PSA PATON STEENSON ASSOCIATES INC

10 ROYAL ORCHARD BOULEVARD • P.O. BOX 53009 • THORNHILL, ONTARIO L3T 7R9
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TEST REPORT NO. 6

CORROSION TESTS ON

PSA STRAP ANCHORS AND INSERTS

Salt Spray Tests - ASTM B117-94

November, 1994

NOTICE

This publication is intended for the use of professional personnel, competent to evaluate the significance and limitations of its contents and who will accept responsibility for the application of the material it contains. Paton Steenson Associates Inc. and JVI Accessories, Inc. disclaim any and all responsibility for the application of the stated principles or for the accuracy of the information contained herein.

APPENDIX A

1. Summary Table of Salt Spray Test Results

2. Individual Salt Spray Test Reports

Page 1	J-Type Finish	-	PSA Strap Anchor
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Page 4	Epoxy Finish	-	PSA Insert
Page 5	H.D. Galv. Finish	-	PSA Insert
Page 6	J-Type Finish	-	PSA Insert

3. Photographs - Figs. 1 through 6 incl.

4. Fig. 7 - Typical Salt Spray Cabinet

5. Fig 8. - Excerpt from ASTM B117-94 Specification
"Standard Practice for Salt Spray Testing Apparatus"

6. PSA Data Sheet for Strap Anchor Connections.

7. PSA Insert Brochure

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ACCELERATED CORROSION TESTS
TEST REPORT NO. 6

INTRODUCTION

The purpose of this report is to compare the corrosion resistance of the new J - TYPE automotive coating used on PSA Strap Anchors and Inserts with the traditional zinc, epoxy and hot dip galvanized coatings used in the construction industry.

TEST SAMPLES

The following insert and strap anchor samples were tested:

Coating	Sample Tested
J - Type	PSA Strap Anchor - Mk. 675
Zinc	PSA Strap Anchor - Mk. 675
Hot Dip Galvanized	PSA Strap Anchor - Mk. 875
Epoxy	PSA Insert - Mk. 6025
Hot Dip Galvanized	PSA Insert - Mk. 6025
J - Type	PSA Insert - Mk. 6025

TEST METHOD

All samples were placed in a commercial Salt Spray Cabinet (Fig. 7) and tested for corrosion resistance in accordance with the ASTM B117-94 Specification "Standard Method of Salt Spray (Fog) Testing" (Fig. 8). A visual inspection was made every 24 hours. The condition of each sample was determined, photographed and recorded.

TEST RESULTS

Detailed test observations for each sample, together with a summary table of Salt Spray Tests are included in Appendix A. Photographs showing the condition of each sample when the particular test was terminated, are also included in Appendix A (Figs. 1 to 6).

DISCUSSION

1. The **J -Type** corrosion resistant finish (guaranteed against red rust for 500 hours), was still intact on both the insert and the strap anchor samples when each test was terminated. There was some white rust but no sign of red rust even after **624** hours (strap anchor) and **648** hours (insert) of test, (see Figs. 2, 4a and 4b in Appendix A). This corrosion resistant finish is being extensively used by the automotive industry for underhood fasteners, brakes and steering parts etc., where salt damage is likely to occur.

2. The **zinc** finish on the PSA strap anchor was 0.00033" thick in accordance with ASTM specification B633 Type II. After **168** hours when the test was terminated, considerable white and red rust had developed on this sample. (Fig. 2). This finish is not used on any PSA products. The test was made for comparative purposes only.

3. The **hot-dip galvanized** finish on the PSA strap anchor was 0.0048" thick, (four times as thick as the insert). This sample was covered with white rust after **360** hours when the test was terminated, but no red rust was observed. (Fig. 1).

4. The **hot-dip galvanized** finish on the PSA insert was completely covered with white rust after **648** hours when the test was terminated. It looked like a Christmas tree. Traces of red rust were observed at termination. (Figs. 5a and 5b)

5. The **epoxy** finish on the PSA insert performed very well. At **168** hours, red rust started along some sharp edges of the sample. At **648** hours when the test was terminated, significant red rust had occurred along sharp edges primarily on the bottom of the sample. (figs. 6a and 6b). It should be noted that 648 hours of salt spray is an extreme exposure for this type of finish. The epoxy finish out-performed the hot-dip galvanized finish.

CONCLUSIONS AND RECOMMENDATIONS

1. Corrosion resistance of the **J - Type** automotive finish is far superior to any other finish tested.

2. The **zinc** finish performed poorly in comparison with the other finishes tested. This finish is not used on any PSA products.

3. The **hot dip galvanized** finish, on both the PSA strap anchor and the Insert performed very well and is recommended as an acceptable construction finish for most applications. Stainless steel inserts are recommended for exposed corrosive conditions.

4. The **epoxy** coating on the PSA insert provides excellent corrosion resistance under normal exposure conditions. Special care must be taken to ensure proper epoxy coverage inside the cavity and at cut edges. The epoxy finish is recommended as an acceptable finish for most building connections.

PATON STEENSON ASSOCIATES INC.

W. D. Paton, P. Eng.

November 15, 1994

November, 1994

SUMMARY OF SALT SPRAY TESTS

HOURS (Av. Thickness)	**J-TYPE** PSA STRAP ANCHOR (0.00034")	**ZINC** PSA STRAP ANCHOR (0.00033")	**H. D. GALV.** PSA STRAP ANCHOR (0.0048")	**EPOXY** PSA INSERT (0.0023")	**H. D. GALV.** PSA INSERT (0.00127")	**J-TYPE** PSA INSERT (0.00037)
24	Nil	Nil	Nil	Nil	Nil	Nil
72	Nil	Nil	Nil	Nil	Nil	Nil
96	Nil	Nil	Nil	Nil	White Started	Nil
168	Nil	White & Red Start Test Terminated	Moderate White	Red Started at Holes & Edges	Moderate White	Nil
336	Nil		Hvy. White-No Red Test Terminated	Same	Moderate White	Nil
432	Slight White			Same	Heavy White	Slight White
648	No Red Test Terminated			Hvy. Red at Edges Test Terminated	Complete White Test Terminated	No Red Test Terminated

NOTE:

(1) Detailed test observations and photographs of all test samples are included in Appendix A.

AUTOTEK ELECTROPLAING INC.

SALT SPRAY TEST RESULTS

Test Method: ASTM B117-94

Customer: Paton Steenson Associates Inc. Part Number: Strap Anchor

Revision Code: Hot Dip Galvanized Cast Day: N/A

Lot Number: N/A Date Plated:

Start Date: 06/13/1994 1300hrs Finish Date: 06/28/1994 1300hrs

Exposure Period: 360 hrs (Test Terminated)

Coating Thickness in Inches:Reading #1 : 0.0048
#2 : 0.0047
#3 : 0.0050
#4 : 0.0047

EVAULATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours(96): No sign of white corrosion products or red rust.

Number of Hours(120):First sign of white corrosion product .

Number of Hours(360): No sign of base metal corrosion (red rust).

parts exhibited 100 percent white corrosion.Test terminated.

Signature: J. Martin Khan Date: 06/28/1994

AUTOTEK ELECTROPLAING INC.

SALT SPRAY TEST RESULTS

Test Method: ASTM B117-94

Customer: Paton Steenson Associates Inc.

Part Number: Strap Anchor

Revision Code: Zinc Finish

Cast Day: N/A

Lot Number: N/A

Date Plated: 05/11/1994

Start Date: 05/12/1994 1130hrs

Finish Date: 05/19/1994 1330hrs

Exposure Period: 168 hrs

Coating Thickness in Inches:Reading #1 : 0.00032
#2 : 0.00034
#3 : 0.00032
#4 : 0.00033

EVAULATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours(24): No sign of white corrosion products or red rust.

Number of Hours(96): No sign of white corrosion products or red rust.

Number of Hours(168): First sign of white corrosion products and red rust on threaded portion of part.

Signature: P. Martin Ham

Date: 05/19/1994

AUTOTEK ELECTROPLAING INC.

SALT SPRAY TEST RESULTS

Test Method: ASTM B117-94

Customer: Paton Steenson Associates Inc. Part Number: Strap Anchor

Revision Code: J-Type Corrosion Finish Cast Day: N/A

Lot Number: N/A Date Plated: 05/11/1994

Start Date: 06/12/1994 1130hrs Finish Date: 06/07/1994 1300hrs

Exposure Period: 624 hrs

Coating Thickness in Inches: Reading #1 : 0.00033
#2 : 0.00035
#3 : 0.00033
#4 : 0.00031

EVAULATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours(96): No sign of white corrosion products or red rust.

Number of Hours(432):First sign of white corrosion product .

Number of Hours(624): No sign of base metal corrosion (red rust).

Test terminated.

Signature: T. Mathew Date: 06/07/1994

AUTOTEK ELECTROPLAING INC.

SALT SPRAY TEST RESULTS

Test Method: ASTM B117-94

Customer: Paton Steenson Associates Inc.

Part Number: Anchor Bracket

Revision Code: Epoxy Coating

Cast Day: N/A

Lot Number: N/A

Date Plated: N/A

Start Date: 09/21/1994 1300hrs

Finish Date: 10/19/1994 1300hrs

Exposure Period: 648 hrs

Coating Thickness in Inches:Not Available

EVAULATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours(96): No sign of white corrosion products or red rust.

Number of Hours(168): First sign of red rust along sharp edges.

Number of Hours(648): significant red rust corrosion along all sharp edges

Signature: T. MacPherson

Date: 10/19/1994

AUTOTEK ELECTROPLAING INC.

SALT SPRAY TEST RESULTS

Test Method: ASTM B117-94

Customer: Paton Steenson Associates Inc.

Part Number: Anchor Bracket

Revision Code: Galvanized zinc

Cast Day: N/A

Lot Number: N/A

Date Plated: N/A

Start Date: 09/21/1994 1300hrs

Finish Date: 10/19/1994 1300hrs

Exposure Period: 648 hrs

Coating Thickness in Inches:Not Available

EVAULATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours(96): First sign of white corrosion products ,no red rust.

Number of Hours(168): white corrosion 30-35% , no red rust.

Number of Hours(648): 100% white corrosion no red rust.

Signature: T. Mathuna

Date: 10/19/1994

AUTOTEK ELECTROPLAING INC.

SALT SPRAY TEST RESULTS

Test Method: ASTM B117-94

Customer: Paton Steenson Associates Inc.

Part Number: Anchor Bracket

Revision Code: J-Type Corrosion Finish

Cast Day: N/A

Lot Number: N/A

Date Plated: 09/27/1994

Start Date: 09/28/1994 1330hrs

Finish Date: 10/25/1994 1300hrs

Exposure Period: 648 hrs

Coating Thickness in Inches: Reading #1 : 0.00038
#2 : 0.00040
#3 : 0.00035
#4 : 0.00034

EVAULATION RESULTS AS PER SPECIFICATION NUMBER: ASTM B117-94

Number of Hours(96): No sign of white corrosion products or red rust.

Number of Hours(408):First sign of white corrosion product .

Number of Hours(648): No sign of base metal corrosion (red rust).

Test terminated.

Signature: T. Matthew

Date: 10/25/1994

PHOTOGRAPHS - 1

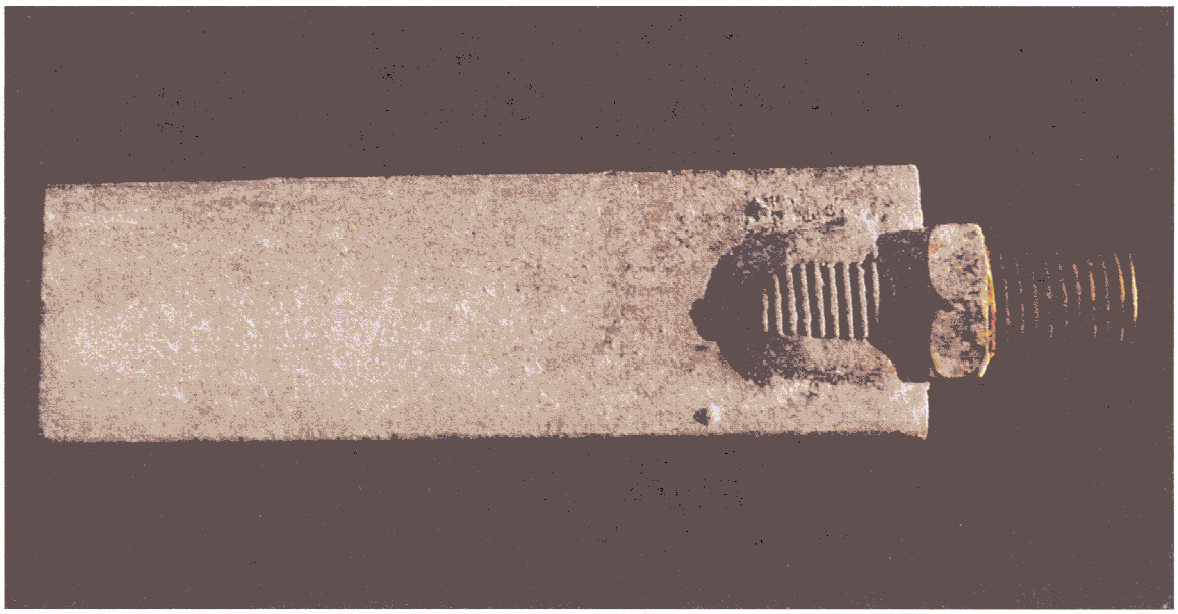


Fig. 1 PSA Strap Anchor Hot Dip Galv. Finish after 360 hours

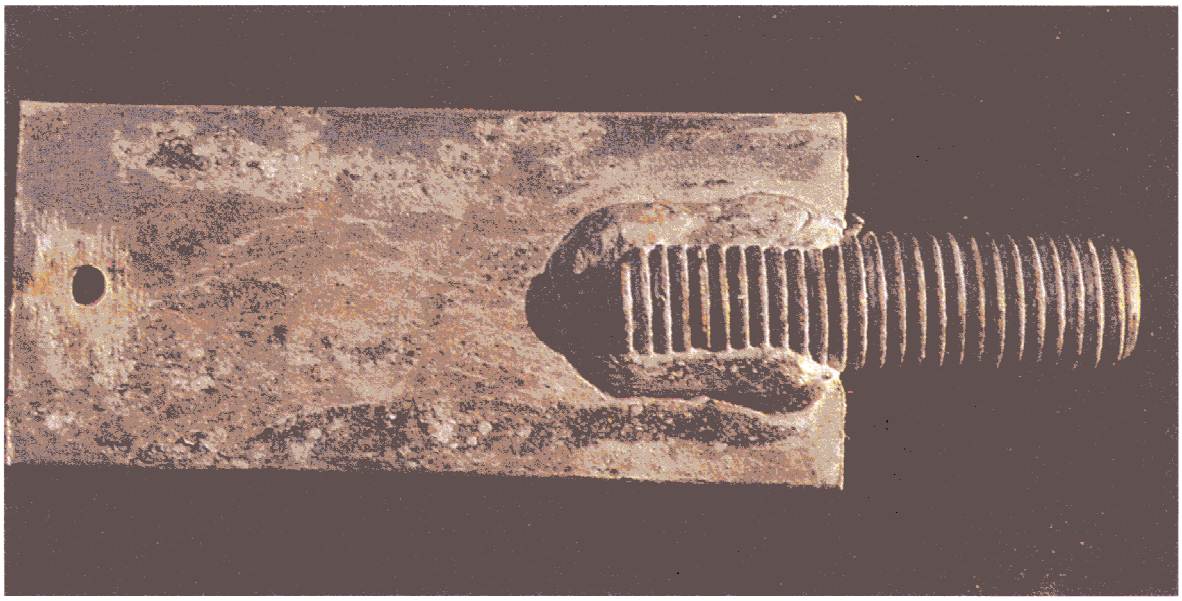


Fig. 2 PSA Strap Anchor J - Type Finish after 624 hours

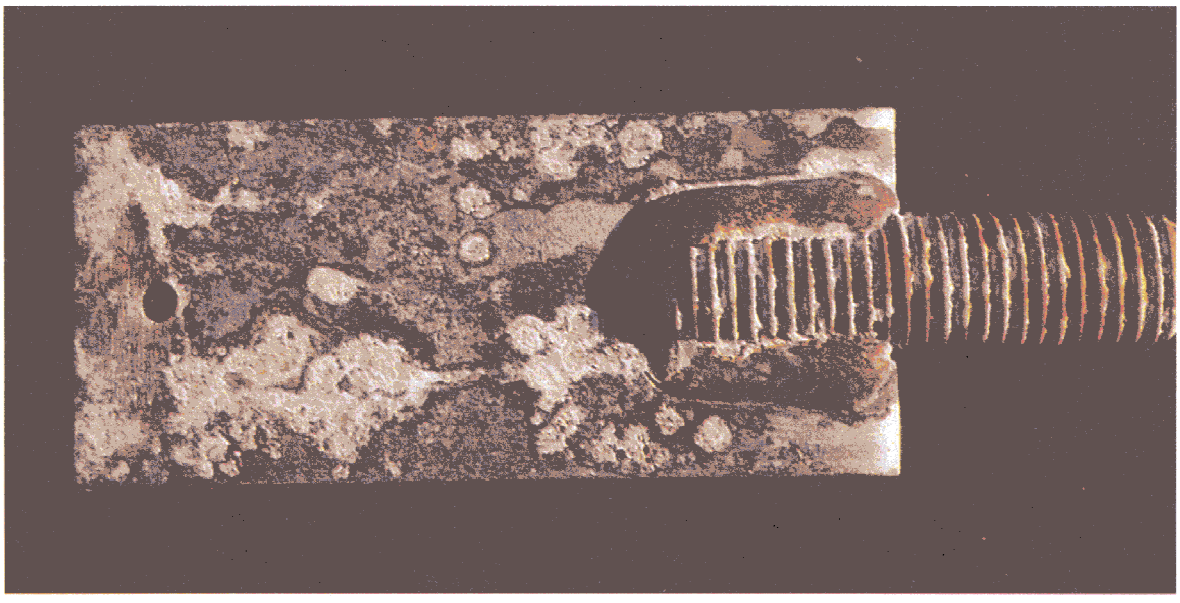


Fig. 3 PSA Strap Anchor Zinc Finish after 168 hours

PHOTOGRAPHS - 2

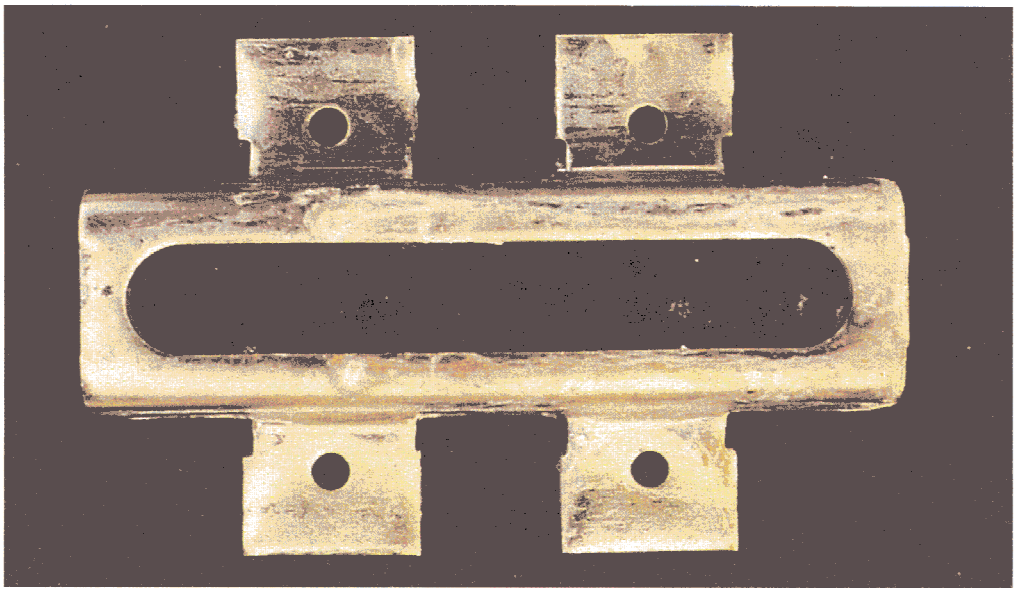


Fig. 4a PSA Insert (Top) J - Type Finish after 648 hours

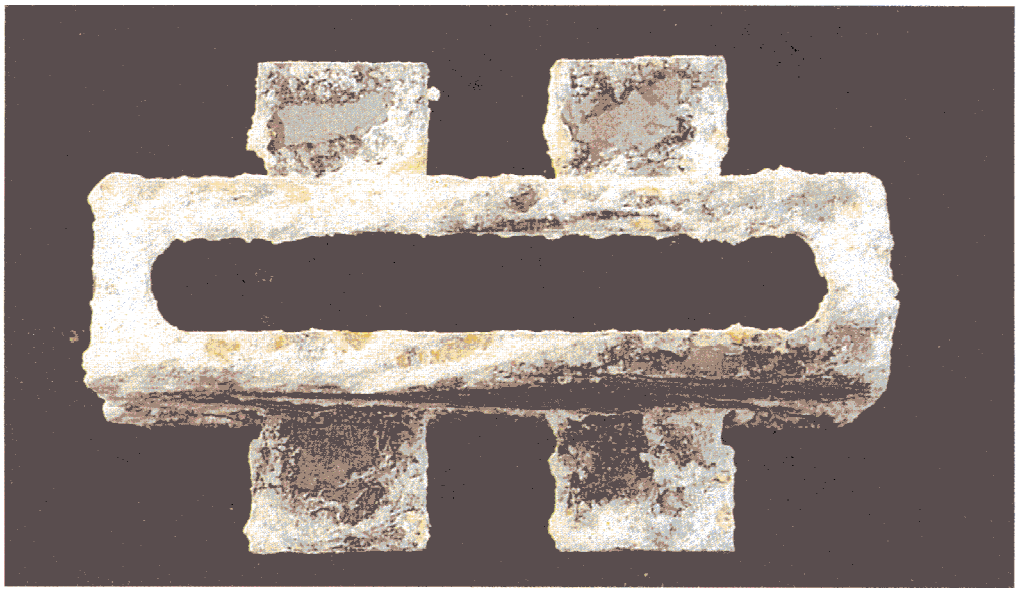


Fig. 5a PSA Insert (Top) Hot Dip Galv. Finish after 648 hours

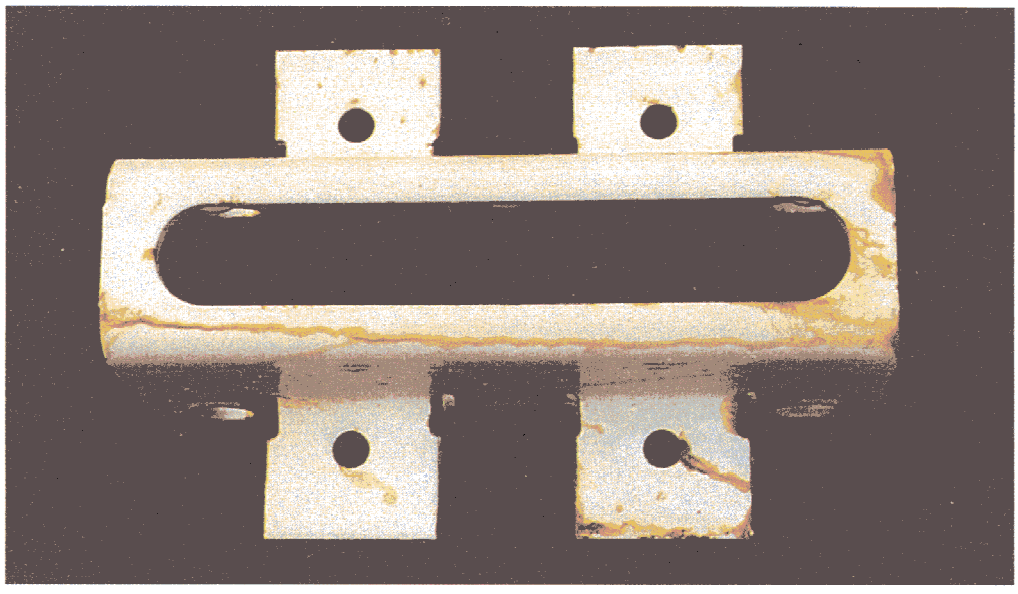


Fig. 6a PSA Insert (Top) Epoxy Finish after 648 hours

PHOTOGRAPHS -3

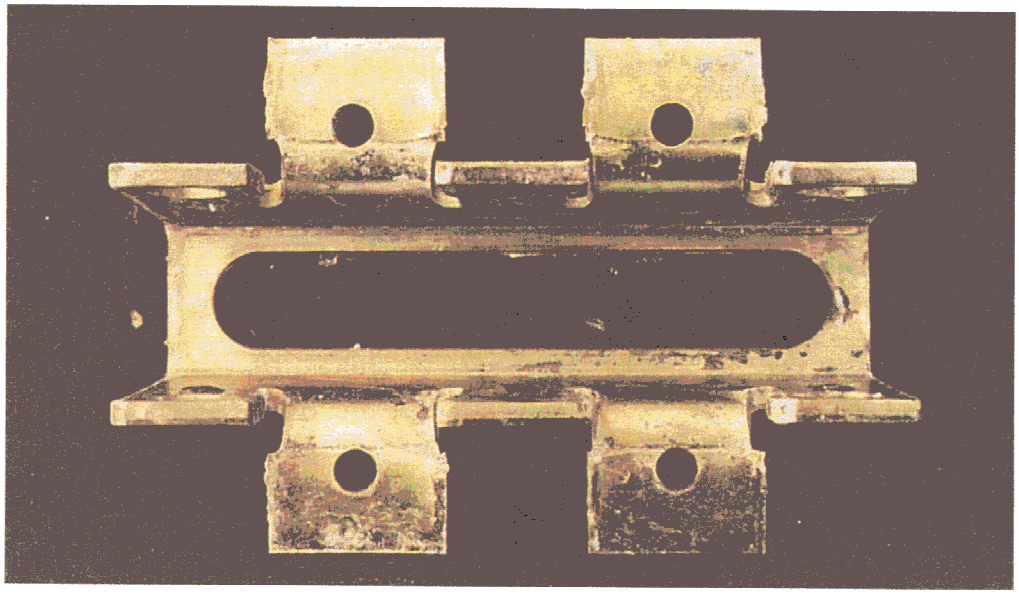


Fig. 4b PSA Insert (Bottom) J - Type Finish after 648 hours

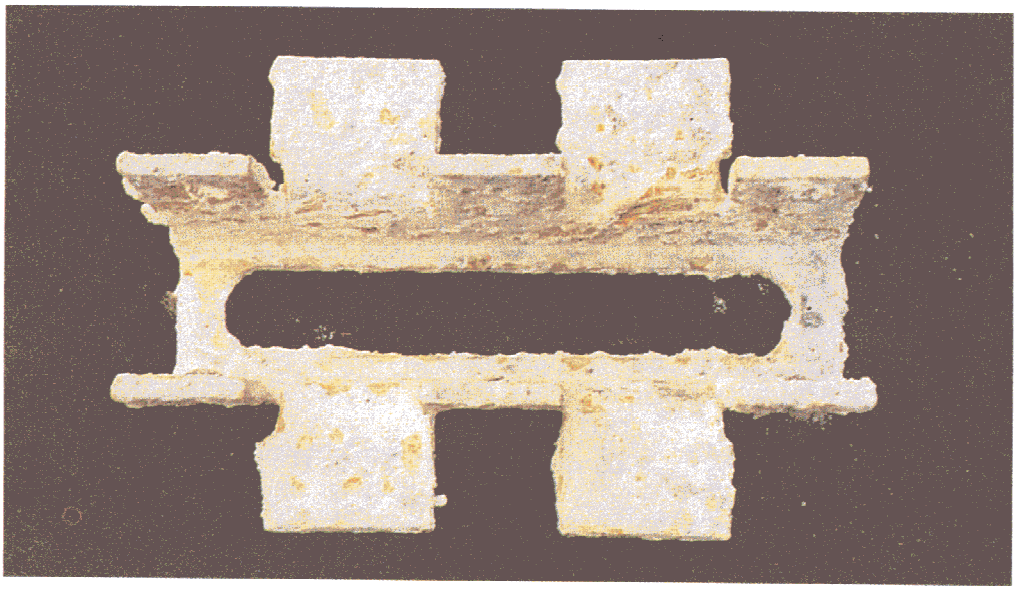


Fig. 5b PSA Insert (Bottom) Hot Dip Galv. Finish after 648 hours

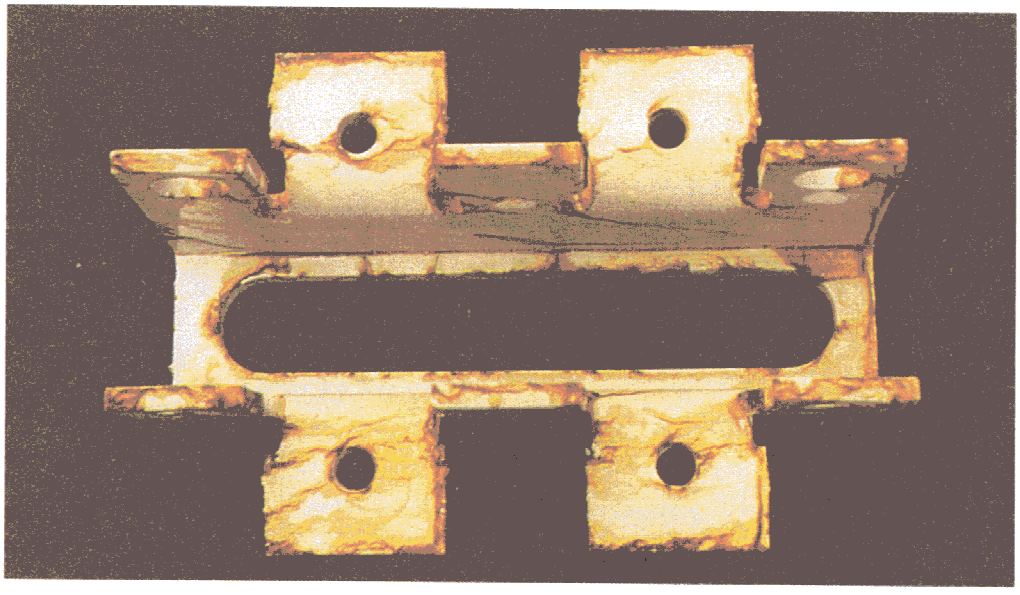
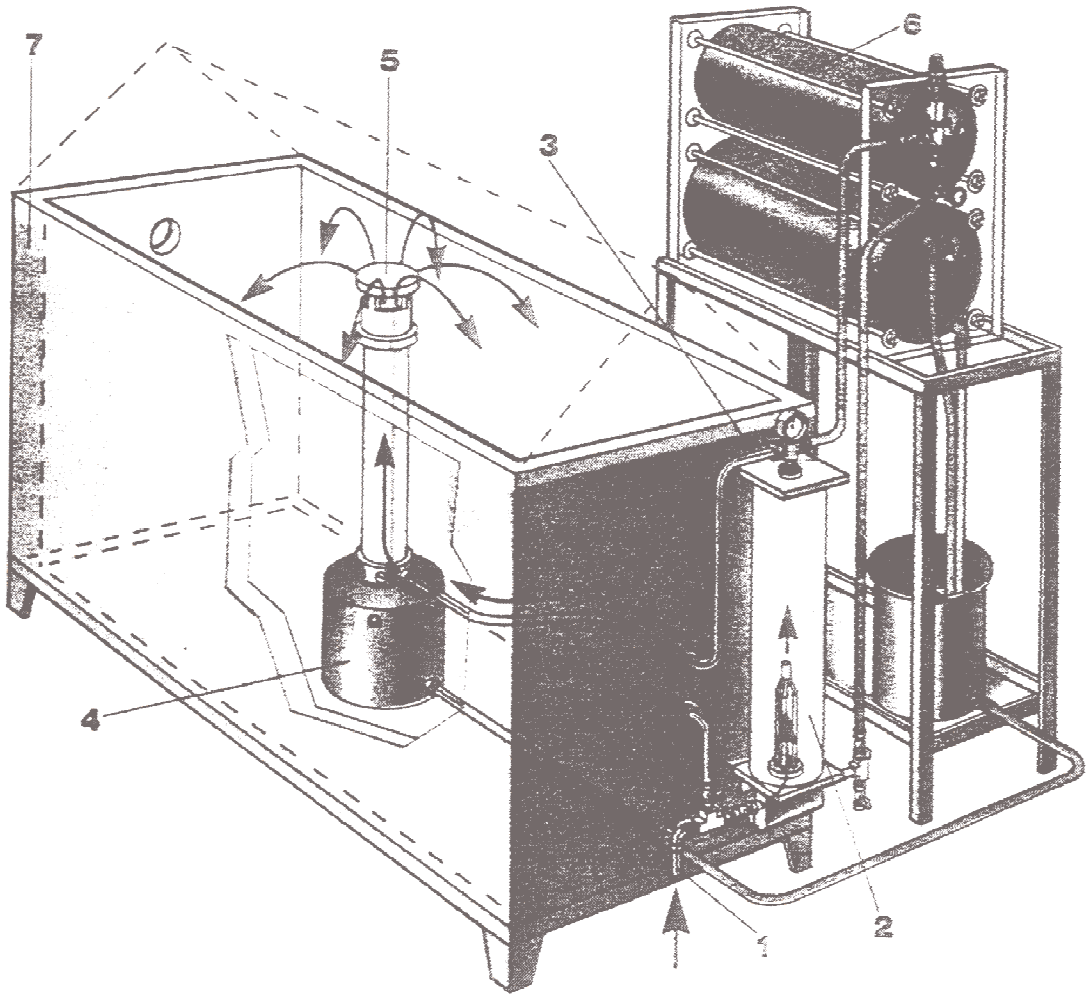


Fig. 6b PSA Insert (Bottom) Epoxy Finish after 648 hours



How a salt fog chamber works.

1. Compressed air enters the humidifying tower via an air line attached to the regulator.

2. Air is forced upward through the tower which contains distilled water that is fed from the level control system.

Once the air is in the tower, it reaches a temperature of approximately 118 degrees Fahrenheit.

3. The air is forced out of the top through an air line tube that continues into the chamber until it reaches the atomizer nozzle in the dispersion tower.

4. Here, the solution of 95 percent distilled water and 5 percent salt is atomized in the tank.

5. The atomized solution rises to the top of the dispersion tower where it baffles off the cone into the chamber, providing a consistent salt fog.

6. To ensure that the saline solution is readily available at the base of the dispersion tower, the nearby level control system automatically feeds the solution as needed.

7. The chamber is heated to 95 degrees Fahrenheit. This is accomplished by a "water jacket," which surrounds the chamber with water. The temperature of the water is maintained by two heaters.

The entire procedure is virtually a "hands-off" operation.

Fig.7 Typical Salt Spray Cabinet

Fig. 8

Designation: B 117 – 94

Standard Practice for Operating Salt Spray (Fog) Testing Apparatus[1]

This standard is issued under the fixed designation B 117; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense to replace Method 811.1 of Federal Test Method Standard No. 151b. Consult the DoD Index of Specifications and Standards for the specific year of issue that has been adopted by the Department of Defense.

1. Scope

1.1 This practice describes the apparatus, procedure, and conditions required to create and maintain the salt spray (fog) test environment. Suitable apparatus which may be used is described in Appendix X1. This practice does not prescribe the type of test specimen or exposure periods to be used for a specific product, nor the interpretation to be given to the results.

1.2 The values stated in SI units are to be regarded as standard. The inch-pound units in parentheses are provided for information.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

B 368 Method for Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)[2]

D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products[3]

D 1193 Specification for Reagent Water[4]

D 1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments[3]

E 70 Test Method for pH of Aqueous Solutions with the Glass Electrode[5]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[6]

G 85 Practice for Modified Salt Spray (Fog) Testing[7]

3. Significance and Use

3.1 This practice provides a controlled corrosive environment which has been utilized to produce relative corrosion resistance information for specimens of metals and coated metals exposed in any particular test chamber.

3.2 Correlation and extrapolation of corrosion performance based on exposure to the test environment provided by this practice are not always predictable. Correlation and extrapolation should be considered only in cases where appropriated corroborating long-term atmospheric exposures have been conducted.

3.3 The reproducibility of results in the salt spray exposure is highly dependent on the type of specimens tested and the evaluation criteria selected, as well as the control of the operating variables. In any testing program, sufficient replicates should be included to establish the variability of the results. Variability has been observed when similar specimens are tested in different fog chambers even though the testing conditions are nominally similar and within the ranges specified in this practice.

4. Apparatus

4.1 The apparatus required for salt spray (fog) exposure consists of a fog chamber, a salt solution reservoir, a supply of suitably conditioned compressed air, one or more atomizing nozzles, specimen supports, provision for heating the chamber, and necessary means of control. The size and detailed construction of the apparatus are optional, provided the conditions obtained meet the requirements of this practice.

4.2 Drops of solution which accumulate on the ceiling or cover of the chamber shall not be permitted to fall on the specimens being exposed.

4.3 Drops of solution which fall from the specimens shall not be returned to the solution reservoir for respraying.

4.4 Material of construction shall be such that it will not affect the corrosiveness of the fog.

5. Test Specimens

5.1 The type and number of test specimens to be used, as well as the criteria for the evaluation of the test results, shall be defined in the specifications covering the material or product being tested or shall be mutually agreed upon between the purchaser and the seller.

6. Preparation of Test Specimens

6.1 Specimens shall be suitably cleaned. The cleaning method shall be optional depending on the nature of the surface and the contaminants. Care shall be taken that

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[1] This practice is under the jurisdiction of ASTM Committee G-1 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.05 on Laboratory Corrosion Tests.

Current edition approved Feb. 15, 1994. Published April 1994. Originally published as B 117 – 39 T. Last previous edition B 117 – 90.

[2] *Annual Book of ASTM Standards*, Vol 02.05.

[3] *Annual Book of ASTM Standards*, Vol 06.01.

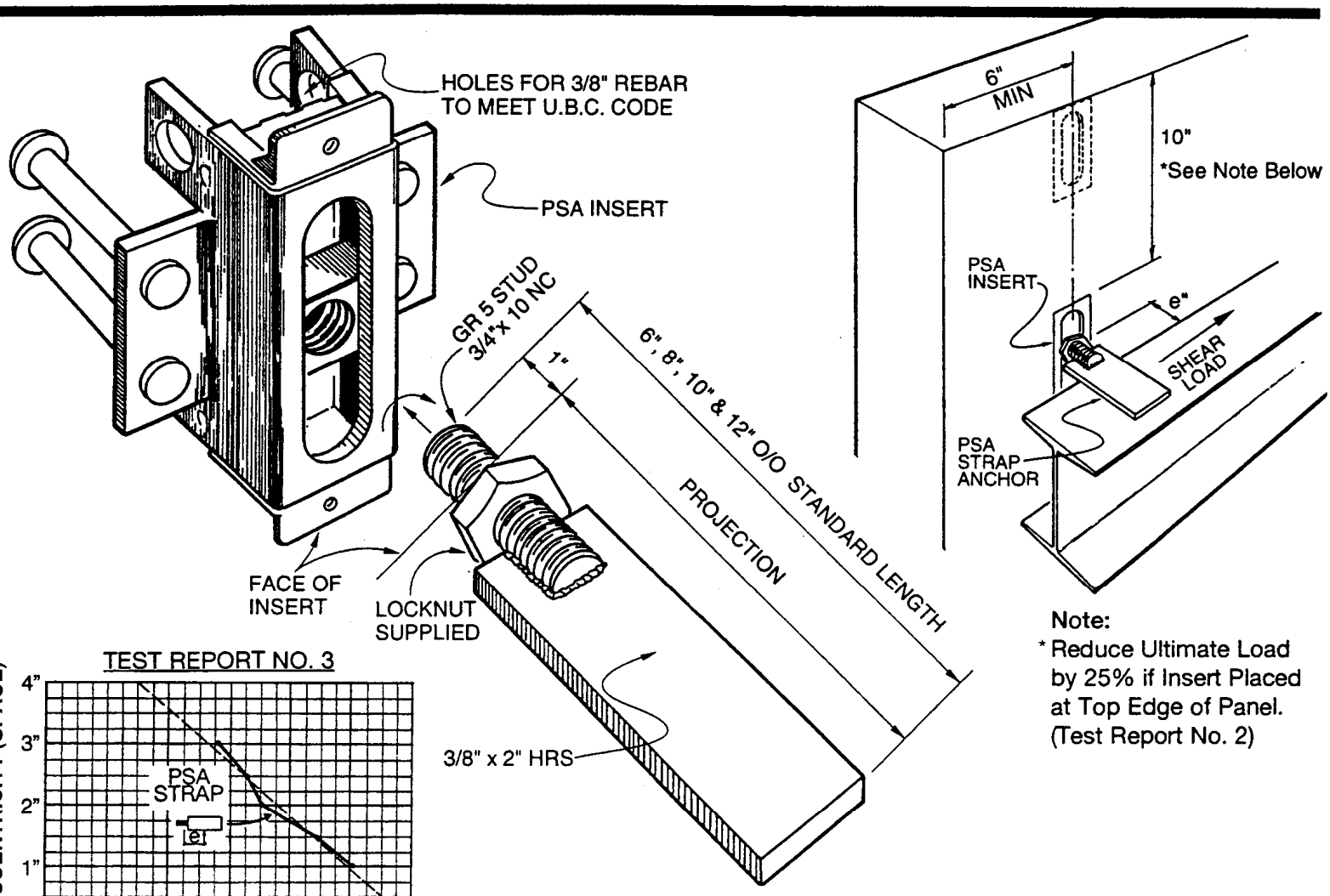
[4] *Annual Book of ASTM Standards*, Vol 11.01.

[5] *Annual Book of ASTM Standards*, Vol 15.05.

[6] *Annual Book of ASTM Standards*, Vol 14.02.

[7] *Annual Book of ASTM Standards*, Vol 14.12.

PSA STRAP ANCHORS



Note:
* Reduce Ultimate Load by 25% if Insert Placed at Top Edge of Panel. (Test Report No. 2)

FEATURES:

• Ultimate Pull-out Capacity

Strap Anchors Develop full Ultimate Capacity of the insert

Insert Type	Depth	Length	Ult. Pull-Out Capacity
4525	2 1/2"	4 1/2"	12,000 lbs
6025		6"	
4535	3 1/2"	4 1/2"	16,000 lbs
6035		6"	
4545	4 1/2"	4 1/2"	20,000 lbs
6045		6"	

Ultimate Pull-Out Capacity Based on Tests Performed in 5,000 psi Normal Weight Concrete (Refer to PSA Test Report No.1)

• Ultimate Shear Capacity

20,350 lbs. at 1" Eccentricity (See Graph Above)
Ult. Shear Capacity based on Tests Performed in 6,000 psi Normal Weight Concrete (Refer to PSA Test Report No. 3)

• Standard Strap Anchor Lengths

6", 8", 10" & 12" Out/Out

• **Available Finishes** – Epoxy or Hot Dipped Galvanized. (Stainless Steel available on Special Order)

• **Material** – High Strength weldable grade HRS Steel

• **Lock Nut** – Ensures Positive Connection in Both Directions

In the U.S.A. JVI In Canada PSA

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