

**N92-28105**

**1993 NASA AEROSPACE BATTERY WORKSHOP**

**BATTERY STUDY FOR THE MARS  
ENVIRONMENTAL SURVEY (MESUR) PATHFINDER**

**JPL**

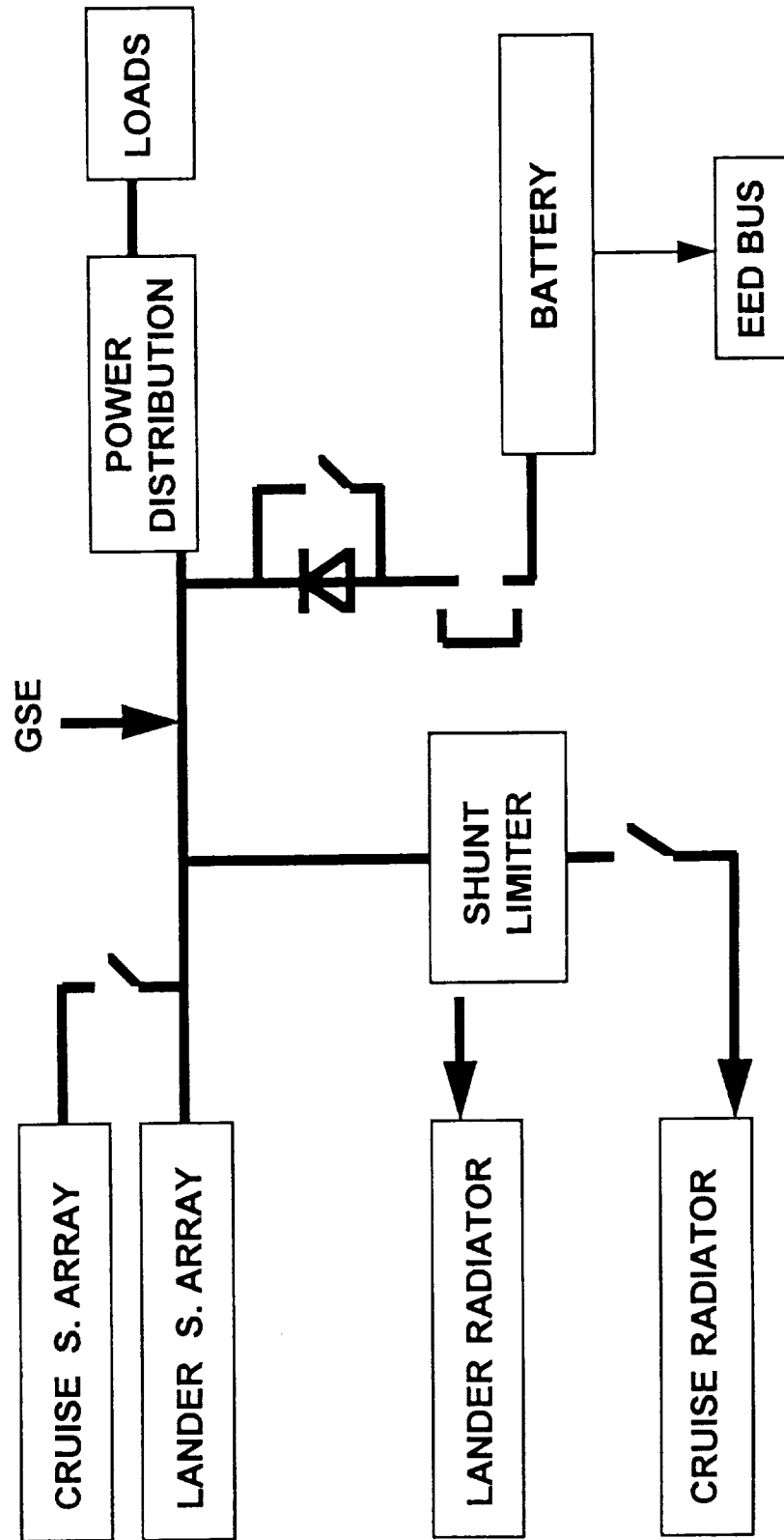
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**MESUR PATHFINDER - BATTERY WORKSHOP  
BATTERY STUDY OVERVIEW**

- **MESUR PATHFINDER INTRODUCTION**
- **POWER SUBSYSTEM CONCEPT**
- **BATTERY TECHNOLOGY SELECTION**
- **MISSION BATTERY PERFORMANCE**
- **CELL/BATTERY BASELINE DESIGN**
- **CHARGE METHODOLOGY**
- **PROPOSED TESTING**

MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
MESUR POWER SYSTEM BLOCK DIAGRAM



MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
Ag/Zn INTRODUCTION

- BATTERY MISSION PROFILE  
PROVIDE AND STORE ELECTRICAL POWER FOR THE MESUR  
LANDER DURING LAUNCH, CRUISE, ENTRY - DESCENT -  
LANDING, AND MARS SURFACE OPERATION.
  
- TECHNOLOGY SELECTION  
PERFORMANCE
  - SPECIFIC ENERGY DENSITY (0° C) ~75 Wh/Kg
  - VOLUMETRIC ENERGY DENSITY ~158 Wh/L
  - RATE CAPABILITY ~C RATE
  - CYCLE LIFE ~50 CYCLESFLIGHT HERITAGE (GENERIC)  
SURVEYOR, MARINER, PIONEER, TITAN, VIKING  
CELL AND BATTERY DESIGN GENERIC

MESUR PATHFINDER - BATTERY WORKSHOP  
 LANDER Ag/Zn BATTERY  
 Ag/Zn HERITAGE

BATTERY PROGRAM	MAR 4557-X MESUR	CELL US ARMY	SAR 4266 APOLLO	MAR - 4333 LOCKHEED / SAT.	LARGE PROBE PIONEER/VENUS	UNKNOWN CLASSIFIED
FLIGHT EXPERIENCE	YES	N/A	YES	YES	YES	YES
NUMBER OF CELLS	18	one	20	16	19	one
WEIGHT (Kg)	13.3		12.9	52.7	13.4	
SIZE (cm)	22.5x21x18.1		29.9x17.4x14.6	50.8x34.3x20.3	33.3x19.3x14.4	
CAPACITY (A-H)	40	43	40	300	40	30
VOLTAGE (NOMINAL)	27	1.5	30	24	28.5	1.5
RATE (AMPERES)	1	10 TO 60	25-35	9 TO 12	10 to 60	6 TO 20
CYCLE LIFE (actual)	30	100 (200)	6 (20)	3200 (6700)	1 (25)	50 (100)
DEPTH-OF-DISCH. (%)	80 (max)	62.5	80 (max)	1 to 4	90	100
WET LIFE (MONTHS)	15	12	12	9	12	12
GROUND (MONTHS)	2	12	11	2	7	7
FLIGHT (MONTHS)	8	N/A	1	7	5	5
CELL PART No.	SZLR 40-3	BB-465/U	1560-7	2599-3	SZLR40	SZHR30
CELL WEIGHT (Kg)	0.577	0.581	0.51	2.951	0.51	0.49
CELL Vol. (cm <sup>3</sup> )	278	373	271	1066	271	260
ELECTRO. CONC. (%)	40	42	40	40	45	45
NEG. to POS. RATIO	1.53	1.67	1.9	1.04	1.46	1.6
SEPARATION SYSTEM	1 WEBRIL	1 DYNEL	1 PELLON	1 PELLON	1 PELLON	1 WEBRIL
POS. ABSORBER *	5 CELLOPHANE	5 CELLOPHANE	4 CELLOPHANE	5 CELLOPHANE	6 CELLOPHANE	6 CELLOPHANE
MEMBRANE			1 PVA	1 PVA		
MEMBRANE			1 VISKON	1 VISKON	1 VISKON	1 VISKON
NEG. ABSORBER *	1 VISKON	1 DYNEL	1 VISKON	1 VISKON	1 VISKON	1 VISKON

**MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
BATTERY OVERVIEW**

- **PERFORMANCE DRIVEN DESIGN**  
OPERATIONAL PARAMETERS WILL BE DETERMINED BY CELL AND BATTERY PERFORMANCE
- **DERIVED PERFORMANCE TARGETS**  
BATTERY VOLTAGE 22-36 VOLTS  
LOAD 1 - 4 AMPERES  
TWO MONTHS ACTIVE STORAGE 20°C (SHIP AND LAUNCH)  
SEVEN MONTH CRUISE  
30 CYCLES MARS SURFACE 20 Ah AT 10 TO -20°C  
CAPACITY  
40 AH AT RT AND BOL  
20 Ah AT 0°C  
VOLUME: 8.3 X 7.37 X 7.12 INCHES (ESTIMATE)  
MASS: LESS THAN 14 KG

MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
CELL DESIGN

• CELL BASELINE DESIGN

ELECTRODE	POSITIVE	NEGATIVE
MATERIAL	SINTERED Ag	Zn OXIDE BLEND
NUMBER	4	5
SURFACE AREA	124.5	
CAPACITY		
THEORETICAL	66.5 AH	101.4 AH
INITIAL EXPECTED	54.5 Ah	
SEPARATOR SYSTEM	5/6 LAYERS - CELLOPHANE	
ELECTROLYTE	40 % KOH, 85 ml	
DIMENSION	6.61 X 3.54 X 0.725 INCHES	
WEIGHT	445 grams DRY (APPX)	

MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
BATTERY DESIGN

- BATTERY BASELINE DESIGN  
BASED ON CURRENT 20 CELL, 3 CONNECTORS, Ti HOUSING  
18 CELL CELL BATTERY  
THREE CONNECTOR. MAIN POWER, INSTRUMENTATION, HEATER POWER  
DIMENSIONS 8.30 X (8.87) X 7.12 INCHES  
FOOTPRINT TBD (HOLE PATTERN) FLANGE 0.75 INCH  
HEATER SET POINT APPX 80 F, POWER TBD, THERMOSTATS TBD  
WEIGHT (ACTIVE BATTERY) ESTIMATES

18 CELLS	22.86	TOTAL = 29.25 lbs
HOUSING	3.22	13.28 KG
COMPOSITE	1.07	EXPECT WEIGHT GROWTH
CONNECTORS	0.28	
WIRING	0.40	
HEATER	0.03	
MISC	1.39	

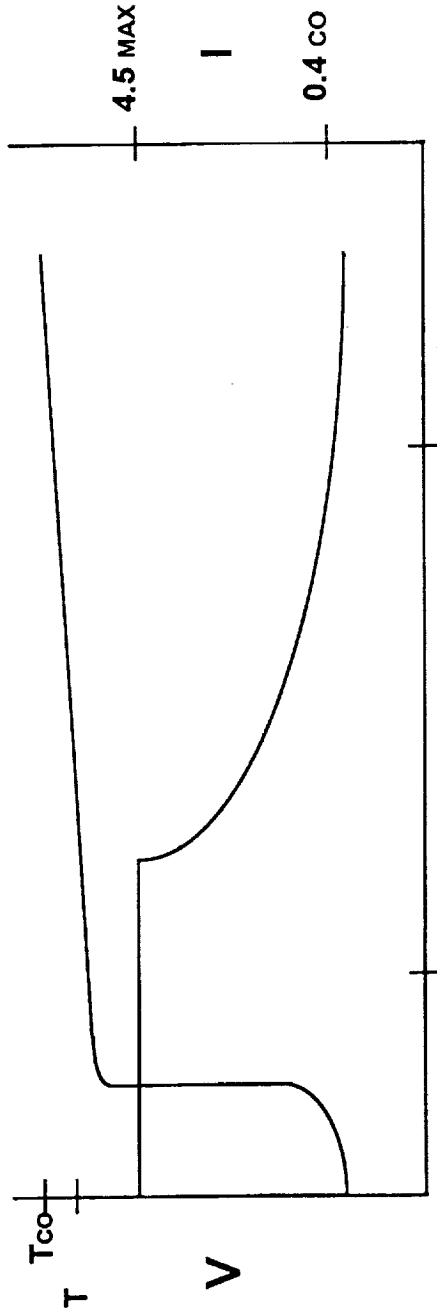


MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
DESIGN/PERFORMANCE ISSUES

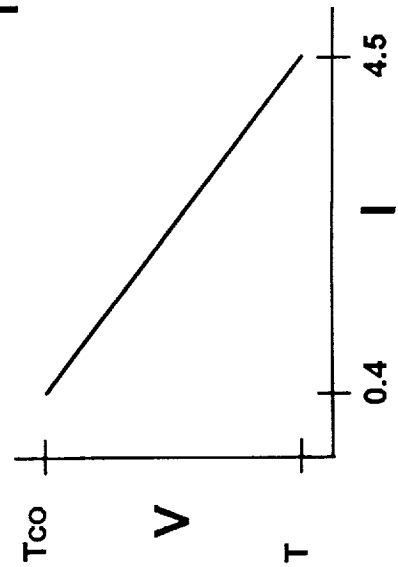
- DESIGN
  - DESIGN BASED ON EXISTING TECHNOLOGY
  - CELL 5 OR 6 LAYERS OF SEPARATOR
  - 18 CELL BATTERY (CONCEPT BASED ON 20 CELL BATTERY)
- OPERATIONAL
  - CHARGE
    - ENERGY BALANCE IS CRITICAL
    - 20 Ah CHARGE IN 6 HOURS
    - CHARGE/DISCHARGE TEMPERATURE LIMITS (PREFER 20°C)
    - CHARGE METHODOLOGY (CP OR TAPER)
  - DISCHARGE
    - TEMPERATURE LIMIT FOR CAPACITY (NOMINAL 20Ah)
  - CRUISE
    - TEMPERATURE 0C PREFERRED WILL TEST AT 20°C
    - OCV OR 1.86 VOLT FLOAT

MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
PROPOSED CHARGE METHODOLOGY

BATTERY CHARGE VOLTAGE/CURRENT



TIME



TAPER

MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
CELL CHARACTERIZATION TESTING

- CHARGE DEFINITION  
CONSTANT POTENTIAL  
V = 1.91 TO 1.94, I = 4.5 MAX TO 0.4, TEMP., 23 TO 10C  
VIRTUAL RESISTANCE  
V<sub>vo</sub> = 1.91 TO 1.94, VT<sub>os</sub> = 1.91, TEMP. = -10 TO 10C
- CHARGE/STAND CYCLE LIFE  
8 MONTH STAND, 0 AND 25C, OCV AND 1.86V FLOAT
- DISCHARGE CHARACTERISTIC  
TEMP. -40, -20, -10, 0, 10C, RATES 1.5, 4.35, 12.5, 1.5 AMPS
- SYSTEM PERFORMANCE  
FLIGHT - PRELAUNCH, CRUISE/TCM, EDL, MARS SURFACE OPERATION
- CYCLE LIFE INITIAL  
CHARGE/DISCHARGE CYCLE AT 0C TO 1.22V, TAPER TBD

**MESUR PATHFINDER - BATTERY WORKSHOP  
LANDER Ag/Zn BATTERY  
DESIGN OPTIONS DETERMINED BY TESTING**

- **HARDWARE**
  - 18 OR 17 CELL BATTERY**
  - 5 OR 6 LAYERS OF SEPARATOR**
- **OPERATION**
  - CHARGE**
    - LIMITED CHARGE MAY LEAD TO NEGATIVE ENERGY BALANCE**
    - DURATION OF CHARGE PERIOD AND CHARGE ACCEPTANCE**
    - CHARGE TEMPERATURE COMPENSATION REQUIRED**
    - CHARGE METHODOLOGY**
  - CRUISE**
    - TEMPERATURE, OCV OR 1.86 VOLT FLOAT**

MESUR PATHFINDER - BATTERY WORKSHOP

SUMMARY

- SELECTION OF Ag/Zn BATTERY BASED ON DERIVED MISSION REQUIREMENTS.
- CELL AND BATTERY DESIGNS ARE CONSISTENT WITH FLIGHT REQUIREMENTS.
- CELL TESTING WILL PROVIDE DATA ON  
CHARGE/DISCHARGE TEMPERATURE COMPENSATION  
CYCLE LIFE  
CHARGE METHODOLOGY  
CRUISE REQUIREMENTS

