Bendix
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Systems Division

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PLATING OF PSE LEVELING STOOL

PAGE 1 OF 4

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This ATM reviews the PSE Stool Plating Materials and Processes and briefly summarizes the thermal changes expected as a result of a loss of gold plate.

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INTRODUCTION

The Plating Process was changed for the PSE Stool assigned to the ALSEP Array D System. This change documented in CRD No. 60756 and ECP-014-1 was approved by NASA/MSC CCBO's IS0122 and ISO123. This ATM documents the original plating process, the reasons for changing, the Array D PSE Stool Plating Process and the thermal affects of degraded stool plating.

Stool Plating

As deployed on the lunar surface the PSE Sensor rests on a stool which serves to level the sensor and to thermally decouple the sensor from the lunar surface. Base material for this stool is Beryllium. The plating processes and materials originally chosen are:

1. Silver Plate 0.0004 to 0.0006 per QQ-S-365 Type II, Class 2.

2. Gold Plate 0.0001 minimum per MIL-G-45204 Type II Class 2.

This plating process was defined in the approved PSE Document "Gold Emissivity Surface Finish Process Specification" - 238046 - which controls both Type I (Nickel deposit prior to gold as used on the sensor base) and Type II (Silver deposit prior to gold as used on the stool) materials and processes. When the Array D Stool was removed from Bonded Storage, inspection revealed discoloration of the gold surface. This was determined to be caused by diffusion of the silver substrate through the gold and subsequent tarnishing of the silver; a condition which is well defined and recognized as occasionally occurring in thin gold plate over silver. This condition was documented in Discrepancy Report (DR) AC 0373. The DR was dispositioned to replate using the Type I Process from Document 238046. The Array D Stool, then, is plated:

1. With electroless Nickel 0.0002 to 0.0003 per MIL-C-26074A.

2. Bright Nickel 0.0005 to 0.0008 per QQ-N-290 Type I.

3. Gold Plate per MIL-G-45204 Type II Class 2.

The replating was performed by the Specific Plating Company of Commerce, California. This vendor has demonstrated superior capabilities in gold plating of other ALSEP Components and hardware on other NASA programs. The vendor certified that:

1. Stool replating was performed to the applicable MIL Standards with resultant plating thicknesses of:

Electroless Nickel	0.00025
Bright Nickel	0.00058
Gold	0.00013

2. All necessary tests were performed (bake, thickness, adhesion and bend).

Thermal Affects from Degraded Stool Plating

The gold plating on the top surfaces of the stool minimizes the heat transfer to and from the sensor via the stool. In the event that the gold detaches from the Nickel Plate the affect on the sensor temperature is summarized in the following table:

	Lunar Night		Lunar Day	
% Gold Plate Loss	Heat Leak Δ (Watts)	Temp. Δ (°F)	Heat Leak Δ (Watts)	Temp. Δ (°F)
100	0.20	9.0	0.03	0.9
50	0.10	4.5	0.015	0.45
25	0.05	2.20	0.008	0.22
10	0.02	0.90	0.003	0.09

It should be noted that the predicted temperature change at lunar night assumes that there is no compensation by the sensor's proportional heater. In actuality, the heater will tend to compensate for the additional heat loss at night provided there is an adequate available supply of system power. The latest power predictions for the Array D system, as derived from the Acceptance Thermal Vacuum Tests, indicates a minimum reserve power of approximately 15 watts. Further, operational experience from Apollo 14 PSE, confirms that with a properly deployed sensor and skirt, the sensor heater capacity is more than adequate to offset the predicted worst case heat loss of 0.2 watts.

CONCLUSIONS

1. For optimum sensor operation, a constant temperature is preferred. This infers decoupling the sensor from the lunar surface and confirms the requirement for a gold plated stool.

2. Should the gold plate be lost, either partially or fully, the results are not catastrophic. The sensor heater will offset the affects during lunar night: the daytime Δ must be accepted.

3. The use of Nickel plate over Beryllium is an acceptable plating process covered by both MIL Spec and the PSE Plating Process Specification 238046.

The use of copper over Beryllium, is also acceptable, according to the plating vendor, but is not covered in Process Specification 238046.