Internal Letter

Rockwell International

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Subject: Corrosion of MGCS Frame at EMI Gasket Interfaces

References:

a) IL UU2-25256/278-071/25-01-43 from E. B. Lachmar; subject: MGCS RFI Gasket Corrosion; dated 11/12/82.

b) IL 82-277-023-EMU-081 from C. W. Koistinen; subject: EMI Gasket Corrosion; dated 11/22/82.

c) IL UU2-25990/274-045/25-74-00 from E. R. Brands; subject: RFI Gasket Corrosion; dated 12/04/82.

d) IL UU2-26001/274-045/25-75-00 from J. M. Kolyer/J. D. Guttenplan; subject: Corrosion Compatibility of Tin and Class 3 Chem Filmed Aluminum; dated 12/16/82.

OBJECTIVE

To evaluate Ferrex versus Spira gaskets for corrosion compatibility with chem filmed aluminum, Action Assignment No. 2, Reference (a).

CONCLUSIONS

Accelerated corrosion testing by salt spray and alternate immersion revealed that Ferrex gaskets, retinned or not, and Spira gaskets with bare copper edges were incompatible with chem filmed 6061 aluminum. Spira gaskets with retinned edges were compatible. Where there was no EMI gasket, there was no corrosion. Retinned Ferrex gaskets were compatible only if the interface was sealed.

RECOMMENDATIONS

For FSED II hardware, Ferrex EMI gaskets should be replaced with Spira gaskets with retinned edges. This will insure a flush mating of interfaces and will eliminate the problem now experienced with the installation of Ferrex gaskets. Sealing the EMI interfaces will further enhance corrosion compatibility.

BACKGROUND

The chem filmed aluminum groove and interface at the EMI gasket under the MECA mounting on Prototype No. 3 MGCS was badly corroded after five months of laboratory operation, References (b) and (c). This EMI gasket was a Ferrex gasket that had not been retinned and was improperly installed. The corrosion occurred at areas where the tin plate was missing and copper was exposed on the gasket.

The Ferrex gaskets (tin-coated, copper-clad steel mesh) do not fit well in the Frame grooves causing a less than flush mating. The gap exposed in Prototype No. 3 was greater than 20 mils due to the mesh protruding outside the Frame groove. This allowed more moisture to enter the Frame groove than normal. A retinned

gasket properly installed will greatly reduce the potential for corrosion, but any small breaks in the wire mesh tin plating will be sites for galvanic corrosion. Tin and MIL-C-5541, Class 3 chem filmed aluminum are compatible, at worst borderline, Reference (d). Copper and chem filmed aluminum, however, form a deleterious galvanic couple.

A moisture sealant applied around the MECA, PDS, and IMU at the MGCS frame, internal and external perimeter, was investigated, Reference (c). Analysis indicated that sealing internal perimeters would be difficult and costly.

The Spira gasket (tin plated beryllium copper) was suggested as a substitute, Reference (a).

PROCEDURE

Seven base plate fixtures, 3.5 in. by 7.4 in., were machined to hold six gaskets, each, with one groove being the control (no gasket), Figure 1. The base plate material was 6061-T651 aluminum which represented the MGCS Frame.

The material for six top plates was 6061-T651 aluminum which represented the MECA and PDS, Figure 1. The seventh top plate material was 7075-T73 aluminum which was machined from the forged center ring on the IMU.

All plates had a MIL-C-5541, Class 3 chem film applied. The outside surface areas were painted with inhibited epoxy primer (MIL-P-23377) and then with a top coat of white polyurethane (MIL-C-83286).

Gasket specimens evaluated were:

Ferrex - (1) As Received, (2) Retinned
Spira - (1) MS-08, (2) ELS-08, (3) E/DLS-0842

(L - low force, M- medium force, E - edge tin plated, D - silicone rubber attached)

Three accelerated corrosion tests were used in evaluating the gaskets. They were:

1) Alternate immersion. The fixture was submerged in deionized water for 20 minutes then allowed to drain for 20 minutes in air.

2) Salt spray test, in conformance to ASTM B117.

3) Cyclic temperature humidity, (two fixtures) operated in conformance with MIL-STD-202, Method 106.

All gaskets were cut and sealed at the edge where cut; except for gaskets in the seven-day salt spray test, Figure 2. The gaskets were placed in fixtures and gapped to 10 mils to represent the gap caused by Ferrex gaskets on assembly of major hardware, Figure 3.

Two fixtures underwent alternate immersion testing. One fixture was sealed externally, at the interface only. The bolts holding the two plates together were not sealed. The sealing compound was AB0120-036 (Type II, Class 2, Recipe 30). After 14 days of alternate immersion in deionized water, the unsealed fixture was opened and no corrosion was present. This fixture was then reassembled and gapped to 20 mils. Sodium chloride (0.5 percent) was added to the deionized water to accelerate galvanic effects. The sealed and unsealed fixtures were then tested for an additional 10 days.

Two fixtures underwent salt spray test. One fixture for seven days and the other for 14 days.

Two fixtures are still undergoing testing in cyclic temperature humidity with no apparent corrosion after 45 days. One fixture has a top plate material 7075-T73 aluminum. These fixtures will be opened at a later date for observation.

RESULTS AND DISCUSSION

An unsealed fixture, after alternate immersion testing, is shown open in Figure 4. The gaskets on the right hand side of the figure are numbered, as are the grooves on the fixture, to indicate where the gaskets were mounted. Gasket 1 is a Spira gasket with bare copper edges. Gaskets 2 and 3 are Spira gaskets with retinned edges; 3 also has a silicone rubber seal bonded to one side. Gaskets 5 and 6 are Ferrex gaskets, retinned and not retinned, respectively. Groove No. 4 on the fixture held no gasket.

This fixture shows evidence of corrosion in the grooves and on the cover plate where both Ferrex gaskets (5 and 6) and the Spira gasket with bare copper edges (1) were mounted. Three small isolated pits were found on the cover plate above each of the Spira gaskets with retinned edges; the grooves were unaffected. No corrosion was detected at the empty groove (4).

Figure 5 shows a sealed fixture which was opened after alternate immersion testing. Slight corrosion was found at the Ferrex gaskets (particularly the gasket that was not retinned). No corrosion was observed at the Spira gaskets. There is evidence, however, that water had seeped in through the fastener holes. If the bolt holes had been sealed, there is a good probability that there would have been no corrosion.

An unsealed fixture opened after 14 days of salt spray exposure is shown in Figure 6. The gaskets and corrosion products are still in place. This shows a dramatic difference in corrosion caused by the Ferrex gaskets (5, 6) on the left and the Spira gaskets (1, 2, 3) on the right. The same fixture is shown in Figure 7 after removal of the gaskets and corrosion products. The severity of corrosion and pitting caused by the gaskets is in the following order:

Most severe:	Ferrex gasket, not retinned	(6)
	Ferrex gasket, retinned	(5)
	Spira gasket, not retinned	(1)
Least severe:	Spira gasket, retinned	(2,3)

The retinned Spira gaskets (2,3) were completely compatible with chem filmed aluminum in this test. No corrosion was found in the empty groove (4).

The two fixtures undergoing cyclic temperature humidity testing will be opened at a later date. If observations on these fixtures differ from those reported here, a follow up report will be issued.

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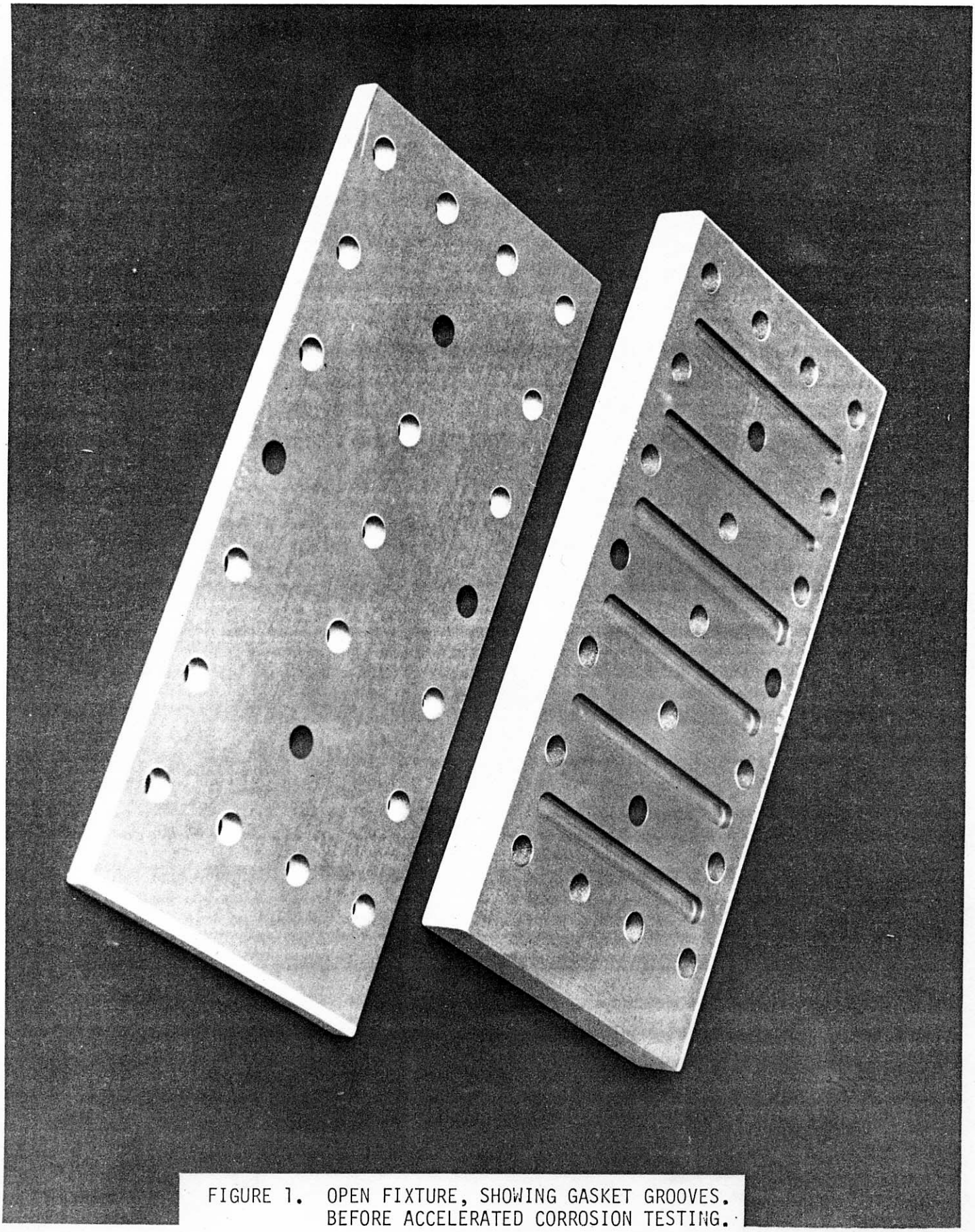

FIGURE 1. OPEN FIXTURE, SHOWING GASKET GROOVES. BEFORE ACCELERATED CORROSION TESTING.

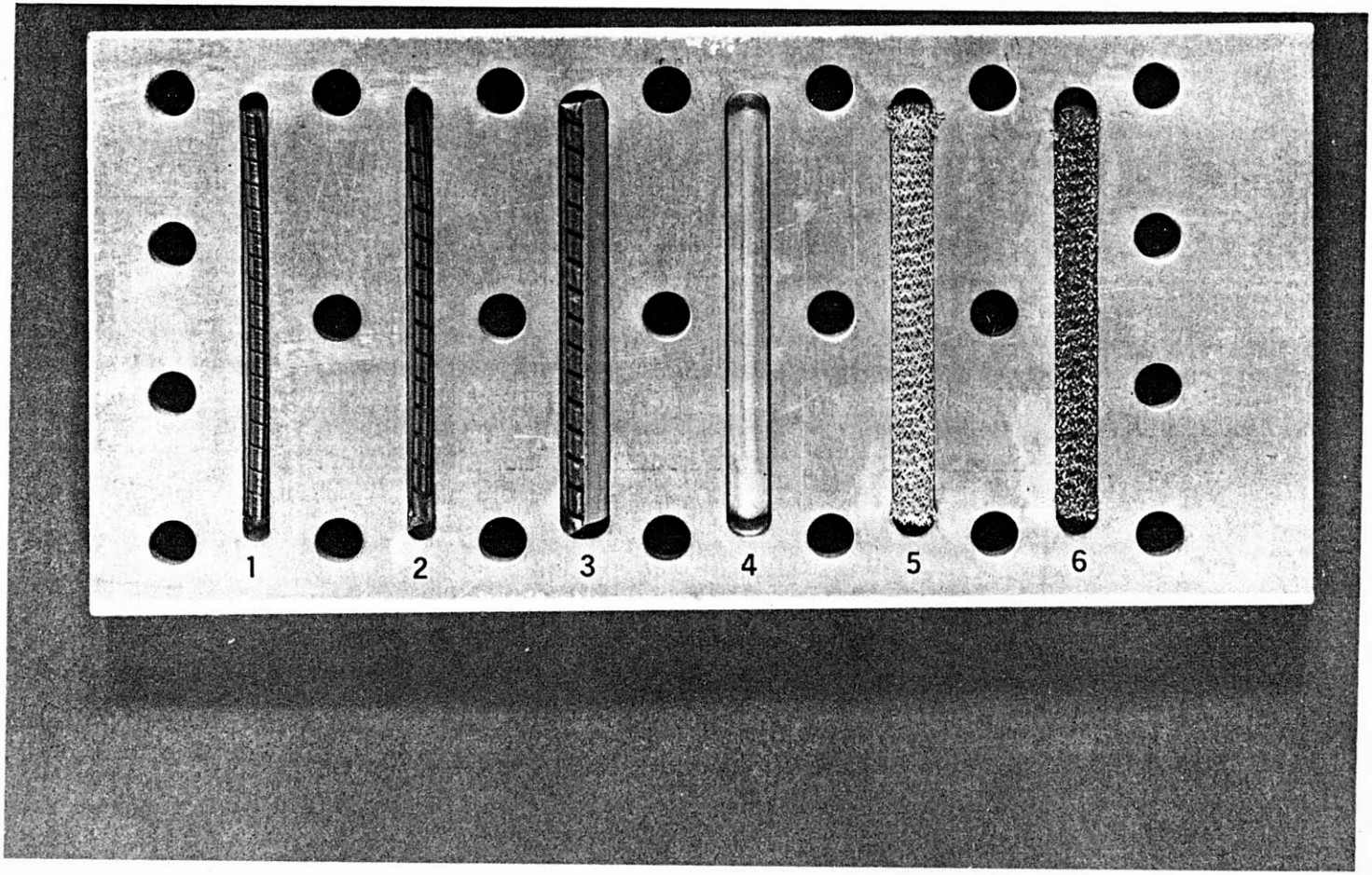

FIGURE 2. FIXTURE WITH GASKETS IN PLACE, BEFORE ACCELERATED CORROSION TESTING.

1	-	SPIRA GASKET WITH BASE COPPER EDGES	MS-08
2,3	-	SPIRA GASKETS WITH RETINNED EDGES	ELS-08 & E/DLS-0842
4	-	CONTROL GROOVE, NO GASKET	
5	-	FERREX GASKET, RETINNED	
6	-	FERREX GASKET, NOT RETINNED	

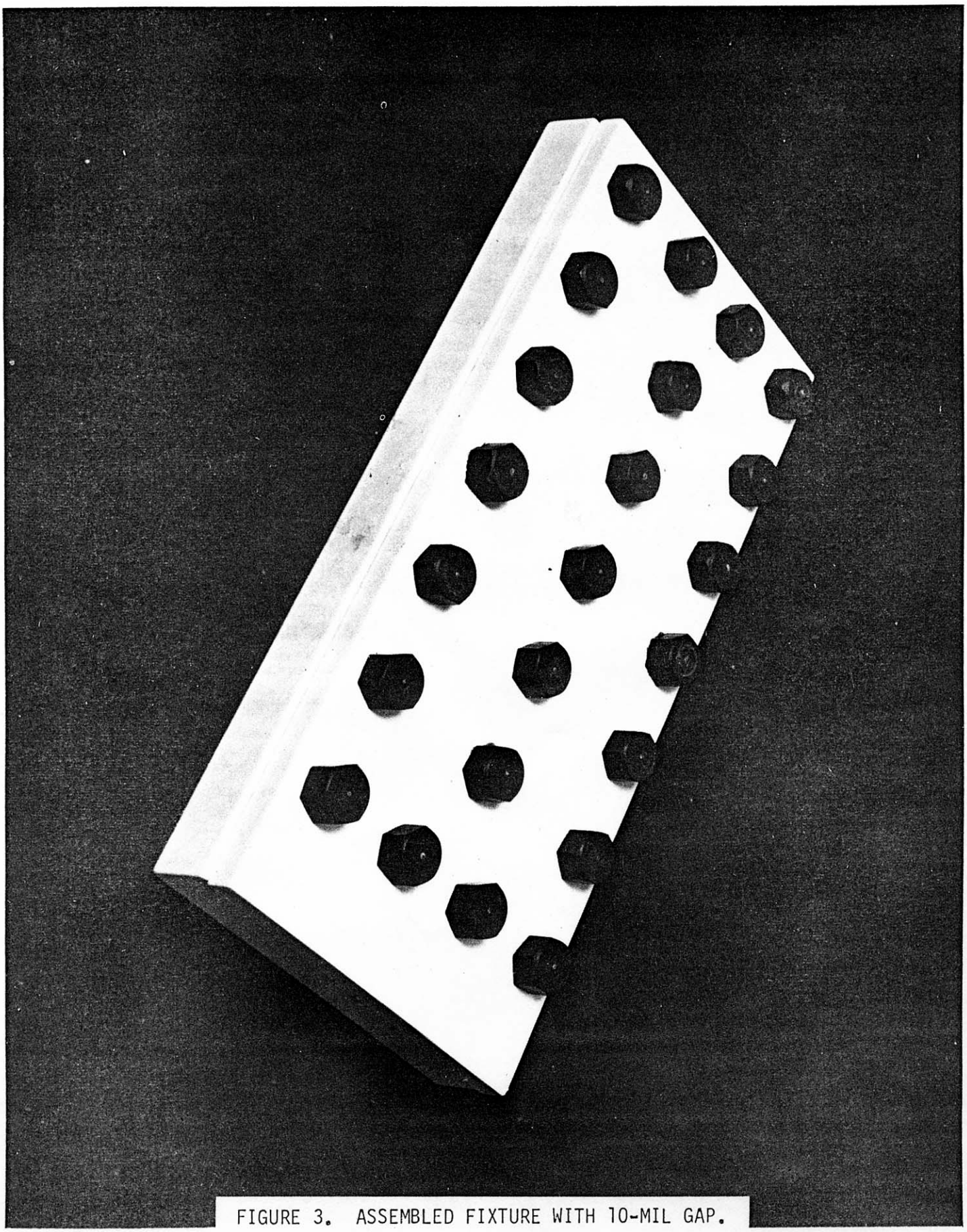

FIGURE 3. ASSEMBLED FIXTURE WITH 10-MIL GAP.

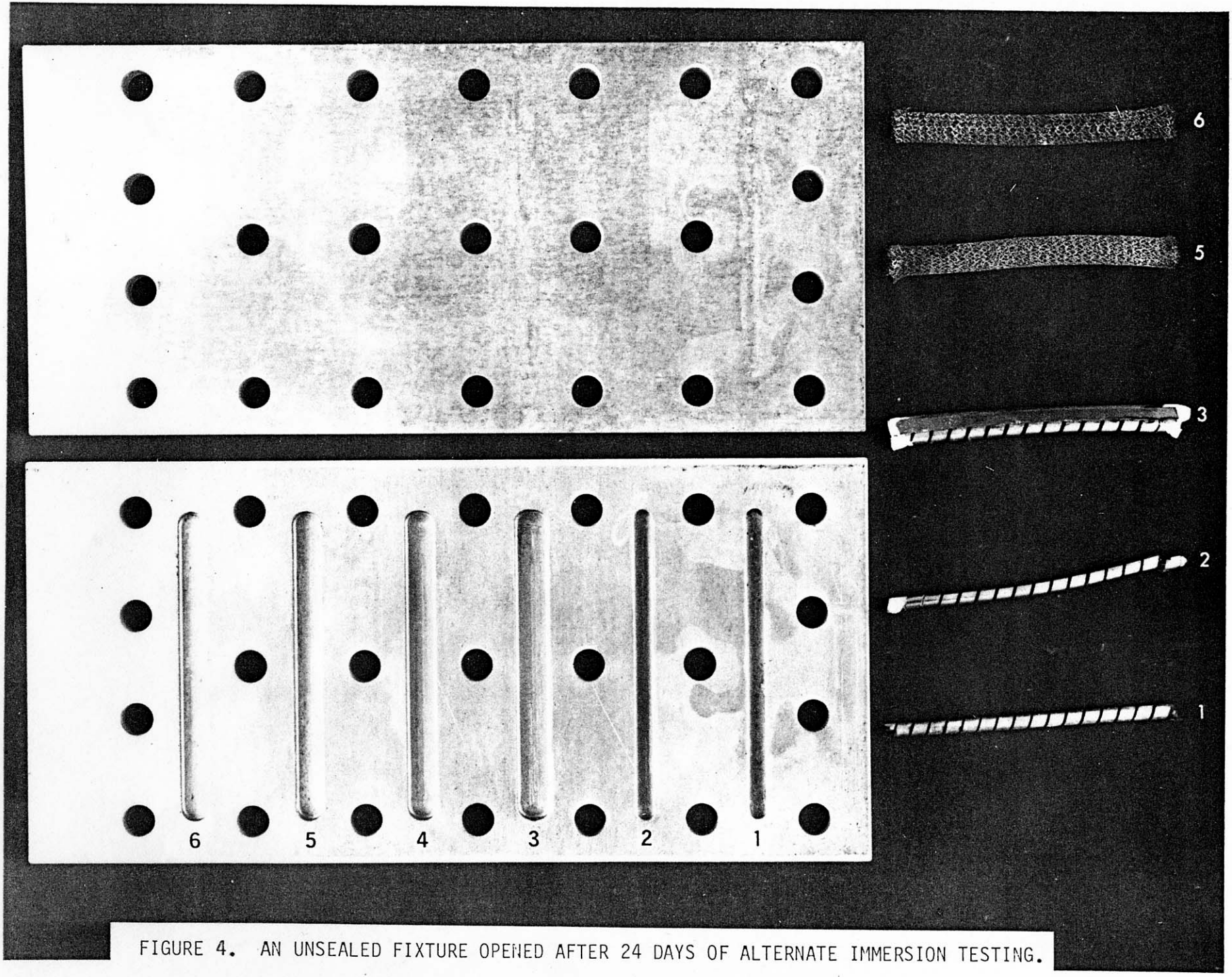

FIGURE 4. AN UNSEALED FIXTURE OPENED AFTER 24 DAYS OF ALTERNATE IMMERSION TESTING.

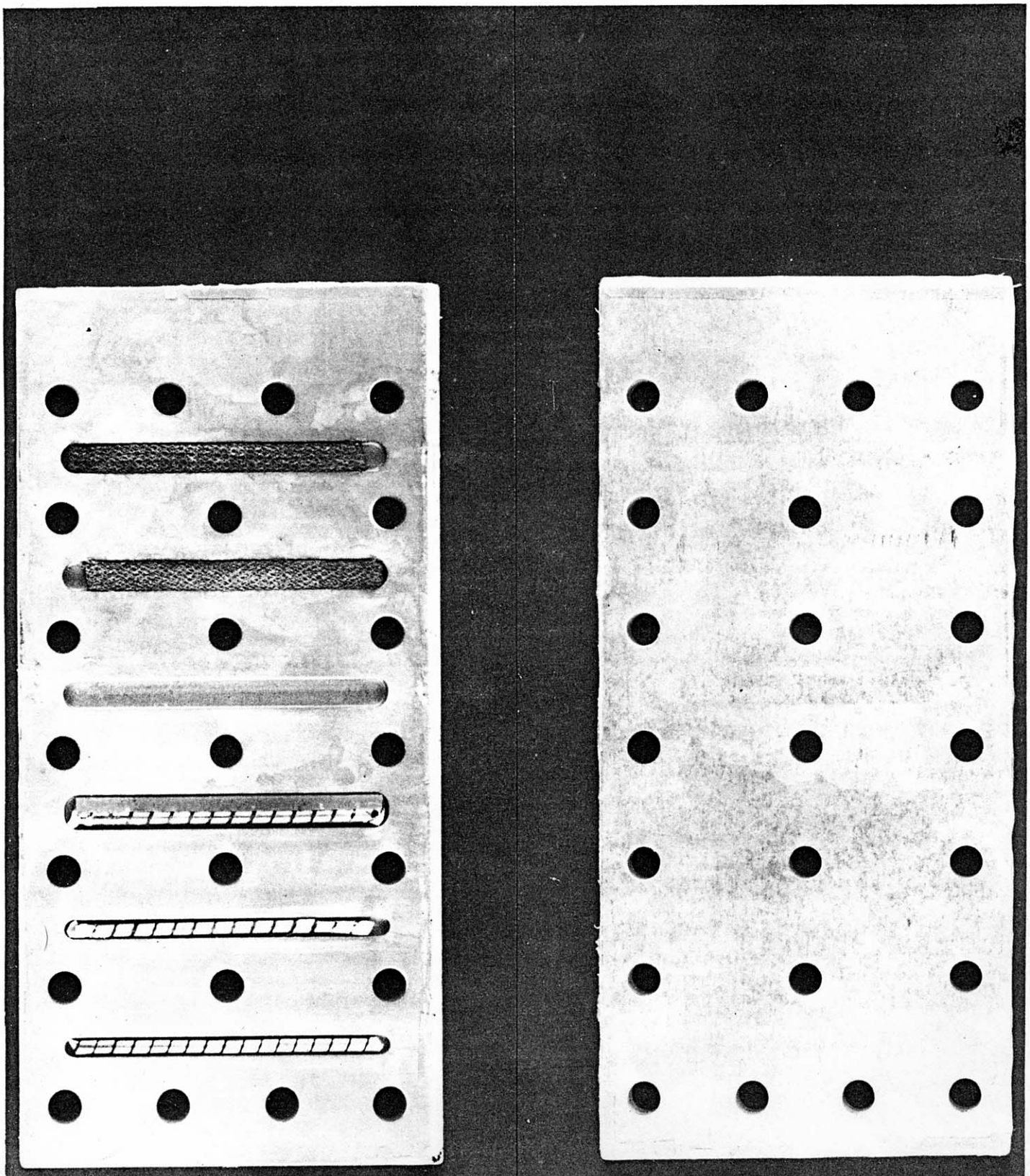

FIGURE 5. A SEALED FIXTURE OPENED AFTER 24 DAYS OF ALTERNATE IMMERSION TESTING. SPIRA GASKETS ARE ON THE LEFT AND FERREX GASKETS ON THE RIGHT.

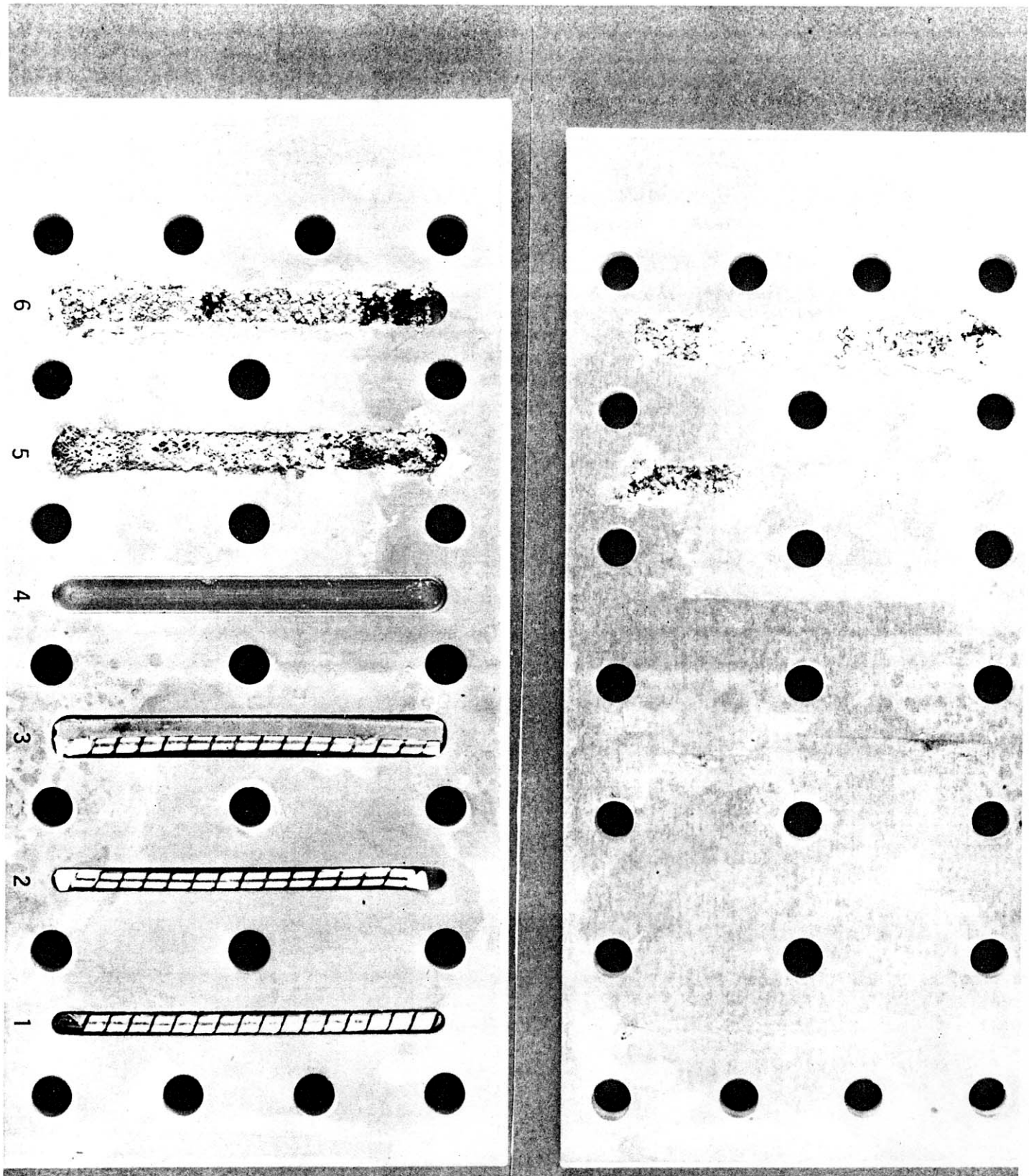

FIGURE 6. OPENED FIXTURE AFTER 14 DAYS OF SALT SPRAY EXPOSURE. CORROSION PRODUCTS HAVE NOT BEEN REMOVED. FERREX GASKETS ARE ON THE LEFT AND SPIRA GASKETS ON THE RIGHT.

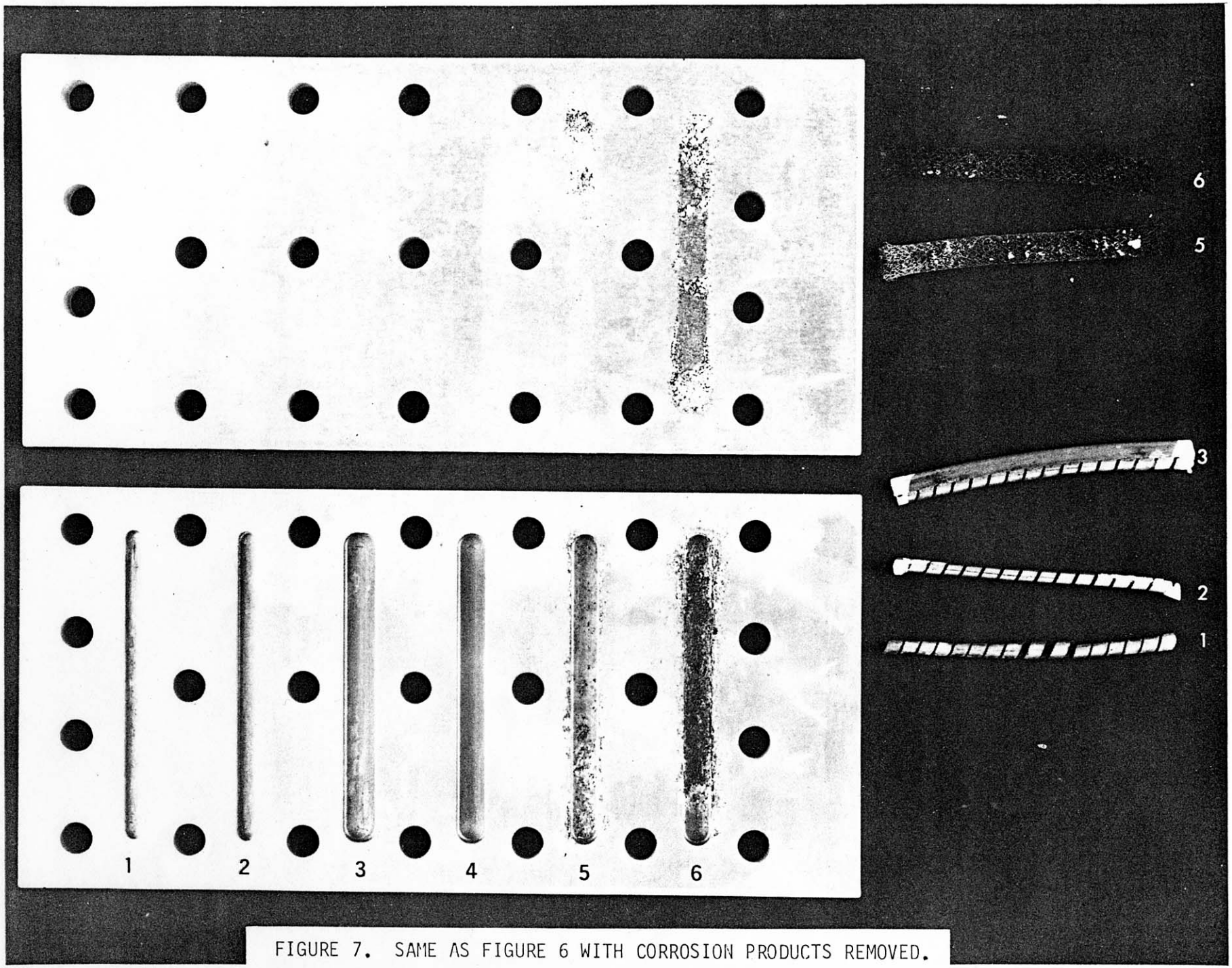

FIGURE 7. SAME AS FIGURE 6 WITH CORROSION PRODUCTS REMOVED.