SOUTHWEST MICROWAVE

# INTERNAL TEST REPORT

ITR NO. 91-3057

## Mating and Unmating Testing

### SSBP-20HD COAXIAL ASSEMBLIES

---

**SSBP-20HDP (50100-001P)**
**SSBP-20HDS (51100-001S)**

**HOUSINGS: M24308/4-2F FOR SSBP-20HDS**
**M24308/2-2F FOR SSBP-20HDP**

**NOTE: TESTING DATES**
**GROUP A: JUNE 9-17, 2009**
**GROUP B1, B2: AUGUST 3-14, 2009**

| | |
|---|---|
| PREPARED BY: B. Clyatt | DATE: 10/12/09 |
| APPROVAL: | DATE: 10/12/09 |

SOUTHWEST MICROWAVE

**ITR NO. 91-3057**

# REVISION HISTORY

| DATE | REV. NO. | DESCRIPTION | ENG. |
|---|---|---|---|
| 10/12/09 | 1.0 | Original release. | dhs |
| 1/7/10 | 1.1 | Correct humidity test hours in Abstract from 48 to 72 to be IAW test data. Add clarification that SSBP-20 and SSBP-20HD have identical interface. | dhs |

Test Report No. ITR 91-3057, Rev. 1.1

# Mating and Demating Test of SSBP-20HD Coaxial Assemblies

## 1. Abstract

Tests were conducted to evaluate effects of mating/demating of Size 20 SSBP coaxial assemblies. This is part of overall in-house qualification testing for SSBP coax assemblies. Connectors were divided into 2 groups.

Group A: For Electrical/Microwave parameters after mating/demating. Criteria for acceptance is maximum VSWR change of 0.10 through 27 GHz for mated assemblies. 30 pairs of SSBP-20HD pin/male and socket/female coaxial assemblies were installed in 2 standard 15-position D-Subminiature connectors and tested to 5,000 mating/demating cycles. VSWR was measured at initial mating and after 100, 500, 1000, 3000 and 5000 cycles. Maximum VSWR change was under 0.10 VSWR for all mated SSBP-20HD pairs. (Comment: Initial test plan for Group A was for 2,500 mating/dematings but results at 2,500 prompted continuing tests.)

Group B: To examine Physical/Mechanical Wear after mating/demating. 2X the number of SSBP-20HD coax assemblies were installed in similar connectors used for Group A testing. One group (B-1) went 500 mating/demating cycles and another group (B-2) was subjected to 1,000 mating/demating cycles. Both groups were subjected to 72 hours of humidity and examined for corrosion. All passed.

SSBP-20 and SSBP-20HD have identical mating interface. Therefore, based upon these evaluations, SSBP-20 and SSBP-20HD coax assemblies are confirmed to provide microwave performance for 1,000 mating cycles.

## 2. Test Procedure

### 2.1. Introduction

SSBP coaxial assemblies are used in industry-standard multi-contact connectors. SSBP coax assemblies are described based upon the “cavity size” for equivalent-sized contacts used for signal (non-microwave) signals. (For example SSBP-20 assemblies are used where Size 20 signal contacts would otherwise fit or be used.) The SSBP-20HD assemblies are used in D-Subminiature connectors, while SSBP-20, -16, -12 and size -8 are for circular connectors. Although used in different connectors, SSBP-20 and SSBP-20HD have identical mating interface. The SSBP are designed to fit standardized “contact cavities” without respect to specific contact arrangements, shell sizes or mating methods involved. While initial applications are for commercial test equipment, to simplify describing the types of connectors that may be used, MIL-DTL-24308 and MIL-PRF-38999 are used for reference. Both connector standards require 500 mating/demating cycles, which was used as basis for this test. SSBP contacts are installed and removed using the same plastic CIET tools used for the non-coax (signal) contacts.

2.2. Content

This report summarizes the procedures and results. Assemblies used consist of two mated pairs of 15-position connectors:

> M24308/4-2F connectors (with cavities for socket/female contacts dimensioned per M39029/64-369), with SSBP-20HDS (socket/female) installed in all 15 cavities.
>
> M24308/2-2F connectors (with cavities for male/pin contacts dimensioned per M39029/63-360), with SSBP-20DHP (pin/male) installed in all 15 cavities.

Refer to the report's Appendix for selected test results, photographs of the fixturing used for mating/unmating testing and the HP8510C used for VSWR testing.

2.3. Applicable Documents

| | |
|---|---|
| MIL-DTL-24308 | Connectors, Electric, Rectangular, Nonenvironmental, Miniature, Polarized Shell, Rack and Panel, General Specification for |
| EIA-364-09 | Durability Test Procedure for Electrical Connectors and Contacts |
| EIA-369-13 | Mating and Unmating Test Procedure for Electrical Connectors |

2.4. Test Specimens and Fixturing

Group A: SSBP-20HDP and -20HDS coax assemblies were terminated with 12 inches of Storm Flex ® .047 cable to Southwest Microwave standard field-replaceable cable plug connectors 201-500SF. The SSBP-20HD assemblies were installed into connectors using plastic CIET-20 tools that were supplied with the MIL-spec D-Sub connectors.

Group B: Unterminated SSBP-20HDP and -20HDS coax assemblies were installed in similar connectors using the same plastic CIET tools used for Group A .

Test fixturing was designed to replicate connector mating with alignment aided by guide posts and one side using float mounts standard for commercial D-Subminiature connectors when used in rack and panel applications.

2.5. Testing

2.5.1. For all tests, mating/demating was done at a rate of 5 cycles per min. in accordance with EIA-364-9 requirements of 200 ± 100 cycles per hour.

2.5.2. Group A: Although SSBP-20 coax assemblies have been tested to 110 GHz by other than Southwest Microwave, for these tests the SSBP were cabled to SMA plug connectors for testing to 27 GHz using HP8510C VNA. This was done for testing convenience. Prior testing over time has shown that surface wear results in increased VSWR. SOLT calibration was performed before each group of measurements using the same VNA (with NIST-traceable calibration date 20/03/09), with air conditioned, stabilized, test room ambient conditions.

2.5.2.1. Assemblies were measured in-line (SMA/plug-to-SSBP-20HDP mated to SSBP-20HDS-to-SMA/plug) at the following conditions:

Upon first mating (100%),
After 100 cycles (100%),
After 500 cycles (6 samples for reference),
After 1,000 cycles (6 samples for reference),
After 5,000 cycles (100%).
The results after 5,000 cycles were then compared to initial readings.

2.5.3. Group B: A total of 60 pairs (pin and socket SSBP-20HDP and -20HDS) unmated, but assembled coaxes were examined under 10X magnification and then installed in 4 pairs of 15-position D-Subminiature connectors. Initial (pre-cycle testing) mating/demating forces were measured in accordance with EIA-364-13, and then connectors were installed in the test fixturing. (See photographs in Appendix for fixturing.) The connectors were split into 2 groups of 2 mating pairs (30 mating SSBP-20HDP and SSBP-20HDS coaxes).

Group B-1: Subjected to 500 mating/demating cycles. Connectors were removed from the test fixturing and given 10X physical examination. Contact (SSBP-20HD coax assembly) mating and unmating forces were measured in accordance with EIA-369-13.

Group B-2: Subjected to 1,000 mating/demating cycles. Connectors were removed from the test fixturing and given 10X physical examination.

2.6. Group A: Test Results

2.6.1. Differences in the per line VSWR measurements between initial and after 5,000 cycles are shown in Table I.

2.6.2. Test anomalies: Testing after 100 cycles indicated high VSWR and other problems associated with 2 specific cables. They were examined and it was found that the termination to the SMA plugs had problems resulting from nicked cable braid and extended solder wicking which had become damaged during handling by the test technician. Since the problems were not associated with SSBP-20, the 2 cables were removed for further study and replaced by new, similar SSBP-20HD (to SMA plug) cables from extra assemblies that were made as part of the initial lot. Since testing was for 5,000 matings/dematings, a differential of 100 cycles was not considered significant (i.e., they would have 4,900 cycles), their initial measurements were substituted for data for the removed cables in Table I and the testing proceeded.

2.7. Group B: Test Results

2.7.1. Group B-1: Completed 500 durability mate/unmate cycles in accordance with MIL-STD 1344, Method 2016, on 9/24/09. Following durability cycling, those samples and 2 control sample loose pairs of SSBP 20HD coaxes completed 78 hours of humidity environmental exposure (steady state 85°C @ 85% relative humidity) in Southwest Microwave chamber (calibrated 2/16/09) in an unmated condition. After humidity testing, SSBP were removed and examined under 10X power.

All 60 SSBP assemblies were examined. There was no evidence of wear or corrosion. However, it was noted that one SSBP-20HD pin coax assembly had 2 radial nicks in the interface reference surface of the outer contact that, due to their location and orientation, were deemed present prior to the beginning of durability and humidity exposures (but had been missed during pre-test visual inspections). The nicks were not in a surface that was involved in the mate/unmate cycling and no evidence of any contribution by its mating socket contact was present. In the nicks, the nickel plating under the gold plating was exposed, but basis beryllium copper was not exposed.

Following all mechanical and humidity environmental exposure, all samples, including the damaged pin coax described in the prior paragraph, passed post durability examination in accordance with MIL-STD 1344, Method 2016, paragraph 3 d. and visual inspection for corrosion or degradation in accordance with MIL-STD 1344, Method 1001.1, paragraph 4.2.6. No evidence of corrosion or degradation was present on/in any of the SSBP 20HD samples. No condition of wear or physical damage that would affect form, fit, or function, including microwave performance, was observed.

**Table 1: SSBP-20 Mating - Demating VSWR Measurement Differences Initial versus After 5,000 cycles**

| Connectors Line | VSWR Difference (If > O) | Pass? Fail? | Connectors Line | VSWR Difference (If > O) | Pass? Fail? |
|---|---|---|---|---|---|
| Conn 1: 1 | 0.03 | P | Conn 2: 16 | 0 | P |
| 2 | 0.02 | P | 17 | 0.02 | P |
| 3 | 0.005 | P | 18 | 0 | P |
| 4 | 0.005 | P | 19 | 0.03 | P |
| 5 | 0 | P | 20 | 0 | P |
| 6 | 0 | P | 21 | 0 | P |
| 7 | 0.01 | P | 22 | 0.01 | P |
| 8 | 0 | P | 23 | 0 | P |
| 9 | 0.01 | P | 23 | 0.02 | P |
| 10 | 0 | P | 25 | 0.005 | P |
| 11 | 0 | P | 26 | 0.01 | P |
| 12 | 0.05 | P | 27 | 0.01 | P |
| 13 | 0.01 | P | 28 | 0 | P |
| 14 | 0 | P | 29 | 0 | P |
| 15 | 0.01 | P | 30 | 0.04 | P |

Notes: Testing with 2 pairs of DA-15 connectors (15 positions per connector). See para. 2.2.
The SSBP cables for Connector 1 Line 15 and Connector 2 line 27 were replaced at 100 cycles due to problems found at termination for SMA plugs. Initial readings for removed cables were replaced with readings for the new cables. The replacement cables have data for 4,900 matings instead of 5,000 cycles. See para. 2.6.2.

2.7.2. Group B-2: Completed 1,000 durability mate/unmate cycles in accordance with MIL-STD 1344, Method 2016, on 9/24/09. Following durability cycling, the SSBP 20HD coaxes completed 78 hours of humidity environmental exposure (steady state 85°C @ 85% relative humidity) in Southwest Microwave chamber in an unmated condition. After humidity testing, SSBP were removed and examined under 10X power.

Four of the SSBP-20HDS (socket) coax assemblies, 2 from each connector but not same contact positions (in housings) were found to have discoloration spots on inside of perimeter socket. No evidence of corrosion or degradation was present on/in any of the other SSBP 20HD samples. The 4 samples with discoloration were identified and sent for analysis by SEMTEC Laboratories (Phoenix, AZ). Response per Test Report STL28923 dated 2 October 2009 (copies available upon request) indicated that: (a) Assemblies showed no evidence of wear. (b) There was presence of copper and sulfates.. The copper showed up under low power SEM suggesting that it was contamination within the plating. Otherwise, there were no detrimental affects resulting from the 1,000 mating cycles. The "conclusion page" (7 of 7) of the SEMTEC test report is enclosed as Attachment 1.

Mating and Unmating Testing
ITR NO. 91-3057

ATTACHMENTS

| ATTACHMENT | CONTENT |
|---|---|
| 1 | Conclusions page (page 7 of 7) from SEMTEC Laboratories' report on SEM analysis of 4 SSBP-20HD coax connector assemblies. Complete report on file at Southwest Microwave. |
| 2 | Photographs:<br><br>SSBP-20HD installed in M24308 connectors. Unmated condition. (Note alignment posts.)<br><br>Mated condition.<br><br>Test fixture, showing testing of mated SSBP-20HDP and SSBP-20HDS assemblies.<br><br>Measuring using HP8510C. |

*SEMTEC Laboratories, Inc.*
*5025 South 33rd Street Phoenix, AZ 85040 602-276-6138*

**Conclusions:**
Optical and SEM examination of the four received connector samples, in two groups of two each, showed very similar conditions for both groups.

In neither case was wear detected that had removed the gold surface plating.

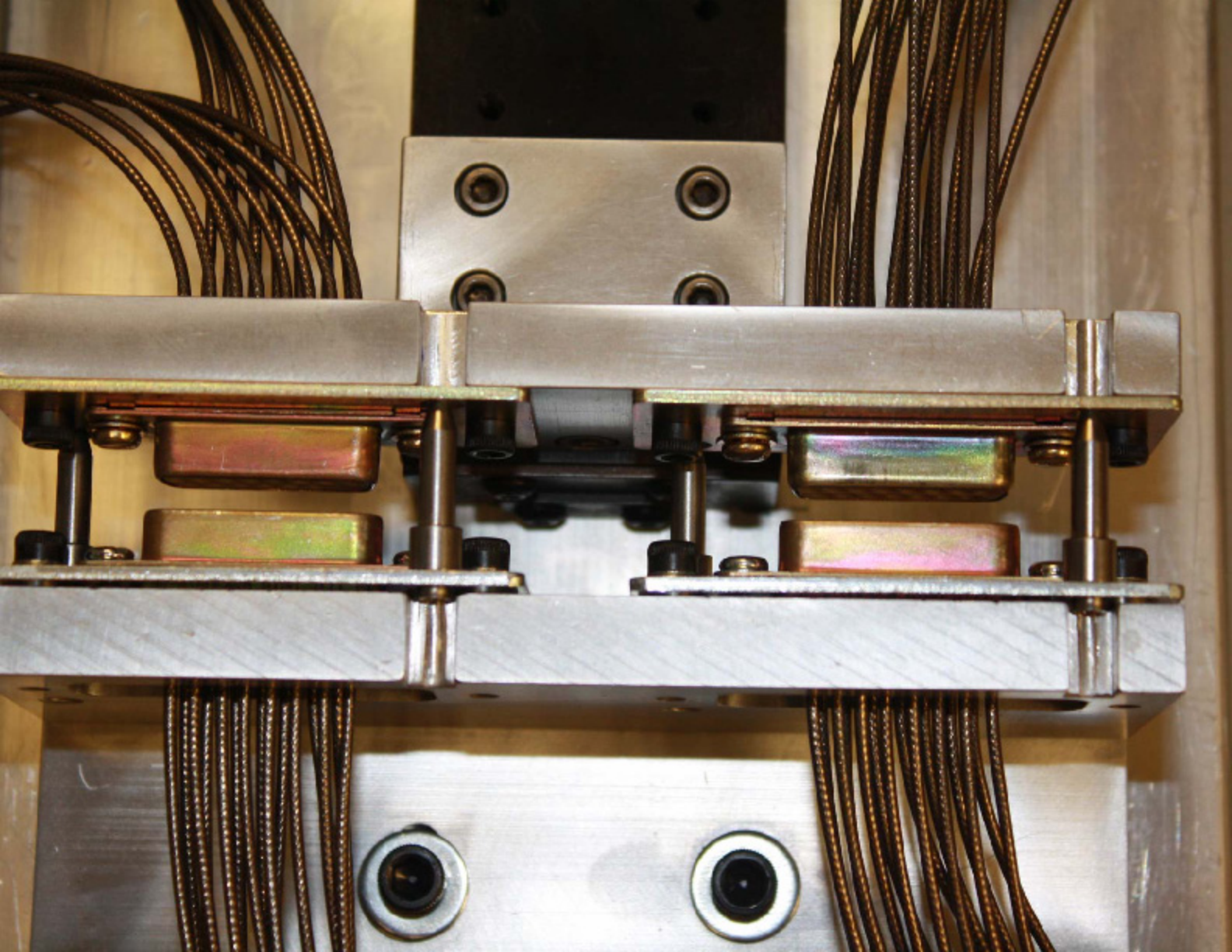
Actual loss of gold was only observed on the interior of a connector (see Fig 8) from Group I and within a small area at the tip of the same connector.

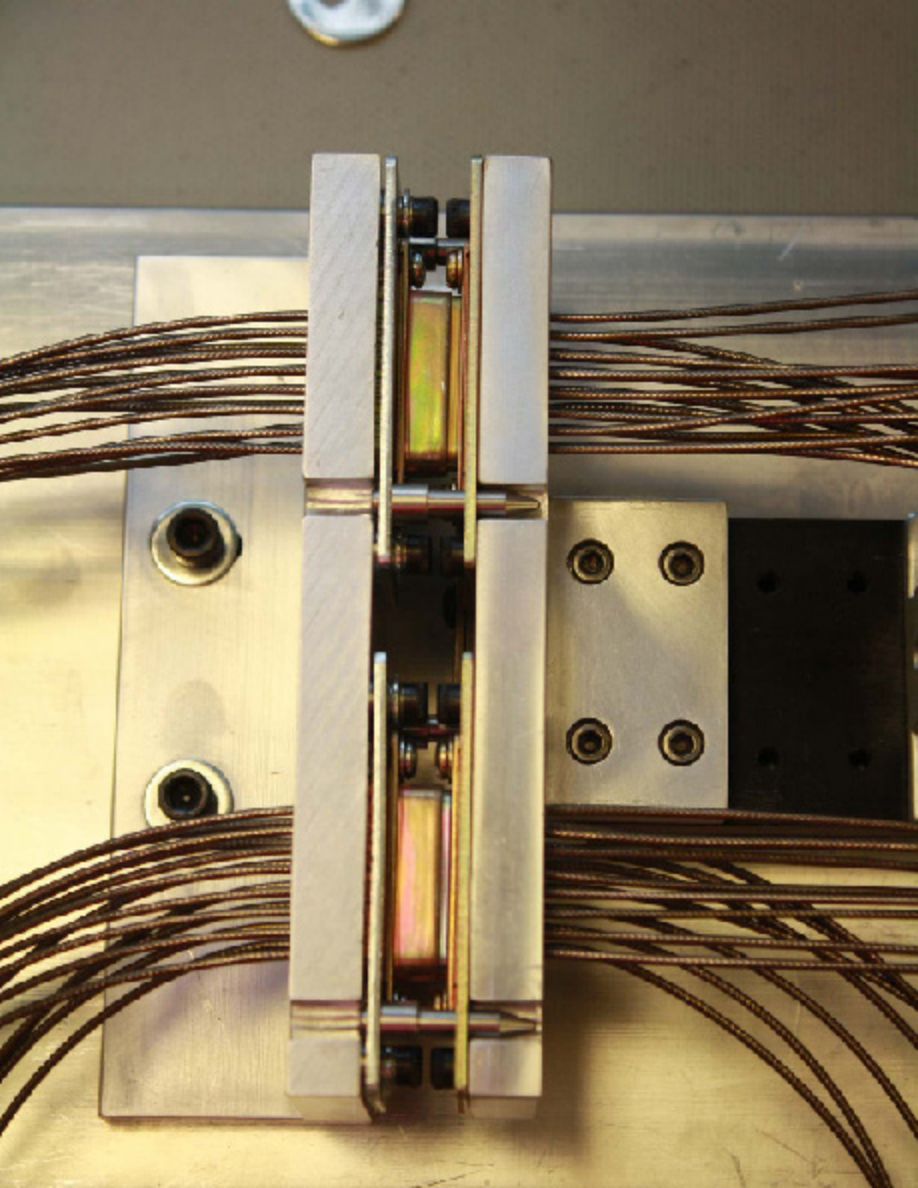
Otherwise, the dark discoloration appears to be due to the presence of contaminate materials that include copper. Whether the copper is present as a reaction product between an active agent and the brass base metal of the connectors is not known.

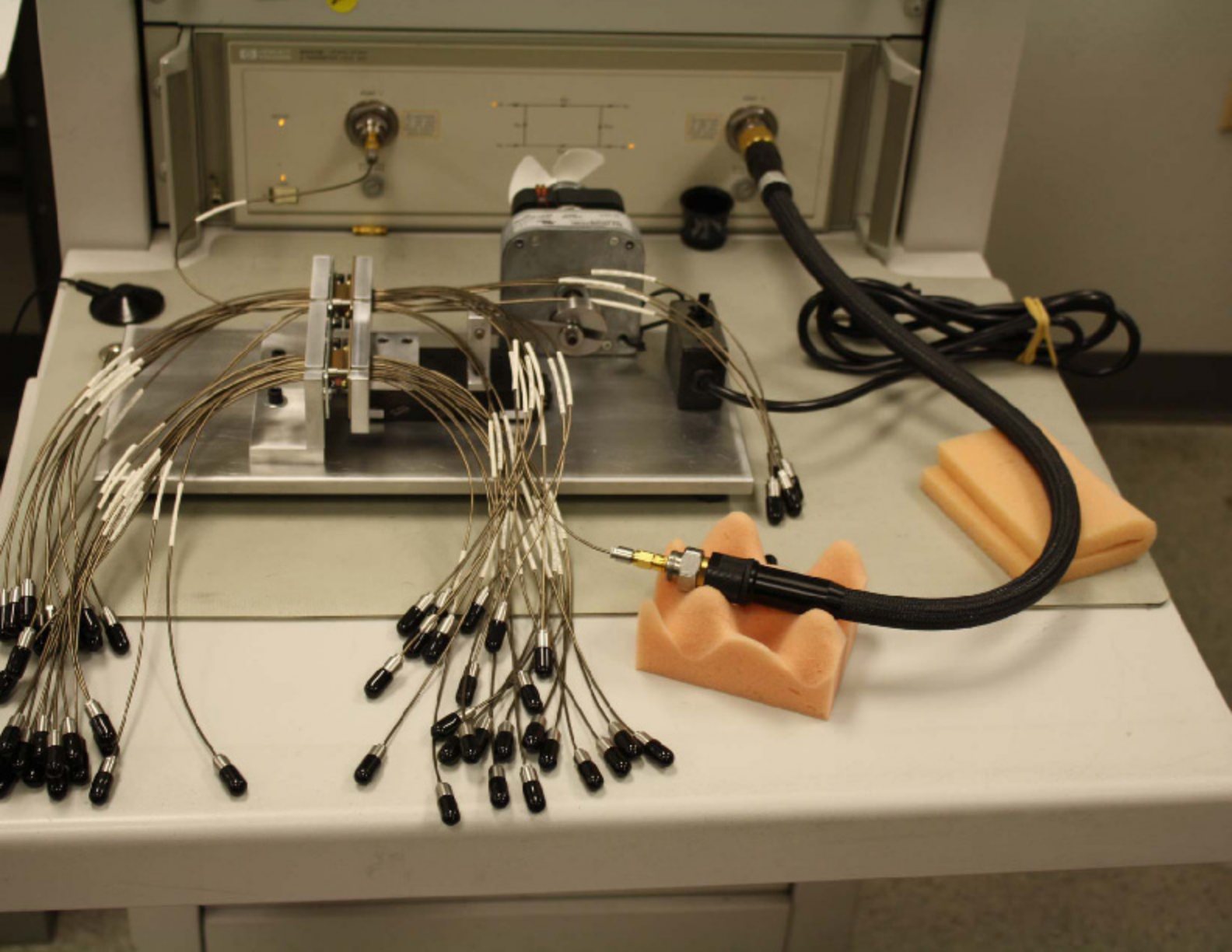
Sulfur and chlorine were both sporadically detected in discolored areas on pins from both groups. Both of these elements are classified as active agents and could have assisted in the corrosion.

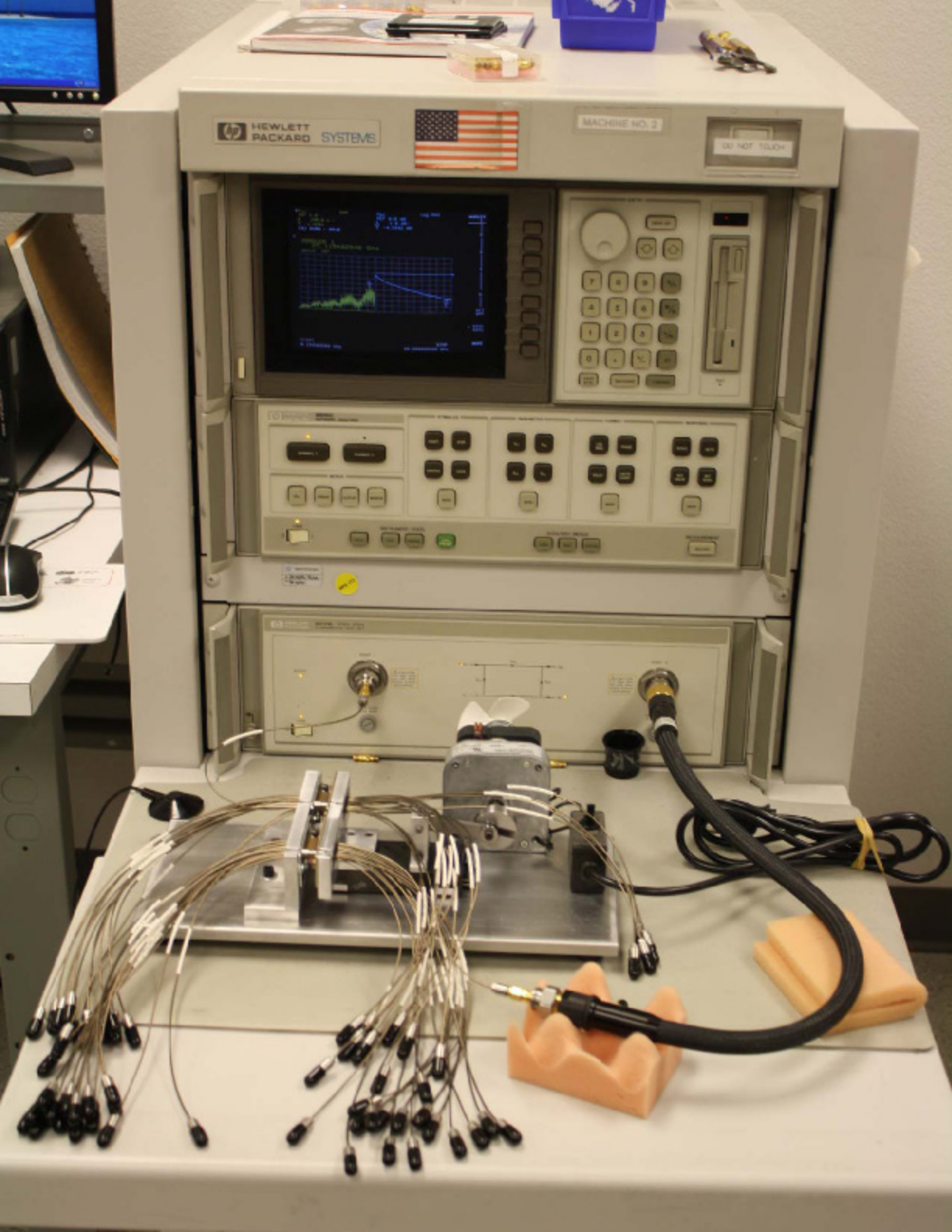
Respectfully Submitted,

Ed Holdsworth
General Mgr/CEO
SEMTEC laboratories, Inc.








HEWLETT
PACKARD SYSTEMS
MACHINE NO. 2
DO NOT TOUCH