CAPACITY RECOVERY AFTER STORAGE
Negatively Precharged Nickel Hydrogen Cells

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Recovery of Capacity Lost During Open Circuit Storage of Negatively Precharged Nickel Hydrogen Battery Cells

- During Storage, NiH2 Cells Experience Loss in Useable Capacity.

- Cells from all Manufacturers exhibit losses.

- Loss Due to Cobalt Migration?

- Extent of Migration and the Ability to recover are function of the Length of Storage Period.

- Attempt to quantify amount of useable capacity that may be recovered and propose a timely procedure for the recovery.
Test Cells

- Four EPI RNH 90-3, TM2 Lot.
- Air Force Design, Pineapple Slice, Neg Precharge.
- Acceptance Test Procedure after build.
- 41 Months Open Circuit Storage at 0 deg C.
Eagle Picher RNH-90-3

Developed for the Hubble Space Telescope
RECOVERY PROCEDURE

- Cells Initially discharged (OCV < .2 V).
- Temp stabilized at 0 deg C.
- Baseline Charge, 160% of C rating in 24 hours:
  - C/10 (9.3 A) for 10 hours.
  - C/22.5 (4 A) for 14 hours.
- Raise Temp to room level.
- Allow to sit open circuit for 14 - 16 days.
- Lower Temp to 0 deg C.
- Discharge cells at C/6 (15 A) to 1.0 V/cell.
- Recondition cells 12 - 16 hours (V < .2).
- Baseline charge cells and allow to stabilize 1 hour.
- Discharge cells at C/6 (15 A) to 1.0 V/cell.
- Capacity is measured at 1.0 V/cell.
Capacity Gain from Open Circuit Stand
EPI RNH 90-3

Fig. 1.
Capacity Gain from OC Stand

EPI RNH 90-3

Cap Gain During OC Stand (Ahrs)

<table>
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<th>S/N</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
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<td>110</td>
<td>11.44</td>
<td>8.33</td>
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<td>113</td>
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<td>120</td>
<td>18.28</td>
<td>1.65</td>
<td>3.90</td>
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</table>

41 Months Storage

Fig. 2.
Capacity Loss from Acceptance Test Value

EPI RNH 90-3

Capacity Loss (Ampere Hours)

-28.9  -22.27  -32.02  -32.78

S/N 110  S/N 113  S/N 119  S/N 120

Storage  1st
3rd  2nd
4th  5th

41 Months Storage

Fig. 3.
Present Capacity as % of Acceptance Test Value

EPI RHN 90-3

![Bar Chart]

**Fig. 4.**
STORAGE

Open Circuit vs. 3/4 Volt at 0 deg?

- 2 Cells OC:
  - S/N 119, 120.
- 2 Cells in series at 1.5 V:
  - S/N 110 - 1.32 V, S/N 113 - .18 V.
    - 1 month in series
- Divide equally at 1.1 V/cell.
- 2 Cells paralleled at .75 V:
  - S/N 110 - .75 V, S/N 113 - .75 V.
    - 1.5 months paralleled.

- Question??? Do cells retain their recovered capacity upon cycling?
Capacity Behavior After Initial Recovery

EPI RNH 90-3

Fig. 5.

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Nickel-Hydrogen Storage / Capacity Fade Session

1992 NASA Aerospace Battery Workshop
CONCLUSIONS

- Capacity lost during storage can be regained as useable capacity.

- Storage conditions did not appear to effect ability to retain capacity.

- Useable capacity lost cannot be regained a second time.

- Future Plan is to LEO cycle cells to investigate capacity retention during cycling.
QUALIFICATION NiH2 CPV BATTERY

CAPACITY (AMPERE-HOURS)

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Qualification Random Vibration
Qualification Thermal Vacuum Test
QUALIFICATION NiH2 CPV BATTERY

CAPACITY (AMPERE-HOURS)

Spacecraft Integration Testing

20 Day Open Circuit Stand @ 10°C

30 Day Open Circuit Stand @ 20°C

1992 NASA Aerospace Battery Workshop
Nickel-Hydrogen Storage / Capacity Fade Session