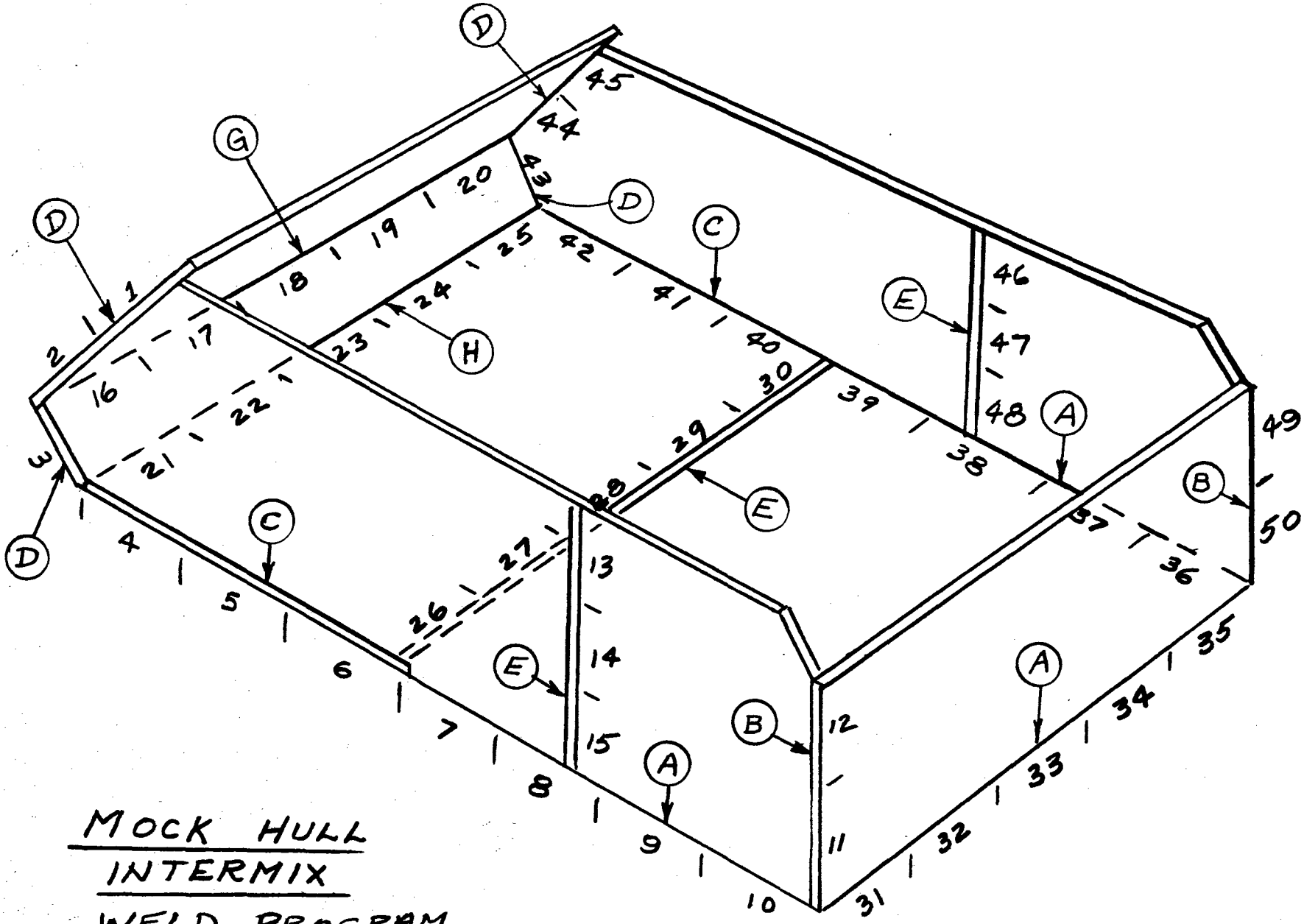


Figure 58

HARDNESS RETENTION



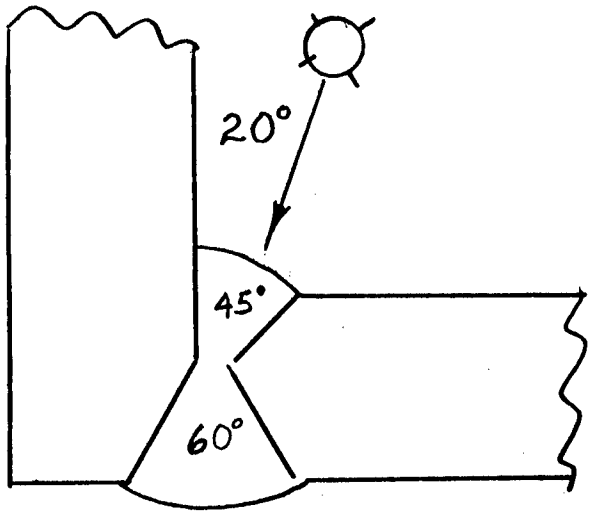


MOCK HULL
INTERMIX
WELD PROGRAM

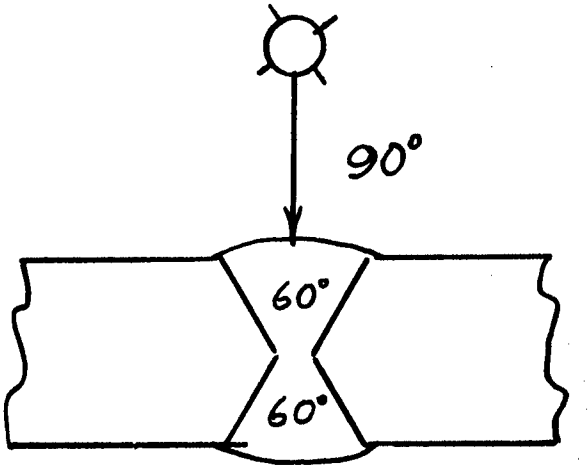
X-RAY POSITIONS

FIG 59

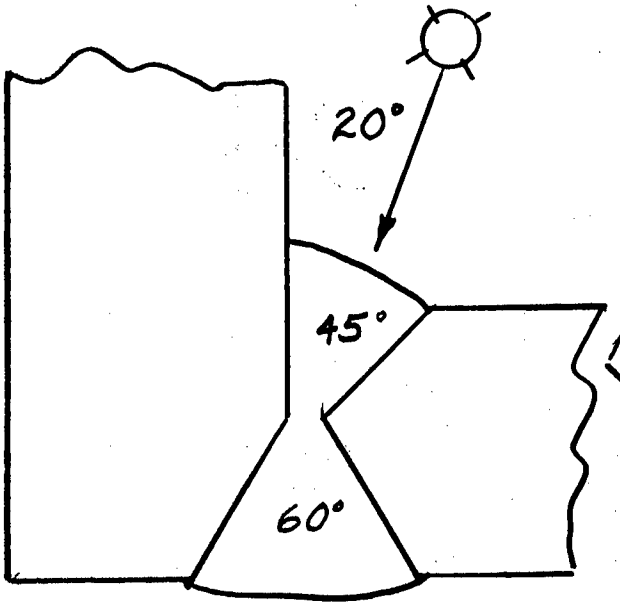
W.F.W.



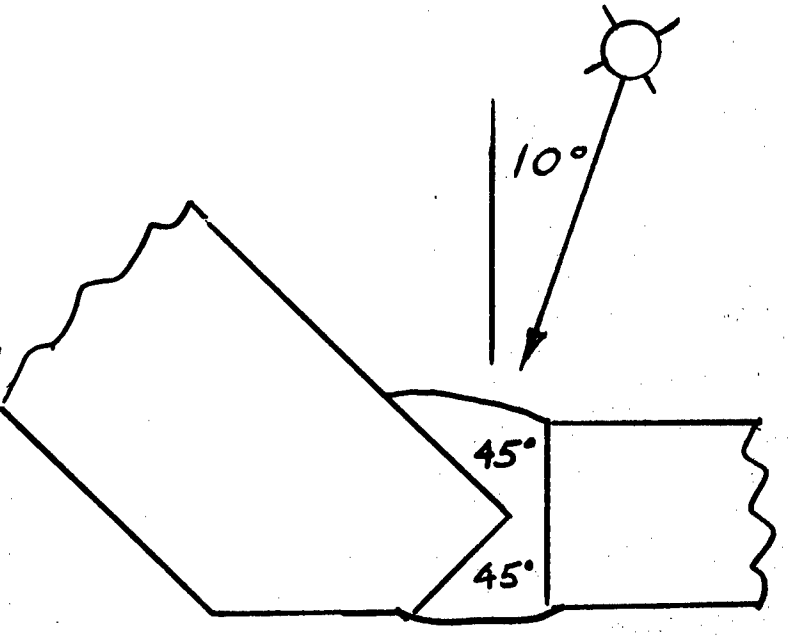
JOINTS A, B, C & D



JOINT E



JOINT G



JOINT H

X-RAY ANGLES
MOCK HULL, INTERMIX

FIG 60
FULL SCALE

DISTRIBUTION LIST

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Several welding processes were used to deposit weld metal into full penetration joints in standard armor. The optimum process, or combination thereof, determined by results of ballistic firing tests, was used to join armors of different types and hardnesses. The types of armors were (1) standard, (2) High hardness, and (3) ESR. The combinations used were standard to high hardness, standard to ESR, and ESR to high hardness. A mock hull was fabricated of these three armors to determine their compatibility in a single structure. Radiography revealed the hull to be free of flaws.

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