

N94-28121

Performance Test Results Of ETS-VI Ni-Cd Cells

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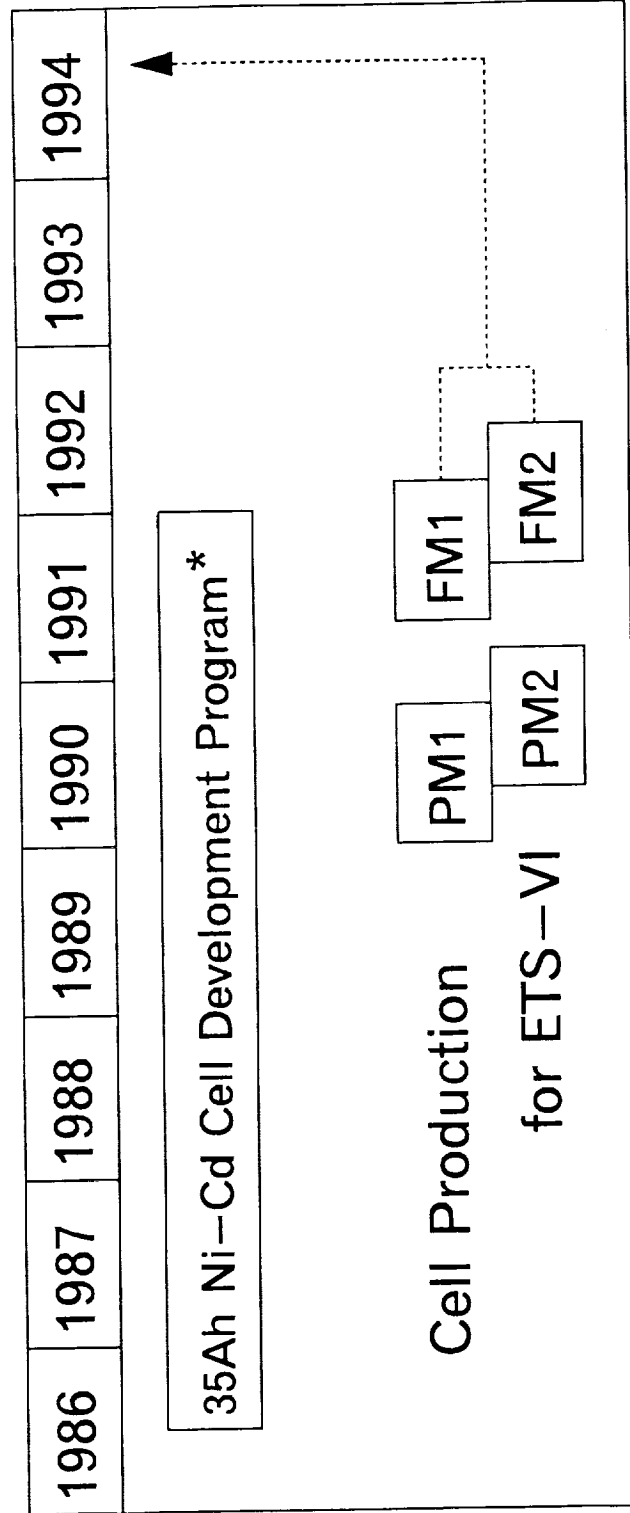
*National Space Development Agency of Japan

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Background

- Development of 35Ah Ni-Cd cell for ETS-VI was initiated in 1986.
- Cell production of ETS-VI/FM : 1991 to 1992
 - 1st lot : delivered 66 cells to battery manufacturer (MELCO)
 - 2nd lot : delivered 83 cells to battery manufacturer
- ETS-VI uses 4 batteries
 - Each battery consists of 2 packs.
 - 16 series cells per pack
- ETS-VI will be scheduled for launch in 1994.
- ETS-VI/FM Batteries are now stored at low temperature.
- Same designed cells were delivered to NASA Lewis Research Center for evaluation in this year.

SANYO Development Schedule



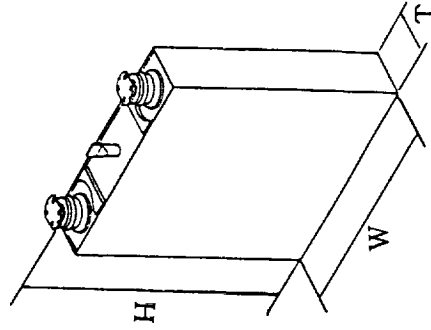
*Life tests are now continued in NASDA.

PM:Prototype Model Cell FM:Flight Model Cell

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Main Specification

- Model Name : N35S
- Dimension : $107^W \times 25^T \times 127^H$ mm
- Weight : max. 1050g
- Nominal Capacity : 35Ah
- Energy Density : 40Wh/kg
- Design Life : 10years in GEO



• Electric Performance

Charge Condition	Charge Volt.	Internal Pressure	Capacity *
0.1C x 24hrs. 20 °C	max. 1.50V	max. 3.5kg/cm ²	min. 35.0Ah
0.1C x 24hrs. 35 °C	max. 1.45V	max. 3.5kg/cm ²	min. 32.0Ah
0.05Cx48hrs. -5 °C	max. 1.55V	max. 3.5kg/cm ²	min. 32.0Ah

* Discharge 0.5C

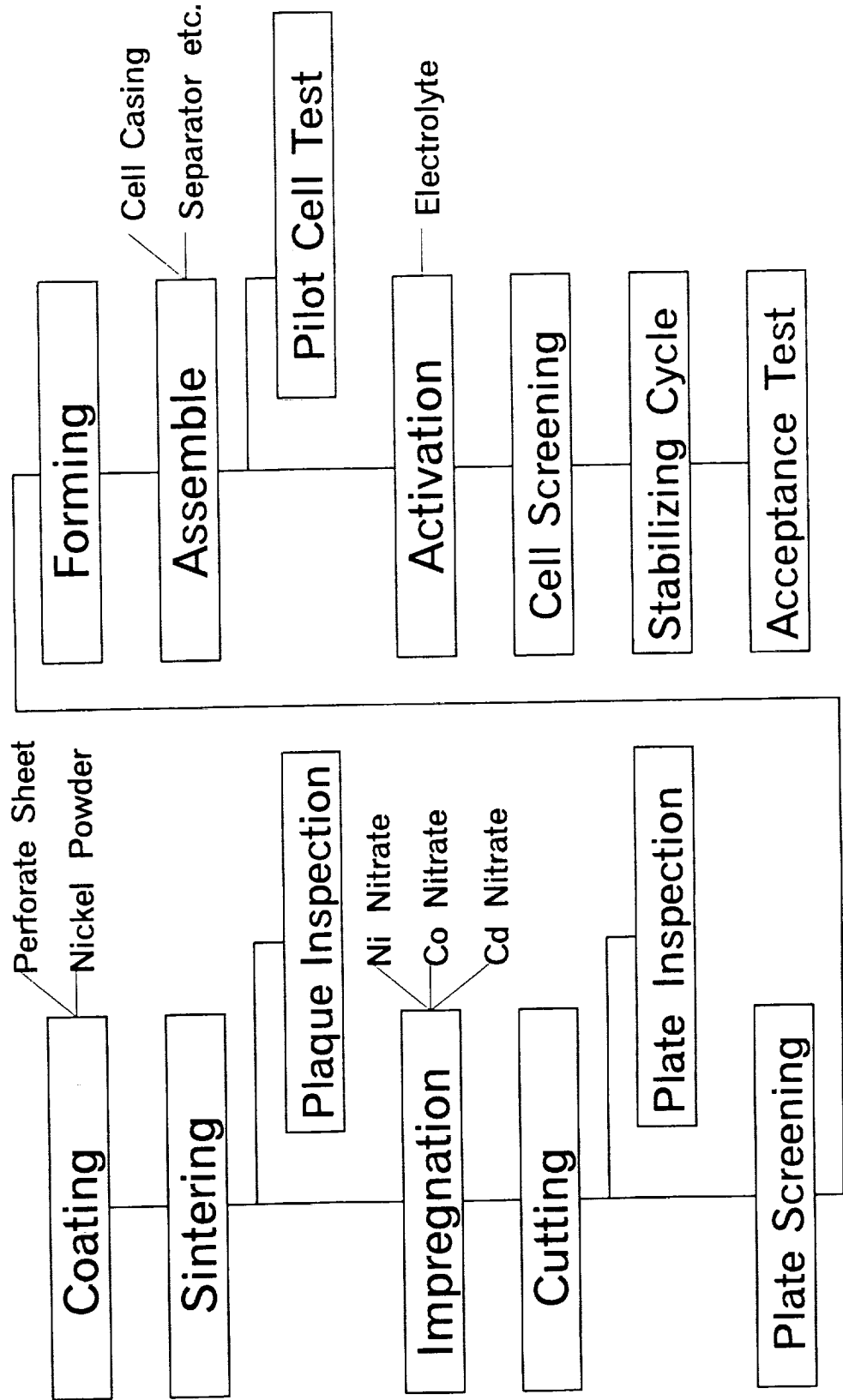
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Cell Design

	Positive	Negative
Substrate Porosity	Sinter Ni / 85%	Sinter Ni / 86%
Impregnation	Chemical Impreg.	Chemical Impreg.
Additives	Co and Cd	Non
Number of Plate	13	14
Plate Dimension	104 x 100mm	104 x 100mm
Plate Thickness	0.63mm	0.80mm
Loading Level	2.4g/cc—void	3.0g/cc—void
Plate Capacity	42.6Ah	69.7Ah
Capacity Ratio	1.64	
Separator	Nylon Nonwoven Cloth	
Electrolyte	31%KOH 98g	
Design Weight	1040g	
Design Capacity	38.7Ah	

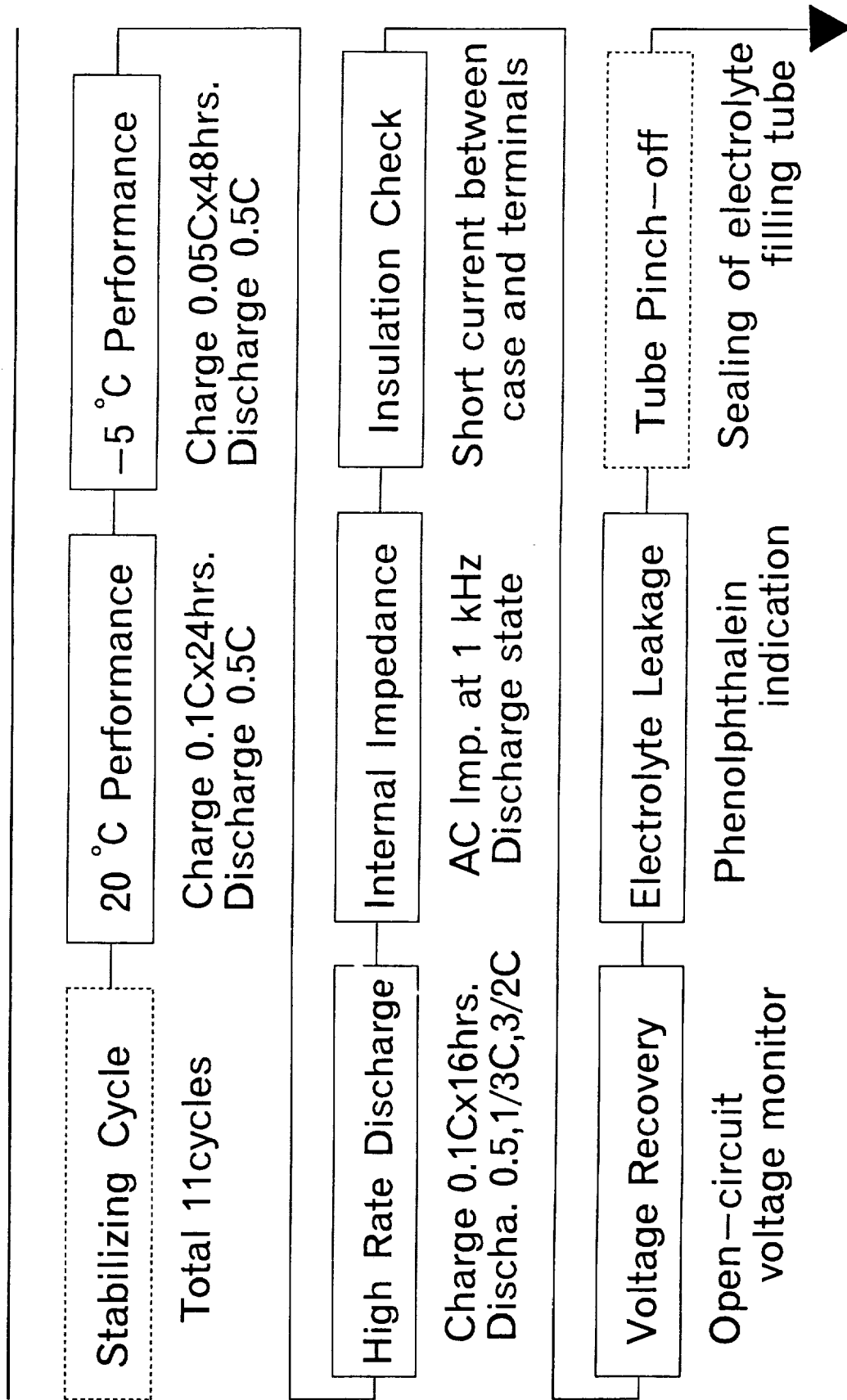
SANYO Production Flow

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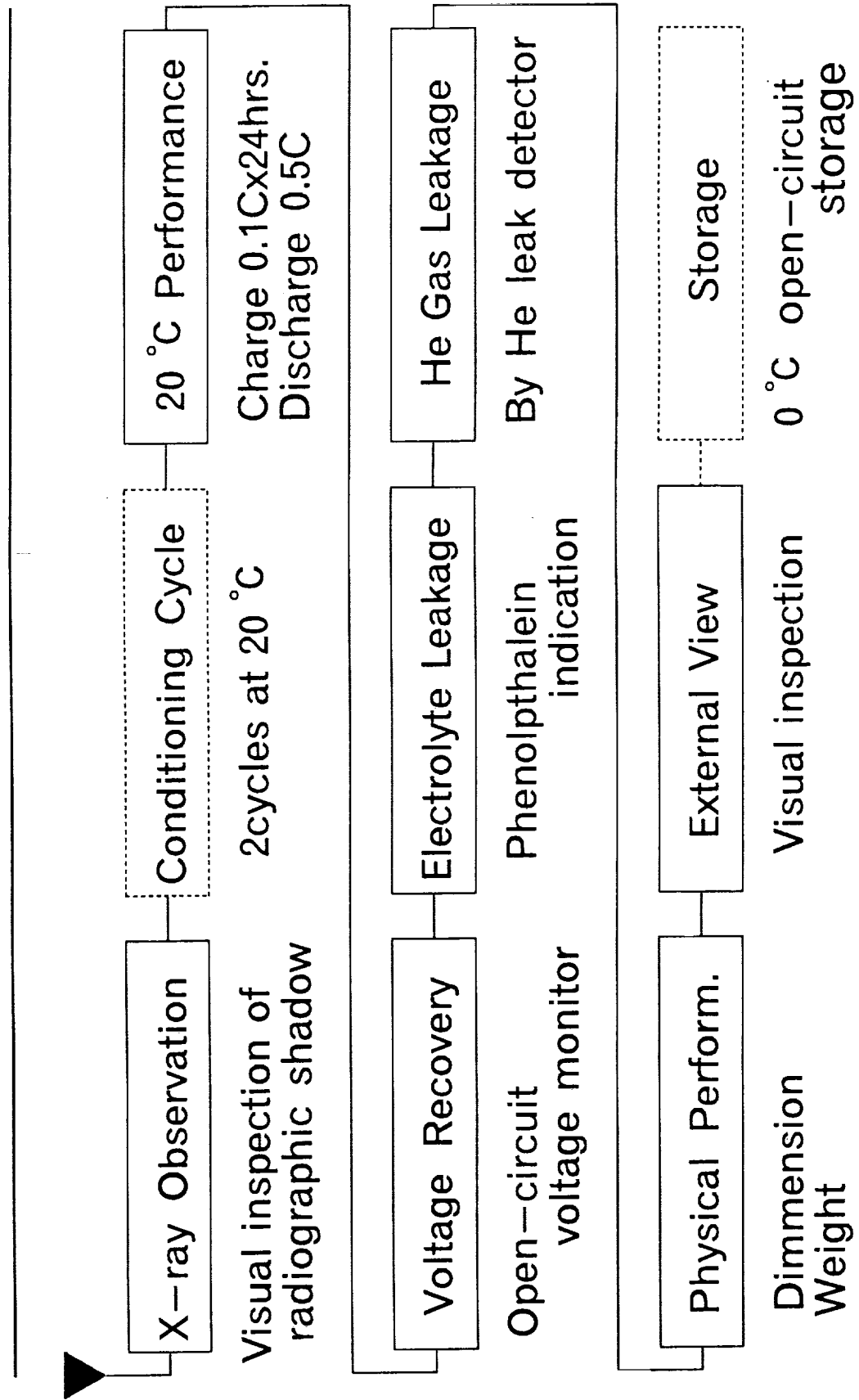


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Acceptance Test (1)

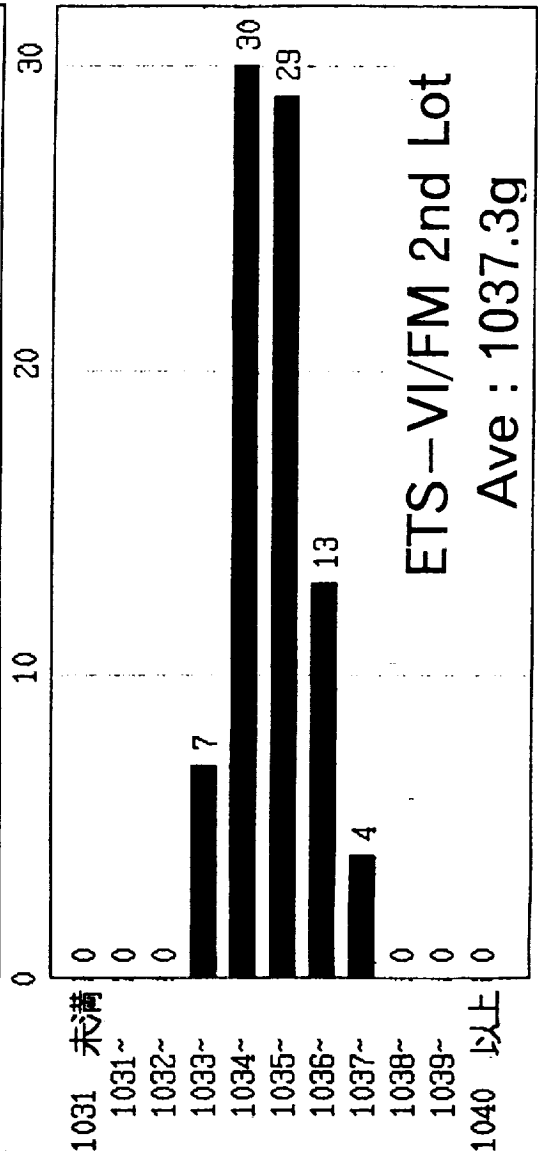
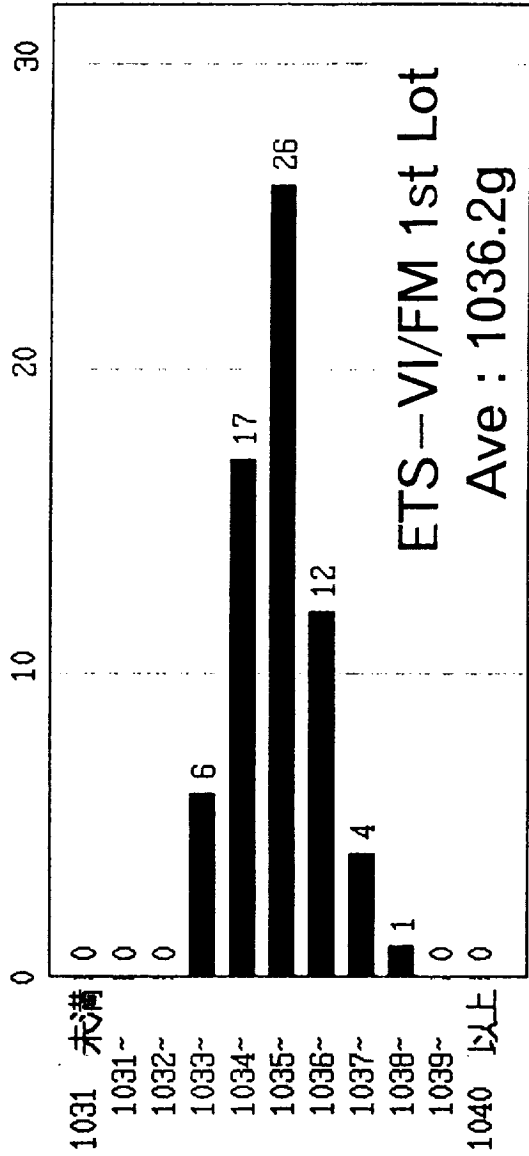


SANYO Acceptance Test (2)

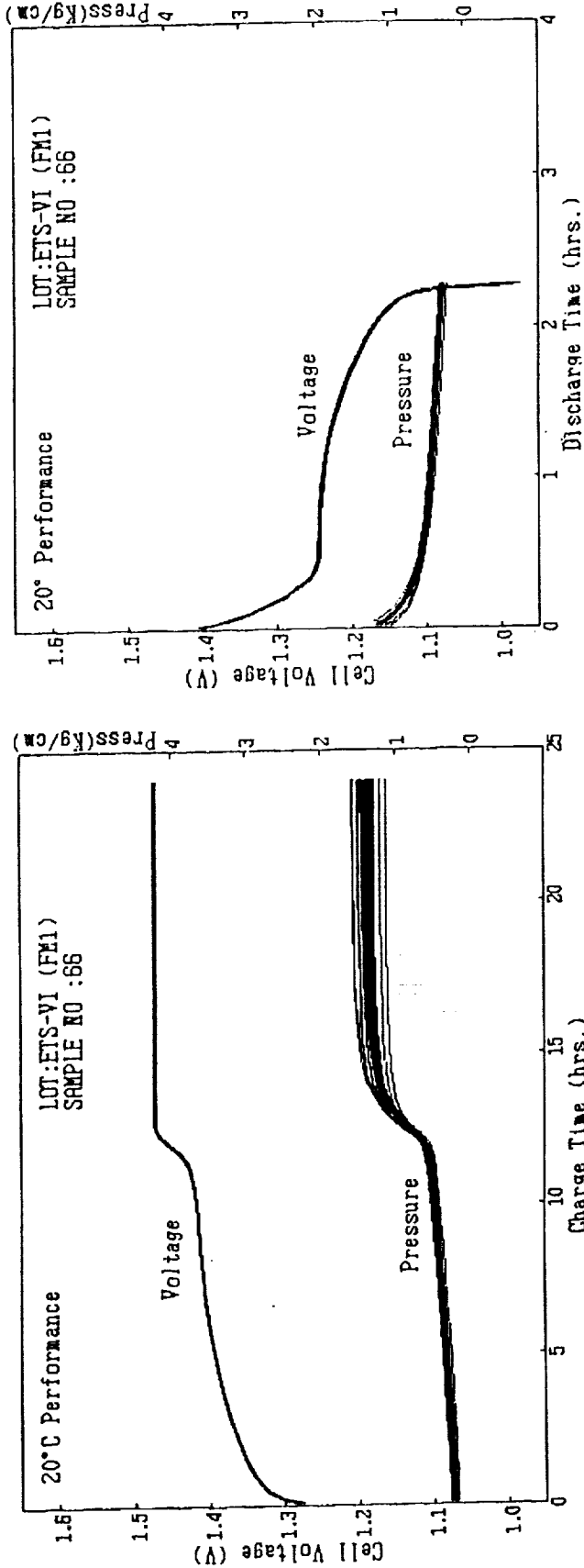


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Cell Weight



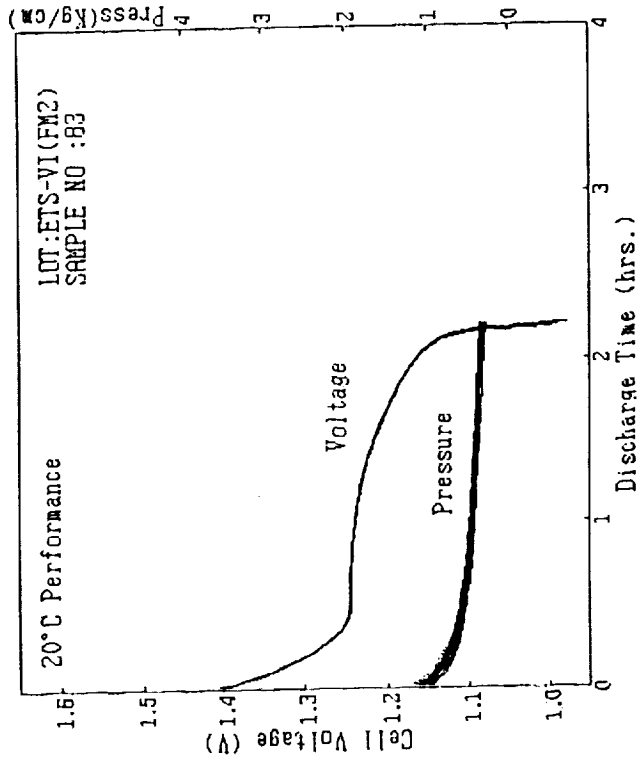
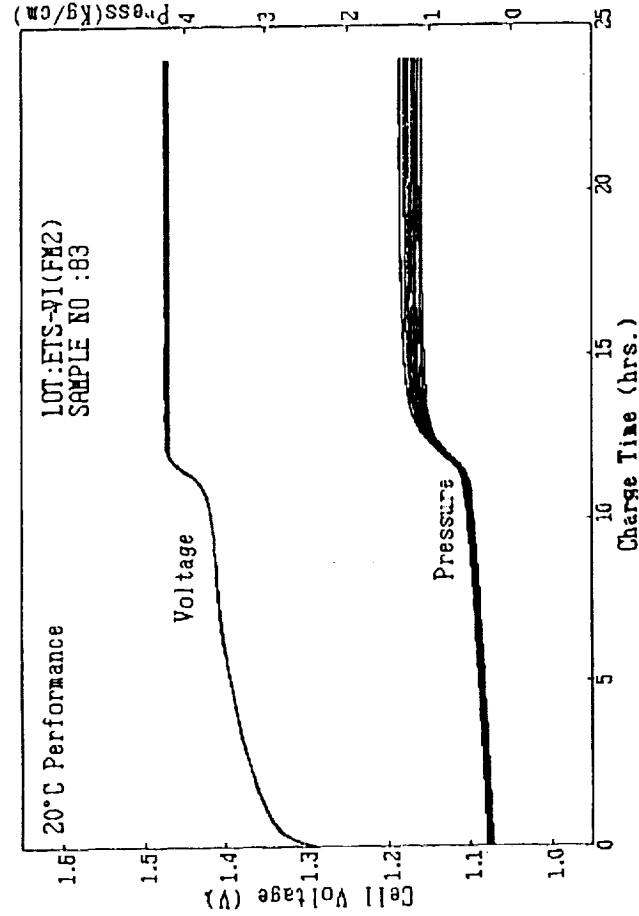
SANYO 20 °C Performance



Charge 3.5A x 24hrs. Discharge 17.5A Temp. 20 °C

Overplot of 66 Data of ETS-VI/FM 1st Lot

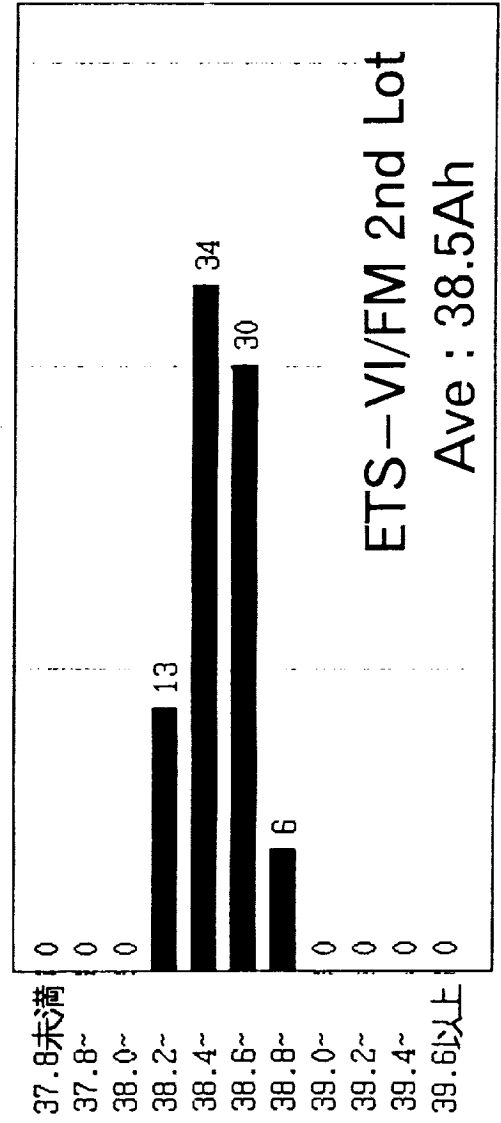
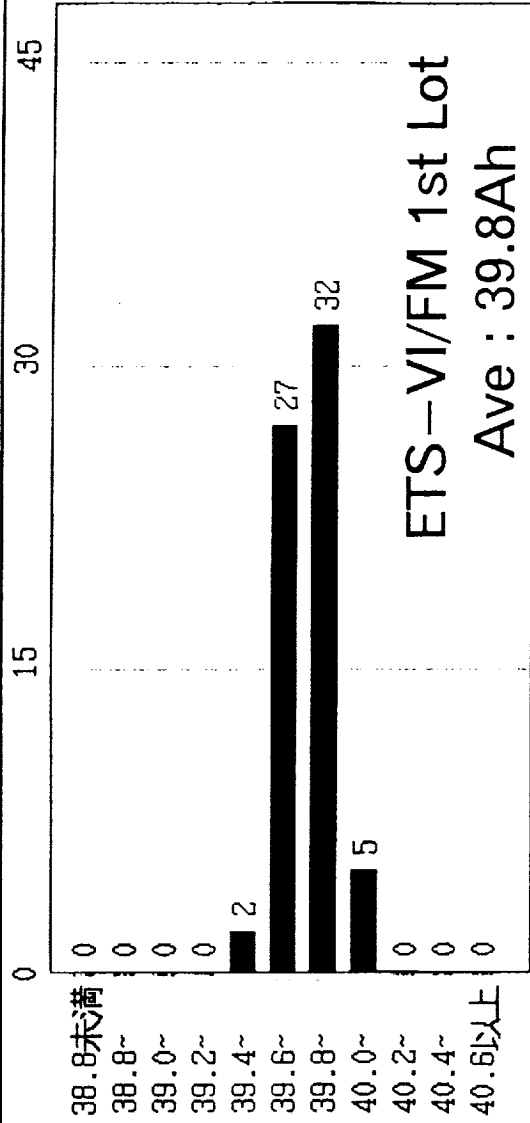
SANYO 20 °C Performance



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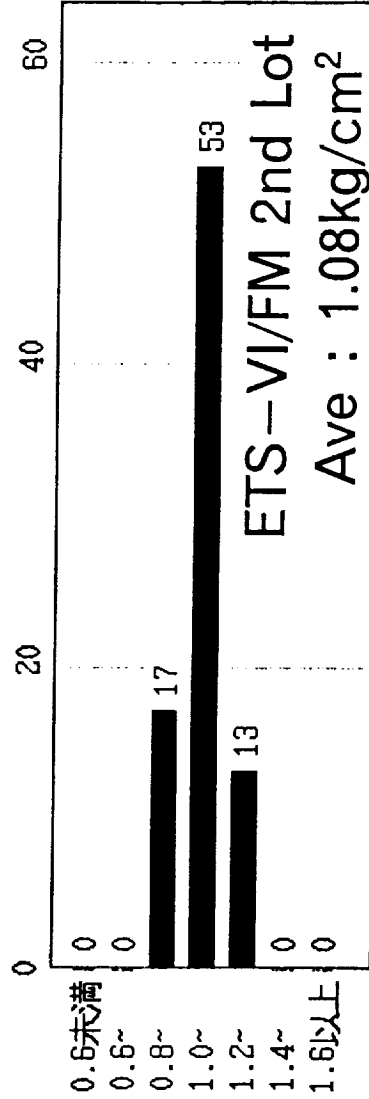
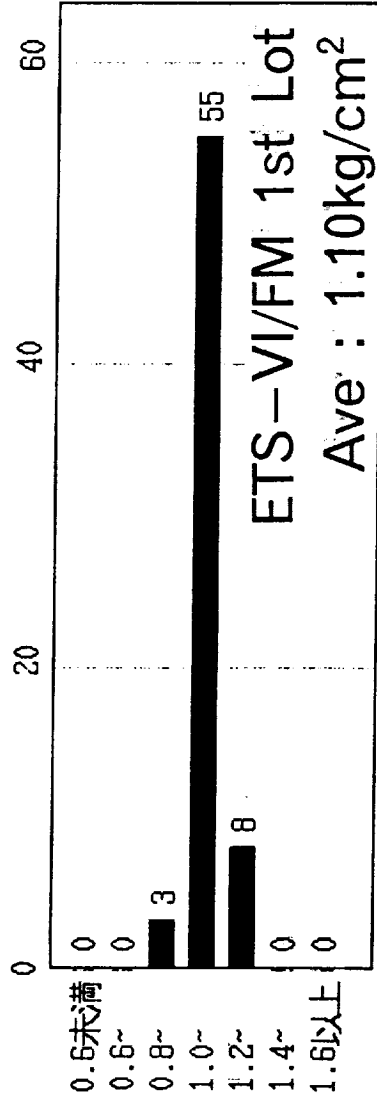
Overplot of 83 Data of ETS-VI/FM 2nd Lot

Capacity



Charge 3.5A x 24hrs. at 20 °C Discharge 17.5A

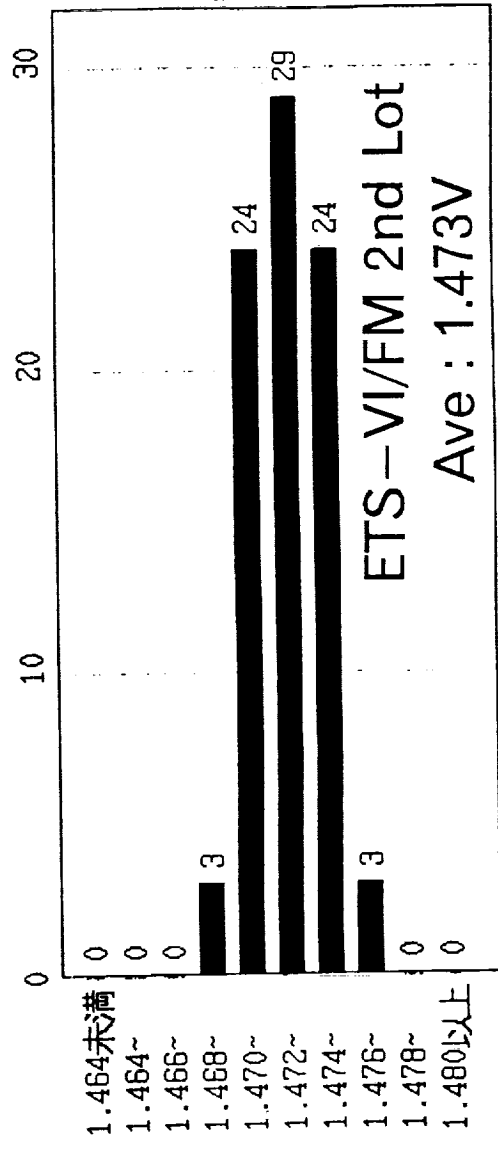
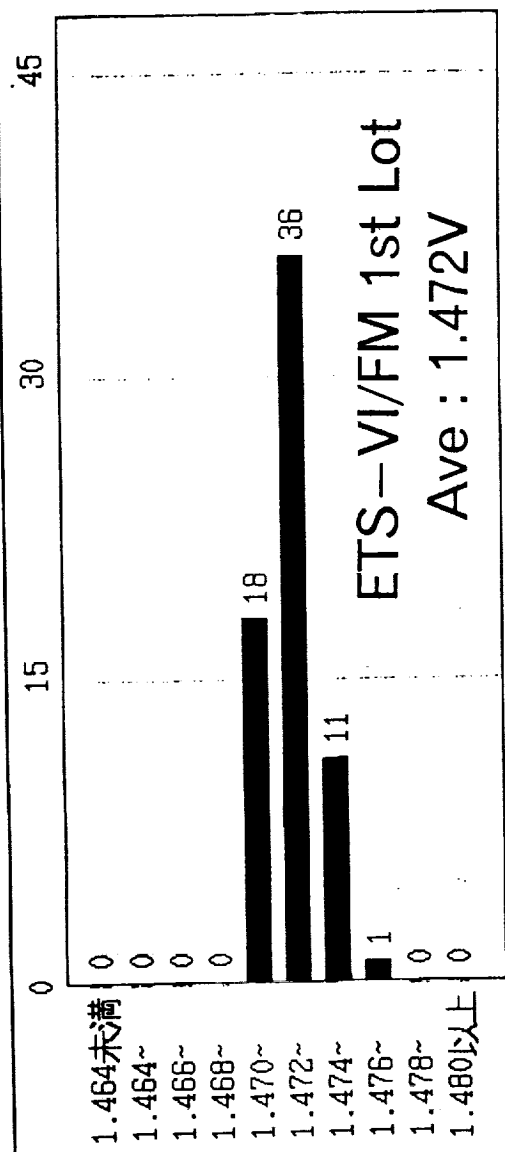
Overcharge Pressure



Charge 3.5A x 24hrs. at 20 °C

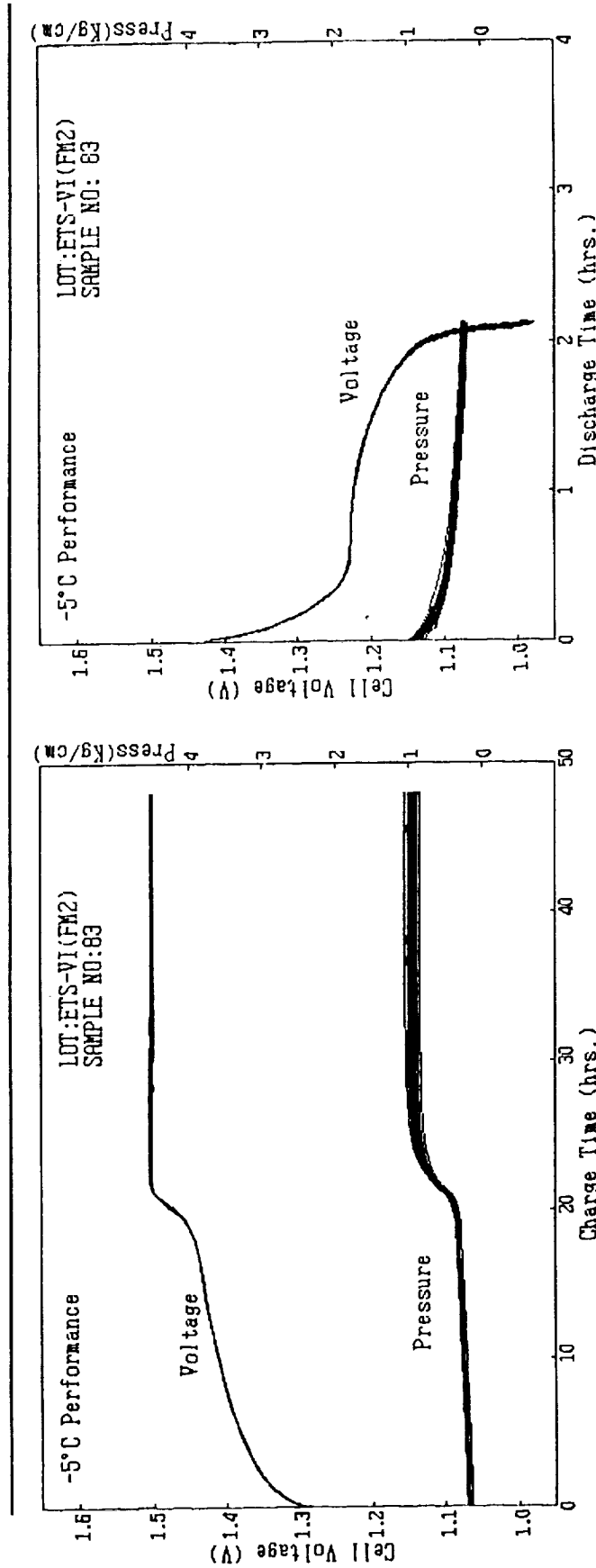
End of Charge Voltage

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Charge 3.5A x 24hrs. at 20 °C

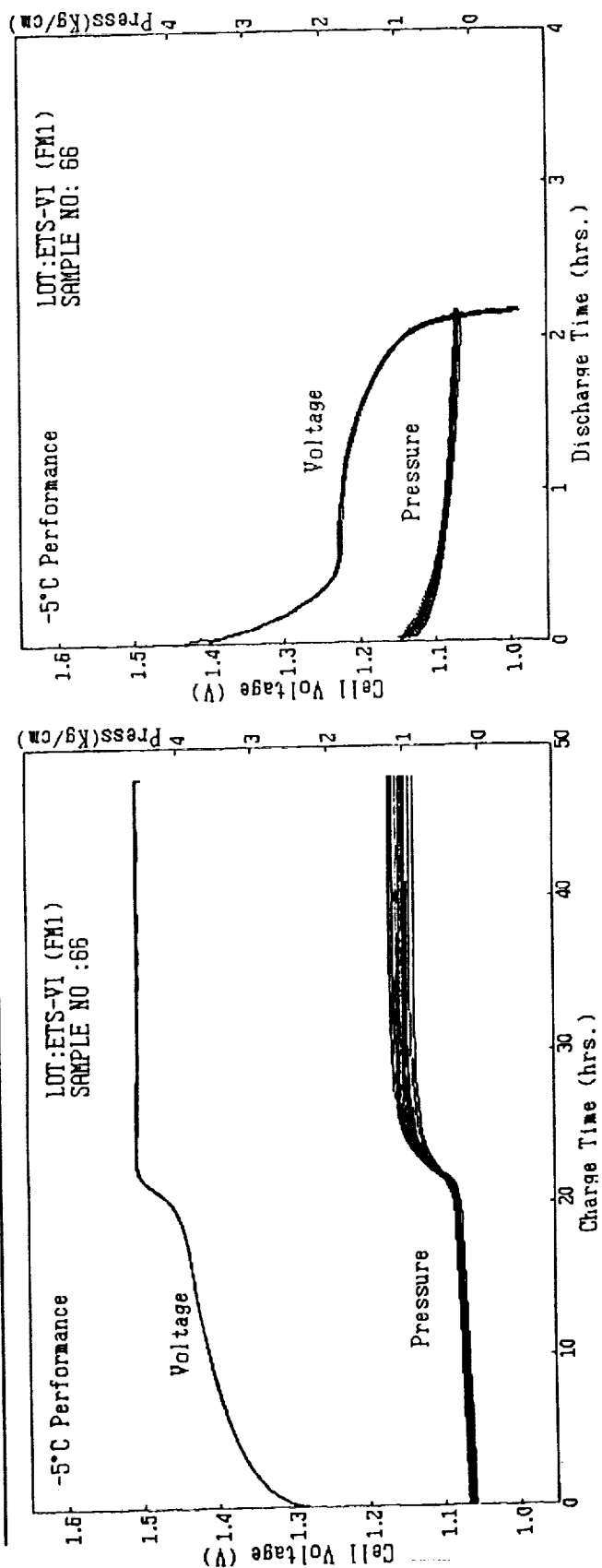
SANYO -5 °C Performance



Charge 1.75A x 48hrs. Discharge 17.5A Temp. -5 °C

Overplot of 83 Data of ETS-VI/FM 2nd Lot

SANYO -5 °C Performance



Charge 1.75A x 48hrs. Discharge 17.5A Temp. -5 °C

Overplot of 66 Data of ETS-VI/FM 1st Lot

SANYO ETS-VI Simulation Cycle Test

Sample :

8cells of PM 2nd lot / electrolyte filling in Nov. 1990

Test facilities :

in NASDA Tsukuba Space Center

Test Status :

Started in Feb. 1991

Continued in 834cycles of 19th season on Nov.1, 1993

Testing Data Summary :

EOCV about 1.45V/cell

8 cells—sample battery has never reached CV mode.

Reconditioning capacities are about 41AH from 5th to 18th season.

SANYO ETS – VI Simulation Cycle Test

Test conditions : from 5th season

Repeat 44cycles

{ Charge : (CC 1.5A + CV 12.5V/8cells) x 14hrs.
Trickle Charge : 0.5A x 8.8hrs.*
Discharge : 14.6A x 1.2hrs. (DOD 50%)
Temperature : 10 °C **

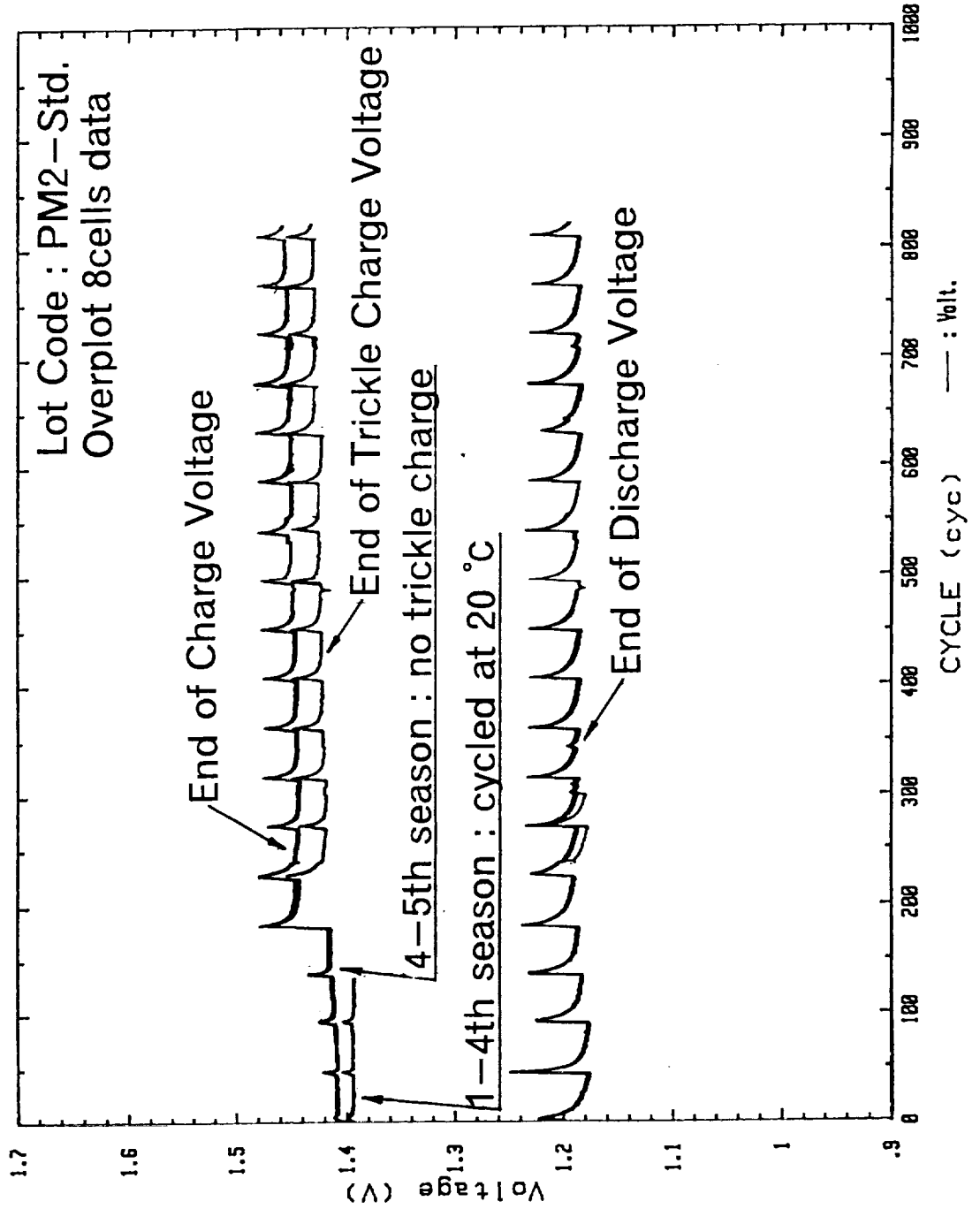
Reconditioning

{ Discharge : 0.66A until any cell falls to 1.0V
Recovery Charge : (CC1.5A+CV12.5V/8cells) x 35hrs.

*Not applied from 4th to 5th season

**Temperature of 20 °C was applied from 1st to 4th season.

SANYO ETS-VI Simulation Cycle Test



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Battery Storage

Storage Condition : Below 0 °C , Open circuit condition
Short circuit storage causes a small fading of capacity.

6months Storage Test of ETS-VI/PM Cells

N=11	Short / 0 °C before → after	Open / 0 °C before → after
End of Charge Volt. [V]	1.471 → 1.471	1.471 → 1.472
Max. Press. [kg/sq.cm]	1.27 → 1.33	1.15 → 1.21
Capacity [Ah]	38.9 → 38.1	38.6 → 38.6

- 35Ah Ni-Cd cells for ETS-VI/FM showed uniform performance in the initial acceptance test.
- Same designed cells are continuously tested in the simulating cycle mode of ETS-VI in NASDA, and these cells operate in a stable state.
- Our aerospace Ni-Cd cells are surely expected to show good performance in space, and selected by the following successive program.
 - ADEOS to launch in 1996 : now manufacturing FM cells to deliver 176cells
 - ETS-VII to be launched in 1998 : will use about 160 cells

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data.

2. The second part of the document outlines the various methods used to collect and analyze data. It includes a detailed description of the sampling process, which was designed to be representative of the entire population. The analysis then focuses on identifying trends and patterns within the data set.

3. The third part of the document provides a comprehensive overview of the results. It includes several tables and charts that illustrate the key findings. The data shows a clear upward trend in the number of transactions over the period studied, which is consistent with the overall market conditions.

4. The final part of the document discusses the implications of these findings. It suggests that the observed trends could be due to a combination of factors, including changes in consumer behavior and the introduction of new products. Further research is needed to explore these factors in more detail.