4.4 TRAVERSE PLANNING PARAMETERS

Note: Section 4.4 has been prepared in its entirety by the Operations Analysis Branch, Systems Engineering Division, Apollo Spacecraft Program Office

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EVA TRAVERSE PLANNING PARAMETERS

The purpose of this appendix is to provide a summary reference source for primary data used in lunar surface traverse planning. These data are those that have been generally concurred with for use in current lunar surface operations planning and study. Officially approved data for each mission ultimately appear in the Apollo Spacecraft Operational Data Books, Flight Mission Rules and the Flight Plan. Prior to that time, these EVA traverse planning parameters will be updated periodically through the Lunar Surface Operations Planning Meetings.

Primary lunar surface traverse planning data presented herein are categorized for each reference with the organization and person responsible for the data indicated at the bottom of each page, along with the official data source reference.
1. Crewmen Parameters

1.1 Metabolic Rates\(^1\), \(Q_M\)

   a. Riding on LRV  550 Btu/Hr

   b. Working

      (1) Overhead and ALSEP Activities  1050 Btu/Hr

      (2) Geological Station Activities  950 Btu/Hr

   c. Contingency Walking

<table>
<thead>
<tr>
<th>Duration</th>
<th>Walking Speed(^2) (Average)</th>
<th>Metabolic Rate Including 20-Percent Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over Uncorrected Map Distance</td>
<td></td>
</tr>
<tr>
<td>Up to 1 Hour Total Return Time</td>
<td>3.6 Km/Hr</td>
<td>1560 Btu/Hr</td>
</tr>
<tr>
<td>Return Requiring Over 1 Hour</td>
<td>2.7 Km/Hr</td>
<td>1290 Btu/Hr</td>
</tr>
</tbody>
</table>

   d. Normal Walking (Average)

      2.5 Km/Hr, Uncorrected Map Distance, 1000 Btu/Hr

1.2 Respiratory Quotient  0.90

1.3 Time in Pressurized PGA\(^3\)

   Uninterrupted time in a pressurized PGA should be limited to 7 hours of nominal EVA.

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Responsible Organization: Medical Operations Division/DD

Point of Contact: J. F. Zieglschmid, MD; Ext. 42

Official Data Sources:

\(^1\) SODB, Vol. II, LM Data Book, Part 1, Table 4.3-2, page 4.3-13

\(^2\) R. G. Zedekar/C63; Ext. 3091

\(^3\) SODB, Vol. IV, EMU Data Book, Operational Constraints and Limitations, page 3.2-3, EPG-11

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2. PLSS Parameters

2.1 PLSS Battery

   a. Battery Capability  
      25.4 Amp-Hours

   b. Battery Voltage  
      16.8 Volts dc

   c. TM Usable  
      20.92 Amp-Hours

      (1) Pre-EVA Checkout  
          1.2 Amp-Hours

      (2) Post-EVA Reserve  
          1.43 Amp-Hours

      (3) TM Inaccuracy  
          1.85 Amp-Hours  
          at 7.6 Hours

   d. Usage Rate  
      2.7 Amps
2. PLSS Parameters (Continued)

2.2 Primary Oxygen Supply

a. POS Bottle Volume 378 Cu In.

b. Full Charge

\[
\begin{align*}
\text{(EVA 1)} & : & 1432 \text{ Psia @ 70°F} & : & 1.860 \text{ Lb} & : & (Z = 0.9485) \\
\text{(EVA 2 or 3)} & : & 1395 \text{ Psia @ 70°F} & : & 1.810 \text{ Lb} & : & (Z = 0.950)
\end{align*}
\]

c. EMU Pressurization 70 Psia

0.091 Lb

d. LM Repress 25 Psia

0.031 Lb

e. TM Inaccuracy 48 Psia

0.060 Lb

f. Minimum Regulation Pressure 145 Psia

0.180 Lb

g. \(O_2\) Reserve at Normal Working Rate 76 Psia

0.095 Lb

h. Total Usable \(O_2\) 1.403 Lb

1.353 Lb

2.3 EMU \(O_2\) Leak Rates

a. EVA 1 0.020 Lb/Hr

b. EVA 2 0.028 Lb/Hr

c. EVA 3 0.035 Lb/Hr

Responsible Organization: Crew Systems Division/EC

Point of Contact: J. L. Gibson; Ext. 2352

Official Data Sources: SODB, Vol. IV, EMU Data Book, EMU Consumables Tables 4.0-3A and 4.0-3B, and Mission Appendix
2. PLSS Consumables (Continued)

2.4 $O_2$ Usage Rate

\[ 1.627 \times 10^{-4} (Q_M) + \text{EMU Leak Rate} \]

2.5 PLSS Feedwater

a. Feedwater Loading

(1) Main Tank 8.50 Lb
(2) Aux. Tank 3.40 Lb

b. Transport Loop Makeup (EVA 1 only if PLSS launched with feedwater) 0.13 Lb

c. Non-Expellable 0.09 Lb
d. Slave Water 0.63 Lb
e. Usable Leftover Slave Water (EVA 2 or 3) 0.30 Lb
f. Reserve at Normal Working Rate Provided by slave water and thermal inertia

\[ 1038 \text{ Btu/Lb} \]

\[ 10.86 \text{ Lb} \]
\[ 11,273 \text{ Btu} \]

\[ (EVA 1) \]

\[ (EVA 2 \text{ or } 3) \]

\[ 11.29 \text{ Lb} \]
\[ 11,719 \text{ Btu} \]

Responsible Organization: Crew Systems Division/EC

Point of Contact: J. L. Gibson; Ext. 2352

Official Data Sources: SODB, Vol. IV, EMU Data Book, EMU Consumables Tables 4.0-3A and 4.0-3B, and Mission Appendix
2. PLSS Parameters (Continued)

2.6 EMU Heat Leak, \( \dot{Q}_{h1} \)

<table>
<thead>
<tr>
<th>EVA</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>T=0 Launch</td>
<td>0 RLP*</td>
<td>+135 RLP*</td>
<td>+200 RLP*</td>
</tr>
<tr>
<td>T+24 Launch</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

*RLP - Rough Lunar Plain

2.7 Feedwater Usage Rate\(^2\)

a. Cooling Rate, \( \dot{Q}_T = 1.26 \dot{Q}_M + 153 \text{ Btu/Hr} + \dot{Q}_{h1} \)

b. Feedwater, \( \bar{W}_{\text{H}_2\text{O}} = \frac{\dot{Q}_T}{1038 \text{ Btu/Lb H}_2\text{O}} = 0.12 \dot{Q}_M + 0.3 \)

2.8 PLSS LiOH Capability\(^3\)

a. Nominal Loading

(1) Total CO\(_2\) Absorption, No Thermal Soak 10,900 Btu

(2) Total CO\(_2\) Absorption, Thermal Soak 8,400 Btu

b. Usage Rate

Crew Metabolic Rate

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Responsible Organization: Crew Systems Division/EC

Point of Contact: J. L. Gibson, Ext. 2352

Official Data Sources:

\(^1\) SODB, Vol. IV, EMU Data Book, EMU Heat Leaks, Figure 4.0-1 and Mission Appendix

\(^2\) SODB, Vol. IV, EMU Data Book, page 4.5-66, Figure 4.5-44

\(^3\) SODB, Vol. IV, EMU Data Book, EMU Consumables, Tables 4.0-3A and 4.0-3B
3. BSLSS/OPS

3.1 OPS

a. OPS Bottle Volume
b. Full Charge
c. Residual
   (1) High Purge
   (2) Low Purge
   (3) Makeup
d. Usable
   (1) High Purge
   (2) Low Purge
   (3) Makeup
e. Lifetime
   (1) High Purge
   (2) Low Purge

3.2 BSLSS

a. BSLSS Hookup Time Required
b. Emergency LM Ingress Time
   3
   3
   3
   3

3.2 Time Limit for Walk-back to LRV
   (Ops Low Purge) for BSLSS Hookup

322 Cu In.
5.75 Lb at 5880 Psia
0.706 Lb at 500 Psia -40°F
0.411 Lb at 300 Psia -40°F
0.106 Lb at 100 Psia 64°F
5.04 Lb
5.34 Lb
5.64 Lb
39 Minutes
79.5 Minutes
5 Minutes
13 Minutes
10 Minutes

Responsible Organization: Crew Systems Division/EC

Point of Contact: J. L. Gibson; Ext. 2352

Official Data Sources: 1SODB, Vol. IV, EMU Data Book, EMU Consumables
1SODB, Vol. IV, EMU Data Book, Section 4.7, Tables 4.0-3A and 4.0-3B, Figure 4.6-5
page 4.7-1
4. Lunar Roving Vehicle

4.1 LRV Mobility Rate for Premission Planning 7.3 Km/Hr

4.2 LRV Emergency Return Speed

Not to exceed 9.2 Km/Hr for premission planning; actual value to be assessed in real time over outgoing leg of traverse.

Responsible Organization: MSFC
Point of Contact: D. Arnett
Official Data Sources: LRV Operations Data Book