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NASA Johnson Space Center

Engineering Directorate

EMU AG-ZN BATTERY WET-LIFE EXTENSION TEST	Propulsion and Power Division	
	B.J. Bragg	10/29/91

EMU AG-ZN BATTERY WET-LIFE EXTENSION TEST

BY

CLAUDE M. WOOTEN / EP6

AND

BOBBY J. BRAGG / EP5

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AGENDA

- EMU BATTERY DESCRIPTION
- BACKGROUND - REASON FOR TEST
- TEST OBJECTIVES
- TEST DESCRIPTION
- RESULTS/CONCLUSIONS

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EMU AG-ZN BATTERY DESCRIPTION

- 11 CELL BATTERY OF ~ 30 AH, WEIGHING 10 LBS
- TWO 4-CELL MONOBLOCKS, ONE 3-CELL MONOBLOCK
- DIMENSIONS: 10.5" LONG X 4.89" HIGH X 2.87" DEEP
- RATED FOR 8, 26.6 AH CYCLES WITHIN 135 DAYS WET-LIFE
- POWERS SPACE SUIT BACKPACK AT 3.8 AMPS FOR 7 HOURS TO 16.0 END V
- BATTERY COST IS ~ $26K
- PRIMARY SEPARATOR IS 4 TURNS OF C-19
- CELL MONOBLOCKS ARE MANUFACTURED BY YTP
- BATTERY IS ASSEMBLED BY HAMILTON STANDARD (EMU VENDOR)
- BATTERY IS DELIVERED DRY WITH ACTIVATION KITS TO JSC

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BACKGROUND - REASON FOR TEST

- FEW PLANNED EVA'S IN CURRENT SHUTTLE FLIGHT SCHEDULE
- CONTINGENCY EVA REQUIREMENT
  - POTENTIALLY 3 EVA'S REQUIRED PER MISSION
  - 7 HOURS/MISSION @ 3.8 AMPS (26.6 AH/EVA)
- CURRENT WET-LIFE OF 135 DAYS SUPPORTS 2 VEHICLES; EVERY OTHER FLT
  - ASSUME SHUTTLE FLIGHT SCHEDULE OF 12 FLIGHTS/YEAR
  - DELTA 20 DAYS ACTIVATION/FORMATION CYCLING PERIOD
  - DELTA 10 DAY SHIPPING/INSTALLATION LEAD TIME
  - ASSUME NO USE ON FIRST VEHICLE SUPPORT
  - DELTA 60 DAYS TO SUPPORT 2ND VEHICLE; CUMULATIVE 90 DAYS
  - THUS; 135 DAY WET-LIFE DOES NOT SUPPORT A 3RD VEHICLE IN 60 DAYS
- TO SUPPORT 3RD VEHICLE; DELTA 60 DAYS FROM 2ND WITH 16 DAY MISSION
  - CUMULATIVE 150 DAYS PLUS 16 DAYS REQUIRES 166 DAYS WET-LIFE
- TO SUPPORT 4 VEHICLES; ANOTHER DELTA 60 DAYS REQUIRES 226 DAYS

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TEST OBJECTIVES

- PRIMARY TEST OBJECTIVE
  - INCREASE VEHICLE SUPPORT FROM 2 TO 3
  - DEMONSTRATE CAPABILITY OF THREE 26.6 AH CYCLES
  - DESIGN TEST FOR CUMULATIVE WET-LIFE OF 166 DAYS

- SECONDARY TEST OBJECTIVE
  - POTENTIALLY INCREASE VEHICLE SUPPORT TO 4 VEHICLES
  - PERFORM ADDITIONAL 3 CYCLES AT 226 DAYS
  - THIS OBJECTIVE PERTURBED BY 3 PREVIOUS CYCLES AT 166 DAYS

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TEST DESCRIPTION

- TEST ARTICLES ARE FLIGHT BATTERIES WITH >135 DAYS WET-LIFE
- BATTERY SPEC REQUIRES CONDITIONING CYCLE(S) FOR CHARGED STAND OF > 85 DAYS
  - EACH MISSION NORMALLY REQUIRES CONDITIONING CYCLE(S)
  - EIGHT CYCLE SPEC MUST COUNT CONDITIONING CYCLES
- TOP CHARGE AT 1.55 AMPS FOR 10 MINUTES (OR TO 21.8 V) BEFORE DISCHARGE
- DISCHARGE AT CONSTANT CURRENT OF 3.8 AMPS TO AN END VOLTAGE OF 16.0 V (MUST BE >/= 7 HOURS; >/=26.6 AH)

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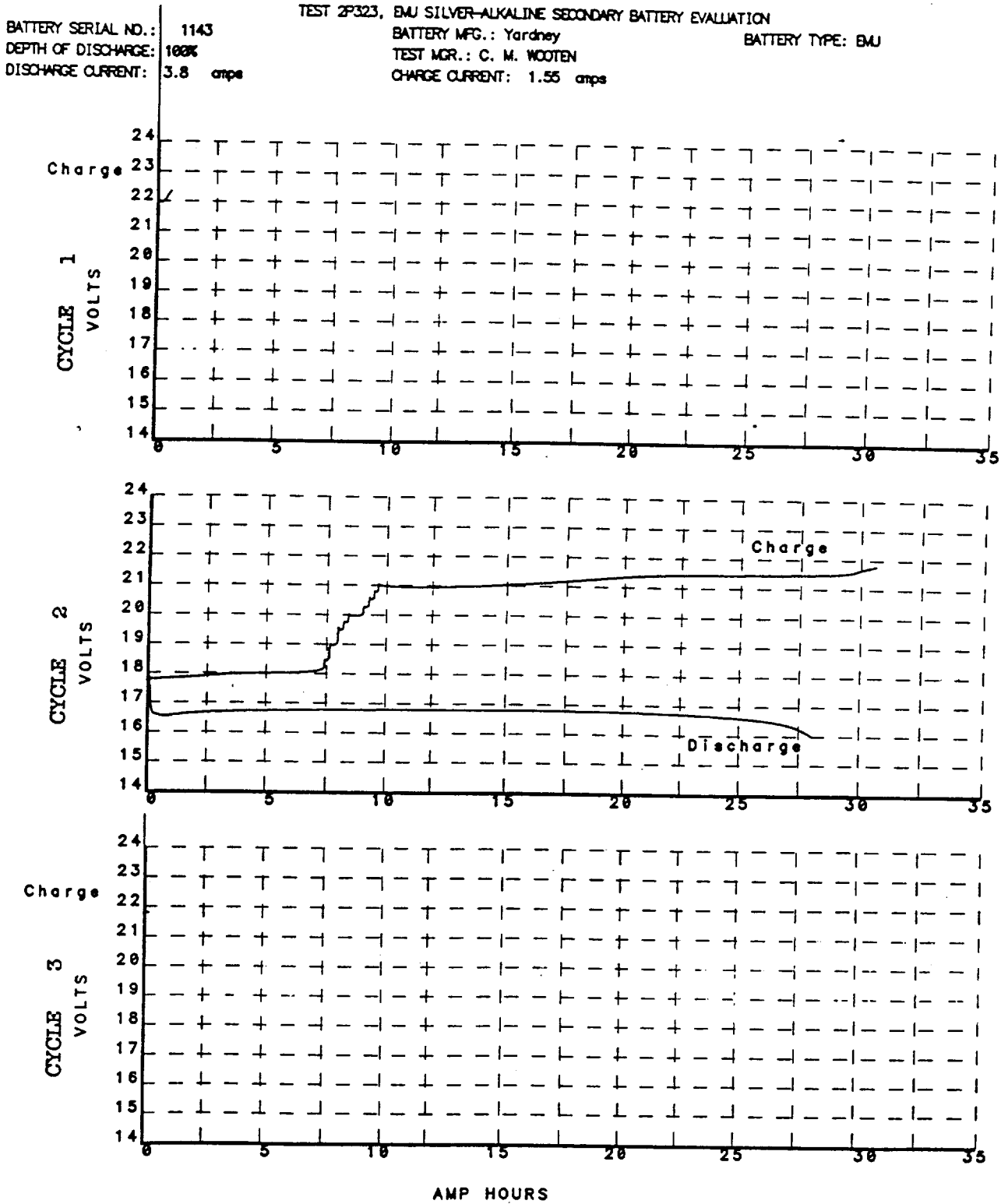
TEST RESULTS/CONCLUSIONS

- NINE BATTERIES HAVE BEEN TESTED FROM FOUR FLIGHT SHIPSETS FROM JAN '89 TO THE PRESENT
- ALL NINE HAVE SUCCESSFULLY PASSED THE 3-CYCLE REQUIREMENT AT 166 DAYS WET-LIFE
- THREE HAVE FAILED THE 3-CYCLE REQUIREMENT OF 226 DAYS
- FOUR HAVE PASSED THE 3-CYCLE REQUIREMENT OF 226 DAYS
- TWO ARE PROJECTED TO PERFORM THE 226-DAY 3-CYCLE REQUIREMENT STARTING NOV 11, 1991
- TWO MORE BATTERIES ARE SCHEDULED FOR TESTING FROM A FUTURE FLIGHT
- IT IS EXPECTED THAT THE WET-LIFE SPEC CAN BE INCREASED FROM 135 DAYS TO 166 DAYS ON THE BASIS OF THESE TEST RESULTS



Cycle #	Type Test
1	Conditioning Topping Charge
2	Conditioning Cycle
3	Topping Charge

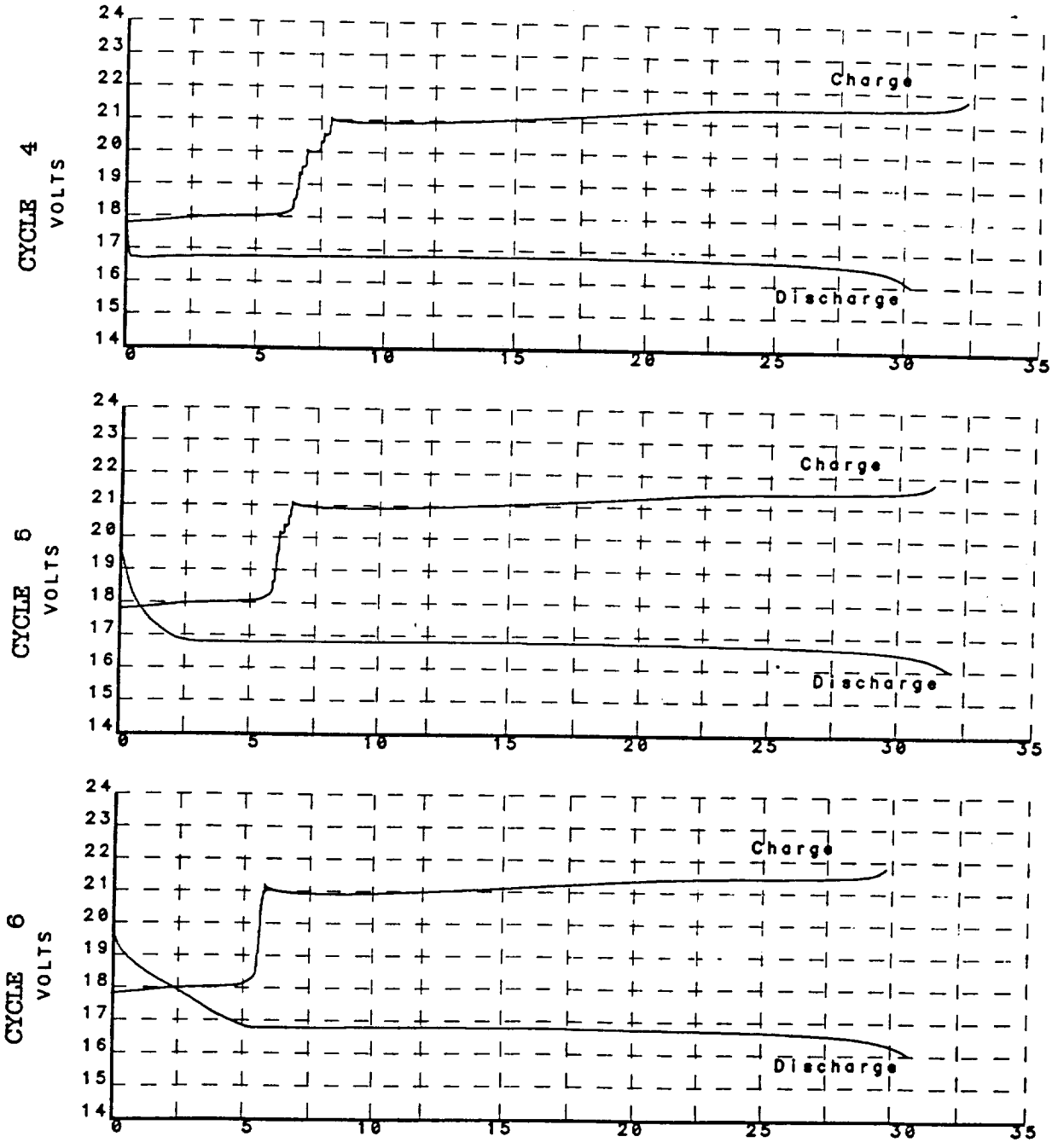
(176 Day Wet-Life)

TEST 2P323, EMU SILVER-ALKALINE SECONDARY BATTERY EVALUATION

BATTERY SERIAL NO.: 1143
DEPTH OF DISCHARGE: 100%
DISCHARGE CURRENT: 3.8 amps

BATTERY MFG.: Yardney
TEST MGR.: C. M. WOOTEN
CHARGE CURRENT: 1.55 amps

BATTERY TYPE: EMU



Cycle #	Type Test
4	Test Cycle
5	Test Cycle
6	Test Cycle

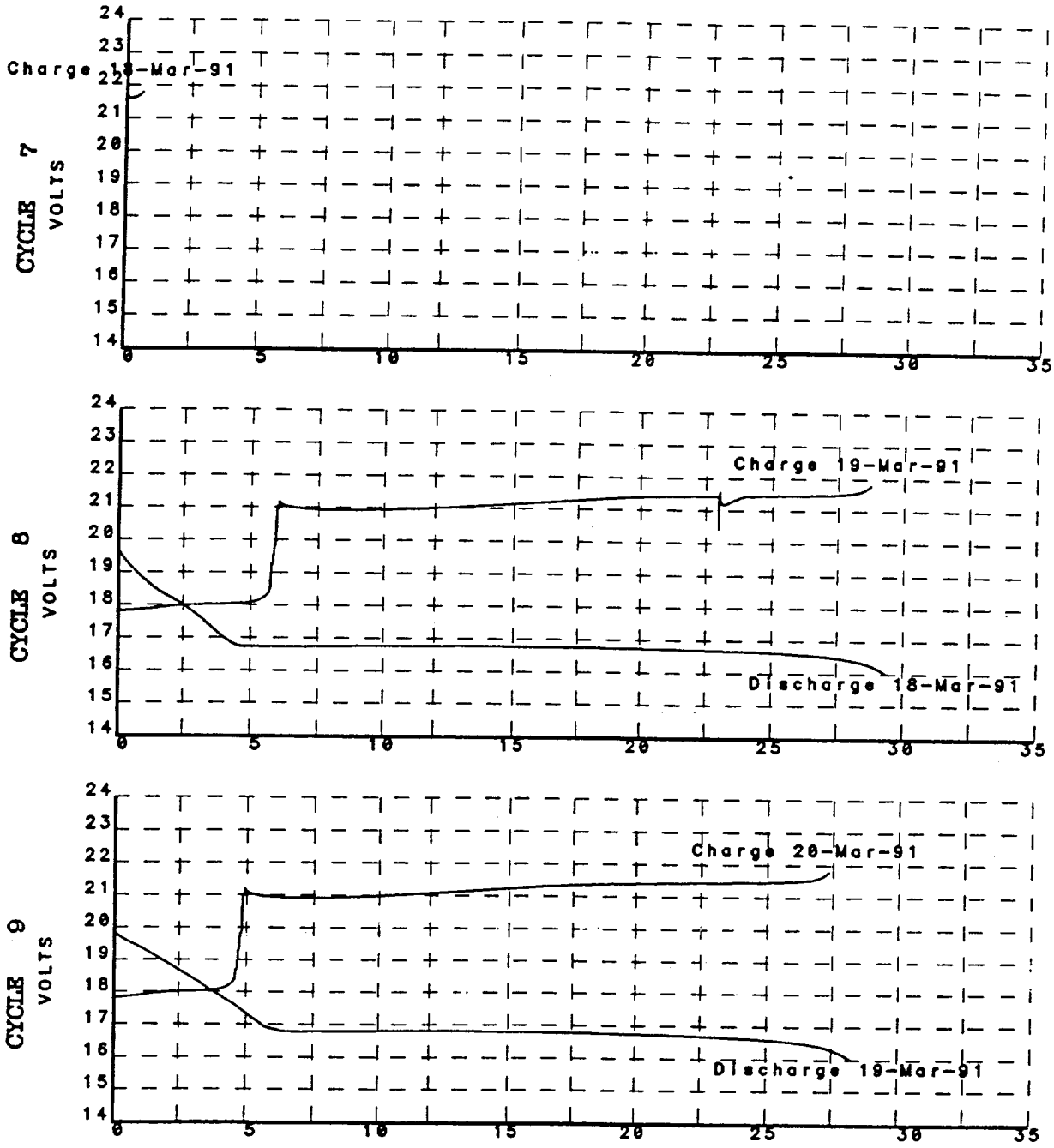
(176 Day Wet-Life)

TEST 2P323, EMU SILVER-ALKALINE SECONDARY BATTERY EVALUATION

BATTERY SERIAL NO.: 1143
DEPTH OF DISCHARGE: 100%
DISCHARGE CURRENT: 3.8 amps

BATTERY MFG.: Yardney
TEST MGR.: C. M. WOOTEN
CHARGE CURRENT: 1.55 amps

BATTERY TYPE: EMU



Cycle #	Type Test
7	Topping Charge
8	Test Cycle
9	Test Cycle

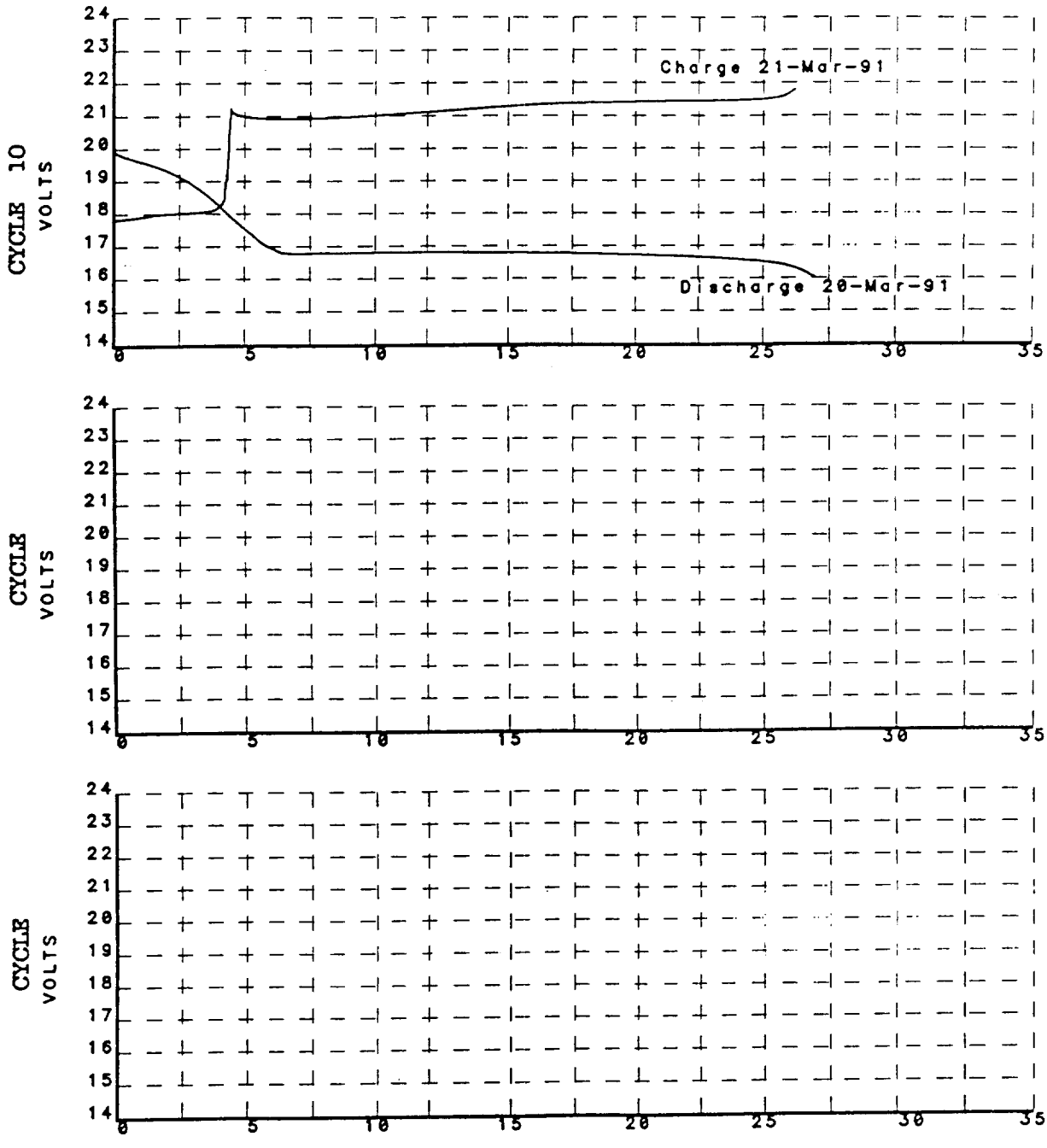
(226 Day Wet-Life)

TEST 2P323, EMU SILVER-ALKALINE SECONDARY BATTERY EVALUATION

BATTERY SERIAL NO.: 1143
DEPTH OF DISCHARGE: 100%
DISCHARGE CURRENT: 3.8 amps

BATTERY MFG.: Yardney
TEST MGR.: C. M. WOOTEN
CHARGE CURRENT: 1.55 amps

BATTERY TYPE: EMU



Cycle #	Type Test
10	Test Cycle

(226 Day Wet-Life)

Test 2P323, EMU Silver-Alkaline Secondary Battery Evaluation

Battery Serial No.: 1143
Battery Mfg.: Yardney
Battery Type: EMU
Depth of Discharge: 100%
Test Mgr.: C. M. Wooten
Discharge Current: 3.8 amps
Charge Current: 1.55 amps
Test End Date: 21-Mar-91