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Produced by the NASA Center for Aerospace Information (CASI)
LOW CONCENTRATION RATIO
SOLAR ARRAY FOR LOW EARTH ORBIT
MULTI-100 kW APPLICATION

VOLUME 2—DRAWINGS

FINAL REPORT
"JLY 1983

Prepared for:
National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

Contract NAS8-34214
LOW CONCENTRATION RATIO
SOLAR ARRAY FOR LOW EARTH ORBIT
MULTI-190 KW APPLICATION
FINAL REPORT
VOLUME 2 - DRAWINGS
JULY 1983

PREPARED FOR:
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER,
AL 35812

CONTRACT NAS8-34214

Rockwell International
Shuttle Integration &
Satellite Systems Division
12214 Lakewood Boulevard
Downey, California 90241
Low Concentration Ratio Solar Array for Low Earth Orbit Multi-100 kW Application, Final Report, Vol. 2 - Drawings

Nalbandian, S. J., French, E. P., et al

Rockwell International Corporation
Shuttle Integration and Satellite Systems Division

July 1983

Concentrators, Solar Arrays, Concentrator Arrays, Concentrating Silicon Solar Cells, Concentrating Gallium Arsenide Cells, Low Earth Orbit Multi-100 kW Solar Array Design

This report describes a preliminary design effort directed toward a low-concentration-ratio photovoltaic array system based on 1984 technology and capable of delivering multi-hundred kilowatts (300 kW to 1000 kW range) in low earth orbit. The array system consists of two or more array modules each capable of delivering between 113 kW to 175 kW using silicon solar cells or gallium arsenide solar cells, respectively.

The array module deployed area is 1320 square meters and consists of 4356 pyramidal concentrator elements. The module, when stowed in the Space Shuttle's payload bay, has a stowage volume of a cube with 3.24 meters on a side. The concentrator elements are sized for a geometric concentration ratio (GCR) of six with an aperture area of 0.5 meters x 0.5 meters.

Volume 1 discusses the structural analysis and design trades leading to the baseline design. It describes the configuration, as well as optical, thermal and electrical performance analyses that support the design and overall performance estimates for the array. Experimental results are also presented for a concentrator element using both silicon and gallium arsenide solar panels. They confirm the preliminary design analysis and performance estimates. Recommendations are provided for future development effort for low earth orbit application. Volume 2 provides drawings for the preliminary design configuration and for the test hardware that was fabricated for design evaluation and test.
FOREWORD

This report describes the effort performed for the preliminary design of low-cost concentrator multi-hundred kilowatt solar arrays. The Volume 1 report summarizes activities performed between June 18, 1981 and July 1983, as required by Contract NAS8-34214 Statement of Work. Volume 2 contains drawings prepared describing the preliminary design configuration, test hardware and manufacturing flow concept. The report was prepared by the Shuttle Integration and Satellite Systems Division of Rockwell International Corporation for the NASA George C. Marshall Space Flight Center (MSFC), Huntsville, Alabama. The NASA technical Contractor Officer Representative for the activity is Mr. W. L. Crabtree. The contents of this document are not necessarily endorsed by the NASA-MSFC.

Mr. S. J. Nalbandian is the project supervisor. Dr. E. F. French is the assistant project supervisor. Principal contributors to the project were:

J. B. Adkins - Mechanism Design
H. C. Ayers - Reflector Design
Z. Backovsky - Testing and Thermal Analysis
R. A. Bellgardt - Electrical Test Equipment
M. S. Biss - Overall Preliminary Design
J. L. Edwards - Structural Analysis
J. D. Eliot - Mechanical Test Equipment
Dr. E. P. French - Optical and Thermal Analysis
G. C. Frey - Materials
R. V. Frost - Reflector Panel Fabrication
H. S. Greenberg - Initial Structural Design and Analysis
K. M. Hicks - Manufacturing Planning
Dr. L. Hsu - Solar Cell Technology
R. L. Long - Materials
M. W. Mills - Electrical Testing and Analysis
Dr. T. S. Nishimoto - Structural Analysis
F. A. Perry - Structural Analysis
A. M. Pope - Development Plans
D. A. Reed - Initial Preliminary Design
A. A. Sileski - Test Planning
L. Vega - Test Hardware
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## ILLUSTRATIONS

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</tr>
</tbody>
</table>

PRECEDING PAGE BLANK NOT FILMED
1.0 PRELIMINARY DESIGN DRAWINGS

1.1 DISCUSSION

The solar array preliminary design developed under this program is described in a set of 30 level-one drawings. These drawings and their relationships are depicted in the drawing tree shown in Figure 1. Together with their associated callouts and specifications, the drawings provide a physical description of two variants of a 1320 m² solar array module (deployed area), one fitted with silicon solar cells and the other with gallium arsenide solar cells. The requirements, trades and analytical studies leading to the design are fully described in Volume 1 of this report.
1.2 DESIGN DRAWINGS

1. V416-935001
2. V416-935002, sheets 1 of 2 and 2 of 2
3. V416-935003
4. V416-935010
5. V416-935100, sheets 1 of 2 and 2 of 2
6. V416-935101, sheets 1 of 3, 2 of 3, and 3 of 3
7. V416-935102
8. V416-935103
9. V416-935200
10. V416-935201
11. V416-935202
12. V416-935203
13. V416-935204
14. V416-935205
15. V416-935400
16. V416-945.001
17. V416-945100
18. V416-945101
19. V416-945103
20. V416-945200
21. V416-945202
22. V416-945203
23. V416-945204A
24. V416-945301
25. V416-945302
26. V416-945303
27. V416-945304
28. V416-945305
29. V416-945400
30. V416-945401
FOLDOUT FRAME

ORIGINAL PAGE IS OF POOR QUALITY
FOLDOUT FRAME

 ORIGINAL PAGE IS OF POOR QUALITY

-003 SHOWN
FOLDOUT FRAME

- ONE SHOWN

END CAP INTERMEDIATE BOLTS
HOUSING INTERMEDIATE BOLTS
NOTES: UNLESS OTHERWISE SPECIFIED
2 FOLDOUT FRAME

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ORIGINAL PAGE IS OF POOR QUALITY

4 FOLDOUT FRAME
ORIGINAL PAGE IS OF POOR QUALITY

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ORIGINAL PAGE IS OF POOR QUALITY

FOLDOUT FRAME

1-19, 1-20
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ORIGINAL PAGE IS OF POOR QUALITY

FOLDOUT FRAME

1-21, 1-22
FOLDOUT FRAME

ORIGINAL PAGE 15
OF POOR QUALITY
FOLDOUT FRAME
FOLDOUT FRAME

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[Diagram of a foldout frame with labels and annotations]

1-23, 1-24
FOLDOUT FRAME
FOLDOUT FRAME
FOLDOUT FRAME

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1-29, 1-30
ORIGINAL PAGE 13
OF POOR QUALITY

CONCENTRATOR ELEMENT REF
Screw
SLIDE HOUSING-
BACK
SLIDE HOUSING-FWD
NUT-SELF LOCKING

12.7 DIA
(1/2)

4.83
(1/4)

18.8
(1/2)

VIEW A A
SCALE 1/4

FOLDOUT FRAME

2. Fab Part
1. All Dim
Notes: UA
2. Fab from graphite imregnated polyimide.
1. All dimensions are in mm, inches are in ( ).
Notes: Unless otherwise specified

-001 Shown

Slide Assembly
Extension Cable

CERM

N/A
V46-9350CZ

D 03953 V46-94520CZ

1-33, 1-34
ORIGINAL PAGE 13
OF POOR QUALITY

7/6 Force

-76 (0.3) Dia Braided Gees Cable

Springs - Constant Force
Fab from 302 Gees

45.70 (180) Maximum Translation

Housing - Fab from 2024 Ti Al 1064 The

Vespe Bushing
6.5 oz
(2.5%)

Reel - Fab From Graphite Impregnated Polyethylene

Foldout Frame

1. All Dimensions Are in Mm, Inches in ( )
Notes: Unless Otherwise Specified
## Foldout Frame

### Parts List

<table>
<thead>
<tr>
<th>QTY</th>
<th>QTY</th>
<th>QTY</th>
<th>QTY</th>
<th>CODE</th>
<th>PART OR IDENTIFYING NUMBER</th>
<th>NOMENCLATURE OR DESCRIPTION</th>
<th>MATERIAL</th>
<th>DATA SPECIFICATIONS</th>
</tr>
</thead>
</table>

- **CONCENTRATOR STACK TRANSLATOR MECHANISM**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
<th>HOLE DETAILS</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td>1</td>
<td>V416-935204</td>
<td>SHEET</td>
<td>D 03953</td>
</tr>
</tbody>
</table>

**Scale:** Full

---

**Notes:** Imregnated
### Parts List

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>CODE IDENT NO.</th>
<th>DATA SPECIFICATIONS</th>
<th>PART OR IDENTIFYING NUMBER</th>
<th>NOMENCLATURE OR DESCRIPTION</th>
<th>MATERIAL</th>
<th>SIZES NOTES SUPPLIERS ZONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIP WIRE ASSY REFLECTOR - RADIATOR</td>
<td>002</td>
<td>V416-935205-001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:** UNLESS OTHERWISE SPECIFIED

- ALL DIMS. IN MM, INCHES IN ( )

- FULL ROTATION BRUSHLESS DC TORQUE MOTOR

- TORQUE TUBE

**REMARKS:**

- UNLESS OTHERWISE SPECIFIED
  - DIMENSIONS ARE IN INCHES
  - DECIMALS
  - TOLERANCES ON DEGREES AND ANGLES
  - ALIGNED "DRILL" HOLE NOTE

**SHEET:** 1/2 1A NOTED
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FOLDOUT FRAME
ORIGINAL PAGE IS OF POOR QUALITY

FOLDOUT FRAME
2 FOLDOUT FRAME
ORIGINAL PAGE IS OF POOR QUALITY

FOLDOUT FRAME
ORIGINAL PAGE IS OF POOR QUALITY

2 FOLDOUT FRAME

INSULATOR FILM
0.03 (0.001) TEFLON FILM
BONDED WITH 0.05 (0.002)
LAYER OF EPTON 222 RESIN/TETRA HARDENER

1/34 (7.23)

-001 SHOWN

3. FINISH BOTTOM, FLANGES, E-HALOBO AREA PER MFG-001, III-2
(94.25 EX H9, MAX SERVICE TEMP 200°C)
2. FAB FROM 6061-O AL, HEAT TREAT TO TC2000
1. MILL DIMENSIONS ARE IN MILL, INCHES IN ()
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIMENSIONS ARE IN MM, INCHES IN ( ).

Notes: Unless otherwise specified.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>QTY</th>
<th>QTY</th>
<th>QTY</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.29 (0.05) DIA WIRE (2.9 IN LB MAX TORQUE)

Foldout frame

Unless otherwise specified, dimensions are in inches.

Tolerances on:
- Decimals: ±0.03
- Angles: ±0° 30’

Holes noted “Drill”:
- 0.013 THRU .040: ±0.001
- 0.041 THRU .130: ±0.002
- .131 THRU .229: ±0.003
- .230 THRU .500: ±0.004
- .501 THRU .750: ±0.005
- .751 THRU 1.000: ±0.007
- 1.001 THRU 2.000: ±0.010

Cc:
1.29 (0.05) DIA WIRE
(2.9 IN LB MAX TORQUE)

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FOLDOUT FRAME
3. Finish Per MF004-001, WS-2 (WHITE Silicone Paint, t=.25, ε=.84 Max. Service Temp. 200°C)
2. Fab from .032 AL, Heat Treat to T6 Cond
1. All Dimensions Are in mm, Inches In ()

NOTES: UNLESS OTHERWISE Specified

FOLDOUT FRAME
**PARTS LIST**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>THRU</th>
<th>EFFECTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOLERANCES ON:**
- DECIMALS: ±0.05
- ANGLES: ±4° 30'
- HOLES NAMED "DRILL":
  - .013 THRU .040: +.001 = -.001
  - .041 THRU .130: +.002 = -.001
  - .131 THRU .229: +.003 = -.001
  - .230 THRU .500: +.004 = -.001
  - .501 THRU .750: +.005 = -.001
  - .751 THRU 1.000: +.007 = -.001
  - 1.001 THRU 2.000: +.010 = -.001

**MATERIAL DATA SPECIFICATIONS**
- SIZES, NOTES, SUPPLIERS

**ZONE LTR DESCRIPTION DATE APPROVED**
- ORIGINAL PAGE IS OF POOR QUALITY

**Rackwood Industries Corp., Downey, California 90242**

**DR BY M.B.155 4/1/62 CHK BY APPROVED BY**

**DRAWING NO.**
- V416-945203 C 03953

**SCALE V1 SHEET V1**
- 1-55, 1-56
### Parts List

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>NEXT ASSY</th>
<th>USED GH</th>
<th>REV ITEM NO.</th>
<th>THRU</th>
<th>EFFECTIVITY</th>
</tr>
</thead>
</table>

**Notes:**
- All dimensions are in inches.
- Tolerances are +0.005 in all dimensions except right angles.
- Holes noted "Small" are 0.015 in diameter.
- The drawing is subject to change without notice.
- All items are subject to availability and availability status.

**Specifications:**
- Material: Steel
- Notes: Supplier Information
- Zone: NA

**Drawing Information:**
- Drawing Number: 03953
- Date: 2-1-61
- Scale: 1:1
- Sheet: 4/1
ORIGINAL PAGE 13
OF POOR QUALITY

(VANE-945901-001 REF)

(VANE-945901-003 REF)

VIEW A-A
SCALE 2:1

(VANE-945901-004 REF)

(VANE-945901-002 REF)

RADIATOR PANEL

FOLDOUT FRAME

(REFLECTOR PANELS OMITTED FOR CLARITY)

(VANE-945901-003 REF)

(VANE-945901-001 REF)

(RADIATOR PANEL)

FOLDOUT FRAME
-003 SHOWN
-004 OPP EXCEPT AS SHOWN

ALUMINIZE SURFACE TO SOCA THICKNESS,
SPECULAR REFLECTIVITY OF 90 AND AN
EMISSIVITY OF 0.95

1. PARTS AND MATERIALS MAY VARY
   AT A RATE OF 0.005 IN 1.000 IN. (0.005 IN. PER HUNDRED
   INCHES)
2. ALL DIMENSIONS ARE IN INCHES.
3. PARTS FROM GRADE 1 DESIGNATED AS PLAIN OR
   FEELS NUTS UNLESS OTHERWISE SPECIFIED

REVISIONS
ZONE LTR DESCRIPTION DATE APPL'D

ORIGINAL PAGE IS
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FOLD-OUT FRAME

VIEW E
SCALE 1/8
(-004 ONLY)

VIEW D
SCALE 1/8
(-002 ONLY)

---
2.0 TEST HARDWARE DRAWINGS

2.1 DISCUSSION

The hardware required to carry out experimental activities under this program are listed in the drawing tree depicted in Figure 2. There are a total of 21 drawings, of several types. Some provide information for subcontractors; others were used to construct Rockwell-fabricated components. The tests and experiments performed using the resulting hardware are fully described in Vol. 1 of this report.

2.2 TEST HARDWARE DRAWINGS

1. D416-340010
2. D416-340020
3. D416-450000
4. D416-450001
5. D416-451000
6. D416-451001
7. D416-451002
8. D416-451003
9. D416-451004
10. D416-451005
11. D416-451006
12. D416-451007
13. D416-452000
14. D416-452001
15. D416-453000
16. D416-454000
17. D416-454001
18. D416-454002
19. D416-454003
20. D416-454004
21. D416-455000
FOLDOUT FRAME

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Note:
1. Fabricate per best mock-up instructions, per accompanying note sheets and reusal discussions.
2. Contain hood and cap assemblies to be in lightweight materials but structurally sound for demonstration and transportation. Maintain the external appearance dimensions to show actual module size. The internal structure can be made to run parallel to rods to provide the opening and closing of the concentrator elements.

2-3, 2-4
FOLDOUT FRAME

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2 FOLDOUT FRAME
2 FOLDOUT FRAME

5. REMOVABLE SHADE
4. MATERIALS: METAL
3. SCALE FOR MOUNTING
2. NAIL, SCREW OR GLUE
1. BRUSH ALL SURFACES

NOTES: UNLESS OTHERWISE
FOLDOUT FRAME

ORIGINAL PAGE "E" OF POOR QUALITY

Details of the image are not clear due to the quality of the scan. However, it appears to be a technical drawing or diagram, possibly related to a mechanical or engineering project. The text seems to be a set of instructions or specifications, but the details are not legible.
FOLDOUT FRAME

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-OO1 SHEET

5. CONTAMINATION CONTROL PEE M70001-001
4. IDENTIFY PART PER MAD004-301
3. INTERCONNECT SHALL BE FORM "SQUEEZE"
2. BOND CELLS USING DC 93-500 ADHESIVE
1. FAB PER STATEMENT OF WORK SOLAR PANEL LCRSA SYSTEM GLAS

NOTES: UNLESS OTHERWISE SPECIFIED
**Foldout Frame**

- **Glass Solar Cell**: 45 deg.
- **Silver Foil**
- **Termination Strips**: 2 mil thick
- **Kapton Insulator**
- **Wire/termination strip**
- **Interfacial Area**: 13 mil thick
- **Insulated Stand-off Ref**

---

**Parts List**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Material</th>
<th>QTY</th>
<th>QTY</th>
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<tbody>
<tr>
<td>1</td>
<td>Dummy MB4-45000</td>
<td>GaAs Solar Panel</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Dummy MB4-45000</td>
<td>GaAs Solar Panel</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Zone**

- **Zone 0**: Rec'd
- **Zone 1**: Rec'd

**Drawing Information**

- **Scale**: 1/4
- **Drawing No**: 416-451002
- **Date**: 2-15, 2-16

**Notes**

- Limit wire routing to this area only.
- Original page is of poor quality.
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FOLDOUT FRAME

PARTS LIST

<table>
<thead>
<tr>
<th>QTY</th>
<th>QTY</th>
<th>QTY</th>
<th>QTY</th>
<th>QTY</th>
<th>PART OR IDENTIFYING NUMBER</th>
<th>NOMENCLATURE/O ID DESCRIPTION</th>
<th>MATERIAL</th>
<th>DATA SPECIFICATIONS</th>
<th>ZONE</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
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<td></td>
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</tr>
</tbody>
</table>

RADIATOR/SOLAR PANEL SUBSTRATE

LCRSA TEST

D 03953 D416-451003

SCALE 1/1

SHEET 1/1

2-17, 2-18
ORIGINAL PAGE IS OF POOR QUALITY

ELECTRICAL PANEL 1 REED

FOLDOUT FRAME

DRILL 1/8X1/8 X 3/4" INSTALLED MOUNTING HOLE 1-005-001 12 NEUTRAL

DRILL 1/8X1/8 X 3/4" INSTALL MOUNTING HOLE 2 PL

4.200

2.900

3. INSTALL RIVETS PER MA0101-301.
Finish Per MF0001-001 ITEM 2-9
2. INSTALL PART NO. PD PA0101-301 CODE SL-08-NG-16
1. CONTAMINATION CONTROL PER MF0001-001

Notes: Unless otherwise specified
ORIGINAL PAGE 19 OF POOR QUALITY

-001 SHOWN

7. FINISH PER MFG001-001, ITEM I-1
6. MARK PART NO. PER MACH04-30I CARD BL-08-NG-16
5. CONTAMINATION CONTROL PER MFG001-001
4. INSPECT PER MT0501-50B CLASS 2
3. STD DETAIL PER MFG01-305
2. BREAK SHARP CORNERS & EDGES
1. BEND RADIUS .060 MAX

NOTES: UNLESS OTHERWISE SPECIFIED

FOLDOUT FRAME
### Parts List

<table>
<thead>
<tr>
<th>PART NO</th>
<th>CODE</th>
<th>IDENT</th>
<th>QTY</th>
<th>QTY REQD</th>
<th>SIZE</th>
<th>MATERIAL</th>
<th>DATA: SPECIFICATIONS</th>
</tr>
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<tbody>
<tr>
<td>4</td>
<td>001</td>
<td>D416-451006</td>
<td>BRACKET</td>
<td>AL-5HT</td>
<td>6061.76 AL QQ-A-250/1</td>
<td>0.32 x 1.12 x 1.75</td>
<td></td>
</tr>
</tbody>
</table>

**Tolerances on:**
- **Dimensions:** All dimensions are in inches.
- **Angles:** All angles are 0° ± 0.010.
- **Holes:** Holes are noted “DRILL,” with tolerances for holes noted as follows:
  - 0.013 THRU 0.400: +0.001 to -0.001
  - 0.41 THRU 1.390: +0.002 to -0.001
  - 1.31 THRU 2.290: +0.003 to -0.003
  - 2.30 THRU 5.000: +0.004 to -0.001
  - 5.01 THRU 7.500: +0.005 to -0.001
  - 7.51 THRU 10.000: +0.007 to -0.001
  - 10.01 THRU 20.000: +0.010 to -0.001

**Effectivity:**
- The parts list is effective from 2-23, 2-24.
6. Finish Panel Per MF0004-001, Item III-3
5. Mark Part No. Per MAC104-301 Code BL-08-1X-16
4. Contamination Control Per MF0001-001
3. Std Detail Per MAC102-305
2. Break Sharp Corners & Edges
1. Bend Radius .060 Max

Notes: Unless Otherwise Specified

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<th>QTY</th>
<th>QTY</th>
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<th>IDENT</th>
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<td>QTY</td>
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<td>QTY</td>
<td>CODE</td>
<td>IDENT</td>
<td>PART OR IDENTIFYING N</td>
</tr>
</tbody>
</table>

Unless otherwise specified, dimensions are in inches.

Tolerances On:
- Decimals: ±.010
- Angles: ±0° 30′
- Holes Noted “Drill”

<table>
<thead>
<tr>
<th>Item</th>
<th>QTY</th>
<th>NEXT ASSY</th>
<th>USED ON</th>
<th>END ITEM NO.</th>
<th>THRU</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>4</td>
<td>D16-15001</td>
<td>1/2 A</td>
<td>T2 4F</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>REQ PER END ITEM</th>
<th>APPLICATION</th>
<th>EFFECTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D16-45</td>
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</tbody>
</table>
## Parts List

<table>
<thead>
<tr>
<th>QTY</th>
<th>QTY CODE</th>
<th>PART OR IDENTIFYING NUMBER</th>
<th>NOMENCLATURE OR DESCRIPTION</th>
<th>MATERIAL</th>
<th>DATA: SPECIFICATIONS</th>
<th>ZONE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Unless otherwise specified, dimensions are in inches.**

**Tolerances on:**
- **Decimals:**
  - $X_1 = \pm 0.01$
  - $X_2 = \pm 0.005$
- **Angles:**
  - $0^\circ \pm 0.1^\circ$
  - $45^\circ \pm 0.5^\circ$

**Holes noted "Drill"**
- 0.013 Thru 0.040 +0.001 -0.001
- 0.041 Thru 0.130 +0.002 -0.001
- 0.131 Thru 0.229 +0.003 -0.001
- 0.230 Thru 0.500 +0.004 -0.001
- 0.501 Thru 0.790 +0.005 -0.001
- 0.791 Thru 1.000 +0.007 -0.001
- 1.001 Thru 2.000 +0.010 -0.001

**Effectivity**
- 0.013 Thru 0.040
- 0.041 Thru 0.130
- 0.131 Thru 0.229
- 0.230 Thru 0.500
- 0.501 Thru 0.790
- 0.791 Thru 1.000
- 1.001 Thru 2.000

**Original Page 13 of Poor Quality**
6. STD DETAIL PER MA0102-305
5. INSPECT PER MT0501-508 CLASS 2
4. CONTAMINATION CONTROL PER MF0001-001
3. FINISH PER MF0004-001, ITEM I-23
2. IDENTIFY PER MA0104-301
1. FAB TORSION SPRING FROM PART NO. T051-270-359-R ASSOCIATED SPRING CATALOG PG. 60, OR EQUIV

NOTES: UNLESS OTHERWISE SPECIFIED
FOLDOUT FRAME

-001 SHOWN

.051 DIA, 2.9 IN-LB TORQUE
X.52 AXIAL LENGTH, RIGHT HAND HELIX

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PARTS LIST

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES.
TOLERANCES ON:
DECIMALS ANGLES
0.001 ± 0.0001
ANGLES ± 0° 30'
HOLES NOTED "DRILL"

DR BY M.BISS 5/4/66
CHK BY
APPROVED BY

TOPIAN SPRING-
SPACE PANEL
LCRSA

尺寸 03953 D416-452000

SCALE 1/1
SHEET 1/1

1.000 THRU 2.000 +.010-.001
0.750 THRU 1.000 +.007-.001
0.501 THRU 0.750 +.005-.001
0.350 THRU 0.500 +.004-.001
0.229 THRU 0.350 +.003-.001
0.131 THRU 0.229 +.002-.001
0.041 THRU 0.131 +.001-.001
0.013 THRU 0.041 +.001-.001

THRU .000 TO .013

SPACE DIVISION
Rockwell International Corporation
12041 Lanwood Boulevard - Downey, California 90241

DATE APPROVED

ZONELTR DESCRIPTION DATE APPROVED

0005/10/74 5/4/66
2 FOLDOUT FRAME

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BACKSIDE OF PANEL SHOWN

SECTION BB
SCALE: 1

ALUMINUM BACKSIDE TO AN EMISSIVITY OF 0.15
PER MIL-E 2025
ALUMINUM SURFACE TO 500 A THICKNESS,
SPECULAR REFLECTIVITY OF 90%, AND
EMISSIVITY OF 0.05, PER MIL-E 2025
3 T.O. DENOTES THICKNESS DIMENSION
2. CONTAMINATION CONTROL PER MIL-0001-001,
COVER MIRROR WITH LDHM CRAFT L.P.C.M. 320 BLUE, 02 EDW
MARK PART NO. PER MACDAR-301 CODE BL-08-XG-16
NOTES: UNLESS OTHERWISE SPECIFIED

VIEW A
SCALE: 1

0.0345° CHAMFER
0.064
0.044 PL
0.063 4 PL
0.044
0.063 4 PL
0.044
0.063 4 PL
0.044
0.063 4 PL
0.044
0.063 4 PL
0.044
FOLDOUT FRAME

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### Parts List

<table>
<thead>
<tr>
<th>Qty</th>
<th>Part No.</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D46-454003</td>
<td>Reflector Panel, Stretch</td>
<td>-001 Shown -002 Same (Except as Noted)</td>
</tr>
</tbody>
</table>

### Tolerances

- **Angles:**
  - ±0.5°
  - ±0.3°

- **Other:**
  - ±0.002

### Specifications

- **Material:**
  - Alumaloy, Alumalloy II

- **Dimensions:**
  - 2-39, 2-40

---

**Note:**

- Scale: 1/4
- Bond this area only, top sides (bottom) REF.
- Kaption film is shown.

---

**Parts List:**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>D46-454003</td>
<td>Reflector Panel, Stretch</td>
<td>-001 Shown -002 Same (Except as Noted)</td>
</tr>
</tbody>
</table>

---

**Specifications:**

- Material: Alumaloy, Alumalloy II
- Dimensions: 2-39, 2-40
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3.0 PRELIMINARY MANUFACTURING FLOW AND BUILD PLAN

3.1 DISCUSSION

In Section 8.3 of Volume 1 a test plan is described for a ground and flight demonstration array. The following two diagrams show the fabrication sequence for assembling the basic unit of such an array (see Section 4.0 of Volume 1), consisting of one pair of canister-mast assemblies and eight rows of concentrators. The first diagram shows assembly of concentrator rows and solar panels. The second diagram describes construction of the structural elements and their integration with the rows of concentrator elements.

3.2 FLOW AND BUILD DIAGRAMS

1. Assembly of Concentrator Elements
2. Assembly Sequence for Flight Test Configuration
ALTERNATE
REFLECTOR PANELS
RIGID PANEL - VAPOR
DEPOSITED ALUMINUM ON
MOLDED POLYSULFONE
GRAPHITE

BASELINE
REFLECTOR PANELS
V416-945401
STRETCHED FILM ON
RIGID FRAME

PANEL-RADIATOR
V416-945103

FOLDOUT FRAME
REFLECTOR PANEL ASSEMBLY
V416-945400

ASSEMBLY AND TAPING SEQUENCES

SEQUENCE #1

TAPE #1

NOTE:
- TAPE IN SEQUENCE
- REVERSE TAPING TWO PLACES

SEQUENCE #2

TAPE #2

OR

- SUBASSEMBLE REFLECTOR PANEL WITH TAPE

- ALUMINIZE SURFACES
- PHYSICAL EMISSIVITY AND REFLECTIVITY INSPECT
- BOND RESILIENT BUTTONS ON -003 AND -004

- APPLY METALIZED FILM

- KAPTON = BOND SOLAR CELLS TO PANELS
- ASSEMBLE PANEL SUBASSEMBLIES WITH SPRINGS, BOLTS, WASHERS AND NUTS

- ASSEMBLE
- INSTALL

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CONCENTRATOR TO CONCENTRATOR INTERFACE
(TYPICAL, TWO PLACES, EACH PANEL JOINT)

- TAPE #1 REF.
- TAPE #2

IN SEQUENCE SHOWN, 4 PLCS
USE TAPING SEQUENCES,
TWO PLACES

- ASSEMBLE PANEL SUBASSEMBLIES

WIRE HARNESS ASSEMBLIES
V416-945301
V416-945302

- ASSEMBLE REFLECTOR
INSTALL AND ETC

- ASSEMBLE AND BOND SOLAR PANEL ASSEMBLIES AND WIRE HARNESS
- INSTALL DIODES

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CONCENTRATING ELEMENT STACK ASSEMBLY
V416-945001

ASSEMBLY OF CONCENTRATOR ELEMENTS

PRELIMINARY MANUFACTURING FLOW AND BUILD PLAN
LOW CONCENTRATION RATIO SOLAR ARRAY

PREPARED BY: K M HICKS DEPT.: 761 EXT.: 3618
DATE: JAN 18, 1983 REVISION: FEB. 22, 1983

3-3, 3-4 FOLDOUT FRAME

PRECEDING-PAGE BLANK NOT FILMED
Representative Riveted Joint Configuration

Solar Panel Tripwire Mechanisms

Concentrator Stack Translation Mechanism (CSTM)

Cable Extension Mechanism (CEM)

3.00 m
(118 approx.)

CH Support Tubes

Foldout Frame
REFLECTOR PANEL TRIPWIRE MECHANISMS

(CSTM)

FOLDOUT FRAME

- FABRICATE AND ASSEMBLE BRACKETRY
- INSTALL BRACKETRY
- FABRICATE AND ASSEMBLE MECHANISMS
- INSTALL MECHANISMS

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- Install Wire Harness Assemblies
- Install Mast/Cannister Assemblies

---

**Diagram Details:**

- MAST CANNISTER ASSEMBLIES
- V416-935103
-CHASE FROM ASTRO RESEARCH

---

**Legend:**

- MAST CANNISTER ASSEMBLIES
- FOLDOUT FRAME

---

**Notes:**

- V416-935103
- CHASE FROM ASTRO RESEARCH

---

**References:**

- MESS ASSEMBLIES
- 15-945304

---

**Additional Information:**

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SLIDE MECHANISMS

CONCENTRATOR ELEMENTS

WIRE HARNESS CABLES

CEM

CONCENTRATOR STACK ASSEMBLIES

FOLDOUT FRAME

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- INSTALL CONCENTRATOR STACK ASSEMBLIES AND SLIDE ASSEMBLIES CONCURRENTLY
- PERFORM ELECTRICAL HOOKUP AND CHECKOUT
• INSTALL END CAP ASSEMBLIES - SECURE TO MAST/CANNISTER ASSEMBLIES
• SECURE CABLES TO END CAP ASSEMBLIES
• INSTALL ACCESS PANELS (TOP, BOTTOM AND ENDS, AS SHOWN)
• INSPECT COMPLETE

FOLDOUT FRAME
ASSEMBLY SEQUENCE
FOR FLIGHT TEST
CONFIGURATION

MANUFACTURING FLOW AND BUILD PLAN
LOW CONCENTRATION RATIO SOLAR COLLECTOR

PREPARED BY: K.M. HICKS  DEPT: 761
EXT: 3618 DATE: Jan 26, 1983 REVISED: Feb 4, 1983
3-8, 3-4