# APOLLO II

## OPERATIONS CHECKLIST

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Interesting Pictures (Selected in CRC)

AS 11-44-6609  Backside Panorama
  37-5445  Best 70mm of Columbia
  36-5295  Epo-storm
  36-5355  4/5 Earth, good of Africa, 80 E Europe, USSR
  36-5337  All clouds & water
  40-5899  Best of the "Here Men...."
  44-6642  "Eagle" against Moon background w Earth rising

5-69-40220  3 crew thru MRF window (EFD)
  40216  LRL Debrief

AS 11-37-5437  Approach to land site 2
  40-5902  Foot Pad + Buzz
  40-5903  Buzz head-on, reflections in Visor
  40-5868  "Coming down ladder"
  40-5880  Foot lifted up, showing print.
  37-5478  Down Sun Washout, LM Shadow
  40-5949  The whole surface sheet gang...
  37-5481  RCS Quad show, flag, TV camera, rock field
  40-5874  Buzz saluting flag
  40-5851  Surface, rocks + craters
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SPS Burns $\Delta V_{TPF} = 32.3$

1. [FOR SCS, S/C CONT-SCS MNVR TO PAD R, P Y, -UNCAGE BMAGS]
2. LOAD DAP (P TRIM Y TRIM) (B&D for 2 JET ULLAGE)
3. P3X CONFIRM TIG & $\Delta V$, SET EVENT TIMER
4. P40: F50 18-CAGE BMAGS-CMC-AUTO
5. PRO TO MNVR: BORESIGHT & SXT STAR CK
6. EMS $\Delta V$ CK 1536.8, SET $\Delta V_c$, FUNC $\Delta V$ & STBY
7. $\Delta V_{cg}$: CSM OR CSM/LM
8. AUTO RCS SEL (16) AS REQ'D (SAME ROLL AS DAP)
9. PNL 8: SCS & SPS CB CLOSED

MAN ATT (3) - RATE CMD
LIMIT CYCLE, D/B - MIN, RATE - HI,
SCS TVC (2) - RATE CMD, TVC GMBL DR
ALIGN GDC - HE VALVES AUTO(B/P)

54:00 MN BUS TIES - ON
TVС SERVO PWR 1 & 2 ON
ROT CONT PWR NORM # 2-AC
ROT CONT #2-ARMED

55:00 GIMBAL MTRS - P1 & Y1 START
THC - CW (VERIFY NO MTVC)
P2 & Y2 - SET TRIM
VERIFY MTVC - THC NEUTRAL
VERIFY GP1=0 (CMC) OR TRIM (SCS)
ROT CONT PWR NORM # 2 - AC/DC
[FOR SCS BURNS, S/C CONT-SCS]
[FOR SCS BURNS, SCS TVS (2)-AUTO]
ROT CONT PWR DIR #2 - MNA/MNB
RECHECK BORESIGHT STAR
PRO TO TRIM ATTITUDE - ENTER
F50 25 (204) PRO GIMBAL DR CK
UNCAGE BMAGS

58:00 $\Delta V$ THRUST NORM (A FOR ALL BUT LOI)
THC - ARMED, EMS $\Delta V$ - NORM
59:30 TAPE-RECORD, HBR, FWD
ULLAGE - PRO AT F99
[TIG NOTE TIME]
\(\Delta V\) THRUST NORM - OTHER BANK ON
SHUTDOWN:
\(\Delta V\) THRUST NORM - 2 OFF
CB SPS P 2 & Y 2 - CLOSED
GIMBAL MTRS - CONFIRM 4 OFF
TVC SERVO PWR (2) OFF
CAGE BMAGS

RESIDUALS: RECORD AND NULL X-AXIS TO 1.0 FPS (EXCEPT .2 TEI)
EMS: NOTE \(\Delta V\)C - TURN OFF
THC PWR - OFF, ROT CONT PWR DIR-OFF
LIMIT CYCLE - ON, RHC&THC-LOCKED
TAPE - LBR
BUS TIES - OFF

FAILURE PROCEDURES:

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<th>OR</th>
<th>G&amp;N BURN</th>
<th>SCS BURN</th>
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<td>TH#1 BMAG FAIL</td>
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<td>TH#2 BMAG FAIL</td>
<td>BMAG RATE 1</td>
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<td>SPS PRESS</td>
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<td>CK HE VALVES OPN</td>
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<td>AC BUS 1</td>
<td>TVC GIMBAL DR↑↓</td>
<td>TH#1 BMAG - &quot;1&quot;</td>
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<td>MN BUS A</td>
<td>FDAI SEL - #2</td>
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<td>AC BUS 2</td>
<td>TVC GIMBAL DR↑↓</td>
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<td>MNB BUS B</td>
<td>BMAG MODE (3)</td>
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<td>UNDERVOLT</td>
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<td>PULL CB SPS P1-Y1</td>
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...
P22 (LM ATTACHED)  
A-1 LAT +02.000  APPROACH R O (INRTL)  
LONG/2 +32.750  P 237 383  
ALT +000.00  Y 0  
NORTH OF TRACK 11 NM  

T1 82:37:35  
PITCH-ACCEL CMD  
T2 82:42:52 (MARK :40 SEC LATER)  
RECORD 06 89+02009+32594,-00177  
STOP PITCH AT SLEEP ATT (R-82, P-229, Y-0)

P22 (LM ATTACHED)  
130 LAT +01.255  APPROACH R O (INRTL)  
LONG/2 +11.839  P 296 270  
ALT -001.55  Y 0  
NORTH OF TRACK +5.5 NM  

T1 98:40:02  
PITCH-ACCEL CMD  
T2 98:42:44 (MARK :40 SEC LATER)  
RECORD 06 89+01444+11817,-00139  
STOP PITCH AT REACQUIRE MSFN ATT (R-0, P-8, Y-0)

P22 (CSM ONLY)  
LM LAT +00.739  NOTE: SCS MIN IMP  
LONG/2 +11.854 4 PULSES=.05°/SEC  
ALT -001.51  
SOUTH OF TRACK 0.2 NM  

V48E CONFIRM R1 = 71100 (FDAO #2 ø = 338°)  
MNVR TO +X 22° BELOW HORIZONTAL (2° Below HORIZON)  
V49E, V25E, __________, __________ PRO  
CMC MODE - FREE  
V37E 22E 34  
T1 104:37:10  T2 104:37;22 (MARK :40 SEC LATER)  
CMC MODE - HOLD  
RECORD 06 89+00776+11693,-00155

START MARKS AT 104:38:08
START DET

SOURCE DATE

TCA 108:35
11/2:25 11/2:30:17
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**HOR entry CK (E1-17,30)**

GET 194:46:06

PITCH 267° (+5°)

05g 000.152,001 (HORIZ 34°) R P Y

RRT 195:03:06 (400K)

RET 05g:28

RET VCIRC 2:14

RET DROGUE 9:02

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| F 06 61 | IMP LAT | .01° |
| IMP LONG | .01° |

**PRO**

HDS UP/DN +000001

| F 06 60 | GMAX | .01G |
| V400K fps |

**Y EI** .01°

| F 06 63 | RTGO | .1 nm |
| VIO fps |

**PRO**

**TFE** min-sec

| F 50 25 | 00041 | REQ SEP |

**PRO**

| F 06 61 | IMP LAT | .01° +01332 |
| IMP LONG | .01° -16917 |

**PRO**

HDS DN -00001

| 06 22 | Poss R | .01° |
| Y | .01° |

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| F 06 64 | G | .01G |
| VI fps |
| RTGO | .1 nm |

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**EI** (400K)

Pitch Needle Off Peg

Vi Dsky=Vi PAD

Event Timer Zero

START EMS (:03)

TRANSFER P64 (:05)

PITCH NEEDLE 0°

PITCH ANGLE 152° (+5°)

HORIZON 34°

RGO DSKY=RGO PAD

BETA 90° UNTIL <5.4g

180° TO 4-5g

RETCIRC VS VDSKY VS VEMS

EMS 26nm @4000FPS (0@DRO)

ELS Cbs, LOGIC, AUTO

PYROS

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| F 16 69 | BETA | .01° |
| DL | .01G |
| VL fps |

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| F 16 67 | BETA, VI, G |

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| F 06 74 | RTOGO | -1 nm |

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| F 06 66 | BETA | .01° |
| CR ERR .1 nm |

| VERB | DR ERR | .1 nm |

| Record | DR ERR |
| KEY RLSE |

| F 16 67 | RTGO | .1 nm |
| LAT .01° |
| LONG .01° |
### SECTION 1. REFERENCE DATA

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<tr>
<td>46</td>
<td>Sun</td>
</tr>
<tr>
<td>47</td>
<td>Earth</td>
</tr>
<tr>
<td>50</td>
<td>Moon</td>
</tr>
</tbody>
</table>

VERB LIST (Decimal)

01 Display Oct Compnt 1 (R1)
02 Display Oct Compnt 2 (R1)
03 Display Oct Compnt 3 (R1)
04 Display Oct Compnt 1, 2 (R1, R2)
05 Display Oct Compnt 1, 2, 3 (R1, R2, R3)
06 Display Decimal (R1 or R1, R2 or R1, R2, R3)
07 Display DP Decimal - (R1, R2)
11 Monitor Oct Compnt 1 (R1)
12 Monitor Oct Compnt 2 (R1)
13 Monitor Oct Compnt 3 (R1)
14 Monitor Oct Compnt 1, 2 (R1, R2)
15 Monitor Oct Compnt 1, 2, 3 (R1, R2, R3)
16 Monitor Decimal (R1 or R1, R2 or R1, R2, R3)
17 Monitor DP Decimal - (R1, R2)
21 Load Compnt 1 (R1)
22 Load Compnt 2 (R2)
23 Load Compnt 3 (R3)
24 Load Compnt 1, 2 (R1, R2)
25 Load Compnt 1, 2, 3 (R1, R2, R3)
27 Display Fixed Memory
30 Request Executive
31 Request Waitlist
32 Recycle Prog
33 Proceed Without DSKY inputs
34 Terminate Function
35 Test Lights
36 Request Fresh Start
37 Change Prog (Major Mode)
*40 Zero ICDU (N20)
41 Coarse Align CDU (N20 & N91)
42 Fine Align IMU
43 Load FDAI ATT Error needles
*44 Set Surface Flag
*45 Reset Surface Flag
*46 Activate DAP
*47  Set LM State Vector into CSM State Vector
48  Load DAP (R03)
49  Start Crew Defined MNVR (R62)
50  Please Perform
51  Please Mark
*52  Marked on offset landing site
53  Please Mark alternate LOS
54  Start REND backup sighting mark (R23)
55  Increment CMC Time (Decimal)
*56  Terminate Tracking (P20)
57  Start REND sighting mark (R21)
*58  Reset Stick Flag
59  Please Calibrate
*60  Set N17 = N20
*61  Display DAP att error
*62  Display total att error (N22-N20)
*63  Display total astro att error (N17-N20)
64  Start S-band ant routine (R05)
*65  Verify Prelaunch Align Optics (CSM)
*66  Set CSM State Vector into LM State Vector
67  W-Matrix RSS Error Display
*68  CSM Stroke Test on (LM on only)
*69  Restart
70  Update Liftoff Time (P27)
71  Univ Update—BLOCK ADR (P27)
72  Univ Update—SINGLE ADR (P27)
73  Update CMC Time (Octal) (P27)
*74  Initialize erasable dump via downlink
*75  Backup Liftoff
*76  Set preferred att flag (pref track axis)
*77  Reset preferred att flag (X axis)
*78  Update prelaunch azimuth
*80  Update LM State Vector
*81  Update CSM State Vector
82  Start Orbit Param Disp (R30)
83  Start REND Param Display (R31)
85  Start REND Param Display No.2 (R34)
*86  Reject REND backup sighting mark
*87  Set VHF range flag
*88  Reset VHF range flag
89  Start REND Final ATT Routine (R63)
90  Request REND out of plane display (R36)
91 Compute Banksum
*92 Start IMU performance test (P07)
*93 Enable W matrix initialization
*94 Enable CISLUNAR Tracking recycle
*96 Terminate integration and go to POO
  (Select POO by V37 after use of V96)
97 SPS Thrust Fail (R40)
99 Enable engine ignition
  *Callable with other extended verb in use
  and does not lock out other extended verbs

NOUN LIST (Decimal)

01 Specify Machine Address (Fract) (R1,R2,R3)
02 Specify Machine Address (Whole) (R1,R2,R3)
03 Specify Machine Address (can be R1,R2,R3)
05 Angular Error/Diff .01°
06 Option Code (R1 & R2) OCTAL
07 FLAGWORD operator,ECADR,BIT ID, Action
08 Add +1 of error OCTAL
B BANK + SUPERBANK OCTAL
No of SELF TEST errors OCTAL
09 Alarm Codes OCTAL
10 Channel to be Specified (R1) OCTAL
11 TIG (CSI) hrs,min,.01sec
12 Option code (R1&R2) OCTAL
13 TIG (CDH) hrs,min,.01sec
15 Increment Machine Address (R1)
16 Time of event hrs,min,.01sec
17 Astronaut total att R,P,Y .01°
18 Auto Maneuver R,P,Y .01°
20 Present ICDU Angles R,P,Y .01°
21 PIPA PULSES X,Y,Z Pulses
22 New ICDU Angles R,P,Y .01°
24 Delta CMC Clock Time hrs,min,.01sec
25 Checklist (please perform)
26 Prio/Delay, ADRES, OCTAL
BBCON(R1,R2 & R3)
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>Self-Test on/off sw</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>X SM LAUNCH Azimuth</td>
<td>.01°</td>
</tr>
<tr>
<td>30</td>
<td>Target Code (Gyrocomp verif)</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Time from Perigee</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>33</td>
<td>Time of Ignition (GETI)</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>34</td>
<td>Time of Event</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>35</td>
<td>Time from Event</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>36</td>
<td>Time of CMC Clock</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>37</td>
<td>GETI-TPI</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>38</td>
<td>State Vector Time</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>39</td>
<td>Δ Time of Transfer</td>
<td>hrs, min, .01sec</td>
</tr>
<tr>
<td>40</td>
<td>TF GETI/TFC</td>
<td>min-sec</td>
</tr>
<tr>
<td></td>
<td>VG</td>
<td>.1 FPS</td>
</tr>
<tr>
<td></td>
<td>ΔV (Accumulated)</td>
<td>.1 FPS</td>
</tr>
<tr>
<td>41</td>
<td>Target</td>
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</tr>
<tr>
<td></td>
<td>Azimuth</td>
<td>.01°</td>
</tr>
<tr>
<td></td>
<td>Elevation</td>
<td>.001°</td>
</tr>
<tr>
<td></td>
<td>Ident</td>
<td>0000X</td>
</tr>
<tr>
<td>42</td>
<td>Apogee Alt (HA)</td>
<td>.1 NM</td>
</tr>
<tr>
<td>43</td>
<td>Lat</td>
<td>.01° (+ North)</td>
</tr>
<tr>
<td></td>
<td>Long</td>
<td>.01° (+ East)</td>
</tr>
<tr>
<td></td>
<td>Alt</td>
<td>.1 NM</td>
</tr>
<tr>
<td></td>
<td>Perigee Alt (HP)</td>
<td>.1 NM</td>
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<tr>
<td></td>
<td>ΔV (Required)</td>
<td>.1 FPS</td>
</tr>
<tr>
<td>44</td>
<td>Apogee Alt (HA)</td>
<td>.1 NM</td>
</tr>
<tr>
<td>45</td>
<td>Marks</td>
<td>XXBXX</td>
</tr>
<tr>
<td></td>
<td>TF GETI of next burn</td>
<td>min-sec</td>
</tr>
<tr>
<td></td>
<td>MGA</td>
<td>.01°</td>
</tr>
<tr>
<td>46</td>
<td>DAP Config (R1&amp;R2)</td>
<td>OCTAL</td>
</tr>
<tr>
<td>47</td>
<td>CSM weight</td>
<td>LBS</td>
</tr>
<tr>
<td>48</td>
<td>Pitch Trim</td>
<td>.01°</td>
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<tr>
<td></td>
<td>Yaw Trim</td>
<td>.01°</td>
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<tr>
<td>49</td>
<td>ΔR</td>
<td>.1 NM</td>
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<tr>
<td></td>
<td>ΔV</td>
<td>.1 FPS</td>
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<tr>
<td></td>
<td>SOURCE CODE (1 optics, 2 VHF)</td>
<td>0000X</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Unit</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>ΔR</td>
<td>(miss distance)</td>
<td>.1 NM</td>
</tr>
<tr>
<td>PERIGEE</td>
<td>HP</td>
<td>.1 NM</td>
</tr>
<tr>
<td>TFF</td>
<td></td>
<td>min-sec</td>
</tr>
<tr>
<td>RHO</td>
<td></td>
<td>.01°</td>
</tr>
<tr>
<td>GAMMA</td>
<td></td>
<td>.01°</td>
</tr>
<tr>
<td>CENTANG</td>
<td>(active veh)</td>
<td>.01°</td>
</tr>
<tr>
<td>RANGE</td>
<td></td>
<td>.01 NM</td>
</tr>
<tr>
<td>RANGE RATE</td>
<td></td>
<td>.1 FPS</td>
</tr>
<tr>
<td>PH1 (lcl horiz)</td>
<td></td>
<td>.01°</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>.01 NM</td>
</tr>
<tr>
<td>Range Rate</td>
<td></td>
<td>.1 FPS</td>
</tr>
<tr>
<td>Theta (lcl horiz)</td>
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<td>.01°</td>
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<tr>
<td>Perigee code</td>
<td></td>
<td>CODE</td>
</tr>
<tr>
<td>E(ELEV ANGLE)</td>
<td></td>
<td>.01°</td>
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<tr>
<td>CENTANG</td>
<td>(passive veh)</td>
<td>.01°</td>
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<tr>
<td>ΔR offset (SOR)</td>
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<td>.1 NM</td>
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<tr>
<td>HP alt (post TPI) (SOR for P38)</td>
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<td>.1 NM</td>
</tr>
<tr>
<td>ΔV (TPI) (SOR for P38)</td>
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<td>.1 FPS</td>
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<tr>
<td>ΔV (TPF) (SOR FINAL for P38)</td>
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<td>.1 FPS</td>
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<tr>
<td>ΔV LOS</td>
<td>1</td>
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<tr>
<td>ΔV LOS 2</td>
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<td>.1 FPS</td>
</tr>
<tr>
<td>ΔV LOS 3</td>
<td></td>
<td>.1 FPS</td>
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<tr>
<td>G Max</td>
<td></td>
<td>.01 G</td>
</tr>
<tr>
<td>V Pred</td>
<td></td>
<td>FPS</td>
</tr>
<tr>
<td>Gamma EI</td>
<td></td>
<td>.01°</td>
</tr>
<tr>
<td>Impact Lat</td>
<td></td>
<td>.01°</td>
</tr>
<tr>
<td>Impact Long</td>
<td></td>
<td>.01°</td>
</tr>
<tr>
<td>Head Up/Down</td>
<td></td>
<td>+/-00001</td>
</tr>
<tr>
<td>VI-Inertial Vel Mag</td>
<td></td>
<td>FPS</td>
</tr>
<tr>
<td>H Dot-Alt Rate</td>
<td></td>
<td>FPS</td>
</tr>
<tr>
<td>H-Alt</td>
<td></td>
<td>.1 NM</td>
</tr>
<tr>
<td>RTGO from 0.05 G To Splash</td>
<td></td>
<td>.1 NM</td>
</tr>
<tr>
<td>VIO, Predicted Iner Vel</td>
<td></td>
<td>FPS</td>
</tr>
<tr>
<td>TFE, time from .05G</td>
<td></td>
<td>min-sec</td>
</tr>
<tr>
<td>Drag Acceleration</td>
<td></td>
<td>.01 G</td>
</tr>
<tr>
<td>VI, Inertial Velocity</td>
<td></td>
<td>FPS</td>
</tr>
<tr>
<td>RTGO to Target</td>
<td></td>
<td>.1 NM</td>
</tr>
</tbody>
</table>
65 Sampled CMC Time hrs, min, .01 sec (fetched in interrupt)

66 Beta, CMD Bank Angle .01°
CRSRNG Error .1 NM
DNRNG Error .1 NM

67 RTGO to Target .1 NM
Lat, Present Position .01° (+ North)
Long, Present Position .01° (+ East)

68 Beta, CMD Bank Angle .01°
VI, Inertial Vel. FPS
H Dot, Alt Rate FPS

69 Beta .01°
DL .01 G
VL FPS

70 Star Code(before mark) OCTAL
LMK Data OCTAL
Horiz data OCTAL

71 Star code (after mark) OCTAL
LMK Data OCTAL
Horiz data OCTAL

72 Δ ang .01°
Δ alt .1 NM
Search option

73 ALT (P21) 10 NM
VEL (P21) FPS
GAMMA (P21) .01°

74 BETA, CMD Bank, Angle .01°
VI, INERTIAL VELOCITY FPS
DRAG ACCELERATION .01 G

75 ΔH (CDH) .1 NM
Δt min-sec
Δt min-sec

80 TF GETI/TFC min-sec
VG FPS

81 ΔVX,Y,Z (incl vert) .1 FPS

82 ΔVX,Y,Z (LV) CDH .1 FPS

83 ΔVX,Y,Z (Body Control Axis) .1 FPS

84 ΔVX,Y,Z (Other Vehicle) .1 FPS

85 VGX,Y,Z (Body Control Axis) .1 FPS

87 Opt Calib Data - Shaft (R1) .01°
Trunnion(R2) .001°
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>88</td>
<td>Planet X,Y,Z</td>
</tr>
<tr>
<td>89</td>
<td>Landmark Latitude, North: Long/2 East: Alt: Y DOT, PSI</td>
</tr>
<tr>
<td>90</td>
<td>REND out of Plane para Y DOT, PSI, Y .01 NM</td>
</tr>
<tr>
<td>91</td>
<td>OCDU Angles Shaft (R1): Trunnion (R2) .01°</td>
</tr>
<tr>
<td>92</td>
<td>New OCDU Angles Shaft (R1): Trunnion (R2) .001°</td>
</tr>
<tr>
<td>93</td>
<td>Delta Gyro Angles X,Y,Z .001°</td>
</tr>
<tr>
<td>94</td>
<td>OCDU ANGLES (R56 &amp; R23): R1 SHAFT .01°, R2 TRUNNION .001°</td>
</tr>
<tr>
<td>95</td>
<td>Pref att ICDU angles .01°</td>
</tr>
<tr>
<td>96</td>
<td>+X axis att ICDU angles .01°</td>
</tr>
<tr>
<td>97</td>
<td>System Test Inputs XXXXX</td>
</tr>
<tr>
<td>98</td>
<td>System Test Results XXXXX</td>
</tr>
<tr>
<td>99</td>
<td>POS ERR VEL ERR OPTION Code 1 FT .1 FPS 0000X</td>
</tr>
</tbody>
</table>

**V05 NO9 ALARM CODES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00110</td>
<td>Mark reject has been entered but ignored</td>
</tr>
<tr>
<td></td>
<td>Continue</td>
</tr>
<tr>
<td>00112</td>
<td>Mark reject with no marks being accepted</td>
</tr>
<tr>
<td></td>
<td>Continue</td>
</tr>
<tr>
<td>00113</td>
<td>No inbits (chan 16)</td>
</tr>
<tr>
<td></td>
<td>Continue; if alarm recurs use MDC DSKY.</td>
</tr>
<tr>
<td>00114</td>
<td>More marks made than desired</td>
</tr>
<tr>
<td></td>
<td>Continue</td>
</tr>
</tbody>
</table>
00115 V41 N91 keyed with OPTICS MODE not in CMC
OPTICS MODE - CMC and OPTICS ZERO - OFF
00116 Optics switch altered before 15 sec zero time elapsed
OPTICS ZERO - ZERO (15 sec).
00117 V41 N91 keyed but CMC has reserved OCDU (from start of gimbal test in P40 until termination of TVC functional allocation of the "optics" CDU Driving Output)
V41 N91 not yet available
00120 Optics torque has been requested but optics have not been zeroed since last FRESH START or RESTART OPTICS ZERO - OFF then ZERO (15 sec).
00121 In 0.05 sec following mark, an ICDU changed by more than 0.033° Repeat MK.
00122 Marking not called for
Continue.
00124 P17 (77) TPI search unsuccessful (F/3-1)
(m)00205 PIPA saturated
Use SCS control (G&N 12).
00206 The IMU zero routine has been entered with both the GMBL LOCK lt and NO ATT lt on Coarse align to 0,0,0 Reselect V40 N20E.
(m)00207 ISS turn-on request not present for 90 sec
Redo IMU turn on (G&N 12).
(m)00210 The IMU is not operating
Redo IMU turn on. If alarm recurs perform fresh start (V36E).
Consult MSFN. (G&N 12).
(m)00211 Coarse align error
If P51(3)/52(4) in progress record gyro torquing angles and perform fine align check in P52(4).
Otherwise, see F/8-2. (G&N 12).
(m)00212 PIPA fail, but PIPA is not being used
PIPA BIAS check (G&N 6/8).
(m)00213 IMU not operating with turn-on request
See 00210.

00214 Program using IMU when turned OFF
See 00210 or exit program.

(m)00217 IMU coarse align or pulse torque
difficulty has occurred
Reinitiate current program.
If alarm recurs, terminate use of
ISS (G&N 12).

00220 IMU orientation unknown
Align or if aligned set REFSMMAT flag.

00401 Desired middle gimbal angle is excessive
Call N22 - maneuver if MGA < 85° or
realign IMU.

00404 Target out of view (90 deg test)
(F/3-5,6-3)

00405 Acceptable star pair is not available
(F/6-3,6-6)

00406 Rend navigation not operating
Select P20 or continue.

00407 Target out of view (50° test)
(F/3-2,3-8,6-3)

00421 W-matrix overflow
Notify MSFN but continue.
W-matrix automatically reinitialized at
next mark.

**00430 Orbital integration has been
terminated to avoid possible
infinite loop.
Notify MSFN.
Probable S.V. uplink required

00600 No solution on first iteration in
P32/72
(F/4-2,7-1)

00601 Post CSI Perigee/lune alt < 85nm / 5.8nm
(F/4-2,7-1)

00602 Post CDH Perigee/lune alt < 85nm / 5.8nm
(F/4-2,7-1)

00603 Time from TIG (CSI) to TIG (CDH)
< 10 min
(F/4-2,7-1)
00604  Time from TIG (CDH) to TIG (TPI)  
<10 min  
(F/4-2,7-1)

00605  Number of iterations exceeds loop maximum  
(F/4-2,4-7,4-8,4-9,4-10,7-2)

00606  ΔV (CSI) has been >1000 fps for last two iterations  
(F/4-2,7-2)

**00607  No solution to conic subroutine  
Reselect program.

**00610  Alt at specified TIG in P37 < 400K ft  
Reselect P37 and decrease TIG.

00611  No TIG for given ELEV angle  
(F/4-4,4-5,7-3)

00612  State vector in wrong sphere of influence at TIG  
(F/4-7,4-9)

00613  Reentry angle out of limits  
(F/4-8,4-10)

(m)00777  ISS warning caused by PIPA fail  
(G&N 6).

01102  CMC self test error  
(F/2-3)

**01103  Unused CCS branch executed  
Copy NO8, notify MSFN, initiate V36 recovery

*01104  Delay routine busy  
Reselect extended verb or continue with program.  
Notify MSFN.

(m)01105  Downlink too fast  
Rset. If alarm recurs DOWNLINK FAILURE.  
(G&N 12).

(m)01106  Uplink too fast  
Rset. If alarm recurs UPLINK FAILURE.  
(G&N 12).

(m)01107  Phase table failure—assume erasable memory is destroyed  
If Comm:  1. V74 CMC DOWNLINK  
2. P27 As Necessary.  
3. V48 As Necessary (V46).
4. Reestablish REFSMMAT via P51 As Necessary.

If FRESH START recurs, CMC FAILURE (SSR-3).

If no Comm, pg F/2 - 19

*01201 Executive overflow - no vac. area
Reselect Extended Verb and/or Continue Program.

*01202 Executive overflow - no core sets
See 01201

*01203 Waitlist overflow - too many tasks
See 01201

**01204 Negative or zero time waitlist call
If ave-g on, continue.
Otherwise reselect program.

**01206 Second job attempts to go to sleep via keyboard and display program
See 01204.

*01207 No vac area for marks
Rset
Reselect program
If alarm recurs, consult MSFN.

**01210 Second attempt is made to stall
Reselect program
Do not attempt use of device while CMC is using it.

*01211 Illegal interrupt of extended verb
Reselect extended verb after optics marking is completed.

01301 Arcsin or arccos input is greater than one
Copy NO8, notify MSFN, continue.

**01302 SQRT called with negative argument
See 01204.

(m)01407 VG increasing
(F/5-6,E/4-6) (G&N 12).

01426 IMU unsatisfactory
Realign or use SCS.

01427 IMU reversed
Note FDAI operation is inverted.

**01501 Keyboard and display alarm during internal use
See 01204.
**01502 Illegal flashing display
   See 01204.

01520 V37 request not permitted at this time
   Wait till COMP ACTY lt.
   not on continuously - reselect V37 or if
   P62-67, select POO and then desired
   program.

**01521 V92 keyed (P07) during POO or POL
   selected and P11 has already been
   performed
   See 01204.

01600 Overflow in drift test
   This is gnd test alarm only.

01601 Bad IMU torque abort
   See 01600

01602 Bad optics during verification
   See 01600

01703 Insufficient time for integration. TIG
   slipped
   (F/5-4,5-10,E/4-4)

(m)03777 ISS warning caused by ICDU fail
   (G&N 6)

(m)04777 ISS warning caused by ICDU & PIPA fail
   (G&N 6)

(m)07777 ISS warning caused by IMU fail
   (G&N 6)

(m)10777 ISS warning caused by IMU & PIPA fail
   (G&N 6)

(m)13777 ISS warning caused by IMU & ICDU fail
   (G&N 6)

(m)14777 ISS warning caused by IMU, ICDU & PIPA
   fail
   (G&N 6)

(m) - Malf procedure indicated
** - Generates restart, F37 (no lt.)
* - Restart (no lt.) and program
   continues (i.e. attempted
   recovery)

NOTE - All **alarms act as *type if
   they occur when Ave-g is on
### V50 N25 CHECKLIST CODES

<table>
<thead>
<tr>
<th>R1 Code</th>
<th>ACTION</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>00013</td>
<td>Key in</td>
<td>Gyro Torque Option</td>
</tr>
<tr>
<td>00014</td>
<td>Key in</td>
<td>Fine Align Option</td>
</tr>
<tr>
<td>00015</td>
<td>Perform</td>
<td>Celestial Body Acq</td>
</tr>
<tr>
<td>00016</td>
<td>Key in</td>
<td>Terminate Mark Sequence</td>
</tr>
<tr>
<td>00041</td>
<td>Switch</td>
<td>CM/SM SEP to UP</td>
</tr>
<tr>
<td>00062</td>
<td>Key</td>
<td>CMC to STBY</td>
</tr>
<tr>
<td>00202</td>
<td>Perform</td>
<td>PGNS AUTO MNVR</td>
</tr>
<tr>
<td>00204</td>
<td>Key in</td>
<td>Engine gimbal test opt</td>
</tr>
</tbody>
</table>

### V04 NO6 (N12) OPTION CODES

<table>
<thead>
<tr>
<th>R1 Code</th>
<th>Purpose</th>
<th>Input for R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>00001</td>
<td>Specify IMU Orientation</td>
<td>1=PREF, 2=NOM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3=REFS, 4=LDG SITE</td>
</tr>
<tr>
<td>00002</td>
<td>Specify vehicle</td>
<td></td>
</tr>
<tr>
<td>00003</td>
<td>Specify tracking Attitude</td>
<td></td>
</tr>
<tr>
<td>00005</td>
<td>Specify SOR Phase</td>
<td>1=First, 2=Second</td>
</tr>
<tr>
<td>00007</td>
<td>Specify Propulsion System</td>
<td>1=SPS, 2=RCS</td>
</tr>
<tr>
<td>TITLE</td>
<td>ADDRESS</td>
<td>BIT</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
<td>-----</td>
</tr>
<tr>
<td>RNDZ</td>
<td>00074</td>
<td>7</td>
</tr>
<tr>
<td>UPDATE</td>
<td>00075</td>
<td>7</td>
</tr>
<tr>
<td>Track</td>
<td>00075</td>
<td>5</td>
</tr>
<tr>
<td>Pref Att</td>
<td>00076</td>
<td>4</td>
</tr>
<tr>
<td>Steer</td>
<td>00076</td>
<td>11</td>
</tr>
<tr>
<td>REFSMMAT</td>
<td>00077</td>
<td>13</td>
</tr>
<tr>
<td>IMU</td>
<td>00074</td>
<td>8</td>
</tr>
<tr>
<td>State Vector</td>
<td>00075</td>
<td>8</td>
</tr>
<tr>
<td>Terminate</td>
<td>00103</td>
<td>15</td>
</tr>
<tr>
<td>Trunnion drive</td>
<td>00074</td>
<td>4</td>
</tr>
<tr>
<td>Target 1</td>
<td>00075</td>
<td>10</td>
</tr>
<tr>
<td>Target 2</td>
<td>00075</td>
<td>9</td>
</tr>
<tr>
<td>W-matrix(RNDV)</td>
<td>00101</td>
<td>1</td>
</tr>
<tr>
<td>W-Matrix (ORB)</td>
<td>00077</td>
<td>6</td>
</tr>
<tr>
<td>3 axis</td>
<td>00101</td>
<td>6</td>
</tr>
<tr>
<td>External AV</td>
<td>00076</td>
<td>8</td>
</tr>
<tr>
<td>Active vehicle</td>
<td>00076</td>
<td>5</td>
</tr>
<tr>
<td>Final comp.</td>
<td>00076</td>
<td>6</td>
</tr>
<tr>
<td>Sighting mark</td>
<td>00074</td>
<td>6</td>
</tr>
</tbody>
</table>
### Stick flag

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00075</td>
<td>14 RHC out of detent</td>
</tr>
</tbody>
</table>

### CMOON flag

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00104</td>
<td>12 Permanent CSM SV in Lunar Sphere of Influence</td>
</tr>
</tbody>
</table>

### NON-FLAGS

**MARKSTAT**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1330</td>
<td>10 After mark</td>
</tr>
</tbody>
</table>

**IMODES**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1320</td>
<td>9 IMU not operating</td>
</tr>
</tbody>
</table>

**BINARY - OCTAL**

<table>
<thead>
<tr>
<th>Set</th>
<th>15,14,13</th>
<th>12,11,10</th>
<th>9,8,7</th>
<th>6,5,4</th>
<th>3,2,1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Set</td>
<td>0 000</td>
<td>0 001</td>
<td>0 010</td>
<td>0 011</td>
<td>0 100</td>
</tr>
<tr>
<td>0</td>
<td>1 101</td>
<td>2 101</td>
<td>3 110</td>
<td>4 111</td>
<td>5</td>
</tr>
</tbody>
</table>
V60-63 DESCRIPTION

Before any of the following verbs will be effective, the RCS DAP must be activated.

V60 - Keying V60E will load present gimbal angles (N20) into N17 cells.
V61 - Keying V61E will display DAP phase plane errors on error needles provided the CMC has access to one of the FDAI displays.
V62 - Keying V62E will display the difference between present gimbal angles (N20) and N22 desired gimbal angles provided the CMC has access to one of the FDAI displays. The difference is resolved into CSM control axes before being displayed.
V63 - Keying V63E will display the difference between present gimbal angles (N20) and N17 (astronaut) desired gimbal angles provided the CMC has access to one of the FDAI displays. If V60E is keyed while V63 needles are active, the needles will be zeroed.
SECTION 2. G&N GENERAL

CMC POWER UP PROCEDURE

1. PRO, push until STBY Lt - out
   (repeat, if necessary)
   *CMC warning, RESTART, PROG ALARM*
   *RSET and continue

IMU POWER UP PROCEDURE

LOGIC POWER 2/3-on
FDAI POWER - BOTH
FDAI SELECT - 1/2
CMC MODE - FREE

G/N IMU PWR - on (up)
   NO ATT lt - on (90 sec)
   NO ATT lt - out
   Wait 15 sec

V37E XXE
   *If CMC not available:*
   * G/N IMU PWR - on(up) *
   * Wait 90 sec *
   * IMU CAGE - on(up) 5 sec, *
   * then off *

P06 - CMC POWER DOWN PROGRAM

V48E
F 04 46
Load 0 (NO DAP) in left digit of R1
PRO
PRO
PRO
V46E

F 50 25
V37E 06E
00062 CMC PWR DN
PRO, push until STBY Lt - on

**OPTICS DUST COVER JETT**

Install Eyepieces
OPT ZERO - OFF
G/N PWR OPTICS - on (up)
OPT MODE - MAN
OPT COUPLING CONT - DIRECT
OPT SPEED CONT - HI
OHC - MAX RIGHT (Obs eject thru eyepiece)

**OPTICS POWER UP PROCEDURE**

1. G/N PWR OPTICS - on (up)
2. OPT ZERO - OFF
   OPT ZERO - ZERO (15 sec)

**OPTICS POWER DOWN**

1. G/N PWR OPTICS - OFF

**IMU POWER DOWN PROCEDURE**

- CMC MODE - FREE

1. G/N IMU PWR - OFF
   *ISS warning*
   *RSET*

**CMC SELF CHECK**

1. F 21 01 V25 N01E, 1365E E,E,E
2. 15 01 V15 N01E, 1365E R1 NUMBER OF ERRORS
   R2 NUMBER OF TESTS STARTED
   R3 NUMBER OF TESTS SUCCESSFUL
V21 N27E 10E SELF TEST FIXED & ERASABLE
(4E SELF CHECKS ERASABLE
5E SELF CHECKS FIXED)

TEST SUCCESSFUL WHEN R2>3 (78 sec)
* IF PROG 1t = On *
* V05 N09E 01102 SELF *
* TEST ERROR *
*N8E-Rec for MSFN *

TERM V21N27E 0E

MEASUREMENT & LOADING OF PIPA BIAS

1 DET - RESET
SC RATES <0.1°/sec
CMC - FREE

2 V25N 21E, E,E,E/Start Event Timer

3 V25N 21E (DO NOT ENTR)

16 21 XYZ PIPA COUNTS

4 At T + 4:16 - ENTR
T4:16 RECORD (X) R1 ____ (Y) R2 ____ (Z) R3 ____ Í(XXXAB)

5 V21N 01E USE SAME SIGN AS ABOVE
F 21 01 1452 E (CALCULATED X BIAS) E,E, (+ABXXX)
1454 E (CALCULATED Y BIAS) E,E
1456 E (CALCULATED Z BIAS) E

FLAG WORD SET/RESET

1 V25N 07E
F 21 07 (LOAD FLAG WORD ADDRESS) E

2 F 22 07 (LOAD CODE FOR BIT TO BE CHANGED)ABCDE ENTR

<table>
<thead>
<tr>
<th>BIT</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
</tr>
</tbody>
</table>

| CODE | 4  | 2  | 1  | 4  | 2  | 1  | 4  | 2  | 1  | 4  | 2  | 1  |
3 F 23 07
   (SET BIT) Key 1E
   (RESET BIT) Key 0E

4 (To Verify) V01 NO1E (FLAG Word ADD) ENTR

5 F 01 01 R1 FLAG WORD (ABCDE)
   R3 FLAG WORD ADDRESS

   EXAMPLE: To cause reinitialization of W-matrix for
   mid-course (P23) or landmark (P22)
   navigation

   Key:
   V25N 07E          This resets bit 6 of
   77E               flagword 3.
   40E               Verification should
                    show D<4
   0E

   EXAMPLE: To set REFSMMAT flag:

   Key:
   V25N 07E          This sets bit 13 of
   77E               flagword 3
   10000E            Verification should show
                     A odd
   1E

   BINARY-TO-OCTAL CONVERSION

   000-0          100-4
   001-1          101-5
   010-2          110-6
   011-3          111-7

   OCTAL-TO-DECIMAL CONVERSION

   1-1           11-9       21-17     31-25     41-33
   2-2           12-10     22-18     32-26     42-34
   3-3           13-11     23-19     33-27     43-35
   4-4           14-12     24-20     34-28     44-36
   5-5           15-13     25-21     35-29     45-37
   6-6           16-14     26-22     36-30     46-38
   7-7           17-15     27-23     37-31     47-39
   10-8          20-16     30-24     40-32     50-40
REVIEW DATA IN ERASABLE MEMORY

1. Perform During Any Flashing Display

2. VO1 NO1E (OCTAL ADD) E

3. F 01 01 R1 DATA R3 OCTAL ADD

4. N15E (For next succeeding word)

5. ENTR (For each succeeding word)

TO CHANGE DATA IN ERASABLE MEMORY

1. V21 NO1E (ADDRESS) E

2. F 21 01 R3 ADDRESS

3. Load New Data in R1 E

4. N15E (For next succeeding word)

5. ENTR (For each succeeding word)

P22 RAW DATA READOUT

CMC - on, HOLDING AT 06 49 FLASH IN P22

1. F 06 49 V1N1E

2. F 01 01 3537E

Rcrd R1

N15E

Rcrd R1

3. F 01 15 ENTR

Rcrd R1

4. Repeat 3 till 7 pieces of data recorded for each mark

5. KEY RLSE

6. F 06 49 Continue P22
MONITOR OF INPUT/OUTPUT CHANNELS

1
F 11 10  V11 N10E
LOAD CHANNEL ADDRESS E
R1 Octal Contents of Specified Channel

LOAD OUTPUT CHANNELS

1
F 21 10  V21 N10E
LOAD CHANNEL ADDRESS E
R1 (Load Octal Data) E

PITCH ORBIT RATE MANEUVER
(Save RCS - Disable 2 Adjacent Quads in RO3)

1
V37E 00E
V49E
Load V06N22 With Desired Initial Attitude MGA=0

2 F 06 22
PRO

3 F 50 18
BMAG MODE (3) - RATE 2
SC CONT - CMC
CMC MODE - AUTO
PRO

4 06 18
AUTO MANEUVER
F 50 18

5
ENTR

6
V24 N10E
3127E
VVVVV E
WWWWE E
April 15, 1969

JUNE 27, 1969

Basic Date

CSM 107 & SUBS

Changed —_

ORB RATE

-0.050

V24E
3131E
XXXXX E
YYYYY E

V21E
3200 E
ZZZZZ E
ORB RATE MAN Now In Progress

To Terminate

1. CMC MODE - HOLD
or 2. V46E
or 3. RHC Out of DETENT
or 4. V49E to 2
or 5. V37E XXE

CDUX

<table>
<thead>
<tr>
<th>ORB RATE</th>
<th>0 deg</th>
<th>+90 deg</th>
<th>+180 deg</th>
<th>+270 deg</th>
</tr>
</thead>
<tbody>
<tr>
<td>VVVVV = 77776</td>
<td>00000</td>
<td>00001</td>
<td>00000</td>
<td></td>
</tr>
<tr>
<td>WWWWW = 46200</td>
<td>70400</td>
<td>31600</td>
<td>07400</td>
<td></td>
</tr>
<tr>
<td>XXXXX = 00000</td>
<td>00001</td>
<td>00000</td>
<td>77776</td>
<td></td>
</tr>
<tr>
<td>YYYYY = 70400</td>
<td>31600</td>
<td>07400</td>
<td>46200</td>
<td></td>
</tr>
<tr>
<td>ZZZZZ = 61337</td>
<td>61337</td>
<td>61337</td>
<td>61337</td>
<td></td>
</tr>
</tbody>
</table>

RCS DAP ATT DBD INCREASE

CMC - on
ISS - on & aligned
SCS - operating
RCS DAP - activated

DBD (see table)
G&N RECOVERY PROCEDURES

Desired DBD DBD
+2.5 343E
+10° 1616E
+15° 2525E
+20° 3434E
+25° 4343E
+30° 5252E

To return to RO3 DBD THC - CW, then neutral (DBD center shifted)
or V48E (DBD center not affected)
PRO
PRO
PRO
or V37E XXE

General System Checkout:

Get to P00 by one of the following:
1. V37E 00E
2. V96E
3. V36E V96E
4. Simultaneously press RSET and MARK REJECT, (GO JAM), V37E 00E

Check for Reasonableness
1. V82 with both options
2. V83
3. P21 NAV CHECK
4. P52 check auto optics positioning If nominal, continue; if not, get P27 update.
5. CMC Self Test

Recoveries:

if P06: (with F 50 25 00062)
1. a. Press PRO to STBY, press PRO again to F 37
or
b. V37E 00E
2. V25 N7E, 76E, 40000E, 1E
3. V25 N7E, 77E, 10000E, 1E

if V30 or 31:
   RECORD N26, NOTIFY MSFN, V74E
   Perform General System Checkout

if V36:
   1. V25 N7E, 76E, 40000E, 1E
   2. V48
   3. V46
   4. Perform General System Checkout as necessary

if GO JAM:
   V74 when convenient, see V36

   RAPID IMU REALIGN

NOTE: This procedure assumes a good GDC alignment

1. Fly spacecraft to 0°,0°,0° on GDC Inertial Ball

2. V41 N20E
   E,E,E, (Coarse Align IMU To 0°,0°,0° Body)

3. V40 N20
   Verify 0°,0°,0° on GDC Ball - ENTR
   (Releases Platform And Recovers PGNS Control Modes)

   (continued on next page)
4  V25 N7E, 76E, 40000E, 1E (Sets Drift Flag)

5  V25 NO7E 77E, 10000E, 1E (Sets REFSMMAT FLAG)

6  Perform P52, Option 3 (AUTO OPTICS are good)

NOTE: If Loss of Alignment Is Due To Temporary Loss of DC BUS, Update CMC Clock With V55 To Complete Recovery.

VHF RNG DSKY DISPLAY

VHF RNG - on
P20 - running

V87E

V06 NO2E 3703E
R1 = XXX.XX nm
(max R1 = 163.83;
If R1 neg, RNG = 327.67-R1)
### CHANGING LANDING SITE REFSTMMAT FOR OUT OF PLANE BURNS

<table>
<thead>
<tr>
<th></th>
<th>V37E 52E</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>F 04 06</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>F 06 34</td>
</tr>
<tr>
<td>3</td>
<td>F 06 89</td>
</tr>
<tr>
<td>4</td>
<td>F 06 22</td>
</tr>
<tr>
<td>5</td>
<td>F 50 25</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16 20</td>
</tr>
<tr>
<td>7</td>
<td>F 50 25</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>P30</td>
</tr>
<tr>
<td>9</td>
<td>P40</td>
</tr>
<tr>
<td>10</td>
<td>YAW BACK TO ±0° (MANUALLY)</td>
</tr>
<tr>
<td>11</td>
<td>V37E 52E</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>F 04 06</td>
</tr>
<tr>
<td>13</td>
<td>F 06 89</td>
</tr>
<tr>
<td>14</td>
<td>F 06 22</td>
</tr>
<tr>
<td>15</td>
<td>F 50 25</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>16 20</td>
</tr>
<tr>
<td>17</td>
<td>F 50 25</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION 3. - NAVIGATION

P17 - TPI SEARCH (P77 LM)
CMC - on (req)

1. F 06 37
   V37E (17E or 77E)
   GETI (TPI) (hrs, min, .01sec)
   Load desired GETI

2. F 06 72
   ΔANG(TPI), ΔALT(TPI), SEARCH OPT
   (.01°, .1nm, 0000X)
   R3 = SEARCH OPT
   00001 < 180°
   00002 > 180°
   (change GETI TPI) V32E to 1
   (change Search opt) V23E

3. F 06 58
   HP, ΔV(TPI), ΔV(TPF) (.1nm, .1fps, .1fps)
   (RECYCLE) V32E to 1 to adjust
   GETI or Search option

4. F 06 55
   R1 = Perigee Code, R3 = CENTANG(0000X, .01°)
   00001, perigee between TPI and TPF
   00002, perigee after TPF
   (RECYCLE) V32E to 1 to adjust
   GETI or Search option

5. F 37
   XXE

P20 - RENDEZVOUS NAVIGATION
CMC - on (req)
ISS - on and aligned (req)
SCS - on (des)
V37E 20E
F 50 18 Request MNVR to FDAO RPY angles (±.01°)

(AUTO) SC CONT - CMC
CMC MODE - AUTO

PRO
06 18 RPY (±.01°) to 1 when MNVR complete
(MAN) SC CONT - SCS
PRO To 1
or V62E
RHC - MNVR To 1

When attitude OK:
CMC MODE - AUTO
ENTR

OPTIC ZERO - OFF
*POSS prog alarm
*Key V5N9E 00407 (TA>50°)
*V16N 22E
*GMBL ANGLES RPY (±.01°)
*or V16N 92E
*OPTICS SHAFT,TRUN(±.01°,±.001°)
*(AUTO) SC CONT - CMC
*CMC MODE - AUTO
*V58E
*(MAN) MNVR to 2 (SXT)
*or to 3 (COAS)

V57E (SXT)
F 51
OPT MODE - MAN
OHC - Cntr Target in SXT
MARK (repeat as necessary)

*POSS F 06 49 ΔR,ΔV,source code*
*(.1nm,.1fps,0000X)*
*(REJECT) V32E
*(ACCEPT) PRO*
P21

F 3-3

OPT ZERO - ZERO

PRO (return to program in process)
(To terminate P20 - V56E)

V54E (COAS)
SHAFT, TRUNNION

(.01°, .001°)

PRO

F 06 94

Request Alt LOS MARK
RHC - ALIGN Target in COAS
ENTR (V86E To reject)
*POSS F 06 49 ΔR, ΔV, source code*
* (.1nm, .1fps, 0000X) *
*(REJECT) V32E *
*(ACCEPT) PRO *

PRO (return to Program in process)
(To Terminate P20 - V56E)

P21 GROUND TRACK DETERMINATION
CMC - on (req)

V37E 21E
R1 00002, Specify Vehicle
R2 00001, CSM
or 00002, LM

PRO

F 04 06

GET LAT, LONG
(hrs, min, .01sec)

Load desired GET

PRO

F 06 34

LAT, LONG, ALT
(.01°, .01°, .1nm)
(RECYCLE) V32E to 2 (Increment GET 10 min)
(EXIT) PRO

F 06 43

NOTE: Additional Information is available
by V6 N73E
N73 Alt, VEL, GAMMA(10nm, fps, .01°)
P22 - ORBITAL NAVIGATION
CMC - on (req)
ISS - on and aligned (req)
SCS - on (req)
BMAG MODE (3) - RATE 2
G&N PWR OPTICS - on (verify)
COUPLING - RESOLVED
SPEED - MED
OPT ZERO - ZERO (verify)
OPT MODE - CMC

V37E 22E
F 06 45  R3=MAX MGA
(REJECT) R3>60° to P52
R3<60° IMU ALIGNED
MNVR To SIGHTING ATTITUDE
Roll to keep shaft axis >10° from
plane defined by X axis & LOS
to LMK
(MAN) OPT MODE - MAN
OPT ZERO - OFF
PRO (To 3 for earth orbit)
(AUTO) OPT ZERO - OFF
PRO (To 3 for earth orbit)

F 05 70  (lunar orbit only)
R2 ABCDE lmk code
Load lmk code
SITE = 10001
KNOWN = 10000
UNKN = 20000
A=1(known), 2(unknown)
B=INDEX OF OFFSET designator
C=not used
DE=LMK ID (0,1, 5X are legal)
IF A=2
OPT MODE - MAN
PRO to 5
or IF A=1 & DE≠00
PRO to 4 (To 5 if OPTICS - MAN)
or IF A=1 & DE=00
PRO to 3
3  F 06 89  LAT, LONG/2, ALT  (.001°, .001°, .01nm)
    Load lmk coords
    PRO (To 5 if OPTICS - MAN)

4  06 92  SHAFT, TRUN NEW OCDU     (.01°, .001°)  
    *POSS Prog Alarm lt (TRUN>50°)*
    * MNVR to acquire  *
    *F 05 09 00404     (TRUN>90°)*
    * MNVR to acquire  *
    * PRO  *
    * or V34E, F 37  *
    Establish proper pitch rate
    OPTICS MODE - MAN

5  F 51  MARK REQUEST (Avoid lmk near horiz)
    MARK (wait 20-30 sec between MARKS)
    After sufficient MARKS:
    *After 5 MARKS: *
    *F 50 25 00016 TERM MARKS*
    PRO

6  F 05 71  R2 ABCDE LMK DATA
    Load lmk code (if nec):
    A=1 if KNOWN LMK
    A=2 if UNKNOWN LMK
    B=INDEX OF OFFSET DESIGNATOR
    (If only 1 mark made, insure B=0)
    C=Not used in P22
    DE=LMK ID NO. (0,1 are valid)
    PRO - if A=2 (or A is 1 & DE = 01) to 8

7  F 06 89  LAT, LONG/2, ALT  (.001°, .001°, .01nm)
    PRO

8  F 06 49  ΔR, ΔV (ORB PARA)  (.1nm, .1fps)
    (RECYCLE) V32E to 2
    (ACCEPT) Hold for 30 sec
    PRO
9 F 06 89 LAT, LONG/2, ALT LMK ID (.001°, .001°, .01nm)
(DON'T STORE) V32E to 2
(STORE-CODE 01) PRO to 2
(terminate Prog) V34E

10 F 37 XXE
OPT ZERO - ZERO

P23 OPTICS CALIBRATION
CMC - on
OPT ZERO - ZERO (verify)
OPT MODE - MAN

1 F 05 70 V37E 23E (IMU NOT ALIGNED - to 3)
STAR ID(ABCDE)/LMK ID/HOR ID
Insure R1 DE400, R2=00000, R3=00XX0
(X=1 or 2)
PRO

2 F 50 25 00202 MNVR/CALIB REQUEST
ENTR

3 F 59 PERFORM OPTICS CALIB
OPT MODE - MAN (verify)
OPTICS COUPLING - DIRECT
SPEED - LOW
OPT ZERO - OFF
SUPERIMPOSE LLLO TO SLOs MARK

4 F 06 87 R2 TRUNNION ANGLE BIAS (.001°)
(repeat until 2 measurements agree within .003°)
For manual load:
V22 N94E
XXXXX
(ACCEPT) PRO
(REJECT) V32E to 3
NOTE: IF HAVING DIFFICULTY WITH OPTICS CALIB, LOAD ZER00ES
V22 N87E, 000000E (V22 N87E, +000000E) AND REPEAT CALIB
AFTER MARK PERIOD.

5 F 51 V37E XXE
OPT ZERO - ZERO
**P23 - Cislunar Midcourse NAV Measurement**

- **CMC** - on
- **SCS** - on
- **ISS** - on & aligned
- **G/N PWR OPTICS** - on (30 min prior)
- **OPT ZERO** - ZERO (verify)
- **OPT MODE** - CMC

**DO NOT ALLOW P23 TO RUN MORE THAN 30 MIN**

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<td><strong>F 05 70</strong></td>
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<td><strong>R1 000DE</strong></td>
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<td><strong>R2 00C00</strong></td>
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<td><strong>R3 00CDO</strong></td>
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<td><strong>00210</strong></td>
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<td><strong>STAR/LL</strong></td>
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<td><strong>00220</strong></td>
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**STAR/HOR PRO TO 5 (DE=00 to 4) **
**STAR/LMK PRO**

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<td>3</td>
<td><strong>F 06 89</strong></td>
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<td><strong>LAT, LONG/2, ALT (LMK)</strong></td>
<td>(.001°N/E, .01nm)</td>
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<td><strong>PRO (DE#00 to 5)</strong></td>
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<td><strong>LOAD DESIRED VECTOR</strong></td>
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<td><strong>(MNVR) PRO</strong></td>
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<td><strong>(CALIB) ENTR to 8</strong></td>
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6 F 50 18 REQUEST MNVR TO FDAI R,P,Y (.01°)
(AUTO) SC CONT - CMC
CMC MODE - AUTO
BMAG MODE (3) -RATE 2
PRO to 7
(MAN) V62E
MNVR to 6
(BYPASS) ENTR to 8 (CALIB COMPLETED to 10)

7 06 18 AUTO MNVR FDAI R, P, Y (.01°)
AUTO MNVR COMPLETE RETURN TO 6

8 F 59 REQUEST OPTICS CALIB
(BYPASS) ENTR to 10
OPT MODE - MAN
OPT COUPLING - DIR
SPEED - LOW
OPT ZERO - OFF
SUPERIMPOSE LLOS ON SLOS

9 F 06 87 R2 TRUN BIAS (.001°)
For manual load:
V22 N94E
XXXXXE
(RECALIB) V32E to 8
(INCROP OPT MODE-CMC
(CALIB) PRO

10 06 92 AUTO OPT SHF/TRUN (.01°,.001°)
(MNVR) V94E to 6

*PROG ALARM *
*V5N9E 407 TRUN > 50° *
*KEY RLSE *
*MNVR SC UNTIL R2 <49.775°*

(MARK) MNVR SC TO POSITION LMK/HOR
IN FOV
OPT MODE - MAN
MARK REQUEST
(MNVR)  V94E to 6
(MARK)  SUPERIMPOSE STAR ON LMK/HOR
 MARK

00016 TERM MARKS
(REJECT) MARK REJECT to 11
(TERM)  PRO

R1  000DE STAR ID
R2  00C00 LMK ID
R3  00CD0 HOR ID

(STAR/HOR) PRO to 16 (DE=00 to 15)
(STAR/LMK) PRO to 14

LAT, LONG/2 ALT(LMK) (.001°+N/E,.01nm)
PRO (DE#00 to 16)

CELESTIAL BODY VECTOR
Verify vector
PRO

ΔR  ΔV (SV PARA)  (.1nm,.1 fps)
(REJECT)  V37E 23E
(UPDATE)  PRO

P27 CMC UPDATE
CMC - on (req)

Auto Update:
V37E 00E

UP TLM (2) - ACCEPT
UPLINK ACTY 1t - on
*POSS LOS before completion*
*If V33 NO2 showing:  *
* Key PRO  *
* UPLINK ACTY 1t - out  *
* P00 displayed  *
*If V21 NO1  *
*or V21 NO2  *
F
3-10

* Key V34E
* UPLINK ACTY lt - out
* POO displayed
* UP TLM (2) - BLOCK

Update complete:
UPLINK ACTY lt - out
V37E 00E
UP TLM (2) - BLOCK

Voice Transmission Update:

1  V37E 00E

2  V70E LIFT-OFF TIME UPDATE
or V71E LOAD DATA CONSEC ADD
or V72E LOAD DATA IN NON CONSEC
or V73E CMC TIME UPDATE

3  P27 Displayed

4  F 21 01  R3 UPDATE BUFFER ADD (initially 304)
    R1 Data E (R3 Increments)
    (If change - To 6)
    Repeat Step 4 for all data

5  F 21 02  R3  330
    (Verify Data) V1 N1E
    R3 304E
    R1 Verify Data
    N15E (R3 305)
    R1 Verify Data
    Consecutive ENTR's display
    remaining comps. Note
    octal ident (01-24) of
    comps which need change
    KEY REL To 6

6  F 21 02  R3 330
    (CHANGE) Load octal ident, XXE to 4
    (ACCEPT UPDATE) PRO

7  POO Displayed
## SECTION 4. PRETHRUST

### P30 EXTERNAL ΔV

If uplinked REFSMMAT, do P52 (OPT 1) before P30

1. F 06 33 V37E 30E (hrs, min, .01sec)
   - GETI
   - Load desired GETI
   - PRO

2. F 06 81 ΔVXYZ(LV) (.1fps)
   - Load desired ΔV's
   - PRO

3. F 06 42 HA, HP, ΔV(REQ) (.1nm, .1nm, .1fps)
   - Set ΔV Counter
   - PRO

4. F 16 45 M, TFI, MGA (MKS, min-sec, .01°)
   - Set DET
   - PRO (MGA Set to -00002 IF REFSMMAT FLAG NOT SET)

5. F 37

### P31 GENERAL LAMBERT PRETHRUST

TARG PARAMS - LOADED FROM GND (P27)

1. F 06 33 V37E 31E (hrs, min, .01sec)
   - GETI
   - Load desired GETI
   - PRO

2. F 06 81 ΔVXYZ(LV) (.1fps)
   - PRO

3. F 06 42 HA, HP, ΔV(REQ) (.1nm, .1nm, .1fps)
   - Set ΔV Counter
   - PRO
4  F 16 45  M,TFI,MGA  (MKS,min-sec,.01°)
    Set DET
    PRO (MGA Set to -00002 IF
    REFSMMAT FLAG NOT SET)

5  F 37

P32 CSI PRETHRUST

1  F 06 11  V37E 32E
    TIG (CSI)  (hrs,min,.01sec)
    PRO

2  F 06 55  APSIS CDH,TPI ELEVATION ANGLE, (+0000N,.01°)
    CENTRAL ANGLE, Passive Vehicle (ω t)
    (For CDH N° from CSI, load non-zero
    in R3)
    PRO

3  F 06 37  TIG (TPI)
    (hrs,min,.01sec)
    PRO

4  F 16 45  MARKS,TFI,-00001
    (RECYCLE) V32E to 5
    (FINAL PASS) TERM MARKS
    PRO

*F 05 09
* 00600 No Intersection on
*   First Iteration
* 00601 hp+CSI <85nm/5.8nm
* 00602 hp+CDH <85nm/5.8nm
* 00603 TIG(CDH)-TIG(CSI)
*   <10 min
* 00604 TIG(TPI)-TIG(CDH)
*   <10 min
* 00605 NO SOL IN 15 Tries
* 00606 ΔV(CSI)>1000fps in 2
*   Iterations
*   V32E to 1 Adjust
*   Inputs
5 F 06 75 △H(CDH), Δ(T(CDH-CXI)), ΔT(TPI-CDH)  
    PRO  (.1nm, min-sec)  

6 F 06 81 ΔV XYZ(LV)CSI  (.1fps)  
    (For Out-of-Plane Corr in Final Comp ONLY)  
    V90E  
    F 04 12 R1 00002 Specify Vehicle  
    R2 00001 CSM  
    00002 LM  
    PRO  
    F 06 16 GET EVENT  (hrs, min, .01sec)  
    PRO  
    F 06 90 Y, YDOT, PSI  (.01nm, .1fps, .01°)  
    Record Y DOT  
    PRO  
    Insert -Y DOT in R2 of ΔV (CSI)  
    PRO  

7 F 06 82 ΔV XYZ(LV)CDH  (.1fps)  
    PRO (If Recycling to 4)  

8 F 16 45 MARKS, TFI, MGA  (marks, min-sec, .01°)  
    SET EVENT TIMER TO TFI  
    PRO (MGA Set to -00002 If No  
    REF SMMAT Set)  

9 F 37  

P33 CDH PRETHRUST  

1 F 06 13 TIG(CDH)  (hrs, min, .01sec)  
    PRO  

2 F 16 45 MARKS, TFI, -00001  (marks, min-sec)  
    (RECYCLE) V32E to 3  
    (FINAL PASS) TERM MARKS  
    PRO
3  F 06 75  $\Delta H(CDH), \Delta T(TPI-CDH), \Delta T(TPI-NOMTPI)$  
    PRO (.1nm, min-sec)

4  F 06 81  $\Delta V XYZ(LV)CDH$  
    (.1fps)  
    (For Out-of-Plane Corr in Final Comp ONLY)

V90E  
F 04 12 R1 00002 Specify Vehicle  
R2 00001 CSM  
00002 LM  
PRO  
F 06 16 GET EVENT  
    (hrs, min, .01sec)
PRO  
F 06 90 Y, YDOT, PSI  
    (.01nm, .1fps, .01°)  
    Record Y DOT
PRO  
    Insert -$Y DOT$ in R2 of $\Delta V (CDH)$
PRO (If Recycling to 2)

5  F 16 45  MARK, TFI, MGA  
    (marks, min-sec, .01°)  
    SET EVENT TIMER TO TFI  
    PRO (MGA Set to -00002 If No  
    REFSMMAT Set)

6  F 37  

P34 TPI PRETHRUST (P74 LM)

1  F 06 37  V37E (34E or 74E)  
    TIG (TPI)  
    (hrs, min, .01sec)  
    Load desired TIG  
    PRO

2  F 06 55  Precision offsets, ELEV ANGLE, $\omega t$  
    (XXXXX, .01°, .01°)
Load desired values
(+00000 in R2 to CALC ELEV
ANGLE AT TIG TIME)

F 16 45 MARKS, TFI, -00001 (min-sec)
(RECYCLE) V32E
(FINAL PASS) TERM MARKS

*F 05 09 (00611 NO SOL)*
*PRO To 1*

F 06 37 TIG (TPI) (hrs, min, .01sec)
(IF ELEV ANGLE COMPUTED BY CMC
THIS DISPLAY WILL BE REPLACED
BY F 06 55 AS IN 2 ABOVE)

F 06 58 HP, AV(TPI), AV(TPF) (.1nm, .1fps, .1fps)
(PRO (If Recycle - To 7)
(If Final - To 6)

F 06 58 AVXYZ(LV) TPI (.1fps)
(For Out-Of-Plane Corr in final Comp only)
Key V90E
F 04 12 R1 00002 Specify Vehicle
R2 00001 CSM
00002 LM

F 06 16 GET EVENT (hrs, min, .01sec)

F 06 90 Y, YDOT, PSI (.01nm, .1fps, .01°)
RECORD YDOT

F 06 59 AVXYZ(LOS) TPI (.1fps)
(PRO (If Recycle - To 3)
8. F 16 45  MARKS, TFI, MGA  (marks, min-sec, .01°)  
   PRO (MGA SET TO -00002 IF NO  
   REFSMMAT SET or If P74)  

9. F 37  
   P74 - Transmit Mnvr Parameters To LM  

**P35 TPM PRETHRUST (P75 LM)**  

1. V37E 35E  
   F 16 45  MARK, TFI, -00001  (marks, min-sec)  
   (RECYCLE) V32E To 3  
   (FINAL PASS) TERM MARKS  
   PRO  

2. F 06 81  ΔVXYZ(LV)TPM  (.1fps)  
   (For Out-of-Plane Corr)  
   V90E  
   F 04 12 R1 00002 Specify Vehicle  
   R2 00001 CSM  
   00002 LM  
   PRO  
   F 06 16 GET EVENT  (hrs, min, .01sec)  
   PRO  
   F 06 90 Y, YDOT, PSI  (.01nm, .1fps, .01°)  
   RECORD YDOT  
   PRO  
   ZERO Out-of-Plane Corr (R2) on First TPM  
   PRO  

3. F 06 59  ΔVXYZ(LOS)TPM  (.1fps)  
   PRO (If Recycle - To 1)  

4. F 16 45  MARKS, TFI, MGA  (marks, min-sec, .01°)  
   PRO (MGA SET TO -00002 IF NO  
   REFSMMAT SET or If P75)  

5. F 37  
   P75 - Transmit Mnvr Parameters To LM  

Basic Date: April 15, 1969  
Changed: June 6, 1969  
107 & SUBS
P37 RETURN TO EARTH PGM - CORRIDOR CONTROL

MAKE SURE DAP HAS CORRECT WEIGHT

Perform the following once:

If TLI+10 min Abort performed
V21 N1E
3376E
OE

If no TLI+10 min Abort
V1N1E
3376E
Verify R1=01637

1  F 06 33  V37E '37E
TIG (hrs,min,.01sec)
Load desired TIG(inside Lunar Sphere)

2  F 06 60  BLANK, V DESIRED, GAMMA EI (fps,.01°)
Load desired values
FOR MIN AV-LOAD +00000 IN R2
(Use PAD values on TLC)
For middle of corridor-load +00000 in R3

PRO

*F 05 09 00605 - Solution Not *
*  Convergent *
*  00612 - State Vector in *
*  Lunar Influence *
*V32E, RSET To 1 *
*  00607 - Conic Routine *
*  Failed *
*  00610 - State Vector *
*  Below 400K ft *
*  alt *
*F 37 37E to 1 *

3  F 06 61  IMPACT LAT, IMPACT LONG (.01°)
(RECYCLE) V32E To 1

PRO

4  F 06 39  AT TRANSFER (hrs,min,.01sec)
(RECYCLE) V32E To 1

PRO
5. F 06 60  BLANK, V PRED, GAMMA EI  
(RECYCLE) V32E To 1  
PRO  

6. F 06 81  ΔVXYZ(LV) TIG  
(OPTION) N40E - VG MAG avail  
in N40 and N80  
KEY REL  
PRO (To 3 on first pass)  

*F 05 09 00605 Solution Not Convergent  
* 00613 Flt Path Angle Not Reached  
* RSET  
* V32E To 1  
* 00607 Conic Routine Failed  
*F 37 37E to 1  

7. F 04 06  THRUST OPTION  
R1 00007  
R2 0000X  
X=1(SPS)  
2(RCS)  
Perform RO3 if not performed just prior to P37 call  
PRO  

8. F 06 33  TIG  
(hrs, min, .01sec)  
PRO  

9. F 16 45  MARK, TFI, MGA  
(mark, min-sec, .01°)  
PRO (MGA SET TO -00002 If No  
REFSMMAT SET)  

10. F 37  
(40E or 41E)
P37 RETURN TO EARTH PGM - LONGITUDE CONTROL
(CANNOT USE WHEN TIME TO ENTRY IS <4 HRS)

Perform the following once:
If TLI+10 min Abort performed
   V21 N1E
   3376E
   0E
If no TLI+10 min Abort
   V1N1E
   3376E
   Verify R1=01637

1  F 06 33  V37E 37E
   TIG
   Load desired TIG
   PRO

2  F 06 60  BLANK, ΔV DESIRED, GAMMA EI DESIRED
   Load desired ΔV:
     PAD ΔV IF ON TLC
     0. IF ON TEC
   Load R3=0
   R2  XXXXX
   PRO
     *F 05 09 00612 State vector in *
     * Lunar Influence *
     * 00605 Solution not *
     * Convergent *
     *V32E, RSET TO 1 *
     * 00607 Conic Routine *
     * Failed *
     * 00610 State vector is *
     * below 400K ft *
     * altitude *
     *F 37 37E to 1 *

3  F 06 61  IMPACT LAT, IMPACT LONG
   If Impact LONG<12° from desired:
     Record Impact LONG as 0cl
     PRO
   (.01°)
If Impact LONG > 12° from desired:

TEC: N40E Record R2 as Δmin fps
V32E to 1 & use |ΔV| > ΔV min
ΔV neg to move LONG WEST
ΔV pos to move LONG EAST

4 F 06 39 ΔAT TRANSFER from specified (hrs, min, .01sec)
PRO

5 F 06 60 BLANK, V PRED, GAMMA EI (fps, .01°)
PRO

6 F 06 81 ΔVXYZ(LV) at TIG
N40E (Rms of N81)
Record R2 as ΔVcl = _____ fps
KEY RLSE
PRO for Precision Solution
  *F 05 09 00605 Solution not *
  * Convergent *
  * 00613 Flt Path Ang *
  * not reached *
  *RSET V32E to 1 *
  * 00607 Conic Routine *
  * Failed *
  *F 37 37E to 1 *

7 F 06 61 IMPACT LAT, IMPACT LONG (.01°)
Record LONG as θpl = _____°
If θpl, acceptable, PRO to step 4 of
CORRIDOR CONTROL (pg. F/4-7)

PRO

8 F 06 39 ΔAT TRANSFER
PRO

9 F 06 60 BLANK, VPRED, GAMMA EI (fps, .01°)
PRO

10 F 06 81 ΔVXYZ(LV) at TIG
N40E
R2 XXXX.X Record as ΔVp1 = _____ fps
V32E to 11

11 F 06 33 TIG
(hrs, min, .01sec)
Load same value used initially
PRO

12 F 06 60 BLANK, ΔV DESIRED, GAMMA EI DESIRED
To move West from θp1
TEC: R2 Load ΔVc2 = ΔVc1 - 10
TLC: Load ΔVc2 = ΔVc1 - 10
To move EAST from θp1
TLC or TEC: Load ΔVc2 = ΔVc1 + 10
Record ΔVc2_____ fps
R2 XXXXX.
PRO

13 F 06 61 IMPACT LAT, IMPACT LONG
( .01°)
Record LONG as θc2 = _____.

PAY CLOSE ATTENTION TO SIGNS

Compute ΔθLong = θd - θp1 = + ______
Obtain from Chart ΔVo = + ______
Make sign of ΔVo same as Δθ Long
If ΔVc2 pos, ΔVd = ΔVp1 (step 10) + ΔVo
If ΔVc2 neg, ΔVd = -ΔVp1 + ΔVo
ΔVd = ______

14 V32E to step 1 of Longitude Cont
& use ΔVd in R2 of N60 (Step 2)

OBTAIN ENTRY REFSMMAT (No Comm)
1. Record 400K time from final P37 solution.
   (Step 1 TIG + FNL N39)
2. Use 400K time for T-align P52 (Option 2).
   NOTE: P37 MCC used to compute T-align
   must be performed prior to step 2.
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P38 SOR TARGETING (P78 LM)

V37E (38E or 78E)
F 06 33
TIG (SOR) (hrs, min, .01sec)
Load desired TIG
PRO

2 F 06 55
R3 wt
Load desired wt
PRO

3 F 04 06
R1 00005 Specify Phase Option
R2 0000X X=1 or 2
PRO (To 6 If R2=2)

4 F 06 57
ΔR SOR (.1nm)
Load desired ΔR
PRO

5 F 06 34
SOR TIME (hrs, min, .01sec)
PRO

6 F 16 45
MARK, TFI, -00001 (mark, min-sec, .01°)
(RECYCLE) V32E
(FINAL PASS) PRO (Terminate Marks)

7 F 06 58
HP(SOR), ΔV(SOR), ΔV(SOR-FINAL)
PRO (.1nm, .1fps, .1fps)

8 F 06 81
ΔVXYZ(LV)
PRO (If Recycle - To 6)

9 F 16 45
MARKS, TFI, MGA (marks, min-sec, .01°)
PRO (MGA SET TO -00002 IF NO
REFSMMAT SET OR P78)

10 F 37

P78 - Transmit Mnvr Parameters To LM
P39 STABLE ORBIT MID (P79 LM)

V37E (39E or 79E)

F 16 45 MARK, TFI, -00001 (mark, min-sec, .01°)
(RECYCLE) V32E
(FINAL PASS) PRO (Terminate Marks)

F 06 81 ΔVXYZ(LV) (.1fps)
PRO (If Recycle - To 2)

F 16 45 MARK, TFI, MGA (mark, min-sec, .01°)
PRO (MGA SET TO -00002
IF NO REFSMMAT SET or P79)

F 37

P79 - Transmit Mnvr Parameters To LM
SECTION 5. THRUSTING

P40-SPS THRUSTING

Prethrust Program Complete
CMC & ISS - on
CYCLE CRYO FANS
SCS - OPERATING
TEST C/W LAMPS
EMS MODE - STBY
EMS FUNC - ΔV SET/VHF RNG
SET ΔV ind To 1586.8 fps
EMS MODE - NORMAL
EMS FUNC - ΔV TEST
SPS THRUST Lt - on/off (10 sec)
ΔV ind. stops at -0.1 to -41.5
EMS MODE - STBY
EMS FUNC - ΔV SET/VHF RNG
SET ΔVC
EMS FUNC - ΔV
SPS GAUGING - AC1
PUGS MODE - NORMAL
OXID FLOW vlv - PRI
BMAG MODE (3) - RATE 2
ΔVCG - LM/CSM or CSM
CMC MODE - FREE
AUTO RCS SELECT(16)-As req'd for ullage
LOAD DAP
ROT CONTR PWR NORM (2) - AC/DC
DET SET
V37E 00E
SC CONT - CMC/AUTO

MNVR TO PAD BURN ATT
V62E

1

2

V49E

3 F 06 22 DESIRED FINAL GMBL ANGLES (.01°)
LOAD MNVR PAD GMBL ANGLES
PRO

CHECK FOR WATER IN TUNNEL AREA
4  F 50 18  REQ MNVR TO FDAI RPY ANGLES  (.01°)
   (AUTO)  PRO
   (MAN)   SC CONT - SCS
   MNVR To 6

5  06 18  AUTO MNVR TO FDAI RPY ANGLES  (.01°)

6  F 50 18  REQ TRIM TO FDAI RPY ANGLES  (.01°)
   (AUTO TRIM)  PRO To 5
   (BYPASS)  ENTR

7  BORESIGHT & SXT STAR CHECK
   OPT MODE - CMC
   OPT ZERO - OFF

8  V41 N91E

9  F 21 92 SHAFT, TRUN  (.01°, .001°)
   LOAD SXTS angles

10 41 OPTICS DRIVE
    CHECK SXT STAR
    OPT ZERO - ZERO
    CHECK BORESIGHT STAR (If avail)

11  V37E 40E

12 F 50 18  REQUEST MNVR TO FDAI RPY ANGLES  (.01°)
    (AUTO)  BMAG MODE (3) - RATE 2
    SC CONT - CMC/AUTO
    PRO To 13
    (MAN/DAP)  BMAG MODE (3) - RATE 2
    SC CONT - CMC/HOLD
    MNVR To 14
    (MAN/SCS)  SC CONT - SCS
    MNVR To 14

13  06 18  AUTO MNVR TO FDAI RPY ANGLES  (.01°)
REQUEST TRIM MNVR TO FDAI RPY ANGLES
ALIGN S/C ROLL (.01°)
GDC ALIGN

TVC CHECK & PREP
cb STAB CONT SYS (Pnl 8) - close
cb SPS (12) - close
ATT DB - MIN
RATE - LOW
LIMIT CYCLE - ON
MAN ATT (3) - RATE CMD
BMAG MODE (3) - RATE 2
ROT CONTR PWR DIRECT (2) - OFF
SCS TVC (2) - RATE CMD

* If SCS, SCS TVC (2) - AUTO *
* SC CONT - SCS *

TVC GMBL DRIVE P&Y - AUTO
MN BUS TIE (2) - ON
TVC SERVO PWR #1 - AC1/MNA
TVC SERVO PWR #2 - AC2/MNB
TRANS CONTR PWR - ON
ROT CONTR PWR NORMAL #2 - AC
RHC #2 - armed

PRIMARY TVC CHECK
GMBL MOT P1-Y1 - START/ON (LMP Confirm)

*If SCS, verify Thumbwheel Trim*

THC - CW
Verify NO MTVC

SEC TVC CHECK
GMBL MOT P2-Y2 - START/ON (LMP Confirm)

SET GPI TRIM
Verify MTVC
THC NEUTRAL
Verify GPI returns to 0,0(CMC) or trim(SCS)

ROT CONT PWR NORM #2 - AC/DC
SC CONT - CMC (verify)

(TRIM) GO to step 12
(BYPASS) BMAG MODE (3) - ATT1/RATE2

ENTR

Monitor GPI Response:
00,02,-02,00,02,-02,00,Trim

*TEST FAIL: *
*SC CONT - SCS *
*SCS TVC (2) - AUTO*

ENTR

ROV CONTR PWR DIR (2) - MNA/B
SPS He vlvs (2) - AUTO (verify)
LIMIT CYCLE - OFF
FDAI SCALE - 50/15

ΔV THRUST A(B) - NORMAL
THC - armed
RHC (2) - armed
TAPE RCDR - CMD RESET/HBR/FWD

DSKY BLANKS

(AVE G ON)

EMS MODE - NORMAL
06 40  TFI, VG, AVM  (min-sec,.1fps)
CHECK PIPA BIAS <2fps for 5 sec

59:XX
(-00:XX)
ULLAGE AS REQ

*IF NO ULLAGE:  *
*DIR ULLAGE PB - PUSH*
*CONTROL ATT W/RHC *

MONITOR AVM (R3) COUNTING UP

59:55
(-00:05)
F 99 40  ENG ON ENABLE REQUEST
(AUTO IGN)  PRO AT TFI >0 Sec
(BYPASS IGN)  ENTR To 19
EXIT - V37E 00E
*ullage or DIRECT ullage *

17 00:00  IGN
*IF SCS - THRUST PB - PUSH*

06 40  TFC, VG, AVM  (min-sec,.1fps,.1fps)

*S 97 40  SPS Thrust fail *
*(RESTART)PRO to IGN *
*(RECYCLE)ENTR to TIG-05 sec*

SPS THRUST Lt - ON
AV THRUST B(A) - NORMAL
MONITOR THRUSTING
Pc 95-105 psia
EMS COUNTING DOWN
SPS INJ VLVS (4) - OPEN
SPS He vlvs tb - gray
SPS FUEL/OXID PRESS - 175-195 psia
PUGS - BALANCED
F
5-6

*PROG ALARM*
*V5 N9E 01407 VG INC*
*LOI & TEI THC - CW,*
*FLY MTVC *
*LOI2 & MCC *
*ΔV THRUST A&B - OFF*

00:XX ECO

*EMER SPS CUTOFF:*
*ΔV THRUST A&B-OFF*
*LOI -BT+6 sec*
*LOI2 -BT +__ sec*
*TEI -BT+2 sec & *
* ΔV CTR<-40 fps *

18   F 16 40   TFC(STATIC),VG,ΔVM   (min-sec,.1fps)
ΔV THRUST A&B - OFF
VERIFY THRUST OFF
SPS INJ VLVS (4) - CLOSED
SPS He vlvs tb (2) - bp
GMBL MTRS (4) - OFF (LMP Confirm)
TVC SERVO PWR 1&2 - OFF
MN BUS TIE (2) - OFF

PRO

19   F 16 85   VG XYZ(CM)   (.1fps)
NULL RESIDUALS (TEI & MCC)
RECORD ΔV COUNTER & RESIDUALS ΔVC
EMS FUNC - OFF VGX
EMS MODE - STBY VGY
BMAG MODE (3) - RATE 2
ATT DB - MAX

PCM BIT RATE - LOW
TRANS CONT PWR - OFF
ROT CONTR PWR DIRECT (2) - OFF
cb SPS P1&P2,Y1&Y2 - open

PRO

20   F 37   V82E
P41 - RCS THRUSTING
Prethrust Program Complete
CMC - on
ISS - on
SCS - OPERATING
TEST C/W LAMPS
EMS MODE - STBY
EMS FUNC - ΔV SET/VHF RNG
Set EMS ΔV ind to 1586.8 fps
EMS MODE - NORMAL
EMS FUNCT - ΔV TEST
SPS THRUST lt - on/off (10 sec)
ΔV ind stops at -0.1 to -41.5
EMS MODE - STBY
EMS FUNCT - ΔV SET/VHF RNG
Slew ΔV ind to -100 fps
EMS FUNCT - ∆V
EMS MODE - NORMAL
Wait 100 sec & record ∆V ind
If change to ind -
  <1fps, no correction
  >1fps, ground correction req
EMS MODE - STBY
EMS FUNCT - ∆V SET/VHF RNG
SET ∆VC
EMS FUNC - ∆V
BMAG MODE (3) - RATE 2
CMC MODE - FREE
AUTO RCS SELECT (16) - As Req'd
LOAD DAP
ROT CONTR PWR NORMAL (2) - AC/DC
ROT CONTR PWR DIRECT (2) - MNA/B
DET SET

V37E 00E
SC CONT - CMC/AUTO

1
MNVR TO PAD BURN ATTITUDE
V62E

2
V49E

3 F 06 22 DESIRED FINAL GMBL ANGLES (.01°)
LOAD MNVR PAD GMBL ANGLES
PRO

4 F 50 18 REQ MNVR TO FDAI RPY ANGLES (.01°)
(AUTO) PRO
(MAN) SC CONT - SCS
MNVR To 6

5 06 18 AUTO MNVR To FDAI RPY ANGLES (.01°)

6 F 50 18 REQ TRIM To FDAI RPY ANGLES (.01°)
(AUTO TRIM) PRO To 5
(BYPASS) ENTR
BORESIGHT & SXT STAR CHECK
OPT MODE - CMC
OPT ZERO - OFF

V41 N91E

SHAFT, TRUN (.01°, .001°)
LOAD SXTS angles

OPTICS DRIVE
CHECK SXT STAR
OPT ZERO - ZERO
CHECK BORESIGHT STAR (If avail)

V37E 41E

REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO) BMAG MODE (3) - RATE 2
SC CONT - CMC/AUTO
PRO To 13
(MAN/DAP) BMAG MODE (3) - RATE 2
SC CONT - CMC/HOLD
MNVR To 14
(MAN/SCS) SC CONT - SCS
MNVR To 14

AUTO MNVR TO FDAI RPY ANGLES (.01°)

REQUEST MNVR TO FDAI RPY ANGLES (.01°)
(AUTO TRIM) BMAG MODE (3) - RATE 2
ALIGN SC ROLL
SC CONT - CMC/AUTO
PRO To 13
(BYPASS) ATT DB - MIN
RATE - LOW
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE 2
GDC ALIGN

VG X,Y,Z (.1fps)
55:00
(-05:00)
TRANS CONT PWR - on (up)
HAND CONTROLLERS - armed

59:25
(-00:35)
DSKY BLANKS

59:30
(-00:30)
VG X,Y,Z (AVE G ON)
TAPE RCDR - CMD RSET/HBR/FWD
LIMIT CYCLE - OFF
EMS MODE - NORMAL

00:00
VG X,Y,Z
NULL COMPONENTS
RECORD ΔV COUNTER & RESIDUALS ΔVC
TAPE RCDR - off (ctr) VGX
PCM BIT RATE - LOW
HAND CONTROLLERS - locked VGY
EMS FUNC - OFF VGZ
EMS MODE - STBY
TRANS CONT PWR - OFF
BMAG MODE (3) - RATE 2

17 F 16 85
VG X,Y,Z
V82E

18 F 37
HA,HP,TFF (.1nm,min-sec)

* R3-59B59 HP>49.4 nm/35K ft *

20 F 37
00E
P47 Thrust Monitor Program

CMC - on
ISS - on & aligned

1. V37E 47E
   F 16 83 \(\Delta V\) XYZ(CSM)
   (lfs)

   *VI, HDOT, H available by N62E*
   *KEY RLSE to return to N83*

(RECYCLE) V32E
(TERM) PRO

2. F 37 XXE
SECTION 6. ALIGNMENTS

P51 - IMU ORIENTATION

CMC - on
ISS - on
SCS - operating
BMAG MODE (3) - RATE 2
G/N PWR OPTICS - on (verify)
OPT ZERO - ZERO (verify)
OPT MODE - MAN

1. V37E 51E
   F 50 25 00015 MNVR TO ACQ STARS
   (Coarse Align IMU To 0,0,0) - ENTR to 2
   (BYPASS) PRO to 3

2. 41 22 DESIRED GIMBAL ANGLES (0,0,0)
   NO ATT 1t - on then off, to 1

3. F 51 PLEASE MARK
   OPT ZERO - OFF
   MARK

4. F 50 25 00016 TERMINATE MARKS
   PRO

5. F 01 71 000DE STAR CODE
   Load desired code
   PRO to 3 after 1st MARK (to 6 if DE=00)
   to 7 after 2nd MARK (to 6 if DE=00)

6. F 06 88 CELESTIAL BODY VECTOR
   Load desired vector
   PRO to 3 after 1st MARK
   to 7 after 2nd MARK

7. F 06 05 STAR ANGLE DIFFERENCE
   (.01°)
   (RECYCLE) V32E to 1
   (ACCEPT) PRO

8. F 37 52E - bypass ZERO OPTICS
   or XXE
   OPT ZERO - ZERO
F
6-2

P52 IMU REALIGN
CMC - on
ISS - on
SCS - operating
BMAG MODE (3) - RATE 2
G/N PWR OPTICS - on (verify)
OPT ZERO - ZERO (verify)
OPT MODE - CMC

1 F 04 06 V37E 52E
R1 00001 IMU ALIGN OPTION
R2 00001 PREF PRO to 4
2 NOM PRO to 2
3 REFSMMAT PRO to 7
4 LDG SITE PRO to 2

2 F 06 34 GET ALIGN (0,0, 0 initially) (hr,min,sec)
Load desired GET
TO SPECIFY PRESENT TIME - PRO on (0,0,0)
PRO (NOM go to 4)

3 F 06 89 LAT, LONG/2, ALT (.001°,.001°,.01nm)
Load ldg site coords
PRO

4 F 06 22 NEW ICDU ANGLES OG, IG, MG (.01°)
(IF MG>+.70°, MNVR) V32E - to 4
PRO

5 F 50 25 00013 GYRO TORQUE
(COARSE) PRO - NO ATT 1t - on then off - to 7
(TORQUE) CMC MODE - FREE
ENTR

6 16 20 ICDU ANGLES (.01°)
When torque complete - go to 17

7 F 50 25 00015 STAR SELECT
(MNVR If Necessary)
(PICAPAR) PRO
(MAN ACQ) ENTR

8  F 01 70  000DE STAR CODE
Load desired code
OPT MODE - CMC (verify)
OPT ZERO - OFF
PRO to 10 (to 9 if DE=00)
*F 05 09 00404 (TA>90°)*
*MNVR - PRO to 10 *

9  F 06 88  CELESTIAL BODY VECTOR
Load desired vector
PRO
*F 05 09 00404 (TA>90°)*
*MNVR - PRO to 10 *

10  06 92  SHAFT, TRUN (.01°, .001°)
*PROG ALARM (TA>50°)*
*V5N9E 00407 *
*KEY RLSE *
*MNVR till R2<49775 *

(MARK ROUTINE) OPTICS MODE - MAN

11  F 51  PLEASE MARK
MARK

12  F 50 25  00016 TERMINATE MARKS
PRO

13  F 01 71  000DE STAR CODE
Load code (if necessary)
PRO to 8 after 1st MARK (to 14 if DE=00)
to 15 after 2nd MARK (to 14 if DE=00)

14  F 06 88  CELESTIAL BODY VECTOR
Load vector
PRO to 8 after 1st MARK
to 15 after 2nd MARK
15 F 06 05 STAR ANGLE DIFFERENCE (.01°)
   (REJECT) V32E to 17
   (ACCEPT) PRO

16 F 06 93 TORQUING ANGLES OG, IG, MG (.001°)
   (TORQUE) CMC MODE - FREE
   PRO
   (BYPASS) V32E

17 F 50 25 00014 ALIGNMENT CHECK
   (RECHECK) PRO To 7
   (BYPASS) ENTR

18 F 37 OPT ZERO - ZERO
   XXE

P53 - BACKUP IMU ORIENT DETERMINATION
   CMC - on
   ISS - on
   SCS - operating
   MAN ATT (3) - MIN IMP
   COAS LOS DETERMINATION - complete

1 V37E 53E
   F 50 25 00015 MNVR To ACQ STARS
   (BYPASS) (Coarse Align IMU to 0,0,0) - ENTER to 2
   PRO to 3

2 41 22 DESIRED GIMBAL ANGLES (0,0,0)
   NO ATT lt - on then off, to 1

3 F 06 94 ALT LOS OPT ANGS SHAFT, TRUN (.01°, .001°)
   Load proper angles
   PRO

4 F 53 PLEASE MARK
   Center Target
   ENTR
5  F 50 25  00016 TERMINATE MARKS  
     (REJECT) ENTR to 4  
     PRO

6  F 01 71  000DE STAR CODE  
     Load desired code  
     PRO to 3 after 1st MARK (to 7 if DE=00)  
     to 8 after 2nd MARK (to 7 if DE=00)

7  F 06 88  CELESTIAL BODY VECTOR  
     Load desired vector  
     PRO to 3 after 1st MARK  
     to 8 after 2nd MARK

8  F 06 05  STAR ANGLE DIFFERENCE  
     (.01°)  
     (RECYCLE) V32E to 1  
     (ACCEPT) PRO

9  F 37  XXE

P54 - BACKUP IMU REALIGN
     CMC - on  
     ISS - on  
     SCS - operating  
     MAN ATT (3) - MIN IMP  
     COAS LOS DETERMINATION - complete

1  F 04 06  V37E 54E  
     R1 000001 IMU ALIGN OPTION  
     R2 000001 PREF PRO to 4  
     2 NOM PRO to 2  
     3 REFSMMAT PRO to 7  
     4 LDG SITE PRO to 2

2  F 06 34  GET ALIGN (0,0,0 initially)(hr,min,sec)  
     Load desired GET  
     TO SPECIFY PRESENT TIME - PRO on (0,0,0)  
     PRO (NOM go to 4)

3  F 06 89  LAT, LONG/2, ALT (.001°,.001°,.01nm)  
     Load ldg site coords  
     PRO
4  F 06 22  NEW ICDU ANGLES OG, IG, MG  (.01°)  
    (IF MG>±70°, MNVR) V32E to 4
    PRO

5  F 50 25  00013 GYRO TORQUE  
    (COARSE) PRO - NO ATT 1t - on  
    then off - to 7
    (TORQUE) CMC MODE - FREE
    ENTR

6  16 20  ICDU ANGLES  (.01°)  
    When Torque complete go to 17

7  F 50 25  00015 STAR SELECT  
    (Mnvr If Necessary)
    (PICAPAR) PRO
    **F 05 09 00405 NO PAIR **
    *(CREW SPECIFY) PRO to 8 *
    *(PICAPAR) MNVR-V32E to 7*

    (MAN ACQ) ENTR

8  F 01 70  000DE STAR CODE  
    Load desired code
    PRO to 10 (to 9 if DE=00)

9  F 06 88  CELESTIAL BODY VECTOR  
    Load desired vector
    PRO

10 F 06 94  ALT LOS OPT ANGS SHAFT, TRUN(.01°, .001°)
    Load angles
    PRO

11 F 53  PLEASE MARK  
    Center Target
    ENTR

12 F 50 25  00016 TERMINATE MARKS  
    (REJECT) ENTR to 11
    PRO
13 F 01 71 000DE STAR CODE
Load code (if necessary)
PRO to 8 after 1st MARK (to 14 if DE=00)
to 15 after 2nd MARK (to 14 if DE=00)

14 F 06 88 CELESTIAL BODY VECTOR
Load vector
PRO to 8 after 1st MARK
(15 after 2nd MARK

15 F 06 05 STAR ANGLE DIFFERENCE (.01°)
(ACCEPT) PRO

16 F 06 93 TORQUING ANGLES OG, IG, MG (.001°)
(TORQUE) CMC MODE - FREE
PRO
(BYPASS) V32E

17 F 50 25 00014 ALIGNMENT CHECK
(RECHECK) PRO to 7
(BYPASS) ENTR

18 F 37 XXE
VENUS HALF-UNIT VECTORS
LIFTOFF - 16 JULY 69, 1330 HRS GMT

<table>
<thead>
<tr>
<th>GET HRS</th>
<th>X vector</th>
<th>Y vector</th>
<th>Z vector</th>
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</table>

* Venus is visible from the landing sites.
**MARS HALF-UNIT VECTORS**

LIFTOFF - 16 JULY 69, 1330 HRS GMT

<table>
<thead>
<tr>
<th>GET HRS</th>
<th>X vector</th>
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<th>Z vector</th>
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<td>199</td>
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**JUPITER HALF-UNIT VECTORS**

LIFTOFF - 16 JULY 69, 1330 HRS GMT

<table>
<thead>
<tr>
<th>GET HRS</th>
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<th>Z vector</th>
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**SATURN HALF-UNIT VECTORS**

LIFTOFF - 16 JULY 69, 1330 HRS GMT

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<th>GET HRS</th>
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<td>199</td>
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<td>0.29254</td>
<td>0.10360</td>
</tr>
</tbody>
</table>
SECTION 7. TARGETING

P72 LM CSI TARGETING

1. V37E 72E
   F 06 11 TIG (CSI) (hrs, min, .01 sec)
   RECORD
   ______ (hrs)
   ______ (min)
   ______ (sec)
   PRO

2. F 06 55 APSIS (CDH), E, CENTANG (+0000N, .01°)
   (For CDH N from CSI, load non-zero in R3)
   RECORD
   ______ (APSIS)
   ______ (E)
   ______ (CENTANG)
   PRO

3. F 06 37 TIG TPI (hrs, min, .01 sec)
   RECORD
   ______ (hrs)
   ______ (min)
   ______ (sec)
   PRO

4. F 16 45 MARKS, TFI, -00001 (marks, min-sec)
   (RECYCLE) V32E to 5
   (FINAL PASS) SET EVENT TIMER TO TFI
   (TERMINATE MARKING)
   PRO

* F 05 09
* 00600 No Intersection on
* 00601 First Iteration
* 00602 hp+CSI < 85nm/5.8nm
* 00603 TIG(CDH)-TIG(CSI)<10min
* 00604 TIG(TPI)-TIG(CDH)<10min
5 F 06 75 $\Delta H(CDH), \Delta T(CDH-CSI), \Delta T(TPI-CDH)$

RECORD (Final Pass Only)

$(\Delta H)$

$(\Delta T\ CDH-CSI)$

$(\Delta T\ TPI-CDH)$

PRO

6 F 06 81 $\Delta V\ XYZ(LV)\ (CSI)$

RECORD (Final Pass Only)

$(\Delta VX)$

$(\Delta VY)$

$(\Delta VZ)$

$V90E$ (Correct out of plane velocity)

F 04 12

R1 00002 Specify vehicle

R2 00001 CSM

00002 LM

PRO

F 06 16 T EVENT

RECORD

$(hrs)$

$(min)$

$(sec)$

PRO

F 06 90 Y, YDOT, PSI

(RECYCLE) V32E To (F 06 16)

RECORD

$(Y)$

$(YDOT)$

$(PSI)$

PRO
P 73

7  F 06 82  ΔV XYZ(LV) (CDH)  (.1fps)

   RECORD (Final Pass Only)
   ______(ΔVX)
   ______(ΔVY)
   ______(ΔVZ)
   PRO

8  F 16 45  M, TFI, MGA  (marks, min-sec, .01°)
   (RECYCLE) V32E To 5
   (TERMINATE) PRO To 5
   (FINAL PASS) SET EVENT TIMER TO TFI
   PRO TRANSMIT PARAMETERS TO LM
   (see Steps 1-7)

9  F 37

P73 LM CDH TARGETING

1  V37E 73E
   F 06 13  TIG CDH  (hrs, min,.01 sec)

   RECORD
   ______(hrs)
   ______(min)
   ______(sec)
   PRO

2  F 16 45  MARKS, TFI, -00001  (marks, min-sec)
   (RECYCLE) V32E To 3
   (FINAL PASS)
   PRO (TERMINATE MARKING)

   *F 05 09   00611 NO TIG FOR *
   * EL ANGLE *
   * (CONTINUE P73) PRO To 3 *
   * (RECYCLE) V32E To 1 CHANGE*
   * TIG *
   * (TERMINATE) V34E To 6 *
3 F 06 75 ΔH(CDH), ΔT(TPI-CDH), ΔT(TIG TPI: P73-P72)

RECORD (Final Pass Only) (.1nm, min-sec)
  (ΔH)
  (ΔT TPI-CDH)
  (ΔT TIG TPI)

PRO

4 F 06 81 ΔV XYZ(LV) (CDH) (.1fps)

RECORD (Final Pass Only)
  (ΔVX)
  (ΔVY)
  (ΔVZ)

V90E (Correct out of plane velocity)

F 04 12 R1 00002 Specify vehicle
         R2 00001 CSM
         00002 LM

PRO

F 06 16 T EVENT (hrs, min, .01 sec)

RECORD
  (hrs)
  (min)
  (sec)

PRO

F 06 90 Y, YDOT, PSI (.01nm, .1fps, .01°)
(RECYCLE) V32E To (F 06 16)

RECORD
  (Y)
  (YDOT)
  (PSI)

PRO

5 F 16 45 M, TFI, MGA (marks, min-sec, .01°)
(RECYCLE) V32E To 3
(TERMINATE) PRO To 3
6 F 37

{FINAL PASS} SET EVENT TIMER TO TFI
PRO TRANSMIT PARAMETERS
TO LM (See Steps 1-4)

P76 - TARGET ΔV

1 F 06 84 V37E 76E
ΔV XYZ (.1fps)
Load ΔV
PRO

2 F 06 33 TIG
Load TIG
PRO

3 F 37 OOE
V82E (check Lm parameters)

4 F 16 44 HA, HP, TFF
(.1 nm, min-sec)

*R3 - 59B59HP > 49.4 nm/35K ft*

PRO
SECTION 8.  EXTENDED VERBS

V35 - DSKY CONDITION LIGHT TEST

CMC - on

1

Key V37E 00E (required)

DSKY - P00

2

Key V35E

3

Monitor the following events

a. All DSKY condition lts - on

b. ISS warning lt - on

CMC warning lt - on

c. All DSKY numerical windows display 8

Sign positions in R1, R2, R3 show + V, N windows flash

Wait 5 sec

d. All DSKY warning lts - off

e. ISS lt - off

CMC lt - off

f. P00 will be displayed.

g. Key RSET

V41 N91 COARSE ALIGN OCDU's

CMC - on

ISS - on

G/N PWR OPTICS - on

OPT MODE - CMC

OPT ZERO - OFF

V41N 91E
2  F 21 92  SHAFT, TRUN NEW OCDU  (.01°, .001°)
Load desired shaft and trun

3  41  OPTICS DRIVE TO SPECIFIED ANGLES

V41 N20 COARSE ALIGN ICDU's
  CMC - on
  ISS - on

1  V41N 20E

2  F 21 22  NEW ICDU ANGLES RPY  (.01°)
Load desired ICDU angles

3  41  NO ATT lt - on
      *POSS PROG ALARM  *
      *V5 N9E 211 Coarse align error*  *
      *Repeat V41 N20  *

4  V40 N20E
NO ATT lt - off  
Wait 20 sec

5  V37E XXE

V42 GYRO TORQUING
  CMC MODE - FREE

1  F 21 93  LOAD DELTA GYRO ANGLES (XYZ)  (.001°)
(In flight - 90° max)

2  42  NO ATT lt - off  
Monitor Gyro Torquing on FDAI
V48 - DAP ACTIVATION
CMC MODE - FREE

V48E
F 04 46
R1 ABCDE
R2 ABCDE

INSURE Left Digit of R1 is:
0 - NO DAP
1 - CSM
2 - CSM/LM
3 - SATURN DAP
6 - CSM/LM ASC

PRO

PRO To Prog in progress
V46E

V48 - DAP DATA LOAD PROCEDURE

<table>
<thead>
<tr>
<th>VEHICLE CONFIG</th>
<th>QUAD A/C FOR X</th>
<th>QUAD B/D for X</th>
<th>ERR DEADBAND</th>
<th>RATE SELECT</th>
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</thead>
<tbody>
<tr>
<td>0 - No DAP</td>
<td>0 - Fail A/C</td>
<td>0 - Fail B/D</td>
<td>0 - ± 5°</td>
<td>0 - 0.05°F/sec</td>
</tr>
<tr>
<td>1 - CSM</td>
<td>1 - Use A/C</td>
<td>1 - Use B/D</td>
<td>1 - ± 5.0°</td>
<td>1 - 0.2°F/sec</td>
</tr>
<tr>
<td>2 - CSM &amp; LM</td>
<td>0 - Fail</td>
<td>0 - Fail</td>
<td>2 - ± 5.0°F</td>
<td>2 - 0.2°F/sec</td>
</tr>
<tr>
<td>3 - CSM &amp; SIVB</td>
<td>1 - Use</td>
<td>1 - Use</td>
<td>3 - 2.0°F/sec</td>
<td>3 - 2.0°F/sec</td>
</tr>
<tr>
<td>6 - CSM &amp; LM</td>
<td>0 - Fail</td>
<td>0 - Fail</td>
<td>4 - Fail</td>
<td>4 - 0.05°F/sec</td>
</tr>
</tbody>
</table>

PRO

2 F 06 47 CSM WT, LM WT
Load correct values
PRO

3 F 06 48 TRIM ENGINE GMBL
Load correct values
PRO

4 V46E to activate, if req.
V49 CREW DEFINED MANEUVER
CMC - on
ISS - on
SCS - operating

1 V37E 00E
   V62E

2 V49E
   F 06 22 NEW ICDU ANGLES RPY (.01°)
   Load desired angles
   PRO

3 F 50 18 REQ MNVR TO FDAI RPY ANGLES (.01°)
   AUTO BMAG MODE (3) - RATE 2
   SC CONT - CMC
   CMC MODE - AUTO
   PRO
   (MAN) MNVR - To 5

4 06 18 AUTO MNVR TO FDAI RPY ANGLES (.01°)

5 F 50 18 REQ TRIM MNVR TO FDAI RPY ANGLES
   (TRIM) PRO To 4
   (BYPASS) ENTR

V55 - CMC TIME UPDATE

1 V55E
   F 21 24 LOAD Δ CMC TIME (hrs, min, .01sec)

V64 HI GAIN ANTENNA POINTING

1 V37E 00E
   V64E

2 F 06 51 RHO, GAMMA (.01°, .01°)
   HGA TRACK - MAN
   Set in required P&Y Angles
   S BD ANT - HI GAIN
   TRACK - AUTO
   PRO
V67 - W-MATRIX ERROR DISPLAY

1

F 06 99 POS ERR, VEL ERR, OPT CODE (ft,.1fps)

R3 00001=Rend
00002=Orbital
00003=Cislunar
00000=No Reinitialization

Load desired data
To reinitialize Cislunar W-matrix,
Load: R1 +30330 +30000
R2 +00330 +00330
R3 +00003

PRO

V74 CMC DOWNLINK

1

(If needed) V21 NO1E 333E

F 21 01 R3 333
R1 20000E for 4 Dumps
or 10000E for 2 Dumps
or 04000E for 1 Dump

V74E (Places erasable memory on downlink)

V82 ORBIT PARAMETER DISPLAY

Note: If high CMC activity (e.g.P4Xw.Lambert)
POSS PROG ALARM and restart (no light)
-code 1201 or 1202 stored

1

V82E (If AVE G On, Go To 2)

F 04 12 R1 00002 Specify Vehicle
R2 00001 CSM
00002 LM

PRO

2

F 16 44 HA, HP, TFF (.1nm,.1nm,min-sec)
(RECYCLE) V32E To 2 (Not Nec If AVE G On)
(AR-miss dist DISP-P11 & POO) N50E To 3
(TF PER) N32E To 4
(EXIT) PRO
3 F 16 50 ΔR (miss, dist) HP, TFF (0.1nm, 0.1nm, min-sec)
   KEY RLSE To 2

4 F 16 32 TIME FROM PER (Useful only if TFF=-59859)
   (hrs, min, 0.01 sec)
   KEY RLSE To 2

V83 RNDZ PARAMETER DISPLAY #1
Note: If high CMC activity (e.g. P3X or P7X w
   P20), POSS PROG ALARM and restart (no light)-code 1201 or 1202 stored
If alt above earth or moon > 432 nm:
   P23 running - do not key V83 (or 85)
   P23 not running:
      Wait for no integration (COMP ACTY not on continuously)
      V96E (selects POO)
      V83E (or 85E) - perform routine
      V37E OOE

1 F 16 54 V83E
   RANGE, RANGE RATE, THETA (0.01nm, 0.1fps, 0.01°)
   PRO

V85 - RNDZ PARAMETER DISPLAY #2
Note: See V83 restrictions

1 F 16 53 V85E
   RANGE, RANGE RATE, PHI (0.01nm, 0.1fps, 0.01°)
   PRO

V87 - SET VHF RNG FLAG
VHF - ON
P20 - running

1 V87E (starts VHF range sampling)

2 V88E (TERMINATE)
   or V37E XXE
V89 - RENDEZVOUS FINAL ATTITUDE

Note: This routine will change N17 cells
CMC - on
ISS - on
SCS - operating

1 V37E OOE
   V62E

2 V89E
   F 04 06 R1 00003 SPECIFY TRACKING ATTITUDE
   R2 00001 (PREF)
       00002 (+X AXIS)
   PRO

3 F 06 18 FINAL FDAI RPY ANGLES
   AUTO MNVR) PRO
   (UPDATE DISPLAY) V32E

4 F 50 18 REQ MNVR TO FDAI RPY ANGLES
   (AUTO) BMAG MODE (3) - RATE 2
   SC CONT - CMC
   CMC MODE - AUTO
   PRO
   (MAN) MNVR To 6

5 06 18 AUTO MNVR TO FDAI RPY ANGLES

6 F 50 18 REQ MNVR TO FDAI RPY ANGLES
   (TRIM) ALIGN SC In ROLL
   PRO To 5
   (BYPASS) ENTR

V90 - OUT-OF-PLANE DISPLAY

1 V90E
   F 04 12 R1 00002 Specify Vehicle
   R2 00001 CSM
       00002 LM
   PRO
2 F 06 16 GET EVENT (hrs, min, .01sec)
Load desired time
PRO

3 F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
(RECYCLE) V32E to 2
(EXIT) PRO

V91 - COMPUTE BANKSUM
CMC - on (req)

V91E

1 V37E 00E

2 V91E

F 05 01 R1 - Sum of all cells in bank
R2 - Bank number
R3 - Bugger word
Verify R1=R2 or R1+R2=77777 (If not, rcd R2)
(NEXT BANK) PRO
(TERM) V34E

V93 - ENABLE W-MATRIX INITIALIZATION
SECTION 9. SCS GENERAL

SCS POWER UP
AUTO RCS SELECT (16) - OFF
BMAG MODE (3) - RATE 2
CMC MODE - FREE
SC CONT - CMC
cb SCS LOGIC PWR (4) - close
ΔV CG - as required
LOGIC PWR 2/3 - on (up)
SIG COND/DRIVER BIAS PWR (2) - ACL
SCS ELEC PWR - CDC/ECA (170 watts)
FDAI PWR - OFF (verify)
BMAG PWR (2) - ON (110 watts)
FDAI PWR - BOTH (104 watts)
AUTO RCS SELECT (16) - enable

SCS POWER DOWN
EMS FUNCTION - OFF
EMS MODE - STBY
FDAI SCALE - 5/1
FDAI SELECT-1/2
FDAI SOURCE - ATT SET
ATT SET - IMU
MAN ATT (3) - MIN IMP
ATT DB - MAX
RATE - LOW
AUTO RCS SELECT (16) - OFF
TRANS CONTR PWR - OFF
RHC PWR NORMAL (2) - OFF
RHC PWR DIRECT (2) - OFF
CMC MODE - FREE
BMAG MODE (3) - RATE 2
SCS TVC (2) - RATE CMD
.05G sw - OFF
α/Pc sw - Pc
TVC GMBL DRIVE (P&Y) - AUTO
BMAG PWR (2) - WARMUP (38 watts)
TVC SERVO PWR (2) - OFF
FDAI PWR - OFF
LOGIC PWR 2/3 - OFF
SCS ELEC PWR - OFF
SIG COND/DRIVER BIAS PWR (2) - OFF
GDC ALIGNMENT TO IMU GIMBAL ANGLES

IMU - on
SCS - operating
Damp vehicle rates
ATT SET dials - set to IMU angles on FDAI 1
FDAI SELECT - 1
FDAI SOURCE - ATT SET
ATT SET - IMU
ATT SET dials - null FDAI 1 error needles
ATT SET - GDC
GDC ALIGN PB - push until needles nulled
FDAI SEL - 1/2

SCS ATTITUDE REFERENCE COMPARISON

CMC - on
IMU - on
SCS - operating
If SIVB SEPARATED: Damp vehicle rates

1  
Key V16 N20E (press IMU angs)

2  
FDAI SELECT - 1
FDAI SOURCE - ATT SET
ATT SET - GDC
ATT SET dials - null FDAI 1 error needles
Key VERB when nulled (freeze display)
Record from DSKY:
R \ \ \ \ °, P \ \ \ \ °, Y \ \ \ °
Record ATT SET dials:
R \ \ \ \ °, P \ \ \ \ °, Y \ \ \ °

BACKUP GDC ALIGNMENT (IMU FAILED)

SCS - operating
RECORD: R,P,Y ALIGN from MSFN

1  
Set SCT to 180° SHFT, 7.5° TRUN
F
9-3

ATT SET dials - R,P,Y ALIGN

3

MNVR to STARS
R line - Vega (36)
50° mark - Deneb (43)

or

<table>
<thead>
<tr>
<th>NORTH</th>
<th>SOUTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>R line - Polaris (5)</td>
<td>Atria (34)</td>
</tr>
<tr>
<td>50°mark - Navi (3)</td>
<td>Acrux (25)</td>
</tr>
</tbody>
</table>

4

FDAI SELECT - 1
ATT SET - GDC
GDC ALIGN - push

5

To Roll about Z:
1 Sh 180°
2 Trun 7.5°
3 Star 50°

BACKUP GDC & IMU ALIGNMENT (CMC FAILED)

ISS - on
SCS - operating
RECORD: R,P,Y ALIGN from MSFN

Set SCT to 180° SHFT, 7.5° TRUN
ATT SET dials - R,P,Y ALIGN
FDAI SELECT - 1/2

CAGE IMU when near 0,0,0 on FDAI 1

MNVR to STARS
R line - Vega (36)
50° mark - Deneb (43)

or

<table>
<thead>
<tr>
<th>NORTH</th>
<th>SOUTH</th>
</tr>
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<tbody>
<tr>
<td>R line - Polaris (5)</td>
<td>Atria (34)</td>
</tr>
<tr>
<td>50°mark - Navi (3)</td>
<td>Acrux (25)</td>
</tr>
</tbody>
</table>

5

FDAI SELECT - 1
ATT SET - GDC
GDC ALIGN - push
ATT SET dials - 0,0,0

MNVR to 0,0,0 and null error needles

UNCAGE IMU
FDAI SELECT - 1/2

IN-PLANE GDC ALIGNMENT
CMC - on
ISS - on
SCS - operating

V37E 52E
F 04 06
00001
Load R2=00002
PRO

GET ALIGN 0,0,0
PRO

R,P,Y

Set ATT SET dials to R,P,Y on DSKY

FDAI SELECT - 1
ATT SET - GDC
GDC ALIGN - push

PGNS ORDEAL INITIALIZATION
(In-Plane Alignment Req'd)

FDAO 1 or 2 - ORB RATE
EARTH/LUNAR - as req'd

V82E
F 04 12
00002 SPECIFY VEHICLE
00001
PRO
3  F 16 44  HA, HP
Calculate Average
ALT SET - Set Average
PRO

4  F 16 54  V83E
R, RDOT, THETA
MODE - HOLD/FAST
SLEW - To THETA
MODE - OPR/SLOW
PRO

SCS ORDEAL INITIALIZATION
(IN-PLANE GDC ALIGNMENT REQ'D)

1  FDAI 1 or 2 - ORB RATE
   EARTH/LUNAR - as req'd

2  MSFN Supply Altitude
   ALT SET - Set

3  SC +X At the Horizon
   MODE - HOLD/FAST
   SLEW FDAI
   MODE - OPR/SLOW

COAS LOS DETERMINATION
CMC - on
ISS - on
SCS - operating
SC CONT - SCS
MAN ATT (3) - MIN IMP
G/N PWR OPTICS - on
OPT MODE - CMC
OPT ZERO - ZERO (verify)

1  V37E 52E
2 F 04 06 00001
   V22E 3E
   PRO

3 F 50 25 00015
   ENTR

4 F 01 70 0000E STAR CODE
   LOAD BORESIGHT STAR CODE
   OPT ZERO - OFF
   PRO (Ignore PROG ALARM)

5 06 92 SHAFT, TRUN (.01°, .001°)
   Center target
   MARK with VERB key
   Record SHAFT, TRUN ___ ___
   (REPEAT) KEY RLSE
   (EXIT) V37E XXE
   OPT ZERO - ZERO

   PASSIVE THERMAL CONTROL (G&N)

   RHC - Locked
   FDAI SCALE - 5/1

1 V48 (Select 0.5° DB)
   V46E
   V37E 00E
   V49E

2 F 06 22 Load V06N22 With Desired Initial Attitude
   PRO
   \[ R = \text{Present Roll} \] assuming
   \[ P = 90° \text{ or } 270° \] PTC REFS NMMAT

3 F 50 18 BMAG MODE (S) - RATE 2
   SC CONT - CMC
   CMC MODE - AUTO
   PRO

4 06 18 AUTO MANEUVER
   F 50 18
5. Damp vehicle rates:

   ENTR

   PNL 8:
   - Disable all jet on two adjacent quads
   - Wait 20 minutes for rates to damp
   - MAN ATT (PITCH & YAW) - ACCEL CMD
   - Enable all jets
   - BMAG MODE (3) - RATE 2

6. Set att hold:
   V21NO1E
   1332E
   00000E

7. Select roll rate

   +0.1°/s   -0.1°/s   +0.3°/s   -0.3°/s
   V24N01E   V24N01E   V24N01E   V24N01E
   3125E     3125E     3125E     3125E
   00003E    77774E    00012E    77776E
   24400E    53400E    35400E    42400E
   V21E      V21E      V24E      V24E
   3176E     3176E     3175E     3175E
   35101E    42676E    00002E    77775E
   27303E    50474E

8. Start roll maneuver
   V21NO1E
   1332E
   70000E

9. Set DBD
   V21NO1E
   3255E

10. MAN ATT (ROLL) - ACCEL CMD
    MAN ATT (PITCH & YAW) - RATE CMD
To exit G&N PTC

1. **MAN ATT (3) - ACCEL CMD**

2. Verify DAP load

3. Select new desired att:
   - **V49E**
   - F 06 22 New ICDU angles
   - SC CONT - SCS, then CMC
   - F 50 18

4. Start auto maneuver:
   - **PRO**
   - MAN ATT (3) - RATE CMD within 180° (in direction of roll) of new att.

For simple termination:
   - **V37E X0E**
   - **MAN ATT (3) - RATE CMD**

**PASSIVE THERMAL CONTROL (SCS)**

- (X axis Roll, Pitch & Yaw Hold)
- CMC - on (for CMC MNVR)
- ISS - on (for CMC MNVR)
- SCS - operating
- CMC MODE - FREE
- BMAG MODE (3) - RATE 2
- AUTO RCS SEL (12) - MNA/B
- LOAD DAP
- ROT CONTR PWR NORMAL #2 - AC/DC
- V37E 00E
- RECORD: R,P,Y PTC from MSFN

1. **MNVR TO PTC ATT**
   - **V62E**

2. **V49E**

3. **F 06 22** DESIRED FINAL GMBL ANGLES
   - LOAD R,P,Y PTC
   - **PRO**

4. **F 50 18** REQ MNVR TO FDAI R,P,Y ANGLES
   - (AUTO) SC CONT - CMC
   - CMC MODE - AUTO
   - **PRO**
(MAN) SC CONT - SCS
MNVR to 6

5 06 18 AUTO MNVR TO FDAI R,P,Y ANGLES (.01°)

6 F 50 18 REQ TRIM TO FDAI R,P,Y ANGLES (.01°)
(AUTO TRIM)
SC CONT - CMC
CMC MODE - AUTO
PRO to 5
(BYPASS) DEADBAND - MAX
RATE - HIGH
LIMIT CYCLE - on (up)
AUTO RCS SEL PITCH & YAW -
Set for single jet operation
MAN ATT (PITCH,YAW) - RATE CMD
MAN ATT (ROLL) - ACCEL CMD
SC CONT - SCS
BMAG MODE (3) - ATT1/RATE 2

ENTR

Initiate .1°/sec roll rate

TERMINATE PTC

MAN ATT (ROLL) - RATE CMD
BMAG MODE (3) - RATE 2
LIMIT CYCLE - OFF

CMC/LGC CLOCK SYNC/TEPHEM UPDATE
V16 N65E (On LM request)
(hr,min,.01sec)
Voice CMC time to LM
V05 N01E 1706E (On LM request)
Voice TEPHEM to LM
DOCKED IMU ALIGN
ATT DB - MIN
SC CONT - SCS
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE 2
V06 N20E
Voice ICDU angles to LM
Terminate attitude hold on LM cmd
V06 N20 (On LM request)
On LM MARK, Key ENTR
Copy ICDU angles and transmit to MSFN
SECTION 10. SYSTEMS MANAGEMENT

PROPULSION SYSTEM

SPS MONITORING CHECK

SPS PRPLNT TK TEMP ind - +45 to +75°F
*IF<45°F, SPS LINE HTRS - A*
*IF>75°F, SPS LINE HTRS - off (ctr)*

SPS PRESS IND sw - He, N2A, & N2B

SPS PRPLNT TK PRESS ind
- He 3900 psia max
- N2A 2900 psia max
- N2B 2900 psia max

SPS PRESS IND sw - He

FUEL & OXID PRESS ind - 170 to 195 psia

SPS ENG INJ VLVS (4) - CLOSE

SPS OXID, FUEL & UNBAL QTY - record

OXID FLOW VLV PRIM - PRIM

SPS He VLV (1&2) - AUTO, tb - bp

SM RCS MONITORING CHECK

SM RCS PRPLNT tb (8) - gray

SM RCS He 1 & 2 tb (8) - gray

RCS IND sel - SM A, B, C, D

PKG TEMP - 25°-100°F (C/W 75°-205°)

He PRESS - record

MANF PRESS - 178-192 psia (C/W 145-205 psia)

He TK TEMP - record

PRPLNT QTY - record

When MANF PRESS <150 psia

RCS SEC FUEL PRESS A (B, C, D) - OPEN

CM RCS MONITORING CHECK

CM RCS PRPLNT tb (2) - bp

RCS IND sw - CM 1,2

He TEMP - 60-90°F

He PRESS - 4100-4200 psia

MANF PRESS - 25-105 psia

(287-302 after activation)

CM RCS HTRS - OFF (on 20 min prior to pressurization if req'd)
EPS SYSTEM

1. Cryogenic Pressure - Quantity Check
   - H2 PRESS (2) - 225-260 psia
   - O2 PRESS (2) - 865-935 psia
   - SURGE TK PRESS - 865-935 psia
   - H2 QTY (2) - record
   - O2 QTY (2) - record
   - CRYO FANS - OFF; ON as req'd

2. FC Power Plant Check
   - FC HTRS (3) - on (up)
   - FC REACT tb (3) - gray
   - FC IND sel - 1, 2, 3
     - H2 FLOW - 0.03-0.15 lb/hr
     - O2 FLOW - 0.25-1.2 lb/hr
     - MOD SKIN TEMP - 390-450° F
     - MOD COND EXH TEMP - 150-175° F
     - FC pH HI th - gray
     - FC RAD TEMP LO tb - gray
     - FC REACS & RAD cb (6) - out, all others in (verify)

3. D-C Voltage-Amperage Check
   - MN BUS TIE (2) - OFF (verify)
   - FC MNA tb - 1 & 2 gray, 3 bp
   - FC MNB tb - 1 bp, 2 & 3 gray
   - FC 1, 2, & 3 (RECORD AMPS)
   - MAIN BUS A, B, (26.5-31 vdc - Record)
   - BAT BUS A, B, & BAT C (31.5-38 vdc < 3 amp)
   - PYRO BAT A, B (36.5-37.5 vdc)
   - DC IND sel - MNB
   - SYS TEST 4B (BAT RLY BUS - 3.4-4.1 vdc)
   - SYS TEST 4A (BAT COMPT PRESS) - <1.5 vdc
     (NA until 1st Vent)
     *If >1.5: BAT VENT vlv -*
     *VENT (to ~0) then CLOSED*

4. A-C VOLTS - 113 to 117 all phases

5. Battery Charging BAT A(B)
   - cb ECS RAD HTRS OVLQD - close (verify)
   - MAIN BUS TIE A/C (B/C) - OFF
   - cb BAT BUS A & B PYRO BUS TIE - open (verify)
cb BAT C BAT BUS A & B - open (verify)
cb BAT RLY BUS BAT A(B) - open
DC IND sel - BAT CHARGER
BAT CHARGE - A(B,C)
DC VOLTS - 37.5-39.5 vdc
BAT CHARGE - OFF at 39.5 vdc or 100% recharge
cb BAT RLY BUS BAT A(B) - closed
SYS TEST - 4A (BAT VENT <1.5)
  *If >1.5: BAT VENT vl -*
  *VENT (to ~0) then CLOSED*
SYS TEST - 4B

6 Fuel Cell Power Plant Purging
A. 02 PURGING
   FC IND sw - 1(2,3)
   FC PURGE 1(2,3) - 02 (2 min.)
   FC FLOW - 02 Flow incr 0.6 lb/hr
   M/A FC 1(2,3) - On/RSET
   FC PURGE - 1(2,3) - OFF

B. H2 PURGING
   H2 PURGE LINE HTR - ON, 20 min prior to purge
   FC IND sw - 1(2,3)
   FC PURGE 1(2,3) - H2 (1 min, 20 sec)
   FC H2 FLOW - Flow incr 0.67 lb/hr
     (will exceed C/W limit)
   M/A FC 1(2,3) - On/RSET
   FC PURGE - 1(2,3) - OFF
   H2 PURGE LINE HTR - OFF

7 H2 or 02 Quantity Balance Correction
ON LOW Tank, H2 or 02 HTRS 1(2) - OFF,
THEN AUTO, WHEN BALANCED

8 FUEL CELL SHUTDOWN (APPLICABLE FC)
cb FC REACS - close
cb FC PURGE - open
FC REAC - OFF
FC HTRS - OFF
FC PUMPS - OFF
cb FC PUMPS AC - open
AT Tskin <200° F
H2 PURGE LINE HTR - ON (for 30 min)
cb FC PURGE - close
FC PURGE - O2 (TIL O2 PRESS = N2 PRESS)
FC PURGE - H2 (TIL PRESS STABILIZES)
FC PURGE - OFF
H2 PURGE LINE HTR - OFF
cb FC PURGE - open

9  FUEL CELL SWITCHING
PRIOR TO DISCONNECTING, INSURE THAT AT LEAST ONE FUEL CELL IS POWERING EACH MAIN BUS
Possible MA & FC DISCONNECT lt

10 INVERTER CHANGEOVER
A. One inverter on each AC bus at all times (if available)
B. If all three AC bus ties for the same bus are on, inverter power to that bus may be lost
C. When switching DC power on inverter 3, pause in OFF position

11 CRYO O2 & H2 MANUAL FAN OPERATION
H2 & O2 FANS - ON (seq at 1 sec intervals for 1 min each)
a. Prior to every SPS or SIVB AV
b. Presleep
c. Postsleep

CAUTION
If CRYO PRESS lt on, do not turn off fan until lt extinguishes

ECS PERIODIC VERIFICATION

1 ECS MONITORING CHECK
CABIN ΔP - -1 to -3.5 in H2O
O2 FLOW - 0.2-0.45 lb/hr (after changeover)
O2 SURGE TANK PRESS - 865-935 psia
REPRESS O2 >865 psia
PRIM RAD tb - gray
*If PRIM RAD tb - 2
* ECS RAD FLOW AUTO CONT - 1 until *
* tb gray, then AUTO *
ECS RAD TEMP PRIM IN - 67-97° F
ECS RAD TEMP PRIM OUT - -20° to +63° F (-20° to 97° F for lunar orb)
PRIM GLY EVAP TEMP OUT - 40-50.5° F
PRIM GLY EVAP STEAM PRESS
.1-.15 boiling, > .16 not boiling
PRIM GLY DISCH PRESS - 40-52 psig
SUIT TEMP - 45-55° F
CABIN TEMP - 70-80° F
SUIT PRESS/CABIN PRESS - 4.7-5.3 psia
(14.7 for launch)
PART PRESS CO2 < 7.6 mm Hg
SUIT COMP ΔP - 0.3-0.4 psid
PRIM GLY ACCUM QTY 30-65% (expect 20-50% at insert)
*If <30% - PRIM ACCUM FILL vlv - *
* ON (Until 40-55%)
POT H2O QTY - 10-100%
*If<25%
*POT TK IN vlv - OPEN*
WASTE H2O QTY - 25-85%
*If >85% - Dump*

**ECS PERIODIC REDUNDANT COMPONENT CK**

Suit Compressor
Sw to other compr
SUIT COMPR ΔP ind - 0.3-0.4 psid
Main O2 Regulators
MAIN REG B vlv - close
EMER CABIN PRESS sel - 1
PUSH TO TEST PB - PUSH (O2 FLOW INC)

MAIN REG B vlv - open
MAIN REG A vlv - close
EMER CABIN PRESS sel - 2
PUSH TO TEST PB - PUSH (O2 FLOW INC)

MAIN REG A vlv - open
EMER CABIN PRESS sel - BOTH (OFF if all suited)
Secondary Glycol Loop
Open cool atten panel (If req'd)
EVAP H2O CONT, SEC vlv - AUTO
ECS IND sw - SEC
SEC COOL LOOP PUMP - AC 1 (AC 2)
   GLY DISCH SEC PRESS - 39-51 psig
   ACCUM SEC QTY IND - 30-55%
SEC COOL LOOP EVAP - EVAP
SEC EVAP STEAM PRESS .1-.15 boiling,
   >.16 not boiling

After 5 min
   SEC EVAP TEMP OUT - 40-50.5°F
SEC COOL LOOP EVAP - RESET for 1 min minimum,
   then off (ctr)

Wait 2 min
SEC COOL LOOP PUMP - off (ctr)
ECS IND sw - PRIM

3 CO2 ABSORBER FILTER REPLACEMENT
Open CO2 Canister attenuation pnl

CAUTION
Connect ground wire when removing or replacing filter
from canister or stowage

CO2 CSTR DIVERT vlv - up (or dn)

CAUTION
Apply pressure to latching handle to allow pressure
interlock pin to withdraw
otherwise latching handle may not disengage

CANISTER MANUAL BLEED vlv - PRESS
COVER LATCHING HANDLE - UNLOCK
Replace used filter
COVER LATCHING HANDLE - LOCK
CO2 CSTR DIVERT vlv - ctr
Close CO2 Canister attenuation pnl
SHIM Stowage - B5 & B6
GLYCOL ACCUMULATOR REFILL (IF <30%)
PRIM ACCUM FILL vlv - ON
GLY ACCUM PRIM QTY - 40-55%
PRIM ACCUM FILL vlv - OFF
   IF OVER FILL
      GLYCOL RESVR INLET - OPEN (MOM)

DEBRIS SCREEN CHECK
Check cabin ht exch inlet screen
Check SUIT RET AIR vlv screen
   SUIT RET AIR vlv - CLOSE (push)
Clean screens
   SUIT RET AIR vlv - OPEN (pull)

CM O2 SUPPLY REFILL
SURGE TANK PRESS ≥500 psia
CAB REPRESS vlv - OFF
REPRESS O2 vlv - CLOSE
REPRESS PKG vlv - FILL
   SURGE TANK PRESS - 865-935 psia
O2 PRESS IND - TANK 1
REPRESS PKG vlv - OFF

DOFFING PGA
EMER CABIN PRESS vlv - BOTH
SUIT RET AIR vlv - OPEN (pull)
Install hose screen on return hose
PWR - OFF
SUIT PWR - OFF for disconnect
AUDIO CONT - NORM
SUIT FLOW vlv - CABIN FLOW (for unsuited crewman)
   (FULL FLOW for 3 unsuited)

DONNING PGA (with helmet & gloves)
SUIT PWR - OFF for comm cable connect
PWR - OFF
AUDIO CONT - NORM
Connect supply and return hoses to PGA
Connect COMM control head to PGA
SUIT FLOW vlv - FULL FLOW (for suited crewman)
SUIT RET AIR vlv - CLOSED (push)
EMERG CABIN PRESS vlv - OFF
9  PARTIAL SUIT CKLIST
EMER CAB PRESS vlv - BOTH
SUIT CKT RET vlv - OPEN (pull)
Reverse 02 umbilicals
Before disconnecting umbilical from head set:
SUIT PWR - OFF
POWER - OFF
AUDIO CONT - NORM

10  URINE DUMP MODES USING UTS
A  PGA URINE COLL BAG DUMP
   Connect Urine transfer hose & filter
to urine feces QD
   Remove cap from PGA thigh QD
   Connect urine transfer hose to thigh QD
   WASTE MGT DRAIN vlv - DUMP
   Disconnect urine transfer hose from PGA
   Replace cap on PGA thigh QD
   Connect UTS to urine transfer hose/filter QD
   UTS vlv - OPEN
   Purge dump line 1 minute (min)
   WASTE MGT OVBD DRAIN vlv - OFF
   UTS vlv - CLOSED
   Disconnect hose & stow

B  UTS (Collection)
   Obtain UTS & verify vlv - CLOSED
   Attach UTS - open vlv - Perform task
   UTS vlv - CLOSED
   Disconnect UTS & stow

C  UTS (Dump)
   Verify UTS vlv - CLOSED
   Connect UT hose/filter to urine/feces QD
   Attach UTS to hose
   WASTE MGT OVBD DRAIN vlv - DUMP
   UTS vlv - OPEN
   Purge lines 1 minute (min)
   WASTE MGT OVBD DRAIN vlv - OFF
   Stow UTS & Hose
11 CABIN PRESSURIZATION

A NORMAL 30 min
CAB PRESS REL vlv (2) - NORMAL (latch on)
MONITOR SURGE TANK PRESS
REPRESS PKG vlv - FILL
REPRESS O2 vlv - OPEN
AT 150 psia on SURGE TANK:
REPRESS PKG vlv - OFF
CABIN REPRESS vlv - Adjust to 150 psia on
SURGE TANK

AT ZERO psia on EMERG O2 GAUGE:
REPRESS O2 vlv - CLOSE
CAB REPRESS vlv - OPEN
WHEN CABIN PRESS = 4.7-5.3
O2 PRESS ind - TANK 1
CAB REPRESS vlv - OFF

B ALTERNATE, 52 min
CAB PRESS REL vlv (2) - NORMAL (Safety latch on)
EMER CAB PRESS vlv - BOTH
CAB REPRESS vlv - OPEN
MONITOR SURGE TANK PRESS
At 150 psia on SURGE TANK:
EMER CAB PRESS vlv - OFF
CAB REPRESS vlv - Adj to 150 psia on SURGE TK
WHEN CAB PRESS >4.7
O2 PRESS IND - TANK 1
CAB REPRESS vlv - OFF

12 (DELETED)

13 SUIT CKT INTEGRITY CHECK
DIRECT O2 vlv - CLOSE
SUIT PRESS - 4.7-5.3 psia
O2 FLOW - 0.2-0.4 lb/hr

CAUTION
SUIT TEST vlv should remain
in the PRESS position until suit circuit pressure is stabilized to preclude seal scarring. If repositioning of SUIT TEST vlv from PRESS is required prior to suit pressure and O2 flow stabilization, perform the following:

a. O2 DEMAND REG vlv - OFF
b. Allow 15 sec (min) stabilization time
c. Reposition SUIT TEST vlv - DEPRESS or OFF as applicable
d. When suit pressure stabilized, O2 DEMAND REG vlv - BOTH

SUIT TEST vlv - PRESS
O2 FLOW - 1.0 lb/hr (pegged)
O2 FLOW HI lt - on
M/A - ON, Reset

SUIT PRESS - 8.8-9.8 psia
PGA PRESS - 4.1-4.5 psig
O2 FLOW HI lt - out
Allow O2 flow to stabilize 15 sec
O2 flow will remain below 0.8 lb/hr for 30 sec after stabilization

SUIT TEST vlv - DEPRESS
O2 FLOW - 0.2-0.4 lb/hr
SUIT PRESS - slightly > CAB PRESS
SUIT TEST vlv - OFF
O2 DEMAND REG vlv - BOTH (verify)

14 PGA INTEGRITY CHECK
DIRECT O2 vlv - CLOSE
SUIT PRESS - 4.7-5.3 psia
O2 FLOW - 0.2-0.4 lb/hr

CAUTION
SUIT TEST vlv - PRESS
02 FLOW - 1.0 lb/hr (pegged)
02 FLOW HI lt - ON
M/A - ON, Reset
SUIT PRESS - 8.8-9.8 psia
PGA PRESS - 4.1-4.5 psig

WARNING

SUIT FLOW vlv(s) may remain in OFF position for no longer than one minute or asphyxiation may result. If all SUIT FLOW vlv s are closed simultaneously the suit compressors must be shut off to prevent compressor damage due to suit loop deadheading.

SUIT FLOW vlv - OFF
Monitor for <0.5 psi/min decay
SUIT FLOW vlv - SUIT FULL FLOW
SUIT TEST vlv - DEPRESS
02 FLOW HI lt - out
02 FLOW - 0.2-0.4 lb/hr
SUIT PRESS - slightly > CAB PRESS
SUIT TEST vlv - OFF

15 CM PRESSURE DUMP
EMER CABIN PRESS vlv - OFF (verify)
CAB REPRESS vlv - OFF (verify)
SUIT RTN AIR vlv - CLOSED (verify)
CABIN FANS (2) - OFF
DIR 02 vlv - CLOSE
CAB PRESS REL vlv (RH) - DUMP (latch off)
CABIN PRESS - 3.0-3.25 psia
CAB PRESS REL vlv (RH) - BOOST ENTRY
02 FLOW - 0.24 lb/hr
SUIT PRESS - 3.5-4.0 psia
CAB PRESS REL vlv (RH) - DUMP
CABIN PRESS - 0.0 psia (within 6 min)
CAB PRESS REL vlv (2) - NORMAL (latch on)

16 SUIT CKT H2 PURGE
DIRECT 02 vlv - OPEN for 1 min
  02 FLOW - 1.0 lb/hr (pegged)
  02 FLOW HI lt - on
  MASTER ALARM pb/lt (3) - on, push
DIRECT 02 vlv - CLOSE
  02 FLOW HI lt - out
  02 FLOW - 0.2 lb/hr

17 CABIN COLD SOAK
ACTIVATE
SUIT HT EXCH SEC GLY vlv - FLOW
EVAP H2O CONT SEC vlv - AUTO
GLY TO RAD SEC vlv - BYPASS (verify)
CAB TEMP - MAN
PRIM CAB TEMP vlv - C (CW)
SEC CAB TEMP vlv - OFF
SUIT CKT HT EXCH - BYPASS (20 sec), then OFF

ECS IND sel - SEC
SEC COOL LOOP PUMP - AC2
GLY DISCH SEC PRESS - 39-51 psig
SEC ACCUM QTY - 30-55%
SEC COOL LOOP EVAP - EVAP
SEC GLY EVAP OUT TEMP - 40-50.5°F
SEC GLY EVAP STM PRESS - 0.1-0.15 psia,
  >.16 not boiling
ECS IND - PRIM
PRIM ECS RAD OUT TEMP - >-20°F
  *IF < -20°F, DEACTIVATE*

DEACTIVATE
SEC CAB TEMP vlv - MAX COOL
CAB TEMP - AUTO
SUIT CKT HT EXCH - ON (20 sec), then OFF
SEC COOL LOOP EVAP - RESET 1 min min, then OFF
SEC COOL LOOP PUMP - OFF
EVAP H2O CONT SEC vlv - OFF (AUTO for ENTRY)
ACTIVATE PRIMARY EVAP
GLY EVAP H2O FLOW - AUTO
GLY EVAP STM PRESS - AUTO

DEACTIVATE PRIMARY EVAP
GLY EVAP H2O FLOW - off (ctr)
GLY EVAP STM PRESS AUTO - MAN
GLY EVAP STM PRESS INCR - INCR for 1 minute

PRIM EVAP RESERVICE
GLY EVAP STM AUTO - MAN
GLY EVAP STM INCR - INCR
for 1 min
Wait 15 min
GLY EVAP H2O FLOW - ON
for 2 min, then AUTO
GLY EVAP STM AUTO - AUTO

ACTIVATE SEC EVAP
SEC EVAP H2O CONT - AUTO
SEC COOL LOOP EVAP - EVAP
SEC COOL LOOP PUMP - AC1

DEACTIVATE SEC EVAP
SEC COOL LOOP EVAP - RESET for 1 minute
SEC EVAP H2O CONT - OFF
SEC COOL LOOP PUMP - OFF

POTABLE WATER CHLORINATION
Unstow chlorination unit
Remove chlor port cap
Attach needle assembly to injection port
Insert chlorine ampoule into casing
Connect knob assembly & rotate (CW) until piston contacts ampoule
Install ampoule assembly on needle assembly
(push & turn CW)
Rotate knob (CW) until ampoule is empty
(3 times for half empty if H2O quantity <50%)
Disconnect ampoule assembly from needle assembly
Rotate knob CCW & stow used ampoule
Repeat above steps with buffer ampoule
POT 1 IN vlv – OPEN (verify)
Wait 10 min & remove ampoule of H2O
Replace chlor port cap
Stow chlorination unit
Do not drink for 30 min

21 WASTE WATER TANK DRAIN
H2O QTY IND sw – WASTE
POTABLE TANK INLET – CLOSE
WATER CONT PRESS REL vlv – DUMP A
Monitor H2O QTY (WASTE) ind – decreasing
When H2O QTY (WASTE) ind reads 25%:
WATER CONT PRESS REL vlv – 2
POTABLE TANK INLET – OPEN

22 SIDE HATCH URINE/WATER DUMP
Remove Dump Nozzle Conn Cover
Remove Plug & Stow
Withdraw Wire Guard & Wires from slot
Install Male QD on Dump Nozzle
Connect cable to heater connector (crew option)
UTIL PWR – OFF
Connect cable to utility outlet
UTIL PWR – ON
Connect Urine Dump Hose to Dump Nozzle QD
Connect other end of UT hose to UTS/
Waste Servicing Tank (as req)
Dump Waste Water/Urine
Disconnect UT hose from UTS/Waste Servicing Tank and Purge
Disconnect UT Hose from Dump Nozzle & stow
UTIL PWR – OFF (verify)
Disconnect Cable from heater & outlet
& stow (verify)
Install plug & dump nozzle connector

23 WATER COLLECTION
Connect urine transfer hose-filter to urine/feces QD
Connect cabin purge QD to urine transfer hose
WASTE MANAGEMENT DRAIN vlv – DUMP
Collect water
After collection complete:
Purge for 1 minute (min)

WASTE MANAGEMENT DRAIN vlv - CLOSE

24 CONTAMINATION CONTROL

Install interconnect on L02 red hose
Install vacuum cleaner brush on R02 red hose

Vacuum/brush CM interior with special attention to the following:
Transfer tunnel wall and top hatch surfaces
Open B5 and B6 cover and clean compartment and SRC bags surfaces
Open A5 and clean compartment and CSC bag and film cassette bags surfaces
Open R13 and clean compartment and film magazine bag surface
Open food containers and clean compartment and helmet stowage bags surfaces
PGA bag surfaces
Move vacuum cleaner brush into all potential "dead air" pockets to ensure thorough scrubbing of CM atmosphere by LiOH canisters

Change routing of hoses to establish new O2 flow pattern in CM for next 24-hour period

C/W SYSTEM OPERATIONAL CHECK
A
C/W LAMP TEST-1 (LH MA & 16 lts)
C/W LAMP TEST-2 (RH MA & 23 lts)
C/W CSM-CM (CM RCS lt(2)-on)
C/W CSM-CSM(CM RCS lt(2)-out)

B ACKNOWLEDGE/RESET MASTER ALARM INDICATION
a. Normal mode
MA tone/lt(3)-on
MA pb/lt(1)-push
MA tone/lt(3)-out
applicable C/W lt remains on

NOTE: IF MASTER ALARMS DUE TO REPORTED O2 HIGH FLOW BECOME BOTHERSOME, DEACTIVATE BY PULLING CB PNL 5: ECS TRANSUDER PRESS GP 2 MN B
b. Acknowledge mode (C/W NORM in ACK)
   MA tone/lt(3)-on
   MA pb/lt(1)-push & hold
   MA tone/lt(3)-out
   applicable C/W lt remains on for
   malfunction indication
   MA pb/lt -release
   applicable C/W lt -out

C  MASTER ALARM TONE HEADSET CONTROL
   a. Inhibit tone (PWR-AUDIO)
   b. Permit tone (PWR-AUDIO/TONE)

TELECOMM PROCEDURES

1  HI-GAIN ANTENNA OPERATION
   cb HI-GAIN ANT FLT BUS - closed
   cb HI-GAIN ANT ac GRP 2 - closed
   HI-GAIN ANT TRACK - MAN
   HI-GAIN ANT SERVO ELEC - PRIM
   HI-GAIN ANT BEAM - WIDE
   HI-GAIN ANT PWR - POWER
   Go to V64 START S-BAND ANTENNA procedures
   Verify required coordinates within full coverage region

   *If required coordinates are in scan limit
   *zone or skin reflection zone, one or more
   *of the following may be done:
   *a.Change CSM attitude to provide antenna
   * coordinates in the full coverage region
   *b.Allow up to 60 seconds for the expected
   * CSM attitude variation to alleviate the
   * condition
   *c.In attitude hold condition, operate in
   * wide beam mode
   *d.Switch to narrow beam and acquire manually

   HI-GAIN ANT PITCH & YAW POS (2) - Set in required coordinates
HIGH GAIN LIMIT GRAPH

YAW—DEGREES

NOTES:
- Yaw measured in the X-Y plane, positively about Z pitch,
- Measured from the yaw plane, positively in the +Z hemisphere, negatively in the -Z hemisphere.

HIGH-GAIN ANTENNA SCAN AND WARNING LIMIT,
VAN-PITCH COORDINATES (CSM)
*If in earth orbit, S-BD NORM PWR AMPL HI-off(ctr)*

S BD ANT - HI GAIN

HI-GAIN ANT S BD ANT ind - >1/2 scale

HI-GAIN ANT TRACK - AUTO or REACQ

HI-GAIN ANT BEAM - as required depending on range

HI-GAIN ANT S BD ANT ind - >1/2 scale

When omni antenna operation is desired:

HI-GAIN ANT TRACK - MAN

HI-GAIN ANT PITCH POS - -52°

HI-GAIN ANT YAW POS - 270°

2 TV CAMERA OPERATION (BLACK & WHITE)

Unstow camera, optical sight, lens, lens attenuator and cables

S BD AUX TAPE - off (ctr) or DN VOICE BU

S BD AUX TV - off

Connect power and RF cables

Install proper lens

(telephoto out of focus at < 143 ft)

(wide angle out of focus at < 18 in)

Attach light attenuator to lens

Install optical ring sight

S BD AUX TV - TV

ALC (camera) - IN (normally)

OUT (when detail on dim objects in presence of bright objects is desired)

Power (camera) - ON

Adjust light attenuator (lower numbers less)

When TV operation is completed -

Power (camera) - OFF

S BD AUX TV - off (center)

Disassemble and stow equipment as desired

2A TV CAMERA OPERATION (COLOR)

Unstow TV camera, monitor, camera cable, and monitor cable

TAPE RCDR FWD - off (ctr)

Verify tb - bp; if gray, notify MSFN to reset all tape recorder RTC's

cb FM XMTR/GRP 1 - open

Verify monitor power sw is in off position
Verify TV camera ALC sw - INSIDE
Set focus to 4ft, zoom control to 12.5, aperture control to f/22
Connect monitor cable to camera and to monitor (arrow-to-arrow)
S BD AUX TAPE - off (ctr) or DN VOICE BU
Verify S BD AUX TV - off (ctr)
Connect TV camera cable to TV camera
S BD AUX TV - TV
TV monitor power sw - ON
Rotate monitor brightness and contrast controls until monitor picture is properly adjusted
Adjust cabin lighting to full max
By using monitor, adjust camera lens aperture, zoom control, and focus control
When TV transmission to MSFN is desired:
cb FM XMTR/GRP 1 - closed
(xmsn will begin immediately)
When TV operation is completed: S BD AUX TV - off (ctr)
Disassemble and stow TV camera, monitor, and cables

VHF RANGING OPERATION
VHF AM A - off (ctr)
VHF AM B - DUPLEX
VHF RNG - on (up)
P20 operating
V87E, TRACKER lt - on
EMS FUNC - AV SET/VHF RNG
EMS MODE - BACKUP/VHF RNG

CAUTION
No VHF voice transmission for
₇ 12 sec after VHF RNG - RESET
VHF RNG - RESET
EMS RANGE ind - 000 00
P20 operating, TRACKER lt - out
EMS RANGE ind - XXX XX
V83E (if desired)
R1 = RANGE
R2 = RANGE RATE
R3 = 0

V85E (if desired)
R1 = RANGE
R2 = RANGE RATE
R3 = Ø

4 RNDZ XPNDR ACTIVATION & SELF TEST
cb RNDZ XPNDR FLT BUS - close (verify)
RNDZ XPNDR - HTR for 24 min
(1 min if self test only)
RNDZ XPNDR - PWR
SYS TEST (1h) - XPNDR
SYS TEST (rh) - A (RRT XMTR OUT PWR)
SYS TEST ind - >1 vdc
SYS TEST (rh) - B (RRT AGC SIG)
RNDZ XPNDR - TEST (hold)
SYS TEST ind - >1 vdc
RNDZ XPNDR - OPERATE
SYS TEST ind - 0 - 4.5 vdc
SYS TEST (rh) - C (RRT FREQ LOCK)
SYS TEST ind - <.8 vdc unlocked, >4 vdc locked
SYS TEST (rh) - B

5 COMM MODES
NORMAL LUNAR CONFIGURATION
S BD XPNDR - PRIM
S BD PWR AMPL - PRIM
S BD PWR AMPL HI - HI
S BD MODE VOICE - VOICE
S BD MODE PCM - PCM
S BD RNG - RNG
S BD AUX TAPE - DN VOICE BU
S BD AUX TV - off (ctr)
UP TLM DATA - DATA
UP TLM CMD - NORM
VHF AM A - off (ctr)
VHF AM B - off (ctr)
VHF RCV ONLY - off (ctr)
**VHF RNG - OFF**
**TAPE RCDR PCM - PCM/ANLG**
**TAPE RCDR RCD - RCD**
**TAPE RCDR FWD - FWD**
**SCE PWR - NORM**
**PMP PWR - NORM**
**PCM BIT RATE - LOW**
**S BD SQUELCH - OFF**
**HI GAIN ANT PWR - PWR**
**HI GAIN ANT TRACK - MAN**
**HI GAIN ANT BEAM - WIDE**
**HI GAIN ANT SERVO ELEC - PRIM**

For the following mission phases select the Normal Lunar Configuration plus the specified deltas:

A. **COAST AWAKE**
   - **S BD AUX TAPE** - off (ctr)
   - **TAPE RCDR FWD** - off (ctr)

B. **COAST ASLEEP**
   - **S BD SQUELCH** - ENABLE
   - **S BD AUX TAPE** - off (ctr)
   - **S BD NORM MODE VOICE** - OFF
   1. **HI GAIN OPERATION**: (NOMINAL>120 KNM)
      - $\gamma, \phi, = 270, +40$ (ROLL RIGHT)
      - $\gamma, \phi, = 90, -40$ (ROLL LEFT)
      - **HI GAIN ANT BEAM** - NARROW
      - **HI GAIN ANT TRACK** - REACQ
      - **S BD ANT** - HI GAIN
   2. **OMNI OPERATIONS**: (NOMINAL<120 KNM)
      - **S BD ANT** - OMNI
      - **S BD ANT OMNI** - B
      - **TAPE RCDR FWD** - off (ctr)

C. **LUNAR ORBIT AWAKE**
   - **USE NORMAL LUNAR CONFIGURATION**

D. **LUNAR ORBIT ASLEEP**
   - **S BD SQUELCH** - ENABLE
   - **HI GAIN ANT TRACK** - REACQ
   - **HI GAIN ANT BEAM** - NARROW
   - **HI GAIN ANT $\gamma, \phi,$** = _____, _____

---

**Basic Date** 15, 1969
**Changed** June 27, 1969
E. VHF RANGING, VOICE
VHF AM A - off (ctr)
VHF AM B - DUPLEX
VHF RNG - RNG
VHF RCV ONLY - B DATA (MINIMIZES CREW SWITCHING)

F. VHF LM-CSM VOICE DATA
VHF AM A - SIMPLEX
VHF AM B - off (ctr)
VHF RCV ONLY - B DATA

G. CONTINGENCY EVA
VHF AM A - SIMPLEX
VHF AM B - DUPLEX

H. RELAY MODE (LM VOICE TO MSFN)
Voice Relay (With VHF Ranging)
MODE - VOX (Pn1 10)
VOX SENS tw - 5 AS CND DESIRES
S BD - OFF
INTERCOM - OFF
VHF AM - T/R
AUDO CONT - BU
MODE - VOX (Pn1 9)
VOX SENS tw - as req
S BD MODE VOICE - RELAY
VHF AM B - DUPLEX
VHF RNG - on (up)

Voice Relay (With LM LBR PCM record)
MODE - VOX (Pn1 10)
VOX SENS tw - 5
S BD - OFF (Pn1 10)
INTERCOM - OFF
VHF AM - T/R
AUDO CONT - BU
MODE - VOX (Pn1 9)
VOX SENS tw - as req
S BD MODE VOICE - RELAY
VHF RCV ONLY - B DATA
PRIVATE LOOP TO EVA:
WHEN AOS LM, S-BAND T/R TO R.
VHF SIMPLEX A TO T/R
TO TALK TO GND W/OUT BOTHERING LM,
REQUEST MSFN RELAY OFF
RCS Engine, Vent, and Radiator Location
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<th>N₂, O₂, H₂ Pressure (PSIA)</th>
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<th>CM-RCS Oxidizer Valve Temperature (°F)</th>
<th>LM Power (Amps)</th>
<th>SPS Temperature (°F)</th>
<th>Battery Manifold Pressure (PSIA)</th>
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**ELECTRICAL POWER SYSTEM**

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Basic Date: APRIL 15, 1969

Changed: JUNE 27, 1969

Cl. 107 & SUBS
SECTION 11. LM INTERFACE

1. IVT TO LM FOR FIRST ENTRY
   Couches: CDR - 0°, CMP - 0°, LMP - 180°
   TUNL LTS - ON
   TUNL VENT vlv - LM/CM ΔP
   Verify LM/CM ΔP <0.2
   *LM/CM ΔP >0.2 *
   *Equalize CM/TUNL pressure*
   *(DECAL) *

   Remove hatch & stow (Decal) (3)
   Remove probe & stow (Decal) (4)
   Remove drogue & stow (Decal) (5)
   Read docking tunnel index angle
   Open LM hatch
   LMP Transfer to LM (6)

   At LM request
   LM PWR - RESET, then OFF
   SYS TEST - 4D
   SYS TEST ind - 0 volts
   Perform comm checks with LM
   At LM request
   LM PWR - CSM
   SYS TEST - 4D
   SYS TEST ind - 0.5 - 3.2 volts
   LMP Transfer to CSM (6A)
   Close LM hatch
   Install drogue (Decal) (8)
   Install probe (Decal) (9)
   Install CM hatch (Decal) (11)
   TUNL VENT vlv - LM/CM ΔP
   TUNL LTS - OFF

   FINAL

2. IVT TO LM FOR ENTRY
   Couches: CDR- 0°, CMP- 0°, LMP- 180°
   CDR don LCC & PGA
   Don helmet protective shield (if req'd)
   Suit Integrity Ck (if req'd)
   TUNL LTS - ON
   TUNL VENT vlv - LM/CM ΔP
   Verify LM/CM ΔP <0.2
   *LM/CM ΔP >0.2 *
   * Equalize CM/TUNL Pressure*
   *(DECAL) *
11. LM INTERFACE

Remove tunnel hatch (Decal) (3)
Remove & stow probe (Decal) (4)
Remove & stow drogue (Decal) (5)
Verify docking tunnel index angle
Open LM hatch
LMP transfer to LM (6)
At LM request,
LM PWR - RESET, then OFF
SYS TEST - 4D
SYS TEST ind - 0 volts

CDR transfer to LM (6)
LMP transfer to CSM (6A)
LMP don LCG & PGA
LMP transfer to LM (6)
Remove LM umbilicals (7)
Install drogue (Decal) (8)
Install probe (Decal) (9)
Preload probe (Decal) (10)
LM hatch closed
Verify CSM roll cmd's inhibited
until LM/CM ΔP ≥ 3.5 psid (>3.5, 2 jet; >4, 4 jet)
Cock docking latches (12) (I) (J)
Verify hook is clear of LM ring

* Hook does not release: *
* AUX REL (yellow) - push *
* Cock hook *

Install tunnel hatch (Decal) (11)
Perform hatch integrity check (Decal) (12)
Remove center couch and stow
Install docking target
DOCKING TARGET - BRIGHT
Receive target alignment verification from LM
Configure side hatch for EVT
ACTR HANDLE SEL - N (neutral)
GN2 VLV HANDLE - pull (inboard)
GN2 PRESS ind - minimum

3 TUNNEL HATCH REMOVAL (Decal)
PRESS EQUAL vlv - open (CCW) (D)
ACTR HNDL - unstow, pull to stop, set to U
- push to stop
Verify gearbox disconnect socket - U
ACTR HNDL SEL - stow
- push to stow
Remove hatch, stow

4 PROBE REMOVAL (CM Side) (Decal)
A. Translunar Docking:
Verify EXTEND LATCH engaged indicator (red) not visible

*EXTEND LATCH not engaged:
* PRELOAD SEL LEVER - rotate CW (away from orange stripe)
* PRELOAD HANDLE - Torque CCW to engage extend latch (red ind. not visible)

GN2 BLEED button (RED) - press (10 sec)
PRELOAD SEL LEVER - rotate CCW (parallel to orange stripe)
PRELOAD HNDL - Torque (CW) unload support beams

B. Lunar Orbit Docking:
PRELOAD SEL LEVER - rotate CW(away from orange stripe)
PRELOAD HNDL - torque CCW to engage EXTEND LATCH (red indicator not visible)
GN2 BLEED button (red) - press (10 sec)

C. Both TLD & LOD:
PROBE UMBILICALS (2) (yellow) - disconnect and stow
Elec connector covers (2) (yellow) - close
PRELOAD HNDL - position against umbilical connector
PRELOAD SEL LEVER - mid position
INSTALLATION STRUT - unstow, position on tunnel wall (yellow marks)
CAPTURE LATCH RLSE HNDL LOCK - Rotate CCW to unlock (orange stripe visible)
RATCHET HNDL
- unstow to full extension
- push to first detent (red band)
- push outbd and hold to fold probe
RATCHET HNDL
- pull to full extension
- ratchet one stroke only
Restow RATCHET HNDL and INSTALLATION STRUT
CAPTURE LATCH RLSE HNDL - Pull, rotate to unlock (180° CW)
- push to recess
*Capture latches will not release: *
* Ratchet probe forward *
* Preload probe until latches release*

Remove PROBE - pull aft to release (25 lbs)

5 DROGUE REMOVAL (Decal)
LOCK LEVER - Pull, rotate 90° CCW
DROGUE - rotate CW, push clear of support
   - remove from tunnel

6 CREW TRANSFER TO LM
CDR and LMP Audio Panels:
   PWR - OFF
   SUIT PWR - OFF
   AUDIO CONT - NORM
CDR and LMP SUIT FLOW vlv - OFF
Connect to TRANSFER UMB if desired

6A CREW TRANSFER TO CSM
CDR and LMP Audio Panels:
   Verify/set PWR - OFF
   Verify/set SUIT PWR - OFF
   Verify/set AUDIO CONT - NORM
   Verify/set CDR and LMP SUIT FLOW vlv - OFF
Connect to TRANSFER UMB if desired
LMP transfer to CSM

7 REMOVE LM UMBILICALS (FINAL)
LM Connector Fairings (2) (orange) - open
Connectors (2) - release and remove
Fairings (2) - close
Pull lanyard on LM end of umbilical
Remove umbilicals from tunnel, stow in Fl or F2

8 INSTALL DROGUE (Decal)
DROGUE - Align Lugs with fittings
   - Rotate CCW to stops
LOCK LEVER - Rotate 90° CW to detent
9 INSTALL PROBE (Decal)
CAPTURE LATCH RLSE HNDL - Pull, rotate CCW to cock pos (150°)
Push PROBE into DROGUE
CAPTURE LATCH RLSE HNDL - rotate CCW to LOCK position (do not force)
- push to recess
Verify capture latches engaged (CDR)
INSTALLATION STRUT - unstow, position on tunnel wall (yellow marks)
RATCHET HNDL - unstow to full extension (green band)
- ratchet probe fwd to orange hash mark
Restow RATCHET HNDL and INSTALLATION STRUT
CAUTION: For stowage, adjust PRELOAD HANDLE until probe loose in tunnel & position at 45° to support beam.
Verify RATCHET PAWL indicator (red) flush with housing
*Ratchet pawl indicator not flush:  *
* Hold RATCHET HANDLE full outboard  *
* Press Pawl indicator to seat (flush)*
* Release RATCHET HANDLE  *
Preload Shaft - push up into detent
CAPTURE LATCH RLSE HNDL - Set in detent
CAPTURE LATCH RLSE HNDL LOCK - Rotate CW to lock (orange stripe not visible)
PROBE UMBILICALS (2) (yellow) - connect to dock ring
NOTE: For stowage, umbilical connection not required.

10 PRELOAD PROBE (Decal)
PRELOAD SEL LEVER - rotate CCW (parallel to orange stripe)
PRELOAD HNDL - torque (CW) to release (F)
Verify capture latches engaged (CDR)
PRELOAD HNDL - Push inboard to detent
- pos 45° to support beam
PRELOAD SEL LEVER - mid position
Verify CAPTURE LATCH RLSE HNDL LOCK is locked (orange stripe not visible)

11 HATCH INSTALLATION (Decal)
Align Hatch in tunnel
ACTR HNDL SEL - unstow, set to L
- push to stop
Verify gearbox disconnect socket - L

*If latches cannot be closed:
*GEARBOX DISCONNECT - 180° CCW (tool B)*
*AUX LATCH DRIVE - LATCH (113° CW) *
*Verify hatch latched, remove tool B *
*(Cannot remove hatch from LM side) *

ACTR HNDL SEL - stow
- push to stow
PRESS EQUAL vlv - CLOSED (CW) (C)

12 HATCH INTEGRITY CHECK (Decal)
Verify LM Hatch Closed, DUMP vlv - AUTO (CDR)
Verify CABIN PRESS ind - 4.7-5.3 psi
TUNL VENT vlv - TUNL VENT for 30 sec
- LM/CM ΔP, check ΔP
- Recycle to TUNL VENT until ΔP>3.5

*Cannot vent tunnel:
* If 02 FLOW ind. increases, open hatch,*
* wipe seal surfaces, close hatch *
* If 02 FLOW ind does not increase, dump*
* tunnel through LM during reg check *
* Monitor LM/CM ΔP & flow to check integrity *

Verify LM/CM ΔP ind constant (+.2) at last value
for 2 min

Verify 02 FLOW ind - no increase

Before undocking only:
TUNL VENT vlv - LM TUNL VENT
for 10 min, then LM/CM ΔP
Verify LM/CM ΔP >4.0(pegged)
TUNL VENT vlv - OFF
TUNNEL LIGHTS - OFF

Before Jettison only:
TUNL VENT vlv - TUNL VENT (at least 10 min)
TUNNEL LIGHTS - OFF

MALFUNCTION LIST

DOCKING
A. Positive Indication of No Capture
THC -X withdraw to formation
flight distance
F
11-7

- PROBE EXTD/REL - EXTD/REL for 5 sec
  - RETR
- PROBE EXTD/REL tb(2) - gray (verify)
- Attempt redocking as before

B. One tb does not indicate bp but capture attained
   For retraction, use bottle (1) in system with
   gray tb
   - If no retraction, use bottle (2) in system with
     gray tb
   - If no retraction, use bottle (1) in system with
     bp tb
   - Trouble shoot later before removing probe as
     follows:
     - DOCK PROBE RETRACT (2) - OFF
     - cb DOCK PROBE (2) - open
     - Interchange probe umbilical connections
       (cut cable retainers if necessary)
     - Cock docking latches #1 and #7
     - cb DOCK PROBE (2) - closed
     - DOCK PROBE EXTD/REL - RETR
     - If previous bp tb is now gray,
       failure is in probe; interchange
       umbilicals again. Only one bottle
       is usable to complete mission.
       If previous bp tb is now bp, failure
       is in SC wiring. Two bottles are usable
       to complete mission as connected.
       Manually release docking latches #1 and #7.

TUNNEL HATCH
C. Pressure Equalization Valve Will
   Not Close.
   - Remove Hatch
   - Use Tool B In External Tool Inter-
     face For Additional Leverage

D. Pressure Equalization Valve Will
   Not Open For TLD:
   - Vent CM
   - Perform Tunnel Operations
   - Repress CM
For Subsequent IVT
TUNL VENT vlv - LM PRESS
(May require up to 12 hrs
to equalize pressure)

PROBE

E. Do not get retraction using PRIM-1 (**WITHIN 30 SEC**)
- Initiate retraction using bottles
  in the following order:
  - PROBE RETRACT SEC-1 PRIM-2
  - If no retraction, initiate
    PROBE RETRACT SEC-1

F. Preload Ratchet Will Not Drive To
   Achieve Proper Preload.
   - Use Tool F To Drive Hex Fitting
     On Aft End Of Preload Shaft (CW
     Direction, 30 To 40 lbs On Tool
     Handle)

G. Both tb’s not gray after undocking
   - PROBE EXTD/REL - EXTD/REL for 5 sec
   - PROBE EXTD/REL - RETR
   - PROBE EXTD/REL tb (2) - gray (verify)

H. Pushing ratchet handle outboard does not
   ratchet probe forward
   - Push ratchet handle to first detent (red band)
   - Slowly push ratchet hndl outboard ~ 25° until
     audible click. (If pushed outboard past
     point of click, probe will release).
   - Repeat until orange hash mark is visible.

DOCKING LATCHES

I. Cannot Cock Docking Latch By Pulling
   Handle
   - Depress Aft End Of RH No-Back
     Pawl While Pulling On Latch
     Handle.
   - If unsuccessful, Use Tool E to
     depress LH No-Back Pawl while
     pulling on Latch Handle
J. High O2 Flow While Cocking Docking Latches
   - Re-engage/verify 3 latches ~ 120° apart are engaged
   - Use Tool F To Drive Hex Fitting
     On Aft End Of Preload Shaft 180° CW
   - Torque preload handle CW until load limiter releases
   - Disengage docking latches

K. Cannot latch side hatch (frozen gearbox)
   - The Following tools are required:
     Tool B, tool F, (3) jackscrews
   - Install (3) jackscrews to restrain hatch in closed position
   - Use tool B to remove (2) clevis pins connecting linkage to gearbox and
     (1) clevis pin from linkage in corner above gearbox.
   - Tighten jackscrews to close hatch as far as possible
   - Use tool F on flats of latch bellcrank to drive latch to over-center closed position
     (Apply tool F to upper latch on hinge side to drive the lower and hinge side linkage closed. Apply tool F to center latch to drive upper linkage closed. Gearbox side linkage may not close if gearbox is in full open position.
   - Install (2) clevis pins in threaded holes in linkage bell cranks at upper gearbox side and lower hinge side. (Clevis pins installed when approx. half the threads are visible).

CSM DOCKING

1 cb DOCK PROBE (2) - closed
   PROBE RETRACT (2) - OFF (verify)
   PROBE EXTD/REL - RETRACT
   PROBE EXTD/REL tb (2) - gray (verify)
   cb SECS LOGIC (2) - closed (verify)
cb SECS ARM (2) - closed
SECS LOGIC (2) - on (up)
MSFN confirm GO for PYRO ARM
SECS PYRO ARM (2) - ARM

2 At Capture: PROBE EXTD/REL tb - bp (A)
SC CONT - CMC/FREE
 Allow Probe to damp SC motion (10 sec)
 When within ± 2° of docking attitude
 PROBE RETRACT PRIM -2

3 At Dock Latch: PROBE EXTD/REL tb-gray (5sec)

*PROBE tb-bp and no dock latch cues:*
* PROBE RETRACT SEC - 1 *

4 After Hard Dock: PROBE EXTD/REL - OFF

5 SECS PYRO ARM (2) - SAFE
SECS LOGIC (2) - OFF
cb SECS ARM (2) - open
cb DOCK PROBE (2) - open
BMAG MODE (3) - RATE 2
PROBE RETRACT (2) - OFF
EXT RUN/EVA LT - OFF
EXT RNDZ LIGHT - OFF
COAS PWR - OFF
RNDZ XPNDR - OFF
LIMIT CYCLE - ON
ATT DB - MAX
BMAG MODE (3) - ATT 1/RATE 2
SC CONT - SCS
LOAD DAP: N46: 61102
11111

V46E

LM JETTISON

1 FINAL IVT TO CSM
CDR Verify FWD DUMP vlv - AUTO
CMP 02 PRESS IND sw - SURGE TK
Verify CRYO 02 PRESS ind - 865-935 psia
REPRESS PKG vlv - OFF
DIRECT 02 vlv - OPEN until CAB PRESS 5.5 psia
then CLOSE until 02 FLOW <.5 lb/hr.
- OPEN adjust 02 FLOW - 0.6 lb/hr
TUNL VENT vlv - LM/CM ΔP
LM/CM ΔP ind - +4 psid (pegged)
PRESS EQUAL vlv - OPEN until LM/CM ΔP ind -
~3 psid then CLOSE
Monitor LM/CM ΔP ind for 3 min and verify
ΔP stable
PRESS EQUAL vlv - OPEN
Remove hatch and stow (DECAL) (3)
Verify docking latches (at least 3)
Transfer the following to CDR:
- Helmet Stowage bag (2)
- SRC bags (2)
- CSC bag (1)
- Hasselblad magazine bag (1)
- Closeup camera cassette bag (1)
- Vacuum brush (1) with 3 ft hose
- Glove bags (2)

Receive from LM & stow

<table>
<thead>
<tr>
<th>Item</th>
<th>CM Stowage Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helmets (2)</td>
<td>B5, B6</td>
</tr>
<tr>
<td>SRC's (2)</td>
<td></td>
</tr>
<tr>
<td>CSC (1)</td>
<td>A5</td>
</tr>
<tr>
<td>Hasselblad magazines (3)</td>
<td>R13</td>
</tr>
<tr>
<td>Closeup camera cassette (1)</td>
<td>A5</td>
</tr>
<tr>
<td>Transfer B5 &amp; B6 containers to LM</td>
<td></td>
</tr>
</tbody>
</table>

CDR to CM with ISA
Remove & stow ISA contents
Return ISA with CM Jettison articles to LM

LMP Close LM hatch
Transfer to CSM

CMP DIRECT 02 vlv - close (CW) (DECAL)
Install forward hatch (11) (DECAL)
Perform hatch integrity check (12)
2 POO, V49, Load LM jett attitude:
   F 06 22
   SC CONT - CMC
   CMC MODE - AUTO
   BMAG MODE (3) - RATE 2
   PRO
   PRO (Auto mnvr to jett att)
   cb SECS ARM (2) - close
   SECS LOGIC (2) - on (up)
   Obtain GO from MSFN
   SECS PYRO ARM (2) - ARM
   EMS MODE - NORMAL
   SEP (4 jet - X 2.0 fps)
   PRO (POO)
   EMS MODE - STBY
   EMS FUNCT - OFF
   cb SECS ARM (2) - open

3 At Jett Attitude:
   ENTR
   BMAG MODE (3) - ATT 1/RATE 2
   SC CONT - SCS
   Load DAP N46: 11102
   V37E 47E

4 CSM/LM FINAL SEP (2) - ON (.4 fps sep)
   SECS PYRO ARM (2) - SAFE
   SECS LOGIC (2) - OFF
   cb SECS ARM (2) - open

5 EMS MODE - NORMAL
   SEP (4 jet - X 2.0 fps)
   PRO (POO)

6 EMS MODE - STBY
   EMS FUNCT - OFF

7 VACUUM & DOFF PGA'S
   ALL SUIT FLOW vlv - OFF FULL FLOW
   Disconnect RH O2 hoses from PGA
   Install vacuum brush on RH
   O2 red hose
   RH SUIT FLOW vlv - CABIN
   Vacuum brush PGA (2)
   Empty PGA (2) pockets
   Doff PGA (2)
   Move watch (2) from PGA to arm
   Stow PGA (2)

8 All wash hands thoroughly
SECTION 13. LOI ABORT

LOI 15 MIN SPS

- ABORT - Stop Clock
- ΔV Thrust A/B - OFF
- SPS INJ valve (4) - CLOSED
- SPS He blow (2) - bp
- GMBL MOTS(4) - OFF (LMP Verify)
- TVC SERVO PWR (2) - OFF
- SC CONT - SCS
- PCM BIT RATE - LOW
- EMS MODE - STBY (verify)

RECORD DATA AND COMPUTE PAD

**PRIMARY**

- F 97 40
  - Record TFC
  - Vg
  - ΔVm
  - EMS Vc
  - ENTR
- F 99 40
  - Maneuver to LOI1 Attitude
  - ENTR
- F 16 85
  - Record Vx
  - Vy
  - Vz
  - PRO
  - F37 V82E

**ALTERNATE**

- ΔVcLOI1 PAD
- EMS Vc(Shutdown)
- Vc(Burned)
- Vc ABORT(Chart)

**F 16 44**

- Record Ha
  - Hp
  - TFF
  - PRO
- F 37 00E

When CMC ACTY 1t out:
  - V66E
13. LOI ABORTS

MAN ATT PITCH - ACCEL CMD 178.8, 62.4, 4.5
SET in GDC THUMBWHEELS - (not shown)
MAN MNVR To ABORT R, P, Y
GDC ALIGN
CHECK DAP (P&Y TRIM)
EMS FUNC - ΔV SET/VHF RNG
SET ΔVc ABORT
EMS FUNCT - ΔV

TVC CHECK & PREP
cb STAB CONT SYS (all) - close
cb SPS (12) - close
RATE - LOW (verify)
LIMIT CYCLE - ON
MAN ATT (3) - RATE CMD
BMAG MODE (3) - ATT1/RATE2
ROT CONTR PWR DIR(2) - OFF
SCS TVC (2) - AUTO
TVC GMBL DRIVE P&Y - AUTO
MN BUS TIE (2) - ON (verify)
TVC SERVO PWR #1 - AC1/MNA
TVC SERVO PWR #2 - AC2/MNB
TRANS CONTR PWR - ON
ROT CONTR PWR NORMAL #2 - AC
RHC #2 - ARMED

PRIMARY TVC CHECK
GMBL MOT P1-Y1 - START/ON (LMP Verify)
THC - CW
Verify NO MTVC

SEC TVC CHECK
GMBL MOT P2-Y2 - START/ON (LMP Verify)
SET GPI TRIM
Verify MTVC
THC - NEUTRAL
Verify GPI Returns To Trim Pos
ROT CONT PWR NORM (2) - AC/DC
ATT DB - MIN (verify)
ROT CONTR PWR DIR (2) - MNA/B
SPS HE v/vs (2) - AUTO, verify tb-bp
LIMIT CYCLE - OFF
F
13-3/4

FDAl SCALE - 50/15 (verify)
EMS MODE - NORMAL
V37E 47E
\( \Delta V \) THRUST A(B) - NORMAL
THC - ARMED (verify)
RHC #1 & #2 - ARMED
PCM BIT RATE - HIGH

ULLAGE
THRUST ON pb - push
SPS THRUST lt - on
MONITOR THRUSTING

Pc 95-105 psia
EMS COUNTING DOWN
SPS INJ vlvs (4) - OPEN
SPS HE vlvs tb (2) - gray
SPS FUEL/OXID PRESS - 175 to 195 psi
ECO
\( \Delta V \) THRUST (2) - OFF
SPS INJ vlvs (4) - CLOSED
SPS He tb (2) - bp
GMBl MOTS (4) - OFF (LMP Verify)
TVC SERVO PWR (2) - OFF
MN BUS TIE (2) - OFF
PCM BIT RATE - LOW
BMAG MODE (3) - RATE 2
F 16 83

RECORD Vx
Vy
Vz

PRO
F37 00E
V66E
EMS \( \Delta Vc \)
EMS MODE - STBY
EMS FUNCT - OFF
Nominal G mission 15 minute LOI crew chart

Nominal LOI 15 minute abort CSM/LM.
SECTION 14. FLIGHT EMERGENCY PROCEDURES

FIRE/SMOKE IN CM (CREW SUITED)

**WARNING:** CM water must not be used to extinguish fire

1. CAB FAN (2) - OFF (verify)
2. Monitor EPS for excessive current and remove power from affected bus
3. Verify suit compressor on good AC bus
4. Use fire extinguisher as appropriate

**FIRE IS OUT**

5. Remove smoke from cabin per "Contamination in CM" procedures before removing helmets

**FIRE PERSISTS - DUMP CABIN**

6. Verify:
   - SUIT CKT RET vlv - CLOSE (push)
   - EMER CAB PRESS vlv - OFF
   - REPRESS PKG vlv - OFF

7. Visually check suit integrity

8. CAB PRESS REL (RH) - DUMP to 3.0 psia then to BOOST ENTRY
   Provides controlled cabin dump until suit circuit pressure is verified

9. Verify Suit pressure >3.5 psia

10. CAB PRESS REL (RH) - DUMP
    and/or CAB PRESS DUMP vlv - OPEN
1. CAB FAN (2) - OFF (verify)
2. SUIT COMPR (2) - OFF
3. Monitor EPS for excessive current and remove power from affected bus
4. Don emergency O2 masks
5. Use fire extinguishers as appropriate
   FIRE IS OUT
6. Remove smoke from cabin per "Contamination in CM" procedure before removing O2 masks

FIRE PERSISTS - DON SUITS and DUMP CABIN
7. Don PGA's except helmets and verify O2 connectors (Use O2 masks as long as possible)
8. DIRECT O2 vlv - OPEN
   Purges suit circuit of smoke and fumes
9. Don helmet
10. SUIT FLOW vlv (3) - SUIT FULL FLOW
11. SUIT COMPR 1 (2) - AC1 (AC2)
12. DIRECT O2 vlv - CLOSE
13. EMER CAB PRESS vlv - OFF
14. Visually check suit integrity
15. CAB PRESS REL (RH) - DUMP to 3.0 psia then to BOOST/ENTRY
16. Verify Suit pressure holding >3.5 psia
17. CAB PRESS REL (RH) - DUMP and/or CAB PRESS DUMP vlv - OPEN
18. CAB PRESS ind 0.0 psia for 6 min.
19. CAB PRESS REL (RH) - NORMAL
20. CAB PRESS DUMP vlv - CLOSE
21. Do not repress cabin until fire source is removed

Contamination in CM
1. Don O2 masks and/or PGA's immediately
2. Evaluate contamination level (isolate & correct source of contamination if possible) and proceed with one of the following steps:
   a. Retain O2 masks or remain in suit and accept contamination level in cabin.

CAUTION
   If in PGA's, adjust DIRECT O2 to maintain suit to cabin AP >+2 in. H2O
b. Retain O2 masks and scrub cabin atmosphere through suit loop. If initially suited, establish partially suited or shirtsleeve configuration and don O2 masks.

CAUTION
Change LiOH cartridges after scrub completed.

c. Retain PGA's or don PGA's
Verify suit integrity (visually)
Perform Cabin Dump
Perform Cabin Repress

Contamination In Suit
1	SUIT COMPR 2 - AC1
2	SUIT COMPR 1 - OFF
3	DIRECT O2 vlv - OPEN for 1 minute then CLOSE

If condition persists:
4	SUIT COMPR 2 - OFF
5	DIRECT O2 vlv - CLOSE
6	Doff helmet
7	Don emergency O2 masks

C&W/MALFUNCTION INDICATORS

SC CONT - SCS, If out in 5 sec
V11 N10E 33E:R1:A:
if R[1,4,5]: C/W fail (if LEB, CMC, no TVC)
ISS
SC CONT - SCS, G&N PWR - AC1
Both Lamps on: G&N PWR - OFF, check V5N9
One lamp: V35 for lamp test

TEMP
RSET, If V11 N10E, 30E, R1A=0,1,2,3: Temp G&N in limits
If not, 15 min available.

SPS PRESS
FUEL/OX ΔP < 20: P>200 He vlv - OFF; SPS
<157: ON
> 20: ΔV THRUST - OFF

SM RCS
He 1 & 2 CLOSE
PKG TEMP < 75: RCS HTRS - SEC
> 205: RCS HTRS - OFF
< 55: QUAD AUTO RCS - OFF

CM RCS
MANF PRESS < 260, He PRESS Low: CM RCS PRPLNT - OFF

CRYO PRESS
Any Lo: FANS and HTRS - ON
Both Hi: FANS and HTRS - OFF: Any Hi: CRYO Inst fail 1

FC 1
Skin Temp > 450°: HTRS Off, Check VI Perf EPS
< 360°: Check VI Perf FC
Con Ex Temp > 200°: Open CKT, Check 1a
RAD OUT TEMPS (3B,3C,3D)
< 150°: Check cb FC PUMPS AC, EPS
Check T skin Hi (450°) 1c
Rad Temp Lo: Check TCE, RAD OUT TEMPS 1d
Ph Hi-bp: If current < 5 amps, shutdown: le PUMPS - OFF 1f
POTABLE TANK INLET vlv - CLOSE
**FC 02 (H2) 02 < (8)(H2): Cycle Purge**

**FLOW HI** .8(.1) 02 > (8)(H2): Check amps vs. flow FC 1g

**FC 02 (H2) 02 < (8)(H2): Check REG PRESS: 10(2C) EPS**

**FLOW LOW** 02 > (8)(H2): Check VI perf FC2

**AC BUS 1** RSET: < 98: Replace Inv. EPS-PD

>128: Replace Inv. 1d

NORM: EPS Sensor Unit Out, 1e

RESET-OFF 1b

**AC BUS + MAIN BUS UNDERVOLT** DC Volts <26, AMPS Hi:

Replace Inv. 3

**BUS B UNDER FC 3 FC 2**

Remove FC2 from MNB, Tie (With FC 1) MNA, Check Volts, Go to EPS-PD1

**AC BUS + AC BUS OVERLOAD + MAIN BUS UNDERVOLT**

Replace INV SSR-2

If still OVERLOAD - Disconnect 2nd INV

**MAIN BUS UNDER** Volts <26, AMPS Hi: Replace Inv.

**INV TEMP HI** Gly Out Temp >51: SEC EVAP - ON, ECS-16

Gly Out Temp <51: AC Volts, Replace EPS-PD INV 2

**FC BUS DISCONNECT** 1 or 3: Connect 1 to B, 3 to A

2 : Attempt Reconnect

**O2 FLOW HI** Indicator, Cabin Press, Surge OK: Waste Mgt Valve Cabin Press Rel; DIRECT O2; Demand Reg; REPRESS O2; Emerg. Reg; H2O/Gly Tank Reg. LM PRESS vlv
EMERGENCY POWER DOWN
(MN BUS Voltage <26.0, no short verified, Powerdown until MN BUS > 26.5 vdc)

SPS BURN

O2 HTRS (2) - off (ctr) 11.05
BAT C on MNA&B
  cb MNA BAT C - close
  cb MNB BAT C - close
ECS RAD HTRS (2) - OFF 17.2 per HTR
If unsuited
  SUIT COMPR (2) - OFF 8.44
S BD PWR AMP - off (ctr) 4.35
FC PUMPS (3) - OFF 9.43
SM RCS HTRS (4) - OFF 2.90 per quad MAX
POT H2O HTR - OFF 1.62
H2 HTRS (2) - off (ctr) 1.43
H2 FANS (2) - off (ctr) 0.72
O2 FANS (2) - off (ctr) 5.4
SPS LINE HTRS - off (ctr) 1.025 A
  2.05 A/B

LIGHTS (min req'd)
TAPE RCDR FWD - off (ctr) 1.69
SPS GAUGING - OFF 2.96
ECS GLY PUMPS (2) - OFF 2.76 per pump
  cb ECS RAD CONT/HTR (2) - open 2.69
SCE PWR - off (ctr) 0.65
TELECOM GRP 1&2 - OFF
cb INSTR ESS (2) - open

BUS LOSS RECONFIGURATION

A Loss of MN BUS A
  FC 2 - MNB only
  FC 1 - MNB (if req'd)
  INV 3 - MNB, AC1
  cb MNA BAT BUS A - open
  cb MNB BAT C - closed
  SUIT H2O ACCUM AUTO - 2
  BMAG MODE (3) - RATE 2
  FDAI SEL - 2
  URINE DUMP - HTR B
  WASTE H2O' DUMP - HTR B
  RHC PWR DIR 2 - MNB
  AUTO RCS SEL (16) - MNB
  RAD PRIM HTR - 1
  SPS LINE HTR - A/B (as req'd)
  RAD FLOW CONT PWR - MAN SEL
  SCS TVC (P&Y) - RATE CMD

B Loss of MN BUS B
  FC 2 - MNA only
  FC 3 - MNA (if req'd)
  INV 3 - MNA, AC2
  cb MNB BAT BUS B - open
  cb MNA BAT C - closed
  BMAG MODE (3) - RATE 1
  RHC PWR DIR 1 - MNA
  AUTO RCS SEL (16) - MNA
  SCS ELEC PWR - ECA
  RAD PRIM HTR - 2
  RAD FLOW CONT AUTO - 1

C Loss of BAT BUS A
  RAD PRIM HTR - 2
  If MN BUS TIE A/C is closed
    cb MNA BAT BUS A - open
    cb MNA BAT C - open
  If MN BUS TIE A/C is open
    cb MNB BAT BUS B - open
cb MNA BAT C - open
MN BUS TIE BAT B/C - on (up)

D Loss of BAT BUS B
RAD PRIM HTR - 1
If MN BUS TIE B/C is closed
  cb MNB BAT BUS B - open
  cb MNB BAT C - open
If MN BUS TIE B/C is open
  cb MNA BAT BUS A - open
  cb MNB BAT C - open
  MN BUS TIE BAT A/C - on (up)

E Loss of AC BUS 1
AC INV 1 MNA - OFF
SUIT COMPR 2 - AC2
FDAOI SEL - 2
BMAG MODE (3) - RATE 2
TELECOM GRP 1 - AC2
FC PUMP 1 - AC2
ECS GLY PUMP 2 - AC2
BMAG 1 PWR - OFF
G/N PWR - AC2
SIG CONT/BIAS PWR 1 - AC2
Maintain GLY EVAP TEMP INLET temp above 40°F
ECS RAD FLOW CONT - 2
BAT CHGR - AC2

F Loss of AC BUS 2
AC INV 2 MNB - OFF
SCS ELEC PWR - ECA
TELECOM GRP 2 - AC1
FC PUMP 2&3 - AC1
BMAG 2 PWR - OFF
FDAOI SEL - 1
SIG CONT/BIAS PWR 2 - AC1
BMAG MODE (3) - RATE 1
Activate SEC COOL LOOP
Shut down PRIM EVAP
PRE/POST SPS BURN

A. Loss of MN BUS A

Pre SPS Burn
Verify reconfiguration per mission phase
Perform G&N SPS maneuver with
following deviations:
  cb MNB BAT C - close
  TVC GMBL DR (P&Y) - 2
  cb SPS P1&2, Y1&2 (4) - open
  (after GMBL MTR turn on)
SCS TVC (P&Y) - RATE CMD
Post SPS Burn
  cb SPS P1&2, Y1&2 - close
  (prior to GMBL MTR turn on)

B. Loss of MN BUS B

Pre SPS Burn
Verify reconfiguration per mission phase
Perform G&N SPS maneuver with
following deviations:
  cb MNA BAT C - close
  TVC GMBL DR (P&Y) - 1
  cb SPS P1&2, Y1&2 - open
  (after GMBL MTR turn on)
Post SPS Burn
  cb SPS P1&2, Y1&2 - closed
  (prior to GMBL MTR turn off)

C. Loss of BAT BUS A

Pre SPS Burn
  cb MNA BAT BUS A - open (verify)
  cb MNB BAT BUS B - closed (verify)
  cb MNA BAT C - closed

NOTE
If BUS TIE B/C is already closed,
BAT C should be brought online
when ready to tie bats to mains.

TVC GMBL DR (P&Y) - 2
After GMBL start,
  cb SPS P1&2, Y1&2 - open
Post SPS burn
  cb SPS P1&2, Y1&2 - closed
  (prior to GMBL MTR turn off)

D. Loss of BAT BUS B

Pre SPS Burn
  cb MNB BAT BUS B - open (verify)
  cb MNA BAT BUS A - closed (verify)
  cb MNB BAT C - closed

NOTE
  If BUS TIE A/C is already closed,
  BAT C should be brought on line
  when ready to tie bats to mains.

TVC GMBL DR (P&Y) - 1
After GMBL start,
  cb SPS P1&2, Y1&2 - open

Post SPS Burn
  cb SPS P1&2, Y1&2 - closed
  (prior to GMBL MTR turn off)

E. Loss of AC BUS 1
  AC INV 1 MNA - OFF
  S BD NORM PWR AMP - SEC
  S BD NORM XPNDR - SEC
  FC PUMP 1 - AC2
  G/N PWR - AC2
  ECS GLY PUMP 2 - AC2
  BMAG 1 PWR - OFF
  SIG COND/BIAS PWR 1 - AC2
  FDAI SEL - 2
  SCS TVC (2) - RATE CMD
  BMAG MODE (3) - RATE 2
  TVC SERVO PWR 1 - AC2/MNB
  SPS GAUGING - AC2

F. Loss of AC BUS 2
  AC INV 2 MNB - OFF
  S BD NORM XPNDR - PRI
F 14-12

Note: If post TLI, TELECOM GRP 2 - AC1
FC PUMP 2&3 - AC1
BMAG 2 PWR - OFF
FDAI SEL - 1
SCS ELEC PWR - ECA
SCS TVC (P&Y) - RATE CMD
BMAG MODE (3) - RATE 1
TVC SERVO PWR 2 - AC1/MNA

DURING CRITICAL SPS BURNS

Loss of MNA
FC 2 - MNB only
TVC GMBL DR (P&Y) - 2
cb SPS P2,Y2 - open
AC BUS 1 INV 1 - OFF
AC BUS 1 INV 2 - on (up)
SCS TVC (P&Y) - RATE CMD
FDAI SEL - 2
ΔV THRUST B - NORM

Loss of MNB
FC 2 - MNA only
cb SPS P1,Y1 - open
TVC GMBL DR (P&Y) - 1
AC BUS 2 INV 1 - on (up)

Loss of AC BUS 1
TVC SERVO PWR 1 - AC2/MNB
BMAG MODE (3) - RATE 2
FDAI SEL - 2
SUIT COMPR 2 - AC2

Loss of AC BUS 2
TVC SERVO PWR 1 - AC1/MNA
BMAG MODE (3) - RATE 1
SCS TVC (2) - AUTO
ΔV CG - LM/CSM
Control MTVC with Trim tw's

Loss of BAT BUS A
cb MNA BAT C - closed
Loss of BAT BUS B

\[ \text{cb MNB BAT C} - \text{closed} \]

**LOSS OF TWO FUEL CELLS**

1. Power down the following:

   **Panel 2**
   - 02 & H2 FANS & HTRS - OFF
   - C/W NORM - ACK
   - POT H2O HTR - OFF
   - GLY EVAP STM AUTO - MAN
   - GLY EVAP H2O FLOW - off (ctr)
   - GLY EVAP IN TEMP - MAN
   - ECS RAD HTRS (2) - OFF

   Power down IMU and CMC to STBY per checklist

   **Panel 3**
   - SPS LINE HTR - off (ctr)
   - TAPE RCDR FWD - off (ctr)
   - S BD NORM PWR AMP - off (ctr)

   Select single inverter operation

   Configure remaining fuel cell to both main busses

   **Panel 5**
   - cb ECS RAD HTR OVL (2) - open
   - Failed FC PUMPS (2) - OFF

   **Panel 7**
   - SCS LOGIC PWR 2/3 - OFF
   - BMAG PWR (2) - OFF (place to WARMUP
     40 min prior to an IMU/GDC align)
   - FDAI/GPI - OFF

   **Panel 8**
   - AUTO RCS SEL (16) - OFF
   - cb SCS LOGIC (4) - open

2. **IGN - 2 hrs**
   
a. Power up CMC, IMU, and OPTICS per
      checklist and perform IMU align (crew option)
b. After IMU align OPT PWR - OFF

c. If main bus voltage 26.0 vdc with CMC, IMU, and OPTICS up perform the following:
   1) If sufficient battery energy is available, place battery with highest energy on both main busses.
   2) If insufficient battery energy available perform:
      - SM RCS HTR - OFF
      - ECS GLY PUMP - OFF (to be turned back on within 1 1/2 hrs)
      - SUIT COMPR - OFF (to be turned back on within 1 hr)
      - cb INSTR ESS (2) - open (to be closed when the batts are on line) (crew option)
      - Lights - as req'd

3. IGN - 1 hr
   BMAG PWR (2) - WARMUP for 40 min before IMU/GDC align.
   After warmup, power up SCS per checklist
   - Arm logic
   - Arm pyros
   - Press CM RCS
   - Safe pyros
   - Safe logic

4. Batts on at normal time prior to SPS deorbit and proceed with normal entry

NON-DIODED/NON-SWITCHABLE LOADS

MAIN A
   O2 & H2 TK 1 HTRS
   PP CO2 (TLM & Onboard)
   PRIM 2 RAD HTR
RAD SEC HTR
RAD MAN SEL
RAD FLOW CONT No. 1 & AUTO SEL capability
RAD SEC TEMP Inlet & Outlet (SFO262T & SFO263T)
AUTO & semi-auto operation of No. 1 H2O ACCUM sw if H2O ACCUM (Pnl 382) is in the RMTE position
INV 1
16mm SEQ Camera
Quads B, D; CM1, HTRS & Isol vlvs
AV THRUST A
PRI GMBL MTRS P,Y
L COAS
Flash RNDZ Lts
FDAI 1
GDC
BMAG 1 (immediately)
RHC PWR DIR 1 (HALF THE JETS)
DIRECT ULLAGE PB (C3 & A4)

MAIN B
O2 & H2 TK HTRS
PRIM 1 RAD HTR
PRIM RAD INLET TEMP
RAD FLOW CONT No. 2
H2O ACCUM 2
INV 2
Quads A, C; CM2, HTRS & Isol vlvs
AV THRUST B
SEC GMBL MTRS P,Y
FDAI 2
GDC (All modes)
BMAG 2
RHC PWR DIR 2 (HALF THE JETS)
DIRECT ULLAGE PB (D3 & B4)
ORDEAL

BAT BUS A
SECS & ELS System A
UPRIGHTING SYS COMPR 1
UPRIGHTING FLOAT BAG 1
EDS Voting Logic 1
GMBL MTR Control (On-Off) P1 & Y1
MN BUS TIE A/C
BAT BUS B
SECS & ELS System B
UPRIGHTING SYS COMPR 2
UPRIGHTING FLOAT BAG 2
EDS Voting Logic 3
GMBL MTR Control (On-Off) P2 & Y2
MN BUS TIE B/C

AC BUS 1
02 & H2 TK 1 FAN, Qty & Temp
CAB FAN 1
RAD FLOW CONT No. 1
Man control of GLY EVAP STM PRESS (φC) (Pri Sys)
Elect control of SUIT HT EXCH PRI GLY CONT vlv (φB)
Auto control of PRI GLY EVAP TEMP IN vlv (φA)
EMS ΔV
FDAI 1
GPI (primary)
GDC
SCS MIN IMP & RATE CMD
BMAG 1
RHC 1 for MTVC (φA only)

AC BUS 2
02 & H2 TK 2 FAN, Qty & Temp
PRI EVAP TEMP Cont Unit (φA)
CABIN TEMP AUTO Control unit (φC)
CAB FAN 2
FDAI 2
RSI
BMAG 2
GDC
RATE CMD
MTVC
GPI (secondary)
ORDEAL