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Report No. 8926-131

Material - Finishes and Coatings - "Touch-Up" Corrosion Preventatives

Long Term Effectiveness in Marine Atmospheres

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Abstract:

The effectiveness of 10 % ~~per cent~~ chromic acid solution, Alodine 1200 ~~(American Chemical Paint Co.)~~, Iridite 14, ~~(Allied Research Products Co., Baltimore, Md.)~~, and Bonderite 710 ~~(Parker Rustproofing Co., Detroit, Michigan)~~, when applied to clad 7075-T6 aluminum alloy sheet provided with stainless steel metal screws and Huck lockbolts, in retarding industrial-marine atmospheric corrosion was checked. Ten months outdoor exposure of representative test panels revealed that none of the "touch-up" finishes were effective in retarding corrosive attack for this length of time.

References: Hooper, A. F., George, J. C., Keller, E. E., " Corrosion Preventative Characteristics of Touch-Up Chemical Surface Treatments on Aluminum Alloy Assemblies," General Dynamics/ Convair Report MP 57-637, San Diego, California, 29 April 1959. (Reference Attached).

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STRUCTURES & MATERIALS LABORATORIES

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

SAN DIEGO

REPORT 57-637

DATE 29 April 1959

MODEL 22

TITLE

REPORT NO. 57-637

CORROSION PREVENTIVE CHARACTERISTICS OF TOUCH-UP CHEMICAL SURFACE TREATMENTS ON ALUMINUM ALLOY ASSEMBLIES

MODEL 22

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INTRODUCTION:

Engineering design requested a determination of the protective merits of various touch-up chemical surface treatments using 10% chromic acid as a control.

A producible, corrosion preventive, non-staining and non-irridescent type of chemical surface treatment was desired. This chemical surface treatment would be applied over aluminum alloy skins using aluminum alloy and cadmium plated stainless steel rivets and cadmium plated steel bolts as fasteners. The fasteners would be in both the milled flush and non-milled conditions.

OBJECT:

To determine the protective merits of various touch-up surface treatments, using 10% chromic acid as a control, on clad aluminum alloy assemblies held with various milled flush fasteners.

CONCLUSIONS:

The touch-up chemical surface treatments, including 10% chromic acid, applied on clad aluminum alloy assemblies held with various milled flush fasteners did not appear to improve corrosion resistance. The test specimens and non-surface treated controls were subjected to ten (10) months industrial marine atmospheric exposure in San Diego.

TEST SPECIMENS AND PROCEDURE:

Ten (10) test specimens, similar to the one shown in Figure 1, were fabricated using two (2) - 0.250 x 1 x 6 inch clad 7075-T6 aluminum alloy panels and two (2) types of metal fasteners.

One side and the edges of each clad 7075-T6 aluminum alloy panel were primed in detail with the following finish system:

1. One (1) spray coat of Mil-C-8514 wash primer
2. One (1) spray coat of Mil-P-8585 zinc chromate primer.

The two (2) panels were lapped together with the faying surface of one panel being primed and other unprimed, and fastened with six (6) fasteners in tandem at a 1 inch spacing with a 1/2" edge distance. (See Figure 1). Five (5) specimens were fabricated using six (6) R-3002-T8-8 cadmium plated steel Huck lock bolts and five (5) specimens were fabricated using AN 509-10-10 cadmium plated steel screws. Three (3) of the six (6) fasteners on each of the ten (10) test specimens were milled flush with the clad 7075-T6 aluminum alloy surface.

TEST SPECIMENS & PROCEDURE: (Cont'd)

One specimen from each group of five (5) specimens was given one of the following touch-up chemical surface treatments:

1. No surface treatment - (Control).
2. 10% Chromic acid - (Control touch-up chemical surface treatment).

   a. Solvent wiped with CVAC Solvent 62 per MPS 14.07.
   b. Brush applied 10% chromic acid - allowed to remain on surface 2 - 3 minutes.
   c. Rinsed with tap water and dried with a damp cloth.
   d. Air dried.

3. Alodine 1000 - (0.45 oz/gal).

   a. Solvent wiped with CVAC Solvent 62 per MPS 14.07.
   b. Applied deoxidine - allowed to remain on surface for 3 - 5 minutes.
   c. Rinsed with tap water and dried with a damp cloth.
   d. Brush applied alodine 1000 - allowed to remain on surface 7 minutes.
   e. Rinsed with tap water and dried with a damp cloth.
   f. Air dried.

4. Iridite 14 - 9 - (0.2 oz/gal)

   a. Solvent wiped with CVAC Solvent 62 per MPS 14.07.
   b. Brush applied deoxidizer - allowed to remain on surface 3 - 5 minutes.
   c. Rinsed with tap water and dried with a damp cloth.
   d. Brush applied Iridite 14 - 9 - allowed to remain on surface for 7 minutes.
   e. Rinsed with tap water and dried with a damp cloth.
   f. Air dried.

5. Bonderite 710 - (132 gms plus 10.6 ml accelerator/liter)

   a. Solvent wiped with CVAC Solvent 62 per MPS 14.07.
   b. Brush applied Bonderite 710 - allowed to remain on surface for 30 minutes.
   c. Rinsed with tap water and dried with a damp cloth.
   d. Air dried.

Five (5) test specimens, similar to the one shown in Figure 2, were fabricated using two - .080" x 2" x 12" clad 7075-T6 aluminum alloy panels and three (3) types of metal fasteners.

ACCESS NO.

Title: MATERIAL-FINISHES AND COATINGS - "TOUCH-UP" CORROSION PREVENTATIVES. LONG TERM EFFECTIVENESS IN MARINE ATMOSPHERES.

Authors: Hooper, A. F., George, J. C., Keller, E. E.
Report No. 8926-131
Contract: Model 22, Commercial
Contractor: General Dynamics/Convair
ABSTRACT: The effectiveness of 10 per cent chromic acid solution, Alodine 1200 (American Chemical Paint Co.), Iridite 14 (Allied Research Products, Co., Baltimore, Md.), and Bonderite 710 (Parker Rustproofing Co., Detroit, Michigan), when applied to clad 7075-T6 aluminum alloy sheet provided with stainless steel metal screws and Huck lockbolts, in retarding industrial-marine atmospheric corrosion was checked. Ten months outdoor exposure of representative test panels revealed that none of the "touch-up" finishes were effective in retarding corrosive attack for this length of time.

7 pages, 3 figures

TEST SPECIMENS & PROCEDURE: (Cont'd)

One (1) side and the edges of each clad 7075-T6 aluminum alloy panel were primed in detail with the following finish system:

1. One (1) spray coat of Mil-C-8514 wash primer.
2. One (1) spray coat of Mil-P-8585 zinc chromate primer.

The two (2)-.080 x 2 x 12 inch clad 7075-T6 aluminum alloy panels were then lapped together with a faying surface of 1-1/2 inches and a 1/2 inch lip. (See Figure 2). The faying surface of one (1) panel was primed and the other unprimed as before. Two (2) tandem rows of metal fasteners, at a 1 inch spacing and 3/4 inch between rows, were used to assemble each specimen. Three (3) different types of metal fasteners were used on each specimen.

1. Eight (8) - AN 426 DD aluminum alloy rivets.
2. Eight (8) - Q 4304-6 stainless steel rivets. (Cadmium plated).
3. Eight (8) - AN 509-10-10 cadmium plated steel screws.

Four (4) of each type of the metal fasteners were milled flush with the clad 7075-T6 aluminum alloy surface on each specimen.

Each of the five (5) specimens was given one of the touch-up chemical surface treatments previously listed.

Two (2) test specimens, similar to the one shown in Figure 3, were obtained from the Structures Test Laboratory as typical sections of the Model 22 airframe structure. The skins on these test specimens were clad 2024-T3 aluminum alloy with AN 426 DD aluminum alloy rivets used as fasteners. The rivets were milled flush with the clad 2024-T3 aluminum alloy panel surface. The two (2) test specimens were chemically cleaned with Turco 3002, a chemical cleaner, manufactured by Turco Products, Inc., Los Angeles, California. The Turco 3002 chemical cleaner was brushed on the surface and allowed to react for a period of 20 minutes. The cleaning solution was kept wet during this period by adding tap water. The specimens were then rinsed with tap water and allowed to air dry.

The previously listed touch-up chemical surface treatments were applied on 6 x 30 inch surface areas on both specimens. WD-40, a corrosion inhibitor, manufactured by Rocket Chemical Company, Inc., San Diego, California, was also applied on a 6 x 30 inch surface area of both specimens.

The seventeen (17) test specimens were exposed to industrial marine atmosphere in San Diego on the roof of Convair's Building No. 51, for a period of 10 months. Periodic inspections were made during the exposure period to determine the corrosion preventive characteristics of the various surface treatments.

RESULTS AND DISCUSSION:

The non-milled metal fasteners showed no significant corrosive effects on the adjacent clad 2024-T3 or clad 7075-T6 aluminum alloy assemblies during the 10 months industrial marine atmospheric exposure. General pitting and surface oxidation were observed on the clad 2024-T3 and clad 7075-T6 aluminum alloy assemblies after completion of the industrial marine atmospheric exposure. This type of corrosion is typical for aluminum alloys which are not periodically cleaned during atmospheric exposure.

The mechanical milling operation on the various metal fasteners, under test, resulted in causing corrosion on the milled surface of the fasteners or of the adjacent aluminum alloy surface. The milled surfaces of the cadmium plated steel AN 509-10-10 screws and R 3002-T8-8 Huck Lock bolts were moderately rusted after the 10 month atmospheric exposure period. Slight corrosion occured on the adjacent clad 7075-T6 aluminum alloy surfaces due to the imbedded mill particles from these two fasteners and the Q-4303-6 stainless steel rivets. The milled surfaces of the AN 426 DD aluminum alloy rivets were moderately corroded with small generalized pits.

The corrosion resistance of the aluminum alloy assemblies did not appear to be improved by the application of the following touch-up chemical surface treatments; 10% chromic acid, Iridite 14-9, Bonderite 710, Alodine 1000, or WD - 40 a corrosion inhibitor. The aluminum alloy assembly surfaces on which these materials were applied showed no significant difference in appearance from that of the non-surface treated aluminum alloy surfaces.

The results of this test program show that the protective merits of the touch-up chemical surface treatments tested were not effective in preventing corrosion on the aluminum alloy assemblies.

The milling operation on the aluminum alloy rivets did not appear to deleteriously affect the adjacent clad aluminum alloy skin areas. The milling operation on the cadmium plated steel fasteners caused corrosion to occur on the milling surface of the fastener and the adjacent clad aluminum alloy skin area.

NOTE: The data from which this report was prepared are recorded in Structures & Materials Laboratory - Data Book No. 984.

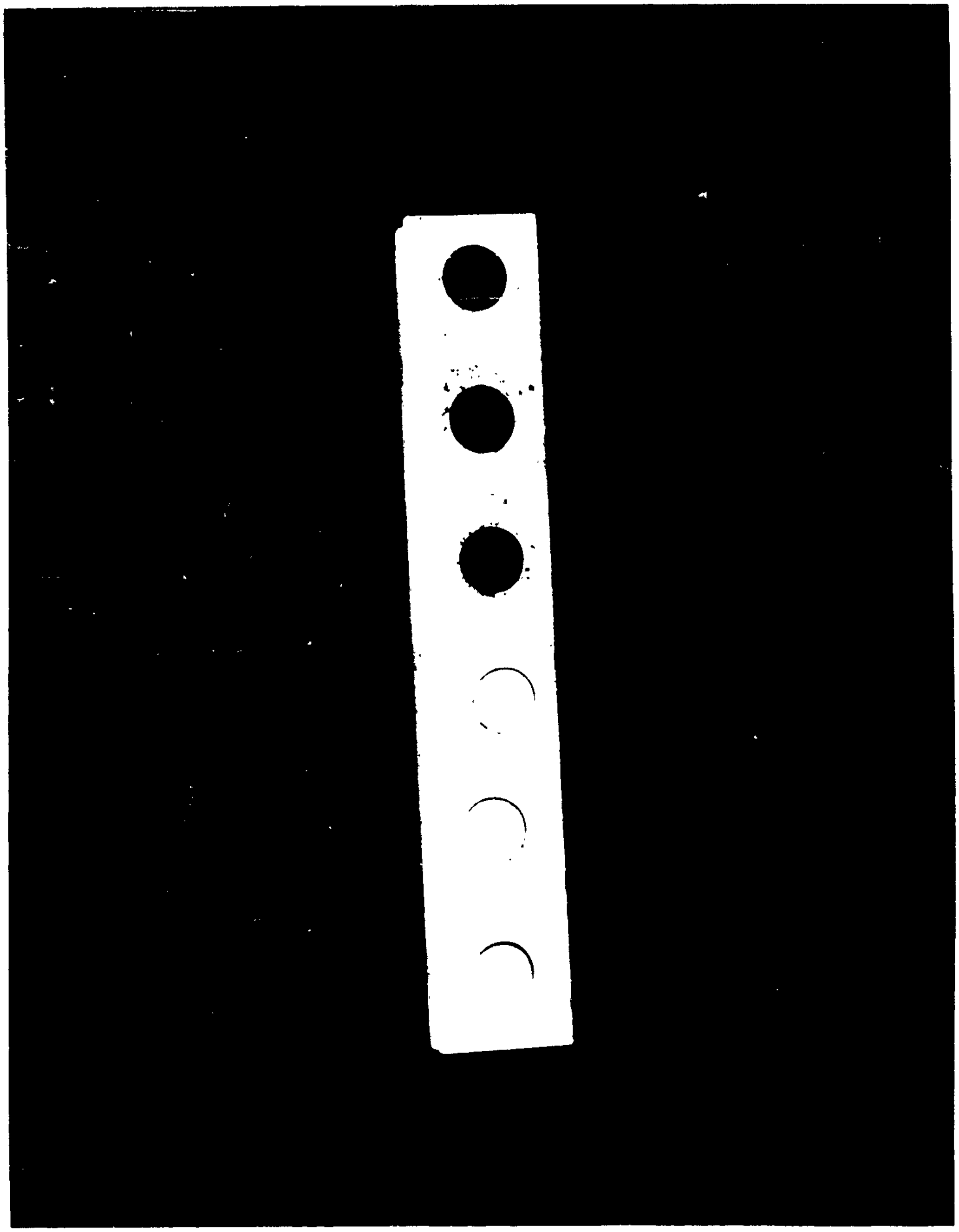

FIGURE I

This specimen represents the typical configuration of ten (10) clad 7075-T6 aluminum alloy test specimens. Two (2) types of fasteners were used on this type of specimen; AN 509-10-10 cadmium plated steel screws and R 3002-T8-8 cadmium plated steel Huck Lock bolts. NOTE: This specimen had been exposed for 10 months; observe the moderate rust on the milled R 3002-T8-8 cadmium plated steel Huck Lock bolts and corrosion on the clad 7075-T6 aluminum alloy panel surface.

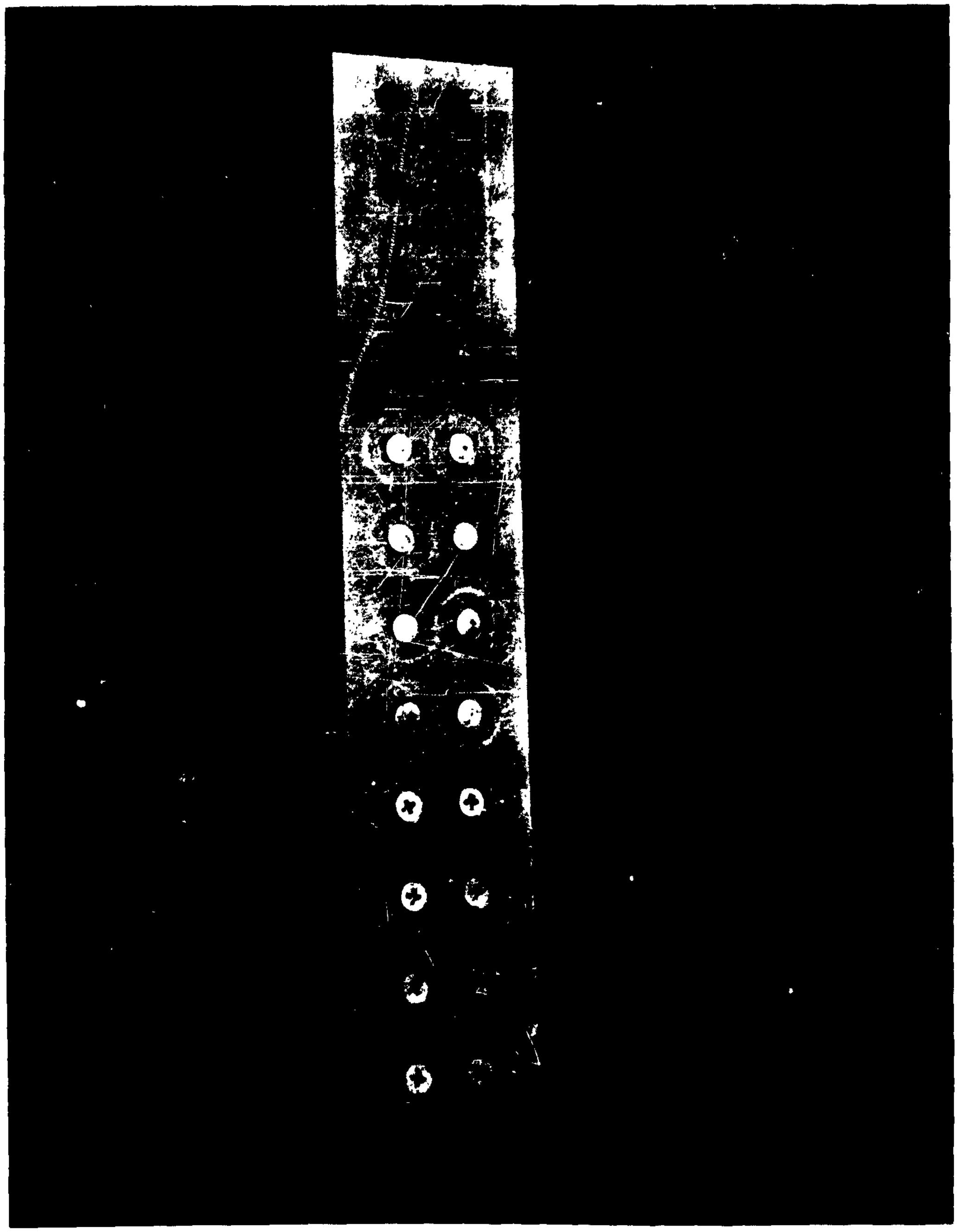

FIGURE II

This specimen is typical of five (5) clad 7075-T6 aluminum alloy test specimens. Three (3) different types of fasteners; AN 509-10-10 cadmium plated steel screws, AN 526 DD aluminum alloy rivets and Q 4303-6 stainless steel rivets were used. The fasteners on the specimen have not been milled.

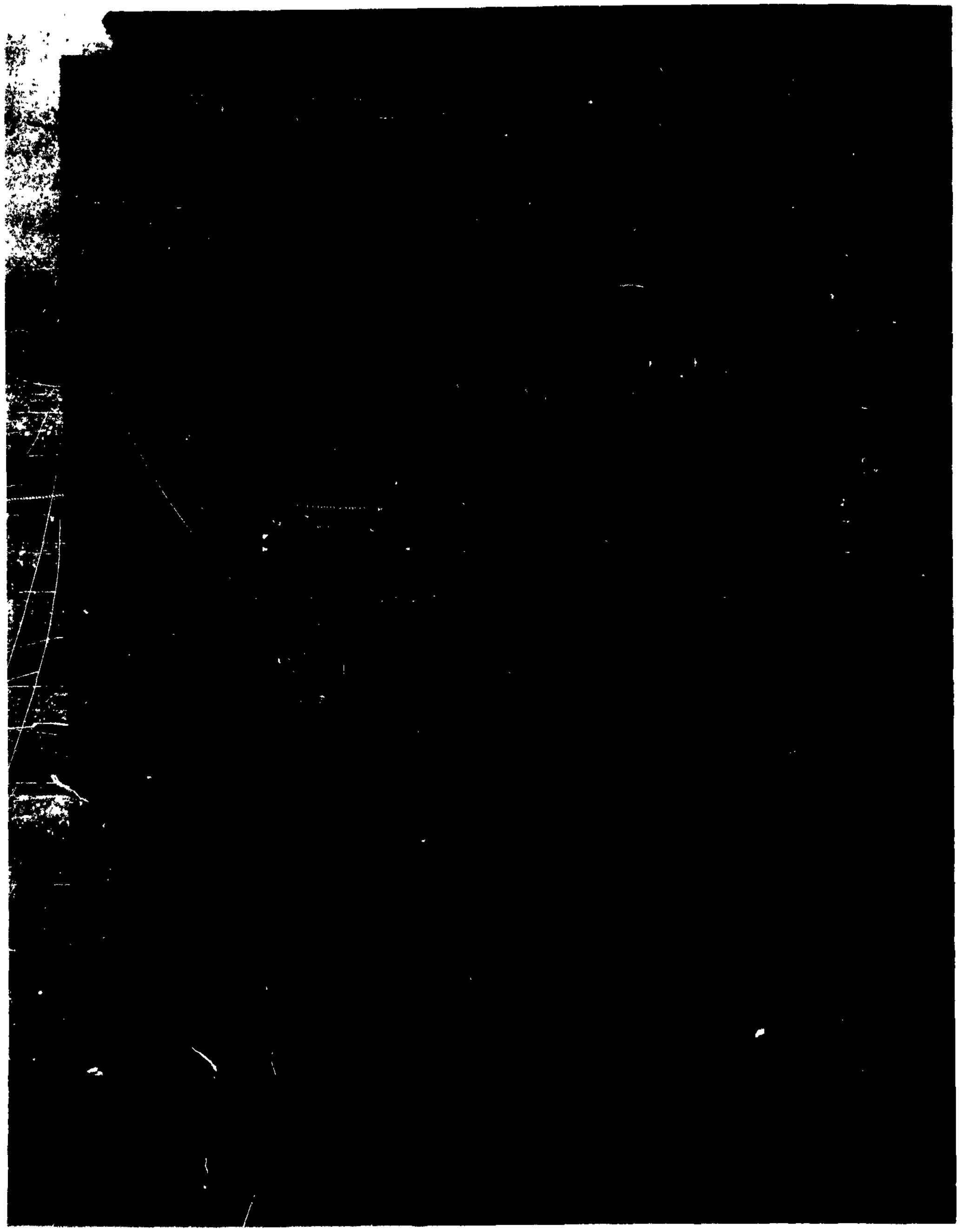

FIGURE III

This specimen is typical of the two (2) clad 2024-T3 aluminum alloy specimens with milled AN 426 DD aluminum alloy rivets.