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# FINAL REPORT NO. 23

# STAINLESS STEEL BOX

Work Orders QK-15-545, QK-15-545.1
and QK-15-545.2

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March 1, 1955

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## INTRODUCTION

The SS Box was developed as a container to be buried in a variety of soils and to serve as an underground storage unit for relatively prolonged periods of time if necessary. This unit was fabricated from stainless steel, type 316, has over-all dimensions of 17-1/4" x 10" x 7-1/2", inside dimensions of 16-1/2" x 9" x 7", and weighs 7 pounds 14 ounces. Figure 1 shows the unit as finally developed and figure 2 an exploded view of the component parts. Reference to the latter figure will aid in determining the function and location of the various parts throughout the following discussion of the development of this item.

The box is equipped with a quick acting closure patterned after the standard Army .30 and .50 caliber ammunition boxes. Like the ammunition box, the SS Box is easy to open and close and yet maintains a near hermetic seal.

The gasket originally followed the same general size and material specifications but had to be changed. The gasket specification was changed to include some natural rubber and the width and corner space was increased. The hardware was stamped from 16 gauge, the shell and gasket retainer from 22 gauge, and the cover and bottom from 20 gauge stainless steel, type 316. Although the initial weight requirement was five pounds, service and test requirements dictated that the above gauges be used.

The SS Box was painted to cover the bright reflecting surfaces and to provide additional corrosion resistance to the stainless steel.

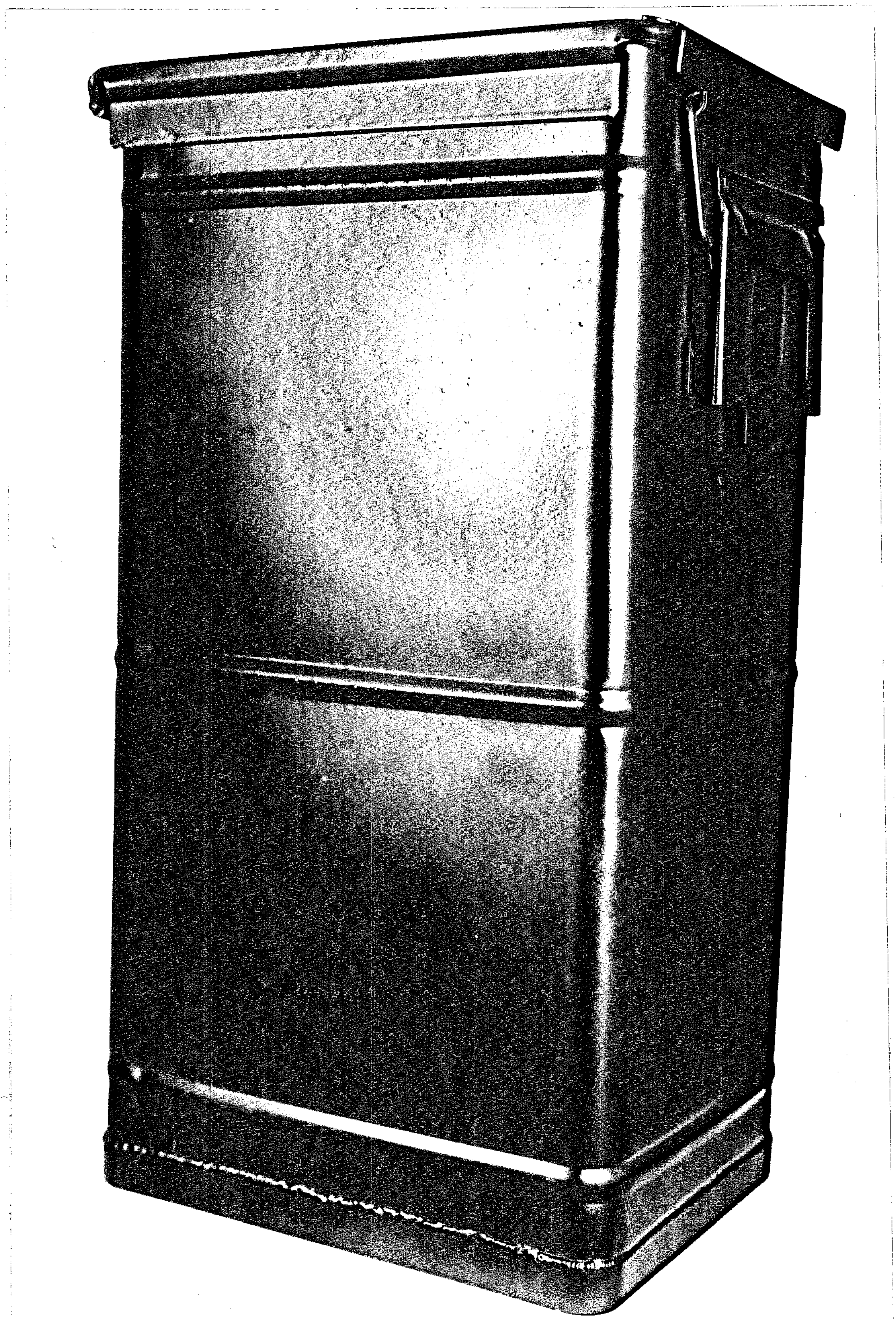

Figure 1

SS Box

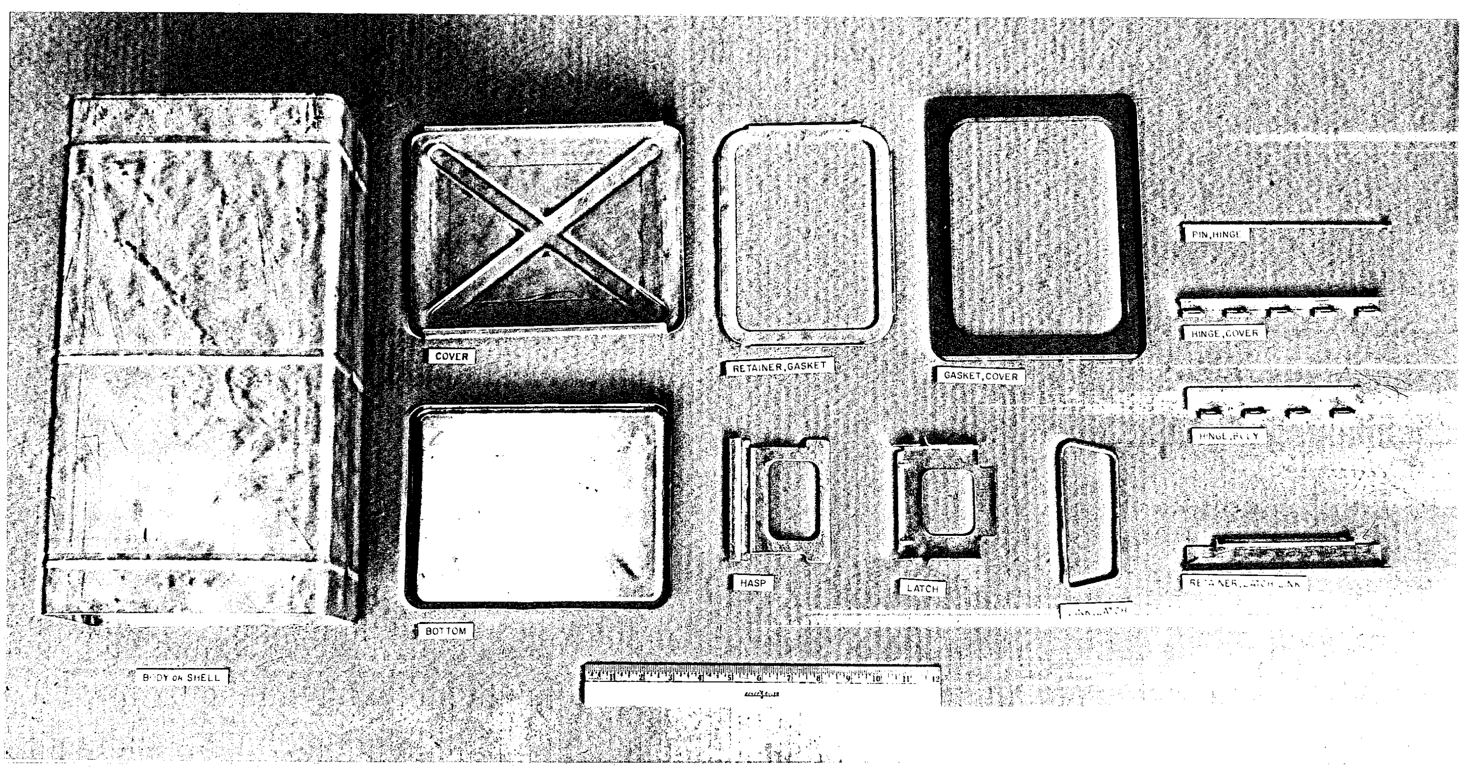


Figure 2

SS Box Component Parts

## SUMMARY

Under Work Orders QK-15-545.1 and QK-15-545.2 the necessary tooling and production facilities have been established at [redacted] 25X1 [redacted] for the manufacturing and testing of a stainless 25X1 steel box to be used as an underground storage container.

A limited production of 100 units by [redacted] 25X1 [redacted]. and the complete testing both for structural design and 25X1 unit performance by [redacted] has been accomplished. 25X1

All the units of this limited production have been expended in testing and evaluation here at the Reservation or elsewhere.

The tooling is being held at the Brockton, Massachusetts location of [redacted] and the production 25X1 and test fixtures are being held at the Mansfield, Massachusetts location.

## CONTRACTUAL HISTORY

The contractual history including over-all cost figures is summarized in the following table:

| | | |
|---|---|---|
| September 3, 1952 | Work Order QK-15-545 to cover preliminary investigation. | $500.00 |
| September 3, 1952 | Work Order QK-15-545.1 to fabricate 10 prototypes. | 500.00 |
| April 13, 1953 | Work Order QK-15-545.1 to fabricate 100 SS Boxes. | 15,000.00 |
| February 18, 1954 | Work Order QK-15-545.2 for redesign and construction of jigs, testing, report, and specification. | 22,000.00 |
| May 7, 1954 | Work Order QK-15-545.2 for additional test jigs and equipment, broadening of scope of Burial Program. | 2,000.00 |
| | Total Appropriated | $40,000.00 |
| | Total Expended | 39,917.65 |
| | Unexpended Funds as of January 31, 1955 | $82.35* |

*The figures do not represent audited or accounting costs, but represent the major costs chargeable to those appropriations and cover the work reported herein. The figures do not reflect the final status of the Work Orders since additional work will be required.

## DEVELOPMENT

On August 28, 1952, the Client's Project Engineer indicated a need for a small box to be used as an underground storage container. [redacted]. was at 25X1 this meeting and submitted a verbal quotation of $410 for 10 different designs, to be fabricated of stainless steel, type 316. Due consideration was given to the use of aluminum and various grades of stainless steels. Aluminum was eliminated due to its greater vulnerability to corrosion than stainless steel. It was realized that types 347 and 316 ELC (extra low carbon) were better types of stainless as far as carbon precipitation due to welding was concerned. However, normal delivery of these steels was impossible to obtain and the 316 ELC was, in addition, more expensive. Conversely, 304 ELC is a poorer grade in respect to welding, but is approximately ten cents per pound cheaper. On the basis of the above, 316 type was chosen as the best all-around available material.

Verbal permission was given by the Client for preliminary work on this project to begin and [redacted] was designated the Project 25X1 Engineer for [redacted] 25X1

On September 18, 1952, [redacted] 25X1 submitted 4 boxes of two different designs. The two designs were patterned after the toggle clamps used on skis. Two of the boxes were made of rigidized stainless. One of the types was made with locked seams which would be normally sealed with the standard compound used for this purpose.

This design was eliminated immediately due to storage in unknown soils which could very possibly affect the compound. Figure 3 indicates several of the original prototypes. At this time, it was also decided that all boxes regardless of design would be passivated. We were informed by Mr. Meyers that this was standard procedure in the fabrication industry. Upon review of these initial units the following actions were to be taken:

1) Rigidized stainless would not be used since it was felt that rigidized material would greatly increase the difficulty of fabrication and decrease the over-all corrosion resistance of the unit.
2) Latch closure would be of a stainless design.
3) The boxes would have a rib 1/4 inch wide located 1 inch from the top.
4) A rod would be incorporated into the rim of the box to stiffen the edge.

On September 22, 1952, a telephone call was received from the Client with the following changes:

1) The new dimensions were to be 7" x 9" x 16-1/2" (inside dimensions).
2) The closure was to be made twice as wide and the bar to be lengthened accordingly.
3) The outer dimension of the cover was to be as close as possible to the shell of the box.

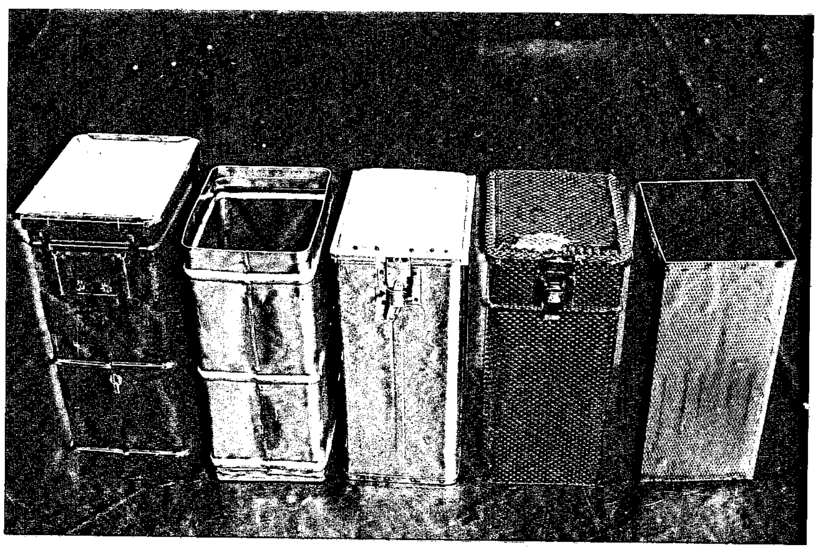

Figure 3

Prototypes

4) Cover was to be the same gauge as the shell. All corners were to be round. A hole in the latch assembly was to be provided for the use of a securing wire.

A Work Order was received from the Client dated September 3, 1952, for $500 to fabricate 10 containers, 6-7/8" x 8-3/4" x 16-1/2" (inside dimensions). Five (5) of the containers were to be 20 gauge and the remaining five (5) of 22 gauge stainless; all boxes were to be suitably painted. This Work Order was designated QK-15-545. At that time, the question arose again as to which material should be used to provide the greatest amount of protection against corrosion by soil. At the August 28th meeting a tentative decision was reached that type 316 would be the best all-around type stainless to use. Type 347 would possibly be a better suited stainless since it contained Columbium, but due to unavailability it was ruled out. Some thought was given to aluminum, but this was also eliminated. A chemist at Industrial Stainless Steel Company, Cambridge, Massachusetts was contacted and he recommended type 316. He felt that the passivated 347 type did not offer sufficiently greater protection if cost was not a factor. He also felt that 316 should not be annealed and water quenched as the warping would be very bad and the gain would be little. He cited the American Cyanamide Company's use of stainless 316 pipe which showed corrosion after four years' use, but it was the consensus of opinion that this was due to the formaldehyde solution being carried in the pipe, rather than the corrosion due to soil conditions.

The International Nickel Company was also contacted, but they informed us that their organization carried on no work pertaining to soil corrosion.

A letter was received from the Client on October 23, 1952 which specified that all future prototypes would have the top belled upward similar to the early prototypes since this would permit stacking. The next prototype would have a second rib 5 inches from the bottom.

The next step in the development was to establish a good closure. The Client's Project Engineer planned to contact an expert in closure hardware to get his recommendations. These recommendations were to be forwarded to us as soon as possible. The first of the two boxes was to be coated with Hypalon (chlorosulfonated polyethylene) by the flame spraying process and second box coated with liquid neoprene. The Plax Corporation, Hartford, Connecticut and the Gates Engineering Company, Wilmington, Delaware were recommended as sources for the above work.

At this time it is well to point out that the terms of our program were not in accordance with the original purchase order forwarded to Technology Engineering Company providing 10 different types of stainless boxes. However, after submission of four (4) prototypes the program was to fabricate one box and then to provide additional engineering and changes before the next box was to be fabricated. This change was pointed out to Technology Engineering Company and also that the cost of such a program would differ widely from the $410 originally quoted. However, they declined to request more money.

On November 7, 1952, a visit was made to Technology Engineering Company and the following points were discussed:

1) The prototype on hand had a rolled back edge on the top of the shell which included a rod. In the next prototype, the top edge was to be sharp to insure a good seal.

2) The top was to be made of a heavier gauge material than the shell, 22 gauge was to be tried first.

3) The sides of the top were to run down as closely as possible to the side of the container.

4) The belled or offset section of the top was to be as close to the edge as possible.

5) The type closure or hardware in all future prototypes would be of the ammunition can type. This hardware was manufactured by the National Lock Company, Rockford, Illinois.

6) The gasket was to be of GRS type, 50 durometer hardness.

7) The top was to be made of non-rigidized stainless.

8) Three ribs were to be used and located near the top, center, and bottom of the shell. The bottom was to be deep drawn or stamped out and welded approximately 2 inches from the bottom.

A new prototype was made incorporating all the above-mentioned features.

On December 15, 1952, during a meeting between Technology Engineering Company and the Client, the following changes to the latest prototype were agreed upon:

1) The lid and side skirts were to be made in one piece. The side skirts were to come down to the upper ridge on the side of the box. Location of the ridge was satisfactory.

2) The lid was to be flat with two crisscross ridges from corner to corner and of such a length that the bottom of the box would fit over the ridges.

3) Incorporate a blanked out section of 22 gauge metal inside of lid to hold the gasket in place.

4) Eliminate portions of the closure latch and its catch to lighten the weight of the hardware.

5) Gasket was to be 40 durometer GRS-400 BFZ. When the lid was closed the gasket was to be 30 to 40% compressed.

6) All fittings on the box were to be heli-arc welded.

7) [redacted] was to try a Veloform coating. 25X1
Firestone Tire and Rubber Company, Ohio was recommended as a source of this material.

On January 5, 1953, a letter was received from the Plax Corporation on flame spraying polyethylene. They had forwarded our request to DeBell and Richardson, Hazardville, Connecticut.

At this particular time, a letter was received from [redacted] 25X1
[redacted] pointing out that they had engineered and fabricated 25X1
eight (8) different containers to date and requested that the original purchase order for $410 be considered complete. A letter was forwarded to [redacted] 25X1
[redacted] concurring with their request. 25X1

On February 2, 1953, a visit was made to [redacted] 25X1
[redacted] and the following points were discussed: 25X1

1) The over-all weight was 7 pounds and, although 5-1/2 pounds was specified, little hope was held to obtain the specified weight. The hardware on the ammunition can was 14 gauge and made of steel. During production the hardware on the SS Box was to be 16 gauge stainless. However, the wire and hinge bar was to be held to the same thickness. The bottom and shell were to be 24 gauge and top 22.

2) It was re-emphasized that all welding during production would be done by the heli-arc method. This method was more expensive but it was felt that the added expense would be counter-balanced by corrosion resistance.

3) The sharp edges on the bottom were to be eliminated in future boxes, since the bottom section would be deep drawn. [redacted] was to prepare a cost 25X1
estimate for 25, 50 and 100 boxes. The estimate was to include a die for the bottom.

4) A molded gasket would be required. The price of a one cavity mold with additional space for 5 cavities would be obtained.

5) It was agreed that the primary source of failure would be the top and/or gasket. Therefore, no die for the top was considered at that time.

6) The Client's Project Engineer was to show the prototype to his Consultants for their comments. He would also work out the packaging details for the contents to insure that the unit was the size desired.

7) Tentative specifications and drawings were to be prepared by [redacted] 25X1
Inc. These were to generally follow the ammunition box specifications.

8) A complete test agenda was to be prepared by the Client's Project Engineer. This would include such tests as drop, stacking, underwater, salt, fog, temperature, humidity, etc.

On February 5, 1953, a letter was received from Technology Engineering Company with the following quotation:

| | | |
|---|---|---|
| 1) | Bottom Die | $3,980 |
| 2) | Top Die | $1,200 |
| 3) | One cavity mold for gasket | $480 |
| 4) | In lots of 25 | $42 each |

5) In lots of 50 $37 each

6) In lots of 100 $34 each

If the covers or top were not to be made with a die an additional $15 each would be required to hand form this piece. It was agreed that handforming the top or cover would not be representative of any production item and in addition, that if any additional work was required or changes made, it would be appropriate at this time to iron out these difficulties. Therefore, a die was to be used to stamp out the covers.

On March 30, 1953, a memorandum was forwarded outlining the cost of producing 100 units as requested by the Client. A Work Order of $11,500 was requested.

On April 13, 1953, a Work Order for $15,000 was received from the Client that included the funds for the coating program. This coating program was conducted by P. L. Young. By April 16, 1953, suitable drawings had been prepared by [redacted] and reviewed by us. 25X1

At this time we pointed out that the heli-arc method of welding should not be insisted on, since it was not only more expensive than arc welding but not necessary on all parts of the box. A request was made to permit both types of welding during production for comparison and evaluation. Upon completion of the 100 containers, sufficient data would be available for a final decision regarding production quantities. This request was granted by the Client.

## PRODUCTION

Although the purchase order for 100 boxes had been placed with [redacted] on April 23, 1953, they were instructed to purchase the material but to hold up the fabrication until the design was frozen. 25X1

In view of the forthcoming test program, a visit was made on June 24, 1954 to the United Metal Box Company, Brooklyn, New York by [redacted] for the purpose of viewing their test procedures. This organization was currently manufacturing the .30 caliber ammunition boxes from which the current project is being patterned. The following tests were observed: 25X1

(1) A destructive hammer test of top hinge and weldment

(2) Leakage test for container body

(3) Destructive hammer test of container bottom in lieu of test coupon

(4) Visual assembly test

(5) Air pressure test of assembly body.

This visit was very informative and, with slight modifications, the test procedures could easily be adapted for our use.

On July 28, 1953, a letter was received from [redacted] stating that the National Lock Company would not manufacture the hardware from stainless because of the difficulty they had experienced in the past with their dies when working with stainless. 25X1 25X1 [redacted] estimated that they could furnish these dies within 8 weeks at a cost of $1,980. This information was forwarded to the Client and on August 3, 1953, authorization was given for the development of the hardware dies. 25X1

By October 1, 1953, drawings for the test jig similar to that used by United Metal Box Company had been completed and bids requested. The following quotations were received:

| | |
|---|---|
| Ober Tool and Die Company, Everett, Massachusetts | $433.00 |
| General Tool Company, Leominster, Massachusetts | $485.00 |
| Technology Engineering Company, Inc., Boston, Mass. | $325.00 |

On October 28 a visit was made to the fabrication shop of [redacted] and the Client's Project Engineer. The following is a summary of the items discussed: 25X1

(1) Cover die would not be completed until the first week in November.

(2) The shells were being fabricated to everyone's satisfaction. However, the length was increased to allow a lap weld instead of the planned butt weld.

(3) The material used was 22 gauge, rather than the 24 gauge originally specified. In addition, the depth of the draw had been shortened 1/4 inch. The reason for these changes was that strain breakage had occurred around the corners and by incorporating these changes, this failure was

eliminated. Figure 4 indicates the strain breakage in the bottom. Approval was given by the Client to investigate the effects of stress corrosion.

(4) The hasp die was not in accordance with the drawings since it had been notched. It was notched to prevent tearing when the corners were formed. The notbhing operation was eliminated.

(5) One sample gasket was given to the Client.

During this period the danger of stress corrosion due to the forming methods employed in the fabrication of the cover and bottom was considered and the possibility of stress- relieving by annealing was investigated. It was the opinion of several fabricators that the lesser of the two evils was the possible stress corrosion, rather than the added cost of annealing. It was felt that the general over-all resistance of the 316 stainless would be lowered and would result in less protection than any possible benefits resulting from annealing. Concern was also given to warpage since the gauge was so light.

However, several bottoms and tops were to be annealed and tested. Corner sections of the tops and bottoms were cut and subjected to a nitric-hydrofluoric acid bath. (Details of the procedure are outlined in the Welding section.) Figures 5 and 6 illustrate that no apparent difference relative to corrosion exists between the stress-relieved and the normal samples. Based on the results of the acid bath tests, it was

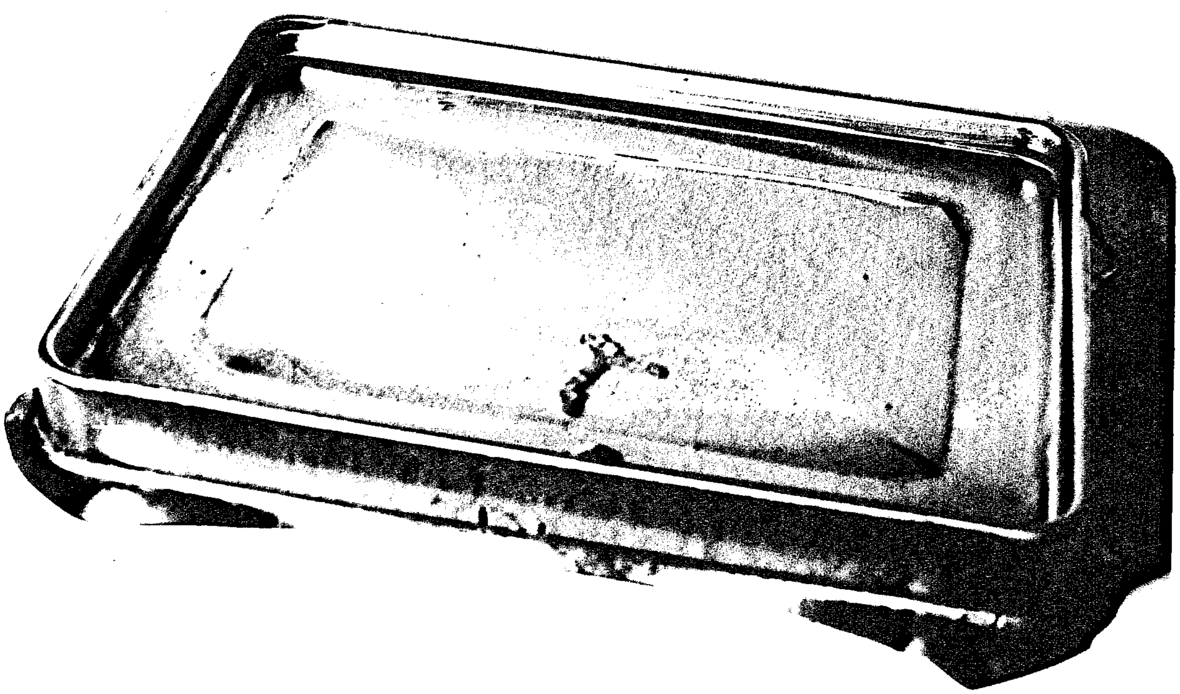

Figure 4

Bottom from original die showing strain breakage

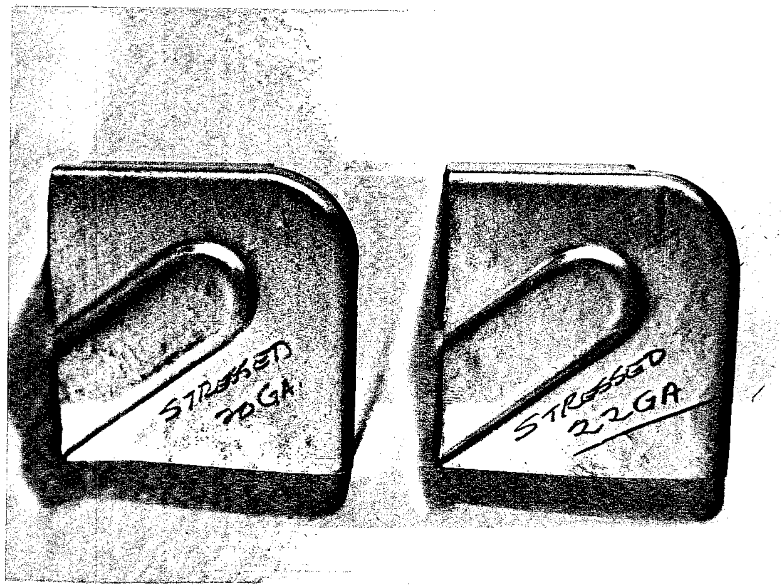


Figure 5

Top sections after acid test

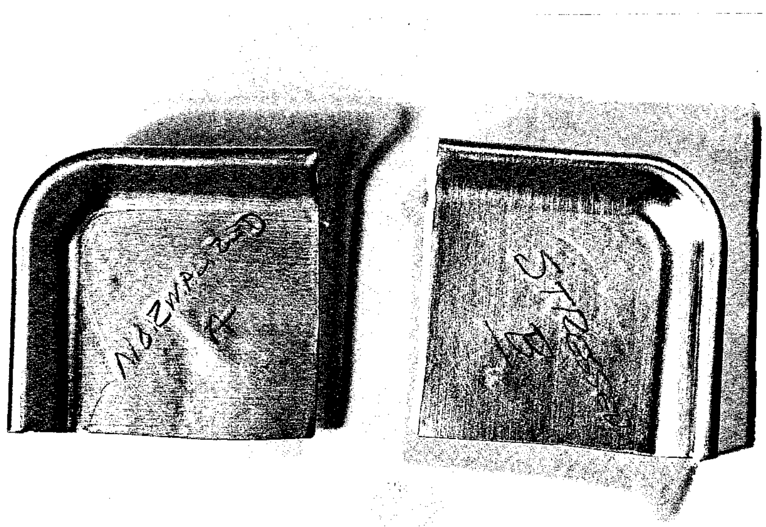

Figure 6

Bottom sections after acid test

decided not to stress relieve the tops and/or bottom since the over-all cost of the box would be increased without any apparent benefits.

By December 1, 1953, a sample hasp had been forwarded to the Client showing the torn sections as illustrated in figure 7. It was agreed that this difficulty must be eliminated. It was felt that if the tearing could be held to a minimum, this failure could be eliminated by spot welding and grinding to smooth out the area. Samples were tried, submitted to the Client and approved. Two sample boxes only were to be fabricated until the component parts were evaluated. It was found that the tearing could be completely eliminated by a slight modification in design. This tearing is shown in figure 7 and was eliminated by lessening the severity of the bend at this particular point.

It was decided at this time to attempt to spot weld the bottom to the shell prior to heli-arc welding. The gasket retainer was also spot welded to the cover. When the shell and bottom was submerged, it was found to leak at eight of the twelve spot welds and had to be corrected by heli-arc spot welding. The same results occurred on the cover when the box was subjected to the hot water test. Due to the failure of spot welding, it was specified that all welding during the production of the 100 units would be by the heli-arc method.

On December 15, 1953, a shell and bottom was examined and found to be satisfactory. Although the samples formed by the head die were found to be in accordance with the drawing, minor changes had to

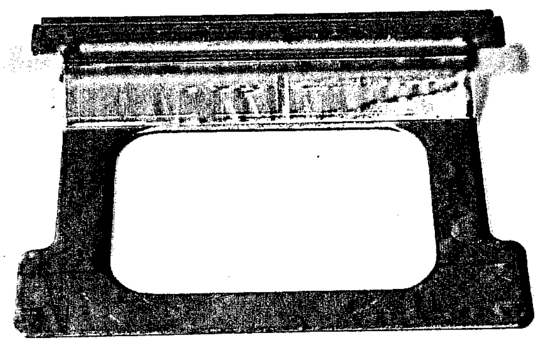

Figure 7

Hasp Illustrating Strain Breakage

be made in the auxiliary die, since tearing at the corners of the side flanges was apparent. It was felt that this fault could be eliminated by extending the side surface parallel with the outer rim of the top 1/8 inch further before curving in towards the body of the container. The curve would be less severe than originally designated.

On December 23, 1953, two prototypes were delivered to the Client. One box was returned with the following comments:

(1) The cover would be made of 20 gauge material unless this meant changes in the die.

(2) The torn section of the hasp was to be worked over as outlined above.

(3) The cover gasket and gasket retainer are to be redesigned. The gasket is to be made slightly wider and the corners filled in. The retained is to be changed accordingly.

On December 28, 1953, a call was received from the Client and changes requested as follows:

(1) Since the top edge of the body is folded, a slight bulge results inward of the fold. An investigation is to be conducted to determine the feasibility of cutting a small section from the rim and spot welded to alleviate the situation.

(2) All welding to be ground smooth.

(3) The gasket to be widened and the thickness increased 1/8 inch.

(4) The rib at the bottom is to be placed one inch from the weld.

On January 5, 1954, a meeting was held at [redacted] 25X1 [redacted] to review the progress of the box. Present were the Client's 25X1 Project Engineer and his assistant and Messrs. [redacted] 25X1 [redacted] 25X1 The major fault of the prototype was the tendency of the cover to rise away from the gasket. This occurs more radically at the hinge end, but is apparent at the hasp end also. It was decided that the following steps would be taken to correct the above:

(1) Increase the cover to 20 gauge although this meant die changes.

(2) Redesign of the hinges in accordance with the sketch supplied by the Client.

In addition, the following comments were added:

(1) Twenty-five (25) covers are to be stamped from 22 gauge metal. Die changes are to be made and the remaining seventy-five (75) covers are to be stamped of 22 gauge material.

(2) Authorization was given to initiate the production of the shells and bottoms. Assembly of these units is to begin as soon as possible.

(3) A 1-1/2 inch wide cut is to be made on the internal fold of the top as outlined in the telephone call of December 28, 1953, as outlined above.

(4) The retaining gasket will be a solid piece and heli-arced to the cover.

(5) The edge of the gasket retainer is to fall 1/16 inch below the surface of the gasket. This will insure that the top edge of the body will always rest on the gasket.

(6) The internal height of the box will be 16-1/2 inches.

As a result of this meeting, changes were necessary in several of the dies. The cover and body hinges were to be altered, in addition to the alteration of the retainer latch link. The cover gasket mold was to be changed to comply with the new dimensions of the gasket. The cover dies would be altered after the 25 covers were stamped from 22 gauge stainless. Since delivery was to be expedited in every way possible, the Client authorized all necessary overtime. Technology promised delivery in 3-4 weeks on this basis, although normal delivery would be 12-14 weeks.

On January 25, 1954, a survey of the entire program was made. The survey included all past requests and changes, in addition to the testing program to be conducted in the future. Accordingly, a request was forwarded to [redacted] requesting cost estimates 25X1
on the following:

(1) 4 bottoms and tops, stress relieved

(2) 6 handmade gaskets

(3) 2 shell and bottom units (butt welded)

(4) 2 shell and bottom units (lap welded)

(5) 3 shell and bottom units (notched)

(6) Die changes for:

a. Bottom

b. Gasket Mold

c. Cover Hinge

d. Body Hinge

e. Latch Link Retainer

f. Gasket Retainer

(7) Engineering and drawing costs on Item 6

(8) Jigs

a. 5 lb. pressure test

b. 3 lb. pressure test

c. Shell seam welding jig

d. Bottom welding jig

e. Hardware positioning jig

f. Block for pull test

(9) Design of "Standard Box" for 3 pound test.

(10) Re-evaluation of cost on 100 boxes due to the changes accrued during past several months.

The gasket compression jig was designed by [redacted] 25X1
constructed by [redacted] 25X1

On February 1, 1954, a letter was received from [redacted] 25X1
[redacted] outlining the costs of changes and requests completed and their estimated figures for the die changes or new dies. The estimated and actual costs are listed as follows: 25X1

| | | Estimated Cost | Actual Cost |
|---|---|---|---|
| 1. | 6 Handmade gaskets (Greene Rubber Company) | | $ 65.00 |
| 2. | Stress relieving, 4 covers and bottoms | | 18.00 |
| 3. | 6 shell and bottom units (butt weld) | | 240.00 |
| 4. | 2 completed boxes | | 390.00 |
| 5. | Alteration of bottom die | | 600.00 |
| 6. | Alteration of gasket mold | $ 350.00 | |
| 7. | Blanking, forming, curling dies for cover hinge | 1,670.00 | 1,674.00 |
| 8. | Blanking, forming, curling dies for body hinge | 1,560.00 | 1,542.00 |
| 9. | Blanking, forming, curling dies for latch link retainer | 1,430.00 | 1,384.00 |
| 10. | Blanking and forming die for gasket retainer | 1,290.00 | 1,460.80 |
| 11. | Cover die alteration | 700.00 | 645.00 |
| 12. | 5 pound pressure test jig | 800.00 | 758.00 |
| 13. | 3 pound pressure test jig | 1,200.00 | 835.00 |
| 14. | Seam welding jig | 400.00 | 744.00 |
| 15. | Bottom welding jig | 800.00 | 940.00 |
| 16. | Hardware positioning jig | 400.00 | 386.00 |
| 17. | Completion of pull test jig | 600.00 | 480.00 |

18. Increase in unit price per box of $7.00 was due to additional cost of the gasket, new covers, heavier hardware, painting, and packaging.

On February 4, 1954, a request was made by the Client for five semi-production boxes. It was pointed out that the gasket and gasket retainer would not be in accordance with the latest changes and the welding would not be typical of the production units, since the welding jigs had not been completed.

The hardware dies were completed by February 7, 1954 and individual pieces stamped out. These were checked and found to be in accordance with the drawings.

On February 24, 1954, a meeting was held to review the program. The following points were discussed:

(1) In order to expedite the specifications, we are to forward drawings to Technology, who will prepare the hardware drawings as soon as the pieces are finalized.

(2) The over-all height dimension was not considered realistic. The allowable tolerances were changed to -0, plus 1/16 inch.

(3) A painted box was exhibited. The flat surfaces were excellent, but the bottom rim and hinges had chipped. Two coats of paint had been applied.

(4) The width of the gasket retainer is to be increased, since the gasket must be pushed up against the side of the cover.

(5) The existing tentative specifications called for a pull test on the welding coupons of 500 pounds. This pull was revised to 1000 pounds.

(6) The boxes will be packed in corrugated fiberboard cartons for shipment to us. The purpose of the packaging is to provide protection to the painted surfaces.

On April 2, 1954, the Client was informed that the 22 gauge covers would bow due to the thinness of the metal. The Client stated that the 22 gauge tops be eliminated. Technology was requested to replace the 22 gauge covers with 20 gauge pieces.

On April 13, 1954, a revised cost estimate was forwarded to the Client. The revised expenditures are as follows:

| | | |
|---|---|---|
| (1) | A 360 pound test fixture | $275.00 |
| (2) | Dial Weston Thermometer | 18.00 |
| (3) | Revision of 3 pound test fixture | 75.00 |
| (4) | 25 - 22 gauge covers | 200.00 |
| (5) | Vernier type height gauge | 75.00 |
| (6) | 10 Armco Reports | 150.00 |
| (7) | Burial Program | 500.00 |
| (8) | Additional costs on final report | 200.00 |

During this period a request was made by the Client for the possibility of the addition of a handle. Figures 8 and 9 indicate one possible solution. The curled sections of the latch link retainer were welded on to the body hinge. Both pieces are 16 gauge material, thus resulting in a strong weld. No definite action was taken on this subject.

Figure 8

Box with handle in carrying position

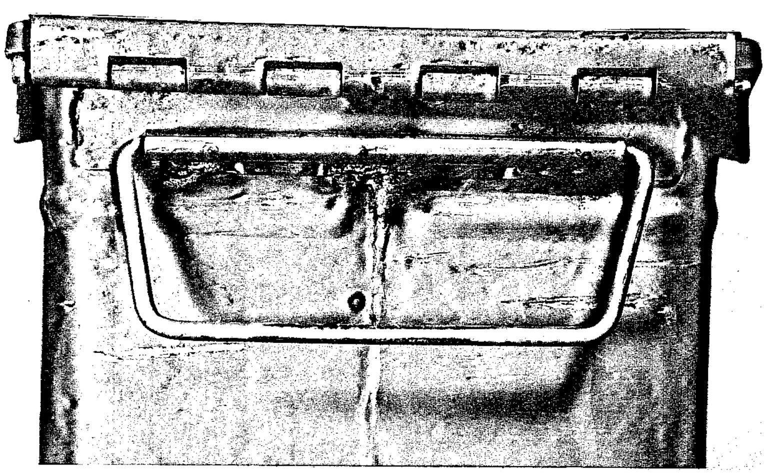

Figure 9

Box Handle

Sixty (60) shells and bottoms were welded prior to assembly of hardware. The shell was heli-arc tack welded as shown in figure 10 prior to the continuous seam weld. Figure 11 shows the seam welding fixture, while figures 12 and 13 show the welding fixture for the bottom and the method of welding. After completion, the shells and bottoms were given the five pound pressure test. It was interesting to note the increase in proficiency of the seam welds between the first and tenth box. Figure 14 indicates the shop working area for the production of the 100 boxes.

During the welding of the first twenty boxes, the gasket compression test was run on each box before the hardware on the next box was welded. By this method the average location was found for the body hinge and once this point was reached, production continued with the gasket compression tests conducted by [redacted] 25X1
[redacted] twice a week. The welder conducted this type of 25X1
test on every fourth box as a check on the hardware location.

Details of the test program can be found in the section entitled "Testing." Pictures of the test fixtures and procedures are also located in this section.

Sixty-six (66) of the boxes were completed by April 21, 1954, and the remaining thirty-two (32) by May 6, 1954. The difference (seven boxes) had been picked up during the production at various times.

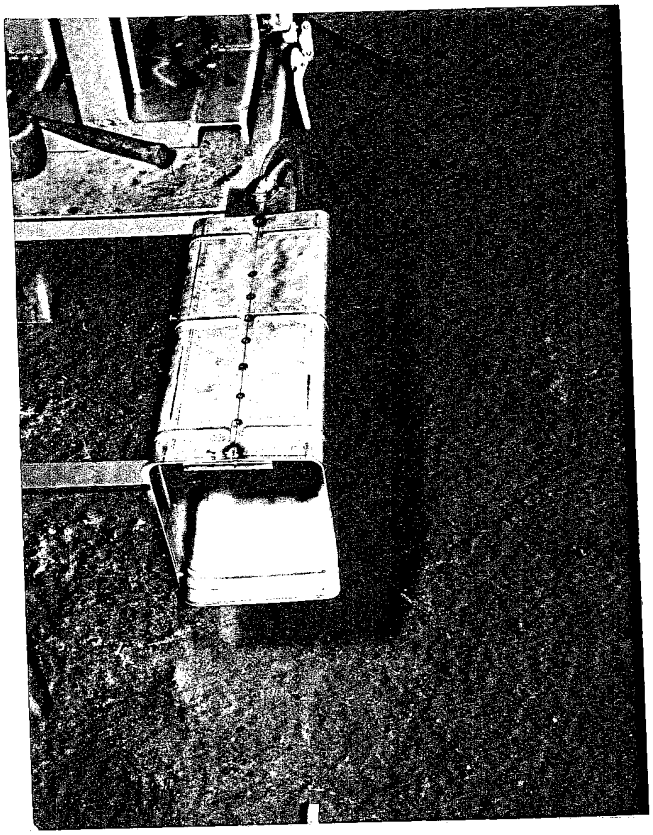

Figure 10

Shell heli-arc tack welded

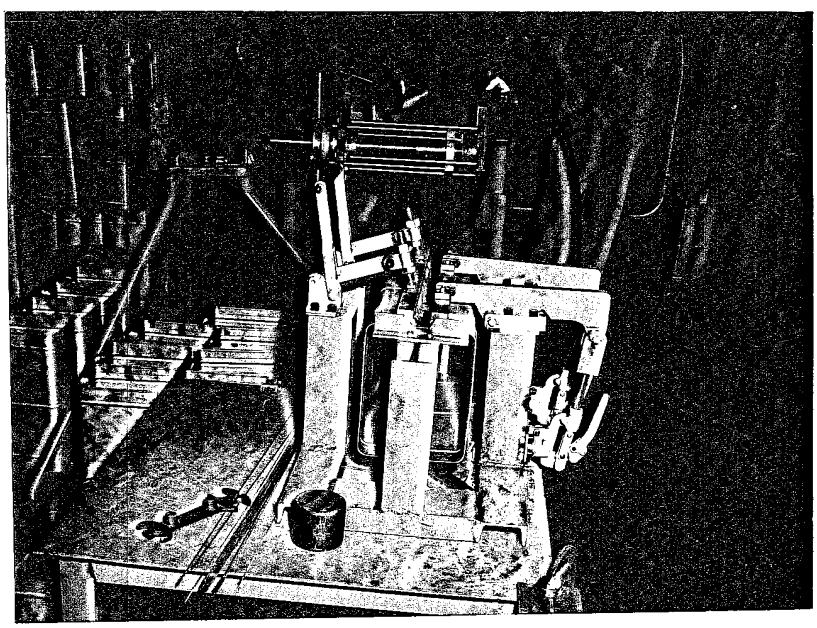

Figure 11

Seam welding fixture

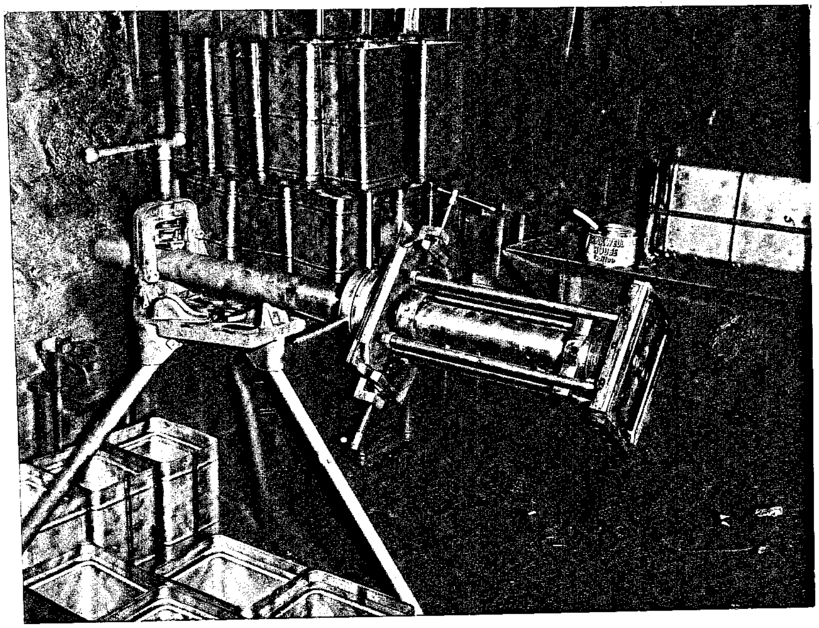

Figure 12

Bottom welding fixture

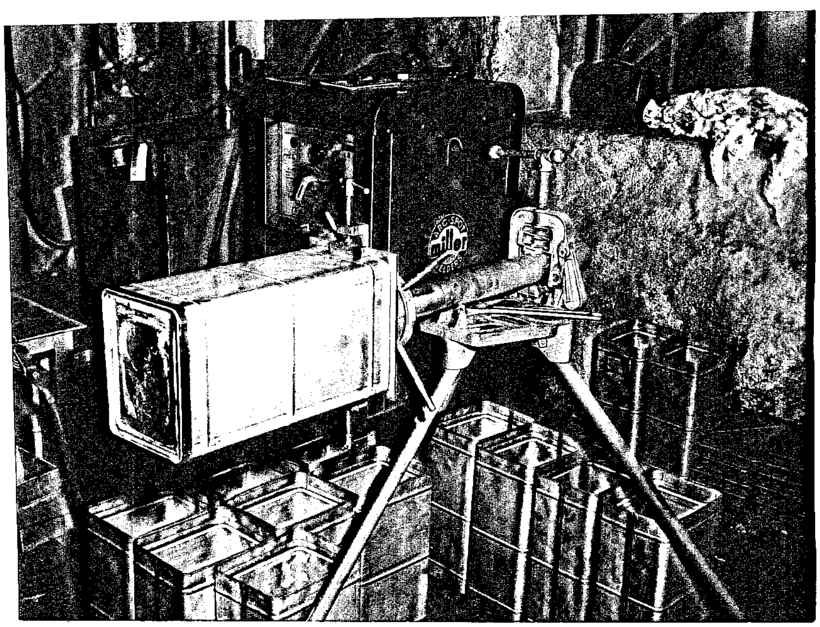


Figure 13

Box body in position for welding



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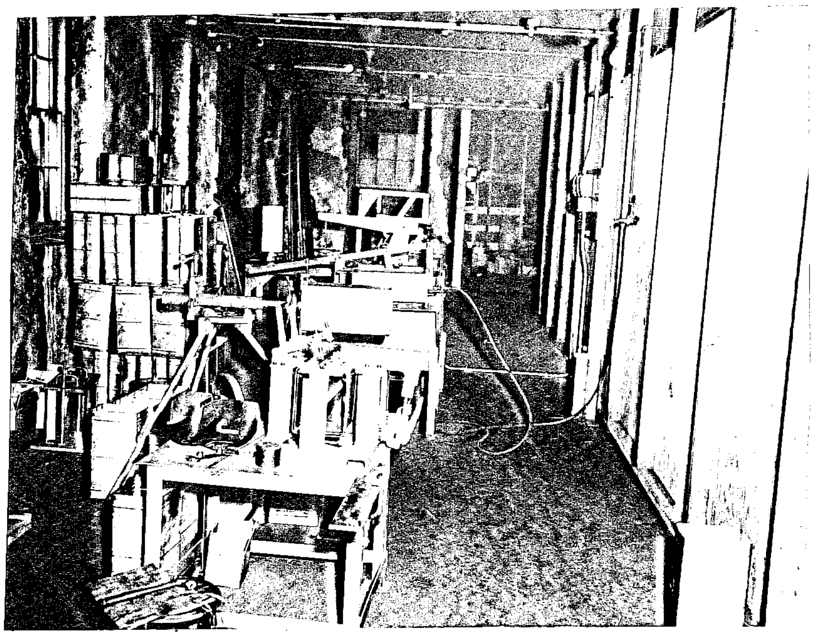

Figure 14

Shop Working Area

## TESTING

During the pilot production, each of the 100 boxes were 100% inspected and numbered using paper slips inside the box. The numbering system was initiated to help provide background information for units that were field tested in the burial program. The tests included a five pound internal pressure test on the shell and bottom, a five pound internal pressure test on the completed box, gasket compression test, static load test, weld coupon tests, hardware pull tests, and a gasket composition test. These tests and testing results are given in the following sections.

### Shell and Bottom Test

The purpose of this test was to insure that the quality of welding met the standards and would result in the absence of pinholes in the welds. A hose was attached to an air line which included in the system a diaphragm valve and a pressure relief valve set at eight pounds. The line was connected to a jig as shown in figure 15. The jig prevented distortion and insured a firm setup against the gasket. The first 15 or 20 units were given a soap test in addition to the hydrostatic test as an added precaution. However, it was found that the minute pinholes would not show. The best method was the submergence of the box in the tank as shown in figure 16. After the water had settled, the box was rotated on each side and the weld areas examined. This test would require a minimum of 6-8 minutes per test.

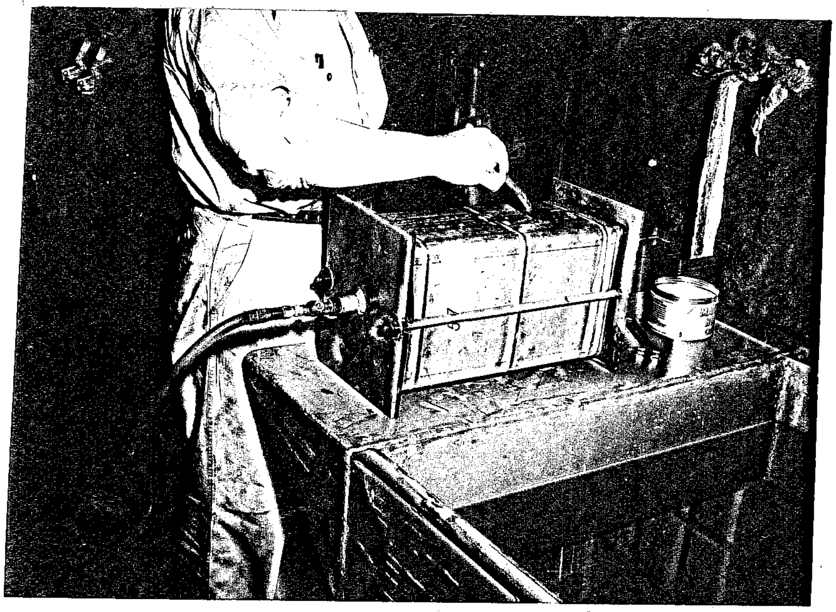

Figure 15

Soap Test

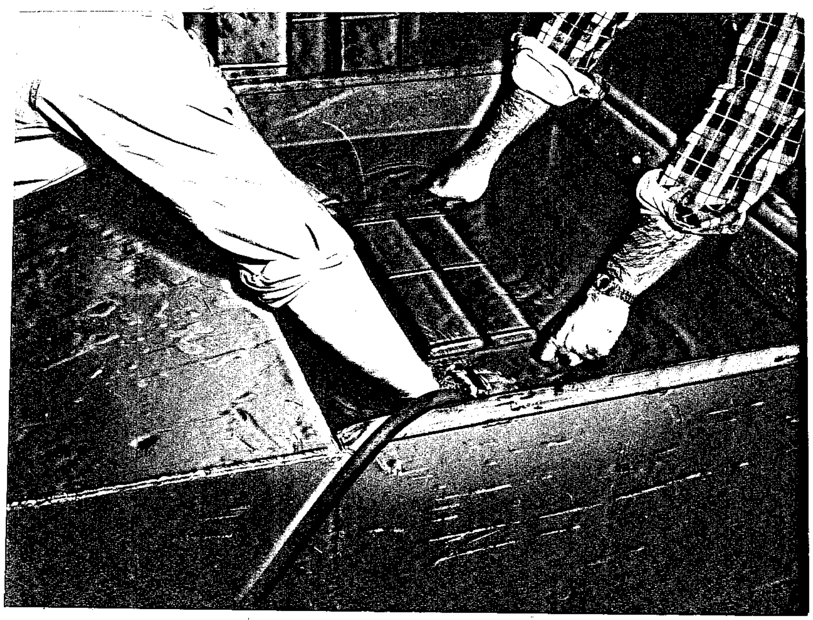

Figure 16

Cold Water Test

Another method of testing was tried with unsatisfactory results. The same jig was used but the box tested in a vertical position. This would allow the escaped air bubbles to go up the side and accumulate on the underside of the top plate of the jig.

Of the initial twenty units, six rejects were found. The pinholes were either on the shell seam or at the junction of the bottom weld and shell seam weld.

A total of nine rejects were found during the production of the 100 units. These units were reworked, retested, and approved for assembly of hardware.

## Static Load Test

The early specification called for a static load test of 360 pounds on the maximum area. Five boxes were tested in the test jig shown in figure 17. On one box a static load of 550 pounds was applied and the box was then tested in the hot water tank. No apparent damage had been caused.

## Internal Pressure Test

A fitting was welded to the bottom of a box and the unit gradually filled with water. Once filled, the pressure was gradually increased until the box leaked at 15 pounds. A leak occurred at two corners of the gasket. The compression on the gasket had been previously checked and

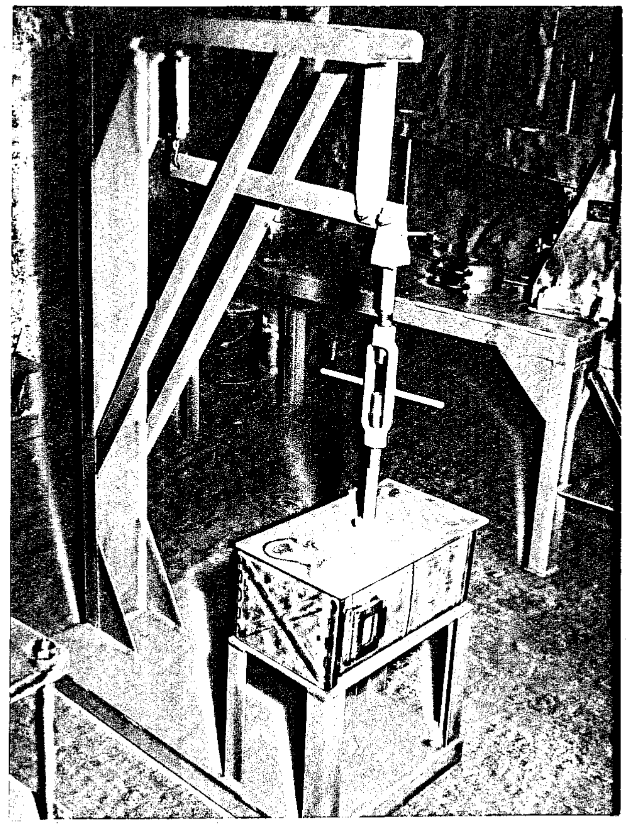

Figure 17

Static Load Test


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found to be between .081" to .089" compression. When the full line force of 75 pounds was applied to the box, the four sides bulged but did not rupture. The leak continued in the same spots but only at a slightly greater rate.

External Pressure Test

One box was placed in a water tank and pressure applied until the equivalent of a five foot depth was reached. The box was removed and examined for leakage. No leakage occurred. The same procedure was followed for the equivalent of 10, and 15 foot depths. Leakage occurred at a depth of 17 feet and was due to the crushing effect of the side at the gasket. The resulting reduction of effectiveness of the gasket allowed the water to flow by into the box.

## Hardware Test

Ten boxes were tested for the security of welds and attachment of component parts on the "bridge." This test unit was designed b[redacted] to not only test the attachment of parts as well as weld coupons. 25X1

The box was clamped in the fixture with the body supported from distortion or collapse by a snug fitting wood filler block. The bottom rested on the bottom with the cover raised at a right angle and the force applied in a vertical direction with the force bearing against the face of the latch when positioned parallel to the box bottom. A force of 250 pounds was slowly applied for two minutes. Figure 18 indicates this procedure which is a test comprised of the following parts: latch, latch link, latch link retainer, cover, cover hinge, body and body hinge.

The boxes would pass the 250 pound test, but when a force of 500 pounds was applied the latch link retainer would bend and effectively destroy the box. However, as an added precaution, several extra welds were added to prevent this bending. These welds were added at the sides of piece making a total of five welds on this piece.

The box was then rotated and a force of 500 pounds applied in a similar manner as shown in figure 19 to the underside of the lip of the hasp. The ten units passed this test.



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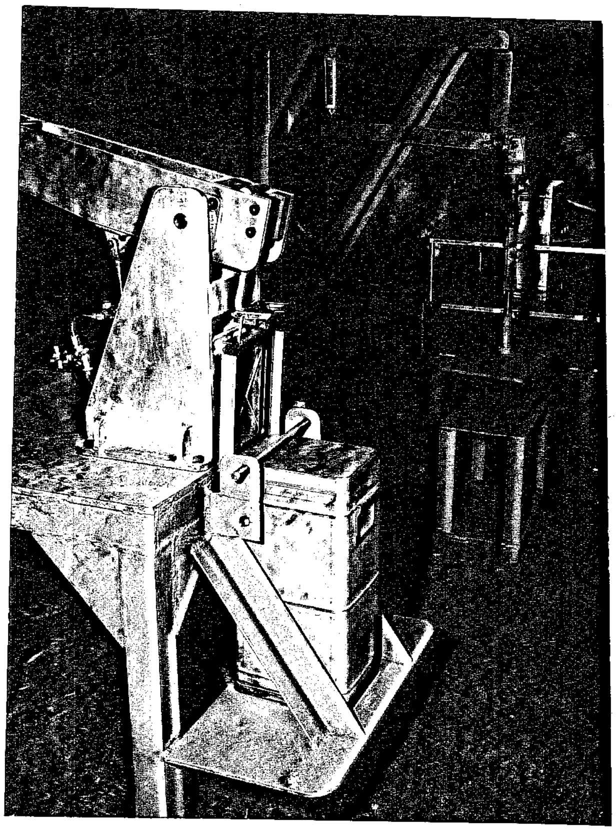


Figure 18

250 Pound Pull Test

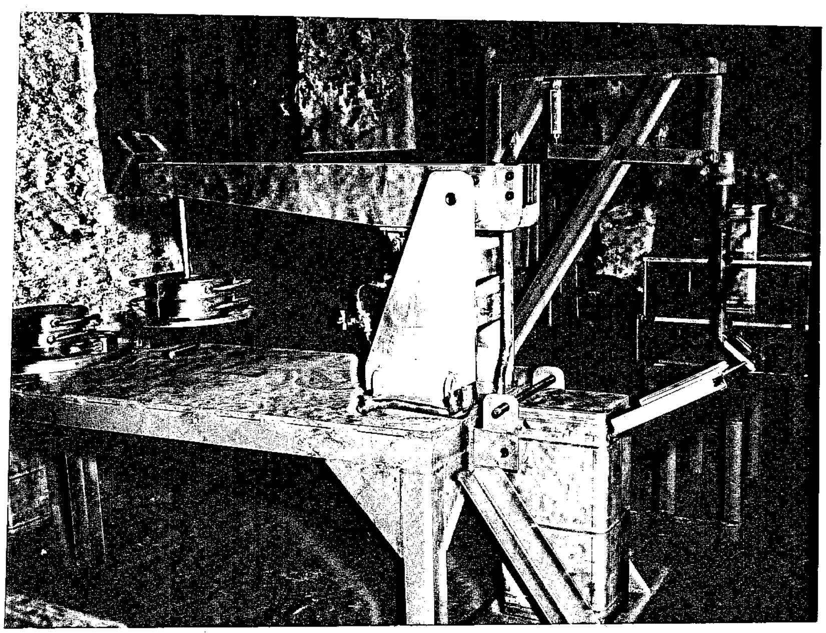


Figure 19

500 Pound Pull Test

Upon completion of these tests, the cans were then tested for leaks in the hot water tank. No leaks were found.

Hot Water Test

The original tentative specifications called for the completed box to be submerged in hot water for 2-3 minutes until three pounds internal pressure was built up inside the box. Experience had shown that the minute leaks were not readily seen at three pounds, but became apparent at five pounds. Based on this experience, the "hot water test" was conducted at the five pound internal pressure level.

The tank was equipped with three immersion heaters(manually controlled) located at the bottom. After the water came to the desired temperature of approximately 170°F, the two outer heaters were shut off. It was found that the controlling factor in the test was the room temperature. At 6-8°F change of the air inside the box would cause the time interval required to raise the internal pressure to vary from 18 seconds on one occasion (room temperature 52°F) to 4 minutes (room temperature 58°F) while the bath temperature remains constant.

One of the early prototypes had a fitting welded to the top and a pressure gauge attached. The box was placed in the rack and submerged as shown in figure 20. Considerable experimenting on water bath conditions was conducted with this box. It was planned to use this box during the testing of the 100 units. However, it was found that a second test box became necessary as the test units required approximately 15 minutes to approach room temperature. Plans indicated that the test unit would be placed in the center with boxes to be tested on either side as indicated in figure 21. This method of testing was eliminated since a "leaker" was not readily recognized since the air bubbles had collected under the lip of the cover. The test rig as shown in figure 22 was the designed unit and was used very successfully, since the box can be rotated during the test. This test unit was a second good check on the body and bottom welds, in addition to finding any adverse affects resulting from the hardware welding.

It was found that the reduction in room temperature would have a direct effect on the time required for the internal box pressure to reach the desired figure if the bath temperature remained constant. The converted box was always tested first to determine the proper time interval required for the five pounds internal pressure while spot tests were conducted throughout the testing period.

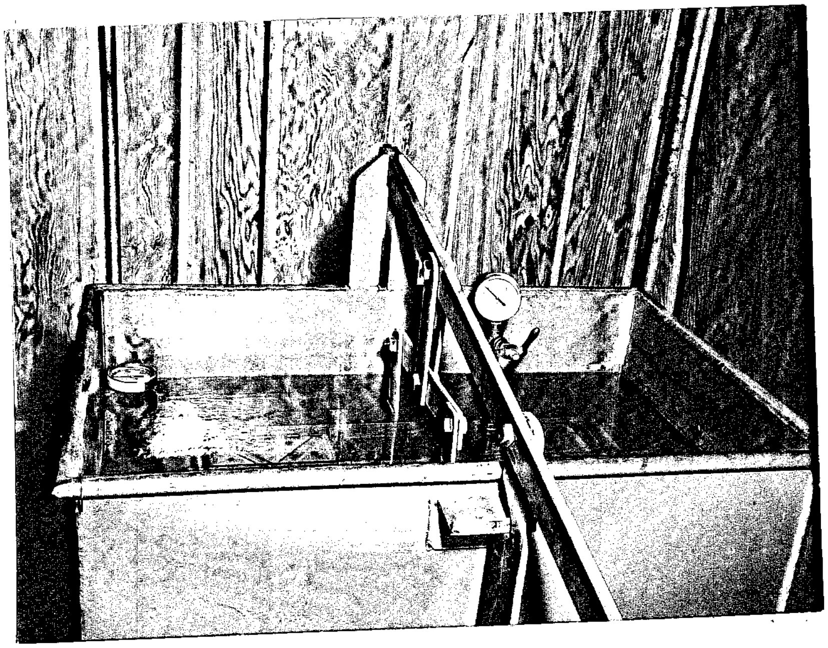


Figure 20

Test box in hot water tank

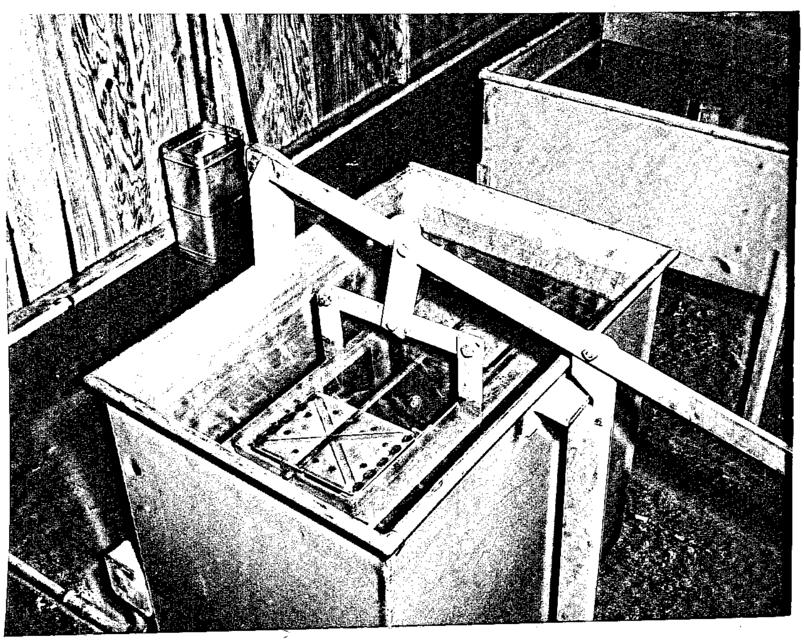


Figure 21

Proposed method of production testing

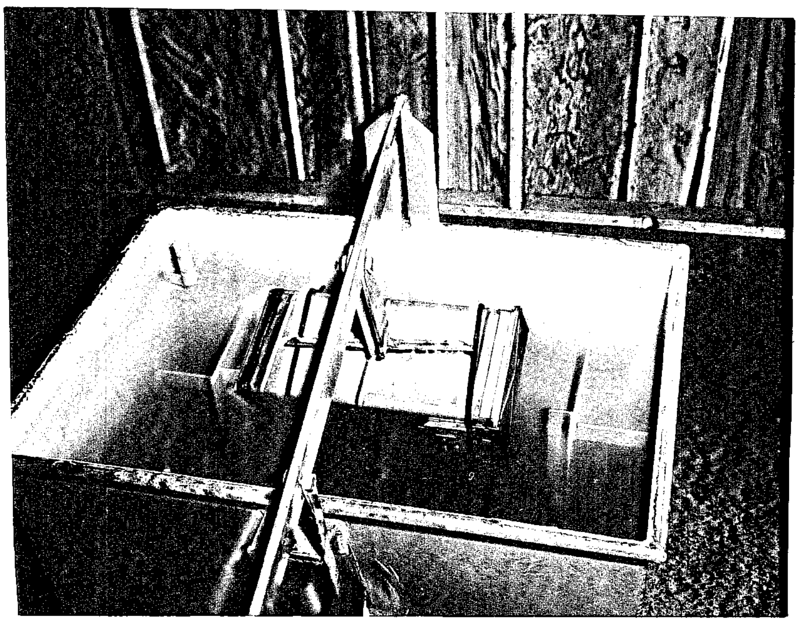


Figure 22

Revised Production Testing

## Gasket Compression Test

The completed box was placed in a device designed and built under the supervision of [redacted]. A set of six readings were taken in the manner shown in figure 23. The cover was then closed and a second set of readings taken. (Figure 24.) 25X1

An example of the method of calculating the compression was as follows:

| | | |
|---|---|---|
| 0.465" | - | Box closed |
| 0.250" | - | Top of shell |
| 0.290" | - | Top and gasket |
| 0.215" | - | Difference |
| 0.075" | - | Compression |

These readings were obtained by measuring the distance from the top of the device to the lip of the body, closing the cover of the box and measuring the distance at the same spot. The difference of these two readings was subtracted from the thickness of the cover and gasket and used as the compression figure. The specified allowable tolerance was 0.090" $\pm$ 0.020".

The first forty (40) boxes were tested without the gasket retainer in place. This program was initiated to expedite production, since the retainer had been redesigned just two weeks prior to the first available boxes. Thirty-six (36) of the boxes had compression readings

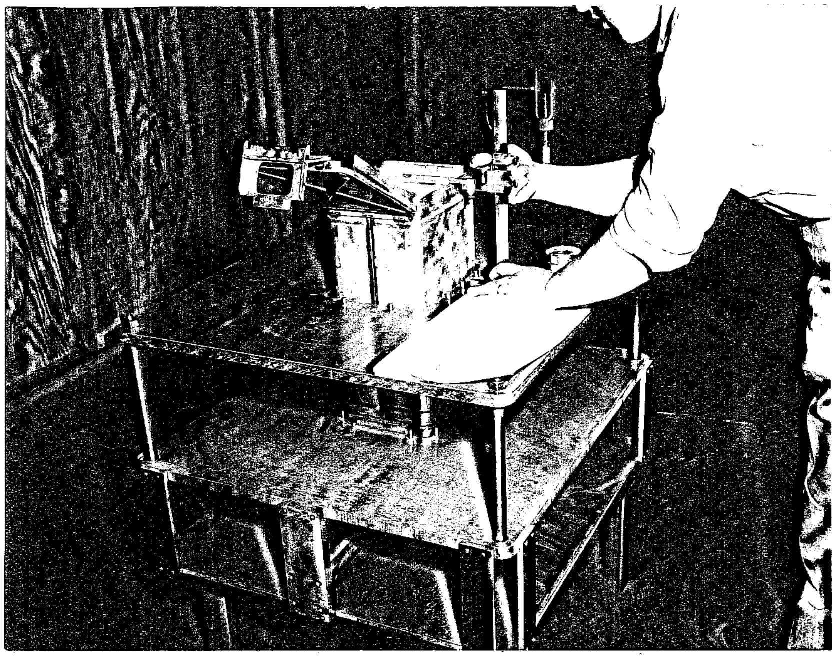


Figure 23

Vernier height gauge reading on body lip

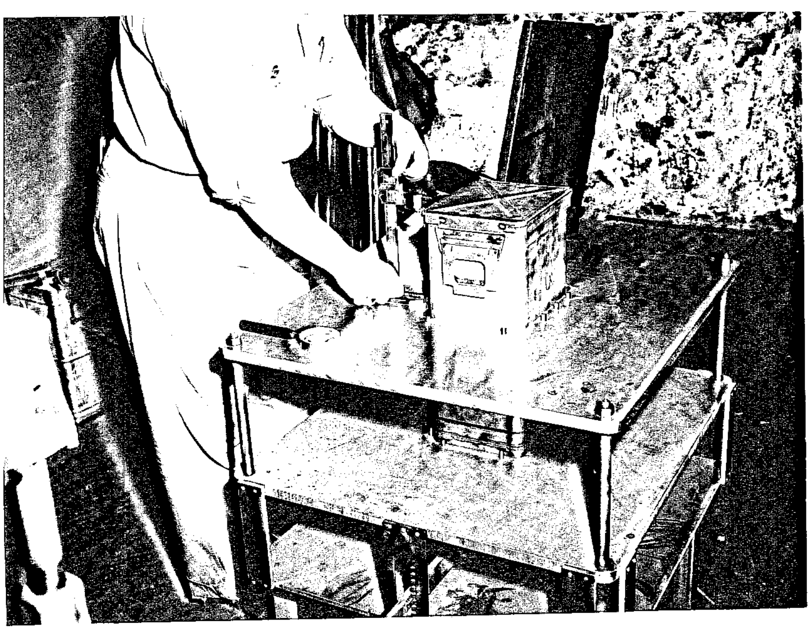


Figure 24

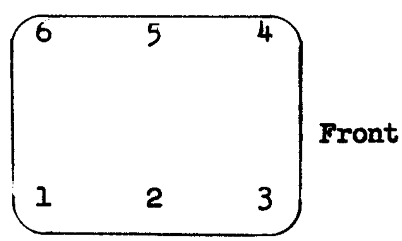
Vernier height gauge reading on cover

between 0.100" and 0.120". The remaining four boxes had readings ranging between 0. 090" and 0.116" compression. Ten of the forty boxes were retested after the gasket retainer had been welded in place. It was found that the average reading was 0.075" to 0.080" compression.

An attempt was made to hold the compression values consistantly in the nineties. However, it was found that the hinges would cause the cover to bend even with the compression values held in the seventies.

The following set of values in Table I are the compression readings for the semi-production lot. The figures are expressed as whole numbers rather than as thousandths. Hence a reading of 85 is actually 0.085" compression.

The readings were taken in the following manner:




Readings 2 and 5 were taken at the center of the shell lip while the remaining 4 readings were taken approximately 1-1/2 inches from the end. The pegs in the fixture (figure 23) made it possible for the readings to be taken in the same place on each can.

While the average readings were excellent on the retest of the initial 40 units, it was decided to retest the initial units with the gasket retainer in place.

TABLE I

GASKET COMPRESSION READINGS

| Unit No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 82 | 79 | 78 | 79 | 84 | 84 |
| 2 | 85 | 83 | 84 | 87 | 82 | 81 |
| 3 | 89 | 80 | 85 | 79 | 78 | 84 |
| 4 | 82 | 81 | 78 | 80 | 82 | 87 |
| 5 | 89 | 86 | 84 | 81 | 79 | 80 |
| 6 | 75 | 72 | 76 | 77 | 74 | 71 |
| 7 | 84 | 80 | 74 | 80 | 81 | 84 |
| 8 | 90 | 88 | 89 | 83 | 81 | 86 |
| 9 | 70 | 68 | 75 | 70 | 74 | 74 |
| 10 | 81 | 74 | 75 | 73 | 81 | 87 |
| 11 | 86 | 79 | 75 | 79 | 84 | 89 |
| 12 | 88 | 75 | 80 | 93 | 79 | 83 |
| 13 | 80 | 80 | 81 | 74 | 85 | 80 |
| 14 | 85 | 80 | 85 | 79 | 81 | 84 |
| 15 | 79 | 85 | 79 | 72 | 70 | 75 |
| 16 | 80 | 78 | 75 | 69 | 73 | 79 |
| 17 | 78 | 80 | 82 | 79 | 78 | 79 |

Gasket Compression Readings - 2

| Unit No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 18 | 92 | 87 | 82 | 88 | 81 | 82 |
| 19 | 80 | 75 | 75 | 79 | 74 | 77 |
| 20 | 94 | 90 | 95 | 95 | 94 | 95 |
| 21 | 83 | 81 | 77 | 72 | 78 | 80 |
| 22 | 84 | 82 | 80 | 77 | 78 | 80 |
| 23 | 75 | 79 | 72 | 70 | 78 | 79 |
| 24 | 72 | 73 | 68 | 70 | 74 | 79 |
| 25 | 77 | 82 | 82 | 80 | 80 | 82 |
| 26 | 79 | 88 | 84 | 92 | 82 | 89 |
| 27 | 93 | 80 | 83 | 87 | 92 | 96 |
| 28 | 91 | 88 | 93 | 88 | 94 | 97 |
| 29 | 99 | 95 | 96 | 87 | 86 | 80 |
| 30 | 79 | 82 | 80 | 77 | 76 | 70 |
| 31 | 79 | 82 | 80 | 73 | 76 | 77 |
| 32 | 81 | 72 | 72 | 78 | 77 | 72 |
| 33 | 99 | 85 | 81 | 86 | 84 | 98 |
| 34 | 94 | 85 | 89 | 91 | 88 | 99 |
| 35 | 89 | 92 | 89 | 78 | 82 | 75 |
| 36 | 80 | 79 | 77 | 78 | 74 | 71 |
| 37 | 77 | 73 | 80 | 74 | 79 | 69 |

Gasket Compression Readings - 3

| Unit No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 38 | 86 | 86 | 89 | 91 | 93 | 92 |
| 39 | 81 | 79 | 83 | 72 | 83 | 89 |
| 40 | 76 | 71 | 73 | 72 | 70 | 71 |
| 41 | 68 | 72 | 73 | 76 | 69 | 76 |
| 42 | 70 | 71 | 70 | 75 | 79 | 72 |
| 43 | 79 | 72 | 79 | 73 | 71 | 72 |
| 44 | 80 | 82 | 81 | 79 | 84 | 87 |
| 45 | 80 | 83 | 84 | 80 | 86 | 90 |
| 46 | 79 | 88 | 88 | 78 | 91 | 92 |
| 47 | 87 | 86 | 88 | 90 | 90 | 98 |
| 48 | 85 | 89 | 89 | 90 | 90 | 91 |
| 49 | 95 | 92 | 96 | 96 | 94 | 95 |
| 50 | 83 | 85 | 84 | 83 | 88 | 87 |
| 51 | 82 | 91 | 91 | 86 | 84 | 90 |
| 52 | 83 | 84 | 83 | 86 | 85 | 82 |
| 53 | 87 | 81 | 86 | 80 | 82 | 84 |
| 54 | 88 | 82 | 81 | 75 | 83 | 86 |
| 55 | 89 | 82 | 87 | 87 | 84 | 86 |
| 56 | 70 | 68 | 69 | 67 | 69 | 68 |
| 57 | 88 | 84 | 80 | 95 | 91 | 94 |

Gasket Compression Readings - 4

| Unit No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 58 | 81 | 84 | 80 | 88 | 92 | 80 |
| 59 | 73 | 74 | 69 | 74 | 72 | 71 |
| 60 | 86 | 88 | 93 | 92 | 85 | 99 |
| 61 | 89 | 92 | 94 | 89 | 83 | 80 |
| 62 | 85 | 90 | 89 | 90 | 80 | 82 |
| 63 | 72 | 71 | 67 | 86 | 84 | 95 |
| 64 | 84 | 84 | 94 | 85 | 80 | 96 |
| 65 | 87 | 78 | 83 | 80 | 79 | 84 |
| 66 | 75 | 88 | 84 | 89 | 83 | 85 |
| 67 | 81 | 78 | 82 | 90 | 99 | 96 |
| 68 | 89 | 84 | 83 | 90 | 90 | 89 |
| 69 | 75 | 70 | 71 | 75 | 70 | 75 |
| 70 | 98 | 76 | 73 | 77 | 66 | 74 |
| 71 | 89 | 78 | 75 | 91 | 88 | 90 |
| 72 | 81 | 81 | 79 | 80 | 81 | 84 |
| 73 | 76 | 78 | 90 | 81 | 85 | 82 |
| 74 | 78 | 72 | 75 | 70 | 75 | 83 |
| 75 | 76 | 71 | 70 | 71 | 71 | 85 |
| 76 | 85 | 70 | 70 | 69 | 72 | 93 |
| 77 | 91 | 74 | 68 | 69 | 67 | 71 |

Gasket Compression Readings - 5

| Unit No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 78 | 74 | 70 | 66 | 68 | 76 | 83 |
| 79 | 86 | 82 | 79 | 74 | 72 | 69 |
| 80 | 90 | 78 | 76 | 84 | 74 | 74 |
| 81 | 71 | 75 | 72 | 79 | 73 | 74 |
| 82 | 80 | 73 | 65 | 81 | 81 | 84 |
| 83 | 93 | 81 | 71 | 70 | 81 | 86 |
| 84 | 82 | 73 | 74 | 69 | 68 | 73 |
| 85 | 72 | 77 | 74 | 73 | 72 | 75 |
| 86 | 73 | 69 | 75 | 79 | 79 | 89 |
| 87 | 89 | 78 | 81 | 78 | 78 | 82 |
| 88 | 85 | 74 | 79 | 90 | 89 | 95 |
| 89 | 79 | 70 | 69 | 73 | 76 | 78 |
| 90 | 77 | 71 | 70 | 75 | 70 | 82 |
| 91 | 77 | 66 | 70 | 74 | 71 | 72 |
| 92 | 67 | 66 | 66 | 64 | 66 | 70 |
| 93 | 85 | 79 | 72 | 71 | 70 | 73 |
| 94 | 71 | 77 | 72 | 90 | 99 | 96 |
| 95 | 91 | 92 | 94 | 90 | 91 | 94 |
| 96 | 91 | 84 | 85 | 83 | 91 | 97 |

Gasket Compression Readings - 6

| Unit No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 97 | 84 | 84 | 94 | 75 | 80 | 96 |
| 98 | 75 | 88 | 84 | 89 | 83 | 75 |
| 99 | 81 | 81 | 86 | 76 | 80 | 86 |
| 100 | 71 | 69 | 71 | 82 | 71 | 78 |

Weld Coupon Test

Prior to any semi-production welding, three welders were chosen and given a rough rating. This rating consisted of several sample pieces of 22 gauge stainless being welded with butt joints. These pieces were cut into 1/2 inch wide strips 8 inches long. The strips chosen appeared to be the less desirable welds. The strips were placed in the jaws of the "bridge" as shown in figure 25. The smaller weights shown to the right are 25 pounds and the larger 100 pounds. Since the over-all length ratio is 10:1, these weights represented 250 and 1000 pounds pull respectively. Once the strip was placed in position, the valve on the hydraulic brake was released and the weights added slowly. It was not deemed advisable to add more than 1250 pounds to the bridge. Six weld samples of this type were tested to destruction at Wentworth Institute and the breakpoints varied between 1800 and 2250 pounds.

It was the practice of the test personnel to run several tests of this type during the day, since it is a quick method of determining the loss of efficiency due to fatigue.

The "hooks" on the table were used to test the hardware as described in the hardware test section. The wood filler block used in this test is placed under the table.

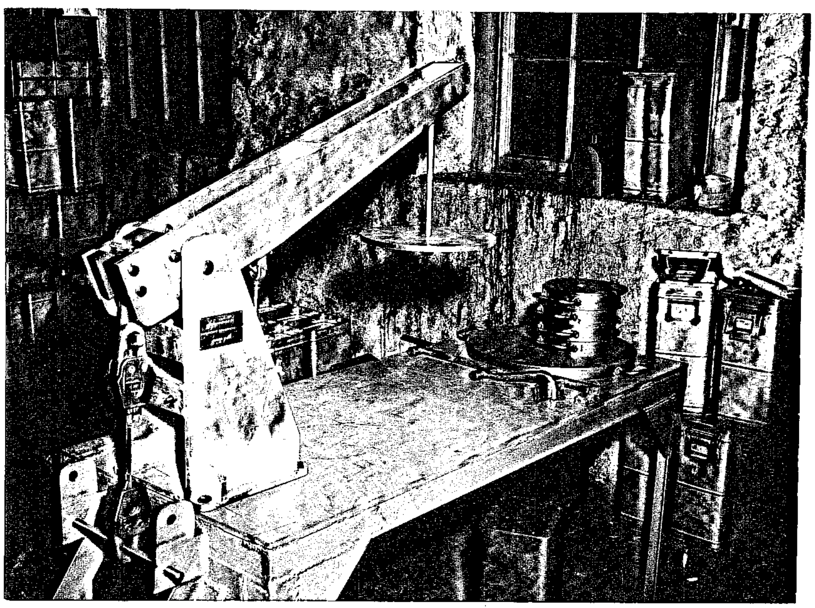


Figure 25

Weld Coupon Test

Explosion Test

Two boxes were packed in accordance with the wishes of the Client for detonation here. In each box two cans of 50 blasting caps (equivalent of #8) were placed at the top and set off by remote control. Figures 26, 27, and 28 are pieces of shrapnel found in the vicinity which indicate the effects of the blast on the different parts. The cover (figure 27) was torn across the center due to the 1/16 inch hole drilled for the lead wires to the blasting machine.

A breakdown of the items packed in the box is shown in figures 29 and 30. The method of packaging is shown in figure 31. The test results indicated that the cans of blasting caps should not be considered as part of the kit (for shipping purposes only) but packed and shipped in a separate container.

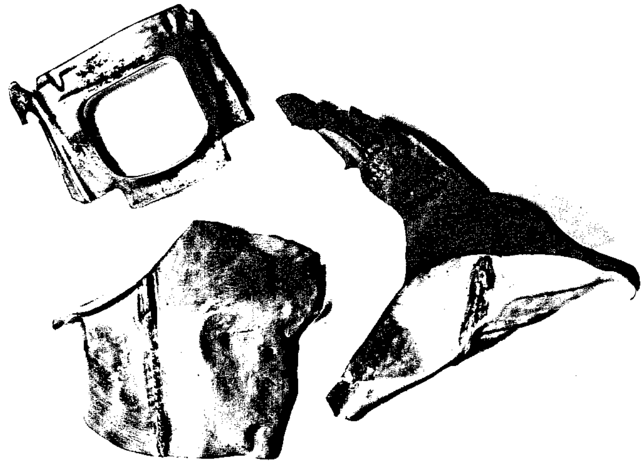


Figure 26

Hasp and body shrapnel

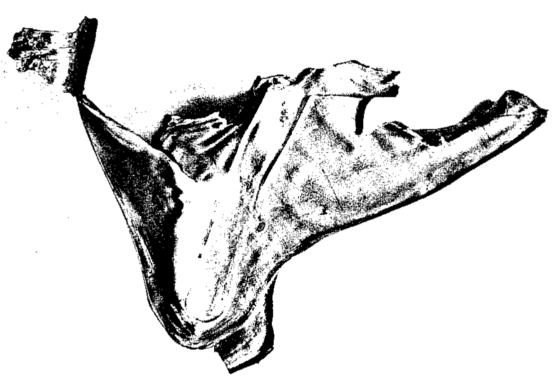


Figure 27

Cover Shrapnel

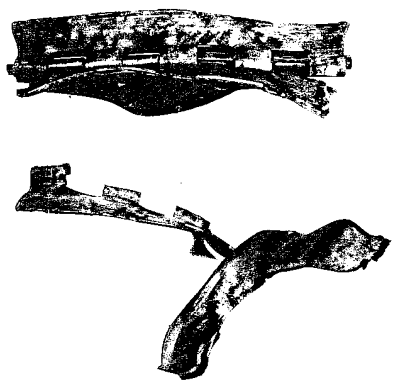


Figure 28

Hinge Shrapnel


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Figure 29

Breakdown of double pack

Figure 30

Breakdown of single pack

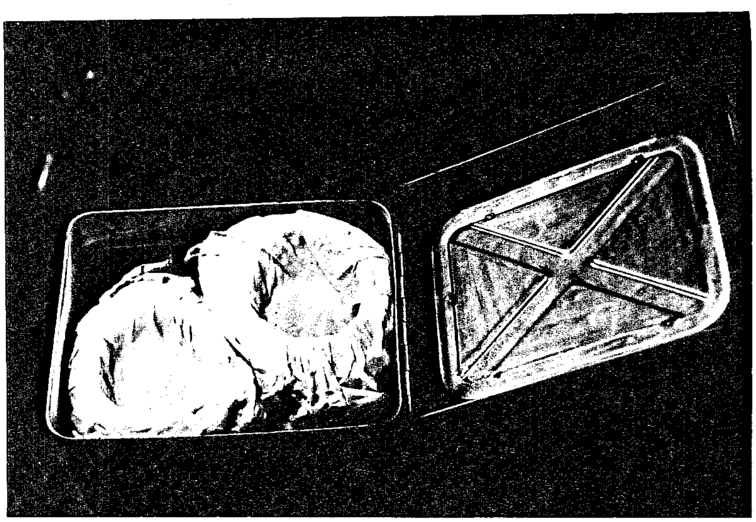

Figure 31

Method of packing box

Gasket Test

A closed box was placed in a laboratory oven for a period of 24 hours at a temperature of 165 ± 3°F. When opened the gasket showed no signs of stickiness.

The test was also conducted on the second lot of gaskets and the same results found.

It was found that the sides of the box would bulge if the box was closed and placed in the heated oven. These sides could not be straightened for reuse. However, if the can is placed in the heated oven for 10-15 minutes with the cover open, the bulging can be prevented if the box is removed, the cover closed and the box replaced in the oven for a 24-hour period.



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## WELDING

In the limited production of the SS Boxes, it became apparent that, next to the gasket, the most vulnerable part of the container were the welded sections. Because of the thinness (22 gauge) of the shell, much consideration was given to the possibility of excess carbon participation around the weld areas.

Carbon precipitation could be held to a minimum by several means; i.e. selection of material, heat treatment and welding technique. The first factor, namely the proper selection of stainless steel, would require the use of type 347 or 316 ELC stainless. These materials were ruled out for reasons discussed earlier in the report (Reference: Development Section.)

Serious consideration was given to heat treatment of the entire container and/or individual parts. This subject was discussed with metallurgical engineers, fabricators and foundry operators. The general consensus was that the process would be very complicated and expensive because of the gauge and structure of the box. In addition, they were not certain that annealing would be beneficial in that the overall corrosion resistance of the parent metal would be reduced. These conclusions pointed out that the welding technique would determine the ultimate useability of this item in the field.

On the basis of the above recommendations, information was requested from the following sources:

(1) Air Reduction Sales Company

(2) The American Brass Company (Anaconda Welding Rod Division)

(3) G. E. Linnert, Research Welding Metallurgist, Armco Steel Corporation

(4) Rodney Hunt Company, Orange, Massachusetts

The Air Reduction Sales Company representative recommended the use of 316 filler rod. They felt that this rod has less carbon than the 316 type stainless sheet stock and would, therefore, prevent excess carbon precipitation.

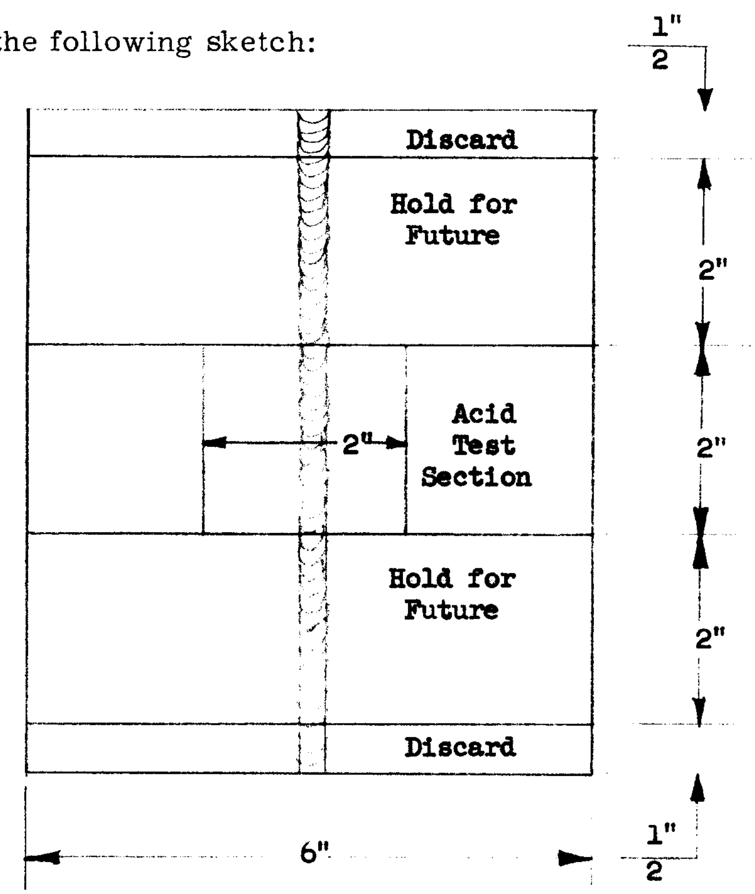
The American Brass Company produces rods for welding brass and copper and could not assist our project.

[redacted] 25X1

The Rodney Hunt Company has wide experience in working all types of stainless, although they primarily work with heavy stock. When contacted they stated that they would be happy to act as a sub-contractor, but would prefer not to give out "company know-how".

The recommendations from the above sources indicated that no definite information was available for our specific needs. On this basis it was decided to conduct various tests on welded samples prepared by the welder, who would be working on the boxes for Technology Engineering Company. This would also establish the quality of the operator, as well as establishing the possible working limitations. The amperage would be varied in addition to the use of various type rods.

Samples of 22 gauge, 316 type stainless were prepared in accordance to the following sketch:



The current was controlled by the use of an AC Miller Electric Welder bought by Technology for this work. All samples were passivated in a 30% solution of nitric acid at a temperature of 160° F for 30 minutes. Prior to the acid tests the welded area was cleaned with No. 180 grit emery cloth to remove discoloration and fused slag while care was taken not to heat the welded section.

The first group (Samples 1, 2, 4, 5, 6, 8, 80) was suspended on wooden rods in a Saran beaker containing 500 ml of 10% nitric and 3% hydrofluoric acid (by weight) in solution. All specimens were immersed in the solution together. The solution was maintained at 176°F ± 3°F for three 4-hour periods. At the end of each period, the acid solution was replaced with fresh solution.

The following specimens were prepared and tested in the above manner:

| Specimen Number | Description |
| --- | --- |
| 1 | 310 filler rod, welded and passed over, Position of welder - standing, strip-horizontal, current 25-170/V10, copper back-up with groove, polarity-straight. |

| Specimen Number | Description |
|---|---|
| 2 & 4 | No filler rod, current 3-35/V35.6 Copper back-up with groove, Position: sitting, horizontal. |
| 5 | No filler rod, current 3-35/V55 Copper back-up plate with groove. |
| 6 | Current 3-35/V56, No filler rod, copper back-up strip. |
| 8 | No filler rod, Current 3-35/V40, lap joint. |
| 80 | 316 filler rod, 3-35/V48 |

The conclusions as shown by figure 32 indicates that welds made with 316 filler rod and the parent metal are the weakest. Type 310 filler rod showed no weld decay.

The second group of specimens was prepared and each specimen placed in a 500 ml glass beaker on a steam table and held at the desired temperature.

| Specimen | Description |
|---|---|
| A | No filler rod, butt weld |
| B | 310 filler rod, lap weld |
| C | 316 filler rod, lap weld |
| D | 316 filler rod, butt weld |
| E | 310 filler rod, butt weld |

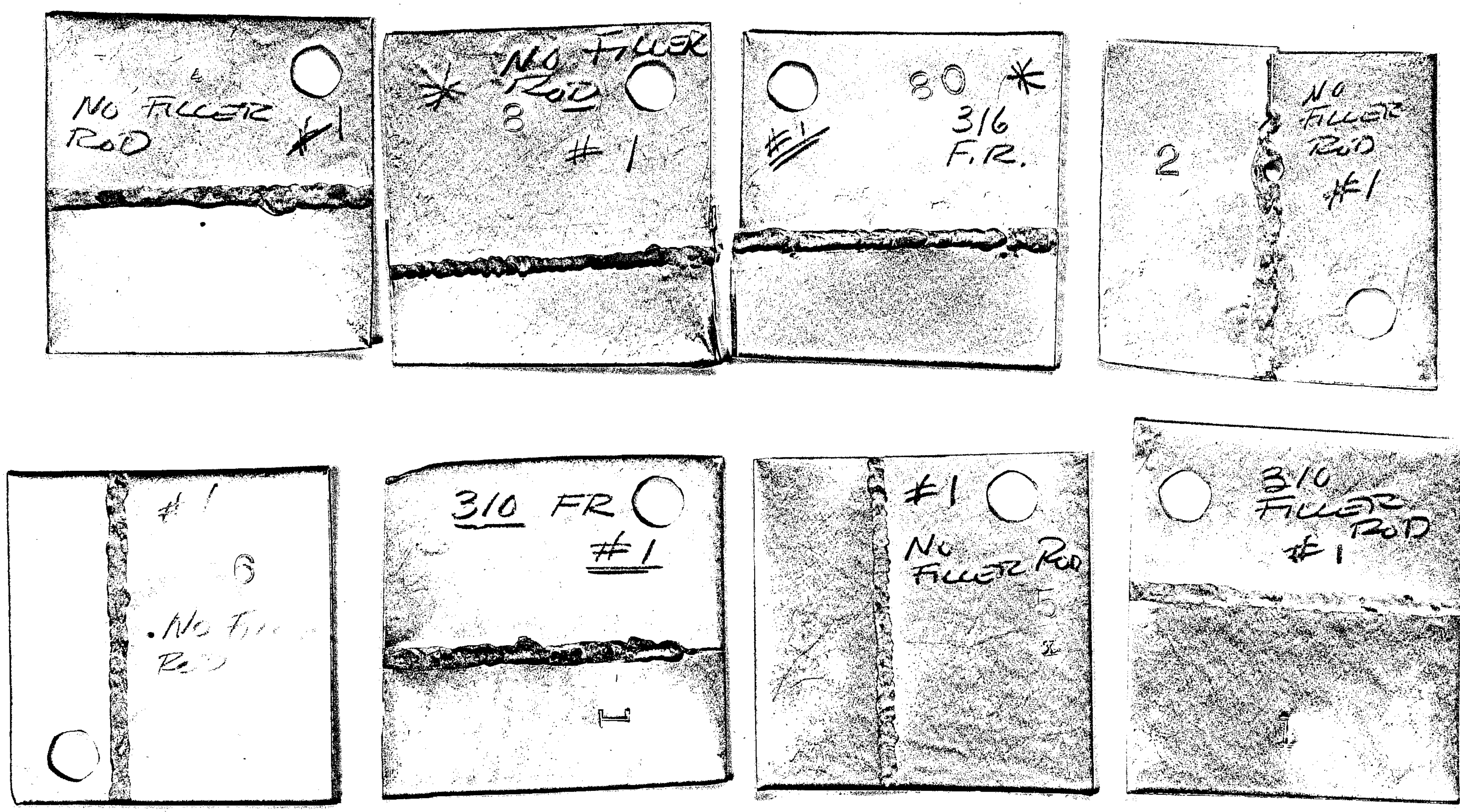



Figure 32

Welding samples after acid test

SECRET



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The solution consisted of 10% nitric and 3% hydrofluoric acid which was changed after the first four hours and every two hours thereafter, for a total of twelve hours. Prior to the test, the specimens were passivated in 30% solution of nitric acid at a temperature of 160°F for 30 minutes.

The conclusions as shown in figures 33, 34, 35, 36, and 37 indicate that the specimens welded up type 310 filler rod proved to be the superior method. Noticeable weld decay was found in both butt and lap welds were type 316 filler rod and no filler rod was used. However, no filler rod is better than the weld made with the 316 rod.

The above results are, in general, in accordance with the results published by Armco Steel Corporation. Their report, entitled "Corrosion Resistance of Shielded Metal-Arc Welded Extra-Low-Carbon Austenitic Chromium-Nickel Stainless Steels", is located in the appendix.

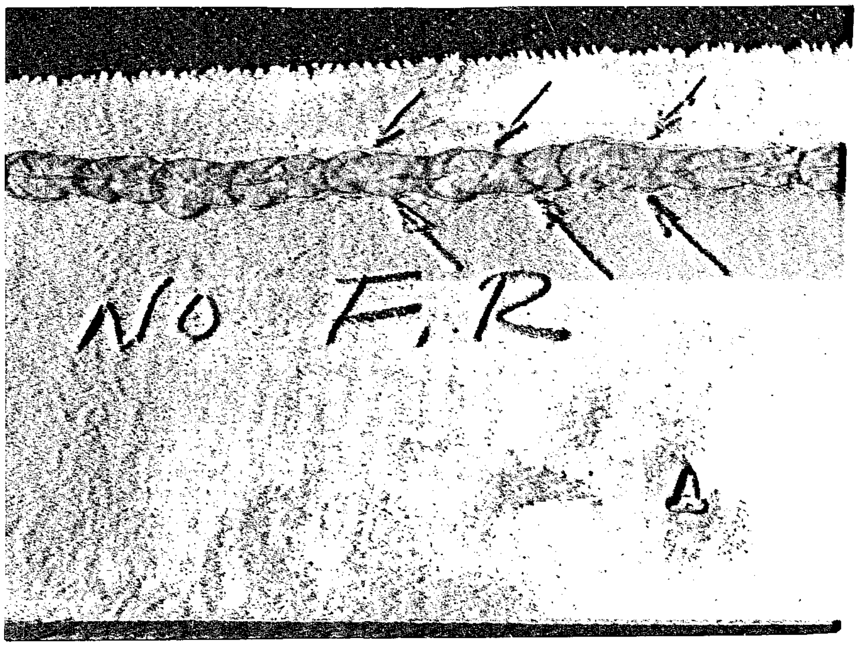


Figure 33

Weld sample - no filler rod, butt weld

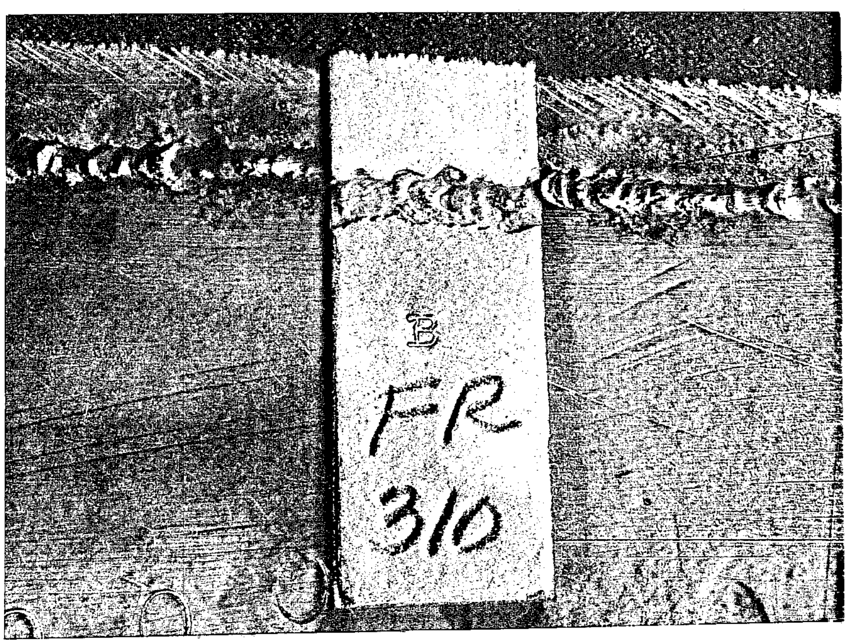


Figure 34

Weld sample - 310 type filler rod, lap weld

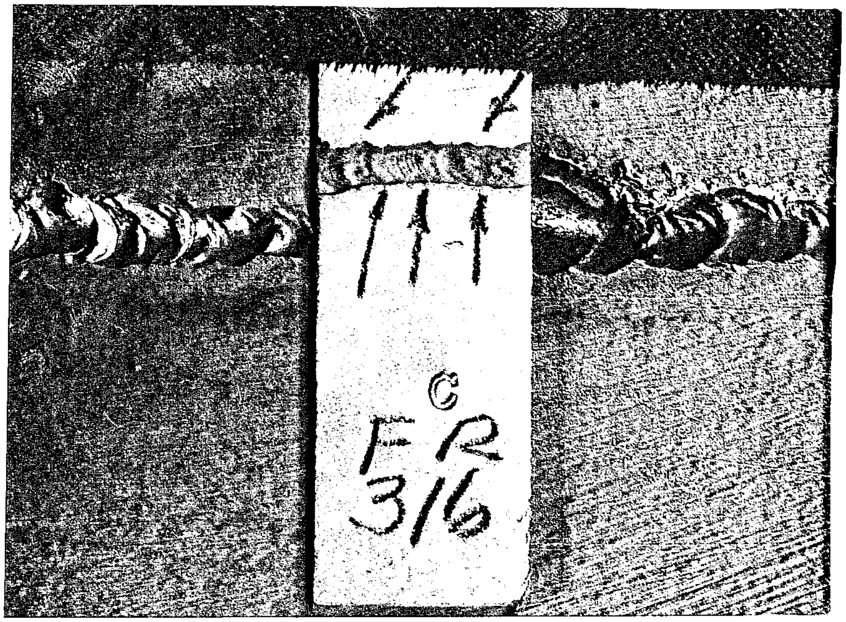


Figure 35

Weld sample - 316 type filler rod, lap weld

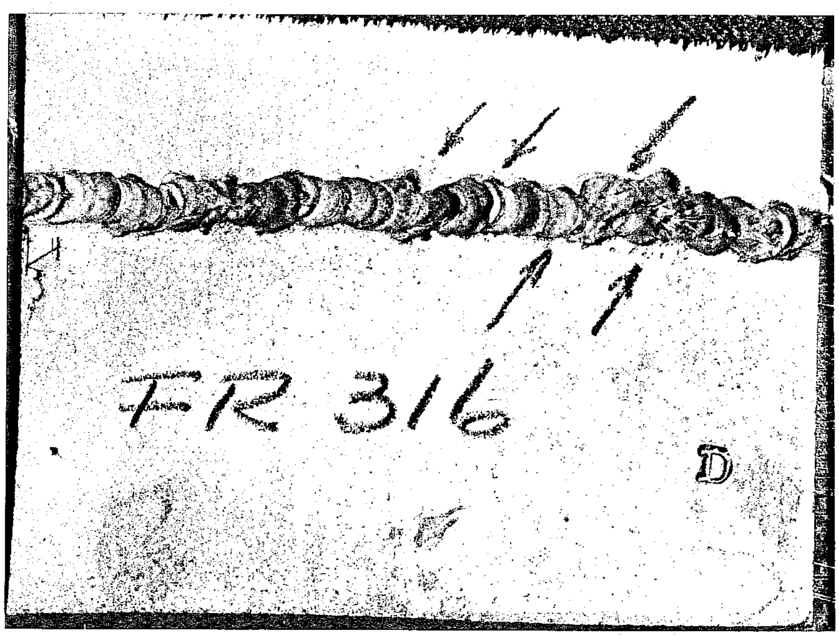


Figure 36

Weld sample - 316 type filler rod, butt weld

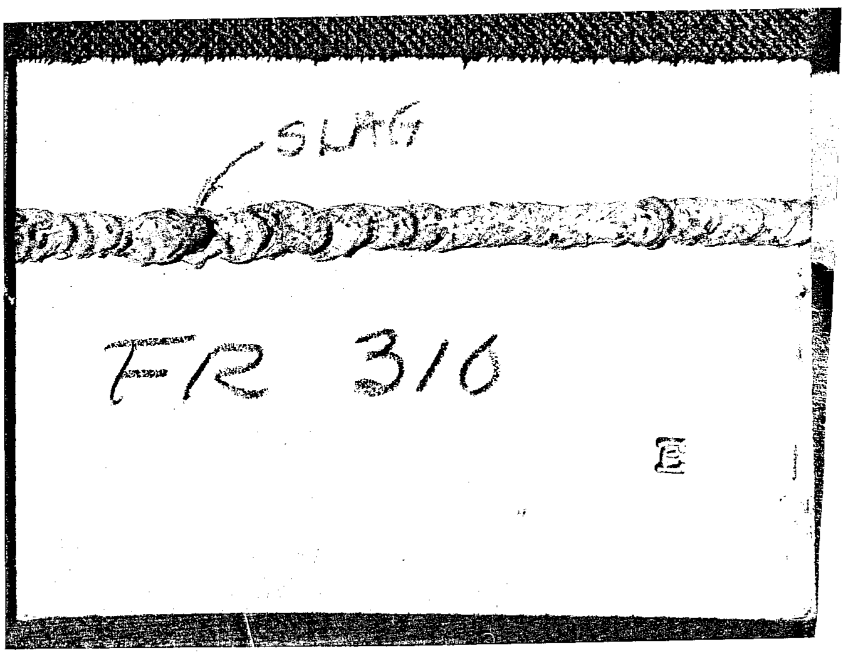


Figure 37

Weld sample - 310 type filler rod, butt weld

## GASKET

For the original prototypes fabricated during the development period, each gasket was cut from flat stock. The purpose of each gasket was to provide a seal until the box design was finalized. Six (6) handmade gaskets were purchased from Greene Rubber Company, Cambridge, Massachusetts in accordance with the original gasket drawing. These gaskets were used until the gasket mold was completed.

On February 5, 1953, [redacted] 25X1
submitted a cost estimate of $480.00 for a one cavity mold. On April 13, 1953, the Work Order was received from the Client and a purchase order was forwarded to [redacted] 25X1
Upon completion of the mold, a request by [redacted] 25X1
[redacted] was forwarded with the specifications to the Lubron Gasket 25X1
Company, Everett, Massachusetts for three sample gaskets. The samples were examined for dimensional compliance with the drawing and, in essence, a check on the mold. One gasket was given to the Client's Project Engineer who forwarded it to the Rock Island Arsenal to determine compliance to Grade RS400BFZ of Specification MIL-R-3065.

The results of test are as follows:

| Test | Sample | Specification |
|---|---|---|
| Polymer | Nitrile | Synthetic |
| Tensile, psi | 935 | |
| Elongation, % | 660 | |
| Hardness | 50 | 40 ± 5 |
| Compression Set, % | 19 | As low as possible |
| (1" length) | | |
| ASTM D1043, Stiffness | -20°F | |
| ASTM D746, Solenoid Brittleness | Failed -40°F | Pass -40°F |
| Ages 70 hours @ 150°F | | |
| Tensile | 915 | |
| Elongation | 460 | |
| Hardness | 60 | 40 ± 5 |

The sample did not meet the hardness or low temperature requirement.

On December 23, 1953, during a conference of all parties concerned, the decision was reached to fill in the existing corners and make the gasket slightly wider. On December 28, 1953, a telephone call from the Client resulted in the width being increased 1/8 inch. By January 5, 1954, these changes in the gasket mold had been incorporated. Figure 38 indicates the changes as outlined above.

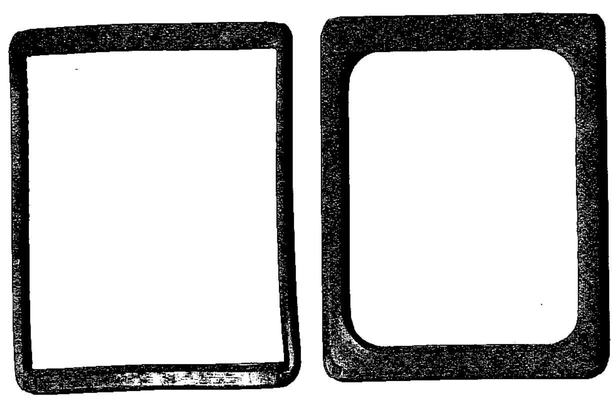

Figure 38-

Original and revised gaskets

The mold was then forwarded by [redacted] Company to the Tillotson Rubber Company, Needham, Massachusetts in order that several preliminary samples be made. Dimensions of the gasket were checked and approved. The fit in the cover of the box was very satisfactory and production of 120 gaskets was started. 25X1

The test report submitted by T. R. Weaver, Chief Chemist, Tillotson Rubber Company on the lot of gaskets was as follows:

| Material Specified | Material Used |
|---|---|
| MIL 3065<br>Class RS Grade 400 BFZ | Tillotson Rubber Co.<br>Compound #420<br>made from GRS |
| Durometer 40 ± 5 | 38 |
| Compression Set 25% max. | 23% |
| Low temperature - not brittle at -40°F | Below -50°F |

After aging 70 hours at 158°F

Must still pass above tests

Durometer 40

Compression Set 21%

Brittle Point Below -50°F

Additional Test Results

| | |
|---|---|
| Permanent Set | 15.5% |
| Tear Resistance | 625 lb./sq. in. |
| Tensile Strength | 1105 lb. /sq. in. |

During the fabrication operation it was necessary to place the gasket inside the retainer on the cover, in order to complete the gasket compression test. During the testing of the first sixty-six (66) units, one (1) gasket was rejected due to a crack at one corner. The next lot of eight (8) were forwarded to Somerville the afternoon of the completion of the gasket compression test. A visit was made to Somerville the next morning to observe the painting technique. A casual examination of these boxes indicated two faulty gaskets. A closer examination indicated slight cracking in four additional boxes. Examination of the sixty-six boxes already delivered here resulted in twenty-eight additional faulty gaskets.

A meeting was held here at which time [redacted] 25X1
[redacted] 25X1
of [redacted], and [redacted] 25X1
Inc., reviewed the series of events leading to the current situation. At this meeting on April 30, 1954, [redacted] Chief Chemist for 25X1
Tillotson Rubber Company expressed an opinion that the cracks were

due to either ozone cracking or elongation beyond the elastic limits of the gasket. A copy of Specification MIL-R-3065 indicated that Grade 400BFZ was the only material on the chart that did not specify the tensile strength and ultimate elongation. GRS type rubber is most liable to be affected by ozone. Six (6) defective gaskets were given to Mr. Weaver who planned extensive tests to pinpoint the failure. He felt that once the source of the difficulty was located, it could be easily remedied.

On May 6, 1954, three sample gaskets were forwarded to us and each installed in a box. No cracking was apparent after four days of testing. A purchase order was forwarded to Tillotson for 60 gaskets only, to cover an emergency request.

A report was submitted by [redacted] outlining his test 25X1
results as follows:

| Material Specified | Material Used |
|---|---|
| MIL 3065<br>Class RS Grade 400 BFZ | Tillotson Rubber Co.<br>Compound #256 made from<br>GRS + Natural |
| Durometer 40 ± 5 | Durometer 44 |
| Compression Set 25% Max. | 23.5% |
| Low temperature - not brittle at -40° F | Not brittle at -65°F |

<u>Additional Test Results</u>

| | |
|---|---|
| Permanent Set | 12.5% |
| Tear Resistance | 560 lb./sq. in. |
| Tensile Strength | 1230 lb./sq. in. |
| Elongation | 500% |

<u>After aging 60 hours at 158°F</u>

| | |
|---|---|
| Permanent Set | 9.4% |
| Tear Resistance | 475 lb./sq. in. |
| Tensile Strength | 1125 lb./sq. in. |
| Elongation | 360% |

NOTE: Test section of gasket clamped in 70% compression under 1/16 inch radius metal ring for seven days showed no evidence of cracking whatsoever.

Three boxes were checked each day for indications of cracking. Five weeks elapsed and no indications of cracking was apparent.

The gasket material in the tentative specification has not been finalized as yet. Tillotson Rubber Company and [redacted] 25X1
[redacted] felt that any final specification should include minimum 25X1
figures for tear resistance, tensile strength and ultimate elongation.

The original gaskets were made in accordance with Specification MIL 3065, Class RS, Grade 400BFZ and designed at Tillotson compound #420.

The revised gasket material now in use is made from the following formula and is designated as Tillotson compound #256.

| | |
|---|---|
| Natural rubber | 29.1% by weight |
| GRS | 29.1 |
| Carbon Black | 29.1 |
| Process Oil | 5.7 |
| Zinc Oxide | 2.9 |
| Sulfur | 1.43 |
| Anti-oxident | 1.15 |
| Accelerator and Activator | 1.52 |
| Total | 100.00% |

When contacted on tying in the above formula with a MIL specification, the following was reported by Tillotson:

"After studying Specification MIL 3056 we feel that about the best way to tie it down would be an addition to the Z portion of the specification. We might suggest a minimum tensile of 100 p. sec. and a minimum elongation of 400% but we don't consider these essential. We might also suggest that 50% by volume of the total elastomer content be natural rubber but here again it is possible that someone could make a satisfactory compound without doing this.

Under the Z section it now reads in effect that the properties must maintain original levels through 70 hours of over aging at 158°F. To this we would recommend adding a section:

"Test section of gasket clamped in 70% compression under a metal edge having a 1/16 inch radius for seven days at ambient temperature shall show no evidence of cracking."

Although the above information was helpful, it was decided to attempt to tie in the gasket material directly with the MIL specification. Tillotson was again contacted and they were unable to furnish the requested information, but suggested that a better way to approach the problem was to describe the test and let someone more familiar with the specification phrase it in the language suitable for a specification.

The following information was received in a letter from Tillotson:

"It is our feeling that the test we performed will insure the customer of an adequate compound. The only other alternative would seem to be placing our formula on the print of the part. We have done work where the compound was written out on the blueprint but it is our feeling that it is not as satisfactory a procedure since every company has its own approach to a compound for any given application. Also this makes changes or improvements difficult.

In actual practice we tested the gaskets as follows:

A section of a molded gasket about 1-1/2" long was cut out. This piece was then placed on a flat 1/4" metal place of approximately the same size as the piece of gasket. A piece of tubing 1" O. D. x 7/8" I. D. by 1" long which was then placed on top of the piece of gasket. The edge of the tube which rested on the gasket was rounded over to a 1/32" radius. The entire assembly was then placed in a "C" clamp which was tightened up until that portion of the gasket which was under the edge of the tube had been compressed 70% of its original thickness. It was left in this clamped condition for seven days. Gaskets which had failed in service cracked within 24 hours but no cracking at all was found on the latest compound #256 which we developed for the job. Various means of speeding up the cracking by heating and weathering were tried but it was found that the action took place at room temperature as fast as under special conditions. You will notice that we have compressed the gasket more than it is in actual practice to insure its proper function in the field."

Figure 39 is a sketch of test method used.

The Client's Project Engineer plans to forward information and sample gaskets to Rock Island Arsenal where the MIL specification was originated. It is hoped that this source can furnish the desired information.

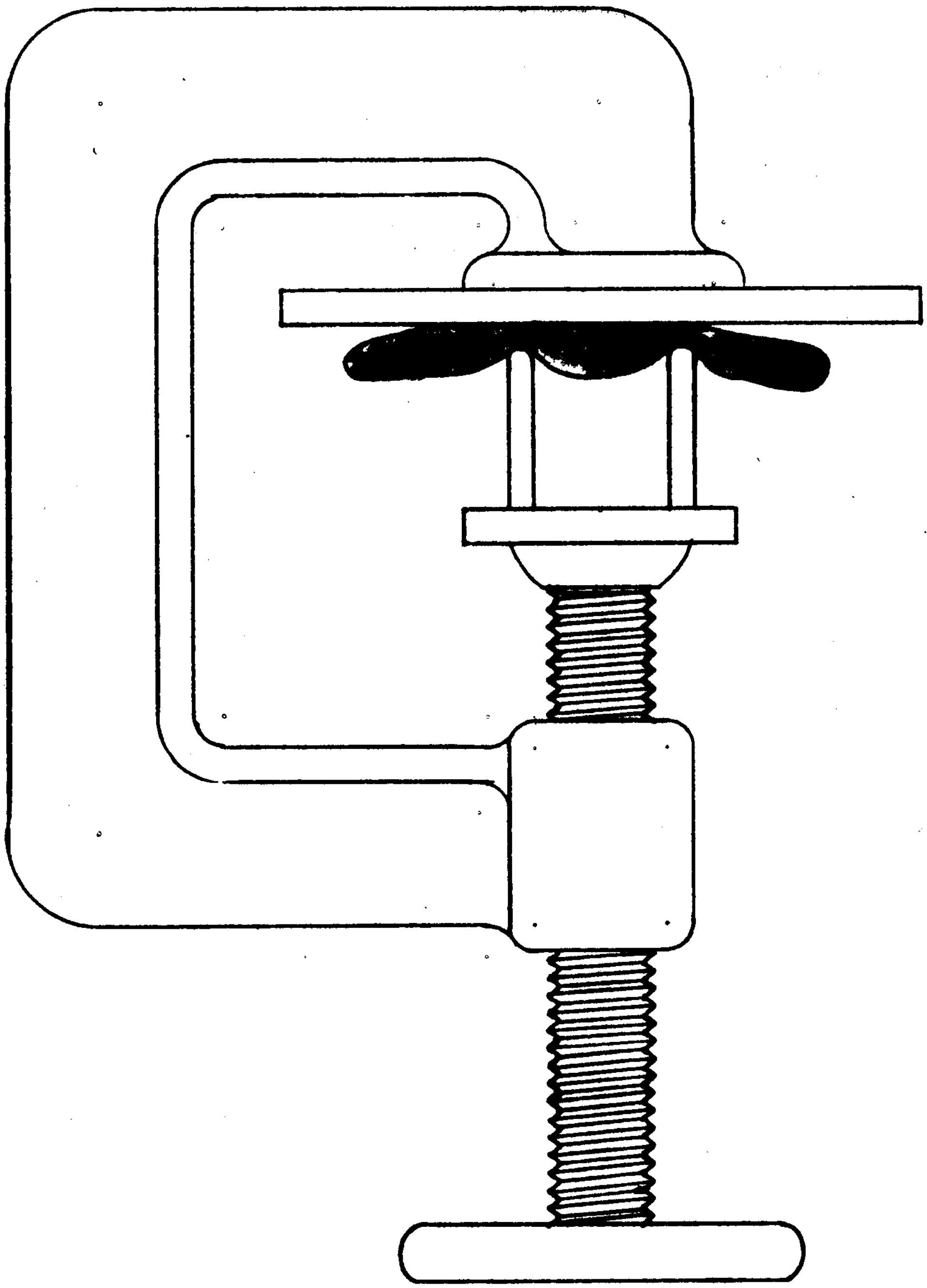

Figure 39

Testing method used by Tillotson Rubber Company

Figure 40 is the original mold used by Tillotson for the production of the 100 gaskets. Figure 41 is the two cavity mold used during the production of the gaskets for the 1000 lot.

During the initial lot, all gasket compression readings were taken by a vernier height gauge. This method was time consuming in that approximately 10 minutes per unit was required. A gasket compression jig was designed which reduced the time required to obtain the readings to approximately one minute. Figure 42 illustrates this jig. The gauge is a precision unit manufactured by the B. C. Ames Company, Waltham, Massachusetts and mounted on a piece of excess equipment no longer used on another project. The 0.290 inch difference has been built into the fixture at the bottom of the gauge spindle.

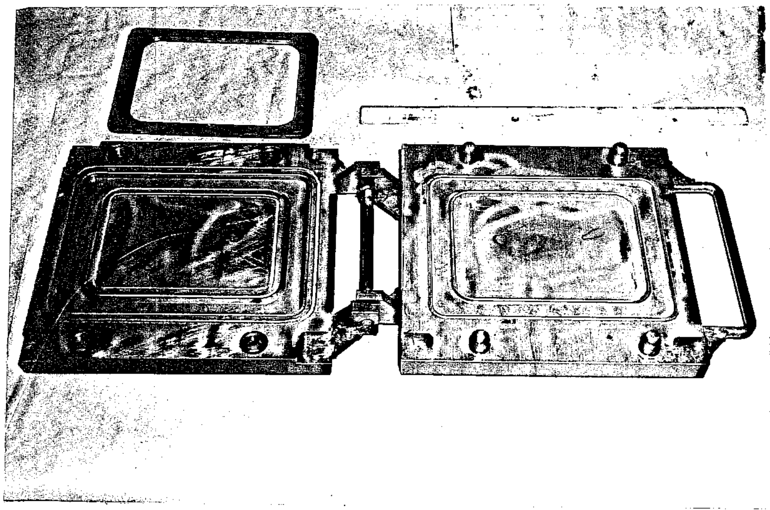

Figure 40

Original gasket mold

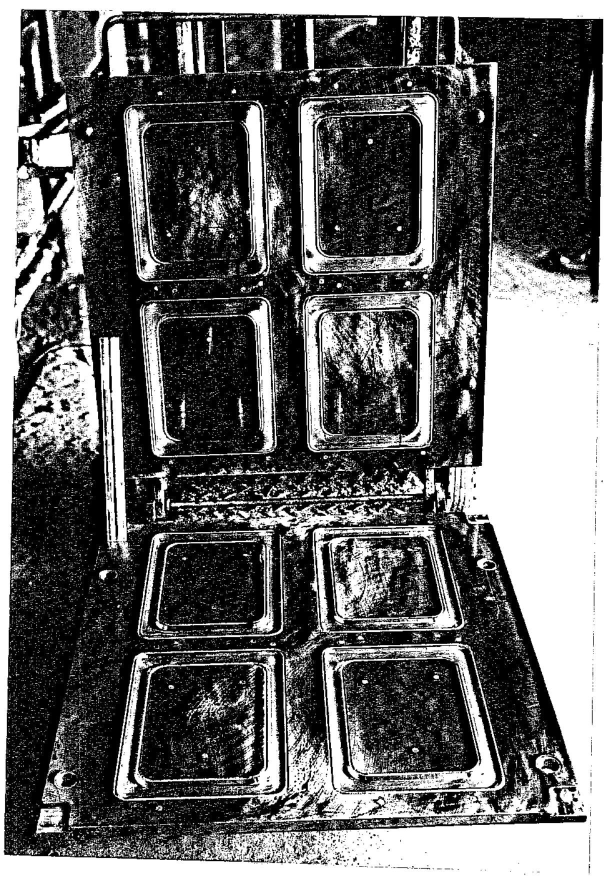

Figure 41

Two cavity gasket mold

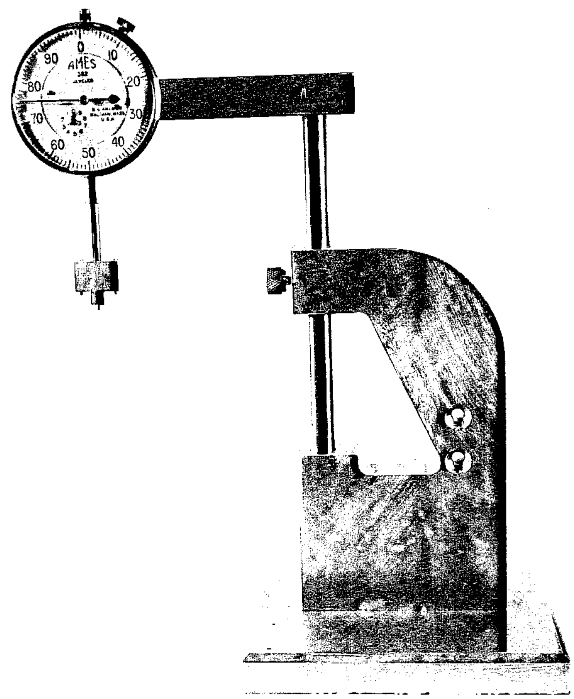


Figure 42

Gasket compression jig

## COATINGS

Since the gauge used in construction of the boxes was very light, a coating was to be applied to the box. The Client recommended that consideration be given to Veloform F-10 (Firestone Tire and Rubber Company), liquid neoprene (Gates Engineering Company) and flame sprayed polyethylene (Plax Corporation). These organizations were contacted during the latter part of December, 1952.

The Gates Engineering Company submitted several samples of neoprene. However, this coating was ruled out since the base metal (22 gauge) had to be sand blasted. This operation had to be performed to establish a rough surface, in that the rubber would not bond properly on a smooth surface. Additional difficulty would be encountered in the closure area of the box.

The letter to Firestone Tire and Rubber Company was directed to [redacted] However, no answer on the original letter or the follow- 25X1
up was ever received.

The letter sent to the Plax Corporation on flame spraying polyethylene was in turn forwarded by Plax Corporation to the De Bell and Richardson Company, Hazardville, Connecticut, who were not interested in this application.

In addition to the coatings recommended by the Client, information and samples were requested from the following organizations:

| | Company | Material |
|---|---|---|
| (1) | U. S. Rubber Company | Royal Guard |
| (2) | U. S. Stoneware Company | Tygon |
| (3) | New Chemical Production Company | NUKENITE 35 |
| (4) | Heresite Chemical Company | Parasite 500 |
| (5) | Norton Chemical Company | Durmite 316 |
| (6) | Industrial Metal Protection, Inc. | Zincilate |
| (7) | Pittsburgh Plate Glass Company | ML 27574 |
| (8) | Pyrene Manufacturing Company | Lube Lok |
| (9) | David E. Long Corporation | Delco |
| (10) | Alvin Products Company | Lab Metal |

On June 3, 1953, [redacted] 25X1
[redacted] at M. I. T. [redacted] is head of the Corrosion Department at 25X1
M. I. T. and the author of a recent handbook on Corrosion. He stated that to his knowledge very little research had been conducted on protective coatings for underground storage. It was his opinion that any attempt at an accelerated test would be of little value except to determine the quality of the application of the coating. [redacted] stated that type 25X1
316 stainless steel used underground was better off corrosion-wise without any coating than with any coating he knew. For this reason he suggested a cocoon type coating which could be peeled off before burying the container. Other suggestions were a vinyl type paint, a tar and paper wrap and cathodic protection.

On August 6, 1953, the test program on various coatings had been completed by [redacted]. Strips of 22 gauge stainless steel (including a welded section) were coated with paint in accordance with the manufacturer's instructions. All samples were the air-dry type coatings, suitable for brush or spray applications. The following types and brief description of each were prepared and examined: 25X1

(1) -S- Navy #TT-E-484: Standard Navy Vinyl, rapid drying, used with one coat of wash primer, supplied by the Client, bonded well.

(2) -S- Navy Vinyl Alkyd: Similar to the above coating, but recommended for the most severe corrosive conditions.

(3) -S- Delcoat Series "A" Vinyl Coating: Excellent bonding, tough finish, dried quickly, four or five coats required.

(4) -B- Prufcoat Series "A" Vinyl Coatings: one coat of primer, two top coats, bonded well.

(5) -B- Type VR-504, Air Dry Heresite Phenolic Coatings: bonded well, thick, tough coat, required a longer drying time than vinyl coatings, more expensive.

(6) -B- Zincilate or Galvicon: very similar coatings. Zincilate is, (one coat only), used by Army Ordnance bomb storage.

(7) -B- Tygon Type K: self-priming, bonded well, tough, not recommended for as highly corrosive conditions as vinyl paints.

(8) -B- Tygon Vinyl Process: very poor bond, primer stripped off.

(9) -B- Tygon Transparent Coating: stripped from metal.

(10) -S- Tuffy Paint: Similar to the vinyl paints, did not bond as well.

(11) -S- Eastern Lacquer Company Vinyl: bonded fair, not abrasive resistant.

(12) -S- Gates Engineering Company: Bonded well, abrasive resistant, one (1) coat primer (N-100-1) and three (3) coats of N-700. The "-S-" indicates spray and the "-B-", brush as a recommended means of application.

A meeting with the Client's Project Engineer was held and it was decided that ninety (90) of the initial lot would be coated with the navy Vinyl Alkyd material and that the remaining ten (10) units would be painted with other coatings from the above list. These units are to be buried and examined at a later date which would be specified.

On October 14, 1953, information was received from the Client that a wash primer was to be used in conjunction with the Navy paint. The wash primer will comply with Specification MIL-P-15328 (Ships). The Navy paint was forwarded by the Client and transmitted to Technology by us.

## DISPOSITION OF UNITS

| | In | Out | On Hand |
|---|---|---|---|
| Semi-production units | 5 | | |
| Client | | 1 | |
| Test Standard | | 1 | |
| Expended | | 3 | |
| | 5 | 5 | |
| Production Units | 100 | | |
| On Hand | | | 1 |
| Shipments | | 73 | |
| Client | | 10 | |
| Expended | | 3 | |
| Testing | | 12* | |
| | 100 | 98 | 1 |

*Available for test purposes but not suitable for shipment.

## BURIAL PROGRAM

The initial burial program was to bury boxes painted with Navy Vinyl Alkyd paint and such other paints specified by both [redacted], and the Client. These units were 25X1 to be buried in sand, loam, day, cinders, swampy location and sunk in water.

During May, 1954, the scope of this program was enlarged to include other types of containers and methods of packaging. This change was due to the scarcity of SS Boxes caused by the enlarged requirements of the Client.

Two types of wood boxes were to be used; i.e., ~~wood~~ PINE and cypress. The boxes were delivered to the Area in September, 1954 in the knocked-down condition. The items to be packaged inside the boxes were also forwarded to this location. The wood boxes were assembled and packaged under the direction of the Client.

Figure 43 indicates the general arrangement of a one unit burial pack, while figure 44 indicates the layout of a double unit pack. Figure 45 illustrates the method used to secure the various boxes for the submergence program.

These "burial kits" were buried in the following locations:

Figure 43

One unit burial pack

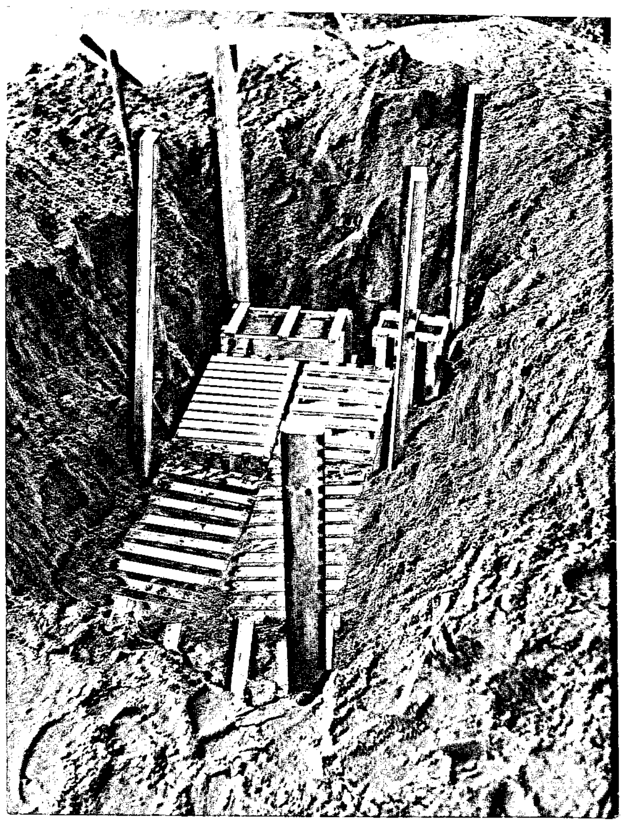

Figure 44

Double unit burial pack

(1) One unit in clay (figure 46). The location of this area is to the right of the road leading into Demolition Area #1 and is marked by a figure 1 on the map of the Reservation.

(2) Two units in a swampy area (figure 47). These units were buried at the edge of a cranberry bog along the patrol road near building T-432 and marked on the map by a figure 2.

(3) Two units in sand (figure 48). These units were buried across the road from Igloo 322 and is shown on the map by a figure 3.

(4) Two sets in a well drained loamy area (figure 49). These units are located in a loam mound near the concrete slab on the north side of track "E" and is marked on the map by a figure 4.

(5) One set in wet loam (figure 50). This set is buried across the road from building T-451 and is marked on the map by a figure 5.

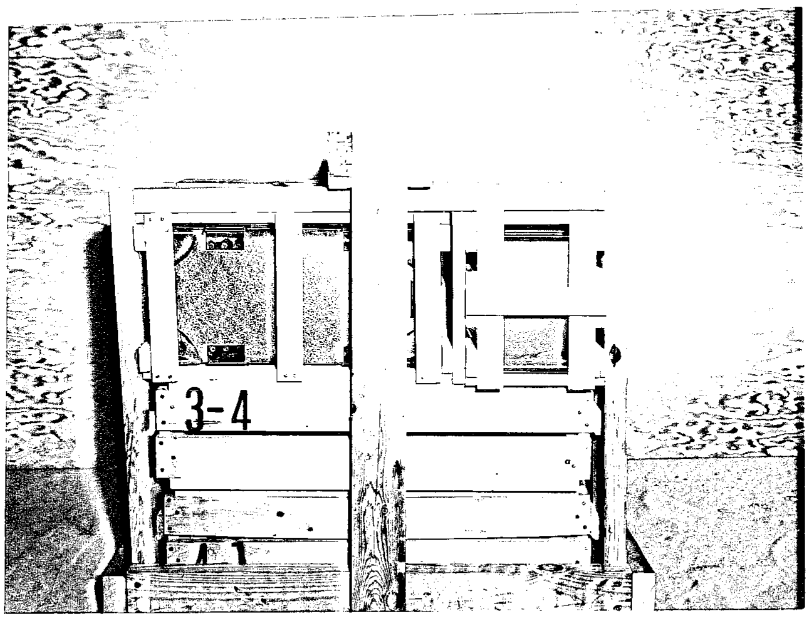


Figure 45 -

Units packed for submergence

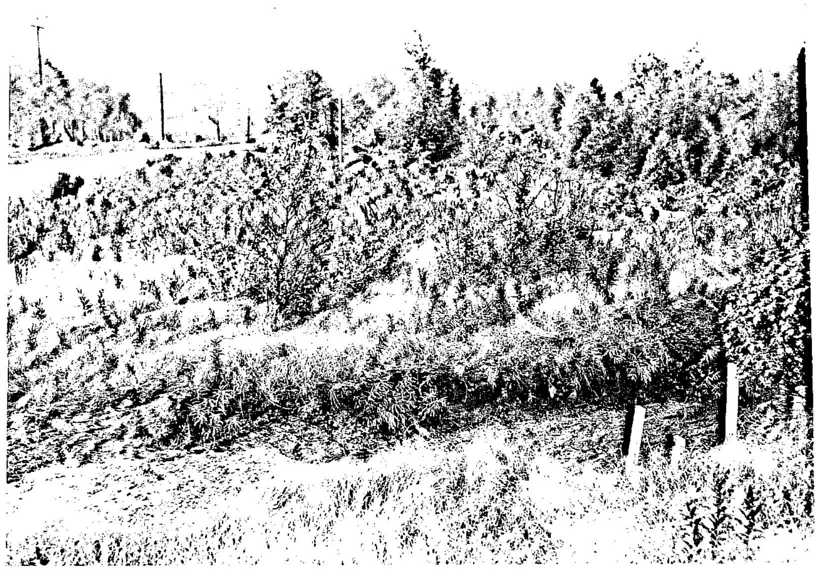

Figure 46

Pack buried in clay

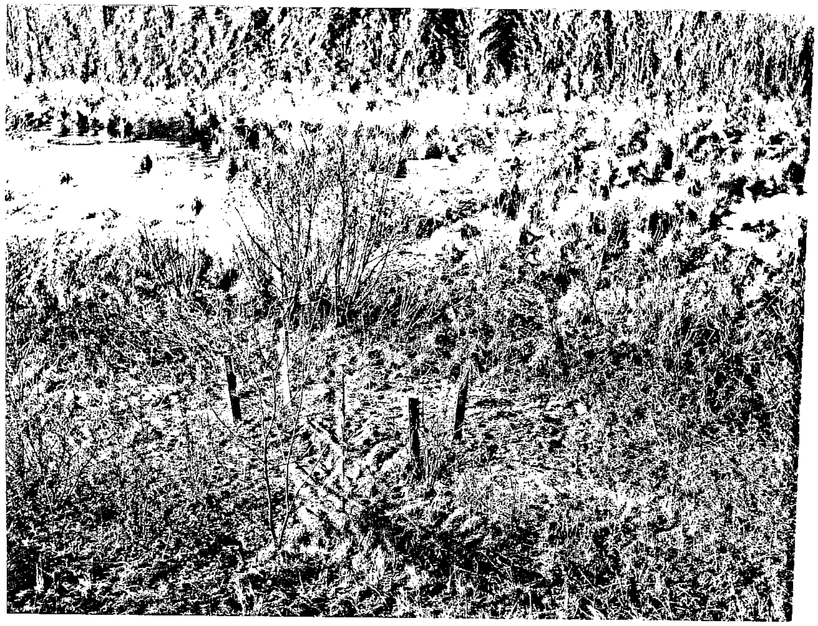

Figure 47

Pack buried in swamp

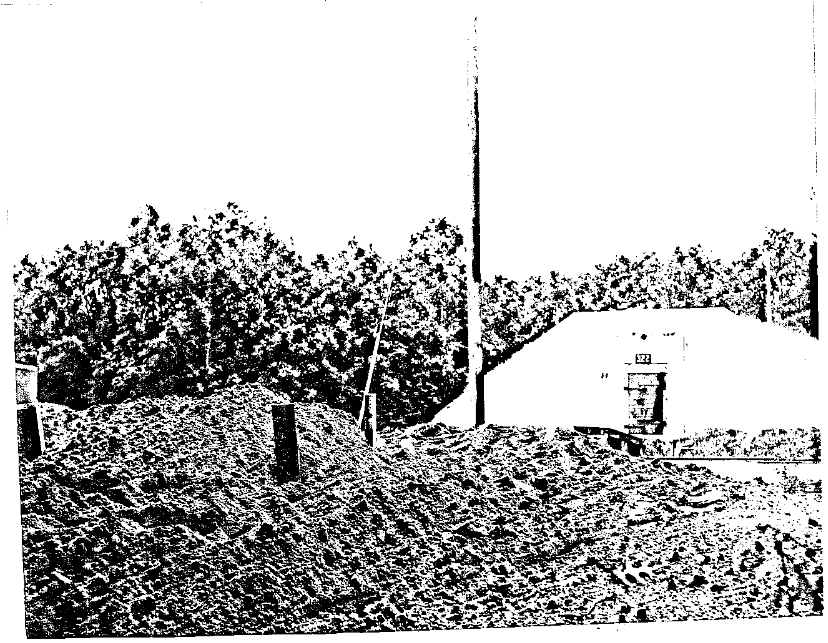

Figure 48

Pack buried in sand

Figure 49

Pack buried in dry loam

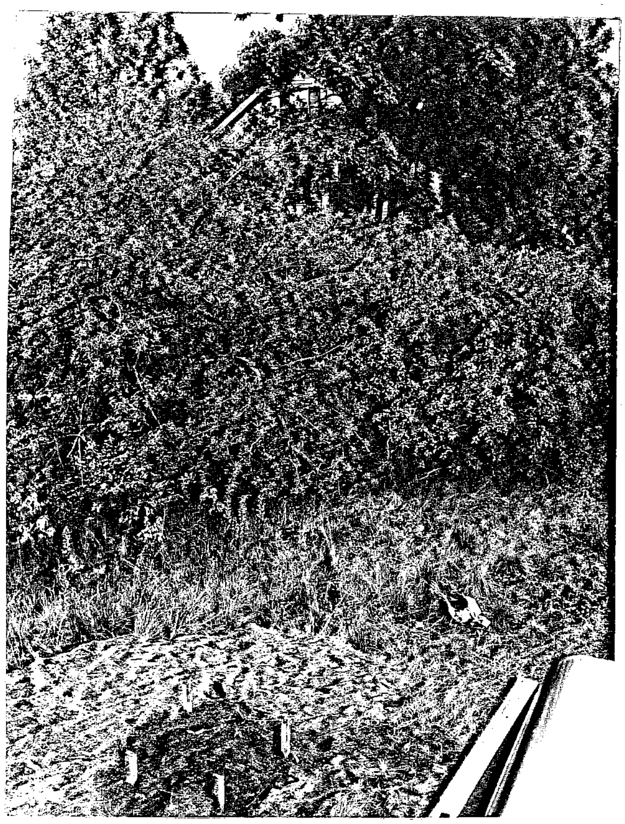

Figure 50

Pack buried in wet loam

(6) One set was submerged in Puffer Pond off shore from the old log cabin. This set is marked on the map by a figure 6.

(7) One set in running water. This set is under the culvert on the patrol road relatively close to building T-418. The location is marked on the area map by a figure 7.

The map of the area indicating the burial locations is located in Appendix F.

Samples of soil from each location were taken and forwarded to the University of Massachusetts Field Station, Waltham, Massachusetts.
The analyses were conducted by [redacted] of the Field Station staff 25X1
and followed the procedures outlined by [redacted] of the University of 25X1
Connecticut. The results are as follows:

## SOIL TEST

Waltham Field Station, University of Massachusetts

VL - very low    L - low    M - medium    H - high

VH - very high    EH - extra high

1 ton per acre - 50 lb per 1000 sq ft or 5 lb per 100 sq ft
Ph 7.0 - neutral    pH 6.0 - slightly acid    pH 5.0 - acid

| Soil | pH Acidity | Nitrogen Nitrate | Nitrogen Ammonia | Phos-phorus | Potash | Calcium | Alumi-num | Soluble Salts |
|---|---|---|---|---|---|---|---|---|
| Sand | 5.0 | VL | L | L | VL | VL | M | 0 |
| Dry Loam | 5.5 | VL | L | L | VL | VL | MH | 10 |
| Wet Loam | 5.0 | VL | L | ML | VL | VL | H | 0 |
| Clay | 6.0 | VL | L | ML | VL | VL | H | 0 |
| Swamp | 5.2 | VL | L | L | VL | VL | H | 0 |
| Pond | 6.1 | VL | L | M | VL | VL | L | 0 |
| Creek | 6.8 | VL | L | M | VL | VL | L | 0 |

Method of Packaging for Shipment

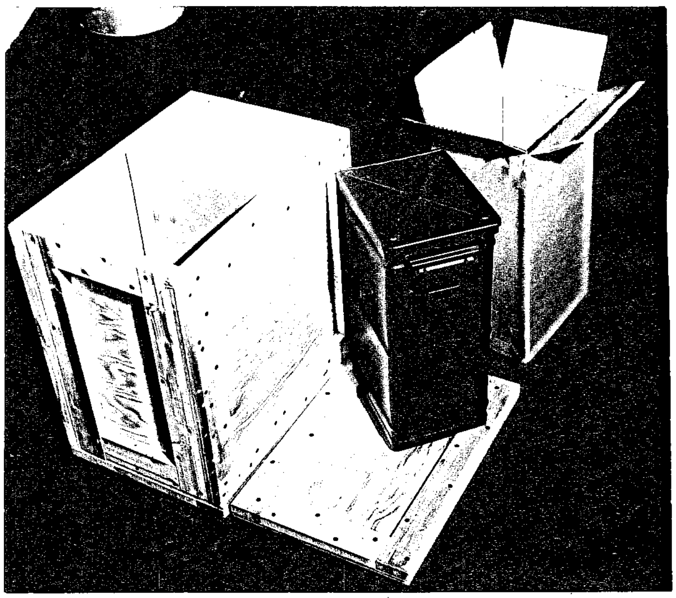

Figure 51

Components of gross package, including two (2) stainless steel boxes, two (2) double-face corrugated liners one (1) JAN-P-105A Style plywood box with top. The steel strapping is not shown.

The outer box is as follows:

Spec: JAN-P-105A, Style A.

Mat'l: 3/8" plyscore and 3/4" soft pine.

Size: 16-1/2" x 10-5/8" x 18-3/8" inside dimensions.

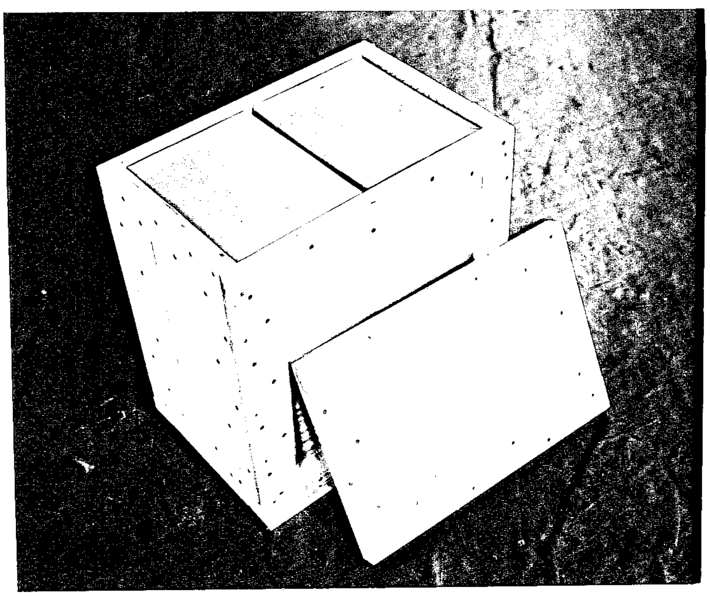

Figure 52

Components of box inserted and box ready for closure.

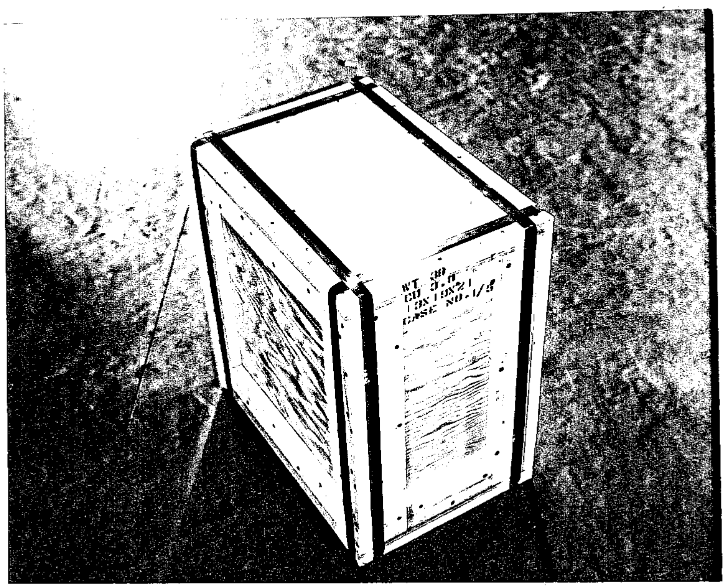

Figure 53

Completed box, closed and strapped with 3/4" steel. Gross weight is 38 lbs., gross cube is 3.0 ft.

## RECOMMENDATIONS

In view of the varied soil conditions to be met in the field, the following pilot lots are recommended for fabrication:

(1) 10 - 20 units of 347 type stainless steel

(2) 10 - 20 units of 316 ELC type stainless steel

(3) 10 - 20 units of 304 ELC type stainless steel

(4) 10 - 20 units of 304 type stainless steel

The above units can be fabricated from existing tools, dies, fixtures, etc. Any difficulty in fabrication can be indicated prior to production. These units can also be subjected to a severe test program and evaluated.

If for any reason 316 stainless may not be available, the problems of the above materials will be known. In addition, the limitations of boxes made from the above types can be determined and selection of another type stainless can be based on facts if type 316 is not available.

## ACKNOWLEDGMENT

The Project Engineer wishes to express his thanks and appreciation to [redacted], for the design of the 25X1 "bridge" which greatly expedited the test program; [redacted], 25X1 [redacted] Research Division, Armco Steel Corporation for his 25X1 help in providing excellent background material on welding; to [redacted] for his able assistance during the production 25X1 and test phases of the program; and to [redacted] 25X1 [redacted], for his assistance and cooperation 25X1 during the design and production of the boxes even though he did not approve all the changes requested and incorporated in the design.

APPENDIX A

Dies made by [redacted] 25X1

Brockton, Massachusetts and used in forming parts of box.

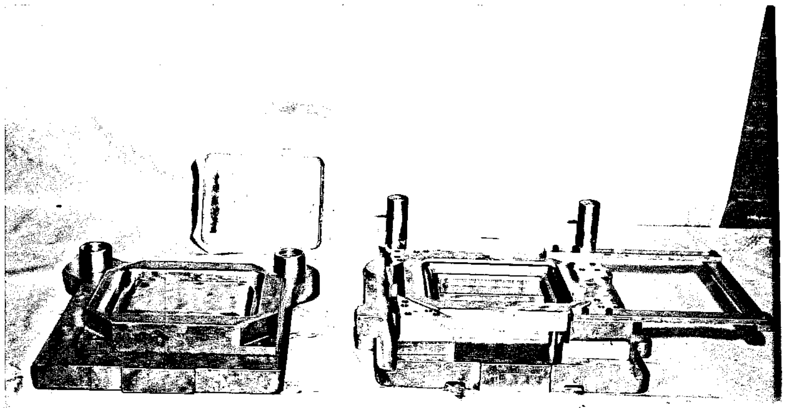

Figure 54

Bottom blanking and first draw dies

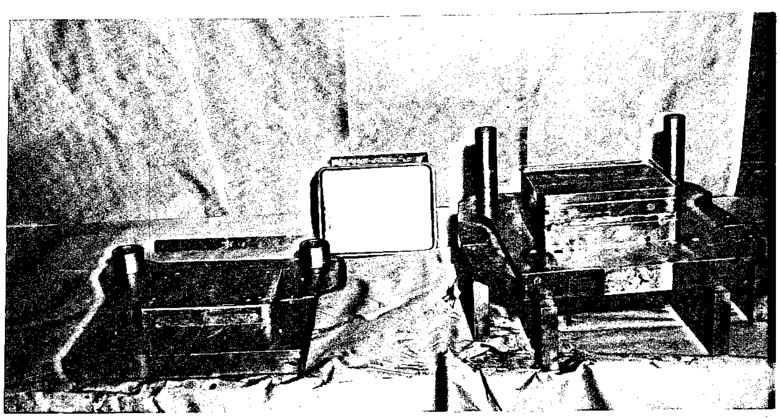

Figure 55

Finish draw for bottom

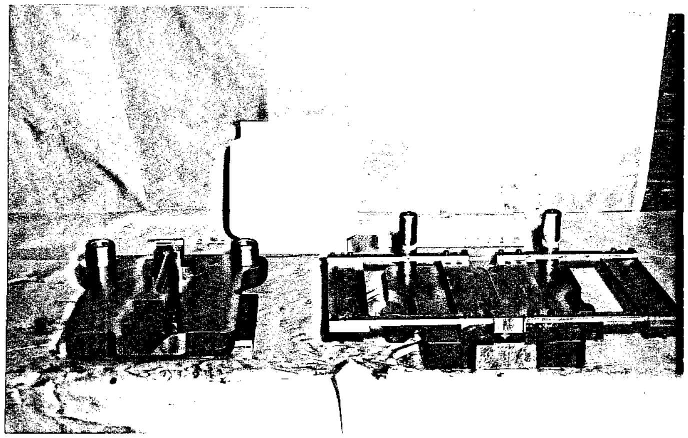

Figure 56

Blanking die for cover

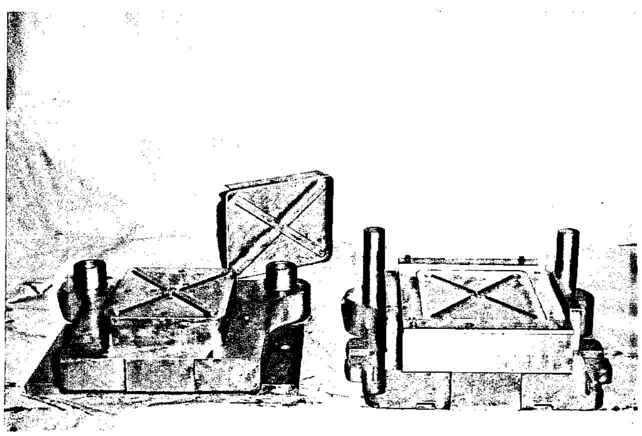

Figure 57

Drawing die for cover

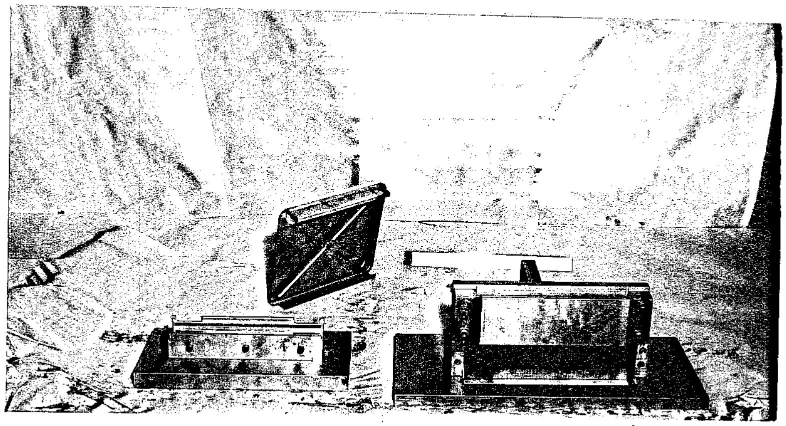

Figure 58

Forming die for sides of cover

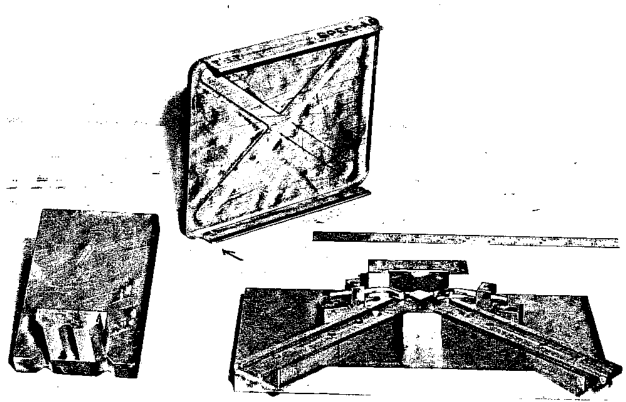

Figure 59

Trimming die for corners of cover

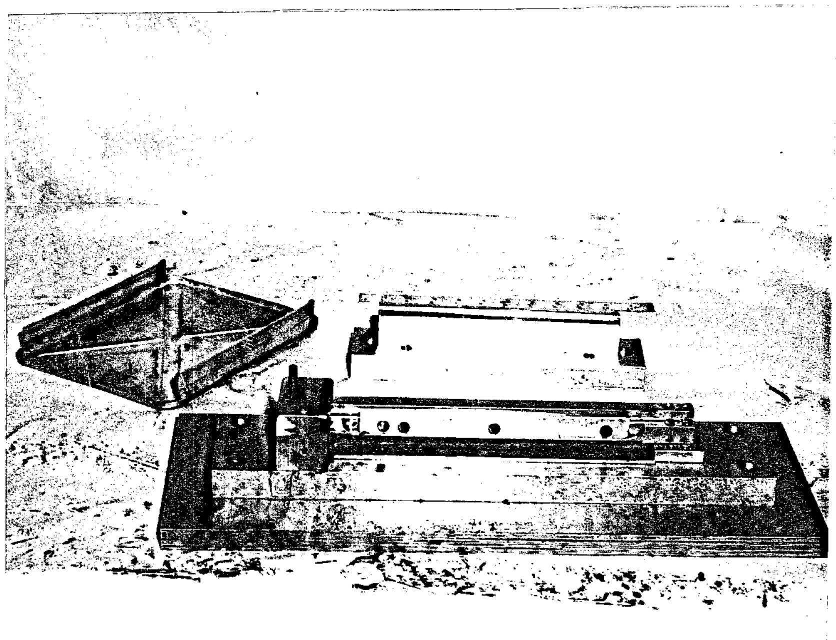

Figure 60

Folding die for cover

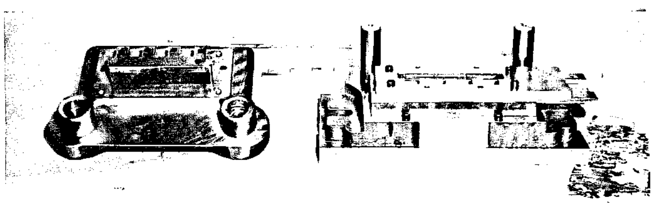

Figure 61

Blanking die for body hinge

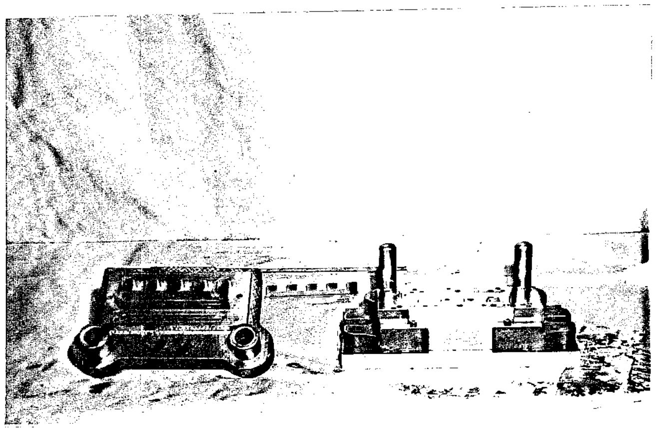

Figure 62

Blanking die for hinge

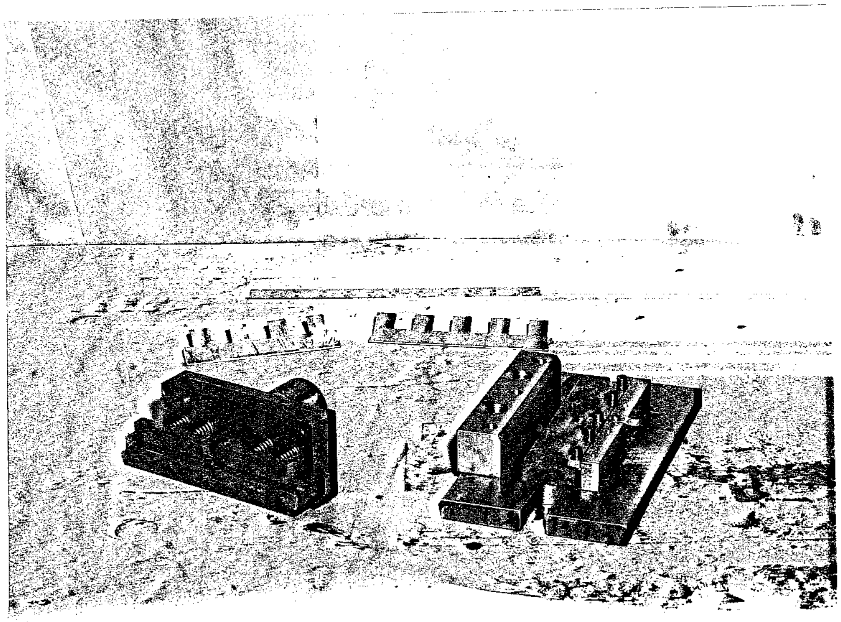

Figure 63

Precurling die for hinge

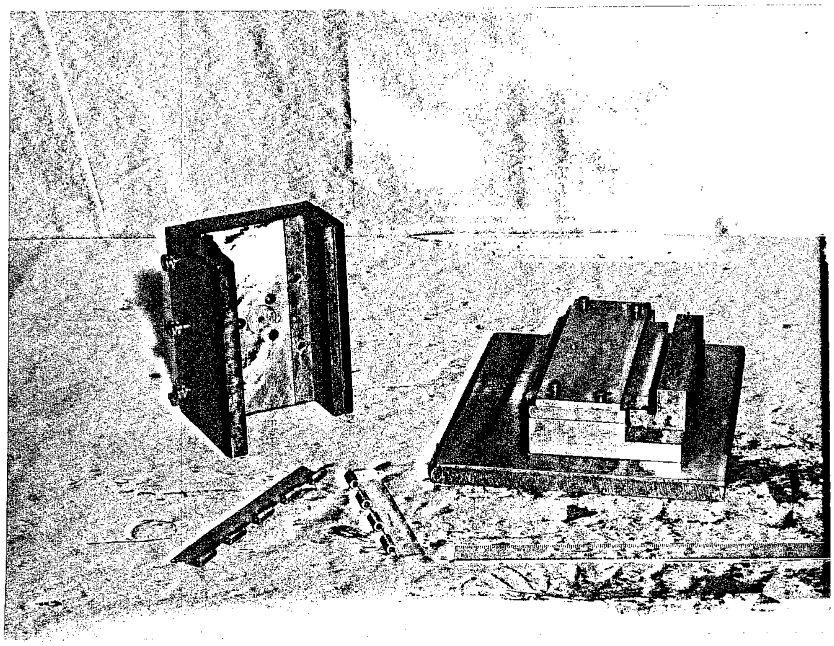

Figure 64

Curling die for hinge

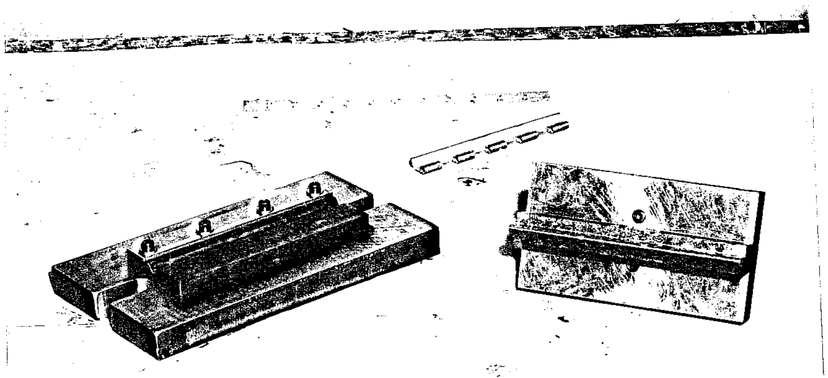

Figure 65

Right angle die for cover hinge

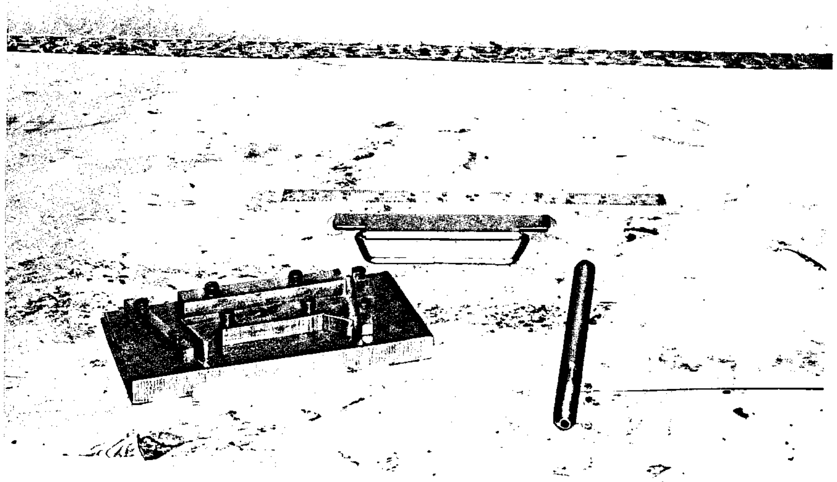

Figure 66

Binding fixture for link

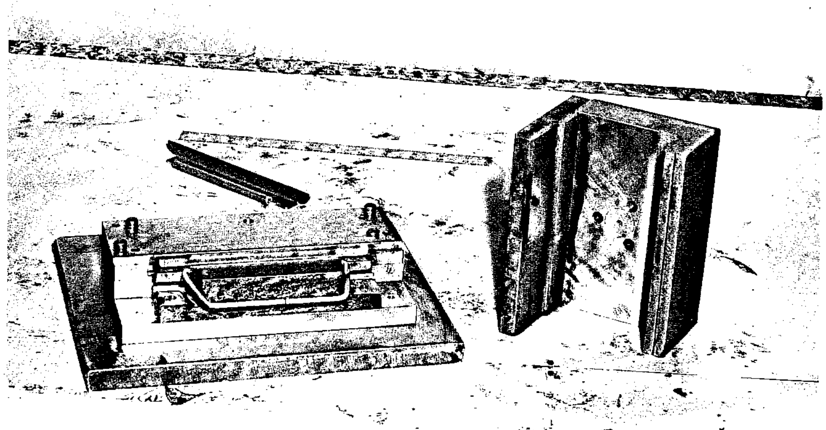

Figure 67

Curling die for retainer, latch link

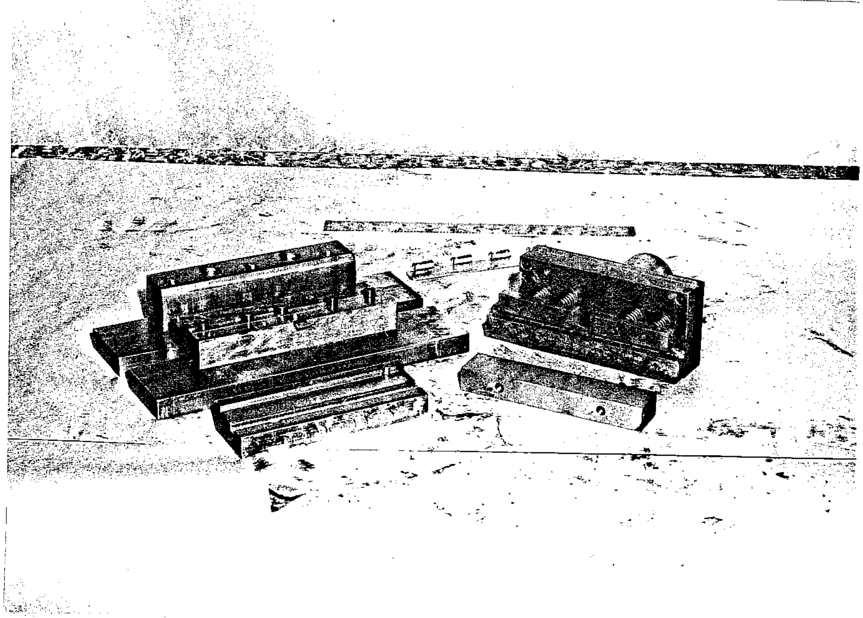

Figure 68

Precurling die for retainer, latch link, also interchangeable part for offset for body hinge.

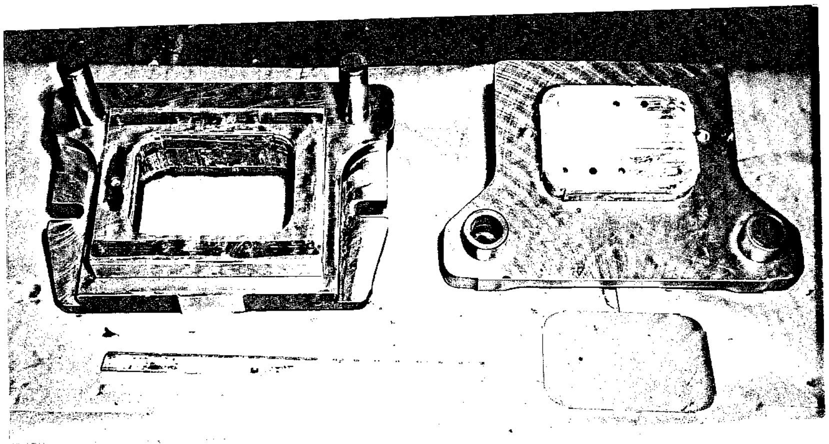

Figure 69

Gasket Retainer Blanking Die

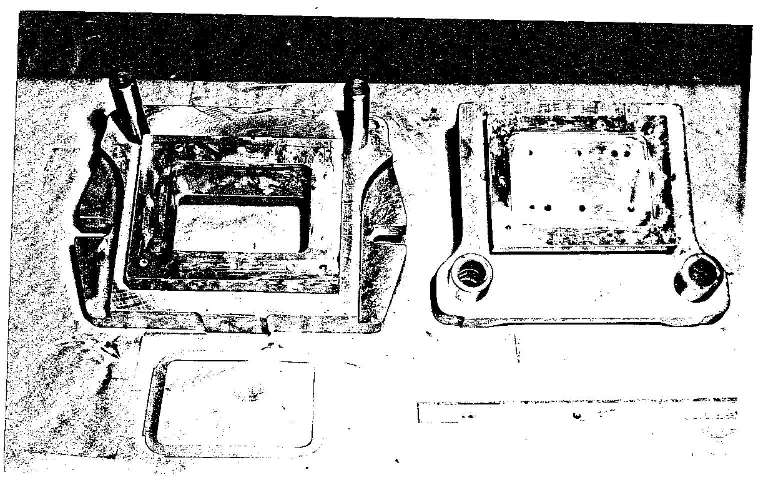

Figure 70

Hole Blanking Die for Gasket Retainer

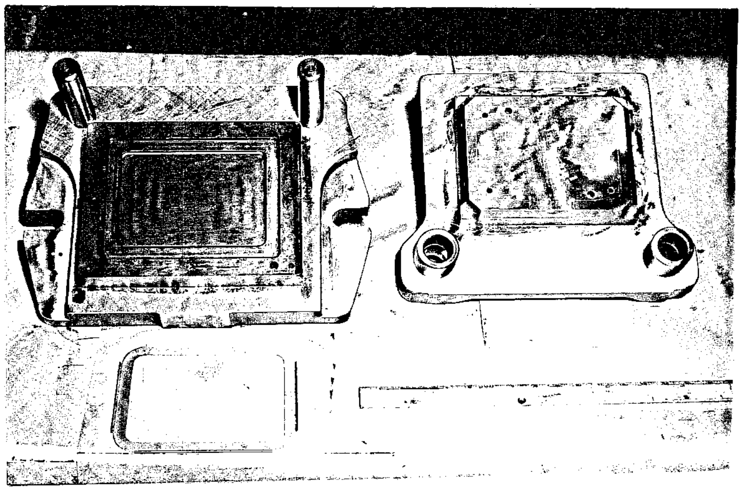

Figure 71

Forming Die for Gasket Retainer

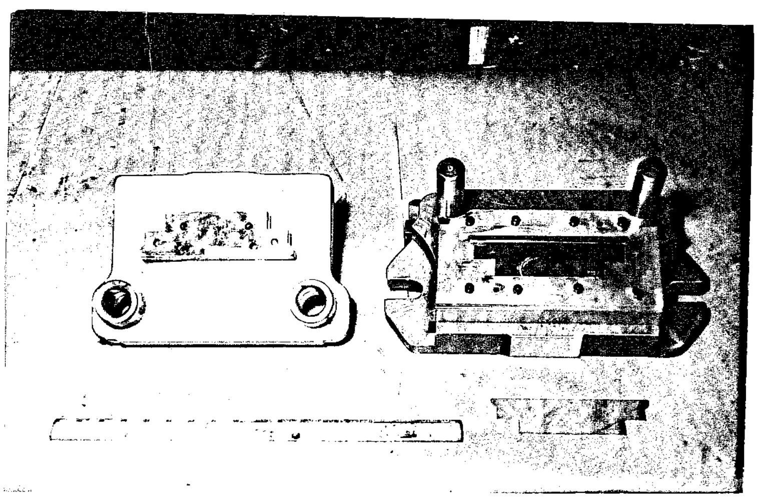

Figure 72

Blanking Die for Retainer, Latch Link

# APPENDIX B

Soil Corrosion Tests

Conducted by

U. S. Bureau of Standards

AND A HIGH ALLOY CAST IRON EXPOSED TO SOIL CORROSION TESTS CONDUCTED BY U. S. BUREAU OF STANDARDS - K. H. Logan



| Soil No. | Soil Type & Location | Soil Properties Composition of Water Extract - Mg Equivalent per 100 g of Soil | | | | | | | Moisture Equiv. in % | Aeration of Soil[1] | Total Acidity Mg Equiv. per 100 g of Soil |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ~~As Na~~ Na K | Ca | Mg | $CO_3$ | $HCO_3$ | Cl | $SO_4$ | | | |
| 51 | Acadia Clay Spindle Top, Texas | 10.27 | 15.55 | 5.03 | 0 | .56 | 5.75 | 22.0 | 47.1 | P | 13.2 |
| 53 | Cecil Clay Loam Atlanta, Georgia | | | | | | | | 33.7 | G | 9.6 |
| 55 | Hagertown Loam Baltimore, Md. | | | | | | | | 32 | G | 10.9 |
| 56 | Lake Charles Clay El Vista, Texas | 3.12 | .69 | .47 | 0 | .8 | 1.59 | 3.04 | 28.7 | P | 4.5 |
| 57 | Merced Clay Adobe Tranquillity, Calif. | | | | | | | | 40.9 | P | A[(4)] |
| 58 | Muck New Orleans, La. | 2.03 | 2.23 | 1.29 | 0 | 0 | .47 | 2.54 | 57.8 | VP | 79.3 |
| 59 | Carlisle Muck Kalamazoo, Mich. | 1.03 | 3.08 | 2.70 | 0 | 0 | 3.47 | 1.04 | 43.6 | VP | 33.3 |
| 60 | Rifle Peat New Orleans, La. | 2.91 | 10.95 | 2.86 | 0 | 0 | 0 | 56.7 | 43.4 | VP | 297.4 |

| Soil No. | Soil Type & Location | Soil Properties: Composition of Water Extract - Mg Equivalent per 100 g of Soil | | | | | | | Moisture Equiv. in % | Aeration of Soil[1] | Total Acidity Mg Equiv. per 100 g of Soil |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | As Na Na K | Ca | Mg | $CO_3$ | $HCO_3$ | Cl | $SO_4$ | | | |
| 61 | Sharkey Clay New Orleans, La. | .73 | .68 | .33 | 0 | .71 | .1 | .91 | 30.8 | P | 8.6 |
| 62 | Susquehanna Clay Meridian, Miss. | | | | | | | | 34.6 | F | 24.2 |
| 63 | Tidal Marsh Charleston, S.C. | 33.6 | 6.85 | 4. | 0 | 0 | 12.7 | 36.6 | 46.7 | VP | 100.2 |
| 64 | Docas Clay Cholame, Calif. | 28.1 | 2.29 | .76 | 0 | .89 | 28.8 | .26 | 41.1 | P | A |
| 65 | Chini Silt Loam Wilmington, Calif. | 7.65 | 12.4 | 2.2 | 0 | 1.3 | 6.05 | 16.9 | 26.4 | F | A |
| 66 | Mohave Fine Gravelly Loam Phoenix, Arizona | 6.55 | .51 | .18 | 0 | .73 | 2.77 | 2.97 | 16.5 | G | A |
| 67 | Cinders Milwaukee, Wisc. | .77 | 3.03 | .53 | 0 | .55 | .08 | 2.89 | 11.1 | VP | A |
| 69 | Houghton Muck Kalamazoo, Mich. | | | | | | | | | VP | |
| 70 | Merced Silt Loam Buttonwillow, Calif. | 8.38 | .38 | .22 | 0.2 | 1.87 | 1.12 | 5.57 | 24.7 | F | A |

Notes: 1. Symbols for aeration of soils: G - good; F - fair; P - poor; VP - very poor.



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Notes: (Continued)

2. Pitting is measured in mils. The symbols are:

   M - Shallow metal attack, roughening of surface, but no definite pitting.
   P - Definite pitting, but no pits greater than 6 mils.
   U - Apparently unaffected by corrosion.
   \+ - One or more specimens contained holes because of corrosion, rendering the computation of the exact penetration impossible. The thickness of the specimen has been used as the maximum pit in this case.

3. Figures for the corrosion rates are expressed in milligrams per square decimeter per day. Calculations for these weight losses were made from ounces lost per square foot per test period. All the specimens were exposed for a period of 9 years except the following:

   (a) All 20 Cr-22 El, 18 Cr-11, Ni steels - 2 years.
   (b) 18 Cr steel in soils Nos. 51, 53 and 56 - 2 years.
   (c) 18 Cr steel in soil No. 58 - 4 years.
   (d) 18 Cr steel in soil Nos. 57 and 64 - 5 years.
   (e) 18 Cr-8 Ni steel in soil No. 63 - 5 years.
   (f) 17.2 Cr, 8.95 Ni, .44 Mn steel in soils Nos. 51 and 63 - 7 years.

4. Alkaline soils are expressed as A.

| | Stainless Steel Plate 17.2 Cr, 8.95 Ni, 0.44 Mn | | Stainless Steel Plate 11.95 Cr, 0.48 Ni, 0.38 Mn | | Stainless Steel Plate 17.08 Cr, 0.09 Ni, 0.36 Mn | |
|---|---|---|---|---|---|---|
| Soil No. | Pitting(2) mil | Corrosion Rate(3) mdd | Pitting mil | Corrosion Rate mdd | Pitting mil | Corrosion Rate mdd |
| 51 | 10 | .0047 | | | | |
| 53 | U | .0008 | | | | |
| 55 | | | M | .0004 | U | .0016 |
| 56 | 25+ | .0976 | | | | |
| 57 | | | | | | |
| 58 | U | .0008 | | | | |
| 59 | M | .0016 | P | .0007 | P | .0016 |
| 60 | M | .0008 | P | .0016 | P | .1328 |
| 61 | P | .0016 | | | | |
| 62 | M | .0008 | | | | |
| 63 | P | .0025 | | | | |
| 64 | 14+ | .0709 | P | 2.82 | 63+ | .9952 |

| | Stainless Steel Plate 17.2 Cr, 8.95 Ni, 0.44 Mn | | Stainless Steel Plate 11.95 Cr, 0.48 Ni, 0.38 Mn | | Stainless Steel Plate 17.08 Cr, 0.09 Ni, 0.36 Mn | |
|---|---|---|---|---|---|---|
| Soil No. | Pitting[2] mil | Corrosion Rate[3] mdd | Pitting mil | Corrosion Rate mdd | Pitting mil | Corrosion Rate mdd |
| 65 | P | .0016 | 53+ | .0352 | 43+ | .2128 |
| 66 | 14+ | .2216 | 55+ | .5190 | 63+ | .6216 |
| 67 | P | .0016 | | | | |
| 69 | | | | | | |
| 70 | | | | | | |

| Soil No. | Stainless Steel Plate 18.69 Cr, 9.18 Ni, 0.36 Mn — Pitting mil | Corrosion Rate mdd | Stainless Steel Plate 22.68 Cr, 12.94 Ni, 1.50 Mn — Pitting mil | Corrosion Rate mdd | Stainless Steel Plate 17.72 Cr, 9.44 Mn — Pitting mil | Corrosion Rate mdd |
|---|---|---|---|---|---|---|
| 51 | | | | | | |
| 53 | | | | | | |
| 55 | P | .0005 | P | .0016 | | |
| 56 | | | | | | |
| 57 | | | | | | |
| 58 | | | | | | |
| 59 | P | .0006 | P | .0016 | | |
| 60 | P | .0008 | P | .0024 | | |
| 61 | | | | | | |
| 62 | | | | | | |
| 63 | | | | | | |
| 64 | P | .0023 | P | .0055 | 63+ | .4264 |
| 65 | P | .0016 | P | .0016 | | |
| 66 | M | .0005 | 14+ | 1.066 | | |
| 67 | | | | | | |
| 69 | | | | | | |
| 70 | | | | | | |

| | 17.76 Cr, 3.83 Ni, 6.09 Mn | | 18 Cr | | 18 Cr | |
|---|---|---|---|---|---|---|
| Soil No. | Pitting mil | Corrosion Rate mdd | Pitting mil | Corrosion Rate mdd | Pitting mil | Corrosion Rate mdd |
| 51 | | | | | 70 | 11.2 |
| 53 | | | | | 70 | .1800 |
| 55 | | | | | | |
| 56 | | | | | 57 | 16.0 |
| 57 | | | 10 | .0088 | | |
| 58 | | | | | 42 | .9600 |
| 59 | | | | | | |
| 60 | | | | | | |
| 61 | | | | | | |
| 62 | | | 6 | .0104 | | |
| 63 | | | 112 | 1.18 | | |
| 64 | P | .3904 | | | | |
| 65 | | | - | .0440 | | |
| 66 | | | | | | |
| 67 | M | .0040 | 84 | 1.29 | | |
| 69 | | | | | | |
| 70 | | | | | | |

| | 18 Cr, 8 Ni | | 20 Cr, 22 Ni | | 18 Cr, 11 Ni | |
|---|---|---|---|---|---|---|
| Soil No. | Pitting mil | Corrosion Rate mdd | Pitting mil | Corrosion Rate mdd | Pitting mil | Corrosion Rate mdd |
| 51 | | | | | | |
| 53 | | | U | .0192 | M | .0216 |
| 55 | | | U | .0256 | M | .0248 |
| 56 | | | U | .0136 | M | .0272 |
| 57 | | | | | | |
| 58 | 8 | .0192 | U | .0072 | P | .0216 |
| 59 | | | | | | |
| 60 | | | U | .0072 | P | .0152 |
| 61 | | | U | .0128 | U | .0256 |
| 62 | 6 | .0024 | U | .0080 | P | .0296 |
| 63 | 7 | .0176 | U | .0184 | M | .0336 |
| 64 | 36 | .0520 | U | .0072 | M | .0256 |
| 65 | | | U | .0192 | M | .0272 |
| 66 | | | U | .0168 | P | .0384 |
| 67 | 6 | .0024 | U | .0168 | U | .0224 |
| 69 | | | U | .0072 | U | .0240 |
| 70 | | | U | .0152 | M | .0312 |

# APPENDIX C

## Manufacturing, Inspection and Packaging Specifications for the SS Box - Specification T238

These specifications were used to produce the semi-lot of 100 boxes.

TENTATIVE MANUFACTURING AND INSPECTION

1. Purpose: The purpose of the specification is to insure the SS Box is properly manufactured, assembled, and inspected.

2. Marking: No part of the SS Box shall carry the manufacturers name or any means of identification.

3. Applicable Drawings:

3.1 Box, Assembly

3.2 Body, Assembly

3.3 Body

3.4 Bottom

3.5 Hasp

3.6 Hinge, Body

3.7 Pin, Hinge

3.8 Cover, Assembly

3.10 Retainer, Gasket

3.11 Gasket, Cover

3.12 Hinge, Cover

3.13 Latch

3.14 Retainer, Latch Link

3.15 Link, Latch

4. Material: Material shall be in accordance with drawings. All metallic parts to be fabricated from stainless steel, type 316, in accordance with ______________________ Specification ________________________.

5. Finish: This finish shall be suitably cleaned, free of deep scratches, sags, runs, chips, dirt or other foreign particles.

6. Dimensions: The dimensions shall be in accordance with the applicable drawing. The boxes shall satisfactorily pass the gauges measuring the following dimensions:

Maximum over-all outside length

Maximum over-all outside width

Maximum over-all outside height

Minimum inside width

Gasket Compression

Camber of Cover

Camber of Body

7. Assembly: The SS Box shall be assembled so as to be in accordance with drawings. All weldings shall be done by the heli-arc method.

8. Requirements:

8.1 Covers of boxes shall open and close without binding or requiring undue force. Gaskets shall not stick to top edges of boxes nor shift within the gasket retainer when the covers are opened.

8.2 Mating parts of the body hasp and the latch shall meet without requiring deformation of any box part, and the hasp shall close and open freely. The latches of assembled boxes shall remain closed without the use of artificial aids.

8.3 The latch, cover, and hinge assembly shall withstand an upward verticle force of 250 pounds for 1 minute without breakage or distortion of any of the components or welds.

8.4 The box bodies shall withstand, without leakage, and internal air pressure of 5 p. s. i.

8.5 The box with cover latched shall withstand, without leakage, an external air pressure of 5 p. s. i.

8.6 A 1-inch section across the seam weld shall withstand a load of 500 pounds without separation of the weld joint.

8.7 Spot welds shall have sufficient strength to meet the test specified 9.1.3.

8.9 Workmanship shall be in accordance with applicable drawings and specifications. The box shall be free of burrs, projections, or other imperfections which may interfere with the

9. Inspection: The SS Boxes shall be inspected in lots not less than 300 or more than 500, as established by the contractor and approved by the inspector.

9.1 Inspections by manufacturer.

9.1.1 All box bodies shall be tested by the manufacturer prior to painting by subjecting them to an internal air pressure of 5 p.s.i. maintained for 15 seconds while they are submerged completely under water, with the bottom nearest the surface and approximately 1 inch beneath it. Leaky boxes, indicated by air bubbles coming from a corner, a welded seam, or other portion, shall not be processed further nor presented to the inspector as finished boxes. Boxes passing this test after repair by heli-arc method welding may be processed further.

9.1.2 Every 4 hours of production a coupon (consisting of two pieces of metal of the same type and thickness as that used for the box body) shall be welded by each seam welder. A 1-inch cross section coupon shall withstand a static load of 500 pounds without separation.

9.1.3 Every 4 hours of production a coupon (consisting of two pieces of metal of the same type and thickness as that used for the box) shall be welded by each spot-welder with five spot welds and tested to destruction by any method satisfactory to the inspector.

Satisfactory welding is indicated if the parent metal, failing around the fuze spot, leaves a hole no smaller in diameter than 75 percent of the diameter of the weld specified on the drawing and deeper than 50 percent of the thickness of the parent metal. If all five welds are not satisfactory, the equipment shall be shut down immediately and not allowed to operate again on production until the condition is corrected and a satisfactory coupon is obtained.

9.1.4 All finished boxes, completely assembled, and with covers latched into closed position, shall be tested by the manufacturer by submerging them in water and maintaining them for a minimum of 15 seconds at an air pressure differential of 3 p.s.i. in excess of the outside pressure. Leaky boxes, indicated by escaping air bubbles, shall be removed by the manufacturer.

9.2 Inspection by Contracting Authority's Inspector. Two samples shall be selected from each lot by the inspector. Sample A for visual inspection, gauging, functioning, and airtightness acceptance tests, and sample B for tests of security of welds and assemblies. The size of sample A shall be 10% of the lot submitted, for inspection. The size of sample B shall be5% of the lot submitted for inspection.

9.2.1 Sample A

9.2.1.1 Each box of sample A shall be visually inspected for completeness of manufacture, assembly, finish, and workmanship. Special examination shall be made to assure that boxes are free of imperfections that would damage contents or injure personnel handling them; that curls of the cover and cover hinge close tightly and evenly over latch link and cover hinge pin, respectively; that the body hem closes tightly and smoothly against the box body; that the gasket bears snuggly against the cover skirt at sides and ends; and that the cover skirt bears snuggly against the sides of the box when the cover is latched.

9.2.1.2 One box of sample A shall be measured to assure conformance with all dimensions shown on applicable drawings. Any deviation from the drawing dimensions and commercial tolerances shall be reported to the manufacturer who shall make appropriate correction.

9.2.1.3 All boxes of sample A shall be gauged for dimensions specified in 6.

9.2.1.4 All boxes of inspection sample A shall be stored at a temperature of 165°F for a period of 24 hours and shall be tested thereafter by opening and closing each cover to check functioning, opening each cover to the fully open position to determine security of assembly. Inspection shall be made to assure that the gaskets are snug within the gasket retainer and do not stick to top edges of the boxes.

9.2.1.5 All boxes of inspection sample A shall be tested by closing the cover of each latching the hasp down in the fully closed position and then opening to check function and security of closure and ease of opening.

9.2.1.6 All boxes of inspection sample A shall be tested as specified in 9.1.1. Leaky boxes are considered serious defects in determining the acceptability of the lot.

9.2.1.7 All boxes of inspection sample A shall be tested as specified in 9.1.4. Leaky boxes are considered serious defects in determining acceptability of the lot.

9.22 Sample B

9.2.2.1 All boxes of inspection sample B shall be tested by applying a static load of 360 lbs. on their maximum area. The boxes shall then be tested as specified in 9.1.4.

9.2.2.2 All boxes of inspection sample B shall be tested for security of welds and attachment of component parts of the assembly (comprising the latch, latch link, latch link retainer, cover, cover hinge, body, and body hinge) by clamping the assembled box in a suitable fixture with the body supported from distortion or collapse by a snug fitting wood filler block, and slowly applying a force of 250 pounds for a period of 2 minutes. During this test the box shall rest upon its bottom with the cover raised at a right angle and the force applied in a vertical direction with bearing against the face of the latch when positioned parallel to the box bottom.

9.2.2.3 All boxes of inspection sample B shall be tested for security of attachment of hasp by clamping the assembled box, in a suitable fixture and slowly applying a force of 500 pounds for a period of 1 minute. During this test the box shall rest upon its bottom with the cover fully open and the force applied in a vertical direction with bearing against the underside of the lip of the hasp over the entire surface available. The box body shall be supported against distortion or collapse by a snug fitting filler block.

9.2.2.4 All boxes of the inspection sample B that have been subjected to the tests specified in 9.2.2.1, 9.2.2.2, and 9.2.2.3 shall be tested again for airtightness as specified in 9.1.4 at the completion of such tests. Boxes found to be airtight may be placed with the remainder of the lot of boxes undergoing acceptance tests. Boxes found to have lost airtightness in the retest shall be discarded, but without penalty for such loss, in the airtightness test.

10. Rejections:

10.1 If any box is found unsatisfactory when inspected under 9.2, it shall be rejected.

10.1 If more than two boxes are found unsatisfactory under 9.2.1.1, or 9.2.1.5 the lot shall be rejected.

10.3 If more than one box is found unsatisfactory under 9.2.1.3, 9.2.1.4, 9.2.1.6, 9.2.1.7, 9.2.2.1, 9.2.2.2, or 9.2.2.3 the lot shall be rejected.

10.4 A lot of boxes which has been rejected for failure to comply with this specification may be returned to the manufacturer for the removal of defective and presented again to the inspector for retest. The retest shall be limited to the failing test or tests, unless the inspector has reason to believe that, additional tests are necessary to determine compliance with the specification, in which case the additional tests shall also be performed.

# APPENDIX D

## Tentative Manufacturing and Inspection Specifications for SS Box

These specifications were used to produce the production lot of 1000 boxes.

Specification No. T238

15 June 1954

MANUFACTURING, INSPECTION AND PACKAGING

SPECIFICATIONS FOR THE SS BOX

1. Purpose: The purpose of this specification is to insure that the SS Box is properly fabricated, assembled and will operate in the desired manner.

2. Markings: No part of the SS Box or any component of the packaging, or packing, shall carry any trademarks, names, specification numbers, or other means of identification. Your attention is directed to the fact that some of the specifications cited herein may require symbols and marks on the material. The elimination of all such marks is required.

3. Parts: The SS Box consists of the following parts and assemblies that are described in the below listed specifications and drawings:

| | | Specifications and Drawings |
|---|---|---|
| 3.1 | Box Assembly | T238-100 |
| 3.2 | Cover Assembly | T238-200 |
| 3.3 | Body Assembly | T238-201 |
| 3.4 | Retainer and Latch Link Sub. Assembly | T238-300 |
| 3.5 | Body and Bottom Sub. Assembly | T238-301 |
| 3.6 | Hasp | T238-401 |
| 3.7 | Hinge, Body | T238-402 |
| 3.8 | Pin, Hinge | T238-403 |
| 3.9 | Hinge, Cover | T238-404 |
| 3.10 | Latch | T238-405 |
| 3.11 | Link, Latch | T238-406 |
| 3.12 | Bottom | T238-407 |
| 3.13 | Retainer, Gasket | T238-408 |
| 3.14 | Gasket, Cover | T238-409 |
| 3.15 | Cover | T238-410 |

4. Materials:

4.1 The body and bottom shall be fabricated of 22 gauge stainless steel, type 316, cold rolled, annealed and pickled, 2B finish.

Materials:

4.2 The cover shall be fabricated of 20 gauge stainless steel, type 316, cold rolled, annealed and pickled, 2B finish.

4.3 The hardware shall be made of stainless steel, type 316, cold rolled, annealed and pickled, 2B finish.

4.4 The welding rod shall be type 310 Mo (25-20-2 Mo) bare welding rod.

4.5 The gasket shall be specified by the Contracting Authority.

5. Finish:

5.1 The completed can, less gasket, shall be passivated in accordance with good shop practice.

5.2 One coat of wash primer shall be applied on outside only. The wash primer shall be the type designated "Pretreatment, Wash Primer" in accordance with Specification MIL-P-15328 (Ships).

5.3 Two coats of paint, supplied by the Contracting Authority, shall be applied by spray painting on the outside only.

6. Dimensions:

6.1 All dimensions shall be in accordance with the drawings listed in Section 3 above.

7. Assembly:

7.1 The parts shall be assembled in accordance with assembly drawings T238-100, T238-200 and T238-201.

7.2 No spot welding to expedite assembly of parts shall be used.

8. Inspection:

8.1 The SS Boxes shall be inspected in lots of 100 unless a larger quantity is established by the fabricator and approved by the Contracting Authority.

8.2 Inspections by the fabricator

8.2.1 All box bodies shall withstand, without leakage, an internal air pressure of five pounds per square inch for a period of 2-3 minutes when completely submerged in water and held below the surface at a depth of at least six inches. Air bubbles indicating a leak in the unit constitutes cause for rejection. A unit rejected for failure to pass this test may be re-submitted for test after the defect has been properly corrected and will be accepted when a re-test has been successfully passed.

8.2.2 Every fourth completed box shall be inspected to insure proper compression of the gasket on Drawing T238-100.

If the box fails to meet these requirements, welding of the body hinge and hasp shall stop until the locating fixture has been corrected. Faulty boxes shall be corrected.

8.2.3 All the completed boxes shall withstand, without leakage, an internal air pressure of five pounds per square inch. The internal pressure shall be accomplished by submerging the container in a bath of heated water to a temperature in the ranges of 170°F.

CAUTION: Experience has been established that the internal air pressure of the box varies abruptly with the room temperature. Prior to any testing a standard box with an appropriate air gauge shall be submerged in the bath to check the actual internal pressure before any production testing is accomplished. The temperature of the water should be regulated so as to obtain a stabilized pressure of 5 psi for a period of one minute, after which two or three minutes should be allowed for thorough inspection to find any leaks.

8.3 Inspection by the Contracting Authority's Inspector.

8.3.1 Ten percent of the boxes bodies shall be inspected by the Contracting Authority's Inspector, as outlined in section 8.2.1 above.

8.3.2 Ten percent of the completed boxes shall be inspected by the Contracting Authority's Inspector as outlined in sections 8.2.2 and 8.2.3 above.

8.3.3 Three percent of the completed boxes shall be tested by applying a static load of 400 pounds on their maximum area.

8.3.4 Five percent of the boxes shall be tested by clamping the completed box in a suitable fixture with the body supported from distortion or collapse by a snug fitting wood filler block, and slowing applying a force of 250 pounds for a period of one minute. During this test, the box shall rest on its bottom with the cover raised at a right angle and the force applied in a vertical direction and bearing against the face of the latch when positioned parallel to the box bottom.

8.3.5 Five percent of the completed boxes shall be tested for the security of attachment of hasp by clamping the box in a suitable fixture and slowly applying a force of 500 pounds for a period of one minute. During this test, the box shall rest on its bottom with the cover fully open and the force applied in a vertical direction with bearing against the underside of the lip of the hasp over the entire surface available. The box shall be supported against distortion or collapse by a snug fitting filler box.

8.3.6 Five boxes shall be stored at a temperature of 160 $\pm$ 5°F for a period of 24 hours. Inspection shall be made to assure that the gasket is snug within the gasket retainer and does not stick to the top edges of box. Each lot or mix of gaskets shall be tested in this manner.

8.3.7 During fabrication weld coupons shall be made at the discretion of the Contracting Authority's Inspector following certification of individual welders as outlined in section 10. A 1/2 inch section taken across the seam of the weld shall withstand a load of 1000 pounds dead load without separation of the welded joint. A similar section shall be bent 180 degrees over a 1/8 inch mandrel without injury to the welded section.

9. Rejections:

9.1 If any box body is found unsatisfactory when tested in accordance with section 8.2.1, the lot shall be rejected.

9.2 If more than one box is found unsatisfactory when tested in accordance with section 8.3.2 through 8.3.5, the lot shall be rejected.

9.3 If more than one gasket sticks to the top of the box when tested in accordance with section 8.3.6, the lot or mix of gaskets shall be rejected.

9.4 Rejects reworked.

10. Welders and Welding:

10.1 Welders - Prior to the assignment of any welder to work covered by this specification, the contractor shall provide the Contracting Authority's Inspector with the names of welders to be employed in the work, together with certification that each welder has passed qualification tests as prescribed by any of the following listed codes for the type of welding operation to be performed and that such qualification is effective as defined by the particular code.

Welding qualifications of A. S. M. E. Standard Qualification Procedure of the American Welding Society.

Qualification tests for welders of the Navy Department.

All welders shall qualify as class A operators for the type welding performed. The Contracting Authority's Inspector shall require any welders to retake the tests when in the opinion of the inspector, the work of the welder creates a reasonable doubt as to his proficiency. Recertification of the welder shall be made by the Contracting Authority only after the welder has taken and passed the required tests.

10.2 Welding - All welding shall be welded by the heli-arc method. Prior to welding all weld areas shall be properly cleaned. The edges shall be held securely in position by appropriate welding jigs or frame. Complete and regular penetration shall be obtained on all welds. Special precautions shall be taken to make welds air tight. A copper backing strip will be used to avoid cracking of the base metal adjacent to the welds during cooling. Skips and blow through holes made while welding may be corrected manually.

10.3 All welding equipment shall be kept in proper working order and shall be checked daily before production is started to insure satisfactory performance. PARTICULAR ATTENTION WILL BE GIVEN TO THE PROPER GROUNDING OF WORK AND WELDING MACHINES.

10.4 Type 310 Mo (25-20-2 Mo) bare welding rod shall be used on all welds of the container.

Specification No. T238
15 June 1954

10.5 The size of the welding rod or wire shall be so adapted to the base metal and thickness of parts to be welded so as to insure effective penetration and an intimate fusion of the filler and base metal. The work shall be positioned for flat welding whenever practicable. Before welding over previously deposited weld metal, all traces of slag shall be removed, the deposit and adjoining base metal shall be properly cleaned at all points.

11. Packaging:

11.1 After painting, the box shall be placed in a double-faced corrugated carton. This carton only serves to protect the painted edges while in transit or storage.

## APPENDIX E

Tentative Manufacturing and Inspection

Specification for SS Box - to be used for future production.

Specification No. T238
1 April 1955

# MANUFACTURING, INSPECTION AND PACKAGING SPECIFICATION FOR THE SS BOX

. Purpose: The purpose of this specification is to insure that the SS Box is properly fabricated, assembled and will operate in the desired manner.

. Markings: No part of the SS Box or any component of the packaging, or packing, shall carry any trademarks, names, specification numbers, or other means of identification. Your attention is directed to the fact that some of the specifications cited herein may require symbols and marks on the material. The elimination of all such marks is required.

. Parts: The SS Box consists of the following parts and assemblies that are described in the below listed specifications and drawings:

| | | Specifications and Drawings |
|---|---|---|
| 3.1 | Box Assembly | T238-100 |
| 3.2 | Cover Assembly | T238-200 |
| 3.3 | Body Assembly | T238-201 |
| 3.4 | Retainer and Latch Link Sub. Assembly | T238-300 |
| 3.5 | Body and Bottom Sub. Assembly | T238-301 |
| 3.6 | Hasp | T238-401 |
| 3.7 | Hinge, Body | T238-402 |
| 3.8 | Pin, Hinge | T238-403 |
| 3.9 | Hinge, Cover | T238-404 |
| 3.10 | Latch | T238-405 |

| | | Specifications and Drawings |
|---|---|---|
| 3.11 | Link, Latch | T238-406 |
| 3.12 | Bottom | T238-407 |
| 3.13 | Retainer, Gasket | T238-408 |
| 3.14 | Gasket, Cover | T238-409 |
| 3.15 | Cover | T238-410 |

4. Materials:

4.1 The body and gasket retainer shall be fabricated of 22 gage stainless steel, type 316, cold rolled, annealed and pickled, 2B finish.

4.2 The cover and bottom shall be fabricated of 20 gage stainless steel, type 316, cold rolled, annealed and pickled, 2B finish.

4.3 The hardware shall be made of 16 gage stainless steel, type 316, cold rolled, annealed and pickled, 2B finish.

4.4 The welding rod shall be type 310 Mo (25-20-2 Mo) bare welding rod.

4.5 The gasket shall be specified by the Contracting Authority.

5. Finish:

5.1 The completed can, less gasket, shall be passivated in accordance with good shop practice.

5.2 One coat of wash primer shall be applied on outside only. The wash primer shall be the type designated "Pretreatment, Wash Primer" in accordance with Specification MIL-P-15328 (Ships).

5.3 Two coats of paint, supplied by the Contracting Authority, shall be applied by spray painting on the outside only.

6. Dimensions:

6.1 All dimensions shall be in accordance with the drawings listed in Section 3 above.

7. Assembly:

7.1 The parts shall be assembled in accordance with assembly drawings T238-100, T238-200 and T238-201.

8. Inspection:

8.1 The SS Boxes shall be inspected in lots of 100 unless a larger quantity is established by the fabricator and approved by the Contracting Authority.

8.2 Inspections by the fabricator.

8.2.1 All box bodies shall withstand, without leakage, an internal air pressure of five pounds per square inch for a period of 2-3 minutes when completely submerged in water and held below the surface at a depth of at least two inches. Air bubbles indicating a leak in the unit constitutes cause for rejection. A unit rejected for failure to pass this test may be re-submitted for test after the defect has been properly corrected and will be accepted when a retest has been successfully passed.

8.2.2 Ten per cent of gaskets received from the subcontractor shall be tested for compliance with the hardness specification of $40 \pm 5$.

8.2.3 Two per cent of each lot shall be examined for compliance with the required physical dimensions.

8.3 Inspection by the Inspecting Authority

8.3.1 At the beginning of each production, the welding of the body hinge and hasp shall not commence except in the presence of the Inspecting Authority. The first ten units shall be inspected with a compression gage (furnished by the Contractor) to insure proper compression of the gasket as specified on DrawingT238-100. If any box fails to meet the gasket compression requirements, further welding of the body hinge and shell shall be stopped until the locating fixture has been corrected.

Once the setting of the locating fixture has been proven satisfactory, every alternate box of the next fifty units shall be inspected.

Every fourth box shall be inspected for gasket compression after the initial lot of 60 has been completed.

If at any time the gasket compression readings fall outside the allowable limits, every succeeding box shall be checked until the fault has been corrected.

8.3.2 All the completed boxes shall withstand, without leakage, an internal air pressure of five pounds per square inch. The internal pressure shall be accomplished by submerging the container in a bath of heated water to a temperature in the ranges of 170°F.

CAUTION: Experience has established that the internal air pressure of the box varies abruptly with the room temperature. Prior to any testing a standard box with an appropriate air gage shall be submerged in the bath to check the actual internal pressure before any production testing is accomplished. The temperature of the water should be regulated so as to obtain a stabilized pressure of 5 psi for a period of one minute, after which two or three minutes should be allowed for thorough inspection to find any leaks.

8.3.3 Three per cent of the completed boxes shall be tested by applying a static load of 400 pounds on their maximum area.

8.3.4 Five per cent of the boxes shall be tested by clamping the completed box in a suitable fixture with the body supported from distortion or collapse by a snug fitting wood filler block, and slowly applying a force of 250 pounds for a period of one minute. During this test, the box shall rest on its bottom with the cover raised at a right angle and the force applied in a vertical direction and bearing against the face of the latch when positioned parallel to the box bottom.

8.3.5 Five per cent of the completed boxes shall be tested for the security of attachment of hasp by clamping the box in a suitable fixture and slowly applying a force of 500 pounds for a period of one minute. During this test, the box shall rest on its bottom with the cover fully open and the force applied in a vertical direction with bearing against the underside of the lip of the hasp over the entire surface available. The box shall be supported against distortion or collapse by a snug fitting filler box.

8.3.6 Five boxes shall be stored at a temperature of 160 ± 5°F for a period of 24 hours. Inspection shall be made to assure that the gasket is snug within the gasket retainer and does not stick to the top edges of box. Each lot or mix of gaskets shall be tested in this manner.

8.3.7 During fabrication weld coupons shall be made at the discretion of the Contracting Authority's Inspector following certification of individual welders as outlined in section 10. A 1/2 inch section taken across the seam of the weld shall withstand a load of 1000 pounds dead load without separation of the welded joint. A similar section shall be bent 180 degrees over a 1/8 inch mandrel without injury to the welded section.

9. Rejections:

9.1 If any box is found unsatisfactory when tested in accordance with sections 8.3.1 and 8.3.2, it shall be rejected.

9.2 If more than one box is found unsatisfactory when tested in accordance with section 8.3.2 through 8.3.5, the lot shall be rejected.

9.3 If more than one gasket sticks to the top of the box when tested in accordance with section 8.3.6, the lot or mix of gaskets shall be rejected.

9.4 Rejections shall not preclude the manufacturer from correcting the conditions which form the basis of rejections, nor precludes the manufacturer from reworking a rejected lot for re-submission for inspection and testing. However, all such units and lots so reworked shall be so indicated to the inspector, who may select twice the quantity of units submitted to test in the first inspection.

10. Welders and Welding:

10.1 Welders - Prior to the assignment of any welder to work covered by this specification, the contractor shall provide the Contracting Authority's Inspector with the names of welders to be employed in the work, together with certification that each welder has passed qualification tests as prescribed by any of the following listed codes for the type of welding operation to be performed and that such qualification is effective as defined by the particular code.

Welding qualifications of A.S.M.E. Standard Qualification Procedure of the American Welding Society.

Qualification tests for welders of the Navy Department.

All welders shall qualify as class A operators for the type welding performed. The Contracting Authority's Inspector shall require any welders to retake the tests when in the opinion of the inspector, the work of the welder creates a reasonable doubt as to his proficiency. Recertification of the welder shall be made by the Contracting Authority only after the welder has taken and passed the required tests.

10.2 Welding - All welding shall be welded by the heli-arc method. Prior to welding all weld areas shall be properly cleaned. The edges shall be held securely in position by appropriate welding jigs or frame. Complete and regular penetration shall be obtained on all welds. Special precautions shall be taken to make welds air tight. A copper backing strip will be used to avoid cracking of the base metal adjacent to the welds during cooling. Skips and blow through holes made while welding may be corrected manually.

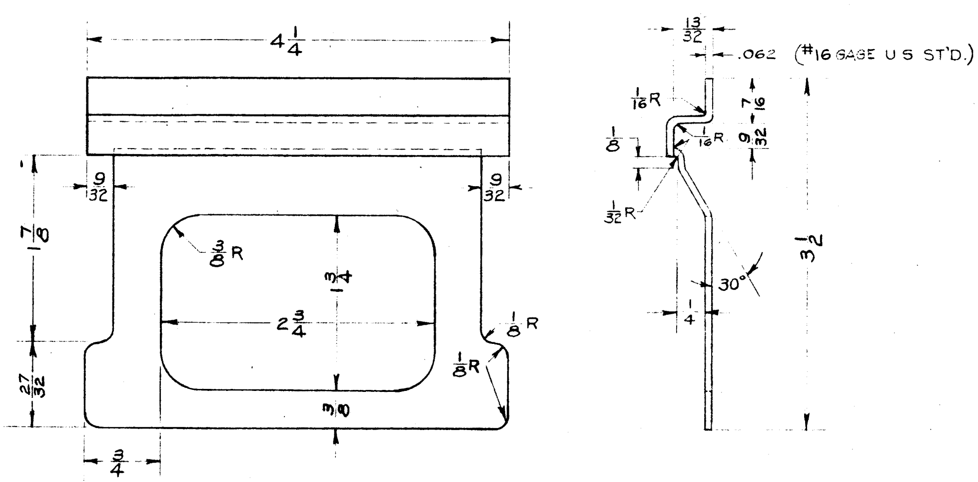
10.3 All welding equipment shall be kept in proper working order and shall be checked daily before production is started to insure satisfactory performance. PARTICULAR ATTENTION WILL BE GIVEN TO THE PROPER GROUNDING OF WORK AND WELDING MACHINES.

10.4 Type 310 Mo (25-20-2 Mo) bare welding rod shall be used on all welds of the container.

10.5 The size of the welding rod or wire shall be so adapted to the base metal and thickness of parts to be welded so as to insure effective penetration and an intimate fusion of the filler and base metal. The work shall be so positioned for flat welding whenever practicable. Before welding over previously deposited weld metal, all traces of slag shall be removed, the deposit and adjoining base metal shall be properly cleaned at all points.

11. Packaging:

11.1 After painting, the box shall be placed in a double-faced corrugated carton. This carton serves only to protect the painted surfaces while in transit.




| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1°

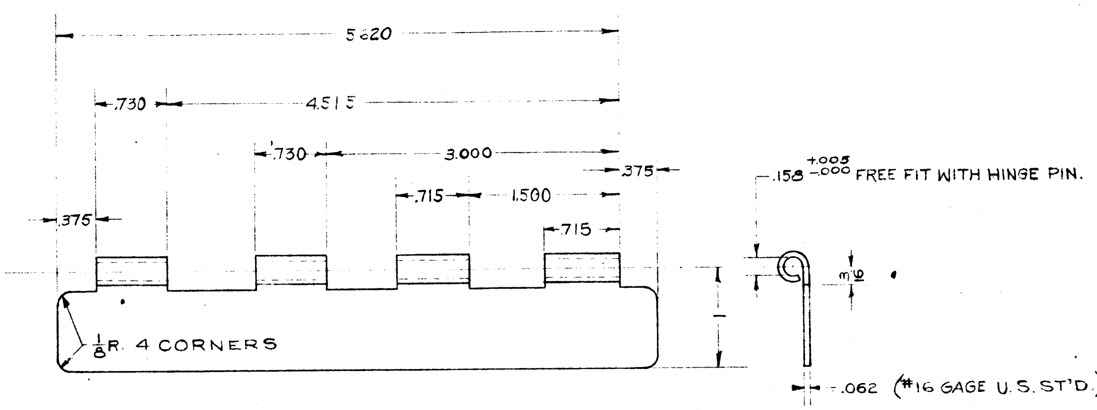
| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|

MATERIAL TYPE 316 S.S. FINISH 2B
DRAWN BY F.J.G. APPROVED BY
DATE 20 MAY 54 SCALE FULL
NEXT ASSEMBLY T-238-201 MODEL

HASP

DWG SIZE B DWG NO T-238-401 ISSUE 2

SHEET 1 OF 15 SHEETS




| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|
| MATERIAL TYPE 316 S.S. | | FINISH 2B | |
| DRAWN BY F.J.G. | | APPROVED BY | |
| DATE 21 MAY 54 | | SCALE FULL | |
| NEXT ASSEMBLY T-238-201 | | MODEL | |

HINGE-BODY

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
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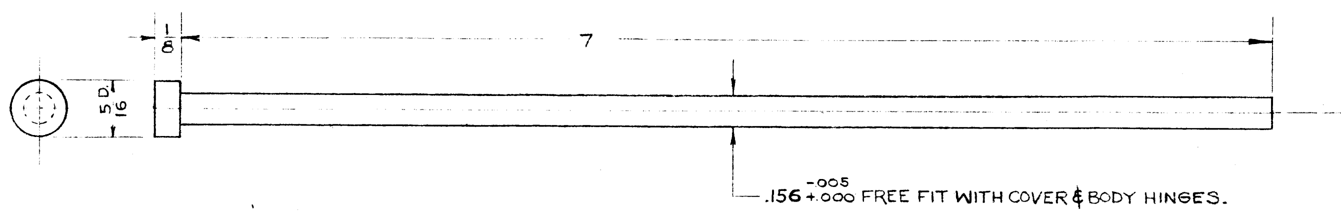
SHEET 2 OF 15 SHEETS




| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|

MATERIAL TYPE 316 S.S. | FINISH 2B
DRAWN BY F.J.G. | APPROVED BY
DATE 21 MAY 54 | SCALE 2" = 1"
NEXT ASSEMBLY T 238-200 | MODEL

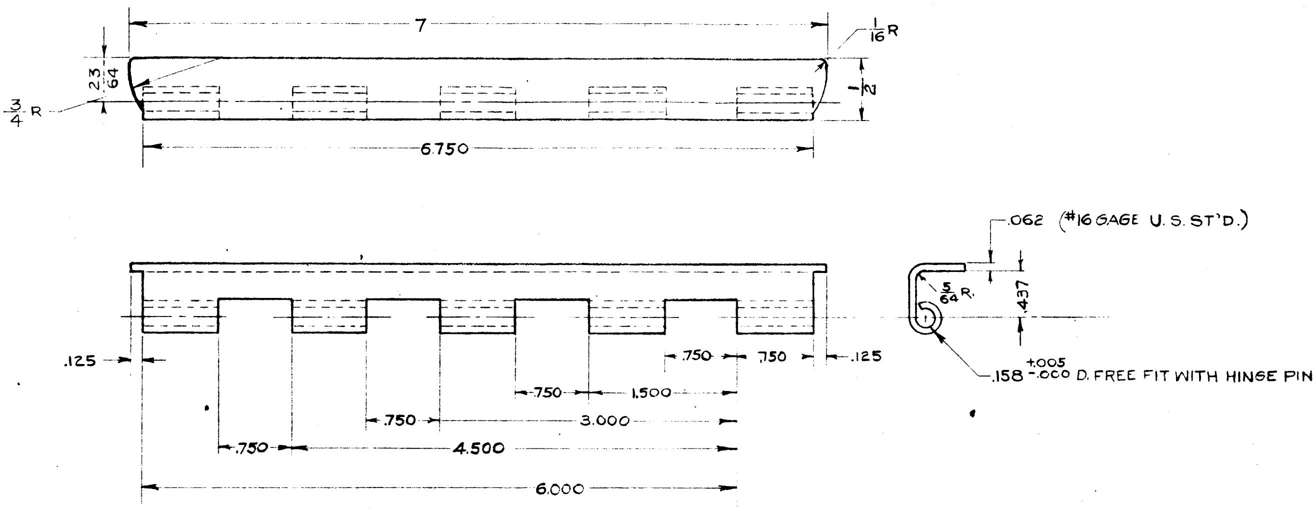
PIN - HINGE

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1°

DWG SIZE B | DWG NO T-238-403 | ISSUE 2

SHEET 3 OF 15 SHEETS




| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|

| | |
|---|---|
| MATERIAL TYPE 316 S.S. | FINISH 2B |
| DRAWN BY F.J.G. | APPROVED BY |
| DATE 21 MAY 54 | SCALE FULL |
| NEXT ASSEMBLY T-238-200 | MODEL |

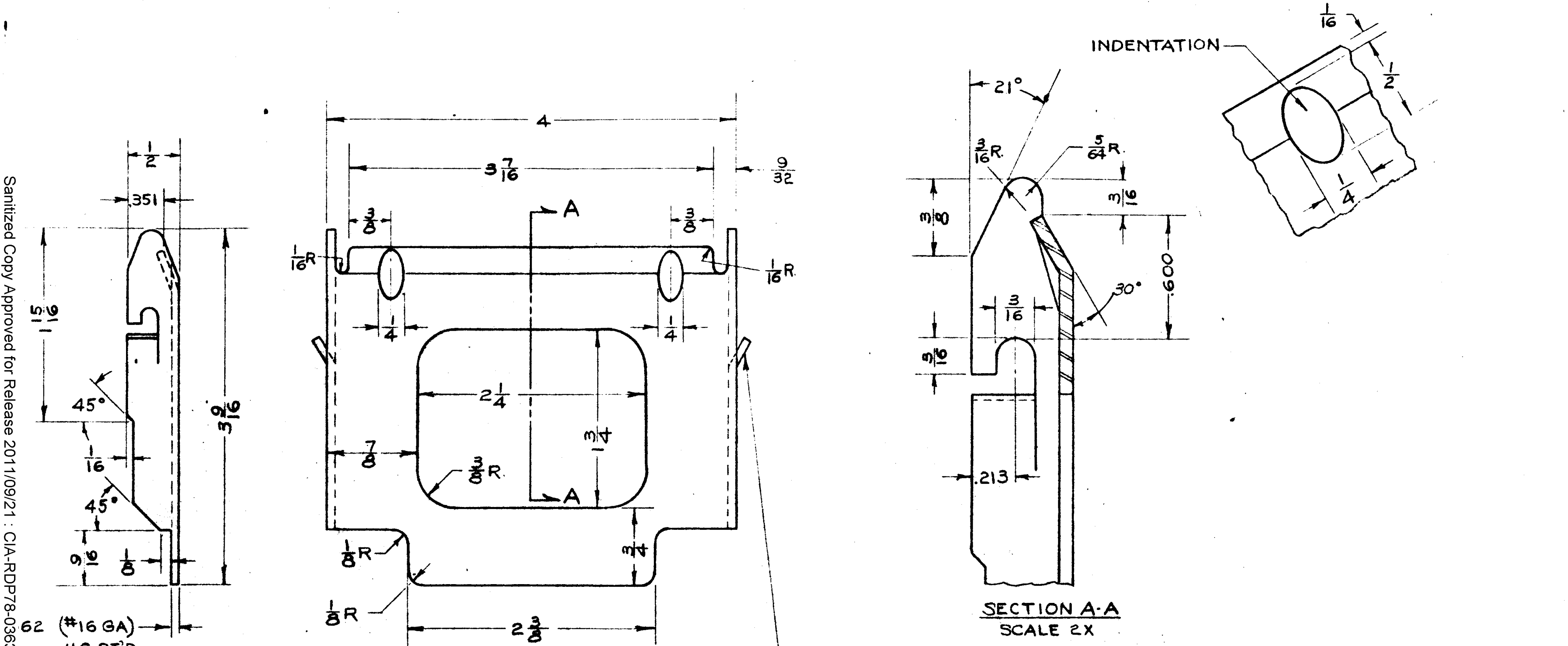
HINGE-COVER

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| B | T-238-404 | 2 |

SHEET 4 OF 15 SHEETS




| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

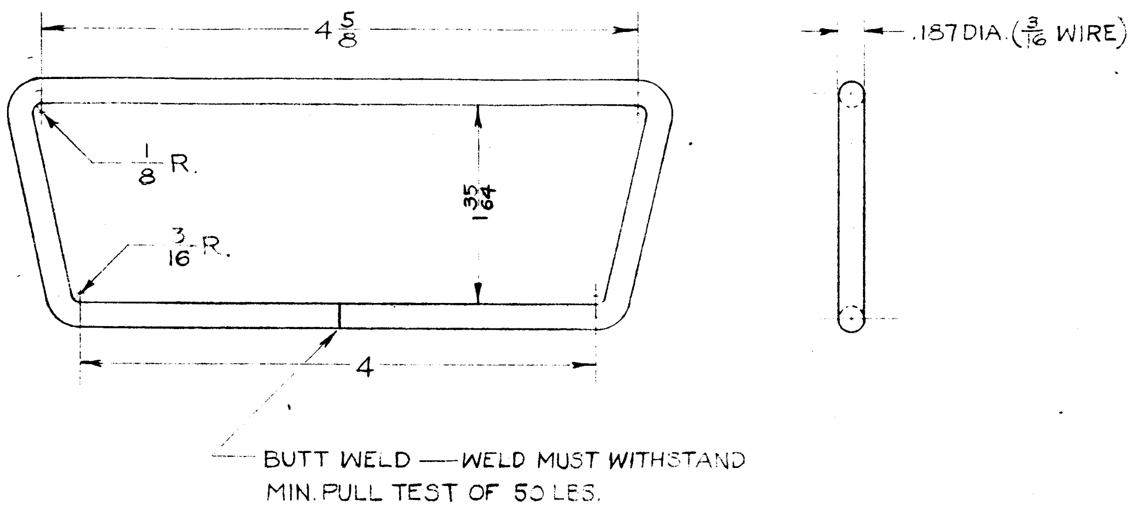
| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|
| MATERIAL TYPE 316 S.S. | | FINISH 2B | |
| DRAWN BY F.J.G. | | APPROVED BY | |
| DATE 21 MAY 54 | | SCALE FULL | |
| NEXT ASSEMBLY T-238-201 | | MODEL | |

LATCH

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| B | T-238-405 | 2 |

SHEET 5 OF 15 SHEETS

Sanitized Copy Approved for Release 2011/09/21 : CIA-RDP78-03639A001500140001-3




| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS $\pm\frac{1}{64}$ DECIMALS $\pm.005$ ANGLES $\pm 1°$

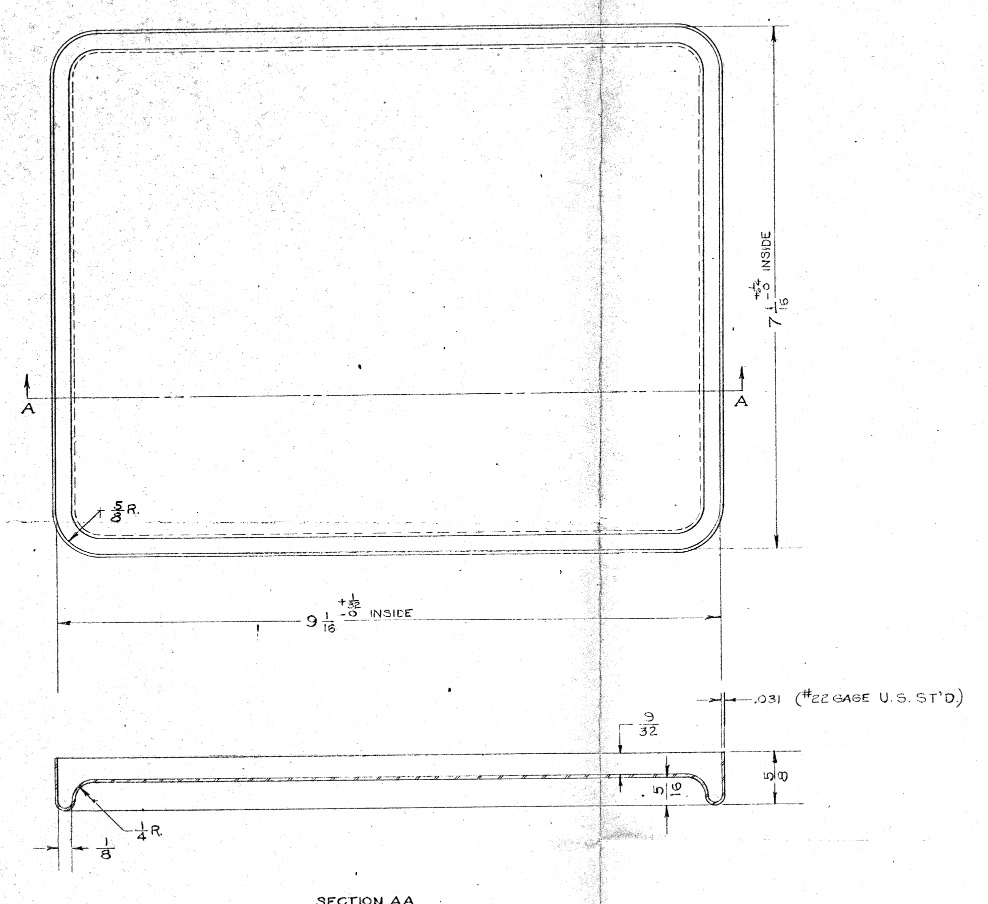
| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|

| | | | |
|---|---|---|---|
| MATERIAL | TYPE 316 S.S. | FINISH | 2 B |
| DRAWN BY | F.J.G. | APPROVED BY | |
| DATE | 19 MAY 54 | SCALE | FULL |
| NEXT ASSEMBLY | T-238-300 | MODEL | |

LINK-LATCH

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| B | T-238-406 | 2 |

SHEET 6 OF 15 SHEETS




| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|

| | |
|---|---|
| MATERIAL TYPE 316 S.S. | FINISH 2 B |
| DRAWN BY F.J.G. | APPROVED BY |
| DATE 22 MAY 54 | SCALE FULL |
| NEXT ASSEMBLY T-238-301 | MODEL |

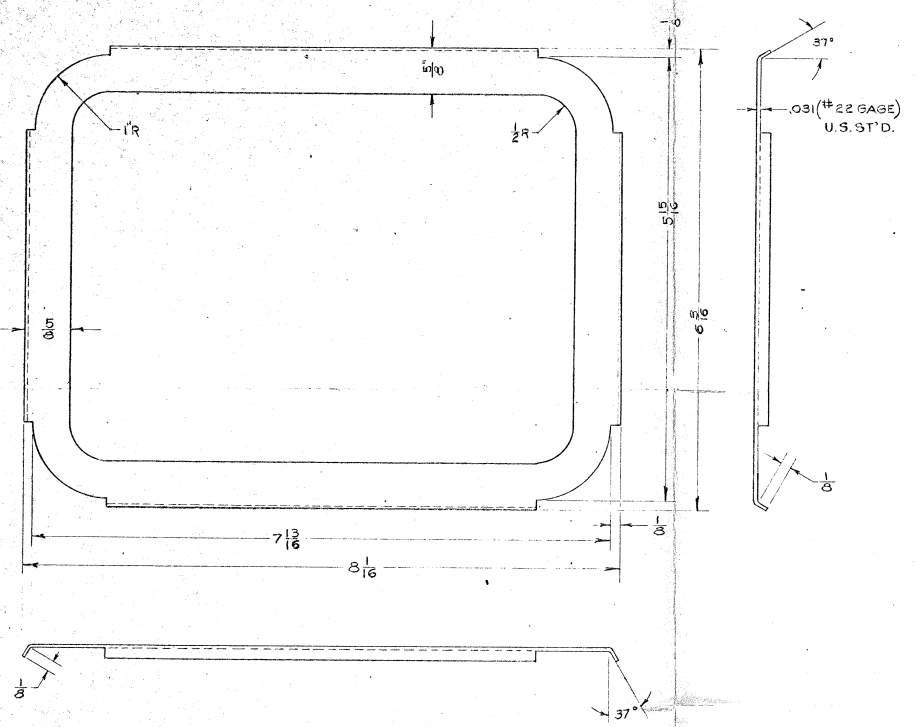
BOTTOM

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1958 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| C | T-238-407 | 2 |

SHEET 7 OF 15 SHEETS




| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

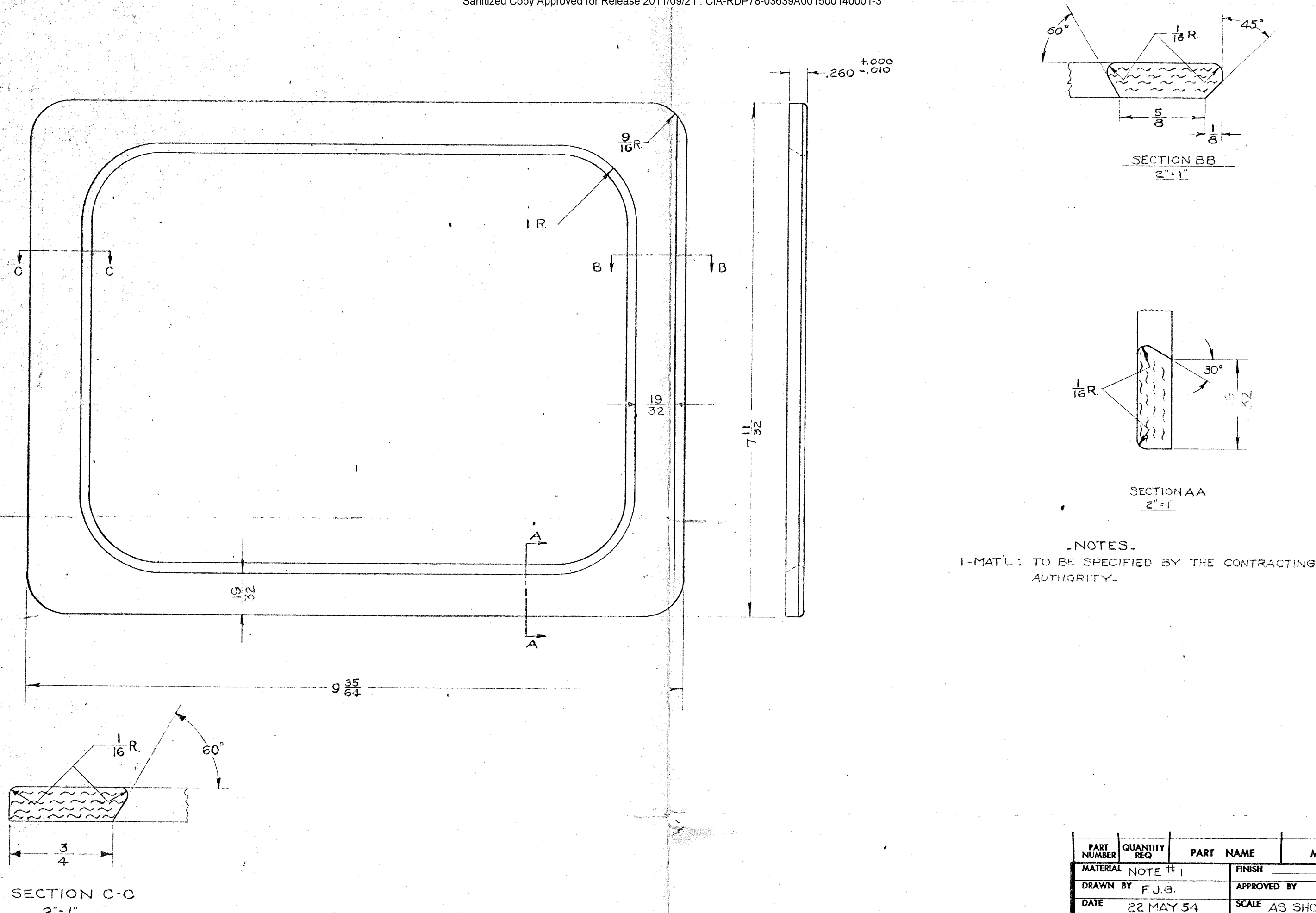
UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

| PART NUMBER | QUANTITY REQ | PART NAME | | MATERIAL |
|---|---|---|---|---|
| MATERIAL | TYPE 316 S.S. | FINISH | 2 B | |
| DRAWN BY | F.J.G. | APPROVED BY | | |
| DATE | 22 MAY 54 | SCALE | FULL | |
| NEXT ASSEMBLY | T-238-200 | MODEL | | |

RETAINER-GASKET

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| C | T-238-408 | 2 |

SHEET 8 OF 15 SHEETS




-NOTES-

1-MAT'L: TO BE SPECIFIED BY THE CONTRACTING AUTHORITY-

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

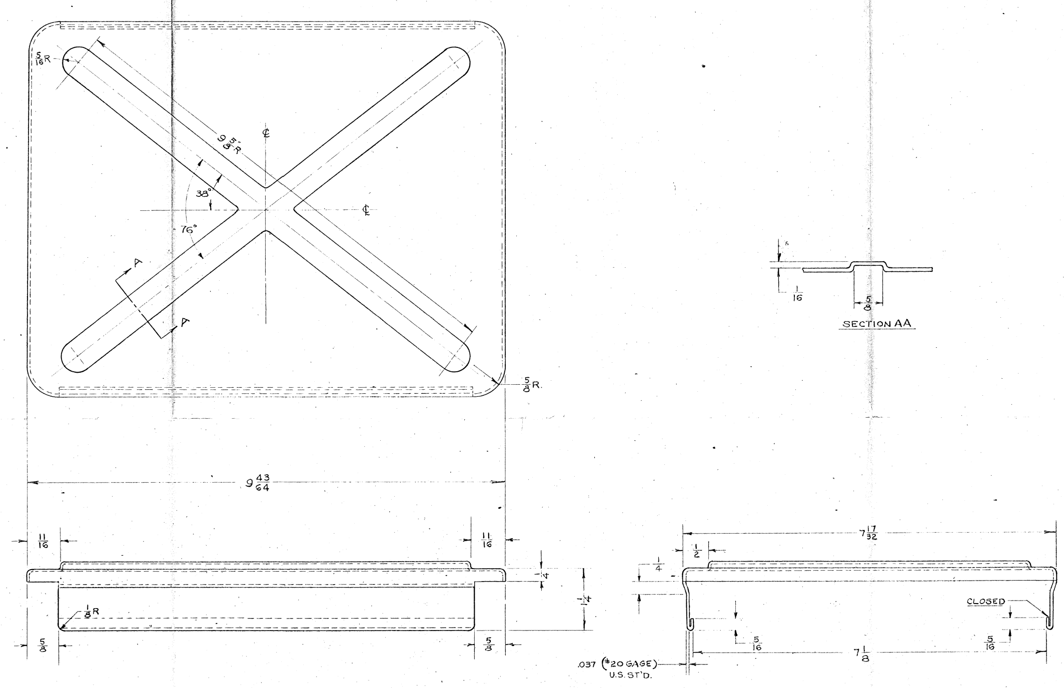
UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|
| MATERIAL NOTE #1 | | FINISH | |
| DRAWN BY F.J.G. | | APPROVED BY | |
| DATE 22 MAY 54 | | SCALE AS SHOWN | |
| NEXT ASSEMBLY T-238-200 | | MODEL | |

GASKET - COVER

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| C | T-238-409 | 2 |

SHEET 9 OF 15 SHEETS




| PART NUMBER | QUANTITY REQ | PART · NAME | MATERIAL |
|---|---|---|---|

| | |
|---|---|
| MATERIAL TYPE 316 S.S. | FINISH 2B |
| DRAWN BY F.J.G. | APPROVED BY |
| DATE 24 MAY 54 | SCALE FULL |
| NEXT ASSEMBLY T-238-200 | MODEL |

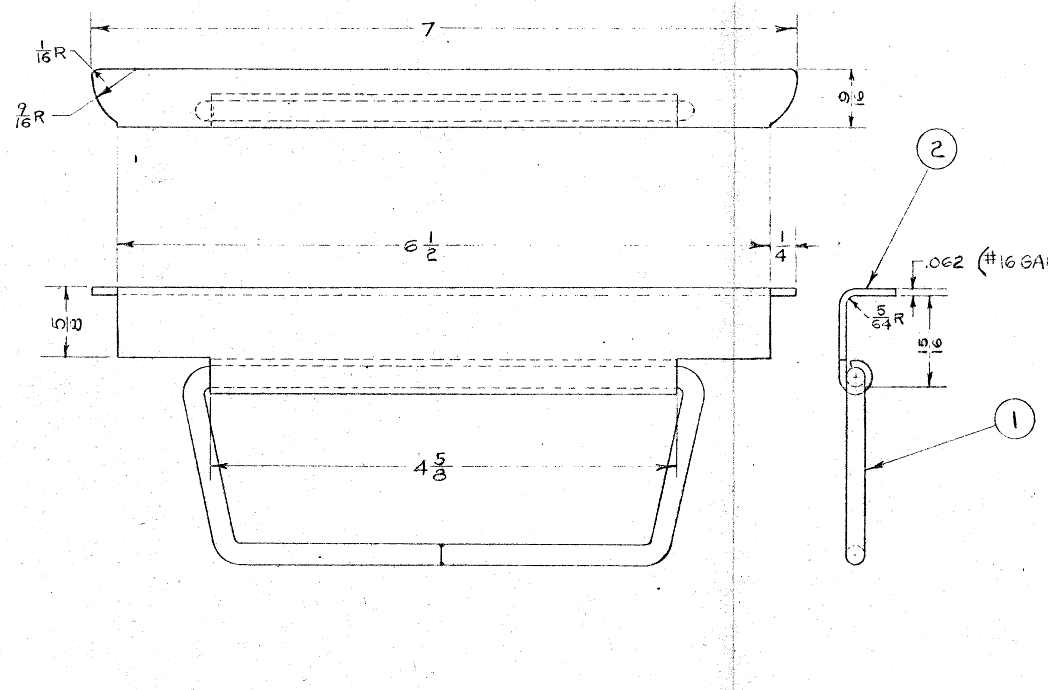
COVER

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE:
FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

DWG SIZE D | DWG NO T-238-410 | ISSUE 2

SHEET 10 OF 15 SHEETS




NOTES

LATCH LINK - PT 1 - TO BE A FREE FIT WITH RETAINER - PT 2.

| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|
| 2 | 1 | RETAINER | ST. ST'L - #316 |
| 1 | 1 | LATCH LINK | ST. ST'L - #316 |

| | |
|---|---|
| MATERIAL: SEE ABOVE | FINISH: 2 B |
| DRAWN BY: F.J.G. | APPROVED BY: |
| DATE: 19 MAY 54 | SCALE: FULL |
| NEXT ASSEMBLY: T-238-200 | MODEL: |

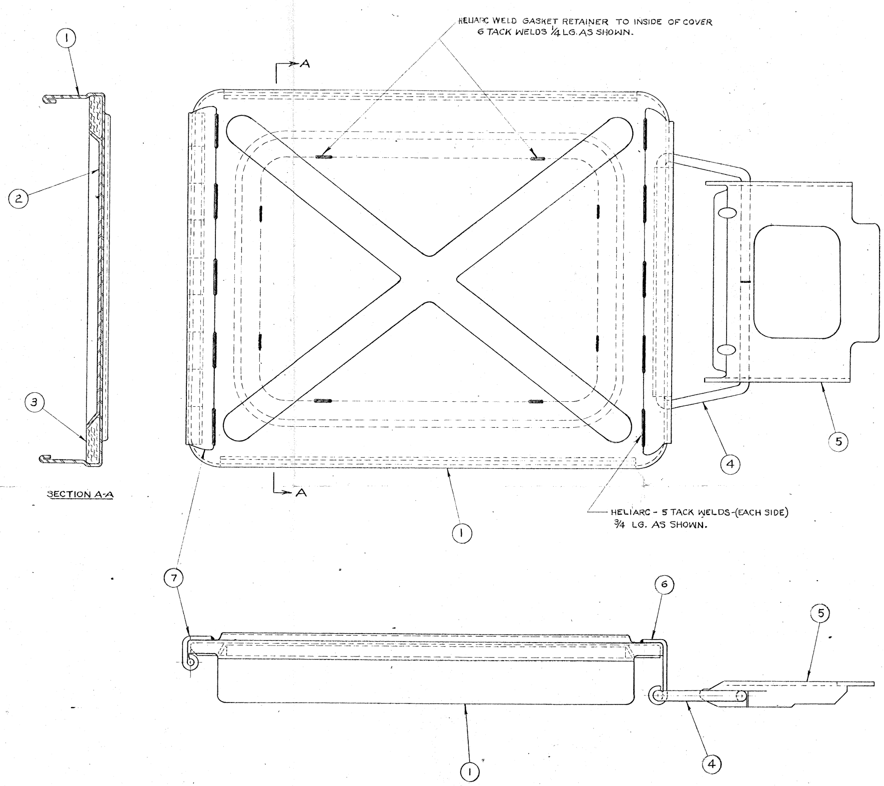
RETAINER & LATCH LINK SUB-ASSEMBLY

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1°

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| B | T-238-300 | 2 |

SHEET 11 OF 15 SHEETS




NOTES:
GASKET TO BE INSERTED UNDER SLIGHT COMPRESSION BY GASKET RETAINER SO THAT NO CLEARANCE EXISTS BETWEEN GASKET & RETAINER OR GASKET AND COVER AT SIDES AND ENDS.

| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|
| 7 | 1 | HINGE " | #316 S.S. |
| 6 | 1 | RETAINER-LATCH | " " |
| 5 | 1 | LATCH | " " |
| 4 | 1 | LINK | " " |
| 3 | 1 | GASKET | " " |
| 2 | 1 | RETAINER-GASKET | " " |
| 1 | 1 | COVER | " " |

| | |
|---|---|
| MATERIAL | FINISH 2B |
| DRAWN BY F.J.G. | APPROVED BY |
| DATE 27 MAY 54 | SCALE FULL |
| NEXT ASSEMBLY T-238-100 | MODEL |

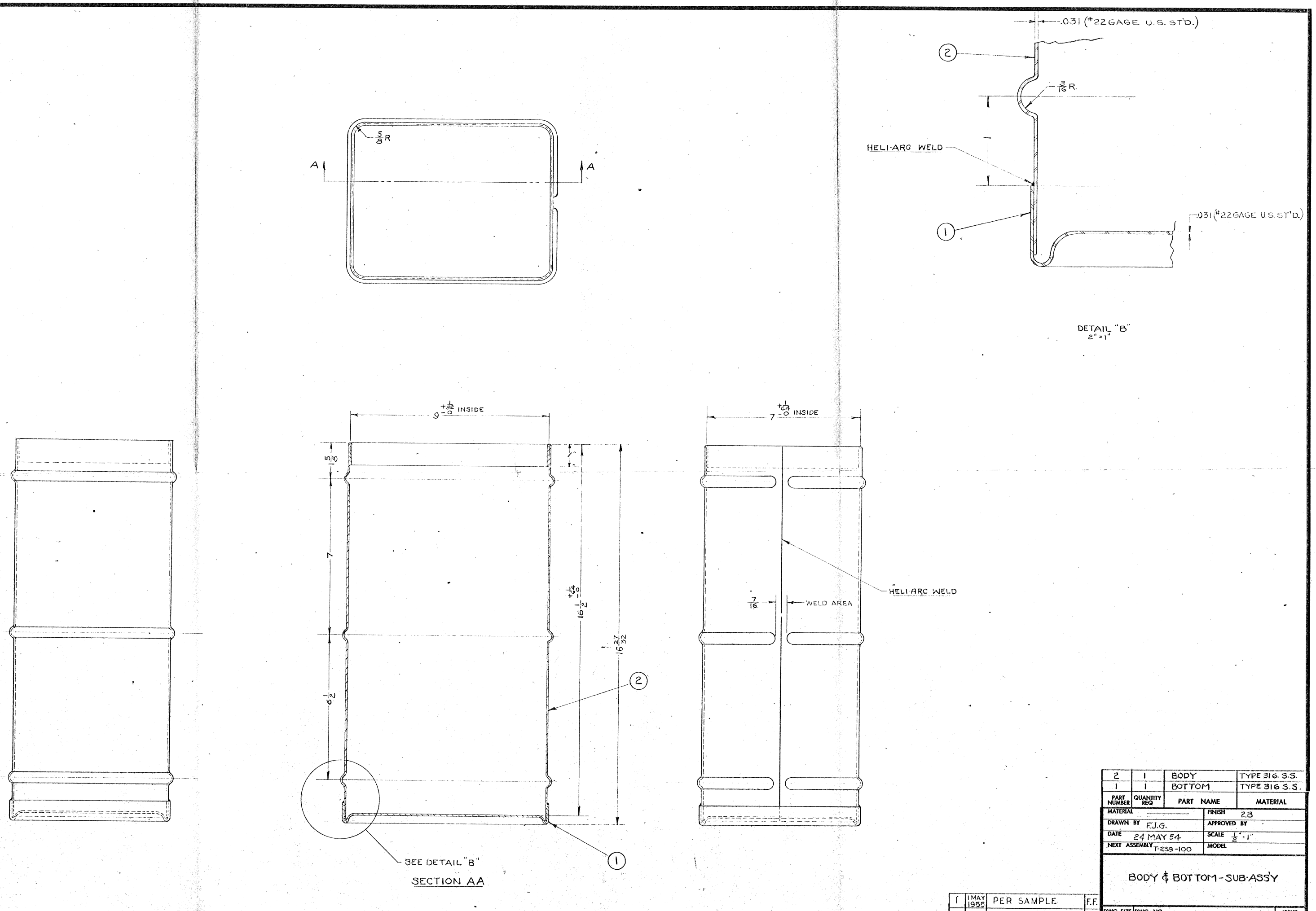
COVER-ASSEMBLY

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1°

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| D | T-238-200 | 2 |

SHEET 12 OF 15 SHEETS




| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|
| 2 | 1 | BODY | TYPE 316 S.S. |
| 1 | 1 | BOTTOM | TYPE 316 S.S. |

| | |
|---|---|
| MATERIAL | FINISH 2B |
| DRAWN BY F.J.G. | APPROVED BY |
| DATE 24 MAY 54 | SCALE 1/2" = 1" |
| NEXT ASSEMBLY T-238-100 | MODEL |

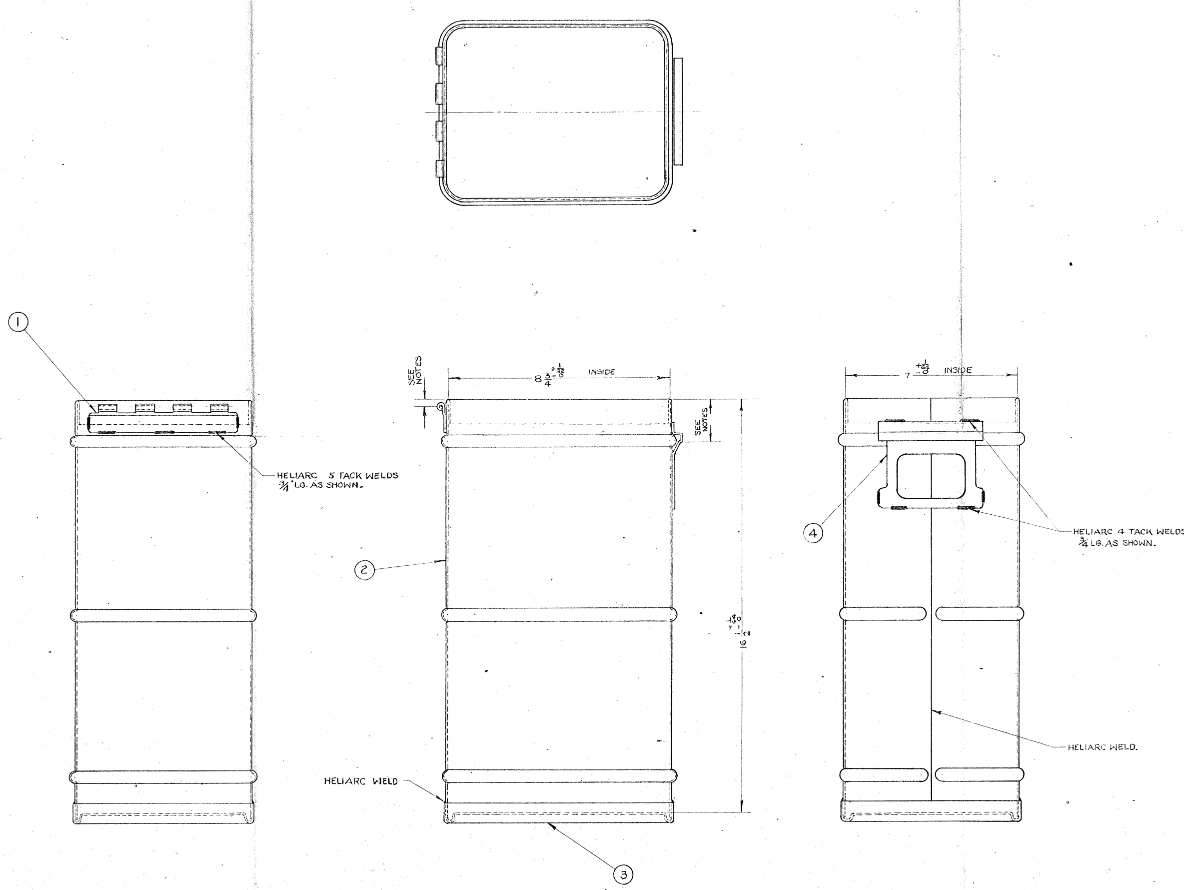
BODY & BOTTOM-SUB-ASS'Y

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1°

DWG SIZE D | DWG NO T-238-301 | ISSUE 2

SHEET 13 OF 15 SHEETS




NOTES:
LOCATION OF HASP & HINGE BODY TO BE DETERMINED BY LOCATING & WELDING FIXTURE FOR SPECIFIED GASKET COMPRESSION.

| PART NUMBER | QUANTITY REQ | PART NAME | MATERIAL |
|---|---|---|---|
| 4 | 1 | HASP | # 316 S.S. |
| 3 | 1 | BOTTOM | # 316 S.S. |
| 2 | 1 | BODY | # 316 S.S. |
| 1 | 1 | HINGE BODY | # 316 S.S. |

| | |
|---|---|
| MATERIAL ________ | FINISH 2B |
| DRAWN BY F.J.G. | APPROVED BY |
| DATE 27 MAY 54 | SCALE 1/2" = 1" |
| NEXT ASSEMBLY T-238-301 | MODEL |

BODY ASSEMBLY

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

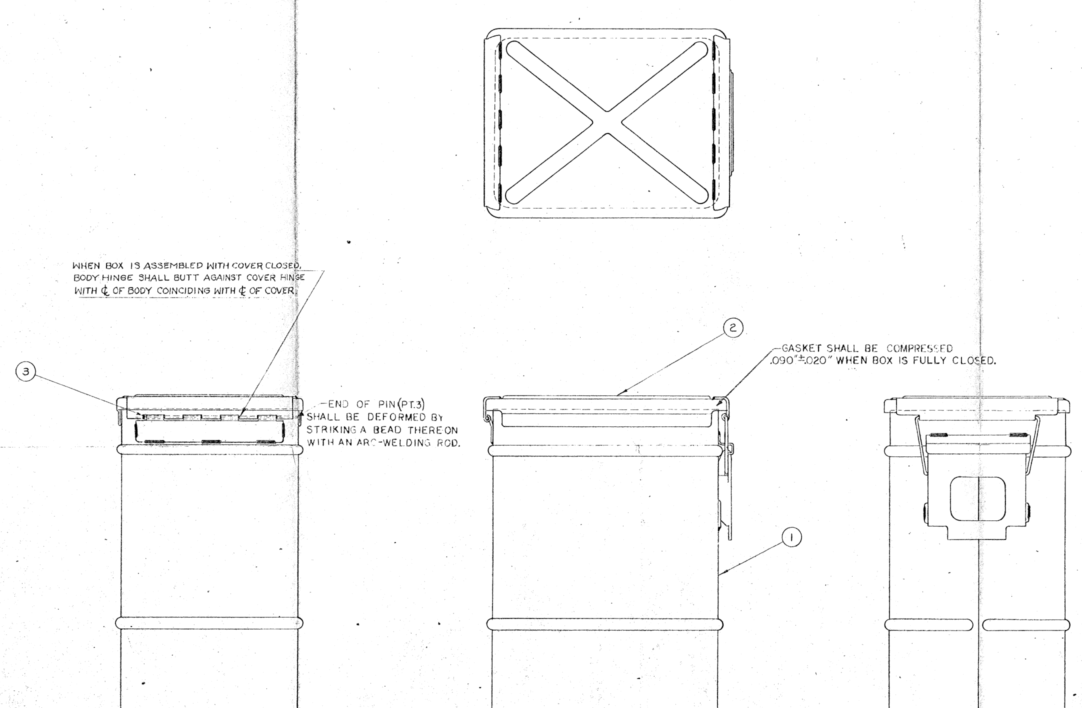
UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± 1/64 DECIMALS ± N ANGLES ± N

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| D | T-238-201 | 2 |

SHEET 14 OF 15 SHEETS

# APPENDIX F

Map of Area Showing Burial Sites




| PART NUMBER | QUANTITY REQ | PART NAME | REF. DWG. No. |
|---|---|---|---|
| 3 | 1 | HINGE PIN | T-238-403 |
| 2 | 1 | COVER ASS'Y. | T-238-200 |
| 1 | 1 | BODY ASS'Y. | T-238-201 |

| | |
|---|---|
| MATERIAL ______ | FINISH 2B |
| DRAWN BY F.J.G. | APPROVED BY |
| DATE 28 MAY 54 | SCALE ½" = 1" |
| NEXT ASSEMBLY ______ | MODEL |

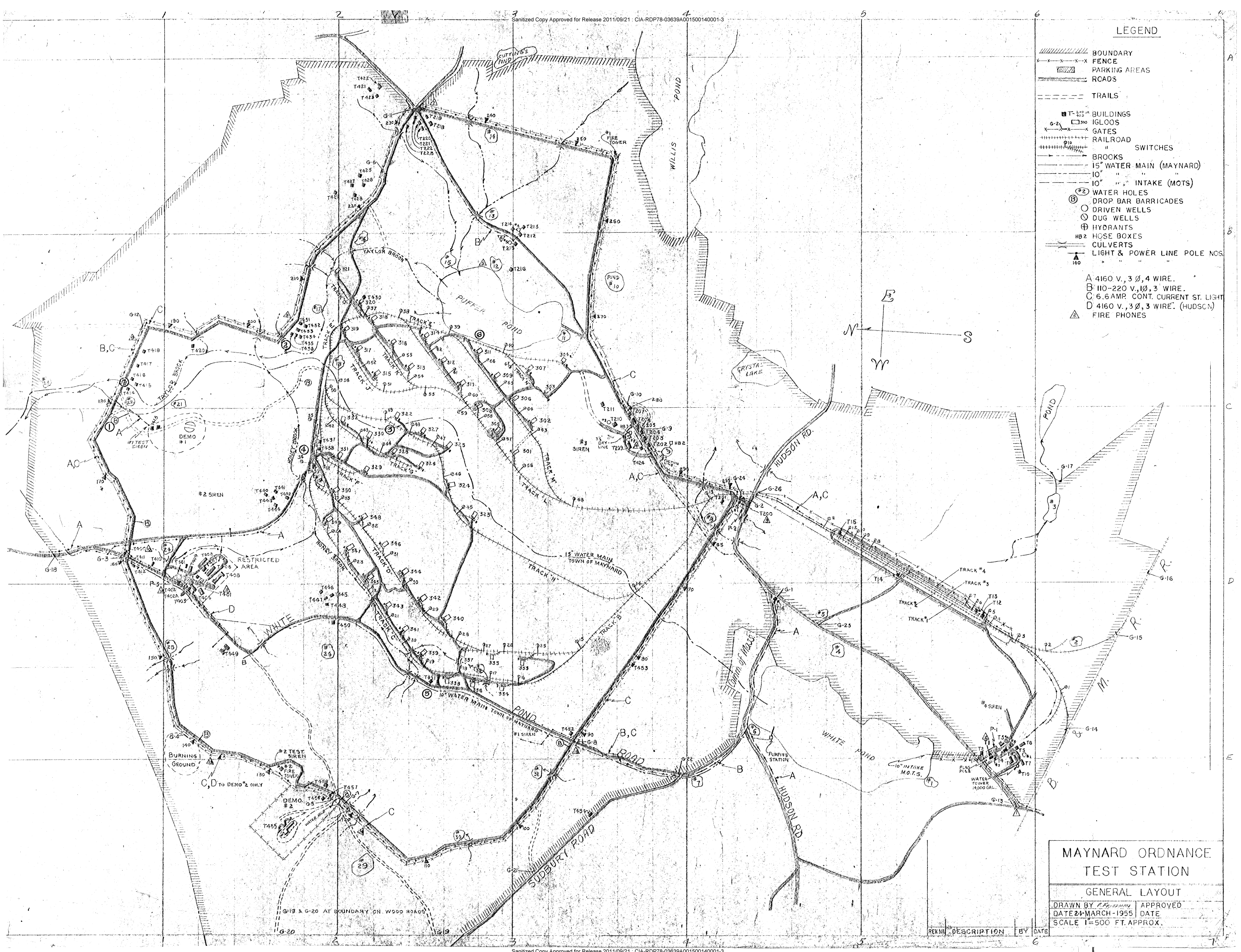
BOX ASSEMBLY

| NO | DATE | REVISIONS | BY |
|---|---|---|---|
| 1 | 1 MAY 1955 | PER SAMPLE | F.F. |

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±1°

| DWG SIZE | DWG NO | ISSUE |
|---|---|---|
| D | T-238-100 | 2 |

SHEET 15 OF 15 SHEETS


LEGEND
BOUNDARY
FENCE
PARKING AREAS
ROADS
TRAILS
BUILDINGS
IGLOOS
GATES
RAILROAD
SWITCHES
BROOKS
15" WATER MAIN (MAYNARD)
10" " " "
10" " INTAKE (MOTS)
WATER HOLES
DROP BAR BARRICADES
DRIVEN WELLS
DUG WELLS
HYDRANTS
HOSE BOXES
CULVERTS
LIGHT & POWER LINE POLE NOS.
A 4160 V., 3 Ø, 4 WIRE.
B 110-220 V., 1 Ø, 3 WIRE.
C 6.6 AMP. CONT. CURRENT ST. LIGHT
D 4160 V., 3 Ø, 3 WIRE. (HUDSON)
FIRE PHONES
MAYNARD ORDNANCE
TEST STATION
GENERAL LAYOUT
DRAWN BY
APPROVED
DATE 21-MARCH-1955
DATE
SCALE 1"=500 FT. APPROX.
REV. NO.
DESCRIPTION
BY
DATE
PUFFER POND
WILLIS POND
CRYSTAL LAKE
WHITE POND
HUDSON RD.
SUDBURY ROAD
POND ROAD
WHITE POND ROAD
TAYLOR BROOK
RESTRICTED AREA
BURNING GROUND
DEMO #1
DEMO #2
#1 TEST SIREN
#2 SIREN
#3 SIREN
#4 SIREN
#2 TEST SIREN
15" WATER MAIN TOWN OF MAYNARD
10" INTAKE M.O.T.S.
PUMPING STATION
WATER TOWER
TRACK "A"
TRACK "B"
TRACK "C"
TRACK "D"
TRACK "E"
TRACK "F"
TRACK "G"
TRACK "H"
TRACK "K"
TRACK "L"
TRACK #1
TRACK #2
TRACK #3
TRACK #4
C, D TO DEMO #2 ONLY
G-19 & G-20 AT BOUNDARY ON WOOD ROADS
CUTTINGS POND
N
S
E
W

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Next 28 Page(s) In Document Denied

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| 14 | Nitric-Hydrofluoric Acid Etch Test Specimens of Type 316 ELC Base Metal Welded with Type 309 Cb Electrodes | 13 |
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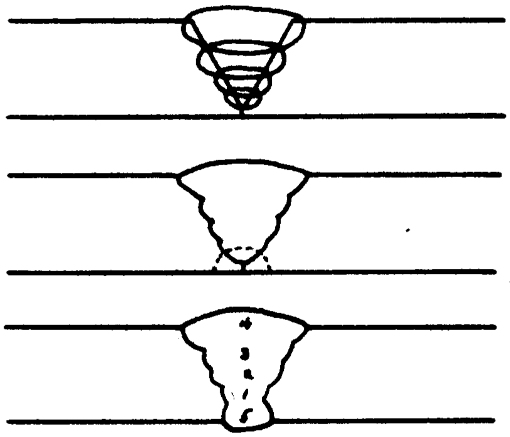
| 24 | Nitric Acid Corrosion Specimen from Type 347 Plate Welded with Type 347 Weld Metal | 21 |

## WELDING PROCEDURE



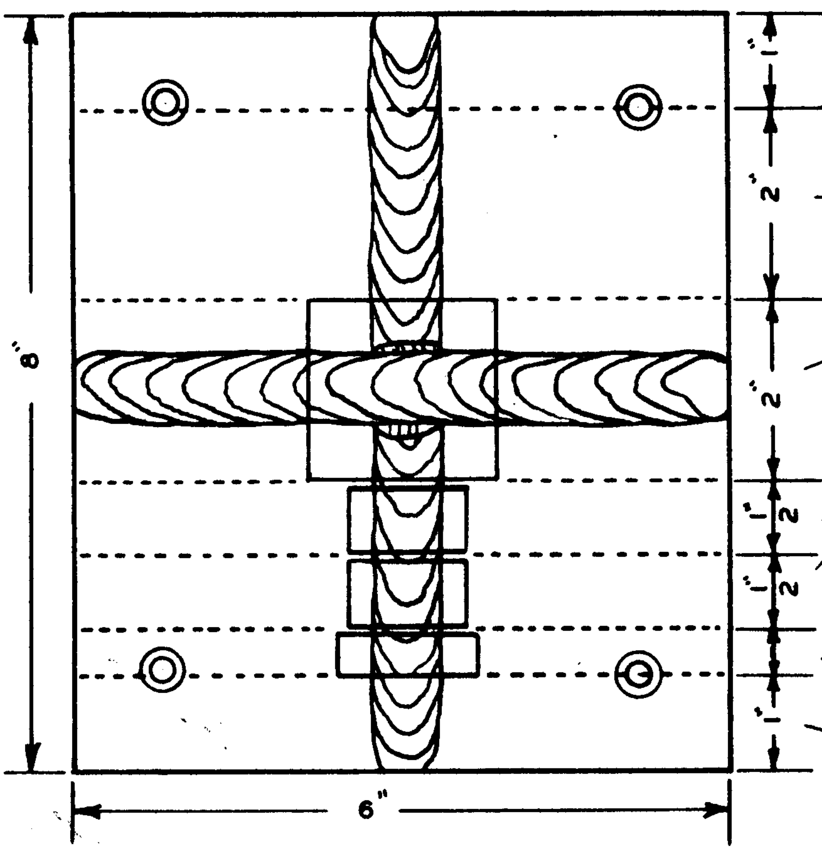
Deposit first two passes with 5/32" size electrode, third and fourth passes with 3/16" size electrode

Remove unfused root joint by chipping to insure complete penetration

Deposit final pass on back side with 3/16" size electrode

See Table I in APPENDIX II for detailed instructions on welding technique

## SAMPLING PROCEDURE




Discard portion

Hold for future work

Nitric-hydrofluoric acid etch test specimen. Size approximately 2" square x 1/2"

Duplicate specimens for boiling 65% nitric acid test. Size approximately 1-1/4" wide x 1/2" long x 1/2" thick

Metallographic specimen

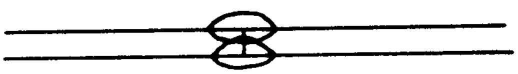
Discard portion

Only specimens to be tested in the as-welded condition will contain the horizontal cross weld joint

Figure 4. Welded Specimen of 1/2" Thick Plate

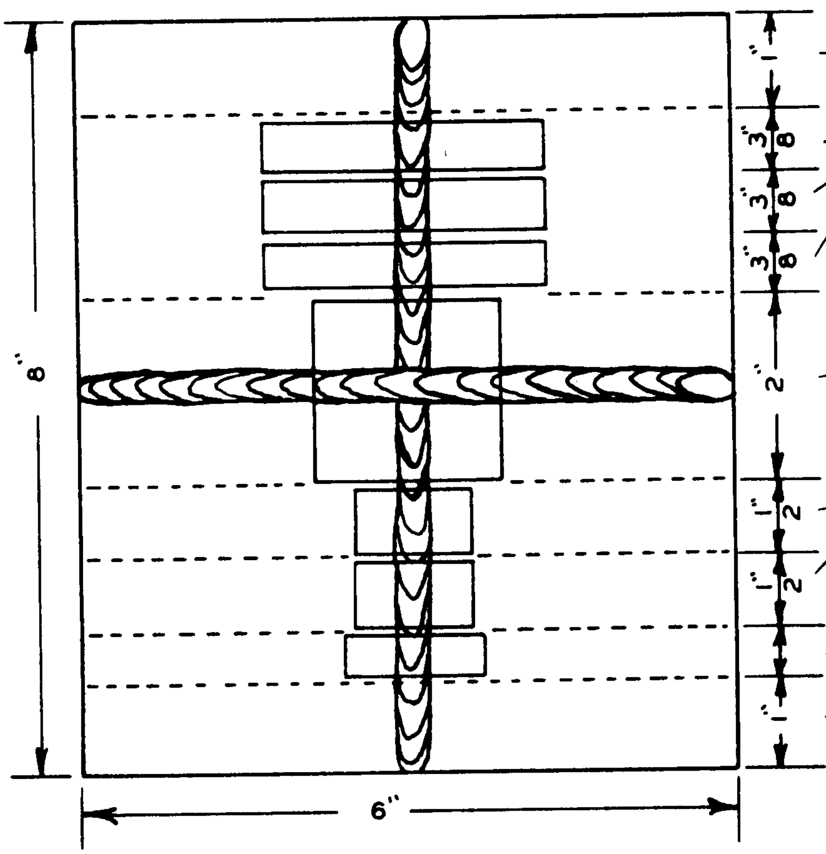
**WELDING PROCEDURE**

Deposit one pass on face side with 5/32" size electrode. Penetration need not be complete



Deposit final pass on back side with 5/32" size electrode. This pass must penetrate to meet bead deposited from face side to eliminate unfused notch

See Table II in APPENDIX II for detailed instructions on welding technique




Discard portion

Triplicate specimens for intergranular corrosion test in boiling sulphuric acid-copper sulphate solution. Size approximately 3" wide x 3/8" long x 1/8" thick

Nitric-hydrofluoric acid etch test specimen. Size approximately 2" square x 1/8" thick

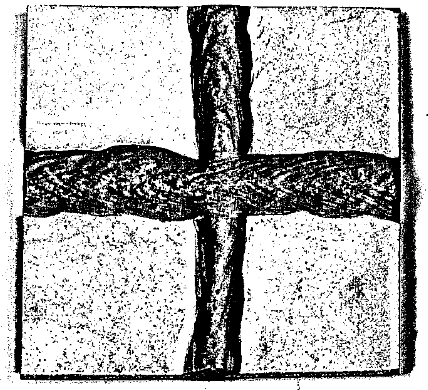
Duplicate specimens for boiling 65% nitric acid test. Size approximately 1-1/4" wide x 1/2" long x 1/8" thick

Metallographic specimen

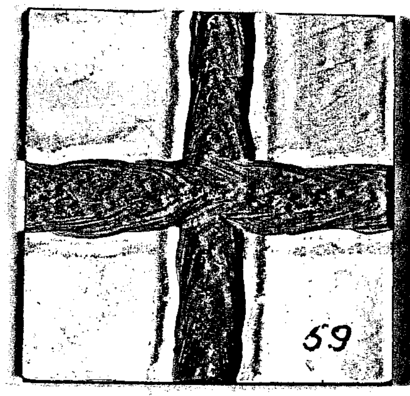
Discard portion

Only specimens to be tested in the as-welded condition will contain the horizontal cross weld joint

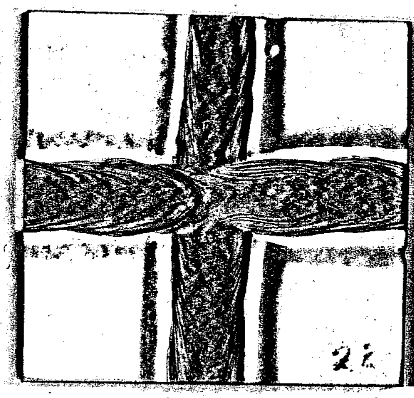
Figure 5. Welded Specimen of 1/8" Thick Sheet



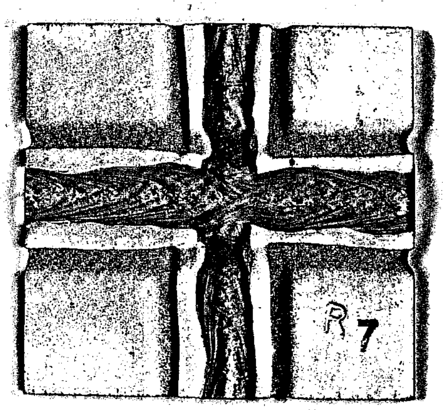
I - No Evidence of Weld Decay




II - Faint Etching Parallel to Weld, No Attack Visible on Cross Section




III - Slight Evidence of Weld Decay, With Slight Attack on Cross-Section




IV - Severe Weld Decay

**Remainder of Base Metal**

a - Light general attack
b - Moderate general attack
c - Severe general attack

Figure [illegible]. Arbitrary Standards Used in Rating Nitric-Hydrofluoric Acid Etch Test Specimens for Weld Decay in Base Metal Heat-Affected Zone

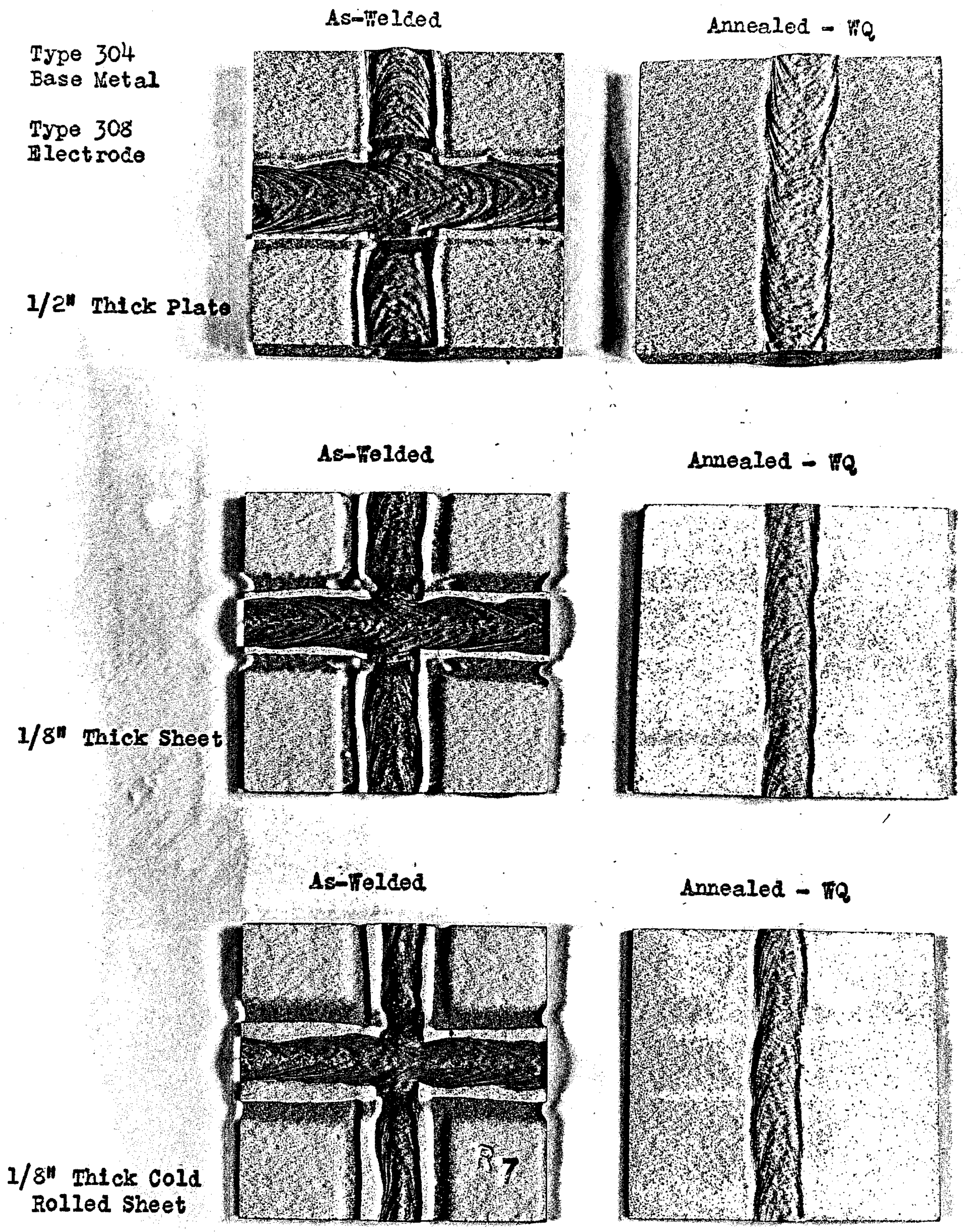



Figure 7. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 304 Base Metal Welded with Type 308 Electrodes. Full Size.

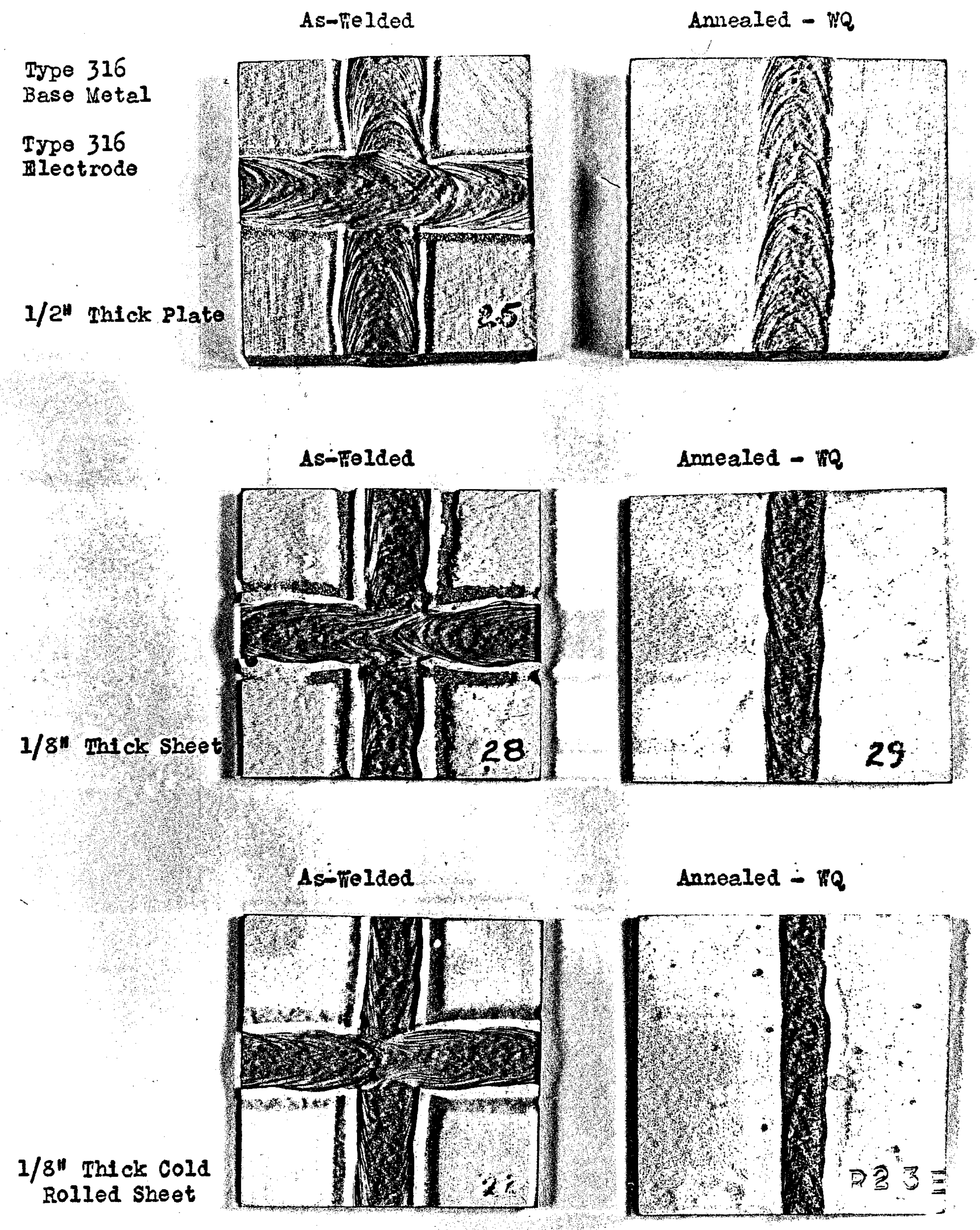



Figure 8. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 316 Base Metal Welded with Type 316 Electrodes. Full Size.

As-Welded | Stress-Relieved

Type 347 Base Metal

Type 347 Electrode

1/2" Thick Plate

1/8" Thick Sheet

1/8" Thick Cold Rolled Sheet

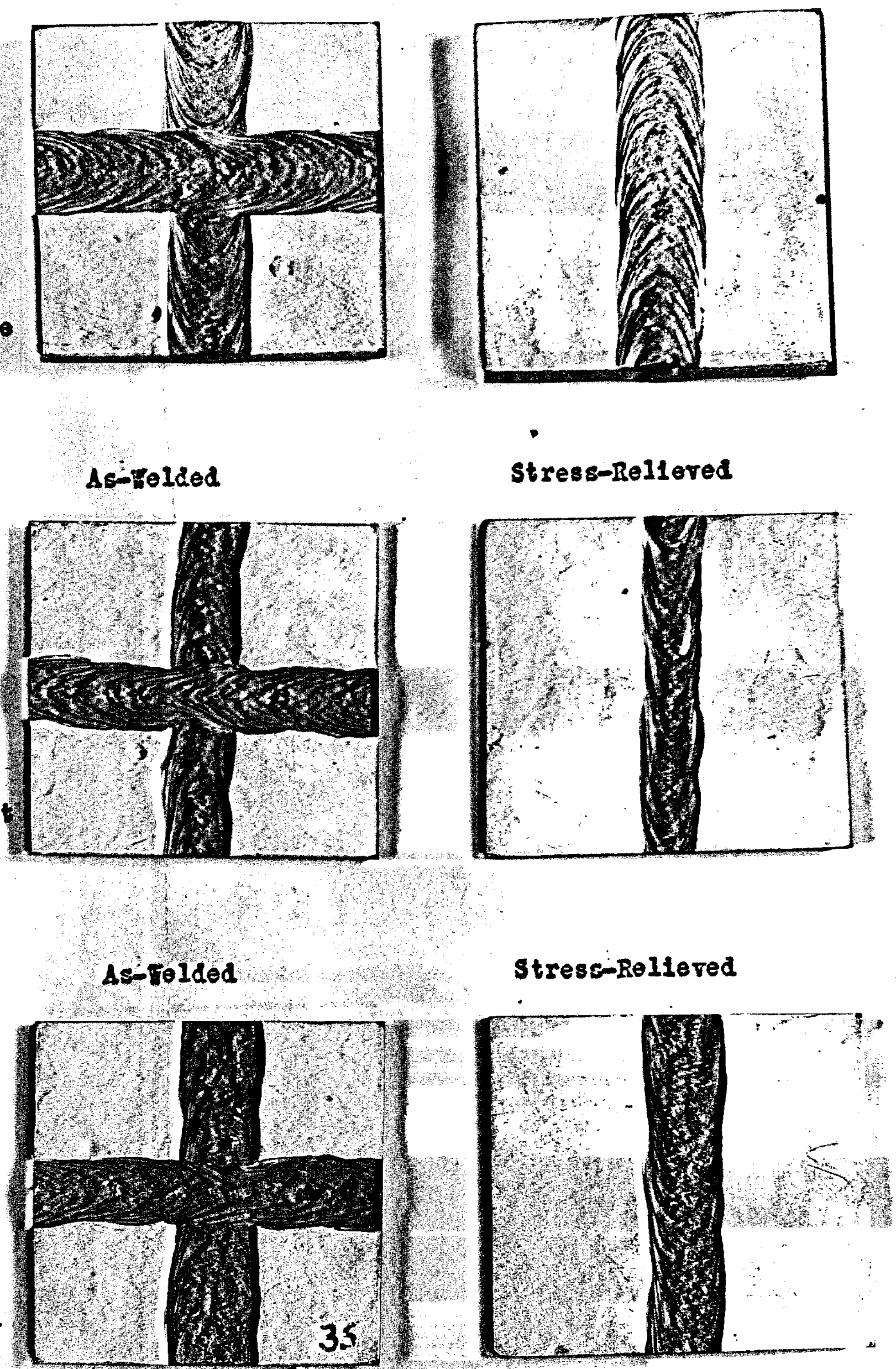



Figure 9. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 347 Base Metal Welded with Type 347 Electrodes. Full Size.

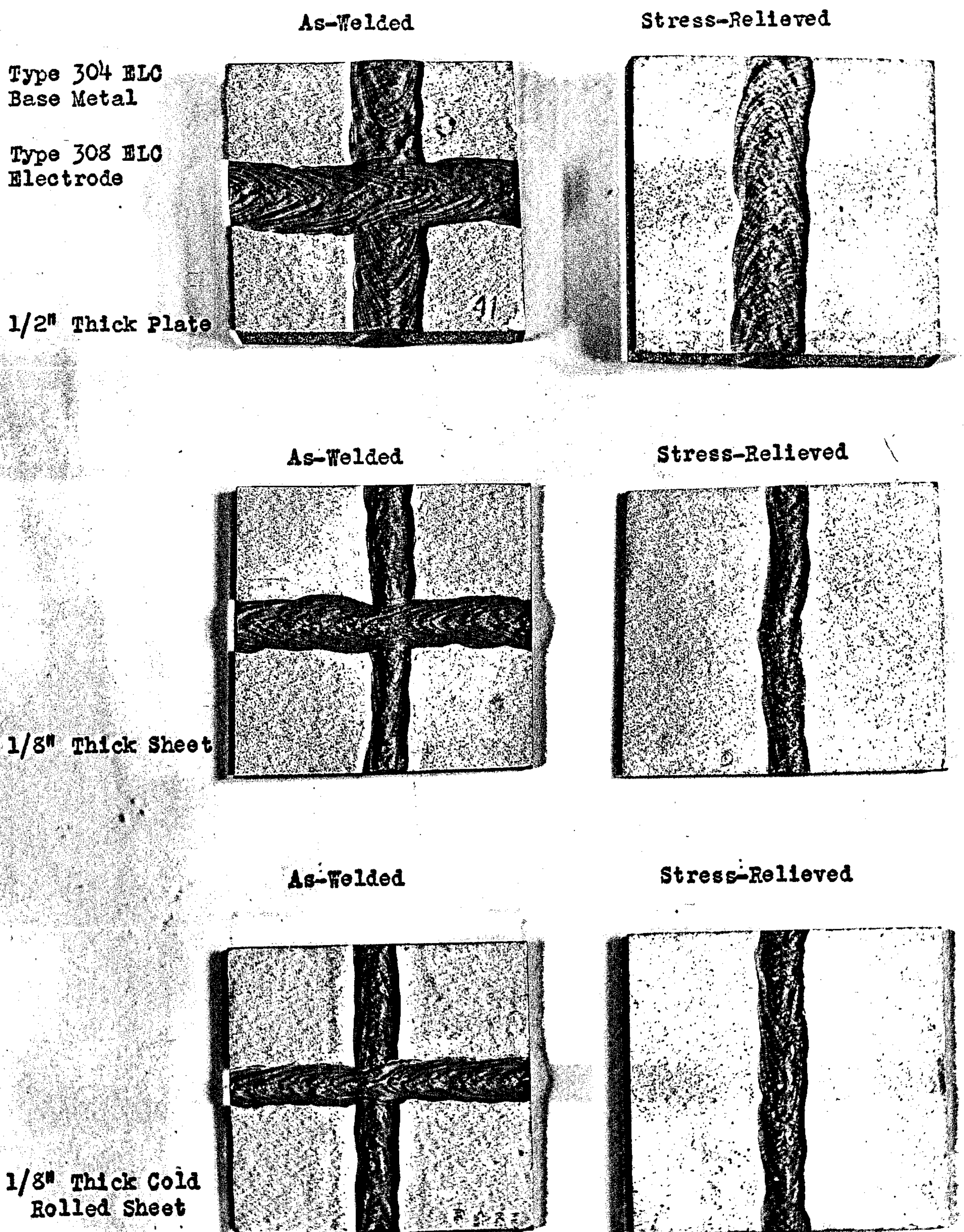



Figure 10. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 304 ELC Base Metal Welded with Type 308 ELC Electrodes. Full Size.

Type 304 ELC Base Metal

Type 347 Electrode

1/8" Thick Sheet

Type 304 ELC Base Metal

Type 308 ELC (Austenitic) Electrode

1/2" Thick Plate

Type 316 ELC Base Metal

Type 316 ELC (Austenitic) Electrode

1/2" Thick Plate

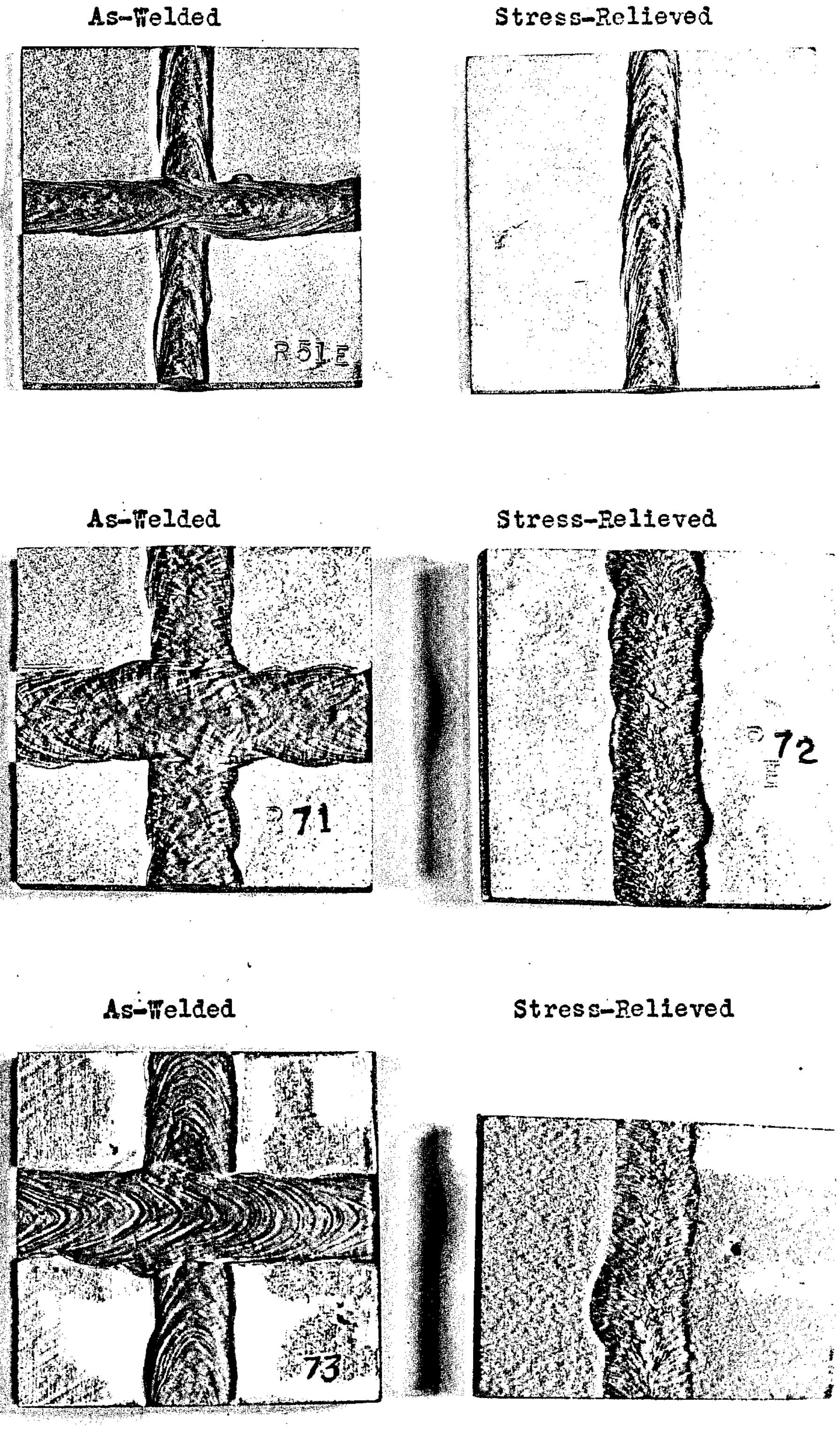
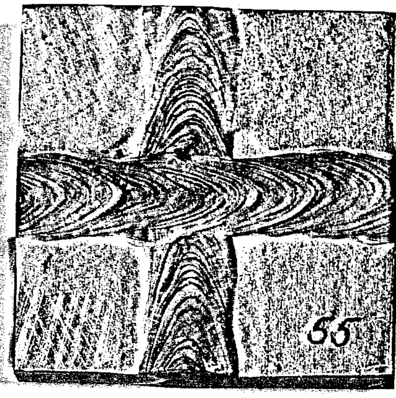



Figure 11. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens Representing Various Combinations of Materials as Indicated Above. Full Size

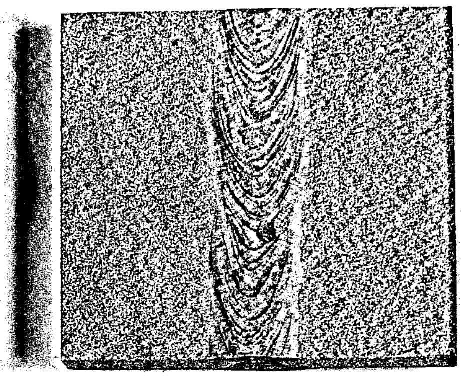
Type 316 ELC Base Metal

Type 316 ELC Electrode

**As-Welded**

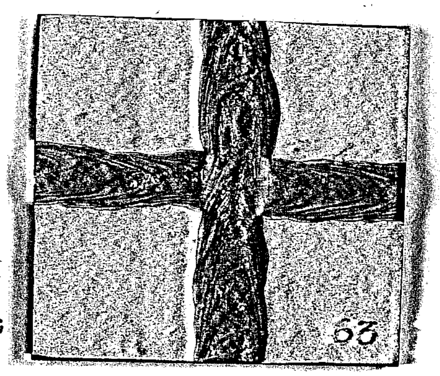



**Stress-Relieved**

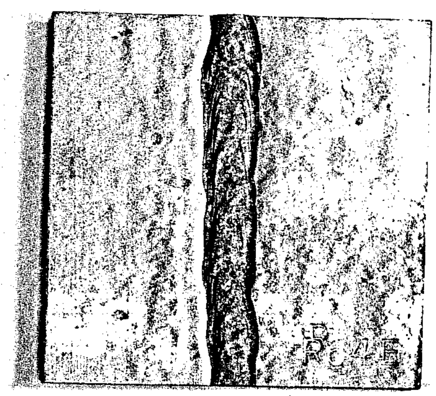


1/2" Thick Plate

**As-Welded**

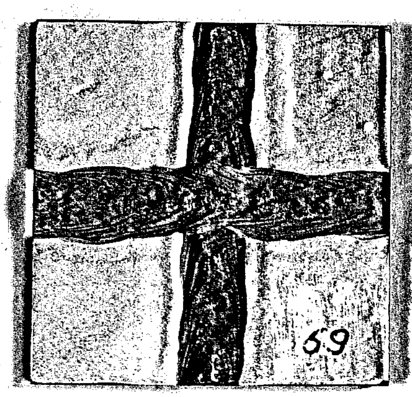



**Stress-Relieved**

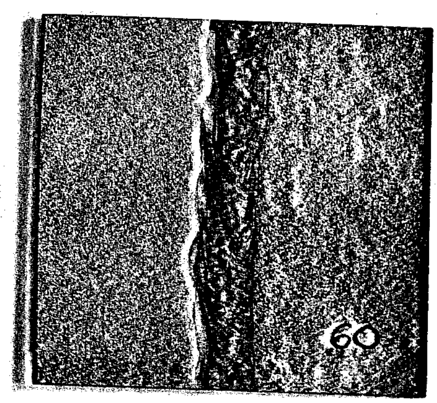


1/8" Thick Sheet

**As-Welded**




**Stress-Relieved**




1/8" Thick Cold Rolled Sheet

Figure 12. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 316 ELC Base Metal Welded with Type 316 ELC Electrodes. Full Size.

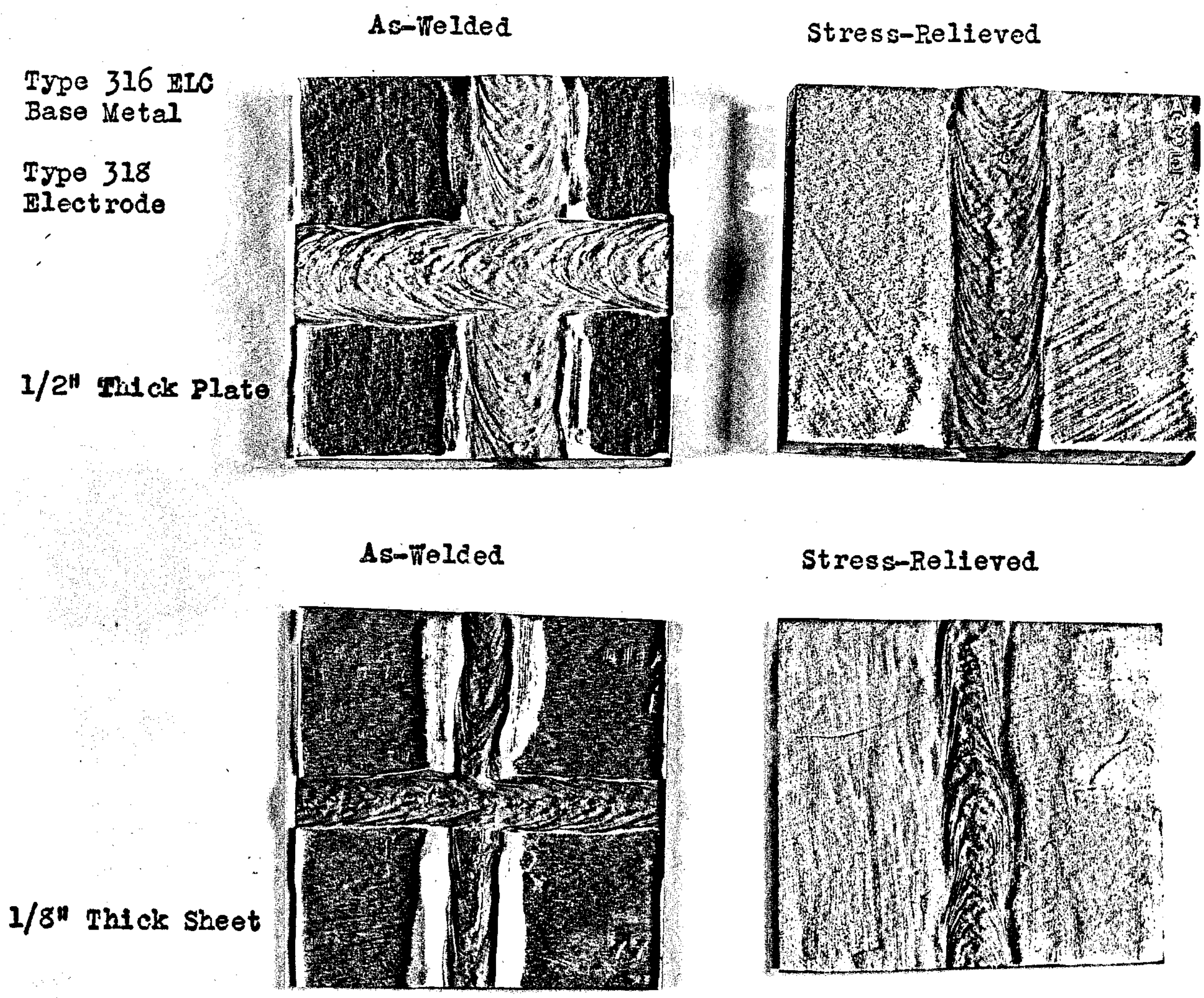



Figure 13. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 316 ELC Base Metal Welded with Type 318 Electrodes. Full Size.

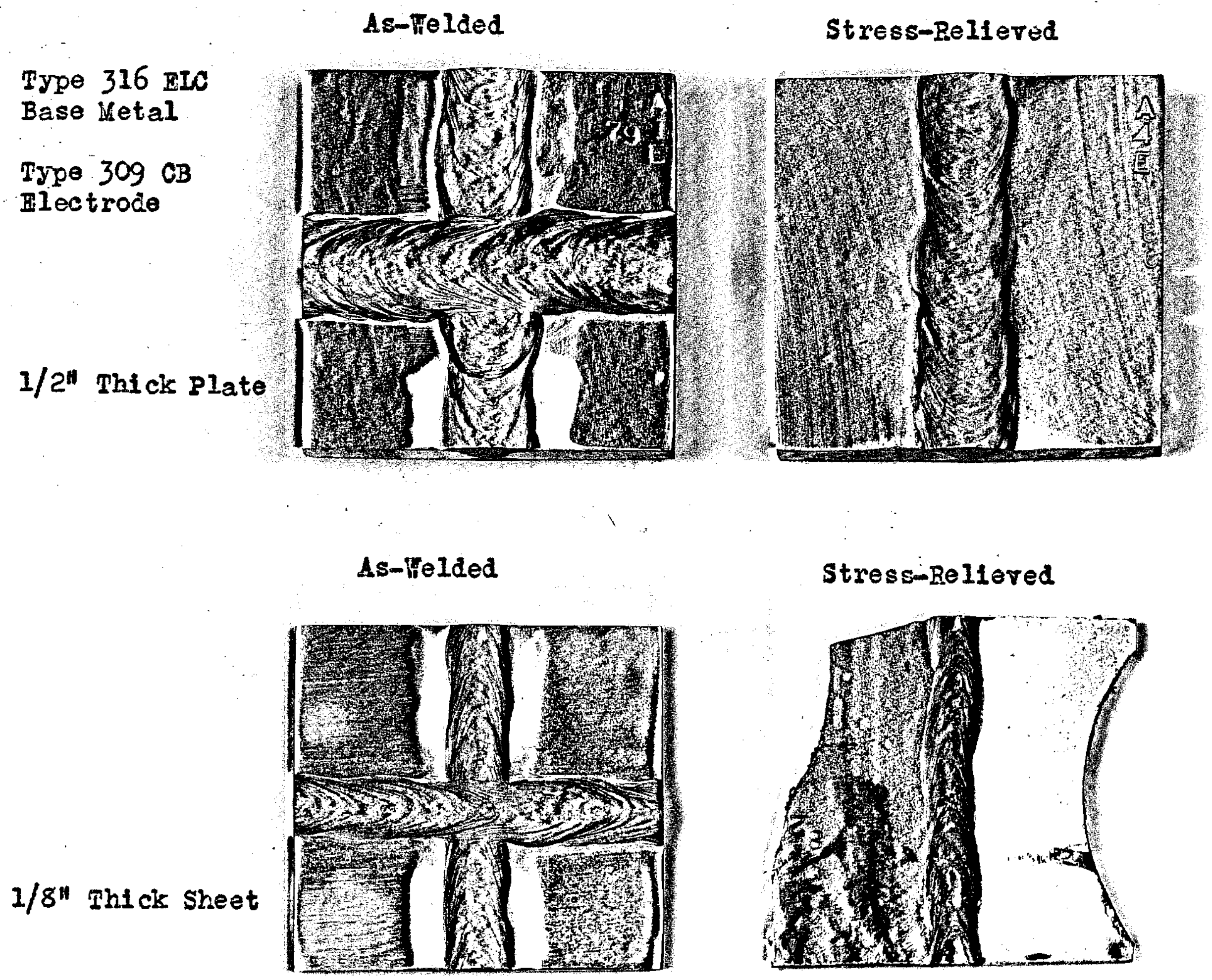



Figure 14. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 316 ELC Base Metal Welded with Type 309 Cb Electrodes. Full Size.

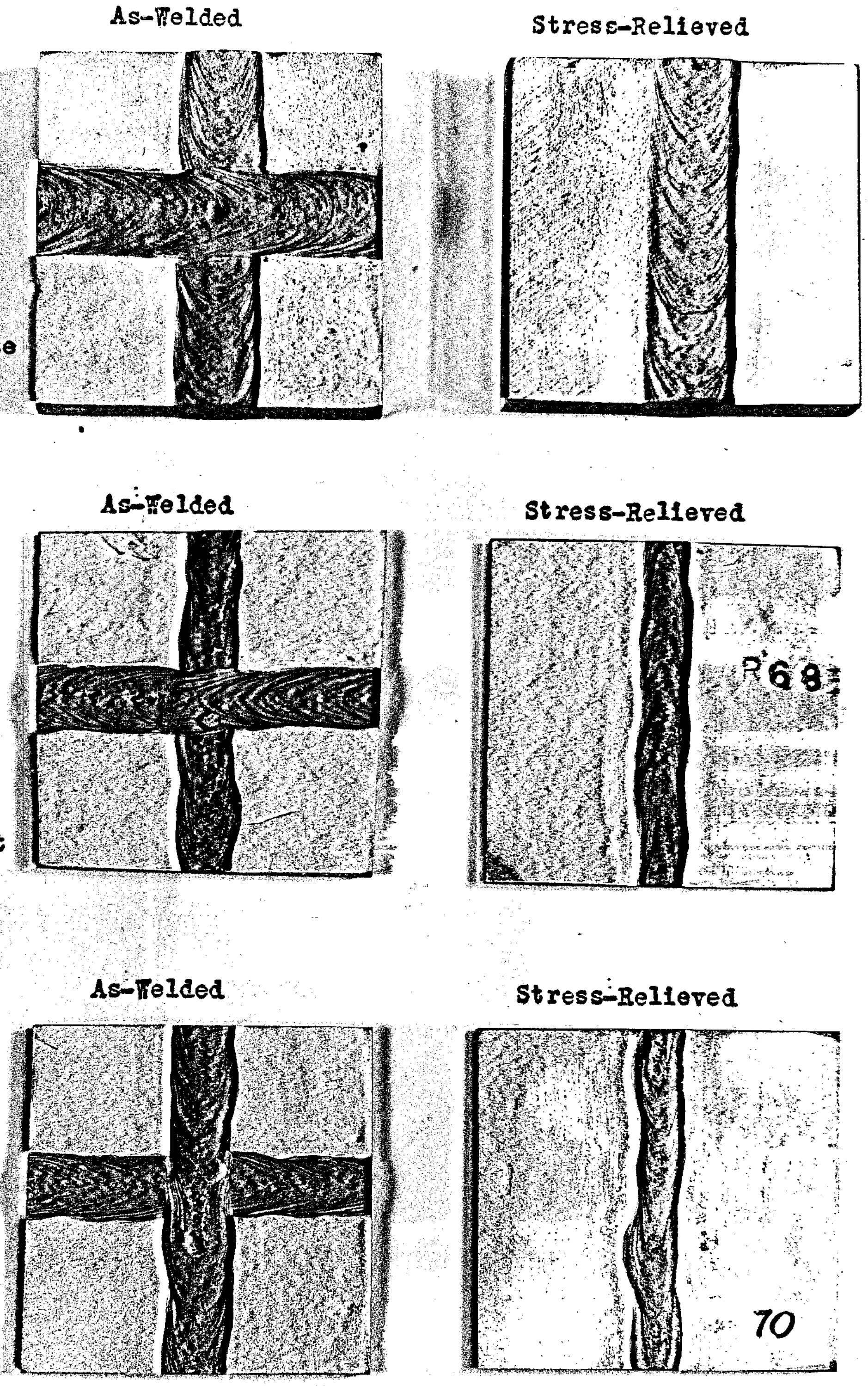
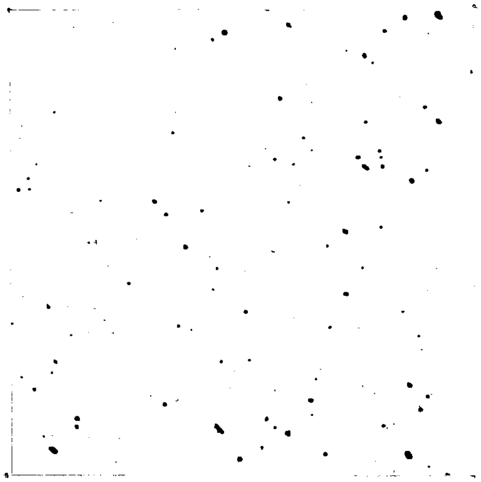
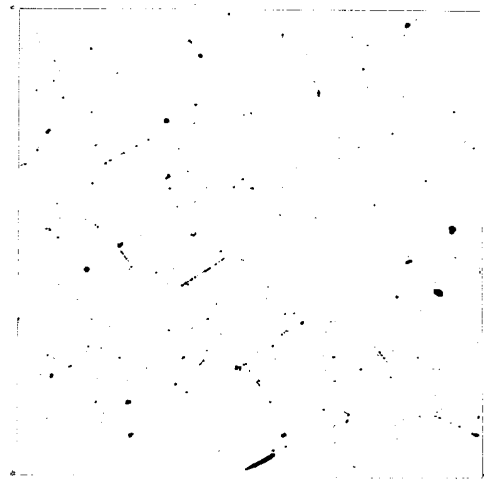


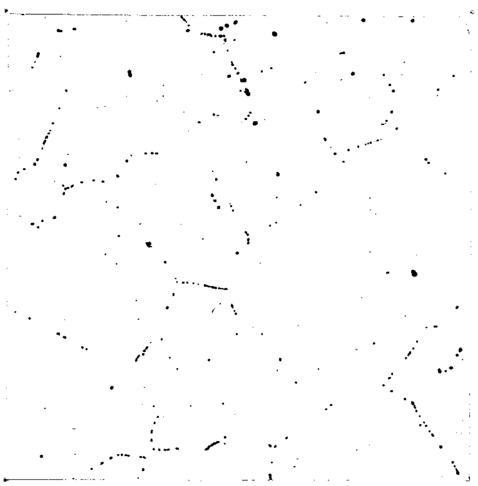

Figure 15. Appearance of Nitric-Hydrofluoric Acid Etch Test Specimens. Type 347 ELC Base Metal Welded with Type 347 ELC Electrodes. Full Size.



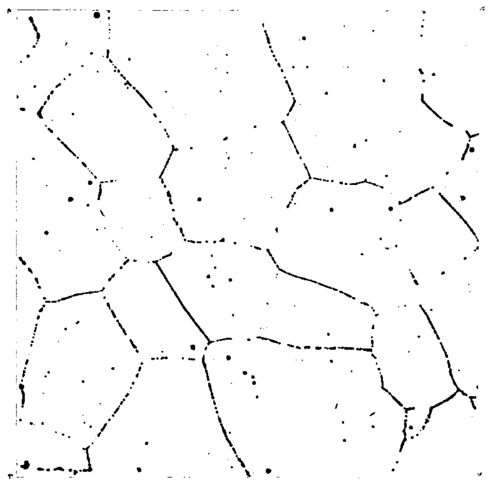
#1 - No Precipitated Carbides



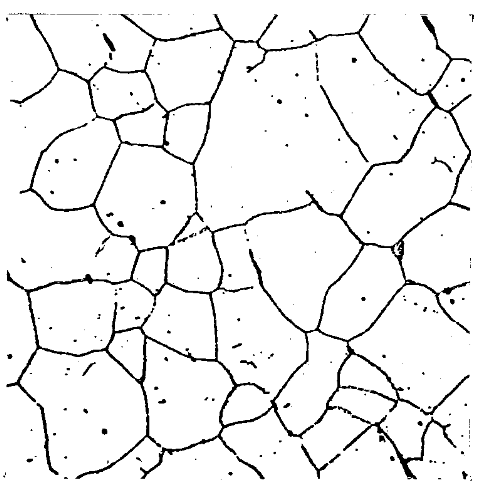
#2 - Scattered Intergranular Precipitated Carbides



#3 - Semi-Continuous Network of Precipitated Carbides



#4 - Almost Continuous Network of Precipitated Carbides



#5 - Continuous Network of Precipitated Carbides

Etchant

Sodium cyanide solution 10% used electrolytically. Specimen anodic; current about 0.5 ampere. Time 5 minutes.

Figure 16. Arbitrary Standards Used in Rating Base Metal Microstructure for Intergranular Carbide Precipitation

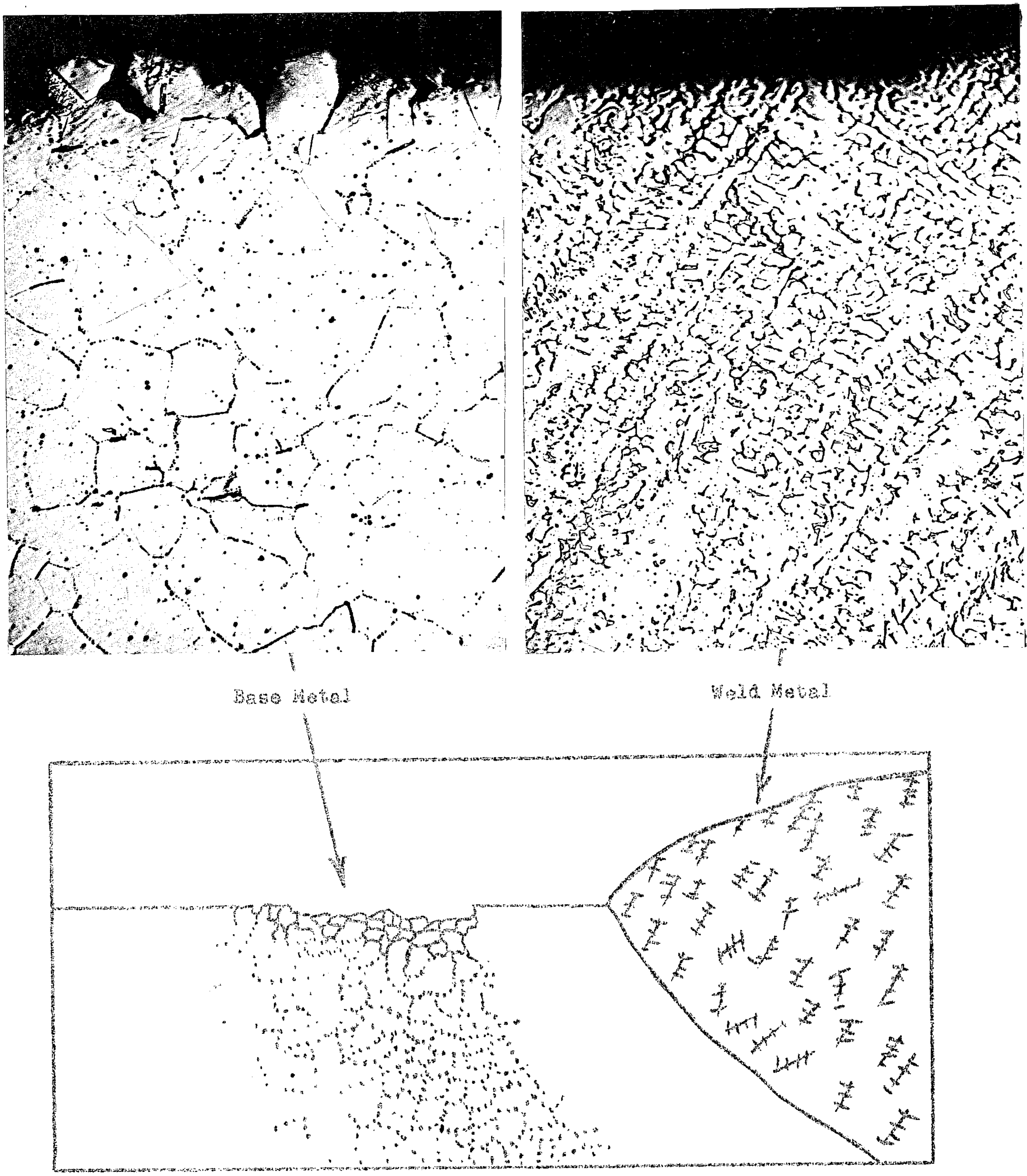



Figure 17. Nitric Acid Corrosion Specimen from 1/8" Thick Test Plate No. 13. Type 304 Base Metal and Type 308 Weld Metal. As-Welded Condition. Note Intergranular Corrosive Attack on Sensitized Zone in Base Metal. Mu 50847. Etchant: 10% NaCN Electrolytic. Mag. 250X

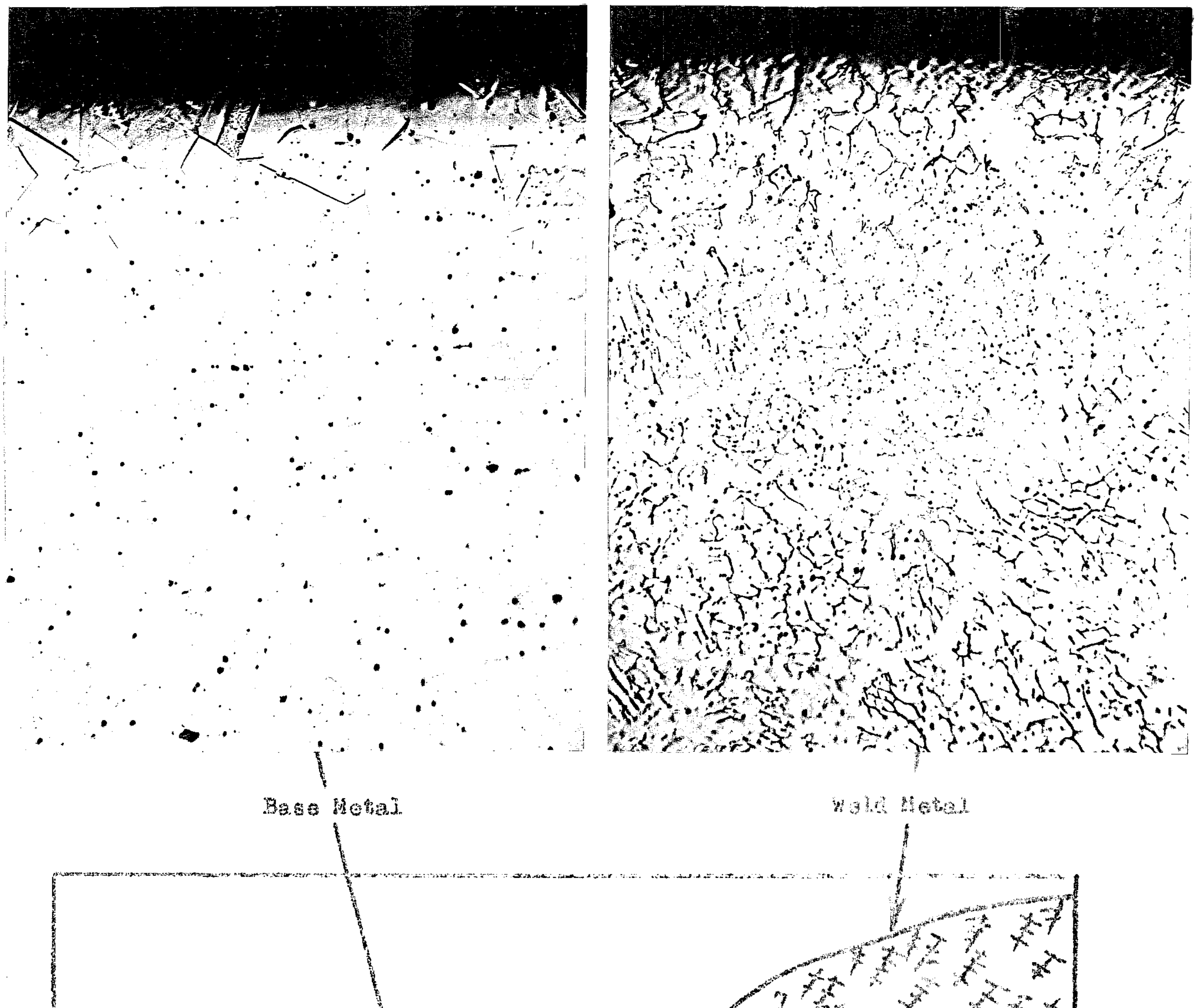



Figure 18. Nitric Acid Corrosion Specimen from 1/8" Thick Test Plate No. 43. Type 304 ELC Base Metal and Type 308 ELC Weld Metal. As-Welded Condition. Note Absence of Any Intergranular Corrosive Attack or Sensitized Zone in Base Metal. ML 50848. Etchant: 10% NaCN Electrolytic. Mag. 250X

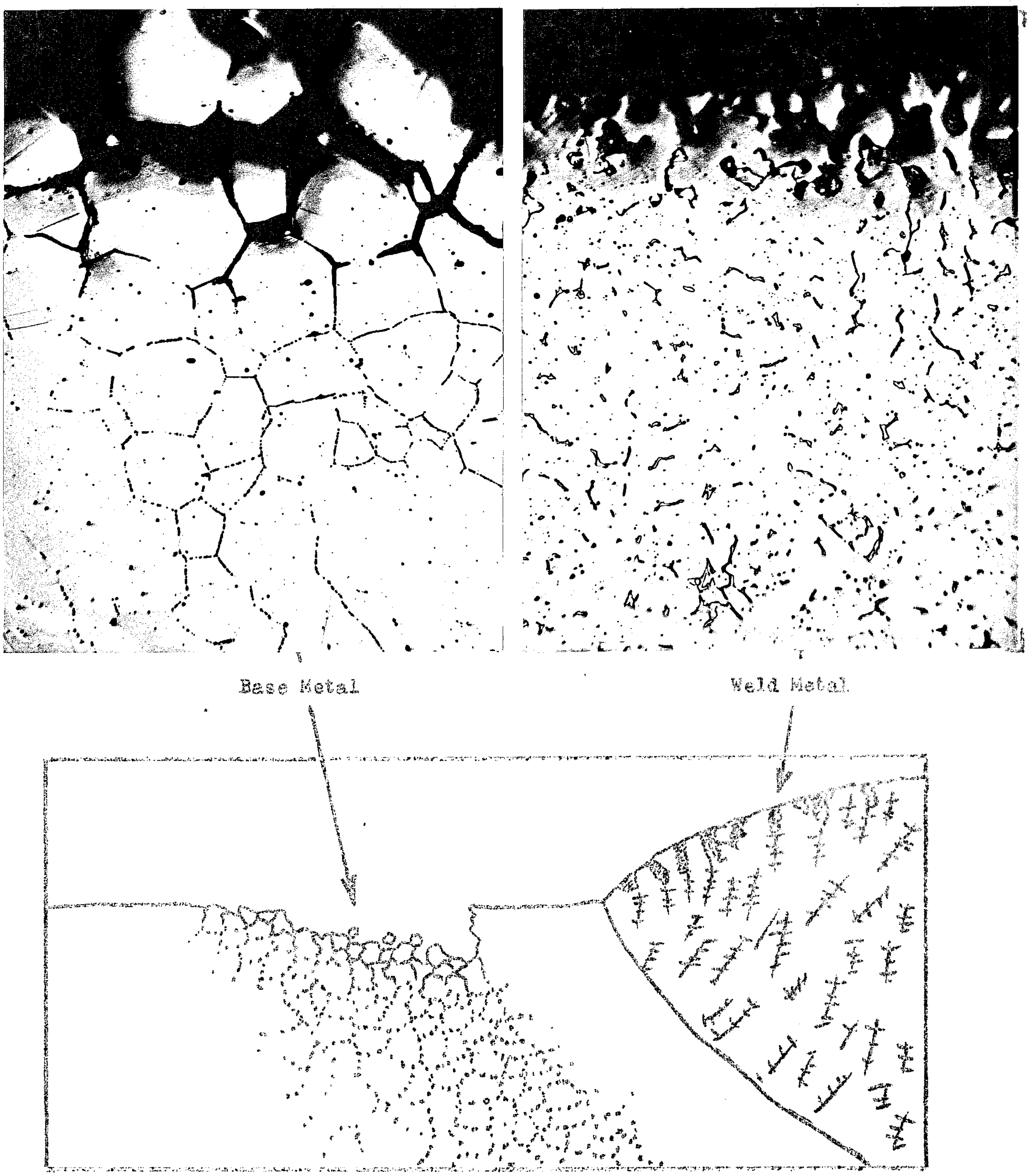



Figure 19. Nitric Acid Corrosion Specimen from 1/8" Thick Test Plate No. 28. Type 316 Base Metal and Type 316 Weld Metal. As-Welded Condition. Note Intergranular Corrosive Attack on Sensitized Zone in Base Metal. Also Note Severe Attack on Weld Metal Which is Promoted by Ferrite in the Structure. ML 50850. Etchant: 10% NaCN Electrolytic. Mag. 250X

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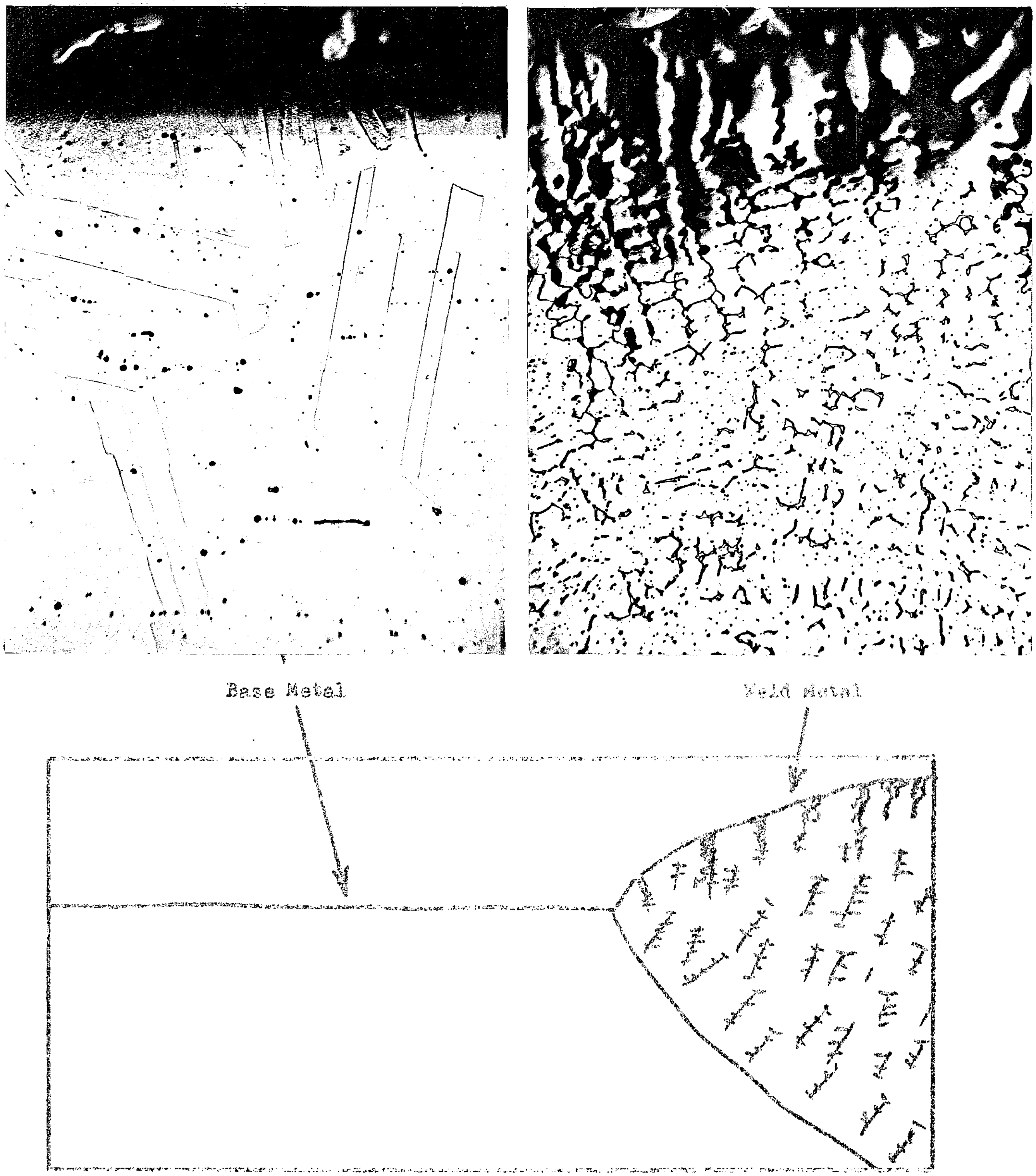


Figure 20. Nitric Acid Corrosion Specimen from 1/8" Thick Test Plate No. 57. Type 316 ELC Base Metal and Type 316 ELC Weld Metal. As-Welded Condition. Note Absence of Any Intergranular Corrosive Attack or Sensitized Zone in Base Metal. Severe Corrosive Attack on Weld Metal is Promoted by Ferrite in the Structure. ML 50851. Etchant: 10% NaCN Electrolytic. Mag. 250X

Weld Metal Surface

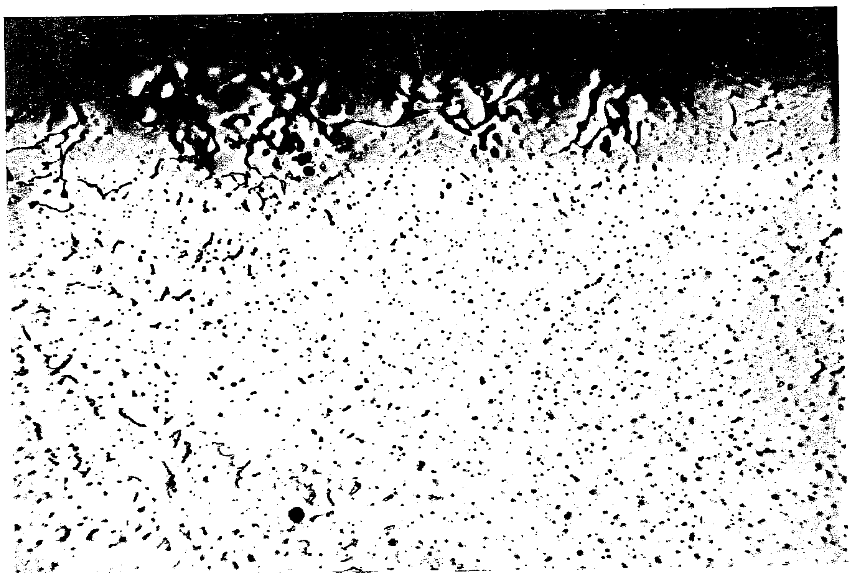

Figure 21. Nitric Acid Corrosion Specimen from 1/8" Thick Test Plate No. 77. Type 316 ELC Base Metal and Type 318 Weld Metal. As Welded Condition. Although this Specimen Produced a Very Satisfactory Test Rate (.0006 IPM), Strong Localized Attack Took Place Wherever Traces of Ferrite Were Exposed at the Weld Surface. ML 50853. Etchant: 10% NaCN Electrolytic. Mag. 250X.

Weld Metal Surface

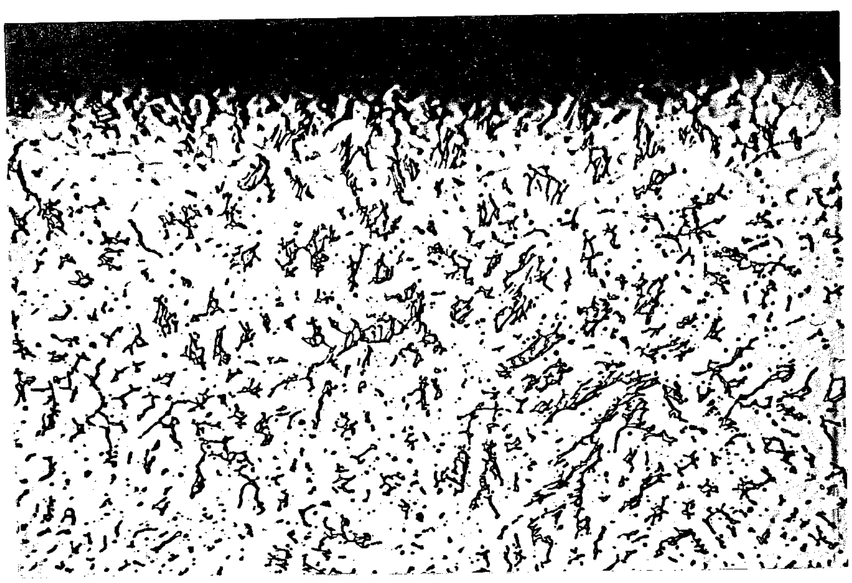

Figure 22. Nitric Acid Corrosion Specimen from 1/8" Thick Test Plate No. 81. Type 316 ELC Base Metal and Type 309 Cb Weld Metal. As-Welded Condition. Note Absence of Any Localized Corrosive Attack on Weld Metal Despite Presence of Considerable Amount of Ferrite in Structure. ML 50854. Etchant: 10% NaCN Electrolytic.

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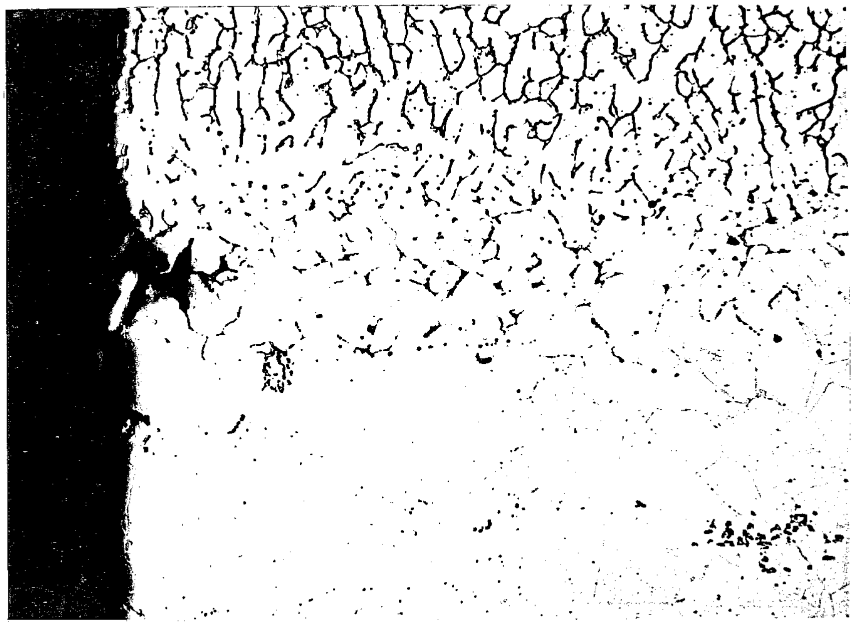
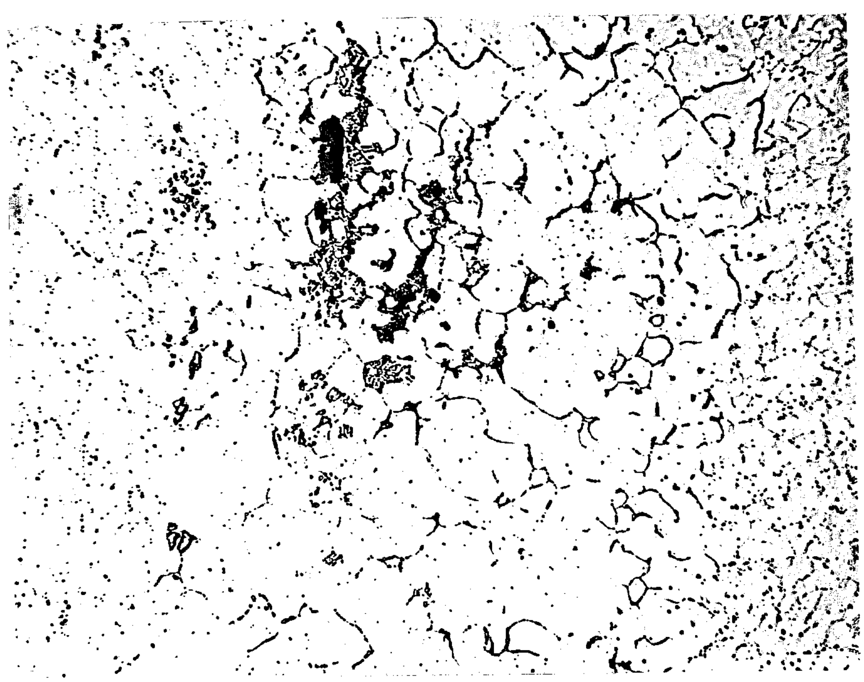
Weld Metal



Base Metal

Figure 23. Nitric Acid Corrosion Specimen from 1/2" Thick Test Plate No. 31 Type 347 Base and Weld Metal. As-Welded Condition. Section Through Area of Localized Attack Immediately Adjacent to the Weld Metal. ML 49243. Etchant: Mixed Acids. Mag. 250X.

Base Metal



Weld Metal

Figure 24. Same Metallographic Specimen as Illustrated in Figure 23, but Another Field Along Fusion Line Showing Carbide Eutectic in Base Metal Immediately Adjacent to Weld. ML 49243. Etchant: 10% NaCN Electrolytic. Mag. 250X.

## Index to Tables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| III | Materials and Conditions | 4 |
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| VI | All-Weld-Metal Tensile Properties | 9 |
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| IX | Microstructure of Welded Specimens | 25 |

## Table I

## Procedure for Welding Specimens of 1/2" Thick Plate

(1) Refer to Figure 4 for specimen size and details.

(2) Two base metal pieces, with matching root faces, were placed together in flat position and tack welded at each extreme end. Specimens were free of grease and oil.

(3) Six specimens were placed in the welding jig and clamped with a torque force of 30 ft/lbs on each nut.

(4) One pass was deposited in each of the six plates in a regular repeated manner of rotation. The interpass temperature was 300°F maximum.

(5) The joint was filled from the "face" side with two layers from a 5/32" size electrode followed by two layers from a 3/16" size electrode. Each layer represented a full weave continuous pass. As a matter of record, all layers in given joint were deposited in the same direction.

(6) Upon deposition of the fourth layer in the groove on the face side, the specimens were unclamped and taken from the jig to permit removal of the unfused root joint by chipping from the back side with a 1/4" wide gouge.

(7) Specimens were placed in jig with back side up, and not clamped to allow normal distortion to level plates. The chipped groove in the back side was filled with one pass from a 3/16" size electrode.

(8) The welding current used to deposit electrodes of all grades was 140/145 amperes - 25 closed circuit volts in the case of the 5/32" size, and 170 amperes - 24 closed circuit volts in the case of the 3/16" size as determined by meter readings.

(9) Only specimens tested in the "as-welded" condition contained a cross weld. This second weld joint was made by cutting the specimen into halves normal to the first weld joint, and rebeveling the newly cut edges. The welding procedure outlined above was then repeated.

(10) In depositing the final face and back beads for the second joint, no change was made in electrode travel speed or manipulation as it passed the intersection with the first joint to fill up any gap left by beveling the crown of the beads.

## Table II

## Procedure for Welding Specimens of 1/8" Thick Sheet

(1) Refer to Figure 5 for specimen size and details.

(2) Two base metal pieces, with matching 8" long sides, were placed in butt-joint position and tack welded at each extreme end. Specimens were free of grease and oil.

(3) Six specimens were placed in the welding jig. Shim bars 3/8" thick were to be placed under the clamping plates. Specimens were clamped with a torque force of 30 ft/lbs on each nut.

(4) One pass was deposited on the face side of each sheet specimen using a 5/32" size electrode. This bead did not penetrate completely through the 1/8" section, but did penetrate at least half-way through.

(5) After depositing one pass on the face side, the specimens were unclamped, turned over, and reclamped. One pass was then deposited in the joint from the back side using a 5/32" size electrode to completely penetrate the joint (layer deposited in reverse direction as that on the face side). The specimens cooled to room temperature before the operator deposited the second pass on the back side of each.

(6) The welding current for the 5/32" size electrode regardless of grade was 140/145 amperes - 25 closed circuit voltage.

(7) Only specimens to be tested in the "as-welded" condition contained a cross weld. The second weld joint was made by cutting the specimen into halves normal to the first weld joint, and reassembling the newly cut edges. The welding procedure outlined above was then repeated.

(8) In depositing beads for the second weld joint, no change was made in electrode travel speed or manipulation as it passed the intersection with the first joint to fill up any gap left by beveling the crown of the beads.

APPENDIX II - 4

## Table III

### Materials and Conditions

| Test No. | Base Materials Grade | Heat | Size | Welding Electrodes Grade | Code No. | Conditions* AT | A-1M | A-1C | SR |
|---|---|---|---|---|---|---|---|---|---|
| 1-3 | Type 304 | 45224 | 1/2" Plate | Type 308 | Airco | X | X | X | |
| 4-6 | | | 1/8" Sheet | | E1&E2 | X | X | X | |
| 7-9 | | | 1/8" CR Sheet | | | X | X | X | |
| 10-12 | | 45854 | 1/2" Plate | | | X | X | X | |
| 13-15 | | | 1/8" Sheet | | | X | X | X | |
| 16-18 | Type 316 | 46485 | 1/2" Plate | Type 316 | Airco | X | X | X | |
| 19-21 | | 56668 | 1/8" Sheet | | E3&E4 | X | X | X | |
| 22-24 | | | 1/8" CR Sheet | | | X | X | X | |
| 25-27 | | 46461 | 1/2" Plate | | | X | X | X | |
| 28-29 | | | 1/8" Sheet | | | X | X | | |
| 30 | | 56668 | 1/8" Sheet | | | | | X | |
| 31-32 | Type 347 | 56713 | 1/2" Plate | Type 347 | Airco | X | | | X |
| 33-34 | | | 1/8" Sheet | | E5&E6 | X | | | X |
| 35-36 | | | 1/8" CR Sheet | | | X | | | X |
| 37-38 | | 56715 | 1/2" Plate | | | X | | | X |
| 39-40 | | | 1/8" Sheet | | | X | | | X |
| 41-42 | Type 304 | 56708 | 1/2" Plate | Type 308 | Lab | X | | | X |
| 43-44 | ELC | | 1/8" Sheet | ELC | E7&E8 | X | | | X |
| 45-46 | | | 1/8" CR Sheet | | | X | | | X |
| 47-48 | | 46424 | 1/2" Plate | | | X | | | X |
| 49-50 | | | 1/8" Sheet | | | X | | | X |
| 51-52 | | 56708 | 1/8" Sheet | Type 347 | Airco | X | | | X |
| 53-54 | | 46424 | 1/8" Sheet | | E5&E6 | X | | | X |
| 71-72 | | 56708 | 1/2" Plate | Type 308 ELC (Austenitic) | Lab E13&E14 | X | | | X |

Table III (Con't)

Materials and Conditions

| Test No. | Base Materials Grade | Heat | Size | Welding Electrodes Grade | Code No. | Conditions* AW | A-WQ | A-AC | SR |
|---|---|---|---|---|---|---|---|---|---|
| 55-56 | Type 316 | 56592 | 1/2" Plate | Type 316 | Lab | X | | | X |
| 57-58 | ELC | | 1/8" Sheet | ELC | E9&E10 | X | | | X |
| 59-60 | | | 1/8" CR Sheet | | | X | | | X |
| 61-62 | | 56740 | 1/2" Plate | | | X | | | X |
| 63-64 | | | 1/8" Sheet | | | X | | | X |
| 73-74 | | 56592 | 1/2" Plate | Type 316 ELC (Austenitic) | Lab E15&E16 | X | | | X |
| 75-76 | | 47378 | 1/2" Plate | Type 318 | (Airco E43) | X | | | X |
| 77-78 | | | 1/8" Sheet | | (Arcos E61) | X | | | X |
| 79-80 | | | 1/2" Plate | Type 309 | Airco | X | | | X |
| 81-82 | | | 1/8" Sheet | Cb | E62&E63 | X | | | X |
| 65-66 | Type 347 | 57178 | 1/2" Plate | Type 347 | Lab | X | | | X |
| 67-68 | ELC | | 1/8" Sheet | ELC | E11&E12 | X | | | X |
| 69-70 | | | 1/8" CR Sheet | | | X | | | X |

*Explanation of Symbols

AW - As-Welded
A-WQ - Annealed 1950°F - 30 minutes - water quenched
A-AC - Annealed 1950°F - 30 minutes - air cooled
SR - Stress-Relieved 1600°F - 2 hours - air cooled

Note: Chromium-nickel-molybdenum grades of base metal were annealed from a temperature of 2050°F.

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Table IV

Chemical Composition of Materials

Base Materials: 1/2" Plate and 1/8" Sheet(1)

| Type No. | Heat No. | C | Mn | P | S | Si | Cr | Ni | Mo | Cb | N | Cb/C Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 304 | 45224 | .050 | .60 | .024 | .012 | .54 | 18.20 | 9.03 | | .027 | .030 | |
| | 45854 | .064 | .56 | .025 | .011 | .58 | 18.22 | 8.97 | | .005 | .046 | |
| 316 | 46485 | .053 | 1.75 | .023 | .014 | .62 | 17.50 | 12.47 | 2.21 | .011 | .024 | |
| | 56668 | .046 | 1.86 | .026 | .020 | .67 | 17.17 | 12.56 | 2.18 | .007 | .024 | |
| | 46461 | .066 | 1.89 | .023 | .025 | .57 | 17.60 | 12.50 | 2.20 | .006 | .035 | |
| 347 | 56713 | .058 | 1.40 | .026 | .021 | .45 | 18.51 | 11.10 | | .75 | .014 | 12.9 |
| | 56715 | .048 | 1.76 | .026 | .020 | .58 | 18.58 | 11.27 | | .87 | .014 | 18.1 |
| 304 ELC | 56708 | .028 | .67 | .023 | .011 | .56 | 18.44 | 9.60 | | .007 | .020 | |
| | 46424 | .029 | .60 | .024 | .009 | .44 | 18.47 | 9.17 | | .010 | .014 | |
| 316 ELC | 56592 | .031 | 1.99 | .023 | .008 | .46 | 18.34 | 13.26 | 2.51 | .013 | .012 | |
| | 56740 | .029 | 1.83 | .022 | .019 | .48 | 17.41 | 12.45 | 2.30 | .003 | .019 | |
| | 47378 | .029 | 1.93 | .023 | .016 | .57 | 18.12 | 13.51 | 2.34 | | .026 | |
| 347 ELC | 57178 | .029 | 1.44 | .023 | .010 | .52 | 18.58 | 10.88 | | .48 | .018 | 16.5 |

Weld Metal: Standard All-Weld-Metal Pads

| Type No. | Source | Code | C | Mn | P | S | Si | Cr | Ni | Mo | Cb | Cb/C Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 308 | Airco | 5/32-E1 | .070 | 2.02 | .022 | .007 | .83 | 20.30 | 9.72 | | | |
| | | 3/16-E2 | .071 | 2.01 | .020 | .006 | .66 | 20.34 | 9.76 | | | |
| 316 | Airco | 5/32-E3 | .079 | 2.25 | .026 | .010 | .71 | 18.83 | 12.85 | 2.32 | | |
| | | 3/16-E4 | .065 | 2.04 | .024 | .006 | .70 | 18.83 | 12.94 | 2.38 | | |

Table IV (Con't)

Chemical Composition of Materials

Weld Metal: Standard All-Weld-Metal Pads (con't)

| Type No. | Source | Code | C | Mn | P | S | Si | Cr | Ni | Mo | Cb | Cb/C Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 347 | Airco | 5/32-E5 | .060 | 1.94 | .025 | .008 | .65 | 19.37 | 9.65 | | .87 | 14.5 |
| | | 3/16-E6 | .063 | 1.94 | .024 | .008 | .70 | 19.30 | 9.59 | | .91 | 14.4 |
| 308 ELC | Lab | 5/32-E7 | .032 | 1.20 | .026 | .016 | .13 | 19.06 | 10.69 | | | |
| | | 3/16-E8 | .030 | 1.18 | .023 | .016 | .17 | 19.09 | 10.66 | | | |
| 308 ELC Austenitic | Lab | 5/32-E13 | .030 | 1.10 | .027 | .019 | .14 | 18.59 | 12.93 | | | |
| | | 3/16-E14 | .028 | 1.10 | .028 | .018 | .12 | 18.54 | 13.03 | | | |
| 316 ELC | Lab | 5/32-E9 | .033 | 1.20 | .023 | .010 | .15 | 17.71 | 13.41 | 2.56 | | |
| | | 3/16-E10 | .028 | 1.22 | .023 | .007 | .15 | 17.86 | 13.48 | 2.61 | | |
| 316 ELC Austenitic | Lab | 5/32-E15 | .032 | 1.12 | .024 | .009 | .13 | 17.40 | 15.56 | 2.56 | | |
| | | 3/16-E16 | .033 | 1.14 | .022 | .008 | .14 | 17.52 | 15.66 | 2.56 | | |
| 318 | Airco | 5/32-E43 | .073 | 1.99 | .017 | .008 | .65 | 19.07 | 12.62 | 2.17 | .58 | 8.0 |
| | Arcos | 3/16-E61 | .057 | 1.83 | .020 | .010 | .47 | 18.42 | 13.88 | 2.15 | .76 | 13.3 |
| 309 Cb | Airco | 5/32-E62 | .086 | 1.89 | .017 | .013 | .62 | 23.14 | 13.12 | | .80 | 9.3 |
| | | 3/16-E63 | .086 | 1.95 | .019 | .011 | .66 | 23.39 | 13.42 | | .89 | 10.3 |
| 347 ELC | Lab | 5/32-E11 | .038 | 1.05 | .026 | .019 | .44 | 18.46 | 10.48 | | .51 | 13.4 |
| | | 3/16-E12 | .037 | 1.04 | .025 | .019 | .45 | 18.48 | 10.47 | | .51 | 13.8 |

(1) For the base materials, the carbon, columbium and nitrogen determinations were made on sheet bars, while the remaining elements represent the ladle analysis.

Table V

Results of Boiling 65% Nitric Acid Tests on Unwelded Base Metal(1)

| Type of Base Metal | Size | Heat No. | No. of Specimens Tested | Range of Values - Mean For 5- 48-Hour Periods, IPM | Average Rate - Mean For 5- 48-Hour Periods, IPM |
|---|---|---|---|---|---|
| 304 | 1/2" Plate | 45224 | 6 | .0007/.0008 | .0008 |
| | 1/8" Sheet | | 6 | .0007/.0009 | .0008 |
| | 1/8" CR Sheet | | 6 | .0008/.0012 | .0009 |
| | 1/2" Plate | 45854 | 6 | .0007/.0008 | .0007 |
| | 1/8" Sheet | | 6 | .0008/.0009 | .0008 |
| 316 | 1/2" Plate | 46485 | 9 | .0008/.0020 | .0012 |
| | 1/8" Sheet | | 6 | .0008/.0015 | .0012 |
| | 1/8" Sheet | 56663 | 5 | .0009/.0013 | .0010 |
| | 1/8" CR Sheet | 46485 | 2 | .0010/.0010 | .0010 |
| | 1/8" CR Sheet | 56663 | 4 | .0009/.0012 | .0010 |
| | 1/2" Plate | 46461 | 9 | .0008/.0010 | .0009 |
| | 1/8" Sheet | | 7 | .0009/.0015 | .0012 |
| 347 | 1/2" Plate | 56713 | 4 | .0006/.0008 | .0007 |
| | 1/8" Sheet | | 4 | .0006/.0007 | .0007 |
| | 1/8" CR Sheet | | 4 | .0008/.0010 | .0009 |
| | 1/2" Plate | 56715 | 4 | .0006/.0010 | .0008 |
| | 1/8" Sheet | | 4 | .0008/.0009 | .0009 |
| 304 ELC | 1/2" Plate | 56708 | 4 | .0005/.0006 | .0006 |
| | 1/8" Sheet | | 8 | .0005/.0006 | .0006 |
| | 1/8" CR Sheet | | 4 | .0006/.0006 | .0006 |
| | 1/2" Plate | 46424 | 4 | .0006/.0006 | .0006 |
| | 1/8" Sheet | | 8 | .0005/.0008 | .0006 |
| 316 ELC | 1/2" Plate | 56592 | 4 | .0007/.0008 | .0007 |
| | 1/8" Sheet | | 4 | .0006/.0007 | .0006 |
| | 1/8" CR Sheet | | 4 | .0006/.0007 | .0006 |
| | 1/2" Plate | 56740 | 5 | .0007/.0013 | .0009 |
| | 1/8" Sheet | | 4 | .0008/.0009 | .0008 |
| 347 ELC | 1/2" Plate | 57178 | 4 | .0005/.0006 | .0006 |
| | 1/8" Sheet | | 4 | .0005/.0006 | .0006 |
| | 1/8" CR Sheet | | 4 | .0006/.0007 | .0006 |

(1) Tests conducted in the du Pont Engineering Research Laboratory at Wilmington.

## Table VI

### All Weld-Metal Tensile Properties(1)

| Type No. | Size | Coating Identification | Core Wire Heat No. | Code No. | Ult. Tens. Str. PSI | .2% Yld. Str. PSI | Elong. 2" % | Remarks |
|---|---|---|---|---|---|---|---|---|
| 308 | 3/16" | Airco | -- | E2 | 90,800 | 61,700 | 39.5 | No weld defects |
| 316 | 3/16" | Airco | 37284 | E4 | 86,800 | 61,500 | 35.0 | No weld defects |
| 347 | 3/16" | Airco | 47319 | E6 | 95,700 | 66,400 | 33.0 | No weld defects |
| 308 ELC | 3/16" | RX128-A | 55783 | E8 | 76,000 | 49,000 | 40.0 | No weld defects |
| 308 ELC Austenitic | 3/16" | RX128-ANI | 55783 | E14 | 54,250 | 39,200 | 12.0 | Many intergranular hot cracks in weld metal |
| 316 ELC | 3/16" | RX128-A | 46443 | E10 | 79,500 | 47,000 | 39.5 | No weld defects |
| 316 ELC Austenitic | 3/16" | RX128-ANI | 46443 | E16 | 75,500 | 50,000 | 31.0 | Many intergranular hot cracks in weld metal |

(1) Tensile properties determined from a standard .505" diameter tensile specimen machined longitudinally from a single-V restrained butt-joint in 1" thick mild steel plates. Scarves of weld groove were clad with two layers of metal representing the same composition as the weld metal being tested.

## Table VII

### Results of Corrosion Tests on Metal-Arc Welded Specimens

| No. of Test Plate | Base Material Size | Base Material Heat | Final Condition of Specimen | Boiling 65% Nitric Acid Test: Corrosion Rate IPM | Boiling 65% Nitric Acid Test: Portion of Specimen Which Suffered Attack and Cause as Revealed by Metallographic Examination | Nitric-Hydrofluoric Acid Etch Test: Corrosion Rate, IPM; Extent of Weld Decay and General Attack | Nitric-Hydrofluoric Acid Etch Test: Portion of Specimen Which Suffered Attack and Cause as Revealed by Metallographic Examination |
|---|---|---|---|---|---|---|---|
| **Group I - Type 304 Base Metal - Type 308 Welding Electrode** | | | | | | | |
| 1 | 1/2" Plate | 45224 | AW | .0008<br>.0009<br>Avg. .0008 | Second and third weld beads on transverse faces because of carbides precipitated at ferrite pools by subsequent beads. | 0.454<br>IVb | Severe attack on base metal and first weld seam heat-affected zones, also first four weld beads because of precipitated carbides. |
| 2 | | | A-WQ | .0008<br>.0008<br>Avg. .0008 | Light general attack. | 0.609<br>Ib | Light general attack. |
| 3 | | | A-AC | .0012<br>.0013<br>Avg. .0012 | Light general attack. | 0.503<br>Ib | Light general attack except attack on weld metal is somewhat heavier than on base metal because of precipitated carbides. |
| 4 | 1/8" Sheet | 45224 | AW | .0010<br>.0010<br>Avg. .0010 | Light general attack. | 0.538<br>IVb | Severe attack on base metal and first weld seam heat-affected zones because of precipitated carbides. |
| 5 | | | A-WQ | .0010<br>.0010<br>Avg. .0010 | Light general attack. | 0.688<br>Ib | Light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 6 | | | A-AC | .0012<br>.0011<br>Avg. .0012 | Light general attack. | 0.662<br>Ib | Light general attack except for few faint signs of heavy attack on transverse faces of weld metal because of precipitated carbides. |
| 7 | 1/8" CR Sheet | 45224 | AW | .0010<br>.0010<br>Avg. .0010 | Slight attack on base metal heat-affected zones on transverse faces because of carbide precipitation. | 0.595<br>IV+b | Severe attack on base metal and first weld seam heat-affected zones because of carbide precipitation. Attack is more severe than found in Plate #4. |
| 8 | | | A-WQ | .0009<br>.0010<br>Avg. .0010 | Light general attack. | 0.672<br>Ib | Light general attack. |
| 9 | | | A-AC | .0011<br>.0011<br>Avg. .0011 | Light general attack. | 0.608<br>Ib | Light general attack except attack on weld metal is somewhat heavier than base metal because of precipitated carbides. |
| 10 | 1/2" Plate | 45854 | AW | .0009<br>.0009<br>Avg. .0009 | Second and third weld beads on transverse faces because of carbides precipitated at ferrite pools by subsequent beads. | 0.487<br>IVb | Severe attack on base metal and first weld seam heat-affected zones, also first four weld beads because of precipitated carbides |
| 11 | | | A-WQ | .0008<br>.0010<br>Avg. .0009 | Light general attack. | 0.556<br>Ib | Light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 12 | | | A-AC<br><br>Avg. | .0009<br>.0009<br>.0009 | Light general attack. | 0.468<br>Ib | Light general attack except attack on weld metal is somewhat heavier than on base metal because of precipitated carbides. |
| 13 | 1/8" Sheet | 45854 | AW<br><br>Avg. | .0010<br>.0011<br>.0010 | Moderate localized attack on base metal heat-affected zones on transverse faces because of carbide precipitation. | 0.742<br>IV++b | Very severe attack on base metal and first weld seam heat-affected zones because of carbide precipitation. |
| 14 | | | A-WQ<br><br>Avg. | .0010<br>.0009<br>.0010 | Light general attack. | 0.774<br>Ib | Light general attack. |
| 15 | | | A-AC<br><br>Avg. | .0012<br>.0011<br>.0012 | Light general attack. | 0.601<br>Ib | Light general attack except attack on weld metal is somewhat heavier than on base metal because of precipitated carbides. |
| Group II - Type 316 Base Metal - Type 316 Welding Electrode | | | | | | | |
| 16 | 1/2" Plate | 46485 | AW<br><br>Avg. | .0028<br>.0030<br>.0029 | Heavy attack on weld metal because of ferrite in structure. No localized attack on base metal heat-affected zones. | 0.157<br>IVa | Localized attack on base metal and first weld seam heat-affected zones, also heavy attack on first three weld metal beads because of carbide precipitation. |
| 17 | | | A-WQ<br><br>Avg. | .0010<br>.0010<br>.0010 | Light general attack. | 0.159<br>Ia | Very light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 18 | | | A-AC | .0011<br>.0011<br>Avg. .0011 | Light general attack. | 0.157<br>Ia | Very light general attack. |
| 19 | 1/8" Sheet | 56668 | AW | .0026<br>.0024<br>Avg. .0025 | Heavy attack on weld metal because of ferrite in structure. No localized attack on base metal heat-affected zones. | 0.138<br>IVb | Localized attack on base metal and first weld seam heat-affected zones because of carbide precipitation. |
| 20 | | | A-WQ | .0012<br>.0013<br>Avg. .0012 | Light general attack. | 0.150<br>Ib | Light general attack. |
| 21 | | | A-AC | .0015<br>.0013<br>Avg. .0014 | Light general attack. | 0.150<br>Ib | Light general attack |
| 22 | 1/8" CR Sheet | 56668 | AW | .0024<br>.0026<br>Avg. .0025 | Heavy attack on weld metal because of ferrite in structure. Light localized attack on base metal heat-affected zones because of carbide precipitation. | 0.142<br>IVb | Localized attack on base metal and first weld seam heat-affected zones because of carbide precipitation. |
| 23 | | | A-WQ | .0014<br>.0013<br>Avg. .0014 | Light general attack. | 0.190<br>Ib | Light general attack. |
| 24 | | | A-AC | .0013<br>.0013<br>Avg. .0013 | Light general attack. | 0.164<br>Ib | Light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 25 | 1/2" Plate | 46461 | AW | .0026<br>.0030<br>Avg. .0028 | Heavy attack on weld metal because of ferrite in structure. Light localized attack on base metal heat-affected zones because of carbide precipitation. | 0.150<br>IVa | Localized attack on base metal and first weld seam heat-affected zones, also heavy attack on first three weld beads because of carbide precipitation. |
| 26 | | | A-WQ | .0010<br>.0010<br>Avg. .0010 | Light general attack. | 0.144<br>Ia | Very light general attack. |
| 27 | | | A-AC | .0012<br>.0011<br>Avg. .0012 | Light general attack. | 0.141<br>Ia | Very light general attack. |
| 28 | 1/8" Plate | 46461 | AW | .0024<br>.0026<br>Avg. .0025 | Heavy attack on weld metal because of ferrite in structure. Light localized attack on base metal heat-affected zones because of carbide precipitation. | 0.250<br>IV+b | Localized attack on base metal and first weld seam heat-affected zones because of carbide precipitation. |
| 29 | | | A-WQ | .0010<br>.0012<br>Avg. .0011 | Light general attack. | 0.159<br>Ib | Light general attack. |
| 30 | | | A-AC | | Specimens misplaced. | | |
| Group III - Type 347 Base Metal - Type 347 Welding Electrode | | | | | | | |
| [illegible] | 1/2" Plate | 56713 | AW | .0009<br>.0009<br>Avg. .0009 | Light general attack except for some localized attack on transverse faces of base | 0.114<br>Ia | Very light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 31 (con't) | | | | | metal immediately adjacent to weld opposite beads #1 and #2 because of inter-granular carbides. | | |
| 32 | | | SR<br>Avg. | .0012<br>.0013<br>.0012 | Light general attack except for very faint signs of localized attack on transverse faces of base metal immediately adjacent to beads #1 and #2 as noted in specimen #31. | 0.129<br>la | Very light general attack. |
| 33 | 1/8" Sheet | 56713 | AW<br>Avg. | .0009<br>.0009<br>.0009 | Light general attack. | 0.132<br>la | Very light general attack. |
| 34 | | | SR<br>Avg. | .0014<br>.0016<br>.0015 | Light general attack. | 0.142<br>la | Very light general attack. |
| 35 | 1/8" CR Sheet | 56713 | AW<br>Avg. | .0013<br>.0012<br>.0012 | Light general attack. | 0.132<br>la | Very light general attack |
| 36 | | | SR<br>Avg. | .0017<br>.0016<br>.0016 | Light general attack except for very faint signs of localized attack on transverse faces of base metal immediately adjacent to #1 and #2 weld beads. | 0.137<br>la | Very light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 37 | 1/2" Plate | 56715 | AW<br>Avg. | .0010<br>.0010<br>.0010 | Light general attack except for some localized attack on transverse faces of base metal immediately adjacent to weld opposite beads #1 and #2 because of intergranular carbides. | 0.124<br>Ia | Very light general attack. |
| 38 | | | SR<br>Avg. | .0013<br>.0012<br>.0012 | Light general attack except for very faint signs of localized attack on transverse faces of base metal immediately adjacent to beads #1 and #2 as noted in specimen #37. | 0.152<br>Ia | Very light general attack. |
| 39 | 1/8" Sheet | 56715 | AW<br>Avg. | .0017<br>.0016<br>.0016 | Localized attack on transverse faces of base metal immediately adjacent to first weld bead only. | 0.125<br>Ia | Very light general attack. |
| 40 | | | SR<br>Avg. | .0022<br>.0022<br>.0022 | Localized attack on transverse faces of base metal immediately adjacent to #1 and #2 weld beads. | 0.149<br>Ia | Very light general attack. |
| Group IV - Type 304 ELC Base Metal - Type 308 ELC Welding Electrode | | | | | | | |
| 41 | 1/2" Plate | 56708 | AW<br>Avg. | .0006<br>.0006<br>.0006 | Light general attack. | 0.384<br>Ib | Light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condi-tion | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 42 | | | SR | .0009<br>.0010<br>Avg. .0010 | Light general attack. | 0.531<br>Ib | Light general attack. |
| 43 | 1/8" Sheet | 56708 | AW | .0006<br>.0007<br>Avg. .0006 | Light general attack. | 0.468<br>Ib | Light general attack. |
| 44 | | | SR | .0011<br>.0010<br>Avg. .0010 | Light general attack. | 0.600<br>Ib | Light general attack. |
| 45 | 1/8" CR Sheet | 56708 | AW | .0007<br>.0007<br>Avg. .0007 | Light general attack. | 0.435<br>Ib | Extremely faint signs of localized attack on base metal heat-affected zones despite absence of any apparent precipitated carbides. |
| 46 | | | SR | .0009<br>.0009<br>Avg. .0009 | Light general attack. | 0.469<br>Ib | Light general attack. |
| 47 | 1/2" Plate | 46424 | AW | .0007<br>.0007<br>Avg. .0007 | Light general attack. | 0.351<br>Ib+ | Moderate general attack on specimen. |
| 48 | | | SR | .0011<br>.0010<br>Avg. .0010 | Light general attack. | 0.715<br>Ic+ | Severe general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 49 | 1/8" Sheet | 46424 | AW | .0007<br>.0007<br>Avg. .0007 | Light general attack. | 0.487<br>Ib | Light general attack. |
| 50 | | | SR | .0011<br>.0010<br>Avg. .0010 | Light general attack. | | Test not completed. |
| Group V - Type 304 ELC Base Metal - Type 308 ELC Welding Electrode (Austenitic) | | | | | | | |
| 71 | 1/2" Plate | 56708 | AW | .0007<br>.0008<br>Avg. .0008 | Light general attack. | 0.441<br>Ib | Light general attack on base metal. Weld metal in #1, 2 and 3 beads on transverse faces shows heavier attack. Also heat-affected zone in first seam shows localized attack. |
| 72 | | | SR | .0010<br>.0009<br>Avg. .0010 | Light general attack. | 0.506<br>Ic | Moderate general attack on base metal, and severe general attack on weld metal. |
| Group VI - Type 304 ELC Base Metal - Type 347 Welding Electrode | | | | | | | |
| 51 | 1/8" Sheet | 56708 | AW | .0007<br>.0007<br>Avg. .0007 | Light general attack. | 0.222<br>Ib | Light general attack. |
| 52 | | | SR | .0009<br>.0008<br>Avg. .0008 | Light general attack. | 0.234<br>Ib | Light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 53 | 1/8" Sheet | 46424 | AW | .0008<br>.0007<br>Avg. .0008 | Light general attack. | 0.227<br>Ib | Light general attack. |
| 54 | | | SR | .0012<br>.0012<br>Avg. .0012 | Moderate general attack, but somewhat non-uniform. | 0.240<br>Ib | Light general attack. Random areas on surfaces are more heavily attacked, as if carburized. |
| Group VII - Type 316 ELC Base Metal - Type 316 ELC Welding Electrode | | | | | | | |
| 55 | 1/2" Plate | 56592 | AW | .0069<br>.0084<br>Avg. .0077 | Severe general attack on weld metal because of ferrite in structure. Heavy general attack on base metal incited by weld metal attack. | 0.091<br>Ia | Very light general attack. |
| 56 | | | SR | .0015<br>.0013<br>Avg. .0014 | Moderate general attack on weld metal and base metal because of precipitated carbides. | 0.227<br>Ic+ | Severe general attack on base metal. Attack on weld metal not quite as severe |
| 57 | 1/8" Sheet | 56592 | AW | .0051<br>.0056<br>Avg. .0054 | Severe general attack on weld metal because of ferrite in structure. Heavy general attack on base metal incited by weld metal attack. | 0.101<br>[illegible] | Very light general attack. |
| 58 | | | SR | .0013<br>.0014<br>Avg. .0014 | Moderate general attack on weld metal and base metal because of precipitated carbides | [illegible]<br>Ib+ | Moderate general attack |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate PSI | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 59 | 1/8" CR Sheet | 56592 | AW<br>Avg. | .0046<br>.0032<br>.0039 | Heavy attack on weld metal because of ferrite in structure. Heavy attack on base metal incited by weld metal attack. | 0.094<br>Ib- | Light general attack. |
| 60 | | | SR<br>Avg. | .0017<br>.0018<br>.0018 | Moderate general attack on base metal and weld metal because of precipitated carbides. | 0.185<br>Ic | Heavy general attack. |
| 61 | 1/2" Plate | 56740 | AW<br>Avg. | .0116<br>.0137<br>.0126 | Very severe general attack on weld metal because of ferrite in structure. Heavy general attack on base metal incited by weld metal attack. | 0.122<br>Ia | Very light general attack. |
| 62 | | | SR<br>Avg. | .0025<br>.0025<br>.0025 | Moderate general attack on weld metal and base metal because of precipitated carbides. | 0.453<br>Ic+ | Very heavy general attack. |
| 63 | 1/8" Sheet | 56740 | AW<br>Avg. | .0053<br>.0052<br>.0052 | Heavy general attack on weld metal because of ferrite in structure. Heavy general attack on base metal incited by weld metal attack. | 0.148<br>Ib- | Light general attack. |
| 64 | | | SR<br>Avg. | .0025<br>.0017<br>.0021 | Moderate/heavy general attack on base metal and weld metal because of precipitated carbides. | 0.155<br>Ib | Light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| **Group VIII - Type 316 ELC Base Metal - Special Type 316 ELC Welding Electrode (Austenitic)** | | | | | | | |
| 73 | 1/2" Plate | 56592 | AW<br>Avg. | .0007<br>.0007<br>.0007 | Very light general attack. | 0.125<br>Ia | Very light general attack on base metal. Weld metal in #1, 2 and 3 beads on transverse faces shows localized attack. Also heat-affected zone in first weld seam shows localized attack. |
| 74 | | | SR<br>Avg. | .0019<br>.0020<br>.0020 | Moderate general attack on base metal and weld metal because of precipitated carbides. | 0.456<br>Ic | Heavy general attack. |
| **Group IX - Type 316 ELC Base Metal - Type 318 Welding Electrode** | | | | | | | |
| 75 | 1/2" Plate | 47378 | AW<br>Avg. | .0007<br>.0008<br>.0008 | Very light general attack on base metal. Moderate general attack on weld metal. | N.D.<br>Ia | Very light general attack. |
| 76 | | | SR<br>Avg. | .0014<br>.0014<br>.0014 | Moderate general attack. | N.D.<br>Ib | Light general attack. |
| 77 | 1/8" Sheet | 47378 | AW<br>Avg. | .0006<br>.0007<br>.0006 | Very light general attack on base metal. Moderate general attack on weld metal. | N.D.<br>Ia | Very light general attack. |
| 78 | | | SR<br>Avg. | .0015<br>.0017<br>.0016 | Moderate general attack. | N.D.<br>Ib | Light general attack. |

TABLE VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate PSI | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| **Group X - Type 316 ELC Base Metal - Type 309 Cb Welding Electrode** | | | | | | | |
| 79 | 1/2" Plate | 47378 | AW | .0006<br>.0007<br>Avg. .0006 | Very light general attack on base metal. Light general attack on weld metal. | N.D.<br>Ia | Very light general attack |
| 80 | | | SR | .0009<br>.0011<br>Avg. .0010 | Light general attack. | N.D.<br>Ib | Light general attack. |
| 81 | 1/8" Sheet | 47378 | AW | .0007<br>.0007<br>Avg. .0007 | Very light general attack on base metal. Light general attack on weld metal. | N.D.<br>Ia | Very light general attack. |
| 82 | (Mixed Steel; sheet on left-hand side of joint found to be .022% C, Cr-Ni steel!) | | SR | .0011<br>.0011<br>Avg. .0011 | Moderate general on right-hand side of joint a/c carbides (#3). Light general attack on left-hand side (#2). | N.D.<br>I | Light general attack on right-hand side. Very light general attack on left-hand side. |
| **Group XI - Type 347 ELC Base Metal - Type 347 ELC Welding Electrodes** | | | | | | | |
| 85 | 1/2" Plate | 57178 | AW | .0007<br>.0007<br>Avg. .0007 | Very light general attack. | 0.[illegible]56<br>Ia | Very light general attack. |
| 86 | | | SR | .0010<br>.0009<br>Avg. .0010 | Light general attack. | 0.131<br>Ia | Very light general attack. |
| 87 | 1/8" Sheet | 57178 | AW | .0009<br>.0008<br>Avg. .0008 | Very light general attack. | 0.170<br>Ia | Very light general attack. |

Table VII (Con't)

Results of Corrosion Tests on Metal-Arc Welded Specimens

| Plate No. | Size | Heat | Condition | Huey Rate IPM | Portion Attacked | $HNO_3$-HF Rate IPM | Portion Attacked |
|---|---|---|---|---|---|---|---|
| 68 | | | SR | .0012 | Light general attack. | 0.154 | Light general attack. |
| | | | | .0011 | | Ib- | |
| | | | Avg | .0012 | | | |
| 69 | 1/8" CR Sheet | 57178 | AW | .0007 | Very light general attack. | 0.175 | Very light general attack. |
| | | | | .0008 | | Ia | |
| | | | Avg. | .0008 | | | |
| 70 | | | SR | .0011 | Light general attack. | 0.133 | Light general attack. |
| | | | | .0011 | | Ib | |
| | | | Avg. | .0011 | | | |



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## Table VIII

### Results of Intergranular Corrosion Tests in Boiling Sulphuric Acid-Copper Sulphate Solution

| No. of Test Plate | Type No. | Heat No. | Size | Welding Electrode Type | Final Condition of Specimen | Time of Exposure to Boiling Sulphuric Acid-Copper Sulphate Solution: 72 Hours | 300 Hours | 1000 Hours |
|---|---|---|---|---|---|---|---|---|
| 4 | 304 | 45224 | 1/8" | 308 | AW | | | |
| 7 | 304 | 45224 | 1/8" CR | 308 | AW | | | |
| 13 | 304 | 45854 | 1/8" | 308 | AW | | | |
| 19 | 316 | 56668 | 1/8" | 316 | AW | | | |
| 22 | 316 | 56668 | 1/8" CR | 316 | AW | | | |
| 28 | 316 | 46461 | 1/8" | 316 | AW | | | |
| 33 | 347 | 56713 | 1/8" | 347 | AW | | | |
| 34 | 347 | 56713 | 1/8" | 347 | SR | | | |
| 39 | 347 | 56715 | 1/8" | 347 | AW | | | |
| 40 | 347 | 56715 | 1/8" | 347 | SR | | | |
| 43 | 304 ELC | 56708 | 1/8" | 308 ELC | AW | | | |
| 44 | 304 ELC | 56708 | 1/8" | 308 ELC | SR | | | |
| 45 | 304 ELC | 56708 | 1/8" CR | 308 ELC | AW | | | |
| 49 | 304 ELC | 46424 | 1/8" | 308 ELC | AW | | | |
| 57 | 316 ELC | 56592 | 1/8" | 316 ELC | AW | | | |
| 58 | 316 ELC | 56592 | 1/8" | 316 ELC | SR | | | |
| 59 | 316 ELC | 56592 | 1/8" CR | 316 ELC | AW | | | |
| 63 | 316 ELC | 56740 | 1/8" | 316 ELC | AW | | | |
| 64 | 316 ELC | 56740 | 1/8" | 316 ELC | SR | | | |

All specimens were bent through a 180° angle on a mandrel having a diameter equal to the thickness of the specimen. No intergranular cracking was observed by microscopic or metallographic examination on any of the specimens regardless of the time of exposure.

Table IX

Microstructure of Welded Specimens

| No. of Test Plate | Base Material Size | Base Material Heat | Final Condition of Specimen | Results of Metallographic Examination: Unaffected Base Metal | Results of Metallographic Examination: Heat-Affected Zone of Base Metal Adjacent to Weld | Results of Metallographic Examination: Weld Metal |
|---|---|---|---|---|---|---|
| Group I - Type 304 Base Metal - Type 308 Welding Electrode | | | | | | |
| 1 | 1/2" Plate | 45224 | AW | Austenite, small amount of ferrite, no carbides. | Austenite, few carbides in ferrite, #2 carbide network. | Austenite, moderate amount of ferrite. Welds 1, 2 and 3 have carbides in ferrite pools and to some extent in austenite boundaries. |
| 2 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, moderate amount of globular ferrite, no carbides. |
| 3 | | | A-AC | Austenite, trace of ferrite, no carbides. | No apparent difference. | Austenite, small/moderate amount of globular ferrite, few carbides in austenite boundaries and at edge of ferrite pools |
| 4 | 1/8" Sheet | 45224 | AW | Austenite, no carbides. | Austenite, #3 carbide network | Austenite, moderate amount of ferrite, traces of carbides |
| 5 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, small/moderate amount of globular ferrite, no carbides |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 6 | | | A-AC | Austenite, no carbides. | No apparent difference. | Austenite, small/moderate amount of globular ferrite, few carbides in austenite grain boundaries and at edges of ferrite pools. |
| 7 | 1/8" CR Sheet | 45224 | AW | Austenite, slip planes. | Austenite, #3 carbide network. | Austenite, moderate amount of ferrite, traces of carbides. |
| 8 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, small/moderate amount of globular ferrite, no carbides. |
| 9 | | | A-AC | Austenite, no carbides. | No apparent difference. | Austenite, small/moderate amount of ferrite, few carbides in austenitic grain boundaries and at edges of ferrite pools. |
| 10 | 1/2" Plate | 45854 | AW | Austenite, no carbides. | Austenite, #3 carbide network. | Austenite, moderate amount of ferrite. Beads 1, 2 and 3 have carbides in ferrite pools. |
| 11 | | | A-WQ | Austenite, no carbides. | No apparent difference | Austenite, small/moderate amount of globular ferrite, no carbides. |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 12 | | | A-AC | Austenite, traces of ferrite with few carbides at edges, no intergranular carbides. | No apparent difference. | Austenite, small/moderate amount of globular ferrite, few carbides in austenite grain boundaries and at edges of ferrite pools. |
| 13 | 1/8" Sheet | 45854 | AW | Austenite, no carbides. | Austenite, #3 carbide network. | Austenite, moderate amount of ferrite, traces of carbides. |
| 14 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, small/moderate amount of globular ferrite, no carbides. |
| 15 | | | A-AC | Austenite, no carbides. | No apparent difference. | Austenite, small/moderate amount of globular ferrite, few carbides in austenite boundaries and at edges of ferrite pools. |
| Group II — Type 316 Base Metal — Type 316 Welding Electrode | | | | | | |
| 16 | 1/2" Plate | 46485 | AW | Specimen misplaced. | | |
| 17 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, very small amount of globular ferrite, no carbides. |
| 18 | | | A-AC | Austenite, small amount of ferrite, traces of carbides around ferrite. | No apparent difference. | Austenite, very small amount of globular ferrite, few carbides at edges of ferrite pools. |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 19 | 1/8" Sheet | 56668 | AW | Austenite, very small traces of ferrite, no carbides. | Austenite, very small traces of ferrite, #2 carbide network. | Austenite, moderate amount of ferrite, few carbides at edges of ferrite pools. |
| 20 | | 56668 | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, small amount of globular ferrite, no carbides. |
| 21 | | 56668 | A-AC | Austenite, traces of ferrite, no carbides. | No apparent difference. | Austenite, small amount of globular ferrite, traces of carbides at edges of ferrite pools. |
| 22 | 1/8" CR Sheet | 56668 | AW | Austenite, no carbides. | Austenite, #3 carbide network. | Austenite, moderate amount of ferrite, few carbides at edges of ferrite pools. |
| 23 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, very small amount of ferrite, no carbides. |
| 24 | | | A-AC | Austenite, traces of ferrite, no carbides. | No apparent difference | Austenite, very small amount of ferrite, few carbides around edges of ferrite pools. |
| 25 | 1/2" Plate | 46461 | AW | Austenite, no carbides. | Austenite, #3 carbide network. | Austenite, moderate amount of ferrite, carbides at edges of ferrite in beads 1, 2 and 3. |

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Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 26 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, very small amount of globular ferrite. no carbides. |
| 27 | | | A-AC | Austenite, traces of ferrite, no carbides. | No apparent difference. | Austenite, Very small amount of globular ferrite, few carbides at edges of ferrite. |
| 28 | 1/8" Sheet | 46461 | AW | Austenite. no carbides. | Austenite, #4 network. | Austenite, moderate amount of ferrite, few carbides at edges of ferrite. |
| 29 | | | A-WQ | Austenite, no carbides. | No apparent difference. | Austenite, small amount of globular ferrite, no carbides. |
| 30 | | | A-AC | Specimen misplaced. | | |
| Group III - Type 347 Base Metal - Type 347 Welding Electrode | | | | | | |
| 31 | 1/2" Plate | 56713 | AW | Austenite, traces of ferrite, general distribution of intragranular carbides. | Austenite, fine intergranular carbides in base metal at some points immediately adjacent to weld. | Austenite, considerable amount of ferrite, carbides at edges of ferrite in all beads, some austenite-columbide eutectic. |
| 32 | | | SR | Austenite, traces of ferrite, general distribution of intragranular carbides, #2 carbide network. | No apparent difference. | Austenite, considerable amount of ferrite, many carbides in and around ferrite pools, some intergranular carbides, some austenite-columbide eutectic. |



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Table [illegible] (cont'd)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 33 | 1/8" Sheet | 56713 | AW | Austenite, general distribution of intragranular carbides. | Austenite, faint intergranular carbide network. | Austenite, [illegible] amount of ferr[illegible] bides at edges [illegible] rite, some aus[illegible] columbide eute[illegible] |
| 34 | | | SR | Austenite, general distribution of intergranular carbides. | Austenite, intergranular carbide network. | Austenite, [illegible] amount of ferr[illegible] bides in and a[illegible] rite, some aus[illegible] columbide eute[illegible] |
| 35 | 1/8" CR Sheet | 56713 | AW | Austenite, general distribution of intragranular carbides. | No apparent difference. | Austenite, [illegible] amount of fer[illegible] bides at edges [illegible] rite, some aus[illegible] columbide eute[illegible] |
| 36 | | | SR | Austenite, general distribution of intragranular carbides. | Austenite, some intergranular carbides immediately adjacent to weld | Austenite, [illegible] amount of fer[illegible] bides in and a[illegible] rite, some au[illegible] columbide e[illegible] |
| 37 | 1/2" Plate | 56713 | AW | Austenite, general distribution of intragranular carbides | Austenite, [illegible] carbide network adjacent to weld. | Austenite, [illegible] amount of [illegible] bides at edge[illegible] rite in all [illegible] austenite [illegible] eutectic |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 38 | | | SR | Austenite, general distribution of intragranular carbides, also scattered intergranular carbides. | No apparent difference. | Austenite, considerable amount of ferrite, carbides in and around ferrite pools, some intergranular carbides, some austenite-columbide eutectic. |
| 39 | 1/8" Sheet | 56715 | AW | Austenite, general distribution of intragranular carbides. | No apparent difference. | Austenite, considerable amount of ferrite, few carbides at edges of ferrite, some austenite-columbide eutectic. |
| 40 | | | SR | Austenite, general distribution of intragranular carbides. | No apparent difference. | Austenite, considerable amount of ferrite, carbides in and around ferrite, some austenite-columbide eutectic. |
| Group IV - Type 304 ELC Base Metal - Type 308 ELC Welding Electrode | | | | | | |
| 41 | 1/2" Plate | 56708 | AW | Austenite, small amount of ferrite, no carbides. | No apparent difference. | Austenite, considerable amount of ferrite, no carbides. |
| 42 | | | SR | Austenite, small amount of ferrite, few carbides at edges of ferrite, #2 carbide network. | No apparent difference. | Austenite, moderate amount of ferrite, scattered carbides at edges of ferrite and in austenite grain boundaries. |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 43 | 1/8" Sheet | 56708 | AW | Austenite, very small amount of ferrite, no carbides. | No apparent difference. | Austenite, considerable amount of ferrite, no carbides. |
| 44 | | | SR | Austenite, very small amount of ferrite, few carbides at edges of ferrite, #2 carbide network. | No apparent difference. | Austenite, moderate amount of ferrite, scattered carbides at edges of ferrite and in austenitic grain boundaries. |
| 45 | 1/8" CR Sheet | 56708 | AW | Austenite, very small amount of ferrite, no carbides. | No apparent difference. | Austenite, moderate amount of ferrite, no carbides. |
| 46 | | | SR | Austenite, very small amount of ferrite, few carbides at edges of ferrite, #2 carbide network. | No apparent difference. | Austenite, moderate amount of ferrite, scattered carbides at edges of ferrite and in austenitic grain boundaries. |
| 47 | 1/2" Plate | 46424 | AW | Austenite, small amount of ferrite, no carbides. | No apparent difference. | Austenite, considerable amount of ferrite, no carbides. |
| 48 | | | SR | Austenite, small amount of ferrite, few carbides at edges of ferrite, #3 carbide network. | No apparent difference. | Austenite, moderate amount of ferrite, scattered carbides at edges of ferrite and in austenite grain boundaries. |
| 49 | 1/8" Sheet | 46424 | AW | Austenite, small amount of ferrite, no carbides. | No apparent difference | Austenite, considerable amount of ferrite, no carbides. |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 50 | | | SR | Austenite, small amount of ferrite, few carbides at edges of ferrite, #2 carbide network. | No apparent difference. | Austenite, moderate amount of ferrite scattered carbides at edges of ferrite. |
| Group V - Type 304 ELC Base Metal - Special Type 308 ELC Welding Electrode (Austenitic) | | | | | | |
| 71 | 1/2" Plate | 56708 | AW | Austenite, small amount of ferrite, no carbides. | No apparent difference. | Austenite, scattered traces of ferrite in weld, diffusion zone at edge of weld contains ferrite, no carbides. |
| 72 | | | SR | Austenite, small amount of ferrite, few carbides at edges of ferrite, #2 carbide network. | No apparent difference. | Austenite, scattered traces of ferrite in weld, diffusion zone at edge of weld contains ferrite, scattered carbides at edges of ferrite, many carbides in austenite grain boundaries. |
| Group VI - Type 304 ELC Base Metal - Type 347 Welding Electrode | | | | | | |
| 51 | 1/8" Sheet | 56708 | AW | Austenite, small amount of ferrite, no carbides. | No apparent difference. | Austenite, considerable amount of ferrite, carbides at edges of ferrite, some austenite-columbide eutectic |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 52 | | | SR | Austenite, small amount of ferrite, few carbides at edges of ferrite, #2 carbide network. | No apparent difference. | Austenite, considerable amount of ferrite, carbides at edges of ferrite, small amount of austenite-columbide eutectic. |
| 53 | 1/8" Sheet | 46424 | AW | Austenite, small amount of ferrite, no carbides. | No apparent difference. | Austenite, considerable amount of ferrite, carbides at edges of ferrite, small amount of austenite-columbide eutectic. |
| 54 | | | SR | Austenite, small amount of ferrite, few carbides at edges of ferrite, #3 carbide network. | No apparent difference. | Austenite, moderate amount of ferrite, carbides at edges of ferrite and in austenite grain boundaries, some austenite-columbide eutectic. |
| Group VII - Type 316 ELC Base Metal - Type 316 ELC Welding Electrode | | | | | | |
| 55 | 1/2" Plate | 56592 | AW | Austenite, small amount of ferrite and sigma phase with carbides at edges of pools, no intergranular carbides. | No apparent difference. | Austenite, small amount of ferrite with traces of sigma phase and few carbides at edges. |

Table [illegible] (Cont'd)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| [illegible] | | | SR | Austenite, small amount of ferrite and sigma phase with carbides at edges of pools, #3 carbide network. | No apparent difference. | Austenite, small amount of ferrite and sigma phase, with carbides at edges of ferrite and sigma, few carbides in austenite boundaries |
| 57 | 1/8" Sheet | 56592 | AW | Austenite, small amount of ferrite and sigma phase, no carbides. | No apparent difference. | Austenite, small amount of ferrite with traces of sigma phase and carbides at edges. |
| 58 | | | SR | Austenite, small amount of ferrite and sigma phase with carbides at edges of pools, #3 carbide network. | No apparent difference. | Austenite, small amount of ferrite and sigma phase with carbides at edges, few carbides in austenite grain boundaries. |
| 59 | 1/8" CR Sheet | 56592 | AW | Austenite, small amount of ferrite and sigma phase, no carbides. | No apparent difference. | Austenite, small amount of ferrite and traces of sigma phase with carbides at edges. |
| [illegible] | | | SR | Austenite, small amount of ferrite and sigma phase with carbides at edges, #3 carbide network | No apparent difference. | Austenite, small amount of ferrite and sigma phase with carbides at edges |
| [illegible] | [illegible] Plate | 567 | AW | Austenite, small amount of ferrite, no carbides. | No apparent difference. | Austenite, small amount of ferrite with traces of sigma phase and few carbides at edges |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 62 | | | SR | Austenite, small amount of ferrite with carbides at edges, #3 carbide network. | No apparent difference. | Austenite, small amount of ferrite and sigma phase with carbides at edges, few intergranular carbides. |
| 63 | 1/8" Sheet | 56740 | AW | Austenite, small amount of ferrite with traces of carbides at edges, no intergranular carbides. | No apparent difference. | Austenite, small amount of ferrite and traces of sigma phase with carbides at edges of pools. |
| 64 | | | SR | Austenite, small amount of ferrite with carbides, #3 carbide network. | No apparent difference. | Austenite, small amount of ferrite and sigma phase with carbides at edges of pools. |
| Group VIII - Type 316 ELC Base Metal - Special Type 316 ELC Welding Electrode (Austenitic) | | | | | | |
| 73 | 1/2" Plate | 56592 | AW | Austenite, small amount of ferrite and sigma phase with few carbides at edges. | No apparent difference. | Austenite, traces of ferrite, diffusion zone at edge of weld contains ferrite, traces of carbides at edges of ferrite. |
| 74 | | | SR | Austenite, small amount of ferrite and sigma phase with carbides at edges, #3 carbide network. | No apparent difference. | Austenite, scattered traces of ferrite in weld, diffusion zone at edge of weld contains ferrite, scattered carbides at edges of ferrite, many carbides in austenite grain boundaries. |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| Group IX - Type 316 ELC Base Metal - Type 318 Welding Electrode | | | | | | |
| 75 | 1/2" Plate | 47378 | AW | Austenite, traces of ferrite, no carbides. | No apparent difference. | Austenite, very small amount of ferrite, scattered columbium carbides and compounds. |
| 76 | | | SR | Austenite, traces of ferrite and sigma phase with carbides at edges, no carbide network. | No apparent difference. | Austenite, very small amount of ferrite, scattered columbium carbides and compounds. |
| 77 | 1/8" Sheet | 47378 | AW | Austenite, traces of ferrite, no carbides. | No apparent difference. | Austenite, very small amount of ferrite, scattered columbium carbides and compounds. |
| 78 | | | [illegible] | [illegible]stenite, traces of [illegible]te and sigma phase [illegible] carbides at edges, [illegible]bide network. | No apparent difference. | Austenite, very small amount of ferrite, scattered columbium carbides and compounds. |
| Group X - Type 316 [illegible] [illegible] Welding Electrodes | | | | | | |
| 79 | 1/2" Plate | [illegible] | [illegible] | [illegible], traces of [illegible] no carbides. | No apparent difference. | Austenite, considerable amount of ferrite, scattered columbium carbides and compounds. |
| 80 | | | | [illegible]nite, traces of [illegible]rite and sigma phase with carbides at edges, no carbide network. | No apparent difference. | Austenite, considerable amount of ferrite, scattered columbium carbides and compounds. |

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Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 81 | 1/8" Sheet | 47378 | AW | Austenite, traces of delta ferrite, no carbides. | No apparent difference. | Austenite, considerable amount of ferrite, scattered columbium carbides and compounds. |
| 82 | | | SR | Austenite, traces of ferrite and sigma phase with ferrite at edges, #3 carbide network. | No apparent difference. | Austenite, considerable amount of ferrite, scattered columbium carbides and compounds. |
| Group XI - Type 347 ELC Base Metal - Type 347 ELC Welding Electrodes | | | | | | |
| 65 | 1/2" Plate | 57178 | AW | Austenite, small amount of ferrite, general distribution of intragranular carbides, some banding of carbides. | No apparent difference. | Austenite, considerable amount of ferrite with few carbides at edges of pools, traces of austenite-columbide eutectic. |
| 66 | | | SR | Austenite, small amount of ferrite, general distribution of carbides with some heavy bands of carbides, some scattered areas containing intergranular carbides. | No apparent difference. | Austenite, moderate amount of ferrite with carbides at edges, few intergranular carbides, small amount of austenite-columbide eutectic. |
| 67 | 1/8" Sheet | 57178 | AW | Austenite, small amount of ferrite, general distribution of carbides with some banding of carbides. | No apparent difference. | Austenite, considerable amount of ferrite with few carbides at edges of pools, traces of austenitic-columbide eutectic. |

Table IX (Con't)

Microstructure of Welded Specimens

| Plate No. | Size | Heat | Condition | Unaffected Base Metal | Heat-Affected Zone | Weld Metal |
|---|---|---|---|---|---|---|
| 68 | | | SR | Austenite, small amount of ferrite, general distribution of carbides, some banding of carbides. | No apparent difference. | Austenite, moderate amount of ferrite with carbides at edges, few intergranular carbides, small amount of austenite-columbide eutectic. |
| 69 | 1/8" CR Sheet | 57178 | AW | Austenite, small amount of ferrite, general distribution of carbides with some banding of carbides. | No apparent difference. | Austenite, moderate amount of ferrite with carbides at edges, traces of austenite-columbide eutectic. |
| 70 | | | SR | Austenite, small amount of ferrite, general distribution of carbides with slight indications of banding, few intergranular carbides. | No apparent difference. | Austenite, moderate amount of ferrite with carbides at edges, few intergranular carbides, some austenite-columbide eutectic. |





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