<table>
<thead>
<tr>
<th>PART NO</th>
<th>S/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKB32100080-307</td>
<td>100</td>
</tr>
</tbody>
</table>
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 AFRA, SO EUROPE, USSR

"  36-5337 " ALL CLOUDS & WATER

"  40-5899 " BEST OF THE "HERE MEN..."

"  44-6642 " EAGLE " AGAINST MOON BACKGROUND W/ EARTH RISING

S - 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 SHINE BANG...

37-5481 RCS QUAD SHOW, FLAG, TV CAMERA, ROCK FIELD

40-5874 BUZZ SALUTING FLAG

40-5851 SURFACE, ROCKS + CRATERS
GET-SEP - 3:15:03

T & D: THC & RHC ADJUSTED FOR COAS & ARMED
CHECK PNL 8 (16 RCS + EB + PYRO A)
DAP 11103, V46E, V60E, V68E
V49E, V25E +3021, +8857, +3198
EMS -100.0, EMS MODE ΔV & NORM
FDAI SCALE 5/1
RCS CMD - ON
DET 59:30 & COUNTING
59:58 + X THRUST
CSM/LV SEP - PUSH
ΔV = -100.8
-X TO -100.5 -100.6
V62E
PRO
MAN ATT (PITCH)-ACCEL CMD
PITCH UP 1°/SEC
PRO
MAN ATT (PITCH)-RATE CMD
CHECK BOOSTER THRU WINDOW
EMS -101.0
UNCAGE BMAGS

AT CONTACT, CMC MODE - FREE
NULL RATES
BOTTLE PRIM 1
\[ \Delta V_{TPF} = 32.3 \]

\[ \Delta V \text{ THRUST NORM} \quad (A \text{ FOR ALL BUT LOI1}) \]

\[ \text{THC} - \text{ARMED, EMS } \Delta V - \text{ NORM} \]
59:30 TAPE-RECORD, HBR, FWD
ULLAGE - PRO AT F99
[SCS-THRUST ON P/B]
TIG NOTE TIME
ΔV THRUST NORM - OTHER BANK ON
SHUTDOWN: (FOR B/T >:06)
ΔV 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 ΔVC- TURN OFF
THC PWR - OFF, ROT CONT PWR DIR-OFF
LIMIT CYCLE - ON, RHC & THC-LOCKED.
TAPE - LBR
BUS TIES - OFF

FAILURE PROCEDURES:

<table>
<thead>
<tr>
<th>OR</th>
<th>G&amp;N BURN</th>
<th>SCS BURN</th>
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</thead>
<tbody>
<tr>
<td>AC BUS 1</td>
<td>TVC GIMBAL DR++</td>
<td>THC</td>
</tr>
<tr>
<td>MN BUS A</td>
<td>FDAI SEL - #2</td>
<td></td>
</tr>
<tr>
<td>UNDERVOLT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC BUS 2</td>
<td>TVC GIMBAL DR++</td>
<td>STEER W/THUMBWHEEL OR</td>
</tr>
<tr>
<td>MNB BUS B</td>
<td>BMAG MODE (3)</td>
<td>SHUTDOWN</td>
</tr>
<tr>
<td>UNDERVOLT</td>
<td>RATE 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PULL CB SPS P1-Y1</td>
<td></td>
</tr>
<tr>
<td>GIMBAL HARDOVER</td>
<td>THC</td>
<td>THC</td>
</tr>
<tr>
<td>#1 BMAG FAIL</td>
<td></td>
<td>THC</td>
</tr>
<tr>
<td>#2 BMAG FAIL</td>
<td>BMAG RATE 1</td>
<td>THC</td>
</tr>
<tr>
<td>SPS PRESS</td>
<td>CK FUEL/OX PRESS</td>
<td>CK RUEL/OR PRESS</td>
</tr>
<tr>
<td></td>
<td>CK HE VALVES OPN</td>
<td>CK HE VALVES OPEN</td>
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# LUNAR ACTIVITIES AND CAMERA SETTINGS

## LOS

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>PM (150° W)</td>
<td></td>
</tr>
<tr>
<td>SUNRISE</td>
<td></td>
</tr>
<tr>
<td>AOS</td>
<td>94:21</td>
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<tr>
<td>SUNSET</td>
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<table>
<thead>
<tr>
<th>OVERHEAD LM:</th>
<th>LAST DAP LOAD:</th>
</tr>
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<tr>
<td></td>
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</table>

## Camera Settings:

<table>
<thead>
<tr>
<th>Camera Setting</th>
<th>Description</th>
<th>Duration</th>
<th>F-stop</th>
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<tbody>
<tr>
<td>CEX @ 1/250</td>
<td></td>
<td>0-9:30</td>
<td>2.8</td>
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<tr>
<td>B&amp;W 70 MM</td>
<td></td>
<td>9:30-13:30</td>
<td>4</td>
</tr>
<tr>
<td>BASIC MOON</td>
<td></td>
<td>13:30-18:00</td>
<td>5.6</td>
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<tr>
<td>TERM</td>
<td></td>
<td>18:00-30:30</td>
<td>8</td>
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<tr>
<td>ZERO PHASE</td>
<td></td>
<td>30:30-37:30</td>
<td>11</td>
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<tr>
<td>VEH/VEH</td>
<td></td>
<td>37:30-45:30</td>
<td>8</td>
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<tr>
<td>EARTH</td>
<td></td>
<td>45:30-51:00</td>
<td>5.6</td>
</tr>
<tr>
<td>58:30-1:10:30</td>
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<td>51:00-58:30</td>
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## How to Track

<table>
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<tr>
<td>V48: 11103</td>
<td>OPTICS ZERO</td>
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<tr>
<td>V44E CONFIRMED</td>
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<tr>
<td>P20: FL 50 18</td>
<td></td>
</tr>
<tr>
<td>V77E, V32E</td>
<td></td>
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<tr>
<td>FL 50 18 (Δ=35°)</td>
<td></td>
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<tr>
<td>SCS MIN IMP</td>
<td></td>
</tr>
<tr>
<td>MCM AUTO</td>
<td></td>
</tr>
<tr>
<td>V58E (UPLINK ACTY)</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>P00 V89 OPT 2</td>
<td></td>
</tr>
<tr>
<td>V62E V32E</td>
<td></td>
</tr>
<tr>
<td>SCS MIN IMP</td>
<td></td>
</tr>
</tbody>
</table>

## Find and Flange Mirror

- 3/a5 36 kelp at 08:200, 2800 000000
- DAP 5/125 11111
- Pitch: 1.8
- C & D: OFF

- 10:00
- Hocton
Ye Ole Lunar Scratch Pad

NIGHT TIME: PUT FRESCO LIGHTS ON (FAA)
DROP 250 lb. MIS - INTO BAG
SPOON UPSIDE DOWN
INTO COMPARTMENT UNDER COULIC WHO COULIC BEING THERE

TEC: J 5 7 8
RECQ P + 30
HGA Y 270

LINEAR ICE TEE

FINGERNAIL CLIPPERS

LOOKS SIMPLE - NOT SO - LAUNCH VEHICLES
98,000 WORD Vocab
SWITCHES > 300 + ETC
SPS MUST LIGHT OR STRANDED CHUTES MUST OPEN

ENTRY

130911N 69° 10" W

ALL THIS IS POSSIBLE - ONLY THOUGHTS OF MANY
AMERICAN WORKMEN AT THE VERTIS
PAINSTAKING TESTS AT ESC
MSC MANAGEMENT, MSC PLAN, NASA
PERISCOPE OF SUB
P22 (LM ATTACHED)

A-1
LAT +02.000
LONG/2 +32.750
ALT +000.00

APPROACH R 0 (INRTL)

P 297 303
Y 0

NORTH OF TRACK 1+7 NM

NOTE: X-AXIS 2° BELOW LOCAL HORIZONTAL AT T-2

T1 82:37:35
PITCH-ACCEL CMD

T2 82:42:50 (MARK :40 SEC LATER)

RECORD 06 89+02009+32594-00172

STOP PITCH AT SLEEP ATT (R-82, P-229, Y-0)

P22 (LM ATTACHED)

130
LAT +01.258
LONG/2 +11.833
ALT -001.35

APPROACH R 0 (INRTL)

P 290 270
Y 0

NORTH OF TRACK 37:35 NM

NOTE: X-AXIS 2° BELOW LOCAL HORIZONTAL AT T-2

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-13, Y-0)

P22 (CSM ONLY)

LM LAT +00.71
LONG/2 +11.954
ALT -001.61

NOTE: SCS MIN IMP 4 PULSES=.05°/SEC

V48E CONFIRM R1 = 11100 (FDAI #2 ø = 338°)

MNVR TO +X 22° BELOW HORIZONTAL (2° Below HORIZON)

V49E, V25E, __________, _________ PRO

CMC MODE - FREE

V37E 22E 24

T1 104:32:16 T2 104:37:28 (MARK :40 SEC LATER)

CMC MODE - HOLD

RECORD 06 89+00776+11693-00155

SOURCE DATE

START MARKS
AT 104:38:08
START DET
Const G
L.V. ↑ to max G
L.V. ↓, then modulate until G = 0
G = 0 until past Veire
Roll 045° Hold until RRT drogue

Drink water
Supply valve off
194:03:06
Start DET

194:33:06

\[ V_e = 36.194 \text{ fps} \]
\[ \gamma_e = -6.50^\circ \]

Pre-entry attitude timeline.

- Horizon at 31.7°
- DAP command
- -45° DB
- -45° DB

Pitch gimbals angle, deg

Time to entry interface, min

HORIZON

Moor occults

DARK LIGHT
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   V49 Crew Defined Maneuver
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6. CM O2 SUPPLY REFILL
7. DOFFING PGA
8. DONNING PGA
9. PARTIAL SUIT CKLIST
10. URINE DUMP MODES
11. CABIN PRESSURIZATION
12. O2 TOP OFF FOR ENTRY
13. SUIT CKT INTEGRITY CK
14. PGA INTEGRITY CK
15. CM PRESSURE DUMP
16. SUIT CKT H2 PURGE
17. CABIN COLD SOAK
18. PRI EVAP OPN
19. SEC EVAP OPN
20. POTABLE WATER CHLORIN
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### STAR LIST

<table>
<thead>
<tr>
<th>STAR NAME (Numerical)</th>
<th>STAR NAME (Alphabetical)</th>
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<tr>
<td>00 Planet</td>
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</tr>
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<td>1 Alpheratz</td>
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<td>2 Diphda</td>
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<td>3 Navi</td>
<td>Aldebaran</td>
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<td>4 Achernar</td>
<td>Alkaid</td>
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<tr>
<td>5 Polaris</td>
<td>Alphard</td>
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<td>6 Acamar</td>
<td>Alphecca</td>
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<td>41 Dabih</td>
<td>Rasalhague</td>
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<td>42 Peacock</td>
<td>Regor</td>
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<tr>
<td>43 Deneb</td>
<td>Regulus</td>
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</tbody>
</table>
1. REF DATA

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
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*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)
94 Enable W matrix initialization
95 Enable CISLUNAR Tracking recycle
96 Terminate integration and go to P00
    (Select P00 by V37 after use of V96)
97 SPS Thrust Fail (R40)
98 Enable engine ignition
 *Callable with other extended verb in use
   and does not lock out other extended verbs

NOUN LIST (Decimal)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Format</th>
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<tr>
<td>01</td>
<td>Specify Machine Address</td>
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<td>(Fract) (R1, R2, R3)</td>
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<td>Option Code (R1 &amp; R2)</td>
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<td>FLAGWORD operator, ECADR, BIT ID, Action</td>
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<td>08</td>
<td>Add +1 of error</td>
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<td>B BANK + SUPERBANK</td>
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<td>Alarm Codes</td>
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<td>Channel to be Specified (R1)</td>
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<td>11</td>
<td>TIG (CSI)</td>
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<td>Increment Machine Address</td>
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<td>17</td>
<td>Astronaut total att</td>
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<td>18</td>
<td>Auto Maneuver</td>
<td>R, P, Y .01°</td>
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<tr>
<td>20</td>
<td>Present ICDU Angles</td>
<td>R, P, Y .01°</td>
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<tr>
<td>21</td>
<td>PIPA PULSES X, Y, Z</td>
<td>Pulses</td>
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<tr>
<td>22</td>
<td>New ICDU Angles</td>
<td>R, P, Y .01°</td>
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<tr>
<td>24</td>
<td>Delta CMC Clock Time</td>
<td>hrs, min, .01sec</td>
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<td>25</td>
<td>Checklist (please perform)</td>
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<td>26</td>
<td>Prio/Delay, ADRES</td>
<td>OCTAL</td>
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<td>BBCON(R1, R2 &amp; R3)</td>
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<td>Self-Test on/off sw</td>
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<td>X SM LAUNCH Azimuth</td>
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<td>Time of Event</td>
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<td>35</td>
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<td>36</td>
<td>Time of CMC Clock</td>
<td>hrs, min, .01 sec</td>
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<td>GETI-TPI</td>
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<td>ΔV (Accumulated)</td>
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<td>ΔV (Required)</td>
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<td>43</td>
<td>Lat</td>
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<td></td>
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<td>(+ North)</td>
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<tr>
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<td>(+ East)</td>
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<td>TF GETI of next burn</td>
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<td>46</td>
<td>DAP Config (R1&amp;R2)</td>
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<td>CSM weight</td>
<td>LBS</td>
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<td>LM Weight</td>
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<td>Pitch Trim</td>
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<td>Yaw Trim</td>
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<td>.1 FPS</td>
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<td>SOURCE CODE (1 optics, 2 VHF)</td>
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</table>
50 ΔR (miss distance) .1 NM
PERIGEE (HP) .1 NM
TFF min-sec
51 RHO .01°
GAMMA .01°
52 CENTANG (active veh) .01°
53 RANGE .01 NM
RANGE RATE .1 FPS
PHI (lcl horiz) .01°
54 Range .01 NM
Range Rate .1 FPS
Theta (lcl horiz) .01°
55 Perigee code
E(ELEV ANGLE)
CENTANG (passive veh) .01°
57 ΔR offset (SOR) .1 NM
 (+ indicates behind target)
58 HP alt (post TPI) (SOR for P38) .1 NM
ΔV (TPI) (SOR for P38) .1 FPS
ΔV (TPF) (SOR FINAL for P38) .1 FPS
59 ΔV LOS 1 .1 FPS
ΔV LOS 2 .1 FPS
ΔV LOS 3 .1 FPS
60 G Max
V Pred FPS
Gamma EI .01°
61 Impact Lat .01°
 (+ North)
Impact Long .01°
 (+ East)
Head Up/Down +/-00001
 (+ Heads up)
62 VI-Inertial Vel Mag FPS
H Dot-Alt Rate FPS
H-Alt .1 NM
63 RTGO from 0.05 G .1 NM
To Splash
VIO, Predicted Iner Vel FPS
TFE, time from .05G min-sec
64 Drag Acceleration .01 G
VI, Inertial Velocity FPS
RTGO to Target .1 NM
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<th>Unit(s)</th>
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<td>65</td>
<td>Sampled CMC Time</td>
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<tr>
<td>66</td>
<td>Beta, CMD Bank Angle</td>
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<td>CRSRNG Error</td>
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<td>RTOGO to Target</td>
<td>.1 NM</td>
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<td>Lat, Present Position</td>
<td>.01° (+ North)</td>
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<td></td>
<td>Long, Present Position</td>
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<td>H Dot, Alt Rate</td>
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<td>Delta</td>
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<td>LMK Data</td>
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<td>Horiz data</td>
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<td>ΔT</td>
<td>min-sec</td>
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<td>VG</td>
<td>FPS</td>
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<td>ΔV (Accumulated)</td>
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<td>ΔVX,Y,Z (lcl vert)</td>
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<td>ΔVX,Y,Z (LV) CDH</td>
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<td>83</td>
<td>ΔVX,Y,Z (Body Control Axis)</td>
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<td>84</td>
<td>ΔVX,Y,Z (Other Vehicle)</td>
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<td>85</td>
<td>VGX,Y,Z (Body Control Axis)</td>
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<td>87</td>
<td>Opt Calib Data - Shaft (R1)</td>
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<td>Trunnion(R2)</td>
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</table>
88 Planet

X

Y

Z

89 Landmark - Lat

(+ North)

0.001°

Long/2

(+ East)

0.001°

Alt

0.01 NM

Plane para

Y

D OT

Y

PSI

0.1°

90 REND out of

91 OCDU Angles Shaft (R1)

Trunnion (R2)

0.01°

0.001°

92 New OCDU Angles Shaft (R1)

Trunnion (R2)

0.01°

0.001°

93 Delta Gyro Angles X, Y, Z

0.001°

94 OCDU ANGLES (R56 & R23)

R1 SHAFT

R2 TRUNNION

0.01°

0.001°

95 Pref att ICDU angles

0.01°

96 +X axis att ICDU angles

0.01°

97 System Test Inputs

98 System Test Results

99 POS ERR

VEL ERR

OPTION Code

1 FT

0000X

V05 N09 ALARM CODES

00110 Mark reject has been entered but ignored

Continue

00112 Mark reject with no marks being accepted

Continue

00113 No inbits (chan 16)

Continue; if alarm recurs use MDC DSKY.

00114 More marks made than desired

Continue
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 It and NO ATT It 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)
Time from TIG (CDH) to TIG (TPI) <10 min (F/4-2,7-1)

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

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

No solution to conic subroutine
Reselect program.

Alt at specified TIG in P37 < \~400K ft
Reselect P37 and decrease TIG.

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

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

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

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

CMC self test error (F/2-3)

Unused CCS branch executed
Copy N08, notify MSFN, initiate V36 recovery

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

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

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

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 Arccos 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 01201.
**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 (PO7) during POO or PO1
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>
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<tr>
<th>R1 Code</th>
<th>ACTION</th>
<th>FUNCTION</th>
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<td>00013</td>
<td>Key in</td>
<td>Gyro Torque Option (P52,54)</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>
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<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>
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<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>
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</table>

### VO4 NO6 (N12) OPTION CODES

<table>
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<tr>
<th>R1 Code</th>
<th>Purpose</th>
<th>Input for R2</th>
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<tr>
<td>00001</td>
<td>Specify IMU Orientation</td>
<td>1=PREF, 2=NOM, 3=REFS, 4=LDG SITE</td>
</tr>
<tr>
<td>00002</td>
<td>Specify vehicle</td>
<td>1=CSM, 2=LM</td>
</tr>
<tr>
<td>00003</td>
<td>Specify tracking attitude</td>
<td>1=Preferred, 2=+X-axis</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>
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<tr>
<td>RNDZ</td>
<td>00074</td>
<td>7</td>
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<tr>
<td>UPDATE</td>
<td>00075</td>
<td>7</td>
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<tr>
<td>Track</td>
<td>00075</td>
<td>5</td>
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<tr>
<td>Pref Att</td>
<td>00076</td>
<td>4</td>
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<tr>
<td>Steer</td>
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<td>11</td>
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<td>REFSMMAT</td>
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<td>13</td>
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<td>IMU</td>
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<td>State Vector</td>
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<td>Terminate</td>
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<td>Field</td>
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<td>------------------------------</td>
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<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Trunnion drive</td>
<td>00074</td>
<td>Enables CMC control of optics trunnion</td>
</tr>
<tr>
<td>Target 1</td>
<td>00075</td>
<td>LM sighting</td>
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<tr>
<td>Target 2</td>
<td>00075</td>
<td>LMK Sighting</td>
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<tr>
<td>W-matrix (RNDV)</td>
<td>00101</td>
<td>W-matrix for rendezvous navigation is valid</td>
</tr>
<tr>
<td>W-Matrix (ORB)</td>
<td>00077</td>
<td>P22, P23, W-matrix valid</td>
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<tr>
<td>3 axis</td>
<td>00101</td>
<td>MNVR Specified by 3 axis</td>
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<tr>
<td>External ΔV</td>
<td>00076</td>
<td>Ext ΔV VG comp</td>
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<td>Active vehicle</td>
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<td>LM active</td>
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<td>Final comp.</td>
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<td>Final RNDZ comp</td>
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<tr>
<td>Sighting mark</td>
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<td>V51 initiated</td>
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Basic Date: April 15, 1969
Changed: June 1, 1969
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<thead>
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<tr>
<td>Stick flag</td>
<td>00075</td>
<td>14</td>
<td>RHC out of detent</td>
<td>RHC in detent</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(auto maneuver</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>enabled)</td>
<td></td>
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<tr>
<td>CMOON flag</td>
<td>00104</td>
<td>12</td>
<td>Permanent CSM</td>
<td>Permanent CSM</td>
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<td>SV in Lunar Sphere</td>
<td>SV in Earth Sphere</td>
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<tr>
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<td></td>
<td>of Influence</td>
<td>of Influence</td>
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<td>NON-FLAGS</td>
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<tr>
<td>MARKSTAT</td>
<td>1330</td>
<td>10</td>
<td>After mark</td>
<td>After mark reject</td>
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<td>IMODES 30</td>
<td>1320</td>
<td>9</td>
<td>IMU not operating</td>
<td>IMU operating</td>
</tr>
<tr>
<td>A</td>
<td></td>
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</tr>
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<td>B</td>
<td></td>
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<td>15,14,13</td>
<td>12,11,10,9,8,7,6,5,4,3,2,1</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>E</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1 Set</td>
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</tr>
<tr>
<td>0 Reset</td>
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<td>BINARY - OCTAL</td>
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<td>111</td>
<td></td>
<td>7</td>
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</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

2. 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 *

PO6 - CMC POWER DOWN PROGRAM

1. Load 0 (NO DAP) in left digit of R1
   PRO
   PRO
   PRO

2. V46E
   V37E 06E
   F 50 25 00062 CMC PWR DN
PRO, push until STBY 1t - 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. V25 N01E, 1365E
   F 21 01 E,E,E
2. V15 N01E, 1365E
   15 01 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)

15 01 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 V25N21E (DO NOT ENTR)

16 21 XYZ PIPA COUNTS

4 At T + 4:16 - ENTR
T4:16

RECORD (X) R1 (Y) R2 (Z) R3 (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>15</th>
<th>14</th>
<th>13</th>
<th>12</th>
<th>11</th>
<th>10</th>
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<th>8</th>
<th>7</th>
<th>6</th>
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<td>4</td>
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FLAG WORD

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<th>C</th>
<th>D</th>
<th>E</th>
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<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
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Basic Date: April 15, 1969
Changed: May 20, 1969
3  F  23  07  
  (SET BIT) Key 1E  
  (RESET BIT) Key 0E  

4  (To Verify) V01 N01E (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  
EXAMPE: 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  

<table>
<thead>
<tr>
<th>Binary</th>
<th>Octal</th>
</tr>
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<tbody>
<tr>
<td>000-0</td>
<td>100-4</td>
</tr>
<tr>
<td>001-1</td>
<td>101-5</td>
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<tr>
<td>010-2</td>
<td>110-6</td>
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<td>011-3</td>
<td>111-7</td>
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OCTAL-TO-DECIMAL CONVERSION  

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<td>12-10</td>
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<td>14-12</td>
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<td>5-5</td>
<td>15-13</td>
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<tr>
<td>6-6</td>
<td>16-14</td>
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<tr>
<td>7-7</td>
<td>17-15</td>
</tr>
<tr>
<td>10-8</td>
<td>20-16</td>
</tr>
</tbody>
</table>
REVIEW DATA IN ERASABLE MEMORY

1 Perform During Any Flashing Display

2 V01 N01E (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 N01E (ADDRESS) E

2 F 21 01 R3 ADDRESS
Load New Data in R1 E
N15E (For next succeeding word)
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  V11 N10E
   F 11 10 (LOAD CHANNEL ADDRESS) E
   R1 Octal Contents of Specified Channel

LOAD OUTPUT CHANNELS

1  V21 N10E
   F 21 10 (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 N01E
   3127E
   WWWV V
   WWWWW E
7

V24E
3131E
XXXXX E
YYYYY E

8

V21E
3200 E
ZZZZZ E
ORB RATE MAN Now In Progress

9

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

TABLE 1

CDUX

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

RCS DAP ATT DBD INCREASE

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

1

V21 NO1E
3255E
DBD (see table)
Desired DBD  

<table>
<thead>
<tr>
<th>DBD</th>
<th>Desired DBD</th>
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<tbody>
<tr>
<td>343E</td>
<td>+2.5</td>
</tr>
<tr>
<td>1616E</td>
<td>+10°</td>
</tr>
<tr>
<td>2525E</td>
<td>+15°</td>
</tr>
<tr>
<td>3434E</td>
<td>+20°</td>
</tr>
<tr>
<td>4343E</td>
<td>+25°</td>
</tr>
<tr>
<td>5252E</td>
<td>+30°</td>
</tr>
</tbody>
</table>

To return to RO3 DBD

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

G&N RECOVERY PROCEDURES

General System Checkout:

Get to PO0 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)
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 N02E
3703E
R1 = XXX.XX nm
(max R1 = 163.83;
If R1 neg, RNG = 327.67-R1)
CHANGING LANDING SITE REFSMMAT FOR OUT OF PLANE BURNS

1 V37E 52E  R1=00001
2 F 04 06   R2=00004 (LOAD LANDING SITE OPTION)
3 F 06 34   GET ALIGN (LOAD TIME OVER LANDING SITE)
4 F 06 89   LAT, LONG/2,ALT (LOAD R1: +350000 FOR +AVy
            or -350000 FOR -AVy)
5 F 06 22   NEW ICDU ANGLES
6 F 50 25   R=00013
            CMC MODE=FREE
            ENTER TO GYRO TORQUE
7 16 20     UNTIL TORQUING COMPLETE
8 F 50 25   R1=00014 ALIGNMENT CHECK
            ENTR
9 P30
10 P40
11 YAW BACK TO -0° (MANUALLY)
12 V37E 52E  R1=00001
            R2=00004
13 F 04 06   (LOAD LANDING SITE OPTION)
14 F 06 34   GET ALIGN (LOAD PREVIOUS TIME)
15 F 06 89   LAT, LONG/2,ALT (LAT WILL BE CHANGED BACK
            TO CORRECT VALUES)
16 F 06 22   NEW ICDU ANGLES
17 F 50 25   R=00013
            CMC MODE=FREE
            ENTR TO START TORQUING
18 16 20    UNTIL TORQUING COMPLETE
19 F 50 25   R1=00014 ALIGNMENT CHECK
            PRO: (TO SELECT 2 STARS IF TIME PERMITS)
            ENTR: (TO LEAVE P52)
SECTION 3. - NAVIGATION

P17 - TPI SEARCH (P77 LM)

CMC - on (req)

1

V37E (17E or 77E)

F 06 37 GETI (TPI) (hrs, min, .01sec)

Load desired GETI

PRO

2

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

PRO

*F 05 09 00124 alarm code *

*V32E, RSET to 1 to adjust*

*GETI or SEARCH OPTION*

3

F 06 58 HP, ΔV(TPI), ΔV(TPF) (.1nm, .1fps, .1fps)

(RECYCLE) V32E to 1 to adjust

GETI or Search option

PRO

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

PRO

5

F 37 XXE

P20 - RENDEZVOUS NAVIGATION

CMC - on (req)

ISS - on and aligned (req)

SCS - on (des)
BMAG MODE (3) - RATE 2
G/N OPT PWR - on (verify)
OPT ZERO - ZERO (verify)
OPT MODE - CMC

V37E 20E
F 50 18 Request MNVR to FDAI 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 *
* CMCO MODE - AUTO *
* V58E *
*(MAN) MNVR to 2 (SXT) *
* or to 3 (COAS) *

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

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

F

3-3

OPT ZERO - ZERO

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

3

F 06 94 SHAFT, TRUNNION (.01°, .001°)

V54E (COAS)

PRO

F 53 Request Alt LOS MARK
RHC - ALIGN Target in COAS
ENTR (V86E To reject)
*POSS F 06 49 ΔR, ΔV, source code*
*(.lnm,.fps,0000X) *
*(REJECT) V32E *
*(ACCEPT) PRO *

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

P21 GROUND TRACK DETERMINATION

CMC - on (req)

1

F 04 06 R1 00002, Specify Vehicle
R2 00001, CSM
or 00002, LM

PRO

2

F 06 34 GET LAT, LONG (hrs, min, .01sec)
Load desired GET

PRO

3

F 06 43 LAT, LONG, ALT (.01°, .01°, lnm)
(RECYCLE) V32E to 2 (Increment GET 10 min)
(EXIT) PRO

4

F 37 XXE

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
(ACEPT) Hold for 30 sec
PRO
F 3-6

9 F 06 89 LAT, LONG/2, ALT LMK ID

(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)

F 05 70 STAR ID(ABCDE)/LMK ID/HOR ID

Insure R1 DE≠00, 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 LLOS TO SLOS
MARK

4 F 06 87 R2 TRUNNION ANGLE BIAS

(repeat until 2 measurements agree within .003°)

For manual load:

V22 N94E

XXXXXE

(Accept) PRO

(REJECT) V32E to 3

NOTE: IF HAVING DIFFICULTY
WITH OPTICS CALIB,
LOAD ZEROES

(V22 N87E, 000000 E)

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

1
V37E 23E

2 F 05 70
R1 0000E STAR ID
R2 00C00 LMK ID
R3 00C0D HOR ID

STAR/ENH STAR/LNH STAR/EL
0000E 0000E 0000E
00000 00000 00100
00110 00210 00000

STAR/EFH STAR/LFH STAR/LL
0000E 0000E 0000E
00000 00000 00200
00120 00220 00000

STAR/HOR PRO TO 5 (DE=00 to 4)
STAR/LMK PRO

3 F 06 89 LAT, LONG/2, ALT (LMK) (.001°N/E, .01nm)
PRO (DE≠00 to 5)

4 F 06 88 CELESTIAL BODY VECTOR
LOAD DESIRED VECTOR
PRO

5 F 50 25 00202 MNVR/CALIB REQUEST
(MNVR) PRO
(CALIB) ENTR to 8
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 MARK

9 F 06 87 R2 TRUN BIAS (.001°) For manual load: V22 N94E XXXXEX (RECALIB) V32E to 8 (INCorp 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
11 F 51 MARK REQUEST
   (MNVR) V94E to 6
   (MARK) SUPERIMPOSE STAR ON LMK/HOR MARK

12 F 50 25 00016 TERM MARKS
   (REJECT) MARK REJECT to 11
   (TERM) PRO

13 F 05 71 R1 000DE STAR ID
       R2 00C00 LMK ID
       R3 00CDO HOR ID

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

14 F 06 89 LAT, LONG/2 ALT(LMK) (.001°+N/E,.01nm)
       PRO (DE#00 to 16)

15 F 06 88 CELESTIAL BODY VECTOR
       Verify vector PRO

16 F 06 49 ΔR ΔV (SV PARA) (.lnm,.1 fps)
       (REJECT) V37E 23E
       (UPDATE) PRO

17 F 37

---

P27 CMC UPDATE
CMC - on (req)

Auto Update:
V37E 00E

UP TLM (2) - ACCEPT
UPLINK ACTY lt - on
  *POSS LOS before completion*
  *If V33 NO2 showing: *
  * Key PRO *
  * UPLINK ACTY lt - out *
  * P00 displayed *
  *If V21 NO1 *
  *or V21 NO2 *
Update complete:
UPLINK ACTY lt - out
V37E 00E
UP TLM (2) - BLOCK

Voice Transmission Update:
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
P00 Displayed
### SECTION 4. PRETHRUST

**P30 EXTERNAL ΔV**

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

<table>
<thead>
<tr>
<th>1</th>
<th>F 06 33</th>
<th>V37E 30E</th>
<th>GETI</th>
<th>(hrs, min, .01sec)</th>
<th>Load desired GETI PRO</th>
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<tbody>
<tr>
<td>2</td>
<td>F 06 81</td>
<td>ΔVXYZ(LV)</td>
<td>GETI</td>
<td>(.1fps)</td>
<td>Load desired ΔV's PRO</td>
</tr>
<tr>
<td>3</td>
<td>F 06 42</td>
<td>HA, HP, ΔV(REQ)</td>
<td>GETI</td>
<td>(.1nm, .1nm, .1fps)</td>
<td>Set ΔV Counter PRO</td>
</tr>
<tr>
<td>4</td>
<td>F 16 45</td>
<td>M, TFI, MGA</td>
<td>GETI</td>
<td>(MKS, min-sec, .01°)</td>
<td>Set DET PRO (MGA Set to -00002 IF REFSMMAT FLAG NOT SET)</td>
</tr>
<tr>
<td>5</td>
<td>F 37</td>
<td></td>
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**P31 GENERAL LAMBERT PRETHRUST**

TARG PARAMS - LOADED FROM GND (P27)

<table>
<thead>
<tr>
<th>1</th>
<th>F 06 33</th>
<th>V37E 31E</th>
<th>GETI</th>
<th>(hrs, min, .01sec)</th>
<th>Load desired GETI PRO</th>
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<tr>
<td>2</td>
<td>F 06 81</td>
<td>ΔVXYZ(LV)</td>
<td>GETI</td>
<td>(.1fps)</td>
<td>Load desired ΔV's PRO</td>
</tr>
<tr>
<td>3</td>
<td>F 06 42</td>
<td>HA, HP, ΔV(REQ)</td>
<td>GETI</td>
<td>(.1nm, .1nm, .1fps)</td>
<td>Set ΔV Counter PRO</td>
</tr>
</tbody>
</table>
F 4-2

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 (marks, min-sec)
(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  ΔH(CDH) ΔAT(CDH–CSI) ΔAT(TPI–CDH) 
    PRO (.1nm,min-sec)
6  F 06 81  ΔV XYZ(LV)CSI
    (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
    REFSMMAT 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
*F 05 09 00611 NO TIG FOR SPECIFIED ANGLE (REDO)V32E to 1 PRO to 3
*CMC WILL use last calculated value of TPI

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
   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 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)
PRO

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

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

4 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)
PRO

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

6 F 06 81 ΔVXYZ(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
PRO
F 06 16 GET EVENT (hrs,min,.01sec)
PRO
F 06 90 Y,YDOT,PSI (.01nm,.1fps,.01°)
RECORD YDOT _______
PRO
INSERT - (YDOT) in R2 of ΔV TPI
PRO

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

P74 - Transmit Mvnr Parameters To LM

P35 TPM PRETHRUST (P75 LM)

V37E 35E

F 16 45  MARK, TFI, -00001  (marks, min-sec)
(RECYCLE) V32E To 3
(FINAL PASS) TERM MARKS

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

ΔVXYZ(LOS)TPM  (.1fps)

PRO (If Recycle - To 1)

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

P75 - Transmit Mvnr Parameters To LM
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
   Load desired TIG (outside lunar sphere)
   PRO

2  F 06 60  BLANK, V DESIRED, GAMMA EI
   Load desired values
   FOR MIN ΔV-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
   (RECYCLE) V32E To 1
   PRO

4  F 06 39  ΔT TRANSFER
   (RECYCLE) V32E To 1
   PRO
5  F 06 60  BLANK, V PRED, GAMMA EI (fps, .01°) (RECYCLE) V32E To 1 PRO

6  F 06 81  ΔVXYZ(LV) TIG (.1fps) (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 R03 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
  OE
If no TLI+10 min Abort
V1N1E
  3376E
Verify R1=01637

1
F 06 33 TIG
V37E 37E
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
  *
  *F 37 37E to 1

3
F 06 61 IMPACT LAT, IMPACT LONG
If Impact LONG<12° from desired:
  Record Impact LONG as θcl
PRO
  (.01°)
If Impact LONG $>12^\circ$ from desired:

- TEC: N40E Record R2 as $\Delta V_{\text{min}}$ \_fps
- TLC: V32E to 1
- V32E to 1 & use $|\Delta V| > \Delta V_{\text{min}}$
- Decrease $\Delta V$ to move LONG WEST
- $\Delta V$ neg to move LONG WEST
- Increase $\Delta V$ to move LONG EAST

4  F 06 39  AT TRANSFER \textit{from specified} (hrs, min, .01 sec)
   PRO

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

6  F 06 81  $\Delta V_{XYZ}(LV)$ at TIG
   N40E \textit{(rms of N81)}
   Record R2 as $\Delta V_{cl}$ = \_\_\_\_\_\_ fps
   KEY RLSE PRO

   \textit{for Precision Solution}
   *F 05 09  00605 Solution not *  *Convergent*
   *  00613 Flt Path Ang  *  *not reached*
   *RSET V32E to 1  *  *F 06 60 00607 Conic Routine*
   *  37 37E to 1  *  *Failed*

7  F 06 61  IMPACT LAT, IMPACT LONG \textit{(0.01°)}
   Record LONG as $\theta_{pl}$ = \_\_\_\_\_.
   If $\theta_{pl}$, acceptable, PRO to step 4 of CORRIDOR CONTROL (pg. F/4-7)
   PRO

8  F 06 39  AT TRANSFER
   PRO

9  F 06 60  BLANK, VPRED, GAMMA EI (fps, 0.01°)
   PRO

10 F 06 81  $\Delta V_{XYZ}(LV)$ at TIG
    N40E
R2 XXXX.X Record as \( \Delta V_{pl} = \text{____.____} \) fps

V32E to step 1 of Longitude Cont

\* Use \( \Delta V_{d} \) 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.
$\Delta V_0$ versus $\Delta_{\text{Long}}$, $K = 0.04$ to 0.004.
$\Delta V_0$ versus $\Delta_{\text{Long}}' \text{ deg}$

$\Delta V_0$ versus $\Delta_{\text{Long}}' \text{ deg} \quad K = .4 \text{ to } .04.$

Basic Date: JUNE 13, 1969
Changed: July 5, 1969 REV I
<table>
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<td>X</td>
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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 (.01°)
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,.lfps,.lfps)

8 F 06 81 ΔVXYZ(LV) (.lfps)
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)

1  V37E (39E or 79E)

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

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

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

5  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 OOE
SC CONT - CMC/AUTO

MNVR TO PAD BURN ATT
V62E

1
2
V49E
3 F 06 22

DESIRED FINAL GMBL ANGLES

(0.01°)

LOAD MNVR PAD GMBL ANGLES

PRO
F
5-2

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 LOAD SXTS angles (.01°, .001°)

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
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

15 F 50 25 00204 GMBL TEST OPTION
SC CONT - CMC (verify)

(ACCEPT) PRO

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

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

(REJECT) ENTR

16 06 40 TFI,VG,AVM (min-sec,.1fps)

*PROG ALM - TIG Slipped*
*V5N9E 01703 *
*KEY RLSE To 16 *

ROT CONTR PWR DIR (2) - MNA/B
SPS He v1vs (2) - AUTO (verify)
LIMIT CYCLE - OFF
FDA1 SCALE - 50/15

58:00
(-02:00) ΔV THRUST A(B) - NORMAL
THC - armed
RHC (2) - armed
TAPE RCDR - CMD RESET/HBR/FWD

59:25
(-00:35) DSKY BLANKS

59:30
(-00:30) (AVE G ON)
EMS MODE - NORMAL
06 40  TFI, VG, $\Delta$VM (min-sec, .1fps)
CHECK PIPA BIAS <2fps for 5 sec

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

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

MONITOR $\Delta$VM (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, $\Delta$VM (min-sec, .1fps, .1fps)

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

SPS THRUST Lt - ON
$\Delta$V 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
*PROG ALARM*
*V5 N9E 01407 VG INC*
*LOI & TEI THC - CW,*
* FLY MTVC *
*LOI2 & MCC *
*ΔV THRUST A&B - OFF*

OO: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,.lfps)
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) (.lfps)
NULL RESIDUALS (TEI & MCC)
RECORD ΔV COUNTER & RESIDUALS ΔVC
EMS FUNC - OFF
EMS MODE - STBY
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
21  F 16 44  HA, HP, TFF

(.1 nm, min-sec)

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

PRO

22  F 37  OOE

When COMP ACTY lit not on continuously:
V66E (If LM S.V. not needed)

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REMARKS

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 lit - 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 - ΔV
EMS MODE - NORMAL
Wait 100 sec & record ΔV ind
If change to ind -
<1fps, no correction
>1fps, ground correction req
EMS MODE - STBY
EMS FUNCT - ΔV SET/VHF RNG
SET ΔVC
EMS FUNC - ΔV
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
7

BORESIGHT & SXT STAR CHECK

OPT MODE - CMC
OPT ZERO - OFF

8

V41 N91E

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

10 41 OPTICS DRIVE

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

11 V37E 41E

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°)

14 F 50 18 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

15 06 85 VG X,Y,Z (.1fps)
* PROG Alarm lt *
* V5N9E - 01703 - TIG SLIPPED *
* KEY RLSE To 15 *

55:00
(-05:00)   TRANS CONT PWR - on (up)
            HAND CONTROLLERS - armed

59:25
(-00:35)   DSKY BLANKS

59:30
(-00:30)
16   16 85 VG X,Y,Z (AVE G ON)
     TAPE RCDR - CMD RSET/HBR/FWD
     LIMIT CYCLE - OFF
     EMS MODE - NORMAL

00:00
17   F 16 85 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

PRO

18   F 37 V82E
19   F 16 44 HA,HP,TFF (.1nm,min-sec)
     * R3-59B59 HP>49.4 mm/35K ft *

PRO

20   F 37 00E
21 When COMP ACTY is not on continuously:
V66E (If LM S.V. not needed)

P47 Thrust Monitor Program

CMC - on
ISS - on & aligned

1 V37E 47E
 F 16 83 ΔV XYZ(CSM) (.1fps)

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

(RECYCLE) V32E
(TERM) PRO

2 F 37 XXE
When COMP AETY 11 not in contact:
APR 11 JU 27 110 received

For: Vincent Monti

CHR

LRS

AV"

543 76

40 68

**MGC**

**PGC**

**MGC**

**PGC**

**MGC**

**PGC**
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 lt - 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
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 00013gyro 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  O00DE 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  O00DE 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
F 06 05  STAR ANGLE DIFFERENCE  
(Reject) V32E to 17  
(Accept)  PRO

16  F 06 93  TORQUING ANGLES OG, IG, MG  
(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 1t - 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
(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 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 ICQCI ANGLES OG, IG, MG  (.01°)  
(IF MG>±70°, MNVR) V32E to 4 PRO

5  F 00 25  00013 GYRO TORQUE  
(COARSE) PRO - NO ATT lt - on  
then off - to 7  
(TORQUE) CMC MODE - FREE EYTR

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

7  F 00 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  0000E STAR CODE  
Load desired code  
PRO to 10 (to 9 if DE=00)

9  F 00 88  CELESTIAL BODY VECTOR  
Load desired vector  
PRO

10  F 00 94  ALT LOS OPT ANGS SHAFT, TRUN(.01°, .001°)  
Load angles  
PRO

11  F 00 53  PLEASE MARK  
Center Target  
ENTR

12  F 00 25  00016 TERMINATE MARKS  
(REJECT) ENTR to II  
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 XXE
VENUS HALF-UNIT VECTORS
LIFTOFF - 16 JULY 69, 1330 HRS GMT

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* 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>
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<th>Z vector</th>
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### JUPITER HALF-UNIT VECTORS

LIFTOFF - 16 JULY 69, 1330 HRS GMT

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### SATURN HALF-UNIT VECTORS

LIFTOFF - 16 JULY 69, 1330 HRS GMT

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<th>Z vector</th>
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<td>.10360</td>
</tr>
</tbody>
</table>
SECTION 7. TARGETING

P72 LM CSI TARGETING

1
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\(\pi\) 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
* 00601 hp+CSI < 85nm/5.8nm
* 00602 hp+CDH < 85nm/5.8nm
* 00603 TIG(CDH)-TIG(CSI)<10min*
* 00604 TIG(TPI)-TIG(CDH)<10min*
F 7-2

* 00605 NO SOL IN 15 Tries  *
* 00606 ΔV (CSI) >1000 fps in 2* 
* Iterations  *
* V32E To 1   Adjust Inputs *

5 F 06 75 ΔH(CDH), ΔT(CDH-CSI), ΔT(TPI-CDH)  (.1nm, min-sec)
   RECORD (Final Pass Only)
       (ΔH)
       (ΔT CDH-CSI)
       (ΔT TPI-CDH)
PRO

6 F 06 81 ΔV XYZ(LV) (CSI)  (.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
   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
7  F 06 82 \( \Delta V \) XYZ(LV) (CDH) (.1fps)

RECORD (Final Pass Only)
______\( \Delta VX \)
______\( \Delta VY \)
______\( \Delta VZ \)
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  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 *
F 7-4

3  F 06 75  ΔH(CDH), ΔT(TPI-CDH), ΔT(TIG TPI: P73-P72)

RECORD (Final Pass Only) (l/m, 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, YDOTT, PSI (.01nm, .1fps, .01°)

(RECYCLE) V32E To (F 06 16)

RECORD

(Y)

(YDOTT)

(PSI)

PRO

PRO

5  F 16 45  M, TFI, MGA

(RECYCLE) V32E To 3

(TERMINATE) PRO To 3

(mark, min-sec, .01°)
PRO TRANSMIT PARAMETERS
TO LM (See Steps 1-4)

6   F 37

**P76 - TARGET ΔV**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F 06 84 V37E 76E ΔV XYZ (ΔV XYZ)</td>
<td>(.1fps)</td>
</tr>
<tr>
<td></td>
<td>Load ΔV PRO</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>F 06 33 TIG (hrs,min,.01sec)</td>
<td>(hrs,min,.01sec)</td>
</tr>
<tr>
<td></td>
<td>Load TIG PRO</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>F 37 OOE V82E (check Lm parameters)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>F 16 44 HA, HP, TFF (.1 nm,min-sec)</td>
<td>(.1 nm,min-sec)</td>
</tr>
<tr>
<td></td>
<td><em>R3 - 59B59HP &gt; 49.4 nm/35K ft</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PRO</td>
<td></td>
</tr>
</tbody>
</table>
FINAL BASE SET SHUT TIME TO UTI PRO TRANSIENT PARAMETERS TO IM (for Grade I &)

T - TARGET VA

V GEE

P OF 82 "Y TAN FORD VA

(50, meter - 0,000)

L.GR. 37 "Y FORD TEC

5 G.E.

2 5 0 9.00

1 1 0 9.00

1 1 0 9.00

2 5 0 9.00

1 1 0 9.00

1 1 0 9.00

4 9 9 9.00

1 1 0 9.00

2 5 0 9.00

1 1 0 9.00

4 9 9 9.00

1 1 0 9.00

1 1 0 9.00

4 9 9 9.00

1 1 0 9.00

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4 9 9 9.00

1 1 0 9.00

1 1 0 9.00

4 9 9 9.00

1 1 0 9.00
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

1
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  V42E  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

1
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
PRO To Prog in progress
V46E

V48 - DAP DATA LOAD PROCEDURE

1
F 04 46
R1 ABCDE
R2 ABCDE

<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>
</tr>
</thead>
<tbody>
<tr>
<td>0 - No DAP</td>
<td>0 - Fail A/C</td>
<td>0 - Fail B/D</td>
<td>0 ± 0.5⁰</td>
<td>0 ± 0.05⁰/sec</td>
</tr>
<tr>
<td>1 - CSM</td>
<td>1 - Use A/C</td>
<td>1 - Use B/D</td>
<td>1 ± 5.0⁰</td>
<td>1 ± 0.2⁰/sec</td>
</tr>
<tr>
<td>2 - CSM &amp; LM</td>
<td>0 - Fail</td>
<td>0 - Fail</td>
<td>2 ± 0.5⁰</td>
<td>2 ± 0.5⁰/sec</td>
</tr>
<tr>
<td>3 - CSM &amp; SIVB</td>
<td>1 - Use</td>
<td>1 - Use</td>
<td>3 ± 2.0⁰</td>
<td>3 ± 2.0⁰/sec</td>
</tr>
<tr>
<td>6 - CSM &amp; LM</td>
<td>(Ascent only)</td>
<td></td>
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</tbody>
</table>

Roll Quad Select | Quad A | Quad B | Quad C | Quad D |
-----------------|--------|--------|--------|--------|
0 - Use B/D      | 0 - Fail| 0 - Fail| 0 - Fail| 0 - Fail|
1 - Use A/C      | 1 - Use | 1 - Use | 1 - Use | 1 - Use |

PRO

2
F 04 46
CSM WT, LM WT
Load correct values
PRO

3
F 06 47
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, .01 sec)

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., lfps)

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

Load desired data
To reinitialize Cislunar W-matrix,
Load: R1 +30000
R2 +00000
R3 +00003

PRO

V74 CMC DOWNLINK

(If needed) V21 NO1E 333E

1

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

F 04 12

V82E (If AVE G On, Go To 2)

R1 00002 Specify Vehicle
R2 00001 CSM
R2 00002 LM

PRO

2

F 16 44

HA, HP, TFF (.1nm, .1nm, min-sec)
(RECYCLE) V32E To 2 (Not Nec If AVE G On)
(ΔR-miss dist DISP-P11 & POO) N50E To 3
(TF PER) N32E To 4
(EXIT) PRO
F 8-6

3 F 16 50 ΔR (miss, dist) HP, TFF (.1nm,.1nm,min-sec)
   KEY RLSE To 2

4 F 16 32 TIME FROM PER (Useful only if TFF=-59B59)
   (hrs,min,.01sec)
   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 P00)
   V83E (or 85E) - perform routine
   V37E 00E

1 V83E
   F 16 54 RANGE, RANGE RATE, THETA (.01nm,.1fps,.01°)
   PRO

V85 - RNDZ PARAMETER DISPLAY #2

Note: See V83 restrictions

1 V85E
   F 16 53 RANGE, RANGE RATE, PHI (.01nm,.1fps,.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 (.01°)
   (AUTO MNVR) PRO
   (UPDATE DISPLAY) V32E

4 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 6

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

6 F 50 18 REQ MNVR TO FDAI RPY ANGLES (.01°)
   (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)

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

1  V93E
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) - AC1
- SCS ELEC PWR - GDC/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 err 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

Key V16 N20E (press IMU angs)

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

Set SCT to 180° SHFT, 7.5° TRUN
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

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

5

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  
FDAO SELECT - 1/2

CAGE IMU when near 0,0,0 on FDA1 1

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>

5

FDAO 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

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

2. F 06 34 GET ALIGN 0,0,0
   PRO

3. F 06 22 R,P,Y

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

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

6. V37E XXE

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

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

2. V82E
   F 04 12 00002 SPECIFY VEHICLE
   00001
   PRO
F 9-5

3 F 16 44 HA, HP (.1nm,.1nm)
Calculate Average
ALT SET - Set Average
PRO

4 V83E
F 16 54 R,RDOT,THETA (.01nm,.1fps,.01°)
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

4 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
C/N PWR OPTICS - on
OPT MODE - CMC
OPT ZERO - ZERO (verify)

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

3  
F 50 25 00015 
ENTR

4  
F 01 70 000DE 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 
FDAT SCALE - 5/1

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

2  
F 06 22 Load V06N22 With Desired Initial Attitude 
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 Disable all jet on two adjacent quads.
Wait 20 minutes for rates to damp.
Enable all jets.

6 Set att hold:
V21NO1E
1332E
00000E

7 Select roll rate
+0.1°/s  -0.1°/s  +.3°/s  -.3°/s

V24N01E  V24N01E  V24N01E  V24N01E
3125E   3125E   3125E   3125E
00003E  77774E  0012E  42400E
24400E  53400E  35400E

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

Lowest 2 Adj. Quads compatible with DAP roll quads selected.
To exit G&N PTC AUTO RCS SEL (12) - MNA/B

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 XXE
   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 (.01°)
   LOAD R,P,Y PTC
   PRO

4. F 50 18 REQ MNVR TO FDAI R,P,Y ANGLES (.01°)
   (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 - °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)
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 tb - 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 OVLD - 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 vlv -*
*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

    AFTER 10 MIN

7 H2 or O2 Quantity Balance Correction
ON LOW Tank, H2 or O2 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 1t

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 ΔV
b. Presleep
c. Postsleep

CAUTION
If CRYO PRESS 1t on, do not
turn off fan until 1t ex-
tinguishes

ECS PERIODIC VERIFICATION

1 ECS MONITORING CHECK
CABIN ΔP - -1 to -3.5 in H20
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 re-
moving 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
4 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)

5 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)

6 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

7 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)

8 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
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

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 02 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 02 GAUGE:
  REPRESS 02 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 sta-
bilized 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 vlvvs 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

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 (20sec), 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)
18 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

19 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

20 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 IN vlv - OPEN (verify)
Wait 10 min & remove ampoule of H2O
Replace chlor port cap
Stow chlorination unit
Do not drink for 30 min

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

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

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
- SUIT CKT RET vlv - CLOSE
- DEMAND REGS - OFF

Install interconnect on LI 02 hose
Install vacuum cleaner brush on 02 red hose

LMP SUIT FLOW vlv - CABIN SCREEN ON CO2 R 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 RL3 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 02 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 REPEATED O2 HIGH FLOW BECOME BOTHERSOME, DEACTIVATE BY PULLING CB PNL 5: ECS TRANSDUCER 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 ANTENNA SCAN AND WARNING LIMIT, YAW-PITCH COORDINATES (CSM)

NOTES:
- YAW MEASURED IN THE XY PLANE, POSITIVELY ABOUT Z
- PITCH MEASURE FROM THE YAW PLANE, POSITIVELY IN THE -Z HEMISPHERE, NEGATIVELY IN THE +Z HEMISPHERE
S BD OMNI C ANTENNA

VHF SCIMITAR LEFT ANTENNA

S BD OMNI B ANTENNA

HIGH GAIN ANTENNA (DEPLOYED)

S BD OMNI D ANTENNA

VHF SCIMITAR RIGHT ANTENNA

S BD OMNI A ANTENNA

RENEZVOUS RADAR ANTENNA

RENEZVOUS RADAR ANTENNA

VHF SCIMITAR ANTENNA RIGHT (COVER REMOVED)

VHF SCIMITAR ANTENNA LEFT (COVER REMOVED)

HIGH GAIN ANTENNA (DEPLOYED)

MICRO WAVE ELECTRONICS
*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 ≥ 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 = \emptyset

V85E (if desired)
R1 = RANGE
R2 = RANGE RATE
R3 = \emptyset

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 (lh) - 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)
      \(Y,P_1 = 270, +40\) (ROLL RIGHT)
      \(Y,P_2 = 90, -40\) (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 \(Y,P_1 = \) ___, ___, ___, ___, ___

   WHEN LM IS ON SURFACE:
   1. DUPLEX B
   2. PNL 9 REGY ONLY
   3. VHF RANGING OFF
   4. S-BAND RELAY IS PRIME.
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 A
   VHF AM B - SIMPLEX B

H. RELAY MODE (LM VOICE TO MSFN)
   Voice Relay (With VHF Ranging)
   MODE - VOX (Pnl 10)
   VOX SENS tw - 5
   S BD - OFF
   INTERCOM - OFF
   VHF AM - T/R
   AUDIO CONT - BU
   MODE - VOX (Pnl 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 (Pnl 10)
   VOX SENS tw - 5
   S BD - OFF (Pnl 10)
   INTERCOM - OFF
   VHF AM - T/R
   AUDIO CONT - BU
   MODE - VOX (Pnl 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/o Bothering LM,
REQUEST MSFN RELAY OFF
RCS Engine, Vent, and Radiator Location
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<th>CM-RCS Oxidizer Valve Temperature (°F)</th>
<th>LM Power (Amps)</th>
<th>SPS Temperature (°F)</th>
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Basic Date: APRIL 15, 1969
Changed: JUNE 27, 1969
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

2. IVT TO LM FOR SECOND ENTRY

- Couches: CDR - 0°, CMP - 0°, LMP - 180°
- CDR don LCG & 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)*

FINAL
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 cmds 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 latch

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 drive - LATCH (113° CW) *
*(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 (≥ 8 1/2 min)
*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 in-
* tegrity 

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
- 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)
     - cb dockling 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 Interface 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 PRIM-2
     - If no retraction, initiate
       PROBE RETRACT **(Simultaneously 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
TUNNEL

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

SIDE HATCH

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 $\pm 2^\circ$ 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

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)
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)
Install forward hatch (11)
Perform hatch integrity check (12)
2 POO, V49, Load LM jett attitude:

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

PRO (Auto mvr to jett att)

cb SECS ARM (2) - close
SECS LOGIC (2) - on (up)
Obtain GO from MSFN
SECS PYRO ARM (2) - ARM

3 At Jett Attitude:

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

5

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

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 vlvs (4) - CLOSED
- SPS He tb (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**

<table>
<thead>
<tr>
<th>F 97 40</th>
<th>[\text{Record TFC}]</th>
<th>[\text{G&amp;N}] ΔVm</th>
<th>[\text{VcABORT(Chart)}]</th>
<th>[\text{GET LOI1}]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vg</td>
<td>[\text{GET TEI ABORT}]</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>ΔVm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EMS Vc</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ENTR**

- **F 99 40**
  - Maneuver to LOI1 Attitude
  - ENTR

**F 16 85**

- **Record Vx**
- Vx

**F 16 44**

- **Record Ha**
- Ha

**F 37 00E**

- When CMC ACTY 1t out:
- V66E

**ALTERNATE**

- ΔVc LOI1 PAD
- EMS Vc (Shutdown)
- Vc (Burned)
- Vc ABORT (Chart)
MAN ATT PITCH - ACCEL CMD
SET in GDC THUMBWHEELS - (77.8, 62.4, 4.5)
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 vlv's (2) - AUTO, verify tb-bp
LIMIT CYCLE - OFF
F
13-3/4

FDAI SCALE - 50/15 (verify)
EMS MODE - NORMAL
V37E 47E
ΔV 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
  ΔV 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 ΔVc
EMS MODE - STBY
EMS FUNCT - OFF
Nominal G mission 15 minute LOI crew chart

G. e. t. LOI-1 ignition: 75:55:03
G. e. t. abort ignition: 76:10:03

Roll: 178.79
Pitch: 62.43
Yaw: 4.46

DPS mode I abort available
Delay > 5 hr from LOI

DPS mode II abort available
Delay > 5 hr from LOI

Mode I or II abort available
Delay > 5 hr from LOI

Preabortion period, hr:
15
10
7
5

LOI ΔV magnitude, DVM, fps
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
11 CAB PRESS ind 0.0 psia for 6 min
12 CAB PRESS REL (RH) - NORMAL
13 CAB PRESS DUMP vlv - CLOSE
14 Do not repress cabin until fire source is removed

FIRE/SMOKE IN CM (CREW UNSUITED)
WARNING: CM water must not be used to extinguish fire

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 ΔP >+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

<table>
<thead>
<tr>
<th>Contamination In Suit</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SUIT COMPR 2 - ACL</td>
<td></td>
</tr>
<tr>
<td>2 SUIT COMPR 1 - OFF</td>
<td></td>
</tr>
<tr>
<td>3 DIRECT O2 vlv - OPEN for 1 minute then CLOSE</td>
<td></td>
</tr>
</tbody>
</table>

**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 G&N
V11 N10E 33E; RL:A;
if RL:A#0,1,4,5: C/W fail (if LEB,CMC, no TVC)
```
ISS
SC CONT - SCS, G&N PWR - ACl
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: RCS
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 >205°: 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 O2 (H2) O2 < (8)(H2): Cycle Purge
FLOW HI .8(.1) O2 > (8)(H2): Check amps vs. flow FC lg

FC O2 (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 UNDERTOLV DC Volts <26, AMPS Hi: EPS
                Replace Inv.

BUS B + BUS A 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 UNDERTOLV

Replace INV
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;
           H20/Gly Tank Reg. LM PRESS vlv
**EMERGENCY POWER DOWN**
(MN BUS Voltage < 26.0, no short verified, Powerdown until MN BUS ≥ 26.5 vdc)

<table>
<thead>
<tr>
<th>SPS BURN</th>
<th>AMPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 HTRS (2) - off (ctr)</td>
<td>11.05</td>
</tr>
<tr>
<td>BAT C on MNA&amp;B</td>
<td></td>
</tr>
<tr>
<td>cb MNA BAT C - close</td>
<td></td>
</tr>
<tr>
<td>cb MNB BAT C - close</td>
<td></td>
</tr>
<tr>
<td>ECS RAD HTRS (2) - OFF</td>
<td>17.2 per HTR</td>
</tr>
<tr>
<td>If unsuited</td>
<td></td>
</tr>
<tr>
<td>SUIT COMPR (2) - OFF</td>
<td>8.44</td>
</tr>
<tr>
<td>S BD PWR AMP - off (ctr)</td>
<td>4.35</td>
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<tr>
<td>FC PUMPS (3) - OFF</td>
<td>9.43</td>
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<tr>
<td>SM RCS HTRS (4) - OFF</td>
<td>2.90 per quad MAX</td>
</tr>
<tr>
<td>POT H2O HTR - OFF</td>
<td>1.62</td>
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<tr>
<td>H2 HTRS (2) - off (ctr)</td>
<td>1.43</td>
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<tr>
<td>H2 FANS (2) - off (ctr)</td>
<td>0.72</td>
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<tr>
<td>02 FANS (2) - off (ctr)</td>
<td>5.4</td>
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<tr>
<td>SPS LINE HTRS - off (ctr)</td>
<td>1.025 A</td>
</tr>
<tr>
<td>LIGHTS (min req'd)</td>
<td>2.05 A/B</td>
</tr>
<tr>
<td>TAPE RCDR FWD - off (ctr)</td>
<td>1.69</td>
</tr>
<tr>
<td>SPS GAUGING - OFF</td>
<td>2.96</td>
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<tr>
<td>ECS GLY PUMPS (2) - OFF</td>
<td>2.76 per pump</td>
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<tr>
<td>cb ECS RAD CONT/HTR (2) - open</td>
<td>2.69</td>
</tr>
<tr>
<td>SCE PWR - off (ctr)</td>
<td>0.65</td>
</tr>
</tbody>
</table>
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
FDAI 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
FDAI SEL - 1
SIG COND/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 on line
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
FDAl 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
Note: If post TLI, TELECOM GRP 2 - AC1
FC PUMP 2&3 - AC1
BMAG 2 PWR - OFF
FDAl 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
FDAl 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
FDAl 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
  cb MNB BAT C - 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 OVLD (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. Battls on at normal time prior to SPS deorbit and proceed with normal entry

NON-DIODED/NON-SWITCHABLE LOADS

MAIN A
02 & 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 (SF0262T & SF0263T)
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
ΔV THRUST A
PRI GMBL MTRS P,Y
L COAS
Flashing RNDZ Lts
FDAI 1
CDC
BMAG 1 (immediately)
RHC PWR DIR 1 (HALF THE JETS)
DIRECT ULLAGE PB (C3 &A4)

MAIN B
02 & 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
ΔV 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
O2 & 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
O2 & 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)
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Basic Date: April 15, 1969

Changed
I HOPE THEY HAVE DOGGIE BAGS ON THE MOON

"COLUMBIA & EAGLE ARE THE GREATEST MAN HAS CREATED"

"JUST ONE MORE PPK"

SO NOONMEN!

Ray, Bill, Ron, L, Frank, E. Taylor, George Steed
HOW CAN I EAT WHEN WE'RE APPROACHING A LUNAR LANDING

Good luck spaceman!
Ray, Dell, Oso, L. Panic, E. Fagby, S. Steele
CSM FILM

16 MM:
  MAG A: T&D, L/M/SUB SEP
  " B: (CIN) MISC INTERIOR SHOTS
  " C: (CEX) UNDOKING
  " D: (CEX) L.O.D.
  " E: (CEX)
  " F: LUNAR ORBIT & TEI
  " M: ENTRY (CIN)

70 MM:
  MAG U (B&W) PENUMBRA APPROACHING MOON
  POST LOI
  LAST FRAME ~ 84 HRS
  MAG N (COLOR) BE LOADED ON CAMERA AT LAUNCH
  EPO & POST TLI
  MAG T (B&W) 250 MM 86 hrs on. INTERVAL
  MAG P (B&W) INV-P22 (300 MM ORB R/A 6° BELOW NOX/II
  250 MM SAME AS ABOVE
  LAST FRM 107:50
  MAG O (B&W) LAST B&W, TEC, PRE-ENTRY
  MAG V (COLOR) LAST COLOR, PRE-ENTRY