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MATERIAL - BRAZED HONEYCOMB PANELS - STRUCTURAL REPAIR - EVALUATION OF -

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MODEL B-58

REPORT FGT-2999

DATE February 11, 1963

TITLE

MATERIAL - BRAZED HONEYCOMB PANELS - STRUCTURAL REPAIR - EVALUATION OF -

SUBMITTED UNDER

CONTRACT NUMBER

AF33(600)-38975

Tests described in this report were conducted 7-20-61 to 5-15-62.

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MATERIAL - BRAZED HONEYCOMB PANELS - STRUCTURAL REPAIR - EVALUATION OF -

PURPOSE:

This investigation was conducted to determine if a brazing alloy addition would improve the static and fatigue strength of TIG fusion spot welded patches used for structural repair of brazed stainless steel sandwich panels on the B-58.

SUMMARY:

The present method of repairing brazed stainless steel sandwich panels on the B-58 involves the attachment of patches by TIG spot welding techniques in accordance with FPS-0085. This investigation has shown that the addition of certain foil brazing alloys to the fusion spot welded joint interface of 17-7PH stainless steel will improve both the static lap shear and flexure fatigue strength. Six brazing alloys were evaluated but only two were found to be completely beneficial. Of these two alloys, 97Ag-3Li was the better, increasing the flexure fatigue strength by 114% and the static shear strength by 11%. The other alloy, 93Ag-7Cu+.2Li, increased the static strength by 14% but the fatigue strength by only 83%. The other alloys increased the static strength but did not improve the fatigue strength. Three MD 1698 test panels which had 1" diameter simulated damage repairs were sonic fatigue tested. All the panels had 97Ag-3Li braze alloy added to the outer skin-patch interface. All patches passed the three hour test at a 160 db sound pressure level.

An experimental system of spot brazing using the spot weld heat to melt the brazing alloy but not form a weld nugget was examined. The spot brazed shear strengths were not sufficiently strong to recommend this type of joining for the repair of brazed stainless steel sandwich panels.

MATERIAL - BRAZED HONEYCOMB PANELS -
STRUCTURAL REPAIR - EVALUATION OF -

OBJECTIVE :

The objective of this test program was to determine the static and fatigue strength of TIG spot welded 0.010" 17-7PH (TH-step aged) stainless steel after various commercial brazing alloys had been added to the joint interface.

TEST SPECIMENS:

Single lap shear static and flexure fatigue test specimen blanks, like those *shown in Figure 1, were machined from 0.010" 17-7PH Condition A sheet supplied from production stock. Tensile control specimens were also machined to the configuration shown in Figure 2. All specimens were machined so that the material would be tested in the longitudinal grain direction. The holes in the flexure fatigue specimens were jig drilled after welding to insure uniform attachment in the fatigue test machine.

TEST PROCEDURE :

The tensile, lap shear, and fatigue specimen blanks were cleaned, sealed in a retort and cyclic purged (evacuated followed by argon back filling) by production personnel using production facilities. The blanks were given a simulated braze cycle and step-aged per P.S. 43.05 Gc.** This heat treatment consisted of the following:

1. Simulated braze at 1655-1670°F for 3 minutes,
2. Furnace cool to 1400°F as rapidly as possible,
3. Remove retort from furnace and cool to room temperature,
4. Hold at room temperature for six hours before proceeding to aging treatment,
5. Age at 1075-1100°F for 15 minutes,
6. Furnace cool to 875-900°F and hold for 60 minutes,
7. Air cool to room temperature.

* MIL-S-25043
** GD/FW In-Plant Process Standard

Following heat treatment, the specimen blanks were TIG spot welded or spot brazed by the Applied Manufacturing Research and Process Development Department. This consisted of making lap shear and flexure fatigue specimens having the following joint configurations:

1. Control - no braze alloy
2. Braze alloy added to joint interface

The addition of brazing alloy to the joint was accomplished by inserting a .002 to .005" thick x 1" sq. strip between the two specimen blanks in the center of the area to be welded or brazed. By adjustment of the welding machine, sufficient heat and pressure could be supplied to result in either a fusion spot nugget or spot brazed interfaces. Five lap shear specimens were prepared for each of the following brazing alloys:

1. Spot Weld -

   a. None - control
   b. None - Type 308 filler wire added to weld nugget
   c. 97Ag-3Li
   d. 97Ag-3Li (nickel plated)
   e. 93Ag-7Cu+.2Li
   f. 87 Ag-Cu-Li+13 Ni sponge
   g. 75 Ag-Cu-Li+25 Ni sponge
   h. HT-15 *

2. Spot Braze -

   a. 87 Ag-Cu-Li+13 Ni sponge
   b. 93Ag-7Cu+.2Li
   c. HT-15 *

Twenty-three flexure fatigue control specimens were fusion spot welded in order to establish a S-N curve for the flexural fatigue strength of the joint. Five fatigue specimens each of the following braze alloys and filler wire additions were welded or brazed to determine the joint fatigue strength:

* 45 Cu-12Ni-43 Mn

1. Spot Weld

   a. Type 308 filler wire added to weld nugget
   b. 97Ag-3Li
   c. 93Ag-7Cu+.2Li
   d. 87 Ag-Cu-Li+13 Ni sponge
   e. HT-15

2. Spot Braze

   a. 93Ag-7Cu+.2Li
   b. 87 Ag-Cu-Li+13 Ni sponge

The TIG spot welding and brazing was conducted in a Miller SR 400 machine using a Miller SCE-1 control panel. A 1/16" dia. electrode was used with a .060" gap. Filler wire of .020" dia. 17-7PH was used for all fusion spot weld except those where Type 308 wire was intentionally added. Argon shielding gas was used with a flow of 7 cfh for the face side and 5 cfh for the penetration side. The following table lists the machine settings for the various brazing alloys examined:

TIG Spot Weld Machine Settings

Braze Alloy	Type Specimen	Preheat Amps	Preheat Sec.	Weld Amps	Weld Sec.	Preheat Amps	Preheat Sec.	Voltage
Control - none	Weld	20	4.7	20	1.1	15	2.2	10
97Ag-3Li		32		15		10		10
97Ag-3Li plated		32		15		10		10
93Ag-7Cu+.2Li		32		15		10		10
75 Ag-Cu-Li + 25 Ni sponge		20		15		10		12
87 Ag-Cu-Li + 13 Ni sponge		32		15		10		10
HT-15	↓	15	↓	15	↓	10	↓	10
97Ag-3Li	Braze	12	4.7	8	1.1	5	4	12
97Ag-3Li plated		12		8		5		12
93Ag-7Cu+.2Li		19		11		5		12
75 Ag-Cu-Li+25 Ni Sponge		19		11		5		12
87 Ag-Cu-Li+13 Ni Sponge	↓	19	↓	11	↓	5	↓	12

All current was D.C., straight polarity.

Preparation of the specimens for welding consisted of removing the oxide surface scale by emery paper followed by trichloroethylene cleaning. After welding, the specimens were inspected radiographically.

Static testing of the control tensile and lap shear specimens was conducted in a 5000 pound capacity Baldwin Universal Test Machine equipped with an autographic load-deformation recorder. Yield strength of the tensile specimens was determined by the 0.2% offset method. A load rate of approximately 500 lbs/min. was maintained during testing.

Flexure fatigue tests were conducted in a Baldwin SF-2 machine of ±25 lbs capacity. Due to the configurations of the weld joint and the thin gage of the material, stress values and machine complimentary weight could not be calculated. Rather, the distance for the complimentary weight was set at its lowest spacing to minimize specimen oscillation amplitude. Tests were conducted at specific loads. Since a comparison of fatigue results was made between the various brazing alloys and joining techniques, absolute values of stress were not essential.

Metallographic cross sections of the weld joints were prepared and photographed. Due to the rapid etching rate of the braze alloy, two photomicrographs of each fusion spot welded nugget are included. One photomicrograph shows the structure of the weld nugget whereas the other is more lightly etched to reveal brazing alloy structure.

From the results of this test the 97Ag-3Li brazing alloy was chosen to be used in the making of patch repairs on five MD 1698* stainless steel sandwich test panels.

The configuration of the TIG spot welded patch is shown in Figure 12. It can be seen that in addition to the sixteen spot welds attaching the patch to the outer skin, there is a pin passing through the panel which is spot welded to a doubler on the back skin. In a standard repair the back skin is not disturbed other than the spot welding of the pin and doubler.

* Configuration of MD 1698 test panel shown in Figures 15-18.

The normal repair procedure, as outlined in FPS-0085*, was followed for panel specimens numbers 1, 2 and 3. Panel specimen number 4 was an experimental repair in which the patch assembly procedures were varied. The patch was shimmed and tension loading of the pin was relieved. The back skin doubler was welded to the pin before assembly with patch. As a result there was no weld bead penetration of the bottom skin. Panel specimen number 5 was completely different from the other four specimens in that the patch was indirect resistance spot brazed to the skin. The same technique was used for attaching the patch to the slug and core. The 97Ag-3Li braze alloy was not only placed between the patch and the panel skin but between the patch and the slug, and the slug and the core. No pin or back skin doubler was used. The system of indirect resistance spot brazing involved placing two copper electrodes in close proximity to the skin area to be brazed. One electrode had more contact area so that the heat was concentrated at the smaller electrode, where it was desired to spot braze. Because of the variations in assembly and joining of the repair patches in panel specimens numbers 4 and 5, test results obtained were not considered to be representative of properly repaired panels.

The test panels were instrumented with strain gages as shown in Figure 13 in order to determine resonant frequencies and detect failures during the test. The specimens were bolted in a steel frame as shown in Figure 14, with the outer skin nearest the siren and normal to the axis of the siren (normal incident). This method of fixturing was similar to that reported in FSG-499.** The specimens were subjected to sound pressures of 160 db and tested to failure or 3 hours elapsed time without failure. If no failure occurred, the sound pressure was increased to 167-170 db and the test was continued to failure.

* GD/FW Detailed Repair Procedure Specification
** GD/FW Structures Group Report

RESULTS:

The results of the TIG spot welded single lap shear tests are given in Table I. Table II lists the spot brazed single shear strengths. Flexure fatigue test results of both TIG spot welded and brazed joints are tabulated in Table III. The effect on the fatigue strength of braze alloy additions are shown in Figures 3 and 4. The tensile strength of the base metal as determined from control tensile tests were:

Spec. No.	Yield Str., ksi	Ultimate Str., ksi	Elongation, % in 2"
1	173.5	195.1	6.5
2	175.3	194.5	6.0
3	165.9	193.0	7.0
4	167.9	193.1	6.5
Avg.	170.7	193.9	6.5

The microstructures of the fusion spot welded joints showing the various brazing alloys investigated are shown in Figures 5 through 11.

The sonic fatigue results of the testing of the five MD 1698 panels is given in Table IV. More detailed description of the strain gage readings is given in FTDM-2500-33.* Panel specimen #2 was coated with stress coat and subjected to 160 db at 710 cps for 60 seconds. Since no stress pattern was visible, the specimen was further exposed to 165 db at 707 cps for 60 seconds. The stress pattern shown in Figure 14 was obtained. Photographs showing details of failure for panel specimens numbers 1, 3, 4 and 5 are shown in Figures 15 through 18.

* GD/FW Report

DISCUSSION:

In general, the TIG spot welding of the thin sheets of 17-7PH stainless steel separated by brazing alloy did not create any unusual problems for the welder. Those alloys containing lithium caused a considerable amount of metal expulsion during the weld cycle. The welding electrode and cup had to be cleaned frequently to maintain good argon flow. Of all the brazing alloys welded, the North American alloy, HT-15, was the most troublesome.

Referring to Table I, it can be seen that all of the six brazing alloys investigated increased the static single lap shear strength of the TIG spot welded joint by at least 11%. The 97Ag-3Li braze alloy was the least effective whereas the HT-15 braze alloy increased the shear strength the most. The 17-7PH filler wire addition produced a weld nugget which was 57 pounds stronger on the average than the Type 308 filler wire.

By reducing the D.C. current flow to the TIG spot welding torch, it was possible to reduce the heat to a level where only localized melting of the braze alloy occurred at the joint interface. No fusion spot weld nugget was formed, but a spot brazed joint was formed. Such TIG spot braze joints were evaluated for three brazing alloys. As can be seen in Table II, the resulting braze joints had less than one-half the static shear strength of the welded-braze reinforced joints.

The same relation was true for the flexure fatigue strength of the spot brazed joints compared to the welded-braze reinforced joints. A spot brazed joint using 93Ag-7Cu+.2Li alloy had an average fatigue life of 38,000 cycles as compared to the 200,000 cycles average life of the welded-brazed material. Likewise, the 87 Ag-Cu-Li+13 Ni sponge alloy had an average fatigue life of 28,000 cycles for the spot brazed joint and 105,000 cycles for the spot welded-brazed joint.

Referring to Table III and Figures 3 and 4, it can be seen that only two braze alloys were effective in increasing the flexure fatigue strength of the TIG spot welded 17-7PH. The 97Ag-3Li braze was the most beneficial joint addition, increasing the fatigue life by 114%. Spot welded-brazed joints of 93Ag-7Cu+.2Li had 83% longer fatigue life than the spot welded control material. The other two braze alloys investigated, 87 Ag-Cu-Li+13 Ni sponge did not affect the fatigue strength of the spot welded-brazed joint whereas HT-15 actually decreased the fatigue strength.

An explanation as to the effects of braze alloy addition on the spot welded fatigue strength of 17-7PH is pictorially shown in the photomicrographs of Figures 5 through 11. As can be seen in Figure 5, the interface of the two sheets of stainless steel form a very sharp notch which would act as a stress raiser. Since all the fatigue failures originated at the weld junction, rather than through the nugget or the heat affected zone, it would be expected that reduction of the stress concentration at the weld junction would increase the fatigue strength. Such was the case with the 97Ag-3Li braze alloy which formed a smooth radius at the weld-braze junction as shown in Figures 6 and 7. From Figure 8 it can be seen that the 93Ag-7Cu+.2Li braze did not form as good a radius as did the 97Ag-3Li alloy. Figures 9 and 11 show that the 75 Ag-Cu-Li +25 Ni sponge and the HT-15 braze alloys were ineffective in forming a fillet at the weld junction. Thus it can be seen, that despite the high static strength obtained with HT-15, the alloy detrimentally affected the fatigue strength because of its non-fillet forming characteristics. The radius formed by the 87 Ag-Cu-Li+13 Ni sponge, shown in Figure 10, actually appears better than that of 93Ag-7Cu+.2Li, shown in Figure 8; however, the fatigue strength was lower. The 97Ag-3Li nickel plated alloy was not investigated for fatigue properties although on the basis of static strength and metallographic examination it appeared to have much promise. Difficulties in uniformly nickel plating the alloy would have prevented its practical application so testing was not pursued further. No cracks were detected in any of the weld nuggets examined metallographically.

Referring to the photographs of the failed sonic panel specimens in Figures 15 and 16, it can be seen that failure originated in the outer panel skin of both panels starting at one of the peripheral spot welds. These failures occurred only after the sound pressure level was increased to above 160 db. Experimental panel #5 has a failure in the outer skin but the patch skin also cracked, as seen in Figure 18. The experimental panel # 4, shown in Figure 17 and representing variations in assembly and welding technique, had a failure which originated at the doubler on the panel inner skin. This panel was the only specimen which failed before three hours of sonic exposure had been attained. However, it was not considered representative of a production quality repair.

CONCLUSIONS:

1. The addition of foil braze alloy to the TIG spot welded interface of .010" 17-7PH (TH-step aged) stainless steel is an effective method for increasing the static lap shear strength.

2. Of the six brazing alloys investigated, HT-15 and 97Ag-3Li nickel plated braze alloys increased the static lap shear strength the most.

3. Only two brazing alloys, 97Ag-3Li and 93Ag-7Cu+.2Li, of the four tested benefited the flexure fatigue strength of TIG spot welded 17-7PH. Of these alloys 97Ag-3Li increased the fatigue life the most by 114%. HT-15 actually decreasedthe fatigue life by 41%.

4. The beneficial effect to the fatigue strength results not from increased static strength of the joint but rather from decreased stress concentration at the weld junction. This decrease in stress concentration results from the braze alloy forming a radius at the junction of the weld nugget and the interface of the two sheets of stainless steel. Not all of the braze alloys were effective in forming this radius.

5. The spot braze joints had static and fatigue strengths which were considerably less than their respective spot welded-braze reinforced strengths.

6. The 17-7PH filler wire addition to the TIG spot welds produced stronger welds than did the Type 308 filler wire.

7. Three MD 1698 brazed honeycomb stainless steel panels which had 1" diameter repairs of simulated damage using FPS-0085 techniques and 97Ag-3Li braze reinforcement to TIG spot welds withstood three hours of 160 db sonic sound pressure without failure.

RECOMMENDATIONS:

1. It is recommended tha 97Ag-3Li braze alloy be used when repair TIG spot welding of 17-7PH stainless steel. This alloy can produce a spot welded-brazed joint which has 11% more static lap shear strength and 114% more flexure fatigue strength.

2. TIG braze joints should not be used as they have less strength than normal TIG spot welded 17-7PH.

3. The filler wire added to the weld nugget should be 17-7PH in preference to Type 308.

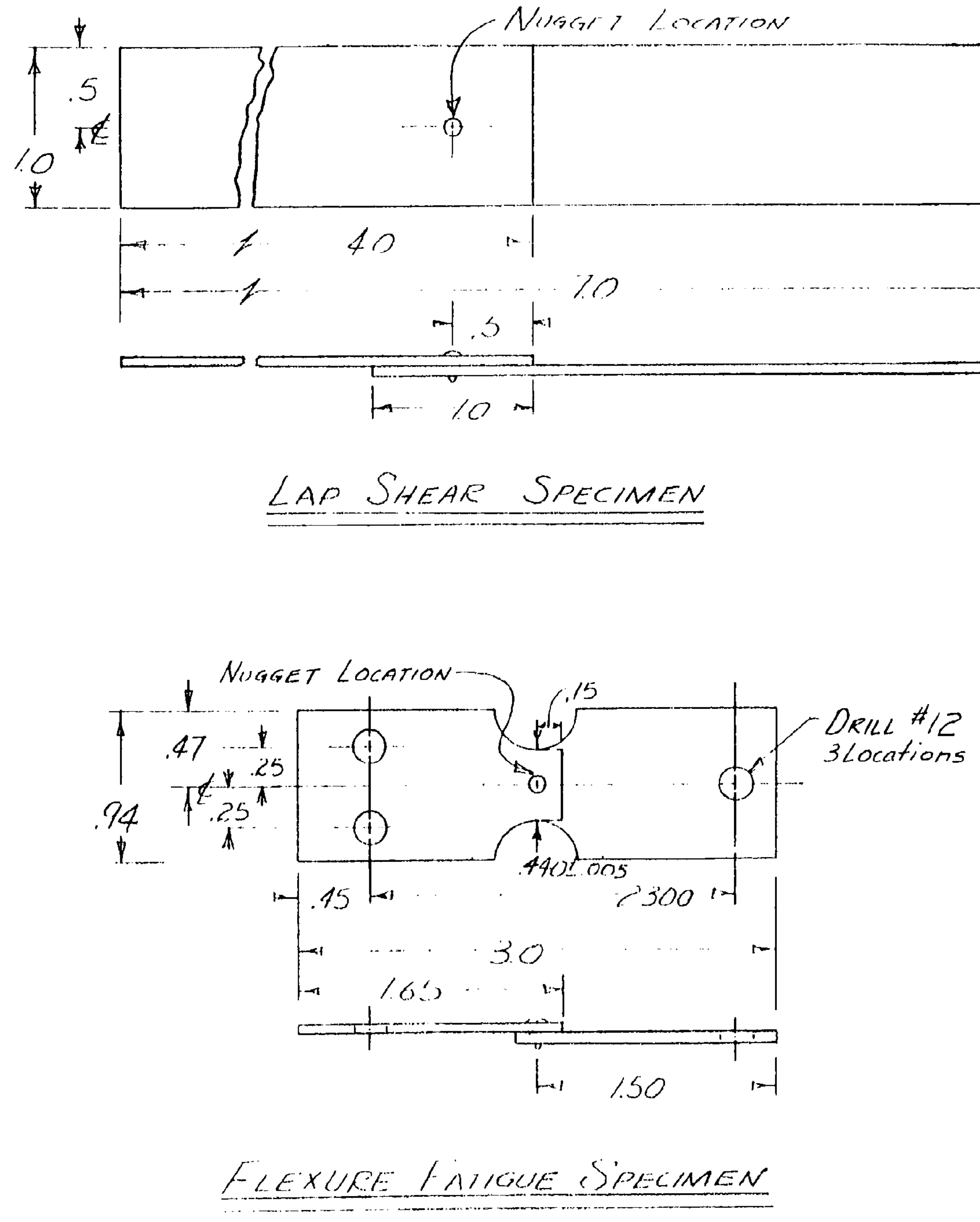
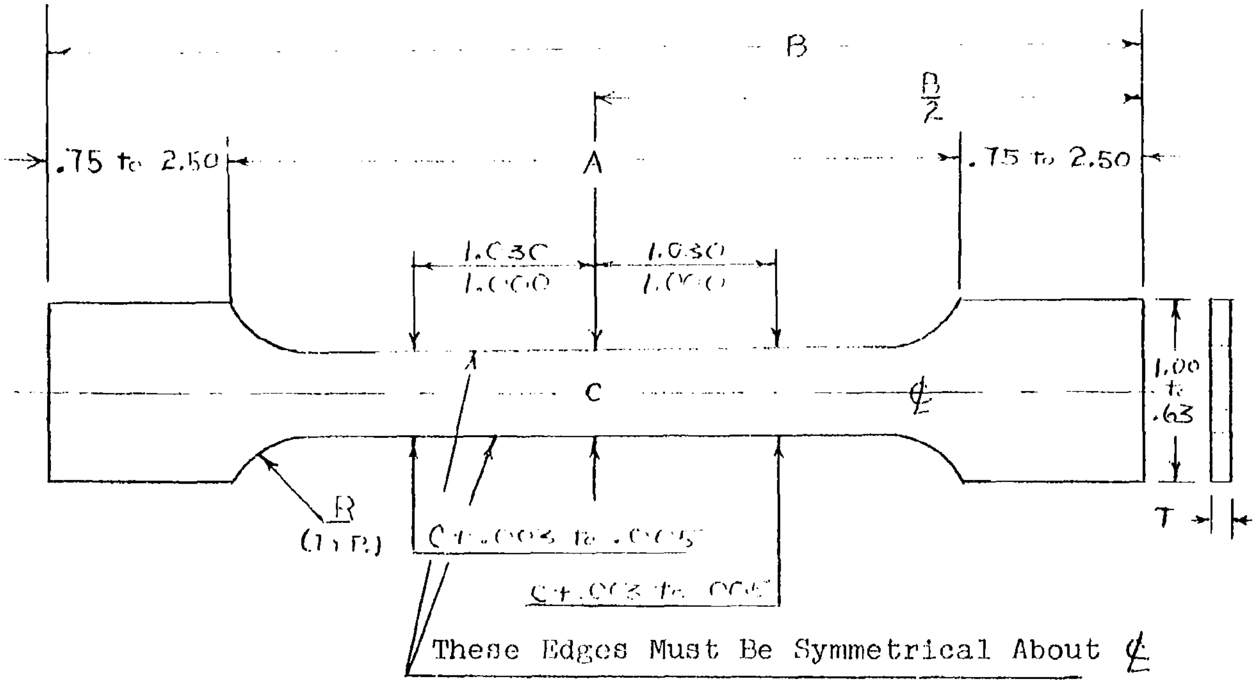


FIGURE 1. TEST SPECIMENS



1. Unless otherwise specified tolerances are as follows:
   Linear dimensions - .xx ± .03 .xxx ± .010

2. T = Material stock thickness
3. Polish edges of reduced section longitudinally with 0 grade emery paper.
4. Material to be as specified.
5. Grain direction to be longitudinal unless otherwise specified.

DASH NO.	A	B	C	R (Min)
- 8	4.00	9.00	.500	1.00

TENSILE

TEST SPECIMEN -- FLAT

FTJ-10940

FIGURE 2

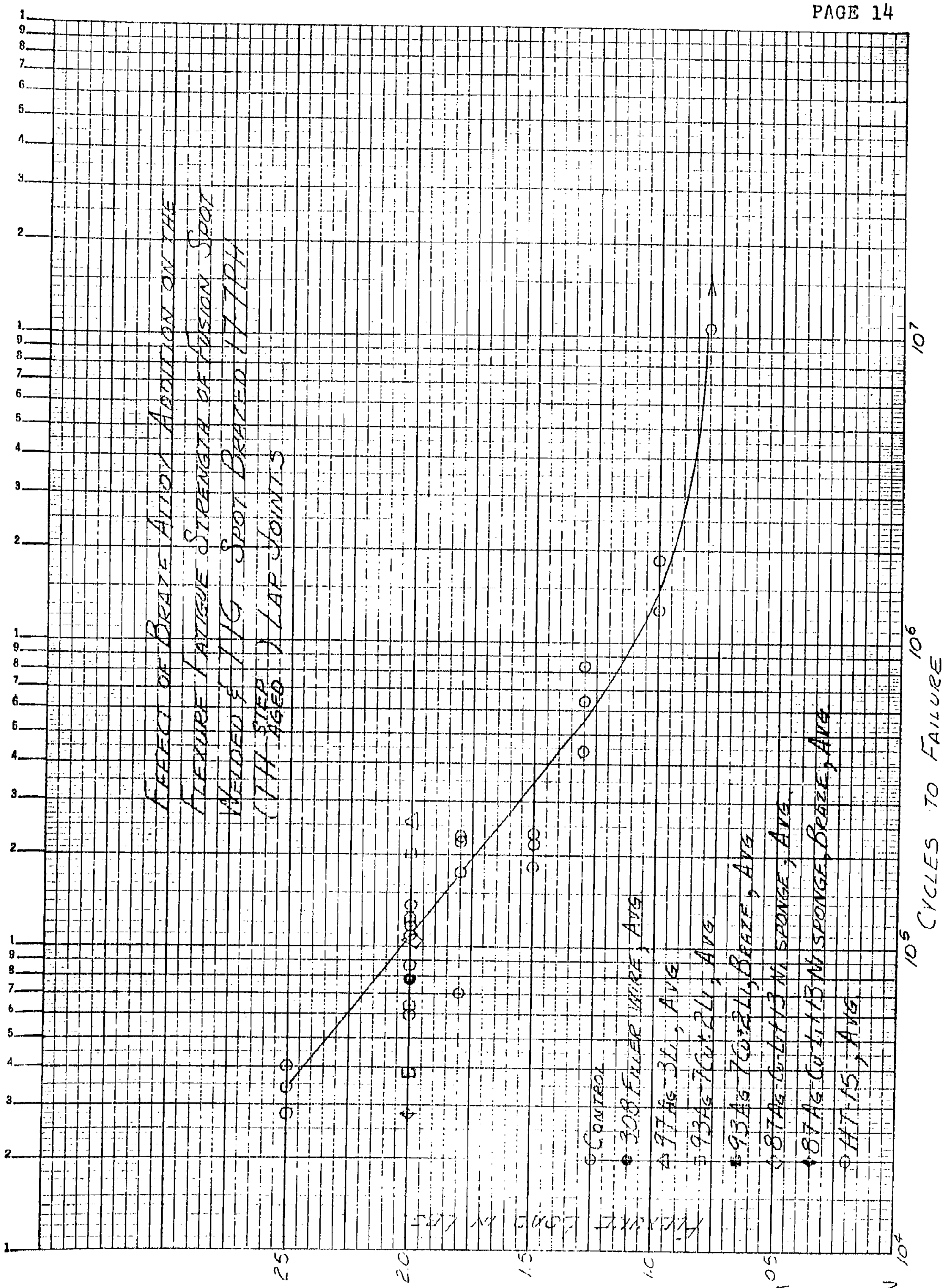
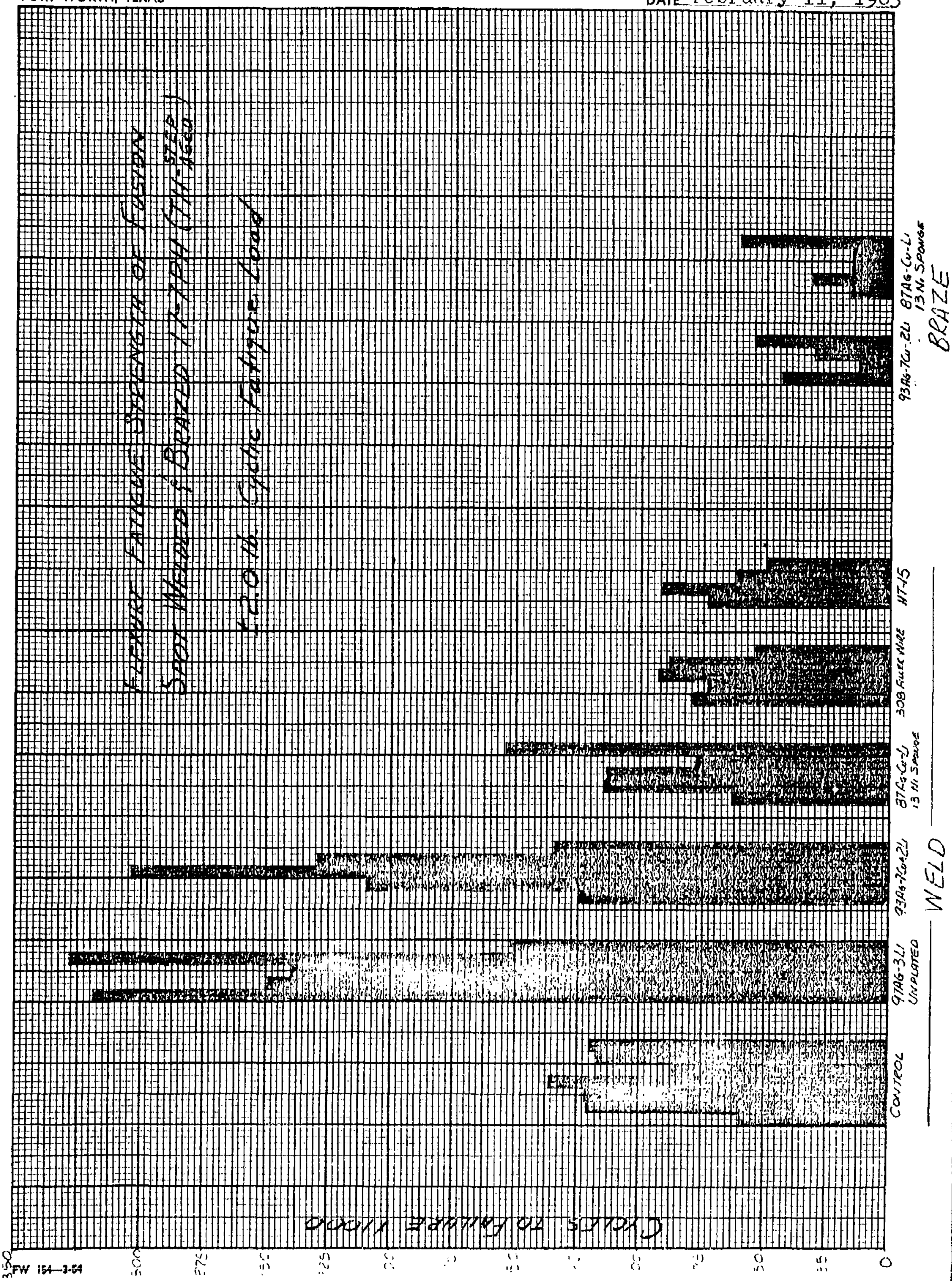
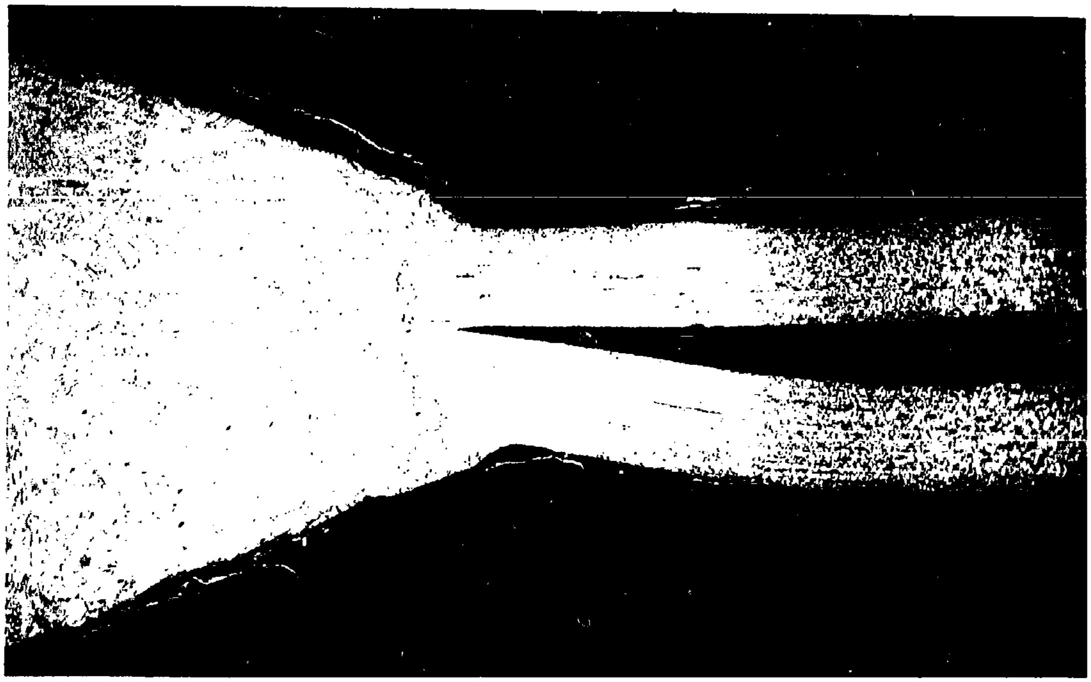

EFFECT OF BRAZE ALLOY ADDITION ON THE FLEXURE FATIGUE STRENGTH OF FUSION SPOT WELDED & TIG SPOT BRAZED 17-7PH (TH STEP AGED) LAP JOINTS
CONTROL
308 FILLER WIRE, AVG
97Ag 3Li, AVG
93Ag 7Cu .2Li, AVG
93Ag 7Cu .2Li BRAZE, AVG
87Ag Cu Li 1.3 Ni SPONGE, AVG
87Ag Cu Li 1.3 Ni SPONGE, BRAZE, AVG
HT-15, AVG
2.5
2.0
1.5
1.0
0.5
10^4
10^5
10^6
10^7
CYCLES TO FAILURE

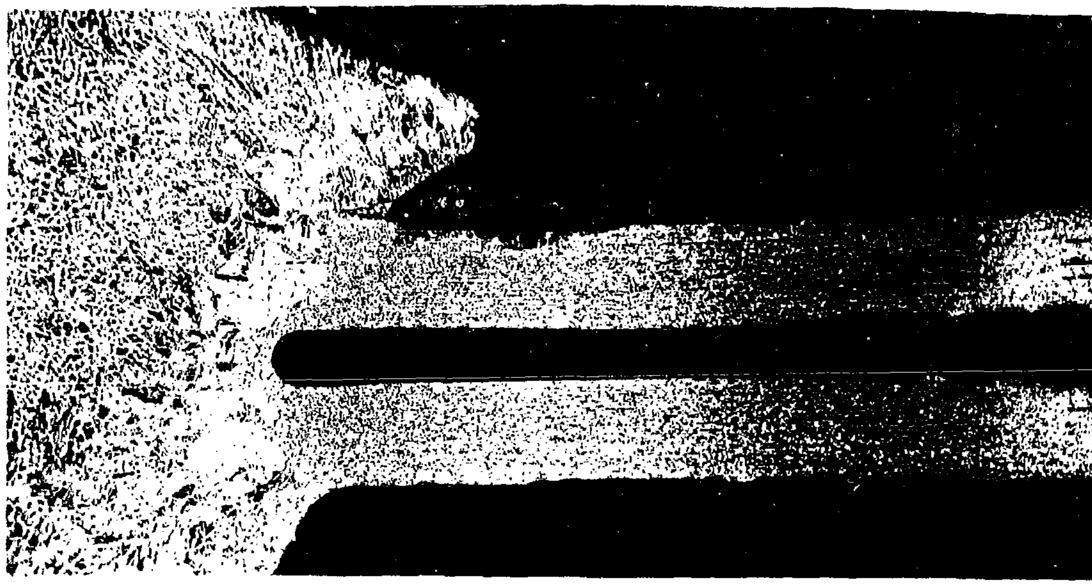
FIGURE 3


Flexure Fatigue Strength of Fusion Spot Welded & Brazed 17-7PH (TH-STEP AGED)
12.0 lb. Cyclic Fatigue Load
Cycles to Failure ×1000
CONTROL
97AG-3LI UNPLATED
93AG-7CU-.2LI
87AG-CU-LI 13 NI SPONGE
308 FILLER WIRE
HT-15
93AG-7CU-.2LI
87AG-CU-LI 13 NI SPONGE
WELD
BRAZE

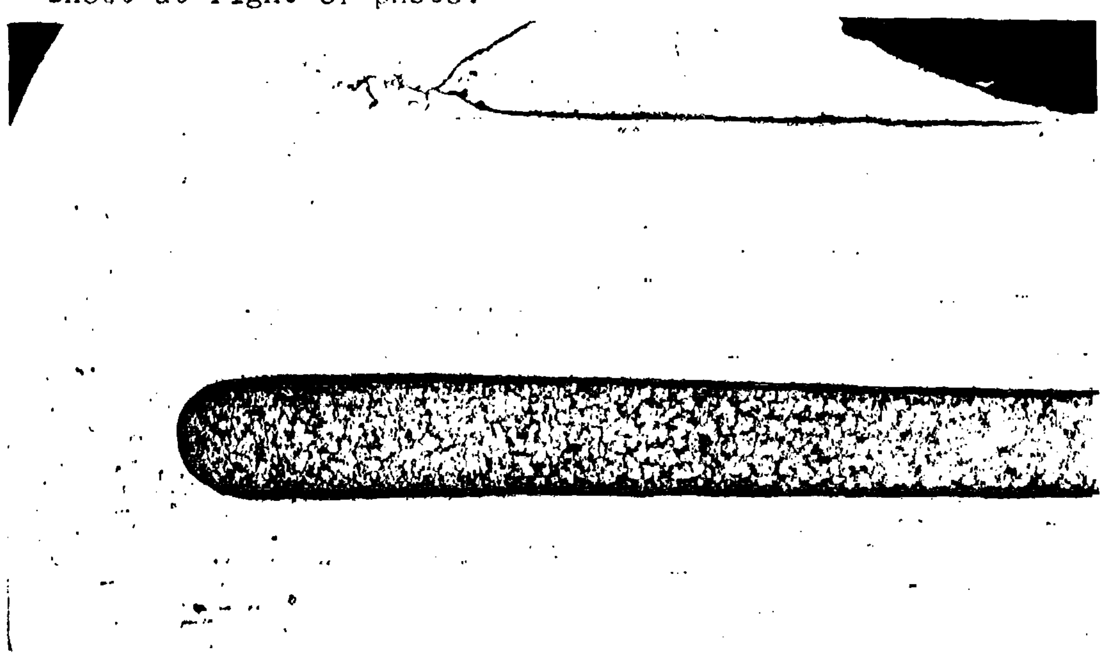


Etchant: 10% Oxalic Acid - Electrolytic Mag. 60X

FIGURE 5 - TIG Fusion Spot Weld Joining Two Sheets of 0.010" 17-7PH (TH Step Aged) Stainless Steel



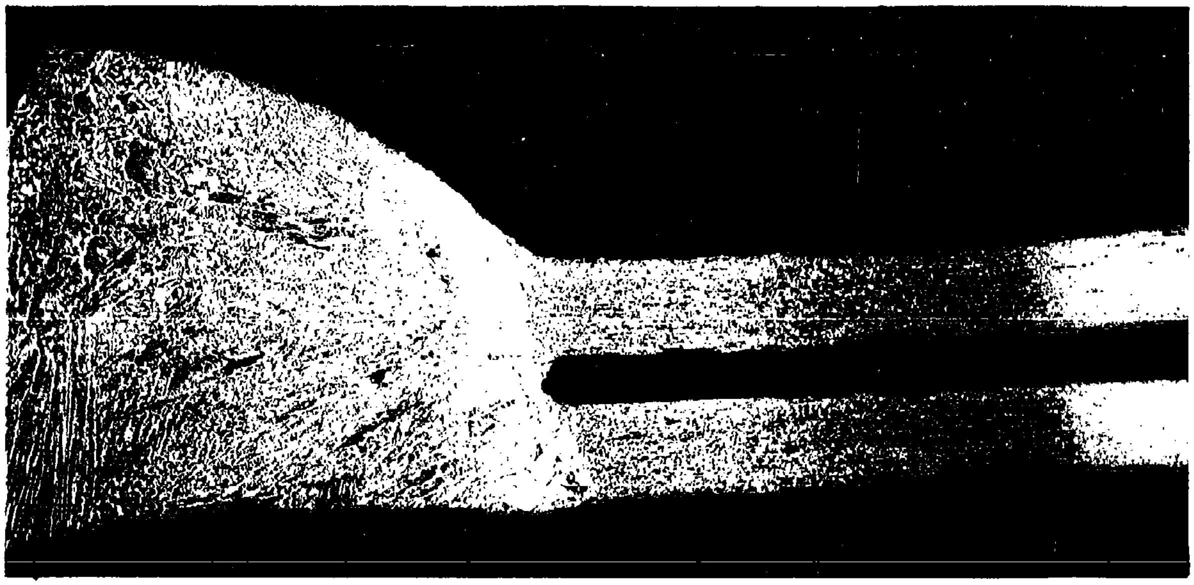
a. Dark area between sheets contains overly etched brazing alloy. Note heat affected zone in 17-7PH sheet at right of photo. Mag.60X



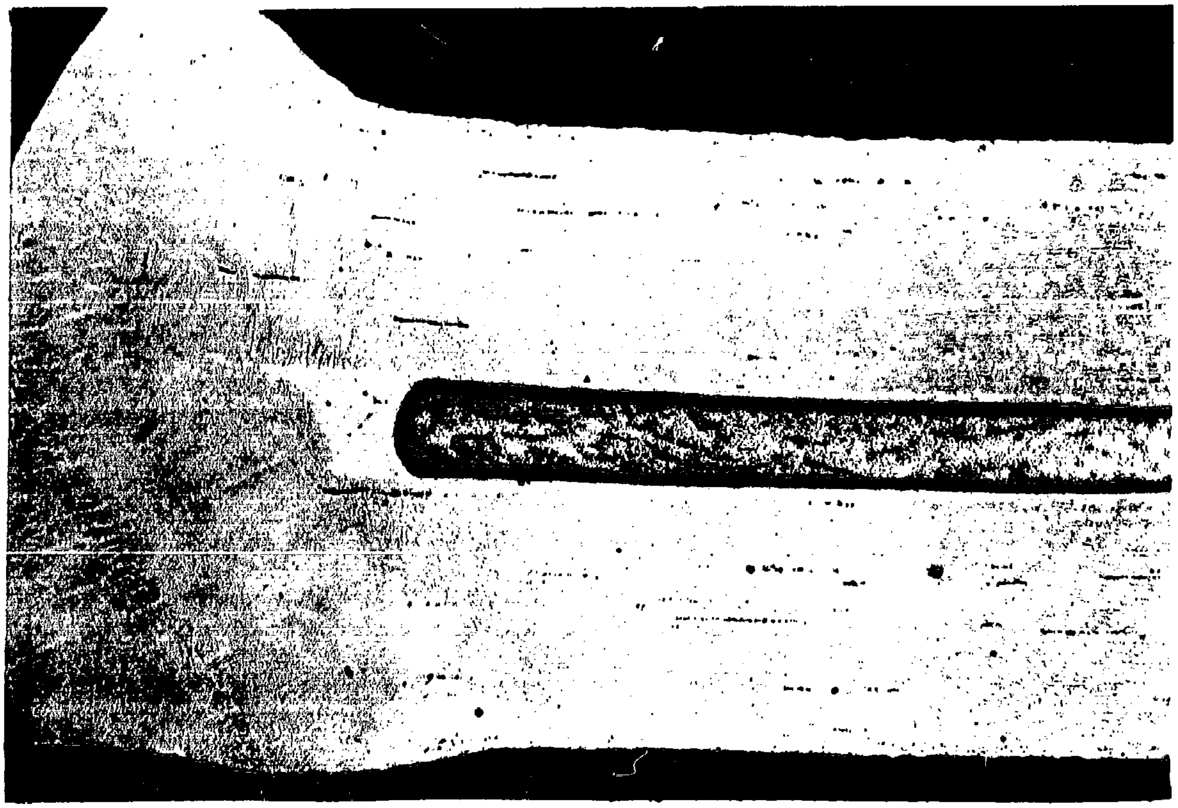
Mag.150X

b. In this photo the 17-7PH was purposely underetched in order to reveal the structure of the more rapidly etching brazing alloy. Note the round fillet joint at the interface of the two sheets of 17-7PH. Brazing alloy can be seen to have expelled out of the joint interface onto the upper skin surface.

FIGURE 6 - TIG Fusion Spot Weld Joint in 17-7PH and 97Ag-3Li Unplated Braze Alloy

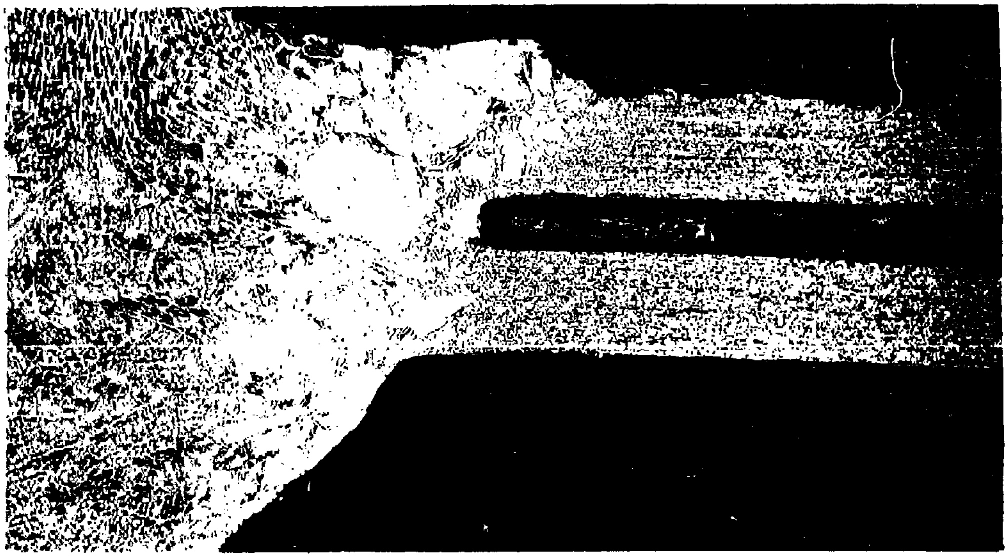


a. Mag. 60X

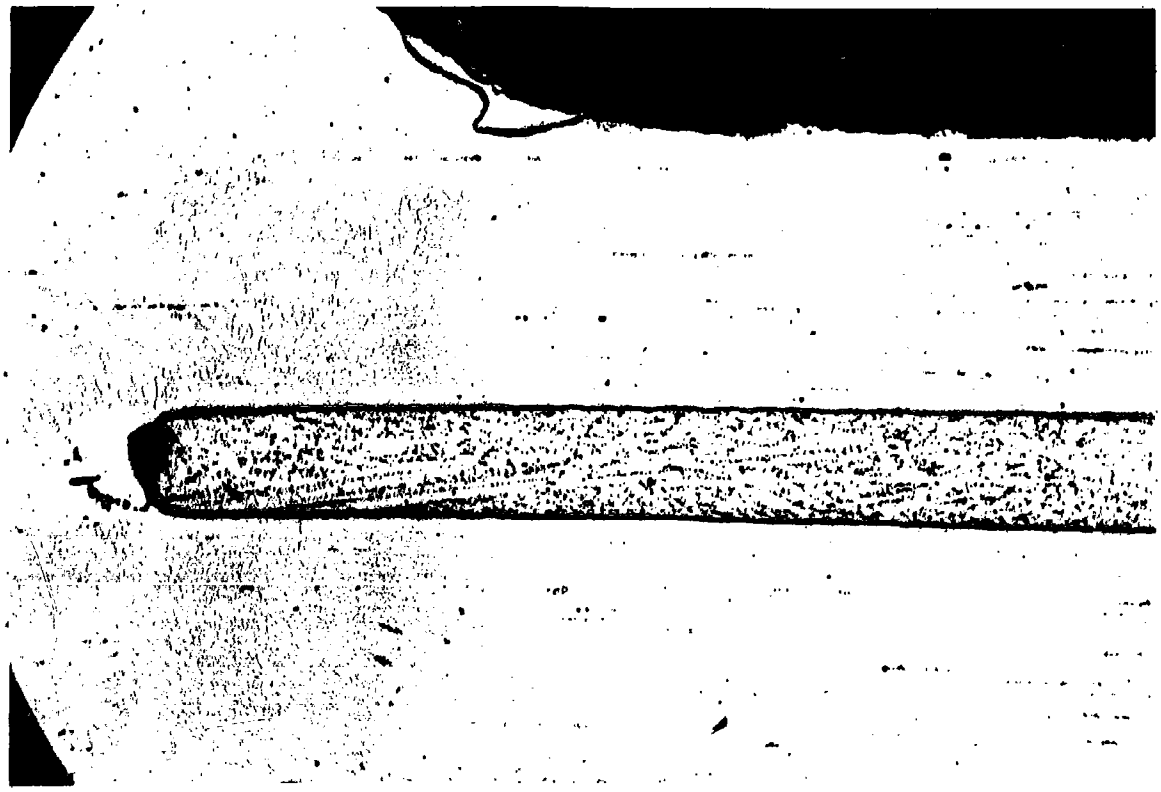


b. Mag. 150X

FIGURE 7 - TIG Fusion Spot Weld Joint in 17-7PH and 97Ag-3Li Nickel Plated Braze Alloy

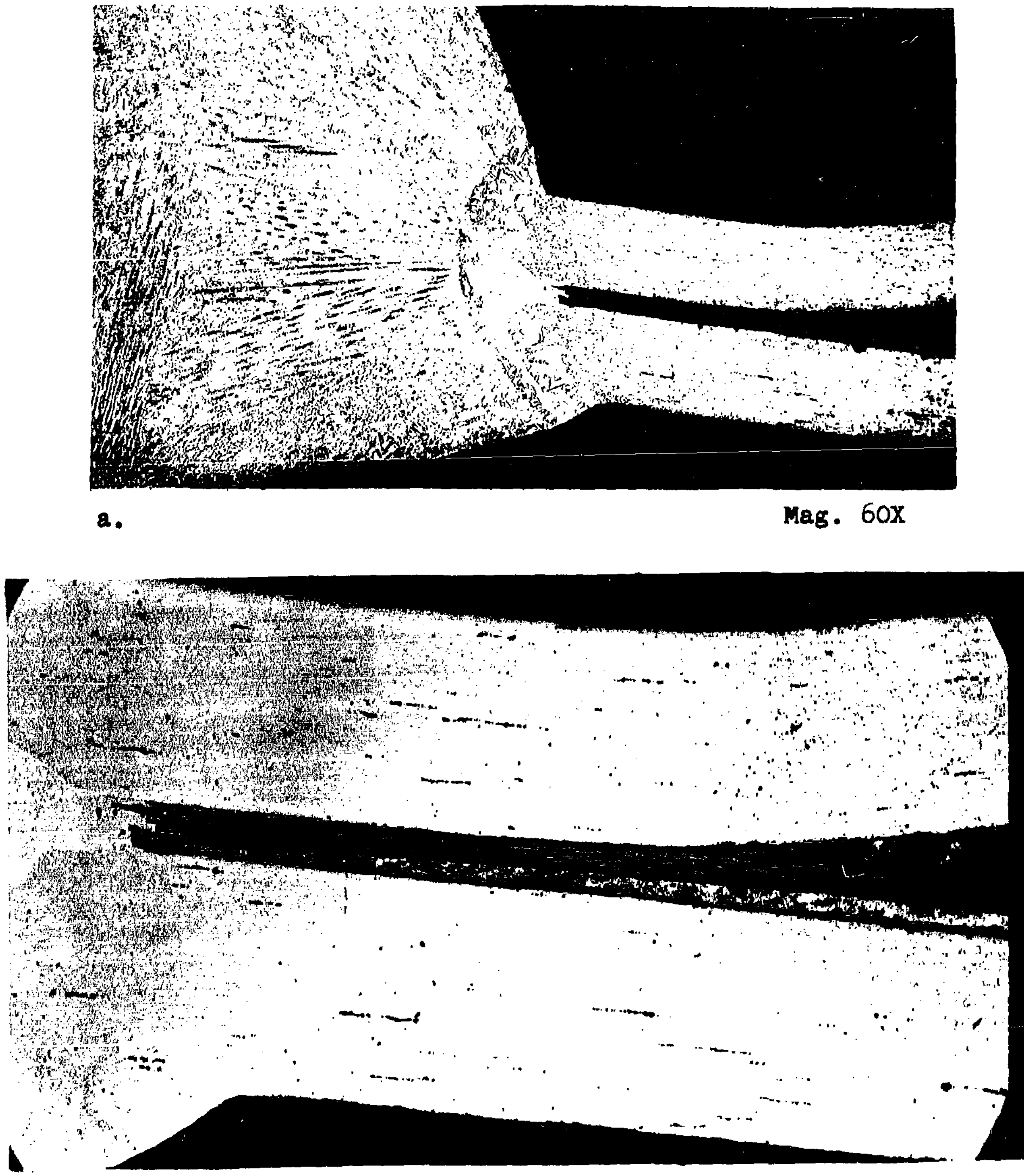


a. Mag. 60X



b. Mag. 150X

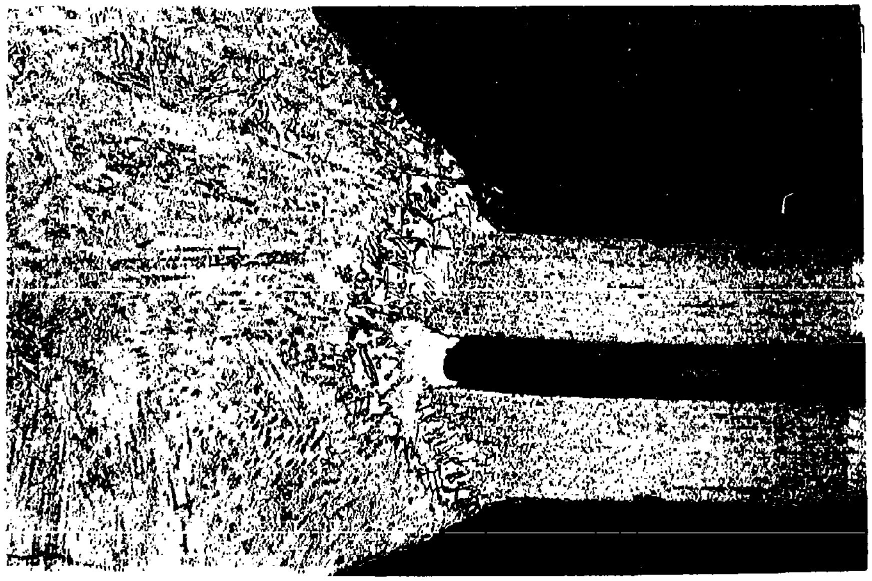
FIGURE 8. TIG Fusion Spot Weld Joint in 17-7PH and 93Ag-7Cu+ .2Li Braze Alloy



a. Mag. 60X

b. Mag. 150X

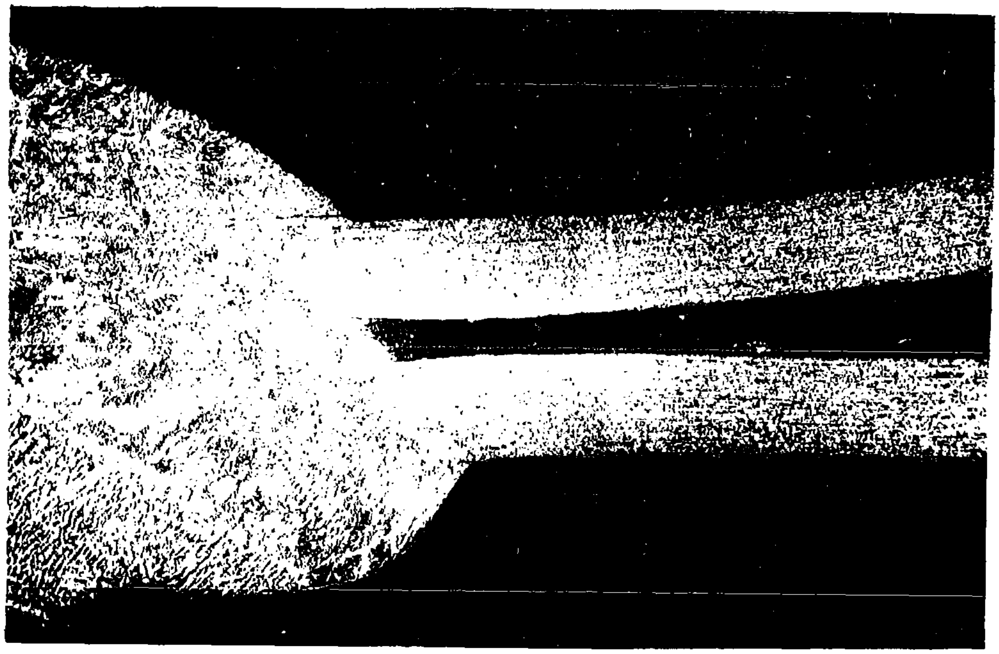
FIGURE 9. TIG Fusion Spot Weld in 17-7PH and 75 AgCuLi+25 Ni Sponge Braze Alloy



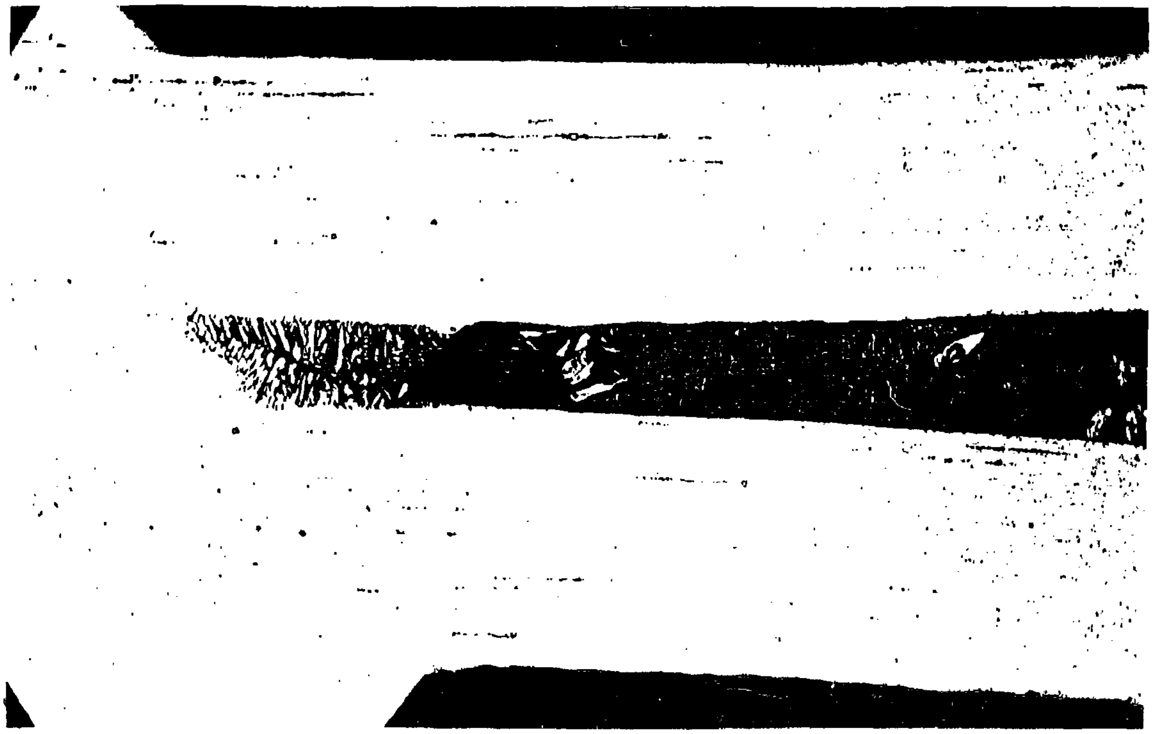
a. Mag. 60X

b. Mag. 150X

FIGURE 10. TIG Fusion Spot Weld in 17-7PH and 87AgCuLi+13Ni Sponge Braze Alloy

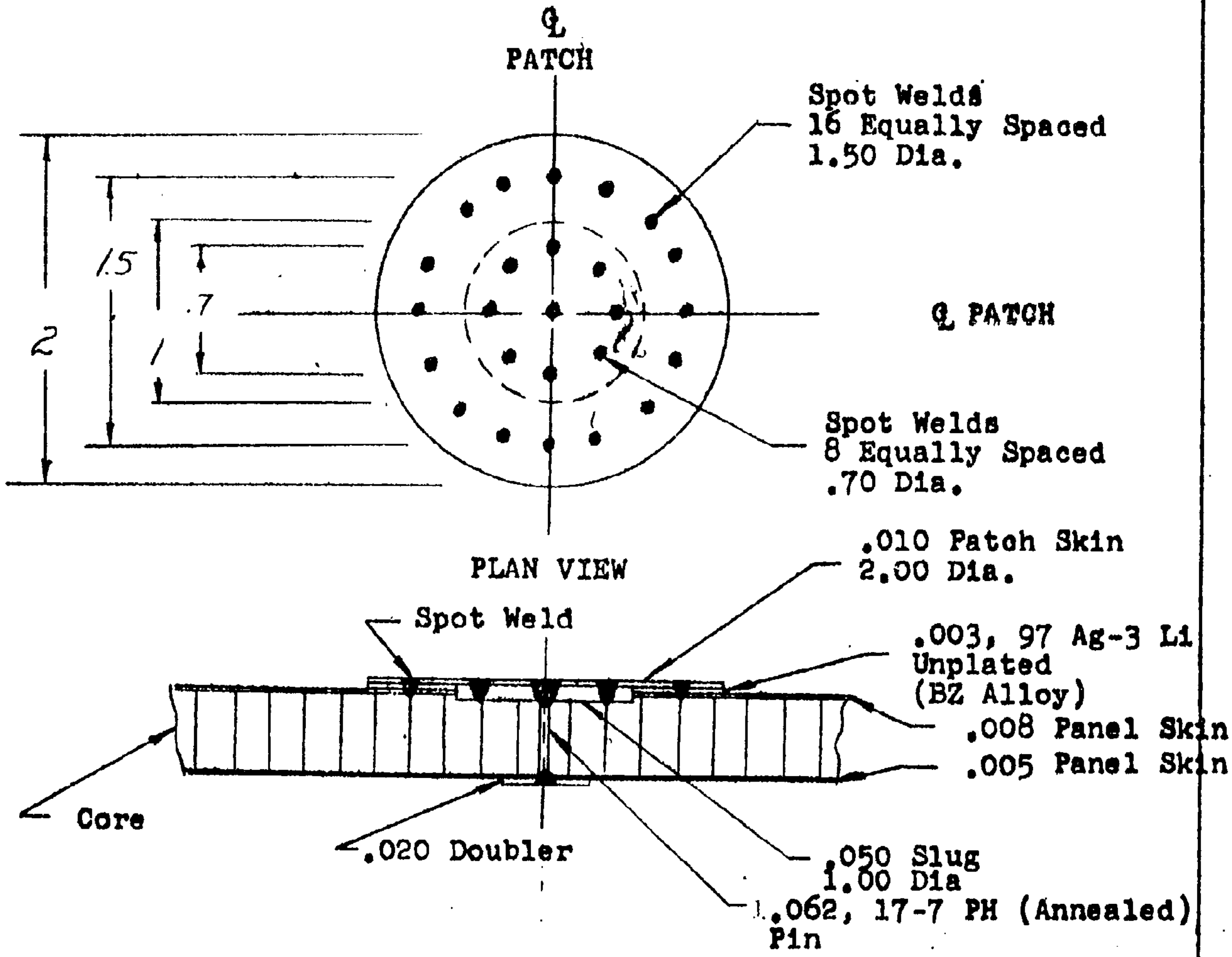


a. Mag. 60X



b. Mag. 150X

FIGURE 11. TIG Fusion Spot Weld in 17-7PH and HT-15 Braze Alloy



CROSS-SECTION
(No Scale)

NOTES: Specimens 1 thru 4
Tig Spot Welded Patch
Tig Spot Welds Thru 97 Ag-3 Li Alloy, Patch Skin to Panel Skin
Specimen 5
Indirect Resistance Spot Braze Patch
Same Configuration as above only Pin and Doubler Omitted

FIGURE 12

TYPICAL REPAIR FOR MD1698 PANEL

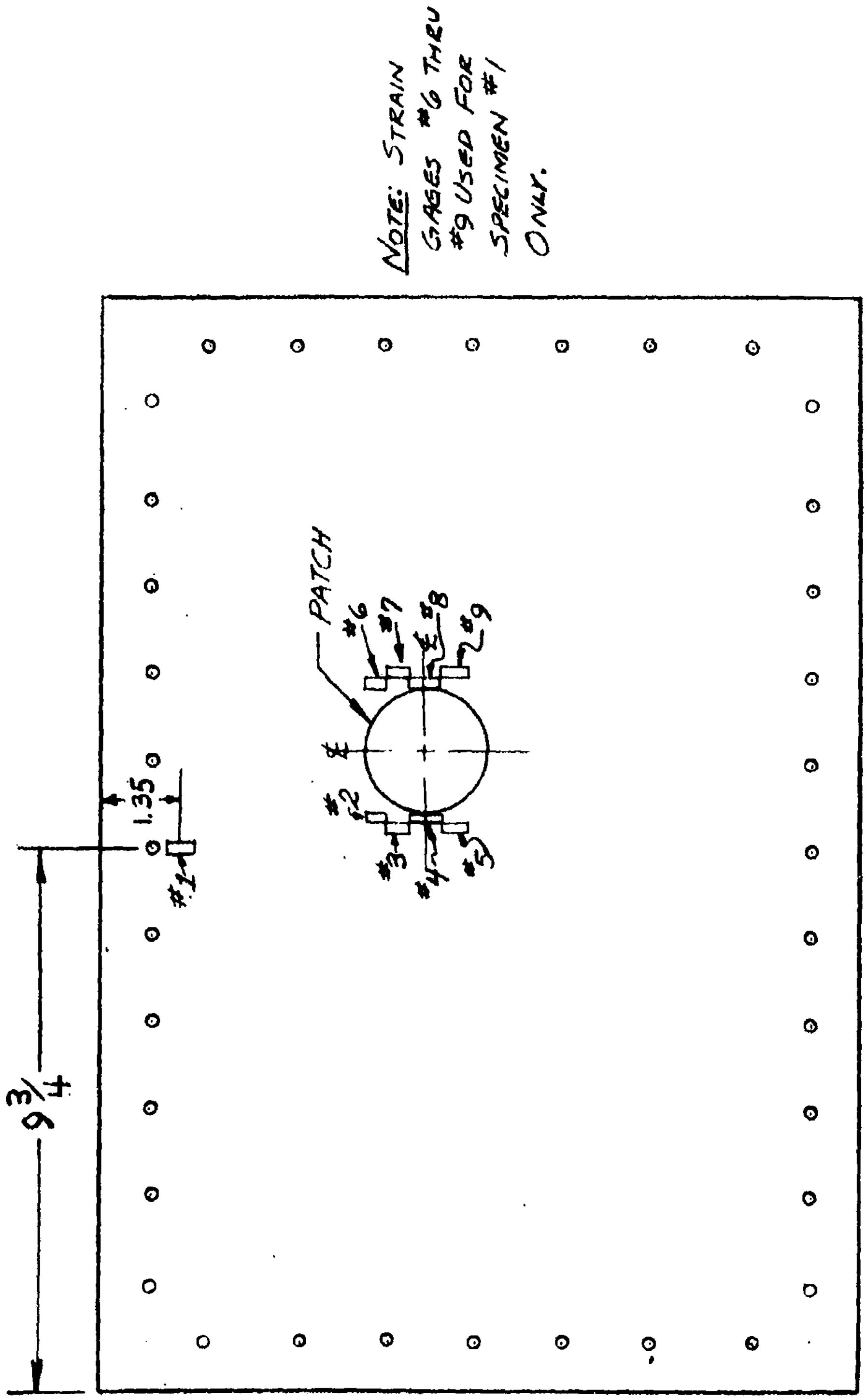


FIGURE 13

STRAIN GAGE LOCATIONS FOR MD1698 PANEL

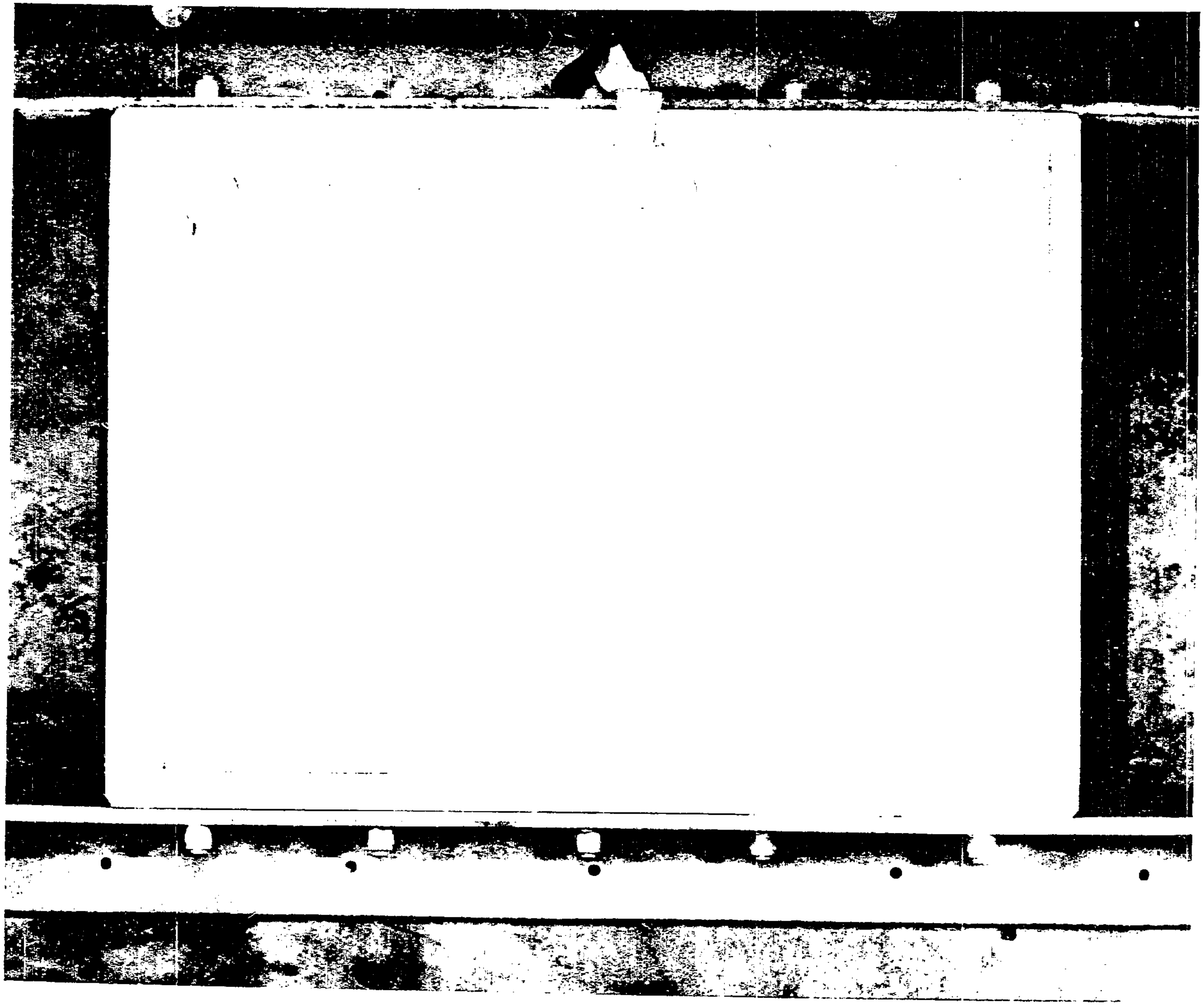


FIGURE 14 STRESSCOAT PATTERN – 165db – SPECIMEN NO. 2 – B–58

FIGURE 15 SONIC TEST FAILURE - SPECIMEN NO. 1 - B-58

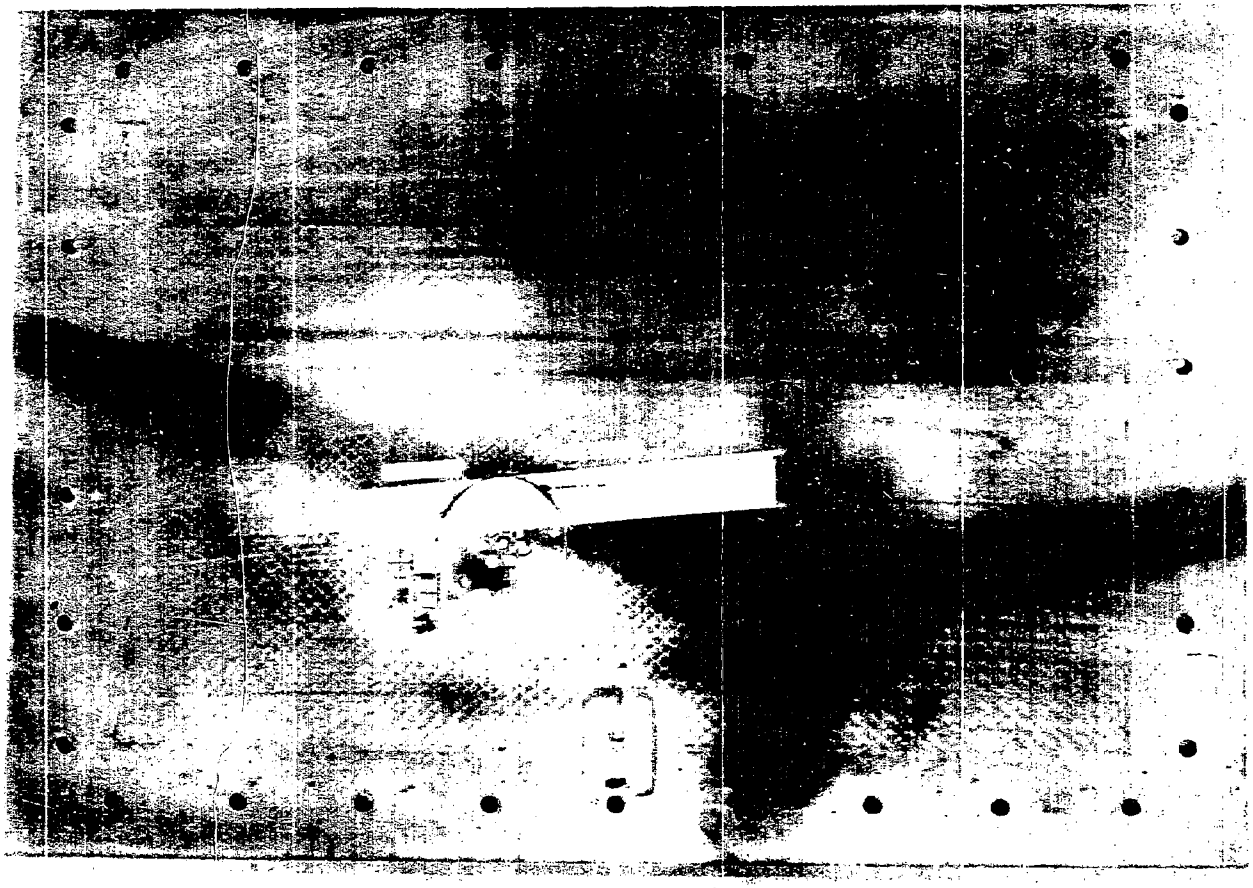


FIGURE 16 SONIC TEST FAILURE – SPECIMEN NO. 3 – B–58

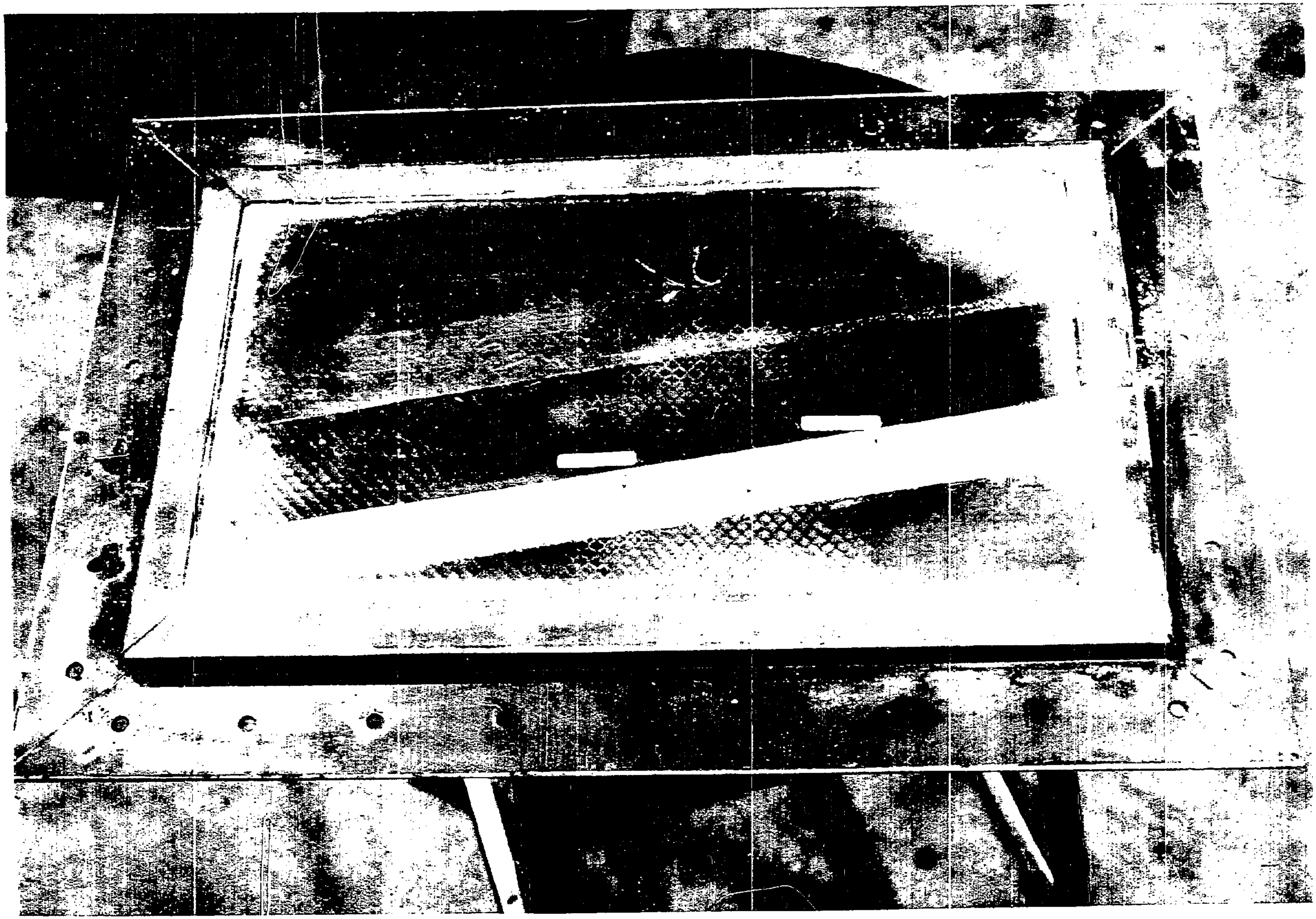


FIGURE 17 SONIC TEST FAILURE – SPECIMEN NO. 4 – B-58

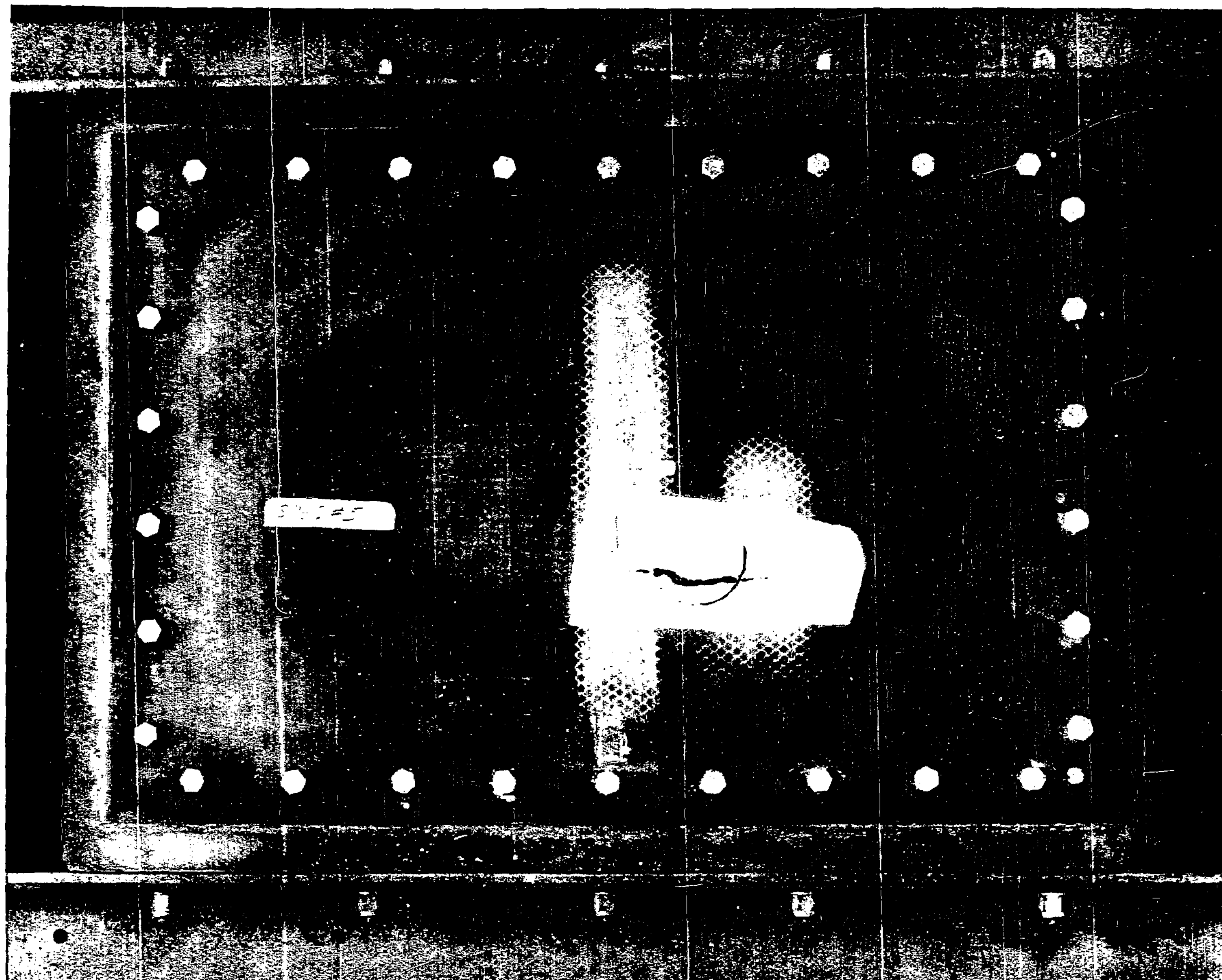


FIGURE 18 SONIC TEST FAILURE - SPECIMEN NO. 5 - B-58

CONVAIR — FORT WORTH

TABULATION SHEET

Table I. Single Lap Shear Strength of Fusion Spot Welded 17-7PH (TH...

Specimen No.	Control	Braze Alloy Inserted Between Welded Sheets: 97Ag-3Li	97Ag-3Li Ni Plated	93Ag-7Cu-.2Li (Production)	87Ag-Cu-Li 13Ni Sponge	75Ag-Cu-Li 25 Ni Sponge	HT-15 (North American)	Type 308 Filler Wire
1	399	419	478	456	440	428	442	373
2	411	473	482	476	446	450	537	321
3	376	479	457	468	461	457	528	375
4	394	405	499	440	440	445	456	354
5	402	434	485	419	419	461	532	273
Average	396	442	480	452	452	448	499	339

Note: Sheet thickness of all specimens was 0.010".
All failures occurred as nugget pull-out

Table II. Single Lap Shear Strength of Spot Brazed .010" 17-7PH (TH-STED AGED)

Specimen No	Braze Alloy: 87Ag-Cu-Li 13Ni Sponge	93Ag-7Cu-.2Li (Production)	HT-15 **	HT-15 Rerun
1	220	171	378	181
2	203	140	302	258
3	245	200	395	235
4	175	164	377	216
5	83*	191	426	183
Average	211	173	376	215

* Unreasonably low value of 83# omitted from average

** Results not valid - weld nugget formed

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TABULATION SHEET

TABLE III. FLEXURE FATIGUE TEST DATA OF FUSION SPOT WELDED AND FUSION SPOT BRAZED 17-7PH (TH-STEP AGED) LAP JOINTS

Specimen No.	Cyclic Load Lbs.	Cycles to Failure X1000	Braze Alloy Added to Joint	Specimen No.	Cyclic Load Lbs.	Cycles to Failure X1000	Braze Alloy Added to Joint	Specimen No.	Cyclic Load Lbs.	Cycles to Failure X1000	Braze Alloy Added
10-1	±2.5	40	None-Control	10-7	±1.8	174	None-Control	10-16	±1.3	640	None-Control
10-2		34	Weld	10-8		229	Weld	10-17		439	Weld
10-3		28		10-10		119		10-18		837	
				10-11		70					
10-4	±2.0	59	None-Control					10-15	±1.0	1851	None-Control
10-5		121	Weld	10-12	±1.5	233	None-Control	10-19		1277	Weld
10-6		122		10-13		217	Weld				
10-20		136		10-14		181		10-23	±0.8	10635	No Failure
10-21		36									
10-22		117									
10-24		120									
Avg.		109									
11-1	±2.0	319	97Ag-3Li	12-1	±2.0	125	93Ag-7Cu+.2Li	13-1	±2.0	63	87Ag-[illegible]-Li-
11-2		249	Unplated	12-2		210	Weld	13-2		115	13 Ni Sponge
11-3		240	Weld	12-3		304		13-3		114	Weld
11-4		328		12-4		229		13-4		73	
11-5		152		12-5		134		13-5		154	
Avg.		258		Avg.		200		Avg.		105	
14-1	±2.0	Sheared during loading	93Ag-7Cu+.2Li	15-1	±2.0	80	None- 308	16-1	±2.0	7	87Ag-[illegible]-Li+
14-2		44	Braze	-2		73	Filler Wire	16-2		32	13 Ni Sponge
14-3		3.		-3		93	Weld	16-3		16	Braze
14-4		31		-4		39		16-4		16	
14-5		55		-5		54		16-5		61	
Avg.		38		Avg.		78		Avg.		28	
17-1	±2.0	73	HT-15								
17-2		92	Weld								
17-3		62									
17-4		50									
Avg.		64									

Note: Specimens of 0.010" sheet thickness

TABLE IV

SUMMARY OF SONIC TESTS ON MD 1698 PANELS

Spec. No.	SPL (db)	Frequency (C.P.S.)	Time	Remarks
1.	160	699-711	3 hrs.	No Failure. Sound pressure level increased to 170 db
	170	711	3 min.8 sec.	Failure. See Figure 15
2.	160	692-707	3 hrs.	No Failure. Sound pressure level increased to 170 db
	170	690	10 min.15 sec.	Failure
3	160	684-688	3 hrs	No Failure. Sound pressure level increased to 170 db
	170	685	3 min	Failure. See Figure 16
4	160	680-712	1 hr. 40 min.	Failure. After failure specimen was examined and it was determined that the bottom weld bead (see Figure 1) had not penetrated through to the skin. Therefore this panel was not considered to be representative of a proper repair. See Figure 17.
5	160	732-736	3 hrs	No Failure. Sound pressure level increased to 167 db
	167	732	20 min	Failure. See Figure 18

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