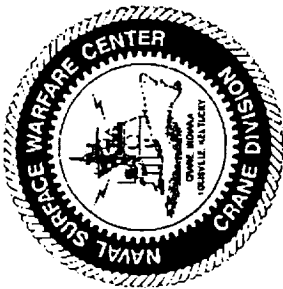


N 9 3 - 2 0 5 0 5

AF Ni-Cd CELL  
QUALIFICATION PROGRAM UPDATE



S. Hall and H. Brown NWSC Crane  
G. Collins, W. Hwang Aerospace Corporation  
Lt. Q. Bui USAF

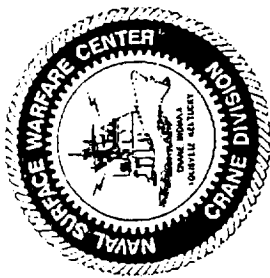


## AIR FORCE NI-CD PROGRAM REVIEW OVERVIEW OF TEST PROGRAM

### BACKGROUND

- 1976 - QUALIFIED 2505ML SEPARATOR MANUFACTURE DISCONTINUED
- 1984 - SURPLUS SUPPLY OF 2505ML DEPLETED
- 1985 - AIR FORCE/NAVY SPONSORED CRANE DIVISION TEST SEPARATOR QUALIFICATION PROGRAM
- 1986-1988 - NO GENERIC QUALIFICATION OF REPLACEMENT PELLON 2536 SEPARATOR
- 1989 - AIR FORCE SPONSOR CRANE DIVISION TEST NICKEL-CADMIUM CELL QUALIFICATION PROGRAM
- 1990 - SAFT/France VOS A (up to 30 Ah) DESIGN CELLS RECOMMENDED FOR GENERIC QUALIFICATION FOR USAF PROGRAMS.

**AIR FORCE NI-CD PROGRAM REVIEW  
OVERVIEW OF TEST PROGRAM**

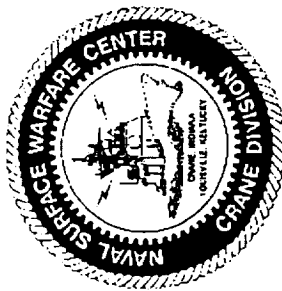


**PURPOSE**

**GENERIC QUALIFICATION OF AEROSPACE NICKEL-CADMIUM CELLS**

**ALL AVAILABLE MANUFACTURERS  
ALL AVAILABLE DESIGNS  
INCLUDES CELLS FROM PREVIOUS PROGRAM  
HIGH AND LOW ORBIT LIFE CYCLING**

**CHARACTERIZE BEGINNING OF LIFE PERFORMANCE**



# AIR FORCE NI-CD PROGRAM REVIEW OVERVIEW OF TEST PROGRAM

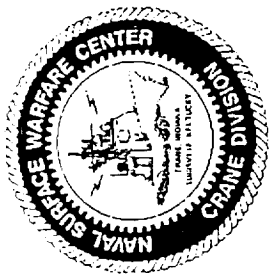
---

## PURPOSE

GENERIC QUALIFICATION OF AEROSPACE NICKEL-CADMIUM CELLS

ALL AVAILABLE MANUFACTURERS  
ALL AVAILABLE DESIGNS  
INCLUDES CELLS FROM PREVIOUS PROGRAM  
HIGH AND LOW ORBIT LIFE CYCLING

CHARACTERIZE BEGINNING OF LIFE PERFORMANCE



# AIR FORCE NI-CD PROGRAM REVIEW OVERVIEW OF TEST PROGRAM

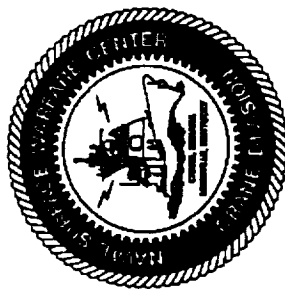
## OUTLINE

### ACCEPTANCE TEST - BASED ON MANUFACTURER TEST

#### CHARACTERIZATION TEST

CHARGE RATE	-10	0	10	25
C/2		X	X	X
C/4		X	X	
C/10	X	X	X	X
C/20	X	X		X
C/80		X	X	

NOTE: DISCHARGES AT C/2



**STRESS TEST  
PACK : 0342H**

---

**TYPE** 42 A/H SUPER NI-CD , HUGHES

**TEMPERATURE** 20 DEGREES CENTIGRADE

**ORBIT** 100 MINUTES

**DISCHARGE** 30.0 AMPS FOR 34 MINUTES, 40%DOD

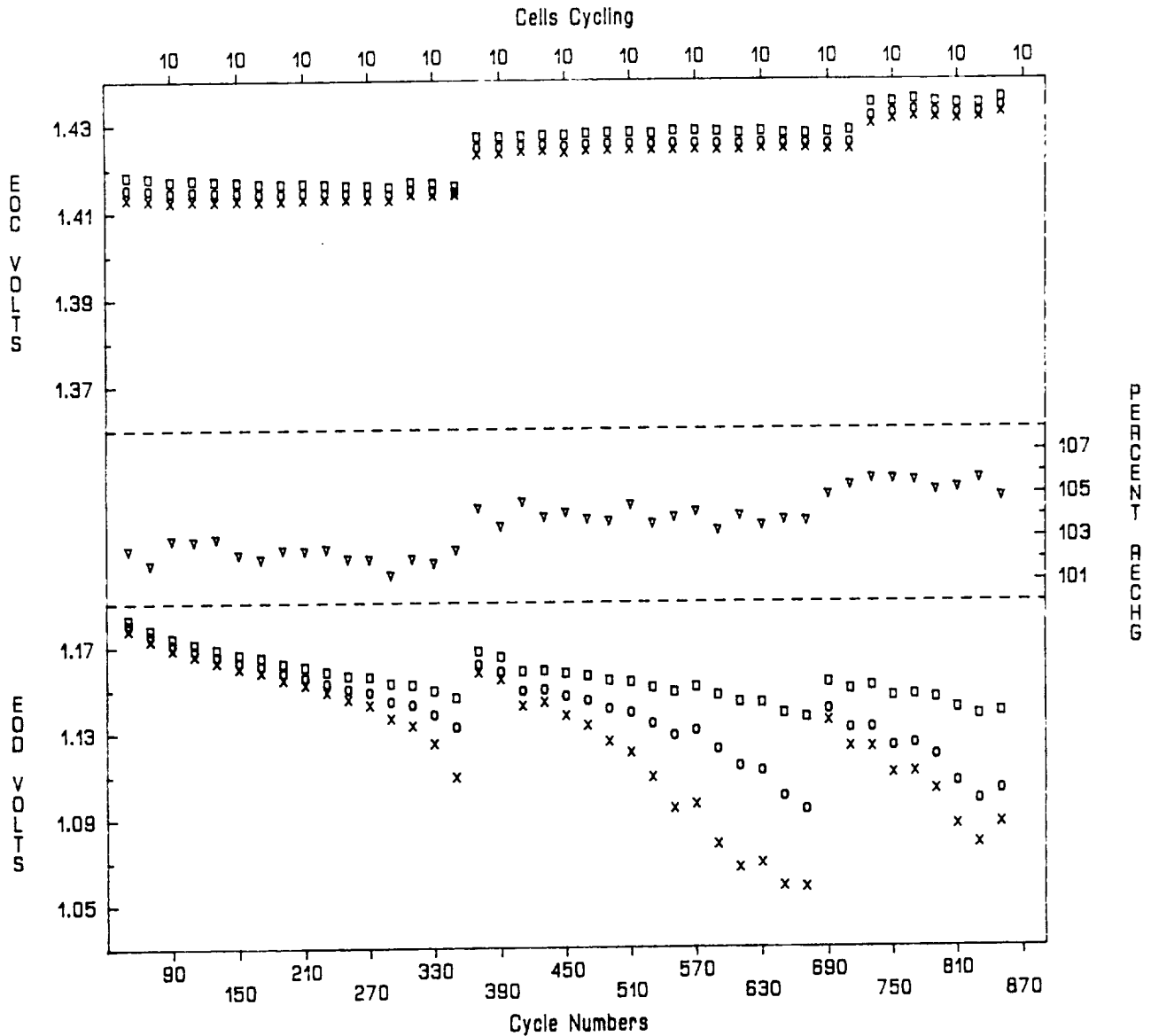
**CHARGE** 21.0 AMPS WITH V/T TAPER AT V/T 5.5 (1.424) V/C

TRENDPLOT

Pack: 0342H    Manf: HUGHES    42.0 AH  
 Orbit: LED    Temp (C): 20    DOD(%): 40.0  
 Discharge(Amp/Hrs): 30.0/0.56    Charge(Amp/Hrs): 21.0/1.12

Plot area #1 -- keys:    Right-side:  
 Left-side:            OFF  
 □ -- High Cell  
 ○ -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:    Right-side:  
 Left-side:            OFF  
                           ▽ -- PERCENT  
 Plot area #3 -- keys:    Right-side:  
 Left-side:            OFF  
 □ -- High Cell  
 ○ -- Average  
 x -- Low Cell

TEST DATA AS OF JUNE 30, 1992



1. CYCLE #310, INCREASED FROM VT 5 (1.414 V/C) TO VT 5.5 (1.424 V/C).
2. CYCLE #680, INCREASED FROM VT 5.5 (1.424 V/C) TO VT 6 (1.434 V/C).
3. CYCLE #722, DUE TO SOFTWARE PROBLEM, THE LAST STEP OF CHARGE WAS ONLY TO 1.424 V/C.
4. CYCLE #870, EQUIPMENT MALFUNCTION CAUSED PACK TO BE DISCHARGED FOR 1.5 HOURS. THE PACK WAS DISCONTINUED DUE TO SWELLING OF CELLS.



**STRESS TEST  
PACK : 6351A**

---

<b>TYPE</b>	<b>50 A/H SUPER NI-CD , HUGHES</b>
<b>TEMPERATURE</b>	<b>20 DEGREES CENTIGRADE</b>
<b>ORBIT</b>	<b>90 MINUTES</b>
<b>DISCHARGE</b>	<b>36 AMPS FOR 34 MINUTES, 40%DOD</b>
<b>CHARGE</b>	<b>25 AMPS WITH V/T TAPER AT 6.5 (1.444 V/C)</b>

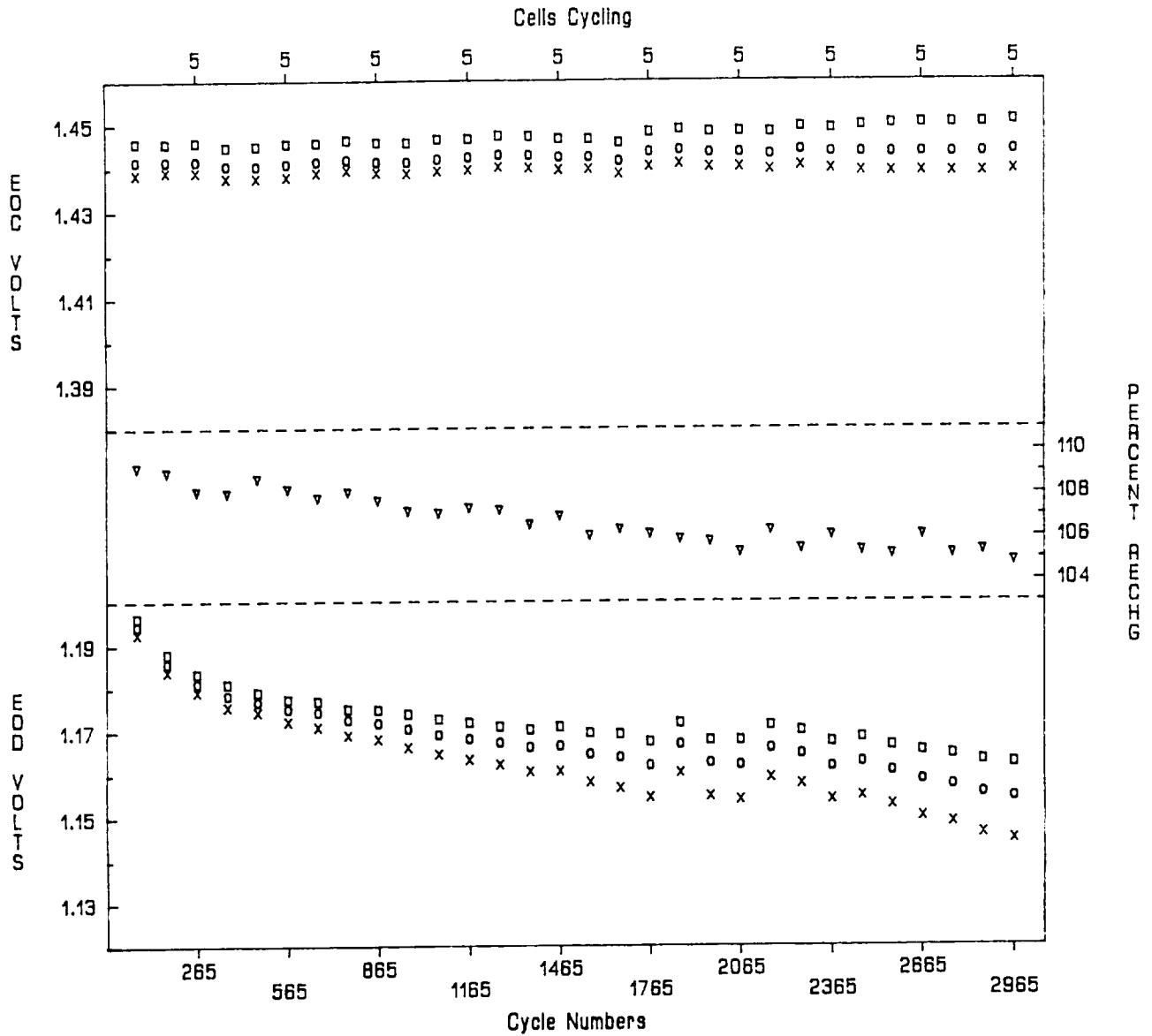


TRENDPLOT

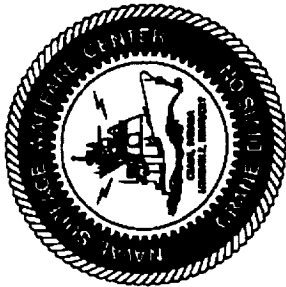
Pack: 6351A    Manf: HUGHES    50.0 AH  
 Orbit: LEO    Temp (C): 20    DOD(%): 40.0  
 Discharge(Amp/Hrs): 36.0/0.56    Charge(Amp/Hrs): 25.0/1.12

Plot area #1 -- keys:    Right-side:  
 Left-side:    OFF  
 o -- High Cell  
 o -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:    Right-side:  
 Left-side:    OFF  
 v -- PERCENT RECHARGE  
 Plot area #3 -- keys:    Right-side:  
 Left-side:    OFF  
 o -- High Cell  
 o -- Average  
 x -- Low Cell

TEST DATA AS OF JUNE 30, 1992



1. CYCLE #18, DECREASED FROM VT 7 (1.454 V/C) TO VT 6.5 (1.444 V/C) DUE TO HIGH PERCENT RECHARGE.



**PACK : 6352A**

---

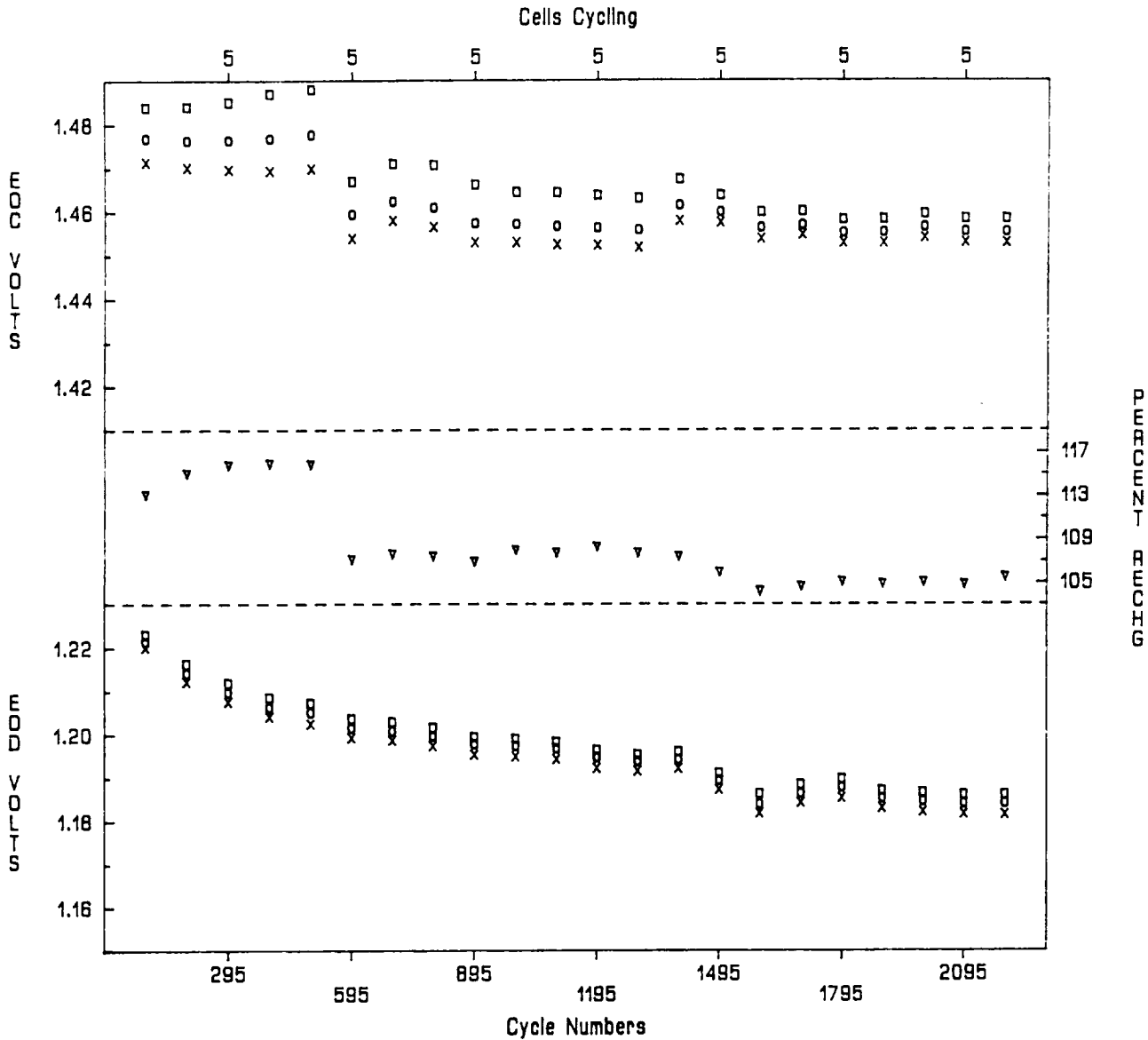
<b>TYPE</b>	<b>50 A/H SUPER NI-CD , HUGHES</b>
<b>TEMPERATURE</b>	<b>5 DEGREES CENTIGRADE</b>
<b>ORBIT</b>	<b>96 MINUTES</b>
<b>DISCHARGE</b>	<b>25 AMPS FOR 30 MINUTES, 25%DOD</b>
<b>CHARGE</b>	<b>25 AMPS WITH V/T TAPER AT 5.5 (1.458 V/C)</b>

TRENDPLOT

Pack: 6352A    Manf: HUGHES    50.0 AH  
 Orbit: LEO    Temp (C): 5.0    DOD(%): 25.0  
 Discharge(Amp/Hrs): 25.0/0.50    Charge(Amp/Hrs): 25.0/1.10

Plot area #1 -- keys:    Right-side:  
 Left-side:            OFF  
 □ -- High Cell  
 ○ -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:    Right-side:  
 Left-side:            OFF  
                              v -- PERCENT REC -  
 Plot area #3 -- keys:    Right-side:  
 Left-side:            OFF  
 □ -- High Cell  
 ○ -- Average  
 x -- Low Cell

TEST DATA AS OF JUNE 30, 1992



1. CYCLE #47, LOWERED FROM VT 7 (1.488 V/C) TO VT 6.5 (1.478 V/C) DUE TO HIGH PERCENT RECHARGE.
2. CYCLE #529, LOWERED FROM VT 6.5 (1.478 V/C) TO VT 6 (1.468 V/C) DUE TO HIGH PERCENT RECHARGE.
3. CYCLE # 569, LOWERED FROM VT 6 (1.468 V/C) TO VT 5.5(1.458 V/C) DUE TO HIGH PERCENT RECHARGE (111%).



## RESULTS OF "SUPER NICD" CELLS LEO TEST

---

### \* CAPACITY LOSS DUE TO STORAGE/HANDLING

#### PROCEDURES

o 50-Ah CELL, 40% DOD & 20 C: EODV > 1.14

#### AFTER 2900 CYCLES

o 50-Ah CELL, 25% DOD & 5 C: EODV > 1.18

#### AFTER 2100 CYCLES

o 42-Ah CELL, 40% DOD & 20 C: EODV > 1.05

FIRST 800 CYCLES WHILE OPTIMIZING V/T

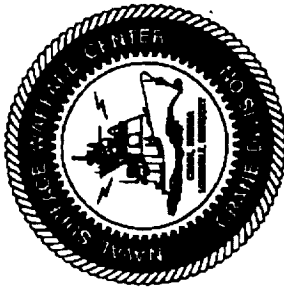
LEVEL



## SUMMARY OF RESULTS OF "SUPER NICD" CELLS

---

- \* THERE IS A STORAGE/HANDLING ISSUE
- \* NO PROBLEMS ON LIFE TEST
  - o STILL IN EARLY PART OF TEST



**STRESS TEST  
PACK : 6340S**

---

**TYPE** 40 A/H NI-CD , SAFT

**TEMPERATURE** 20 DEGREES CENTIGRADE

**ORBIT** 100 MINUTES

**DISCHARGE** 28.6 AMPS FOR 34 MINUTES, 40%DOD

**CHARGE** 20.0 AMPS WITH V/T TAPER AT V/T 9 (1.494 V/C)

**POST CYCLING C/2, CAPACITY CHECK**

1.00 VOLT C-1 25.0, C-2 31.0, C-3 29.6, C-4 ,31.6

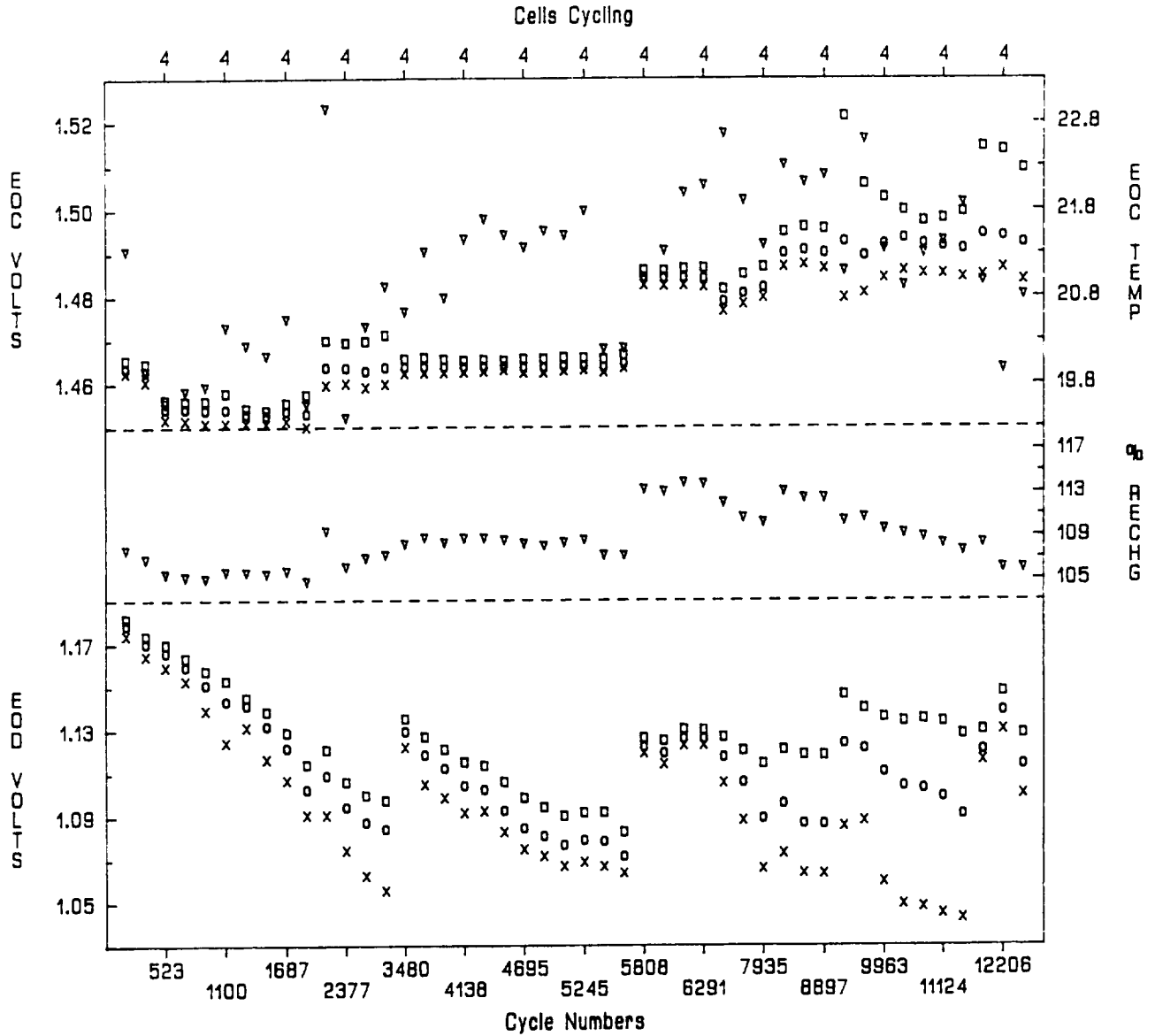
0.75 VOLT C-1 46.5, C-2 51.0, C-3 49.2, C-4 ,51.6

TRENDPLOT

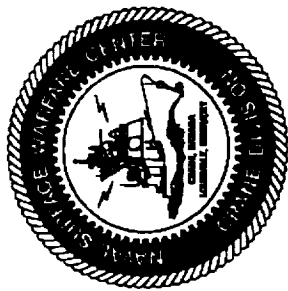
Pack: 6340S    Manf: SAFT    40.0 AH    AIR FORCE  
 Orbit: LED    Temp (C): 20    DOD(%): 40.0  
 Discharge(Amp/Hrs): 28.6/ .56    Charge(Amp/Hrs): 20.0/1.12

Plot area #1 -- keys:    Right-side:  
 Left-side:    o -- High Cell    v -- EOC TEMP  
                   o -- Average  
                   x -- Low Cell  
 Plot area #2 -- keys:    Right-side:  
 Left-side:    OFF    v -- % RECHG  
 Plot area #3 -- keys:    Right-side:  
 Left-side:    OFF  
                   o -- High Cell  
                   o -- Average  
                   x -- Low Cell

TEST DATA AS OF JUNE 30, 1992



1. Cycle # 467, lowered VT to 7.5 (1.454 V/C) due to slight temperature rise of 1 degree C.
2. Cycle # 2080, raised VT to 8.0 (1.464 V/C).
3. Cycles # 2793 thru 3200, Special Testing performed.
4. Cycle # 5752, raised VT to 9.0 (1.484 V/C) due to low EOD's.
5. Cycle # 8091, raised VT to 9.5 (1.494 V/C).
6. Cycle #7257, Voltage clamp changed to temperature controlled voltage limit.
7. Cycle #12416, pack discontinued per Aerospace Instructions.



**STRESS TEST  
PACK : 6324S**

---

**TYPE** 24 A/H NI-CD , SAFT

**TEMPERATURE** 20 DEGREES CENTIGRADE

**ORBIT** 100 MINUTES

**DISCHARGE** 17.2 AMPS FOR 34 MINUTES, 40%DOD

**CHARGE** 12.0 AMPS WITH V/T TAPER AT V/T 8.5 (1.484 V/C)

**POST CYCLING** C-1 29.7, C-2 25.1, C-3 24.0  
**C/2, CAPACITY CHECK**

AFREV 30 June 92

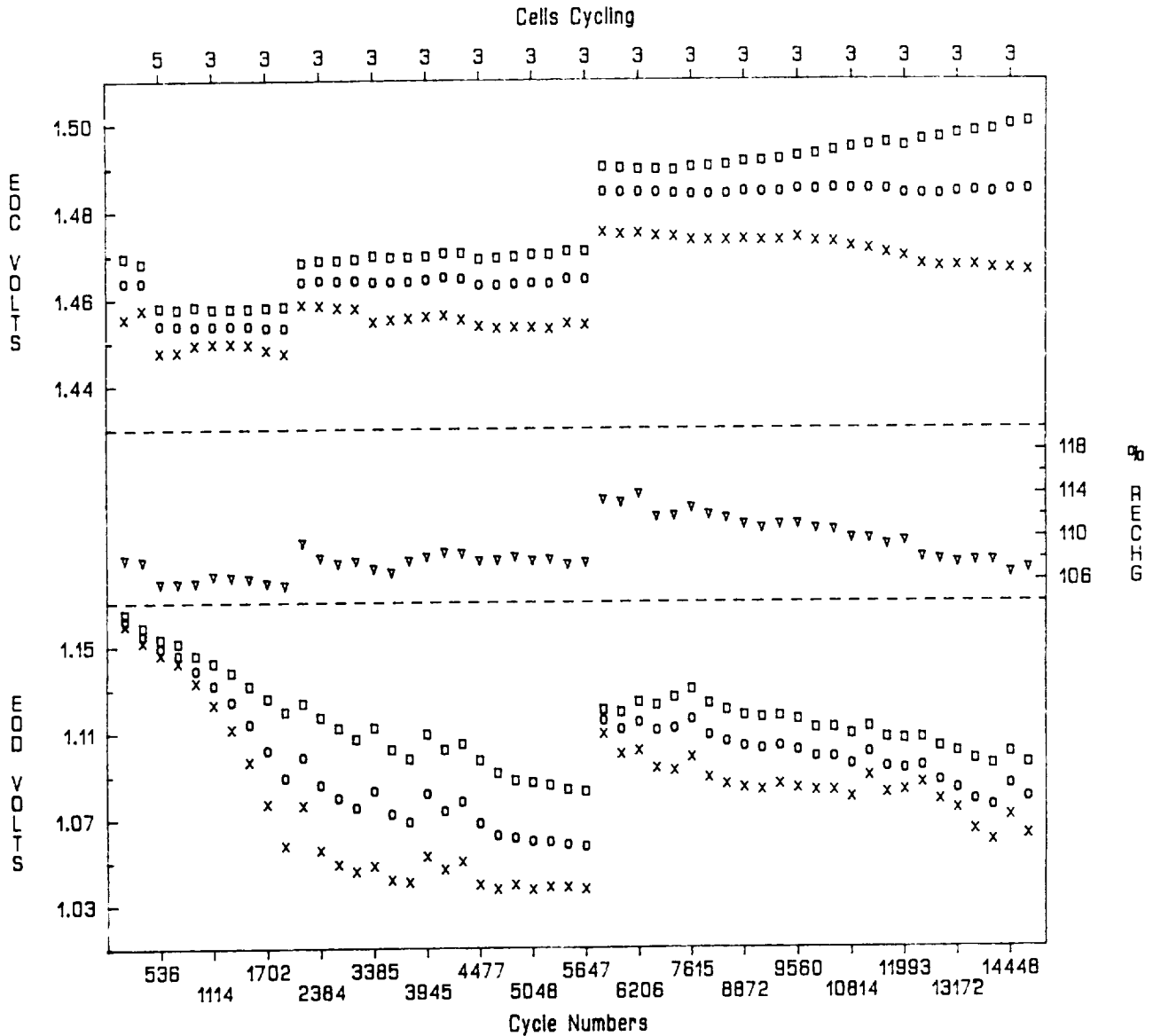


TRENDPLOT

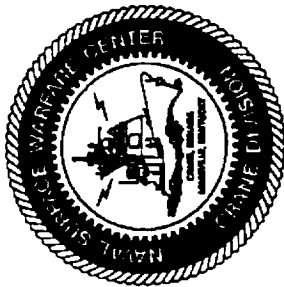
Pack: 6324S Manf: SAFT 24.0 AH AIR FORCE  
 Orbit: LEO Temp (C): 20 DOD(%): 40.0  
 Discharge(Amp/Hrs): 17.2/ .56 Charge(Amp/Hrs): 19.2/1.12

Plot area #1 -- keys:  
 Left-side: Right-side:  
 o -- High Cell OFF  
 o -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:  
 Left-side: Right-side:  
 OFF v -- % RECHG  
 Plot area #3 -- keys:  
 Left-side: Right-side:  
 o -- High Cell OFF  
 o -- Average  
 x -- Low Cell

TEST DATA AS OF JUNE 30, 1992



1. Cycle # 481, lowered VT to 7.5 (1.454 V/C) due to slight temperature rise.
2. Cycle # 740, cells # 4 & 5 were removed for vibration cycle.
3. Cycle # 2100, VT raised to 8.0 (1.464 V/C).
4. Cycles # 2803 thru 3215, Special Testing performed.
5. Cycle # 5764, VT raised to 9.0 (1.484 V/C) due to low EOD's.
6. Cycle # 14,821, pack was discontinued.



**COMPRESSED TIME GEO  
PACK : 6240S**

---

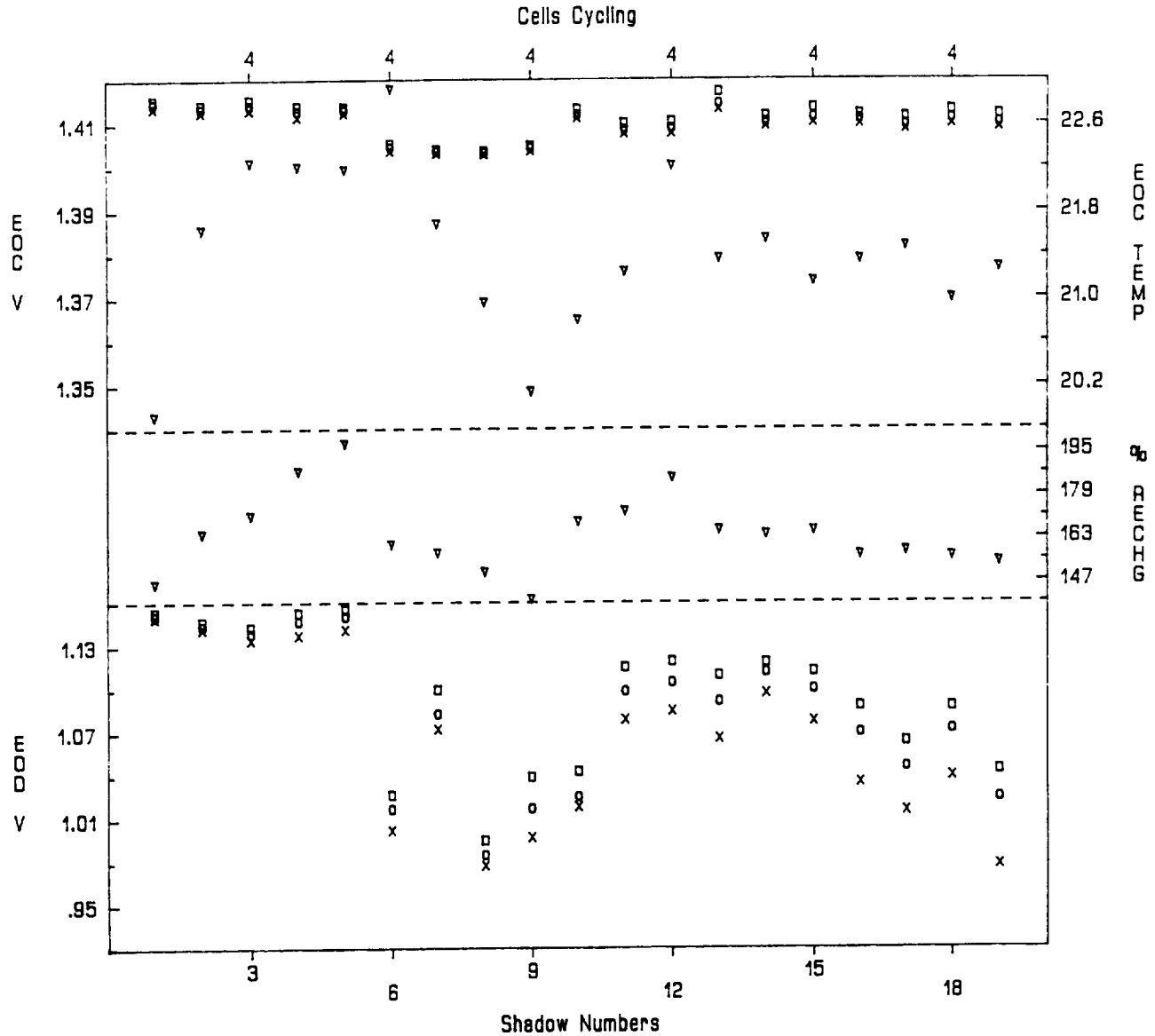
<b>TYPE</b>	<b>40 A/H NI-CD , SAFT</b>
<b>TEMPERATURE</b>	<b>20 DEGREES CENTIGRADE</b>
<b>ORBIT</b>	<b>24 HOURS</b>
<b>DISCHARGE</b>	<b>26.7 AMPS FOR MAXIMUM OF 80%DOD</b>
<b>CHARGE</b>	<b>4.0 AMPS WITH V/T TAPER AT V/T 5 (1.414 V/C)</b>

\*\*\*GEO\*\*\*AIR FORCE  
 TRENDS OF MID SHADOW  
 Pack: 6240S    Manf: SAFT    40.0 AH  
 Orbit: GEO    Temp (C): 20    DOD(%): 80.0

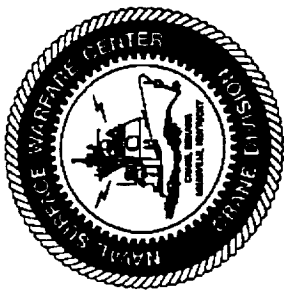
DISCHARGE (26.7 AMPS)  
 CHARGE (4.0 AMPS)

SHADOWS 1 THRU 19

Plot area #1 -- keys:  
 Left-side:    Right-side:  
 □ -- High Cell    ▽ -- EOC TEMP  
 ○ -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:  
 Left-side:    Right-side:  
 OFF    ▽ -- % RECHG  
 Plot area #3 -- keys:  
 Left-side:    Right-side:  
 □ -- High Cell    OFF  
 ○ -- Average  
 x -- Low Cell



1. Shadow # 1, VT 5 (1.414 V/C).
2. Shadow # 4, DOD changed from 86 to 80 per cent recharge.
3. Shadow # 6, VT 4.5 (1.404 V/C) due to cells warming during charge.
4. During Shadow # 9, the pack was using a 2 step V/T. The first ten days and the last nine days of the shadow period were at VT 4.0 (1.394 V/C). During days 11 thru 33 (mid-shadow) the pack ran at VT 4.5 (1.404 V/C).
5. Shadow # 10, voltage clamp changed to voltage/temperature controlled voltage limit at VT 5 (1.414 V/C).



**COMPRESSED TIME GEO  
PACK : 6224S**

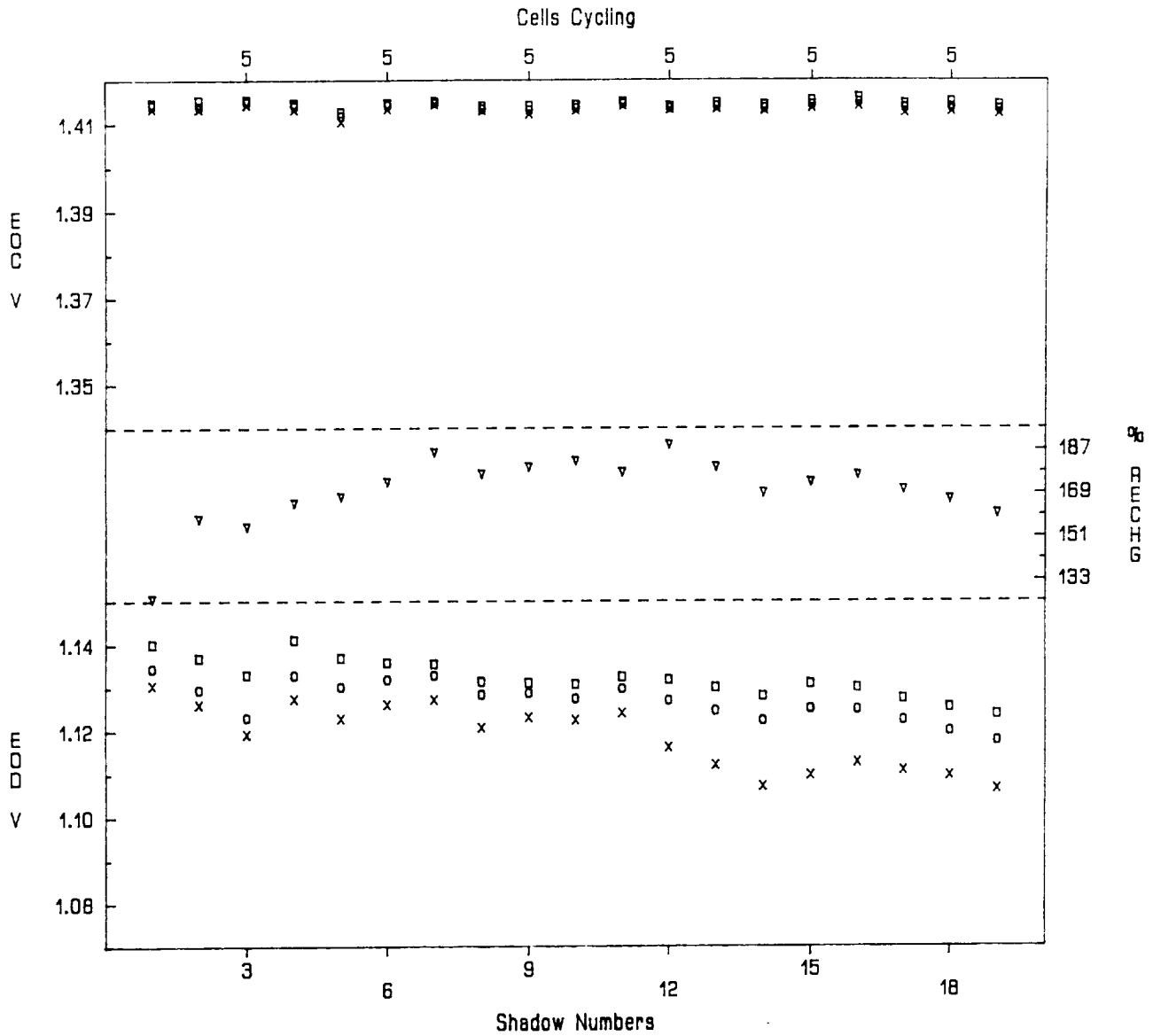
---

<b>TYPE</b>	<b>24 A/H NI-CD , SAFT</b>
<b>TEMPERATURE</b>	<b>20 DEGREES CENTIGRADE</b>
<b>ORBIT</b>	<b>24 HOURS</b>
<b>DISCHARGE</b>	<b>16.0 AMPS FOR MAXIMUM OF 80%DOD</b>
<b>CHARGE</b>	<b>2.4 AMPS WITH V/T TAPER AT V/T 5 (1.414 V/C)</b>

\*\*\*GEO\*\*\* AIR FORCE  
 TREND OF MID SHADOW  
 Pack: 62245 Manf: SAFT 24.0 AH  
 Orbit: GEO Temp (C): 20 DOD(%): 80.0

DISCHARGE (16.0 AMPS).  
 CHARGE (2.4 AMPS) WITH 1.414 V/C  
 SHADOWS 1 THRU 19

Plot area #1 -- keys:  
 Left-side: Right-side:  
 o -- High Cell OFF  
 o -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:  
 Left-side: Right-side:  
 OFF v -- % RECHG.  
 Plot area #3 -- keys:  
 Left-side: Right-side:  
 o -- High Cell OFF  
 o -- Average  
 x -- Low Cell



1. Shadow # 4, DOD changed from 86 to 80 per cent recharge.



## RESULTS FOR SAFT CELLS

- \* COMPRESSED TIME GEO: 80% DOD, 20 C
  - o EODV > 1.00 AFTER 18 ECLIPSE SEASONS
  - o TERMINAL & THERMAL TEST PROBLEMS FOR 40-Ah CELLS
  - o C/D AS HIGH AS 185 % TO MAINTAIN
  
- \* LEO: 40% DOD, 20 C
  - o EODV > 1.03 AFTER 14800 CYCLES FOR 24-Ah CELLS
  - o EODV > 1.03 AFTER 12400 CYCLES FOR 40-Ah CELLS
  - o TEST DISCONTINUED



# **SUMMARY OF RESULTS OF SAFT 24-Ah & 40-Ah CELLS**

---

**\* C/D HIGHER THAN THAT OF PRE-1986 GATES CELLS  
\* LEO RESULTS VERIFY GENERIC QUALIFICATION OF  
VOS A CELLS**

**GPS STRESS TEST  
PACK : 6335A**



---

<b>TYPE</b>	<b>35 A/H NI-CD , GATES</b>
<b>TEMPERATURE</b>	<b>20 DEGREES CENTIGRADE</b>
<b>ORBIT</b>	<b>100 MINUTES</b>
<b>DISCHARGE</b>	<b>25 AMPS FOR 34 MINUTES, 40%DOD</b>
<b>CHARGE</b>	<b>17.5 AMPS WITH V/T TAPER AT V/T 8 (1.474 V/C)</b>

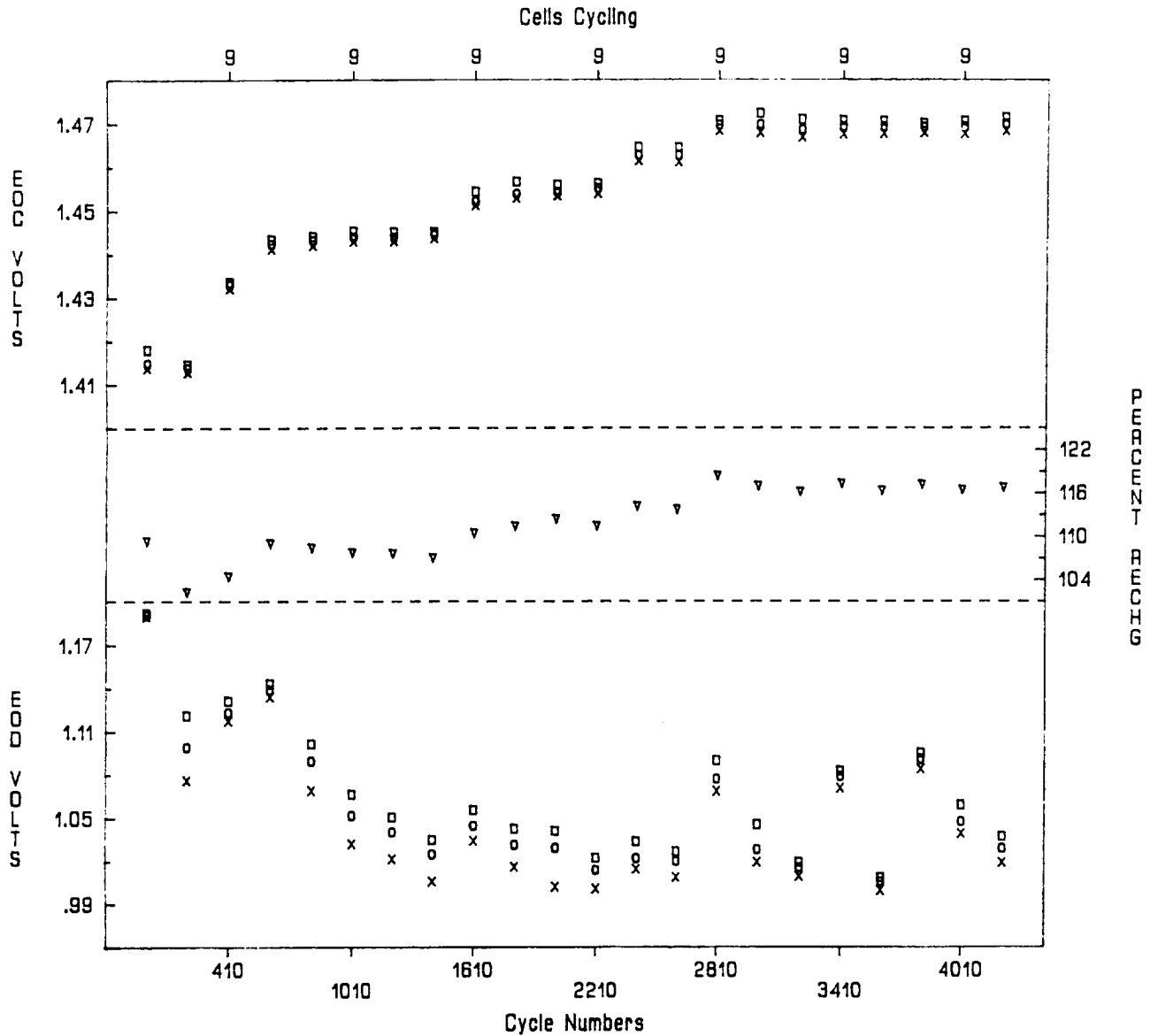


TRENDPLOT

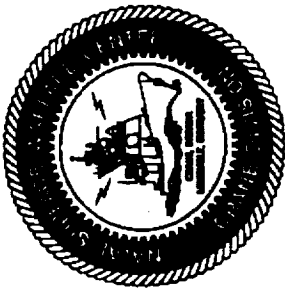
Pack: 6335A    Manf: GPS    35.0 AH  
 Orbit: LEO    Temp (C): 20    DOD(%): 40.0  
 Discharge(Amp/Hrs): 25.0/0.56    Charge(Amp/Hrs): 17.5/1.12

Plot area #1 -- keys:    Right-side:  
 Left-side:    OFF  
 □ -- High Cell  
 ○ -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:    Right-side:  
 Left-side:    OFF  
 ○ -- High Cell  
 ○ -- Average  
 x -- Low Cell  
 Plot area #3 -- keys:    Right-side:  
 Left-side:    OFF  
 ○ -- High Cell  
 ○ -- Average  
 x -- Low Cell

TEST DATA AS OF JUNE 30, 1992



1. CYCLE #8, VT INCREASED TO VT5 (1.414 V/C) DUE TO LOW EOD.
2. CYCLE #223, VT INCREASED TO VT6 (1.434 V/C) DUE TO LOW % RECHG.
3. CYCLE #607, VT INCREASED TO VT6.5 (1.444 V/C).
4. CYCLE #1424, VT INCREASED TO VT7 (1.454 V/C) PER AEROSPACE INSTRUCTIONS
5. CYCLE #2235, VT INCREASED TO VT7.5 (1.464 V/C) PER AEROSPACE INSTRUCTIONS.
6. CYCLE #2627, VT INCREASED TO VT8 (1.474 V/C) DUE TO LOW EOD.
7. A PERCENT OF RECHARGE INCREASE WAS NOTICED AFTER EXTENDED OPEN CIRCUIT TIMES DURING CHAMBER PROBLEMS.
8. CYCLE #3840, PACK HALTED BECAUSE ALL CELL CASES FOUND SWOLLEN DUE TO HIGH PERCENT OF RECHARGE (117%).
9. ON JUNE 30, 1992, PACK RETURNED TO AUTOMATIC CYCLING PER AEROSPACE INSTRUCTIONS.



**GPS SIMULATED ORBIT TEST  
PACK : 6335B**

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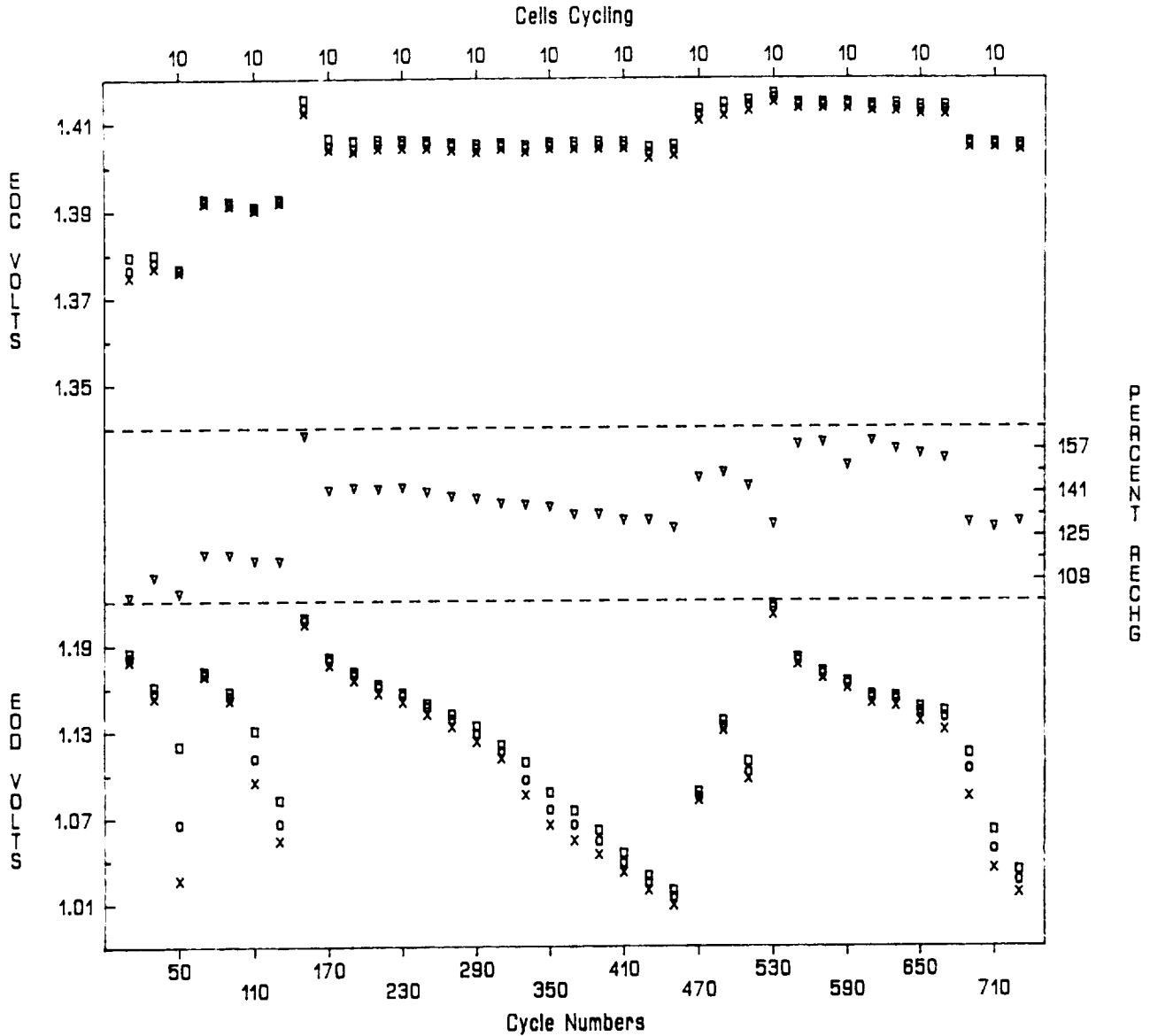
<b>TYPE</b>	<b>35 A/H NI-CD , GATES</b>
<b>TEMPERATURE</b>	<b>20 DEGREES CENTIGRADE</b>
<b>ORBIT</b>	<b>10 HOURS ,26 MINUTES</b>
<b>DISCHARGE</b>	<b>15.8 AMPS FOR 56 MINUTES, 42%DOD</b>
<b>CHARGE</b>	<b>3.5 AMPS WITH V/T TAPER AT V/T 6 (1.444 V/C)</b>

TRENDPLOT

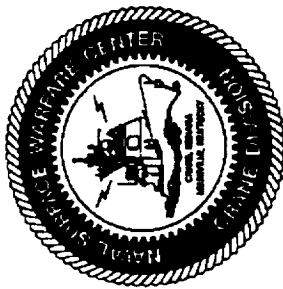
Pack: 6335B    Manf: GPS    35.0 AH  
 Orbit: LEO    Temp (C): 20    DOD(%): 41.4  
 Discharge(Amp/Hrs): 15.8/0.92    Charge(Amp/Hrs): 03.5/9.50

Plot area #1 -- keys:  
 Left-side:    Right-side:  
 o -- High Cell    OFF  
 o -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:  
 Left-side:    Right-side:  
 OFF    v -- PERCENT RECH-  
 Plot area #3 -- keys:  
 Left-side:    Right-side:  
 o -- High Cell    OFF  
 o -- Average  
 x -- Low Cell

TEST DATA AS OF JUNE 30, 1992



1. CYCLE #52, INCREASED TO V/T 4.5(1.390 V/C) DUE TO LOW EOD VOLTS.
2. CYCLE #137, INCREASED TO V/T 5(1.414 V/C) DUE TO LOW EOD VOLTS.
3. CYCLE #160, DECREASED TO V/T 4.5(1.404 V/C) DUE TO HIGH % RECHARGE.
4. CYCLE #467, INCREASED TO V/T 5.0(1.414 V/C) DUE TO LOW EOD.
5. CYCLE #528, PACK WAS RECONDITIONED WITH A/HO 20.12.
6. CYCLE #894, DECREASED TO V/T 4.5(1.404 V/C) DUE TO HIGH EOC TEMP.



**STRESS TEST  
PACK : 0350G**

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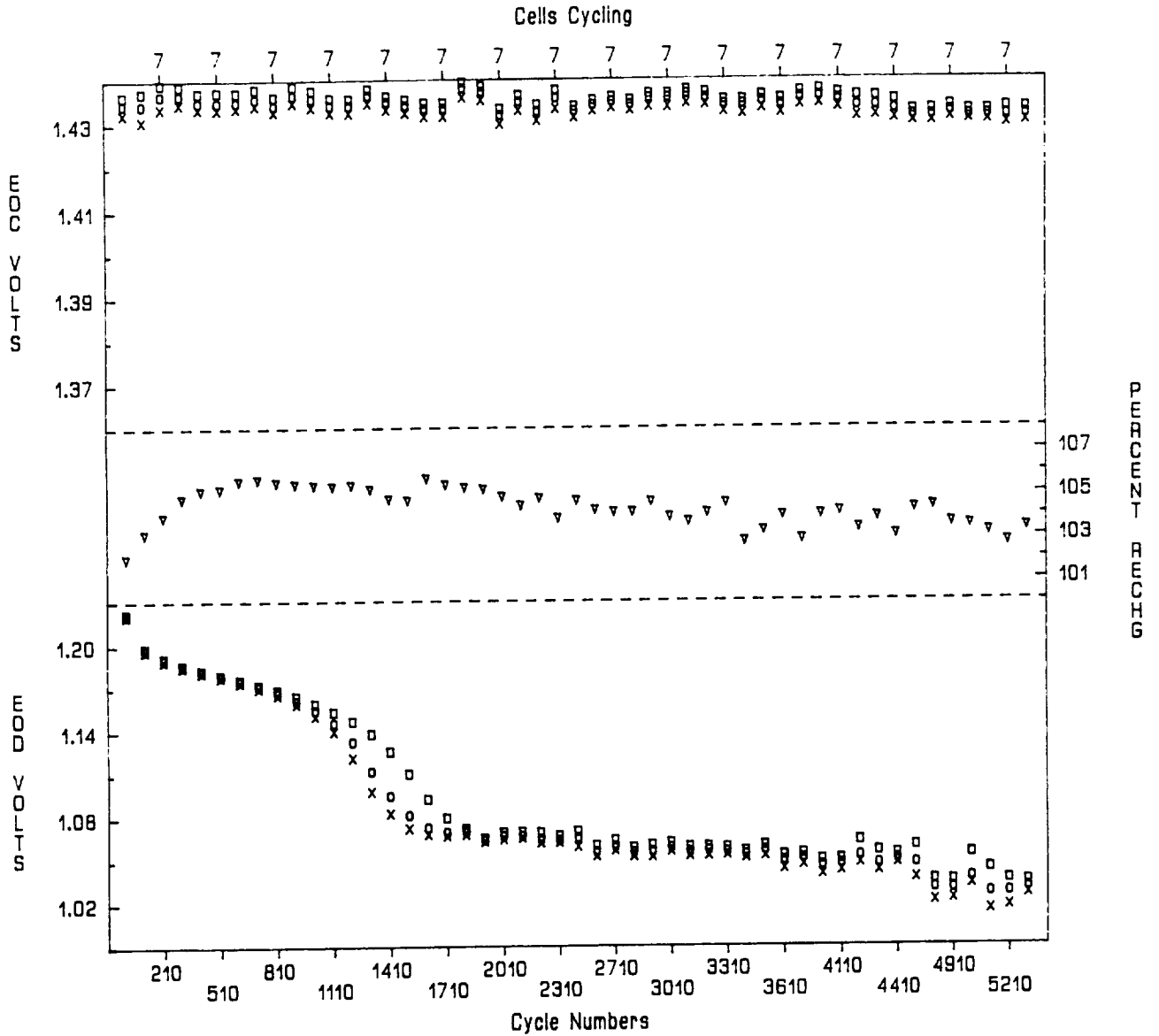
<b>TYPE</b>	<b>50 A/H NI-CD , GATES, WITH 2505ML SEPARATOR</b>
<b>TEMPERATURE</b>	<b>20 DEGREES CENTIGRADE</b>
<b>ORBIT</b>	<b>100 MINUTES</b>
<b>DISCHARGE</b>	<b>35.7 AMPS FOR 34 MINUTES, 40%DOD</b>
<b>CHARGE</b>	<b>25.0 AMPS WITH V/T TAPER AT V/T 6 (1.434 V/C)</b>

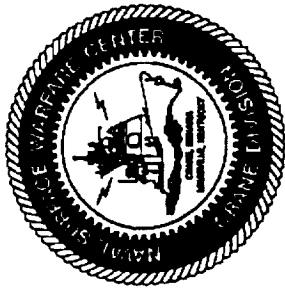
TRENDPLOT

Pack: D350G    Manf: GATES    50.0 AH  
 Orbit: LED    Temp (C): 20    DOD(%): 40.0  
 Discharge(Amp/Hrs): 35.71/0.56    Charge(Amp/Hrs): 25.0/1.12

Plot area #1 -- keys:  
 Left-side:    Right-side:  
 o -- High Cell    OFF  
 o -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:  
 Left-side:    Right-side:  
 OFF    v -- PERCENT REC-  
 Plot area #3 -- keys:  
 Left-side:    Right-side:  
 o -- High Cell    OFF  
 o -- Average  
 x -- Low Cell

TEST DATA AS OF JUNE 30, 1992





**STRESS TEST  
PACK : 0351G**

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**TYPE** 50 A/H NI-CD , GATES , WITH 2536 SEPARATOR

**TEMPERATURE** 20 DEGREES CENTIGRADE

**ORBIT** 100 MINUTES

**DISCHARGE** 35.7 AMPS FOR 34 MINUTES, 40%DOD

**CHARGE** 25.0 AMPS WITH V/T TAPER AT V/T 6 (1.434 V/C)

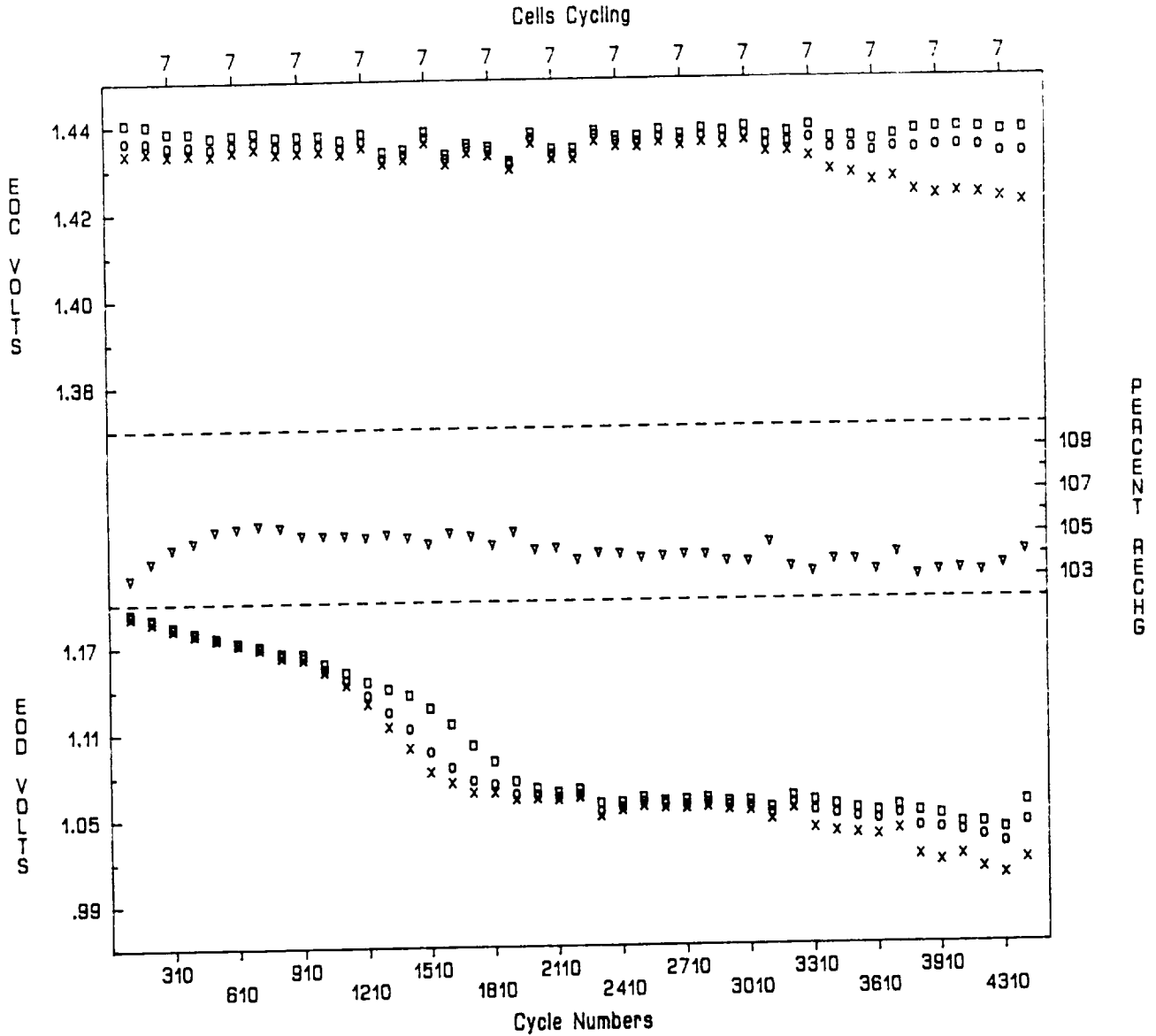
TRENDPLOT

Pack: 0351G    Manf: GATES    50.0 AH  
 Orbit: LEO    Temp (C): 20    DOD(%): 40.0  
 Discharge(Amp/Hrs): 35.71/0.56    Charge(Amp/Hrs): 25.0/1.12

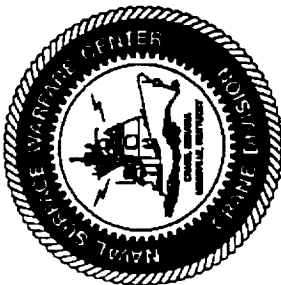
PELLON 2536 SEPARATOR

TEST DATA AS OF JUNE 30, 1992

Plot area #1 -- keys:  
 Left-side:    Right-side:  
 o -- High Cell    OFF  
 o -- Average  
 x -- Low Cell  
 Plot area #2 -- keys:  
 Left-side:    Right-side:  
 OFF    v -- PERCENT RECHG  
 Plot area #3 -- keys:  
 Left-side:    Right-side:  
 o -- High Cell    OFF  
 o -- Average  
 x -- Low Cell



1. CYCLE #4424, DUE TO EQUIPMENT MALFUNCTION, PACK WAS DISCHARGED FOR 2.0 HOURS, CAUSING SWELLING OF CELLS. PACK WAS DISCONTINUED.



**STRESS TEST  
PACK : 0352G**

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**TYPE** 50 A/H NI-CD , GATES, WITH 2538 SEPARATOR

**TEMPERATURE** 20 DEGREES CENTIGRADE

**ORBIT** 100 MINUTES

**DISCHARGE** 35.7 AMPS FOR 34 MINUTES, 40%DOD

**CHARGE** 25.0 AMPS WITH V/T TAPER AT V/T 6 (1.434 V/C)

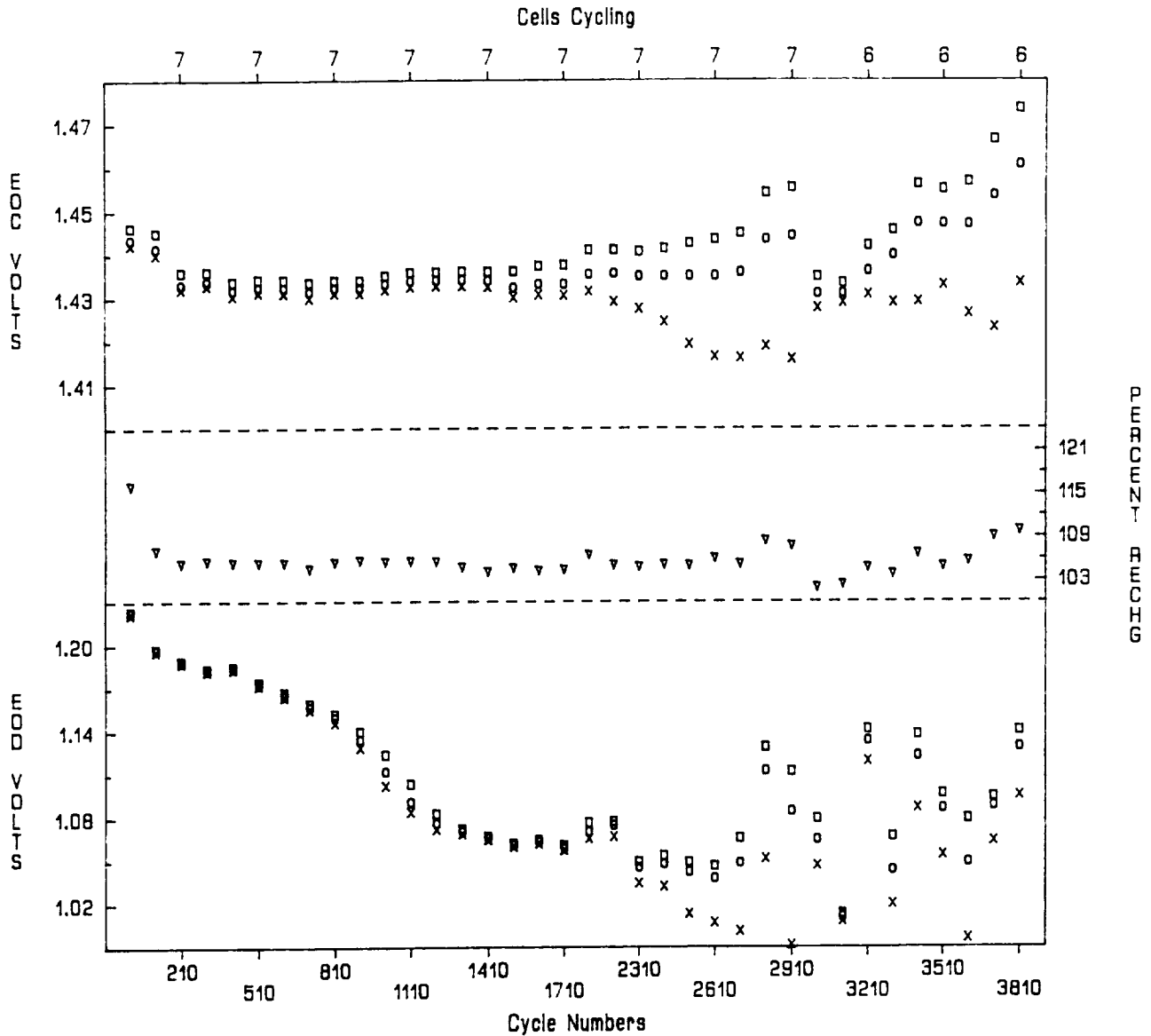


TRENDPLOT

Pack: 0352G    Manf: GATES    50.0 AH  
 Orbit: LED    Temp (C): 20    DOD(%): 40.0  
 Discharge(Amp/Hrs): 35.71/0.56    Charge(Amp/Hrs): 25.0/1.12

Plot area #1 -- keys:    Right-side: OFF  
 Left-side:    High Cell (□)  
               Average (○)  
               Low Cell (x)  
 Plot area #2 -- keys:    Right-side: PERCENT RECH  
 Left-side:    OFF (▽)  
 Plot area #3 -- keys:    Right-side: OFF  
 Left-side:    High Cell (□)  
               Average (○)  
               Low Cell (x)

TEST DATA AS OF JUNE 30, 1992



1. CYCLE #2789, INCREASED VT 6.0 (1.434 V/C) TO VT 6.5 (1.444 V/C) DUE TO LOW EOD.
2. CYCLE #3004, REMOVED CELL #2 DUE TO LOW END OF CHARGE AND END OF DISCHARGE. LOWERED VT 6.5 (1.444 V/C) TO VT 6.0 (1.434 V/C).
3. CYCLE #3190, INCREASED VT 6.0 (1.434 V/C) TO VT 6.5 (1.444 V/C) DUE TO LOW END OF DISCHARGE.
4. CYCLE #3389, INCREASED VT 6.5 (1.444 V/C) TO T 7 (1.454 V/C) DUE TO LOW END OF DISCHARGE VOLTAGES.
5. CYCLE #3701, INCREASED VT 7 (1.454 V/C) TO VT 7.5(1.464 V/C) PER AEROSPACE INSTRUCTIONS.
6. CYCLE #3838, EQUIPMENT MALFUNCTION CAUSED PACK TO BE DISCHARGE FOR 2.0 HOURS. THE PACK WAS DISCONTINUED DUE TO SWELLING OF CELLS.



## RESULTS FOR GATES 50-Ah CELLS

LEO TEST: 40% DOD , 20 C

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- \* 2538 SEPARATOR CELLS: CELL #2
  - o SOFT SHORT CHARACTERISTICS (LOW EOCV & EODV) AFTER 2500 CYCLES
  - o BELOW 1.0 V (FAILED) AFTER 3000 CYCLES
  
- \* 2536 SEPARATOR CELLS: CELLS #1 & #3
  - o SOFT SHORT CHARACTERISTICS AFTER 3300 CYCLES
  
- \* 2505 SEPARATOR CELLS
  - o AS LOW AS 1.02 V AFTER 5000 CYCLES



## **SUMMARY OF RESULTS OF GATES CELLS COMPARISON WITH PRE-1986 (GE/BBD)**

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- \* EARLY FAILURE OF PRESENT 2538 50-Ah CELL**
- \* EARLIER SIGN OF SOFT SHORTS FOR PRESENT  
50-Ah CELLS**
- \* NOT ABLE TO GENERICALLY QUALIFY CELL WITH  
2538 MATERIAL**

STATUS OF PACKS AS OF 11/9/92

PACK ID	MFG	REGIME	SIZE (AH)	QTY	D.O.D (%)	TEMP (C)	START DATE	CYCLE NUMBER
0350S	SAFT	LEO	50	10	40	20	12/15/92	
0250S	SAFT	GEO	50	10	80	20	12/15/92	
6240S	SAFT	GEO	40	4	80	20	7/ 5/89	892
6224S	SAFT	GEO	24	5	80	20	7/ 5/89	977
6335A	GEP	LEO	35	9	40	20	7/25/91	5143
6335B	GEP	GPS (GEO)	35	10	41.4	20	7/25/91	859
0350G	GEP	LEO	50ST	7	40	20	7/17/91	6478
6351A	HUGHES	LEO	50	5	40	20	12/27/91	4253
6352A	HUGHES	LEO	50	5	25	5	12/27/91	3439
6321H	HUGHES	LEO	21	10	40	20	12/15/92	